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Protocol Validation Studies
Confidential Final Project Report

June 30, 2015

Executive Summary

In Alberta, six agricultural carbon offset protocols are available for use; however, to date only one, the Quantification Protocol for Conservation Cropping, has been widely used. Given this, in fall 2012 Climate Change and Emissions Management Corporation (CCEMC) and Alberta Agriculture and Forestry (AF) commissioned a set of protocol validation studies (PVSs) to gather learnings from the application and validation of four agricultural protocols:

- Beef Reduced Days on Feed (DOF);
- Beef Reduced Age to Harvest (RAH);
- Conservation Cropping (CCP) (Tillage System Management and Summerfallow reduction); and
- Nitrous Oxide Emission Reductions (NERP)[1].

The objectives of the PVSs were:

1. To validate through small-scale pilots, how the protocols could be applied in the field;
2. To provide guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale;
3. To demonstrate how verification to a reasonable level of assurance can be accomplished under the included protocols; and
4. To catalyze continued aggregation efforts for bringing forward offsets from agricultural projects.

A number of tools were produced as a result of the protocol validation studies to meet the above objectives including: a data collection template, an excel based emission reduction calculator, a sample offset project plan, a sample offset project report and an excel based cost-benefit analysis calculator for each protocol. These tools were developed to assist project developers and producers in establishing agricultural offset projects under the selected protocols. At a high level the PVSs found:

1. Additional clarity on the requirements for verifying agricultural offset projects is needed.
2. The increased transaction costs associated with the move to "reasonable level of assurance" impairs adoption and prevents new entrants under current carbon prices, based on the results of the cost-benefit analysis.
3. Some of the protocols penalize early adopters. For example, the small number of growers who have the records needed to support the NERP are already efficient at managing applied nitrogen, eliminating the opportunity for emission reductions.
4. Inconsistencies in verification have led to inconsistent outcomes amongst verifiers and government auditors. This has created confusion and resulted in increased credit revocation risk.

In order to help address items one and four a set of best practice guides for implementing and verifying projects at a reasonable level of assurance were developed as an additional outcome of the PVSs. In addition to the above high level findings a number of protocol specific findings were made. A brief summary of these findings is provided by protocol below.

NERP – Three key obstacles to implementing the NERP were identified: 1.few producers have the required data and evidence to support a three year historic baseline; 2. there is significant variability in how farmers

[1] CCEMC funded the NERP, RAH and DOF validation studies.

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measure yield and level of accuracy associated with those measurements; and 3. the requirement to have all fields under 4R management disqualifies many farms. In response to issues one and two a dynamic baseline quantification approach and a set of acceptable crop mass determination methods were developed and included in the modified protocol. The issue related to ineligible fields is still being resolved; however, for increased adoption it is recommended that flexibility be added to the protocol to allow the exclusion of fields that do not qualify. Other issues include the annual soil test and ownership requirements of the NERP.

DOF / Fed Cattle – The most significant barrier to implementing the DOF protocol was found to be the indicator for reduced days on feed. Market demand is for heavier and heavier animals and therefore reducing days on feed prevents a challenge. As a result, the protocol was updated to a Reduced Carbon Intensity of Fed Cattle Protocol. Once the modified protocol is approved it is believed that the majority of the issues previously associated with the DOF protocol will have been addressed.

RAH – The most significant obstacle to implementing the RAH protocol is obtaining confirmation of death. Shipping manifests contain average harvest dates, but do not contain individual harvest dates. Therefore, in order to increase uptake of the RAH protocol it is recommended that the protocol be changed to allow use of average harvest dates.

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Introduction

On July 1, 2007, the Government of Alberta introduced the Specified Gas Emitters Regulation. This regulation requires Alberta facilities emitting more than 100,000 tonnes of greenhouse gases (GHGs) a year to reduce their emissions intensity by 12 per cent. One way regulated facilities can meet this target is by purchasing Alberta-based carbon offset credits.

Although the agriculture sector has six protocols available for use in generating offset credits in the Alberta Offset System, only one - the Quantification Protocol for Conservation Cropping (formerly Tillage System Management), V 1.0, April 2012 – has been widely used. Table 1 below lists the active agricultural offset protocols, states their date of approval and lists the number of tonnes registered.

Table 1: Agricultural Carbon Offset Credits Registered in the Alberta Offset System

Protocol	Date of Approval	Tonnes Registered
Conservation Cropping & Tillage System Management	April 2012	11,585,750
Emission Reductions from Dairy Cattle	January 2010	0
Nitrous Oxide Emissions Reductions in Agriculture	October 2010	0
Reducing Days on Feed of Beef Cattle	July 2011	0
Reduced Age at Harvest of Beef Cattle	July 2011	0
Selection for Low Residual Feed Intake Markers in Beef Cattle	April 2012	0

What sets the Conservation Cropping Protocol apart, is a performance standard baseline and standardized quantification approach, simplifying and enabling adoption. In contrast, the remaining protocols require establishing three year project specific baselines. Project specific baselines require more data and documentation, making them more cumbersome to adopt. As a result, many animal and/or cropping operations do not have all the information needed to calculate and substantiate GHG reductions under these protocols.

In March 2012, The Prasino Group was commissioned by the Climate Change and Emissions Management Corporation (CCEMC) to complete a "Gap and Opportunity Analysis for Advancing Meaningful Biological Greenhouse Gas Reductions[2]" in Alberta. The report concluded that in order to accelerate deployment of these protocols at scale, investment was needed to demonstrate the benefits of these protocols. Specifically, innovative beef cattle and nitrogen management projects were classified as "Enabler" projects or opportunity areas that are ready for demonstration and have a total reduction potential of greater than 1 Mt CO_2e/year across the biological reduction sector, if deployed at scale.

[2] http://ccemc.redaffect.com/wp-content/uploads/2013/01/Direct-Reductions-Report-Prasino-March-2012.pdf

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Given this recommendation, in the fall of 2012 Alberta Agriculture and Forestry (AF) and the CCEMC collaboratively commissioned a set of protocol validation studies (PVSs) to gather learnings from the application and validation of four agricultural protocols, to accelerate their adoption:

- Beef Reduced Days on Feed (DOF);
- Beef Reduced Age to Harvest (RAH);
- Conservation Cropping (CCP) (Tillage System Management and Summerfallow reduction); and
- Nitrous Oxide Emission Reductions (NERP).

CCEMC funded the NERP, RAH and the second year of the DOF validation studies. The results and findings of the NERP, RAH and DOF PVS projects are summarized in the following report.

Project Objectives

The objectives of the Protocol Validation Studies (PVSs) were:

1. To validate through small-scale pilots, how the protocols can be applied in the field;
2. To provide guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale;
3. To demonstrate how verification to a reasonable level of assurance can be accomplished under the included protocols; and
4. To catalyze continued aggregation efforts for bringing forward offsets from agricultural projects.

Project Activities and Approach

The protocol validation studies (PVSs) commenced in September 2012 and were implemented following a phased approach. Specifically, the project involved the following four phases:

Phase I: Stakeholder Engagement, Study Design and Project Initiation

In August 2012 the PVSs commenced. In the early stages of the project the project team worked with CCEMC and AF to develop a detailed project plan for each of the studies (Please see Appendix A for the NERP, DOF and RAH project plans). In addition, a strengths, weaknesses, opportunities and threats (SWOT) analysis was performed to identify risks associated with the studies design (Appendix B: SWOT Analysis). Once this preliminary work was completed an orientation workshop was scheduled and held on September 12, 2012 in Edmonton (See Appendix C for Workshop Minutes). A number of individuals attended the workshop including government representatives, aggregators, project developers, scientists and industry association representatives. At this workshop the project team introduced the project, provided context on why the selected protocols were chosen and presented the studies purpose, design and objectives. In addition, the process for selecting collaborating aggregators was explained and a request for qualifications/interest (RFQ) from interested aggregators issued (Appendix D). Three aggregation firms were selected as partners for the project: Agritrend Aggregation (NERP/Fed Cattle), FailSafe (RAH) and Carbon Credit Solutions (CCP). Once the aggregators were notified and a summary of the selection process sent to all individuals on the orientation workshop mailing list, a kick-off meeting was held in early October 2012 to coordinate activities for Phase II of the project.

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Phase II: Project Implementation

At the beginning of Phase II cooperating producers were engaged in the project with support from the selected aggregators. Simultaneously a set of data collection spreadsheets were built by the consulting team and an RFP for verifiers was issued (January 2013). Two verification firms were selected to complete the mock verifications. Specifically, ICF International was selected to perform a mock verification for the DOF, NERP and RAH validation studies and KPMG was selected to perform a mock verification for the CCP validation study. A copy of the Statement of Work is provided in Appendix E.

Once the verifiers were engaged, the baseline years were established and the corresponding data and documentation collected to prepare the offset project plan and offset project report for the first year's mock verifications. The year one DOF, NERP and RAH mock verifications were completed in March 2013, April 2013 and May 2013 respectively, based on the published versions of the protocols at the time.

In Phase II, Dr. Paul Thomassin, an agricultural economist from McGill University, also worked with the selected aggregation firms to gather the necessary economic data to perform a cost benefit analysis of implementing a project under each of the four protocols. The analyses were performed from the perspective of both an aggregator and a producer. The results of the cost benefit analyses are presented in detail in the results section below.

Table 2 below summarizes the main roles and responsibilities of producers, aggregators, verifiers as well as AF, CCEMC and the Consulting Team (The Prasino Group) in the PVSs.

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Table 2: Roles and Responsibilities

Stakeholder	Role(s)	Responsibilities
Producers	Project participants and providers of farm activity data, proof of practice (documentation) and field level experience.[3]	• Provide farm data to support the project. • Review farm-specific data, and supporting documentation. • Participate in mock verification and provide project implementation support.
Aggregators	Project partners, aggregation of producers and gatherers of the data/farm documentation.	• Engage with producers and implement data gathering/management strategies. • Provide active support of project deliverables (cost benefit analysis, mock verifications, etc.) to identify innovative solutions.
Verifiers	Complete mock verifications to a reasonable level of assurance. Third party auditors that review farm data, calculations, documentation (proof) to determine conformance with protocol criteria.	• Complete the verification work as an independent third-party. • Provide feedback on the validation study project documents/underlying protocols.
AF	Contract manager and member of the project steering committee	• Contribute to on-going project design and document reviews. • Participate in project management meetings. • Extend learning's to the Office of the Auditor General (OAG) and Alberta Environment and Parks, as appropriate. • Help make connections with internal AF resources for the NERP projects.
CCEMC/AI Bio	Contract manager, funder and member of the project steering committee.	• Contribute to on-going project design and document reviews. • Participate in project management meetings. • Provide feedback on project progress and deliverables in relation to funding agreement.
Consulting Team (The Prasino Group)	Project delivery team and coordinator of the aggregators and verifiers.	• Responsible for ensuring the completion of all tasks in the work plan.

[3] Note- farm-specific data was not shared with the Consulting Team and remained confidential to the producer and aggregator. The mock verifier, under its agreement with the aggregator could review the farm-specific data.

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Phase III: Knowledge Transfer and Reporting

Phase III commenced in December 2012 and continued until August 2013. In this phase the cost benefit analyses were completed and the results of the year one studies presented in a set of validation study reports. At the end of Phase III the interim findings of the project were compiled and an extension workshop held in Edmonton to present the findings to a larger group of stakeholders including producers, aggregators, verifiers and government. Feedback on results to date, as well as recommendations from the Offset system stakeholders were compiled by AF, CCEMC-AI Bio and The Consulting Team and presented to Environment and Parks in October 2013. The meeting minutes from this workshop are provided in Appendix F. As a result of the findings of the PVS studies in Phase III, the NERP and DOF protocols (latter revised to Fed Cattle protocol) underwent revisions to increase uptake in the agriculture sector.

Phase IV: Extension

In Phase IV, the steps taken in Phases I through III were repeated for the NERP and DOF validation studies. The NERP and DOF (now Fed Cattle) protocols underwent a number of revisions during the protocol validation studies. Consequently, in the case of these two protocols it was necessary to repeat the mock verifications to see how the changes to the protocols influenced ease of adoption. Once again the necessary project documentation (offset project plans and offset project reports) were prepared so that the mock verifications could be completed. Although the project team initially planned to perform a second mock verification for the RAH validation study, at the end of year one it was determined that a second mock verification was unnecessary since it would provide limited additional value. Similarly, the cost benefit analyses were not repeated in year two since the results were expected to be largely the same as year one. Phase IV ended with a final project extension workshop held in Calgary on June 17, 2015 (See Appendix G for the final workshop meeting minutes). At this workshop the findings of the year two NERP and DOF (fed cattle) validation studies were presented to relevant stakeholders.

Project Findings

A summary of the findings of the Validation Studies are presented by protocol below. In addition, the deliverables produced as part of this project have been attached as appendices for additional information. Please note that at the time of writing, the NERP, Fed Cattle and RAH protocols were not yet finalized by Alberta Environment and Parks. As a result, most of the deliverables included as appendices in this document will need to be updated once the protocols are finalized.

Nitrous Oxide Emission Reductions (NERP) Protocol Validation Study

Year 1 Findings

Cost Benefit Analysis

The NERP cost benefit analysis was performed by Dr. Paul Thomassin in consultation with The Prasino Group and Agritrend Aggregation Inc. (ATAI). As stated above, the analysis was conducted from both an aggregator and a producer perspective. For the aggregator perspective, three scenarios were analyzed: optimistic, expected and pessimistic. For all three of these scenarios the analysis was based on the aggregators's start-up and operational costs and assumed:

- An existing aggregator would have a robust agronomic reporting framework already established that could keep track of agricultural practices and performance. Therefore, the aggregation functions would be an expansion of current agronomic information systems;

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- Aggregators receive 40% of the market price of credits, while producers receive 60%;
- A seven year timeframe over which start-up costs such as modifying the existing agronomic framework would be spread;
- Data gathering costs are 10% of the carbon offset price; and
- Verification costs are 3% of the carbon offset price.

Three scenarios were analysed, where the price of carbon, number of tonnes generated and discount rate differed. Table 3 below presents the findings of the analysis and highlights the differences in assumptions between the three scenarios. For the complete NERP cost-benefit results please refer to Appendix H: NERP Aggregator Spreadsheet and Appendix I: The Benefit Cost Analysis of the Aggregator's Position as it Relates to the Nitrous Oxide Emission Reductions Protocol.

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Table 3: NERP Aggregator Cost-Benefit Analysis Findings

	Present Value		
	Expected Scenario	**Optimistic Scenario**	**Pessimistic Scenario**
Present Value of the Costs	$2,004,054.78	$2,712,547.05	$1,374,003.03
Present Value of the Revenue	$2,483,236.22	$4,426,857.17	$752,228.54
Cost Per Offset Credit Generated	$5.73	$5.17	$7.85
Revenue Per Offset Credit Generated	$7.09	$8.43	$4.30
Net Present Value	$479,181.44	$1,714,310.12	-$621,774.49
Assumptions	• Current carbon prices ($13/tonne) continue for two years then increase to $23/tonne • 50,000 tonnes generated/year • 3% discount rate	• Current carbon prices ($13/tonne) continue for two years then increase to $23/tonne • 75,000 tonnes generated/year • 2% discount rate	• Price of carbon remains constant at $13.00/tonne over the seven year period • 25,000 tonnes generate/year • 5% discount rate

The producer cost-benefit analysis was conducted for three farms of similar size (3,000 ha) in three different soil zones (dark brown, brown and black) with three different crops (canola, spring wheat and feed barley – 1000 ha of each). For all three farms the analysis assumed:

- The amount of nitrogen being applied increased from 2 to 4 kg per acre with the change in management (a 4R framework at the basic level of performance)
- Agricultural professionals would cost $7.50/acre for advice and administrative work
- $1,000 would be needed for additional soil samples on the farm
- Average yield increases of 20% (with implementation of the NERP at the basic level) and increased nitrogen use efficiency
- An initial carbon price of $13/t$CO_2$e, of which 70% or $9.10 goes to the producer
- Crop moisture contents as follows:

Moisture Content (%)	Canola	Spring Wheat	Feed Barley
Off the field	12.5%	18%	18%
Delivered to the elevator	10%	13.5%	14.5%

Overall, the results of the producer analysis revealed that the 4R program could provide an increase in net revenue per acre. Furthermore, the costs associated with implementing the protocol are small relative to the potential revenue that can be gained. Of the three crops analyzed, canola had the largest economic potential. A summary of the results at a carbon price of $13/tonne is presented in Table 4 below.

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For additional information and further sensitivity analysis to the price of carbon please see Appendix J: NERP Producer Spreadsheet and Appendix K: The Benefit Cost Analysis of the Agricultural Producer's Position as it Relates to the Nitrous Oxide Emission Reductions Protocol.

Table 4: NERP Producer Cost Benefit Analysis Findings at a Carbon Price of $13/tonne

Cost and benefits of the NERP									
	Dark Brown Soil Zone			Brown Soil Zone			Black Soil Zone		
	Canola	Spring Wheat	Feed Barley	Canola	Spring Wheat	Feed Barley	Canola	Spring Wheat	Feed Barley
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24	$11.54	$10.24	$10.24	$11.54	$10.24	$10.24
Additional Revenue from 4R Program from Cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50	$117.00	$84.70	$82.50	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$0.64	$0.55	$0.47	$0.95	$0.69	$0.68	$1.49	$1.24	$0.94
Net Change in Revenue per Acre	**$106.10**	**$75.01**	**$72.73**	**$106.41**	**$75.15**	**$72.94**	**$106.95**	**$75.70**	**$73.20**

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Mock Verification (Year One)

In year one Agritrend Aggregation Inc. (ATAI) aggregated six farms under the provisions of version 1.0 of the Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions (NERP). At the time this was the most up to date version of the protocol available for use in Alberta. For the purposes of the mock verification the project year was set as 2011 with a baseline average emissions intensity of 2008, 2009 and 2010. It should be noted that at the time of the mock verification ATAI had not finished gathering all of the participating farm records. Furthermore, 4R consistent plans were not in place. Consequently, a full mock-verification at reasonable level of assurance was not possible. Nevertheless, ICF was able to assess ATAI's Agri-Data Solutions platform to test the data management system and NERP quantification algorithms for supporting a correct GHG assertion. Furthermore, ICF also completed farm visits to observe how the required data is gathered at the farm level and to observe what data controls were in place.

The PVS Study revealed a number of barriers to implementing the NERP. In particular, the need for three years of farm specific historic baseline data proved problematic since few farms have this information. In order to address this issue, The Canadian Fertilizer Institute formed a technical expert review committee that developed two conservative dynamic baseline approaches to be used as alternatives to the conventional historic baseline approach. The dynamic baselines use the expected project emissions and the reduction modifiers to estimate baseline emissions. As a result, historical data is no longer needed if using the new baseline approaches. The level of reductions realized from the dynamic baselines is conservative relative to the conventional historic baseline. The revised protocol is undergoing review by Alberta Environment and Parks for adoption in the Alberta Offset System, which will result in a greatly enhanced probability of adoption for growers in Alberta.

A second significant finding of the year one mock verification was that the evidence presented to support yield was often insufficient to meet protocol requirements. Specifically, during the farm visits the verification team found that many farms do not use weigh wagons or their weigh wagons are not properly calibrated. Given this, in 2013, The Prasino Group worked with ATAI and ICF to develop a set of acceptable crop mass determination methods to address inconsistencies in the way farmers were measuring yield and the level of accuracy associated with these methods for inclusion in the protocol.

The third most significant issue identified is the protocol requires annual soil testing; however, annual testing on every field is rarely done in practice since best management practices published by the Canadian Fertilizer Institute and other organizations indicate that annual tests may not be necessary. Instead many sources suggest that a nitrogen balance assessment based on known nitrogen inputs from the previous year is sufficient. Given this it was suggested that this requirement be reviewed.

In addition to the above items a number of smaller protocol issues were identified. For example, the layout of the protocol (in particular its evidence tables) was out of date, the protocol was unclear in some sections (e.g. whether or not the crop residue factors in Appendix E of the protocol need to be corrected for a dry matter basis and how to estimate the fraction of total area that is renewed annually). A couple of ways for streamlining the protocol's quantification approach were also identified including allowing calculations to be completed on a mass basis (rather than on a unit per area basis) and allowing quantification to be completed at the field level or farm level if the EF_{ECO}, $FRAC_{renew}$, crop type and performance level are constant across the field/farm. Finally, it was recommended that the changes made in the Saskatchewan version of the NERP be considered for adoption in Alberta as well (See Table 5 for additional details).

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In regards to documentation and records, the mock verification found that increased clarity on documentation requirements was needed. In order to address this need it was recommended that a best practice guide to verification be developed. Furthermore, ICF emphasized that project developers need to have a complete 4R plan for each farm as described in the NERP. Additional information on documentation and record related findings is provided in table 5 below. Further information can also be found in the Year One NERP Validation Study Report (Appendix L: Year One NERP Validation Study Report) and the full mock verification report (Appendix M: Year One NERP Mock Verification Report). In 2013, the Canadian Fertilizer Institute engaged The Prasino Group to modify the NERP based on the findings of the mock verification.

Table 5: Year One NERP Mock Verification Findings

Item	Findings

Protocol Issues	• The evidence tables in section five need to be revised to be consistent with the layout of the Conservation Cropping Protocol.
	• The quantification methodology could be streamlined by allowing data and calculations to be completed on a mass basis for nitrogen input and yield data, rather than on a unit per area basis. This would simplify the data collection process, manage uncertainty of field having a crop failure by aggregating data at the farm level and reduce verification costs.
	• The protocol should allow emission reduction quantification to be completed at the field level if the EF_{ECO}, $FRAC_{renew}$, crop type and performance level are constant across a field. Similarly, the protocol should allow the quantification to be completed at the farm level for each crop if the EF_{ECO}, $FRAC_{renew}$ and performance level are constant across the farm.
	• Additional guidance is needed on how to estimate the fraction of total area that is renewed annually ($FRAC_{renew}$). Specifically in the case of annual crops this factor is equal to one; however, for perennial crops it has to be forecasted based on the number of years that the crop will be grown. Additional guidance would make the process of verifying this factor easier.
	• Best management practices published by the Canadian Fertilizer Institute and other organizations indicate that soil testing may not be required on an annual basis. In contrast, the "post-harvest assessment" defined in the NERP protocol seems to indicate that soil testing is required annually after harvest. This requirement should be updated in the protocol to focus on the nitrogen balance assessment. Specifically, the protocol should clarify that the balance assessment can be used based on known nitrogen inputs from the year before and nitrogen consumption values for the yields achieved.
	• Changes/additions made to the NERP when it was being adapted for Saskatchewan should also be considered in Alberta. These changes/additions include:
	  ○ Adding clarity to assure that crop types are the same between the baseline and the project. This was done to ensure accounting equivalency.
	  ○ Adding wording to clarify that if a crop is irrigated in the baseline it must also be irrigated in the project (also to ensure accounting equivalency).
	  ○ Allowing baling and removal of straw to be eligible activities if it can be shown that 70% of the straw is retained on the soil.

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Item	Findings
	○ Updating the quantification methodology to clarify that the reduction modifier should not be applied to fallow year emissions since no nitrogen management occurs in that crop year. Under the current AB NERP the reduction modifier is applied resulting in an overestimation of emission reductions.
Documentation and Records	• It was recommended that project developers have a concrete 4R Plan for each farm, as described in the NERP, and according to the Canadian Fertilizer Institute's training program for Accredited Professional Advisors. Field level practices and field sheets/electronic records need to be linked to the BMPs described in the 4R Plan at the appropriate performance level (Basic, Intermediate or Advanced). Also, plans need to be traced to goals at the farm enterprise level. • Evidence is needed to support the 4Rs – this includes rates of N applied, timing (including soil testing dates); placement (including linking the equipment used for seeding/fertilizing) and source for the field in question. • The method used for determining yield needs to meet the requirements of the protocol. The methods used in the sample aggregated project presented a significant measurement risk for verification purposes. • A consistent 4R template would reduce verification risk. • A best practice guide to verification for NERP projects is needed to clarify documentation requirements and support reasonable level of assurance; • Clarification is needed on whether soil testing is required on every field, every year. Queries from project developers and verifiers indicate that clarity is needed. Best practices by the CFI and IPNI indicate that soil testing may not be required on an annual basis, and nitrogen balances based on N applied, crop yield and crop N uptake tables. This includes approaches for post-harvest assessments.

Year 2 Findings

Cost Benefit Analysis

In early 2014 it was decided that a second round of cost-benefit analyses would not provide added value. Therefore, this task was removed from the year two validation study project plan.

Mock Verification (Year Two)

In year two Agritrend Aggregation Inc. (ATAI) aggregated two farms under the draft Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions (NERP), v 1.1 April 2015. As described above, under the modified NERP, project developers can employ one of two dynamic baseline quantification approaches that enable emission reductions to be quantified in the absence of three years of baseline data. For the purposes of the year two mock verification, dynamic baseline one (which quantifies the baseline CO_2e emissions for each crop using the present year's data and actual yields) was used. As in year one, ICF International completed the mock verification, including farm and office site visits. The office site visit included a review of all record requirements. In addition, data management processes were discussed and observed. In the second

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year ATAI had 4R consistent plans in place, the revised protocol was clearer in terms of the evidence that was needed and therefore a more complete mock verification was possible.

The purpose of the second year's mock verification was to identify whether or not additional barriers to implementation continue to exist, despite the changes to the protocol. The year two mock verification revealed that a number of issues continue to persist. In particular, the following four items were of concern:

1. Moisture sampling on harvested crops;
2. Soil temperature readings;
3. Land title certificates; and
4. The requirement for all fields to be included in the project.

Presently, the protocol requires moisture readings for every load; however, the farm field visits revealed that this requirement is impractical and likely more rigorous than what is required to determine the moisture content. Most farmer's measure moisture content daily by field and crop type. Ensuring the moisture content of crops is a critical risk management activity in crop production necessary to avoid spoilage in storage and that is why daily readings are taken. Similarly, if nitrogen is applied in the fall the draft protocol requires soil temperature readings for three consecutive days as evidence that the temperature was less than $10^{O}C$. This is also impractical for farmers to implement. Given the above, in the case of moisture readings it was recommended that a flexibility mechanism be added to the protocol that permits project developers to use the most conservative moisture values form the Canadian Grain Commissions' Standard Storage Requirements and in the case of soil temperature it was suggested that data (ambient air temperatures showing 10 degrees Celsius or less for 5 consecutive days) from the closest weather station be considered as an alternative.

Another issue is the requirement for land title certificates for each field being claimed in the project. This requirement is challenging to fulfill since many producers rent their land from owners that they have limited contact with. Furthermore, some producers may fear increased rents from their land owners once they mention the prospect of generating additional income from carbon credits. Given that the NERP is a reduction protocol and not a soil sequestration protocol, land title certificates seem unnecessary. Therefore, it was recommended that this requirement be removed.

The last significant issue is the requirement that if ineligible activities are employed on any field, the entire farm is disqualified from the project. Although this criteria limits the possibility of gaming when using the conventional baseline approach, it unnecessarily excludes farms using either of the dynamic baseline approaches. Therefore, ICF suggested that an applicability criteria be added to allow the inclusion of farms with ineligible fields under the 4R Plan. In order to ensure a conservative approach and avoid leakage, two possible options could be adopted in the protocol:

1. If a field becomes ineligible at any time during the baseline period or at any time during the project crediting period is could be disqualified for the entire crediting period.
2. If a field/crop does not meet 4R eligibility for a given year, the emission reduction does not occur and any potential offsets from those fields/crops in the mass based accounting is removed from the overall GHG claim. In this case APA sign-off would provide an added level of assurance that the accounting is done appropriately, according to the protocol.

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In addition to the above items a number of smaller protocol issues and points of clarity were identified. For example, record requirements for one of the acceptable crop mass determination methods, a method for how additional fuel use should be accounted for when using either of the dynamic baseline approaches and clarity around who must physically collect the data and conduct on-farm visits need to be added to the protocol. These items are described in more detail in Table 6 below. Further information can also be found in the Year Two NERP Validation Study Report (Appendix N: Year Two NERP Validation Study Report) and the full mock verification report (Appendix O: Year Two NERP Mock Verification Report).

In regards to documentation, the mock verification revealed that obtaining weight logs, moisture logs and soil temperature data may be challenging. Furthermore, the protocol references a practice standard for greenhouse gas assessment and management; however, this practice standard does not exist. As a result, ICF

Table 6: Year Two NERP Mock Verification Findings

Item	Findings
Protocol Issues	• Table 12: Crop Mass Determination Methods presently only lists the record requirements for three of the four acceptable crop mass determination methods presented in Appendix I of the protocol. Records for the fourth method need to be added. • Presently moisture readings are required for every load. Interviews with farmers revealed that this requirement is impractical and likely more rigorous than required to determine the moisture content. Presently, the farmers interviewed measure moisture content once per field, daily by crop type. Given this, it is recommended that a flexibility mechanism be added to the protocol that permits project developers to use the most conservative moisture values from the Canadian Grain Commissions' Standard Storage Requirements. • Presently, the draft protocol requires project developers to have land title certificates for each field being claimed in the project to demonstrate ownership. Given that the NERP is a reduction protocol (and not a sequestration protocol) multi-year lease agreements would provide sufficient evidence to satisfy the ownership requirements. • If nitrogen is applied in the fall, the draft protocol requires soil temperature readings for three consecutive days as evidence that the temperature was less than 10^{O}C. This is impractical. Instead it is suggested that data (ambient air temperatures showing 10 degrees Celsius or less for 5 consecutive days) from the closest weather station be considered as an alternative. • The protocol requires APA's to be authorized to practice under the practice standard for GHG assessment and management; however, no practice standard currently exists. • In Section 1.2 Protocol Applicability it is unclear which fields should be included in the project / greenhouse gas accounting. For example, applicability criteria number nine states that ineligible fields "must be included in the 4R Plan, but are excluded from GHG accounting", while applicability criteria number twelve states that "farms in the project must have all fields enrolled in the 4R program and need to be part of the project and baseline greenhouse gas accounting". Therefore, the applicability criteria need to be reviewed for consistency and clarity to ensure correct interpretation.

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Item	Findings
	• Presently, if ineligible activities are employed on any field under the draft protocol, the entire farm is disqualified from the project. Although this criteria limits the possibility of gaming when using the conventional baseline approach, it unnecessarily excludes farms using either of the dynamic baseline approaches. It is suggested that an applicability criteria be added to allow the inclusion of farms with ineligible fields under the 4R Plan. In order to ensure a conservative approach, one option would be to disqualify any fields for the entire crediting period if the field becomes ineligible at any time during the baseline period or any time during the project crediting period. • It is unclear in the protocol how additional fuel use should be accounted for when using either of the dynamic baseline approaches. • In Appendix K: Additional Fuel Pass Method in the protocol, the definition of the pass area (sum of extra passes on all fields of the farm) contradicts the quantification methodology. Therefore, this definition should be removed. • It should be more clearly stated that the protocol does not require the APA to be the person who physically collects farm data and conducts on-farm observations. However, the APA must confirm all record requirements and supporting data are on file and review the documentation before approving and implementing the 4R plan. • For clarity, the ratio factor of 44/28 should be replaced in the quantification approach with a symbol and defined as the molecular mass ration of N_2O to N_2O as N (N_2O/N_2O-N).
Documentation and Records	• In year two a set of 4R plans were developed for each of the farms included in the mock verification. Consequently, a number of the challenges identified in year one in terms of documentation were overcome. Outstanding barriers related to documentation and records include the following: o Weight logs are not commonly kept by farmers in Alberta. As a result, many will not be able to satisfy the record requirements of the acceptable crop mass determination methods. o Practices for measuring and logging moisture content vary by farm and many farms do not keep moisture logs. Therefore, this requirement may also limit participation in a NERP project. o A practice standard for greenhouse gas assessment and management practice does not exist. As a result, it is not possible to reach a verification conclusion in relation to this requirement. o Most farmers do not take soil temperature readings prior to applying fertilizer in the fall, since it is impractical to do so. Given this, few can meet this requirement. It is recommended that data from nearby weather stations be allowed instead.

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Reduced Days on Feed (DOF)/Fed Cattle

Year 1 Findings

Cost Benefit Analysis

The DOF/Fed Cattle cost benefit analysis was also performed by Dr. Paul Thomassin in consultation with The Prasino Group and Agritrend Aggregation Inc. (ATAI)/ Feedlot Health Management Services (FHMS). The analysis was conducted from both an aggregator and a feedlot perspective. From the aggregator perspective, three scenarios were analyzed – optimistic, expected and pessimistic. The assumptions of each of these three scenarios are presented in Table 7 below.

Table 7: Assumptions for Each of the Aggregator Cost Benefit Analysis Scenarios

	Costs	Optimistic		Expected		Pessimistic	
	Start-up + Operating*	Price	Quantities (Tonnes)	Price	Quantities (Tonnes)	Prices	Quantities (Tonnes)
Initial Costs	$ 103,000						
Year 1	$ 123,000	$13	10,000	$13	10,000	$13	4,000
Year 2	$ 133,000	$13	20,000	$13	15,000	$13	5,000
Year 3	$ 159,500	$27	30,000	$23	18,000	$13	6,000
Year 4	$ 180,000	$27	45,000	$23	25,000	$13	6,000
Year 5	$ 201,000	$27	45,000	$23	25,000	$13	6,000
Year 6	$ 201,000	$27	50,000	$23	25,000	$13	6,000
Year 7	$ 206,000	$27	50,000	$23	25,000	$13	6,000

In addition to the above assumptions the analysis assumed that the aggregator would receive 2/3 of the value of the credits while the producer received 1/3 of the value. Furthermore, for the optimistic scenario the discount rate was three percent, for the expected scenario it was five percent and for the pessimistic scenario it was seven percent. Table 8 below presents the findings of the aggregator cost-benefit analysis. The analysis indicates that a positive net present value can be obtained in two of the three scenarios analyzed. It is important to note that the two most important factors in determining profitability is the price of carbon and the number of tonnes being sold. Increasing the number of tonnes generated decreases the fixed costs per tonne and increases the revenue being generated. For the complete DOF cost-benefit results please refer to Appendix P: DOF Aggregator Spreadsheet and Appendix Q: The Benefit Cost Analysis of the Aggregator's Position as it Relates to Livestock Feeding (DOF).

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Table 8: DOF Aggregator Cost-Benefit Analysis Findings

	Present Value		
	Expected Scenario	**Optimistic Scenario**	**Pessimistic Scenario**
Present Value of the Costs	$1,080,525	$1,162,891	$1,007,173
Present Value of Benefits	$1,866,453	$3,655,128	$266,338
Net Present Value	$785,928	$2,492,237	-$740,834
Number of Credits	143,000	250,000	39,000
Cost per Credit	$7.56	$4.65	$25.82
Revenue per Credit	$13.05	$14.62	$6.83
Net Revenue per Credit	$5.50	$9.97	-$19.00

In the producer cost benefit analysis Canfax data was used to generate the costs and returns for four animal groupings – calf-fed steers, calf-fed heifers, yearling-fed steers and yearling-fed heifers. This data was then modified using actual project data where possible. For example, in order to estimate the cost of barley and silage, the following formula was used:

Cost = (Canfax cost/head)*(weight gain mgnt/weight gain of Canfax)*(ADG Canfax/ADG mgnt)

Where:

Weight gain mgnt = weight gain under the management practice
Weight gain of Canfax = weight gain from the Canfax data
ADG Canfax = Average Daily Gain from Canfax
ADG mgnt = Average Daily Gain from management practice.

The above formula attempts to adjust the average costs that are generated from the Canfax data to better reflect the change in management for the specific management system. In addition to the above, the analysis assumed the following:

- An aggregator would be used and therefore the feedlot operator would receive a portion of the funds for the carbon reduced ($4.00 per tonne of carbon reduced);
- The change in management included a change in the beta-adrenergic agonist used in the operation;
- 22,769 heifer calves, 31,898 steer calves, 73,517 yearling heifers and 131,375 yearling steers; and
- The same animal numbers and types in the baseline and project.

GHG emission reductions were calculated using data from actual operations. The modeled results indicated that the baseline management practice provided higher net margins per head for heifer calves and steer calves, while the change in management practice provided better net margins per head for yearling heifers and yearling steers. The model was also able to estimate the carbon revenue generated from the change in management. In both cases however, the net present value of the operations were overall negative over the three years. Tables 9 below presents the net margin per head for each management practice. Table 10 presents the carbon revenue per head.

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Table 9: DOF Net Margin per Head for Each Management Practice

	Year 1	Year 2	Year 3
Net Margin Per Head (Baseline Management Practice)			
Heifer Calves	23.83	-112.51	-58.36
Steer Calves	23.83	-112.51	-58.36
Yearling Heifers	23.02	-109.74	-53.74
Yearling Steers	59.28	-87.46	-55.96
Net Margin Per Head (Change in Management Practice)			
Heifer Calves	-1.06	-141.01	-91.83
Steer Calves	-1.06	-141.01	-91.83
Yearling Heifers	26.68	-109.17	-54.35
Yearling Steers	70.02	-79.44	-46.22

Table 10: Carbon Market Revenue from the Change in Practice

Carbon Market Revenue (Per Head)			
	Year 1	**Year 2**	**Year 3**
Heifer Calves	$0.20	$0.20	$0.20
Steer Calves	$0.36	$0.36	$0.36
Yearling Heifers	$0.12	$0.12	$0.12
Yearling Steers	$0.16	$0.16	$0.16
Total Carbon Revenue	**$45,879.12**	**$45,879.12**	**$45,879.12**

In addition, a net present value calculation over the three years was estimated for both the baseline and change in management. Using a five percent discount rate, the net present value for the baseline management option was a negative $25.5 million, while the net present value for the change in management was a negative $26 million.

For additional information please see Appendix R: DOF Producer Spreadsheet and Appendix S: The Benefit Cost Analysis of Feedlot Operators.

Mock Verification

In year one AgriTrend-FHMS aggregated six feedlots under the Reduced Days on Feed Protocol, v 2.0, July 2011. The project year was 2012 with a baseline of 2009 to 2011. A total of 300,000 head were included in the project. ICF International completed the mock verification; however, it should be noted that at the time the state of AgriTrend-FHMS's DOF project was such that the gathering of substantiating feedlot records by the co-aggregators was not complete and compiled in such a way to support a full mock-verification at reasonable level of assurance. Nevertheless, ICF-Marbek observed that the feedlots in the project had the

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capacity to measure, manage and report the data required to meet the protocol requirements and that documentation was available to support a reasonable level of assurance.

One of the most important findings of the DOF mock verification was that increasingly cattle are being sold at heavier and heavier carcass weights. As a result, the average number of days that beef cattle are on feed is increasing in comparison to the baseline years. Given this and given that the protocol's quantification approach will determine whether a net reduction has occurred across animal groupings in the feedlots it was recommended that 'indicators' such as 'reduced days on feed' be removed from the protocol. Specifically, it was recommended that the Reduced Days on Feed protocol be revised to a 'Reduced Carbon Intensity of Fed Cattle' protocol, since the basics of the protocol quantification depend on the GHG emissions level per kg of hot carcass weight of the project being less than the levels in the baseline, on a net basis across all animal groupings. This proposed revision would not change the quantification methodology, nor the scope of the protocol.

A second issue the mock verification identified was that a material discrepancy can occur if key parameters such as average number of head, average number of days on feed and average daily dry matter intake are not calculated using the animal*head day basis (a weighted average approach) for an animal grouping. This occurs because animals in a grouping may be sent for sale and effectively leave the group at various times (i.e. the whole group is not sold simultaneously). As a result it was recommended that the protocol be amended to say the animal head*days approach must be used.

In addition to the above items, section five of the protocol needs to be updated to be consistent with the layout of the evidence tables in the Conservation Cropping Protocol. Furthermore, the quantification methodology should clearly state that it is the net reduction across all animal groupings in the project year that determines whether a feedlot has a claim since the feeding efficiencies of animals in a feedlot are based on a number of factors (weather, animal health, diet, feeding strategies, additives, animal husbandry, etc) in addition to the changes in management practices.

In terms of documentation the mock verification revealed that in comparison to cropping projects, electronic record keeping and data management systems at beef feeding operations in Alberta with respect to inventory, feeding, performance and rations, have a high level of accuracy in measurement and significant control-based measures. Table 11 below summarizes the findings. Further information can also be found in the Year One DOF Validation Study Report (Appendix T: Year One DOF Validation Study Report) and the full mock verification report (Appendix U: Year One DOF Mock Verification Report).

Table 11: Year 1 DOF Mock Verification Findings

Item	Findings
Protocol Issues	• The evidence tables in section five need to be revised to be consistent with the layout of the Conservation Cropping Protocol. • A material discrepancy can occur if key parameters of average number of head, average number of days on feed and average daily dry matter intake are not calculated using the animal*head day basis (a weighted average approach) for an animal grouping (Section 4.3 of the DOF Protocol). The protocol should be amended to say the animal head*days approach must be used. • Increasingly cattle are being sold in the open market (as opposed to a quality grid program) at heavier and heavier carcass weights, and retained longer in feedlots. As a result, on average, the number of days that beef cattle are on feed

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Item	Findings
	is actually increasing in comparison to the baseline years, but efficiency improvements are continuing. Consequently, under the current protocol it was recommended that indicators like reduced days on feed be removed from the protocol and instead the protocol be revised to a 'Reduced Carbon Intensity of Fed Cattle' protocol to reflect the per unit of production improvements in GHG emissions shown by innovative producers.
GHG Quantification	• Some animal groups will show a reduction in emissions while other will not. It is the net reduction of all relevant animal groupings in the project year that determines whether a feedlot has a claim.
Documentation and Records	• At the time of the mock verification AgriTrend-FHMS was still gathering the participating feedlot records and therefore a full mock-verification at reasonable level of assurance could not be performed. Nevertheless, ICF conducted field visits and observed that the feedlots in the project had the capacity to measure, manage and report the data required to meet the protocol requirements. Furthermore, documentation was available to support a reasonable level of assurance. • Compared to cropping projects, electronic record keeping and data management systems at beef feeding operations in Alberta with respect to inventory, feeding, performance and rations, have a high level of accuracy in measurement and significant control-based measures. • The data with the greatest risk of error is the actual feed fed on the feedlot. The feedlots that participated in the mock verification had strong systems; however, small feedlots may not have sufficient controls in place to ensure the integrity of feeding data.

Year 2 Findings

Cost Benefit Analysis

In early 2014 it was decided that a second round of cost-benefit analyses would not provide added value. Therefore, this task was removed from the year two validation study project plan.

Mock Verification

In year two, ATAI-FHMS aggregated four feedlots for the 2012 and 2013 project years with a total of 118,260 head under the Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle protocol, v2.1, April 2013 (please note that this is the modified protocol). Once again ICF conducted the mock verification. In year two ATAI-FHMS had all the data and documentation required to quantify and verify the emission reductions according to the requirements of the protocol and the verification team was able to satisfactorily complete all verification procedures with sufficient evidence to form a conclusion.

The year two mock verification identified a few outstanding issues (albeit minor) in the modified protocol (v2.1, August 2013). For example, it was suggested that a general description of the quantification approach be incorporated into the protocol introduction, the equations in sections 4.4 and 4.5 be numbered for easy reference and the total mass of each GHG be shown in the final step of Appendix A of the protocol prior to converting to carbon dioxide equivalent mass. Furthermore, intensity should be defined as "emissions per kg of weight gain" throughout the protocol and it should be clarified that IPCC 2007 global warming potentials

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are to be used for 2014 vintage credits. Otherwise, the modified protocol did not seem to present further issues for project developers.

In terms of documentation, the second year's mock verification confirmed the availability and quality of evidence at beef feeding operations in order to support reasonable level of assurance. Control's based testing on the procedures and data measures at the feed yards satisfactorily met ICF's audit procedures.

The key findings from the year two mock verification are summarized in table 12 below. Further information can also be found in the Year Two DOF Validation Study Report (Appendix V: Year Two DOF Validation Study Report) and the Year Two Mock Verification Report (Appendix W: Year Two DOF Mock Verification Report).

Table 12: Year 2 DOF Mock Verification Findings

Item	Findings
Protocol Issues	• It would be beneficial if a general description of the quantification approach was incorporated in the protocol introduction (e.g. taking the difference between the baseline and project carbon intensities and multiplying this difference by the total production in the project reporting period). • Intensity should be described as "emissions per kg weight gain" throughout the protocol. • It would be beneficial if the equations in sections 4.4 and 4.5 were numbered for easy reference. • Section 4.2 is redundant and should be removed. • In the final step of Appendix A of the protocol the quantification should show the calculation of the total mass of each greenhouse gas prior to converting these values to the carbon dioxide equivalent mass. • 2007 IPCC global warming potentials should be used in the Protocol for 2014 vintage credits.
Documentation and Records	• Control's based testing on the procedures and data measures at the feed yards satisfactorily met ICF's audit procedures.

Reduced Age at Harvest (RAH)

Year 1 Findings

Cost Benefit Analysis

The RAH cost-benefit analysis was also conducted from both a producer and an aggregators perspective. For the aggregator analysis, once again, three scenarios were analyzed – optimistic, expected and pessimistic. The aggregator cost-benefit analysis assumed:

- An existing aggregator is already established and already involved in either the aggregation of other protocols or in providing services to the cattle industry. Therefore, the reducing age at harvest aggregation function would just be a new service of an existing firm;
- Aggregators receive 60% of the carbon price, while producers receive 40%;
- A seven year timeframe for the aggregator (over which start-up costs or infrastructure development would be spread); and
- Start-up costs are the same for all three scenarios.

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Table 13 below summarizes the results of the aggregator cost-benefit analysis for each of the three scenarios. For additional information please see Appendix X: RAH Aggregator Spreadsheet and Appendix Y: The Benefit Cost Analysis of the Aggregator's Position as it Relates to the Reduced Age to Harvest Protocol.

Table 13: RAH Aggregator Cost-Benefit Analysis Findings

	Present Value		
	Expected Scenario	**Optimistic Scenario**	**Pessimistic Scenario**
Present Value of the Costs	$2,370,034.85	$2,923,593.41	$1,963,416.95
Present Value of the Revenue	$3,619,555.93	$7,583,823.55	$1,128,342.81
Cost Per Offset Credit Generated	$7.65	$5.95	$11.22
Revenue Per Offset Credit Generated	$11.68	$15.45	$6.45
Net Present Value	$1,249,521.09	$4,660,230.143	-$835,074.14
Assumptions	• Carbon price of $13/tonne for two years, followed by an increase to $23/tonne for two years and then an increase to $27/tonne for the remaining three years • Quantity of offset credits starts at 40,000 tonnes/year and then gradually increases to 50,000 tonnes/year • Discount rate of 3%	• Carbon price of $13/tonne for first two years, $27/tonne in year three, $30/tonne in years four and five and $40/tonne in final two years. • Quantity of offset credits starts at 60,000 tonnes/year and then gradually increases to 75,000 tonnes/year • Discount rate of 2%	• Carbon price of $13/tonne for full seven years • 25,000 tonnes/year • Discount rate of 5%

The cost-benefit analysis for producers was conducted for two scenarios:

1. Steer calves; and
2. Heifer calves

For both analyses the following assumptions were made:

- An average market price for beef of $112 / hundred weight (based on industry data from 2012).
- Three carbon price scenarios: Expected - $15/tonne, Optimistic - $40 per tonne, and Pessimistic - $13/tonne.
- A carbon revenue split of 40% for the feedlot operator and 60% for the aggregator.

Additional assumptions for the steer calves scenario are presented in Table 14 below.

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Table 14: Additional Assumptions for the Steer Calves Producer Cost Benefit Analysis

	Baseline (3-year average)	Project
Average Age at Harvest (months)	19	15
Number in Production (head)	2633	2500
Average Live Weight (kg)	602.27	590.91
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing) (lbs)	335.35	329.02
• The change in management plan reduces the number of yearling steers in the feedlot and replaces them with steer calves. • The change in management practice made by the producer decreases the age at harvest of the animal. • In the baseline condition, steer yearlings come into the feedlot at 845 lbs and leave at a weight of 1,325 lbs, gaining 480 lbs after spending 125 days in the feedlot. • In the project condition, steer calves come into the feedlot at 550 lbs and leave at a weight of 1,300 lbs, gaining 750 lbs after spending 221 days in the feedlot. • Additional assumptions are summarized in the table below.		

Additional assumptions for the heifer calves scenario are presented in Table 15 below.

Table 15: Additional Assumptions for the Heifer Calves Producer Cost Benefit Analysis

	Baseline (3-year average)	Project
Average Age at Harvest (months)	19	15
Number in Production (head)	2633	2500
Average Live Weight (kg)	556.09	545.45
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing) (lbs)	311.30	303.71
• The change in management plan reduces the number of yearling heifers in the feedlot and replaces these with heifer calves. • The change in management practice made by the producer decreases the age of harvest of the animal. • In the baseline condition, heifer yearlings come into the feedlot at 750 lbs and leave at a weight of 1,225 lbs, gaining 475 lbs after spending 140 days in the feedlot. • In the project condition, heifer calves come into the feedlot at 550 lbs and leave at a weight of 1,200 lbs, gaining 650 lbs after spending 217 days in the feedlot.		

The results for both scenarios were as follows:

Scenario 1 – Steer Calves

The net margins for both yearling steers and steer calves were negative. The net margin was -$8.03 per CWT or -$106.43 per head for yearling steers. The net margin for a steer calf was -$4.75 per CWT or -$61.97 per head. The total number of tonnes of CO_2e reduced was 5,758. Carbon revenue would increase the total revenue, decreasing the negative margin for production; however, the value remains negative. In the expected scenario on a per-head basis, the net margin was -$47.97. In the optimistic scenario on a per-head

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basis, the net margin increased to -$24.93 per head. In the pessimistic scenario on a per-head basis, the net margin decreased to -$49.81. The break-even price of carbon, given the assumptions on the allocation of carbon revenue between the feedlot operator (40%) and the aggregator (60%) and the estimated carbon reduction per head (2.30 tCO2e), would be $67.16.

Scenario 2 – Heifer Calves

The net margins for both a yearling heifer and a heifer calf were negative. In this scenario, the net margin per CWT was -$6.15, or -$75.29 per head for yearling heifers and the net margin for a heifer calves was -$3.91 per CWT, or -$46.97. The total number of tonnes CO_2e reduced was 6,214.69. Given that this was based on producing 2500 head, the average reduction per head was 2.49 tCO_2e.

Carbon would increase the total revenue going to steer calf production and would therefore decrease the negative margin for production. In the expected scenario on a per-head basis, the net margin is -$32.05. In the optimistic scenario on a per-head basis, the net margin increased to -$7.20 per head. In the pessimistic scenario on a per-head basis, the net margin decreased to -$34.04. The break-even price of carbon, given the assumptions as above, would be $47.16. The break-even price for the heifer calf scenario is substantially lower than for the steer calf scenario.

For additional information please see Appendix Z: RAH Producer Spreadsheet and Appendix AA: The Benefit Cost of the Agricultural Producer's Position as it Relates to the Reduced Age at Harvest Protocol.

Mock Verification

For the Reduced Age at Harvest (RAH) protocol validation study FailSafe Canada Inc. engaged one feedlot under the Reducing the Age at Harvest of Beef Cattle Protocol, v 2.0, July 2011. The project year was 2011 with a baseline of 2009 to 2010 (note: FailSafe did not have sufficient data for a three year baseline due to a lack of CCIA registered animals in 2008. Consequently, the decision was made to proceed with a two year baseline for the purposes of the PVS). A total of 1,150 head were included in the project.

As with the other protocols, the mock verification recommended that the protocol format be updated for consistency with the other agricultural protocols. Furthermore, greater clarity is needed in the applicability section on eligible animal age. Presently, the protocol's preamble states that the project activity applies to "youthful cattle, or those under 24 months of age"; however, this is not mentioned again in the applicability section leading to confusion. Improved clarity is also needed in regards to the selection of baseline years. Specifically, the protocol should state that the three baseline years need to immediately proceed the project year. Furthermore, the requirements for establishing functional equivalence should be defined. In particular, the animal grouping should be defined by sex only and not sex by weight class. Weight class groupings are not appropriate for this protocol because the project activity and goal of the protocol is to drive down the age (which corresponds with weight) at which the animal enters the feedlot, which reduces the number of days an animal is in backgrounding lots and pasture. Therefore, animals that are older and larger in the baseline condition are functionally equivalent to animals that are younger and smaller in the project condition. As a result, grouping by weight class removes the carbon mitigation benefit. Other minor, yet needed, protocol revisions include correcting the explanation of how to use equations two and three (which are currently incorrect) and adding a description of the appropriate documentation needed to establish that manure is being managed according to the *Agricultural Operation Practices Act.*

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Another important issue identified through the mock verification is that of ownership. Presently, the way the ownership criteria is stated in the protocol is overly punitive. The owner of the emission reductions should not have to be the owner of the cattle. Instead it should be the feedlot owner. ICF pointed out that precedence for this is found in the energy sector under the Specified Gas Emitter's Regulation. For example, a natural gas processing facility owner processes raw natural gas provided by several production companies. If the facility owner implements a project that reduces energy consumption at the facility, the resulting GHG reduction (and any credit or reduced liability) associated with this project activity clearly resides with the facility owner. The owner may, in turn, pass the financial benefit to the companies that are supplying the commodity (either through reduced fees or direct compensation); however, this is handled through a commercial arrangement, not through the Protocol.

A number of important issues were also identified in the GHG quantification approach of the protocol. First, section 4.4 presently provides two approaches for establishing the birth date of each animal. The "default method" attempts to provide a more conservative approach by requiring that the birth date used to calculate the emission reduction includes the addition of 28 days to the birth certificate date. If this default approach is applied to both the baseline and the project condition, the resulting emission reduction actually increases (versus a non-adjusted birth date approach). If the cow-calf producers are not changing their methodology for registering the birth date of the animals between the baseline and the project periods, then it stands to reason that no adjustment is required because the process is functionally equivalent. Therefore, ICF recommended that the protocol be adjusted to either account for functional equivalence that already seems to exist, or the default approach modified to correct the unintended increase in the quantified emission reduction.

Another concern raised related to the quantification approach is the annualizing of the life span of greenhouse gas emissions from cattle slaughtered at different ages. Scientists involved in the review of the Alberta protocols for adaptation into the US, under the auspices of a USDA Conservation Innovation Grant called BIGGs (Bovine Innovative Greenhouse Gas Solutions), questioned the appropriateness of the current approach and as a result modifications were made in the US. ICF recommended the same changes be made in the Alberta version of the protocol.

Last, it was discovered that the sum of the emission reductions achieved for each animal in the project is mathematically equivalent to calculating the total emission reduction using the average animal age and average animal live weight. Therefore, it is not necessary to know the specific harvest date for each animal in a lot. Instead the average harvest date can be used along with the average birth date to calculate the average age at slaughter. Shipping manifests can provide this data and serve as sufficient documentation for supporting evidence.

In general, ICF found that the capacity of the sector to implement the protocol is high. In terms of documentation, the only concern was confirmation of death. Through extensive investigations by AF and The Prasino Group, it was found that RFID tag retirement or slaughter date data from packing plants is not readily available to feedlot operators / project developers. As a result, it is presently very difficult to obtain this piece of evidence, presenting a barrier which could for many prevent adoption of the protocol. The protocol was revised by The Prasino Group and submitted to Alberta Environment and Forestry for consideration. The deliverables in this project for RAH will need to be updated if the RAH revised RAH protocol is approved by Alberta Environment and Parks.

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Table 16 below summarizes the results of the RAH mock verification. Further information can also be found in Appendix AB: Year One RAH Validation Study Report and Appendix AC: Year One RAH Mock Verification Report.

Table 16: Year 1 RAH Mock Verification Findings

Item	Findings
Protocol Issues	• The protocol should be updated to the new format for consistency with other agricultural protocols. • Clarity should be added in the applicability section on eligible animal age. • The way the ownership criteria is stated in the RAH Protocol is overly punitive. It should not be required that the owner of the emission reductions be the owner of the cattle, but rather it should be the feedlot owner. • The protocol should specify that the baseline years need to immediately precede the project year. • The requirements for establishing functional equivalence should be defined. Specifically, the animal grouping should be defined by sex only and not sex by weight class. Grouping by weight class removes the carbon mitigation benefit. • Section 5 of the protocol should provide a description of the appropriate documentation needed to establish that manure is being managed according to the *Agricultural Operation Practices Act.* • The explanation of how to use Equations 2 and 3 (pages 40 and 41 respectively) is incorrect and needs to be modified.
GHG Quantification	• Section 4.4 of the Protocol provides two approaches to establishing the birth date of each animal. The "default method" attempts to provide a more conservative approach by requiring that the birth date used to calculate the emission reduction includes the addition of 28 days to the birth certificate date. If this default approach is applied to both the baseline and the project condition, the resulting emission reduction actually increases (versus a non-adjusted birth date approach). The Protocol should be adjusted to either account for the functional equivalence that already seems to exist, or modified to correct the unintended increase in the quantified emission reduction. • The approach of annualizing the life span of greenhouse gas emissions from cattle slaughtered at different ages was questioned. Scientists involved in the review of the Alberta protocols for adaptation into the US, under the auspices of a USDA Conservation Innovation Grant called BIGGs (Bovine Innovative Greenhouse Gas Solutions), questioned the appropriateness of the approach and modifications were made in the US. It was recommended the same changes be made in the Alberta version of the protocol. • It was discovered that the sum of the emission reductions achieved for each animal in the project is mathematically equivalent to calculating the total emission reduction using the average animal age and average animal live weight. Therefore, it is not necessary to know the specific harvest date for each animal in a lot. Instead the average harvest date can be used along with the average birth date to calculate the average age at slaughter.

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Item	Findings
Documentation and Records	• The capacity of the sector to implement the protocol is high based on ICFs findings, with the exception of the confirmation of death. Third party data confirming death is not readily available to feedlot operators / project developers.

Year 2 Findings

In early 2014 it was decided that a second cost-benefit analysis and mock verification would not provide added value. Therefore, the second year of the Reduced Age at Harvest validation study was not performed.

Project Deliverables

A number of tools were produced as a result of the protocol validation studies. Specifically, the project produced:

1. **Best Practice Guides –** A set of documents for implementing and verifying agricultural offset projects at reasonable level of assurance – targeted at project developers, verifiers and government auditors. The complete documents for the NERP, Fed Cattle and RAH protocols are provided in Appendices AD, AE and AF respectively.

2. **Data Collection Templates –** A set of templates for each offset protocol that can be used for offset project data collection/compilation. A brief description of the NERP, Fed Cattle and RAH templates are provided in Appendices AG, AH and AI respectively. The original excel files are needed for full functionality and are available separately from CCEMC.

3. **GHG Calculators –** A set of excel based emission reduction calculators built based on the quantification methodologies in the respective protocol. A brief description of the NERP, Fed Cattle and RAH templates are provided in Appendices AJ, AK and AL respectively. The original excel files are needed for full functionality. These spreadsheets are available separately from CCEMC.

4. **Sample Offset Project Plans and Reports –** A set of offset project plans (See Appendices AM, AN and AO) and reports (See Appendices AP, AQ and AR) for each of the protocols that can be used for reference by project developers.

5. **Cost-Benefit Analysis –** A set of excel based calculators (See Appendices H, J, P, R, X & Z), including sensitivity analysis for analysing the costs-benefits of implementing the protocols from an aggregator and producers perspective. The calculators are based on a number of assumptions that could be modified by the user. The original excel files are needed for full functionality and are available separately from CCEMC.

Conclusion and Recommendations

Alberta Environment and Parks has approved a number of agricultural offset protocols. Nevertheless, to date uptake has been disappointing with the exception of the Conservation Cropping protocol. Given this and given that entities capable of generating offsets for the registry, and those willing to purchase offset credits are interested in improving the rate of adoption of agricultural offset protocols, the Protocol Validation Studies were commissioned in 2012. At a high level the Protocol Validation studies revealed:

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1. Additional clarity is needed on the requirements for verifying agricultural offset projects, including sufficient and appropriate evidence standards. Standardization of record management, GHG data and information controls would ease verification and government audit processes and reduce credit revocation risk; and
2. The increased transaction costs associated with the move to "reasonable level of assurance", and economic barriers for aggregators and producers impair adoption and prevent new entrants. Cost/benefit analyses show protocol adoption rates and avoided emissions both rise with carbon credit value. Otherwise the increased costs in supplying offsets will result in market failure.

Given the above, the project team is pleased with Alberta Environment and Parks recent policy adjustment to increase the nominal price for carbon over the next two years. In order to improve clarity on the requirements for verifying agricultural offset projects, the project team recommends the Best Practice Guides for implementing a verifying projects developed as part of this project be adopted by Alberta Environment and Parks.

Other common challenges to adopting agricultural offset protocol identified through the Protocol Validation Studies include the following:

1. *Some protocols penalize early adopters* – For example, the small number of growers who have the records needed to support the NERP are already efficient at managing applied nitrogen, eliminating the opportunity for further emission reductions. As a result, the protocol penalizes early adopters. A similar problem exists with the RAH protocol.
2. *The price of carbon* - At current Technology Fund prices, several project types are no longer profitable. The transaction costs of the offset system have gone up as the system continues to demand more rigour with reasonable level of assurance; however, the technology fund price, until recently, had not increased. This has made it increasingly difficult to get farmers engaged enough to supply the information that is required to generate credits. Furthermore, it has threatened the financial viability of being an aggregator. A number of scenarios were calculated in the cost-benefit analyses, using escalating conservative carbon prices[4] and conservative expected tonnage estimated by the aggregator-project team[5]. The following table presents an aggregator's average annual return at net present value from the 8 year period analysis.

Protocol	Optimistic	Expected	Pessimistic
NERP	$281,471.67	-$31,462.20	-$258,333.14
DOF	$281,884.25	$104,056.11	-$55,759.94
CCP	$244,901.45	$68,454.49	-$88,824.93
RAH	$665,747.16	$178,503.01	-$119,296.31

3. *Inconsistencies in Verification* – Lack of standardization and verifier accreditation has led to inconsistency in outcomes amongst verifiers and government auditors. This is creating confusion amongst project developers on what is considered sufficient and appropriate evidence, and increases risk of failure of ex poste audit impacting fungibility of offsets.

[4] Price increases ranged: $13 for first 2 years; Lower $20's in years 3 and 4; $30's in years 5 to 7

[5] For Optimistic, Expected and Pessimistic tonnes, respectively - NERP – 75,000; 50,000; 25,000; DOF (escalating) – 10 to 50,000; 10 to 25,000; 4 to 6,000; CCP (escalating) – ; 120 to 160,000; 100 to 140,000; 90 to 100,000; RAH – (escalating) 60 to 75,000; 40 to 50,000; 25,000 across the board.

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4. *Credit Revocation Risk* – Lack of standardization in the verification process introduces the risk that verifiers and auditors may come to different conclusions. This is a significant challenge and risk for project developers.

Each of these issues has previously been raised in a briefing note sent to Alberta Environment and Parks in 2013 and provided again in this document in Appendix AS: Briefing Note. Table 17 below is taken directly from the briefing note and presents a number of possible solutions to the challenges identified above.

Table 17: Possible Solutions to the Challenges Identified in the Protocol Validation Studies

Issue	Solution	Implications
Inconsistent Verification Outcomes Credit Revocation Risk	1. Adopt the Best Practice Guides 2. Training to verifiers for verifying a project type 3. Accreditation of Verifiers (ANSI, SCC) 4. Permanent auditors on staff at AESRD 5. Test the verification process on problematic protocols 6. Verifiers submit verification plans on all new project types for review 7. Government auditors shadow verifiers while verifying projects – to observe	• Other Registries/Programs have protocol-specific verification guides to reduce uncertainty • Other Registries/Programs train verifiers on a specific project type • Other Registries/Programs accredit verifiers on a specific project type • Consistency/continuity improved and familiarity with project types and evidentiary requirements • Conduct a test on common project types to see how the outcomes of a group of verifiers differ; could be used to build common understanding • Would create an opportunity to ensure a similar approach across verifiers in mid-term, while a plan for training is being developed. • Auditors would get comfortable with the verification techniques and processes used by specific firms; help to avoid the two-tier project quality
Economic Barriers to Entry and Continued Engagement by Aggregators Implementation Barriers	1. Increase the price of carbon to achieve more projects at scale 2. Accept recommendations for streamlining the 4 protocols to make them more implementable	• More agricultural project types become financially feasible for both aggregators and producers. • Increased ease of protocol adoption

In addition to the above high level findings, the following section provides a brief summary of protocol specific conclusions.

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Summary of Protocol Specific Findings

NERP

All of the issues identified in year one of the NERP validation study were addressed; eliminating a number of barriers to uptake. For example, the introduction of dynamic baselines one and two provides producers without three years of historical data the opportunity to participate in an aggregated project. Similarly, the introduction of a set of acceptable crop mass determination methods has addressed issues associated with inconsistencies in the way farmers measure yield and the level of accuracy of those yield measurements. Nevertheless, there are still a few outstanding issues identified in the second year of the NERP PVS that may limit adoption of the protocol. Specifically, the following items continue to be of concern:

1. *Annual soil tests* – most farms in Alberta do not test their soil on every field annually. The agronomist working with the farmer will use professional judgement, post-harvest assessments or other means to determine an agronomic rate on the fields not soil tested for a given year. This will have to change in order to implement the NERP.
2. *Weight and moisture logs* – weight and moisture logs are required to support crop mass assertions using one of the acceptable crop mass determination methods; however, are usually not recorded at the detail required by the current draft protocol. In the case of moisture readings it is recommended that a flexibility mechanism be added to the protocol allowing use of the most conservative value for the crop from the Canadian Grain Commissions – Standard Storage Requirements.
3. *Soil temperature readings* – It is impractical to take soil temperature readings prior to applying fertilizer in the fall and therefore few, if any, farmers do. It is recommended that data from the nearest weather station be used instead.
4. *Ownership* – Land titles are an unnecessary added expense given that the NERP is an emissions reduction protocol and not a sequestration protocol. At current carbon prices ($15/tonne) this requirement will further reduce profit margins making it even more difficult to attract growers in implementing the NERP. Furthermore, obtaining documentation supporting the transfer of carbon ownership from the land owner to land lessee can be a significant challenge. Many lessee's have limited contact with their land owners and would fear increased rent if they requested carbon ownership.
5. *Flexibility* - Flexibility needs to be added to the protocol for ineligible fields. This issue is of particular importance since the NERP mock verification revealed that the requirement to have all fields under 4R management disqualifies many farms. Presently, the protocol states that all fields on a farm must be enrolled in a 4R program. It is recommended that flexibility be added to the protocol to allow the exclusion of fields that do not qualify in the same way other ineligible fields/crops are handled and excluded. These fields would then be ineligible to generate offsets for the year in which they are excluded. Before the protocol was publicly posted, there was some flexibility for fields/annual crops to be excluded if they do not meet one or more of the 4R eligibility criteria. This flexibility was conservative in that the yield contributions from these fields were excluded to avoid yield leakage. It is strongly recommended that this flexibility be revisited. Please note that under the proposed approach for field exclusion, project developers must still endeavor to have all eligible annual crops under 4R management.

Fed Cattle

In the Year 1 DOF Validation Study Report, verified against The Reduced Days on Feed Protocol (v 2.0, July 2011), it was recommended that the Beef Reduced Days on Feed protocol be revised to a 'Reduced Carbon Intensity of Fed Cattle' protocol. This recommendation was made because the number of day's animals spend

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in the feedlot is dependent on market demand, which is currently for heavier and heavier animals. As a result, the requirement for reduced days on feed in the protocol presented a significant barrier to implementation.

In year two the protocol was revised and the indicator for reducing days on feed removed. The revised 'Reduced Carbon Intensity of Fed Cattle' protocol was then used in the Year 2 mock verification. Through the mock verification process a number of minor issues were identified in the modified version (v2.1, August 2013). These issues were presented in detail above and edits have now been made to the protocol. Once the modified protocol is approved it is believed that the majority of issues previously associated with the DOF protocol will have been addressed and the first fed cattle project in Alberta (and the world) is expected to be registered soon.

RAH

The RAH protocol represents the most streamlined and easy to implement of the beef protocols. As explained above the biggest challenge is obtaining confirmation of death. However, through the mock verification ICF identified that average harvest dates rather than individual harvest dates could be used and that this information is available in shipping manifests. The protocol will need to be updated to allow the use of average harvest dates.

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Appendix A: Original NERP, DOF and RAH Project Plans

(Please note that the project timelines evolved as the project progressed. As a result, the dates listed in the project plans below may be incorrect; however, the general flow of work remains correct)

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NERP Project Plan

PROJECT ELEMENTS

1. **Protocol Validation Study Design:** Finalizing the design of the validation studies, engaging industry partners and initiating the project.

2. **Implementing Protocol Validation Studies:** Implementing the first year of the protocol validation studies. This will involve developing guidelines and templates for data management; engaging and enrolling cooperating farms; collecting baseline data and documentation; monitoring project outcomes, aggregating all qualified project reductions and preparing product documentation.

3. **Reporting on Protocol Validation Studies:** The first year of reporting, knowledge transfer and extension. Will involve conducting cost benefit analysis.

4. **Extension of Protocol Validation Study for NERP and Stakeholder Engagement:** Extension of the project for NERP. This phase will involve ongoing support, data collection, monitoring and reporting amongst other activities.

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ELEMENTS	GOALS	TACTICS/ TIMING	TASKS	MILESTONES/ DELIVERABLES
1. Protocol Validation Study Design	• Project planning, organization and risk analysis	• **Design summary:** draft – August 4, 2012, final – August 10, 2012 • **Cost-benefit analysis plan**: draft - August 10, 2012; reviewed plan by August 30, 2012 • **Orientation workshop prep:** send out invites by August 15, 2012 • Monthly call and report	1.01 TPG - Work with ARD/CCEMC to plan the key components of the validation studies 1.02 TPG - Finalize study design for each of the four project areas 1.03 TPG - Prepare a detailed project plan 1.04 TPG - Complete a SWOT and risk analysis on the study design 1.05 TPG - Prepare materials for orientation workshop; ARD/CCEMC to review 1.06 ARD/CCEMC – Send out invitations to workshop 1.07 TPG - Prepare cost-benefit analysis plan 1.08 ARD/CCEMC - Review the cost-benefit analysis plan	• Validation study design summaries • Detailed project plans • Agenda, invite list and dates for workshop set • Invitations sent out • Cost-benefit analysis plan
	• Align expectations, clarify roles and plan for next steps	• **Request for qualifications/request for interest (RFQ/RFI) criteria and process**: draft - September 1, 2012, final -September 7, 2012 • Workshop - September 12, 2012 • Monthly call and report	1.09 TPG – Draft the criteria for the RFQ/RFI process; ARD/CCEMC to review 1.10 CCEMC - Secure space at Alberta Innovates-Technology Futures for Sept 12, 2012 1.11 ARD/CCEMC - Host orientation workshop in conjunction with TPG	• Workshop minutes and attendee list • PowerPoint presentations
	• Selection of cooperating aggregator(s)	• **RFQ/RFI**: issued September 15, 2012 • **Summary letter**: September 30, 2012 • **Aggregator kick-off meeting:** October 5, 2012 (tentative)	1.12 TPG – Issue RFQ/RFI to aggregation community 1.13 TPG - Select aggregator partners for each project area 1.14 TPG - Communicate results of selection process 1.15 TPG – Form NERP working group with successful aggregator; go over project plan and validation study design document	• Project participant summary letter issued to successful cooperating aggregator(s)

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
2. Implementing Protocol Validation Studies	• Create data template and establish collection guidelines	• **NERP data management guidelines/templates**: first draft - October 15, 2012; reviewed draft for implementation - October 22, 2012; final – March 1, 2013	2.01 TPG - Build data management guidelines and templates 2.02 TPG – Review the data materials and go over the data collection issues with the aggregator to align understanding of requirements	• Data management guidelines and templates
	• Enroll cooperating producers and establish a 4R Consistent Plan for each Farm • Establish baseline years for each farm (try for 2008-2010 baseline) • Test and evaluate implementation of the protocol • Identify data gaps, barriers and implementation issues • Assess availability of farm-based and sector-based data/documentation sources • Determine offset feasibility	• **Field engagement of producers** • **Data collection (2011/2012 Project Year)** • **Project documentation:** draft offset project plan – December 19, 2012; draft for verifier due December 19, 2012; final due by March 1, 2013 • **Project documentation - draft offset report:** January 15, 2013	2.03 TPG - Support enrollment of cooperating farms in coordination with aggregator 2.04 TPG– Work with the aggregator to draft 4R consistent plans for each cooperating farm; obtain APA sign-off 2.05 TPG – Work with aggregator to draft the offset project plan and establish appropriate records that will be obtained from cooperating farms /third party sources to support verification 2.06 Aggregator - Collect baseline data/documentation from cooperating producers using template; establish baselines 2.07 TPG – Work with the aggregator to collect economic data associated with project implementation 2.08 TPG - Work with aggregator to proceed with project monitoring, measurement 2.09 Aggregator - Aggregate all qualified project reductions for 2011 year and collect project documentation 2.10 TPG/Aggregator – Work together to address barriers to implementation for the farms 2.11 TPG – Work with aggregator to prepare offset project report	• Completed project plans and reports • Farm and third party records established and collected for mock verification • Collected economic data for cost-benefit analysis
	• RFP for selection of verifier for mock verification • Mock-verification completed and emission reductions validated • Assess verification requirements at reasonable level of assurance	• **Engage verifier by** December 19, 2012 • **Verifier engagement meeting:** December 22, 2012 (tentative) • **Mock verification reports:** March 1, 2013	2.12 TPG – Draft the RFP criteria for verifier and issue RFP 2.13 TPG - Select mock-verification partner 2.14 Review requirements of mock verification with successful verifier (including presenting at the interim workshop in August) 2.15 TPG – Work with verifier and aggregator to validate the emission reductions from each of the projects 2.16 Verifier – Prepare assessment of reasonable level of assurance	• Project mock verification reports • Reasonable assurance assessment

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
3. Reporting on Protocol Validation Studies	• Establish example for effective data management/quantification in order to support aggregation platforms	• **Excel-based calculation template:** January 15, 2013	3.01 TPG – Prepare excel-based calculation template with example dataset 3.02 TPG - Recommend data management and operation approaches for scaled-up projects	• Finalize guidance on data management and operation approaches
	• Conduct initial assessment of project feasibility – including co-benefit qualification and costs of data collection and management	• **Cost benefit analysis case studies:** • Draft – March 1, 2013, Final – March 15, 2013	3.03 TPG – Prepare case studies for cost/benefit analysis for extension purposes; qualify and identify any co-benefits	• Cost benefit analysis reports
	• Dissemination and sharing of results/ information with stakeholders • Educate verifiers and other stakeholders on requirements for achieving reasonable level of assurance • Use case studies to facilitate communication with producers and other stakeholders on the magnitude of the opportunity	• **Interim extension workshop prep:** send out invites by July 1, 2013 • **Interim workshop**: tentative dates week of August 19th, 2013	3.04 TPG - Prepare and coordinate preparation of materials for interim extension workshop; ARD/CCEMC to review 3.05 ARD/CCEMC - Host interim workshop with producers, aggregators, verifiers, regulators – same list as in the orientation workshop	• Workshop presentation(s) • Workshop minutes and attendee list

	• Creation of validation study reports	• **Validation study reports:**
		  • Draft – March 1, 2013
		  • Final – March 15, 2013
			3.06 TPG - Reporting on the results of the validation study	• Year 1 Validation Study Report

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
4. Extension of Protocol Validation Studies (DOF, RAH, NERP) and Stakeholder Engagement	• Develop carbon project documentation • Identify solutions to data gaps and other barriers leading to clearer understanding of data requirements and mechanisms for resolving gaps in data/documentation availability • Provide guidance to producers on use of protocols to generate value • Continue to test and evaluate implementation of the protocols	**Project plans and reports DOF/NERP/ RAH:** • Draft for review – December 15, 2013 • Draft for verifier – December 31, 2013 • Final – March 1, 2014	4.01 Ongoing support for enrollment of cooperating farms in coordination with aggregators 4.02 Ongoing collection of baseline data/documentation from producers 4.03 Collect additional economic data associated with project implementation 4.04 On-going project monitoring, measurement and reporting 4.05 Aggregate all qualified project reductions and prepare project documentation 4.06 Continue to address barriers to implementation within each of the studies	• Completed project plans and reports
	• Creation of mock verification reports	**Mock verification reports DOF/NERP/RAH:** • Draft – March 1, 2014 • Final – March 15, 2014	4.07 Validate the emission reductions from each of the projects	• Project mock verification reports DOF/NERP/RAH
	• Final assessment and evaluation of project feasibility	**DOF/NERP/RAH cost benefit analysis reports:** • Draft – March 1, 2014 • Final – March 15, 2014	4.08 Update case studies for cost/benefit analysis for extension purposes, including expansion of beef economic analysis and enhancement of the calculators/beta testing	• Updated cost benefit analysis reports
	• Host workshop and engage with stakeholders to improve overall understanding of the scale of opportunity • Build capacity for further protocol implementation	• July to August 2014	4.09 Project extension workshops with producers, aggregators, verifiers, regulators, etc.	• Workshop presentation(s) • Workshop minutes and attendee list
	• Completion of validation study reports • Extract lessons learned from the protocol validation studies to inform protocol implementation/potential revisions • Design scalable approaches to adopting the four protocols	**DOF/NERP/RAH:** • Draft – March 1, 2014 • Final – March 15, 2014	4.10 Reporting on the results of the validation studies during extension period	• Year II validation study reports

PROJECT ELEMENTS

6. **Protocol Validation Study Design:** Finalizing the design of the validation studies, engaging industry partners and initiating the project.

7. **Implementing Protocol Validation Studies:** Implementing the first year of the protocol validation studies. This will involve developing guidelines and templates for data management; engaging and enrolling cooperating farms; collecting baseline data and documentation; monitoring project outcomes, aggregating all qualified project reductions and preparing product documentation.

8. **Reporting on Protocol Validation Studies:** The first year of reporting, knowledge transfer and extension. Will involve conducting cost benefit analysis and the beta testing of calculators.

9. **Extension of Protocol Validation Study for Reduced Days on Feed (DOF) and Stakeholder Engagement:** Extension of the project for DOF. This phase will involve ongoing support, data collection, monitoring and reporting amongst other activities.

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ELEMENTS	GOALS	TACTICS/ TIMING	TASKS	MILESTONES/ DELIVERABLES
2. Protocol Validation Study Design	• Project planning, organization and risk analysis	• **Design summary:** draft – August 4, 2012, final – August 10, 2012 • **Cost-benefit analysis plan and beef economic calculator plan**: draft -August 10, 2012; reviewed plan by August 30, 2012 • **Orientation workshop prep:** send out invites by August 15, 2012 • Monthly call and report	1.16 TPG - Work with ARD/CCEMC to plan the key components of the validation studies 1.17 TPG - Finalize study design for each of the four project areas 1.18 TPG - Prepare a detailed project plan 1.19 TPG - Complete a SWOT and risk analysis on the study design 1.20 TPG - Prepare materials for orientation workshop; ARD/CCEMC to review 1.21 ARD/CCEMC – Send out invitations to workshop 1.22 TPG - Prepare cost-benefit analysis plan 1.23 ARD/CCEMC - Review the cost-benefit analysis plan	• Validation study design summaries • Detailed project plans • Agenda, invite list and dates for workshop set • Invitations sent out • Cost-benefit analysis plan • Beef economic calculator plan
	• Align expectations, clarify roles and plan for next steps	• **Request for qualifications/request for interest (RFQ/RFI) criteria and process**: draft - September 1, 2012, final - September 7, 2012 • Workshop - September 12, 2012 • Monthly call and report	1.24 TPG – Draft the criteria for the RFQ/RFI process; ARD/CCEMC to review 1.25 CCEMC - Secure space at Alberta Innovates-Technology Futures for September 12, 2012 1.26 ARD/CCEMC - Host orientation workshop in conjunction with TPG	• Workshop minutes and attendee list • PowerPoint presentations
	• Selection of cooperating aggregator(s)	• **RFQ/RFI**: issued September 15, 2012 • **Summary letter**: September 30, 2012 • **Aggregator kick-off meeting:** October 5, 2012 (tentative)	1.27 TPG – Issue RFQ/RFI to aggregation community 1.28 TPG - Select aggregator partners for each project area 1.29 TPG - Communicate results of selection process 1.30 TPG – Form beef working group with successful aggregator; go over project plan and validation study design document	• Project participant summary letter issued to successful cooperating aggregator(s)

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
3. Implementing Protocol Validation Studies	• Create data template and establish collection guidelines	• **DOF data management guidelines/templates**: first draft - October 15, 2012; reviewed draft for implementation - October 22, 2012; final – March 1, 2013	2.17 TPG - Build data management guidelines and templates 2.18 TPG – Review the data materials and go over the data collection issues with the aggregator to align understanding of requirements	• Data management guidelines and templates
	• Enroll cooperating feedlots • Establish baseline years for each farm (try for 2008-2010 baseline) • Test and evaluate implementation of the protocol • Identify data gaps, barriers and implementation issues • Assess availability of farm-based and sector-based data/documentation sources • Determine feasibility of offset generation	• **Field engagement of feedlots** • **Data collection (2011/2012 Project Year)** • **Project documentation:** draft offset project plan - December 7, 2012; draft for verifier - December 15, 2012; final by March 1, 2013 • **Project documentation – draft offset report:** January 31, 2013	2.19 TPG - Support enrollment of cooperating feedlots in coordination with aggregator 2.20 TPG – Work with aggregator to draft the offset project plan and establish appropriate records that will be obtained from cooperating feedlots/third party sources to support verification 2.21 Aggregator - Collect baseline data/documentation from cooperating feedlots using template; establish baselines 2.22 TPG – Work with the aggregator to collect economic data associated with project implementation/Beef Calculators 2.23 TPG- Work with aggregator to proceed with project monitoring, measurement 2.24 Aggregator - Aggregate all qualified project reductions for 2011 year and collect project documentation 2.25 TPG/Aggregator – Work together to address barriers to implementation for the farms 2.26 TPG – Work with aggregator to prepare offset project report	• Completed project plans and reports • Farm and third party records established and collected for mock verification • Collected economic data for cost-benefit analysis
	• RFP for selection of verifier for mock verification • Mock-verification completed and emission reductions validated • Assess verification requirements at reasonable level of assurance	• **RFP**: issued December 1, 2012 • **Summary letter**: December 7, 2012 • **Verifier engagement meeting:** December 15, 2012 (tentative) • **Mock verification reports:** February 28, 2013	2.27 TPG – Draft the RFP criteria for verifier and issue RFP 2.28 TPG - Select mock-verification partner 2.29 Review requirements of mock verification with successful verifier (including presenting at the interim workshop in August) 2.30 TPG – Work with verifier and aggregator to validate the emission reductions from each of the projects 2.31 Verifier – Prepare assessment of reasonable level of assurance	• Project mock verification reports • Reasonable assurance assessment

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
4. Reporting on Protocol Validation Studies	• Establish example for effective data management/quantification in order to support aggregation platforms	• **Finalized draft beef economic calculators:** January 15, 2013 • **Excel-based calculation template:** January 7, 2013	3.07 TPG – Prepare excel-based calculation template with example dataset 3.08 TPG - Recommend data management and operation approaches for scaled-up projects	• Finalize guidance on data management and operation approaches
	• Conduct initial assessment of project feasibility – including co-benefit qualification and costs of data collection and management	• **Beta testing of beef calculators:** February 15, 2013 (tentative); finalize calculator • **Cost benefit analysis case studies:** • Draft – March 1, 2013, Final – March 15, 2013	3.09 TPG - Prepare the beef economic calculator for beta-testing 3.10 TPG – Invite 2-5 feedlot operators for beta-testing of the calculator (possible webinar) 3.11 TPG – Prepare case studies for cost/benefit analysis for extension purposes 3.12 Finalize the beef calculator	• Cost benefit analysis reports • Beta-tested and finalized beef economic calculator
	• Dissemination and sharing of results/ information with stakeholders • Educate verifiers and other stakeholders on requirements for achieving reasonable level of assurance • Use case studies to facilitate communication with producers and other stakeholders on the magnitude of the opportunity	• **Interim extension workshop prep:** send out invites by July 1, 2013 • **Interim workshop**: tentative dates week of August 19th, 2013	3.13 TPG - Prepare and coordinate preparation of materials for interim extension workshop; ARD/CCEMC to review 3.14 ARD/CCEMC - Host interim workshop with producers, aggregators, verifiers, regulators – same list as in the orientation workshop	• Workshop presentation(s) • Workshop minutes and attendee list

	• Creation of validation study reports	• **Validation Study Reports:**
		  • Draft – March 1, 2013
		  • Final – March 15, 2013
			3.15 TPG - Reporting on the results of the validation study	• Year 1 validation study report

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
5. Extension of Protocol Validation Studies (DOF, RAH, NERP) and Stakeholder Engagement	• Develop carbon project documentation • Identify solutions to data gaps and other barriers leading to clearer understanding of data requirements and mechanisms for resolving gaps in data/documentation availability • Provide guidance to producers on use of protocols to generate value • Continue to test and evaluate implementation of the protocols	**Project plans and reports DOF/NERP/ RAH:** • Draft for review – December 15, 2013 • Draft for verifier – December 31, 2013 • Final – March 1, 2014	4.11 Ongoing support for enrollment of cooperating farms in coordination with aggregators 4.12 Ongoing collection of baseline data/documentation from producers 4.13 Collect additional economic data associated with project implementation 4.14 On-going project monitoring, measurement and reporting 4.15 Aggregate all qualified project reductions and prepare project documentation 4.16 Continue to address barriers to implementation within each of the studies	• Completed project plans and reports
	• Creation of mock verification reports	**Mock verification reports DOF/NERP/RAH:** • Draft – March 1, 2014 • Final – March 15, 2014	4.17 Validate the emission reductions from each of the projects	• Project mock verification reports DOF/NERP/RAH
	• Final assessment and evaluation of project feasibility	**DOF/NERP/RAH cost benefit analysis reports:** • Draft – March 1, 2014 • Final – March 15, 2014	4.18 Update case studies for cost/benefit analysis for extension purposes, including expansion of beef economic analysis and enhancement of the calculators/beta-testing	• Updated cost benefit analysis reports
	• Host workshop and engage with stakeholders to improve overall understanding of the scale of opportunity • Build capacity for further protocol implementation	• July to August 2014	4.19 Project extension workshops with producers, aggregators, verifiers, regulators, etc.	• Workshop presentation(s) • Workshop minutes and attendee list
	• Completion of validation study reports • Extract lessons learned from the protocol validation studies to inform protocol implementation/potential revisions • Design scalable approaches to adopting the four protocols	**DOF/NERP/RAH:** • Draft – March 1, 2014 • Final – March 15, 2014	4.20 Reporting on the results of the validation studies during extension period	• Year II validation study reports

RAH Project Plan

PROJECT ELEMENTS

1. **Protocol Validation Study Design:** Finalizing the design of the validation studies, engaging industry partners and initiating the project.

2. **Implementing Protocol Validation Studies:** Implementing the first year of the protocol validation studies. This will involve developing guidelines and templates for data management; engaging and enrolling cooperating farms; collecting baseline data and documentation; monitoring project outcomes, aggregating all qualified project reductions and preparing product documentation.

3. **Reporting on Protocol Validation Studies:** The first year of reporting, knowledge transfer and extension. Will involve conducting cost benefit analysis and the beta testing of calculators.

4. **Extension of Protocol Validation Study for Reduced Age at Harvest (RAH) and Stakeholder Engagement:** Extension of the project for RAH. This phase will involve ongoing support, data collection, monitoring and reporting amongst other activities.

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ELEMENTS	GOALS	TACTICS/ TIMING	TASKS	MILESTONES/ DELIVERABLES
3. Protocol Validation Study Design	• Project planning, organization and risk analysis	• **Design summary:** draft – August 4, 2012, final – August 10, 2012 • **Cost-benefit analysis plan and beef economic calculator plan**: draft -August 10, 2012; reviewed plan by August 30, 2012 • **Orientation workshop prep:** send out invites by August 15, 2012 • Monthly call and report	1.31 KHK - Work with ARD/CCEMC to plan the key components of the validation studies 1.32 KHK - Finalize study design for each of the four project areas 1.33 KHK - Prepare a detailed project plan 1.34 KHK - Complete a SWOT and risk analysis on the study design 1.35 KHK - Prepare materials for orientation workshop; ARD/CCEMC to review 1.36 ARD/CCEMC – Send out invitations to workshop 1.37 KHK - Prepare cost-benefit analysis plan 1.38 ARD/CCEMC - Review the cost-benefit analysis plan	• Validation study design summaries • Detailed project plans • Agenda, invite list and dates for workshop set • Invitations sent out • Cost-benefit analysis plan • Beef economic calculator plan
	• Align expectations, clarify roles and plan for next steps	• **Request for qualifications/request for interest (RFQ/RFI) criteria and process**: draft - September 1, 2012, final - September 7, 2012 • Workshop - September 12, 2012 • Monthly call and report	1.39 KHK – Draft the criteria for the RFQ/RFI process; ARD/CCEMC to review 1.40 CCEMC - Secure space at Alberta Innovates-Technology Futures for September 12, 2012 1.41 ARD/CCEMC - Host orientation workshop in conjunction with KHK	• Workshop minutes and attendee list • Powerpoint presentations
	• Selection of cooperating aggregator(s)	• **RFQ/RFI**: issued September 15, 2012 • **Summary letter**: September 30, 2012 • **Aggregator kick-off meeting:** October 5, 2012 (tentative)	1.42 KHK – Issue RFQ/RFI to aggregation community 1.43 KHK - Select aggregator partners for each project area 1.44 KHK - Communicate results of selection process 1.45 KHK – Form beef working group with successful aggregator; go over project plan and validation study design document	• Project participant summary letter issued to successful cooperating aggregator(s)

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
4. Implementing Protocol Validation Studies	• Create data template and establish collection guidelines	• **RAH data management guidelines/templates**: first draft – February 14, 2013; reviewed draft for implementation – March 1, 2013; final – June 1, 2013	2.32 KHK - Build data management guidelines and templates 2.33 KHK – Review the data materials and go over the data collection issues with the aggregator to align understanding of requirements	• Data management guidelines and templates
	• Enroll cooperating feedlots • Establish baseline years for each farm (try for 2008-2010 baseline) • Test and evaluate implementation of the protocol • Identify data gaps, barriers and implementation issues • Assess availability of farm-based and sector-based data/documentation sources • Determine feasibility of offset generation	• **Field engagement of feedlots** • **Data collection (2011 Project Year)** • **Project documentation:** draft offset project plan – Feb 14, 2013; draft for verifier due March 1, 2013; final draft for verifier due April 1, 2013 • **Project documentation – draft offset report:** June 1, 2013	2.34 KHK - Support enrollment of cooperating feedlots in coordination with aggregator 2.35 KHK – Work with aggregator to draft the offset project plan and establish appropriate records that will be obtained from cooperating feedlots/third party sources to support verification 2.36 Aggregator - Collect baseline data/documentation from cooperating feedlots using template; establish baselines 2.37 KHK – Work with the aggregator to collect economic data associated with project implementation/beef calculators 2.38 KHK- Work with aggregator to proceed with project monitoring, measurement 2.39 Aggregator - Aggregate all qualified project reductions for 2011 year and collect project documentation 2.40 KHK/Aggregator – Work together to address barriers to implementation for the farms 2.41 KHK – Work with aggregator to prepare offset project report	• Completed project plans and reports • Farm and third party records established and collected for mock verification • Collected economic data for cost-benefit analysis
	• RFP for selection of verifier for mock verification • Mock-verification completed and emission reductions validated • Assess verification requirements at reasonable level of assurance	• **RFP**: issued January 15, 2013 • **Summary letter**: January 30, 2013 • **Verifier engagement meeting:** February 5, 2013 (tentative) • **Mock verification reports:** June 1, 2013	2.42 KHK – Draft the RFP criteria for verifier and issue RFP 2.43 KHK - Select mock-verification partner 2.44 Review requirements of mock verification with successful verifier (including presenting at the interim workshop in August) 2.45 KHK – Work with verifier and aggregator to validate the emission reductions from each of the projects 2.46 Verifier – Prepare assessment of reasonable level of assurance	• Project mock verification reports • Reasonable assurance assessment

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
5. Reporting on Protocol Validation Studies	• Establish example for effective data management/quantification in order to support aggregation platforms	• **Finalized draft beef economic calculators:** January 15, 2013 • **Excel-based calculation template:** March 15, 2013	3.16 KHK – Prepare excel-based calculation template with example dataset 3.17 KHK - Recommend data management and operation approaches for scaled-up projects	• Finalize guidance on data management and operation approaches
	• Conduct initial assessment of project feasibility – including co-benefit qualification and costs of data collection and management	• **Beta testing of beef calculators:** February 15, 2013 (tentative); finalize calculator • **Cost benefit analysis case studies:** • Draft – June 1, 2013, Final – June 15, 2013	3.18 KHK - Prepare the beef economic calculator for beta-testing 3.19 KHK – Invite 2-5 feedlot operators for beta-testing of the calculator (possible webinar) 3.20 KHK – Prepare case studies for cost/benefit analysis for extension purposes 3.21 Finalize the beef calculator	• Cost benefit analysis reports • Beta-tested and finalized beef economic calculator
	• Dissemination and sharing of results/ information with stakeholders • Educate verifiers and other stakeholders on requirements for achieving reasonable level of assurance • Use case studies to facilitate communication with producers and other stakeholders on the magnitude of the opportunity	• **Interim extension workshop prep:** send out invites by July 1, 2013 • **Interim workshop**: tentative dates week of August 19th, 2013	3.22 KHK - Prepare and coordinate preparation of materials for interim extension workshop; ARD/CCEMC to review 3.23 ARD/CCEMC - Host interim workshop with producers, aggregators, verifiers, regulators – same list as in the orientation workshop	• Workshop presentation(s) • Workshop minutes and attendee list

	• Creation of validation study reports	• **Validation study reports:**
		  • Draft – June 1, 2013
		  • Final – June 15, 2013
			3.24 KHK - Reporting on the results of the validation study	• Year 1 validation study report

ELEMENTS	GOALS	TACTICS/TIMING	TASKS	MILESTONES/DELIVERABLES
6. Extension of Protocol Validation Studies (DOF, RAH, NERP) and Stakeholder Engagement	• Develop carbon project documentation • Identify solutions to data gaps and other barriers leading to clearer understanding of data requirements and mechanisms for resolving gaps in data/documentation availability • Provide guidance to producers on use of protocols to generate value • Continue to test and evaluate implementation of the protocols	**Project plans and reports DOF/NERP/ RAH:** • Draft for review – December 15, 2013 • Draft for verifier – December 31, 2013 • Final – March 1, 2014	4.21 Ongoing support for enrollment of cooperating farms in coordination with aggregators 4.22 Ongoing collection of baseline data/documentation from producers 4.23 Collect additional economic data associated with project implementation 4.24 On-going project monitoring, measurement and reporting 4.25 Aggregate all qualified project reductions and prepare project documentation 4.26 Continue to address barriers to implementation within each of the studies	• Completed project plans and reports
	• Creation of mock verification reports	**Mock verification reports DOF/NERP/RAH:** • Draft – March 1, 2014 • Final – March 15, 2014	4.27 Validate the emission reductions from each of the projects	• Project mock verification reports DOF/NERP/RAH
	• Final assessment and evaluation of project feasibility	**DOF/NERP/RAH cost benefit analysis reports:** • Draft – March 1, 2014 • Final – March 15, 2014	4.28 Update case studies for cost/benefit analysis for extension purposes, including expansion of beef economic analysis and enhancement of the calculators/beta-testing	• Updated cost benefit analysis reports
	• Host workshop and engage with stakeholders to improve overall understanding of the scale of opportunity • Build capacity for further protocol implementation	• July to August 2014	4.29 Project extension workshops with producers, aggregators, verifiers, regulators, etc.	• Workshop presentation(s) • Workshop minutes and attendee list
	• Completion of validation study reports • Extract lessons learned from the protocol validation studies to inform protocol implementation/potential revisions • Design scalable approaches to adopting the four protocols	**DOF/NERP/RAH:** • Draft – March 1, 2014 • Final – March 15, 2014	4.30 Reporting on the results of the validation studies during extension period	• Year II validation study reports

Appendix B: SWOT Analysis

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Introduction

The enclosed SWOT analysis summarizes TPG's initial assessment of the **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats associated with the four Protocol Validation Studies (PVSs). The broad objectives of the PVSs are to identify barriers, assess availability of farm-based and sector-based data sources and develop ways to encourage greater adoption of the Conservation Cropping/Tillage System Management (CCP), Nitrous Oxide Emission Reductions (NERP), Beef Reduced Days on Feed (DOF) and Beef Reduced Age to Harvest (RAH) Protocols in Alberta.

Since the strengths, weaknesses, opportunities and threats are largely similar across all four PVSs, a single SWOT analysis is presented. Nevertheless, if a specific point only applies to a sub-set of the four protocols, the protocol(s) to which it applies are specified in the comments. Therefore, if the specific name(s) of the protocols are not specified, it can be assumed that this point applies to all four PVSs. Under each section (i.e. strengths, weaknesses, opportunities and threats) the findings are broken down into sub-sections, with a heading for each specific strength/weakness/opportunity/threat followed by a brief description of the point.

The SWOT analysis was conducted to identify and predict any challenges the project may face in order to plan for potential obstacles and where possible, apply measures to mitigate the risk. In general, the results of the SWOT analysis show that the project team and its partners are well-equipped and prepared to successfully complete the PVSs. The team and its partners have significant expertise in this area and have created a well-developed project plan/organizational structure for completing the project. However, a weakness exists in the project team's inability to reasonably fully control every aspect of the project. This inability adds an element of uncertainty. As a result, the project team will need to be flexible enough to be reactive to any challenges that arise.

Assuming the project moves forward as currently planned, there is significant potential for a number of opportunities to present themselves as a result of the PVSs. In particular, the PVSs are anticipated to improve understanding of the protocols and how to meet a reasonable level of assurance. In turn, this would lead to streamlined protocol implementation and where needed improvements in the protocols themselves. Although the opportunities for improvement are many, there are also factors external to the project team's control that could threaten the project. Some of these factors include the ongoing debate on climate change and perceptions by producers/willingness to engage, market volatility and the possibility that there will be lack of qualified producers and/or producers willing to participate. Further detail on each of the strengths, weaknesses, opportunities and threats identified by the project team are provided below. The analysis also includes mitigative strategies for managing some of the weaknesses and threats.

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Strengths	Weaknesses	Mitigative Strategies
<u>Project Team and Project Partners</u> **Wealth of Experience** • The project team and its partners collectively have significant past experience in offset protocol development, carbon project development, carbon financing, project verification, registration and market transactions. **Multi-disciplinary Expertise** • The project team has expertise in a diverse range of fields including livestock science, cropping, soils, economics and engineering. **ARD/CCEMC Co-Funding and Involvement** • The involvement of both ARD and CCEMC in the project will help give the project credibility and access to a broad network of individuals and resources. <u>Project Design</u> **A Series of Project Workshops** • Workshops have been scheduled at three phases of the project to connect with project partners/participants. These workshops will help engage those involved and will be used as a platform to discuss the project, disseminate information and share results. This will help ensure alignment between all of the parties involved.	<u>Project Design</u> **Lack of Control** • The project team will educate and encourage accurate data capture and review the information submitted; however, the project team does not have control over this process and the information/data that the producers track. <u>Project Partners</u> **Engagement** • The level of success at engaging cooperating aggregators by hosting the Orientation Workshop, with ARD/CCEMC leadership is not guaranteed. There is a risk that the perceived risks of a shared learning exercise may outweigh the private benefits for those aggregators who have already invested significant resources to develop projects (particularly for NERP and Beef DOF) – and they will not engage.	• **Lack of Control:** The workshops will be used to explain and encourage accurate data collection. Furthermore, all information collected will be reviewed for accuracy and quality control. • **Engagement:** Participating aggregators and their producers will be assured that sensitive information will remain confidential and will not be exposed. This will be supported by a confidentiality agreement. Furthermore, aggregators will be given the opportunity to provide feedback at the workshop which will be used to inform the process (including what is proprietary and what is not). This will be a critical factor in their participation.

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Strengths (Continued)	Weaknesses (Continued)	Mitigative Strategies
<u>Project Design</u> **A Well-Developed Work Plan** • The project team will be guided by a thorough work plan with clear objectives, deliverables and timelines. This will help ensure the project stays on schedule and achieves its goals. **Competitive Verifier and Aggregator Selection Process** • A competitive selection process will be used to ensure the most qualified cooperating verifier and aggregator(s) are chosen and used in the project. **Efficient Use of Producer Time** • The project was designed to encourage producer engagement, by optimizing use of their time. This was done to try to make the project not too onerous to participate in and to encourage continued participation throughout the duration of the project. **Monthly Project Steering Committee Calls** • Throughout each phase of the work plan, monthly project steering committee calls have been scheduled to ensure frequent communication and information sharing amongst the project team. This will help ensure alignment in approach and timely project implementation. Meetings will be set ahead and at least one senior staff person will be in attendance.	**Unsuccessful Aggregators and Verifiers** • Ultimately only one verifier and one or two aggregators will be chosen. This may leave those who were unsuccessful feeling disgruntled.	• **Unsuccessful Aggregators and Verifiers:** A transparent and robust selection process will be used that leads to clear conclusions and strong justification for or against selecting a specific aggregator/verifier

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Strengths (Continued)	Weaknesses (Continued)	Mitigative Strategies
Identification of Data Gaps • The project is designed to identify data gaps associated with implementing the protocols. Once these gaps are identified solutions can be identified and an example of effective data management/quantification can be created to inform future protocol implementation. **Cost-benefit Analysis** • The project includes an assessment of the costs and benefits associated with implementing each of the selected protocols. This will help determine their feasibility, which can be used to inform future protocol implementation as well as policy. A variety of scenarios will be assessed in order to ensure a range of possibilities are considered. **Alignment with Corporate Social Responsibility Values** • This project is in alignment with growing corporate/consumer support for less carbon intensive food products. **Completion of a Sample Mock-Verification** • At the end of the project a mock-verification at a reasonable level of assurance will have been completed.	**Missing Data Gaps** • Although the project is designed to identify data daps, there is still the potential for some gaps to be missed.	• **Missing Data Gaps:** In order to help prevent gaps from being missed an iterative approach that is cyclical in nature will be used.

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Opportunities	Threats	Mitigative Strategies
<u>Project Outcomes</u> **Improved Understanding of the Protocols and Meeting a Reasonable Level of Assurance** • Learnings from the protocol validation studies can be used to build understanding amongst producers and projects developers as well as reduce skepticism in the agricultural and beef sectors towards employing the protocol studies. • Learnings from the protocol validation studies can be used to educate verifiers and other stakeholders on the requirement for achieving reasonable level of assurance under the four protocols investigated. **Improved Protocols and Streamlined Protocol Implementation** • Knowledge gained from the protocol validation studies can be used to inform and streamline future protocol implementation. Furthermore, this knowledge may be used to modify/revise the protocols themselves to make them more user friendly. Ultimately, there is an opportunity to use this information to help move adopters, aggregators and verifiers past the barriers that presently exist in implementing projects under the four protocols investigated.	<u>Legislation/Policy</u> **Ongoing Debate on Climate Change** • Ongoing debate on the causes of climate change has the potential to affect legislation. Changes in perception could lead to associated changes in regulation that would remove the need for carbon credits. <u>Market Factors</u> **Market Volatility (RAH/DOF)** • Volatility in oil seed and grain prices may threaten the economic benefits of livestock operations. This would impact the feasibility of implementing activities in the Reduced Age at Harvest (RAH) and Days on Feed (DOF) protocols. <u>Producer Involvement</u> **Lack of Qualified Producers** • Whether or not producers will engage remains to be seen. • Furthermore, many animal and/or cropping operations may not have all of the information needed to calculate and substantiate GHG reductions according to the protocol. In particular, the Nitrous Oxide Emission Reductions Protocol (NERP) requires producers to have a significant amount of data. Given this, this threat is particularly an issue for the NERP PVS since it is possible that the project team will not be able to find any qualified producers.	• **Lack of Qualified Producers:** KHK Consulting will reach out to its network of aggregators to increase its chances of finding producers with the information needed to implement the NERP.

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Opportunities (Continued)	Threats (Continued)	Mitigative Strategies
Unexpected Positive Results/Findings • It is possible that some operators may find that they are already implementing practices that reduce carbon. If this were the case they may have the opportunity to gain credit for those practices moving forward. • Through the demonstration and analysis of the pilot projects, some of the co-benefits of implementing the protocols (e.g. feed savings, fertilizer savings, etc.) may emerge. This will help improve the case for implementing the protocols.	**Possibility of Disengagement Part Way Through the Project** • It is possible that some of the producers initially involved in the pilot may not follow through with the full process until project completion. This would compromise the results of the validation studies. **Skepticism** • Some producers may be skeptical about the motives of the aggregators. This could compromise project relationships, collaboration and ultimately project outcomes. • Some producers and individuals involved in the agricultural/beef sectors may not believe that anthropogenic sources of greenhouse gas emissions are causing climate change. This may compromise their willingness to be involved. **Negative Results/Findings** • The protocol validation studies may find that some of the mitigation strategies given in the protocols are not cost-effective for producers to implement. Depending on the extent of this finding, such a result could compromise the value of the affected protocol altogether.	• **Disengagement:** Effort will be made to ensure regular communication, adequate support and timely responses to any questions. Furthermore, the project team will be flexible and willing to accommodate the producer's schedules. • **Skepticism:** create an environment for questions and open communication between all parties involved. Furthermore, emphasis will be placed on the co-benefits of implementing the project activities (e.g. production efficiencies)

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Appendix C: Orientation Workshop Minutes

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Protocol Validation Studies – Workshop Minutes

DATE: September 12, 2012

TIME MDT: 12:00 PM

Meeting called by:	**Note taker:** Candace Vinke
Participants:	Sheilah Nolan, Susan Wood-Bohm, Laurie Vaughan-Evans, Keith Driver, Len Kryzanowski, Candace Vinke, Garth Boyd, Diana Staley, Amanda Stuparyk, Arron Best, Blair McClinton, Bob Coulter, Bruce Love, Carlene Godwin, Dan Heaney, Diane McCann-Hiltz, Graham Gilchrist, Jack Hodsworth, Paul Jungnitsch, Ron Acleson, Timo Makinen, Tom Goddard, Ty Faechner, Zoia Komirenko, Ray Farrow, John Zylstra, Kirk Andries, Tanya Maynes, Kevin Pattison

Documents:

1. Agenda
2. Design Documents – RAH, CCP, NERP, DOF

Agenda

1. Welcome and Introductions
2. Purpose of the Protocol Validation Studies
3. Protocol Validation Study Design
4. Break
5. Open Floor Question and Answer/Discussion Period
6. Process for Request for Qualifications/Interest
7. Open Floor Question and Answer/Discussion Period
8. Lunch

Minutes

1. Welcome and Introductions (Sheilah Nolan (ARD) and Susan Wood-Bohm (Al Bio))
   - Background on the Basis for the Alberta Carbon Market
     - Opportunity for carbon market arose out of pro-active measures to address the large volume of emissions from AB
     - In 2007, the Specified Gas Emitters Regulation came into place. Under this regulation large emitters must reduce emission intensities by 12% per year
   - Under AOS, protocols must be additional/real, quantifiable and verifiable
   - Offsets have been used extensively to meet compliance – tillage offsets in particular have made up 20% of the market
   - Challenges and Opportunities
     - The new types of protocols are no longer regional - instead they are based on proof of the baseline condition which is more intensive and complex. However, this will improve knowledge of farm systems
     - Verification standards have become more rigorous as of Jan. 1, 2012
     - The supply of offsets is increasing

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- Ways of approaching proof are changing with the use of a qualified third party
- Volatility in farm prices, size, management, etc.

- Study Purpose
  - To identify reasons for barriers, develop solutions, assess availability of data and reduce overall risk
  - Four protocols will be investigated: CCP, NERP, DOF, RAH
- Protocol Selection
  - These protocols were chosen based on background research conducted for CCEMC
  - The full reports with results are available on CCEMC's website
  - The decision was based on the current state of policy and science (more detail is provided in the full documentation)
  - CCP Report Results – need for better understanding of the impact of BMPs across the full range of soil and cropping systems
  - NERP Report Results – there is a need for 1) farm level demonstration of variable rate technology, 2) adoption of precision application and 3) tools for emission measurements
  - DOF Report Results – there is a need for 1) better cattle sorting (gender/weight class), 2) better individual cattle performance monitoring and 3) farm level demonstration of feeding strategies, assessment of costs
  - RAH Report Results – there is need for farm level demonstration of strategies to reduce time on roughage diets
- Outcomes and Deliverables
  - Streamlined solutions to overcome barriers, increase certainty
  - Scalable approaches to adopting protocols
  - Learning tools to lift barriers for early adopters, aggregators and verifiers

2. Purpose of the Protocol Validation Studies (KHK Consulting)
   - Concern was expressed about the possibility of the protocols changing once again after a pilot project has been invested in and brought to the table
   - To date, very few agricultural projects have been implemented. As a result, we are trying to figure out why and try to find ways to overcome these challenges
   - ADFI, DFC and Alberta Milk are currently conducting a 2 year dairy pilot
   - The purpose of the dairy pilots was to identify data gaps and field test the quantification methodology
   - One of the outcomes was that the studies identified how hard it is to get some of the data. As a result, solutions are beginning to be developed
   - Note: a recommendation was made to include bedding type in the dairy protocol
   - Objectives of the current PVSs are to:
     1. Validate, through small-scale pilots, how the protocol can be applied in the field
     2. Provide guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale
     3. Demonstrate how verification to a reasonable level of assurance can be accomplished following the available protocols.

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4. Catalyze continued aggregation efforts for bringing offsets forward from aggregated agricultural projects.

- Note: A suggestion was made to include the opportunity costs for spending time doing this versus something else
- A four phased timeline will be used for the protocol validation studies
- Attempting to use 2008 to 2010 baselines and 2011 as the project year
- Note: a recommendation was made to change "producer" to "livestock operator" in the presentation and documentation (design documents)
- Concern was raised about the benefits of participation for producers and whether or not they will engage without financial compensation
- Comment: many feedlot operators do not keep their data

3. Process for Request for Qualifications/Interest (KHK Consulting)
   - Karen reviewed the draft aggregator evaluation criteria

4. Open Floor Question and Answer/Discussion Period

- Q: Would the in-kind contribution from aggregators qualify for R&D tax credit?
- **Action Item: Susan to look into this and get back to the group**
- Q: Keith asked – Is it possible to meet the data management system and data control criteria without having to disclose confidential information?
- A: The group felt they could provide a broad/ high level description, without revealing their "trade secrets"
- **Action: Perhaps a verifier testimonial is all we need and a high level overview – the language in the RFQ criteria needs to be updated to reflect this**
- Comment: The same issue comes up in the field services side and disclosing names
- **Action Item: Make the wording clearer in the RFQ criteria that they only need to meet the additional criteria for NERP/DOF if they selected those boxes on the first page.**

What are we missing?

- You could ask the individual businesses to come in and make a presentation or webinar
- (add language that the short list will be invited for a presentation)
- Need to specify the project and baseline years into the RFQ criteria
- It was suggested that we consider using the additional expectations for the remaining two protocols as well (perhaps in the 'Preferred, but not required' section)
- Comment: It's important the final report is not too closely tied to the chosen aggregators systems and communicates the most useful information – the interim workshops may be a good forum for accomplishing this. (study findings – a section on what didn't work and why would be useful)
- **Action Item: Update the RFQ criteria to meet the above suggestions**

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Appendix D: Aggregator Request for Information (RFI)

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Alberta Innovates Bio Solutions

#1800 Phipps-McKinnon Building
10020 – 101A Avenue
Edmonton, Alberta T5J 3G2

REQUEST FOR INFORMATION (RFI)
Aggregation Services for Protocol Validation Studies
RFI No. AIB-09-12

RFI Issue Date:	September 20, 2012
Submission Period:	Up to 4:00:59 p.m., Alberta Time on September 27, 2012
RFI Administrator:	Susan Wood-Bohm
Phone:	613-920-0516
E-mail:	Susan.Wood-Bohm@albertainnovates.ca

Invitees have received this document directly from the RFI Administrator.
Responses must be sent by e-mail (i.e., MS Word). Invitees are encouraged to review section 2.4 for the proposed schedule of events.

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1. Definitions

Invitees are advised to pay careful attention to the wording used throughout this Request for Information (RFI). Failure to satisfy any term or condition of this RFI may result in an unacceptable Response.

Throughout this RFI, terminology is used as follows:

Aggregator means an entity acting as the project developer of aggregated projects.

Alberta Time means Mountain Standard Time or Daylight Saving Time as provided for in the *Daylight Saving Time Act* of Alberta.

Alberta Innovates Bio Solutions or "AI Bio" means the publicly funded board-governed corporation in Alberta that works with partners to identify, coordinate and fund research projects. We help solve industry challenges with solutions that deliver economic, environmental and social benefits. AI Bio is administrating this RFI.

Business Day means 8:15 a.m. to 4:30 p.m., Alberta Time, Monday to Friday.

Business Hours mean 8:15 a.m. to 4:30 p.m., Alberta Time, on Business Days.

Consortium means two or more individuals and/or organizations that together submit a Response.

Climate Change and Emissions Management Corporation means the not for profit organization managing the funds from the Climate Change and Emissions Management Fund made available to the CCEMC by the Government of Alberta through a grant agreement. Funds can only be spent on initiatives and other measures related to reducing greenhouse gas emissions and improving the ability to adapt to climate change. http://ccemc.ca/about.

Data means Personal Information, Deliverables (regardless of form or their state of development), and any other information created or acquired as a result of this RFI.

Deliverables means the tasks and Services described in section 3.2.

Evaluation Team means the individuals who, on behalf of AI Bio, will evaluate Responses to this RFI.

Capabilities means knowledge, skills and/or experience gained through post-secondary education, employment, voluntary activities, and continuous learning.

FOIP means the *Freedom of Information and Protection of Privacy Act* of Alberta, R.S.A. 2000, c. F-25, as amended, revised or substituted from time to time.

Legal Name means the name under which an invitee is legally registered and under which a Non-Disclosure Agreement would be issued. A Legal Name may be the name of an individual if that

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individual has not registered a different name for his/her business with the appropriate provincial registry.

Must, mandatory, required, will, and **shall** mean a requirement that must be met in order for the Response to receive consideration.

Non-Disclosure Agreement or "NDA" means a legal contract between two parties that outlines confidential material, knowledge, or information that the parties wish to share with one another for certain purposes, but wish to restrict access to or by third parties.

Personal Information means recorded information about an identifiable individual defined in section 1(n) of *FOIP*, R.S.A. 2000, c. F-25, as amended.

Project Invitation means a written request by AI Bio to one or more invitees to submit Reponses for the provision of some or all of the information, in order to be considered for participation in the Project.

Project Team means the individuals who, on behalf of AI Bio, are responsible for the completion of a project, including but not limited to, the drafting of a Project Invitation, the selection of a cooperating aggregator, the negotiation of an NDA, and the receipt, review and approval of the Services as defined in this RFI.

Response means the invitees completed Response Package and includes all of the invitee's attachments.

Response Package means the forms that the invitee must complete and return to the RFI Administrator for evaluation, as described in section 4.

Review Date means the date when the Evaluation Team will review Responses, as described in section 2.4.

RFI means this Request for Information document and associated documentation and appendices.

RFI Administrator means the person named in this RFI as the contact person or his/her delegate.

Services means information services, that may be required under an NDA, and includes one or more of the tasks and Deliverables described in section 3.2

Should, may and **desirable** mean a requirement that is not mandatory, but which has a significant degree of importance to the objectives of this RFI.

Signing Authority means the individual who has the legal authority to enter into NDA's on behalf of an invitee.

Submission Period means the period of time, as further described in section 2.4, when Responses can be received in order for invitees to be evaluated.

Invitee means an individual, organization or Consortium providing a Response to this RFI.

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References to “Enterprise and Advanced Education”, “Government of Alberta”, “Her Majesty”, “Minister” and “Ministry” mean “Her Majesty the Queen in right of Alberta” and are only used for administrative purposes.

Headings are used for convenience only, and they do not affect the meaning or interpretation of the clauses. Words in the singular include the plural and vice versa.

2. Introduction

The purpose of this RFI is to select cooperating aggregator(s) to participate in a series of Protocol Validation Studies (PVS) funded by the Climate Change and Emission Management Corporation and Alberta Agriculture and Rural Development. The PVS studies are a capacity-building initiative designed to gather learnings from the application and validation of specified protocols. Specifically, the PVS studies are designed to be non-commercial undertakings that will emulate the process of aggregating participating producers under the provisions of the specified protocols to bring forward "offsets" that can be tested in a mock verification exercise to a reasonable level of assurance, for the purposes of collectively learning about the barriers, gaps, solutions and options for adopting these protocols in the marketplace. In short, the objectives of the PVS studies include:

- Validating, through small-scale pilots, how the protocol can be applied in the field.
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale.
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols.
- Catalyzing continued aggregation efforts for bringing offsets forward from aggregated agricultural projects.

The specified protocols for the PVS are:

- Reduced Age to Harvest (RAH)
- Reduced Days on Feed (DOF)
- Nitrous Oxide Emission Reductions (NERP)
- Conservation Cropping (CCP)

Invitees will be reviewed for conformance to the requirements in section 5.2. When the successful invitees are notified of their success, an email communication will go out to all stakeholders by the RFI Administrator notifying the stakeholder network of the selected aggregator.

Successful invitees will receive no remuneration under this RFI process, and will be expected to sign a Non-Disclosure Agreement with AI Bio.

2.1 Project Invitations

When issuing Project Invitations AI Bio may:

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- Wherever feasible, invite at least three invitees to submit Response Packages. The Project Invitation will describe the specific scope of work and information requirements, which may include, but is not limited to, timelines, Deliverables, evaluation process and criteria.
- Include a draft NDA.

AI Bio and the Evaluation Team will evaluate all conformant Response Packages, and may enter into an NDA with an invitee.

AI Bio reserves the right to interview invitees, contact supplied references and/or request a presentation to assess the IT/Data Management Systems (DMS) of invitees. AI Bio reserves the right to refuse the Services of an invitee should the interview and/or reference checks, and/or IT/DMS presentation prove unfavourable in the opinion of the Evaluation Team, acting reasonably.

2.2 Non-Disclosure Agreement

Invitees selected as cooperating aggregators pursuant to this RFI will be eligible to enter into an NDA agreement with AI Bio.

Participation in this RFI neither adversely affects nor bars the invitee from participating in other procurement activities of the Government of Alberta.

2.3 Proposed Schedule of Events

RFI Issue Date:	**September 20, 2012**
Submission Period:	Submissions of Response Packages to this RFI can be made at any time up to 4:00:59 **p.m., Alberta Time on Sept. 27, 2012.**

AI Bio will accept Responses on an ongoing basis up to the end of the Submission Period for review by the Evaluation Team. Review Dates will occur immediately after the close of submission period**.**

Notification to invitees of the evaluation results will be e-mailed within five (5) Business Days of the Review Date.

The above dates are subject to change without notice at the sole discretion of AI Bio.

3. RFI Requirements

The selected aggregators will be partnering in the study, as an in-kind contribution to the project. There are several benefits to cooperating in the PVSs, including:

- Access to technical consultants for developing Project Plans, data management systems and Project Report Designs.
- Working with Government staff, researchers, extension and technical consultants to find solutions to barriers encountered in data gaps; accounting problems; and accessing external data sources.

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- Added comfort that a mock-verification of the implemented project has been completed to a reasonable level of assurance.
- Field experience with the implementation of the protocol.

The Protocol Validation Studies for the RAH, NERP and DOF will be completed over a two year period from July 2012 to August 2014. For CCP, the validation study will be completed August 2013.

3.1 Services

AI Bio requires cooperating aggregators to be responsible for engaging with the participating farm operations. Further, they will be the primary resource for collecting the data from participating farms. This data will be proprietary and remain with the producers/feedlot operators and the aggregator. The selected aggregator(s) will receive support from the project team with all aspects of producer recruitment, data collection and data management system development, as appropriate.

Please note that AI Bio reserves the right to limit the number of participating farms to a reasonable level for a pilot.

The requirements for this RFI are split into two categories - Minimum Expectations for Participation and Preferred Expectations; and then a Capabilities Section (see Section 7 for more information). The Expectation categories are explained below.

3.2 Minimum Expectations

The Minimum Expectations section outlines the minimum criteria that must be met in order for a Response Package to move forward in the selection process. Those applications meeting all of these criteria, will go on to be evaluated based the preferred expectations. Further, there may be an invitation for a short listed set of applicants to present the details of their IT and Data Management System to the Evaluation Team. In keeping with the interests of a non-commercial, learning initiative, please note that 2008-2010 farm-level data is expected to be used for the project baselines and 2011 data will be used for the project year.

Pre-qualified Vendors must meet the following requirements:

1) Be open to disclosure of results (not project-level data) which includes identified offset project plans, project reports and mock verification, AND;
2) Have demonstrated experience with agricultural projects in the Alberta Offset System, AND;
3) Hold General Liability Insurance typically required by the Government of Alberta;
4) Additional expectations for the DOF and NERP projects due to the tighter delivery timelines of these Protocol Validation Studies.

More information on these requirements are given in Section 7, the Response Package.

3.3 Preferred Expectations

In addition, the following preferred expectations have a significant degree of importance. Invitees should:

a) Number of years of business operation in Alberta AND;

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b) Participation, current or past in an Government coordinated audit on a carbon offset project, AND;
c) Any additional steps taken to initiate a CCP or RAH project.

4. Response Guidelines

Invitees must complete and return the entire Response Package, as required, to AI Bio, in order to be considered by the Evaluation Team. Invitees may include additional attachments, **but those attachments will not be evaluated.**

Responses must be delivered electronically.

In responding to this RFI:

a. The Response Package must be completed and the Invitee must sign the cover page.

b. Electronic signatures or scanned and emailed documents are acceptable..

c. Responses received will be held in a secure location by the RFI Administrator.

d. Ambiguous, unclear or unreadable Responses may be cause for rejection.

e. Electronic Responses should have the RFI number in the subject line and must be sent to Susan.Wood-Bohm@albertainnovates.ca

AI Bio is not responsible for failures (technical or otherwise) that may result in the Responses not being received prior to the end of the Submission Period.

5. Response Evaluation

5.1 Process and Sequence

Each Response will be evaluated separately against the RFI expectations and specified capabilities.

There is no pre-determined limit to the number of invitees invited to respond.

5.2 Evaluation Criteria

Responses will be evaluated on the following mandatory administrative requirements:

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Mandatory Administrative Requirements	Yes	No
Submission of the Response Package by the end of the Submission Period (i.e. any time up to **4:00:59 p.m., Alberta Time on Sept. 27, 2012)**.	☐	☐
Response cover sheet and, dated and signed.	☐	☐

Those Responses that meet all of the mandatory administrative requirements will be released to the Evaluation Team and will be evaluated on the following Minimum Expectations:

Minimum Expectations for Participation:	**Criteria**
Openness to disclosure of results (not project level data) which includes items such as: • Identified offset project plans, project reports and verification reports	• Willingness to sign the Response Package and the NDA • Proof of data currently being gathered for baseline

Project Development in Alberta:
• Agricultural projects
  ○ Number of projects verified in Alberta (number/year)
  ○ Geographic distribution of agricultural projects (i.e. soil zones – which ones?)
	• > 3 projects

General liability insurance	• At least $2 million coverage
If you indicated that you were interested in DOF and/or NERP projects above, please demonstrate that you meet these additional expectations*	Projects initiated: • Proof of producers and/or feedlot operators engaged • Proof of data currently being gathered for baseline determination • Draft offset project plan in place
***** Due to the quicker turnaround time on the DOF and NERP projects, the successful applicant is expected to have already taken some steps to initiate projects under these protocols. Please note that these additional expectations are not required for those applicants only interested in Conservation Cropping and/or Reduced Age at Harvest projects; however, are included in the preferred expectations below.	

Those invitees that meet all of the minimum expectations will move on in the Evaluation process.

The preferred expectations described in this RFI is additional information that will be used to further assess eligible invitees as defined by the Evaluation Team. See Section 7 for more detail on these expectations.

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6. RFI Administration Terms and Conditions

6.1 Invitee Questions

In order for AI Bio to deal effectively with invitee questions or concerns about any term, condition or requirement of this RFI, such questions or concerns must be communicated by email to the RFI Administrator. Enquiries and responses will be recorded distributed to the all other invitees.

The invitee is responsible for notifying the RFI Administrator in writing of any ambiguity, divergence, error, omission, oversight, contradiction, or item subject to more than one interpretation in the RFI, as it is discovered, and to request any instruction, decision, or direction required to prepare the Response.

Verbal responses to enquiries are not binding on any party.

Questions may be directed to Susan Wood-Bohm at: Susan.Wood-Bohm@albertainnovates.ca

6.2 Confidentiality

6.2.1 Confidentiality and Security of Information

The Invitee shall:

(a) keep strictly confidential all information concerning AI Bio and/or third parties, or any of the business or activities of AI Bio and/or third parties acquired as a result of participation in this RFI; and

(b) Only use, copy or disclose such information as necessary for the purpose of submitting a Response or upon written authorization of AI Bio.

The Invitee maintain security standards, including control of access to data and other information, consistent with the highest standards of business practice in the industry.

6.2.2 FOIP and Collection of Personal Information

The Personal Information requested in this RFI is being collected to enable AI Bio to ensure the accuracy and reliability of the Response, to enable AI Bio to evaluate the invitee's response to this RFI. Authority for this collection is section 33(c) of *FOIP*.

FOIP applies to all information and records relating to, or obtained, generated, created, collected or provided under, the RFI and/or the NDA and which are in the custody or control of AI Bio.

All documents submitted to AI Bio are governed by the access and privacy provisions of *FOIP*. While *FOIP* allows persons a right of access to records in AI Bio's custody or control, it also prohibits AI Bio from disclosing Personal Information or confidential business information. This prohibition takes effect if disclosure would be significantly harmful to an invitee's business interests or would be an unreasonable invasion of personal privacy as defined in sections 16 and 17 of the Act. Invitees are encouraged to identify those portions of their submissions which they are submitting in confidence and which, if revealed, would harm the business interests of the invitee.

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Evaluation criteria and process for this RFI are public information. Individual assessments of invitees are considered confidential and of interest to competitors or other invitees under this RFI. Individual assessment information will, therefore, be provided, upon request, to the invitee to whom it relates, and to others only in accordance with *FOIP*.

6.2.3 Protection of Privacy

FOIP imposes an obligation on AI Bio, and through the RFI and related NDA(s) on the invitee, to protect the privacy of individuals to whom information relates.

The successful invitee will meet the standards set by the requirements of Part 2 of *FOIP*, for all Personal Information the Pre-qualified Vendor has access to, collects or uses, discloses or destroys as a consequence of carrying out obligations under an NDA(s).

By submitting Personal Information, the invitee consents and shall obtain the consent of the invitee's Resources to its disclosure for the purposes, stated in section 6.2.2, to verify professional standing and to conduct reference checks, if needed.

All costs associated with meeting the invitee's requirements of *FOIP* as set out in this RFI will be borne by the invitee. All costs associated with meeting the invitee's requirements of *FOIP* as set out in this RFI and any subsequent NDA(s) will be borne by the invitee.

Invitees are strongly encouraged to review the *FOIP Act* and Regulations at: http://www.servicealberta.ca/foip/

6.3 Data Storage and Security

Invitees who are selected as cooperating aggregators and who are offered to sign an NDA pursuant to this RFI **may be required** to meet all or part of the following data storage and security requirements:

Data, including Personal Information, must be handled and stored securely. Where applicable, Data will be stored on a secure Canadian owned server in Alberta or, upon written approval of AI Bio, on a secure Canadian owned server within Canada. Personal Information will not be transported outside of Canada. Data transmitted or stored on computers, portable devices or other media must be password protected and encrypted using secure procedures. The invitee will provide AI Bio, upon request, details describing their plan for meeting the Data storage and security requirements, prior to entering into an NDA.

When the NDA ends, whether through expiry or termination, the successful aggregator will provide cooperative information to AI Bio in a method to be determined at the time of NDA end, and the successful aggregator will be required to delete all data from any computers, servers, or portable media under their control.

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6.4 Computers, Software, Parking, Secretarial Services, Travel, Expenses and Insurance

Cooperating aggregators who enter into an NDA:

- Will provide their own office space, equipment, computers, software, telephone and photocopy facilities as required, and other tools as necessary for the purpose of performing the Services. Amenities, including but not limited to secretarial services and parking, will not be provided. Onsite equipment, computers, software, telephone and photocopy facilities may be available for use when the work requires face-to-face collaboration at Alberta Agriculture and Rural Development or AI Bio Solutions offices.
- May be required to provide evidence of a valid security clearance check, normally a background and criminal records check, on the Pre-qualified Vendor, if the Pre-qualified Vendor is an individual, or on any or all of the Pre-qualified Vendor's employees, agents or subcontractors that may be providing the Services, prior to a Contract being executed. EAE will be under no obligation to enter into any Contract with a Pre-qualified Vendor if, in the opinion of EAE, acting reasonably, the results of such a security clearance check is not satisfactory.
- May be required to travel to meet contractual requirements and may be expected to attend occasional project meetings at their own expense.
- Are required, at their own expense, to obtain insurance under a contract of General Liability Insurance in accordance with the Alberta *Insurance Act* in an amount not less than **$2,000,000** inclusive per occurrence insuring against bodily injury, personal injury, and property damage including loss of use thereof. Evidence of such insurance in a format acceptable to AI Bio shall be made available to AI Bio, at AI Bio's request, as a condition of any NDA(s).

6.5 Reporting

Cooperating aggregators who enter NDAs will be required to submit Deliverables as negotiated with AI Bio and as outlined in the NDA.

6.6 Copyright

Copyright in Deliverables produced in accordance with a Contract shall belong to the Crown in Right of Alberta unless otherwise negotiated. The Vendor will also waive all moral rights to the Deliverables.

6.7 Conflict of Interest

Vendors must fully disclose in writing, to the RFI Administrator upon submitting a Response, the circumstances of any possible conflict of interest or what could be perceived as a possible conflict of interest on services and information with any party pursuant to this RFI. AI Bio shall review any submissions by invitees under this provision and may reject any Responses where, in the opinion of AI Bio, the invitee could be in a conflict of interest or could be perceived to be in a possible conflict of interest position if the invitee were to enter into an NDA pursuant to this RFI.

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6.8 Irrevocability of Responses

Invitees may amend or withdraw their Responses prior to the Review Date by submitting a clear and detailed written notice by email to AI Bio. All Responses become irrevocable after the Review Date.

6.9 Response Rejection

AI Bio reserves the right to reject any or all Responses when it is in the best interest of AI Bio.

6.10 Response Returns

Subject to section 6.10, Responses and accompanying documentation submitted by the invitees are the property of AI Bio and will not be returned.

6.11 Invitee Debriefing

AI Bio will, at the request of an unsuccessful invitee who responded to this RFI, conduct a debriefing for the purpose of informing the invitee as to why their Response was not selected.

6.12 Further Information

For further information, contact:

Susan Wood-Bohm, RFI Administrator
Phone: 613-920-0516
E-mail: Susan.Wood-Bohm@albertainnovates.ca

7. Response Package

To provide information as requested below, **single click** within the grey areas. The grey areas will expand to accommodate your text. To check a box (☒), **double-click** on the box and **choose "checked"** as the default value.

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Invitees should check or fill out ALL areas of interest, expertise and qualifications.

Name of Invitee: Address: Telephone: E-mail: Legal Name: Name of Signing Authority:	**Aggregation Services for Protocol Validation Studies** **RFI No. AIB-09-12** For the purposes of this RFI I am operating as a(n) [**check one**]: ☐ Individual ☐ Organization ☐ Consortium (**complete Attachment**) Date submitted to AI Bio:

Please indicate which Project Types you are Interested in and Why?

☐ Reduced Age at Harvest

☐ Reduced Days on Feed ☐ Conservation Cropping

☐ Nitrous Oxide Emission Reduction

Please provide further information demonstrating your interest in each of the 4 project types (no more than half a page):

Comment:_____

_____

_____

_____

_____

_____

_____

_____

Failure to complete, sign and date the declaration below will render your Response non-compliant.

I, _____, on behalf of _____:

Print Name Vendor Name

Name of Invitee:	**Aggregation Services for Protocol Validation Studies** **RFI No. AIB-09-12**

- Have read and understand the terms and conditions of this RFI;
- Agree to be bound by **all** terms and conditions of this RFI including section 6.3 (Data Storage and Security) and section 6.7 (Conflict of Interest);
- Consent, and I have obtained written consent of any individuals identified in the Response, to the use of the information in the Response by AI Bio;
- Understand that Alberta Agriculture and Rural Development, who is jointly conducting parallel PVS, may also access this information at the sole discretion of AI Bio. Any Contracts offered to me by other government departments as a result of this RFI will be bound by the terms and conditions of this RFI.

_____ _____

Signature Date

Mandatory Expectations	Criteria for Evaluation
Openness to disclosure of results (not project level data) which includes items such as: • Identified offset project plans, project reports and mock verification reports	• Willingness to agree to the terms of the RFI and sign the cover sheet • Willingness to enter into an NDA • Proof of data currently being gathered for baseline
Project Development in Alberta: • Agricultural projects o Number of projects verified in Alberta (number/year) Geographic distribution of agricultural projects (i.e. soil zones – which ones?)	• > 3 projects
General liability insurance	• At least $2 million coverage
If you indicated that you were interested in DOF and/or NERP projects above, please demonstrate that you meet these additional expectations*	Projects initiated: • Proof of producers and/or feedlot operators engaged • Proof of data currently being gathered for baseline determination • Draft offset project plan in place

***** Due to the quicker turnaround time on the DOF and NERP studies, the successful invtee is expected to have already taken some steps to initiate projects under these protocols. Please note that these additional expectations are not required for those applicants only interested in Conservation Cropping and/or Reduced Age at Harvest projects; however, are included in the preferred expectations below.

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Provide the names of three (3) references using the following format:

Reference 1
Name: _____
Contact Information: _____
Job Title: _____
Relationship to Vendor: _____

Reference 2
Name: _____
Contact Information: _____
Job Title: _____
Relationship to Vendor: _____

Reference 3
Name: _____
Contact Information: _____
Job Title: _____
Relationship to Vendor: _____

Preferred (But Not Required) Expectations	
Experience in the Alberta Offset System	**Criteria for Evaluation**
• Number of years of business operation in Alberta	• > 3 years
• Have you participated in an AESRD audit? • Number of audits submitted (by project type)	• Current or past participation in an AESRD audit
• If you indicated that you were interested in CCP and/or RAH projects, have you already taken any steps to initiate a project?	Projects initiated: • Proof of producers and/or feedlot operators engaged • Proof of data currently being gathered for baseline determination

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Capabilities	Evidence	Team Rank
Project Management **(10%)** • Demonstrated project management skillsets	• Course certificates • Description of project management resources and procedures (including software used)	**/10 pts**
Data Management Systems and Data Controls **(35%)** • IT Resources • Certifications	• High level design document with data flow diagrams and description of procedures • Submission of a Verifier review of the data management system and its control and review checkpoints • In house IT capabilities with existing IT system in place • Certification and designations (i.e. ISO, Microsoft, PWC certification, others)*	**/35 pts**
Team qualifications, including education, experience and any professional designations, GHG training **(20%)** • Administrative resources	• Corporate structure and resources org chart • Team lead CV's • Other team member bios • Three other client references/testimonials (see previous section)	**/20 pts**
Field Services **(35%)** • Ability to engage producers and/or feedlot operators	• Description of field services offered by company or affiliated companies (e.g. agronomic advice, business services, aggregation services, agricultural input sales, etc.) • Partners involved with the company	**/35 pts**
	Total Score	**/100 pts**

*Short-listed invitees may be asked to give an oral presentation to provide further details about their data management system and IT capabilities.

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Appendix E: Example Verifier Statement of Work

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Description of the Services

Project: Validation and Technical Assistance

Date of Services: January 30, 2013 to, Sept 30, 2013

Background

Alberta's greenhouse gas (GHG) regulatory framework has created a vibrant carbon market, with over 24 million tonnes of voluntary carbon emission reductions generated in the form of carbon offsets since 2007. Carbon offsets are provided by sectors that do not have a regulatory target, and are sold to companies with regulatory obligations under Alberta's *Specified Gas Emitter Regulation (SGER), 2007*. The agriculture sector has been a major provider of carbon offsets to the market, contributing over 20% of offsets used for compliance with the SGER.

The Office of the Auditor General challenged the verification standards that were used to provide evidence that claimed GHG emission reductions actually occurred. In response, Alberta Environment and Sustainable Resource Development raised the level of assurance from limited to reasonable, starting January 1, 2012. In order to support efforts needed to attain this higher standard of verification, Alberta Agriculture and Rural Development (AARD) initiated a Protocol Validation Study (PVS) as a capacity-building exercise to gather knowledge about the application of the Nitrous Oxide Emission Reduction protocol (NERP) to compile a Carbon Offset Project, including validation to a reasonable level of assurance. The aggregation company, XYZ Inc., has volunteered to compile a Carbon Offset Project using on-farm data from five farms.

Specifically, the PVS study will emulate the process of aggregating participating producers under the provisions of the protocol to bring forward agricultural offsets that can be tested in a mock verification exercise to a reasonable level of assurance, for the purposes of collectively learning about the barriers, gaps, solutions and options for adopting these protocols in the marketplace. The objectives of the PVS study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field.
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale.
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols, including providing feedback on estimation procedures to arrive at reasonable accuracy on yield data.

Key Deliverables and Methodology:

1. Provide verification advice on reasonable assurance for the Case Study project.
2. Include a pre-verification, gap analysis and recommendations to include in a separate Best Practice Guide to Verifying Projects for the Alberta NERP.
3. Provide verification advice on the following issues over the course of this contract:

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a. ***Issue of reasonably accurate yields:*** assist with an estimation procedure using several techniques for estimating yield and justify the conservative method being applied;
b. ***Issue of farm enterprise***: In the NERP protocol it says you have to include every field in the baseline and project, whereas the reality is NERP is not implemented on every field

4. Deliverables will be a report describing pre-verification results, gap analysis and recommendations for a Best Practice Guide.

Writing

XYZ Inc. will develop and write paper versions as scheduled. First drafts of reports will be made available 2 weeks prior to due date and reviewed by ABC Consulting. XYZ Inc. will edit the papers based on input.

Completion and Evaluation

Completion will mean the final paper is edited to the satisfaction of ABC Consulting representatives.

Fee Schedule

Maximum contract amount is $XXX paid on completion of each of the following phases based on a fixed price per deliverable, as indicated below. Total is inclusive of disbursements for travel and accommodation as well as communication.

Project Deliverable	Due Date	Payment Amount
Draft Pre-Verification, Gap Analysis and Recommendations	April 15, 2013	
Final Versions of Above	April 30, 2013	
Review of Best Practice Guide to Verifying NERP Projects	March 15, 2013	
Assistance with Issues Analysis	Sept 30, 2013	
Total		

Term

January 15, 2013 – Sept 30, 2013

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Appendix F: Interim Workshop Minutes

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Protocol Validation Studies – Interim Workshop

Overview – Protocol Validation Studies

- AOS – Evolution of efforts focusing on verification
    - Greater attention being paid to verifiable aspect of AOS
    - Learn by doing approach
    - Emphasis that the AOS is regulated (regulatory back-stop)
        - Rigor is needed
        - Regulated compliance unit
        - Protocol documents based on ISO standard
        - Verification tools and processes based on ISO
    - Alberta's Verification pathway
        - Know there are barriers to implementing some of the protocols
        - System has been undergoing continuous improvement since 2007
        - Engineers and accountants can verify under the system
        - Evolving commodity
        - Presently, trying to understand through the Protocol Validation Studies what the barriers and gaps are to implementation
    - What are we trying to accomplish?
        - Want to de-risk the system
    - Tools and Deliverables
        - Data collection templates
        - GHG calculators
        - Sample offset project plan and report
        - Cost-benefit analysis
        - Best practice guides
    - Note on the Protocols
        - They are not all at the same stage of development
        - CCP has the most robust Section 5 (documentation/Evidence table)
        - Learnings from mock verifications have been incorporated into the Best Practice Guides
    - Best Practice Guides
        - The need for these documents was identified as part of the Protocol Validation Studies
    - For Clarity
        - Farm Activity Data – used for quantification
        - Evidence of Practice – documentation used to provide positive proof of practices and the data used in the quantification
    - Questions?
        - Challenge – there is a carbon supply chain; however, 60 – 70% of the sale goes back to the producer.

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        - DOF – If cattle are ready to go, but you're holding them in the feedlot until opportunity to sell, you can lose the value of all your credits.
            - This was a barrier identified in the study that will be discussed in the DOF presentation

Nitrous Oxide Emission Reductions (NERP) Protocol Validation Study

- Protocol has undergone a number of revisions since 2007
- The project activity in the protocol is the implementation of a 4R plan
    - A reduction modifier has been developed by scientists for each performance level (basic, intermediate or advanced)
- Findings of PVS
    - Update Section 5 to look like CCP
    - Adopt modifications made in SK's version of the protocol and ICF findings
        - E.g. allow calculations to be completed on a mass basis for nitrogen inputs and yield, instead of a cropped area basis
        - Allow baling and removal of straw if evidence to show only 30% of the straw is removed
        - Comparing like crops, etc (see presentation)
- Evidence
    - Can come from different sources
    - Mock verifications considered the hierarchy of evidence
    - Historical data was used in mock verifications - evaluated as though complete, but not actual projects
    - Greatest Issue – uncertainty in yield calculations
    - SK Case Studies – the growers with the records to support the NERP are already highly efficient, eliminating the opportunity for further emission reductions
    - Q: NERP not a nitrogen management protocol
        - The correct way to approach this is good agronomy
    - The protocol penalizes early adopters using the current project (with 3 year baseline)
    - 4R planning process requires a significant amount of documentation
    - Process for completing and documenting crop plans can vary between projects
    - Q: Difference in verification costs as a result of this difference (2 types of crop plans and 2 types of yield measurements)
        - 20% to 30% of the total costs could get doubled
- Recommendations:
    - Develop a conservative approach for estimating yield
    - Develop a performance standard baseline by crop
- Questions:
- Q: What has AB Environment's perspective on this?
- A: They have been available, but will be more involved was the final findings/recommendations have been made

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- Q: Are there any potential issues that may come out of this that could affect other protocols?
- A: Hard to generalize at this point

- Cost-Benefit Analysis:
    - Expensive to develop aggregation software
    - Looked at three scenarios: expected, pessimistic and optimistic
        - Profitable in optimistic and expected
    - Approx. 0.25 tonnes / acre – successful project requires a lot of land
    - Suggestions: In presenting results, may want to be cautious about showing that price could go down and aggregators would still be profitable
    - Split: 60/40
    - Producer Analysis: What is the actual cost benefit/acre for the farmer? $1.50 - $1.70/acre for black soil zone
    - Important to consider the co-benefits of implementing a project
    - Q: What is the aggregator making / acre? Aggregator making 20% less/acre than the producer
    - Q: Aggregator assumes a lot of the risk? If a producer was willing to take all the risk on the credit and then pay aggregator to get a producer "in"?
    - A: One of the main findings of the study was that producers do not want to be selling their own carbon, it is very risky for the producer to try to take this on, on their own.
    - The only advantage for the producer to pay a service fee to the aggregator would be if they think it is a lower percentage (they could also sit on their credits for future price increases)

Reduced Age at Harvest Protocol

- Completed with FailSafe and Aaron from ICF Marbek
- Key Findings:
    - Revise ownership requirements to the feedlot owner
    - Update section 5
    - Add clarity on eligible animal age
    - Group animals by sex only between baseline and project
    - Specify that the baseline years need to immediately precede the project year (to eliminate possibility of gaming)
    - Using default approach to establish animal birth dates can result in an emission increase if producers not changing methodology of registering
    - Annualization of life span may not be appropriate
- Capacity of Sector to Implement RAH
    - Protocol currently requires confirmation of death and this is not currently available to the feedlot
    - Comment: Packers gather a lot of the information that is needed
    - Packers do not care if there is a project, they hold the animals for as long as they want

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    - Comment: when animals leave the feedlot they are dead
    - Shipping Manifests – Is the level of detail enough?
    - A: Pen numbers listed on all of the manifests (referred back to data management system at the feedlot)
    - Protocol currently under revision – incorporate suggestions
- Cost Benefit Analysis
    - 60/40 split
    - Used CanFax data
    - Positive returns is optimistic and expected scenarios
    - Negative returns for producers under all three scenarios based on today's costs
- Discussion
    - We did not have time to look at backgrounding costs, results just show the integration the feedyard
    - Q: Cap fund setting price for offsets. If Tech Fund not increased, need to demonstrate that industry is not profitable
    - A: If price stays at $14, cannot expect to see many projects
    - The costs of the offset system have gone up, but tech fund price has not increased proportionately
    - As soon as we get to $40.00/tonne, there will be many more options for reducing GHG emission reductions (i.e. feasible project types)
    - The data collection and documentation is key to RAH projects
    - Note: Reduction burden on LFE's would also increase if price went up (i.e. 40 x 40)
    - Supply will be an issue for the foreseeable future
    - Agriculture may have the opportunity to act as the "bridge" until technology projects start to move forward
    - RAH protocol also penalizes strong feedlots/producers
        - Protocol not incenting the correct people to implement the protocol
    - Most feedlots do not own animals post BSE

Days on Feed

- When will the updated DOF protocol be posted?
- A: Will be sent off to Environment in a week or so
- If you don't use the head.days approach you can come up with different results (to ensure equitable between project developers)
- Q: What are you measuring in DOF?
- A: Estimating enteric methane and manure CH4 and N2O – see calculator for details
- Substantive approach – looking at documents (i.e. Land titles)
- Controls approach – system for pulling documents into a master database
- With this protocol can test the system as opposed to testing individual documents
    - This can lower verification costs
- AB Environment prefers substantive

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- One exception – feeding records are kept within individual trucks (significant transcription error exists)
- Risk comes from when you fill a truck and transcribe value (feed rations)
    - One feedlot was using an electronic system, which reduces secondary transcription risk (manual process)

Cost Benefit Analysis

- Positive returns in expected and optimistic scenarios
- Modelled the feedyard switching from Optiflexx to Zilmax (Zilmax double the price)
- Volume is crucial at today's prices – under current prices a single feedlot would not be able to do it
- Producer analysis takes into consideration some of the co-benefits (i.e. feed cost)

Conservation Cropping

- Performance standard baseline – you do not need to establish your own baseline, you just use the values from the protocol
- Currently no project developers on the committee to evaluate best practice guides – however, there will be a stakeholder review
- Q: Did we consider verification methodology in terms of ISO vs. handbook
- A: No
- Comment: Do not rely on crop insurance to define croppable area for a field – if only a portion of land insured, but satellite imagery shows otherwise, you can claim credits for the area in imagery
- Verifiers Report – opinion or negative assurance?
- A: Positive assurance, it's not an absolute opinion; however, it is an opinion.

Cost Benefit Analysis

- Limited number of reductions can be generated with CCP
- 70/30 split
- Negative returns in expected and pessimistic scenarios

Discussion

- From a new market entry perspective implementing CCP would be very difficult
- Also a challenging for existing aggregators to stay in the industry
- Biggest challenge is getting farmers engaged enough to supply the information that is required to generate credits
- Q: Is there any way to share costs between aggregators?
- A: Cost sharing is difficult because everyone has different systems and processes
- Land title searches have doubled in price

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Discussion Session

- Consistent challenges/themes across the four protocols:
  1. Price – has not changed
  2. System demanding more rigour
- To what extent can we actually improve things for aggregators and producers?
  - Trying to overcome barriers associated with complexity
    - Reduce data requirements
    - Ensure updated Table 5 in all protocols (at least in BPGs)
      - Reduces verification costs
      - Decreases variance in understanding of what's sufficient
    - Best Practice Guide is meaningless if government auditor has a different opinion (this is the biggest risk)
      - Also, do not know if audit will be consistent across industry players (competitors)
      - Lots of uncertainty about government audit – need to move toward greater consistency
        - Challenge is regulatory body ensuring this consistency
      - Economics – can we decrease the transaction costs of meeting requirements of the protocol?
      - Recognizing costs to producers in terms of data and time
      - Various level of barriers – some of which we have no control over (the same issues are being raised over and over)
    - How do you formalize this effort and get it recognized?
      - Standardization of verification?
      - The people that make the decisions are not in the room
        - This is the interim report, final still to come
      - The system has evolved to higher scrutiny, higher costs, no retro-activity; yet, price has carbon has stayed the same. Eventually, no one will be able to generate credits
    - Are there other competing factors influencing farmers to uptake different or in some cases directly opposite factors? E.g. animal welfare
      - In this context, how viable are offsets
    - Next steps to get formal recognition?
      - Need aggregators to adopt protocol and educate verifiers/auditors on what is in there
      - If audit is going sideways from a lack of understanding of agriculture, someone can step in
      - Consistent set of auditors needed
        - RFP issued earlier this year for 3 year list (pre-qualified auditors for next 3 years) – not specific to project type
    - Q: Would it make sense for auditors to shadow verifiers?

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        - A: Audit is re-verify the project as opposed to verify the verifier. Accreditation standard for all verifiers is needed or verifiers need to be verifier
        - Alberta only place not using ISO 14065
    - Next Steps
        - Present documents to Environment
        - Put together a CCP project with 15 farms with varying levels of evidence and then see if verifiers come to same conclusion (see if documents have given greater clarity to the system)
        - Five years ago knew the issues, but did not have protocol validation studies to back up / support these issues

Carbon Market Updates

- It will be harder to comply as regulatory reductions for LFE's increases e.g. 12% to 40%
- 9,000,000 tonnes currently out there
- LFE's sitting on their tonnes and waiting to see if there will be a price increase
- Coal performance standard has had desired impact
    - There's no flexibility (i.e. tech fund/credits) in this performance standard
- Currently, looking at oil and gas as well as chemical industry
    - Some flexibility
- Each province looking into equivalency agreements with federal government
- US Perspective
    - 2006 lots of activity with carbon credits with Chicago Climate Exchange
    - No appetite for market based mechanism outside of California
    - Increasingly tight sector requirements
- California
    - 4 protocols
    - Offsets can be generated in any state
    - 1 Agriculture protocol – destruction of livestock methane (anaerobic digestion for biogas)
    - Rice cultivation protocol under review
    - Absolute emission reductions (20% decrease by 2020 based on 2007 baseline)

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Appendix G: Final PVS Workshop Minutes

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Protocol Validation Study Workshop Meeting Minutes

DATE: June 17, 2015

TIME: 10 am MT

Meeting called by: CCEMC

Note Takers: Candace Vinke and Liz Brennan

Participants: Refer to attendee list

Meeting Minutes

Welcome and Introductions – Past, Present and Future for the Protocol Validation Studies

Sheilah Nolan (Alberta Agriculture and Forestry) and Susan Wood-Bohm (Alberta Innovates BioSolutions)

Note: As a result of the recent change in government in Alberta, the province is presently reviewing its climate change strategy. Changes are anticipated; however, at this time it is unclear how these changes will impact the work that was completed on the Protocol Validation Studies.

- Acknowledgements:
    - The project team thanked Climate Change and Emissions Management Corporation and Alberta Agriculture and Forestry for funding the studies
    - The project team thanks Alberta Innovates BioSolutions, Agritrend and ICF for their involvement and support with the studies
- Overview
    - Background and Context
        - Offsets lie at the intersection of policy, science and practice.
        - Offsets need to be quantifiable, verifiable and additional/real
        - Policy is still developing
        - Driver: higher verification standard
        - Context of this study is to look at agricultural protocols and the challenges preventing their implementation.
            - Challenges include selling price of offsets, uncertainty about reasonable assurance, record keeping and changing commodity prices
        - The PVS provide an opportunity for continuous improvement
    - Objectives and Outcomes
        - Facilitate adoption of agricultural offset protocols (find solutions to barriers, assessing availability of data and documentation, reducing risk)
        - Four protocols assessed: Conservation cropping, days on feed/feed cattle, nitrous oxide emission reductions, reduced age at harvest

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        - Approach – kick off workshop in September 2012 followed by RFI for participating project developers, interim workshop held in August 2013
        - Progress to Date
            - CCP – Best Practice Guide now available online at www.agriculture.ab.ca/agcarbonoffsets.com
            - NERP and Fed Cattle outcomes posted on CCEMC website
    - Future
        - The Protocol Validation Study project is complete as per the terms of the funding agreement
            - Materials penultimate for distribution, once protocols are approved

Updates on NERP and Fed Cattle Protocol Status

Karen Haugen-Kozyra (Prasino/Viresco)

- Some of the protocols were approved before the new reasonable assurance standards
- A number of reports/efforts completed to address reasonable assurance
- One of the objectives of the PVS is to increase clarity and reduce risk
- PVS Objectives: validate, provide guidance and demonstrate
- Tools: Best practice guides, data collection templates, GHG calculators, sample offset project plans and reports and cost-benefit analyses
    - The best practice guides have undergone a number of reviews

Fed Cattle Validation Study Findings

Karen Haugen-Kozyra (Prasino/Viresco)

- Protocol Changes
    - Protocol updated from reduced days on feed to "fed cattle"
        - Days on feed removed as an indicator; however, quantification approach has not changed
    - Updated Section 5
    - Now requires use of the head*days approach
    - A specific feeding practice is not required, instead project developer needs to describe its innovative approach
    - It is expected that the project developer gathers the data and quantifies the emissions to determine if there is a net reduction (as opposed to using DOF as an indicator)
    - A flexibility mechanism was introduced to allow use of lower enteric methane emission factor
    - Updated nation emission inventory of certain factors
    - Restored missing equations
- Key Findings
    - Some animal groupings will show a reduction while others do not
    - Feeding efficiencies are based on a number of factors
    - It is the net reduction that determines the claim

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- Protocol is now finalized. Environment and Parks are hoping it can be publicly posted shortly.

Aaron Schroeder (ICF) – Mock Verification Findings

- A number of items/issues with the protocol were identified (refer to presentation for list)
- If the emission reductions are negative in one year, then there is no claim for the year
- Within a year it is the net reduction across all groupings
- When protocol is posted please review and submit comments if there is any ongoing issues that are not clear

Discussion

- Has anyone investigated what the opportunity is?
    - Protocol needs to be implemented at a large scale
    - Estimate of 0.06 tonnes/head
- A number of new technologies are emerging
- Pork protocol validation study revealed that the opportunity is very small now that the beta-agonist that was previously was used is no longer used.
- Interest in Australia and Brazil in beef protocols

Fed Cattle Protocol Validation Study – Cooperating Aggregator Perspectives

Bill Dorgan (AgriTrend) and Adam Shreck (FHMS)

- Economics – 50,000 head could generate approx. 3,500 offsets (equivalent to $5K at $13/ton)
- Technologies: Zilmax can no longer be used
- Largest challenge: Capturing data from the start is a challenge for some feedlots (e.g. carcass weight data)
- Most feedlots in Alberta have a reporting system; however, the data may not be in the form needed

Discussion

- There is a scalability advantage for larger operations
- A common platform would reduce the barrier and open the door to participation from a larger number of feedlots
- Role of the verifier is simply to check that operation is in compliance with other regulations, but not to reassess this compliance
- Would it be a challenge for the beef industry for legal land locations to be listed in the Offset Project Plan? Use the same approach as is used with cropping projects (update OPP/OPR)
- Other projects: Farming 4R Land project with CFI and two other beef projects – more available on CCEMC's website under biological projects. Another project focused on land scape level changes (rangeland management) is also worth keeping an eye on.

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Update on Canada and US Carbon Policies and General Discussion

Katie Sullivan, International Emissions Trading Association

- Introduction to IETA
- Presented the reasons why emissions trading is the preferred option
- A number of developments have taken place in the last 10 months
    - Growing number of countries committed to climate action
    - Developing countries are also taking climate seriously
    - UN Climate summit in NYC and major carbon pricing momentum
    - US EPA Clean Power Plan
    - EU 2030 Climate & Energy Package and Reform
    - US-China Joint Climate & Energy Cooperation MOU
    - Billions in initial pledges to the Green Climate Fund & Climate Finance (to be used for adaptation and mitigation in developing countries)
- Path to Paris
    - Post-2020 targets
    - Starting to see targets and contributions
    - Negative perception globally of Canada's targets and commitments
    - Ottawa has stated that it will use market based mechanisms to help it meet its targets
- China has 7 pilot cap and trade programs
    - Expect China to either pick the best program and make it national or select the best components of the pilots and make it one national market
- Korea launched its cap and trade program
- Taiwan just announced its pending program
- Alberta experience in offsets, in particular agriculture is in the spotlight globally
- Manitoba interesting right now since it is the most likely province to link next
- California - Quebec
    - Cap and trade program
    - Jan. 1, 2015 expanded to fuels and natural gas (80% coverage by cap and trade program)
    - Three auctions have occurred to date
        - Revenue from the auctions (2.9 to 4 billion $) must be invested into mitigation of GHGs or assistance to communities having to adjust to impacts of regulation
    - California
        - Now also looking at post-2020 and what the role of a cap and trade program would be
        - First agriculture protocol pending approval in California (rice protocol)
- Ontario has announced its intentions to link with California and Quebec
    - Moving fast – expect draft regulation by early 2016 with a start date of January 1, 2017

Nitrous Oxide Emissions Reduction Protocol – Findings, Results and Deliverables

Karen Haugen-Kozyra (Viresco) and Aaron Schroeder (ICF)

- First version of the protocol published October 2010, modified version recently completed public comment period
- To employ the protocol, producers must develop and implement a 4R plan
- Anticipate a technical review of the science next year (2016)

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- Protocol Revisions
    - Had to update minimum records required
    - Adapted modifications from the SK protocol
    - Introduced acceptable crop mass determination methods
    - Manure is the only or organic nitrogen included in the quantification
    - Full farm enterprise must be included in the project
    - Two dynamic baseline quantification approaches that do not require historical data were introduced
        - Dynamic baseline one uses actual crop masses and dynamic baseline two uses AFSC five-year averages
        - Dynamic baseline two can only be used for two years and has a larger discount factor
    - Q: Why is the discount higher using AFSC?
    - A: We are looking for site specific data for use in the protocol
    - AFSC records are not attestations – they are signed under Canadian and Alberta evidence act. Comment that this is a higher piece of evidence than attestation that should meet reasonable assurance
    - Exploring an industry baseline: exploring one or more of the other five baseline types.

Outstanding issues:

- Record requirements (as discussed above)
- Annual soil tests – was significant for amending protocol.
- Weight and moisture logs: taking weight and moisture content on every single load is impractical. Also, there is a strict range enforced in industry of soil moisture.
- Requirements for approval of landowners was a barrier.
- Soil temperature readings – now it is being considered whether the closest weather station data can be considered and how (passing the 10 degree mark).
- Definition of a pass area – this definition has probably already been reviewed.

Issues Identified and Recommendations

- Data requirement Issues:
    - Measurement of crop yield was the most challenging measurement required by the Protocol. The protocol table 12 *Crop Mass Determination Methods Records Requirements* lists the record requirements.
        - Need to strike a balnae between doing as much data validation as possible and relying on controls as a verifier.
        - Heading towards approach of relying on data systems and data controls.
    - Moisture readings: the protocol is on a dry matter basis, so everything must be related back to dry matter.
        - Cannot store grain if it has too high moisture content – recommended using this maximum moisture content as a flexibility mechanism.
    - Ownership:
        - Multi-year lease agreement on file would satisfy requirement of the protocol. The emissions reduction is related to the practice as opposed to the land.
    - An eco-district line can cross a single field – a conservative approach would be to use the more conservative eco-district value for that field.

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- APA Practice Standard: The Greenhouse Gas Assessment and Management Practice Area is required to be met by the APA under the AIA because they are actually creating records that are being used for assurance purposes. People who were under the practice area before will be grandfathered in, and then new entrants into the professions will need to prove skillset and competencies.
    - Alberta Environment and Parks have been in direct conversation with the Alberta Institute of Agronomists. Educational reviews starting this May.
- Soil temperature data – Tom has data that could be incorporated as an appendix
    - Could also use Environment Canada data from weather stations
- Eligibility – if activities make one field ineligible, the entire farm is disqualified. An alternative may be to disqualify any fields for the entire crediting period if that field becomes ineligible at any time during the baseline period or any time during the project crediting period.
- GHG accounting – ensure consistency of applicability criteria (dependent on outcome on eligibility)
- Additional fuel consumption – protocol is unclear on how to determine if additional fuel is required if using either of the dynamic baseline approaches. Possibly the APA could make this judgement
- APA sign-off – clarity that the protocol does not require the APA to physically collect farm data and conduct on-farm observations; however, must review documentation and confirm all record requirements
- Verifiers cannot re-perform the work, instead they are verifying the controls in place

NERP Protocol – Cooperating Aggregator Perspectives

Bill Dorgan (Agritrend)

- Barriers to adoption
    - All or none – eligibility
        - One farm fully excluded due to a single fall application of urea
    - Ownership – land titles do not seem relevant for a non-sequestration protocol
        - For example, the wind protocol does not require ownership
    - Soil testing on every field every year - not economical for return
        - Not essential to write a proper crop plan
    - Soil temperature – resolved in earlier discussions
    - Moisture content (every load) – use Canadian grain commission storage requirements
    - Yield – scales, climbing bins
    - Economics at 50 cents/acre make it unrealistic to expect mass participation
    - Added expenses of aggregation
    - Government uncertainty

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Discussion

- Balance between robustness and feasibility of implementing is needed
- Ownership – the challenge is that without ownership requirements, owners are not informed of the credits being claimed on their land and then that piece of land becomes ineligible to generate credits after 8 years, so they lose out on the opportunity permanently (relates to additionality as well)
    - Need to have further discussion on why the offset is tied to the land rather than the producer (if it was the producer, then the producer would become ineligible rather than the land)
- Another option is to set an expiration date on the protocol
- The issue is the agreement with the land lessee and owner, not the title

Adjourn Workshop

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Appendix H: NERP Aggregator Spreadsheet

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University

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Introduction

As part of the cost-benefit analysis an excel based calculator was generated. This calculator allows the user to modify the input assumptions and assess the sensitivity of the costs-benefits of implementing the protocol. In the calculator there are four input sheets that must be completed by the user. These include the start-up costs, expected input, optimistic input and pessimistic input sheets. The information from these sheets is carried over into the analysis sheets and an estimate of the costs per credit, revenue per credit and the net present value of the credits over a seven year time period is provided. Changes to the values in the input sheets result in new estimates in the results sheets. A copy of the "Expected Input Sheet" is provided below for reference. The original excel spreadsheet is needed for full functionality. This spreadsheet is available separately from CCEMC.

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Expected Returns	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Discount Rate (ex. 3%; Entered as = 0.03) Enter for Each Year	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Tonnes of Carbon Generated (in Tonnes)	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Carbon Price (in $/tonne)	$13.00	$13.00	$23.00	$23.00	$23.00	$23.00	$23.00
Split Between Aggregator and Producer For Each Year							
Producer's Portion (in %, 60%=0.60)	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Aggregator's Portion (in %; 40%=0.40)	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Summing Portions should equal 1.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Annual Costs (costs that do not vary by the number of tonnes)							
Travel and Marketing Costs	$30,000.00	$30,000.00	$30,000.00	$30,000.00	$30,000.00	$30,000.00	$30,000.00
Legal Costs for Selling Carbon Offsets	$16,000.00	$16,000.00	$16,000.00	$16,000.00	$16,000.00	$16,000.00	$16,000.00
Additional Computer Storage Space	$6,000.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
Management Costs	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
Software Up-grade and Development	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
Marketing and Print Campaigns	$30,000.00	$30,000.00	$30,000.00	$30,000.00	$30,000.00	$30,000.00	$30,000.00
Accounting Costs	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00
Total Annual Fixed Costs	**$152,000.00**	**$152,000.00**	**$152,000.00**	**$152,000.00**	**$152,000.00**	**$152,000.00**	**$152,000.00**
Annual Costs that Vary as a Percentage of the Carbon Price							
Data Gathering (as a percentage of carbon credit price, ex. 10% = 0.10)	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Verification Costs (as a percentage of carbon credit price; ex. 3%= 0.03)	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Dollar Value of the Annual Costs that Vary as a Percentage of the Carbon Price							
Data Gathering Costs	$65,000.00	$65,000.00	$115,000.00	$115,000.00	$115,000.00	$115,000.00	$115,000.00
Verification Costs	$19,500.00	$19,500.00	$34,500.00	$34,500.00	$34,500.00	$34,500.00	$34,500.00
Total Annual Costs that Vary as a Percentage of the Carbon Price	**$84,500.00**	**$84,500.00**	**$149,500.00**	**$149,500.00**	**$149,500.00**	**$149,500.00**	**$149,500.00**
Total Annual Costs	**$236,500.00**	**$236,500.00**	**$301,500.00**	**$301,500.00**	**$301,500.00**	**$301,500.00**	**$301,500.00**

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Appendix I: The Benefit Cost Analysis of the Aggregator's Position as it Relates to the Nitrous Oxide Emission Reductions Protocol (NERP)

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University and The Prasino Group

Introduction

Changes in fertilizer management practices by agricultural producers can result in a decrease in the amount of greenhouse gas emissions being generated as compared to the baseline production practice. The Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions outlines the 4R Consistent Nitrogen Stewardship plan which can reduce the amount of nitrous oxide emissions that result from nitrogen fertilizer applications. The 4R Stewardship plan consists of applying the Right source of nitrogen fertilizer at the Right rate, at the Right time and the Right place.

The decrease in nitrous oxide emissions from the 4R Consistent Stewardship plan can be sold in the Alberta Offset System. The aggregator will work with the producer and the agricultural professional in order to ensure that the project that is developed will be in accordance with the protocol. One of the areas where there is little information is the economics of the aggregation function for the 4R Consistent Stewardship plan. This study attempts to address this lack of information by investigating the costs and benefits of the aggregation function as it relates to the Nitrous Oxide Emissions Reductions Protocol.

Function of the Aggregator

The aggregator will work with the producer and the agricultural professional to ensure that the protocol is being followed but is also involved in the marketing and selling of credits into the Alberta Offset System. More specifically, the role of the aggregator is to gather the data on both the baseline and new management system (project condition) in order that the generation of offset credits can be justified. In this regard, the aggregator has to gather data that can be used to justify the selling of credits into the offset market. The aggregator will be responsible for data collection, legal costs, registry costs, verification costs, marketing and other costs.

Assumptions and Data Inputs

It was assumed that an existing aggregator would already have established a robust agronomic reporting framework that could keep track of agricultural practices and performance and that the aggregation functions would be an expansion of current information systems. This assumption was made after discussions with individuals in the industry who suggested that the cost of developing a robust agronomic reporting system, which would be needed for the nitrous oxide emission reductions protocol, would be prohibitively large if some form of it was not already in existence. Given this assumption, the estimated costs included in this study are the additional costs of developing the offset information into an existing agronomic reporting framework.

Another important assumption made in the study was the split in revenue between the agricultural producer and the aggregator. After several discussions, it was assumed that the producer would receive 60 percent of the carbon price, while the aggregator would receive 40 percent of the market price. This assumption seems reasonable since the agriculture producer is implementing the protocol and providing the aggregator with the data. The aggregator, ensures that the protocol is being followed, gathers the data, and markets the offset credits.

The analysis assumes a seven year timeframe for the aggregator. It is expected that there will be substantial initial or start-up costs to modify the existing agronomic framework to take into account the aggregation function, but these modification and infrastructure developments would be available for a

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number of years. The analysis undertaken will estimate the present value of the aggregation function taking into account the initial cost of establishing the infrastructure, the annual operating costs, and the revenue generated from the sale of carbon offset credits.

An aggregator was contacted in order to get an understanding of the aggregation function as it related to the nitrous oxide emissions reductions protocol (NERP). These discussions included identifying the costs associated with the aggregation function as well as the benefits. Several of the assumptions made above were the result of these discussions. Given this information, a spreadsheet survey instrument was designed to estimate the costs and benefits associated with the aggregation function as it relates to NERP.

The survey instrument was a spreadsheet containing multiple sheets that asked the respondents to place their best estimates on the costs and revenue questions that were asked of them. Result sheets take this information and estimate the net present value of the project, the costs per credit and the revenue per credit, as well as the net present value of the project for the aggregator. This tool was specifically designed to study the NERP aggregation function.

The spreadsheet instrument contained eight sheets. The first sheet provided an introduction and brief instructions on how to complete the other sheets. The second sheet contained information on the start-up costs for the aggregator (See Table I-1 below). The start-up costs are the initial costs that are needed to establish the infrastructure to collect and store the necessary information to generate offset credits. The items included in the start-up costs are: equipment, office space, administrative support, software development, programmer costs, security, data storage, training, marketing, title searches, financial and legal costs. Most of the costs will occur in the initial period; however, the model has been designed so that other infrastructure costs can be added in future periods to take into account things such as additional programmer time, new equipment, etc. The information generated for the start-up costs will be transferred to the results sheets as a component of total costs in order to estimate the cost of generating the carbon offset credits.

The next three sheets request information on the operating or input costs of the aggregator. The operating costs are the annual costs that will be incurred by the aggregator to generate the carbon offset credits. Three sheets have been designed to take into account three possible scenarios; expected costs, optimistic costs, and pessimistic costs. These three scenarios were defined by the number of credits generated in each scenario, the annual costs associated with generating those credits and the discount rate. After discussions with existing aggregators, the expected scenario was based on 50,000 tonnes of carbon offsets, the optimistic scenario generated 75,000 tonnes of carbon offsets, while the pessimistic scenario generated 25,000 tonnes annually.

The first question asked in the input sheets was the discount rate that should be applied (Table I-2). The discount rate is used to estimate the present value of the costs and/or benefits that do not occur in the initial time period. The discount rate measures the aggregator's time value of money.

The second question asked the price expectations for the carbon offset credits (Table I-2). The respondent is able to provide an expected annual price path for carbon offset credits for the next seven years. The price path can be varied by scenario: expected, optimistic, and pessimistic.

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The worksheet allows the respondent to split the carbon revenue between the agricultural producer and the aggregator. As stated above, in the analysis it was assumed that the split between the agricultural producer and the aggregator was 60 percent and 40 percent respectively.

Existing aggregators identified that the annual operating costs could be divided into two categories (Table I-2). The first group of costs would be somewhat constant for any number of credits being generated. These costs included such things as: travel and marketing, legal costs, additional computer storage space, management costs, software up-grades, marketing, and accounting costs. This category of costs is important because as more carbon offset credits are generated the cost per credit of this category of costs decreases. Similarly, as the number of carbon offset credits decreases the cost per credit of this category goes up.

The second category of costs that are included are those that vary per carbon offset credit generated. Two costs fall into this group: data gathering and verification costs. The cost per data gathering and verification costs were estimated based on the price of the carbon offset credit. In this analysis, the data gathering costs were estimated to be 10 percent of the carbon offset price, while the verification cost was estimated to be 3 percent of the carbon offset price (Table I-2).

The final three sheets in the model provide estimates of the results given the input values estimated by the aggregator. As noted previously, optimistic, expected and pessimistic values were requested to provide a range of values for the number of credits, carbon price and discount rate. A sensitivity analysis was undertaken for each of the three scenarios (optimistic, expected and pessimistic) in order to estimate how variations in the variables impacted the results.

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Table I - 1: Start-Up Cost Sheet in the Program

Start-up Costs	Initial Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
		$	$	$	$	$	$	$
Equipment								
Capital Purchases								
Laptops								
Servers								
Office Space								
Admin Support								
Software Development								
Programmer Costs								
IT Security								
Off-site Data Storage								
Training								
Marketing								
Collateral Materials								
Financing Costs								
Legal Costs (Contract Development)								
Certification for Approved Advisors								
Total Start Up Costs								

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Table I - 2: The Expected Input Sheet in the Program

Expected Returns	Year 1	…	Year 7
Discount Rate (ex. 3%; Entered as = 0.03) Enter for Each Year			
Tonnes of Carbon Generated (in Tonnes)			
Carbon Price (in $/tonne)			
Split Between Aggregator and Producer For Each Year			
Producer's Portion (in %, 60%=0.60)			
Aggregator's Portion (in %; 40%=0.40)			
Summing Portions should equal 1.			
Annual Costs (costs that do not vary by the number of tonnes)			
Travel and Marketing Costs			
Legal Costs for selling carbon offsets			
Additional Computer Storage Space			
Management Costs			
Software Up-grade and Development			
Marketing and Print Campaigns			
Accounting costs			
Total Annual Fixed Costs			
Annual Costs that Vary as a Percentage of the Carbon Price			
Data Gathering (as a percentage of carbon credit price, ex. 10% = 0.10)			
Verification Costs (as a percentage of carbon credit price; ex. 3%= 0.03)			
Dollar Value of the Annual Costs that Vary as a Percentage of the Carbon Price			
Data Gathering Costs			
Verification Costs			
Total Annual Costs that Vary as a Percentage of the Carbon Price			
Total Annual Costs			

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Results

The results are given in terms of a number of indicators: net present value of the project, cost per credit and revenue per credit. The start-up costs were the same for each of the three scenarios (optimistic, expected, and pessimistic). The annual costs varied by scenario based on the number of credits that were generated. The revenue for each scenario varied due to different price expectations and the quantity of carbon offset credits generated over time. Each of the three scenarios will be reported separately.

The Expected Scenario

The price expectations, carbon offset credit generation, and discount rate for the expected scenario are given in Table I-3. It was expected that the current market price for carbon offset credits would continue for two years and then increase to $23.00 per tonne. The quantity of carbon offset credits generated remained the same at 50,000 tonnes per year. Finally, the discount rate was set at three percent over the seven years.

Table I - 3: Carbon Price, Carbon Offsets Generated and the Discount Rate for the Expected Scenario

	Price of Carbon Offset ($)	Carbon Offsets Generated (Tonnes)	Discount Rate (as a %)
Year 1	$13.00	50,000	3
Year 2	$13.00	50,000	3
Year 3	$23.00	50,000	3
Year 4	$23.00	50,000	3
Year 5	$23.00	50,000	3
Year 6	$23.00	50,000	3
Year 7	$23.00	50,000	3

The annual flow of costs and revenue for the expected scenario are given in Table I-4. The revenue generated in each year is greater that the costs in any year, except for the start-up period. The present value of the costs and revenue, cost per credit generated, revenue per credit and the net present value are given in Table I-5. The results from the expected scenario indicate that the net present value of the stream of benefits and costs would be $479,000.00 over seven years. The cost per offset credit generated was $5.73 and the revenue per offset credit was $7.09. The net revenue per credit for the aggregator over the seven years was $1.36 per credit. These results would indicate that under the expected scenario assumptions the aggregator would be expected to make a profit.

Table I - 4: Start –Up Costs, Annual Operating Costs and Annual Revenue for the Expected Scenario

	Start-up Costs	Annual Costs	Annual Revenue
Initial Costs	$250,000.00	$0.00	$0.00
Year 1	$0.00	$236,500.00	$260,000.00
Year 2	$0.00	$236,500.00	$260,000.00
Year 3	$0.00	$301,500.00	$460,000.00
Year 4	$0.00	$301,500.00	$460,000.00
Year 5	$0.00	$301,500.00	$460,000.00
Year 6	$0.00	$301,500.00	$460,000.00
Year 7	$0.00	$301,500.00	$460,000.00

Table I - 5: Present Value of the Costs and Revenue, Cost per Credit, Revenue per Credit and Net Present Value for the Expected Scenario

Indicator	Present Value
Present Value of the Costs	$2,004,054.78
Present Value of the Revenue	$2,483,236.22
Cost Per Offset Credit Generated	$5.73
Revenue Per Offset Credit Generated	$7.09
Net Present Value	$479,181.44

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A sensitivity analysis was undertaken to investigate how sensitive these results were to changes in various parameters. Keeping all of the parameters in the model the same, the annual costs that were in the fixed or constant category were increased by the same percentage rate each year. Table I-6 provides the results of increasing these annual fixed costs. Increasing these costs by 10 percent or 20 percent still results in a positive net present value for the aggregator. The break-even increase in annual fixed costs is approximately 27.32 percent.

Table I - 6: Impact of Increasing the Annual Fixed Costs on the Net Present Value of the Aggregator - Expected Scenario

	Present Value of the Benefits	Present Value of the Costs	Net Present Value
10% per year increase in Annual Fixed Costs	$2,483,236.22	$2,179,460.26	$303,775.96
20% per year increase in Annual Fixed Costs	$2,483,236.22	$2,354,865.74	$128,370.48
27.32% per year increase in Annual Fixed Costs	$2,483,236.22	$2,483,262.55	-$26.33

Two additional sensitivity analyses were undertaken. The first investigated the break-even prices of carbon offset credits that would equate the present value of the benefits to the present value of the costs. It was assumed that the carbon offset credit price would remain the same for the first two years at its current price ($13.00 per tonne). The price was allowed to decrease in year's three to seven at the same rate. The price of carbon could decrease to approximately $14.77 in years three to seven to break-even given that all other parameters remained the same (Table I-7).

Table I - 7: Carbon Offset Prices and the Aggregator's Present Value - Expected Scenario

	Assumed Carbon Offset Prices	Break-Even Carbon Offset Prices	Present Value
Year 1	$13.00	$13.00	
Year 2	$13.00	$13.00	
Year 3	$23.00	$14.77	
Year 4	$23.00	$14.77	
Year 5	$23.00	$14.77	
Year 6	$23.00	$14.77	
Year 7	$23.00	$14.77	
Present Value of the Benefits of the Break-Even Carbon Offset Prices			$1,772,688.76
Present Value of the Costs of the Break-Even Carbon Offset Prices			$1,773,126.86
Net Present Value with the Break-Even Carbon Prices			-$438.10

The final sensitivity analysis was undertaken to investigate the decrease in the quantity of carbon offset credits generated that would be acceptable to break-even. It was assumed for this break- even analysis that the number of credits would be the same for each year. The analysis would indicate that the quantity of offset credits could decrease to approximately 35,705 offset credits from the assumed 50,000 offset credits per year. The net present value when only 35,705 offset credits were generated annually was a -$39.69.

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The Optimistic Scenario

A number of the assumptions were changed in the optimistic scenario. These included the carbon price, the quantity of carbon offset credits produced and the discount rate. For this scenario, it was assumed that the carbon price remained the same for the first two years and then increased to $27.00 per tonne in year's three to seven. The number of carbon offset tonnes generated was also increased to 75,000 tonnes per year. Finally, the discount rate used in this analysis was two percent (Table I-8).

Table I - 8: Carbon Price, Carbon Offsets Generated and the Discount Rate for the Optimistic Scenario

	Price of Carbon Offset ($)	Carbon Offsets Generated (Tonnes)	Discount Rate (as a %)
Year 1	$13.00	75,000	2
Year 2	$13.00	75,000	2
Year 3	$27.00	75,000	2
Year 4	$27.00	75,000	2
Year 5	$27.00	75,000	2
Year 6	$27.00	75,000	2
Year 7	$27.00	75,000	2

As expected, both the aggregator's annual costs and annual revenues increased with this scenario, however, the revenue increased at a faster rate (Table I-9). In this scenario, the net present value after seven years was $1.7 million. The cost per carbon offset tonne decreased from $5.73 in the expected scenario to $5.17 in the optimistic scenario. The decrease in the cost per credit is the result of the larger volume of credits being sold by the aggregator; i.e. 75,000 tonnes versus 50,000 tonnes. The impact of the increased number of tonnes generated can also be seen in the present value of the revenue generated. The present value of the revenue increased from $2.4 million in the expected scenario to $4.4 million with the optimistic scenario (Table I-10).

Table I - 9: Start –Up Costs, Annual Operating Costs and Annual Revenue for the Optimistic Scenario

	Start-up Costs	Annual Costs	Annual Revenue
Initial Costs	$250,000.00	$0.00	$0.00
Year 1	$0.00	$280,750.00	$390,000.00
Year 2	$0.00	$283,750.00	$390,000.00
Year 3	$0.00	$420,250.00	$810,000.00
Year 4	$0.00	$420,250.00	$810,000.00
Year 5	$0.00	$424,250.00	$810,000.00
Year 6	$0.00	$424,250.00	$810,000.00
Year 7	$0.00	$424,250.00	$810,000.00

Table I - 10: Present Value of the Costs and Revenue, Cost per Credit, Revenue per Credit and Net Present Value for the Optimistic Scenario

Indicator	Present Value
Present Value of the Costs	$2,712,547.05
Present Value of the Revenue	$4,426,857.17
Cost Per Offset Credit Generated	$5.17
Revenue Per Offset Credit Generated	$8.43
Net Present Value	$1,714,310.12

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A sensitivity analysis was undertaken to investigate by how much the annual fixed cost could increase by to reach a break-even position. The annual fixed costs were increased by a given percentage each year to determine the break-even value. As can be seen in Table I-11, the break-even increase in annual fixed cost was approximately 69.9 percent. This would indicate that the increase in the carbon offset credits sold provides a buffer for potential increases in costs.

Table I - 11: Impact of Increasing the Annual Fixed Costs on the Net Present Value of the Aggregator - Optimistic Scenario

	Present Value of the Benefits	Present Value of the Costs	Net Present Value
10% per year increase in Annual Fixed Costs	$4,426,857.17	$2,958,801.76	$1,468,055.42
30% per year increase in Annual Fixed Costs	$4,426,857.17	$3,451,311.17	$975,546.00
50% per year increase in Annual Fixed Costs	$4,426,857.17	$3,943,820.58	$483,036.59
69.9% per year increase in Annual Fixed Costs	$4,426,857.17	$4,426,479.80	$377.37

A sensitivity analysis was also undertaken to determine the break-even price that would be necessary to bring the net present value close to zero. For this analysis, it was assumed that the current carbon price was set for the first year. However, the carbon price could vary after this period over the next six years. The break-even carbon price was approximately $9.13 in years two through seven (Table I-12). This would indicate that aggregator price risk was very low given the assumptions on costs, volume and discount rate.

Table I - 12: Carbon Offset Prices and the Aggregator's Present Value - Optimistic Scenario

	Assumed Carbon Offset Prices	Break-Even Carbon Offset Prices	Present value
Year 1	$13.00	$13.00	
Year 2	$13.00	$9.13	
Year 3	$27.00	$9.13	
Year 4	$27.00	$9.13	
Year 5	$27.00	$9.13	
Year 6	$27.00	$9.13	
Year 7	$27.00	$9.13	
Present Value of the Benefits with the Break-Even Carbon Prices			$1,886,501.88
Present Value of the Costs with the Break-Even Carbon prices			$1,886,931.58
Net Present Value with the Break-Even Carbon Prices			-$429.70

As with the previous scenario, a break-even volume of carbon offset credits was estimated for the optimistic scenario. It was assumed that the volume of offset credits would remain the same over the seven year period. In this case, the volume of carbon offset credits could decrease to approximately 39,170 offset credits. With this volume of credits annually, the net present value for the optimistic scenario was -$78.86.

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The Pessimistic Scenario:

The final scenario investigated was the pessimistic scenario. In this scenario the number of carbon offset credits generated and the prices of the offset credits were lower than in the two previous scenarios and the discount rate was higher. For this scenario, the price of carbon offset credits is assumed to remain constant at $13.00 per tonne over the seven year period, the volume of offset credits was decreased to 25,000 tonnes and the discount rate increased to five percent (Table I-13).

Table I - 13: Carbon Price, Carbon Offsets Generated and the Discount Rate for the Pessimistic Scenario

	Price of Carbon Offset ($)	Carbon Offsets Generated (Tonnes)	Discount Rate (as a %)
Year 1	$13.00	25,000	5
Year 2	$13.00	25,000	5
Year 3	$13.00	25,000	5
Year 4	$13.00	25,000	5
Year 5	$13.00	25,000	5
Year 6	$13.00	25,000	5
Year 7	$13.00	25,000	5

Given the assumptions in the pessimistic scenario it is not surprising that the annual costs are higher than the annual revenue for this scenario (Table I-14). This would indicate that under these conditions it would not be profitable to be an aggregator. Taking into account the present value of the costs and benefits over the seven years, the net present value for the aggregator would be a negative $621,000 (Table I-15). In this scenario the cost to the aggregator of generating the carbon offset was $7.85 per tonne while the revenue was only $4.30 per tonne. Under these conditions aggregators would leave the market.

Table I - 14: Start – Up Costs, Annual Operating Costs and Annual Revenue for the Pessimistic Scenario

	Start-up Costs	Annual Costs	Annual Revenue
Initial Costs	$250,000.00	$0.00	$0.00
Year 1	$0.00	$194,250.00	$130,000.00
Year 2	$0.00	$194,250.00	$130,000.00
Year 3	$0.00	$194,250.00	$130,000.00
Year 4	$0.00	$194,250.00	$130,000.00
Year 5	$0.00	$194,250.00	$130,000.00
Year 6	$0.00	$194,250.00	$130,000.00
Year 7	$0.00	$194,250.00	$130,000.00

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Table I - 15: Present Value of the Costs and Revenue, Cost per Credit, Revenue per Credit and Net Present Value for the Pessimistic Scenario

Indicator	Present Value
Present Value of the Costs	$1,374,003.03
Present Value of the Revenue	$752,228.54
Cost Per Offset Credit Generated	$7.85
Revenue Per Offset Credit Generated	$4.30
Net Present Value	-$621,774.49

A sensitivity analysis was undertaken of the pessimistic scenario to investigate how much fixed annual costs would have to decrease in order to break-even. In this analysis, the annual fixed cost portion of total costs would have to decrease by approximately 55.3 percent in order to break-even (Table I-16). Such a large decrease in fixed annual costs would be difficult to achieve.

Table I - 16: Impact of Decreasing the Annual Fixed Costs on the Net Present Value of the Aggregator - Pessimistic Scenario

	Present Value of the Benefits	Present Value of the Costs	Net Present Value
10% per year increase in Annual Fixed Costs	$752,228.54	$1,261,602.73	-$509,374.19
30% per year increase in Annual Fixed Costs	$752,228.54	$1,036,802.12	-$284,573.58
50% per year increase in Annual Fixed Costs	$752,228.54	$812,001.52	-$59,772.97
55.3% per year increase in Annual Fixed Costs	$752,228.54	$752,429.36	-$200.81

One means of addressing the negative net present value in this scenario would be to increase the volume of carbon offsets being generated. An analysis was undertaken to estimate the increase in carbon offsets that were necessary to break-even. It was estimated that approximately 55,600 tonnes of carbon offsets would be required in each of the seven years in order to break-even. With this volume of credits the net present value for the aggregator was -$283.27. This increased volume of carbon offsets to break-even is substantially higher than the assumed volume in this scenario but is close to the volume in the expected scenario.

Another means of breaking-even with the pessimistic scenario would be to increase the price of carbon. For this analysis, it was assumed that the current price of carbon would remain for the first year but then the price of carbon was allowed to increase. The price of carbon would have to increase to approximately $32.05 per tonne in order for the net present value for the aggregator to be a negative $183.49 (Table I-17). The price increase to break-even in this situation was greater than the price scenario in the optimistic scenario. In addition, the price increase was faster, i.e. in the second year, and at a much higher level.

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Table I - 17: Carbon Offset Prices and the Aggregator's Present Value - Pessimistic Scenario

	Assumed Carbon Offset Prices	Break-Even Carbon Offset Prices	Present Value
Year 1	$13.00	$13.00	
Year 2	$13.00	$32.05	
Year 3	$13.00	$32.05	
Year 4	$13.00	$32.05	
Year 5	$13.00	$32.05	
Year 6	$13.00	$32.05	
Year 7	$13.00	$32.05	
Present Value of the Benefits with the Break-Even Carbon Offset Prices			$1,673,104.10
Present Value of the Costs with the Break-Even Carbon Offset Prices			$1,673,287.59
Net Present Value with the Break-Even Carbon Offset Prices			-$183.49

Conclusions

This study provides insight into the economics of the aggregation function for the 4R Consistent Stewardship plan that fulfills the requirements of the nitrous oxide emission reductions protocol of Alberta. It was assumed that the aggregator already had a robust agronomic framework and that the aggregation function would be an added service. This assumption was made after discussions with individuals in the industry who stated that if a robust agronomic framework did not already exist it would be uneconomic to design one for only the NERP aggregation function.

Three scenarios were evaluated: expected scenario, optimistic scenario, and pessimistic scenario. The expected scenario assumed a moderate level of carbon offset credit generation by the aggregator of 50,000 tonnes, a moderate increase in the carbon price and a discount rate of three percent. In this scenario the net present value to the aggregator of a seven year aggregation plan was $479,181. This would indicate that there would be some incentive to pursue being an aggregator that included the NERP.

In the optimistic scenario, the number of offset credits generated increased to 75,000 tonnes; with a larger increase in the carbon offset price and a discount rate of two percent. The net present value of the seven year analysis was $1.7 million. This analysis would suggest that there are adequate incentives to become an aggregator that included the NERP.

In the pessimistic scenario the number of tonnes generated was substantially less, i.e. 25,000 tonnes. The price of carbon offsets was held constant at the rate of $13.00 per tonne and the discount rate was increased to five percent. In this scenario, the net present value was a negative $621,774. This result would suggest that aggregators would leave the industry given the negative economic returns.

A sensitivity analysis was undertaken for all three scenarios. From this analysis it was shown that the price of the carbon offsets, the volume of offsets generated, the annual fixed or constant costs and the discount rate were all important variables in determining the incentives to become an aggregator.

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Appendix J: NERP Producer Spreadsheet

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Introduction

As part of the cost-benefit analysis three excel based calculators (one for each of the three soil zones) were generated for producers to estimate the changes in revenues and costs associated with implementing a change in management practices consistent with the NERP. The calculators are composed of 24 sheets. In the first tab the producer must supply information about their baseline and project practices. Required information includes: type of crops grown, farm ecodistrict, nitrogen fertilizer used and yield (amongst other items). The estimated change in cost-benefits associated with the project is then given in the "Change in Net Revenue" sheet. A copy of the "Expected Input Sheet" is provided below for reference. The original excel spreadsheets are needed for full functionality. These spreadsheets are available separately from CCEMC.

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Complete all areas in green, yellow or blue that are appropriate for your operation.

Soil Zone:	Dark Brown																		
Ecodistrict:	788																		
Size of Field			1000			1000			1000			1000			1000			1000	
Off the field Moisture Content (in percentage: ex. 12.5 = 12.5%)			12.5			12.5			18			18			18			18	
Standard Moisture (in percentage: ex. 10.0 = 10%			10			10			13.5			13.5			14.5			14.5	
Production Information		**Canola**						**Spring Wheat**						**Feed Barley**					
		Baseline			**4R**			**Baseline**			**4R**			**Baseline**			**4R**		
	$/ac, Cost/ac,or Quantity	**kg/ac, bu/ac or Quantity**	**kgDM**		**kg/ac, bu/ac or Quantity**	**kgDM**	**$/ac, Cost/ac, or Quantity**	**kg/ac, bu/ac or Quantity**	**kgDM**		**kg/ac, bu/ac or Quantity**	**kgDM**	**$/ac, Cost/ac, or Quantity**	**kg/ac, bu/ac or Quantity**	**kgDM**		**kg/ac, bu/ac or Quantity**	**kgDM**	
Nitrogen Fertilizer		**kg (actual N)**			**kg**			**kg**			**kg**			**kg**			**kg**		
Anhydrous Ammonia (average Price=$1,100.95/tonne)	$0.00	0			0		$0.00	0			0		$0.00	0					
Urea - $600/tonne = $0.60/kg (46% N = $1.30/kg actual N)	$1.30	37			40		$1.30	32			34		$1.30	27			29		
Manure	$0.00	0			0		$0.00	0			0		$0.00	0			0		
Other N	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
Changes in Field Operations (Describe and put a cost per acre)																			
1.	$0.00	0			0		$0.00	0			0		$0.00	0			0		
2.	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
Addition Costs of the 4R program																			
Professional Agrologist ($/ha) 7.50/acre	$7.50	0			1		$7.50	0			1		$7.50	0			1		
Additional Soil samples (number of samples*cost per sample)	$0.14	0			1		$0.14	0			1		$0.14	0			1		
Other	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
Change in Revenue																			
Price or Yield of crop (bushels/acre)	$13.00	38			47		$7.70	50			61		$5.50	70			85		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		
	$0.00	0			0		$0.00	0			0		$0.00	0			0		

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Appendix K: The Benefit Cost Analysis of the Agricultural Producer's Position as it Relates to the Nitrous Oxide Emission Reductions Protocol (NERP)

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University and The Prasino Group

Introduction

Changes in fertilizer management practices by agricultural producers can result in a decrease in the amount of greenhouse gas emissions being generated as compared to their baseline production practice. The Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions outlines the 4R Consistent Nitrogen Stewardship plan which can reduce the amount of nitrous oxide emissions that results from nitrogen fertilizer applications. The 4R Stewardship plan consists of applying the Right source of nitrogen fertilizer at the Right rate, at the Right time and the Right place.

The decrease in nitrous oxide emissions from the 4R Consistent Stewardship plan can be sold in the Alberta Offset System. An aggregator will work with the agricultural producer and the agricultural professional in order to ensure that the project that is developed will be in accordance with the protocol. This report will provide some information on the benefits and costs for an agricultural producer to take on a change of management that is acceptable to the Nitrous Oxide Emissions Reductions Protocol.

Role of the Agricultural Producer

The agricultural producer will work with an agricultural professional and the aggregator to undertake a change in management practice in the application of fertilizer that will decrease the amount of greenhouse gas emissions emitted from their operation. The reduction in greenhouse gas emissions are the result of using the right source of nitrogen, at the right rate, at the right time and the right place (i.e. the 4Rs). The agricultural professional will work with the producer to ensure that the producer receives the greatest benefit from the 4R's. The aggregator will work with the producer, with support from the agricultural professional to sell the reductions in greenhouse gas emissions into the Alberta carbon offset market.

The change in management by the agricultural producer will generate both costs and revenue for their operation. This study reports on the potential benefits and costs that could be received by the producer. It should be noted that these results are based on the scenarios that were developed based on information obtained from individuals in the industry. Agricultural producers can use the NERP Agriculture Producers Calculator to estimate their own costs and benefits.

Assumptions and Data Inputs

The economic analysis undertaken uses a scenario approach to estimate the costs and benefits of changing the fertilizer management on a farm to be in compliance with NERP. Since the amount of nitrous oxide that is reduced is a function of the soil zone and ecodistrict where the management change takes place, and the level of management change (i.e. basic level or intermediate/advanced); it was decided that three different soil zones and representative ecodistricts, within the ecozone would be included in the study. These locations were ecodistrict 788 in the dark brown soil zone, ecodistrict 812 in the brown soil zone and ecodistrict 738 in the black soil zone. Further, the economic analysis assumes that the 4R Stewardship Plan is implemented at the Basic Performance Level. According to the latest Census of Agriculture, each of these ecodistricts had greater than 50% of their area dedicated to annually cultivated crops, and had significant acreage dedicated to oilseeds, barley and spring wheat. It was assumed that the farms were of similar size, 3,000 ha, in each soil zone and that three crops were grown; canola, spring wheat and feed barley. Each of the crops was assumed to be grown on 1,000 ha of land (Table K-1).

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Table K - 1: Producer Farm Assumptions used in the Analysis

Soil Zones	Dark Brown	Brown	Black
Ecodistrict	788	812	738
Size of Farm	3,000 ha	3,000 ha	3,000 ha
Crop Mix			
Canola	1,000 ha	1,000 ha	1,000 ha
Spring Wheat	1,000 ha	1,000 ha	1,000 ha
Feed Barley	1,000 ha	1,000 ha	1,000 ha

In order to estimate the costs and revenue for the change in management a calculator was designed to estimate the impact of the change in management. In order to undertake this analysis estimates of the change in the amount of nitrogen used on the farm was necessary. Agri-Trend agri-coaches were consulted to determine changes in nitrogen applied and resulting yields after growers enter into a 4R program. The agri-coaches indicated that on average, the nitrogen applied tends to be similar after implementing a 4R plan, because growers do not want to apply more fertiliser at today's high prices; however, yields increased about 20% on average. Therefore, this analysis assumed that applied nitrogen increased by two to four kg per acre depending on the soil zone, and yields increased by 20%. In the example input calculator sheet presented in Table K-2 for the Black Soil Zone, the amount of actual nitrogen being applied increases from 60 kg per acre to 62 kg per acre with the change in management. The input data sheet allows the producer to include multiple types of nitrogen including manure. The producer can also include any other potential costs for the change in management. This could include such things as extra labour or tractor use. In addition, there are other costs that will be incurred with this change of management. This would include the cost of the agricultural professional and additional soil samples. In our examples, based on Agri-Trend's input, it was estimated that the agricultural professional would cost an additional $7.50 per acre for advice and administrative work. It was also expected that $1,000 would be needed for additional soil samples on the farm as a result of implementing the 4R plan. This cost was estimated as a per acre charge (Table K-2).

The adoption of the 4R management system impacts not only the costs of the operation but also the yield and revenue of the farm. In our example, the yield was expected to increase from 45 bu/acre to 57 bu/acre (the average yield increase observed by the Agri-Coaches). This increased output, that is the result of increased nitrogen use efficiency, increases the revenue going to the operation.

The change in fertilizer management not only increases the yield but also generates greenhouse gas reductions that can be sold in the Alberta carbon offset market. A carbon calculator developed by The Prasino Group as part of the NERP Protocol Validation Study was used to estimate the potential carbon reductions from the baseline management practices and the 4R practice implementation. The data necessary to estimate the change in carbon emissions is given in Table K-3.

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Table K - 2: Input Data to the Economic Calculator for Producers

Soil Zone:	Black					
Ecodistrict:	738					
Size of Field (ha):	1000					
Off the field Moisture Content (in percentage: ex. 12.5 = 12.5%):		12.5				
Standard Moisture (in percentage: ex. 10.0 = 10%		10				
Production Information		**Canola**				
		Baseline			**4R (Project)**	
	$/ac, Cost/ac, or Quantity	**kg/ac, bu/ac or Quantity**	**Kg DM**		**kg/ac, bu/ac or Quantity**	**kgDM**
Nitrogen Fertilizer		**kg (actual N)**			**Kg (actual N)**	
Anhydrous Ammonia (average Price=$1,100.95/tonne)	$0.00	0			0	
Urea $600/tonne = $0.60/kg (46% N = $1.30/kg actual N)	$1.30	60			62	
Manure	$0.00	0			0	
Other N	$0.00	0			0	
Changes in Field Operations (Describe and put a cost per acre)						
1.	$0.00	0			0	
2.	$0.00	0			0	
Addition Costs of the 4R program						
Professional Agrologist ($/ha) 7.50/acre	$7.50	0			1	
Additional Soil samples (number of samples*cost per sample)	$0.14	0			1	
Other	$0.00	0			0	
Change in Revenue						
Price or Yield of crop (bushels/acre)	$13.00	45			57	

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Table K - 3: Data Requirements to Estimate Carbon Emissions

Management Zone	Field 1		**Year**	2011
Crop	Barley		**Irrigated**	No
Ecodistrict	812			
Area MZ	1,000	ha		
Yield	2425.06	kg DM/ha		
Fertilizer N	61.78	kg N/ha		
Manure N	0	kg N/ha		
Other N Source	0	kg N/ha		

In order to estimate the carbon emissions, the crop yield had to be converted to kilograms of dry matter per hectare. This calculation is based on the yield, the amount of moisture when the crop comes off the field and the standard moisture content when sold. The following assumptions were made concerning the moisture content for the three crops (Table K-4). These moisture content levels were assumed to remain the same across all three soil zones.

Table K - 4: Moisture Content of Crops

Moisture Content (%)	Canola	Spring Wheat	Feed Barley
Off the field	12.5%	18%	18%
Delivered to the Elevator	10%	13.5%	14.5%

Reductions in greenhouse gas emissions are another benefit of adopting NERP. Once the change in carbon emissions was estimated, they were multiplied by the producer price of carbon to estimate the carbon benefits of adopting NERP.

Results

The results for the three soil zones are presented separately. In each case the difference in the costs and benefits of the baseline and the change in management are presented.

The Dark Brown Soil Zone

The results for the dark brown soils would indicate that adopting the NERP program for an agricultural producer provides an increase in net farm income on a per acre basis. This increase in net farm income ranged from $106.10 per acre for canola to $72.73 for feed barley. Spring wheat had an increase in net farm income slightly above feed barley at $75.01 per acre. The greatest increase in economic benefit came from the increased yield from the crops. This increase in revenue went from a high of $117.00 per acre for canola to $82.50 for barley.

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Given the assumptions in the model, the cost of adopting the NERP management system ranged from $10.24 to $11.54 per acre for feed barley and canola, respectively. This fairly small increase in costs over the baseline costs would indicate that additional costs could be absorbed by this change in management. A break-even analysis indicated that the costs of canola could increase by $106 per acre before net present value would go to zero. For spring wheat costs could increase by $75 and feed barley by $72 per acre before net revenue would equal zero.

Table K - 5: Cost and Benefits of NERP in the Dark Brown Soil Zone

	Canola	Spring Wheat	Feed Barley
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline)	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$0.64	$0.55	$0.47
Net Change in Revenue per Acre	**$106.10**	**$75.01**	**$72.73**

The revenue from the sale of carbon offset credits is small relative to revenue generated from better crop management at today's grain elevator prices. The NERP calculator estimated that on the 3,000 hectares, approximately 173 tCO_2e from the canola acreage, 148 tCO_2e from the spring wheat acreage and 127 tCO_2e from the barley acreage were reduced.

In the initial scenario the carbon price was assumed to be $13 per tCO_2e and the producer price was estimated to be 70 percent of this or $9.10 per tonne. A sensitivity analysis was undertaken on the price of carbon. In this case the price of carbon was increased to $23.00 per tonne and $37.00 per tonne. The producer price for carbon was still assumed to be 70 percent of the carbon market price. With an increase in price to $23.00 per tonne, the carbon revenue from the canola crop was $1.05 per acre, which was approximately $0.50 more per acre than the original situation. At $37.00 per tonne, the carbon revenue from the canola crop was $1.69, which was more than double the initial situation. The same type of relationship can be found for barley and spring wheat.

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Table K - 6: Sensitivity Analysis around the Price of Carbon (Dark Brown Soil Zone)

Carbon Price of $23.00 per Tonne	Canola	Spring Wheat	Feed Barley
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline)	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$1.13	$0.97	$0.83
Net Change in Revenue per Acre	**$106.59**	**$75.43**	**$73.09**
Carbon Price of $37.00 per Tonne	**Canola**	**Spring Wheat**	**Feed Barley**
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline)	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$1.82	$1.56	$1.34
Net Change in Revenue per Acre	**$107.28**	**$76.02**	**$73.60**

The Brown Soil Zone

The costs and benefits of changing the fertilizer management plan on the brown soil zone are given in Table K-7 below. The cost of the management change on the brown soil zone is similar to the dark brown soil zone. The increase in fertilizer use, the cost of the agricultural professional and the cost of additional soil samples are not large relative to the benefits from adopting the 4R management regime. The largest economic benefit comes from the additional revenue from the increase in yield from the crops. The largest economic benefit comes from the canola acreage followed by the spring wheat and feed barley. The increase in net revenue for canola was $106 per acre, followed by spring wheat at $75 per acre and then by feed barley at $73 per acre.

There is a substantial margin between the costs and the benefits for this management change. As was seen with the dark brown results, costs could increase substantially before the change in management would break-even. In the case of canola, costs could increase by over $106 per acre before revenue and costs would be equal. The margin for spring wheat and feed barley is not as large as for canola but they are substantial at more than $70 per acre.

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Table K - 7: Costs and benefits of NERP in the Brown Soil Zone

	Canola	Spring Wheat	Feed Barley
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline)	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$0.95	$0.69	$0.68
Net Change in Revenue per Acre	**$106.41**	**$75.15**	**$72.94**

As expected, the greatest increase in revenue was from the increased output from the crop areas. The revenue from the carbon offset market was relatively small. However, the revenue from the carbon market was larger in the brown soil zone than in the dark brown zone. For the canola acreage, the carbon revenue was $0.95 (Table K-7), which was 1.5 times as large as the amount coming from the canola crop grown on the dark brown soil zone. The carbon revenue for spring wheat and feed barley was higher than when grown in the dark brown zone, however, the increases were not as large as with canola.

In the brown soil zone, the carbon calculator estimated that the 1,000 ha of canola would generate 259 tCO_2e, while 188 tCO_2e were generated from the spring wheat and 184 tCO_2e from the feed barley acreage. As expected, as the price of carbon increases the revenue from the carbon stream in the model also increases. A carbon price of $23.00 per tonne has an impact on the carbon revenue generated by the model. Carbon prices of $23.00 per tonne and $37.00 per tonne could be possible in the near future (Table K-8).

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Table K - 8: Sensitivity Analysis around the Price of Carbon (Brown Soil Zone)

Carbon Price of $23.00 per Tonne	Canola	Spring Wheat	Feed Barley
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline)	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$1.69	$1.23	$1.20
Net Change in Revenue per Acre	**$107.15**	**$75.69**	**$73.46**
Carbon Price of $37.00 per Tonne	**Canola**	**Spring Wheat**	**Feed Barley**
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline)	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$2.72	$1.97	$1.94
Net Change in Revenue per Acre	**$108.18**	**$76.43**	**$74.20**

The Black Soil Zone

The results of the costs and benefits for the black zone are similar to those of the dark brown and the brown zones. The costs of implementing the change in management to better utilize fertilizer are small relative to the potential benefits from increased revenue from crop sales and carbon revenue. The costs fall in the same range as the previous estimates. As can be seen in Table K-9, the greatest revenue comes for the increase in sales of crops, followed by the revenue from carbon sales. As with the previous results, the carbon revenue is substantially smaller than the increased crop revenue.

The net revenue per acre for all three crops is positive and quite large. This suggests that cost could increase substantially before net revenue becomes zero or negative. The break-even amount for canola is $106 per acre, while for spring wheat and feed barley it is over $70 per acre.

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Table K - 9: Cost and Benefits of NERP in the Black Soil Zone

	Canola	Spring Wheat	Feed Barley
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$1.49	$1.24	$0.94
Net Change in Revenue per Acre	**$106.95**	**$75.70**	**$73.20**

The reduction in carbon emissions from the 1,000 ha of canola was 404 tCO_2e, while for spring wheat and feed barley it was 337 tCO_2e and 255 tCO_2e respectively. Increasing the price of carbon does increase the carbon revenue. Increasing the carbon price to $23 per tonne, and having the producer receive 70 percent of this value, generates carbon revenue per acre on canola of $2.64 per acre. The carbon revenue for spring wheat goes to $2.20 per acre while the revenue from feed barley increases to $1.66 per acre (See Table K-10). At a price of $37.00 per tonne, the carbon revenue per acre from canola pays for more than 50 percent of the agricultural professional fee per hectare.

Table K - 10: Sensitivity Analysis around the Price of Carbon (Black Soil Zone)

Carbon Price of $23.00 per Tonne	Canola	Spring Wheat	Feed Barley
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$2.64	$2.20	$1.66
Net Change in Revenue per Acre	**$108.10**	**$76.66**	**$73.92**

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Carbon Price of $37.00 per Tonne	Canola	Spring Wheat	Feed Barley
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additonal Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$4.24	$3.54	$2.68
Net Change in Revenue per Acre	**$109.70**	**$78.00**	**$74.94**

Conclusion

This study provides insight into the economics of a change in management that would reduce the amount of nitrous oxide emissions from agriculture, under a carbon offset protocol. The results would indicate that the 4R program could provide an increase in net revenue per acre. The costs associated with the implementation of the program are not large relative to the potential revenue that can be gained. Of the three crops included in the analysis, canola has the largest economic potential followed by spring wheat and feed barley.

An increase in the price of agricultural commodities or the carbon price could increase the economic potential. A carbon price of $37.00 per tonne could generate enough revenue on the farm that it could substantially go against the cost of the agricultural professional.

The results of the analysis are dependent upon the soil zone, ecodistrict, crop and management ability. Additional work could be undertaken to investigate these other factors on the economics. In addition, the impact of moisture content at harvest and when delivered could be investigated. These two variables have an impact on the greenhouse emissions that are reduced.

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Appendix L: Year One NERP Validation Study Report

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Nitrous Oxide Emission Reductions Protocol (NERP) Validation Study Report

Year One

Submitted to: Alberta Innovates Bio Solutions/ Climate Change Emissions Management Corporation

Date: June 3, 2014

Submitted by: The Prasino Group

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Disclaimer

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 2013[6]. The views expressed in this report are not necessarily the views of the Climate Change Emissions Management (CCEMC) Corporation.

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

Findings to Date

The purpose of the NERP Protocol Validation Study is to learn about the barriers, gaps, solutions and options for adopting the NERP protocol in the marketplace. More specifically, the objectives of the Study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field;
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocol at a commercial scale;
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocol (NERP v1.0; October 2010); and
- Catalyzing continued aggregation efforts for bringing offsets forward from aggregated agricultural projects.

In order to accomplish the above objectives, the NERP Protocol Validation Study team worked with the aggregation firm of AgriTrend – Agritrend Aggregation Inc. (ATAI). ATAI aggregated 6 farms, under the provision of the Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, v 1.0, October 2010. The project year was 2011 with a baseline of 2008, 2009 and 2010. ICF-Marbek completed the mock verification and gap analysis on the aggregated project for the Protocol Validation Study. It should be noted that at the time of the mock verification, the state of ATAI's NERP project was such that the robust development of a 4R Consistent Plan, or the gathering of participating farm records was not complete and compiled in such a way to support a full mock-verification at reasonable level of assurance by ICF Marbek. Further, a formal Offset Project Report was not completed. However, ICF-Marbek did assess ATAI's Agri-Data Solutions platform to test the data management system and NERP quantification algorithms for supporting a correct GHG assertion. ICF-Marbek also completed farm visits to observe how the key data requirements are gathered at the farm level and what data controls were in place at these operations. Issues identified in the mock verification are reported here.

Version 1.0 of the Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions (NERP) is on AESRD's website based on an older protocol format compared to the current format for agricultural protocols in the Alberta Offset System. As a result, Section 5 has not been updated to meet Reasonable Level of Assurance as currently understood in the Alberta Offset System. Therefore, ICF-Marbek's verification recommendations reflect some of the needed updates for NERP to be consistent with the most current agricultural protocol format. Interpretive guides have been prepared in the past for ARD, with a detailed evidence table, but these are not part of the AESRD licensed version 1.0, which was used in the PVS Study's mock verification.

Key Findings from the PVS study are listed below. Please refer to the Interim Recommendations section for explicit recommendations for moving forward.

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Protocol Recommendations for Revisions:

1) The NERP protocol needs to be revised to be consistent with the Conservation Cropping Protocol's Section 5 - Data Management section, particularly the minimum evidence tables.
2) Currently, the quantification methodology uses cropped area (i.e. seeded area) to calculate emission reductions. The protocol can be streamlined by allowing data and calculations to be completed on a mass basis for nitrogen input and yield data, rather on a unit per area basis (e.g. kg/ha) – which is the way the protocol currently quantifies the emissions. This would simplify the data collection process, manage uncertainty of fields having a crop failure by aggregating data at the farm level, and reduce verification costs. Both ICF-Marbek and the Saskatchewan adaptation process have identified this streamlining option. Further, to support these revisions – the following criteria could be applied:
    a. Criteria added along with this revision that specifies that the emission reduction quantification can be completed at the field level (rather than management zone level) if the EF_{ECO}, $FRAC_{renew}$, crop type and performance level are constant across a field. Similarly, the emission reduction quantification can be completed at the farm level for each crop if the EF_{ECO}, $FRAC_{renew}$ and performance level are constant across the farm. (See ICF Mock Verification and Gap Analysis Report – AgriTrend NERP).
3) Further guidance needs to be added to the protocol to clarify a number of items. These items include:
    a. Clarifying and confirming that the crop residue factors provided in Appendix E of the protocol need to be corrected for a dry matter basis. Currently, it appears that these values have been provided on a standard moisture content basis, rather than a dry matter basis. This needs to be confirmed with Henry Janzen.
    b. Providing additional guidance on how to estimate the fraction of total area that is renewed annually ($FRAC_{renew}$). In the case of annual crops this factor is equal to one; however, for perennial crops it has to be forecasted based on the number of years that the crop will be grown. Additional guidance would make the process of verifying this factor easier.
4) Best management practices published by the Canadian Fertilizer Institute and other organizations indicate that soil testing may not be required on an annual basis. In contrast, the "post-harvest assessment" defined in the NERP protocol seems to indicate that soil testing is required annually after harvest. This requirement should be updated in the protocol to focus on the nitrogen balance assessment. Specifically, the protocol should clarify that the balance assessment can be used based on known nitrogen inputs from the year before and nitrogen consumption values for the yields achieved.
5) A number of changes/additions were made to the NERP protocol when it was being adapted for Saskatchewan. These changes/additions included:
    a. Adding clarity to assure that crop types are the same between the baseline and the project. This was done to ensure accounting equivalency.
    b. Added wording to clarify that if a crop is irrigated in the baseline it must also be irrigated in the project (also to ensure accounting equivalency).
    c. Allowing baling and removal of straw to be eligible activities if it can be shown that 70% of the straw is retained on the soil.
    d. Updating the quantification methodology to clarify that the reduction modifier should not be applied to fallow year emissions since no nitrogen management occurs in that crop year. Under the current AB NERP the reduction modifier is applied resulting in an overestimation of emission reductions.

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It is recommended that these changes be considered in the Alberta NERP. These can be discussed at a future meeting.

Deletion from draft report on GHG Calculations[7].

Cost-Benefit Analysis:

1) The Cost-Benefit Analysis for the NERP PVS study was conducted on both a producer basis and an aggregator position basis. For the Aggregator Position, three scenarios were analysed – optimistic, expected and pessimistic (See Aggregator Spreadsheet and "The Benefit Cost Analysis of the Aggregator's Position as it Relates to the Nitrous Oxide Emission Reductions Protocol" documents).
2) The aggregator cost benefit analysis assumed:
    a. An existing aggregator would already have established a robust agronomic reporting framework that could keep track of agricultural practices and performance and that the aggregation functions would be an expansion of current information systems.
    b. Aggregators receive 40% of the market price, while producers receive 60%
    c. A seven year timeframe for the aggregator (over which start-up costs such as modifying the existing agronomic framework would be spread)
    d. Data gathering costs are 10% of the carbon offset price
    e. Verification costs are 3% of the carbon offset price
    f. Start-up costs are the same for each of the three scenarios (optimistic, expected, and pessimistic)

Aggregator Expected Scenario:

3) The results from the aggregator expected scenario indicate that the net present value of the stream of benefits and costs would be $479,000.00 over seven years. The cost per offset credit generated was $5.73 and the revenue per offset credit was $7.09. The net revenue per credit for the aggregator over the seven years was $1.36 per credit. These results would indicate that under the expected scenario assumptions (that current carbon offset credit prices would continue for 2 years and then increase to $23.00/tonne; 50,000 tonnes of credits were generated/year; and a discount rate of 3%) the aggregator would be expected to make a profit. The results are summarized in the table below.

Present Value of the Costs and Revenue, Cost per Credit, Revenue Per Credit and Net Present Value for the Expected Scenario	
Indicator	**Present Value**
Present Value of the Costs	$2,004,054.78
Present Value of the Revenue	$2,483,236.22
Cost Per Offset Credit Generated	$5.73
Revenue Per Offset Credit Generated	$7.09
Net Present Value	$479,181.44

[7] ICF Marbek identified what they thought was an anomaly in the calculation in their mock verification report. After going through the technical expert review conducted December through to February 2014, it was clarified with ICF Marbek that the use of the reduction modifier did not represent double counting.

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4) Sensitivity analysis of the expected scenario revealed that:
    a. Fixed costs could increase by 10 or 20 percent and still result in a positive net present value for the aggregator (the break-even increase in annual fixed costs was found to be approximately 27.32%)
    b. The price of carbon could decrease to approximately $14.77 in year's three to seven to break-even if all other parameters remained the same.
    c. The quantity of offset credits could decrease to approximately 35,705 credits from the assumed 50,000 offset credits per year before a loss would be observed

Aggregator Optimistic Scenario:

5) In the case of the optimistic scenario, as expected, both the aggregator's annual costs and annual revenues increased. Under this scenario, the net present value after seven years was $1.7 million. Furthermore, the cost per carbon offset tonne decreased from $5.73 in the expected scenario to $5.17 in the optimistic scenario; and the present value of the revenue increased from $2.4 million in the expected scenario to $4.4 million with the optimistic scenario. The optimistic scenario assumed that the carbon price remained the same for the first two years and then increased to $27.00 per tonne in year 3 to year 7; the number of carbon offset tonnes generated increased to 75,000 tonnes/year and a discount rate of two percent. The results are summarized in the table below.

Present Value of the Costs and Revenue, Cost Per Credit, Revenue Per Credit and Net Present Value for the Optimistic Scenario	
Indicator	**Present Value**
Present Value of the Costs	$2,712,547.05
Present Value of the Revenue	$4,426,857.17
Cost Per Offset Credit Generated	$5.17
Revenue Per Offset Credit Generated	$8.43
Net Present Value	$1,714,310.12

6) Sensitivity analysis of the optimistic scenario revealed that:
    a. The break-even increase in annual fixed costs was approximately 69.9%
    b. The price of carbon could decrease to approximately $9.13 in year's two to seven to break-even if all other parameters remained the same.
    c. The quantity of offset credits could decrease to approximately 39,170 credits from the assumed 75,000 offset credits per year before a loss would be observed

Aggregator Pessimistic Scenario:

7) For the pessimistic scenario, the price of carbon was assumed to remain constant at $13.00 per tonne over the seven year period, the volume of offset credits was decreased to 25,000 tonnes and the discount rate increased to 5 percent. Under this scenario annual costs were higher than annual revenue, indicating that it would not be profitable for aggregators. Specifically, based on present costs and benefits over the seven years, the net present value for the aggregator would

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be negative $621,000. Furthermore, the cost to the aggregator of generating the offset was $7.84/tonne while revenue was only $4.30/tonne.

Present Value of the Costs and Revenue, Cost Per Credit, Revenue Per Credit and Net Present Value for the Pessimistic Scenario.	
Indicator	**Present Value**
Present Value of the Costs	$1,374,003.03
Present Value of the Revenue	$752,228.54
Cost Per Offset Credit Generated	$7.85
Revenue Per Offset Credit Generated	$4.30
Net Present Value	-$621,774.49

8) Sensitivity analysis of the pessimistic scenario revealed that:
    a. Annual fixed costs would have to decrease by approximately 55.3% in order to break-even
    b. Approximately 55,600 tonnes of carbon offsets would be needed in each of the seven years to break-even
    c. The price of carbon would have to increase to approximately $32.05/tonne in order to break-even (note: this price is higher than the price in the optimistic scenario do the differences in the underlying assumptions described above)

9) The producer cost-benefit analysis was conducted for three farms of similar size (3,000 ha) in three different soils zones (dark brown, brown and black) with three different crops (canola, spring wheat and feed barley). The analysis assumed:
    a. The amount of nitrogen being applied increased slightly by 2 to 4 kg per acre with the change in management
    b. Agricultural professionals would cost $7.50/acre for advice and administrative work
    c. $1,000 would be needed for additional soil samples on the farm
    d. Yield increased on average by 20% with implementation of the NERP and increased N Use Efficiency
    e. An initial carbon price of $13/t$CO_2$e, of which 70% or $9.10 goes to the producer
    f. The crops had the following moisture contents:

Moisture Content (%)	Canola	Spring Wheat	Feed Barley
Off the field	12.5%	18%	18%
Delivered to the elevator	10%	13.5%	14.5%

10) In the dark brown soil zone, adopting the NERP provided an increase in net farm income of $106.10/acre for canola, $72.73/acre for feed barley and $75.01/acre for spring wheat. The greatest increase in economic benefit came from the increased yield of the crops. For example, additional revenue from cropping for canola was $117.00/acre; whereas the additional revenue from carbon credits was $0.64/acre. Therefore, the revenue from selling the carbon offset credits is small relative to the revenue generated from better crop management. Based on the assumptions of the model, the cost of adopting the NERP ranged from $10.24 to $11.54 per acre for reed barley and canola, respectively. The table below summarizes the results.

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Cost and benefits of NERP on Dark Brown Soil Zone			
	Canola	**Spring Wheat**	**Feed Barley**
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$0.64	$0.55	$0.47
Net Change in Revenue per Acre	**$106.10**	**$75.01**	**$72.73**

11) A sensitivity analysis was undertaken on the price of carbon. With an increase in price to $23.00 per tonne, in the dark brown soil zone, the carbon revenue from the canola crop was $1.13 per acre, which was approximately $0.49 more per acre than the original situation. At $37.00 per tonne, the carbon revenue from the canola crop was $1.82, which was more than double the initial situation. The same type of relationship was found for barley and spring wheat.
12) Similar results were found in the brown soil zone. The increase in net revenue for canola was $106 per acre, followed by spring wheat at $75 per acre and then by feed barley at $73 per acre. Costs could increase substantially before the change in management would break-even. Once again the greatest increase in revenue was from the increased output from areas cropped. However, the revenue from the carbon market was larger in the brown soil zone than in the dark brown zone. For example, the carbon revenue for canola was $0.95/acre (at a price of $13/tonne). The carbon revenue for spring wheat and feed barley was higher than when grown in the dark brown zone; however, the increases were not as large as with canola. The results are summarized in the table below.

Costs and benefits of NERP in the Brown Soil Zone			
	Canola	**Spring Wheat**	**Feed Barley**
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$0.95	$0.69	$0.68
Net Change in Revenue per Acre	**$106.41**	**$75.15**	**$72.94**

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13) In the black soil zone the costs of implementing the change in management to better utilize fertilizer were also small relative to the potential benefits from increased revenue from crop sales and carbon sales. The results are summarized in the below table.

Cost and benefits of NERP in the Black Soil Zone			
	Canola	**Spring Wheat**	**Feed Barley**
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$1.49	$1.24	$0.94
Net Change in Revenue per Acre	**$106.95**	**$75.70**	**$73.20**

14) Overall, the results of the producer analysis revealed that the 4R program could provide an increase in net revenue per acre. Furthermore, the costs associated with implementing the protocol are small relative to the potential revenue that can be gained. Of the three crops analyzed, canola had the largest economic potential.

Documentation and Records[8]:

In general, the state of development of the ATAI NERP project could not support a robust assessment of documentation and records due to the level of development in the NERP v1.0; December 2010 Data Management section. The state of development of the ATAI project is likely indicative of most others scoping the NERP protocol at this time.

1) It's recommended that project developers have a concrete 4R Plan for each farm, as described in the NERP, and according to the Canadian Fertilizer Institute's training program for Accredited Professional Advisors. Field level practices and field sheets/electronic records need to be linked to the BMPs described in the 4R Plan at the appropriate performance level Basic, Intermediate or Advanced). Also, plans need to be traced to goals at the farm enterprise level.
2) Evidence needs to support the 4Rs – this includes rates of N applied, timing (including soil testing dates); placement (including linking the equipment used for seeding/fertilizing) and source for the field in question.
3) Methods for determining yield need to be sufficient to meet the requirements of the protocol. Current methods present a significant measurement risk for verification purposes.
4) A consistent template for 4R Plans would reduce verification risk.

[8] This section has been edited into general recommendations based on the NERP protocol validation study. Sensitive information related to ATAI's data management system have been removed.

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5) A best practice guide to verification for NERP projects is needed to clarify documentation requirements and support reasonable level of assurance;
6) Clarification is needed in the protocol regarding whether soil testing is required on every field, every year. Queries from project developers and verifiers indicate that clarity is needed. Best practices by the CFI and IPNI indicate that soil testing may not be required on an annual basis, and nitrogen balances based on N applied, crop yield and crop N uptake tables. This includes approaches for post-harvest assessments.

Interim Recommendations:

Capacity of the Sector to Implement the NERP:

At this stage of the study, it is difficult to speak to the capacity of the sector to implement and adopt the NERP. Certainly, the study has found a number of barriers that would inhibit broad scale uptake. In general, those firms that have agronomists on the ground working with growers are in the best position to implement the NERP. Further, those growers who have electronic data collection linked to GPS - assisted application and yield equipment are also going to be in the best position to implement the NERP. In the next year of this study, the opportunity for ATAI to address these gaps and implement the NERP in a more comprehensive way will reveal the size of the opportunity. Given the complexity of the NERP, the state of technology implementation in the agricultural sector to date, and the strong grain and oilseed prices, the current value of carbon ($15/tonne) will make it difficult to attract growers in implementing the NERP beyond this PVS study.

However, there are some modifications to the protocol that will remove barriers, streamline implementation and hopefully improve uptake.

Recommendations to Address Major Challenges with Implementation of the NERP:

Due to inconsistencies in the way that farmers are measuring yield, and the level of accuracy of those yield measurements, The Prasino Group is working with a technical expert committee to identify acceptable yield methods for inclusion in a revision to the protocol. These will be incorporated as flexibility mechanisms within a revised protocol[9].

Secondly, a significant challenge with the NERP protocol is the need to establish a 'project or farm-level' historic benchmark baseline, based on 3 years of crop data. Given the issues with accurate yield estimates, the 3-year average baseline means that the NERP can't be implemented until at least 4 years for a particular crop on a farm, once the yield estimation methods are approved and incorporated into the protocol. Therefore, the Prasino Group, in conjunction with the technical expert review committee has established 2 dynamic baselines that can be used as alternatives and pre-cursors to a conventional historic baseline until 3 years of acceptable yields have been established. These will be included as flexibility mechanisms in the revised NERP protocol[3].

Both of these key pieces should enhance uptake of the NERP in Alberta, and will be completed by February 2013.

[9] This section edited from the original draft to reflect the status of protocol revisions as of June 2014.

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Recommendations for Immediate Revisions to the Protocol:

1. Update Section 5 - Data Management Section. This is already completed in the Interpretive Guide submitted to ARD under KHK Consulting contract and will be in the revised version of the NERP protocol.
2. Adopt the modifications to the NERP from Saskatchewan's version of the Protocol, in conjunction with the technical expert committee, which includes[10]:
    a. Add in the streamlining option allowing for data and calculations to be complete on a mass basis for nitrogen inputs and yield, with accompanying criteria listed above)
    b. Add applicability conditions for crop types to ensure accounting equivalency between baseline and project (this includes irrigated crops applied in baseline and project to ensure "like" comparisons)
    c. Allow baling and removal of straw to be eligible activities if it can be shown that 70% of the straw is retained in the field
    d. Fix the accounting glitch with summerfallow fields and the reduction modifier
3. Clarify requirements around annual soil testing vs nitrogen balance assessments
4. Potentially fix the problem with the application of the reduction modifier, by multiplying the modifier by the delta between the baseline emissions/kg of crop and the project emissions/kg of crop). The Prasino Group will prove the veracity of this potential modification by modeling a number of scenarios.

Further, the findings of this PVS study, including the mock verification, will be incorporated into the Best Practice Guide to Implementing and Verifying NERP projects. This guide will be prepared by The Prasino Group and reviewed by ICF-Marbek. The Guide represents a document that is appropriate to share with stakeholders after Year 2 of the PVS.

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[10] See Appendix A for an excerpt of SK NERP modifications

Relevant Documents

ICF Marbek's Mock Verification and Gap Analysis Report

Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.0, October 2010

Interpretive Guide to Applying the Nitrous Oxide Emissions Reductions Protocol, March 2012

Draft Saskatchewan NERP Protocol – excerpt from the Protocol Applicability section shown below:

To apply this protocol, the Project Developer must prove the following requirements:

1. *The 4R Consistent Plan, including clear identification of the baseline and project condition has been accredited and signed by an Accredited Professional Advisor;*
2. *All farms being included in the project are being implemented according to the 4R Consistent Plan and has received annual sign-off by the Accredited Professional Advisor;*
3. *New crops and land being added to the participating farms have correctly established three years of baseline data on crop events prior to including the crop in the farm/project;*
4. *Crop types, according to the list below, are the same in the baseline and project to ensure equivalency in straw/residue N accounting.*
    - *Wheat (all spring planted types)*
    - *Winter Wheat*
    - *Fall Rye*
    - *Barley*
    - *Barley silage*
    - *Corn*
    - *Corn silage*
    - *Pulses*
    - *Canola*
    - *Oats*
    - *Flax*
    - *Tame Hay*
    - *Alfalfa/clovers*
    - *Others;*
5. *Crops produced under irrigation in the 3 year average baseline are also under irrigation in the project for the duration of the project;*
6. *Baling and removal of straw is an eligible activity under this protocol; however, it must be demonstrated that 70% or more of the straw remains on the field to assure against declines in soil organic carbon[11];*
7. *In order to provide consistency and completeness to the greenhouse gas accounting under this protocol, all fields for a farm enrolled in an aggregation program, need to be part of the project and baseline greenhouse gas accounting;*

[11] According to findings in Malhi et al., 2001 http://www.agriculture.gov.sk.ca/apps/adf/ADFAdminReport/19990026.pdf; Lafond et al., 2009; Lemke et al., 2010. Note normal baling activities result in less than 30% straw removal; on average it's 22% (Lafond et al., 2009.

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Appendix M: Year One NERP Mock Verification Report

Submitted by: ICF Consulting Canada Inc.

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ICF Marbek
an ICF International Company

Agricultural Nitrous Oxide Emission Reduction (NERP) – Pool 1

Agri-Trend Aggregation Inc. (ATAI)

Mock Verification Final Report

April 30, 2013

ICF Consulting Canada, Inc.
2600 – 144 Fourth Avenue SW
Calgary, AB T2P 3N4

Introduction

Alberta's greenhouse gas (GHG) regulatory framework has created a vibrant carbon market, with over 8.4 million tonnes of voluntary carbon emission reductions generated in the form of carbon offsets. Carbon offsets are provided by sectors that do not have a regulatory target, and are sold to companies with regulatory obligations under Alberta's Specified Gas Emitter Regulation (SGER), 2007. The agriculture sector has been a major provider of carbon offsets to the market, contributing over 20% of offsets used for compliance with the SGER.

In order to support efforts needed to attain this higher standard of verification, Alberta Agriculture and Rural Development (AARD) initiated a Protocol Validation Study (PVS) as a capacity-building exercise to gather knowledge about the application of the Agricultural Nitrous Oxide Emission Reduction (NERP) protocol to compile a Carbon Offset Project, including validation to a reasonable level of assurance. The aggregation company, Agri-Trend Aggregation Inc. (ATAI), has volunteered to compile a Carbon Offset Project using on-farm data from five farms in Alberta.

Specifically, the PVS study will emulate the process of aggregating participating producers under the provisions of the protocol to bring forward agricultural offsets that can be tested in a mock verification exercise to a reasonable level of assurance, for the purposes of collectively learning about the barriers, gaps, solutions and options for adopting these protocols in the marketplace. The objectives of the PVS study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field.
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale.
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols.

This report provides the results of the mock verification, an analysis of the gaps found in the project to meet the current quantification protocol and potential gaps or areas for improvement with the Protocol itself.

1 Verification Summary

Lead Verifier:	Aaron Schroeder, P.Eng.
Associate Verifier(s):	Michelle Stelmach, Janice Tran
Verification Timeframe:	January – April 2013
Objective of the verification:	Gap analysis through a mock verification on pilot Project
Final report being provided to:	Alberta Agriculture and Rural Development
Standard being verified to:	ISO 14064-3:2006 (ISO, 2006)
Verification criteria employed:	Climate Change and Emissions Management Act Specified Gas Emitters Regulation (Alberta Regulation 139/2007) Technical Guidance for Offset Project Developers, Version 4.0, February 2013 Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013 Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions, Version 1.0, October, 2010
Verification scope – Gases:	Carbon Dioxide, Methane, Nitrous Oxide
Project:	Agriculture Nitrous Oxide Emissions Reductions (NERP) – Pool 1
Location(s):	Five farms in Alberta
Project Start Date:	January 1, 2011
Credit Start Date:	January 1, 2011
Credit Duration Period:	January 1, 2011 – December 31, 2018
Project Report Temporal period:	January 1, 2011 – December 31, 2011

Main Contact (Verifier):	Aaron Schroeder, P.Eng. Senior Manager - Climate Suite 2600 144 - 4 Ave SW Calgary, Alberta T2P 3N4 403.450.7522 aaron.schroeder@icfi.com
Main Contact	Agri-Trend Aggregation Inc. (ATAI) Bill Dorgan, President #6 – 4630 61st Street Red Deer, Alberta, T4N 2R2 Phone: 403.608.0992 Fax: 403.474.6287 Email: bdorgan@agritrend.com

2 Project Information

Agri-Trend Aggregation and Feedlot Health Management Services, ("**ATAI**") has developed the necessary documentation detailing project activities to support a claim for emission reductions to be registered on the Alberta Offset Registry under Alberta's Specified Gas Emitters Regulation. ICF Consulting Canada, Inc. ("**ICF Marbek**") has been engaged to provide a third-party mock verification of the emission reduction asserted by ATAI related to the project activities discussed herein.

The quantification of the emission reductions associated with the project is defined by Alberta Environment and Sustainable Resource Development's ("**AESRD**") Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.0, October 2010 ("**the Protocol**"). The Project Report describes the emission reduction claim ("**GHG Assertion**") made by ATAI related to this project.

The Agricultural Nitrous Oxide Emission Reduction (NERP – Pool 1 Project ("**the Project**") covered by this verification engagement involves 2011 vintage emission reductions achieved through switching to an integrated set of Beneficial Nitrogen (N) Management Practices (BMPs) for annual and perennial cropping. The Project is an aggregation of five farms within Alberta.

ATAI has a contractual relationship with each of the farms to aggregate the emission reduction assertion from each farm into the Project. ATAI has established the right to transact on credits that would be created from the Project.

This is the first verification of any project under the Protocol (although this is a mock verification).

This document describes the terms and scope of this verification. It serves to communicate the findings of the verification.

3 Verification Execution

The scope of the mock verification was defined during the planning stage and is detailed in the Verification Plan, which is appended to this document. The Verification Plan also describes ICF Marbek's verification process that was executed through the course of the verification, and identifies the specific verification procedures that were planned and executed through the process.

The mock verification was conducted over a four month period from January – April, 2013. A head office visit coincided with the kickoff meeting on January 9, 2012.

Since site visits to six of the eight participating farms in September, 2012 as part of an Agri-Trend pre-verification review, site visits were not repeated during the verification. Further information regarding the site visits is provided in the following section.

The final mock verification report and gap analysis was released on April 30, 2013.

3.1 Site Visits

The farm visits were conducted by Michelle Stelmach on September 24, 2012.

The farm visit interview consisted of inquiry and observations in four categories:

- Farm eligibility: 4R Consistent Planning, baseline conditions, deviations from the 4R plan
- Yield data: method for measuring yield, method for measuring grain moisture
- Nitrogen fertilizer: fertilizer purchase practices, record keeping for fertilizer application, fertilizer equipment
- Manure: record keeping for manure application

The following observations were made during the farm visits:

- Farmers do not have a firm understanding of the 4R Consistent Planning process. While they understand the components of the plan, which are being conducted on each farm, the concept the integrated 4R planning process is not well understood.
- There were no deviations from the crop plans due to unforeseen issues such as weather related events.
- There are different methods used for measuring yield.
    - Some farmers use a grain cart to measure yield. Measurements are recorded in a log book and the grain cart scale is calibrated at a local elevator annually. Grain moisture is measured on each load.
    - One farmer is certified seed grower and therefore, their cereal crops are weighed through their seed-cleaning plant. Each load is tested for grain moisture content.
    - Some farmers estimate yield using bin sizes.
    - Moisture content is measured consistently, but usually only for the purpose of ensuring grain is not too wet to store. Measurements are not always recorded.
    - Sales records are available; however, they do not provide a complete record because some grain is retained for seed or fed to cattle. Further, sales occur throughout the year, so some grain may still be in inventory when NERP calculations are completed.
- Farmers do not keep an inventory of nitrogen fertilizer because it is expensive and difficult to store. Therefore, fertilizer is purchased and applied in exact quantities according to crop plans.
- None of the farms in the Project apply manure.

3.2 Summary of Project Changes

Major GHG emission sources and sinks have been identified by the Responsible Party and are detailed in the Offset Project Plan. The quantification methodologies outlined in the Protocol have been used to calculate GHG emission sources and sinks. There have been no changes made to the project since the Offset Project Plan was completed (this is the first year of the pilot project).

The uncertainty associated with the quantification methodologies applied was evaluated during Protocol development. The Project meets the data collection and project specific calculation requirements of the Protocol and therefore, the uncertainty associated with the quantification and resulting assertion meets AESRD requirements.

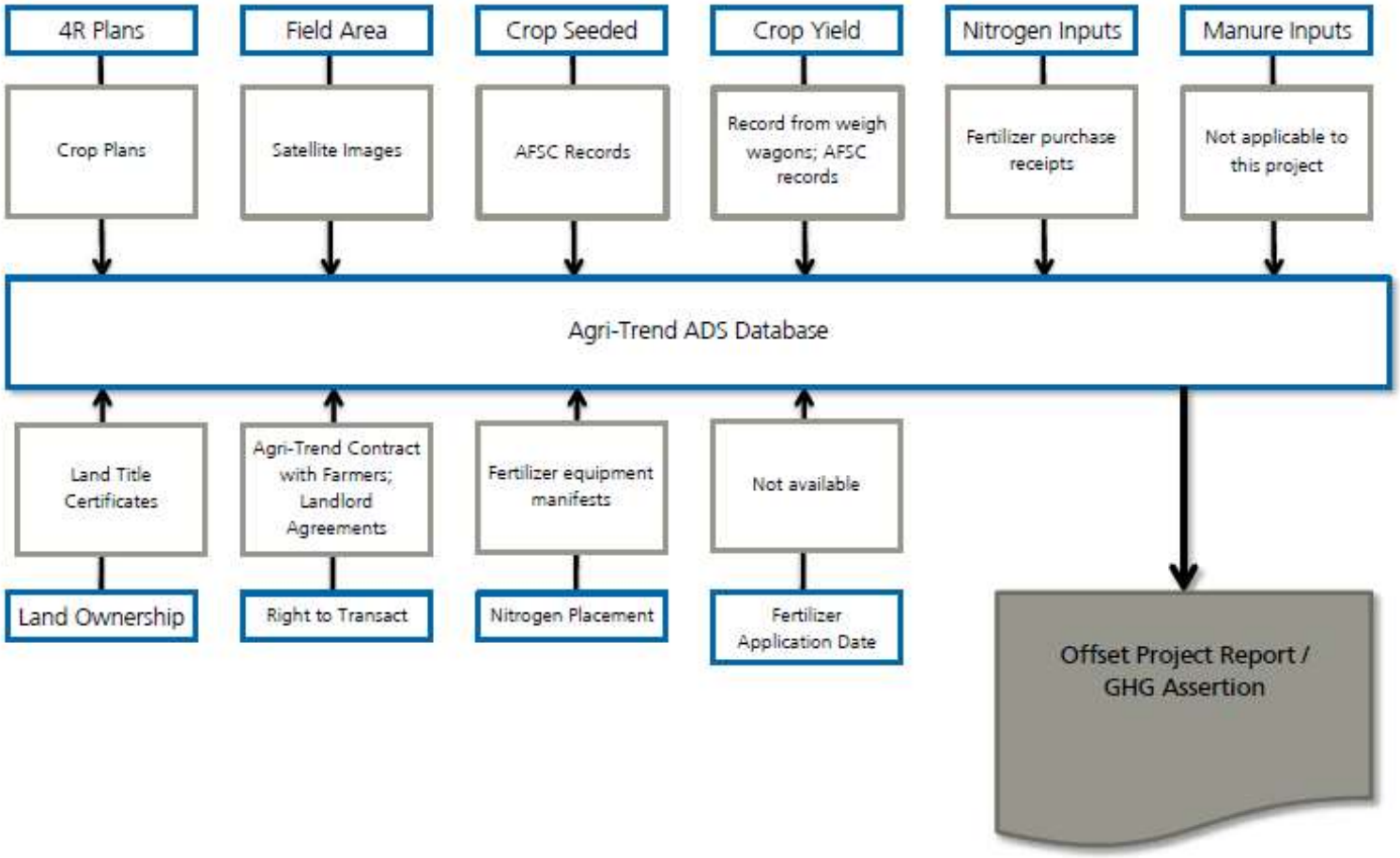
3.3 Verification Strategy

The Verification Strategy applied to this mock verification was a predominantly substantive approach. The Verification Team designed and executed verification procedures that focused on review of original metered and measured data.

The Responsible Party relies on certain controls for the quantification of emissions and to establish project eligibility. ICF Marbek relied on the following controls and as such, tested the operational effectiveness of these controls and data the controls are processing. Detail of the verification procedures employed to conduct these tests are provided in the Verification Plan.

3.4 Data Management and Control System Review

The Verification Team developed a thorough knowledge of the data management and control systems utilized in the Project through the review of the Offset Project Plan, observations during the site visit, and interviews with key Project personnel. The data flow diagram shown below outlines the flow of project data and the custody of control.



4 Mock Verification Results

4.1 Evaluation of Evidence

The following gaps in documentation were determined in the Project:

1. Documentation to substantiate the credentials of the Accredited Professional Advisors (APA) was not available for review during the mock verification and therefore, was not evaluated.
2. The field level plans do not provide a linkage to the higher level of the 4R Plan, so the plans cannot be traced to goals at the Farm Enterprise level. Goals and other higher level elements do not need to be stated on each and every field sheet but there should be a clear link between the field sheet and the Farm Enterprise Plan so this sheet is identified as part of a specific 4R Plan.
3. There is insufficient information in the 4R plans to determine what BMPs for Right Source, Right Place and Right Time were adopted. In some cases, we can infer what was likely done, but the BMPs need to be explicitly stated for each of the 4Rs. In some cases, the source or the placement or the application timing is mentioned in the notes in others it is not. Some of the "Rs" like source and placement are decided at the farm level based on equipment choices, fertilizer prices etc., but we need to be able to trace them to the management zone. At a minimum, the N sources for each field should be stated (urea, UAN, anhydrous ammonia, ESN, MAP); the time of application (fall banded, spring banded pre-seeding, etc) and date if fall-applied; and the placement (urea banded on 12 inch centres at a depth of three inches with MAP in the seed row).
4. There is sufficient information to support the Right Rate decisions and although the methodology for the rate decision is not explicit, they do include soil test data and the rate recommendations. The agronomists notes also provide some insight into their reasoning with respect to rate. Since annual soil testing is being used as a Best Management Practice (BMP) for source and rate decisions then the date of the test should be given. Using a test taken in the period between post-harvest 2010 to seeding 2011 would meet the BMP requirement. Annual soil testing (or every second year) or whatever is the BMP can be stated at the farm enterprise level and then any exceptions noted on the field sheet. Sampling date would tie what was actually done to the BMP.
5. Photographs of nitrogen application equipment that is on file is not specifically related to the fields where the equipment was used.
6. During the farm visits conducted during this analysis, the verification team found that some weigh wagon measurements were recorded as crop was harvested and this information was recorded in a farm log book. Moisture readings were made on each weigh wagon record and a moisture correction was performed. This level of practice is sufficient to substantiate the yield at the field level provided the data recorded is verifiable.

   However, in many cases, the evidence presented was insufficient to meet Protocol requirements. Many farms do no use weigh wagons or weigh wagons are not properly calibrated. Farm records alone are insufficient to prove yield unless the measurements used to calculate yield are substantiated with supporting evidence.
7. APA approval of baseline conditions was not evaluated because evidence was not presented.
8. Fertilizer application dates and soil temperature data was not evaluated because evidence was not presented.
9. Nitrogen inputs from manure were not evaluated because none of the farms in the Project applied manure during the project period.
10. Incremental fuel consumption was not evaluated because none of the farms in the Project changed from a single application to a split application.

4.2 Protocol Issues

1. Land area is actually not required for the emission reduction calculation. While nitrogen and yield data are shown on a unit per area basis (kg/ha), all data and calculations could be completed on an absolute mass basis. This is further evidenced by the sample calculation provided in Appendix F where calculation on an absolute mass basis results in the same final result.

   Land area should be removed from the protocol. Evidence of land area should not be required and all calculations should be updated to be completed on an absolute mass basis. This change would simplify quantification and verification of projects under this protocol.

2. The emission reduction quantification *may* be completed at the field level if the following factors are constant across the field:

   - EF_{ECO} (emission factor related to local soil and climatic conditions)
   - $FRAC_{renew}$ (fraction of total area under crop that is renewed annually)
   - Crop type
   - Performance level (basic, intermediate, advanced)

   Further, the emission reduction quantification *may* be completed at the farm level *for each crop* if the following factors are constant across the farm:

   - EF_{ECO} (emission factor related to local soil and climatic conditions)
   - $FRAC_{renew}$ (fraction of total area under crop that is renewed annually)
   - Performance level (basic, intermediate, advanced)

   Completing these calculations at the field or farm level will significantly simplify the overall quantification, reduce risk of error and reduce verification costs.

3. Crop residue factors, which are used to calculate direct emissions of nitrous oxide from crop residue decomposition, are provided in Appendix E and appear to be provided on a standard moisture content basis, rather than a dry matter basis. Additional guidance should be provided indicating if these factors need to be corrected for a dry matter basis.

4. The Protocol does not adjust the mass of nitrogen fertilizer (in the calculation of direct emissions of nitrous oxide from nitrogen fertilizer) and mass of manure (in the calculation of direct emissions of nitrous oxide from manure) for the mass of nitrogen that is consumed by the plants (10% of nitrogen from nitrogen fertilizer and 20% of nitrogen from manure) or lost through leaching (9 – 25% - see Protocol Appendix B). Therefore, the direct emissions from nitrogen fertilizer and manure are being over estimated.

5. Additional guidance should be provided to estimate the fraction of total area that is renewed annually ($FRAC_{renew}$). This factor is simply equal to 1 for annual crops; however, for perennial crops, the Project Developer must forecast the number of years that the crop will be grown. There is no guidance provided for establishing this forecast. Further, without a standard or guidance, it is difficult to verify this factor.

6. For clarity, the ratio "44/28" should be replaced with a symbol and then defined as the molecular mass ratio of N_2O to N_2O as N (N_2O/N_2O-N).

7. The "post-harvest assessment" defined in the Protocol (page 67) describes a requirement for "Analysis of yield data and testing results including the nitrogen balance assessment". This statement seems to indicate that soil testing is required annual after harvest; however, best management practices published by the Canadian Fertilizer Institute and other organizations indicate that soil testing may not be required on an annual basis. This requirement should be updated to focus on the nitrogen balance assessment, which can be completed using the known nitrogen inputs from the year and nitrogen consumption values from published lookup tables.

5 Verification Team

Since 1969, ICF International ("ICF") has been serving major corporations, all levels of government, and multilateral institutions. Globally, approximately 500 of our 4,500 employees are dedicated climate change specialists, with experience advising public and private-sector clients. ICF has earned an international reputation in the field of climate change consulting for its analytical rigour, in-depth expertise, and technical integrity through scores of GHG emissions-related assignments over the past two decades.

Within Canada over the past 10 years, ICF Consulting Canada, Inc., a fully owned subsidiary of ICF, has carried out numerous facility-level GHG verifications and verifications of emission reduction projects. ICF Marbek has developed the necessary internal controls to ensure qualified and competent staffing uphold the principles of the relevant standard while quality control processes are utilized to assure data integrity is maintained and safeguarded. ICF Marbek's clients choose ICF Marbek for its strong brand, technical expertise, and rigorous methodological approach.

ICF Marbek has assembled a Verification Team consisting of experienced GHG verifiers with relevant technical expertise.

Lead Verifier

Aaron Schroeder is a Professional Engineer in the Province of Alberta and holds a B.Sc. in Engineering from the University of Saskatchewan. He has completed supplementary training in ISO 14064 as well as Auditing and Assurance Engagements through the University of Toronto, School of Continuing Studies. Aaron has acted as lead verifier on third-party assurance assignments for multiple compliance periods under Alberta's Specified Gas Emitters Regulation. These projects included work at SAGD facilities in Alberta's oil sands, a complex sour gas processing facility, two of Alberta's largest natural gas pipelines and combined-cycle electric generating facilities. Additionally, Aaron has completed numerous verifications as lead verifier for emission reduction (offset) projects in agricultural tillage management, wind electricity generation, and acid gas injection projects.

Associate Verifier

Michelle Stelmach works on contract with ICF Marbek and will conduct the farm visits during the course of the verification. She holds a Bachelor of Science in Agriculture from the University of Saskatchewan and certification in agricultural application of ISO 19011 – Internal System Auditing and has worked with the Hazard Analysis Critical Control Point (HACCP) to design and conduct internal system audits and to meet Canadian Food Inspection Agency standards at the producer level, in feed manufacturing plants and poultry processing plants. She has extensive experience working with agricultural producers across Alberta through her work as Program Advisor and Coordinator with Maple Leaf Foods and Landmark Feeds.

Associate Verifier

Janice Tran has extensive experience in providing a broad range of audit and consulting services. She has experience working with greenhouse gas emission quantification in the oil and gas, agriculture and utilities industries. She also has experience in financial auditing and in verification of voluntary reporting under the Global Reporting Initiative and the Carbon Disclosure Project. Janice holds a Masters of Professional Accounting degree from the University of Saskatchewan, a Bachelor of Commerce degree in Accounting, and Bachelor of Arts degree in Philosophy from the University of Calgary.

Appendices

Verification Plan

Sampling Plan

Verification Plan

Agri-Trend Aggregation Inc. – Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1

1 Introduction

This document provides details on the verification scope and process that is planned to conduct a mock verification of Agri-Trend Aggregation Inc.'s Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1, (the "**Project**"). A summary of the Project is provided in the mock Verification Report.

A verification risk assessment was conducted prior to the development of this document and the results are provided in Section 4. The results of the risk assessment were also used to inform the development of the Sampling Plan, which is a companion to this document.

The Verification and Sampling Plans will be updated through the course of the verification as additional information becomes available.

The verification conclusion will be documented in the Verification Statement and the verification findings will be further described in the Verification Report. The Verification and Sampling Plans will be appended to the Verification Report to provide information related to the verification scope and process.

2 Verification Scope

2.1 Objective

The primary objective of this verification is to determine if the Project described in the Offset Project Plan resulted in the greenhouse gas ("**GHG**") emission reduction reported in the *Notice of Creation of Emission Reduction Credits* (the "**GHG Assertion**").

2.2 Parties and Users

The person or persons responsible for the provision of the GHG Assertion and the supporting GHG information, as defined in Section 2.23 of ISO 14064-1:2006, is the "**Responsible Party**". For this verification, Agri-Trend Aggregation Inc. is the Responsible Party.

ICF Consulting Canada Inc., the "**Verifier**" or "**ICF Marbek**", has been engaged by the Client, to provide a third-party verification of the emissions report. The Lead Verifier, Associate Verifiers and Technical Resources compose the ICF Marbek "**Verification Team**".

The "**Intended User**" is defined in Section 2.24 of ISO 14064-1:2006 as the individual or organization identified by those reporting GHG-related information that relies on that information to make decisions. Alberta Agriculture and Rural Development is the Intended User of the information contained within the Verification Statement.

2.3 Scope

The mock verification will be conducted in accordance with ISO 14064-3:2006.

The Verification and Sampling Plans were developed based on the relevant criteria described in the following:

- Climate Change and Emissions Management Act
- Technical Guidance for Offset Project Developers, Version 3.0, February 2012
- Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.0, October 2012

The following table defines the scope elements specified for the Project.

Scope Element	ISO 14064-3 Definition	Alberta Offset System
Boundary	The facility boundary, including legal, financial, operational and geographic boundaries	Farm operations across Alberta
Infrastructure and Activities	The physical infrastructure, activities technologies and processes of the organization	Farm operations that have implemented a Consistent 4R Nitrogen Stewardship Plan.
GHG Sources	GHG sources to be included	• Fertilizer and Lime Distribution (B7 & P7) • Fertilizer and Lime Use (B8 & P8) • Soil Crop Dynamics (B13 & P13)
GHG Types	Types of GHGs to be included	• Nitrous Oxide (N_2O) • Carbon Dioxide (CO_2) • Methane (CH_4)
Reporting Period	Time periods(s) to be covered	January 1, 2011 – December 31, 2011

2.4 Materiality

During the course of the verification, individual errors, omissions or misrepresentations (collectively referred to as discrepancies) or the aggregate of these discrepancies will be evaluated qualitatively and quantitatively.

Materiality defines the level at which discrepancies in the GHG Assertion or any underlying supporting information precludes the issuance of a limited level of assurance.

The Lead Verifier is responsible for applying professional judgment to determine if *qualitative* discrepancies could adversely affect the GHG Assertion and subsequently influence the decisions of the Intended User, in which case, the discrepancies are deemed to be material.

Quantitative discrepancies will be calculated individually to determine the percentage of the GHG Assertion that is affected.

All discrepancies that are outstanding at the conclusion of the verification are documented in the Verification Report and classified on an individual basis as either material or immaterial.

Materiality Threshold

The materiality threshold is defined by Alberta Environment and Sustainable Resource Development as 5% of the GHG Assertion. Individual discrepancies and the aggregate of individual discrepancies will be analyzed to determine if the materiality threshold has been breached.

2.5 Principles

ISO 14064-3:2006 defines six principles that should be upheld in the development of the GHG Assertion. These principles "are intended to ensure a fair representation and a credible and balanced account of GHG emission reductions and removal enhancements from projects" (ISO 14064-3:2006). The verification procedures developed and executed during the course of this verification will present evidence such that each of these principles is satisfied.

Relevance

Appropriate data sources are used to monitor and quantify emission sources and sinks. Appropriate minimum thresholds are used to justify the exclusion or the aggregation of minor GHG sources or the number of data points monitored in accordance with the Protocol and Alberta Environment and Sustainable Resource Development guidance documents.

Completeness

All emission sources and sinks relevant to the Project are considered in the Offset Project Plan, including sources and sinks that are described in the Protocol and any additional relevant sources and sinks that are not described in the Protocol.

Consistency

Uniform calculations are employed between the baseline and project condition and through the entire crediting period. Emission calculations for each emission source and sink are calculated uniformly. If more accurate procedures and methodologies become available during the crediting period, documentation is provided to justify the changes and show that all other principles are upheld.

Accuracy

Measurements and estimates are presented, without bias as far as is practical. Where sufficient accuracy is not possible or practical, measurements and estimates are used while maintaining the principles of conservativeness and transparency.

Transparency

Information is presented in an open, clear, factual, neutral and coherent matter that facilitates independent review. All assumptions are stated clearly and explicitly and all calculation methodologies and background material are clearly referenced.

Conservativeness

Appropriate parameters affecting the Project emission sources and sinks are utilized in the calculation of the GHG Assertion. When parameters or data sources are highly uncertain, the choice of parameter or data source utilized results in an underestimation in the GHG Assertion (i.e. baseline emissions are under-estimated, Project emissions are overestimated) so as to not overestimate the Project emission reduction.

2.6 Limitation of Liability

Due to the complex nature of the operations within the Project and the inherent limitations of the verification procedures employed, it is possible that fraud, error, or non-compliance with laws, regulations, and relevant criteria may occur and not be detected.

3 Verification Process

The ICF Marbek approach for conducting verification of a GHG Assertion follows the tasks outlined in the following diagram. Although these tasks are generally completed sequentially, the order may be modified according to circumstances such as scheduling and data availability.

Pre-Engagement	Approach	Execution of Verification	Completion
1. Selection of Lead Verifier 2. Initiate Conflict of Interest Procedure 3. Pre-Engagement Planning and Proposal Development 4. Contract Execution 5. Assess Verification Management System and Revise as Required 6. Initiate Verification Tracking	1. Selection of Verification Team 2. Communication with Client/Responsible Party 3. Kick-off Meeting 4. Verification Risk Assessment 5. Draft Verification & Sampling Plan	1. Site Visit(s) 2. Conduct Verification Procedures 3. Issue Clarification Request 4. Revise and Finalize Verification & Sampling Plan 5. Address and Evaluate Outstanding Issues	1. Draft Verification Report & Verification Statement 2. Internal Peer Review 3. Responsible Party Review of Draft Verification Report and Verification Statement 4. Issue Verification Report & Verification Statement 5. Close Verification File

3.1 Pre-Planning the Engagement

Prior to submitting a proposal to conduct this verification, the following preplanning steps were taken:

- The results of any previous business engagements or verifications with the Responsible Party were reviewed to determine if any previous unresolved conflicts may preclude ICF Marbek from engaging in the verification;
- The client's motivation for completing the verification was established; and
- A Conflict of Interest report was completed. No perceived or real conflicts were found when considering threats due to:
    - Advocacy
    - Financial interest
    - Familiarity/sympathy
    - Intimidation
    - Self-Review
    - Incentives

Following the acceptance of the proposal and signing of a contract for services, the Verification Team was selected. The Verification Team is comprised of the following individuals. The qualifications of the Verification Team are provided in the Statement of Qualifications.

Lead Verifier, Aaron Schroeder, P.Eng.

The Lead Verifier is responsible for all activities conducted within the verification, including overseeing the development of the Verification and Sampling Plan and the execution of the verification procedures. The Lead Verifier is the lead author of the Verification Report and executes the Verification Statement at the conclusion of the engagement.

Associate Verifier(s), Michelle Stelmach, Janice Tran

The Associate Verifier(s) work under the direction of the Lead Verifier to conduct the activities of the verification.

3.2 Verification Planning

An extensive knowledge of the Responsible Party's business, the relevant industry, and the details of the Project itself are required to conduct a thorough verification that can lead to a conclusion. The initial information collected about the Responsible Party and the Project formed the basis of the preliminary Verification Plan. The development of the Verification Plan is iterative process; that is, the process will be completed several times through the course of the verification and the resulting plan will be updated as new information became available.

There are three types of risk associated with the GHG Assertion defined in ISO 14064-3:

- Inherent Risk
- Control Risk
- Detection Risk

The process of designing the Verification Plan began with the development of a risk profile of both the Project as well as the Responsible Party. The steps in this process included:

- Reviewing the GHG Assertion, the Offset Project Report and Offset Project Plan;
- Reviewing information on the industry and the specific Project under review;
- Assessing the likelihood that a material misstatement might exist in the GHG Assertion, if no controls were used to prevent misstatements in the GHG Assertion (i.e. inherent risk);
- Assessing the Responsible Party's control environment and the corporate governance process (i.e. control risk); and
- Reviewing each emission source and sink identified at the Project. The contribution of each source and sink to the GHG Assertion and the potential material discrepancy for each was calculated.

A summary of the verification risk assessment is provided in Section 4 of this document. The results of the risk assessment informed the development of the verification procedures, which are documented in the Sampling Plan. The Sampling Plan and the verification risk assessment will be reviewed by ICF Marbek's designated Technical Expert(s) to ensure the verification procedures address each of the verification risks identified through the Verification Planning stage. Subsequently, this Verification Plan and the Sampling Plan will be reviewed with the Responsible Party before proceeding with the verification.

3.3 Execution

With Verification and Sampling Plans in place, the verification procedures will be executed and the verification will be subsequently completed. This process involves collecting evidence, testing internal controls, conducting substantive testing, and developing a review file.

Collecting Evidence and Review of Documentation

Sufficiency and appropriateness are two interrelated concepts that are fundamental to the collection of verification evidence. The decision as to whether an adequate quantity (sufficiency) of evidence has been obtained is influenced by its quality (appropriateness).

Through the execution of the verification procedures described in the Sampling Plan, the Verification Team will review the following sources of evidence covering the three key forms of evidence: physical, documentary and testimonial:

- Management documentation: policies, programs, and procedures related to the collection, safeguarding, and management of the data supporting the GHG Assertion;
- Records: records comprise time-sensitive data, correspondence, and files including: the Offset Project Plan; 4R Consistent Plans for each management zone; farm records (showing yield logs, fertilizer application dates and rates); fertilizer purchase receipts; irrigation district invoices (where applicable); and post-harvest reports;
- Interviews: interviews will be conducted with central data management staff, Agri-Trend Aggregation coaches, Accredited Professional Advisors and farm operators. The interviews will provide information regarding operations and data management and will provide evidence to support the sufficiency of data controls; and
- Computer systems: Agri-Trend's proprietary data management software used to capture and manage the GHG-related data and to calculate the GHG Assertion.

Testing and Assessment of Internal Controls

The Verification Team will develop a sufficient understanding of the GHG information system and internal controls to determine whether the overall data management system is sound. This assessment will seek to identify any weakness or gaps in the controls that pose a significant risk of not preventing or correcting problems with the quality examining it for sources of potential errors, omissions, and misrepresentations. It will incorporate an examination of three aspects of the Responsible Party's internal controls: (1) the control environment, (2) the data systems, and (3) the control and maintenance procedures.

Assessment of Data

Substantive testing procedures will be used to assess the reasonability and validity of the GHG Assertion. Both quantitative and qualitative analysis will be performed to achieve the desired level of assurance. The verification procedures are described in the Sampling Plan as separate tables for each process or activity involved in the quantification and reporting of the GHG Assertion. The verification procedures include verification activities designed to:

- Review the Project boundary, including a review of the Project eligibility, ownership and completeness of emission sources and sinks identified;
- Review the Offset Project Plan to ensure the Project conforms with the established criteria;
- Review the Project data sources to ensure the GHG Assertion is calculated based on metered or estimated data that meets the Protocol requirements;
- Recalculate the GHG Assertion, which demonstrates transparency and accuracy; and

- Review the GHG Assertion to ensure the emission reduction calculated by the Responsible Party has been accurately reported.

Clarification Action Request

To facilitate information flow between the Verification Team and the Responsible Party, a consolidated request for additional information will be developed through the course of the verification and issued to the Responsible party near the conclusion of the execution of the verification procedures. This "Clarification Action Request" will be used to document the request for information and summarize the responses received. It will also be used to document the Verification Team's assessment of each response.

Developing a Review File

A review file ("File") comprised of documents, records, working papers and other evidence collected and created during the course of the review that support the review conclusions will be developed for this verification. This evidence stored in hard copy and/or electronic format will serve to: provide support for the verification conclusion; provide evidence that the verification was conducted in accordance with the criteria set forth in this document; and aid the Verifier in conducting current and future reviews.

The File will include:

- The Offset Project Report, Offset Project Plan, GHG Assertion and supporting information
- Decisions on the level of materiality and the components of review risk;
- Documentation on the Responsible Party's internal controls;
- Descriptions of the controls assessment work and results;
- Documentation of the substantive testing procedures that were carried out and the results;
- Copies of any correspondence with the Responsible Party or other parties relevant to the review;
- Issues Log (verification task tracking of identified issues);
- The Verification Team's working papers;
- The Clarification Action Request; and
- Client data (copies of relevant records, spreadsheets, and other data files).

The File is the property of ICF Marbek and access to it is normally restricted to the Verifier and the Responsible Party. ICF Marbek will retain and safeguard the file for a minimum of seven years.

3.4 Completion

This engagement will be formally closed after the verification has been executed and this Verification Report has been finalized.

Preparing the Verification Report

The purpose of the Verification Report is to document the verification findings. All errors are described and compared to the materiality threshold individually and in aggregate. The Verification Statement, which presents ICF Marbek's verification conclusion, is appended to Verification Report.

Internal Peer Review Process

Prior to releasing this Verification Report and the accompanying Verification Statement, an internal review process is conducted with the lead reviewer. This process ensures that:

- All steps identified as being required to complete the verification were completed;
- Any identified material or immaterial discrepancies identified have been either:
  - corrected by the Responsible Party and reflected in the GHG Assertion; or
  - documented in the Verification Report, if discrepancies persist at the conclusion of the verification.
- All required documentation detailing the verification process has been prepared, delivered, and retained.

Closing the Engagement

The review engagement will be closed out upon delivery of the final Verification Report and a meeting with the Responsible Party.

4 Verification Risk Assessment

The following table describes the *inherent* and *control* risks analyzed by the Verification Team and the corresponding verification procedures outlined in the Sampling Plan that have been designed to address these risks.

Description of Risk	Evaluation	Verification Procedure(s)
Inherent Risks		
Measurement risk associated with crop yield. Farmers are using varying methods of measurement from farm to farm. Calibration of measurement equipment is not available or has not been recorded in some cases.	High	D2.1
Availability of baseline data to support emission reduction assertion	Medium	D2.2 D2.3
Manual transcription of data to data management system	Low	D2.1 D2.2 D4.1
Control Risks		
Crop plans do not follow a consistent template. Therefore, each crop plan must be evaluated independently to evaluate completeness and transparency	Medium	D1.4 D1.5 D6.1

The *detection risk* is a measure of the risk that the verification procedures will fail to detect material misstatements, should such misstatements exist. The verification procedures will be developed to address inherent and control risks, while ensuring the level of detection risk is sufficiently low to reach a verification conclusion at a reasonable level of assurance.

The results of the Verification Risk Assessment will be utilized by the Verification Team to develop the verification procedures, which are detailed in the Sampling Plan.

5 Verification Schedule

The following schedule is planned for the verification (subject to change with agreement between the Verifier and the Responsible Party).

Description	Scheduled Date
Verification Kickoff Meeting	January 9, 2013
Farm Visits	September 2012
Head Office Visit	January 9, 2013
Draft Mock Verification and Gap Analysis Report	April 15, 2013
Final Mock Verification and Gap Analysis Report	April 30, 2013

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Sampling Plan

Agri-Trend Aggregation Inc. –
Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1

Objective:

The primary objectives of completing verification procedures is to collect evidence in support of the principles and quantification methodology underlying the emission reduction assertion made by the Project Proponent and to reveal any material discrepancies in the GHG assertion, should they exist.

Testing Procedures:

This plan describes the testing procedures that will be utilized. The specific procedures are summarised in separate tables for each process or activity involved in the quantification and reporting of the GHG emission reduction assertion. Materiality is specified for each specific procedure. Aggregate materiality is determined separately.

The table on the following page provides information on the details that are included for each verification procedure.

Summary of Procedures:

Project Boundaries

B1: Documentation of Boundaries – Offset Project Plan (OPP)

Ownership

O1: Confirmation of Contractual Relationship – Farm Operator and Aggregator

O2: Confirmation of Contractual Relationship – Landowner and Farm Operator

O3: Confirmation of Ownership – Documentation Control

Data Sources and Supporting Data

D1: Eligibility of Crop Event

D2: Evaluation of Baseline and Project Data

D3: Area in Crop Production

D4: Data Handling

D5: Declaration of Ecodistrict

D6: Site Visits

Calculation

C1: Emission Reduction Calculation – Database Calculations

Assertion:

A1: Greenhouse Gas Emission Reduction Assertion

Procedure Definition Table Explained

Z1 – Procedure Title	
Introduction: This introduction serves to explain the reason the verification team has interest in the procedure described below. For instance the inclusion of all emission sources ensures that that quantification of the total direct emission satisfies the principle of completeness.	
Type of Evidence	The Type of Evidence can usually be grouped as: Physical Examination, Confirmation, Documentation, Observation, Inquiries of the Client, Reperformance, or Analytical Procedures.
Data Sources	The *Data Sources* describes the form in which the evidence is presumed to be available to the verification team. Specific Documents or Assigned Positions, for example.
Objective (specific principles)	The objective serves to focus the procedure as pursuant to one of the audit principles of: *Relevance, Completeness, Consistency, Accuracy, Transparency, or Conservativeness*.
Specific Activities	1. The *Specific Activities* are outlined here.
Potential Error Conditions	• Bullet form; • The anticipated *Potential Error Conditions* are listed here to aid the verification team; • As the sampling plan is a living document until the end of the verification process additional error conditions may be identified during the execution of the procedures.
Sample Unit	The *Sample Unit* describes the individual record unit required to define the *Sample Size*. i.e. one parcel of land
Sample Size	The *Sample Size* represents the original planned depth of the sampling, as a percent. i.e. 15% of the parcels of land in the aggregated assertion
Materiality Threshold	Two options exist for the definition of the *Materiality Threshold*; • A Quantitative description describing the threshold in tonnes, eg. 5% of the emission reduction assertion; • A Qualitative statement where the nature of the error not a quantitative one. Qualitative errors will be reviewed on a case by case basis for materiality.

Project Boundaries

B1: Documentation of Boundaries – Offset Project Plan (OPP)	
Introduction: The Offset Project Plan details the quantification methodology, data management and quality assurance/quality controls that are employed by the Project Proponent. This verification procedure compares the details of the OPP to the Protocol to ensure the OPP is in conformance with approved procedures.	
Type of Evidence	Documentation
Data Sources	Offset Project Plan (OPP)
Objective (specific principles)	Completeness, Relevance
Specific Activities	1. Compare each SSR listed in the OPP to those listed in the Protocol
Error Conditions	• SSR defined in protocol was wrongfully excluded in OPP • Use of a flexibility mechanism without justification • Divergence from the protocol that is not in conformance with ISO 14064 and associated guidance documents
Sample Unit	N/A
Sample Size	N/A
Materiality	Any inconsistencies are evaluated for qualitative materiality.

Ownership

O1: Confirmation of Contractual Relationship – Farm Operator and Aggregator	
Agri-Trend establishes a contractual relationship with each farm operator in the aggregated project. The purpose of this procedure is to review every participant (farm operator) file within the aggregated project to ensure a documented contractual arrangement has been established.	
Type of Evidence	Documentation
Data Sources	Farm Operator Contracts with Agri-Trend Aggregation
Objective (specific principles)	Completeness, Transparency
Specific Activities	1. Review landowner contract for each landowner within each project
Error Conditions	• Missing signatures • Expired contract
Sample Unit	One contract
Sample Size	All contracts
Materiality	No exceptions in the aggregated assertion

O2: Confirmation of Contractual Relationship – Landowner and Farm Operator	
In the case that a farm operator is leasing/renting land, a *transfer of offset credits* agreement between the farm operator and the landowner contractually transfers any emission reduction credits generated on the land during the contractual period to the farm operator.	
Type of Evidence	Documentation
Data Sources	Landowner – Farm Operator Contracts in project files
Objective (specific principles)	Completeness, Transparency
Specific Activities	1. Review landowner transfer contract for each landowner/farm operator within each project
Error Conditions	• No contractual relationship established between the land owner and farm operator • Missing signatures on contracts • Expired contract
Sample Unit	One contract
Sample Size	All contracts
Materiality	No exceptions in the aggregated assertion

O3: Confirmation of Ownership – Documentation Control	
Agri-Trend uses publicly available land title information as further evidence of ownership for each parcel of land included in the aggregated project. This procedure reviews the land title information for land in the project.	
Type of Evidence	Documentation, Confirmation
Data Sources	Land Title Certificates; Agri-Trend ADS Database
Objective (specific principles)	Completeness, Transparency, Accuracy
Specific Activities	1. Review land title information compared against ADS database - Ownership (name and date) - Land Area 2. Review date document was created to establish that it is a current document
Error Conditions	• Missing ownership document for land asserted • Ownership document shows land asserted is not currently in landowner's name • Ownership document shows less land area than area asserted
Sample Unit	One land area (generally a quarter section)
Sample Size	Review all land title certificates in aggregated project
Materiality	No exceptions in aggregated assertion

Data Sources and Supporting Data

D1: Eligibility of Crop Event	
The purpose of this procedure is to evaluate the eligibility criteria that apply to each crop event (crop type, crop year and management zone). This includes a review to determine that the 4R Consistent Plan was implemented.	
Type of Evidence	Documentation
Data Sources	4R Consistent Plan; AFSC Records; Farm Records - date of seeding, date of fall applied fertilizers, rate of fertilizer application; photographs of fertilizer equipment, Irrigation District invoices; Post Harvest Assessment
Objective (specific principles)	Completeness, Transparency
Specific Activities	1. Review evidence supporting the declared crop seeded 2. Review evidence supporting soil temperature of fall applied fertilizers 3. Review evidence supporting irrigation, if irrigation is asserted 4. Review 4R Consistent Plan to ensure APA signoff on the plan 5. Review evidence showing that 4R Consistent plan was implemented, specifically: a) Rate of fertilizer application b) Timing of fertilizer application c) Placement of fertilizer d) Type of fertilizer (consider manure and nitrogen fertilizers) 6. Review post-harvest assessment, which should address any deviations from the 4R Consistent Plan, analysis of yield and a post-harvest nitrogen balance assessment. The post-harvest assessment should be signed by the farmer and the APA.
Error Conditions	• Missing evidence to support the eligibility of each management zone • Deviation from the 4R Consistent Plan that is not substantiated • Missing or incomplete 4R Consistent Plan
Sample Unit	Each management zone
Sample Size	All management zones
Materiality	Any ineligible management zones must be removed from the assertion

D2: Evaluation of Baseline and Project Data	
The emission reduction calculation for the baseline and the project conditions is based on nitrogen inputs, production (yield) and area in production. Area is evaluated in procedure D3. This procedure evaluates the evidence supporting nitrogen inputs and yield. In some cases an additional application of nitrogen relative to the baseline is required to meet the 4R consistent plan, in which case, evidence supporting additional farm fuel consumption is also required.	
Type of Evidence	Documentation, Confirmation
Data Sources	Farm records (yield measurements) and supporting yield documentation; nitrogen fertilizer invoices; manure management plans; custom manure application invoices; fuel consumption estimate evidence (if required)
Objective (specific principles)	Completeness, Accuracy, Conservativeness
Specific Activities	1. Evaluate asserted yield estimates against supporting documentation 2. Evaluate asserted nitrogen applied (both nitrogen fertilizer and manure) against supporting documentation 3. Evaluate asserted incremental fuel consumption against supporting documentation (if required)
Error Conditions	• Asserted baseline and project data is not supported by documentation
Sample Unit	Each management zone
Sample Size	All management zones
Materiality	5% of total GHG assertion

D3: Area in Crop Production	
Eligible land includes only land in crop production. This procedure reviews the asserted cropped area against third-party data to provide additional evidence to the claimed area.	
Type of Evidence	Documentation, Confirmation, Inquiry of the Client
Data Sources	Alberta Agriculture and Food – Alberta Soil Information Viewer; Google Earth; Producer Interviews
Objective (specific principles)	Accuracy, Conservativeness
Specific Activities	1. Review cropped area claimed by producer against third-party satellite or areal images 2. Where discrepancies exist, interview producers for additional information.
Error Conditions	• Area claimed is not supported by third-party images due to forested areas, areas under water or areas not in crop production.
Sample Unit	Each management zone
Sample Size	10% of management zones for each farmer
Materiality	5% of total GHG assertion when sample is generalized to the population

D4: Data Handling	
This procedure reviews the farm operator and field information that is entered into the system to determine the accuracy of the data in the Agri-Trend ADS database.	
Type of Evidence	Documentation
Data Sources	AFSC records, nitrogen fertilizer invoices, farm records (yield information)
Objective (specific principles)	Accuracy, Transparency, Conservativeness
Specific Activities	1. Compare data entered into database against backup documentation
Error Conditions	• Incomplete database records • Transcription errors
Sample Unit	One soil management zone (field level for "basic" application)
Sample Size	All land areas asserted
Materiality	5% of total GHG assertion

D5: Declaration of Ecodistrict	
Each field falls within an ecodistrict, which has relatively homogenous biophysical and climatic conditions. The purpose of this procedure is to ensure that the correct ecodistrict has been identified for each field	
Type of Evidence	Confirmation
Data Sources	Alberta Agriculture and Food ecodistrict database, Agri-Trend EDS database
Objective (specific principles)	Completeness, Accuracy
Specific Activities	1. Match ecodistrict asserted to ecodistrict listed by Alberta Agriculture and Food for each management zone
Error Conditions	• Ecodistrict provided by Alberta Agriculture and Food does not match assertion
Sample Unit	One land area (generally a quarter section of land)
Sample Size	All land areas asserted
Materiality	5% of total GHG assertion

D6: Site Visits	
Site visits include interviews with farmers and observation of fertilizer application equipment. The site visit may also include observation of measurement equipment used to determine yield.	
Type of Evidence	Observation; Inquiry of the Client
Data Sources	Producer Interviews
Objective (specific principles)	Transparency, Accuracy
Specific Activities	1. Interview producer and review farm records relating to fertilizer equipment used; rate, timing and placement of nitrogen (including nitrogen fertilizer and manure); crop type, area in production, irrigation and yield 2. Observe fertilizer application equipment. Measure opener width (noting type of opener) and row spacing
Error Conditions	• Information provided by the producer does not match information in the Agri-Trend ADS database • Fertilizer application equipment does not match information in the Agri-Trend ADS database
Sample Unit	Each farmer
Sample Size	All farmers in the project
Materiality	Any discrepancies will be evaluated qualitatively for impact on the aggregated assertion; ineligible producers or land cannot remain in the final assertion

Calculation

C1: Emission Reduction Calculation – Database Calculations	
This procedure recalculates the emission reduction calculation that is completed in the Agri-Trend ADS database.	
Type of Evidence	Reperformance
Data Sources	Agri-Trend ADS Database
Objective (specific principles)	Accuracy, Completeness, Consistency, Transparency, Conservativeness
Specific Activities	1. Check application of factors provided in the Protocol 2. Complete a recalculation of the asserted emission reduction using original data 3. Check application of significant figures in calculation
Error Conditions	• Difference between calculation in the ADS database and recalculated value • Incorrect significant figures applied • Rounding figures inappropriately
Sample Unit	Calculations are completed for each soil management zone within each farm operation
Sample Size	All land areas asserted
Materiality	5% of total GHG assertion when sample is generalized to the population

Attestation:

A1: Greenhouse Gas Emission Reduction Assertion	
This procedure reviews the final Project Report and GHG Assertion/Notice of Creation to verify that the final assertion matches the calculated value in the Agri-Trend ADS database.	
Type of Evidence	Documentation
Data Sources	Project Report, Notice of Creation of Emission Reduction Credits, Agri-Trend ADS Database
Objective (specific principles)	Consistency, Completeness, Accuracy, Transparency, Conservativeness
Specific Activities	1. Review Project Report for consistency with the Agri-Trend ADS Database and Offset Project Plan 2. Review assertion language for consistency with language recommended in guidance documents
Error Conditions	• Language in assertion is inconsistent with language recommended in guidance documents • Annual totals do not match values calculated in electronic calculator • Annual totals are rounded inappropriately
Materiality	Any inconsistencies are evaluated for qualitative materiality

Appendix N: Year Two NERP Validation Study Report

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Nitrous Oxide Emission Reductions Protocol (NERP) Validation Study Report

Year Two

Submitted to: Alberta Innovates Bio Solutions/ Climate Change Emissions Management Corporation

Date: June 10, 2015

Submitted by: The Prasino Group

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Disclaimer

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 Draft Alberta Offset System's Nitrous Oxide Emissions Reduction in Agriculture Quantification Protocol v 1.1 April 2015. The views expressed in this report are not necessarily the views of the Climate Change Emissions Management (CCEMC) Corporation.

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Introduction/Background

As stated in the Year 1 Validation Study Report, the purpose of the NERP Protocol Validation Study (PVS) is to learn about the barriers, gaps, solutions and options for adopting the NERP in the marketplace. More specifically, the objectives of the study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field;
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocol at a commercial scale;
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocol; and
- Catalyzing continued aggregation efforts for bringing offsets forward from aggregated agricultural projects.

In order to accomplish the above objectives, the NERP Protocol Validation Study team worked with the aggregation firm of Agritrend Aggregation Inc. (ATAI). For the second mock verification, ATAI aggregated three farms under the draft Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, v 1.1, April 2015. Under the draft NERP, project developers can employ one of two dynamic baseline quantification approaches that enable emission reductions to be quantified in the absence of three year of baseline data. For the purposes of this project dynamic baseline one (which quantifies the baseline CO_2e emissions for each crop using the present year's data) was used. As in year one, ICF International completed the mock verification and gap analysis on the aggregated project for the Protocol Validation Study. Key Findings from the NERP PVS study are presented below. Please refer to recommendations section for explicit recommendations for moving forward.

Key Findings in Year Two of the NERP Protocol Validation Study

Protocol Related Issues

The year two mock verification completed by ICF, identified a few outstanding issues in the draft protocol (v1.1, April 2015). These issues/points of clarity are summarized below.

1. Table 12: Crop Mass Determination Methods in the protocol presently only lists the record requirements for three of the four acceptable crop mass determination methods presented in Appendix I of the protocol. Records for the fourth method need to be added to the protocol.
2. Presently the protocol requires moisture readings to be taken for every load. Interviews with farmers conducted as part of the mock verification revealed that this requirement is impractical and likely more rigorous than required to determine the moisture content. Presently, the farmers interviewed measure moisture content once per field, daily by crop type. Given this, it is recommended that a flexibility mechanism be added to the protocol that permits project developers to use the most conservative moisture values from the Canadian Grain Commissions' Standard Storage Requirements.
3. Presently, the draft protocol requires project developers to have land title certificates for each field being claimed in the project to demonstrate ownership. Given that the NERP is a reduction protocol (and not a sequestration protocol) multi-year lease agreements would provide sufficient evidence to satisfy the ownership requirements and avoid creating unnecessary costs associated with requiring land titles.

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4. If nitrogen is applied in the fall, the draft protocol requires soil temperature readings for three consecutive days as evidence that the temperature was less than $10^{O}C$. The protocol validation study revealed that this is impractical. Instead it was suggested that data (ambient air temperatures showing 10 degrees Celsius or less for 5 consecutive days) from the closest weather station be considered as an alternative.
5. The protocol requires APA's to be authorized to practice under the practice standard for GHG assessment and management; however, no practice standard currently exists.
6. In Section 1.2 Protocol Applicability it is unclear which fields should be included in the project / greenhouse gas accounting. For example, applicability criteria number nine states that ineligible fields "must be included in the 4R Plan, but are excluded from GHG accounting", while applicability criteria number twelve states that "farms in the project must have all fields enrolled in the 4R program and need to be part of the project and baseline greenhouse gas accounting". Therefore, the applicability criteria need to be reviewed for consistency and clarity to ensure correct interpretation.
7. Presently, if ineligible activities are employed on any field under the draft protocol, the entire farm is disqualified from the project. Although this criteria limits the possibility of gaming when using the conventional baseline approach, it unnecessarily excludes farms using either of the dynamic baseline approaches. It is suggested that an applicability criteria be added to allow the inclusion of farms with ineligible fields under the 4R Plan. In order to ensure a conservative approach, one option would be to disqualify any fields for the entire crediting period if the field becomes ineligible at any time during the baseline period or any time during the project crediting period.
8. It is unclear in the protocol how additional fuel use should be accounted for when using either of the dynamic baseline approaches.
9. In Appendix K: Additional Fuel Pass Method in the protocol, the definition of the pass area (sum of extra passes on all fields of the farm) contradicts the quantification methodology. Therefore, this definition should be removed.
10. It should be more clearly stated that the protocol does not require the APA to be the person who physically collects farm data and conducts on-farm observations. However, the APA must confirm all record requirements and supporting data are on file and review the documentation before approving and implementing the 4R plan.
11. For clarity, the ratio factor of 44/28 should be replaced in the quantification approach with a symbol and defined as the molecular mass ration of N_2O to N_2O as N (N_2O/N_2O-N).

All of the protocol revision recommendations from year one of the protocol validation studies were addressed in the modified protocol.

Cost-Benefit Analysis

In early 2014 it was decided that a second round of cost-benefit analyses would not provide added value. Therefore, the findings have not changed and are presented below, as they were presented in the Year 1 Validation Study Report. Please note that the results presented below were based on a conventional baseline. If the analysis were performed using dynamic baseline one or two, the results would likely reveal lower returns, due to the lower number of credits generated (dynamic baselines one and two are more conservative).

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Year 1 Cost-Benefit Analysis Summary

The Cost-Benefit Analysis for the NERP PVS study was conducted on both a producer basis and an aggregator position basis. For the Aggregator Position, three scenarios were analysed – optimistic, expected and pessimistic (See Aggregator Spreadsheet and "The Benefit Cost Analysis of the Aggregator's Position as it Relates to the Nitrous Oxide Emission Reductions Protocol" documents).

The aggregator cost benefit analysis assumed:

a. An existing aggregator would already have established a robust agronomic reporting framework that could keep track of agricultural practices and performance and that the aggregation functions would be an expansion of current information systems.
b. Aggregators receive 40% of the market price, while producers receive 60%
c. A seven year timeframe for the aggregator (over which start-up costs such as modifying the existing agronomic framework would be spread)
d. Data gathering costs are 10% of the carbon offset price
e. Verification costs are 3% of the carbon offset price
f. Start-up costs are the same for each of the three scenarios (optimistic, expected, and pessimistic)

Aggregator Expected Scenario

1) The results from the aggregator expected scenario indicate that the net present value of the stream of benefits and costs would be $479,000.00 over seven years. The cost per offset credit generated was $5.73 and the revenue per offset credit was $7.09. The net revenue per credit for the aggregator over the seven years was $1.36 per credit. These results would indicate that under the expected scenario assumptions (that current carbon offset credit prices would continue for two years and then increase to $23.00/tonne; 50,000 tonnes of credits were generated/year; and a discount rate of 3%) the aggregator would be expected to make a profit. The results are summarized in the table below.

Present Value of the Costs and Revenue, Cost per Credit, Revenue Per Credit and Net Present Value for the Expected Scenario	
Indicator	**Present Value**
Present Value of the Costs	$2,004,054.78
Present Value of the Revenue	$2,483,236.22
Cost Per Offset Credit Generated	$5.73
Revenue Per Offset Credit Generated	$7.09
Net Present Value	$479,181.44

2) Sensitivity analysis of the expected scenario revealed that:
   a. Fixed costs could increase by 10 or 20 percent and still result in a positive net present value for the aggregator (the break-even increase in annual fixed costs was found to be approximately 27.32%)
   b. The price of carbon could decrease to approximately $14.77 in year's three to seven to break-even if all other parameters remained the same.

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c. The quantity of offset credits could decrease to approximately 35,705 credits from the assumed 50,000 offset credits per year before a loss would be observed

Aggregator Optimistic Scenario

1) In the case of the optimistic scenario, as expected, both the aggregator's annual costs and annual revenues increased. Under this scenario, the net present value after seven years was $1.7 million. Furthermore, the cost per carbon offset tonne decreased from $5.73 in the expected scenario to $5.17 in the optimistic scenario; and the present value of the revenue increased from $2.4 million in the expected scenario to $4.4 million with the optimistic scenario. The optimistic scenario assumed that the carbon price remained the same for the first two years and then increased to $27.00 per tonne in year 3 to year 7; the number of carbon offset tonnes generated increased to 75,000 tonnes/year and a discount rate of two percent. The results are summarized in the table below.

Present Value of the Costs and Revenue, Cost Per Credit, Revenue Per Credit and Net Present Value for the Optimistic Scenario	
Indicator	**Present Value**
Present Value of the Costs	$2,712,547.05
Present Value of the Revenue	$4,426,857.17
Cost Per Offset Credit Generated	$5.17
Revenue Per Offset Credit Generated	$8.43
Net Present Value	$1,714,310.12

2) Sensitivity analysis of the optimistic scenario revealed that:
   d. The break-even increase in annual fixed costs was approximately 69.9%
   e. The price of carbon could decrease to approximately $9.13 in year's two to seven to break-even if all other parameters remained the same.
   f. The quantity of offset credits could decrease to approximately 39,170 credits from the assumed 75,000 offset credits per year before a loss would be observed

Aggregator Pessimistic Scenario

1) For the pessimistic scenario, the price of carbon was assumed to remain constant at $13.00 per tonne over the seven year period, the volume of offset credits was decreased to 25,000 tonnes and the discount rate increased to 5 percent. Under this scenario annual costs were higher than annual revenue, indicating that it would not be profitable for aggregators. Specifically, based on present costs and benefits over the seven years, the net present value for the aggregator would be negative $621,000. Furthermore, the cost to the aggregator of generating the offset was $7.84/tonne while revenue was only $4.30/tonne.

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Present Value of the Costs and Revenue, Cost Per Credit, Revenue Per Credit and Net Present Value for the Pessimistic Scenario	
Indicator	**Present Value**
Present Value of the Costs	$1,374,003.03
Present Value of the Revenue	$752,228.54
Cost Per Offset Credit Generated	$7.85
Revenue Per Offset Credit Generated	$4.30
Net Present Value	-$621,774.49

2) Sensitivity analysis of the pessimistic scenario revealed that:
    a. Annual fixed costs would have to decrease by approximately 55.3% in order to break-even
    b. Approximately 55,600 tonnes of carbon offsets would be needed in each of the seven years to break-even
    c. The price of carbon would have to increase to approximately $32.05/tonne in order to break-even (note: this price is higher than the price in the optimistic scenario do the differences in the underlying assumptions described above)

3) The producer cost-benefit analysis was conducted for three farms of similar size (3,000 ha) in three different soils zones (dark brown, brown and black) with three different crops (canola, spring wheat and feed barley). The analysis assumed:
    a. The amount of nitrogen being applied increased slightly by 2 to 4 kg per acre with the change in management
    b. Agricultural professionals would cost $7.50/acre for advice and administrative work
    c. $1,000 would be needed for additional soil samples on the farm
    d. Yield increased on average by 20% with implementation of the NERP and increased N Use Efficiency
    e. An initial carbon price of $13/t$CO_2$e, of which 70% or $9.10 goes to the producer
    f. The crops had the following moisture contents:

Moisture Content (%)	Canola	Spring Wheat	Feed Barley
Off the field	12.5%	18%	18%
Delivered to the elevator	10%	13.5%	14.5%

4) In the dark brown soil zone, adopting the NERP provided an increase in net farm income of $106.10/acre for canola, $72.73/acre for feed barley and $75.01/acre for spring wheat. The greatest increase in economic benefit came from the increased yield of the crops. For example, additional revenue from cropping for canola was $117.00/acre; whereas the additional revenue from carbon credits was $0.64/acre. Therefore, the revenue from selling the carbon offset credits is small relative to the revenue generated from better crop management. Based on the assumptions of the model, the cost of adopting the NERP ranged from $10.24 to $11.54 per acre for reed barley and canola, respectively. The table below summarizes the results.

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Cost and benefits of NERP on Dark Brown Soil Zone			
	Canola	**Spring Wheat**	**Feed Barley**
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$0.64	$0.55	$0.47
Net Change in Revenue per Acre	**$106.10**	**$75.01**	**$72.73**

5) A sensitivity analysis was undertaken on the price of carbon. With an increase in price to $23.00 per tonne, in the dark brown soil zone, the carbon revenue from the canola crop was $1.13 per acre, which was approximately $0.49 more per acre than the original situation. At $37.00 per tonne, the carbon revenue from the canola crop was $1.82, which was more than double the initial situation. The same type of relationship was found for barley and spring wheat.
6) Similar results were found in the brown soil zone. The increase in net revenue for canola was $106 per acre, followed by spring wheat at $75 per acre and then by feed barley at $73 per acre. Costs could increase substantially before the change in management would break-even. Once again the greatest increase in revenue was from the increased output from areas cropped. However, the revenue from the carbon market was larger in the brown soil zone than in the dark brown zone. For example, the carbon revenue for canola was $0.95/acre (at a price of $13/tonne). The carbon revenue for spring wheat and feed barley was higher than when grown in the dark brown zone; however, the increases were not as large as with canola. The results are summarized in the table below.

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Costs and benefits of NERP in the Brown Soil Zone			
	Canola	**Spring Wheat**	**Feed Barley**
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$0.95	$0.69	$0.68
Net Change in Revenue per Acre	**$106.41**	**$75.15**	**$72.94**

7) In the black soil zone the costs of implementing the change in management to better utilize fertilizer were also small relative to the potential benefits from increased revenue from crop sales and carbon sales. The results are summarized in the below table.

Cost and benefits of NERP in the Black Soil Zone			
	Canola	**Spring Wheat**	**Feed Barley**
Additional Costs for 4R Program on a Per Acre Basis (positive values are increased costs while negative values are decreased costs from the baseline).	$11.54	$10.24	$10.24
Additional Revenue from 4R program from cropping on a Per Acre Basis (positive values are increased revenue while negative values are decreased values)	$117.00	$84.70	$82.50
Additional Revenue from Carbon Credits (per Acre Basis)	$1.49	$1.24	$0.94
Net Change in Revenue per Acre	**$106.95**	**$75.70**	**$73.20**

8) Overall, the results of the producer analysis revealed that the 4R program could provide an increase in net revenue per acre. Furthermore, the costs associated with implementing the protocol are small relative to the potential revenue that can be gained. Of the three crops analyzed, canola had the largest economic potential.

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Documentation and Records

In year two a set of 4R plans were developed for each farm included in the mock verification, overcoming a number of the challenges identified in year one. However, a few potential barriers to protocol adoption still exist:

1. Weight logs are not commonly kept by farmers in Alberta. As a result, many will not be able to satisfy the record requirements of the acceptable crop mass determination methods.
2. Practices for measuring and logging moisture content vary by farm and many farms do not keep moisture logs. Therefore, this requirement may also limit participation in a NERP project.
3. A practice standard for greenhouse gas assessment and management practice does not exist. As a result, it is not possible to reach a verification conclusion in relation to this requirement.
4. Most farmers do not take soil temperature readings prior to applying fertilizer in the fall, since it is impractical to do so. Given this, few can meet this requirement. It is recommended that data from nearby weather stations be allowed instead.

Conclusions / Recommendations

Capacity of the Sector to Implement the NERP:

The introduction of dynamic baselines one and two has removed a number of the obstacles associated with a project or farm-level historic benchmark baseline. Similarly, the introduction of a set of acceptable crop mass determination methods has addressed issues associated with inconsistencies in the way farmers measure yield and the level of accuracy of those yield measurements. Nevertheless, there are still a few outstanding issues that may limit adoption of the NERP, particularly at the price of carbon today. In particular:

6. *Annual soil tests* – most farms in Alberta do not test their soil on every field annually. The agronomist working with the farmer will use professional judgement, post-harvest assessments or other means to determine an agronomic rate on the fields not soil tested for a given year. This will have to change in order to implement the NERP.
7. *Weight and moisture logs* – weight and moisture logs are required to support crop mass assertions using one of the acceptable crop mass determination methods; however, are usually not recorded at the detail required by the current draft protocol. In the case of moisture readings it is recommended that a flexibility mechanism be added to the protocol allowing use of the most conservative value for the crop from the Canadian Grain Commissions – Standard Storage Requirements.
8. *Soil temperature readings* – It is impractical to take soil temperature readings prior to applying fertilizer in the fall and therefore few, if any, farmers do. It is recommended that data from the nearest weather station be used instead.
9. *Land title certificates* – Land titles are an added expense that is unnecessary given that the NERP is an emissions reduction protocol and not a sequestration protocol. At current carbon prices ($15/tonne) this requirement will further reduce profit margins making it even more difficult to attract growers in implementing the NERP.

In addition to the above items, a key learning from the year two NERP protocol validation study is that flexibility needs to be added to the protocol for ineligible fields. This issue is of particular importance

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since the NERP mock verification revealed that the requirement to have all fields under 4R management disqualifies many farms. For example, on a farm of 16,000 acres with all of the necessary documentation and management, if a farmer decides to broadcast 300 acres of urea after the soil has cooled, this could potentially disqualify the entire 16,000 acre farm. This type of inflexibility will once again result in poor uptake of the NERP.

Presently, the protocol states that all fields on a farm must be enrolled in a 4R program that clearly delineates the farm enterprise boundary. An APA must then sign off on the 4R plan and farm enterprise boundary. Annual APA sign off is required to ensure that if any new fields are acquired they are identified. The protocol also states that summerfallow fields and fields in perennial crops, can be excluded from the quantification since they will not be eligible for 4R Management. In general, there are three important points to consider:

1. APA sign off on the farm enterprise boundary is required each year to 'catch' whether new fields or crops have been added to the farm;
2. There are ways to exclude fields that do not quality for 4R for various reasons. AESRD views the risk of these fields contributing to a yield leakage issue as minimal since no annual crop is harvested; and
3. On Page 48, footnote 22 of the protocol, fields receiving ineligible organic N sources can be excluded from generating offsets for that year.

Given the above, it is recommended that flexibility be added to the protocol to allow the exclusion of fields that do not qualify in the same way other ineligible fields/crops are handled and excluded (e.g. footnote 22 on page 48). These fields would then be ineligible to generate offset for the year in which they are excluded.

Before the protocol was publicly posted, there was some flexibility for fields/annual crops to be excluded if they do not meet one or more of the 4R eligibility criteria. This flexibility was conservative in that the yield contributions from these fields were excluded to avoid yield leakage. It is strongly recommended that this flexibility be revisited to avoid scenarios like the 16,000 acre farm described above. Please note that under the proposed approach for field exclusion, project developers must still endeavor to have all eligible annual crops under 4R management. Furthermore, it is important to consider that the NERP is an emission reduction protocol, not a carbon sequestration protocol. Consequently, there is no risk of reversal, if a field/crop does not meet the requirements of a 4R plan for a given year. Instead the emission reduction simply does not occur and any potential offsets from those fields/crops is removed from the overall GHG claim in the mass based accounting. APA sign-off provides an added level of assurance that this accounting can be done appropriately, according to the protocol.

Protocol Revisions:

In order to address the outstanding challenges associated with implementing the NERP it is recommended that the following adjustments be made to the protocol:

1. A flexibility mechanism be added that permits project developers to use the most conservative moisture values from the Canadian Grain Commission's Standard Storage Requirements.

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2. The requirement for land title certificates be replaced with multi-year lease agreements to demonstrate ownership.
3. A flexibility mechanism be added that allows use of data from the closest weather station to be used to determine the temperature of the soil at the time of fall fertilizer application.
4. Allow ineligible fields to be excluded (under certain conditions), without disqualifying the entire farm. In order to ensure a conservative approach, one option would be to disqualify any fields for the entire crediting period if the field becomes ineligible at any time during the baseline period or any time during the project crediting period.

In addition the following additional protocol revisions are recommended:

1. The record requirements for the "Storage Volume Measurement" acceptable crop mass determination method should be added to Table 12.
2. The requirement for APA's to meet the practice standard for GHG assessment and management be removed since no practice standard exists.
3. The applicability criteria be reviewed for consistency and clarity on the inclusion/exclusion of fields in the project.
4. Further clarity be added on how additional fuel use should be accounted for when using either of the dynamic baseline approaches.
5. The definition for pass area in Appendix K of the protocol be removed.
6. Clarity be added that the APA does not need to physically collect the farm data; however, must confirm all record requirements/supporting data are on file and review the documentation before approving and implementing the 4R plan.
7. The molecular mass ratio be replaced with a symbol and defined in the quantification tables.

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Appendix O: Year Two NERP Mock Verification Report

Submitted by: ICF Consulting Canada Inc.

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Agricultural Nitrous Oxide Emission Reduction (NERP) – Pool 1

Agri-Trend Aggregation Inc. (ATAI)

PVS Mock Verification Report

May 27, 2015

Introduction

Alberta's greenhouse gas (GHG) regulatory framework has created a vibrant carbon market, with millions of tonnes of voluntary carbon emission reductions generated in the form of carbon offsets. Carbon offsets are provided by sectors that do not have a regulatory target, and are sold to companies with regulatory obligations under Alberta's *Specified Gas Emitter Regulation (SGER), 2007*. The agriculture sector has been a major provider of carbon offsets to the market.

The Office of the Auditor General challenged the verification standards that were used to provide evidence that claimed GHG emission reductions actually occurred. In response, Alberta Environment and Sustainable Resource Development ("ESRD") raised the level of assurance from limited to reasonable, starting January 1, 2012. In order to support efforts needed to attain this higher standard of verification, Climate Change and Emissions Management Corporation ("CCEMC") initiated a Protocol Validation Study (PVS) as a capacity-building exercise to gather knowledge about the application of the Agricultural Nitrous Oxide Emission Reduction (NERP) protocol to compile a Carbon Offset Project, including verification to a reasonable level of assurance.

Alberta ESRD issued a new draft protocol in April 2015 (Draft Version 1.1) which will be used for this PVS. The offsets aggregation company, Agri-Trend Aggregation Inc. ("ATAI"), volunteered to compile a Carbon Offset Project using on-farm data from two farms in Alberta.

Specifically, the PVS study will emulate the process of aggregating participating producers under the provisions of the protocol to bring forward agricultural offsets that can be tested in a mock verification exercise to a reasonable level of assurance, for the purposes of collectively learning about the barriers, gaps, solutions and options for adopting these protocols in the marketplace. The objectives of the PVS study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field.
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale.
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols, including providing feedback on estimation procedures to arrive at reasonable accuracy on yield data.

This report provides the results of the mock verification, an analysis of the ability of a verification conclusion to be reached based on available data and potential gaps or areas for improvement with the Protocol itself. The offset pilot project used to conduct this mock verification was prepared by Agri-Trend Aggregation and consisted of three Alberta farms that have implemented the management practices described in the Protocol.

1 Verification Summary

Lead Verifier:	Aaron Schroeder, P.Eng.
Associate Verifiers:	Kate Nesbitt, M.Sc. and Michelle Stelmach, AIT
Verification Timeframe:	April – June 2015
Site Visit Date:	May 11, 2015
Objective of the verification:	Determine if a verification conclusion may be reached given availability of farm data
Final report being provided to:	Climate Change and Emissions Management Corporation
Standard being verified to:	ISO 14064-3:2006 Specification with guidance for the validation and verification of greenhouse gas assertions
Verification criteria employed:	Climate Change and Emissions Management Act Specified Gas Emitters Regulation (Alberta Regulation 139/2007) Technical Guidance for Offset Project Developers, Version 4.0, February 2013 Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013 Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions, DRAFT Version 1.1, April 2015
Verification scope – Gases:	Carbon Dioxide, Methane, Nitrous Oxide
Project Title:	Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1
Location:	Two Farms in Alberta
Project Start Date:	January 1, 2014
Credit Start Date:	January 1, 2014
Expected Lifetime of the Project:	Up to 13 years
Actual 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.
Project Activity:	The Project is located in Alberta and is a result of actions taken after January 1, 2002. The project activity is not required by law and is beyond business as usual practices. The project is real, demonstrable, quantifiable, and verifiable, as demonstrated in the Offset Project Plan.

	The project has clearly established ownership by all participating sites under this aggregated project, and the Project Proponent is an authorized representative of the aggregation participants. The project is not registered under any other offset schemes (as attested to in a Statutory Declaration) and is only counted once for compliance purposes.
Project Report Temporal Period:	January 1, 2014 – December 31, 2014
Verification Summary:	TBD
Main Contact (Verifier)	ICF International Aaron Schroeder, Principal – Climate 734 – 7 Avenue SW, Suite 605 Calgary, Alberta T2P 3P8 604.353.0264 Aaron.Schroeder@icfi.com
Main Contact (Reporting Company)	Agri-Trend Aggregation Inc. Bill Dorgan, President 1911 Highfield Crescent SE Calgary, AB T2G 5M1 403.608.0992 bdorgan@agri-trend.com

2 Project Information

Agri-Trend Aggregation Inc. ("**ATAI**") has developed the necessary documentation detailing project activities to support their claim for emissions reductions to be registered on the Alberta Offset Registry under Alberta's Specified Gas Emitters Regulation. ATAI has engaged ICF Consulting Canada, Inc. ("**ICF**") to provide a third-party mock verification of the emissions reductions asserted by ATAI related to the project activities discussed herein.

The quantification of the emissions reductions associated with the project is defined by Alberta Environment and Sustainable Resource Development's ("**ESRD**") Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions ("**the Protocol**"). The Project Report describes the emissions reductions claim ("**GHG Assertion**") made by ATAI related to this project.

The Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1 ("**the Project**") covered by this verification engagement involves the creation of 2014 vintage emissions reductions achieved through the management of on-farm applied nitrogen sources through the implementation of an integrated set of Beneficial Nitrogen Management Practices ("**BMPs**").

The Project is an aggregation of two farms located in Alberta.

ATAI has a contractual relationship with each of the farms to aggregate the emission reduction assertion from each farm into the Project. ATAI has established the right to transact on credits that would be created from the Project.

This document describes the terms and scope of this verification. It serves to communicate the findings of the verification.

3 Verification Procedures

The scope of the mock verification was defined during the verification planning stage and is detailed in the Verification Plan, which is appended to this document. The Verification Plan also describes ICF's verification process that was executed through the course of the verification. The specific verification procedures that were planned and executed through the verification process are detailed in Section 4 of this report.

The verification was completed according to Plan. The final verification schedule was as follows:

Table 3-1: Verification Schedule

Procedure	Date
Verification Kick-Off Meeting	April 24, 2015
Verification Procedures Conducted	April – May 2015
Farm Site Visits	May 11, 20154
Office Site Visit	May 13, 2015
Draft Verification Report	May 27, 2015
Final Verification Report Issued	June 4, 2015

3.1 Site Visit

The farm site visits were conducted by Aaron Schroeder and Michelle Stelmach on May 11, 2015. The office site visit was conducted by Aaron Schroeder and Kate Nesbitt on May 13, 2015.

The site visits were a key step in planning and executing the verification. During the course of the site tour, ICF interviewed key Project personnel regarding the operations and data management for the Project.

Personnel interviewed included:

- Bill Dorgan, President – ATAI
- Andrew Clements, Agri-Coach, ATAI
- Kelly Montgomery, Agri-Coach, ATAI
- Lori-Ann Bergeron, Administrative Coordinator – ATAI
- Candace Vinke, Sustainability Specialist – Viresco Solutions

The office site visit included a review of all GHG emissions sources and sinks in the Project to identify and categorize each one as well as a review of record requirements and Protocol applicability. Subsequently, a review of data management processes was discussed and observed on site, including a review of the Agri-Data Solutions data management system.

The farm visit interview consisted of inquiry and observations in four categories:

- Farm eligibility: 4R Consistent planning, implementation of the 4R Plan, documentation of the 4R Plan (as applied), baseline conditions, deviations from the 4R plan
- Yield data: method for measuring yield, method for measuring grain moisture
- Nitrogen fertilizer: fertilizer purchase practices, record keeping for fertilizer application, fertilizer equipment
- Manure: record keeping for manure application

The following observations were made during the farm visits:

- Each farm uses different methods for recording farm and field level data; however, data is entered into the Agri-Trend ADS, which provides a common platform for project information
- Data is entered into ADS by both the Agri-Trend representatives and the farmers.
- Yield monitoring is different on each farm. Although yield is recorded by field, in the midst of a busy harvest period, yield logging may not be perfect. A reconciliation of yield following harvest is typically completed and the total farm yield can be measured/estimated using the bin measurement method.
    - The bin measurement method may not be practical due to the requirement to establish inventory prior to harvest. It may be possible to have the Agri-Trend representative conduct an inventory prior to harvest.
- Crop plans are typically implemented exactly as proposed in the 4R plan. If there ever is a deviation from the plan, it is only to apply *less* fertilizer than recommended in the plan, which would be conducted on the farmer's prerogative (generally due to cost)
- There was general consensus among farmers that the implementation of the 4R management system improved nitrogen use efficiency.

3.2 Summary of Project Changes

Major GHG emissions sources and sinks have been identified by the Responsible Party and are detailed in the Offset Project Plan. The quantification methodologies outlined in the Protocol have been used to calculate GHG emissions sources and sinks.

3.3 Program Applicability Criteria

The Project was assessed against the following program applicability criteria outlined in the Protocol, which includes the eligibility criteria specified in ESRD guidance documents. This is described as a verification procedure in Section 4, Verification Findings, in this report.

Protocol applicability criteria, outlined in Section 1.2 of the Protocol, are evaluated through the verification procedures, outlined in Table 4.1-1.

Offset program eligibility criteria include:

- Occur in Alberta;
- Result from actions not otherwise required by law and be beyond business as usual and sector common practices;
- Result from actions taken on or after January 1, 2002;
- Occur on or after January 1, 2002;
- Be real, demonstrable, quantifiable, and verifiable;
- Have clearly established ownership; and
- Be counted once for compliance purposes.

3.4 Verification Strategy

The Verification Strategy applied to this mock verification was a combined controls testing and substantive approach. The Verification Team designed and executed verification procedures that focused on testing of ATAI controls and substantive testing of project data.

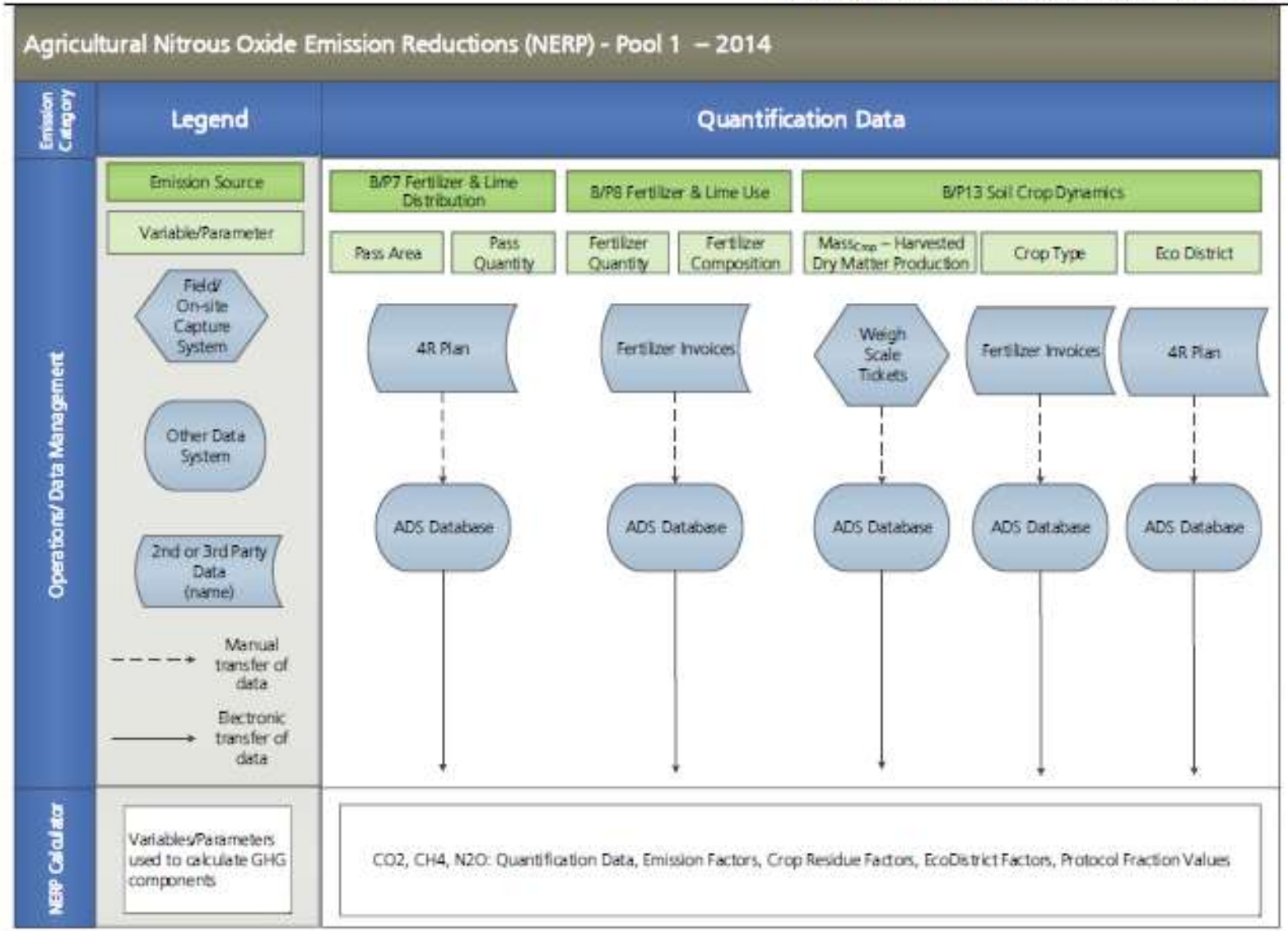
The Responsible Party relies on certain controls for the quantification of emissions. ICF relied on the following controls and as such, tested the operational effectiveness of these controls as well as the data processed by

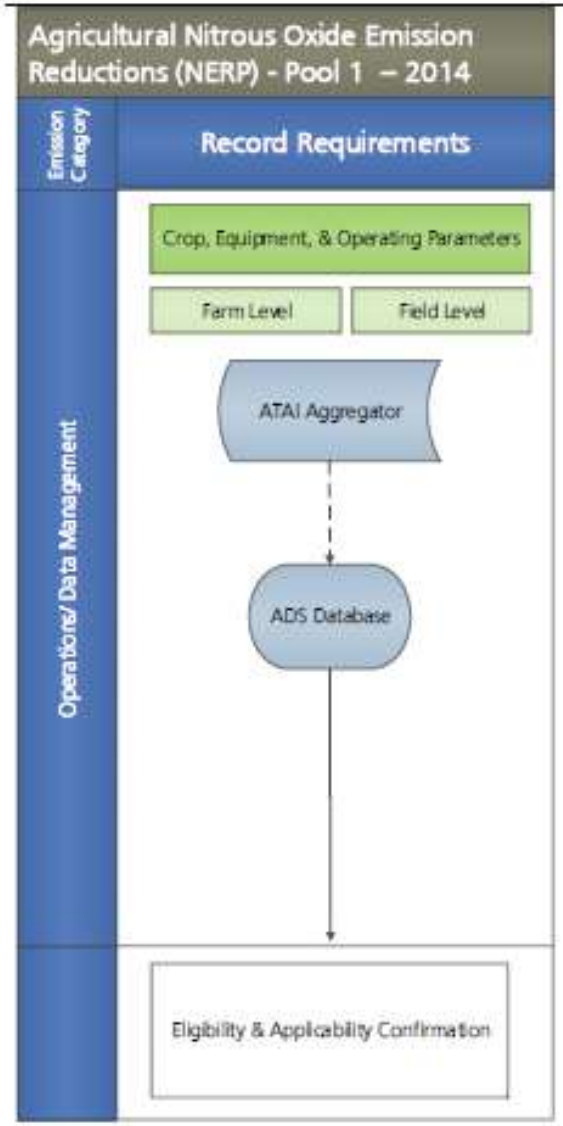
these controls. Details of the verification procedures employed to conduct these tests are provided in Section 4 of this report.

- APA develops 4R Plan and verifies that it has been implemented, sufficient to Protocol requirements.
- QA/QC Control plan utilized by ATAI for each farm file to ensure all documents are complete and signed and the database information is accurate and complete.

3.5 Data Management and Control System Review

The Verification Team developed a thorough knowledge of the data management and control systems utilized in the Project through the review of the Offset Project Plan, observations during the site visit, and interviews with key Project personnel. The data flow diagram shown below outlines the flow of Project data and the custody of control.


Agricultural Nitrous Oxide Emission Reductions (NERP) - Pool 1 – 2014
Emission Category
Legend
Quantification Data
Operations/ Data Management
Emission Source
Variable/Parameter
Field/ On-site Capture System
Other Data System
2nd or 3rd Party Data (name)
Manual transfer of data
Electronic transfer of data
B/P7 Fertilizer & Lime Distribution
B/P8 Fertilizer & Lime Use
B/P13 Soil Crop Dynamics
Pass Area
Pass Quantity
Fertilizer Quantity
Fertilizer Composition
Mass$_{Crop}$ – Harvested Dry Matter Production
Crop Type
Eco District
4R Plan
Fertilizer Invoices
Weigh Scale Tickets
Fertilizer Invoices
4R Plan
ADS Database
ADS Database
ADS Database
ADS Database
ADS Database
NERP Calculator
Variables/Parameters used to calculate GHG components
CO2, CH4, N2O: Quantification Data, Emission Factors, Crop Residue Factors, EcoDistrict Factors, Protocol Fraction Values


Agricultural Nitrous Oxide Emission Reductions (NERP) - Pool 1 – 2014
Emission Category
Record Requirements
Operations/ Data Management
Crop, Equipment, & Operating Parameters
Farm Level
Field Level
ATAI Aggregator
ADS Database
Eligibility & Applicability Confirmation

3.6 Responsible Party Documentation Reviewed

Section 5.0 of the Protocol defines the documentation and record requirements to substantiate a GHG Assertion. Through the course of this mock verification, ICF reviewed the following documentation:

- Offset Project Plan for Agricultural Nitrous Emission Reductions (NERP) – Pool 1
- Agri-Trend Agrology Ltd. – Writing A Strategic Crop Plan – BMP
- Emission Reduction Calculators:
  - Modified NERP Calculator (no area, no manure) 2015 05 21.xlsx
  - NERP Dynamic Baseline Calculator (Discount) 2015 05 21.xlsx
- Fertilizer sales records
- 4R Plan – Farm Level
- 4R Plan – Field Level (including backup documentation such as soil testing results)
- Satellite data/aerial images
- Farm maps establishing the farm boundary
- Additional field pass data/documentation
- Land Title Certificates
- Landlord Agreements
- Grain scale calibration records
- Accredited professional advisor credentials

Additional documentation that would need to be reviewed (but not applicable to the farms in the pilot project):

- Irrigation records
- Manure application logs
- Manure composition tests
- Soil temperature readings
- Farm records describing any extraordinary growing conditions

4 Mock Verification Findings

4.1 Mock Verification Findings

The Verification Team planned and completed the verification procedures described in the following two tables. The procedures and findings related to each *specific Project or Baseline emissions source and sink variable* used to quantify the GHG Assertion as well as record requirement under the Protocol are provided in Table 4.1-1.

Detailed descriptions of any Protocol issues identified by the Verification Team (emphasized by **bold** font in Table 4.1-2) are provided in Table 4.2-1.

Table 4.1-1: Verification Findings

Data Description	Verification Procedure(s)	Findings
B7/P7 Fertilizer & Lime Distribution		
Pass Area - area that received extra field passes	Compare pass area defined in 4R Plan to aerial images.	The pass area established by the APA can be confirmed through review of aerial images.
Pass Quantity - number of passes on each field	Interview farmers during farm visits to determine if information established by APA and on file is correct.	The number of additional passes[1] established by the APA can be confirmed through interviews with farmers during farm visits.
B9/P9 Fertilizer & Lime Use		
Quantity of Fertilizer	Compare fertilizer quantity in ADS against fertilizer invoices to confirm accuracy of transcription.	The quantity of fertilizer applied in the NERP Calculator can be compared against fertilizer invoices to confirm accuracy and completeness.
Composition of Fertilizer	Compare composition of fertilizer in ADS against fertilizer invoices to confirm accuracy of transcription.	The composition of fertilizer applied in the NERP Calculator can be compared to fertilizer invoices to confirm completeness and accuracy.
Application Date of Fertilizer	Review farm files to confirm documentation of fertilizer application dates are on file.	Farm logs are available to confirm application date of nitrogen fertilizer and/or manure application.
B13/P13 Soil Crop Dynamics		

[1] *Additional passes* pertain only to nutrient applications, i.e. if a pesticide application has a small amount of nitrogen, this is not considered a nutrient application and therefore is not defined as an additional pass.

Data Description	Verification Procedure(s)	Findings
$Mass_{Crop}$ (Harvested Annual Dry Matter Production for Crop)	Compare crop mass in ADS against weight logs to confirm accuracy of transcription.	Crop mass in weight logs can be compared against crop mass in the NERP Calculator to confirm accuracy. **This documentation requirement may limit Protocol uptake as it is not common practice with farmers in Alberta (see Table 4.2-1, Issue 1).**
Calibration Reports	Review calibration reports to confirm calibration of weigh scales was completed according to Protocol requirements.	Calibration reports are available for review from scale operators to confirm equipment was calibrated to manufacturer specifications, by a qualified third party, prior to harvest.
Moisture Logs	Review moisture content of crop production at time of mass measurement to confirm mass used in the NERP Calculator is measured as dry matter.	Practices for measuring and logging moisture content vary by farm. Moisture logs can be used to confirm the crop mass was measured as dry matter. **Based on feedback from farmers, this requirement may limit uptake of the Protocol (see Table 4.2-1, Issue 2).**
Quantification Methodology		
NERP Calculator	Review quantification formulae and estimation calculations prescribed by the Protocol against those utilized in the Calculator for each GHG emissions source/sink	The quantification workbook ("calculator") accurately and completely represents the formulae and applicability criteria described in the Protocol.
Record Requirements - Ownership		
Land Title Certificate	Review farm files to confirm land title certificates are on file and accurate.	The completeness and accuracy of land title certificates can be confirmed through review of farm files and comparison against information from SPIN2.

Data Description	Verification Procedure(s)	Findings
Lease Agreements	Review farm files to confirm lease agreements are signed and on file.	The completeness and accuracy of lease agreements can be assessed through farm file reviews and comparison against land title information. **The requirement to have lease agreements signed annually may not be necessary unless there are changes made to the land owners, lease holders or conditions of the agreement (see Table 4.2-1, Issue 3).**
Record Requirements – Location of Farm Enterprise		
Legal land locations, farm map	Review farm files to confirm legal land titles and farm map are on file.	The completeness and accuracy of land title certificates and farm maps can be confirmed through farm file reviews, using SPIN2 and Google Maps for comparative analyses, respectively.
EcoDistrict location	Compare the EcoDistrict for each field in the NERP Calculator to the EcoDistrict in the National Soils Database for consistency.	The National Soils Database can be used to confirm EcoDistrict allocations in ADS. The addition of a flexibility mechanism in consideration of fields within multiple EcoDistrict boundaries would simplify the quantification (see Table 4.2-1, Issue 4).
Record Requirements – Irrigation		
Supporting documentation (two forms required)	Compare irrigation evidence to data in ADS for completeness and accuracy.	There were no irrigated fields in the Project, however several forms of supporting documentation are available (i.e. water use records, crop insurance records) to confirm completeness and accuracy of irrigation of fields.
Record Requirements – APA Credentials		
Confirmation of 4R APA training program completion	Review farm files to confirm training certificate is on file.	The completeness of APA training certificates can be confirmed through review of the training certificate.
Proof of AIA member registration	Review farm files to confirm proof of AIA member registration is on file.	The completeness of APA AIA member registration can be confirmed through farm file review.

Data Description	Verification Procedure(s)	Findings
Confirmation of the Practice Standard	Review farm files to confirm AIA evidence is on file that APA meets Practice Standard for the Greenhouse Gas Assessment and Management Practice Area.	No verification conclusion can be reached as there is no Practice Standard established by the AIA (see Table 4.2-1, Issue 5).
Record Requirements – Location of 4R Management Zones		
EcoDistrict location	Compare the EcoDistrict for each field in the NERP Calculator to the EcoDistrict in the NSDB for consistency.	The National Soils Database can be used to confirm EcoDistrict allocations within the Project.
Legal land locations	Review farm files to confirm legal land locations of entire farm enterprise are on file.	The completeness and accuracy of legal land locations can be confirmed through farm file reviews.
Record Requirements – Crop Type		
Crop type from crop plans	Review crop types from crop plans to confirm accuracy of transcription into ADS.	Crop types in ADS can be compared against crop plans for consistency and to confirm all crops are eligible under the Protocol.
Record Requirements – Farm Enterprise Boundary, 4R Practices by Management Zone		
Signed APA reports for farm level requirements	Review 4R Plans to confirm APA sign-off is complete for farm level requirements.	4R Plans can be reviewed to confirm all farm level requirements are included and APA sign-off is complete.
Record Requirements –Crop Type, Irrigation, Soil sampling details (Available Nitrogen), Annual nitrogen balance calculation (Available Nitrogen), Soil temperature readings, APA nitrogen analysis from crop residue		
Signed APA reports for field level requirements	Review 4R Plans to confirm APA sign-off is complete for field level requirements.	4R Plans can be reviewed to confirm all field level requirements are included and APA sign-off is complete.

Data Description	Verification Procedure(s)	Findings
Record Requirements – Eligibility		
Soil temperature readings	Review soil temperature readings to confirm eligibility under the Protocol.	There was no fall application of fertilizer in the pilot project farms. **The Responsible Party indicated that using actual soil temperature readings is impractical and suggested using data from nearby weather stations instead (see Table 4.2-1, Issue 6).**
Date stamped photos of fertilizer placement equipment and openers	Review farm files to confirm photographs are complete and on file.	Completeness of photographs can be confirmed though review of farm files and observation of equipment during farm visits.

4.2 Protocol Issues

The section below summarizes the Protocol issues identified in the mock verification findings in Section 4.1 and other issues identified during the verification and Protocol review.

Table 4.2-1: Protocol Issues

Protocol Issue		Description of Issue
1	Crop Mass Determination Method – Data Requirements	Measurement of crop yield is the most challenging measurement required by the Protocol, based on feedback from farmers and the Responsible Party. This requirement will limit the implementation of the Protocol. Protocol Table 12: *Crop Mass Determination Methods Records Requirements* lists the record requirements for only three of the four acceptable crop mass determination methods described in Appendix I.

Protocol Issue		Description of Issue
2	Moisture Readings	The current requirements for moisture logs requires moisture readings to be taken for every load. For clarity, this measurement should be performed at the time of the mass measurement to facilitate the calculation of dry matter. If grain is dried, the mass and moisture content measurements could be conducted before or after the grain drying process. Farmers interviewed during this mock verification indicated that this requirement is impractical and probably more rigorous than required to establish the moisture content of production. Farmers interviewed during this mock verification indicated that typical practice is to measure moisture content once per field, daily, by crop type. That is, if harvest of a particular field spans more than one day, a moisture measurement on each day of harvest for that field would be conducted. Stakeholders have suggested the addition of a flexibility mechanism that would permit the use of established storage moisture values from the *Canadian Grain Commission – Standard Storage Requirements*[2]. The flexibility mechanism option would apply the most conservative moisture values.
3	Ownership	Multi-year lease agreements would provide sufficient evidence to satisfy the ownership requirements of the Protocol (see Protocol Table 9), provided that no changes have been made to ownership or lease holder information.
4	EcoDistrict location	The Responsible Party indicated that it is not practical to divide fields into separate parcels when multiple EcoDistricts apply. The addition of a flexibility mechanism would simplify the application of the Protocol for these situations. If the most conservative of the applicable EcoDistrict factors is applied across the whole field, the resulting calculated emission reduction would be conservative.
5	APA Practice Standard	The Protocol includes a record requirement from the AIA that the APA meets the requirements of the Practice Standard for the GHG Assessment and Management Practice Area; however, there is no Practice Standard currently available from the respective professional associations in Alberta.
6	Soil temperature	The Responsible Party indicated that using actual soil temperature readings is impractical and suggested using data from nearby weather stations as an alternative record requirement option.

[2] Canadian Grain Commission – Safe storage guidelines available at https://www.grainscanada.gc.ca/storage-entrepose/ssg-de-eng.htm#wheat

Protocol Issue		Description of Issue
7	Eligibility	Under the current draft Protocol, if activities make one field ineligible, the entire farm is disqualified from the Project. This requirement prevents the possibility of gaming the project using the conventional baseline approach; however, if either of the dynamic baseline approaches are applied, this requirement does not necessarily improve the quality of the GHG Assertion because the inclusion of ineligible fields would not benefit the Responsible Party. Stakeholders have suggested a modification to this applicability criterion to allow the inclusion of farms that fields that are ineligible under the 4R Plan. One suggestions, which would result in a conservative emission reduction and mitigate leakage issues would be to disqualify any fields for the *entire crediting period* if that field becomes ineligible at any time during the baseline period (if the conventional baseline is applied) or any time during the project crediting period.
8	GHG Accounting	Protocol Section 1.2 *Protocol Applicability* is not clear as to what fields should be included within the Project / greenhouse gas accounting. Item (9) states that ineligible fields *must be included in the 4R Plan, but are excluded from GHG accounting*, whereas item (12) states that *farms in the project must have all fields enrolled in the 4R program and need to be part of the project and baseline greenhouse gas accounting.* It is recommended that these sections be updated to be clear and consistent, noting the decision regarding eligibility in Issue 6 above.
9	Additional fuel consumption	The Protocol is not clear regarding how to determine if additional fuel is required if either of the dynamic baseline approaches were applied (i.e. what is the basis for comparison of additional fuel consumption, since there is no established baseline period).
10	Protocol definition – Pass Area	*Appendix K: Additional Fuel Pass Method* in the Protocol provides a definition for 'Pass Area'. The following phrase in the definition should be removed as it is inconsistent with the quantification methodology: "(sum of extra passes on all fields of farm)".
11	APA Sign-off	The Protocol does not require the APA to be the person who physically collects farm data and conduct on-farm observations; however, the Protocol requires that the APA has: 1. Confirmed all record requirements and supporting data are on file; and 2. Reviewed the documentation before approving the 4R Plan (before seeding) and the implementation of the 4R Plan (post-harvest). Verification of projects under this Protocol will rely upon controls established by the Responsible Party to ensure that the APA meets the requirements of the Protocol. If these controls are found to be insufficient, verification of a project under this Protocol, as written, is not possible.

Protocol Issue		Description of Issue
12	NERP Calculator	There were three issues identified through review of the NERP Calculator: 1. The NERP Calculator applies a value of 0.015 for the EF_{ECO} for fields that are irrigated, however the Protocol stipulates an EF_{ECO} of 0.017 be used for irrigated fields. 2. The Crop Residue Factors utilized in the NERP Calculator refers to the Crop Residue Factors table (Appendix E, Table E-1) from the previous draft of the Protocol, which includes additional crop types. 3. The NERP Calculator includes manure and other organic nitrogen sources as an aggregated value; however, fields receiving organic fertilizers other than manure are excluded from greenhouse gas accounting for that year. While emissions from these fertilizer sources are not applicable under the Dynamic Baselines, it is recommended that these fertilizer sources be disaggregated in the case that the conventional baseline methodology is applied.

4.3 Other Findings

There were several issues identified in the previous Protocol Validation Study. These issues have been addressed in the table below.

Previous Protocol Issue	Status
1. Land area is actually not required for the emission reduction calculation. While nitrogen and yield data are shown on a unit per area basis (kg/ha), all data and calculations could be completed on an absolute mass basis. This is further evidenced by the sample calculation provided in Appendix F where calculation on an absolute mass basis results in the same final result. Land area should be removed from the protocol. Evidence of land area should not be required and all calculations should be updated to be completed on an absolute mass basis. This change would simplify quantification and verification of projects under this protocol.	This is no longer an issue – land area has been removed from the calculation and Protocol.

Previous Protocol Issue	Status
2. The emission reduction quantification *may* be completed at the field level if the following factors are constant across the field: • EF_{ECO} (emission factor related to local soil and climatic conditions) • $FRAC_{renew}$ (fraction of total area under crop that is renewed annually) • Crop type • Performance level (basic, intermediate, advanced) Further, the emission reduction quantification *may* be completed at the farm level *for each crop* if the following factors are constant across the farm: • EF_{ECO} (emission factor related to local soil and climatic conditions) • $FRAC_{renew}$ (fraction of total area under crop that is renewed annually) • Performance level (basic, intermediate, advanced) Completing these calculations at the field or farm level will significantly simplify the overall quantification, reduce risk of error and reduce verification costs.	This is no longer an issue – Protocol now permits quantification at the farm level. Note that the Protocol does permit the implementation of different performance levels (basic / intermediate / advanced). The basic analytical unit for calculating an emission reduction is at the crop type, ecodistrict and performance level (Protocol Section 4.1, page 48).
3. Crop residue factors, which are used to calculate direct emissions of nitrous oxide from crop residue decomposition, are provided in Appendix E appear to be provided on a standard moisture content basis, rather than a dry matter basis. Additional guidance should be provided indicating if these factors need to be corrected for a dry matter basis.	No longer an issue – crop residue factors are provided on a 'Relative Dry Matter Allocation' basis.
4. The Protocol does not adjust the mass of nitrogen fertilizer (in the calculation of direct emissions of nitrous oxide from nitrogen fertilizer) and mass of manure (in the calculation of direct emissions of nitrous oxide from manure) for the mass of nitrogen that is consumed by the plants (10% of nitrogen from nitrogen fertilizer and 20% of nitrogen from manure) or lost through leaching (9 – 25% - see Protocol Appendix B). Therefore, the direct emissions from nitrogen fertilizer and manure are being over estimated.	No longer an issue – 'Precipitation / Potential Evapotranspiration Ratio' and 'Fraction of Nitrogen lost in leachate' (Table A-1) have been included in the Protocol quantification approach.
5. Additional guidance should be provided to estimate the fraction of total area that is renewed annually ($FRAC_{renew}$). This factor is simply equal to 1 for annual crops; however, for perennial crops, the Project Developer must forecast the number of years that the crop will be grown. There is no guidance provided for establishing this forecast. Further, without a standard or guidance, it is difficult to verify this factor.	No longer an issue – only annual crops are eligible for participation under the protocol, therefore $FRAC_{renew}$ can be equal only to 1.

Previous Protocol Issue	Status
6. For clarity, the ratio "44/28" should be replaced with a symbol and then defined as the molecular mass ratio of N_2O to N_2O as N (N_2O/N_2O-N).	Remaining issue – quantification methodologies in the protocol still refer to "44/28". The previous recommendation regarding this ratio remains.
7. The "post-harvest assessment" defined in the Protocol (page 67) describes a requirement for "Analysis of yield data and testing results including the nitrogen balance assessment". This statement seems to indicate that soil testing is required annually after harvest; however, best management practices published by the Canadian Fertilizer Institute and other organizations indicate that soil testing may not be required on an annual basis. This requirement should be updated to focus on the nitrogen balance assessment, which can be completed using the known nitrogen inputs from the year and nitrogen consumption values from published lookup tables.	No issues remaining in regards to the annual soil testing requirement.

5 Verification Team

Since 1969, ICF International has been serving major corporations, all levels of government, and multilateral institutions. Globally, approximately 500 of our 5,000 employees are dedicated climate change specialists, with experience advising public and private-sector clients. ICF International has earned a reputation in the field of climate change consulting for its analytical rigour, in-depth expertise, and technical integrity through scores of GHG emissions-related assignments over the past two decades.

Over the past ten years, ICF Consulting Canada, Inc., a fully owned subsidiary of ICF International, has carried out numerous facility-level GHG verifications and verifications of emissions reduction projects. ICF's Verification Body has developed the necessary internal controls to ensure qualified and competent staffing uphold the principles of the relevant standard while quality control processes are utilized to assure data integrity is maintained and safeguarded. ICF's clients choose ICF for its strong brand, technical expertise, and rigorous methodological approach.

ICF has assembled a Verification Team consisting of experienced GHG verifiers.

Lead Verifier – Aaron Schroeder, P.Eng.

Aaron Schroeder is a Professional Engineer in the Province of Alberta and holds a B.Sc. in Engineering from the University of Saskatchewan. He has completed supplementary training in ISO 14064 as well as Auditing and Assurance Engagements through the University of Toronto, School of Continuing Studies. Further, Aaron has presented ICF's internal ISO 14064 training several times over the past two years. Aaron has acted as Lead Verifier for nearly 100 third-party assurance engagements over multiple compliance periods under Alberta's Specified Gas Emitters Regulation and British Columbia's Greenhouse Gas (Cap and Trade) Act Reporting Regulation. The facility compliance reports have included bitumen extraction facilities in Alberta's oil sands, oil and gas extraction and processing plants across Western Canada, coal and natural gas fired electricity generating facilities, cogeneration facilities, petrochemical facilities, refineries, upgraders and natural gas pipelines. Emissions reduction project verifications have included acid gas injection, enhanced oil recovery, wind electricity generation, energy efficiency, landfill gas capture and utilization and conservation cropping/tillage management projects. Additionally, Aaron has led the validation team that has provided assurance that ethanol and biodiesel facilities were designed to produce renewable fuels within the guidelines of Alberta's Renewable Fuel Standard Regulation.

Associate Verifier – Kate Nesbitt, M.Sc.

Kate Nesbitt is an Associate in ICF's Energy and Carbon Markets division in the Calgary office. Kate has worked as an associate verifier of annual GHG compliance reports for industrial clients in several sectors, including natural gas processing facilities, power generation and cogeneration facilities, oil sands in-situ extraction, and mining facilities under the Specified Gas Emitters Regulation in the province of Alberta and the British Columbia Greenhouse Gas Reduction (Cap and Trade) Act. Additionally, Kate also has experience verifying emissions reductions for wind energy, conservation cropping, energy efficiency and acid gas injection projects. Kate holds a B.Sc.in Environmental Science from the University of Lethbridge and an M.Sc. in Environmental Sustainability from the University of Edinburgh. She has completed training in ISO 14064, and holds current H_2S Alive training.

Associate Verifier – Michelle Stelmach, AIT

Michelle Stelmach works on contract with ICF and acted as the Technical Expert for this verification, performing the site visits and assisting with verification planning and procedures. She holds a Bachelor of Science in Agriculture from the University of Saskatchewan and certification in agricultural application of ISO 19011 – Internal System Auditing and has worked with the Hazard Analysis Critical Control Point (HACCP) to design and conduct internal system audits and to meet Canadian Food Inspection Agency standards at the producer

level, in feed manufacturing plants and poultry processing plants. She has extensive experience working with agricultural producers across Alberta through her work as Program Advisor and Coordinator with Maple Leaf Foods and Landmark Feeds.



Aaron Schroder, P.Eng.
Professional Engineer, Alberta (75566)
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Appendices

Verification Plan

Sampling Plan

Conflict of Interest Checklist

Verification Plan

Agri-Trend Aggregation Inc., Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1

1 Introduction

This document provides details on the verification scope and process that is planned to conduct a reasonable level mock verification of the 2014 Alberta Offset System Greenhouse Gas Assertion of Emission Reduction Credits (the "**GHG Assertion**") for the Agri-Trend Aggregation Inc. Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1 (the "**Project**"). An overview of operations at the Project will be provided in the Verification Report.

A Verification Risk Assessment was conducted during the verification planning stage; the results will be provided in Section 6 of the final Verification Plan. These results were used to inform the development of the verification procedures outlined in the Verification Findings Section of the Verification Report. Additionally, the results of the Risk Assessment informed the development of the Sampling Plan, which will be included in the Verification Report.

The Verification and Sampling Plans will be updated through the course of the verification as additional information becomes available.

The verification conclusion will be documented in the Verification Statement and the verification findings will be further described in the Verification Report. The Verification and Sampling Plans will be appended to the Verification Report to provide information related to the verification scope and process.

2 Verification Scope

2.1 Objective

The primary objective of this verification engagement is to provide assurance to Climate Change and Emissions Management Corporation ("**CCEMC**") that the GHG Assertion is reliable, and of sufficient quality.

2.2 Parties and Users

The person or organization that has overall control and responsibility for the GHG Project, as defined in Section 2.13 of ISO 14064-2:2006, is the "**Project Proponent**". For this verification, Agri-TrendAggregation Inc. ("**ATAI**") is the Project Proponent.

The person or persons responsible for the provision of the GHG Assertion and the supporting information, as defined in Section 2.24 of ISO 14064-3:2006, is the "**Responsible Party**". For this verification, ATAI is also the responsible party.

ICF Consulting Canada, Inc., the "**Verifier**" or "**ICF**", has been engaged to provide a third-party verification of the GHG Assertion. The Lead Verifier and Associate Verifiers compose the ICF "**Verification Team**".

The "**Intended User**" is defined in Section 2.22 of ISO 14064-2:2006 as the individual or organization identified by those reporting GHG-related information that relies on that information to make decisions. The Climate Change and Emissions Management Corporation is the Intended User of the information contained within the Verification Statement.

2.3 Scope

The mock verification will be conducted in accordance with *ISO 14064-3: Specification with guidance for the validation and verification of greenhouse gas assertions.*

The Verification and Sampling Plans were developed based on the relevant criteria described in the following:

- *Climate Change and Emissions Management Act*
- *Specified Gas Emitters Regulation, Alberta. Reg.139/2007*
- *Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions*
- *Technical Guidance for Offset Project Developers, v4.0, February 2013*
- *Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013*

The following table defines the scope elements specified for the Project.

Scope Element	ISO 14064-3 Definition	Project Specific
Boundary	The Project boundary, including legal, financial, operational and geographic boundaries	Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1 Farm operations across Alberta
Infrastructure and Activities	The physical infrastructure, activities, technologies and processes associated with the Project	Farm operations that have implemented a Consistent 4R Nitrogen Stewardship Plan
GHG Sources and Sinks	GHG sources to be included	• Fertilizer and Lime Distribution (B7 & P7) • Fertilizer and Lime Use (B8 & P8) • Soil Crop Dynamics (B13 & P13)
GHG Types	Types of GHGs to be included	• Carbon Dioxide (CO_2) • Methane (CH_4) • Nitrous Oxide (N_2O)
Reporting Period	Vintage of credits to be included	January 1, 2014 – December 31, 2014

2.4 Materiality

During the course of the verification, individual errors, omissions or misrepresentations (collectively referred to as misstatements) or the aggregate of these misstatements will be evaluated qualitatively and quantitatively.

Materiality defines the level at which misstatements in the GHG Assertion or any underlying supporting information precludes the issuance of a reasonable level of assurance.

The Lead Verifier is responsible for applying professional judgment to determine if *qualitative* misstatements could adversely affect the GHG Assertion and subsequently influence the decisions of the Intended User, in which case, the misstatements are deemed to be material.

Quantitative misstatements will be calculated individually to determine the impact of the misstatement as a percentage of the GHG Assertion.

All misstatements that are outstanding at the conclusion of the verification are documented in the Verification Report and classified on an individual basis as either material or immaterial.

Materiality Threshold

The materiality threshold is defined as 5% of the total reported emissions reductions in the GHG Assertion. Individual misstatements and the aggregate of individual misstatements will be analyzed to determine if the materiality threshold has been breached.

Tolerable Error Threshold

Tolerable error dictates the level of rigor applied to the verification at the emissions source level. Tolerable error for this verification will be set at half of materiality (2.5%) of the total GHG Assertion.

2.5 Principles

ISO 14064 defines six principles that should be upheld in the development of the GHG Assertion. These principles are intended to ensure a fair representation and a credible and balanced account of GHG-related information. The verification procedures developed and executed during the course of this verification will present evidence such that each of these principles is satisfied.

Relevance

Appropriate data sources are used to quantify, monitor, or estimate emissions sources. Appropriate minimum thresholds are used to justify the exclusion or the aggregation of minor GHG sources or the number of data points monitored.

Completeness

All emissions sources relevant to the Project are included within an identified source category.

Consistency

Uniform calculations are employed between reporting periods. Emissions calculations for each emissions source are calculated uniformly. If more accurate procedures and methodologies become available, documentation should be provided to justify the changes and show that all other principles are upheld.

Accuracy

Measurements and estimates are presented, without bias as far as is practical. Where sufficient accuracy is not possible or practical, measurements and estimates are used while maintaining the principles of conservativeness and transparency.

Transparency

Information is presented in an open, clear, factual, neutral and coherent manner that facilitates independent review. All assumptions are stated clearly and explicitly and all calculation methodologies and background material are clearly referenced.

Conservativeness

Appropriate parameters affecting the Project's emissions sources are utilized in the calculation of the GHG Assertion. When parameters or data sources are highly uncertain, the choice of parameter or data source utilized results in an underestimation of the GHG Assertion. Note that any error, underestimation or overestimation, would be evaluated as a potential material error.

2.6 Limitation of Liability

Due to the complex nature of the operations within the Project and the inherent limitations of the verification procedures employed, it is possible that fraud, error, or non-compliance with laws, regulations, and relevant criteria may occur and not be detected.

3 Verification Team

The qualifications of the Verification Team and Internal Peer Reviewer are provided in the Statement of Qualifications.

Lead Verifier, Aaron Schroeder, P.Eng.

The Lead Verifier is responsible for all activities conducted within the verification, including overseeing the development of the Verification and Sampling Plans and the execution of the verification procedures. The Lead Verifier is the lead author of the Verification Report and executes the Verification Statement at the conclusion of the engagement.

Associate Verifiers, Kate Nesbitt, M. Sc. And Michelle Stelmach, AIT

The Associate Verifiers work under the direction of the Lead Verifier to conduct the verification procedures.

4 Verification Process

The ICF approach for conducting verification of a GHG Assertion follows the tasks outlined in the following diagram. Although these tasks are generally completed sequentially, the order may be modified according to circumstances such as scheduling and data availability.

Pre-Engagement	Approach	Execution of Verification	Completion
1. Selection of Lead Verifier 2. Initiate Conflict of Interest Procedure 3. Pre-Engagement Planning and Proposal Development 4. Contract Execution 5. Assess GHG Program & Revise VMS as Required 6. Initiate Verification Tracking	7. Selection of Verification Team 8. Communication with Project Proponent 9. Kick-off Meeting 10. Verification Risk Assessment 11. Draft Verification and Sampling Plan	12. Site Visit 13. Conduct Verification Procedures 14. Issue Clarification & Data Request 15. Revise & Finalize Verification and Sampling Plan 16. Address and Evaluate Outstanding Issues	17. Evaluate Evidence 18. Hold Verification Findings Meeting (if necessary) 19. Draft Verification Report & Statement 20. Internal Peer Review 21. Completion of COI Form 22. Independent Review of Impartiality 23. Issue Verification Report & Statement 24. Close Verification File 25. Develop and Issue Management Memo(s)

4.1 Pre-Engagement

Prior to submitting a proposal to conduct this verification, the following pre-planning steps were taken:

- The results of any previous business engagements or verifications with the Project Proponent were reviewed to determine if any previous unresolved conflicts may preclude ICF from engaging in the verification;
- The Project Proponent's motivation for completing the verification was established; and
- A Conflict of Interest procedure was initiated that documents whether any perceived or real conflicts were found when considering threats due to:
  - Advocacy
  - Financial Interest
  - Familiarity/Sympathy
  - Intimidation
  - Self-Review
  - Incentives

Following the acceptance of the proposal and signing of a contract for services, the Verification Team was selected. The Verification Team for this engagement is comprised of the individuals identified in Section 3.

4.2 Approach

An extensive knowledge of the Project Proponent's business, the relevant industry, and the details of the Project itself are required to conduct a thorough verification that can lead to a conclusion. The initial information collected about the Project Proponent and the Project formed the basis of the preliminary draft Verification Plan. The development of the final Verification Plan is an iterative process; that is, the process will be completed several times through the course of the verification and the resulting plan will be updated as new information became available.

There are three types of risk associated with the GHG Assertion defined in ISO 14064-3:

- Inherent Risk
- Control Risk
- Detection Risk

The process of designing the Verification Plan began with the development of Verification Risk Assessment for both the Project as well as the Project Proponent. The steps in this process included:

- Reviewing the GHG Assertion, and the methodologies employed by the Project;
- Reviewing information on the industry and the specific Project under review;
- Assessing the likelihood that a material misstatement might exist in the GHG Assertion, if no controls were used to prevent misstatements in the GHG Assertion (i.e. inherent risk);
- Assessing the control environment and the corporate governance process (i.e. control risk); and
- Reviewing each emissions source identified in the Project, and evaluating the contribution of each source to the GHG Assertion and the associated potential material misstatement for each.

The results of the Verification Risk Assessment inform the development of the verification procedures, which will be documented in Section 5, Verification Findings, of the Verification Report. A summary of the Verification Risk Assessment will be provided in Section 6 of the final Verification Plan. The draft Verification Plan will be provided to the Project Proponent before proceeding with the verification.

4.3 Execution of Verification

With draft Verification and Sampling Plans in place, the verification procedures will be executed. This process involves collecting evidence, testing internal controls, conducting substantive testing, and developing a review file. Over the course of the verification, the draft Verification and Sampling Plans may change; the final Verification and Sampling Plans provided in the Verification Report reflect the verification parameters and procedures that were actually executed.

Site Visit

The farm visits will be conducted by Aaron Schroeder and Michelle Stelmach on May 11, 2015. The office site visit will be conducted by Aaron Schroeder and Kate Nesbitt on May 13, 2015.

The site visits will be a key step in the planning and execution of the verification. During the course of the site tour, ICF will interview key Project personnel regarding the operations and data management for the Project.

Personnel to be interviewed on-site include:

- Bill Dorgan, President – ATAI
- Andrew Clements, Agri-Coach – ATAI
- Lori-Ann Bergeron, Administrative Coordinator – ATAI
- Candace Vinke, Sustainability Specialist – Viresco

During the site visits all GHG emissions sources for the Project will be reviewed to ensure appropriate identification and categorization. A review of process flow and metering diagrams will be followed by physical observation of the Project.

Collecting Evidence and Review of Documentation

Sufficiency and appropriateness are two interrelated concepts that are fundamental to the collection of verification evidence. The decision as to whether an adequate quantity (sufficiency) of evidence has been obtained is influenced by its quality (appropriateness).

Through the execution of the verification procedures described in the Verification Report, the Verification Team will review three key forms of evidence including physical, documentary and testimonial:

- Management documentation: policies, programs, and procedures related to the collection, safeguarding, and management of the data supporting the GHG Assertion;
- Records: records comprise time-sensitive data, correspondence, and files including: the Offset Project Plan; 4R Consistent Plans for each management zone; farm records (showing yield logs, fertilizer application dates and rates); fertilizer purchase receipts; irrigation district invoices (where applicable); and post-harvest reports;
- Interviews: the interviews will provide information regarding operations and data management and will provide evidence to support the sufficiency of data controls; and
- Computer systems: Agri-Trend's proprietary data management software used to capture and manage the GHG-related data and to calculate the GHG Assertion.

Testing and Assessment of Internal Controls

The Verification Team will develop a sufficient understanding of the GHG information system and internal controls to determine whether the overall data management system is sound and if it supports the GHG Assertion. This assessment will seek to identify any weakness or gaps in the controls that pose a significant risk of not preventing or correcting problems with the quality of the data and examining it for sources of potential errors, omissions, and misrepresentations. It will incorporate an examination of three aspects of the Project Proponent's internal controls: (1) the control environment, (2) the data systems, and (3) the control and maintenance procedures.

Assessment of Data

Substantive testing procedures will be used to assess the reasonability and validity of the GHG Assertion. Both quantitative and qualitative analysis will be performed to achieve the desired level of assurance. The verification procedures conducted and ICF's associated findings are described in Section 5 of the Verification Report. The verification procedures include verification activities designed to:

- Review the Project boundary, including a review of the completeness of emissions sources identified;
- Review the Project data sources to ensure the GHG Assertion is calculated based on metered or estimated data that meets the requirements of the Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions;
- Re-calculate the GHG Assertion, which demonstrates transparency and accuracy; and
- Review the GHG Assertion to ensure the emissions reductions calculated by the Project Proponent have been accurately reported.

Clarification and Data Request

To facilitate information flow between the Verification Team and the Project Proponent, a consolidated request for additional information will be developed through the course of the verification and issued to the Project Proponent. This "Clarification and Data Request" will be used to document information requests and summarize the responses. It will also be used to document the Verification Team's assessment of each response.

Developing a Review File

A review file (the "File") comprised of documents, records, working papers and other evidence collected and created during the course of the review that support the review conclusions will be developed for this verification. This evidence stored in hard copy and/or electronic format will serve to provide support for the verification conclusion, provide evidence that the verification was conducted in accordance with the criteria set forth in this document, and aid the Verifier in conducting current and future reviews.

The File will include:

- The GHG Assertion and supporting documentation;
- Decisions on the level of materiality and the results of the Verification Risk Assessment;
- Documentation on the Project Proponent's internal controls;
- Descriptions of the controls assessment work and results;
- Documentation of the substantive testing procedures that were carried out and the results;
- Documentation of the confirmations outlined in Table 26 of ESRD's *Technical Guidance for GHG Verification at Reasonable Level Assurance*, v1.0, January 2013;
- Copies of any correspondence with the Project Proponent or other parties relevant to the review;
- The Verification Team's working papers;
- The Clarification and Data Request with documented responses from the Project Proponent; and
- Client data (copies of relevant records, spreadsheets, and other data files).

The File is the property of ICF and access to it is normally restricted to the Verifier and the Project Proponent. ICF will retain and safeguard the file for a minimum of seven years.

4.4 Completion

This engagement will be formally closed after the verification has been executed and the Verification Report has been finalized.

Preparing the Verification Report

The purpose of the Verification Report is to document the verification findings. All misstatements are described and compared to the materiality threshold individually and in aggregate. The Verification Statement, which presents ICF's verification conclusion, is included in the Verification Report.

Internal Peer Review Process

Prior to releasing the Verification Report and Verification Statement, an internal review process is conducted by the Internal Peer Reviewer. This process ensures that:

- All steps identified as being required to complete the verification were completed;
- Any identified material or immaterial misstatements identified have been either:
  - corrected by the Project Proponent and reflected in the GHG Assertion; or
  - documented in the Verification Report, if misstatements persist at the conclusion of the verification.

- All required documentation detailing the verification process has been prepared, delivered, and retained.

Closing the Engagement

The verification engagement will be closed out upon delivery of the final Verification Report.

5 Verification Schedule

The following schedule is planned for the verification (subject to change with agreement between the Verifier and the Project Proponent).

Description	Scheduled Date
Verification Kick-Off Meeting	April 24, 2015
Draft Verification Plan to Project Proponent	May 26, 2015
Farm Visits	May 11, 2015
Head Office Visit	May 13, 2015
Draft Verification Statement and Report	May 27, 2015
Final Verification Statement and Report	May 29, 2015

6 Verification Risk Assessment

The process for completing a Verification Risk Assessment was described in Section 4.2. The following table describes the *inherent* and *control* risks analyzed by the Verification Team and the corresponding verification procedure(s) outlined in Section 5 of the Verification Report that have been designed to address these risks.

Description of Inherent Risks	Inherent Risk Evaluation	Description of Control Risks	Control Risk Evaluation	Verification Procedure(s)
The area claimed to have received additional passes compared to the baseline is not correct.	Medium	N/A - no reliance on Responsible Party's controls	N/A - no reliance on Responsible Party's controls	Compare pass area defined in 4R plan to aerial images.
The number of field passes established for the baseline period is not accurate and/or the documentation required is not complete.	Medium	QA/QC procedures are not completed.	Low	Interview farmers during farm visits to determine if information established by APA and on file is correct.
Quantity of fertilizer applied on field is not consistent with the fertilizer invoice used in the quantification of emission reductions. OR Data may not be correctly manually transcribed.	Medium	N/A - no reliance on Responsible Party's controls	N/A - no reliance on Responsible Party's controls	Compare fertilizer quantity in ADS against fertilizer invoices to confirm accuracy of transcription.
Data may not be correctly manually transcribed.	Medium	N/A - no reliance on Responsible Party's controls	N/A - no reliance on Responsible Party's controls	Compare composition of fertilizer in ADS against fertilizer invoices to confirm accuracy of transcription.
Documentation confirming application dates of fertilizer is not on file.	Medium	QA/QC procedures are not completed.	Low	Review farm files to confirm documentation of fertilizer application dates are on file.
Data may not be correctly manually transcribed from weight logs.	Medium	N/A - no reliance on Responsible Party's controls	N/A - no reliance on Responsible Party's controls	Compare crop mass in ADS against weight logs to confirm accuracy of transcription.
Calibration is not completed for weigh scales.	Medium	N/A - no reliance on Responsible Party's controls	N/A - no reliance on Responsible Party's controls	Review calibration reports to confirm calibration of weigh scales was completed according to Protocol requirements.

Harvested production may not be measured as dry matter.	Medium	N/A - no reliance on Responsible Party's controls	N/A - no reliance on Responsible Party's controls	Review moisture content of crop production at time of mass measurement to confirm mass used in ADS is measured as dry matter.
A current land title is not on file.	Medium	QA/QC procedures are not completed.	Low	Review farm files to confirm land title certificates are on file and accurate.
A current lease agreement is not on file.	Medium	QA/QC procedures are not completed.	Low	Review farm files to confirm lease agreements are signed and on file.
Legal land locations and farm map are not on file.	Medium	QA/QC procedures are not completed.	Low	Review farm files to confirm legal land titles and farm map are on file.
Eco districts are not assigned correctly in NERP calculator.	Medium	QA/QC procedures are not completed.	Low	Compare the EcoDistrict for each field in the NERP Calculator to the Eco district in the NSDB for consistency.
Documentation provided does not support irrigation claim.	Medium	N/A - no reliance on Responsible Party's controls	N/A - no reliance on Responsible Party's controls	Compare irrigation evidence to data in ADS for completeness and accuracy.
APA has not completed the 4R APA training program.	Medium	QA/QC procedures are not completed.	Medium	Review farm files to confirm training certificate is on file.
APA is not a registered AIA member.	Medium	QA/QC procedures are not completed.	Medium	Review farm files to confirm proof of AIA member registration is on file.
APA does not meet requirements of Practice Standard.	Medium	QA/QC procedures are not completed.	Medium	Review farm files to confirm proof is on file that APA meets Practice Standard.
Eco districts are not assigned correctly in NERP calculator.	Medium	QA/QC procedures are not completed.	Low	Compare the EcoDistrict for each field in the NERP Calculator to the Eco district in the NSDB for consistency.
Legal land locations are not accurate or on file.	Medium	QA/QC procedures are not completed.	Low	Review farm files to confirm legal land titles are on file.
Farm maps are not on file.	Low	QA/QC procedures are not completed.	Low	Review farm files to confirm farm map are on file.
Crop types are not accurately transcribed into ADS	Medium	N/A - no reliance on Responsible Party's controls	N/A - no reliance on Responsible Party's controls	Review crop types from crop plans to confirm accuracy of transcription into ADS.
Reports do not include all farm level record requirements or have not been signed by an APA.	Medium	QA/QC procedures are not completed.	Medium	Review 4R Plans to confirm APA sign-off is complete for farm level requirements.

Reports do not include all field level record requirements or have not been signed by an APA.	Medium	QA/QC procedures are not completed.	Medium	Review 4R Plans to confirm APA sign-off is complete for field level requirements.
Undocumented soil temperature readings in ADS.	Medium	QA/QC procedures are not completed.	Low	Compare soil temperature readings from Canadian Grain Commission against readings applied by ATAI for consistency.
Undocumented equipment photographs in ADS.	Medium	QA/QC procedures are not completed.	Low	Review farm files to confirm photographs are complete and on file.
Incorrect equipment measurements in ADS.	Medium	QA/QC procedures are not completed.	Low	Compare width of fertilizer openers and spacing in ADS against photographs to confirm accuracy of transcription.

The *detection risk* is a measure of the risk that the verification procedures will fail to detect material misstatements, should such misstatements exist. The verification procedures will be developed to address inherent and control risks, while ensuring the level of detection risk is sufficiently low to reach a verification conclusion at a reasonable level of assurance.

The results of the Verification Risk Assessment will be utilized by the Verification Team to develop the verification procedures, which are outlined in Section 5 of the Verification Report.

Sampling Plan

Agri-Trend Aggregation Inc., Agricultural Nitrous Oxide Emission Reductions (NERP) – Pool 1

The following sampling plan defines the methodology used to select data to be tested under verification procedures related to confirmation of data through analysis and/or sampling of supporting evidence. All other procedures that do not include sampling, are described in the Verification Report.

Data Description	Verification Procedure(s)	Sampling Methodology
Pass Area - area that received extra field passes	Compare pass area defined in 4R plan to aerial images.	Representative sample based on number of farms/fields in Project
Quantity of Fertilizer	Compare fertilizer quantity in ADS against fertilizer invoices to confirm accuracy of transcription.	Representative sample based on number of farms/fields in Project
Composition of Fertilizer	Compare composition of fertilizer in ADS against fertilizer invoices to confirm accuracy of transcription.	Representative sample based on number of farms/fields in Project
$Mass_{Crop}$ (Harvested Annual Dry Matter Production for Crop)	Compare crop mass in ADS against weight logs to confirm accuracy of transcription.	Representative sample based on number of farms/fields in Project
Calibration Reports	Review calibration reports to confirm calibration of weigh scales was completed according to Protocol requirements.	Representative sample based on number of farms/fields in Project
Moisture Logs	Review moisture content of crop production at time of mass measurement to confirm mass used in ADS is measured as dry matter.	Representative sample based on number of farms/fields in Project
Irrigation supporting documentation	Compare irrigation evidence to data in ADS for completeness and accuracy.	Representative sample based on number of farms/fields in Project
Crop type from crop plans	Review crop types from crop plans to confirm accuracy of transcription into ADS.	Representative sample based on number of farms/fields in Project

Conflict of Interest Checklist

Question	Yes	No
1. Can the verifying organization or the Verification Team members directly benefit from a financial interest in the Project Developer or the Project Developer's Project?		X
For example: • *Owning shares of the Project Developer;* • *Having a close business relationship with the Project Developer;* • *Contingent fees relating to the results of the engagement;* • *Potential employment with the Project Developer; or* • *Undue concern about the possibility of losing the verification or other fees from the Project Developer.*		
2. Can the verifying organization or Verification Team members be in a position of assessing their own work?		X
For example: • *Provided GHG consultation services to the project;* • *Provided validation for the project;* • *If providing non-GHG work for the company, consideration needs to be given as to how potential and perceived conflicts of interest can be managed;* • *A member of the Verification Team was previously employed with the company.*		
3. Does the verifying organization or a member of the Verification Team, or a person in the chain of command for the verification, promote or be perceived to promote, a Project Developer's position or opinion to the point that objectivity may, or may be perceived to be, compromised?		X
For example: • *Dealing in, or being a promoter of, GHG credits on behalf of a Project Developer;* • *Advocating on behalf of the client to advance a particular position or point of view on an issue that directly affects the GHG assertion; or* • *Acting as an advocate on behalf of the Project Developer in litigation or in resolving disputes with third parties.*		
4. Is one or more of the Verification Team too sympathetic to the Project Developer's interests by virtue of a close relationship with a Project Developer, its directors, officer or employees?		X
For example: • *A person on the Verification Team has a close personal relationship with a person who is in a senior GHG compilation role at the Project Developer; or* • *The Verification Team or a person of influence on the Verification Team has accepted significant gifts or hospitality from the Project Developer.*		
5. Is a member of the Verification Team or a person in the chain of command deterred from acting objectively and exercising professional skepticism by threats, actual or perceived, from the directors, officers or employees of the Project Developer?		X
For example: • *The threat of being replaced as a third party verifier due to a disagreement with the application of a GHG quantification protocol;* • *Fees from the Project Developer represent a large percentage of the overall revenues of the verifying organization;* • *The application of pressure to inappropriately reduce the extent of work performed in order to reduce or limit fees; or* • *Threats of litigation from the Project Developer.*		

The declaration made in this statement is correct and truly represents ICF Consulting Canada, Inc. and the members of the Verification Team. Dated this fourth day of June, 2015.

Aaron Schroeder, P.Eng.
Professional Engineer, Alberta (75566)
Lead Verifier and Designated Signing Authority
ICF Consulting Canada, Inc.
Vancouver, British Columbia, Canada

Duncan Rotherham
Vice President
ICF Consulting Canada, Inc.
Toronto, Ontario, Canada

Appendix P: DOF Aggregator Spreadsheet

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University

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Introduction

As part of the cost-benefit analysis an excel based calculator was generated. This calculator allows the user to modify the input assumptions and assess the sensitivity of the costs-benefits of implementing the protocol. In the calculator there are three input sheets that must be completed by the user. These include the start-up costs, operating costs and scale, credit price and discount rate sheets. The information from these sheets is carried over into the analysis sheets and an estimate of the costs per credit, revenue per credit and the net present value of the credits over a seven year time period is provided under three different scenarios (expected, optimistic and pessimistic). Changes to the values in the input sheets result in new estimates in the results sheets. A copy of the "Expected Input Sheet" is provided below for reference. The original excel spreadsheet is needed for full functionality. This spreadsheet is available separately from CCEMC.

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		Initial Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Annual Costs									
Start-Up Costs		$103,000	$0	$0	$0	$0	$0	$0	$0
Annual Operating Costs			$123,000	$133,000	$159,500	$180,000	$201,000	$201,000	$206,000
Total Costs		$103,000	$123,000	$133,000	$159,500	$180,000	$201,000	$201,000	$206,000
Normal Discount Rate	0.050								
Present Value of Costs	$1,080,525	$1,188,577							
Number of Credits per Year			10000.00	15000.00	18000.00	25000.00	25000.00	25000.00	$25,000
Total Number of Credits	143,000								
Cost per Credit	$7.56								
Expected Price per Credit			$13	$13	$23	$23	$23	$23	$23
Carbon Credit Revenue			$130,000	$195,000	$414,000	$575,000	$575,000	$575,000	$575,000
Expected Aggregator Carbon Price			$9	$9	$15	$15	$15	$15	$15
Expected Aggregator Revenue			$90,000	$135,000	$275,940	$383,250	$383,250	$383,250	$383,250
Present Value of Aggregators Revenue	$1,620,473								
Revenue per Credit	$11.33								
Net Present Value (Benefits-Costs)	$539,949								

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Appendix Q: The Benefit Cost Analysis of the Aggregator's Position as it Relates to Livestock Feeding (DOF)

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University and The Prasino Group

Disclaimer

This document has been produced independently by Dr. Paul Thomassin and 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 2013[12]. The views expressed in this report are not necessarily the views of the Climate Change Emissions Management (CCEMC) Corporation.

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

Introduction

Changes in livestock management practices in feedlots have the potential for decreasing the amount of greenhouse gas emissions being generated as compared to baseline production management techniques. One of the areas where there is little information is the aggregation function as it relates to feedlot operations. This study attempts to address this lack of information by investigating the cost and benefits of the aggregation function as it relates to feedlot cattle production.

Function of the Aggregator

The aggregator is an individual who will purchase the credits from the feedlot operator and sell these carbon reductions in the market. The role of the aggregator is to gather the data on both the baseline and new management system in order that the generation of offset credits can be justified. In this regard, the aggregator has to gather data that can be used to justify the selling of credits into the offset market. The aggregator will be responsible for data collection, legal costs, registry costs, verification costs, marketing and other costs.

Assumptions, Sample and Instrument

It was assumed that an existing aggregator would be expanding their portfolio of projects to include feedlot management practices. This assumption was made after discussions with individuals in the industry who suggested that the costs of starting the data collection process and the required legal and management requirements would be too large if only feedlot projects would be included or if an existing infrastructure to undertake the aggregation function was not in place. Given this assumption, the estimated costs from this study only includes the additional costs of developing the feedlot project dimension of the aggregation function.

Another important assumption made in the model was the split in revenue between the feedlot operator and the aggregator. After several discussions, it was assumed that the operation would receive two-thirds of the carbon payment and the feedlot operator would receive one-third of the carbon revenue. This assumption seems reasonable since the aggregator is taking on the risk of getting the carbon reductions to the market and ensuring that they are verified and free from default when audits take place. This also minimizes the time and effort for a feedlot operator to administer the generation of credits.

The analysis assumes a seven year timeframe for the aggregator. It is expected that there will be substantial initial costs to establish the infrastructure for data collection, etc., but this infrastructure should be able to collect data for a number of years. The analysis undertaken will estimate the present value of the aggregation function taking into account the initial cost of establishing the infrastructure, the annual operating costs, and the revenue generated from the selling of carbon offset credits.

A number of experts involved in the aggregation function and providing services to feedlot operators were contacted. Discussions were held with these individuals to get an understanding of the aggregation function as it would pertain to feedlot carbon offset projects. Several of the assumptions made above were after discussions with these experts. Two individuals were identified to provide data that was used in this analysis.

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The survey instrument was a spreadsheet that contained multiple sheets that asked the respondents to place their best estimates to the costs and revenue questions that were asked of them. Result sheets take this information and estimate the net present value of the project, the costs per credit and the revenue per credit, as well as the net present value per credit. This tool was specifically designed to study the aggregation function.

The spreadsheet instrument contained seven sheets. The first sheet provided an introduction and brief instructions on how to complete the other sheets. The second sheet contained information on the start-up costs for the aggregator (Table 1). The start-up costs are the initial costs that are needed to establish the infrastructure to collect and store the necessary information to generate offset credits. The items included in the start-up costs include: equipment, office space, administrative support, software development, programmer costs, security, data storage, training, marketing, financial and legal costs. Most of the costs will occur in the initial period; however, the model has been designed so that other infrastructure costs can be added in future periods to take into account things such as additional programmer time, new equipment, etc. The information generated for the start-up costs will be transferred to the results sheets as a component of total costs in order to estimate the cost of generating the carbon offset credits.

The next sheet requests information on the operating costs of the aggregator. The operating costs are the annual costs that will be incurred by the aggregator to generate the carbon offset credits. These costs include: legal costs, accounting, administration, project planning, project documentation, land title searches, registry costs, data gathering costs, offset documentation, verification costs, insurance, travel, office expenses, and marketing (Table 2). Combining the start-up costs and the annual operating costs provides an estimate of the total costs of generating the offset credits. It should be noted that the costs reported in this study are based on those of an established aggregator who is adding this protocol to their operation. It is expected that these costs would increase substantially if this was a new business opportunity and the individual did not have an existing business.

The fourth sheet in the model is called the “Scale, Credit Price, Disc. Rate” sheet. This sheet contains information on the number of carbon credits that are expected to be generated, the price of carbon, and the discount rate that will be used to bring all values into the present value (Table 3). In this sheet, the respondents are asked to provide optimistic, expected and pessimistic values for the information requested. This will provide a sensitivity analysis around the values that have been estimated. As with the operating cost sheet, the values can change on an annual basis to better reflect the potential changes in scale, carbon prices, and discount rate.

The scale refers to the number of credits that can be sold given the investment in infrastructure and operating costs. As a result, the more credits that one can sell in any one period will substantially lower the cost per credit. This is an important variable in determining the economic viability for both the aggregator and the producer. The next variable of importance in this sheet is the carbon price. The model allows the carbon price to vary over the seven year period. It is expected that the carbon price will increase over time and therefore provide greater incentives for both producers and aggregators. The respondents are asked to allocate the price to be received by the aggregator for the carbon credit. This will be used to divide the carbon revenue between the producer and the aggregator. In this analysis, it has been assumed that the split is 2/3 for the aggregator and 1/3 for the producer. This can be modified in the model. Finally, the respondents are asked to provide a discount rate. This is the rate that will be

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used to estimate the present value of the flow of costs and benefits for the aggregator. A net present value estimate is used in order that comparisons can be made between scenarios that have different flows of benefits and costs over time.

The final three sheets in the model provide estimates of the results given the input values estimated by the aggregator. As noted previously, optimistic, expected and pessimistic values were requested to provide a range of values for the numbers of credits, carbon price and discount rate. A sensitivity analysis was undertaken for each of the three scenarios (optimistic, expected and pessimistic) in order to estimate how variations in the variables impacted the results.

Table 1. Start-Up Cost Sheet in the Program.

Start-up Costs	Initial Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
		$	$	$	$	$	$	$
Equipment								
Capital Purchases								
Laptops								
Servers								
Office Space								
Admin Support								
Software Development								
Programmer Costs								
IT Security								
Off-site Data Storage								
Training								
Marketing								
Collateral Materials								
Financing Costs								
Legal Costs								
Certification for Approved Advisors								
Total Start Up Costs								

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Table 2: The Operating Cost Sheet in the Program.

Operating Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
	$	$	$	$	$	$	$
Legal Costs							
Accounting							
Admin Costs - Data Punch							
Project Planning and Delivery Costs							
Project Documentation Costs							
Land Title Searches							
Registry Costs							
Data Gathering Costs							
Field Agents Percentage							
Offset Documentation Costs							
Offset Verification Costs							
Office costs							
Insurance Costs							
Travel							
Marketing							
Website							
Total Operating Costs (Annual Costs)							

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Table 3: The Scale, Carbon Price and Discount Rate Sheet in the Model.

Other Information	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Economies of Scale (Total number of Carbon Credits to be Sold)							
Optimistic volume of Carbon Credits Sales							
Expected volume of Carbon Credits Sales							
Pessimistic volume of Carbon Credit Sales							
Carbon Price							
Optimistic Carbon price							
Expected Carbon Price (Current)							
Pessimistic Carbon Price							
Aggregators Carbon Price (Price the Aggregator Receives)							
Optimistic Aggregator Carbon Price							
Expected Aggregator Carbon Price							
Pessimistic Aggregator Carbon Price							
Discount Rate in percentage terms (5% is entered as 0.05 - choose one rate for the seven years)							
Optimistic Discount Rate (Low rate - in percentage terms)							
Normal Discount Rate (Expected rate - in percentage terms)							
Pessimistic Discount Rate (High rate -in percentage terms)							

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Results

The results are given in terms of a number of indicators: net present value, cost per credit, revenue per credit, and net revenue per credit. The start-up costs and annual operating costs were the same for each of the three scenarios (optimistic, expected, and pessimistic). The revenue for each scenario varied due to different price expectations and the quantity of carbon offset credits generated over time. The flow of costs and benefits for each scenario are given in Table 4.

Table 4 provides the key variables utilized in the analysis. It was estimated that the initial cost to provide the aggregation function for the cattle protocol for an existing firm was $103,000. The results indicate that the respondent did not feel that additional infrastructure cost would be required over the seven year period. The annual operating costs of the aggregator were expected to increase from $123,000 to $206,000 over the seven year period. In all three scenarios, the carbon price of $13 per tonne was expected to remain for at least the first two years. The optimistic scenario suggested a more than doubling of the carbon price to $27 per tonne by the third year and for it to remain at that level to year seven. The expected scenario also had a large price increase in year 3 to $23 per tonne and it was expected

that this value would continue to year seven. Finally, the pessimistic scenario had the carbon price remaining at $13 per tonne over the whole seven year time horizon. As stated previously, this is the estimate price for a tonne of carbon and it is expected that the aggregator would receive 2/3 of the value while the producer received 1/3 of the value. It should be noted that the discount rate for each scenario also varied. For the optimistic scenario the discount rate was 3 percent, for the expected scenario it was 5 percent, and the pessimistic scenario it was 7 percent.

Table 4. Initial Estimates of Key Variables for the Three Scenarios (Optimistic, Expected, and Pessimistic).

	Costs	Optimistic		Expected		Pessimistic	
	Start-up + Operating	Price	Quantities (Tonnes)	Price	Quantities (Tonnes)	Prices	Quantities (Tonnes)
Initial Costs	$ 103,000						
Year 1	$ 123,000	$13	10,000	$13	10,000	$13	4,000
Year 2	$ 133,000	$13	20,000	$13	15,000	$13	5,000
Year 3	$ 159,500	$27	30,000	$23	18,000	$13	6,000
Year 4	$ 180,000	$27	45,000	$23	25,000	$13	6,000
Year 5	$ 201,000	$27	45,000	$23	25,000	$13	6,000
Year 6	$ 201,000	$27	50,000	$23	25,000	$13	6,000
Year 7	$ 206,000	$27	50,000	$23	25,000	$13	6,000

The results of the analysis are given in Table 5. There is a large amount of variation between the three scenarios. For example, the net return per credit for the aggregator varied from $9.97 per tonne for the optimistic scenario to a negative $19.00 a tonne in the pessimistic scenario. The expected scenario provided a net return of $5.50 per credit. The number of tonnes between the scenarios also varied widely from 250,000 tonnes in the optimistic scenario to 39,000 tonnes in the pessimistic scenario. The low number of credits in the pessimistic scenario caused the cost per tonne of carbon generated to be high; i.e. $25.82 per tonne, as compared to the optimistic scenario where the cost per tonne was $4.65 per tonne. The number of tonnes generated is an important variable because as this value increases it decreases the fixed costs per tonne. The cost per tonne in the expected scenario was $7.56 per tonne.

In two of the three scenarios the aggregator made money with this operation (Table 5). In the pessimistic scenario the aggregator was estimated to generate a net loss of $740,834 over the seven years. Two of the important variables that will determine the profitability of the aggregator will be the price of the carbon credit, the split between the aggregator and the producer, and the number of carbon offset credits that are generated.

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Table 5. Results of the Scenario Analysis.

Scenario	Present Value of Costs	Present Value of Benefits	Net Present Value	Number of Credits	Cost Per Credit	Revenue Per Credit	Net Revenue per Credit
Optimistic Returns	$1,162,891	$3,655,128	$2,492,237	250,000	$4.65	$14.62	$9.97
Expected Returns	$1,080,525	$1,866,453	$785,928	143,000	$7.56	$13.05	$5.50
Pessimistic Returns	$1,007,173	$266,338	-$740,834	39,000	$25.82	$6.83	-$19.00

A sensitivity analysis was undertaken for each of the scenarios. In this analysis a number of important variables were varied in order to estimate the impact on the results. The following variables were varied: cost of the aggregator, revenue of the aggregator, credits generated, and changes in the discount rate. For all variables, except the discount rate, each variable was increased and decreased by 10, 20 and 30 percent from the original scenario. The discount rate was increased and decreased by specific percentages. The results of the analysis for the optimistic, expected and pessimistic scenarios are given in Tables 6, 7, and 8 respectively.

The range of net revenue per credit varied from a high of $14.36 per tonne to $5.58 per tonne in the optimistic scenario sensitivity analysis depending on the changes (Table 6). The highest return occurs when there is an increase in the aggregator`s revenue by 30 percent. This increase in revenue could be from an increase in price, a change in the split between aggregator and producer, and an increase in the number of credits generated. The largest net present value occurred with the largest increase in revenue; i.e. 30 percent, and resulted in a net present value of $3,588,776 while the lowest net present value was $1,395,699 which occurred with the largest decrease in revenue, i.e. 30 percent, and when the number of carbon credits generated was decreased from 250,000 tonnes to 175,000 tonnes.

In the expected scenario, the initial estimate of the net return per credit was $5.50, but this could range from $9.41 per tonne to $1.58 per tonne depending on the changes in the variables (Table 7). The highest net returns per credit occurred when the revenue to the aggregator was increased by 30 percent, while the lowest estimate was when the aggregator`s revenue was decreased by 30 percent. The largest net present value was $1,345, 864 when the aggregator`s revenue was increased by 30 percent. The smallest return was when the aggregator`s revenue was decreased by 30 percent or when the number of credits generated was decreased by 30 percent.

In the pessimistic scenario, there was no situation where the net return per credit was positive and as a result there was no situation where there was a positive net present value (Table 8). The range of the net returns per credit was a negative $11.25 when the aggregator`s costs were decreased by 30 percent, to a negative $30.06, when the number of credits generated decreased by 30 percent. The net present value for the aggregator varied from a negative $438,683 to a negative $1,042,986. These occurred when the aggregator`s cost decreased by 30 percent and when the aggregators costs increased by 30 percent.

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Conclusions

The analysis indicates that a positive net present value can be obtained in two of the three scenarios. However, the range of results is large indicating a risk for the entrepreneur. The ability to generate revenue through a higher price per tonne of carbon and an increase in the number of tonnes being sold is crucial. Increasing the number of tonnes generated decreases the fixed costs per tonne and also increases the revenue being generated.

Table 6. Sensitivity Analysis for the Optimistic Scenario

Scenario	Present Value of Costs	Present Value of Benefits	Net Present Value	Number of Credits	Cost Per Credit	Revenue Per Credit	Net Revenue per Credit
Optimistic Returns	$1,162,891	$3,655,128	$2,492,237	250,000	$4.65	$14.62	$9.97
Increase in Costs of Aggregator							
by 10%	$1,279,180	$3,655,128	$2,375,948	250,000	$5.12	$14.62	$9.50
by 20%	$1,395,469	$3,655,128	$2,259,659	250,000	$5.58	$14.62	$9.04
by 30%	$1,511,758	$3,655,128	$2,143,370	250,000	$6.05	$14.62	$8.57
Decrease in Costs of Aggregator							
by 10%	$1,046,602	$3,655,128	$2,608,526	250,000	$4.19	$14.62	$10.43
by 20%	$930,313	$3,655,128	$2,724,815	250,000	$3.72	$14.62	$10.90
by 30%	$814,024	$3,655,128	$2,841,104	250,000	$3.26	$14.62	$11.36
Increase in Revenue to Aggregator							
by 10%	$1,162,891	$4,020,641	$2,857,750	250,000	$4.65	$16.08	$11.43
by 20%	$1,162,891	$4,386,154	$3,223,263	250,000	$4.65	$17.54	$12.89
by 30%	$1,162,891	$4,751,667	$3,588,776	250,000	$4.65	$19.01	$14.36
Decrease in Revenue to Aggregator							
by 10%	$1,162,891	$3,289,615	$2,126,724	250,000	$4.65	$13.16	$8.51
by 20%	$1,162,891	$2,924,103	$1,761,212	250,000	$4.65	$11.70	$7.04
by 30%	$1,162,891	$2,558,590	$1,395,699	250,000	$4.65	$10.23	$5.58
Increase in Credits Generated							
by 10%	$1,162,891	$4,020,641	$2,857,750	275,000	$4.23	$14.62	$10.39
by 20%	$1,162,891	$4,386,154	$3,223,263	300,000	$3.88	$14.62	$10.74
by 30%	$1,162,891	$4,751,667	$3,588,776	325,000	$3.58	$14.62	$11.04
Decrease in Credits Generated							
by 10%	$1,162,891	$3,289,615	$2,126,724	225,000	$5.17	$14.62	$9.45
by 20%	$1,162,891	$2,924,103	$1,761,212	200,000	$5.81	$14.62	$8.81
by 30%	$1,162,891	$2,558,590	$1,395,699	175,000	$6.65	$14.62	$7.98

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Scenario	Present Value of Costs	Present Value of Benefits	Net Present Value	Number of Credits	Cost Per Credit	Revenue Per Credit	Net Revenue per Credit
Increase in the Discount Rate							
by 1%	$1,120,499	$3,486,378	$2,365,880	250,000	$4.48	$13.95	$9.46
by 2%	$1,080,525	$3,327,704	$2,247,179	250,000	$4.32	$13.31	$8.99
by 3%	$1,042,801	$3,178,390	$2,135,589	250,000	$4.17	$12.71	$8.54
Decrease in the Discount Rate							
by 0.5%	$1,185,051	$3,743,523	$2,558,472	250,000	$4.74	$14.97	$10.23
by 1%	$1,207,886	$3,834,735	$2,626,849	250,000	$4.83	$15.34	$10.51
by 1.5%	$1,255,683	$4,026,049	$2,770,366	250,000	$5.02	$16.10	$11.08

Table 7. Sensitivity Analysis for the Expected Returns Scenario

Scenario	Present Value of Costs	Present Value of Benefits	Net Present Value	Number of Credits	Cost Per Credit	Revenue Per Credit	Net Revenue per Credit
Expected Returns	$1,080,525	$1,866,453	$785,928	143,000	$7.56	$13.05	$5.50
Increase in Costs of Aggregator							
by 10%	$1,188,577	$1,866,453	$677,876	143,000	$8.31	$13.05	$4.74
by 20%	$1,296,630	$1,866,453	$569,823	143,000	$9.07	$13.05	$3.98
by 30%	$1,404,682	$1,866,453	$461,771	143,000	$9.82	$13.05	$3.23
Decrease in Costs of Aggregator							
by 10%	$972,472	$1,866,453	$893,981	143,000	$6.80	$13.05	$6.25
by 20%	$864,420	$1,866,453	$1,002,033	143,000	$6.04	$13.05	$7.01
by 30%	$756,367	$1,866,453	$1,110,086	143,000	$5.29	$13.05	$7.76
Increase in Revenue to Aggregator							
by 10%	$1,080,525	$2,053,098	$972,574	143,000	$7.56	$14.36	$6.80
by 20%	$1,080,525	$2,239,744	$1,159,219	143,000	$7.56	$15.66	$8.11
by 30%	$1,080,525	$2,426,389	$1,345,864	143,000	$7.56	$16.97	$9.41
Decrease in Revenue to Aggregator							
by 10%	$1,080,525	$1,679,808	$599,283	143,000	$7.56	$11.75	$4.19
by 20%	$1,080,525	$1,493,162	$412,638	143,000	$7.56	$10.44	$2.89
by 30%	$1,080,525	$1,306,517	$225,992	143,000	$7.56	$9.14	$1.58
Increase in Credits Generated							
by 10%	$1,080,525	$2,053,098	$972,574	157,300	$6.87	$13.05	$6.18
by 20%	$1,080,525	$2,239,744	$1,159,219	171,600	$6.30	$13.05	$6.76

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Scenario	Present Value of Costs	Present Value of Benefits	Net Present Value	Number of Credits	Cost Per Credit	Revenue Per Credit	Net Revenue per Credit
by 30%	$1,080,525	$2,426,389	$1,345,864	185,900	$5.81	$13.05	$7.24
Decrease in Credits Generated							
by 10%	$1,080,525	$1,679,808	$599,283	128,700	$8.40	$13.05	$4.66
by 20%	$1,080,525	$1,493,162	$412,638	114,400	$9.45	$13.05	$3.61
by 30%	$1,080,525	$1,306,517	$225,992	100,100	$10.79	$13.05	$2.26
Increase in the Discount Rate							
by 1%	$1,042,801	$1,786,308	$743,507	143,000	$7.29	$12.49	$5.20
by 2%	$1,007,173	$1,710,745	$703,572	143,000	$7.04	$11.96	$4.92
by 3%	$973,497	$1,639,449	$665,952	143,000	$6.81	$11.46	$4.66
Decrease in the Discount Rate							
by 1%	$1,120,499	$1,951,522	$831,023	143,000	$7.84	$13.65	$5.81
by 2%	$1,162,891	$2,041,887	$878,996	143,000	$8.13	$14.28	$6.15
by 3%	$1,207,886	$2,137,954	$930,068	143,000	$8.45	$14.95	$6.50

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Table 8. Sensitivity Analysis for the Pessimistic Scenario

Scenario	Present Value of Costs	Present Value of Benefits	Net Present Value	Number of Credits	Cost Per Credit	Revenue Per Credit	Net Revenue per Credit
Pessimistic Returns	$1,007,173	$266,338	-$740,834	39,000	$25.82	$6.83	-$19.00
Increase in Costs of Aggregator							
by 10%	$1,107,890	$266,338	-$841,552	39,000	$28.41	$6.83	-$21.58
by 20%	$1,208,607	$266,338	-$942,269	39,000	$30.99	$6.83	-$24.16
by 30%	$1,309,325	$266,338	-$1,042,986	39,000	$33.57	$6.83	-$26.74
Decrease in Costs of Aggregator							
by 10%	$906,455	$266,338	-$640,117	39,000	$23.24	$6.83	-$16.41
by 20%	$805,738	$266,338	-$539,400	39,000	$20.66	$6.83	-$13.83
by 30%	$705,021	$266,338	-$438,683	39,000	$18.08	$6.83	-$11.25
Increase in Revenue to Aggregator							
by 10%	$1,007,173	$292,972	-$714,201	39,000	$25.82	$7.51	-$18.31
by 20%	$1,007,173	$319,606	-$687,567	39,000	$25.82	$8.20	-$17.63
by 30%	$1,007,173	$346,240	-$660,933	39,000	$25.82	$8.88	-$16.95
Decrease in Revenue to Aggregator							
by 10%	$1,007,173	$239,704	-$767,468	39,000	$25.82	$6.15	-$19.68
by 20%	$1,007,173	$213,071	-$794,102	39,000	$25.82	$5.46	-$20.36
by 30%	$1,007,173	$186,437	-$820,736	39,000	$25.82	$4.78	-$21.04
Increase in Credits Generated							
by 10%	$1,007,173	$292,972	-$714,201	42,900	$23.48	$6.83	-$16.65
by 20%	$1,007,173	$319,606	-$687,567	46,800	$21.52	$6.83	-$14.69
by 30%	$1,007,173	$346,240	-$660,933	50,700	$19.87	$6.83	-$13.04
Decrease in Credits Generated							
by 10%	$1,007,173	$239,704	-$767,468	35,100	$28.69	$6.83	-$21.87
by 20%	$1,007,173	$213,071	-$794,102	31,200	$32.28	$6.83	-$25.45
by 30%	$1,007,173	$186,437	-$820,736	27,300	$36.89	$6.83	-$30.06
Increase in the Discount Rate							
by 1%	$973,497	$256,761	-$716,736	39,000	$24.96	$6.58	-$18.38
by 2%	$941,642	$247,691	-$693,952	39,000	$24.14	$6.35	-$17.79
by 3%	$911,488	$239,093	-$672,395	39,000	$23.37	$6.13	-$17.24
Decrease in the Discount Rate							
by 1%	$1,042,801	$276,457	-$766,344	39,000	$26.74	$7.09	-$19.65

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Scenario	Present Value of Costs	Present Value of Benefits	Net Present Value	Number of Credits	Cost Per Credit	Revenue Per Credit	Net Revenue per Credit
by 2%	$1,080,525	$287,158	-$793,367	39,000	$27.71	$7.36	-$20.34
by 3%	$1,120,499	$298,482	-$822,016	39,000	$28.73	$7.65	-$21.08

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Appendix R: DOF Producer Spreadsheet

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University

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Introduction

As part of the cost-benefit analysis an excel based calculator was generated. This calculator allows the user to modify the input assumptions and assess the sensitivity of the costs-benefits of implementing the protocol. In the calculator there are four input sheets that must be completed by the user. These include the Input Values – Heifer Calf, Input Values – Steer Calf, Input Values – Yearling Heifer and Input Values – Yearling Steer. Specifically, the Input Values sheets ask the user to supply information from their operation including the number of each cattle type, average weight in, average weight out, average daily gain, number of days on feed and an estimate of the costs of production for both the baseline and change of management. The spreadsheet also asks the user to estimate their costs and prices into the future. The information from these sheets is carried over into the results sheet and an estimate of the carbon revenue, net margin per head and net present value is provided. Changes to the values in the input sheets result in new estimates in the output sheets. A copy of the "Producer Profitability Sheet" is provided below for reference. The original excel spreadsheet is needed for full functionality. This spreadsheet is available separately from CCEMC.

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Producer Gross Margin Analysis			
Discount Rate for the Present Value Calculation -enter as a percentage, i.e. 5% entered as 0.05			0.05
	Year 1	**Year 2**	**Year 3**
Number of Head (Baseline Practice)			
Heifer Calves	22,769	22,769	22,769
Steer Calves	31,898	31,898	31,898
Yearling Heifers	73,517	73,517	73,517
Yearling Steers	131,375	131,375	131,375
Number of Head (Change in management Practice)			
Heifer Calves	22,769	22,769	22,769
Steer Calves	31,898	31,898	31,898
Yearling Heifers	73,517	73,517	73,517
Yearling Steers	131,375	131,375	131,375
Net Margin Per Head (Baseline Management Practice)			
Heifer Calves	23.83	-112.51	-58.36
Steer Calves	23.83	-112.51	-58.36
Yearling Heifers	23.02	-109.74	-53.74
Yearling Steers	59.28	-87.46	-55.96
Net Margin (Baseline Management Practice)			
Heifer Calves	$542,667.76	-$2,561,716.89	-$1,328,737.17
Steer Calves	$760,244.90	-$3,588,811.34	-$1,861,480.88
Yearling Heifers	$1,692,655.89	-$8,068,036.25	-$3,950,526.58
Yearling Steers	$7,788,104.83	-$11,490,025.27	-$7,351,331.00
Total Net Margins (Baseline Management Practice)	$10,783,673.37	-$25,708,589.76	-$14,492,075.62
Net Margin Per Head (Change in Management Practice)			
Heifer Calves	-1.06	-141.01	-91.83
Steer Calves	-1.06	-141.01	-91.83
Yearling Heifers	26.68	-109.17	-54.35
Yearling Steers	70.02	-79.44	-46.22

Net Margin (Change in Management Practice)			
Heifer Calves	-$24,126.07	-$3,210,708.93	-$2,090,910.98
Steer Calves	-$33,799.18	-$4,498,010.16	-$2,929,240.57
Yearling Heifers	$1,961,747.94	-$8,025,567.08	-$3,995,631.46
Yearling Steers	$9,199,323.48	-$10,436,733.33	-$6,072,733.83
Total Net Margins (Change in Management Practice)	$11,103,146.18	-$26,171,019.50	-$15,088,516.84
Carbon Market Revenue (Per Head)			
Heifer Calves	0.20	0.20	0.20
Steer Calves	0.36	0.36	0.36
Yearling Heifers	0.12	0.12	0.12
Yearling Steers	0.16	0.16	0.16
Carbon Market Revenue (Total)			
Heifer Calves	$4,553.80	$4,553.80	$4,553.80
Steer Calves	$11,483.28	$11,483.28	$11,483.28
Yearling Heifers	$8,822.04	$8,822.04	$8,822.04
Yearling Steers	$21,020.00	$21,020.00	$21,020.00
Total Carbon Revenue	**$45,879.12**	**$45,879.12**	**$45,879.12**
Carbon Credits Generated (Tonnes)	**11,470**	**11,470**	**11,470**
Total Net Revenue (Change in Management Practice)	**$11,149,025.30**	**-$26,125,140.38**	**-$15,042,637.72**
Change in Revenue from the Change in Management Practice			
(New Mangement Practice Minus Baseline Practice)	**$365,351.92**	**-$416,550.63**	**-$550,562.10**
Net Present Value of the Baseline	**-$25,567,083.44**		
Net Present Value of the Change in Management	**-$26,072,549.17**		

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Appendix S: The Benefit Cost Analysis of Feedlot Operators Change in Management Practices

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University

Introduction

Changes in livestock management practices in feedlots have the potential of decreasing the amount of greenhouse gas emissions being generated as compared to baseline production management techniques. The changes in feedlot management practices have both financial and environmental implications. A change in management practice has the potential of changing the margin per hundred weight or margin per head received from the market. In addition, it can also increase firm revenue by receiving income from the carbon market. The change in management practice can also reduce the amount of greenhouse gas emissions coming from the operation. This study attempts to estimate the benefits and costs for the feedlot operator of changing these management practices to decrease greenhouse gas emissions.

Feedlot Owner or Manager

The feedlot owner or manager has the ability to change the management practices within the feedlot in order to gain access to the carbon offset market. Changes in management that may reduce greenhouse gas emissions include the use of beta-adrenergic agonist, adopting new feeding regimes, etc. In order to access the carbon market, the feedlot operator has to generate the data necessary to estimate the baseline situation as well as collect the information for the change in management practice.

Assumptions, Sample and Instrument

Several important assumptions were made when undertaking this analysis that have an important impact on the results. First, the information incorporated into the model was based on the average results from a documented three year baseline period. The values for the weight in, weight out, days on feed, and average daily gain were based on these averages. Second, the change in management was based on a one year change in management and these same values were used for the three years of the analysis. This included values for weight in, weight out, average daily gain, and the number of days on feed.

Canfax was the major data source used to estimate the cost of the production for both the baseline and change in management practices. Three years of analysis was undertaken and the average data for 2011, 2012, and the projected data for the six months of 2013 were used in the analysis. Modifications to this data were needed in order to reflect the particular operations where the average change of management occurred. For example, a major cost for the feedlot operation is the cost of the feeder and the feeding cost of the animal while in the feedlot. The feeder cost per hundred weight was used from the Canfax data source. This value was multiplied by the weight in of the feeder to determine the cost of the feeder. The cost of barley and silage was estimated taking into account the differences in the weight of the animal and the average daily gain. The following formula was used to modify the barley and silage values:

Cost = (Canfax cost/head)*(weight gain mgnt/weight gain of Canfax)*(ADG Canfax/ADG mgnt)

Where:

weight gain mgnt = weight gain under the management practice
weight gain of Canfax = weight gain from the Canfax data
ADG Canfax = Average Daily Gain from Canfax

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ADG mgnt = Average Daily Gain from management practice.

This formula attempts to adjust the average costs that are generated from the Canfax data to better reflect the change in management for specific management systems.

The greenhouse gas emission data was based on a net change in greenhouse gas emissions from actual operations. In this case, the net change is the reduction in greenhouse gas emissions per animal in the feedlot and this value was multiplied by the price of carbon to get the revenue from the carbon offset reductions. It was assumed that the feedlot operator used an aggregator to sell the carbon offset. As a result, it was assumed that the feedlot operator would receive $4.00 per tonne of carbon reduced but would have no cost in generating the carbon credit. Talking to aggregators, this seemed to be a reasonable assumption.

It was assumed that the change in management included a change in the beta-adrenergic agonist used in the operation. As a result, the cost of production included the additional cost of the new beta-adrenergic agonist.

Finally, it was assumed that the same animal numbers and types would be used to compare the baseline management practice and the change in management practice. It should be noted that the baseline management practice tended to favour the development of smaller animals and finishing them at lower weight than the change in management practice. This change in management to heavier animals seems to be more market driven.

Interviews were undertaken with experts who worked with feedlot operators to obtain information on the baseline practices and the change in practice. This included the changes in practices, information on weight in, weight out, average daily gain, and number of days in the feedlot.

A spreadsheet model was developed to analyze the costs and benefits of the change in management practice. The spreadsheet model contained 10 sheets. The first sheet provided an introduction to the spreadsheet and instructions on how to fill it out. There are four input data sheets, one for each animal type; heifer calf, steer calf, yearling heifer, and yearly steer. Each of the input data sheets is identical and an example is given in Table S-1. The sheet is divided into two sections, the first section relates to the baseline management practice while the second section relates to the change in management practice. The first component of each section collects information on weight in, weight out, days on feed, and average daily gain. The next component collects information on the cost of production for each management practice, the third component collects information on greenhouse gas emissions and the number of animals.

All of this information for each animal type is collected for both management practices. It is possible to put up to three years of information into the spreadsheet. This allows for planning but also to evaluate the change in management practices over various periods of the cattle cycle.

There are four calculation sheets in the model. Each calculation sheet retrieves the information from the input sheet for each animal type. Thus the four sheets are: heifer calf calculations, steer calf calculations, yearling heifer calculations, and yearling steer calculations. An example of the first year of a calculation sheet is given in Table S-2.

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The calculations sheet include the basic information on the animal in terms of the production practice; i.e. weight in, weight out, average daily gain, days on feed, and gain. The next section contains the cost of the production and estimates the margin per hundred weight and per head. The next section contains the price per hundred weight and estimates the net margin per head. Finally there is a greenhouse gas calculation that estimates the revenue generated from greenhouse gas reductions on a per head basis.

The final sheet in the model is the "producer profitability" sheet (Table S-3). This sheet starts by asking the producer to provide a discount rate so that a present value calculation can be undertaken over the three years. The next section carries over the number of animals in each animal type for both the baseline production method and the change in management. The next section estimates the net margin per head for the baseline management as well as the total margin. This is followed by a similar calculation for the change in management practice. The next section estimates the value and tonnes of carbon generated from the change. Finally, the impact of the change as well as a net present value calculation for the three years is estimated.

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Table S - 1: An Example of the Input Sheet – Heifer Calf

Heifer Calf	Year 1	Year 2	Year 3
Baseline Management Practice			
Baseline -Weight In			
Baseline - Days on Feed			
Baseline - Average Daily Gain			
Baseline - Weight Out			
Input Costs Per Animal (Baseline Management Practice)			
Feeder ($/CWT)			
Silage ($/head)			
Barley or Future Price (cost) of Barley ($/head)			
Supplements ($/head)			
Ractopamine Hydrochloride ($/head)			
Transportation ($/head or $11.50 per head)			
Vet and medicine ($/head or 3% of the value of the feeder calf)			
Interest ($/head or Prime plus 1% on the value of cattle)			
Overhead ($/head or $0.17/calve/day)			
Death loss ($/head or default 1.5% of feeder cost)			
Marketing Charges ($/head or $2 per head)			
Interest Adjustment			
Feed Adjustment			
Market Price (Expected Market Price or Hedgeable Price)			
Carbon Emissions per Head - in tonnes (Baseline Management)			
Number of Animals (Total number of Heifer Calves in Baseline)			
Change in Management Practice			
Weight In			
Days on Feed			
Average Daily Gain			
Weight Out			
Input Costs per Animal (Change in Management)			
Feeder ($/CWT)			
Silage ($/head)			
Barley or Future Price (cost) of Barley ($/head)			
Supplements ($/head)			
Ractopamine Hydrochloride ($/head)			

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Heifer Calf	Year 1	Year 2	Year 3
Transportation ($/head)			
Vet and medicine ($/head or 3% of the value of the feeder calf)			
Interest ($/head or Prime plus 1% on the value of cattle)			
Overhead ($/head or $0.17/calve/day)			
Death loss ($/head or default 1.5% of feeder cost)			
Marketing Charges ($/head or $2 per head)			
Interest Adjustment			
Feed Adjustment			
Market Price- $/cwt (Expected Market Price or Hedgeable Price)			
Carbon Emissions per Head - in Tonnes (Management Change)			
Producer Revenue per Tonne of Carbon			
Producer Costs per Tonne of Carbon			
Number of Animals (Total number of Heifer Calves)			

Table S - 2: An Example of a Calculation Sheet – Yearling Heifer

	Year 1	
	Type of Cattle Yearling Heifer	
	Baseline	**Management Change**
	Your Operation	
Sex	Female	Female
Weight In (lbs)	844.00	**860.06**
Weight Out (lbs)	**1329.00**	**1382.70**
Days on Feed	**147**	157
Gain (lbs)	485	523
Average Daily Gain (lbs)	3.33	3.33
	Your Costs	Expected Cost
	Current Practice	Reduced Days on Feed
Cost of Feeder ($/cwt)*(weight in/100)	942.24	960.17
Feeder Price ($/cwt)	111.64	111.64
Silage ($ per head)	26.79	28.83
Barley ($ per head)	257.15	276.76
Ractopamine Hydrochloride (28 days)	10.00	23.00
Supplement ($ per head)	8.31	8.31
Cost of Feed ($)	302.24	336.90

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	Year 1	
	Type of Cattle Yearling Heifer	
	Baseline	**Management Change**
Feed and Feeder ($)	1244.48	1297.07
Transportation In ($ per head)	16.75	16.75
Vet and Medicine ($ per head)	12.56	12.56
Interest ($ per head)	16.62	16.62
Overhead ($ per head)	57.37	57.37
Death Loss	8.37	8.37
Marketing Charges	2.00	2.00
Interest Adjustment	0.13	0.13
Feed Adjustment	**10.82**	**10.82**
Total All Costs	**1369.10**	**1421.69**
Selling Price to Cover		
Feed and Feeder	94.45	94.59
All Costs	103.02	102.82
Cost Per CWT Gain		
Feed	**64.55**	**66.53**
All Costs	**88.01**	**88.31**
Expected Market Price ($ per CWT)	**104.75**	104.75
Net Margin		
Current ($/cwt)	1.73	1.93
Margin Per Head ($/hd)	23.02	26.68
Carbon Emissions per Head	0.0000	0.0300
Change in Carbon Emission per Head		0.0300
Net Carbon Revenue per Tonne		4
Carbon Revenue per Head		0.12

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Table S - 3: Producer Profitability Calculations for the Change in Management

Producer Gross Margin Analysis			
Discount Rate for the Present Value Calculation -enter as a percentage, i.e. 5% entered as 0.05			
	Year 1	**Year 2**	**Year 3**
Number of Head (Baseline Practice)			
Heifer Calves			
Steer Calves			
Yearling Heifers			
Yearling Steers			
Number of Head (Change in management Practice)			
Heifer Calves			
Steer Calves			
Yearling Heifers			
Yearling Steers			
Net Margin Per Head (Baseline Management Practice)			
Heifer Calves			
Steer Calves			
Yearling Heifers			
Yearling Steers			
Net Margin (Baseline Management Practice)			
Heifer Calves			
Steer Calves			
Yearling Heifers			
Yearling Steers			
Total Net Margins (Baseline Management Practice)			
Net Margin Per Head (Change in Management Practice)			
Heifer Calves			
Steer Calves			
Yearling Heifers			
Yearling Steers			
Net Margin (Change in Management Practice)			
Heifer Calves			
Steer Calves			

Producer Gross Margin Analysis			
Yearling Heifers			
Yearling Steers			
Total Net Margins (Change in Management Practice)			
Carbon Market Revenue (Per Head)			
Heifer Calves			
Steer Calves			
Yearling Heifers			
Yearling Steers			
Carbon Market Revenue (Total)			
Heifer Calves			
Steer Calves			
Yearling Heifers			
Yearling Steers			
Total Carbon Revenue			
Carbon Credits Generated (Tonnes)			
Total Net Revenue (Change in Management Practice)			
Change in Revenue from the Change in Management Practice			
(New Mangement Practice Minus Baseline Practice)			
Net Present Value of the Baseline			
Net Present Value of the Change in Management			

Results

The results from the analysis are given in a number of different forms; i.e. net margin per head, total values, carbon values per head, total carbon value, total tonnes of carbon, and the net present value. Table S-4 provides the results of each management practice in terms of the net margin per head. The results would indicate that the net margins per head in year 2 and 3 are negative for both management practices. The baseline management practice provides better estimates of the net margin for the heifer calf and steer calf animal types. While for the larger animal types; yearling heifer and yearling steer, the change in management provides better net margin estimates except for year 3 for yearling heifer. However, the net margin for this animal type in year 3 are close; -$53.74 versus -$54.35. It is only in year 1, when the 2011 Canfax average data was used, where we find positive net margins.

Table S - 4: Net Margin per Head for Each Management Practice

	Year 1	Year 2	Year 3
Net Margin Per Head (Baseline Management Practice)			
Heifer Calves	23.83	-112.51	-58.36
Steer Calves	23.83	-112.51	-58.36
Yearling Heifers	23.02	-109.74	-53.74
Yearling Steers	59.28	-87.46	-55.96
Net Margin Per Head (Change in Management Practice)			
Heifer Calves	-1.06	-141.01	-91.83
Steer Calves	-1.06	-141.01	-91.83
Yearling Heifers	26.68	-109.17	-54.35
Yearling Steers	70.02	-79.44	-46.22

Table S-5 provides an estimate of the total net margins going to the feedlot operation. The total net margin is estimated by taking the margin per head and multiplying it by the number of head. In this scenario, it was assumed that 259,559 head would go through the feedlot in any one year. The distributions of animals by animal type going through the feedlot were: heifer calves 22,769, steer calves 31,898, yearling heifers 73,517 and yearling steers 131,375. Given the negative margins per head in years 2 and 3, in particular, there is a negative total net margin in those years.

Table S - 5: Total Net Margins for Both the Baseline and Change in Management Practice

Total Net Margins (Baseline Management Practice)		
Year 1	**Year 2**	**Year 3**
$10,783,673	-$25,708,590	-$14,492,076
Total Net Margins (Change in Management Practice)		
Year 1	**Year 2**	**Year 3**
$11,103,146	-$26,171,020	-$15,088,517

The carbon revenue per head for the three years plus the total carbon revenue is given in Table S-6. The greatest carbon revenue per head by animal type is for steer calves. This is followed by heifer calves, yearling steers, and yearling heifers. The carbon revenue estimates are based on the feedlot operator

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receiving $4.00 per tonne of carbon generated. The total revenue generated from the carbon reduction is $45,879 per year. The total reductions in carbon were 11,470 tonnes. This increase in revenue from the carbon market from the change in management is not large enough to offset the lower net margins per head.

Table S - 6: Carbon Market Revenue from the Change in Practice

Carbon Market Revenue (Per Head)			
	Year 1	**Year 2**	**Year 3**
Heifer Calves	$0.20	$0.20	$0.20
Steer Calves	$0.36	$0.36	$0.36
Yearling Heifers	$0.12	$0.12	$0.12
Yearling Steers	$0.16	$0.16	$0.16
Total Carbon Revenue	**$45,879.12**	**$45,879.12**	**$45,879.12**

A net present value calculation over the three years was estimated for both the baseline and change in management. Using a 5 percent discount rate, the net present value for the baseline management option was a negative $25.5 million, while the net present value for the change in management was a negative $26 million.

Conclusions

A spreadsheet model was developed to estimate the total net margin for both a baseline and a change of management practice that would result in a decrease in greenhouse gas emissions. The model results indicated that the baseline management practice provided higher net margins per head for heifer calves and steer calves, while the change in management practice provided better net margins per head for yearling heifers and yearling steers. The model was also able to estimate the carbon revenue generated from the change in management. In both cases however, the net present value of the operations were overall negative over the three years.

Finally, it should be noted that the accuracy of the net margins per head calculation in the spreadsheet model is dependent on the data going into the model. The data used in this scenario analysis was based on average Canfax data with some modifications for management practices. Providing actual producer data for the cost of production for the two management systems would provide better estimates of the net margins per ha.

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Appendix T: Year One DOF Validation Study Report

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Days on Feed (DOF) Validation Study Report

Submitted to: Alberta Agriculture and Rural Development

Date: May 31, 2013

Submitted by: KHK Consulting Consortium

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Findings to Date

The purpose of the DOF Protocol Validation Study is to learn about the barriers, gaps, solutions and options for adopting the DOF protocol in the marketplace. More specifically, the objectives of the Study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field;
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocol at a commercial scale;
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocol; and
- Catalyzing continued aggregation efforts for bringing offsets forward from aggregated agricultural projects.

In order to accomplish the above objectives, the DOF Protocol Validation Study worked with the aggregation group of AgriTrend-FHMS. This group aggregated 6 feedlots, under the provision of the Reduced Days on Feed Protocol v 2.0, July 2011, totalling 300,000 head in the 2012 project year, using a baseline of 2009-2010-2011 average emissions. ICF-Marbek completed the mock verification and gap analysis on the aggregated project for the Protocol Validation Study (the results of this analysis can be found in ICF Marbek's Mock Verification and Gap Analysis Report). It should be noted that at the time of the mock verification, the state of AgriTrend-FHMS's DOF project was such that the gathering of substantiating feedlot records by the co-aggregators was not complete and compiled in such a way to support a full mock-verification at reasonable level of assurance by ICF Marbek. However, ICF-Marbek observed that the feedlots in the project have the capacity to measure, manage and report the data required to meet protocol requirements and that documentation is available to support reasonable level of assurance.

Version 2.0 of the Beef Reduced Days on Feed Protocol (DOF) is based on an older protocol format. As a result, Section 5 has not been updated to meet Reasonable Level of Assurance as currently understood in the Alberta Offset System. Interpretive guides have been prepared in the past for ARD, with a detailed evidence table, but these are not part of the published version on line, used in the PVS Study's mock verification.

Key Findings from the PVS study are as follows:

Protocol Revisions:

1) The DOF protocol needs to be revised to be consistent with the Conservation Cropping Protocol's Section 5 - Data Management section, particularly the minimum evidence tables.
2) A material discrepancy can occur if key parameters of average number of head, average number of days on feed and average daily dry matter intake are not calculated using the animal.head day basis (a weighted average approach) for an animal grouping (Section 4.3 of the DOF Protocol). This occurs because animals in a grouping may be sent for sale and effectively leave the group at various times (i.e. the whole group is not sold simultaneously). Therefore, the protocol should be amended to say the animal head.days approach **must** be used (Section 4.3 of the DOF Protocol).

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Market Factors:

1) In the beef industry, a significant amount of cattle are being sold in the open market (as opposed to a quality grid program) at heavier and heavier carcass weights, and retained longer in the feedlots. As a result, on average, the number of days that beef cattle are on feed is actually increasing in comparison to the baseline years. Consequently, under the current protocol the opportunity to generate credits based on reduced days on feed is very small.

Calculation of GHG Emission Reductions:

1) This study has examined how the protocol functions in calculating the reductions of GHG emissions, and in a commercial feedlot the reality is that some animal groupings will have shown a reduction from baseline, while others will not. The feeding efficiencies of animals in a feedlot are based on a number of factors – weather, animal health, condition, frame, animal diets, feeding strategies, additives and animal husbandry. It is the net reduction of all relevant animal groupings in the project year that determines whether a feedlot has a claim.

2) On a net basis, the GHG tonnage generated by the 6 feedlots was approximately 18,000 tonnes of emission reductions/offsets on roughly 300,000 animals for the 2012 project year. That works out to about 0.06 tonnes/head. The original estimates by John Basarab and Karen Haugen-Kozyra on reduction potential was on average 0.04 tonnes/head (See Final Producer Spreadsheet prepared by Paul Thomassin).

Cost-Benefit Analysis:

15) The Cost-Benefit Analysis for the DOF PVS study was conducted on both a feedlot production basis and an aggregator position basis. For the Aggregator Position, three scenarios were analysed – optimistic, expected and pessimistic (See Aggregator Spreadsheet and "The Benefit Cost Analysis of the Aggregator's Position as it Relates to Livestock Feeding" documents). The key variables are shown in the following table:

	Costs	Optimistic		Expected		Pessimistic	
	Start-up + Operating*	Price	Quantities (Tonnes)	Price	Quantities (Tonnes)	Prices	Quantities (Tonnes)
Initial Costs	$ 103,000						
Year 1	$ 123,000	$13	10,000	$13	10,000	$13	4,000
Year 2	$ 133,000	$13	20,000	$13	15,000	$13	5,000
Year 3	$ 159,500	$27	30,000	$23	18,000	$13	6,000
Year 4	$ 180,000	$27	45,000	$23	25,000	$13	6,000
Year 5	$ 201,000	$27	45,000	$23	25,000	$13	6,000
Year 6	$ 201,000	$27	50,000	$23	25,000	$13	6,000
Year 7	$ 206,000	$27	50,000	$23	25,000	$13	6,000

*start-up costs are based on building the Days on Feed data management system on an existing platform.

16) The results of the Aggregator Cost-Benefit Analysis (CBA) showed the net return per credit for the aggregator varied from $9.97 per tonne for the optimistic scenario to a negative $19.00 a tonne in the pessimistic scenario (net present value basis). The expected scenario provided a net return of $5.50 per credit. The low number of credits in the pessimistic scenario caused the cost per

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tonne of carbon generated to be high; i.e. $25.82 per tonne, as compared to the optimistic scenario where the cost per tonne was $4.65 per tonne. The number of tonnes generated is an important variable because as this value increases it decreases the fixed costs per tonne. This speaks to the need to have the proper scale of aggregation in order to be profitable in the carbon offset market. The cost per tonne in the expected scenario was $7.56 per tonne. In two of the three scenarios the aggregator made money with this operation. In the pessimistic scenario the aggregator was estimated to generate a net loss of $740,834 over the seven years. Three of the important variables that will determine the profitability of the aggregator will be the price of the carbon credit, the split between the aggregator and the producer, and the number of carbon offset credits that are generated. The calculator spreadsheet produced in the CBA can be used by stakeholders to vary the size of the project, split between aggregator and feedlot operator and price per tonne of carbon to find the touchpoint for engaging in a Beef DOF project. The CBA also demonstrated that a single feedlot attempting to bring a project forward on their own would likely not be a profitable endeavour, unless it was very large, and even then, the assumed risk would likely deter most operations (See Aggregator Spreadsheet and "The Benefit Cost Analysis of the Aggregator's Position as it Relates to Livestock Feeding" documents).

17) In the producer CBA (see Producer Spreadsheet and "The Benefit Cost Analysis of Feedlot Operators Change in Management Practices" documents), Canfax data was used to generate the costs and returns for 4 animal groupings – calf-fed steers, calf-fed heifers, yearling-fed steers and yearling-fed heifers (these are the majority of animals found in feedlots today). Then, some real project data was used to revise some of the estimates for the analysis, but most of the stats came from Canfax data (these can be found in the producer spreadsheet). The net margins calculated from the data are shown below:

Total Net Margins (Baseline Management Practice)		
Year 1	**Year 2**	**Year 3**
$10,783,673	-$25,708,590	-$14,492,076
Total Net Margins (Change in Management Practice)		
Year 1	**Year 2**	**Year 3**
$11,103,146	-$26,171,020	-$15,088,517

18) The modeled results indicated that the baseline management practice provided higher net margins per head for heifer calves and steer calves, while the change in management practice provided better net margins per head for yearling heifers and yearling steers. The model was also able to estimate the carbon revenue generated from the change in management. In both cases however, the net present value of the operations were overall negative over the three years. It should be noted that the accuracy of the net margins per head calculation in the spreadsheet model is dependent on the data going into the model. The data used in this scenario analysis was based on average Canfax data with some modifications for management practices. Providing actual producer data for the cost of production for the two management systems would provide better estimates of the net margins per head and the total net margin (see Producer Spreadsheet and "The Benefit Cost Analysis of Feedlot Operators Change in Management Practices" documents).
19) The feed cost assumptions in the Feedlot Operator economic analysis has been confirmed as appropriate by the contact at FHMS (Luis Felix; personal communication April 12, 2013).

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Documentation and Records - Materiality:

1) Compared to cropping projects, electronic record keeping and data management systems at beef feeding operations in Alberta with respect to inventory, feeding, performance and rations, have a high level of accuracy in measurement and significant control-based measures (see ICF Marbek's Mock Verification and Gap Analysis Report).
2) The mock –verification revealed that the data with the greatest risk of error is the actual feed that has been fed on the feedlot. This data is collected on each feed truck as it is loaded. The verifier for each project needs to evaluate the systems in place for measuring, recording and storing this data. In the mock-verification the feedlots visited had strong systems (data was recorded by each truck operator and transcribed into the feedlot data management system the same day); however, some feedlots (particularly those that are small) may not have sufficient controls in place to ensure the integrity of feeding data. During the mock-verification ICF Marbek heard that there was an initiative underway to install electronic devices in each truck that would be wirelessly connected to the feedlot's central data management system. This would further reduce risk because it would eliminate one of the steps in the process. Ultimately, it will be up to the feedlot operators to ensure they have the appropriate systems in place and verifiers to evaluate those systems..
3) Available evidence and documentation assessment – ICF Marbek has provided further comments as to the availability of evidence to support reasonable level of assurance (Appendix T - B) even though the documentation was not compiled in the manner the protocol requires.
4) A best practice guide to verification for DOF projects is needed to clarify documentation requirements and support reasonable level of assurance (See DOF Best Practice Guide).

Recommendations:

Due to the capacity and practical realities of raising cattle in Alberta feedlots, both KHK Consulting and ICF-Marbek recommend that any 'indicators' like 'reduced days on feed' or decreased feed to gain ratio should be removed from the protocol. The protocol quantification, as it stands, for baseline and project will determine whether a net reduction has occurred across animal groupings in the feedlots. The protocol should also recognize that the 'net reduction' across all animal groupings represents the emission reduction, even though some animal groupings may be net emitters and some animal groupings are net reducers. It is the overall net-net of the sum of all GHG emissions, baseline to project that represents the true reduction.

The Beef Reduced Days on Feed protocol should be revised to a 'Reduced Carbon Intensity of Fed Cattle' protocol, since the basics of the protocol quantification depend on the GHG emissions level per kg of hot carcass weight of the project being less than the levels in the baseline, on a net basis across all animal groupings. This does not change the quantification of the methodology at all, nor the scope. Just eliminates the 'quick and easy' indicator for potential reductions requested at a time when project developers were used to the simpler quantification methodologies of the Tillage Management System protocol.

The revisions to the Beef Reduced Days on Feed protocol, to the 'Reduced Carbon Intensity of Fed Cattle' protocol, along with summary of changes document have been submitted to ARD for review. The protocol

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now aligns well with the USDA-BIGGS pilot-adapted version submitted to the American Carbon Registry for review.

In Summary, larger feedlot operators in Alberta have sufficient controls and the capacity to ensure integrity of data and documentation to support the data.

Background on the Protocol:

The Reduced Days on Feed protocol was originally drafted to include an 'indicator' of emission reductions, requested at the time by project developers, so they wouldn't have to go to all of the trouble of collecting 3 years of baseline data, calculate the average emissions level, and then collect a year's worth of project data to see whether or not the emissions level was lower in the project than the baseline. The concern at the time, was that the protocol is so complex, the project developer needed an easy and accessible 'indicator' to see whether there may be a potential reduction worth going after, before they went to all the trouble of implementing the protocol and building the infrastructure to support it.

The Protocol Validation study has revealed that the number of days animals spend in the feedlot can be a function of the market demand, which has been for heavier and heavier animals. ***This is a significant barrier to implementation of the protocol.*** Further, in practice, not all animal groupings will show a reduction. The feeding efficiencies of animals in a feedlot are based on a number of factors – weather, animal health, condition, frame, animal diets, feeding strategies, additives and animal husbandry. It is the net reduction of all relevant animal groupings that determines whether a feedlot has a claim.

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Appendix T-A: Relevant Documents

ICF Marbek's Mock Verification and Gap Analysis Report – ATAI and FHMS Beef DOF Pilot Project

Quantification Protocol for Reducing Days on Feed for Beef Cattle, Version 2.0, July 2011

Interpretive Guide to Applying the Reducing Days on Feed of Beef Cattle Quantification Protocol, March 2012

Reduced Days on Feed Best Practice Guide

The Benefit Cost Analysis of Feedlot Operators Change in Management Practices

The Benefit Cost Analysis of the Aggregator's Position as it Relates to Livestock Feeding

Producer Spreadsheet

Aggregator Spreadsheet

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Appendix T- B: Mock Verification Documentation Summary

Data Requirement	Source of Data and Supporting Documentation	Mock Verification Evaluation
Animal Identification Tags	Feedlot records	Completed during site visits. All feedlots in project use CFIA identification tags and electronic records for managing animals within each lot.
Number of cattle in group	Feedlot records and project developer records	Process for sorting animals into lots was observed during site visit. Project developer's method for sorting animals into groupings was reviewed and confirmed through review of project data.
Number of animals in production	Feedlot inventory records	Feedlot inventory records reviewed and compared against Project Developer groupings. Shipping manifests were not reviewed during mock verification, but were available for review.
Incoming and Outgoing Weights	Weigh scale records for both individual animal weights (as received/shipped) and shipping truck Packing plant weights	Records of animal weights, truck weights and packing plant weights were observed within data management systems during site visit. In a full verification, a sample of original records would be compared to electronic records to review potential for transcription error.
Number of Days on Feed	Feed rations Feedlot feeding records	Actual feed fed to each lot is recorded through feeding truck logs. The process for recording this information was observed during site visits. Number of days on feed is determined from days each ration is actually fed.
Composition of Each Diet	Nutrition analysis reports	Nutrition analysis was reviewed within project data.
Dry Matter Intake	Feedlot feeding records	Actual feed fed to each lot is recorded through feeding truck logs. The process for recording this information was observed during site visits.
Eligibility - Manure Management	NRCB permit	Permit observed during site visit. Inquiry and observation confirmed current state of manure management systems.

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Appendix U: Year One DOF Mock Verification Report

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ICF Marbek
an ICF International Company

Beef Reduced Days on Feed Aggregation Pilot Project

Agri-Trend Aggregation Inc. (ATAI) and Feedlot Health Management Services (FHMS)

Mock Verification Final Report

March 28, 2013

ICF Consulting Canada, Inc.
2600 – 144 Fourth Avenue SW
Calgary, AB T2P 3N4

Introduction

Alberta's greenhouse gas (GHG) regulatory framework has created a vibrant carbon market, with over 8.4 million tonnes of voluntary carbon emission reductions generated in the form of carbon offsets. Carbon offsets are provided by sectors that do not have a regulatory target, and are sold to companies with regulatory obligations under Alberta's Specified Gas Emitter Regulation (SGER), 2007. The agriculture sector has been a major provider of carbon offsets to the market, contributing over 20% of offsets used for compliance with the SGER.

In order to support efforts needed to attain this higher standard of verification, Alberta Agriculture and Rural Development (AARD) initiated a Protocol Validation Study (PVS) as a capacity-building exercise to gather knowledge about the application of the Reducing Days on Feed protocol to compile a Carbon Offset Project, including validation to a reasonable level of assurance. The aggregation company, Agri-Trend Aggregation Inc. (ATAI), has volunteered to compile a Carbon Offset Project using on-farm data from 6 feedlots in Alberta.

Specifically, the PVS study will emulate the process of aggregating participating producers under the provisions of the protocol to bring forward agricultural offsets that can be tested in a mock verification exercise to a reasonable level of assurance, for the purposes of collectively learning about the barriers, gaps, solutions and options for adopting these protocols in the marketplace. The objectives of the PVS study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field.
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale.
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols.

This report provides the results of the mock verification, an analysis of the gaps found in the project to meet the current quantification protocol and potential gaps or areas for improvement with the Protocol itself. Additionally, an analysis of a "Verifiers Best Practices Guidance" document, which has been developed through the PVS has been appended to this report.

1 Verification Summary

Lead Verifier:	Aaron Schroeder, P.Eng.
Associate Verifier(s):	Michelle Stelmach, Jessica Abella
Internal Peer Reviewer:	Duncan Rotherham
Verification Timeframe:	January – March, 2013
Objective of the verification:	Gap analysis through a mock verification on pilot Project
Final report being provided to:	Alberta Agriculture and Rural Development
Standard being verified to:	ISO 14064-3:2006 (ISO, 2006)
Verification criteria employed:	Climate Change and Emissions Management Act Specified Gas Emitters Regulation (Alberta Regulation 139/2007) Technical Guidance for Offset Project Developers, Version 4.0, February 2013 Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013 Quantification Protocol for Reducing Days on Feed for Beef Cattle, Version 2.0, July 2011
Verification scope – Gases:	Methane, Nitrous Oxide
Project:	Beef Reducing Days on Feed Aggregation Pilot Project
Location(s):	Highland Feeders – Vegreville, Alberta Western Feedlots – High River, Alberta Western Feedlots – Mossleigh, Alberta Western Feedlots – Strathmore, Alberta Strangmuir Farms – Strathmore, Alberta Lakeside Feeders – Brooks, Alberta
Project Start Date:	January 1, 2012
Credit Start Date:	January 1, 2012
Credit Duration Period:	January 1, 2012 – December 31, 2019
Project Report Temporal period:	January 1, 2012 – December 31, 2012

Main Contact (Verifier):	Aaron Schroeder, P.Eng. Senior Manager - Climate Suite 2600 144 - 4 Ave SW Calgary, Alberta T2P 3N4 403.450.7522 aaron.schroeder@icfi.com
Main Contact	Agri-Trend Aggregation Inc. (ATAI) Bill Dorgan, President #6 – 4630 61st Street Red Deer, Alberta, T4N 2R2 Phone: 403.608.0992 Fax: 403.474.6287 Email: bdorgan@agritrend.com Feedlot Health Management Services (FHMS) Calvin Booker PO Box 140 Okotoks, Alberta, T1S 2A2 Phone: (403) 938-5151 Fax: (403) 938-5175 Email: calvinb@feedlothealth.com

2 Project Information

Agri-Trend Aggregation and Feedlot Health Management Services, ("**ATAI and FHMS**") have developed the necessary documentation detailing project activities to support their claim for emission reductions to be registered on the Alberta Offset Registry under Alberta's Specified Gas Emitters Regulation. Alberta Agriculture and Rural Development (**"AARD"**) engaged ICF Consulting Canada, Inc. ("**ICF Marbek**") to provide a third-party mock verification of the emission reduction asserted by ATAI and FHMS related to the project activities discussed herein.

The quantification of the emission reductions associated with the project is defined by Alberta Environment and Sustainable Resource Development's ("**AESRD**") Quantification Protocol for Reducing Days on Feed for Beef Cattle, Version 2.0, July 2011 ("**the Protocol**"). The Project Report describes the emission reduction claim ("**GHG Assertion**") made by ATAI and GHMS related to this project.

The Beef Reducing Days on Feed Aggregation Pilot Project ("**the Project**") covered by this verification engagement involves 2012 vintage emission reductions achieved through innovative feeding practices on participating feedlots. The Project is located in on six participating feedlots from across Alberta.

ATAI and FHMS have a contractual relationship with each of the feedlot owners to aggregate the emission reduction assertion from each site into the Project. ATAI and FHMS have established the right to transact on credits that would be created from the Project.

This is the first verification of any project under the Protocol (although this is a mock verification).

This document describes the terms and scope of this verification. It serves to communicate the findings of the verification.

3 Verification Execution

The scope of the mock verification was defined during the planning stage and is detailed in the Verification Plan, which is appended to this document. The Verification Plan also describes ICF Marbek's verification process that was executed through the course of the verification, and identifies the specific verification procedures that were planned and executed through the process.

The verification was completed according to Plan. The final verification schedule was as follows:

Procedure	Date
Verification Kickoff Meeting	January 9, 2013
Verification Procedures Conducted	January 9 – March 15, 2013
Site Visits	February 21, 2013
Internal Peer Review	March 27, 2013
Final Verification Report Issued	March 28, 2013

3.1 Site Visit

The site visit was conducted by Aaron Schroeder on February 21, 2013

The site visit was a key step in planning and executing the verification. During the course of the site tour, ICF Marbek interviewed key site operations personnel regarding the operations and data management for the Project.

Two of the six participating feedlots were visited during the site visits. Luis Felix, Special Projects Consultant from FHMS, coordinated the site visits and provided technical information related to data management and quality controls applied at the Project level to ensure consistency across the participating feedlots.

Strangmuir Farms – Strathmore, Alberta

- Interviewed Scott Laing – Feedlot Accountant

Western Feedlots – High River, Alberta

- Interviewed Cory Severtson and Donna Speers

The process used for tracking animals through the feedlot is similar at both feedlots that were visited and generally follows these steps:

- Animals entering the feedlot are recorded in the feedlot electronic management system by scanning the radio frequency identification (RFID) tag that was implanted in the animal prior to leaving the originating farm. The electronic record of the animal (including birth date, immunizations, weights, and other information) is downloaded into the feedlot management system. Additional information will be added to the record during the animal's time on the feedlot.
- The animal's received weight is measured in a sorting barn on a calibrated scale. This information is recorded in the feedlot management system.
- Generally, the received weights of all animals is compared to the truck weight as a control check.
- Animals may be re-sorted during the time at the feedlot. During the re-sorting process, animals are weighed again and these weights are recorded in the feedlot electronic management system.
- If any animal loses its RFID tag, a new tag is implanted and linked to the animal's record. Since this is a very rare event (anecdotally reported as 1/20,000), feedlot operators generally do not have any difficulty identifying the animal missing a tag. Animals also have ear tags that may be used in identification. Ear tags in conjunction with other animal characteristics (breed, color, sex) are used in identification.
- If animals leave the group to enter the hospital, they continue to be tracked through the hospital group. If the animal cannot be returned to its original group, it is general sent to a smaller, local packer. Typically four to five animals per 300-head lot are sent through this pathway.
- Deaths are tracked and these animals are immediately removed from the group tracking.
- The total quantity of feed fed to the group is adjusted for animals that are permanently removed from the group (either sent to the hospital group and never returned or deaths). Therefore, the total quantity of feed fed to a group represents only that which is fed to the animals that are in the close out group.
- When animals leave the group to be sent to the packing plant, they are weighed again on an individual level and the shipping truck is weighed. These weights are compared with the weights provided by the packing company and highly scrutinized as these weights form the basis for the commercial sale of the animals.

The process used for tracking animal feed is also similar at both feedlots that were visited as follows:

- Samples of silage, straw and grain are sent to a third-party laboratory for analysis
- Grain moisture content is known; silage moisture content is measured daily
- Feed rations for each cattle type is formulated (some modifications between rations for sex and stage of feeding with animals starting in the feedlot receiving high silage/low grain rations; grain is gradually increased as animal finishes)
- Feed additives are generally added to the feed ration over time as the animal finishes
- Feed ration is sent to feed truck driver who mixes the feed using calibrated weigh scales, then feeds the ration and records the pen that was actually fed.
- The feedlot's electronic management system calculates the dry matter intake (DMI) , which is recorded for each pen
- The mix efficiency is monitored through random testing to ensure that all animals in the pen are receiving the defined ration (within tolerance)

Matt May, Ph.D, Feedlot Nutritionist Consultant at Feedlot Health Management Services, provided additional information regarding the analysis of feed used at the feedlots in the project. All feed data is stored electronically in the FHMS database for each feedlot. Matt also provided information regarding innovative feed management processes and feed additives that are being implemented to increase feed conversion efficiency. Further, Matt and Luis provided a description of the calculation of the average ration used for the emission reduction calculation.

Sandi Parr, Feedlot Nutritionist and Production Consultant at Feedlot Health Management Services, provided a demonstration of the electronic data management systems used by FHMS that periodically receives data from each of the feedlots in the project and is also used for storing and formulating feed rations. She provided information on data validation, integrity and security.

3.2 Summary of Project Changes

Major GHG emission sources and sinks have been identified by the Responsible Party and are detailed in the Offset Project Plan. The quantification methodologies outlined in the Protocol have been used to calculate GHG emission sources and sinks. There have been no changes made to the project since the Offset Project Plan was completed (this is the first year of the pilot project).

The uncertainty associated with the quantification methodologies applied was evaluated during Protocol development. The Project meets the data collection and project specific calculation requirements of the Protocol and therefore, the uncertainty associated with the quantification and resulting assertion meets AESRD requirements.

3.3 Verification Strategy

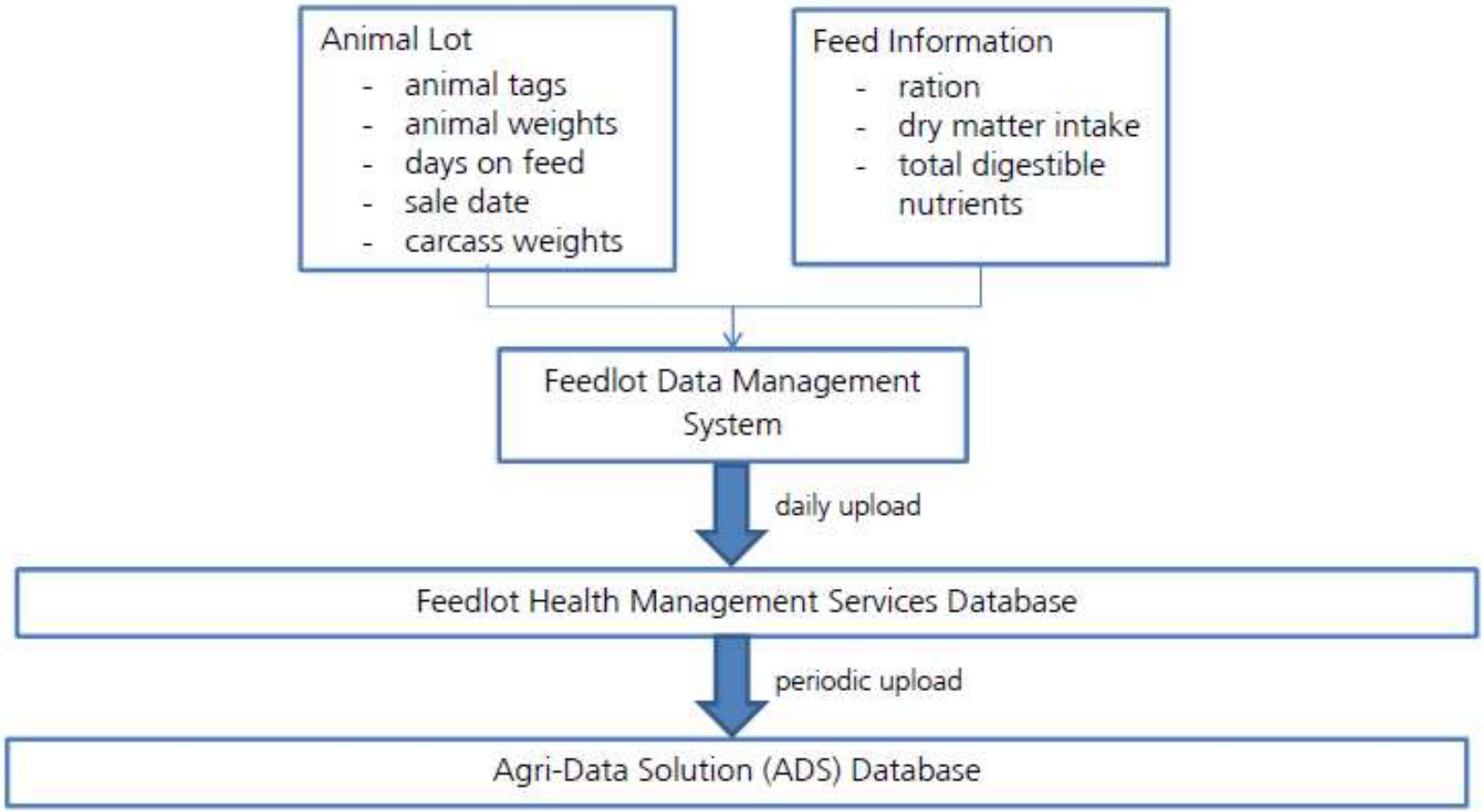
The Verification Strategy applied to this mock verification was a predominantly substantive approach. The Verification Team designed and executed verification procedures that focused on review of original metered and measured data.

The Responsible Party relies on certain controls for the quantification of emissions and to establish project eligibility. ICF Marbek relied on the following controls and as such, tested the operational effectiveness of these controls and data the controls are processing. Detail of the verification procedures employed to conduct these tests are provided in the Verification Plan.

- Feedlot data (including total head days, days on feed, feed dry matter intake, animal weight and calculation of total gain) is all managed using software that is maintained by each feedlot. The primary purpose of this software is to manage production of animals and to reconcile payments made for finished product. During the site visits, the data integrity and security of these systems was evaluated. Further testing of the data produced by these systems was conducted subsequent to the site visits using analytical procedures, which are detailed in the Verification Plan.

3.4 Data Management and Control System Review

The Verification Team developed a thorough knowledge of the data management and control systems utilized in the Project through the review of the Offset Project Plan, observations during the site visit, and interviews with key Project personnel. The data flow diagram shown below outlines the flow of project data and the custody of control.



4 Verification Results

4.1 Misstatements

The misstatement details sections below include an approximated value of the asserted quantity affected by each misstatement, described as a percentage of the total assertion. These values should be relied upon only for determining if misstatements breech the materiality threshold and not for any other purpose.

Procedure	Misstatement Title	Final Status
B1: Documentation of Boundaries – Offset Project Plan and Offset	None detected	
B2: Demonstration of Applicability Ownership	None detected	
O1: Confirmation of Contractual Relationships	None detected	
D1: Data Collection and Quality Controls	None detected	
D2: Substantiating Evidence	None detected	
C1: Appropriate and Consistent Calculation Methodology	None detected	
C2: Re-Performance of Calculation Assertion	None detected	
A1: Final GHG Assertion	None detected	

4.2 Materiality

There were no misstatements detected in the aggregated project; therefore, materiality is not a consideration.

5 Verification Team

Since 1969, ICF International ("ICF") has been serving major corporations, all levels of government, and multilateral institutions. Globally, approximately 500 of our 4,500 employees are dedicated climate change specialists, with experience advising public and private-sector clients. ICF has earned an international reputation in the field of climate change consulting for its analytical rigour, in-depth expertise, and technical integrity through scores of GHG emissions-related assignments over the past two decades.

Within Canada over the past 10 years, ICF Consulting Canada, Inc., a fully owned subsidiary of ICF, has carried out numerous facility-level GHG verifications and verifications of emission reduction projects. ICF Marbek has developed the necessary internal controls to ensure qualified and competent staffing uphold the principles of the relevant standard while quality control processes are utilized to assure data integrity is maintained and safeguarded. ICF Marbek's clients choose ICF Marbek for its strong brand, technical expertise, and rigorous methodological approach.

ICF Marbek has assembled a Verification Team consisting of experienced GHG verifiers with relevant technical expertise.

Lead Verifier

Aaron Schroeder is a Professional Engineer in the Province of Alberta and holds a B.Sc. in Engineering from the University of Saskatchewan. He has completed supplementary training in ISO 14064 as well as Auditing and Assurance Engagements through the University of Toronto, School of Continuing Studies. Aaron has acted as lead verifier on third-party assurance assignments for multiple compliance periods under Alberta's Specified Gas Emitters Regulation. These projects included work at SAGD facilities in Alberta's oil sands, a complex sour gas processing facility, two of Alberta's largest natural gas pipelines and combined-cycle electric generating facilities. Additionally, Aaron has completed numerous verifications as lead verifier for emission reduction (offset) projects in agricultural tillage management, wind electricity generation, and acid gas injection projects.

Associate Verifier

Michelle Stelmach works on contract with ICF Marbek and will conduct the farm visits during the course of the verification. She holds a Bachelor of Science in Agriculture from the University of Saskatchewan and certification in agricultural application of ISO 19011 – Internal System Auditing and has worked with the Hazard Analysis Critical Control Point (HACCP) to design and conduct internal system audits and to meet Canadian Food Inspection Agency standards at the producer level, in feed manufacturing plants and poultry processing plants. She has extensive experience working with agricultural producers across Alberta through her work as Program Advisor and Coordinator with Maple Leaf Foods and Landmark Feeds.

Internal Peer Reviewer

Chris Caners is a Professional Engineer in the Province of Ontario, and holds a Master of Science in Engineering from Queen's University, as well as a Bachelor of Applied Science from the University of Toronto. He has completed supplementary verification training, receiving a certificate of training for ISO 14064. Chris has acted as the lead verifier for numerous facilities under Alberta's Specified Gas Emitters Regulation, and British Columbia's Greenhouse Gas Reporting Regulation, including natural gas linear facility operations, natural gas compressor stations, cogeneration plants, and SAGD facilities. Chris has also led third-party assurance and reassurance engagements for several offset projects under the Alberta Offset System, including wastewater treatment, aerobic composting, acid gas injection, and energy efficiency.

6 Evaluation of Pilot Project Data and Documentation

This section provides the results of the verification team's in-depth analysis of the pilot project implementation of the quantification protocol and the documentation supporting the data used for the pilot project.

The first sub-section includes general comments that relate to the eligibility and approach, which is followed by a sub-section devoted to the quantification defined by the Protocol.

6.1 Eligibility and General Approach

1. The Protocol uses a static historic approach to determine the baseline. This type of approach necessitates an evaluation of the functional equivalence between the historic baseline period and the project period. The Protocol defines the functional unit as an animal group, which is defined by the weights of the animals that comprise the group.

   There are other factors that affect the functional equivalence (other than animal weight). These may include average age of animal in the group, time of year of purchase, breed and other factors. While the Protocol does not define a mechanism for establishing function equivalence beyond animal weight, Project Developers should provide for these considerations.

2. It is possible for the project to result in an emission reduction *without* a reduction in the number of days animals are on a finishing diet regimen through an increase in feed conversion efficiency. Further, it is possible to demonstrate a emission reduction that results from market conditions demanding smaller animal carcasses in the project period than the baseline period. This latter situation poses a significant risk to the integrity of the Protocol.

   Modifying the Protocol to an intensity basis (emissions/kg live weight gain) would alleviate this risk because changing market conditions may affect the mass of individual animals, but the emission reduction calculation would be performed on a mass basis, rather than an animal group basis.

   Further, the considerations of functional equivalence described in issue #1 above, would be less significant because the emission intensity calculation would be performed across a larger population of animals (the whole feedlot) instead of smaller animal groups.

3. The feedlots participating in the pilot project utilize professional feedlot nutrition management services as well as sophisticated software for monitoring and managing feed intake. Smaller feedlots may not use these tools, which would potentially result in increased inherent risks associated with quantification of an emission reduction. The verification team observed that the software and management practices that are available in industry exceed the Protocol and Alberta Offset System requirements. Therefore, no changes are recommended in terms of data collection, management and security.

6.2 Calculation

1. The Protocol presents a default value for gross energy content of the diet (GE_{Diet} – see Table 8, SS B10 and SS P10). This important value changes as feed rations within the group are modified to increase the grain content. While gross energy in the feed changes similarly in the baseline and

project condition, an improvement in feed conversion likely results in a more rapid change in gross energy through the course of the finishing feeding regime.

This value is measured in feed laboratory analysis. An actual value, instead of a default value, should be used by Project Developers, wherever possible. Alternately, the edible oil/fat content of the feed should be used to adjust the gross energy value.

2. Feedlots track the total dry matter intake (DMI) fed to each group on an aggregate basis using automated data management software. Feeding is conducted at the pen level (several pens compose a lot) and not at the individual animal level.

   The Protocol consolidates animals into a "group" of similar animals across a number of lots. To calculate the total feed fed at the group level, the average feed fed at the animal level must first be calculated. This preliminary average calculation of feed per animal must be calculated using a *head day* basis, not a straight average on a head basis (number of animals in the lot) because the number of animals in the lot is not a constant value.

   The Protocol guidance should be updated to clearly indicate the calculation of average feed intake must be calculated using a head day basis.

Appendices

Verification Plan

Verification Plan

Agri-Trend Aggregation Inc. and Feedlot Health Management Services

Beef Reduced Days on Feed Aggregation Project

1 Introduction

This document provides details on the verification scope and process that is planned to conduct a reasonable level verification of the Vintage 2012 of emission reductions Alberta Offset System, Greenhouse Gas Assertion of Emission Reduction Credits (the "**GHG Assertion**") for the Agri-Trend Aggregation Inc. and Feedlot Health Management Services ,Beef Reduced Days on Feed Aggregation Pilot Project, (the "**Project**"). An overview of operations at the Project will be provided in the Verification Report.

A Verification Risk Assessment was conducted during the verification planning stage; the results will be provided in Section 6 of the final Verification Plan. These results were used to inform the development of the verification procedures outlined in Section 7 of the final Verification Plan. Additionally, the results of the Risk Assessment informed the development of the Sampling Plan, which will be included in the Verification Report.

The Verification and Sampling Plans will be updated through the course of the verification as additional information becomes available.

The verification conclusion will be documented in the Verification Statement and the verification findings will be further described in the Verification Report. The Verification and Sampling Plans will be appended to the Verification Report to provide information related to the verification scope and process.

2 Verification Scope

2.1 Objective

The primary objective of this verification engagement is to provide assurance to Alberta Agricultural and Rural Development (**AARD**) that the GHG Assertion is reliable, and of sufficient quality.

2.2 Parties and Users

The person or organization that has overall control and responsibility for the GHG Project, as defined in Section 2.13 of ISO 14064-2:2006, is the "**Project Proponent**". For this verification, Agri-Trend Aggregation Inc and Feedlot Health Management Services ("**ATAI and FHMS**") is the Project Proponent.

ICF Consulting Canada Inc., the "**Verifier**" or "**ICF Marbek**", has been engaged to provide a third-party verification of the GHG Assertion. The Lead Verifier, the Associate Verifier, and the Technical Expert, compose the ICF Marbek "**Verification Team**".

The "**Intended User**" is defined in Section 2.22 of ISO 14064-2:2006 as the individual or organization identified by those reporting GHG-related information that relies on that information to make decisions. **AARD** is the Intended User of the information contained within the Verification Statement.

2.3 Scope

The verification will be conducted in accordance with *ISO 14064-3: Specification with guidance for the validation and verification of greenhouse gas assertions.*

The Verification and Sampling Plans were developed based on the relevant criteria described in the following:

- *Specified Gas Emitters Regulation, Alberta. Reg.139/200*

- *Quantification Protocol for Reducing Days on Feed for Beef Cattle, V.2, July 2011*
- *Technical Guidance for Offset Project Developers, v.3, February 2012*
- *Offset Project Plan for Beef Reduced Days On Feed Aggregation Project, December 2012*
- *Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013*

The table on the following page defines the scope elements specified for the Project.

Scope Element	ISO 14064-3 Definition	Project Specific
Boundary	The Project boundary, including legal, financial, operational and geographic boundaries	Beef Reduced Days on Feed Aggregation Project **Legal Land Description:** Highland Feeders Ltd.: 26.7 km North of Vegreville, AB, T9C 1R4 53.701733, -111.981367 NW27-TWP54-R6E14-W4 Western Feedlots, High River: High River, AB, T1V 1M4 50.58109304, -113.9791889 NE5-19-29-W4 Western Feedlots, Mossleigh, AB, T0L 1P0 50.75965, -113.287017 SE8-21-24W4 Western Feedlots, Strathmore: Strathmore, AB, T1P 1K3 51.014483, -113.391883 SW2-24-25W4 Strangmuir Farms, PO Box 2325 Stn Main, Strathmore, AB T1P 1K3 50.8821, -113.3613 SE23-TWP22-RGE25-W4 Lakeside Feeders: Brooks, AB T1R 1E4 50.61831704, -111.935081

Scope Element	ISO 14064-3 Definition	Project Specific
Infrastructure and Activities	The physical infrastructure, activities, technologies and processes associated with the Project	Implementation of feeding strategies that reduce the number of days beef cattle are on a finishing diet, also known as decreasing the feed to gain ratio • Use of Ractopamine hydrochloride (RAC) • Use of Zilpaterol • Shifting away from Corn Dried Distillers Grains • Changes to dietary roughage levels (movement to lower or higher levels than those used previously (7-10% DM) RAC is an additive which has been implemented under the project condition for all participating sites under this aggregated project.
GHG Sources	GHG sources to be included	• direct and indirect GHG emissions related to enteric fermentation that result of beef cattle digestive process • direct and indirect GHG emissions related to manure storage and handling that result of beef cattle digestive process
GHG Types	Types of GHGs to be included	• Methane (CH_4) • Nitrous Oxide (N_2O)
Time Period	Vintage of credits to be included	January 1, 2012 – December 31, 2012

2.4 Materiality

During the course of the verification, individual errors, omissions or misrepresentations (collectively referred to as discrepancies) or the aggregate of these discrepancies will be evaluated qualitatively and quantitatively.

Materiality defines the level at which discrepancies in the GHG Assertion or any underlying supporting information precludes the issuance of a reasonable level of assurance.

The Lead Verifier is responsible for applying professional judgment to determine if *qualitative* discrepancies could adversely affect the GHG Assertion and subsequently influence the decisions of the Intended User, in which case, the discrepancies are deemed to be material.

Quantitative discrepancies will be calculated individually to determine the impact of the discrepancy as a percentage of the GHG Assertion.

All discrepancies that are outstanding at the conclusion of the verification are documented in the Verification Report and classified on an individual basis as either material or immaterial.

Materiality Threshold

The materiality threshold is defined as <5% of the total reported emission reductions in the GHG Assertion. Individual discrepancies and the aggregate of individual discrepancies will be analyzed to determine if the materiality threshold has been breached.

2.5 Principles

ISO 14064 defines six principles that should be upheld in the development of the GHG Assertion. These principles are intended to ensure a fair representation and a credible and balanced account of GHG-related information. The verification procedures developed and executed during the course of this verification will present evidence such that each of these principles is satisfied.

Relevance

Appropriate data sources are used to quantify, monitor, or estimate emission sources. Appropriate minimum thresholds are used to justify the exclusion or the aggregation of minor GHG sources or the number of data points monitored.

Completeness

All emission sources relevant to the Facility are included within an identified source category.

Consistency

Uniform calculations are employed between reporting periods. Emission calculations for each emission source are calculated uniformly. If more accurate procedures and methodologies become available, documentation should be provided to justify the changes and show that all other principles are upheld.

Accuracy

Measurements and estimates are presented, without bias as far as is practical. Where sufficient accuracy is not possible or practical, measurements and estimates are used while maintaining the principles of conservativeness and transparency.

Transparency

Information is presented in an open, clear, factual, neutral and coherent matter that facilitates independent review. All assumptions are stated clearly and explicitly and all calculation methodologies and background material are clearly referenced.

Conservativeness

Appropriate parameters affecting the Facility's emission sources are utilized in the calculation of the GHG Assertion. When parameters or data sources are highly uncertain, the choice of parameter or data source utilized results in an overestimation of the GHG Assertion. Note that any error, underestimation or overestimation, would be evaluated as a potential material error.

2.6 Limitation of Liability

Due to the complex nature of the operations within the Project and the inherent limitations of the verification procedures employed, it is possible that fraud, error, or non-compliance with laws, regulations, and relevant criteria may occur and not be detected.

3 Verification Team

The qualifications of the Verification Team and Internal Peer Reviewer are provided in the Statement of Qualifications.

Lead Verifier, Aaron Schroeder (P.Eng)

The Lead Verifier is responsible for all activities conducted within the verification, including overseeing the development of the Verification and Sampling Plans and the execution of the verification procedures. The Lead Verifier is the lead author of the Verification Report and executes the Verification Statement at the conclusion of the engagement.

Associate Verifier(s), Jessica Abella

The Associate Verifier(s) work under the direction of the Lead Verifier to conduct the verification procedures.

Technical Expert(s), *Michelle Stelmach*

The Verification Team is supported by the Technical Expert(s), who review the Verification Risk Assessment and provide advice on the development of the Verification and Sampling Plans to ensure risks are addressed with rigorously designed verification procedures. The Technical Expert is also available to the Verification Team through the course of the verification to provide assistance with any issues as they arise.

Internal Peer Reviewer[1], *Chris Caners*

The Internal Peer Reviewer is not a member of the Verification Team and does not participate in the verification until the draft Verification Report and draft Verification Statement have been prepared. The Internal Peer Reviewer conducts an internal assessment of the verification to ensure the verification procedures have been completed, the results of the verification have been thoroughly documented, any issues or discrepancies have been investigated and the verification evidence is sufficient to reach the verification conclusion described in the Verification Statement.

[1] Note: the Internal Peer Reviewer is not a member of the Verification Team, but is listed here keep the list of personnel involved in the engagement in one place.

4 Verification Process

The ICF Marbek approach for conducting verification of a GHG Assertion follows the tasks outlined in the following diagram. Although these tasks are generally completed sequentially, the order may be modified according to circumstances such as scheduling and data availability.

Pre-Engagement	Approach	Execution of Verification	Completion
1. Selection of Lead Verifier 2. Initiate Conflict of Interest Procedure 3. Pre-Engagement Planning and Proposal Development 4. Contract Execution 5. Assess GHG Program & Revise VMS as Required 6. Initiate Verification Tracking	7. Selection of Verification Team 8. Communication with Project Proponent 9. Kick-off Meeting 10. Verification Risk Assessment 11. Draft Verification and Sampling Plan	12. Site Visit(s) 13. Conduct Verification Procedures 14. Issue Clarification & Data Request 15. Revise & Finalize Verification and Sampling Plan 16. Address and Evaluate Outstanding Issues	17. Evaluate Evidence 18. Hold Verification Findings Meeting (if necessary) 19. Draft Verification Report & Statement 20. Internal Peer Review 21. Completion of COI Form 22. Independent Review of Impartiality 23. Issue Verification Report & Statement 24. Close Verification File 25. Develop and Issue Management Memo(s)

4.1 Pre-Engagement

Prior to submitting a proposal to conduct this verification, the following pre-planning steps were taken:

- The results of any previous business engagements or verifications with the Project Proponent were reviewed to determine if any previous unresolved conflicts may preclude ICF Marbek from engaging in the verification;
- The Project Proponent's motivation for completing the verification was established; and
- A Conflict of Interest procedure was initiated that documents whether any perceived or real conflicts were found when considering threats due to:
  - Advocacy
  - Financial Interest
  - Familiarity/Sympathy
  - Intimidation
  - Self-Review
  - Incentives

Following the acceptance of the proposal and signing of a contract for services, the Verification Team was selected. The Verification Team for this engagement is comprised of the individuals identified in Section 3.

4.2 Approach

An extensive knowledge of the Project Proponent's business, the relevant industry, and the details of the Project itself are required to conduct a thorough verification that can lead to a conclusion. The initial information collected about the Project Proponent and the Project formed the basis of the preliminary draft Verification Plan. The development of the final Verification Plan is an iterative process; that is, the process will be completed several times through the course of the verification and the resulting plan will be updated as new information became available.

There are three types of risk associated with the GHG Assertion defined in ISO 14064-3:

- Inherent Risk
- Control Risk
- Detection Risk

The process of designing the Verification Plan began with the development of Verification Risk Assessment for both the Project as well as the Project Proponent. The steps in this process included:

- Reviewing the GHG Assertion, and the methodologies employed by the Project;
- Reviewing information on the industry and the specific Project under review;
- Assessing the likelihood that a material misstatement might exist in the GHG Assertion, if no controls were used to prevent misstatements in the GHG Assertion (i.e. inherent risk);
- Assessing the control environment and the corporate governance process (i.e. control risk); and
- Reviewing each emission source identified in the Project, and evaluating the contribution of each source to the GHG Assertion and the associated potential material discrepancy for each.

The results of the Verification Risk Assessment inform the development of the verification procedures, which will be documented in Section 7 of the final Verification Plan. A summary of the Verification Risk Assessment will be provided in Section 6 of the final Verification Plan. The draft Verification Plan will be provided to the Project Proponent before proceeding with the verification.

4.3 Execution of Verification

With draft Verification and Sampling Plans in place, the verification procedures will be executed. This process involves collecting evidence, testing internal controls, conducting substantive testing, and developing a review file. Over the course of the verification, the draft Verification and Sampling Plans may change; the final Verification and Sampling Plans provided in the Verification Report reflect the verification parameters and procedures that were actually executed.

Site Visit

The site visit will be conducted by Aaron Schroeder in February.

The site visit will be a key step the planning and execution of the verification. During the course of the site tour, ICF Marbek will interview key site operations personnel regarding the operations and data management of the Project.

During the site visit all GHG emission sources for the Project will be reviewed to ensure appropriate identification and categorization. A review of process flow and metering diagrams will be followed by physical observation of the Project.

Health and Safety Requirements

Steel toed boots are required for the site visit. ICF Marbek personnel will be required to be accompanied by feedlot staff at all times. Observe posted speed limits on feedlot sites.

Collecting Evidence and Review of Documentation

Sufficiency and appropriateness are two interrelated concepts that are fundamental to the collection of verification evidence. The decision as to whether an adequate quantity (sufficiency) of evidence has been obtained is influenced by its quality (appropriateness).

Through the execution of the verification procedures described in Section 7 of the final Verification Plan, the Verification Team will review three key forms of evidence including physical, documentary and testimonial:

- Management documentation: policies, programs, and procedures related to the collection, safeguarding, and management of the data supporting the GHG Assertion;
- Records: records comprise time-sensitive data, correspondence, and files including: Ration Formulation Records, Feedlot's close out data sheets, NCRB Permits, weight scales calibration records
- Interviews: the interviews will provide information regarding operations and data management and will provide evidence to support the sufficiency of data controls; and
- Computer systems: data systems, FHSM Information System, and Agri-Trend Data Solution Plataform used to capture and manage the GHG-related data and to calculate the GHG Assertion.

Testing and Assessment of Internal Controls

The Verification Team will develop a sufficient understanding of the GHG information system and internal controls to determine whether the overall data management system is sound and if it supports the GHG Assertion. This assessment will seek to identify any weakness or gaps in the controls that pose a significant risk of not preventing or correcting problems with the quality of the data and examining it for sources of potential errors, omissions, and misrepresentations. It will incorporate an examination of three aspects of the Project Proponent's internal controls: (1) the control environment, (2) the data systems, and (3) the control and maintenance procedures.

Assessment of Data

Substantive testing procedures will be used to assess the reasonability and validity of the GHG Assertion. Both quantitative and qualitative analysis will be performed to achieve the desired level of assurance. The verification procedures are described in Section 7 of the final Verification Plan as separate tables for each process or activity involved in the quantification and reporting of the GHG Assertion. The verification procedures include verification activities designed to:

- Review the Project boundary, including a review of the completeness of emission sources identified;
- Review the Project data sources to ensure the GHG Assertion is calculated based on metered or estimated data that meets the requirements of the *Quantification Protocol for Reducing Days on Feed for Beef Cattle,V.2, July 2011*;
- Re-calculate the GHG Assertion, which demonstrates transparency and accuracy; and
- Review the GHG Assertion to ensure the 2012 emissions reductions calculated by the Project Proponent have been accurately reported.

Clarification and Data Request

To facilitate information flow between the Verification Team and the Project Proponent, a consolidated request for additional information will be developed through the course of the verification and issued to the Project Proponent. This "Clarification and Data Request" will be used to document information requests and summarize the responses. It will also be used to document the Verification Team's assessment of each response.

Developing a Review File

A review file (the "**File**") comprised of documents, records, working papers and other evidence collected and created during the course of the review that support the review conclusions will be developed for this verification. This evidence stored in hard copy and/or electronic format will serve to provide support for the verification conclusion, provide evidence that the verification was conducted in accordance with the criteria set forth in this document, and aid the Verifier in conducting current and future reviews.

The File will include:

- The GHG Assertion and supporting documentation, as submitted to AARD;
- Decisions on the level of materiality and the results of the Verification Risk Assessment;
- Documentation on the Project Proponent's internal controls;
- Descriptions of the controls assessment work and results;
- Documentation of the substantive testing procedures that were carried out and the results;
- Copies of any correspondence with the Project Proponent or other parties relevant to the review;
- The Verification Team's working papers;
- The Clarification and Data Request with documented responses from the Project Proponent; and
- Client data (copies of relevant records, spreadsheets, and other data files).

The File is the property of ICF Marbek and access to it is normally restricted to the Verifier and the Project Proponent. ICF Marbek will retain and safeguard the file for a minimum of seven years.

4.4 Completion

This engagement will be formally closed after the verification has been executed and the Verification Report has been finalized.

Preparing the Verification Report

The purpose of the Verification Report is to document the verification findings. All discrepancies are described and compared to the materiality threshold individually and in aggregate. The Verification Statement, which presents ICF Marbek's verification conclusion, is included in the Verification Report.

Internal Peer Review Process

Prior to releasing the Verification Report and Verification Statement, an internal review process is conducted by the Internal Peer Reviewer. This process ensures that:

- All steps identified as being required to complete the verification were completed;
- Any identified material or immaterial discrepancies identified have been either:
    - corrected by the Project Proponent and reflected in the GHG Assertion; or
    - documented in the Verification Report, if discrepancies persist at the conclusion of the verification.
- All required documentation detailing the verification process has been prepared, delivered, and retained.

Closing the Engagement

The verification engagement will be closed out upon delivery of the final Verification Report.

5 Verification Schedule

The following schedule is planned for the verification (subject to change with agreement between the Verifier and the Project Proponent).

Description	Scheduled Date
Verification Kick-Off Meeting	January 9, 2013
Site Visit	February, 2013
Head Office Visit	February, 2013
Draft Verification Plan to Project Proponent	January 21, 2013
Initial Clarification & Data Request	January 18, 2013
Draft Verification Statement and Report	March 15, 2013
Final Verification Statement and Report	March 31, 2013

6 Verification Risk Assessment

The process for completing a Verification Risk Assessment was described in Section 4.2. The following table describes the *inherent* and *control* risks analyzed by the Verification Team and the corresponding verification procedure(s) outlined in Section 7 of the final Verification Plan that has(ve) been designed to address the risk.

Description of Risk	Evaluation	Verification Procedure(s)
Inherent Risks		
Animal weights, numbers, feed dry matter intake and animal groupings are very large datasets that are measured and recorded at each feedlot.	Medium	D1, D2
Mass of feed actually fed is measured and recorded using a manual process	Medium	D1, D2
The project consists of aggregated project sites.	Low	O1
There are several parties involved in the quantification of the emission reduction (feedlots, ATAI, FHMS)	Medium	D1, C2
Control Risks		
Reliance upon measured data in feedlot electronic data management systems.	Low	D1
Automated system for identifying inconsistency in planned feed ration and actual feed delivered to each pen	Low	D1

The *detection risk* is a measure of the risk that the verification procedures will fail to detect material misstatements, should such misstatements exist. The verification procedures will be developed to address inherent and control risks, while ensuring the level of detection risk is sufficiently low to reach a verification conclusion at a reasonable level of assurance.

The results of the Verification Risk Assessment will be utilized by the Verification Team to develop the verification procedures, which are outlined in Section 7 of the final Verification Plan.

7 Verification Procedures

Summary of Procedures:

Facility Boundaries and Definition

B1: Documentation of Boundaries – Offset Project Plan and Offset Project Report

B2: Demonstration of Applicability

Ownership

O1: Confirmation of Contractual Relationships

Data Sources and Supporting Data

D1: Data Collection and Quality Controls

D2: Substantiating Evidence

Calculation

C1: Appropriate and Consistent Calculation Methodology

C2: Re-Performance of Calculation

Assertion

A1: Final GHG Assertion

Procedure Definition Table Explained

Z1 – Example Procedure Category – Example Procedure Title	
Introduction: This introduction serves to explain the reason the Verification Team is undertaking the procedures described below. For instance, the inclusion of all emission sources ensures that that quantification of the total direct emission satisfies the principle of completeness.	
Type of Evidence	The Type of Evidence can usually be grouped as: Physical Examination, Confirmation, Documentation, Observation, Inquiries of the Client, Re-performance, or Analytical Procedures.
Data Sources	The *Data Sources* describes the form in which the evidence is presumed or is known to be available to the Verification Team. Specific Documents or Assigned Positions, for example.
Objective (specific principles)	The objective serves to focus the procedure as pursuant to one or more of the audit principles of: *Relevance, Completeness, Consistency, Accuracy, Transparency,* or *Conservativeness.*
Specific Activities	• In bullet form; • The *Specific Activities* are outlined here.
Error Conditions	• Again in bullet form; • The anticipated *Error Conditions* are listed here to aid the Verification Team; • As the Sampling Plan is a living document until the end of the verification process, additional error conditions may be identified during the execution of the procedures.

Facility Boundaries and Definition

B1 – Documentation of Boundaries – Offset Project Plan and Offset Project Report	
Introduction: The Offset Project Plan must outline how the Project Proponent is implementing the quantification methodology described in the Protocol. Specifically, each emission source and sink listed in the Protocol as relevant to be included in the emission reduction calculation must be considered in the Project unless the use of a flexibility mechanism specifically permits its exclusion. Additionally, any sources or sinks not contemplated by the Protocol that are relevant to the project must be considered.	
Type of Evidence	Documentation, Observation, Inquiries of the Client, Physical Examination
Data Sources	Offset Project Plan: Beef Reduced Days on Feed ("**OPP**"), Project Report: Beef Reduced Days on Feed ("**OPR**"), Project Process Flow Diagrams, GHG Assertion, Project Operations Personnel
Objective (specific principles)	*Completeness, Relevance*
Specific Activities	1. Compare each emission source and sink listed in the OPP to those listed in the Protocol considering all equipment and activities; 2. Compare OPP, OPR, GHG Assertion against the corresponding AESRD templates, as applicable; 3. Through the site visit and understanding of the Project, evaluate any emission sources or sinks that are not considered by the Protocol.
Error Conditions	• Emission source or sink defined in protocol was wrongfully excluded in OPP • Divergence from the protocol that is not in conformance with ISO 14064 and associated guidance documents

B2 – Demonstration of Applicability	
Introduction: The Protocol describes the specific applicability criteria that must be satisfied to utilize the Quantification Protocol. The Project Proponent must provide evidence that clearly demonstrates applicability as described.	
Type of Evidence	Documentation, Confirmation
Data Sources	OPP and Supporting Documentation
Objective (specific principles)	*Completeness, Relevance*
Specific Activities	1. Review OPP for evidence of applicability for each requirement described by the Protocol; 2. Review supporting documents from external sources; 3. Interview key project personnel regarding the application of applicability criteria. 4. Review supporting evidence for any flexibility mechanisms that are being used in the Project.
Error Conditions	• Evidence does not clearly demonstrate Protocol applicability as described • Flexiblity mechanisms that are employed without supporting evidence that is required by the Protocol

Ownership

O1 – Confirmation of Contractual Relationship – Proponent and Project Partners	
Introduction: The ownership of the emission reduction must be demonstrated. The intent of this procedure is not to provide a legal opinion on ownership, but to establish that a contractual relationship exists between the Project Proponent and any other parties who may have an ownership interest in the emission reduction through ownership of land, equipment or resources related to the Project.	
Type of Evidence	Documentation, Inquiries of the Client
Data Sources	OPP, GHG Assertion, Contracts between ATAI/FHMS and participating feedlots
Objective (specific principles)	*Completeness, Relevance, Transparency*
Specific Activities	1. Review of documents proving the ownership of the assets creating the emission reductions; 2. Review of contracts binding Project Proponent to other project partners; 3. Ensure temporal coverage of current assertion in project contracts.
Error Conditions	• Missing documentation • Incorrect identification of legal entities covered by contract • Expired or incomplete terms in relevant contracts

Data Sources and Supporting Data

D1 – Data Collection and Quality Controls	
Introduction: The systems for measuring and storing Project data and chain of custody are evaluated in this procedure to determine if the data quality controls are effective.	
Type of Evidence	Documentation, Confirmation, Observation, Inquiries of the Client, Analytical Procedures
Data Sources	OPP, ATAI and FHMS Personnel, Agri-Trend *Agri-Data Solution* (ADS) database, Feedlot Health Management Services Feedlot Data Management System
Objective (specific principles)	*Accuracy, Transparency, Conservativeness*
Specific Activities	1. Develop a data life cycle diagram, or data map for each major GHG emission source/sink and confirm with Project operations and GHG reporting personnel; 2. Observe or interview Project operations personnel regarding the operation of data transfer systems during site tour, including manual data entry procedures and associated controls; 3. Interview Project personnel responsible for quantifying emission reduction regarding data metering and validation, data storage, data security, and any manual data entry or transcription; 4. Review OPP and OPR regarding data sources, transcription and data security; 5. Compare raw data from feedlots against data used in ADS for consistency; 6. Observe meter verification (calibration) reports during site tour.
Error Conditions	• Missing or incomplete data sets • Transcription errors • Uncontrolled access to Project data • Meter verification/calibration not completed according to manufacturer/engineering specification

D2 – Substantiating Evidence	
Introduction: During the Risk Assessment, the inherent and/or controls risk associated with the primary supporting evidence for specific components of the GHG Assertion was determined to be high enough to require additional substantiating evidence. The specific activities in this verification procedure are specifically customized to focus on substantiating evidence related to those specific components identified in the verification risk assessment.	
Type of Evidence	Analytical Procedures
Data Sources	Feedlot data management systems, Feedlot Health Management Services Feedlot Data Management System, ATAI ADS Database
Objective (specific principles)	*Accuracy, Conservativeness*
Specific Activities	1. Compare project data received from feedlots to the data used in ATAI ADS database 2. Compare feed rations to actual feed delivered to animal pens
Error Conditions	• Data integrity compromised between feedlot data and ATAI ADS Database • Feed delivered to animal pen is inconsistent with planned feed ration. Since this type of inconsistency should raise control flags, this error condition indicates either a data error or a control failure

Calculation

C1 – Appropriate and Consistent Calculation Methodology	
Introduction: The specific quantification methodology utilized in the Project must be clearly defined in the Offset Project Plan. This procedure is executed simultaneously with other procedures analyzing the methodology employed against the Protocol requirements. It specifically examines the quantification formulae and any estimation methodologies employed.	
Type of Evidence	Documentation
Data Sources	OPP and Supporting Data, ATAI ADS Database
Objective (specific principles)	*Consistency, Completeness, Accuracy, Transparency*
Specific Activities	1. Compare quantification formulae and estimation calculations prescribed by the Protocol against those described in the OPP; 2. Review the methodology actually employed by reviewing Project calculations and supporting data; 3. Compare emission factors used in calculations against reference documents cited in Protocol and OPP.
Error Conditions	• Deviation from the Protocol methodology that is not supported by the use of a contingent procedure or flexibility mechanism • Formula or methodology used in the emission reduction quantification that is not documented in the OPP • Inconsistent calculation methodologies between Baseline and Project Scenarios • Incorrect or unreferenced emission factors

C2 – Re-performance of Calculation	
Introduction: Calculation of the emission reductions claimed in the GHG Assertion includes several intermediate calculations. The re-performance of all calculations is a key verification procedure.	
Type of Evidence	Re-performance, Analytical Procedures, Inquiries of the Client
Data Sources	OPR, GHG Assertion and Supporting Calculation Documents, Project Data, and ADS Database
Objective (specific principles)	*Accuracy, Conservativeness, Transparency*
Specific Activities	1. Re-performance of emission reduction claim from original data.
Error Conditions	• Calculation error including spreadsheet reference errors, and incorrect spreadsheet formula development • Inability to achieve same emission reduction quantity in GHG Assertion due to insufficient detail in underlying data • Incorrect application of significant figures; non-conservative rounding • Inaccurate or non-conservative estimation results

Assertion

A1 – Final GHG Assertion	
Introduction: This procedure is intended as a final review of the OPR to ensure all required information is complete. This procedure in intended to review the transfer of data from the ATAI ADS Database into the GHG Assertion.	
Type of Evidence	Documentation, Confirmation
Data Sources	GHG Assertion, OPR, ATAI ADS Database
Objective (specific principles)	*Completeness, Accuracy, Transparency, Conservativeness*
Specific Activities	1. Review GHG Assertion for consistency with language recommended in guidance documents; 2. Compare calculated values to those in the GHG Assertion for transcription accuracy; 3. Review asserted emission reduction shown in OPR and GHG Assertion compared to values calculated in the ATAI ADS database.
Error Conditions	• Incomplete OPR and GHG Assertion • Language in GHG Assertion is inconsistent with language recommended in guidance documents • Annual totals do not match values calculated in Electronic Calculator

Appendix V: Year Two DOF Validation Study Report

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Days on Feed (DOF) Validation Study Report

Submitted to: Climate Change and Emissions Management Corporation
Date: October 31, 2014
Submitted by: The Prasino Group

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Disclaimers

This report has been produced independently by The Prasino Group at the request of the Climate Change Emissions Management (CCEMC) Corporation as specified under contract. The views expressed in this report are not necessarily the views of the Climate Change Emissions Management (CCEMC) Corporation.

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Introduction/Background

As stated in the Year 1 Validation Study Report, the purpose of the DOF Protocol Validation Study (PVS) is to learn about the barriers, gaps, solutions and options for adopting the DOF protocol in the marketplace. More specifically, the objectives of the Study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field;
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocol at a commercial scale;
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocol; and
- Catalyzing continued aggregation efforts for bringing offsets forward from aggregated agricultural projects.

In order to accomplish the above objectives, the PVS project team worked with Agri-Trend Aggregation Inc. (ATAI), Feedlot Health Management Services (FHMS) and ICF-International. In year 1, ATAI-FHMS aggregated six feedlots, with a total of 300,000 head, under the Reduced Days on Feed Protocol (v 2.0, July 2011). In year 2, ATAI-FHMS aggregated four feedlots[13] for the 2013 project year (total of 118,260 head), under the modified Reduced Days on Feed Protocol submitted to AESRD in August 2013 (v 2.1, August 2013). In both years ICF conducted a mock verification on the aggregated project; however, it is important to note that in year 1 the mock verification was completed against version 2.0 of the protocol (July 2011) and in year 2 the mock verification for both year's data (2012 and 2013) was completed against version 2.1 of the protocol, submitted to AESRD for approval by Alberta Agriculture and Rural Development (April 2013). Unlike in the first year's mock verification, in Year 2 ATAI-FHS had all the data and documentation required to quantify and verify the emission reductions according to the requirements of the protocol and the verification team satisfactorily completed all verification procedures with sufficient evidence to form a verification conclusion, under a reasonable level of assurance.

Key Findings in Year Two of the DOF Protocol Validation Study

Protocol Related Issues:

The year two mock verification process, completed by ICF, identified a number of potential issues in the modified protocol (v2.1, August 2013). These issues/points of clarity are summarized below. The Prasino Group has commented in italics why it believes some of these items are not of material concern.

3) The modified protocol should more clearly state that all calculations completed at the project group level must use the weighted average of the grouping using the number of animals shipped. Presently, this requirement is not clear in the protocol, nor is it reflected in the quantification equations. The calculations were done correctly in the Offset Project Plan and Report, but it is recommended that the protocol be updated accordingly.
   After reviewing with ICF, the use of animal.head days, recommended to be a mandated approach in the Year 1 PVS study, was deemed to be sufficient to the calculations and no further modifications to the protocol are required.

[13] Highland Feeders and Lakeside were not included in the 2013 quantification due to poor quality feed (Highland) and a change in ownership (Lakeside from Excel to JBS) and data availability was limited.

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4) The protocol quantifies emission reductions by taking the difference between the baseline and project carbon intensities (emissions per kg weight gain) and multiplying this difference by the total production in the project reporting period. It would be beneficial if a general description of this approach was incorporated into the protocol introduction (Section 1.0). Furthermore, a more detailed explanation of this process should be shown in the equations provided in Section 4.1 of the Protocol.
5) Intensity should be described as "emissions per kg weight gain" throughout the protocol. Currently, several inconsistencies exist. For example, in Section 4.4 the baseline and project intensities are listed as "emissions per kilogram of hot carcass weight", while Appendix A in the protocol uses "average carcass weight gained while in the feedlot". Furthermore, the protocol should be revised to clarify the measurement in Section 4.4 to be weight gained while in the feedlot, to ensure functional equivalence.
6) It would be beneficial if the equations in Sections 4.4 and 4.5 were numbered for easy reference.
7) According to Protocol Flexibility #4 it is conservative to assume that the cattle are on a concentrate diet greater than or equal to 85% the entire time they are in the feedlot. However, if the animals were actually on a diet with greater than 85% concentrates in the baseline condition and less than 85% in the project condition, it would result in an overstatement of the asserted emission reduction.

   In the last 8 to 9 years, step up diets (where the animals are fed a higher forage diet and then gradually switched to a higher concentrate diet as the rumen adapts) have become less than a month of the 200 or so days a calf spends in the feedyard. Originally, the above flexibility mechanism stated that a feedyard could obtain credit for a reduction arising from shrinking the amount of time the animals were on a higher forage diet. However, through the PVS studies, we found that most have already shrunk the time animals are on higher forage diets, and further, it is unlikely a feedlot could utilize this flexibility, since the availability of calculation data mid-way through a closeout for a lot in a feedyard does not exist (animal head.days inventory and associated weighted averages). Therefore the ability to capture emission reductions by shrinking the step-up diet times was removed and the more conservative flexibility of utilizing the concentrate diet emission factor for methane (4%) across the board was introduced as a flexibility mechanism.
8) Under the DOF protocol there is an opportunity for emissions leakage to occur if dry distiller's grains with solubles (DDGS) are fed in the baseline condition and not in the project. DDGS have historically had a higher crude protein content than other grains and as a result, when fed result in higher emissions under equation #5 of the protocol. If DDGS are subsequently not fed during the project reporting period, the offset project developer would receive credit because the crude protein in the diet has been reduced. Leakage would occur if the DDGS not used by the feedlot in the project were purchased and fed at another feedlot that is not participating in an offset project. In other words, the feedlot not participating in the project would be emitting the emissions associated with the higher crude protein content of the DDGS, while the feedlot participating in the project would be obtaining credit for not feeding this volume of DDGS.

   In recent years, DDGS producers south of the border have begun to remove the protein from DDGS and sell it separately as a high protein meal. As a result, current DDGS feeds typically have a crude protein content similar to other grains. Further, rail prices have nearly doubled over the last year with the 2013 bumper crop, complicated by more rail being utilized by transporting

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crude. For these reasons it would not be economical to transport DDGS from the US in recent years. The leakage scenario presented above is minimal in the medium term.

9) Section 4.2 of the protocol is redundant and should be removed. This will simplify the protocol and eliminate the possibility for discrepancies between section 4.2 and Table 8 in Section 4.3.
10) In the final step of Appendix A in the protocol the quantification should show the calculation of the total mass of each greenhouse gas prior to converting these values to the carbon dioxide equivalent mass.
11) 2007 IPCC global warming potentials should be used in the Protocol for 2014 vintage credits.

Market Factors:

Animals in the 2013 project year were not exposed to Zilmax beta-agonists due to market bans on this product by the packing houses. Zilmax is a more aggressive beta-agonist than Optiflexx.

Calculation of GHG Emission Reductions:

In Year 2 the DOF PVS once again examined how the protocol functions in calculating reductions of GHG emissions. Last year the project team reported that within a commercial feedlot some animal groupings will show a reduction from the baseline, while others will not. In year 2 the project team also found that it is possible for there to be a reduction for a feedyard in one year of a project, while in other years there is not. The feeding efficiencies of animals in a feedlot are based on a number of factors – weather, animal health, condition, frame, animal diets, feeding strategies, additives and animal husbandry. Given this there can be variability both within animal groupings and between project years. In a single year it is the net reduction of all relevant animal groupings in the project year that determines whether a feedlot has a claim. In those years in which there is no net reduction, ICF International recommends that these values still be reported if the feedlot intends to remain in the offset project. Since the emission reduction in a given year, has no linkage to the next year or the past year; in other words these are emission reductions and not emission removals – it is acceptable that the feedlot report a negative emission reduction and gain no credit for that particular year given the complexities of the biological systems. They would not be included in the accounting for the GHG assertion and be awarded any credit for that given year. This maintains the environmental integrity of the system, because the purchase of carbon offsets by a regulated facility as a compliance mechanism would only reflect those emission reductions that took place in the project. The actions undertaken by feedyards are not part of the compliance system.

On a net basis, the GHG tonnage generated by the three feedlots included in the 2012 project year was 18,410 tCO_2e from 300,000 head. For the 2013 project year it was 10,253 tCO_2e from 118,260 head. This works out to approximately 0.07 tCO_2e / head for the 2012 project year and 0.09 tCO_2e / head for the 2013 project year. The original estimates by John Basarab and Karen Haugen-Kozyra on reduction potential was on average 0.04 tonnes/head (See Final Producer Spreadsheet prepared by Paul Thomassin).

Cost-Benefit Analysis:

In early 2014 it was decided that a second round of cost-benefit analyses would not provide added value. Therefore, the findings have not changed and are presented below, as they were presented in the Year 1 Validation Study Report.

Year 1 Cost-Benefit Analysis Findings

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The Cost-Benefit Analysis for the DOF PVS study was conducted on both a feedlot production basis and an aggregator position basis. For the Aggregator Position, three scenarios were analysed – optimistic, expected and pessimistic (See Aggregator Spreadsheet and "The Benefit Cost Analysis of the Aggregator's Position as it Relates to Livestock Feeding" documents). The key variables are shown in the following table:

	Costs	Optimistic		Expected		Pessimistic	
	Start-up + Operating*	Price	Quantities (Tonnes)	Price	Quantities (Tonnes)	Prices	Quantities (Tonnes)
Initial Costs	$ 103,000						
Year 1	$ 123,000	$13	10,000	$13	10,000	$13	4,000
Year 2	$ 133,000	$13	20,000	$13	15,000	$13	5,000
Year 3	$ 159,500	$27	30,000	$23	18,000	$13	6,000
Year 4	$ 180,000	$27	45,000	$23	25,000	$13	6,000
Year 5	$ 201,000	$27	45,000	$23	25,000	$13	6,000
Year 6	$ 201,000	$27	50,000	$23	25,000	$13	6,000
Year 7	$ 206,000	$27	50,000	$23	25,000	$13	6,000

*start-up costs are based on building the Days on Feed data management system on an existing platform.

The results of the Aggregator Cost-Benefit Analysis (CBA) showed the net return per credit for the aggregator varied from $9.97 per tonne for the optimistic scenario to a negative $19.00 a tonne in the pessimistic scenario (net present value basis). The expected scenario provided a net return of $5.50 per credit. The low number of credits in the pessimistic scenario caused the cost per tonne of carbon generated to be high; i.e. $25.82 per tonne, as compared to the optimistic scenario where the cost per tonne was $4.65 per tonne. The number of tonnes generated is an important variable because as this value increases it decreases the fixed costs per tonne. This speaks to the need to have the proper scale of aggregation in order to be profitable in the carbon offset market. The cost per tonne in the expected scenario was $7.56 per tonne. In two of the three scenarios the aggregator made money with this operation. In the pessimistic scenario the aggregator was estimated to generate a net loss of $740,834 over the seven years. Three of the important variables that will determine the profitability of the aggregator will be the price of the carbon credit, the split between the aggregator and the producer, and the number of carbon offset credits that are generated. The calculator spreadsheet produced in the CBA can be used by stakeholders to vary the size of the project, split between aggregator and feedlot operator and price per tonne of carbon to find the touch point for engaging in a Beef DOF project. The CBA also demonstrated that a single feedlot attempting to bring a project forward on their own would likely not be a profitable endeavour, unless it was very large, and even then, the assumed risk would likely deter most operations (See Aggregator Spreadsheet and "The Benefit Cost Analysis of the Aggregator's Position as it Relates to Livestock Feeding" documents).

In the producer CBA (see Producer Spreadsheet and "The Benefit Cost Analysis of Feedlot Operators Change in Management Practices" documents), Canfax data was used to generate the costs and returns for four animal groupings – calf-fed steers, calf-fed heifers, yearling-fed steers and yearling-fed heifers (these are the majority of animals found in feedlots today). Then, some real project data

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was used to revise some of the estimates for the analysis, but most of the stats came from Canfax data (these can be found in the producer spreadsheet). The net margins calculated from the data are shown below:

Total Net Margins (Baseline Management Practice)		
Year 1	**Year 2**	**Year 3**
$10,783,673	-$25,708,590	-$14,492,076
Total Net Margins (Change in Management Practice)		
Year 1	**Year 2**	**Year 3**
$11,103,146	-$26,171,020	-$15,088,517

The modeled results indicated that the baseline management practice provided higher net margins per head for heifer calves and steer calves, while the change in management practice provided better net margins per head for yearling heifers and yearling steers. The model was also able to estimate the carbon revenue generated from the change in management. In both cases however, the net present value of the operations were overall negative over the three years. It should be noted that the accuracy of the net margins per head calculation in the spreadsheet model is dependent on the data going into the model. The data used in this scenario analysis was based on average Canfax data with some modifications for management practices. Providing actual producer data for the cost of production for the two management systems would provide better estimates of the net margins per head and the total net margin (see Producer Spreadsheet and "The Benefit Cost Analysis of Feedlot Operators Change in Management Practices" documents).

The feed cost assumptions in the Feedlot Operator economic analysis have been confirmed as appropriate by the project team's contact at FHMS (Luis Felix; personal communication April 12, 2013).

Documentation and Records - Materiality:

5) Compared to cropping projects, electronic record keeping and data management systems at beef feeding operations in Alberta with respect to inventory, feeding, performance and rations, have a high level of accuracy in measurement and significant control-based measures (see ICF International's Mock Verification and Gap Analysis Report – Year 1).
6) The second year's mock verification confirmed the availability and quality of evidence at beef feeding operations in order to support reasonable level of assurance. Control's based testing on the procedures and data measures at the feedyards satisfactorily met ICF's audit procedures.

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Recommendations

In the Year 1 DOF Validation Study Report, verified against The Reduced Days on Feed Protocol (v 2.0, July 2011) it was recommended that the Beef Reduced Days on Feed protocol be revised to a 'Reduced Carbon Intensity of Fed Cattle' protocol. This recommendation was made because the number of day's animals spend in the feedlot is dependent on market demand, which is currently for heavier and heavier animals. As a result, the requirement for reduced days on feed in the protocol presented a significant barrier to implementation.

A revised version of the DOF protocol, referred to as the 'Reduced Carbon Intensity of Fed Cattle' protocol was used in the Year 2 mock verification. This version of the protocol is currently being reviewed by AESRD and does not include a requirement for reduced days on feed. Through the mock verification process a number of issues were identified in the modified version (v2.1, August 2013). These issues were presented in detail above. In light of these findings The Prasino Group recommends that the Reduced Carbon Intensity of Fed Cattle protocol be reviewed once more and the following changes made:

- The addition of a general description of the quantification approach (difference between the baseline and project carbon intensities multiplied by the difference by the total production in project reporting period) in the introduction.
- The equations in Section 4.1 should be modified to more clearly show the quantification approach
- Update intensity to be defined as "emissions per kg weight gain" while in the feedlot throughout the protocol; with adjustments at the end to hot carcass weights.
- Numbers added to the equations in Sections 4.4 and 4.5
- Section 4.2 removed
- The final step in Appendix A (of the protocol) updated to show the calculation of the total mass of each greenhouse gas prior to converting these values to the carbon dioxide equivalent mass.
- The global warming potentials updated
- Additional clarity added on how the three-year average historical baseline should be calculated

As explained above, The Prasino Group does not believe it is necessary to change flexibility mechanism #4 which states that it is conservative to assume that the cattle are on a concentrate diet greater than or equal to 85% the entire time they are in the feedlot. Furthermore, The Prasino Group does not feel that the opportunity for leakage associated with changing from feeding DDGS to not feeding DDGS presents a significant concern moving forward. In recent years DDGS producers have begun removing the protein and selling it separately and rail costs will prevent importation of US-based DDGS. Consequently, DDGS now often have the same crude protein content as other grains.

The Prasino group agrees that in those years in which there is no net reduction for a feedyard, emissions should still be reported for the feedyard, if it intends to remain in the offset project. However, for reasons stated above, it does not need to be part of the overall accounting in the GHG assertion.

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Appendix V-A: Relevant Documents

ICF Marbek's Mock Verification – ATAI and FHMS Beef DOF Pilot Project

Quantification Protocol for Reducing Days on Feed for Beef Cattle, Version 2.1, April 2013

Reduced Days on Feed Best Practice Guide

The Benefit Cost Analysis of Feedlot Operators Change in Management Practices

The Benefit Cost Analysis of the Aggregator's Position as it Relates to Livestock Feeding

Producer Spreadsheet

Aggregator Spreadsheet

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Appendix W: Year Two DOF Mock Verification Report

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Protocol Validation Study Mock Verification: Beef Reduced Days on Feed Aggregation Project

Agri-Trend Aggregation Inc. & Feedlot Health Management Services

Mock Verification Report

September 30, 2014
(Revised October 24, 2014)

ICF Consulting Canada, Inc.
Suite 605, 734 – 7th Avenue SW,

Introduction

Alberta's greenhouse has ("GHG") regulatory framework has created a vibrant carbon market, with over 10 million tonnes of voluntary carbon emission reductions generated in the form of carbon offsets. Carbon offsets are provided by sectors that do not have a regulatory target, and are sold to companies with regulatory obligations under Alberta Specified Gas Emitter Regulation (**"SGER"**), 2007. The agriculture sector has been a major provider of carbon offsets to the market, contributing roughly 20% of offsets used for compliance with the SGER.

In order to support efforts needed to attain this higher standard of verification, Alberta Environment and Sustainable Development (**"ESRD"**) initiated a Protocol Validation Study (**"PVS"**) as a capacity-building exercise to gather knowledge about the application of the Reducing Days on Feed protocol to compile a Carbon Offset Project, including validation to a reasonable level of assurance. The aggregation company, Agri-Trend Aggregation Inc. (**"ATAI"**), has volunteered to compile a Carbon Offset Project using on-farm data from six feedlots in Alberta.

Specifically, the PVS study will emulate the process of aggregating participating producers under the provisions of the protocol to bring forward agricultural offsets that can be tested in a mock verification exercise to a reasonable level of assurance, for the purpose of collectively learning about the barriers, gaps, solutions and options for adopting these protocols in the marketplace.

The objectives of the PVS study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field.
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale.
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols.

This is the second mock verification conducted for this Protocol. The results of the previous mock verification within the Protocol Validation Study were applied to a revised version of the Protocol. This mock verification has been conducted using the criteria defined in the revised (draft) version of the Protocol.

Since this is a mock verification, it does not specify the total quantity of emission reduction asserted or provide assurance for the pilot project that was used as the subject of the mock verification. Instead, the focus of this mock verification is to determine if sufficient and appropriate data and documentation is available to reach a verification conclusion at a reasonable level of assurance.

This report provides the results of the second mock verification. An analysis of the data and documentation that was presented from the pilot project is presented in Section 4.1 and a summary statement is provided in Section 4.2. A discussion of issues related to the revised (draft) Protocol is provided in Section 4.3.

1 Verification Summary

Lead Verifier:	Aaron Schroeder, P. Eng
Associate Verifier:	Kate Nesbitt
Technical Resource:	Michelle Stelmach, AIT
Verification Timeframe:	July – September, 2014
Site Visit Date:	July 11, 2014
Objective of the verification:	Gap analysis through a mock verification on pilot Project
Standard applied:	ISO 14064-3:2006 Specification with guidance for the validation and verification of greenhouse gas assertions
Verification criteria employed:	Climate Change and Emissions Management Act Specified Gas Emitters Regulation (Alberta Regulation 139/2007) Technical Guidance for Offset Project Developers, Version 4.0, February 2013 Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013 (Draft) Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle, V2.1, April 2013
Verification scope – Gases:	Methane, Nitrous Oxide
Project Title:	Reduced Days on Feed Aggregation Project
Locations:	Highland Feeders Ltd., 26.7 km north of Vegreville, AB, NW27-54-14-W4 53.701733, -111.981367 Western Feedlots, High River: High River, AB, NE5-19-29-W4 50.58109304, -113.9791889 Western Feedlots, Mossleigh: Mossleigh, AB, SE8-21-24- W4 50.75965, -113.287017 Western Feedlots, Strathmore: Strathmore, AB, SW2-24-25-W4 51.014483, -113.391883 Strangmuir Farms, Strathmore, AB, SE23-22-25-W4 50.8821, -113.3613 Lakeside Feeders, Brooks, AB, SW19-19-14-W4 50.61831704, -111.935081
Project Start Date:	January 1, 2012

Credit Start Date:	January 1, 2012
Credit Duration Period:	January 1, 2012 – December 31, 2020
Expected Lifetime of the Project:	20 years
Other Environmental Attributes:	This project will not generate any other environmental attributes.
Project Registration:	N/A
Project Activity:	*The Project is located in Alberta and is a result of actions taken after January 1, 2002. The project activity is not required by law and is beyond business as usual practices. The project is real, demonstrable quantifiable and verifiable, as demonstrated in the Offset Project Plan.* *The project has clearly established ownership by all participating sites under this aggregated project, and the project developer is an authorized representative of the aggregation participants.*
Project Report Temporal Period:	January 1, 2012 – December 31, 2013

Main Contact (Verifier)	Aaron Schroeder, P. Eng Principal, Air & Climate Suite 605, 734 – 7th Avenue SW Calgary, Alberta T2P 3P8 1.604.353.0264 aaron.schroeder@icfi.com
Main Contact (Responsible Party)	Bill Dorgan President, Agri-Trend Aggregation Inc. #6 – 4630 61st Street Red Deer, AB T4N 2R2 1.403.608.0992 bdorgan@agritrend.com
Secondary Contact (Responsible Party)	Calvin W. Booker, D.V.M., M.Vet.Sc. Managing Partner, Feedlot Health Management Services P.O. Box 140 Okotoks, Alberta T1S 2A2 1.403.938.5151 calvinb@feedlothealth.com

2 Project Information

Agri-Trend Aggregation Inc. ("**ATAI**") and Feedlot Health Management Services ("**FHMS**") have developed the necessary documentation detailing project activities to support their claim for emissions reductions to be registered on the Alberta Offset Registry under Alberta's Specified Gas Emitters Regulation. ATAI and FHMS has engaged ICF Consulting Canada, Inc. ("**ICF**") to provide a third-party verification of the emissions reductions asserted by ATAI and FHMS related to the project activities discussed herein.

The quantification of the emissions reductions associated with the project is defined by Alberta Environment and Sustainable Resource Development's ("**ESRD**") Quantification Protocol for Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle, V2.1, April 2013 ("**the Protocol**"). The Project Report describes the emissions reductions claim ("**GHG Assertion**") made by ATAI and FHMS related to this project.

The Reduced Days on Feed Aggregation Project ("**the Project**") covered by this verification engagement involves the creation of 2012 and 2013 vintage emissions reductions achieved through innovative feeding practices and animal management in the finishing stages of beef cattle that results in increased feed use efficiencies. The Project is located within six participating feedlots in Alberta.

ATAI and FHMS have a contractual relationship with each of the feedlot owners to aggregate the emission reduction assertion from each site into the Project. ATAI and FHMS have established the right to transact on credits that would be created from the Project.

Two of the feedlots included in the Offset Project Plan were removed from the project because the application of the project activity did not result in an emission reduction. Highland Feeders Ltd. Was removed for both the 2012 and 2013 years and Lakeside Feeders was removed for the 2013 year.

This is the second time ICF has been engaged for a protocol validation study pertaining to this Project.

This document describes the terms and scope of this verification. It serves to communicate the findings of the verification.

3 Verification Procedures

The scope of the verification was defined during the verification planning stage and is detailed in the Verification Plan, which is appended to this document. The Verification Plan also describes ICF's verification process that was executed through the course of the verification, and identifies the specific verification procedures that were planned and executed through the process.

The final verification schedule was as follows:

Procedure	Date
Verification Kick-Off Meeting	July 11, 2014
Verification Procedures Conducted	July – September, 2014
Site Visit	July 11, 2014
Final Mock Verification Report Issued	September 30, 2014

3.1 Site Visit

The site visit was conducted by Aaron Schroeder and Michelle Stelmach on July 11, 2014.

The site visit was a key step in planning and executing the verification. During the course of the site tour, ICF interviewed key Project operations personnel regarding the operations and data management for the Project.

FHMS staff interviewed included:

- Luis Félix, Special Projects Consultant
- Matt May, Nutritionist
- Feedlot Cattle Operations Managers

The site visit included a review of all greenhouse gas ("**GHG**") emissions sources and sinks in the Project to identify and categorize each one as well as a review of close-out reports, ration formulations and variance reports followed by physical observation of a sample of the feedlots. Subsequently, a review of the feedlot database (data management system) was discussed and observed on site, including a review of meter calibration/validation procedures and a review of meter maintenance logs

3.2 Summary of Project Changes

Major GHG emissions sources and sinks have been identified by the Responsible Party and are detailed in the Offset Project Plan. The quantification methodologies outlined in the revised (draft) Protocol have been used to calculate GHG emissions sources and sinks.

The uncertainty associated with the quantification methodologies applied was evaluated during Protocol development. The Project meets the data collection and project specific calculation requirements of the Protocol and therefore, the uncertainty associated with the quantification and resulting assertion meets ESRD requirements.

3.3 Program Applicability Criteria

The Project was assessed against the following program applicability criteria listed on the Protocol, which includes the eligibility criteria specified on ESRD guidance documents. The results of the evaluation of program applicability criteria are provided in Section 4.1.

Protocol applicability criteria include:

- Diets and feeding strategies for animals in the baseline and project conditions can be demonstrated to show reduced greenhouse gas emissions of fed cattle in the finishing stages at a feedlot. Verifiable records (see Section 5) and project level documentation for the content and quantity of feed, including additives/technologies and animal performance per animal grouping, are necessary in order to quantify enteric and manure emissions;
- Animal grouping criteria for the quantification of emissions must be shown to be similar between the baseline and project conditions;
- Manure must be managed according to the Agricultural Operation Practices Act requirements for confined feeding operations;
- Sampling of baseline and project conditions is allowed under this protocol and must be done according to the statistical sampling methodology provided in Appendix B; and

- The quantification of reductions achieved by the project must be based on actual measurement and monitoring as indicated by the proper application of this protocol.

Offset program eligibility criteria include:

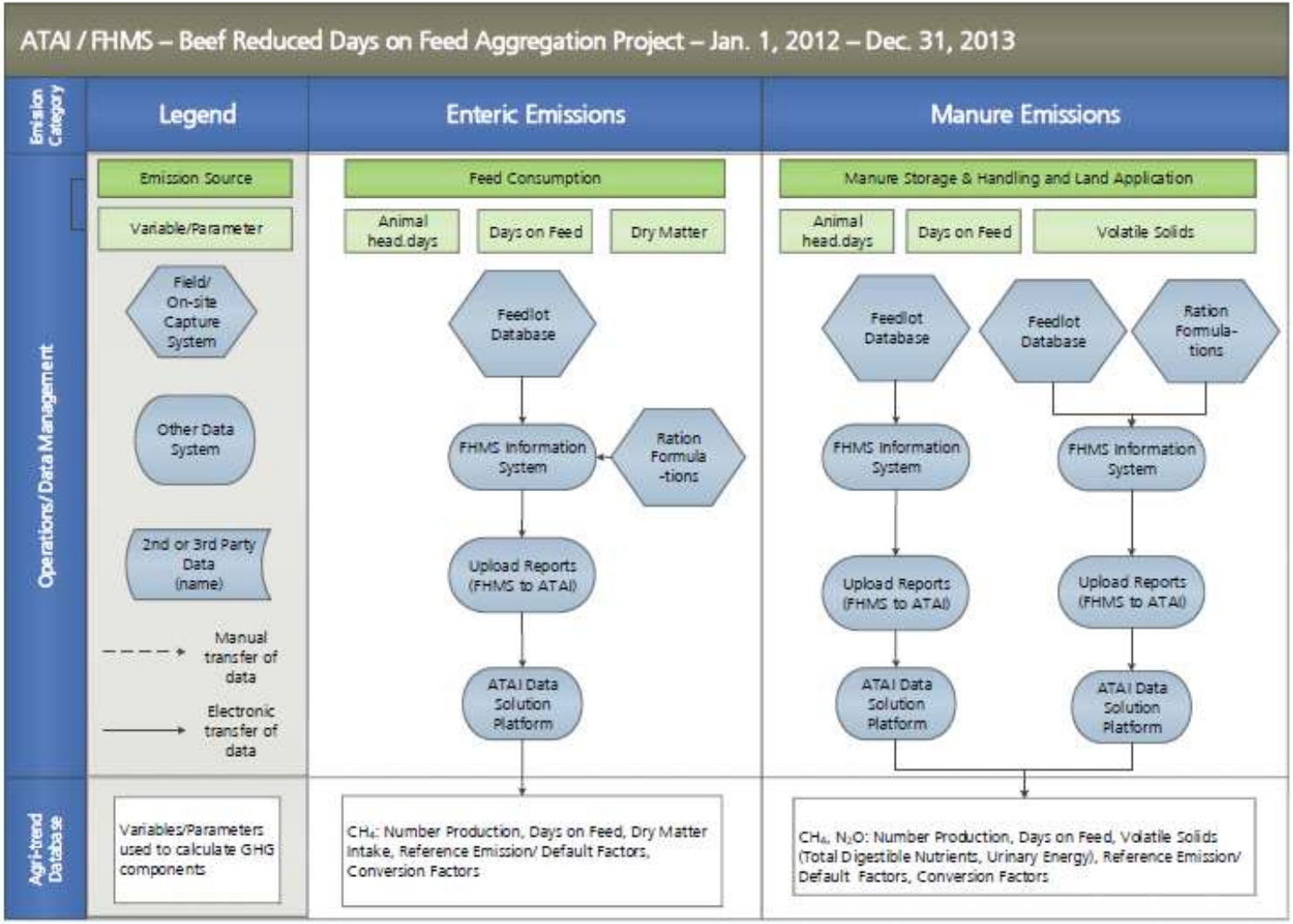
- Occur in Alberta;
- Result from actions not otherwise required by law and be beyond business as usual and sector common practices;
- Result from actions taken on or after January 1, 2002;
- Occur on or after January 1, 2002;
- Be real, demonstrable, quantifiable, and verifiable;
- Have clearly established ownership; and
- Be counted once for compliance purposes.

3.4 Verification Strategy

The Verification Strategy applied to this verification included testing of controls and substantive testing of data. Tests of the controls associated with the tracking of animals in each group were applied to confirm the data integrity of the variables associated with the number of animals in each lot and group as well as the total dry matter intake for each group. The Verification Team designed and executed verification procedures that focused on review of original data for the remaining data parameters.

3.5 Data Management and Control System Review

The Verification Team developed a thorough knowledge of the data management and control systems utilized in the Project through the review of the Offset Project Plan, observations during the site visit, and interviews with key Project personnel. The data flow diagram shown on the following page outlines the flow of Project data and the custody of control.


ATAI / FHMS – Beef Reduced Days on Feed Aggregation Project – Jan. 1, 2012 – Dec. 31, 2013
Emission Category
Legend
Enteric Emissions
Manure Emissions
Operations/ Data Management
Emission Source
Variable/Parameter
Field/ On-site Capture System
Other Data System
2nd or 3rd Party Data (name)
Manual transfer of data
Electronic transfer of data
Feed Consumption
Animal head.days
Days on Feed
Dry Matter
Feedlot Database
FHMS Information System
Ration Formula -tions
Upload Reports (FHMS to ATAI)
ATAI Data Solution Platform
Manure Storage & Handling and Land Application
Animal head.days
Days on Feed
Volatile Solids
Feedlot Database
Feedlot Database
Ration Formula-tions
FHMS Information System
FHMS Information System
Upload Reports (FHMS to ATAI)
Upload Reports (FHMS to ATAI)
ATAI Data Solution Platform
ATAI Data Solution Platform
Agri-trend Database
Variables/Parameters used to calculate GHG components
CH4: Number Production, Days on Feed, Dry Matter Intake, Reference Emission/ Default Factors, Conversion Factors
CH4, N2O: Number Production, Days on Feed, Volatile Solids (Total Digestible Nutrients, Urinary Energy), Reference Emission/ Default Factors, Conversion Factors

4 Mock Verification Findings

4.1 Findings

The following table provides a summary of the verification procedures used to evaluate this source and any findings of the verification. Note that the same variables are used for the baseline and project emissions calculations and therefore, these tables are not repeated.

Cattle Enteric Emissions		
Data Description	**Verification Procedure(s) Applied**	**Findings**
Number of head.days **Number of animals in production** **Days on Feed for each feeding regime**	Inquiry: interview Responsible Party personnel regarding systems used for tracking animals through the feedlot and for removing sick animals from the lot	Complete. Inquiry and documentation shows that animals are tracked as they enter the feedlots by scanning RFID tags. Animals are assigned to a lot and tracked through the course of their time at the feedlot. Sick or dead animals are removed from the lot. Animals are tracked as they are shipped by scanning RFID tags. Shipping manifests show the identification numbers of animals shipped, which can be traced back to each lot, which produces an accurate number of animals shipped.
	Documentation: Review a sample of close-out reports to confirm dead animals have been removed from the lot and specific animals have been documented throughout the feedlot stages; from initial to final processing.	The system records the date of each transaction (entering or leaving the lot) and calculates the value for head.days.
	Observation - system used for tracking RFIDs.	During the site visit, the verification team observed that RFID tag protocols are being applied to track animals through the feedlot.
	Recalculation of number of head days and number of head in production	ICF completed a manual recalculation of the head days from the animal tracking data and found that the feedlot system for calculating the value for head.days is accurate.
Daily Dry Matter Intake - based on total quantity of feed for diet	Review a sample of scale calibration documentation for all feedlots. (Scales used for purchasing grain, therefore accuracy is important and low likelihood of Control Risk.)	Calibration records were reviewed. All scales were found to be maintained routinely. Cross-check calibration is completed routinely by comparing measured values on truck scales against the yard scale.
	Manually calculate DDMI for a sample of lots to determine if fed value excludes dead animals.	Close out reports contain the information required to conduct this calculation. The quantity of DDMI was confirmed to exclude the mass fed to animals that were removed from the group (sick or dead).

Cattle Enteric Emissions		
Data Description	**Verification Procedure(s) Applied**	**Findings**
	Inquire regarding process for incorrect feeding during site visit.	Incorrect feeding is deemed to be an "emergency" and is addressed immediately. Incorrect feed is removed from the bunk. Upon inquiry with several staff, this type of event was determined to occur very infrequently.
Level of Concentrates (used to determine Enteric Emission Factor)	Review Level of Concentrates in ration formulation reports to ensure correct percentage was applied in emission reduction calculations.	Data is available from ration formulation sheets. This data was correctly transcribed into the GHG quantification software.
Edible Oils (used to determine Enteric Emission Factor and Gross Energy of the diet)	Review ration formulation to ensure correct level of edible oils was applied.	Data is available from ration formulation sheets. This data was correctly transcribed into the GHG quantification software.

Manure Storage & Handling and Land Application Emissions		
Data Description	**Verification Procedure(s)**	**Findings**
Number of animals in production Days on Feed for each feeding regime Daily Dry Matter Intake - based on total quantity of feed for diet	See table above	See table above
Total Dietary Nutrients	Review Total Digestible Nutrients in Ration Formulation reports to ensure correct percentage was applied in emission reduction calculations.	Data is available from ration formulation sheets. This data was correctly transcribed into the GHG quantification software.
Level of Concentrates (used to determine Urinary Energy)	See table above	See table above
Percent Crude protein in diet of each feeding regime	Review Crude Protein Content in Ration Formulation reports to ensure correct value was applied in emission reduction calculations.	Data is available from ration formulation sheets. This data was correctly transcribed into the GHG quantification software.

Production		
Data Description	**Verification Procedure(s)**	**Findings**
Total Gain	Recalculate total gain from measurements of landed and shipped weights	The calculation of the baseline and project emission intensities in the project was completed by applying the weight gain as the denominator (production) value. The Protocol specifies the use of the production value as the carcass weight (however, the example in the Protocol applies gain). This Protocol inconsistency is further described in Section 4.3

Data Description	Findings
Diet & Feeding Strategies	Content and quantity of feed data was available from ration formulation sheets and the feedlot database. This data was available for both baseline and project conditions.
Animal Grouping Criteria	Animal grouping criteria was provided for each feedlot and was similar between the baseline and project conditions.
Manure Management Requirements	Confirmation of manure management practices was provided for each feedlot to demonstrate conformance with the *Agricultural Operation Practices Act*.
Statistical Sampling Methodology	Not applicable – the statistical sampling methodology was not applied for the pilot project.
Measurement & Monitoring	Quantification of emission reductions was based on actual measurement and monitoring including; measurement of feed quantity, measurement of feed content, measurement of cattle weights.
SGER Eligibility Criteria	The project met the eligibility criteria stated in Section 7 of the *Specified Gas Emitters Regulation*. The feedlots in the project were located in Alberta; the actions taken to reduce emissions were not required by law; the actions were taken after January 1, 2002; and emission reductions were real, demonstrable, and quantifiable.

4.2 Mock Verification Conclusion

All data and documentation required to quantify the emission reduction according to the requirements of the Protocol were available for verification. The verification team satisfactorily completed all verification procedures with sufficient evidence to form a verification conclusion.

4.3 Protocol Related Issues

This section provides the results of the verification team's in-depth analysis of the pilot project implementation of the quantification protocol and the documentation supporting the data used for the pilot project. All of these comments relate to the Protocol that was revised following the previous Protocol

Validation Study (the "**Revised Protocol**"). As of the date of this report, this version of the Protocol is pending approval from ESRD.

1. It is imperative that any calculations at the project group level are completed as the weighted average of the lots using the number of animals in production (number of animals shipped) as the basis for calculating the weighted average. This requirement should be clearly stated throughout the Protocol and should be reflected in the quantification equations.

2. The general emission reduction quantification methodology is to independently calculate the emission intensities for production in the baseline and project, then calculate the difference between these intensities. The emission reduction is the product of the difference of the project and baseline intensities multiplied by the total production in the project reporting period. This explanation (with equations) would be best served in Section 4.1 of the Protocol. This general description would also be beneficial in the Protocol introduction (Section 1.0). "Intensity" should be specified as "emissions per kg weight gain" throughout the Protocol.

3. In Section 4.4 of the Protocol, the baseline and project emission intensities are specified as "emissions per kilogram of hot carcass weight once the emissions are calculated for all animal groupings". In Appendix A of the Protocol, the hot carcass weight is specified as "average carcass weight gained while in the feedlot".

   The Protocol should be revised to clarify the measurement in Section 4.4 to be weight gained while in the feedlot as this is the appropriate measurement to be applied to ensure functional equivalence. Further, the parameters for calculating this value should be specified.

   Further, the equations in Section 4.4 and Section 4.5 should be labeled with equation numbers to make them easy to reference.

4. Protocol Flexibility #4 states that assuming that cattle were on a concentrate diet equal or greater to 85% the entire time they are in the feedlot is a conservative approach. However, if the animals were *actually* on a diet with greater than 85% concentrates in the baseline condition and less than 85% in the project condition, this assumption described in the protocol flexibility would actually result in an overstatement of the asserted emission reduction.

   Therefore, to be as conservative as possible in the flexibility, the Protocol should be revised to state that the assumed concentrates should be set as greater than or equal to 85% in the baseline and less than 85% in the project.

5. Section 4.2 of the Protocol provides a detailed explanation of the equations used to calculate the emission reduction. This section is redundant and should be removed because all of this information is already presented in Table 8, Section 4.3. Repeating this information in Section 4.2 adds complexity to the Protocol because there are two sources of information for each equation.

6. The Protocol creates a pathway for emissions leakage related to the feeding of dry distillers grains with solubles (DDGS).

   The crude protein content of DDGS has historically been higher than other grains, although DDGS producers have more recently removed protein from DDGS and sold the protein separately in a high protein meal. Therefore, current DDGS feeds typically have a crude protein content that is similar to other grains.

DDGS is produced in Alberta and across Western Canada as a co-product of ethanol production. It is typically sold locally due to transportation costs. Therefore, the quantity of DDGS available for sale in Alberta is generally not dependent on market prices outside Alberta.

If DDGS was fed during the baseline period, the higher levels of crude protein would result in greater emissions (equation #5 of the Protocol, Nitrogen excreted by cattle applies crude protein to the calculation). If DDGS is subsequently not fed during the project reporting period, the offset project developer will receive credit because the crude protein in the diet has been reduced.

Leakage would occur if the DDGS that this feedlot did not purchase was purchased and fed at a feedlot that is not participating in the offset system. In this scenario, the emissions associated with the higher crude protein of the DDGS would be emitted at this feedlot, while the feedlot participating in the offset system would receive credit for not feeding this specific volume of DDGS.

7. In Appendix A of the Protocol, the final step should show the calculation of the total mass of each greenhouse gas (methane and nitrous oxide) reduced through the project reporting period before calculating the carbon dioxide equivalent mass.

8. The 2007 IPCC global warming potentials should be applied to the Protocol for 2014 vintage credits (although the pilot project includes only 2012 and 2013 vintage credits).

9. The Protocol specifies the use of a three-year average historical baseline. The calculation of the three year average should be defined explicitly. This calculation should be consistent with the technical guidance used for new facilities under the *Specified Gas Emitters Regulation*, that is, the sum of the emissions for the baseline years for all lots in the group divided by the sum of the production for the baseline years for all lots in the group.

10. The project period emissions at a feedlot may fluctuate from year to year during the project crediting period. In years where the emission intensity in the project reporting period is actually greater than the baseline period, no credits would be issued. However, the emission intensity for that project reporting period should still be reported if the feedlot remains in the offset project to avoid the potential for manipulation of future credits.

11. The protocol specifies the calculation of "average daily gain" in several places. In fact, only the total gain for each protocol group is required for the calculation of the emission reduction. The Protocol should be revised to specify total gain for the group. If average daily gain is measured by the feedlot, then head.days also needs to be used to calculate total gain.

5 Verification Team

Since 1969, ICF International has been serving major corporations, all levels of government, and multilateral institutions. Globally, approximately 500 of our 4,500 employees are dedicated climate change specialists, with experience advising public and private-sector clients. ICF International has earned a reputation in the field of climate change consulting for its analytical rigour, in-depth expertise, and technical integrity through scores of GHG emissions-related assignments over the past two decades.

Over the past ten years, ICF Consulting Canada, Inc., a fully owned subsidiary of ICF International, has established a GHG Verification Body and carried out hundreds of facility-level GHG verifications and verifications of emissions reductions projects. The Verification Body has developed the necessary internal controls to ensure qualified and competent staffing uphold the principles of the relevant standard while quality control processes are utilized to assure data integrity is maintained and safeguarded. ICF's clients choose ICF for its strong brand, technical expertise, and rigorous methodological approach.

The Verification Team assigned to this verification consists of experienced GHG verifiers with relevant technical expertise.

Lead Verifier – Aaron Schroeder, P. Eng

Aaron Schroeder is a Professional Engineer in the Province of Alberta and holds a B.Sc. in Engineering from the University of Saskatchewan. He has completed supplementary training in ISO 14064 as well as Auditing and Assurance Engagements through the University of Toronto, School of Continuing Studies. Further, Aaron has presented ICF's internal ISO 14064 training several times over the past two years. Aaron has acted as Lead Verifier for nearly 100 third-party assurance engagements over multiple compliance periods under Alberta's Specified Gas Emitters Regulation and British Columbia's Greenhouse Gas (Cap and Trade) Act Reporting Regulation. The facility compliance reports have included bitumen extraction facilities in Alberta's oil sands, oil and gas extraction and processing plants across Western Canada, coal and natural gas fired electricity generating facilities, cogeneration facilities, petrochemical facilities, refineries, upgraders and natural gas pipelines. Emissions reduction project verifications have included acid gas injection, enhanced oil recovery, wind electricity generation, energy efficiency, landfill gas capture and utilization and conservation cropping/tillage management projects. Additionally, Aaron has led the validation team that has provided assurance that ethanol and biodiesel facilities were designed to produce renewable fuels within the guidelines of Alberta's Renewable Fuel Standard Regulation.

Associate Verifier – Kate Nesbitt

Kate Nesbitt is an Associate in ICF's Energy and Carbon Markets division in the Calgary office. Kate has worked on regulatory compliance GHG verifications for gas processing plants, oil and gas upstream operations and power generation facilities under the Specified Gas Emitters Regulation in the province of Alberta and the British Columbia Greenhouse Gas Reduction (Cap and Trade) Act. Additionally, Kate has worked on verifications of emissions reductions for wind energy, energy efficiency, conservation cropping and acid gas injection projects. Kate holds a B.Sc.in Environmental Science from the University of Lethbridge and a M.Sc. in Environmental Sustainability from the University of Edinburgh. She has completed training in ISO 14064, and holds current H_2S Alive training.

Technical Expert – Michelle Stelmach, AIT

Michelle Stelmach works on contract with ICF and acted as the Technical Expert for this verification, performing the site visits and assisting with verification planning and procedures. She holds a Bachelor of Science in Agriculture from the University of Saskatchewan and certification in agricultural application of ISO 19011 – Internal System Auditing and has worked with the Hazard Analysis Critical Control Point (HACCP) to design and conduct internal system audits and to meet Canadian Food Inspection Agency standards at the producer level, in feed manufacturing plants and poultry processing plants. She has extensive experience working with agricultural producers across Alberta through her work as Program Advisor and Coordinator with Maple Leaf Foods and Landmark Feeds.

Statement of Qualifications

As the Lead Verifier and a Professional Engineer registered in the province of Alberta, I, Aaron Schroeder meet or exceed the required qualifications described in Section 18 of the *Specified Gas Emitters Regulation*, including the training requirements under ISO 14064.

The information contained within this document and this statement of qualifications, is complete and correctly represents the qualifications of ICF and the members of the Verification Team described herein. Dated this 30th day of September, 2014.



Aaron Schroeder, P.Eng.
Professional Engineer, Alberta (75566)
Lead Verifier
ICF Consulting Canada, Inc.
Calgary, Alberta

Appendices

Verification Plan

Verification Plan

Agri-Trend Aggregation Inc. & Feedlot Health Management Services Beef Reduced Days on Feed Aggregation Project

1 Introduction

This document provides details on the verification scope and process that is planned to conduct a reasonable level verification of the 2012 and 2013 Alberta Offset System Greenhouse Gas Assertion of Emission Reduction Credits (the "**GHG Assertion**") for the Agri-Trend Aggregation Inc. and Feedlot Health Management Services Beef Reduced Days on Feed Aggregation Project, (the "**Project**"). An overview of operations at the Project will be provided in the Verification Report.

A Verification Risk Assessment was conducted during the verification planning stage; the results will be provided in Section 6 of the final Verification Plan. These results were used to inform the development of the verification procedures outlined in Section 7 of the final Verification Plan. Additionally, the results of the Risk Assessment informed the development of the Sampling Plan, which will be included in the Verification Report.

The Verification and Sampling Plans will be updated through the course of the verification as additional information becomes available.

The verification conclusion will be documented in the Verification Statement and the verification findings will be further described in the Verification Report. The Verification and Sampling Plans will be appended to the Verification Report to provide information related to the verification scope and process.

2 Verification Scope

2.1 Objective

The primary objective of this verification engagement is to provide assurance to Alberta Environment and Sustainable Resource Development ("**ESRD**") that the GHG Assertion is reliable, and of sufficient quality.

2.2 Parties and Users

The person or organization that has overall control and responsibility for the GHG Project, as defined in Section 2.13 of ISO 14064-2:2006, is the "**Project Proponent**". For this verification, Aggregation Inc. ("**ATAI**") and Feedlot Health Management Services and ("**FHMS**") are the Project Proponents. ATAI and FHMS are also the Responsible Parties.

ICF Consulting Canada, Inc., the "**Verifier**" or "**ICF**", has been engaged to provide a third-party verification of the GHG Assertion. The Lead Verifier, Associate Verifier and Technical Expert compose the ICF "**Verification Team**".

The "**Intended User**" is defined in Section 2.22 of ISO 14064-2:2006 as the individual or organization identified by those reporting GHG-related information that relies on that information to make decisions. ESRD is the Intended User of the information contained within the Verification Statement.

2.3 Scope

The verification will be conducted in accordance with *ISO 14064-3: Specification with guidance for the validation and verification of greenhouse gas assertions.*

The Verification and Sampling Plans were developed based on the relevant criteria described in the following:

- *Specified Gas Emitters Regulation, Alberta. Reg.139/2007*
- *Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle, Version 2.1, April 2013*
- *Technical Guidance for Offset Project Developers, v4.0, February 2013*
- *Offset Project Plan, Beef Reduced Days on Feed Aggregation Project, June 2014 V2*
- *Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013*

The following table defines the scope elements specified for the Project.

Scope Element	ISO 14064-3 Definition	Project Specific
Boundary	The Project boundary, including legal, financial, operational and geographic boundaries	The Project boundary includes six participating feedlots. All participating project sites are located within Alberta.
Infrastructure and Activities	The physical infrastructure, activities, technologies and processes associated with the Project	The scope includes activities that occur during the latter third of the life of beef cattle and that primarily occur in feedlots. Processes include the implementation of feeding practices and management strategies to increase feed use efficiency and thereby reduce direct and indirect GHG emissions related to the enteric fermentation, manure storage and handling emission sources for beef cattle.
GHG Sources	GHG sources to be included	Baseline and Project emissions from the following GHG sources: • Feed Consumption • Manure Storage and Handling • Land Application
GHG Types	Types of GHGs to be included	• Methane (CH_4) • Nitrous Oxide (N_2O)
Reporting Period	Vintage of credits to be included	January 1, 2012 – December 31, 2013

2.4 Materiality

During the course of the verification, individual errors, omissions or misrepresentations (collectively referred to as misstatements) or the aggregate of these misstatements will be evaluated qualitatively and quantitatively.

Materiality defines the level at which misstatements in the GHG Assertion or any underlying supporting information precludes the issuance of a reasonable level of assurance.

The Lead Verifier is responsible for applying professional judgment to determine if *qualitative* misstatements could adversely affect the GHG Assertion and subsequently influence the decisions of the Intended User, in which case, the misstatements are deemed to be material.

Quantitative misstatements will be calculated individually to determine the impact of the misstatement as a percentage of the GHG Assertion.

All misstatements that are outstanding at the conclusion of the verification are documented in the Verification Report and classified on an individual basis as either material or immaterial.

Materiality Threshold

The materiality threshold is defined as 5% of the total reported emissions reductions in the GHG Assertion. Individual misstatements and the aggregate of individual misstatements will be analyzed to determine if the materiality threshold has been breached.

Tolerable Error Threshold

Tolerable error dictates the level of rigor applied to the verification at the emissions source level. Tolerable error for this verification will be set at half of materiality (2.5%) of the total GHG Assertion.

2.5 Principles

ISO 14064 defines six principles that should be upheld in the development of the GHG Assertion. These principles are intended to ensure a fair representation and a credible and balanced account of GHG-related information. The verification procedures developed and executed during the course of this verification will present evidence such that each of these principles is satisfied.

Relevance

Appropriate data sources are used to quantify, monitor, or estimate emissions sources. Appropriate minimum thresholds are used to justify the exclusion or the aggregation of minor GHG sources or the number of data points monitored.

Completeness

All emissions sources relevant to the Project are included within an identified source category.

Consistency

Uniform calculations are employed between reporting periods. Emissions calculations for each emissions source are calculated uniformly. If more accurate procedures and methodologies become available, documentation should be provided to justify the changes and show that all other principles are upheld.

Accuracy

Measurements and estimates are presented, without bias as far as is practical. Where sufficient accuracy is not possible or practical, measurements and estimates are used while maintaining the principles of conservativeness and transparency.

Transparency

Information is presented in an open, clear, factual, neutral and coherent manner that facilitates independent review. All assumptions are stated clearly and explicitly and all calculation methodologies and background material are clearly referenced.

Conservativeness

Appropriate parameters affecting the Project's emissions sources are utilized in the calculation of the GHG Assertion. When parameters or data sources are highly uncertain, the choice of parameter or data source utilized results in an underestimation of the GHG Assertion. Note that any error, underestimation or overestimation, would be evaluated as a potential material error.

2.6 Limitation of Liability

Due to the complex nature of the operations within the Project and the inherent limitations of the verification procedures employed, it is possible that fraud, error, or non-compliance with laws, regulations, and relevant criteria may occur and not be detected.

3 Verification Team

The qualifications of the Verification Team and Internal Peer Reviewer are provided in the Statement of Qualifications.

Lead Verifier, Aaron Schroeder, P. Eng

The Lead Verifier is responsible for all activities conducted within the verification, including overseeing the development of the Verification and Sampling Plans and the execution of the verification procedures. The Lead Verifier is the lead author of the Verification Report and executes the Verification Statement at the conclusion of the engagement.

Associate Verifier, Kate Nesbitt

The Associate Verifier work under the direction of the Lead Verifier to conduct the verification procedures.

Technical Expert, Michelle Stelmach, ATI

The Verification Team is supported by the Technical Expert, who review the Verification Risk Assessment and provide advice on the development of the Verification and Sampling Plans to ensure risks are addressed with rigorously designed verification procedures. The Technical Expert is also available to the Verification Team through the course of the verification to provide assistance with any issues as they arise.

4 Verification Process

The ICF approach for conducting verification of a GHG Assertion follows the tasks outlined in the following diagram. Although these tasks are generally completed sequentially, the order may be modified according to circumstances such as scheduling and data availability.

Pre-Engagement	Approach	Execution of Verification	Completion
1. Selection of Lead Verifier 2. Initiate Conflict of Interest Procedure 3. Pre-Engagement Planning and Proposal Development 4. Contract Execution 5. Assess GHG Program & Revise VMS as Required 6. Initiate Verification Tracking	7. Selection of Verification Team 8. Communication with Project Proponent 9. Kick-off Meeting 10. Verification Risk Assessment 11. Draft Verification and Sampling Plan	12. Site Visit 13. Conduct Verification Procedures 14. Issue Clarification & Data Request 15. Revise & Finalize Verification and Sampling Plan 16. Address and Evaluate Outstanding Issues	17. Evaluate Evidence 18. Hold Verification Findings Meeting (if necessary) 19. Draft Verification Report & Statement 20. Internal Peer Review 21. Completion of COI Form 22. Independent Review of Impartiality 23. Issue Verification Report & Statement 24. Close Verification File 25. Develop and Issue Management Memo(s)

4.1 Pre-Engagement

Prior to submitting a proposal to conduct this verification, the following pre-planning steps were taken:

- The results of any previous business engagements or verifications with the Project Proponent were reviewed to determine if any previous unresolved conflicts may preclude ICF from engaging in the verification;
- The Project Proponent's motivation for completing the verification was established; and
- A Conflict of Interest procedure was initiated that documents whether any perceived or real conflicts were found when considering threats due to:
  - Advocacy
  - Financial Interest
  - Familiarity/Sympathy
  - Intimidation
  - Self-Review
  - Incentives

Following the acceptance of the proposal and signing of a contract for services, the Verification Team was selected. The Verification Team for this engagement is comprised of the individuals identified in Section 3.

4.2 Approach

An extensive knowledge of the Project Proponent's business, the relevant industry, and the details of the Project itself are required to conduct a thorough verification that can lead to a conclusion. The initial information collected about the Project Proponent and the Project formed the basis of the preliminary draft Verification Plan. The development of the final Verification Plan is an iterative process; that is, the process will be completed several times through the course of the verification and the resulting plan will be updated as new information became available.

There are three types of risk associated with the GHG Assertion defined in ISO 14064-3:

- Inherent Risk
- Control Risk
- Detection Risk

The process of designing the Verification Plan began with the development of Verification Risk Assessment for both the Project as well as the Project Proponent. The steps in this process included:

- Reviewing the GHG Assertion, and the methodologies employed by the Project;
- Reviewing information on the industry and the specific Project under review;
- Assessing the likelihood that a material misstatement might exist in the GHG Assertion, if no controls were used to prevent misstatements in the GHG Assertion (i.e. inherent risk);
- Assessing the control environment and the corporate governance process (i.e. control risk); and
- Reviewing each emissions source identified in the Project, and evaluating the contribution of each source to the GHG Assertion and the associated potential material misstatement for each.

The results of the Verification Risk Assessment inform the development of the verification procedures, which will be documented in Section 7 of the final Verification Plan. A summary of the Verification Risk Assessment will be provided in Section 6 of the final Verification Plan. The Sampling Plan and the Verification Risk Assessment will be reviewed by ICF's designated Technical Expert to ensure the verification procedures address each of the risks identified. The draft Verification Plan will be provided to the Project Proponent before proceeding with the verification.

4.3 Execution of Verification

With draft Verification and Sampling Plans in place, the verification procedures will be executed. This process involves collecting evidence, testing internal controls, conducting substantive testing, and developing a review file. Over the course of the verification, the draft Verification and Sampling Plans may change; the final Verification and Sampling Plans provided in the Verification Report reflect the verification parameters and procedures that were actually executed.

Site Visit

The site visit will be conducted by Aaron Schroeder and Michelle Stelmach on July 11, 2014.

The site visit will be a key step in the planning and execution of the verification. During the course of the site tour, ICF will interview key site operations personnel regarding the operations and data management of the Project.

FHMS staff to be interviewed on-site include:

- Luis Félix, Special Projects Consultant
- Matt May, Nutritionist

- Eduardo, Cattle Boss
- Moon, Cattle Boss

During the site visit all GHG emissions sources for the Project will be reviewed to ensure appropriate identification and categorization. A review of process flow and metering diagrams will be followed by physical observation of the Project.

Health and Safety Requirements

Basic level personal protective equipment is required for the site visit.

Collecting Evidence and Review of Documentation

Sufficiency and appropriateness are two interrelated concepts that are fundamental to the collection of verification evidence. The decision as to whether an adequate quantity (sufficiency) of evidence has been obtained is influenced by its quality (appropriateness).

Through the execution of the verification procedures described in Section 7 of the final Verification Plan, the Verification Team will review three key forms of evidence including physical, documentary and testimonial:

- Management documentation: policies, programs, and procedures related to the collection, safeguarding, and management of the data supporting the GHG Assertion;
- Records: records comprise time-sensitive data, correspondence, and files including: close-out reports, Variance Reports, weigh scale tickets, shipping manifests, feedlot ration and nutrient analysis sheets, NRCB permits, feedlot purchase receipts;
- Interviews: the interviews will provide information regarding operations and data management and will provide evidence to support the sufficiency of data controls; and
- Computer systems: data systems and Agri-Trend Solutions Platform used to capture and manage the GHG-related data and to calculate the GHG Assertion.

Testing and Assessment of Internal Controls

The Verification Team will develop a sufficient understanding of the GHG information system and internal controls to determine whether the overall data management system is sound and if it supports the GHG Assertion. This assessment will seek to identify any weakness or gaps in the controls that pose a significant risk of not preventing or correcting problems with the quality of the data and examining it for sources of potential errors, omissions, and misrepresentations. It will incorporate an examination of three aspects of the Project Proponent's internal controls: (1) the control environment, (2) the data systems, and (3) the control and maintenance procedures.

Assessment of Data

Substantive testing procedures will be used to assess the reasonability and validity of the GHG Assertion. Both quantitative and qualitative analysis will be performed to achieve the desired level of assurance. The verification procedures are described in Section 7 of the final Verification Plan as separate tables for each process or activity involved in the quantification and reporting of the GHG Assertion. The verification procedures include verification activities designed to:

- Review the Project boundary, including a review of the completeness of emissions sources identified;
- Review the Project data sources to ensure the GHG Assertion is calculated based on metered or estimated data that meets the requirements of the *Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle, Version 2.1, April 2013*;
- Re-calculate the GHG Assertion, which demonstrates transparency and accuracy; and

- Review the GHG Assertion to ensure the emission reductions calculated by the Project Proponent have been accurately reported.

Clarification and Data Request

To facilitate information flow between the Verification Team and the Project Proponent, a consolidated request for additional information will be developed through the course of the verification and issued to the Project Proponent. This "Clarification and Data Request" will be used to document information requests and summarize the responses. It will also be used to document the Verification Team's assessment of each response.

Developing a Review File

A review file (the "**File**") comprised of documents, records, working papers and other evidence collected and created during the course of the review that support the review conclusions will be developed for this verification. This evidence stored in hard copy and/or electronic format will serve to provide support for the verification conclusion, provide evidence that the verification was conducted in accordance with the criteria set forth in this document, and aid the Verifier in conducting current and future reviews.

The File will include:

- The GHG Assertion and supporting documentation, as submitted to ESRD;
- Decisions on the level of materiality and the results of the Verification Risk Assessment;
- Documentation on the Project Proponent's internal controls;
- Descriptions of the controls assessment work and results;
- Documentation of the substantive testing procedures that were carried out and the results;
- Documentation of the confirmations outlined in Table 26 of ESRD's *Technical Guidance for GHG Verification at Reasonable Level Assurance*, v1.0, January 2013;
- Copies of any correspondence with the Project Proponent or other parties relevant to the review;
- The Verification Team's working papers;
- The Clarification and Data Request with documented responses from the Project Proponent; and
- Client data (copies of relevant records, spreadsheets, and other data files).

The File is the property of ICF and access to it is normally restricted to the Verifier and the Project Proponent. ICF will retain and safeguard the file for a minimum of seven years.

4.4 Completion

This engagement will be formally closed after the verification has been executed and the Verification Report has been finalized.

Preparing the Verification Report

The purpose of the Verification Report is to document the verification findings. All misstatements are described and compared to the materiality threshold individually and in aggregate. The Verification Statement, which presents ICF's verification conclusion, is included in the Verification Report.

Internal Peer Review Process

Prior to releasing the Verification Report and Verification Statement, an internal review process is conducted by the Internal Peer Reviewer. This process ensures that:

- All steps identified as being required to complete the verification were completed;
- Any identified material or immaterial misstatements identified have been either:

  - corrected by the Project Proponent and reflected in the GHG Assertion; or
  - documented in the Verification Report, if misstatements persist at the conclusion of the verification.
- All required documentation detailing the verification process has been prepared, delivered, and retained.

Closing the Engagement

The verification engagement will be closed out upon delivery of the final Verification Report.

5 Verification Schedule

The following schedule is planned for the verification (subject to change with agreement between the Verifier and the Project Proponent).

Description	Scheduled Date
Verification Kick-Off Meeting	July 11, 2014
Draft Verification Plan to Project Proponent	July 18, 2014
Site Visit	July 11, 2014
Head Office Visit	July 11, 2014
Initial Clarification & Data Request	July 18, 2014
Draft Verification Statement and Report	July 29, 2014
Final Verification Statement and Report	August 1, 2014

6 Verification Risk Assessment

The process for completing a Verification Risk Assessment was described in Section 4.2. The following table describes the *inherent* and *control* risks analyzed by the Verification Team and the corresponding verification procedure(s) outlined in Section 7 of this document that have been designed to address these risks.

Description of Inherent Risks	Inherent Risk Evaluation	Description of Control Risks	Control Risk Evaluation	Verification Procedure(s)
The number of cattle in production is not accurate due to animal movements or death.	Medium	Each distinct grouping of animals is uniquely identified with a Lot ID Number. Feedlot operators track and reconcile animal movement and deaths. Each animal has an RF ID tag that is read at multiple points within the feedlot.	Medium	D1.2, D2.1, D2.2
The calculation of the weighted average is not performed correctly.	High	No controls identified.	N/A	C2.1
Some animals may not be included within the lot counts.	Medium	Two forms of ID tags are used - Lot ID Numbers and RF ID tags.	Medium	D1.2
Calculation is not performed correctly.	Medium	No controls identified.	N/A	C2.2
Scales are reading inaccurate values.	High	Calibration of scales performed.	Medium	D1.5
Trucks deliver feed to the incorrect lot.	Medium	Management process defined for identifying incorrect feed delivery.	Medium	D1.2
Calculation is not performed correctly.	High	No controls identified.	N/A	C2.3
Incorrect percentage applied in calculations.	Medium	No controls identified.	N/A	D2.5
Incorrect factor applied in calculation.	Medium	No controls identified.	N/A	D2.4. D2.5
The calculation of the average is not performed correctly.	High	No controls identified.	N/A	C2.4
Scales are reading inaccurate values.	High	Calibration of scales performed.	Medium	D1.5
The calculation of the average is not performed correctly.	High	No controls identified.	N/A	C2.4
Scales are reading inaccurate values.	High	Calibration of scales performed.	Medium	D1.5
Incorrect percentage applied in calculations.	Medium	No controls identified.	N/A	D2.7
Incorrect factor applied in calculation.	Medium	No controls identified.	N/A	D2.5
Incorrect percentage applied in calculations.	Medium	No controls identified.	N/A	D2.6
The calculation of the average is not performed correctly.	High	No controls identified.	N/A	C2.4
Scales are reading inaccurate values.	High	Calibration of scales performed.	Medium	D1.5
Live Weight is used instead of Hot Carcass	High	No controls identified.	N/A	C2.5

Weight				
Normal operational changes at the Facility may lead to significant changes in emissions and/or production during the reporting period.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	B1.1, B2.1
Emission sources may not have been included in the GHG Assertion.	Medium	N/A - ICF is not relying upon Responsible Party's controls	N/A	B1.2, B1.3, B1.4
Negligible emission sources may not meet the definition and threshold for "negligible" or may have changed in magnitude from previous reporting periods.	Low	N/A - ICF is not relying upon Responsible Party's controls	N/A	B1.5
Data used to quantify emissions and production is consolidated from several systems.	Medium	N/A - ICF is not relying upon Responsible Party's controls	N/A	D1.1, D1.2
Quantification of emissions within the GHG program requires the use of specific accepted methodologies.	Medium	N/A - ICF is not relying upon Responsible Party's controls	N/A	C1.1
Accepted quantification methodologies may not be correctly implemented.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	C2.5
Quantification of emissions may contain arithmetic errors.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	C2.5
Information may be missing from the GHG Assertion.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	A1.1
Information may be incorrectly transcribed into the final GHG Assertion	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	A1.2
There has been inconsistency in personnel responsible for environmental reporting within the Responsible Party over the past year or since the baseline period.	Medium	N/A - ICF is not relying upon Responsible Party's controls	N/A	B2.1
The GHG Assertion is comprised of emissions from multiple aggregated facilities.	Medium	N/A - ICF is not relying upon Responsible Party's controls	N/A	C1.2
Data is entered into a centralized data management system manually, which poses a risk of transcription error.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	D2.2, D2.5
This is the first GHG Assertion that has been prepared by the Responsible Party for this facility.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	C1.1
The GHG Assertion has not previously been validated or verified by an independent third-party.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	C1.1, C2.5

The GHG Assertion includes involves uncommon technologies that may involve novel quantification methodologies.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	C1.1
A significant shut-down or turn-around occurred at the facility over the past year.	Medium	N/A - ICF is not relying upon Responsible Party's controls	N/A	B2.1
The facility employs complex processes, relies on numerous measurement points, and/or complicated quantification procedures.	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	C2.1, C2.2, C2.3, C2.4, C2.5
Quantification of emissions within the GHG program requires the use of specific accepted emission factors (Risk is that the appropriate emission factor may not be applied and/or the conversion/calculation may be inaccurate.)	High	N/A - ICF is not relying upon Responsible Party's controls	N/A	D2.6, D2.7, D2.8

The *detection risk* is a measure of the risk that the verification procedures will fail to detect material misstatements, should such misstatements exist. The verification procedures will be developed to address inherent and control risks, while ensuring the level of detection risk is sufficiently low to reach a verification conclusion at a reasonable level of assurance.

The results of the Verification Risk Assessment will be utilized by the Verification Team to develop the verification procedures, which are outlined in Section 7 of this document.

7 Verification Procedures

Summary of Procedures:

Project Boundaries and Definition

B1: Documentation of Boundaries – Offset Project Plan and Offset Project Report

B2: Demonstration of Applicability

Ownership

O1: Confirmation of Contractual Relationships

Data Sources and Supporting Data

D1: Data Collection and Quality Controls

D2: Substantiating Evidence

Calculation

C1: Appropriate and Consistent Calculation Methodology

C2: Re-Performance of Calculation

Assertion

A1: Final GHG Assertion

Procedure Definition Table Explained

Z1 – Example Procedure Title	
Introduction: This introduction serves to explain the reason the Verification Team is undertaking the procedures described below. For instance, the inclusion of all emissions sources ensures that that quantification of the total direct emission satisfies the principle of completeness.	
Type of Evidence	The Type of Evidence can usually be grouped as: Physical Examination, Confirmation, Documentation, Observation, Inquiries of the Client, Re-performance, or Analytical Procedures.
Data Sources	The *Data Sources* describes the form in which the evidence is presumed or is known to be available to the verification team. Specific Documents or Assigned Positions, for example.
Objective (specific principles)	The objective serves to focus the procedure as pursuant to one or more of the audit principles of: *Relevance, Completeness, Consistency, Accuracy, Transparency, or Conservativeness*.
Specific Activities	• In bullet form; • The *Specific Activities* are outlined here.

Project Boundaries and Definition

B1 – Documentation of Boundaries – Offset Project Plan and Offset Project Report	
Introduction: This procedure evaluates the boundaries defined by the Project Proponent against the requirements of the GHG Programme. The Offset Project Plan must outline how the Project Proponent is implementing the quantification methodology described in the Protocol. Specifically, each emissions source and sink listed in the Protocol as relevant to be included in the emissions reduction calculation must be considered in the Project unless the use of a flexibility mechanism specifically permits its exclusion. Additionally, any sources or sinks not contemplated by the Protocol that are relevant to the project must be considered.	
Type of Evidence	Documentation, Observation, Inquiries of the Client, Physical Examination
Data Sources	Offset Project Plan, Beef Reduced Days on Feed Aggregation Project, June 2014 V2 ("**OPP**"), OFFSET PROJECT REPORT…PROVIDE TITLE INCL. DATE (need to request) ("**OPR**"), Project Process Flow Diagrams, GHG Assertion, Project Operations Personnel, FHMS Personnel, ATAI Personnel
Objective (specific principles)	*Completeness, Consistency, Relevance*
Specific Activities	1. Compare each emissions source and sink listed in the OPP to those listed in the Protocol considering all activities; 2. Compare OPP, OPR, GHG Assertion against the corresponding ESRD templates, as applicable; 3. Interview Project operations personnel regarding changes in operation that have occurred in the time period covered by the GHG Assertion; 4. Through the site visit and understanding of the Project, evaluate any emissions sources or sinks that are not considered by the Protocol.

B2 – Demonstration of Applicability	
Introduction: The Protocol describes the specific applicability criteria that must be satisfied to utilize the Quantification Protocol. The Project Proponent must provide evidence that clearly demonstrates applicability as described.	
Type of Evidence	Documentation, Confirmation
Data Sources	OPP and Supporting Documentation, Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle ("Protocol")
Objective (specific principles)	*Completeness, Relevance*
Specific Activities	1. Review OPP to confirm it complies with the Protocol and that no discrepancies exist. 2. Review OPP for evidence of applicability for each requirement described by the Protocol (applicability requirements outlined in *Protocol Applicability and Data Requirements Checklist);* and 3. Interview key Project personnel regarding the application of applicability criteria.

Ownership

O1 – Confirmation of Contractual Relationship – Proponent and Project Partners	
Introduction: The ownership of the emissions reductions must be demonstrated. The intent of this procedure is not to provide a legal opinion on ownership, but to establish that a contractual relationship exists between the Project Proponent and any other parties who may have an ownership interest in the emissions reductions through ownership of land, equipment or resources related to the Project.	
Type of Evidence	Documentation, Inquiries of the Client
Data Sources	OPP, GHG Assertion, Demonstration of Ownership, Agreements with Feedlot Owners
Objective (specific principles)	*Completeness, Relevance, Transparency*
Specific Activities	1. Review of documents proving the ownership of the assets creating the emissions reductions; 2. Review of contracts binding Project Proponents to other project partners (feedlot owners); 3. Ensure temporal coverage of current assertion in project contracts.

Data Sources and Supporting Data

D1 – Data Collection and Quality Controls	
Introduction: This procedure is intended to systematically review the Project Proponent's internal procedures and controls that are used to calculate the GHG Assertion.	
Type of Evidence	Documentation, Confirmation, Observation, Inquiries of the Client, Analytical Procedures
Data Sources	OPP, Project Operations Personnel, Agri-Data Solutions Platform, Scale calibration reports, Upload Reports
Objective (specific principles)	*Accuracy, Transparency, Conservativeness*
Specific Activities	1. Develop a data life cycle diagram, or data map for each major GHG emissions source/sink and confirm with Project operations and GHG reporting personnel; 2. Observe or interview Project operations personnel regarding the operation of data transfer systems during site tour, including manual data entry procedures and associated controls; 3. Interview Project personnel responsible for quantifying emissions reductions regarding data metering and validation, data storage, data security, and any manual data entry or transcription; 4. Review OPP and OPR regarding data sources, transcription and data security; 5. Review sample of scale calibration documentation for all feedlots – including feedtrucks, yard and processing room scales;

D2 – Documentation Evidence	
Introduction: During the Risk Assessment, the inherent and/or controls risk associated with the primary supporting evidence for specific components of the GHG Assertion was determined to be high enough to require additional substantiating evidence. The specific activities in this verification procedure are specifically customized to focus on additional evidence related to those specific components identified in the verification Risk Assessment.	
Type of Evidence	First-party reports and documentation
Data Sources	Close-out Reports, Upload Reports, Variance Reports, Ration Formulations, feedtruck print-outs
Objective (specific principles)	*Accuracy, Conservativeness*
Specific Activities	1. Review sample of close-out reports to confirm that dead animals have been removed from the lot; 2. Review close-out reports to confirm that sample of animals have been documented throughout the feedlot process; from initial processing to final processing; 3. Review sample of Variance Reports, corresponding ration formulation and feedtruck print-outs to ensure acceptable level of variance; 4. Review edible oils range in sample of Ration Formulations reports to ensure the correct default value was applied for GE Diet and EF Enteric variables; 5. Review Level of Concentrates in sample of Ration Formulations reports to ensure the correct default value was applied for Urinary Energy and GE Diet; 6. Review Crude Protein Content in Ration Formulation reports to ensure the correct value was used; and 7. Review Total Digestible Nutrients in Ration Formulation reports to ensure the correct value was used.

Calculation

C1 – Appropriate and Consistent Calculation Methodology	
Introduction: The specific quantification methodology utilized in the Project must be clearly defined in the Offset Project Plan. This procedure is intended to systematically analyzing the methodology employed against the Protocol requirements. It specifically examines the quantification formulae and any estimation methodologies employed.	
Type of Evidence	Documentation, Inquiries of the Client
Data Sources	Agri-Data Solutions ("ADS") Platform, OPP and Supporting Data
Objective (specific principles)	*Consistency, Accuracy, Transparency*
Specific Activities	1. Review quantification formulae and estimation calculations prescribed by the Protocol against those described in the OPP and utilized in ADS Platform for each GHG emissions source/sink; 2. Compare the quantification methodologies utilized for the current vintage credits against those used in the Baseline periods; 3. Compare emission factors used in calculations against reference documents cited in Protocol and OPP. 4. Review Statistical Sampling Method for Baseline Qualifications used for the Baseline for consistency with the methodology prescribed by the GHG Programme.

C2 – Re-Performance of Calculation	
Introduction: In order to ensure the accuracy of the GHG Assertion, this procedure re-performs the calculation independent from the calculations performed by the Project Proponent.	
Type of Evidence	Re-performance, Inquiries of the Client
Data Sources	OPR, Original Project, Second-Party or Third-Party Activity Data
Objective (specific principles)	*Accuracy, Conservativeness, Transparency*
Specific Activities	1. Calculate the Number of head.days per lot (weighted average); 2. Calculate the Number in Production (straight average); 3. Calculate the Days on Feed (straight average); 4. Calculate the Landed Live Weight and Hot Carcass Weight; and 5. Calculate emissions reduction claim from original, second-party or third-party data.

Assertion

A1 – Final GHG Assertion	
Introduction: This procedure is intended as a final review of the GHG Assertion and OPR to ensure all required information is complete. This procedure in intended to review the transfer of data from the Agri-Data Solutions Platform into the GHG Assertion.	
Type of Evidence	Documentation, Confirmation
Data Sources	GHG Assertion, OPR, Agri-Data Solutions Platform
Objective (specific principles)	*Completeness, Accuracy, Transparency*
Specific Activities	1. Review GHG Assertion against guidance documents for completeness; 2. Compare calculated values to those in the GHG Assertion for transcription accuracy; 3. Review asserted emissions reductions shown in OPR and GHG Assertion compared to values calculated in the Agri-Data Solutions Platform.

Appendix X: RAH Aggregator Spreadsheet

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Introduction

As part of the cost-benefit analysis an excel based calculator was generated. This calculator allows the user to modify the input assumptions and assess the sensitivity of the costs-benefits of implementing the protocol. In the calculator there are four input sheets that must be completed by the user. These include the start-up costs, expected operating cost, optimistic operating cost and pessimistic operating cost sheets. The information from these sheets is carried over into the analysis sheets and an estimate of the costs per credit, revenue per credit and the net present value of the credits over a seven year time period is provided. Changes to the values in the input sheets result in new estimates in the output sheets. A copy of the "Expected Operating Costs Sheet" is provided below for reference. The original excel spreadsheet is needed for full functionality. This spreadsheet is available separately from CCEMC.

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Expected Inputs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Discount Rate (ex. 3 % = 0.03)	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Tonnes of Carbon (in tonnes)	40,000	40,000	42,000	44,000	46,000	48,000	50,000
Price of Carbon (in $/tonne)	$13.00	$13.00	$23.00	$23.00	$27.00	$27.00	$27.00
Expected Number of Projects	4	4	4	4	4	4	4
Split between Producer and Aggregator (In percentage terms)							
Producer (in % terms; ex: 70%=0.70)	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Aggregator`s % (in % terms, ex: 30%=0.30)	0.40	0.40	0.40	0.40	0.40	0.40	0.40
% must sum to 1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Costs that are Fixed for the expected projects							
Legal Costs (Sign up contract plus selling costs)	$12,000.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
Accounting	$6,000.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
Admin/ Office Staff Costs	$25,000.00	$10,000.00	$10,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
Project Planning and Delivery Costs	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
Project Management	$70,000.00	$70,000.00	$70,000.00	$70,000.00	$70,000.00	$70,000.00	$70,000.00
Travel	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00
Marketing/ sales staff							
Office Costs (office space, phones, miscellaneous)	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
Computer Storage, Website and Software	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00
Maintenance of Database and software system upgrades (10 to 15% of initial)	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00
Sub-Total Operating Costs (Annual Costs)	$174,000.00	$159,000.00	$159,000.00	$164,000.00	$164,000.00	$164,000.00	$164,000.00
Annual Costs that vary with the volume of carbon							

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Data Gathering (cost per credit; ex. $0.70=0.70)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
De-Listing Fee (cost per tonne. Ex: $0.10=0.10)	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Registration Costs (cost per tonne: ex: $0.10 =0.10)	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Insurance (Percentage of market price)	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Annual Costs that vary with the number of projects							
Project Listing Fee (cost per project: ex: $250 per project)	$250.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Annual Report Posting Fee (Cost per project: $250 per report)	$250.00	$250.00	$250.00	$250.00	$250.00	$250.00	$250.00
Verification Costs (cost per project: ex $20,000 per project)	$22,000.00	$22,000.00	$22,000.00	$22,000.00	$22,000.00	$22,000.00	$22,000.00
Dollar Value of the Annual Costs that vary with the volume of carbon or number of projects							
Data Gathering Costs	$40,000.00	$40,000.00	$42,000.00	$44,000.00	$46,000.00	$48,000.00	$50,000.00
Registration Costs	$4,000.00	$4,000.00	$4,200.00	$4,400.00	$4,600.00	$4,800.00	$5,000.00
De-Listing Fee	$4,000.00	$4,000.00	$4,200.00	$4,400.00	$4,600.00	$4,800.00	$5,000.00
Project Listing Fee	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Annual Report Posting Fee (2 reports per project)	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00
Insurance Costs (percent of Carbon Price* Number of Credits)	$26,000.00	$26,000.00	$48,300.00	$50,600.00	$62,100.00	$64,800.00	$67,500.00
Verification Costs	$88,000.00	$88,000.00	$88,000.00	$88,000.00	$88,000.00	$88,000.00	$88,000.00
Sub-Total Annual Costs that Vary with the Volume of Carbon	$165,000.00	$164,000.00	$188,700.00	$193,400.00	$207,300.00	$212,400.00	$217,500.00
Total Costs	$339,000.00	$323,000.00	$347,700.00	$357,400.00	$371,300.00	$376,400.00	$381,500.00

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Appendix Y: The Benefit Cost Analysis of the Aggregator's Position as it Relates to the Reduced Age to Harvest Protocol

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University and The Prasino Group

Introduction

The reduced age to harvest protocol is designed to quantify the emission reductions based on reducing the age of the animal when harvested. The protocol is based on estimating the emissions per kilogram of carcass weight of beef as its common metric. The protocol requires quantifying the emissions per kilogram of beef for both the baseline and the change in practice; i.e. the project. The starting point for all quantification is the birth of the animal, the number of cattle, dry matter intake and the mass of the cattle produced using the management practice during the baseline and the change in management in the project. The protocol does not prescribe the management practices or the age of harvest, it does, however, provide a guide to project developers to meet the measurement, monitoring and GHG quantification requirements of the offset credits being generated in the Alberta offset system.

The reduced age to harvest protocol includes the pasture, backgrounding and feedlot operations as well as manure storage and handling as its boundaries. A project will have to demonstrate a reduction in the age of harvest of the cattle which results in reductions in enteric emissions and manure emissions.

The decrease in greenhouse gas emissions from reducing the age to harvest for cattle can be sold in the Alberta carbon offset credit market. An aggregator will work with the producer to ensure that the project that is developed will be in accordance with the reducing the age at harvest protocol. One of the areas where there is little information is on the economics of the aggregator's function in this protocol. This study attempts to address this lack of information by investigating the costs and benefits of the aggregator as it relates to the Reducing the Age at Harvest Protocol.

Function of the Aggregator

The aggregator will work with the producer to ensure that the protocol is being followed but is also involved in the marketing and selling of credits into the Alberta carbon offset system. More specifically, the role of the aggregator is to gather the data on both the baseline and new management system in order that the generation of offset credits can be justified. In this regard, the aggregator has to gather data that can be used to justify the selling of credits into the offset market. The aggregator will be responsible for data collection, legal costs, registry costs, verification costs, marketing and other costs.

Assumptions, Sample and Instrument

Several assumptions were made based on interviews and discussions with individuals currently in the industry. It was assumed that the aggregator was already established and already involved in either the aggregation of other protocols or was involved in providing services to the cattle industry. This assumption is important because the start-up costs assumed in this analysis are those of a firm that already has some relationship with the cattle industry or with the aggregation function. The analysis assumes that reducing the age at harvest aggregation function is a new additional service that an existing firm is providing.

Another important assumption made in the study was the split in revenue between the agricultural producer and the aggregator. After several discussions, it was assumed that the producer would receive 40 percent of the carbon price, while the aggregator would receive 60 percent of the market price. This tends to be the current allocation between producer and aggregator at this time.

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The analysis assumes a seven year timeframe for the aggregator. It is expected that there will be substantial initial or start-up costs for the aggregator but these infrastructure developments; ex. software, contracts, etc., would be available for a number of years. The analysis undertaken will estimate the present value of the aggregation function taking into account the initial cost of establishing the infrastructure, the annual operating costs, and the revenue generated from the selling of the carbon offset credits.

An aggregator was contacted in order to get an understanding of the aggregation function as it related to the reducing the age to harvest protocol. These discussions included identifying the costs associated with the aggregation function as well as the benefits. Several of the assumptions made above were the result of these discussions. Given this information, a spreadsheet survey instrument or calculator was designed to estimate the costs and benefits associated with the aggregation function as it relates to reducing the age at harvest protocol.

The survey instrument was a spreadsheet that contained multiple sheets that asked the respondents to place their best estimates on the costs and revenue questions that were asked of them. Result sheets take this information and estimate the net present value of the project, the costs per credit and the revenue per credit, as well as the net present value per credit. This tool was specifically designed to study the reduced age to harvest aggregation function.

The spreadsheet instrument contained eight sheets. The first sheet provided an introduction and brief instructions on how to complete the other sheets. The second sheet contained information on the start-up costs for the aggregator (Table Y-1). The start-up costs are the initial costs that are needed to establish the infrastructure to collect and store the necessary information to generate offset credits. The items included in the start-up costs are: equipment, software development, programmer costs, security, data storage, training, marketing, financing costs, and legal costs. Most of the costs will occur in the initial period; however, the model has been designed so that other infrastructure costs can be added in future periods to take into account things such as new equipment. The information generated for the start-up costs will be transferred to the results sheets as a component of total costs in order to estimate the cost of generating the carbon offset credits.

The next three sheets requests information on the operating or input costs of the aggregator. The operating costs are the annual costs that will be incurred by the aggregator to generate the carbon offset credits. Three sheets have been designed to take into account three possible scenarios; expected costs and revenue, optimistic costs and revenue, and pessimistic costs and revenue. These three scenarios were defined by the number of credits generated in each scenario, the price of carbon, and the costs associated with generating the credits.

The first question asked in the input sheets was to identify a discount rate that should apply. The discount rate is used to estimate the present value of costs or benefits that do not occur in the initial time period. The discount rate measures the aggregator's time value of money (Table Y-2).

The second question asks the respondent to estimate the expected number of tonnes that would be generated in each year. After discussions, the expected scenario was based on generating a volume of carbon of 40,000 tonnes in the first year and then gradually increasing to 50,000 tonnes in year seven, the number of tonnes generated with the optimistic scenario ranged from 60,000 tonnes in the first year to

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75,000 in year seven, while in the pessimistic scenario the number of tonnes generated was 25,000 tonnes per year over the seven years.

The next question asked the respondent to estimate the price of the carbon offset credits. The respondent is able to provide an expected annual price path for carbon offset credits for the next seven years. The price path can vary by year and scenario; expected, optimistic, and pessimistic.

This was followed with a question that asked the number of projects that would be included in the aggregator's portfolio. This question was asked because some of the operating costs would vary by the number of projects that would be included in the aggregator's portfolio. This has particular implications for the cost of verification.

The worksheet allows the respondent to split the carbon revenue between the agricultural producer and the aggregator. In this analysis it was assumed that the split between the agricultural producer and the aggregator was 40 percent and 60 percent respectively.

The aggregator identified that the annual operating costs could be divided into three categories. The first group of costs would be somewhat constant or fixed for any number of credits being generated. These costs included such things as: legal costs, accounting, office staff costs, project planning, travel and marketing, office costs, and computer storage, website and software costs. This category of costs is important because as more carbon offset credits are generated the cost per credit of this category of costs decreases. Similarly, as the number of carbon offset credits decreases the cost per credit of this category goes up.

The second category of costs is those that vary as a function of the number of carbon offset credit generated. Four costs fall into this group; data gathering, de-listing costs, registration costs and insurance costs. The rate for each of these costs can vary; however, for some of these items the rate is set. For example, data gathering costs could vary widely depending upon the method used to gather the data, while such things as the de-listing costs would not vary by very much and was set at $0.10 per tonne.

The third category of costs is based on the number of projects that were included in the aggregator's portfolio. The costs included in this category were the project listing and verification costs. The likely number of projects that could be included in the aggregator's portfolio would range between 2 and 4 projects. The project listing cost was set at $250.00 per project, while the verification costs could vary based on the scenario. In this analysis the verification costs per project varied from $20,000 to $25,000.

The final three sheets in the calculator provided estimates of the results given the input values estimated by the aggregator. As noted previously, optimistic, expected and pessimistic values were requested to provide a range of values for the numbers of credits, carbon price and discount rate. A sensitivity analysis was undertaken for each of the three scenarios (optimistic, expected and pessimistic) in order to estimate how variations in the variables impacted the results.

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Table Y - 1: Start-Up Cost Sheet in the Program

Start-up Costs	Initial Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
		$	$	$	$	$	$	$
Equipment								
Capital Purchases								
Laptops								
Servers								
Software Purchase								
Software Development								
Programmer Costs								
IT Security								
Off-site Data Storage								
Training								
Marketing								
Collateral Materials								
Financing Costs								
Legal Costs (Contract development)								
Certification for Approved Advisors								
Total Start Up Costs								

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Table Y - 2: The Operating Cost Sheet in the Program

Expected Input Scenario	**Year 1**	**……**	**Year 7**
Discount Rate (ex. 3 % = 0.03)			
Tonnes of Carbon (in tonnes)			
Price of Carbon (in $/tonne)			
Expected Number of Projects			
Split between Producer and Aggregator (In percentage terms)			
Producer (in % terms; ex: 40%=0.40)			
Aggregator`s % (in % terms, ex: 60%=0.60)			
% must sum to 1.0			
Costs that are Fixed for the expected projects			
Legal Costs (Sign up contract plus selling costs)			
Accounting			
Admin/ Office Staff Costs			
Project Planning and Delivery Costs			
Project Management			
Travel			
Marketing/ sales staff			
Office Costs (office space, phones, miscellaneous)			
Computer Storage, Website and Software			
Maintenance of Database and software system upgrades (10 to 15% of initial)			
Sub-Total Operating Costs (Annual Costs)			
Annual Costs that vary with the volume of carbon			
Data Gathering (cost per credit; ex. $0.70=0.70)			
De-Listing Fee (cost per tonne. Ex: $0.10=0.10)			
Registration Costs (cost per tonne: ex: $0.10 =0.10)			
Insurance (Percentage of market price)			
Annual Costs that vary with the number of projects			
Project Listing Fee (cost per project: ex: $250 per project)			
Annual Report Posting Fee (Cost per project: $250 per report)			
Verification Costs (cost per project: ex $20,000 per project)			

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Dollar Value of the Annual Costs that vary with the volume of carbon or number of projects			
Data Gathering Costs			
Registration Costs			
De-Listing Fee			
Project Listing Fee			
Annual Report Posting Fee (2 reports per project)			
Insurance Costs (percent of Carbon Price* Number of Credits)			
Verification Costs			
Sub-Total Annual Costs that Vary with the Volume of Carbon			
Total Costs			

Results

The results are given in terms of a number of indicators: net present value, present value of the costs, cost per credit, present value of the revenue, and the revenue per credit. The start-up costs were the same for each of the three scenarios (optimistic, expected, and pessimistic). The annual costs varied by scenario based on the number of credits that were generated. The revenue for each scenario varied due to different price expectations and the quantity of carbon offset credits generated over time. Each of the three scenarios will be reported separately.

The Expected Scenario

The price expectations, carbon offset credit generation, and discount rate for the expected scenario are given in Table Y- 3. It was expected that the current market price of $13.00 per carbon offset credit would continue for two years, increase to $23.00 per carbon offset credit in years 3 and 4 and then increase to $27.00 per tonne for the remaining three years. The quantity of carbon offset credits generated was set at 40,000 tonnes in year 1 and gradually increased to 50,000 tonnes in year 7. Finally, the discount rate was set at 3 percent over the seven years.

Table Y - 3: Carbon Price, Carbon Offsets Generated and the Discount Rate for the Expected Scenario

	Price of Carbon Offset ($)	Carbon Offsets Generated (Tonnes)	Discount Rate (as a %)
Year 1	$13.00	40,000	3
Year 2	$13.00	40,000	3
Year 3	$23.00	42,000	3
Year 4	$23.00	44,000	3
Year 5	$27.00	46,000	3
Year 6	$27.00	48,000	3
Year 7	$27.00	50,000	3

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The annual flow of costs and revenue for the expected scenario are given in Table Y-4. The revenue generated during the initial period and year 1 and 2 is less than the costs during this time period. In the remaining years, i.e. 3 to 7, the revenue generated is substantially greater than the costs.

The present value of the costs and revenue, cost per credit generated, revenue per credit and the net present value are given in Table Y-5. The results from the expected scenario indicate that the net present value of the stream of benefits and costs would provide a net present value of a positive $1.25 million. The cost per offset credit generated was $7.65 and the revenue per offset credit was $11.68. These results would indicate that under the expected scenario assumptions the aggregator would be profitable and would provide an economic incentive to supply this service.

Table Y - 4: Start-Up Costs, Annual Operating Costs and Annual Revenue for the Expected Scenario

	Start-up Costs	Annual Costs	Annual Revenue
Initial Costs	$155,000.00	$0.00	$0.00
Year 1	$0.00	$339,000.00	$312,000.00
Year 2	$0.00	$323,000.00	$312,000.00
Year 3	$0.00	$347,700.00	$579,600.00
Year 4	$0.00	$357,400.00	$607,200.00
Year 5	$0.00	$371,300.00	$745,200.00
Year 6	$0.00	$376,400.00	$777,600.00
Year 7	$0.00	$381,500.00	$810,000.00

Table Y - 5: Present Value of the Costs and Revenue, Cost per Credit, Revenue Per Credit and Net Present Value for the Expected Scenario

Indicator	Present Value
Present Value of the Costs	$2,370,034.85
Present Value of the Revenue	$3,619,555.93
Present Value of the Cost Per Offset Credit Generated	$7.65
Present Value of the Revenue Per Offset Credit Generated	$11.68
Net Present Value	$1,249,521.09

A sensitivity analysis was undertaken to investigate how sensitive these results were to changes in various parameters. Keeping all of the parameters in the model the same, the annual operating costs that were in the fixed category were increased by the same percentage rate for each year until the net present value approached zero. Table Y-6 provides the results of increasing the annual operating costs that are fixed. With a doubling of these costs, the net present value for the aggregator is still positive. The break-even increase in annual fixed costs is approximately 122 percent.

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Table Y - 6: Impact of Increasing the Annual Fixed Costs on the Net Present Value of the Aggregator; Expected Scenario

	Present Value of the Benefits	Present Value of the Costs	Net Present Value
100% per year increase in Annual Costs that are Fixed	$3,619,555.93	$3,392,221.30	$227,334.63
122% per year increase in Annual Costs that are Fixed	$3,619,555.93	$3,617,102.32	$2,453.61

Two additional sensitivity analyses were undertaken. The first investigated the breakeven prices of carbon offset credits that would equate the present value of the benefits equal to the present value of the costs. It was assumed that the carbon offset credit price would remain the same for the first two years at its current price ($13.00 per tonne). The price was allowed to decrease by the same rate in years 3 to 7. The price of carbon could have to decrease to $13.48 in years 3 to 4 and to $15.82 in years 5 to 7 to approximately break-even. This was a 41.4 percent decrease in the expected prices in years 3 to 7 (Table Y-7).

Table Y - 7: Sensitivity Analysis on the Carbon Offset Prices; Expected Scenario

	Assumed Carbon Offset Prices	Break Even carbon Offset Prices	Present value
Year 1	$13.00	$13.00	
Year 2	$13.00	$13.00	
Year 3	$23.00	$13.48	
Year 4	$23.00	$13.48	
Year 5	$27.00	$15.82	
Year 6	$27.00	$15.82	
Year 7	$27.00	$15.82	
Present Value of the Benefits			$2,368,218.83
Present Value of the Costs			$2,370,034.85
Net Present Value			-$1,816.01

The final sensitivity analysis undertaken investigated the decrease in the quantity of carbon offset credits generated that would result in a break-even situation. It was assumed for this break-even analysis that the percentage decrease in the number of credits would be the same for each year. The analysis indicates that the quantity of offset credits would have to decrease from a total of 310,000 tonnes to 202,740 tonnes in order to break-even. This was a 34.6 percent decrease in the number of tonnes per year from the assumed levels in the expected scenario. This decrease in the number of tonnes per year resulted in a net present value over the seven years of -$2,845.26 (Table Y-8).

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Table Y - 8: Sensitivity Analysis on the Number of Tonnes Generated; Expected Scenario

	Assumed Quantity of Carbon Offset Credits	Break Even Quantity of Carbon Offset Credits	Present value
Year 1	40,000	26,160	
Year 2	40,000	26,160	
Year 3	42,000	27,468	
Year 4	44,000	28,776	
Year 5	46,000	30,084	
Year 6	48,000	31,392	
Year 7	50,000	32,700	
Present Value of the Benefits			$2,367,189.58
Present Value of the Costs			$2,370,034.85
Net Present Value			-$2,845.26

The Optimistic Scenario

A number of the assumptions changed with the optimistic scenario. These included the carbon price, the quantity of carbon offset credits produced and the discount rate. For this scenario, it was assumed that the carbon price remained the same for the first two years, increased to $27.00 per tonne in year 3, then increase to $30.00 per tonne in years 4 and 5, and then increase to $40.00 per tonne in the final two years. The number of carbon offset credits generated was also increased. In the first year 60,000 carbon offset credits were generated and this gradually increased to 75,000 carbon offset credits in year 6 and 7. Finally, the discount rate used in this analysis was 2 percent (Table Y-9).

Table Y - 9: Carbon Price, Carbon Offsets Credits Generated and the Discount Rate for the Optimistic Scenario

	Price of Carbon Offset ($)	Carbon Offsets Credits Generated (Tonnes)	Discount Rate (as a %)
Year 1	$13.00	60,000	2
Year 2	$13.00	65,000	2
Year 3	$27.00	70,000	2
Year 4	$30.00	72,000	2
Year 5	$30.00	74,000	2
Year 6	$40.00	75,000	2
Year 7	$40.00	75,000	2

As expected, the aggregator's annual revenues increased with this scenario (Table Y-10). In this scenario, the costs in the initial period was the only time when the cost was greater than the revenue generated over this time period. With this scenario, the net present value after seven years was $4.66 million (Table Y-11). The cost per carbon offset tonne decreased from $7.65 in the expected scenario to $5.95 in the optimistic scenario. The decrease in the cost per credit is the result of the larger volume of credits being sold by the aggregator; i.e. 491,000 tonnes versus 310,000 tonnes, and the changes in cost structure. The impact of the increased number of tonnes generated and the carbon price can also be seen in the present value of the revenue generated. The present value of the revenue increased from $1.25 million in the expected scenario to $4.66 million with the optimistic scenario (Table Y-11).

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Table Y - 10: Start –Up Costs, Annual Operating Costs and Annual Revenue for the Optimistic Scenario

	Start-up Costs	Annual Costs	Annual Revenue
Initial Costs	$155,000.00	$0.00	$0.00
Year 1	$0.00	$368,000.00	$468,000.00
Year 2	$0.00	$361,250.00	$507,000.00
Year 3	$0.00	$419,500.00	$1,134,000.00
Year 4	$0.00	$440,400.00	$1,296,000.00
Year 5	$0.00	$445,800.00	$1,332,000.00
Year 6	$0.00	$486,000.00	$1,800,000.00
Year 7	$0.00	$486,000.00	$1,800,000.00

Table Y - 11: Present Value of the Costs and Revenue, Cost per Credit, Revenue Per Credit and Net Present Value for the Optimistic Scenario

Indicator	Present Value
Present Value of the Costs	$2,923,593.41
Present Value of the Revenue	$7,583,823.55
Present Value of the Cost Per Offset Credit Generated	$5.95
Present Value of the Revenue Per Offset Credit Generated	$15.45
Net Present Value	$4,660,230.13

A sensitivity analysis was undertaken to investigate by how much the annual operating costs that were in the fixed category could increase to reach a break-even situation. The annual operating costs that are fixed costs were increased by a given percentage each year to determine the break-even value. As can be seen in Table Y-12, the break-even increases in annual operating costs that were fixed were approximately 439 percent.

To further investigate the potential increase in costs, all operating costs were increased by a given percentage each year to determine the break-even situation. In this case, total annual operating costs could be increased by approximately 168.4 percent to reach the break-even situation (Table Y-13). This would indicate that given the assumed revenue stream, that total operating costs cost could increase substantially before negative returns would be seen by the aggregator.

Table Y - 12: Impact of Increasing the Annual Operating Costs that were fixed on the Net Present Value of the Aggregator; Optimistic Scenario

	Present Value of the Benefits	Present Value of the Costs	Net Present Value
200% per year increase in Annual Costs that are Fixed	$7,583,823.55	$5,046,979.42	$2,536,844.13
300% per year increase in Annual Costs that are Fixed	$7,583,823.55	$6,108,672.42	$1,475,151.13
439% per year increase in Annual Costs that are Fixed	$7,583,823.55	$7,584,425.69	-$602.14

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Table Y - 13: Impact of Increasing the Total Annual Operating Costs on the Net Present Value of the Aggregator; Optimistic Scenario

	Present Value of the Benefits	Present Value of the Costs	Net Present Value
50% per year increase in Annual Operating Costs	$7,583,823.55	$4,307,890.12	$3,275,933.43
100% per year increase in Annual Operating Costs	$7,583,823.55	$5,692,186.83	$1,891,636.72
168.4% per year increase in Annual Operating Costs	$7,583,823.55	$7,585,904.72	-$2,081.18

A sensitivity analysis was also undertaken to determine the break-even price of carbon offset credits that would be necessary to bring the net present value close to zero. For this analysis, it was assumed that the current carbon price would remain for the first two years. The break-even carbon price decreased to below $13.00 in years 3 through 7 (Table Y-14). This was a reduction in carbon price by over 70 percent from the assumed values in years 3 through 7. This would indicate that the aggregator's price risk was very low given the assumptions on the original carbon price, costs, volume and discount rate.

As with the previous scenario, a break-even volume of carbon credits was estimated for the optimistic scenario. In this analysis the same percentage of carbon offset credits were removed from the assumed level of credits generated. The break-even analysis would indicate that the number of carbon offset credits could decrease from a total of 491,000 to 189,231(Table Y-15). Given this reduced volume of carbon offset credits the net present value for the aggregator was a negative $6,064.14. This volume of credits was approximately 38.5 percent of the assumed volume of credits.

Table Y - 14: Sensitivity Analysis on the Carbon Offset Price; Optimistic Scenario

	Assumed Carbon Offset Prices	Break Even carbon Offset Prices	Present value
Year 1	$13.00	$13.00	
Year 2	$13.00	$13.00	
Year 3	$27.00	$8.02	
Year 4	$27.00	$8.91	
Year 5	$27.00	$8.91	
Year 6	$27.00	$11.88	
Year 7	$27.00	$11.88	
Present Value of the Benefits			$2,917,529.27
Present Value of the Costs			$2,923,593.41
Net Present Value			-$6,064.14

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Table Y - 15: Sensitivity Analysis on the Number of Tonnes Generated; Optimistic Scenario

	Assumed Quantity of Carbon Offset Credits	Break Even Quantity of Carbon Offset Credits	Present value
Year 1	60,000	23,124	
Year 2	65,000	25,051	
Year 3	70,000	26,978	
Year 4	72,000	27,749	
Year 5	74,000	28,520	
Year 6	75,000	28,905	
Year 7	75,000	28,905	
Present Value of the Benefits			$2,922,805.60
Present Value of the Costs			$2,923,593.41
Net Present Value			-$787.82

The Pessimistic Scenario

The final scenario investigated was the pessimistic scenario. In this scenario the number of carbon offset credits generated and the prices of the offset credits were lower than in the two previous scenarios and the discount rate was higher. For this scenario, the price of carbon offset credits is assumed to remain constant at $13.00 per tonne for the whole time period; seven years. The volume of carbon offset credits generated was set at 25,000 tonnes per year for each of the seven years. The discount rate used in this scenario was 5 percent (Table Y-16).

Table Y - 16: Carbon Price, Carbon Offsets Generated and the Discount Rate for the Pessimistic Scenario

	Price of Carbon Offset ($)	Carbon Offsets Generated (Tonnes)	Discount Rate (as a %)
Year 1	$13.00	25,000	5
Year 2	$13.00	25,000	5
Year 3	$13.00	25,000	5
Year 4	$13.00	25,000	5
Year 5	$13.00	25,000	5
Year 6	$13.00	25,000	5
Year 7	$13.00	25,000	5

Given the assumptions in the pessimistic scenario it is not surprising that the annual costs are higher than the annual revenue (Table Y-17). This would indicate that under these conditions it would not be profitable to be an aggregator. Taking into account the present value of the costs and benefits over the seven years, the net present value for the aggregator would be a negative $835,074.14 (Table Y-18). In this scenario the cost to the aggregator of generating a carbon offset credit was $11.22 per tonne while the revenue was only $6.45 per tonne. Under these conditions aggregators would leave the market.

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Table Y - 17: Start –Up Costs, Annual Operating Costs and Annual Revenue for the Pessimistic Scenario

	Start-up Costs	Annual Costs	Annual Revenue
Initial Costs	$155,000.00	$0.00	$0.00
Year 1	$0.00	$323,250.00	$195,000.00
Year 2	$0.00	$307,250.00	$195,000.00
Year 3	$0.00	$307,250.00	$195,000.00
Year 4	$0.00	$312,250.00	$195,000.00
Year 5	$0.00	$312,250.00	$195,000.00
Year 6	$0.00	$312,250.00	$195,000.00
Year 7	$0.00	$312,250.00	$195,000.00

Table Y - 18: Present Value of the Costs and Revenue, Cost per Credit, Revenue per Credit and Net Present Value for the Pessimistic Scenario

Indicator	Present Value
Present Value of the Costs	$1,963,416.95
Present Value of the Revenue	$1,128,342.81
Present Value of the Cost Per Offset Credit Generated	$11.22
Present Value of the Revenue Per Offset Credit Generated	$6.45
Net Present Value	-$835,074.14

A sensitivity analysis was undertaken for the pessimistic scenario to investigate how much the annual operating costs that were in the fixed category would have to decrease in order to break-even. In this analysis, the annual fixed cost portion of total costs would have to decrease by approximately 87 percent in order to break-even (Table Y-19).

A sensitivity analysis was also undertaken on the total annual operating costs for the aggregator. In this case the total annual operating costs were decreased by the same percentage in every year. Table Y-20 would indicate that the total annual operating costs would have to decrease by 46.2 percent before the aggregator could break-even.

These two sensitivity analysis would indicate that the costs would have to substantially decrease for the aggregator to break-even given the assumptions concerning the carbon price and quantity of credits generated.

Table Y - 19: Impact of Decreasing the Annual Operating Costs that are fixed on the Net Present Value of the Aggregator; Pessimistic Scenario.

	Present Value of the Benefits	Present Value of the Costs	Net Present Value
20% per year decrease in Annual Operating Costs that are Fixed	$1,128,342.81	$1,773,490.01	-$645,147.19
50% per year decrease in Annual Operating Costs that are Fixed	$1,128,342.81	$1,488,599.59	-$360,256.78
87% per year decrease in Annual Operating Costs that are Fixed	$1,128,342.81	$1,128,213.22	$129.59

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Table Y - 20: Impact of Decreasing the Total Annual Operating Costs on the Net Present Value of the Aggregator; Pessimistic Scenario

	Present Value of the Benefits	Present Value of the Costs	Net Present Value
20% per year decrease in Total Annual Operating Costs	$1,128,342.81	$1,601,733.56	-$473,390.75
30% per year decrease in Total Annual Operating Costs	$1,128,342.81	$1,420,891.86	-$292,549.05
46.2% per year decrease in Total Annual Operating Costs	$1,128,342.81	$1,128,342.81	$414.49

One means of addressing the negative net present value in this scenario would be to increase the volume of carbon offsets credits being generated. An analysis was undertaken to estimate the increase in carbon offsets credits that would be necessary to break-even. In the original pessimistic scenario it was assumed that the volume of carbon offset credits that would be generated would be 175,000 tonnes. This volume would have to increase to 304,588 tonnes in order to break-even (Table Y-21). This was a 74.05 percent increase in the volume of credits. This increase in volume of carbon offset credits to break-even is substantially higher than the assumed volume in this scenario.

Another means of breaking-even with the pessimistic scenario would be to increase the price of carbon. It was assumed that the current price of carbon would remain for the first year but then the price of carbon was allowed to increase by the same percentage increase over the next six years. The price of carbon would have to increase to $24.52 per tonne in years 2 through 7. These price increases are substantial in order for the aggregator to break-even given the assumptions of the pessimistic scenario.

Table Y - 21: Break-Even Analysis on the Quantity of Carbon Offset Credits; Pessimistic Scenario

	Assumed Quantity of Carbon Offset Credits	Break Even Quantity of Carbon Offset Credits	Present value
Year 1	25,000	43,513	
Year 2	25,000	43,513	
Year 3	25,000	43,513	
Year 4	25,000	43,513	
Year 5	25,000	43,513	
Year 6	25,000	43,513	
Year 7	25,000	43,513	
Present Value of the Benefits			$1,963,880.67
Present Value of the Costs			$1,963,416.95
Net Present Value			$463.72

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Table Y - 22: Break-Even on the Carbon Offset Credit Prices; Pessimistic Scenario

	Assumed Carbon Offset Prices	Break Even Carbon Offset Prices	Present Value
Year 1	$13.00	$13.00	
Year 2	$13.00	$24.52	
Year 3	$13.00	$24.52	
Year 4	$13.00	$24.52	
Year 5	$13.00	$24.52	
Year 6	$13.00	$24.52	
Year 7	$13.00	$24.52	
Present Value of the Benefits			$1,963,511.69
Present Value of the Costs			$1,963,416.95
Net Present Value			$94.74

Conclusions

This study estimated the benefits and costs for the aggregator of supplying carbon offset credits to the market from reducing the age at harvest for cattle. Three scenarios were investigated; expected, optimistic and pessimistic. For each of the scenarios a sensitivity analysis was undertaken on some of the key variables that would impact the results.

The analysis would seem to indicate that the economics for the reduce age to harvest aggregator is favourable given the assumptions used in this analysis. In the expected scenario, the net present value over seven years for the aggregator was a $1.249 million. This result would indicate that it would be profitable to be an aggregator based on the assumptions on the number of credits generated, price, and costs for the expected scenario.

The optimistic scenario provided the aggregator with a substantial larger net present value after seven years. This value was estimated to be $4.66 million. This scenario was based on higher carbon offset credit prices and a fairly large volume of credits being traded. This scenario provided substantial room for increased costs or decreased revenue before a break-even situation would occur.

The pessimistic scenario provided an estimated net present value for the aggregator of a negative $835,074. 14. In this situation, costs would have to be substantially decreased before the aggregator would break-even. Similarly, the price of carbon would have to increase substantially or the number of carbon offset credits would have to increase considerably before the aggregator could break-even.

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Appendix Z: RAH Producer Spreadsheet

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Introduction

As part of the cost-benefit analysis an excel based calculator was generated. This calculator allows the user to modify the input assumptions and assess the sensitivity of the costs-benefits of implementing the protocol. In the calculator there are 14 worksheets. There are six input sheets that must be completed by the user. These include the Change in Management, Yearling Heifer Costs, Yearling Steer Costs, Heifer Calf Costs, Steer Calf Costs and Carbon Market Scenario sheets. The information from these sheets is carried over into the analysis sheets and the results are provided in the "Results Heifer Yearling to Calf" and "Results Yearling Steers to Steer Calfs" sheets. Changes to the values in the input sheets result in new estimates in the output sheets. A copy of the "Change in Management - Heifers" sheet is provided below for reference. The original excel spreadsheet is needed for full functionality. This spreadsheet is available separately from CCEMC.

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Baseline Information				
Animal Type	**Yearling fed Heifer**	**Yearling fed Heifer**	**Yearling fed Heifer**	
Year	2009	2010	2011	Average
Average Age at Harvest (months)	20	19	18	19
Number in Production (head)	2600	3000	2300	2633
Average Live Weight (kg)	554.54	556.82	559.09	556.82
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing)	308.77	310.04	311.30	310.04
Reduced Age to Harvest - Project Calculation. (This caclulation would be needed for each animal grouping.)				
Animal Type	Calf fed heifer			
Year	2012			
Average Age at Harvest (months)	15			
Number in Production (head)	2500			
Average Live Weight (kg)	545.45			
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing)	303.71			

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Appendix AA: The Benefit Cost of the Agricultural Producer's Position as it Relates to the Reduced Age at Harvest Protocol

Submitted by: Dr. Paul Thomassin, Associate Professor, McGill University and The Prasino Group

Introduction

The production of livestock results in the natural generation of greenhouse gas emissions. In beef production, greenhouse gas emissions are generated from both enteric fermentation and manure production. Enteric fermentation is the result of the digestion of feed in the rumen and generates methane (CH_4). Methane and nitrous oxide (N_2O) are generated from the storage and handling of manure that result from beef cattle production.

The reduced age to harvest protocol estimates the decrease in greenhouse emissions that result from decreasing the number of days it takes to bring beef cattle from birth to harvest. According to the protocol of the day, this applies to youthful animals under 24 months of age, including calf fed and yearling fed heifers, steers or bulls. In particular, reducing the number of days an animal spends either in a backgrounding or on pasture, on higher roughage based diets and before entering the feedlot, decreases the amount of greenhouse gases from both enteric fermentation and manure handling and storage. This shift in production systems results in reduced GHG emissions from enteric and manure-based sources.

Role of the Beef Production Chain

To account for equivalency due to shifts in production systems to shorter life spans of beef cattle, the protocol quantifies emission reductions based on the mass of beef produced. In this case, the metric used to measure the change in greenhouse emission reductions is the greenhouse gas emissions per kilogram of carcass weight for both the baseline; i.e. current production practice, and the new production system; i.e. the project. The reduced age to harvest protocol requires the following information for both the baseline and project situations: the birth date of the animals, number of cattle produced, average carcass weights and age at harvest. The protocol does not prescribe a certain harvest age or means of production, but the producer must demonstrate that there has been a decrease in the age of beef cattle harvested. This reduction in age of harvest is the basis for estimating the change in greenhouse gas emissions between the baseline situation and the project situation. The aggregator will work with the producer to sell the reductions on the Alberta carbon offset market.

The change in production systems by the beef production chain, accounted for at the stage of finishing in the feedlot, will generate both costs and revenue for their operation. This study reports on the potential benefits and costs that could be received by the feedlot operator. It should be noted that these results are based on the scenarios that were developed based on information obtained from individuals in the industry. Feedlot operators can use the Reduced Age to Harvest Agriculture Producers Calculator to estimate their own costs and benefits.

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Instrument

The Agriculture Producer Calculator for Reduced Age to Harvest has been designed to assist feedlot operators in making decisions concerning the economics of shifting the age of animals entering the feedlot to decrease age to harvest. The calculator is an Excel workbook that consists of 20 spreadsheets. These include an instruction sheet, two sheets that include the change in management for heifers and steers, then four sheets that include the cost of production for yearling heifers, yearling steers, calf-fed heifers and calf-fed steers; a sheet for the carbon market scenarios, a results sheet for changing the management from yearlings to calves, a result sheet for changing from yearling steers to steer calves, and then 8 sheets that estimate the greenhouse gas emissions for the baseline and project for heifers and steers. These last 8 sheets are the carbon calculator developed by Candace Vinke and Karen Haugen-Kozyra. The Agriculture Producer Calculator for Reduced Age to Harvest was used to evaluate the benefits and costs of two scenarios for a change in management that reduced the age to harvest.

Assumptions

The economic analysis undertaken uses a scenario approach to estimate the benefits and costs of changing the feedlot operator's management plan to reduce the age at harvest. The two scenarios that will be analyzed will assume that the change in management plan reduces the number of yearling heifers and steers in the feedlot and replaces these with calf-fed heifers and steers. Though a complete change in the age of animals in a feedlot is not sustainable from a beef processing standpoint, the two scenarios provide an indication of the potential economic impact of adopting a new production system shift.

Under the protocol the baseline condition is determined by the average emissions for 3 years prior to the implementation of the change in management. The baseline emissions are estimated on a per head basis adjusted for carcass weight. The estimated baseline average for the 3 years will be the baseline that will be compared to the project. In scenario one, the assumptions concerning the 3 year baseline used for a feedlot that was producing yearling steers is given in Table AA-1.

Table AA - 1: Assumptions made for the 3 year baseline scenario for yearling steers (Scenario 1)

Year	2009	2010	2011	Average
Average Age at Harvest (months)	20	19	18	19
Number in Production (head)	2600	3000	2300	2633
Average Live Weight (kg)	602.27	604.55	600.00	602.27
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing)	335.34	336.61	334.08	335.35

The change in management practice made by the producer is assumed to decrease the age of harvest of the animal. In this scenario the age to harvest has been reduced from an average in the baseline of 19 months to a project harvest age of 15 months. The change in management practice is assumed to have the following results (Table AA-2). It is assumed that the change in management was to bring in more calf-fed steers into the feedlot operation.

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Table AA - 2: Assumptions of the results from the change in management practice to steer calves (Scenario 1)

Animal Type	
Year	2012
Average Age at Harvest (months)	15
Number in Production (head)	2500
Average Live Weight (kg)	590.91
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing)	329.02

The greenhouse gas emission calculator developed by Candace Vinke and Karen Haugen-Kozyra was used to estimate the change in greenhouse gas emissions from this shift in production. It was estimated that the average greenhouse gas emissions for the baseline scenario was 5,427.77 kg of CO_{2e} of enteric emissions per kg of carcass beef, 87.94 kg of CO_{2e} per kg of carcass beef for manure methane, and 1,967.71 kg of CO_{2e} per kg of carcass beef for indirect and direct manure nitrous oxide emissions (Table AA-3). The total emissions from the baseline scenario were 7,483.41 kg of CO_{2e} per kg of carcass beef produced.

Table AA - 3: Baseline greenhouse gas emissions for yearling steers (Scenario 1)

Year	Enteric Emissions Intensity (Kg CO_2e/ Kg Carcass Beef / Year)	Manure Methane Enteric Emissions Intensity (kg CO_2e Produced / kg Carcass Beef / Year)	Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg CO_2e Produced/ kg Carcass Beef / Year)
2009	5862.290	102.879	2262.124
2010	5396.561	86.823	1946.680
2011	5024.453	74.108	1694.318
Average	5427.768	87.937	1967.707

The greenhouse gas emissions for the project are given in Table AA-4. The change in management results in 4,025.23 kg of CO_{2e} per kg of carcass beef from enteric fermentation, 45.75 kg of CO_{2e} per kg of carcass beef from manure methane, and 1,108.88 kg of CO_{2e} per kg of carcass beef from indirect and direct manure nitrous oxide emissions. The total amount of kg of CO_{2e} per kg of carcass beef was 5,179.85 for the project scenario.

Table AA - 4: Greenhouse gas emission estimates from the project – steer calves (Scenario 1)

Enteric Emissions Intensity (Kg CO_2e/ Kg Carcass Beef / Year)	Manure Methane Enteric Emissions Intensity (kg CO_2e Produced / kg Carcass Beef / Year)	Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg CO_2e Produced/ kg Carcass Beef / Year)
4025.232	45.746	1108.875

Tables AA-5 and AA-6 provide some of the needed information to estimate the benefits and costs of decreasing the age to harvest. Table AA-5 estimates the average cost of production for a yearling steer coming into the feedlot in 2012. It is estimated that the yearling steer comes into the feedlot at 845 lbs. and leaves at a weight of 1,325 lbs. The gain is 480 lbs. and the animal is in the feedlot for 125 days. The

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total cost of finishing a yearling steer for such an operation was $1,591 per head. The average market price for beef in 2012 was $112 per hundred weight, giving revenue per head of $1,485. The net margin per head was a negative $106.

The average cost in 2012 of finishing a steer calf is given in Table AA-6. In this case, the animal comes into the feedlot at a weight of 550 lbs. and leaves at a weight of 1,300 lbs. The steer calf is in the feedlot for 221 days and has a weight gain of 750 lbs. over this period. The total cost of finishing this animal was $1,519 per head. Given a market price of $112 per hundred weight, the revenue generated from this animal is $1,457. The net margin per animal is a negative $62.

Table AA - 5: Costs and revenue for producing a yearling steer

Current Cost of Production - Yearling Steer	**Average**
Number of Days on Feed	125
Weight In - (in lbs)	**845**
Weight Out - (in lbs)	**1,325**
Gain - (in lbs)	480
	Average **Costs**
	2012
Cost of Feeder	1,141.48
Feeder Price	134.29
Silage	29.10
Barley	279.36
Supplement	8.91
Cost of Feed	317.37
Feed and Feeder	1,458.86
Transportation In	16.75
Vet and Medicine	17.12
Interest	17.89
Overhead	52.58
Death Loss	11.42
Marketing Charges	2.00
Interest Adjustment	0.00
Feed Adjustment	14.73
Total All Costs	1,591.35
Selling Price to Cover	

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Current Cost of Production - Yearling Steer	Average
Feed and Feeder	110.10
All Costs	120.10
Cost Per CWT Gain	
Feed	66.12
All Costs	93.72
Market Price	
Current	112.07
Net Margin	
Current	-8.03
Per Head Calculations	
Revenue Per Head (Price * Weight)	1,484.92
Cost Per Head (Cost per CWT*Weight)	1,591.35
Net Margin Per Head	-106.43

Source: Based on Canfax information

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Table AA - 6: Costs and revenue for producing a steer calf

Current Cost of Production - Steer Calf	Average
Number of Days on Feed	221
Weight In - (in lbs)	**550**
Weight Out - (in lbs.)	1,300
Gain - (in lbs)	750
	Average **Costs**
	2012
Cost of Feeder	884.83
Feeder Price	160.88
Silage	55.25
Barley	376.79
Supplement	13.99
Cost of Feed	446.03
Feed and Feeder	1,330.86
Transportation In	11.50
Vet and Medicine	26.55
Interest	24.24
Overhead	78.47
Death Loss	13.27
Marketing Charges	2.00
Interest Adjustment	0.00
Feed Adjustment	31.80
Total All Costs	1,518.69
Selling Price to Cover	
Feed and Feeder	102.37
All Costs	116.82
Cost Per CWT Gain	
Feed	59.47
All Costs	84.51

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Current Cost of Production - Steer Calf	Average
Market Price	
Current	112.07
Net Margin	
Current	-4.75
Per Head Calculations	
Revenue Per Head (Price * Weight)	1,456.90
Cost Per Head (Cost per CWT*Weight)	1,518.69
Net Margin Per Head	-61.79

Source: Based on Canfax information.

Scenario 2

The shift in production system outlined in scenario 2 is to replace yearling heifers with calf-fed heifers. The baseline calculations are given in Table AA-7. The average age at harvest for the three previous years was 19 months. The average number of head produced during this period was 2633, with an average live weight of 556.82 kg and an average dress weight of 310.04 kg.

Table AA - 7: Assumptions made for the 3 year baseline scenario for yearling heifers (Scenario 2)

Year	2009	2010	2011	Average
Average Age at Harvest (months)	20	19	18	19
Number in Production (head)	2600	3000	2300	2633
Average Live Weight (kg)	554.54	556.82	559.09	556.82
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing)	308.77	310.04	311.30	310.04

The assumptions for the change of management to bringing in heifer calves are given in Table AA-8. The age at harvest has been reduced to 15 months and the expected number of animals to be produced is 2,500. The average live weight of the animals is expected to be 545.45 kg and the average carcass weight is 303.71 kg.

Table AA - 8: Assumptions of the results from the change in management practice to heifer calves (Scenario 2)

Animal Type	
Year	2012
Average Age at Harvest (months)	15
Number in Production (head)	2500
Average Live Weight (kg)	545.45
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing)	303.71

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The greenhouse gas emission estimates for the baseline and project for scenario 2 are given in Tables AA-9 and 10 respectively. The total greenhouse gas emissions on a per kg of carcass beef in the baseline was 8,097.44 kg of CO_{2e}. The total greenhouse gas emissions for the project were estimated to be 5,611.56 kg of CO_{2e} per kg of carcass beef.

Table AA - 9: Baseline greenhouse gas emissions for yearling heifers (Scenario 2)

Year	Enteric Emissions Intensity (Kg CO2e/ Kg Carcass Beef / Year)	Manure Methane Enteric Emissions Intensity (kg CO2e Produced / kg Carcass Beef / Year)	Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg CO2e Produced/ kg Carcass Beef / Year)
2009	6366.866	111.734	2456.828
2010	5859.148	94.266	2113.548
2011	5392.105	79.531	1818.295
Average	5872.706	95.177	2129.557

Table AA - 10: Greenhouse gas emission estimates from the project – heifer calves (Scenario 2)

Enteric Emissions Intensity (Kg CO_2e/ Kg Carcass Beef / Year)	Manure Methane Enteric Emissions Intensity (kg CO_2e Produced / kg Carcass Beef / Year)	Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg CO_2e Produced/ kg Carcass Beef / Year)
4360.711	49.558	1201.293

The costs and revenue of producing yearling heifers and heifer calves are given in Tables AA 11 and 12 respectively. It was assumed that yearling heifers would enter the feedlot at 750 lbs and leave at 1,225 lbs. This was a weight gain of 475 lbs in 140 days. The total cost of producing this animal was $1,448.15. Using a market price of beef of $112.07 per CWT, the total revenue from this production was $1,372.86. The net margin per head was a negative $75.29 (Table AA-11).

It was assumed that the project would increase the number of heifer calves in the operation. In this scenario, it was assumed that the heifer calf would enter the feedlot at 550 lbs and exit at 1,200 lbs. The weight gain on this animal was 650 lbs in 217 days. The total cost of producing this animal was $1,391.81. Given the market price, the revenue generated from selling this animal was $1,344.84. The net margin per head for this production was a negative $46.97 (Table AA-12).

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Table AA - 11: Cost and revenue for yearling heifer production (Scenario 2)

Current Cost of Production - Yearling Heifer	Average Costs (2012)
Number of Days on Feed	140
Weight In - (in lbs)	750
Weight Out - (in lbs)	1,225
Gain - (in lbs)	475
Average Costs (2012)	
Cost of Feeder	978.28
Feeder Price	130.44
Silage	30.20
Barley	289.94
Supplement	9.53
Cost of Feed	329.67
Feed and Feeder	1,307.95
Transportation In	16.75
Vet and Medicine	14.67
Interest	19.62
Overhead	57.37
Death Loss	9.78
Marketing Charges	2.00
Interest Adjustment	0.00
Feed Adjustment	20.00
Total All Costs	1,448.15
Selling Price to Cover	
Feed and Feeder	106.77
All Costs	118.22
Cost Per CWT Gain	
Feed	69.41
All Costs	98.92
Market Price	
Current	112.07
Net Margin	
Current	-6.50

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Per Head Calculations	
Revenue Per Head (Price * Weight)	1,372.86
Cost Per Head (Cost per CWT*Weight)	1,448.15
Net Margin Per Head	-75.29

Source. Based on information from Canfax.

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Table AA - 12: Costs and revenue of heifer calf production (Scenario 2)

Current Cost of Production - Heifer Calf	Average
Number of Days on Feed	217
Weight In - (in lbs)	550
Weight Out - (in lbs)	1,200
Gain - (in lbs)	650
Average Costs (2012)	
Cost of Feeder	783.63
Feeder Price	142.48
Silage	53.59
Barley	365.30
Supplement	12.65
Cost of Feed	431.53
Feed and Feeder	1,215.17
Transportation In	11.50
Vet and Medicine	23.51
Interest	20.61
Overhead	76.48
Death Loss	11.75
Marketing Charges	2.00
Interest Adjustment	0.00
Feed Adjustment	30.79
Total All Costs	1,391.81
Selling Price to Cover	
Feed and Feeder	101.26
All Costs	115.98
Cost Per CWT Gain	
Feed	66.39
All Costs	93.57
Market Price	
Current	112.07
Net Margin	
Current	-3.91

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Per Head Calculations	
Revenue Per Head (Price * Weight)	1,344.84
Cost Per Head (Cost per CWT*Weight)	1,391.81
Net Margin Per Head	-46.97

Source: Based on information from Canfax

The Carbon Market

Two other important assumptions were made concerning the carbon market. The first involved the price of carbon in the carbon offset market. In order to take this into account, three carbon price scenarios were estimated. The expected carbon price reflected the current carbon price in the market; i.e. $15 per tonne, the second scenario was an optimistic scenario where the carbon price increased to $40 per tonne, while the third scenario was a pessimistic scenario where the carbon price decreased to $13 per tonne.

The second important assumption involved the split in the carbon revenue between the livestock producer and the aggregator. The aggregator plays an important role in the aggregation of several feedlot operators' greenhouse gas emission reductions so that they can be sold in the carbon offset market. The aggregator sells the carbon emission reductions in the carbon offset market and deals with all of the transaction costs of aggregation, certification, validation and marketing. After discussions with individuals in the industry, it was assumed that the split of the carbon revenue would be 40 percent to the feedlot operator and 60 percent to the aggregator.

Table AA - 13: Carbon price and allocation assumptions

Carbon Price Scenarios	Carbon Price	Allocation going to feedlot operator
Expected Price	$15.00 per tonne of CO_{2e}	40%
Optimistic Price	$40.00 per tonne of CO_{2e}	40%
Pessimistic Price	$13.00 per tonne of CO_{2e}	40%

Results

The benefits of reducing the age of harvest for steers are given in Table AA-14. The table provides estimates of the impact of the shift in production systems in terms of both net margin per hundred weight (CWT) and by net margin per head. The net margin was negative for both the yearling steer and the steer calf. Given the assumptions on the cost of production and the market price for beef, the net margin for yearling steers was a negative $8.03 per CWT and a negative $106.43 per head. The net margin for a steer calf was a negative $4.75 per CWT or a negative $61.79 per head. However, the net margin was less negative for the steer calf and thus had an advantage even without the carbon revenue. In scenario 1, the total number of tonnes of CO_{2e} reduced was 5,758.90. Given that this was based on producing 2500 head, the average reduction per head was 2.30 tCO_{2e}. As noted above, the carbon revenue per CWT and per head will depend on the price of carbon and the allocation of the carbon revenue between the aggregator and the feedlot operator.

The carbon revenue will increase the total revenue going to steer calf production and will therefore decrease the negative margin for this production. Assuming the expected carbon price of $15.00 per tCO_{2e}

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and 40 percent of the revenue going to the feedlot operator, the net margin per CWT is a negative $3.69 and on a per head basis the net margin is a negative $47.97.

Increasing the carbon price, as in the optimistic carbon price scenario, to $40.00 per tCO_2e results in a further decrease in the negative margin. In this case, the revenue coming from the carbon market is $2.84 per CWT or $36.86 per head. This brings the net margin for a steer calf to a negative $1.92 per CWT or a negative $24.93 per head.

If the carbon price decreases from the expected level to a pessimistic level of $13.00 per tCO_{2e}, this will further reduce the incentives for feedlot operators to change their management practices as a means of reducing their greenhouse gas emissions. At $13.00 per tCO_{2e}, the carbon market revenue going to the feedlot operator would be $0.92 per CWT or $11.98 per head. The net margin for this scenario is a negative $3.83 per CWT or a negative $49.81 per head.

The breakeven price of carbon would be the price of carbon that would bring the net margin to zero. Given the assumptions on the allocation between the feedlot operator (40%) and the aggregator (60%) and the estimated carbon reduction per head (2.3 tCO_{2e}), the breakeven price would be $67.16.

It should be noted that the results of the benefit cost analysis will depend on the cost of production of the yearling steer, the calf fed steer, and the price of beef. The size of the revenue from the carbon market will depend on the price of carbon and the percentage of the carbon revenue that is allocated to the feedlot operator.

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Table AA - 14: The economic impact of reducing the age to harvest for steers (Scenario 1)

Replacing Yearling Steers with Steer Calves	
YEARLING STEER	
Margin per CWT	-$8.03
Margin Per Head	-$106.43
STEERCALF	
Margin per CWT (without project carbon)	-$4.75
Margin Per Head (without project carbon)	-$61.79
Carbon Reduction	
Total Amount of Carbon Reduced	5,758.90
Total Number of Animals	2,500
Carbon Reduction Per Animal	2.30
Expected Scenario Carbon Revenue	
Expected Carbon Revenue per CWT	$1.06
Expected Carbon Revenue per Head	$13.82
Heifer Calf Margin with Carbon Included (Expected Scenario)	
Expected Scenario Margin per CWT (Market plus Carbon)	-$3.69
Expected Scenario Margin per Head (Market plus Carbon)	-$47.97
Optimistic Scenario Carbon Revenue	
Optimistic Carbon Revenue per CWT	$2.84
Optimistic Carbon Revenue per Head	$36.86
Heifer Calf Margin with Carbon Included (Optimistic Scenario)	
Optimistic Margin per CWT (Market plus Carbon)	-$1.92
Optimistic Margin per Head (Market plus Carbon)	-$24.93
Pessimistic Scenario Carbon Revenue	
Pessimistic Carbon Revenue per CWT	$0.92
Pessimistic Carbon Revenue per Head	$11.98
Heifer Calf Margin with Carbon Included (Pessimistic Scenario)	
Pessimistic Margin per CWT (Market plus Carbon)	-$3.83
Pessimistic Margin per Head (Market plus Carbon)	-$49.81

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Scenario 2

The net margin for both a yearling heifer and a heifer calf were negative (Table AA-15). In this scenario, the net margin per CWT for the yearling heifer was a negative $6.15 or a negative $75.29 per head. The net margin for a heifer calf was a negative $3.91 per CWT or a negative $46.97 per head. The net margin for the heifer calf is less negative than the net margin for the yearling heifer, which is similar to the previous scenario.

In this scenario, the reduction in greenhouse gas emissions from this change in management was 6,214.69 tCO_{2e}. This reduction in greenhouse gas emissions was equivalent to 2.49 tCO_{2e} per head. This 2.49 tCO_{2e} per head will be the basis for estimating the carbon revenue going to the feedlot operator.

Using the expected carbon price of $15.00 per tCO_{2e}, the carbon revenue generated for the change in practice was $14.92 per head or $1.24 per CWT. The net margin for this change in production was a negative $2.67 per CWT or a negative $32.05 per head. This increase in carbon revenue increases the spread between the baseline production condition and the change in management.

The optimistic carbon price scenario increases the carbon price substantially to $40.00 per tCO_{2e}. This carbon revenue is equal to $39.77 per head or $3.31 per CWT. The resulting net margin with this carbon price scenario is a negative $0.60 per CWT or a negative $7.20 per head.

The final carbon price scenario was pessimistic on the carbon price and assumed a carbon price of $13.00 per tCO_{2e}. This translates into a carbon revenue of $1.08 per CWT or $12.93 per head. The net margin given the assumptions for this scenario was a negative $2.84 per CWT or a negative $34.04 per head.

The breakeven price of carbon for the heifer calf scenario was $47.16. The break-even price for the heifer calf scenario is substantially lower than for the steer calf scenario.

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Table AA - 15: The economic impact of reducing the age to harvest for heifers (Scenario 2)

Replacing Yearling Heifers with Heifer Calves	
YEARLING HEIFER	
Margin per CWT	-$6.15
Margin Per Head	-$75.29
HEIFER CALF	
Margin per CWT (without project carbon)	-$3.91
Margin Per Head (without project carbon)	-$46.97
Carbon Reduction	
Total Amount of Carbon Reduced (tCO_{2e})	6214.69
Total Number of Animals	2500
Carbon Reduction Per Animal	2.49
Expected Scenario Carbon Revenue	
Expected Carbon Revenue per CWT	$1.24
Expected Carbon Revenue per Head	$14.92
Heifer Calf Margin with Carbon Included (Expected Scenario)	
Expected Scenario Margin per CWT (Market plus Carbon)	-$2.67
Expected Scenario Margin per Head (Market plus Carbon)	-$32.05
Optimistic Scenario Carbon Revenue	
Optimistic Carbon Revenue per CWT	$3.31
Optimistic Carbon Revenue per Head	$39.77
Heifer Calf Margin with Carbon Included (Optimistic Scenario)	
Optimistic Margin per CWT (Market plus Carbon)	-$0.60
Optimistic Margin per Head (Market plus Carbon)	-$7.20
Pessimistic Scenario Carbon Revenue	
Pessimistic Carbon Revenue per CWT	$1.08
Pessimistic Carbon Revenue per Head	$12.93
Heifer Calf Margin with Carbon Included (Pessimistic Scenario)	
pessimistic Margin per CWT (Market plus Carbon)	-$2.84
Pessimistic Margin per Head (Market plus Carbon)	-$34.04

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Conclusion

This study evaluated the economic impact of changing production systems in a feedlot that would reduce the age at harvest of beef cattle. The economic impact of changing production systems to reduce the age at harvest will depend on the cost of production and the revenue from beef at a given point in time. Two scenarios were evaluated. In both scenarios, the age at harvest decreased from a baseline of 19 months to a project age of 15 months with the change in production systems. The first scenario investigated a reduction in age by increasing the number of steer calves and decreasing the number of yearling steers in the feedlot; while the second scenario increased the number of heifer calves and decreased the number of heifer yearlings. It was estimated that the change in production systems decreased the greenhouse gas emissions per head by 2.3 tCO_2e for scenario 1 and 2.49 tCO_2e for scenario 2.

It was assumed that the price of a tonne of carbon could range from a pessimistic $13.00 per tCO_2e to an optimistic $40.00 per tCO_2e. In scenario 1, the revenue from the carbon market for the feedlot operator ranged from $11.98 per head to $36.86 per head depending on the carbon price assumption. Similarly, in the second scenario, the revenue from the carbon market ranged from $12.93 per head to $39.77 per head for the feedlot operator. Given these results, the price of carbon plays an important role in determining the revenue from the carbon market.

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Appendix AB: Year One RAH Validation Study Report

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Reduced Age at Harvest (RAH) Validation Study Report

Submitted to: Climate Change and Emissions Management Corporation

Date: June 1, 2013

Submitted by: The Prasino Group

Findings to Date

The purpose of the RAH Protocol Validation Study is to learn about the barriers, gaps, solutions and options for adopting the RAH protocol in the marketplace. More specifically, the objectives of the Study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field;
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale;
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols; and
- Catalyzing continued aggregation efforts for bringing offsets forward from aggregated agricultural projects.

In order to accomplish the above objectives, the RAH Protocol Validation Study worked with the aggregation firm of FailSafe Canada Inc. This firm engaged 1 feedlot, under the provision of the Reducing the Age at Harvest of Beef Cattle Protocol v 2.0, July 2011, totalling 1,150 head in the 2011 project year, using a baseline of 2009-2010 average emissions (NOTE – Failsafe did not have sufficient data for a 3 year baseline given the lack of CCIA registered animals in the 2008 project year, so it was decided to proceed with just a 2-year baseline for the PVS Study). The estimated total eligible tonnes of reductions were 118 tonnes for 2011. However, due to a number of uncertainties with protocol interpretation, as pointed out in the following sections, this number should not be relied upon to make direct connections between number of head and emissions reductions (i.e. 0.1 tonnes/head). The second year of this study, provided Failsafe is interested in continuing, will bear this out.

ICF-Marbek completed the mock verification and gap analysis on the aggregated project for the Protocol Validation Study (the results of this analysis can be found in ICF Marbek's Mock Verification and Gap Analysis Report).

Version 2.0 of the Reducing the Age at Harvest (RAH) is based on an older protocol format. As a result, Section 5 has not been updated to meet Reasonable Level of Assurance as currently understood in the Alberta Offset System. Interpretive guides have been prepared in the past for ARD, with a detailed evidence table, but these are not part of the published version on line, used in the PVS Study's mock verification. Therefore, many of the comments provided by ICF-Marbek reflect the clarity needed for an updated RAH protocol into the new format, particularly Section 5 – Data Management.

Key Findings from the PVS study are as follows:

Suggested Protocol Revisions:

1) The RAH protocol is in an older protocol format than the current agricultural protocols.

2) The RAH protocol needs to clarify in the Applicability section the eligible animal age. The Protocol's preamble states that the project activity applies to "youthful cattle, or those under 24 months of age" but it is not mentioned in the applicability section. This leads to confusion for verifiers and removes about 30% of eligible cattle in Alberta who finish beyond 24 months of age.

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3) The way the ownership criteria is stated in the RAH Protocol is overly punitive. It should not be required that the owner of the emission reductions be the owner of the cattle, but rather it should be the feedlot owner. ICF-Marbek point out that precedence for this is found in the energy sector under the Specified Gas Emitter's Regulation. For example, a natural gas processing facility owner processes raw natural gas provided by several production companies. If the facility owner implements a project that reduces energy consumption at the facility, the resulting GHG reduction (and any credit or reduced liability) associated with this project activity clearly resides with the facility owner. The owner may, in turn, may pass the financial benefit to the companies that are supplying the commodity (either through reduced fees or direct compensation); however, this is handled through a commercial arrangement, not through the Protocol.

   Further, the ownership of the emission reduction should not be compared to the Conservation Cropping protocol, where the carbon is sequestered in the soil which is owned by the landowner (not necessarily the farmer applying the tillage practice).

4) The RAH Protocol does not specify that the selection of baseline years needs to immediately precede the project year. A project developer could potentially provide justification for a baseline period that does not immediately precede the project period. This could be an issue because the project developer may choose years that benefit their emissions reductions and are not necessarily representative of their operation.

5) The requirements for establishing functional equivalence should be defined by the RAH Protocol. As such, the animal grouping should be defined by sex only and not sex by weight class otherwise the protocol does not work.

   The current RAH protocol states that animals be grouped by incoming weight class. Weight class groupings is not appropriate for this protocol because the project activity and goal of the protocol is to drive down the age (which corresponds with weight) at which the animal enters the feedlot, which reduces the number of days an animal is in backgrounding lots and pasture. Therefore, animals that are older and larger in the baseline condition are functionally equivalent to animals that are younger and smaller in the project condition. Grouping by weight class removes the carbon mitigation benefit.

6) Section 5 of the RAH Protocol (or the Best Practices Guidance Document) should provide a description of the appropriate documentation needed to establish that manure is being managed according to the *Agricultural Operation Practices Act.* (the section in the Interpretive Guide submitted last fiscal has this in it).

7) The RAH protocol has two descriptions of how to use an equation in Section 4.5 Quantification Approach that needs to be corrected. The explanation of how to use the equation is incorrect for Equations 2 and 3 (pages 40 and 41 respectively). The description for equations 2 and 3 is copied from the first equation and will need to be modified.

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Risk of Material Mis-statements:

1) ICF-Marbek found three risks:
    a. Failsafe is using only a 2-year baseline for this study.
    b. Eligible Age of Animals – protocol level; the protocol is unclear if animals over 24 months are eligible (see above section).
    c. Ownership of carbon – protocol level; needs to be addressed through revisions in protocol (see previous section).

Calculation of GHG Emission Reductions:

1) ICF-Marbek points out an anomaly in the quantification. Section 4.4 of the Protocol provides two approaches to establishing the birth date of each animal. The "default method" attempts to provide a more conservative approach by requiring that the birth date used to calculate the emission reduction includes the addition of 28 days to the birth certificate date. If this default approach is applied to both the baseline and the project condition, the resulting emission reduction actually increases (versus a non-adjusted birth date approach). If the cow-calf producers are not changing their methodology for registering the birth date of the animals between the baseline and the project periods, then it stands to reason that no adjustment is required because the process is functionally equivalent. Therefore, the Protocol should be adjusted to either account for functional equivalence that already seems to exist, or modify the default approach to correct the unintended increase in the quantified emission reduction.
2) The RAH Protocol needs further investigation into the veracity of its current accounting approach. The annualization of the life span of greenhouse gas emissions from cattle slaughtered at different ages was done to bring the accounting into a yearly time step for ease of project implementation. However, that approach is now under question. Scientists involved in the review of the Alberta protocols for adaptation into the US, under the auspices of a USDA Conservation Innovation Grant called BIGGs (Bovine Innovative Greenhouse Gas Solutions), have raised the question of the appropriateness of the approach. As a result, Dr. Ermias Kebreab from UCDavis is currently analyzing whether this is a correct approach, with support from The Prasino Group and Dr. John Basarab from Alberta Agriculture and Rural Development.

Cost-Benefit Analysis:

1) The cost-benefit analysis for the RAH protocol validation study was conducted on both a producer basis and an aggregator position basis. For each, three scenarios were analysed – optimistic, expected, and pessimistic. *Reference to other docs or spreadsheets if necessary*.
2) The aggregator cost-benefit analysis assumed:
    a. An existing aggregator is already established and already involved in either the aggregation of other protocols or was involved in providing services to the cattle industry. The analysis assumes that reducing age at harvest aggregation function is a new additional service that an existing firm is providing;
    b. Aggregators receive 60% of the carbon price, while the producers receive 40%;
    c. A seven year timeframe for the aggregator (over which start-up costs or infrastructure development would be spread);
    d. Data gathering costs
    e. Verification costs

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f. Start-up costs are the same for each of the three scenarios (optimistic, expected, and pessimistic).

3) The results from the aggregator expected scenario indicate that the net present value of the stream of benefits and costs would be $1.25 Million over seven years. The cost per offset credit generated was $7.65 and the revenue per offset credit was $11.68. The net revenue per credit for the aggregator over the seven years was $4.03 per credit. These result would indicate that under the expected scenario assumptions (that current carbon offset prices would continue for two years and then increase to $23.00 per tonne for years three and four and then increase to $27.00 per tonne for the remaining three years; the quantity of offset credits generated starts at 40,000 tonnes per year and gradually increases to 50,000 tonnes per year in year seven; and a discount rate of 3% over the three years) the aggregator would be expected to make a profit. The results are summarized in the table below.

Present Value of the Costs and Revenue, Cost per credit, Revenue Per Credit and Net Present Value for the Expected Scenario	
Indicator	**Present Value**
Present Value of the Costs	$2,370,034.85
Present Value of the Revenue	$3,619,555.93
Cost Per Offset Credit Generated	$7.65
Revenue Per Offset Credit Generated	$11.68
Net Present Value	$1,249,521.09

4) Sensitivity Analysis of the expected scenario revealed that:
   a. Fixed costs could double and still result in a positive net present value (the break-even increase in annual fixed costs was found to be approximately 122%).
   b. The price of carbon could decrease to approximately $13.48 in years three and four, and $15.82 in years five through seven for the aggregator to approximately break-even, representing a 41.4% decrease in the expected prices.
   c. The quantity of offset credits could decrease to approximately 202,740 tonnes from the expected 310,000 tonnes before a loss would be observed.

Aggregator Optimistic Scenario:

1) The aggregator's annual revenues increased in the case of the optimistic scenario, as expected, while the costs per credit decreased. Under this scenario, the net present value after seven years was $4.66 million. The optimistic scenario assumed the carbon price remained the same for the first two years and would then increase to $27.00 per tonne in year three, then $30.00 per tonne in years four and five, and then $40.00 in the final two years. The optimistic scenario also assumed that the number of carbon tonnes would increase from 60,000 in the first year to 75,000 by years six and seven. Finally, the discount rate used in this analysis was 2%. The results are summarized in the table below.

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2)

Present Value of the Costs and Revenue, Cost per credit, Revenue Per Credit and Net Present Value for the Optimistic Scenario	
Indicator	**Present Value**
Present Value of the Costs	$2,923,593.41
Present Value of the Revenue	$7,583,823.55
Cost Per Offset Credit Generated	$5.95
Revenue Per Offset Credit Generated	$15.45
Net Present Value	$4,660,230.143

3) Sensitivity analysis of the optimistic scenario revealed that:
   a. The break-even increase in total annual operating costs was approximately 168%;
   b. The break-even price of carbon was a decrease to $13.00 for years three to seven; and,
   c. The quantity of offset credits could decrease to a total of 189,231 from a total of 491,000 offset credits per year before a loss would be observed.

Aggregator Pessimistic Scenario:

1) In the aggregator pessimistic scenario, the price of carbon was assumed to remain constant at $13.00 per tonne over the whole seven year period, the volume of carbon offset credits generated was set at 25,000 tonnes in each year, and the discount rate used was 5%. Under this scenario, the annual costs were higher than annual revenue, indicating that it would not be profitable to be an aggregator. Specifically, based on the present costs and benefits over the seven years, the net present value for the aggregator would be negative $835,074.14. In this scenario the cost to the aggregator of generating a carbon offset credit was $11.22 per tonne while the revenue was only $6.45 per tonne. Under these conditions the aggregator would leave the market. The results are summarized in the table below.

Present Value of the Costs and Revenue, Cost per credit, Revenue Per Credit and Net Present Value for the Pessimistic Scenario	
Indicator	**Present Value**
Present Value of the Costs	$1,963,416.95
Present Value of the Revenue	$1,128,342.81
Cost Per Offset Credit Generated	$11.22
Revenue Per Offset Credit Generated	$6.45
Net Present Value	-$835,074.14

2) Sensitivity analysis of the pessimistic scenario revealed that:
   a. Total annual operating costs would have to decrease by 46.2% before the aggregator could break even;
   b. The total volume of carbon offsets would have to increase to 304,588 tonnes in order to break even; and
   c. The price of carbon would have to increase to $24.52 per tonne years two through seven in order to break even.

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Producer Cost-Benefit Analysis:

1) The producer cost-benefit analysis was conducted to assess the change in management by the agricultural producer in two scenarios, either a change to heifer calves, or a change to steer calves. The analysis assumes:
    a. The change in management plan reduces the number of yearling heifers and steers in the feedlot and replaces these with heifer and steer calves.
    b. The change in management practice made by the producer is assumed to decrease the age of harvest of the animal.
    c. In the baseline condition, steer yearlings come into the feedlot at 845 lbs and leave at a weight of 1,325 lbs, gaining 480 lbs after spending 125 days in the feedlot.
    d. In the project condition, steer calves come into the feedlot at 550 lbs and leave at a weight of 1,300 lbs, gaining 750 lbs after spending 221 days in the feedlot.
    e. Assumptions concerning the baseline and results from the change in management practice to steer calves (Scenario 1) is summarized in the following table:

Scenario 1 Assumptions for the Baseline and Change in Management practices		
	Baseline (3-year average)	**Results of Changed Management Practice**
Average Age at Harvest (months)	19	15
Number in Production (head)	2633	2500
Average Live Weight (kg)	602.27	590.91
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing) (lbs)	335.35	329.02

    f. In the baseline condition, heifer yearlings come into the feedlot at 750 lbs and leave at a weight of 1,225 lbs, gaining 475 lbs after spending 140 days in the feedlot.
    g. In the project condition, heifer calves come into the feedlot at 550 lbs and leave at a weight of 1,200 lbs, gaining 650 lbs after spending 217 days in the feedlot.
    h. Assumptions concerning the baseline and results from the change in management practice to heifer calves (Scenario 2) is summarized in the following table:

Scenario 2 Assumptions for the Baseline and Change in Management practices		
	Baseline (3-year average)	**Results of Changed Management Practice**
Average Age at Harvest (months)	19	15
Number in Production (head)	2633	2500
Average Live Weight (kg)	556.09	545.45
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing) (lbs)	311.30	303.71

    i. The average market price for beef was $112 per hundred weight, based on industry data from 2012.

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j. Three carbon price scenarios: the "expected" scenario sets carbon at $15/tonne, the "optimistic" scenario sets carbon at $40 per tonne, and the "pessimistic" scenario sets carbon at $13/tonne.
k. The split of carbon revenue would be 40% to the feedlot operator and 60% to the aggregator.

Scenario 1: Change to Steer Calves:

1) The net margins for both yearling steers and steer calves were negative in scenario one. In this scenario, the net margin was -$8.03 per CWT or -$106.43 per head for yearling steers. The net margin for a steer calf was -$4.75 per CWT or -$61.97 per head. The total number of tonnes of CO_2e reduced was 5,758.90. Given that this was based on producing 2500 head, the average reduction per head was 2.30 tCO_2e. The results of the change in management practice in scenario one are summarized in the table below:

Scenario 1: Greenhouse Gas Emissions for the Baseline and Changed Management practices (Steer yearlings to steer calves)		
	Baseline (3-year average)	**Results of Changed Management Practice**
Enteric emissions intensity (kg CO_2e/kg carcass beef/yr)	5269.188	4025.232
Manure Methane Enteric Emissions Intensity (kg CO_2e produced/kg carcass beef/yr)	85.367	45.746
Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg CO_2e produced/ kg carcass beef/yr)	1910.212	1108.875

2) The carbon revenue will increase the total revenue going to steer calf production and will therefore decrease the negative margin for production. In the expected scenario on a per-head basis, the net margin is -$47.97. In the optimistic scenario on a per-head basis, the net margin increases to -$24.93 per head. In the pessimistic scenario on a per-head basis, the net margin decreases to -$49.81. The break-even price of carbon, given the assumptions on the allocation of carbon revenue between the feedlot operator (40%) and the aggregator (60%) and the estimated carbon reduction per head (2.30 tCO2e), would be $67.16.

Scenario 2: Change to Heifer Calves:

1) The net margins for both a yearling heifer and a heifer calf were negative. In this scenario, the net margin per CWT was -$6.15, or -$75.29 per head for yearling heifers. The net margin for a heifer calf was -$3.91 per CWT, or -$46.97. The total number of tonnes CO_2e reduced was 6,214.69 tonnes of CO_2e. Given that this was based on producing 2500 head, the average reduction per head was 2.49 tCO_2e. Producer cost-benefit results in scenario two are summarized in the table below:

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Scenario 2: Greenhouse Gas Emissions for the Baseline and Changed Management practices (Heifer yearlings to heifer calves)		
	Baseline (3-year average)	**Results of Changed Management Practice**
Enteric emissions intensity (kg CO_2e/kg carcass beef/yr)	5872.706	4360.711
Manure Methane Enteric Emissions Intensity (kg CO_2e produced/kg carcass beef/yr)	95.177	49.558
Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg CO_2e produced/ kg carcass beef/yr)	2129.577	1201.293

2) The carbon revenue will increase the total revenue going to steer calf production and will therefore decrease the negative margin for production. In the expected scenario on a per-head basis, the net margin is -$32.05. In the optimistic scenario on a per-head basis, the net margin increases to -$7.20 per head. In the pessimistic scenario on a per-head basis, the net margin decreases to -$34.04. The break-even price of carbon, given the assumptions as above, would be $47.16. The break-even price for the heifer calf scenario is substantially lower than for the steer calf scenario.

3) Overall summary: The results of the benefit-cost analysis for the producer will depend on the cost of production of the yearling steer, the heifer steer, and the price of beef. Whether the initial net margin for either yearling steers or steer calves will depend on these values. The size of the revenue from the carbon market will depend on the price of carbon and the percentage of the carbon revenue that is allocated to the feedlot operator. The results of the benefit-cost analysis for the aggregator indicate that the economics is favorable given the assumptions of credits generated, price, and costs used in the "expected" scenario.

Documentation and Records

Of the three Beef protocols in the Alberta Offset System, the RAH protocol represents the least complex in terms of data collection. Because standardized quantification emission equations have been developed, the age of the animal at harvest drives the emissions output per kg of hot carcass weight. There is no need to collect the feed inventory, analysis, animal intake data which is a large component of other Beef protocols. From an industry perspective, the capacity of the sector to implement the protocol is high based on ICF-Marbek's findings, with the exception of the confirmation of death. Through extensive investigations by ARD and The Prasino Group, it was found that third party collection of RFID tag retirement or slaughter dates from packing plants for animals are not readily available to feedlot operators in some cases, and project developers in all cases.

Through the mock verification process it was discovered that the sum of the emission reductions achieved for each animal in the project is mathematically equivalent to a calculation of the total emission reduction that uses the average animal age and average animal live weight. Therefore, it is not necessary to know

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the specific harvest date for each animal in a lot; the average harvest date may be used along with the average birth date to calculate the average age at slaughter. The shipping manifests, which identify animals being shipped from which lots, can provide the data to perform the calculation and sufficient documentation to provide evidence of the project activity.

Shipping manifests were used to substantiate the harvest date in this mock project. In the opinion of ICF-Marbek, this is sufficient evidence when the manifest provides a lot number for animals on the truck heading to the packing plant, which can then be used to link the animal ID number by lot within the feedlot's tracking system, and calculate the average age at slaughter.

Recommendations

Capacity of the Sector to Implement the RAH Protocol:

The RAH protocol represents the most streamlined and easy to implement of all the Beef protocols. As ICF-Marbek recommends, there is a way to remove the barrier of the confirmation of death as previously understood. Given this barrier can be removed, and clarification of the 24 months not being a barrier, the capacity is there.

Recommendations for Immediate Revisions to the Protocol:

1) Revise ownership requirements in the protocol; use precedents that exist in energy sector protocols to inform AESRD;
2) Update Section 5 - Data Management Section. This is already completed in the Interpretive Guide submitted to ARD under KHK Consulting contract but add in ICF-Marbek's recommendations on evidence for confirmation of death;
3) Add clarity for eligible animal age in applicability section; remove restriction of 24 months and below. This reduces the opportunity to shift harvest dates to younger animals which is what the protocol is designed to do;
4) Address functional equivalence issues – animals should be grouped by sex only between baseline and project for functional equivalence, otherwise the opportunity to shift animals to younger harvest dates, and the reduction of carbon associated with that is removed;
5) Fix the equations in Section 4.5;

Addressing Challenges in the Protocol moving forward:

1) To address the anomaly of default birth dates – since the project developer has difficulty accessing methods of birth date establishment, and CCIA does not do quality control on birth dates (i.e. accepts reported by cow-calf operator), explore adding 28 days to project only. This should be a conservative method.
2) The Prasino Group will continue to manage and report on the ongoing methodology testing undertaken by Dr. Ermias Kebreab at UCDavis

The findings of this PVS study, including the mock verification, have been incorporated into a draft of the Best Practice Guide to Verifying RAH projects. This guide has been prepared by The Prasino Group and is undergoing a final review by The Prasino Group and ICF-Marbek. The Guide represents the document that is appropriate to share with stakeholders, since the mock verification conducted on Failsafe's project contains 'sensitive information' on Failsafe and Highway 21's data processes and controls.

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Appendix AB-A: Relevant Documents

ICF Marbek's Mock Verification and Gap Analysis Report

Quantification Protocol for Reducing the Age at Harvest, Version 2.0, July 2011

Interpretive Guide to Applying the Reducing the Age at Harvest of Beef Cattle Quantification Protocol, March 2012, submitted to ARD.

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Appendix AC: Year One RAH Mock Verification

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ICF Marbek
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Reducing the Age at Harvest of Beef Cattle Aggregation Project – Protocol Validation Study

Failsafe Canada Inc.

Mock Verification Final Report

May 31, 2013

ICF Consulting Canada, Inc.
2600 – 144 Fourth Avenue SW
Calgary, AB T2P 3N4

Introduction

Alberta's greenhouse gas (GHG) regulatory framework has created a vibrant carbon market, with over 8.4 million tonnes of voluntary carbon emission reductions generated in the form of carbon offsets. Carbon offsets are provided by sectors that do not have a regulatory target, and are sold to companies with regulatory obligations under Alberta's Specified Gas Emitter Regulation (SGER), 2007. The agriculture sector has been a major provider of carbon offsets to the market, contributing over 20% of offsets used for compliance with the SGER.

In order to support efforts needed to attain this higher standard of verification, Alberta Agriculture and Rural Development (AARD) initiated a Protocol Validation Study (PVS) as a capacity-building exercise to gather knowledge about the application of the Reducing the Age at Harvest of Beef Cattle protocol to compile a Carbon Offset Project, including a mock verification to a reasonable level of assurance. The aggregation company, Failsafe Canada, has volunteered to compile a Carbon Offset Project using feedlot data from the Highway 21Feeders feedlot near Acme, Alberta.

More specifically, the PVS study will emulate the process of aggregating participating producers under the provisions of the protocol to bring forward agricultural offsets that can be tested in a mock verification exercise to a reasonable level of assurance, for the purposes of collectively learning about the barriers, gaps, solutions and options for adopting these protocols in the marketplace. The objectives of the PVS study include:

- Validating, through small-scale pilots, how the protocol can be applied in the field.
- Providing guidance to producers, aggregators and verifiers on the implementation of the protocols at a commercial scale.
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols.

This report provides the results of the mock verification, an analysis of the gaps found in the project to meet the current quantification protocol and potential gaps or areas for improvement with the Protocol itself. Additionally, the verification team has provided feedback to the authors of a "Best Practices Guidance" document, which has been developed through the PVS.

1 Verification Summary

Lead Verifier:	Aaron Schroeder, P.Eng.
Associate Verifier(s):	Michelle Stelmach, AIT
Verification Timeframe:	May 2013
Objective of the verification:	Gap analysis through a mock verification on pilot Project
Final report being provided to:	Alberta Agriculture and Rural Development
Standard being verified to:	ISO 14064-3:2006 (ISO, 2006)
Verification criteria employed:	Climate Change and Emissions Management Act Specified Gas Emitters Regulation (Alberta Regulation 139/2007) Technical Guidance for Offset Project Developers, Version 4.0, February 2013 Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013 Quantification Protocol for Reducing the Age at Harvest of Beef Cattle, Version 2.0, July 2011
Verification scope – Gases:	Methane (enteric and manure), Nitrous Oxide (manure)
Project:	Reducing the Age to Harvest of Beef Cattle Aggregation Project
Location(s):	Highway 21 Feeders, Acme, AB
Project Start Date:	January 1, 2011
Credit Start Date:	January 1, 2011
Project Report Temporal period:	January 1, 2011 – December 31, 2011

Main Contact (Verifier):	Aaron Schroeder, P.Eng. Senior Manager - Climate Suite 2600 144 - 4 Ave SW Calgary, Alberta T2P 3N4 403.450.7522 aaron.schroeder@icfi.com
Main Contact	Failsafe Canada Inc. Brandon Grant, Project Manager 4628 5th Street NE Calgary, Alberta T2E 7C3 403.620.9794 Brandon@failsafecananda.com

2 Project Information

Failsafe Canada Inc. has developed the necessary documentation detailing project activities to support their claim for emission reductions to be registered on the Alberta Offset Registry under Alberta's Specified Gas Emitters Regulation. Alberta Agriculture and Rural Development ("**AARD**") engaged ICF Consulting Canada, Inc. ("**ICF Marbek**") to provide a third-party mock verification of the emission reduction asserted by Failsafe Canada Inc. related to the project activities discussed herein.

The quantification of the emission reductions associated with the project is defined by Alberta Environment and Sustainable Resource Development's ("**AESRD**") Quantification Protocol for Reducing the Age at Harvest of Beef Cattle, Version 2.0, July 2011 ("**the Protocol**"). The Project Report describes the emission reduction claim ("**GHG Assertion**") made by Failsafe Canada related to this project.

The Beef Reducing Days on Feed Aggregation Pilot Project ("**the Project**") covered by this verification engagement involves 2011 vintage emission reductions achieved through innovative feeding practices on a participating feedlot. The Project is located in on one participating feedlot in Alberta.

As this project is a non-commercial exercise, an agreement between Failsafe Canada Inc. and the feedlot owners to aggregate the emission reduction assertion is not necessary. The emission reduction quantified in this mock-project are not intended for serialization as offsets.

This project uses 100% data and does not use the optional statistical sampling approach provided in the Protocol.

This is the first verification of any project under the Protocol (although this is a mock verification).

This document describes the terms and scope of this verification. It serves to communicate the findings of the verification.

3 Verification Execution

The scope of the mock verification was defined during the planning stage and is detailed in the Verification Plan, which is appended to this document. The Verification Plan also describes ICF Marbek's verification process that was executed through the course of the verification, and identifies the specific verification procedures that were planned and executed through the process.

The verification was completed according to Plan. The final verification schedule was as follows:

Procedure	Date
Verification Kickoff Meeting	April 5, 2013
Verification Procedures Conducted	May 7 – May 29, 2013
Site Visits	May 24, 2013
Final Mock Verification Report Issued	May 31, 2013

3.1 Site Visit

The site visit was conducted by Aaron Schroeder on May 24, 2013. The site visit began at the Failsafe Canada offices in Calgary, where a review of project data and documentation collection and analysis was performed. An onsite visit to Highway 21 Feeders feedlot near Acme, Alberta was also conducted.

The site visit was a key step in planning and executing the verification. During the course of the site tour, ICF Marbek interviewed Mike Dygert, Foreman at Highway 21 Feeders regarding the operations and data management for the Project.

The following pertinent information was obtained through the interviews, observations and data review conducted during the site visit:

- The mock project includes only animals that are owned by the feedlot (no custom-fed cattle were included).
- Animals that do not have birth date information are excluded from the project (i.e. – missing CCIA tag upon entering the feedlot)
- Dead animals are removed from project. If CCIA assigned identification number is recorded upon death this animal is removed; if specific animal is unknown, an average animal is removed. For the sample of records reviewed in the mock project, the specific dead animal was recorded in all cases.
- Animals enter the feedlot in lots. Generally, lots are grouped together to fill a pen (lots generally do not span over several pens).
- Animals are weighed incoming and leaving the feedlot on a calibrated truck scale (calibration records were available for review during the site visit).
- Trucking manifests are available at the feedlot as substantiating documentation for data recorded in lot close-out reports. The information from these manifests is not recorded electronically.

3.2 Summary of Project Changes

Major GHG emission sources and sinks have been identified by the Responsible Party and are detailed in the Offset Project Plan. The quantification methodologies outlined in the Protocol have been used to calculate GHG emission sources and sinks. There have been no changes made to the project since the Offset Project Plan was completed (this is the first year of the pilot project).

The uncertainty associated with the quantification methodologies applied was evaluated during Protocol development. The Project meets the data collection and project specific calculation requirements of the Protocol and therefore, the uncertainty associated with the quantification and resulting assertion meets AESRD requirements.

3.3 Verification Strategy

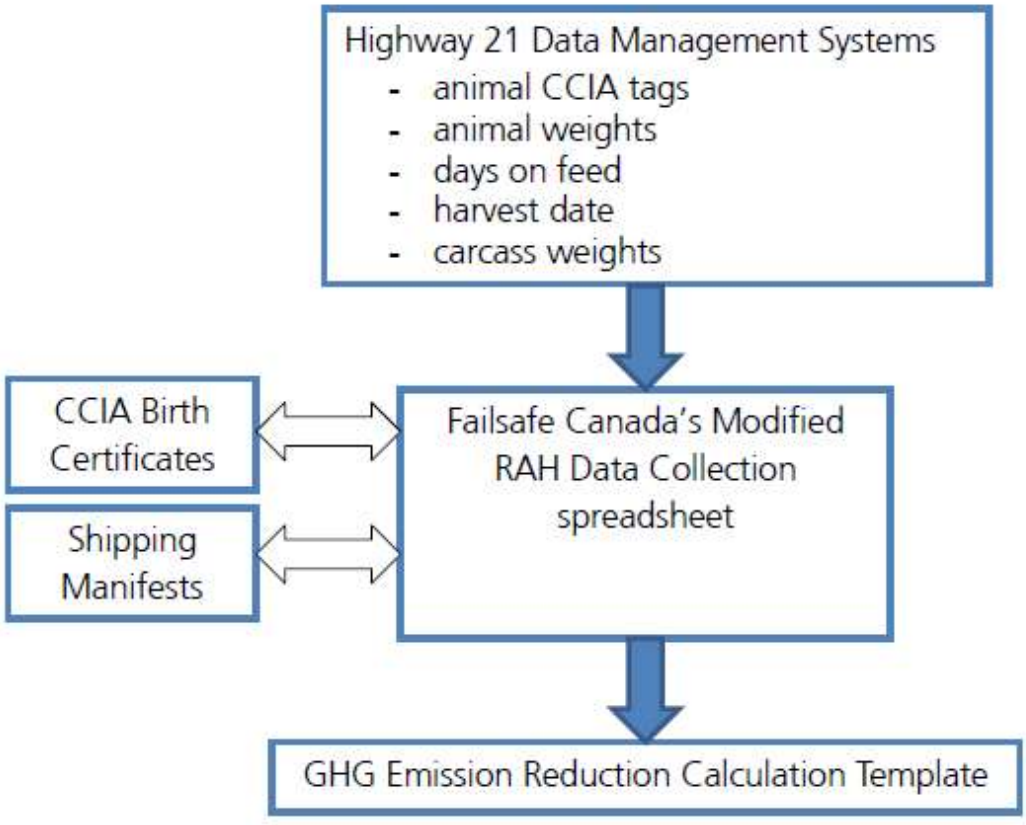
The Verification Strategy applied to this mock verification was a predominantly substantive approach. The Verification Team designed and executed verification procedures that focused on review of original metered and measured data.

The Responsible Party relies on certain controls for the quantification of emissions and to establish project eligibility. ICF Marbek relied on the following controls and as such, tested the operational effectiveness of these controls and data the controls are processing. Detail of the verification procedures employed to conduct these tests are provided in the Verification Plan.

- Feedlot data (including animal weight and age at harvest) is all managed using software that is maintained by each feedlot. The primary purpose of this software is to manage production of animals and to reconcile payments made for finished product. During the site visits, the data integrity and security of these systems was evaluated. Further testing of the data produced by these systems was conducted subsequent to the site visits using analytical procedures, which are detailed in the Verification Plan.

3.4 Data Management and Control System Review

The Verification Team developed a thorough knowledge of the data management and control systems utilized in the Project through the review of the Offset Project Plan, observations during the site visit, and interviews with key Project personnel. The data flow diagram shown below outlines the flow of project data and the custody of control.



4 Verification Results

4.1 Misstatements

The misstatement details sections below include an approximated value of the asserted quantity affected by each misstatement, described as a percentage of the total assertion. These values should be relied upon only for determining if misstatements breech the materiality threshold and not for any other purpose.

Procedure	Misstatement Title	Final Status
B1: Documentation of Boundaries – Offset Project Plan and Offset	Two year baseline period	Material misstatement
B2: Demonstration of Applicability Ownership	Eligible age of animals	Potential material misstatement
O1: Confirmation of Contractual Relationships	None detected	
D1: Data Collection and Quality Controls	None detected	
D2: Substantiating Evidence	None detected	
C1: Appropriate and Consistent Calculation Methodology	None detected	
C2: Re-Performance of Calculation Assertion	None detected	
A1: Final GHG Assertion	None detected	

Misstatement Title	Misstatement Description
Two year baseline period	The mock project includes only two years of baseline data. While this was sufficient to evaluate the mock project for the purpose of this mock verification, it would constitute a material misstatement if the project was submitting an assertion for serialization of credits.
Eligible age of animals	The baseline and project condition include animals that were older than 24 months of age at time of harvest. The Protocol suggests (although is not entirely clear) that it applies only to animals 24 months of age or less. Removing animals from the baseline and project that exceed 24 months of age significantly changes the emission reduction asserted. See Section 6.1 (bullet 1) for a further description of this issue.

4.2 Materiality

There is one potential material misstatement in the project; however, the Protocol applicability needs to be clarified to determine if this is in fact a misstatement.

5 Verification Team

Since 1969, ICF International ("**ICF**") has been serving major corporations, all levels of government, and multilateral institutions. Globally, approximately 500 of our 4,500 employees are dedicated climate change specialists, with experience advising public and private-sector clients. ICF has earned an international reputation in the field of climate change consulting for its analytical rigour, in-depth expertise, and technical integrity through scores of GHG emissions-related assignments over the past two decades.

Within Canada over the past 10 years, ICF Consulting Canada, Inc., a fully owned subsidiary of ICF, has carried out numerous facility-level GHG verifications and verifications of emission reduction projects. ICF Marbek has developed the necessary internal controls to ensure qualified and competent staffing uphold the principles of the relevant standard while quality control processes are utilized to assure data integrity is maintained and safeguarded. ICF Marbek's clients choose ICF Marbek for its strong brand, technical expertise, and rigorous methodological approach.

ICF Marbek has assembled a Verification Team consisting of experienced GHG verifiers with relevant technical expertise.

Lead Verifier

Aaron Schroeder is a Professional Engineer in the Province of Alberta and holds a B.Sc. in Engineering from the University of Saskatchewan. He has completed supplementary training in ISO 14064 as well as Auditing and Assurance Engagements through the University of Toronto, School of Continuing Studies. Aaron has acted as lead verifier on third-party assurance assignments for multiple compliance periods under Alberta's Specified Gas Emitters Regulation. These projects included work at SAGD facilities in Alberta's oil sands, a complex sour gas processing facility, two of Alberta's largest natural gas pipelines and combined-cycle electric generating facilities. Additionally, Aaron has completed numerous verifications as lead verifier for emission reduction (offset) projects in agricultural tillage management, wind electricity generation, and acid gas injection projects.

Associate Verifier

Michelle Stelmach works on contract with ICF Marbek and will conduct the farm visits during the course of the verification. She holds a Bachelor of Science in Agriculture from the University of Saskatchewan and certification in agricultural application of ISO 19011 – Internal System Auditing and has worked with the Hazard Analysis Critical Control Point (HACCP) to design and conduct internal system audits and to meet Canadian Food Inspection Agency standards at the producer level, in feed manufacturing plants and poultry processing plants. She has extensive experience working with agricultural producers across Alberta through her work as Program Advisor and Coordinator with Maple Leaf Foods and Landmark Feeds.

6 Evaluation of Pilot Project Data and Documentation

This section provides the results of the verification team's analysis of the mock project implementation of the quantification protocol and the documentation supporting the data used for the pilot project.

1. Eligible animal age: The protocol preamble suggests that the project activity applies to "youthful cattle, or those under 24 months of age"; however, the Protocol applicability section is silent regarding the eligible age of animals in the project.
2. Ownership: the project activity occurs in the feedlot (reduction of GHG emissions in beef cattle based on reduced age at harvest). Therefore, ownership of the emission reduction resides with the feedlot owner not the owner of the cattle. This is analogous to a natural gas processing facility where the facility owner is processing raw natural gas from several production companies. If the facility owner implements a project that reduces energy consumption at the facility, the resulting GHG reduction (and any credit or reduced liability) associated with this project activity clearly resides with the facility owner. The owner may, in turn, pass the financial benefit to the companies that are supplying the commodity (either through reduced fees or direct compensation); however, this is should be handled through a commercial arrangement, not through the Protocol.

   Further, the ownership of the emission reduction should not be compared to the Conservation Cropping protocol, where the carbon is sequestered in the soil which is owned by the landowner (not necessarily the farmer applying the tillage practice).
3. The Protocol does not provide guidance regarding the selection of baseline years. A project developer could potentially provide justification for a baseline period that does not immediately precede the project period. The baseline period would; however, need to begin no earlier than January 1, 2002, provided all Protocol requirements can be met (i.e. CCIA tags were not standard prior to 2006/07).
4. The requirements for establishing functional equivalence should be defined by the Protocol. Grouping animals by sex should be a clearly defined requirement. Grouping animals by incoming weight class is not appropriate for this protocol because the project activity and goal of the protocol is to drive the age (which corresponds with weight) at which the animal enters the feedlot down, so as to reduce the number of days the animal is in backgrounding lots and on pasture. Therefore, older and larger animals in the baseline condition are functionally equivalent to younger and smaller animals in the project condition.
5. Section 4.4 of the Protocol provides two approaches to establishing the birth date of each animal. The "default method" attempts to provide a more conservative approach by requiring that the birth date used to calculated the emission reduction includes the addition of 28 days to the birth certificate date. If this default approach is applied to both the baseline *and* the project condition, the resulting emission reduction actually *increases* (versus a non-adjusted birth date approach).

   If the cow-calf producers are not changing their methodology for registering the birth date of the animals between the baseline and the project periods, then it stands to reason that no adjustment is required because the process is functionally equivalent.

   Therefore, the Protocol should be adjusted to either account for function equivalence that already seems to exist, or modify the default approach to correct the unintended *increase* in the quantified emission reduction.

6. Manure management. Section 5 of the Protocol (or the Best Practices Guidance Document)should provide guidance regarding the appropriate documentation to establish that manure is being managed according to the *Agricultural Operation Practices Act*.

7. Shipping manifests were used to substantiate the harvest date in this mock project, which should be sufficient if the manifest provides a means of tracing the animals that were shipped back to the feedlot's assigned lot number.

   The emission quantification requires animal age and live weight as input data. The sum of the emission reductions achieved for each animal in the project is mathematically equivalent to a calculation of the total emission reduction that uses the average animal age and average animal live weight. Therefore, it is not necessary to know the specific harvest date for each animal in a lot; the *average* harvest date may be used along with the *average* birth date to calculate the *average* age at slaughter. The shipping manifests can provide the data to perform the calculation and sufficient documentation to provide evidence of the project activity.

Appendices

Verification Plan

Verification Plan

Failsafe Canada Inc – Reducing the Age to Harvest of Beef Cattle Aggregation Project – Protocol Validation Study

1 Introduction

This document provides details on the verification scope and process that is planned to conduct a reasonable level verification of the Vintage 2012 of emission reductions Alberta Offset System, Greenhouse Gas Assertion of Emission Reduction Credits (the "**GHG Assertion**") for the Failsafe Canada Inc, Reducing the Age to Harvest of Beef Cattle Aggregation Project, (the "**Project**"). An overview of operations at the Project will be provided in the Verification Report.

A Verification Risk Assessment was conducted during the verification planning stage; the results will be provided in Section 6 of the final Verification Plan. These results were used to inform the development of the verification procedures outlined in Section 7 of the final Verification Plan. Additionally, the results of the Risk Assessment informed the development of the Sampling Plan, which will be included in the Verification Report.

The Verification and Sampling Plans will be updated through the course of the verification as additional information becomes available.

The verification conclusion will be documented in the Verification Statement and the verification findings will be further described in the Verification Report. The Verification and Sampling Plans will be appended to the Verification Report to provide information related to the verification scope and process.

2 Verification Scope

2.1 Objective

The primary objective of this verification engagement is to provide assurance to Alberta Agricultural and Rural Development (**AARD**) that the GHG Assertion is reliable, and of sufficient quality.

2.2 Parties and Users

The person or organization that has overall control and responsibility for the GHG Project, as defined in Section 2.13 of ISO 14064-2:2006, is the "**Project Proponent**". For this verification, Failsafe Canada Inc. is the Project Proponent.

ICF Consulting Canada Inc., the "**Verifier**" or "**ICF Marbek**", has been engaged to provide a third-party verification of the GHG Assertion. The Lead Verifier, the Associate Verifier, and the Technical Expert, compose the ICF Marbek "**Verification Team**".

The "**Intended User**" is defined in Section 2.22 of ISO 14064-2:2006 as the individual or organization identified by those reporting GHG-related information that relies on that information to make decisions. **AARD** is the Intended User of the information contained within the Verification Statement.

2.3 Scope

The verification will be conducted in accordance with *ISO 14064-3: Specification with guidance for the validation and verification of greenhouse gas assertions.*

The Verification and Sampling Plans were developed based on the relevant criteria described in the following:

- *Specified Gas Emitters Regulation, Alberta. Reg.139/200*
- *Quantification Protocol for Reducing the Age at Harvest of Beef Cattle,V.2, July 2011*
- *Technical Guidance for Offset Project Developers, v.3, February 2012*
- *Offset Project Plan for Failsafe Canada's Reducing the Age to Harvest of Beef Cattle Aggregation Project – Protocol Validation Study (May 2013)*
- *Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance, Version 1.0, January 2013*

The table on the following page defines the scope elements specified for the Project.

Scope Element	ISO 14064-3 Definition	Project Specific
Boundary	The Project boundary, including legal, financial, operational and geographic boundaries	Beef Reduced Age to Harvest Aggregation Project Highway 21 Feeders
Infrastructure and Activities	The physical infrastructure, activities, technologies and processes associated with the Project	Implementation of feedlot management practices that demonstrate through documentation and records that a reduction in age at harvest has been achieved.
GHG Sources	GHG sources to be included	• Enteric Methane Emissions • Manure Methane Emissions • Manure Nitrous Oxide Emissions
GHG Types	Types of GHGs to be included	• Methane (CH_4) • Nitrous Oxide (N_2O)
Time Period	Vintage of credits to be included	January 1, 2011 – December 31, 2011

2.4 Materiality

During the course of the verification, individual errors, omissions or misrepresentations (collectively referred to as discrepancies) or the aggregate of these discrepancies will be evaluated qualitatively and quantitatively.

Materiality defines the level at which discrepancies in the GHG Assertion or any underlying supporting information precludes the issuance of a reasonable level of assurance.

The Lead Verifier is responsible for applying professional judgment to determine if *qualitative* discrepancies could adversely affect the GHG Assertion and subsequently influence the decisions of the Intended User, in which case, the discrepancies are deemed to be material.

Quantitative discrepancies will be calculated individually to determine the impact of the discrepancy as a percentage of the GHG Assertion.

All discrepancies that are outstanding at the conclusion of the verification are documented in the Verification Report and classified on an individual basis as either material or immaterial.

Materiality Threshold

The materiality threshold is defined as <5% of the total reported emission reductions in the GHG Assertion. Individual discrepancies and the aggregate of individual discrepancies will be analyzed to determine if the materiality threshold has been breached.

2.5 Principles

ISO 14064 defines six principles that should be upheld in the development of the GHG Assertion. These principles are intended to ensure a fair representation and a credible and balanced account of GHG-related information. The verification procedures developed and executed during the course of this verification will present evidence such that each of these principles is satisfied.

Relevance

Appropriate data sources are used to quantify, monitor, or estimate emission sources. Appropriate minimum thresholds are used to justify the exclusion or the aggregation of minor GHG sources or the number of data points monitored.

Completeness

All emission sources relevant to the Facility are included within an identified source category.

Consistency

Uniform calculations are employed between reporting periods. Emission calculations for each emission source are calculated uniformly. If more accurate procedures and methodologies become available, documentation should be provided to justify the changes and show that all other principles are upheld.

Accuracy

Measurements and estimates are presented, without bias as far as is practical. Where sufficient accuracy is not possible or practical, measurements and estimates are used while maintaining the principles of conservativeness and transparency.

Transparency

Information is presented in an open, clear, factual, neutral and coherent matter that facilitates independent review. All assumptions are stated clearly and explicitly and all calculation methodologies and background material are clearly referenced.

Conservativeness

Appropriate parameters affecting the Facility's emission sources are utilized in the calculation of the GHG Assertion. When parameters or data sources are highly uncertain, the choice of parameter or data source utilized results in an overestimation of the GHG Assertion. Note that any error, underestimation or overestimation, would be evaluated as a potential material error.

2.6 Limitation of Liability

Due to the complex nature of the operations within the Project and the inherent limitations of the verification procedures employed, it is possible that fraud, error, or non-compliance with laws, regulations, and relevant criteria may occur and not be detected.

3 Verification Team

The qualifications of the Verification Team and Internal Peer Reviewer are provided in the Statement of Qualifications.

Lead Verifier, Aaron Schroeder (P.Eng)

The Lead Verifier is responsible for all activities conducted within the verification, including overseeing the development of the Verification and Sampling Plans and the execution of the verification procedures. The Lead Verifier is the lead author of the Verification Report and executes the Verification Statement at the conclusion of the engagement.

Associate Verifier, *Michelle Stelmach, (AIT)*

The Verification Team is supported by the Technical Expert(s), who review the Verification Risk Assessment and provide advice on the development of the Verification and Sampling Plans to ensure risks are addressed with rigorously designed verification procedures. The Technical Expert is also available to the Verification Team through the course of the verification to provide assistance with any issues as they arise.

4 Verification Process

The ICF Marbek approach for conducting verification of a GHG Assertion follows the tasks outlined in the following diagram. Although these tasks are generally completed sequentially, the order may be modified according to circumstances such as scheduling and data availability.

Pre-Engagement	Approach	Execution of Verification	Completion
1. Selection of Lead Verifier 2. Initiate Conflict of Interest Procedure 3. Pre-Engagement Planning and Proposal Development 4. Contract Execution 5. Assess GHG Program & Revise VMS as Required 6. Initiate Verification Tracking	7. Selection of Verification Team 8. Communication with Project Proponent 9. Kick-off Meeting 10. Verification Risk Assessment 11. Draft Verification and Sampling Plan	12. Site Visit(s) 13. Conduct Verification Procedures 14. Issue Clarification & Data Request 15. Revise & Finalize Verification and Sampling Plan 16. Address and Evaluate Outstanding Issues	17. Evaluate Evidence 18. Hold Verification Findings Meeting (if necessary) 19. Draft Verification Report & Statement 20. Internal Peer Review 21. Completion of COI Form 22. Independent Review of Impartiality 23. Issue Verification Report & Statement 24. Close Verification File 25. Develop and Issue Management Memo(s)

4.1 Pre-Engagement

Prior to submitting a proposal to conduct this verification, the following pre-planning steps were taken:

- The results of any previous business engagements or verifications with the Project Proponent were reviewed to determine if any previous unresolved conflicts may preclude ICF Marbek from engaging in the verification;
- The Project Proponent's motivation for completing the verification was established; and
- A Conflict of Interest procedure was initiated that documents whether any perceived or real conflicts were found when considering threats due to:
    - Advocacy
    - Financial Interest
    - Familiarity/Sympathy
    - Intimidation
    - Self-Review
    - Incentives

Following the acceptance of the proposal and signing of a contract for services, the Verification Team was selected. The Verification Team for this engagement is comprised of the individuals identified in Section 3.

4.2 Approach

An extensive knowledge of the Project Proponent's business, the relevant industry, and the details of the Project itself are required to conduct a thorough verification that can lead to a conclusion. The initial information collected about the Project Proponent and the Project formed the basis of the preliminary draft Verification Plan. The development of the final Verification Plan is an iterative process; that is, the process will be completed several times through the course of the verification and the resulting plan will be updated as new information became available.

There are three types of risk associated with the GHG Assertion defined in ISO 14064-3:

- Inherent Risk
- Control Risk
- Detection Risk

The process of designing the Verification Plan began with the development of Verification Risk Assessment for both the Project as well as the Project Proponent. The steps in this process included:

- Reviewing the GHG Assertion, and the methodologies employed by the Project;
- Reviewing information on the industry and the specific Project under review;
- Assessing the likelihood that a material misstatement might exist in the GHG Assertion, if no controls were used to prevent misstatements in the GHG Assertion (i.e. inherent risk);
- Assessing the control environment and the corporate governance process (i.e. control risk); and
- Reviewing each emission source identified in the Project, and evaluating the contribution of each source to the GHG Assertion and the associated potential material discrepancy for each.

The results of the Verification Risk Assessment inform the development of the verification procedures, which will be documented in Section 7 of the final Verification Plan. A summary of the Verification Risk Assessment will be provided in Section 6 of the final Verification Plan. The draft Verification Plan will be provided to the Project Proponent before proceeding with the verification.

4.3 Execution of Verification

With draft Verification and Sampling Plans in place, the verification procedures will be executed. This process involves collecting evidence, testing internal controls, conducting substantive testing, and developing a review file. Over the course of the verification, the draft Verification and Sampling Plans may change; the final Verification and Sampling Plans provided in the Verification Report reflect the verification parameters and procedures that were actually executed.

Site Visit

The site visit will be conducted by Aaron Schroeder in May.

The site visit will be a key step the planning and execution of the verification. During the course of the site tour, ICF Marbek will interview key site operations personnel regarding the operations and data management of the Project.

During the site visit all GHG emission sources for the Project will be reviewed to ensure appropriate identification and categorization. A review of process flow and metering diagrams will be followed by physical observation of the Project.

Health and Safety Requirements

Steel toed boots are required for the site visit. ICF Marbek personnel will be required to be accompanied by feedlot staff at all times. Observe posted speed limits on feedlot sites.

Collecting Evidence and Review of Documentation

Sufficiency and appropriateness are two interrelated concepts that are fundamental to the collection of verification evidence. The decision as to whether an adequate quantity (sufficiency) of evidence has been obtained is influenced by its quality (appropriateness).

Through the execution of the verification procedures described in Section 7 of the final Verification Plan, the Verification Team will review three key forms of evidence including physical, documentary and testimonial:

- Management documentation: policies, programs, and procedures related to the collection, safeguarding, and management of the data supporting the GHG Assertion;
- Records: records comprise time-sensitive data, correspondence, and files including: Feedlot's close out data sheets, NCRB Permits, weight scales, calibration records, shipping manifest, CCIA registration numbers, methods used to group cattle in the baseline and project.
- Interviews: the interviews will provide information regarding operations and data management and will provide evidence to support the sufficiency of data controls; and
- Computer systems: Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template

Testing and Assessment of Internal Controls

The Verification Team will develop a sufficient understanding of the GHG information system and internal controls to determine whether the overall data management system is sound and if it supports the GHG Assertion. This assessment will seek to identify any weakness or gaps in the controls that pose a significant risk of not preventing or correcting problems with the quality of the data and examining it for sources of potential errors, omissions, and misrepresentations. It will incorporate an examination of three aspects of the Project Proponent's internal controls: (1) the control environment, (2) the data systems, and (3) the control and maintenance procedures.

Assessment of Data

Substantive testing procedures will be used to assess the reasonability and validity of the GHG Assertion. Both quantitative and qualitative analysis will be performed to achieve the desired level of assurance. The verification procedures are described in Section 7 of the final Verification Plan as separate tables for each process or activity involved in the quantification and reporting of the GHG Assertion. The verification procedures include verification activities designed to:

- Review the Project boundary, including a review of the completeness of emission sources identified;
- Review the Project data sources to ensure the GHG Assertion is calculated based on metered or estimated data that meets the requirements of the *Quantification Protocol for Reduced Days at Harvest of Beef Cattle,V.2, July 2011*;
- Re-calculate the GHG Assertion, which demonstrates transparency and accuracy; and
- Review the GHG Assertion to ensure the 2011 emissions reductions calculated by the Project Proponent have been accurately reported.

Clarification and Data Request

To facilitate information flow between the Verification Team and the Project Proponent, a consolidated request for additional information will be developed through the course of the verification and issued to the Project Proponent. This "Clarification and Data Request" will be used to document information requests and summarize the responses. It will also be used to document the Verification Team's assessment of each response.

Developing a Review File

A review file (the "**File**") comprised of documents, records, working papers and other evidence collected and created during the course of the review that support the review conclusions will be developed for this verification. This evidence stored in hard copy and/or electronic format will serve to provide support for the verification conclusion, provide evidence that the verification was conducted in accordance with the criteria set forth in this document, and aid the Verifier in conducting current and future reviews.

The File will include:

- The GHG Assertion and supporting documentation, as submitted to **AARD**;
- Decisions on the level of materiality and the results of the Verification Risk Assessment;
- Documentation on the Project Proponent's internal controls;
- Descriptions of the controls assessment work and results;
- Documentation of the substantive testing procedures that were carried out and the results;
- Copies of any correspondence with the Project Proponent or other parties relevant to the review;
- The Verification Team's working papers;
- The Clarification and Data Request with documented responses from the Project Proponent; and
- Client data (copies of relevant records, spreadsheets, and other data files).

The File is the property of ICF Marbek and access to it is normally restricted to the Verifier and the Project Proponent. ICF Marbek will retain and safeguard the file for a minimum of seven years.

4.4 Completion

This engagement will be formally closed after the verification has been executed and the Verification Report has been finalized.

Preparing the Verification Report

The purpose of the Verification Report is to document the verification findings. All discrepancies are described and compared to the materiality threshold individually and in aggregate. The Verification Statement, which presents ICF Marbek's verification conclusion, is included in the Verification Report.

Internal Peer Review Process

Prior to releasing the Verification Report and Verification Statement, an internal review process is conducted by the Internal Peer Reviewer. This process ensures that:

- All steps identified as being required to complete the verification were completed;
- Any identified material or immaterial discrepancies identified have been either:
  - corrected by the Project Proponent and reflected in the GHG Assertion; or
  - documented in the Verification Report, if discrepancies persist at the conclusion of the verification.
- All required documentation detailing the verification process has been prepared, delivered, and retained.

Closing the Engagement

The verification engagement will be closed out upon delivery of the final Verification Report.

5 Verification Schedule

The following schedule is planned for the verification (subject to change with agreement between the Verifier and the Project Proponent).

Description	Scheduled Date
Verification Kick-Off Meeting	April 5, 2013
Site Visit	May 24, 2013
Head Office Visit	May 24, 2013
Draft Verification Plan to Project Proponent	May 24, 2013
Draft Verification Statement and Report	May 28, 2013
Final Verification Statement and Report	May 30, 2013

6 Verification Risk Assessment

The process for completing a Verification Risk Assessment was described in Section 4.2. The following table describes the *inherent* and *control* risks analyzed by the Verification Team and the corresponding verification procedures outlined in Section 7 of the final Verification Plan that have been designed to address the risk.

Description of Risk	Evaluation	Verification Procedure(s)
Inherent Risks		
Animal weights, identification numbers and deaths are very large datasets that are measured and recorded at each feedlot.	Medium	D1, D2
Animals may exit the feedlot for reasons other than harvest (example- to return to backgrounding program). These animals must be identified from manifest and not included in project.	Medium	D2
Control Risks		
Reliance upon measured data in feedlot electronic data management systems.	Low	D1

The *detection risk* is a measure of the risk that the verification procedures will fail to detect material misstatements, should such misstatements exist. The verification procedures will be developed to address inherent and control risks, while ensuring the level of detection risk is sufficiently low to reach a verification conclusion at a reasonable level of assurance.

The results of the Verification Risk Assessment will be utilized by the Verification Team to develop the verification procedures, which are outlined in Section 7 of the final Verification Plan.

7 Verification Procedures

Summary of Procedures:

Facility Boundaries and Definition

B1: Documentation of Boundaries – Offset Project Plan and Offset Project Report

B2: Demonstration of Applicability

Ownership

O1: Confirmation of Contractual Relationships

Data Sources and Supporting Data

D1: Data Collection and Quality Controls

D2: Substantiating Evidence

Calculation

C1: Appropriate and Consistent Calculation Methodology

C2: Re-Performance of Calculation

Assertion

A1: Final GHG Assertion

Procedure Definition Table Explained

Z1 – Example Procedure Category – Example Procedure Title	
Introduction: This introduction serves to explain the reason the Verification Team is undertaking the procedures described below. For instance, the inclusion of all emission sources ensures that that quantification of the total direct emission satisfies the principle of completeness.	
Type of Evidence	The Type of Evidence can usually be grouped as: Physical Examination, Confirmation, Documentation, Observation, Inquiries of the Client, Re-performance, or Analytical Procedures.
Data Sources	The *Data Sources* describes the form in which the evidence is presumed or is known to be available to the Verification Team. Specific Documents or Assigned Positions, for example.
Objective (specific principles)	The objective serves to focus the procedure as pursuant to one or more of the audit principles of: *Relevance, Completeness, Consistency, Accuracy, Transparency,* or *Conservativeness.*
Specific Activities	• In bullet form; • The *Specific Activities* are outlined here.
Error Conditions	• Again in bullet form; • The anticipated *Error Conditions* are listed here to aid the Verification Team; • As the Sampling Plan is a living document until the end of the verification process, additional error conditions may be identified during the execution of the procedures.

Facility Boundaries and Definition

B1 – Documentation of Boundaries – Offset Project Plan and Offset Project Report	
Introduction: The Offset Project Plan must outline how the Project Proponent is implementing the quantification methodology described in the Protocol. Specifically, each emission source and sink listed in the Protocol as relevant to be included in the emission reduction calculation must be considered in the Project unless the use of a flexibility mechanism specifically permits its exclusion. Additionally, any sources or sinks not contemplated by the Protocol that are relevant to the project must be considered.	
Type of Evidence	Documentation, Observation, Inquiries of the Client, Physical Examination
Data Sources	Offset Project Plan: Beef Reduced Age at Harvest ("**OPP**"), Project Report: Beef Reduced Age at Harvest ("**OPR**"), Project Process Flow Diagrams, GHG Assertion, Project Operations Personnel
Objective (specific principles)	*Completeness, Relevance*
Specific Activities	1. Compare each emission source and sink listed in the OPP to those listed in the Protocol considering all equipment and activities; 2. Compare OPP, OPR, GHG Assertion against the corresponding AESRD templates, as applicable; 3. Through the site visit and understanding of the Project, evaluate any emission sources or sinks that are not considered by the Protocol.
Error Conditions	• Emission source or sink defined in protocol was wrongfully excluded in OPP • Divergence from the protocol that is not in conformance with ISO 14064 and associated guidance documents

B2 – Demonstration of Applicability	
Introduction: The Protocol describes the specific applicability criteria that must be satisfied to utilize the Quantification Protocol. The Project Proponent must provide evidence that clearly demonstrates applicability as described.	
Type of Evidence	Documentation, Confirmation
Data Sources	OPP and Supporting Documentation
Objective (specific principles)	*Completeness, Relevance*
Specific Activities	1. Review OPP for evidence of applicability for each requirement described by the Protocol; 2. Review supporting documents from external sources; 3. Interview key project personnel regarding the application of applicability criteria. 4. Review supporting evidence for any flexibility mechanisms that are being used in the Project. 5. Review shipping manifests to determine that animals leaving the feedlot were sent to harvest. 6. Review data to verify eligible age and consistency in group selection between Baseline and Project.
Error Conditions	• Evidence does not clearly demonstrate Protocol applicability as described • Flexibility mechanisms that are employed without supporting evidence that is required by the Protocol

Ownership

O1 – Confirmation of Contractual Relationship – Proponent and Project Partners	
Introduction: The ownership of the emission reduction must be demonstrated. The intent of this procedure is not to provide a legal opinion on ownership, but to establish that a contractual relationship exists between the Project Proponent and any other parties who may have an ownership interest in the emission reduction through ownership of land, equipment or resources related to the Project.	
Type of Evidence	Documentation, Inquiries of the Client
Data Sources	OPP, GHG Assertion, Contracts between Failsafe Canada and participating feedlots
Objective (specific principles)	*Completeness, Relevance, Transparency*
Specific Activities	1. Review of documents proving the ownership of the assets creating the emission reductions; 2. Review of contracts binding Project Proponent to other project partners; 3. Ensure temporal coverage of current assertion in project contracts.
Error Conditions	• Missing documentation • Incorrect identification of legal entities covered by contract • Expired or incomplete terms in relevant contracts

Data Sources and Supporting Data

D1 – Data Collection and Quality Controls	
Introduction: The systems for measuring and storing Project data and chain of custody are evaluated in this procedure to determine if the data quality controls are effective.	
Type of Evidence	Documentation, Confirmation, Observation, Inquiries of the Client, Analytical Procedures
Data Sources	• OPP, Failsafe Canada Personnel, Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template
Objective (specific principles)	*Accuracy, Transparency, Conservativeness*
Specific Activities	1. Develop a data life cycle diagram, or data map for each major GHG emission source/sink and confirm with Project operations and GHG reporting personnel; 2. Observe or interview Project operations personnel regarding the operation of data transfer systems during site tour, including manual data entry procedures and associated controls; 3. Interview Project personnel responsible for quantifying emission reduction regarding data metering and validation, data storage, data security, and any manual data entry or transcription; 4. Review OPP and OPR regarding data sources, transcription and data security; 5. Compare raw data from feedlots against data used in Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template for consistency; 6. Observe meter verification (calibration) reports during site tour.
Error Conditions	• Missing or incomplete data sets • Transcription errors • Uncontrolled access to Project data • Meter verification/calibration not completed according to manufacturer/engineering specification

D2 – Substantiating Evidence	
Introduction: During the Risk Assessment, the inherent and/or controls risk associated with the primary supporting evidence for specific components of the GHG Assertion was determined to be high enough to require additional substantiating evidence. The specific activities in this verification procedure are specifically customized to focus on substantiating evidence related to those specific components identified in the verification risk assessment.	
Type of Evidence	Analytical Procedures
Data Sources	Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template
Objective (specific principles)	*Accuracy, Conservativeness*
Specific Activities	1. Review shipping manifests to substantiate date of harvest, number of animals shipped and lot number for all animals in each shipment. All animals in the project should be accounted for on a shipping manifest. 2. Review feedlot close-out reports and compare against project data to determine that data integrity has been maintained between the feedlot systems and the project calculations.
Error Conditions	• Discrepancies between feedlot close-out reports and project data • Animals not accounted for on shipping manifests

Calculation

C1 – Appropriate and Consistent Calculation Methodology	
Introduction: The specific quantification methodology utilized in the Project must be clearly defined in the Offset Project Plan. This procedure is executed simultaneously with other procedures analyzing the methodology employed against the Protocol requirements. It specifically examines the quantification formulae and any estimation methodologies employed.	
Type of Evidence	Documentation
Data Sources	OPP and Supporting Data, Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template
Objective (specific principles)	*Consistency, Completeness, Accuracy, Transparency*
Specific Activities	1. Compare quantification formulae and estimation calculations prescribed by the Protocol against those described in the OPP; 2. Review the methodology actually employed by reviewing Project calculations and supporting data; 3. Compare emission factors used in calculations against reference documents cited in Protocol and OPP.
Error Conditions	• Deviation from the Protocol methodology that is not supported by the use of a contingent procedure or flexibility mechanism • Formula or methodology used in the emission reduction quantification that is not documented in the OPP • Inconsistent calculation methodologies between Baseline and Project Scenarios • Incorrect or unreferenced emission factors

C2 – Re-performance of Calculation	
Introduction: Calculation of the emission reductions claimed in the GHG Assertion includes several intermediate calculations. The re-performance of all calculations is a key verification procedure.	
Type of Evidence	Re-performance, Analytical Procedures, Inquiries of the Client
Data Sources	OPR, GHG Assertion and Supporting Calculation Documents, Project Data from Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template
Objective (specific principles)	*Accuracy, Conservativeness, Transparency*
Specific Activities	1. Re-performance of emission reduction claim from original data.
Error Conditions	• Calculation error including spreadsheet reference errors, and incorrect spreadsheet formula development • Inability to achieve same emission reduction quantity in GHG Assertion due to insufficient detail in underlying data • Incorrect application of significant figures; non-conservative rounding • Inaccurate or non-conservative estimation results

Assertion

A1 – Final GHG Assertion	
Introduction: This procedure is intended as a final review of the OPR to ensure all required information is complete. This procedure in intended to review the transfer of data from the Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template into the GHG Assertion.	
Type of Evidence	Documentation, Confirmation
Data Sources	GHG Assertion, OPR, Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template
Objective (specific principles)	*Completeness, Accuracy, Transparency, Conservativeness*
Specific Activities	1. Review GHG Assertion for consistency with language recommended in guidance documents; 2. Compare calculated values to those in the GHG Assertion for transcription accuracy; 3. Review asserted emission reduction shown in OPR and GHG Assertion compared to values calculated in the Failsafe Canada's Modified RAH Data Collection spreadsheet and Calculation Template.
Error Conditions	• Incomplete OPR and GHG Assertion • Language in GHG Assertion is inconsistent with language recommended in guidance documents • Annual totals do not match values calculated in Electronic Calculator

Appendix AD: NERP Best Practice Guide

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Best Practice Guide: The Preparation for and Verification of Nitrous Oxide Emissions Reductions (NERP) Projects at Reasonable Level of Assurance

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Prepared By:

The Prasino Group and

ICF International

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. It was produced according to the requirements in the Alberta Offset System's Nitrous Oxide Emissions Reductions in Agriculture Quantification Protocol v 1.1 April 2015. The views expressed in this report are not necessarily the views of the Climate Change Emissions Management (CCEMC) Corporation.

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1.0 Introduction

Greenhouse gas (GHG) quantification and verification is a relatively new process compared to more established systems like financial auditing or environmental management systems. Accreditation programs for GHG verifiers have emerged only in the last few years, and the requirements for verification are evolving in many GHG programs. As of January 1, 2012, Alberta moved to a reasonable level of assurance for Offset Projects and is updating protocols with more explicit guidance on the types and nature of evidence required to substantiate a claim to offset credits. The latest version of the Nitrous Oxide Emissions Reductions Protocol (NERP) is an example of the updated protocol format, with more explicit requirements for data, supporting documentation and records.

Given the current state of practice of GHG quantification and verification, and the ongoing evolution of the processes, procedures and requirements for such[14], the following needs for offset projects must be addressed in the short term:

1) Greater requirements for offset project's and project developer's data collection and management capabilities,
2) Quality control processes for data management systems and;
3) Supporting evidence used to compile the GHG claim – to enable the verifier to assess the completeness, accuracy, reliability, consistency, relevance, and transparency of the collected GHG data and information[15].

Further, verifiers will need to enhance their understanding of sufficient and appropriate evidence to support a GHG claim under the Nitrous Oxide Emissions Reductions Protocol (NERP) in order to produce more consistent verification outcomes.

The purpose of this Best Practice Guide is to provide parties involved in creating compliance-quality NERP Offset Credits (i.e. participating farmers, project developers and verifiers) with guidance on:

- GHG quantification considerations for agricultural offset projects/NERP projects
- General risks and data-related risks in NERP projects
- Data integrity and controls to manage risks in NERP projects
- Sufficient and appropriate evidence for NERP projects

The expected outcomes for those following this Best Practice Guide are:

- **Project Developers -** greater consistency in approach to GHG data and information quality controls and records management to support increased intensity of testing under reasonable level of assurance; and,
- **Verifiers –** Clarity for verifiers on the requirements for verifying NERP offset projects leading to greater consistency in verification of NERP offset claims in the Alberta Offset System.

[14] Alberta 's Technical Guide for Verification at Reasonable Level of Assurance was published in late 2013; and as a result, Alberta Environment and Parks is updating the GHG Offset Quantification Protocols to prepare the system for reasonable level of assurance.

[15] Alberta Environment and Parks, 2013. Technical Guidance for GHG Verification at Reasonable Level of Assurance.

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A companion document to this Best Practice Guide is the *Offset Data Management Principles for Agriculture* (DMP) document[16]. This document provides the principles and framework behind data management systems and illustrations of its application in an agricultural context. The purpose of the DMP document is to provide a high-level, principles-based approach to data management for the **data manager**[17].

The key questions proposed in the DMP document, and repeated here, can serve as a checklist for practitioners as they design and implement their data management systems for their fed cattle projects.

- Is there a **line of sight** between all **measurement** points and reporting?
- Is the data management system and its **controls** well documented?
- Are there sufficient controls at key risk areas in the data management system?
- Have the controls been designed appropriately?
- Does the data management system generate high quality evidence?
- Does the data management system and the associated controls appropriately manage risk along each line of sight taking into consideration the relative effect of the data on the assertion?
- Does the data management system also address changes to **static data**?
- Is there adequate **separation of duties** between different participants in the data management system?

2.0 Agricultural Offsets and Nitrous Oxide Emissions Reductions (NERP) Offsets

There are unique aspects to agricultural offset projects that need to be considered when quantifying and verifying GHG offset claims. Some aspects of agricultural offsets are generated from sources that are typically not metered (i.e. mechanically measured). As a result, some of the parameters do not have the associated certainty and reproducibility that well-calibrated mechanical systems can achieve. Their reliance on biological systems, with inherent complexity in measurement, and changing variables due to weather, disease and diversity in cropping production systems, has resulted in the development of scientifically vetted and accepted estimation procedures, based on international and country relevant standards[18], to manage complexity, cost and reproducibility. Uncertainty in agricultural protocols has been accounted for in the development of the quantification/estimation procedures and accepted by the regulator in Alberta.

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[16] Offset Data Management Principles for Agriculture; available at http:/XXXX

[17] A data manager is any person that is involved in measurement, storage, manipulation, reporting, management, and control of data. A data manager can be a farmer that takes inventory of seed or head count of a shipment, a P.Ag. who reviews crop records or beef scale data, an aggregator that conducts calculations, the senior management that reviews the annual data, etc.

[18] Intergovernmental Panel on Climate Change Guidance and Canada's National Emissions Inventory Report quantification methodologies.

In general terms, the approach to quantification in agricultural offset protocols is:

GHG Emissions = Agricultural Activity * Emission Factor

The emission factor equations derived through standardized measurement and modeling developed by the IPCC and further refined in Canada's National Emissions Inventory manages the risk of scientific uncertainty by accepting that measuring greenhouse gas emissions at farm operations is infeasible, and that standardized quantification within the protocol can be applied to farm data to conservatively estimate reductions between baseline and project condition. Thus, for agricultural projects, GHG data is a combination of farm activities/practices and in some cases performance data (e.g. yield of a crop).

For nitrous oxide emission reduction projects, the GHG data is manually or electronically recorded information for the farm activities on each eligible field (Figure AD-1). For example, this data may include crop mass, ecodistrict, nitrogen application rates, etc. This information is used to apply the emission factors and run the equations outlined in the protocol to calculate the emission reductions.

The GHG data found in farm records and used to calculate the emission reduction needs to be substantiated by evidence which could include third party records and physical evidence. The Nitrous Oxide Emissions Reductions Protocol provides specific requirements and additional guidance on the types of records and evidence that need to be collected to substantiate that the GHG data underlying the claim is accurate (See Section 5.0 of the protocol or Appendix A in this document).

At a reasonable level of assurance, project developers applying the Nitrous Oxide Emissions Reductions Protocol will be exposed to rigorous testing by verifiers of the following processes:

- The control environment - defined as the overall system of internal checks by project developers to ensure all claims are accurate and fully supportable by records;
- Due diligence on farm/field eligibility – defined as consistent and transparent procedures on the acceptance of farms/fields into the offset project; and,
- Data and record collection and management systems – defined as the framework developed for collecting, storing and retrieving farm/field specific records and calculations that support the claims made (Please see the Government of Alberta's "Technical Guidance for Greenhouse Gas Verification at Reasonable Level Assurance" for additional information)[19].

Project developers will be expected to establish, document and implement a quality assurance/quality control system to ensure that data integrity is maintained throughout the project and sufficient and appropriate records/evidence are documented to support the existence and accuracy of all eligible offset credit claims under the Nitrous Oxide Emissions Reductions Protocol. Further, the extent and nature of records collected to substantiate the GHG claim has increased under reasonable level of assurance as outlined in Appendix A. More guidance is offered in the next few sections.

At a high level, in order for a farm field to be eligible in a NERP project, it must meet a minimum set of data requirements (Figure AD-1) as defined in Section 5 of the NERP. These requirements can be used as part of a project developer's due diligence to screen eligibility of a farm field to participate in the offset project.

[19] http://environment.gov.ab.ca/info/library/8802.pdf

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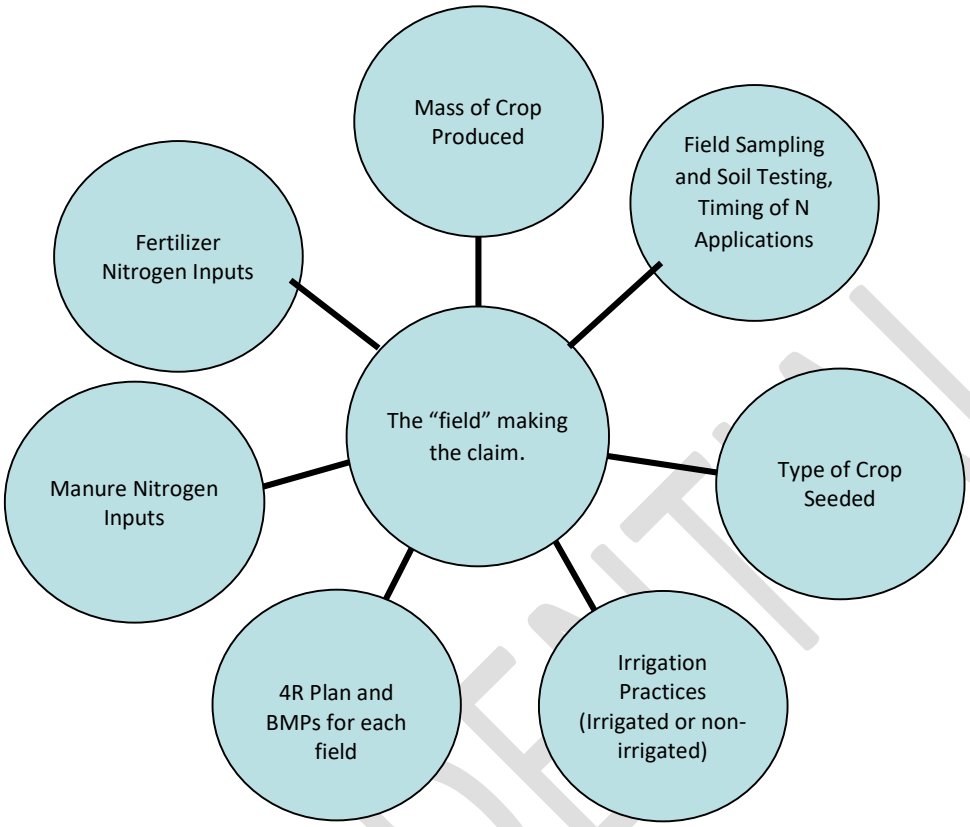


Figure AD- 1: Basic set of data requirements in order for a farmer's field to qualify under the Nitrous Oxide Emissions Reductions Protocol

3.0 Roles and Responsibilities

3.1 Overview

Several responsible parties are involved in the creation of NERP offsets (Figure AD-2). The process for developing, verifying and registering Nitrous Oxide Emission Reduction offsets is as follows:

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Undertake Eligible Farming Activities

- Farming activity is undertaken by a farmer which meets the eligible farming practices as defined by the Nitrous Oxide Emissions Reduction Protocol. Eligible farming practices include implementing a 4R Plan, including an integrated set of best management practices that were designed in consultation with an Accredited Professional Advisor and implemented at one of the three performance levels provided in the Nitrous Oxide Emissions Reductions Protocol.

Gathering Data

- Prior to the projects commencement, the project developer or their representative confirms with the farmer that they have developed a 4R Plan for implementation.
- The project developer or their representative visits the farm during the crop year to ensure that the farmer has detailed farm records to support the eligible farming practices. In addition, they will conduct a field investigation and collect supporting documentation and records from the farm operator regarding the crop, equipment and operating parameters for each field.
- The project developer gathers the data to support the GHG calculations (crop mass, , ecodistrict, nitrogen application rates, 4R Plan BMPs, irrigation practices) and the records that support the data, such as farm records, GPS data, AFSC records, crop advisor records, etc. for the cropping year (see Appendix A for further details).[20]
- The project developer reviews all of the supporting documentation for each individual offset claim to ensure it is eligible to be verified and registered as an offset credit in the Alberta Offset System. *Note: Claims that are ineligible due to a lack of supporting documentation must be excluded from the total offsets included in the project report.*
- The project developer enters the eligible offset credits into a data management system, quantifies the total offset credits and compiles an offset credit plan and report.
- The project developer engages an independent third party qualified to perform verification in the Alberta Offset System. *Note: Minimum requirements for verification qualifications are specified in the Specified Gas Emitters Regulation (SGER).*

Verification

- The verifier will request project data to develop a verification plan.
- The verifier may conduct site visits to a sample of farms enrolled in the project to interview farmers, evaluate data collection procedures and develop a general understanding of the project.
- The verifier will conduct verification procedures to confirm the evidence is sufficient and appropriate to support the GHG assertion at a reasonable level of assurance.
- The verifier will complete a verification statement and verification report that describes the verification findings.

[20] Note: The project developer should visit the farm for monitoring purposes during the crop year.

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Registration

- The project developer registers the verified offset credits with AEP.

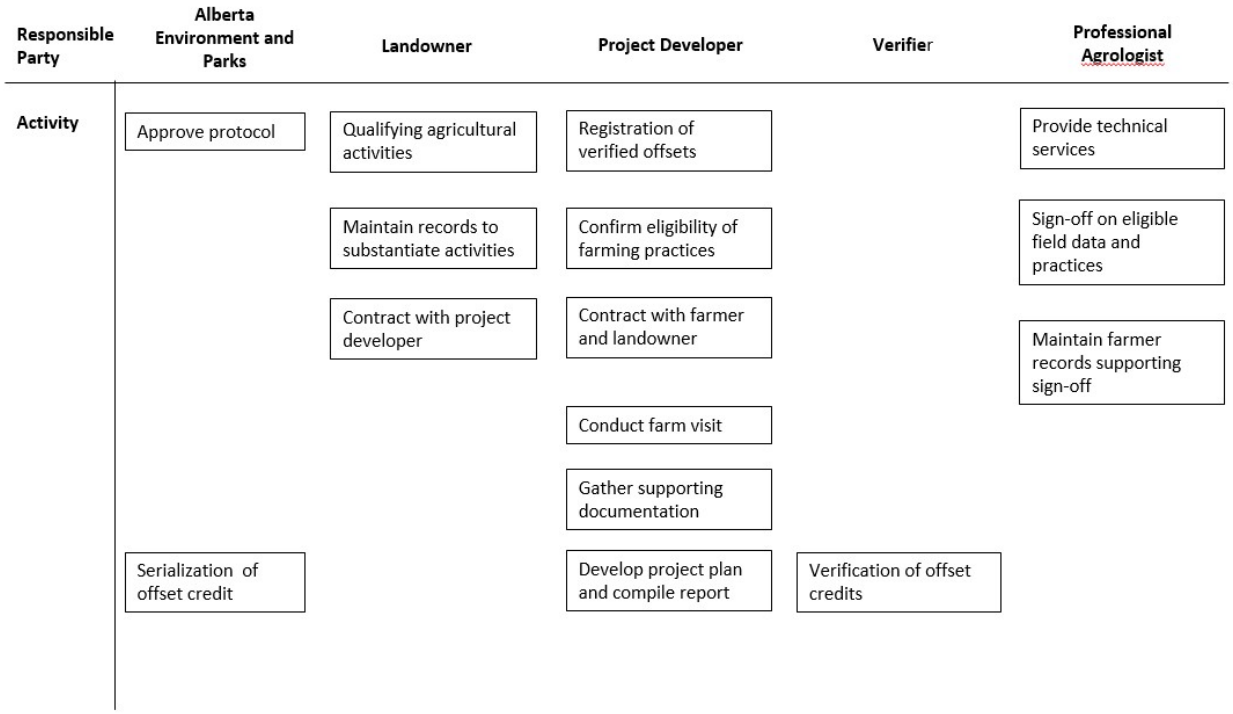


Figure AD- 2: Process for creating, aggregating, verifying and registering agricultural offset credits as it relates to each responsible party

3.2 Roles and Responsibilities

In agricultural offset projects, responsible parties involved in the development and verification of credible GHG offset claims include: AEP, farmers, landowners, Accredited Professional Advisors, project developers, professional agrologists and verifiers. The respective roles and responsibilities of each party are described below in Table AD-1. In some instances the farmer and the project developer may be the same individual.

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Table AD- 1: Roles and responsibilities and minimum documentation requirement for each responsible party

Responsible Party	Roles and Responsibilities	Minimum Documentation Requirement
AEP	• Approve protocols that identify the methodology for calculating offsets • Approve verification methodology • Ensure due diligence processes are followed for assessing and accepting verified offset project reports	• Approved protocols and related verification guidance
Farmer	• Farming practices performed in accordance with protocol requirements and 4R Plans • Rights to sell offset credits • Knowledge of farming practices	• Detailed field specific farm records • Signed offset credit agreement
Accredited Professional Advisor (APA)	• Review and sign-off on baseline calculations made by and the project developer • Design and sign-off on the 4R Plans • Sign-off that the 4R Plan was implemented	• Signed 4R Plans • Signed Form – example shown in Appendix D of the Protocol
Project developer*	• Ensure agreement is in place to sell offsets on behalf of farmer • Ensure 4R Plan in place, signed off by an APA • Inspect farm records and other supporting documentation • Inspect supporting documentation to confirm that the farming practices that occurred and the records of these practices meet the protocol requirements • Knowledge of farming practices • Calculate offset claims accurately • Establish a strong control environment • Maintain sufficient evidence to support claim	• Signed offset credit agreement • Land title certificate • Data collection records (may be used as a control at the discretion of the project developer) • Detailed listing of farming practices for each field included in offset claim by year • Process documentation relating to data management and record keeping for offset credits
Professional agrologist (if used)**	• May be used to provide technical services on project development or as a secondary source of corroborating evidence of eligible farm practices • Can work for farmer or project developer (if providing technical services)	• Signed-off statement regarding their opinion on eligible field data and practices (see Appendix A). • Records from farmer supporting the opinion, collected and maintained to support the professional opinion

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Responsible Party	Roles and Responsibilities	Minimum Documentation Requirement
	• If secondary source of corroborating evidence, they must sign-off on their opinion	
Verifier	• Determine whether the overall emission reduction is fairly stated (reasonable assurance) • Verification team will include a subject matter expert with expertise in agricultural nitrogen management practices	• All supporting documentation that is assigned to the project developer, landowner and farmer may be requested throughout the assurance engagement to provide support for the agricultural offset credit claim.

*Project Developer and their representatives

**The role of the professional agrologist is being developed under a Practice Standard by the Alberta Institute of Agrologists. See Appendix A for more information on the role of a P.Ag. during this transitory time.

Further information on the specific roles and responsibilities of project developers and verifiers is provided in the form of guidelines below.

3.3 Guidelines for Project Developers

The information below documents your roles and responsibilities in relation to gathering and managing agricultural NERP offset credit records and preparing the offset credit claim.

What is your role?

As a project developer, you are responsible for:

- Entering into offset credit agreements with the farmer;
- Ensuring that the farming activities and supporting records meet the protocol requirements for each individual offset claim included in your project report;
- Visiting multiple farms. At each farm, you will need to inspect all relevant farm records. You will ask questions about all farming practices and will inspect supporting documentation for the implementation of a 4R Plan;
- Working with the APA to ensure the 4R Consistent Plan is implemented on the farm and meets the requirements of the protocol;
- Gathering all supporting documentation to support the GHG calculations as outlined in the protocol; and,
- Ensuring the accuracy of the offset claim and supporting data.

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What to expect – Project Developers?

- You will need to establish contact with a farmer and confirm the eligibility of the farm for an offset credit under the protocol (Refer to Appendix A for eligibility criteria and supporting records). You will explain the terms of your offset credit agreement.
- Where applicable, you will be responsible for ensuring that your representative has sufficient knowledge and expertise to carry out their roles and responsibilities.[21]
- You will need to collect the completed inspection records (where applicable) and farm records that relate to all individual offset claims included in your project report (see Appendix A for a listing of appropriate supporting records).
- You will need to implement a system of checks to ensure the evidence that has been collected is sufficient and appropriate to support the claim.
- You will need to gather the data for farming practices (e.g. type of crop seeded, fertilizer nitrogen inputs, manure nitrogen inputs, etc. as outlined in the Protocol) and the records that support the data, such as crop advisor records, AFSC records, hail insurance records, manure management plans, seed purchase receipts, etc.
- You will need to review all of the evidence for each individual offset claim to ensure it is eligible to be verified and registered as an offset credit in the Alberta Offset System.
- You will need to maintain a data management system that contains all of the supporting documentation for all the offset credits included in your project report.
- You will need to quantify the total offset credits and compile an offset project plan and report.
- You will need to engage an independent third party qualified to perform verification in the Alberta Offset System. *Note: Minimum requirements for verification qualifications are outlined in the Specified Gas Emitters Regulation and a Technical Guidance Document to Verification found at http://environment.gov.ab.ca/info/library/8802.pdf.*
- You will need to register the verified offset credits with the Alberta Emissions Offset Registry at http://www.csaregistries.ca/albertacarbonregistries/home.cfm.
- You will need to establish, document and implement a quality assurance/ quality control system to ensure that data integrity is maintained throughout the project and to support the existence and accuracy of all eligible offset credit claims.

What is a farm record?

Records that the farmer uses to document the farming activities that occurred on a field or documents obtained from other parties such as rental agreements for leased land, insurance records, crop plans, custom seeding receipts and invoices for equipment purchases (see Appendix A for examples).

[21] The Project Developer should have written procedures for the inspection requirements as part of their process documentation. This is necessary to avoid mis-interpretation and inconsistencies between farm visits.

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How detailed do farm records need to be?

Farm records should clearly describe all relevant information. For nitrous oxide emissions reduction offsets, records of field activities should identify the field and each of the activities carried out on a field (e.g. type of crop seeded, types of fertilizer applications, water usage, etc. – see Appendix A) and the timing of the activities.

Farm records should be supported by relevant additional records, such as crop advisor records, fertilizer purchase receipts and custom application receipts. The farm records reviewed need to include at minimum the records specified in Section 5 of the Nitrous Oxide Emissions Reductions Protocol (further guidance is given in Appendix A of this document).

How long do all supporting documents need to be retained?

AEP requires that all documents relating to all verified offset credits that have been registered in the Alberta offset system be retained for seven years after the project crediting period (e.g., if you claimed offsets for employing the nitrous oxide emissions reductions protocol for the 2012 season and these were converted into offsets in 2013, records for the 2012 season would need to be kept until at least 2019).

What is a data management system (DMS)?

The DMS is the system used by the project developer to collect and manage the data. You will need to establish and document data management and record keeping procedures, identifying key controls over the records associated with the offset credits, to mitigate the key risks relevant to the Nitrous Oxide Emission Reductions project. For a simple project with limited data, this may be as simple as a brief description of the controls, a spreadsheet and paper files for the collected records. For more complex projects with a large amount of data, the data management system may be comprised of a well-documented description of the system and controls, including a custom built database with electronic copies of farm records.

In order to support third party verification and the potential supplemental government audit, you must put in place data management and record keeping procedures that at minimum meet the following requirements:

- All records must be kept in areas that are easily located;
- All records must be legible, dated and revised as needed;
- All records must be maintained in an orderly manner;
- All documents must be retained for seven years after the project crediting period, including raw data for the project (Required by AEP);
- Electronic and paper documentation are both satisfactory; and,
- Copies of records should be stored in two locations and backed up regularly to prevent loss of data.

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Do you need to share your records with others?

- As a project developer you will need to share the records and data supporting your offset project report with the verifier. This will also include access to any electronic database that you may use for managing the offset data.

What is your role in ensuring data quality?

In order to ensure that the underlying data supports the NERP offset claim, you must create a strong control environment to mitigate the risks associated with the offset claims. A strong control environment will ensure the existence and accuracy of all eligible agricultural offset credit claims. In designing the controls to be put in place, you should ensure that there is segregation of duties between the individual responsible for collecting and processing offset credit agreements and supporting data and the individual approving offset credit agreements and reviewing offset credit files for completeness of information. Recommended controls include, but are not limited to:

- Management review and approval of offset credit agreements;
- Management review of your representative's performance and records to determine consistency with your (project developer's) guidelines for undertaking farm data collection and due diligence;
- Management review of offset credit files for completeness of information prior to processing, particularly in relation to the quality of records supporting assertions;
- Management review of data entered into the database against farm records collected.
- Exception reports to identify duplicate records, incorrect emission factors, incorrect ecodistrict classification, data outside of the expected range (e.g. in relation to field size) etc.;
- Restricted user access to offset claim calculations;
- Maintaining a record of all changes to data and calculations in the database; and
- Management review of reported data to ensure it is consistent with underlying offset credit data.

In addition, Section 5.5 of the NERP Protocol mentions the following:

- Ensuring that the changes to operational procedures continue to function as planned and achieve greenhouse gas reductions;
- Ensuring that the measurement and calculation system and greenhouse gas reduction reporting remains in place and accurate;
- Checking the validity of all data before it is processed, including emission factors, static factors, and acquired data;
- Performing recalculations of quantification procedures to reduce the possibility of mathematical errors;
- Storing the data in its raw form so it can be retrieved for verification;
- Protecting records of data and documentation by keeping both a hard and soft copy of all documents;
- Recording and explaining any adjustment made to raw data in the associated report and files; and

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- A contingency plan for potential data loss.

What is your role during verification?

As project developer your initial role is to hire a verifier that has the breadth and depth of experience required to evaluate agricultural projects. It's your responsibility to ensure you have gathered sufficient and appropriate evidence, so that the verifier has an opportunity to sample field activities at the farm level. Failure to hire a verifier early enough in the cycle limits the types of tests a verifier may conduct as part of the verification and is likely to lead to a qualified report from the verifier which could preclude registration of the associated offsets.

During the verification, you will be required to provide the verifiers with documentation describing your data management system; your project plan and project report; and information supporting your offset claim. The verifiers will examine your project report; supporting records and data; and select a sample of the data to confirm claim related information. Based on the sample selected, best practice is for the verifier to visit individual farms and interview farmers. As project developer, you will be asked to facilitate the verification process by making any necessary contacts with the farmers. You may also be asked questions related to your knowledge of the farms and your data collection and quality control processes.

The overall cost efficiency of the verification process is significantly impacted by the extent of due diligence procedures implemented by the project developer, particularly in relation to due diligence over the types of activities carried out on individual fields. Where a broad set of due diligence procedures have been established, and the implementation and effectiveness of these procedures can be tested by the verifier, the amount of time required for the verification will be substantially reduced.

3.4 Guidelines for Verifiers

The process of verification is to independently provide an opinion on whether the GHG assertion is fairly stated in all material respects. Alberta Environment and Parks (AEP) have published a Technical Guide for Verification at Reasonable Level of Assurance[22]. The AEP Technical Guide is the primary resource for verifiers who are providing assurance services in the Alberta Offset System. For completeness sake, the following section for Verifiers is included in this Best Practice Guide.

22 http://environment.gov.ab.ca/info/library/8802.pdf

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What is your Role as a Verifier?

As a verifier, your role is to answer three basic questions:

1. Has the project been implemented in accordance with the requirements of the Offset System Quantification Protocol, AEP Guidance Documents, Specified Gas Emitters Regulation and Legislation as amended?

2. Are the asserted greenhouse gas reductions over the reporting period fairly stated in all material respects?

3. Does the project satisfy the eligibility criteria outlined in the Program Rules and Guidance for Project Developers?

What to Expect?

- You and your firm will have expertise in the ISO 14064-3 verification standard and any other additional standards your profession requires. Verifiers shall be a member of a registered profession (i.e. Chartered Accountants or Professional Engineers)[23].
- You have assembled a competent team to conduct the verification that may comprise:
    - A designated signing authority;
    - A lead verifier;
    - A peer reviewer; and
    - Technical subject matter experts.
- Your technical subject matter experts have an understanding of the operations and processes related to implementing a 4R Plan as well as an understanding of the effect of management/technologies used in these systems on greenhouse gas sources and sinks.
- Your firm has conducted an evaluation of independence, and is arm's length and impartial in your role as an assurance provider to the project developer and farmers. A conflict of interest statement has been completed and submitted.
- You and your team have conducted an initial assessment of the project's subject matter (project greenhouse gas, production and performance data), project developer's data management system and the extent of substantiating evidence and records to support the project; and deemed it is appropriate to proceed with the assurance engagement.
- You and your team will have designed verification procedures for the project's GHG assertion based on an initial planning exercise where you and your team go through a series of inquiries, observations and inspections of the project's operations, management practices, GHG data, data

[23] A CA or P.Eng. that meets the requirements of Section 18 of the Specified Gas Emitter's Regulation.

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management system, records and controls to determine inherent, control, and detection risk in the GHG assertion.

- Based on the risk assessment above, you will have developed a verification plan with associated verification procedures that will drive the data and evidence collection for the assurance engagement. A summary verification plan is shared with the Project Developer so they know what to expect. However, this plan does not require detail on specific samples as this could undermine the effectiveness of the tests conducted during verification if the project developer has the opportunity to treat the samples differently. The plan has a balance between controls reliance and substantive testing.
- You will need to develop a sampling plan, using structured types of sampling procedures, based on the nature of the evidence type and analysis being done.
- You and your team will need to understand the nature of the evidence being gathered and what constitutes sufficient and appropriate evidence against a GHG data point in the protocol.
- You will need to let the project developer know when you will be coming to their offices to execute the verification, ensuring both you and your team, as well as the project developer have sufficient staff and resources available to you.
- You and your firm will need to have a documented quality management system (QMS) in place including the following:
    - A quality manual demonstrating compliance to ISO 14064-3 standard and other standards as required by your profession, as applicable to verification activities; and documented procedures for implementing the QMS;
    - Record control procedures;
    - Independence procedures;
    - Preventative action procedures (potential non-compliance activities); and
    - Corrective action procedures (non-compliance activities)
- You and your team are aware of the mandatory procedures required by AEP in the Verification Guidance Document (Section 4.1.4.2 for Offset Projects) and have incorporated them into your Verification Plan.
- You will evaluate the evidence presented by the Project Developer, which will include documentation (minimum documentation requirements are described in Appendix A) and may also include observations made during the site visit, enquiry of the project developer and farmer, confirmations (information received directly from third-parties), re-performance of calculations and analytical procedures.
- You will come to a conclusion regarding the material correctness of the GHG assertion- following the materiality assessment guidance in the AEP's Verification Guide, compile that into a Verification Statement and Report, and submit to the Project Developer.

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Will I have to make site visits to the individual farms or operations?

You will need to visit the Project Developer's offices for physical inspections. Site visits must be conducted in accordance with the NERP and the Verification Guidance Document. The sampling of farm visits can be done on a risk basis. This procedure needs to be written up in the verification plan and verification report.

What if I think there are fraudulent activities going on regarding a GHG Assertion and Project by the Project Developer?

You are best advised to cease the verification, and seek legal counsel regarding the nature of the fraud. Depending on the legal counsel, you and your firm will need to decide whether to withdraw from the verification, or continue with the verification and notify AEP of the situation.

According to AEP's Verification Guidance Document - you are responsible to notify the Project Developer's senior management of the issues and intended course of action.

4.0 Identifying and Mitigating Risks in Developing and Verifying Nitrous Oxide Emissions Reductions Projects (NERP)

Identifying risks is the first step in designing risk assessment procedures and control measures to manage the risk of a misstatement of a GHG Offset claim. By documenting the risks, project developers can also help the verifier better understand the verification strategy needed to successfully verify NERP projects. By understanding the risks, verifiers can design applicable verification procedures to assess whether the GHG Assertion is fairly stated in all material respects.

To help guide project developers and verifiers in understanding risks in agricultural offset projects in general, and NERP projects in particular, a risk matrix has been prepared. Table AD-2 provides guidance on the key risk areas associated with NERP offsets, the evidence required to support the GHG claim and possible controls that could be put in place by the project developers to mitigate these risks.

Table AD- 2: Risks Associated with Nitrous Oxide Emissions Reductions Projects

#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
1	Project Developer does not have ownership of emissions reductions	Signed offset credit agreement between project developer and farmer that clearly states transfer of offset credits from farmer to project developer	Management review[24] and approval of offset credit agreements

[24] Management review refers to a manual review of the data to check for accuracy and completeness.

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#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
2	Farmer has already sold emission reduction rights on another registry or to another project developer	Signed offset credit agreement between project developer and farmer that clearly states farmer has not sold offset credits	Note: currently, there is no registry maintained by AEP and accessible to project developers that permits this risk from being mitigated (see recommendations)
3	Fields claimed that do not exist in province of Alberta	Legal land locations for each field/farm included in the offset credit agreement	Management review of offset credit files for completeness of information and confirmation of the location of the fields.
4	Data management system does not track required ownership, farming practices, etc.	Detailed listing of all fields/farms included in offset claim by year that links to information required to establish ownership, eligibility, specific farm practices and offset credits claimed	Management review of data transparency (i.e. Linkages are maintained both ways between base data and field specific offset claims)
5	Insufficient controls over stored data	Process documentation relating to data management and record keeping for offset credits Secondary data source and management processes for documenting any data validation processes and restricted access to project data	Restricted user access to offset claim calculations and data
6	Incorrect formulae for calculating emission reductions	Process documentation relating to data management and record keeping for offset credits	Exception reports to identify duplicate records, incorrect emission factors records with values outside of expected parameters
7	Discrepancies between reported amounts of offsets and data management system	Report of the total emission reductions from the data management system	Management review of reported data to ensure it is consistent with underlying offset credit data
8	Type of crop seeded is mis-represented	Supporting documentation for crop type (e.g. readings from seeding equipment, insurance records, seed purchase receipts, etc.)	Management review to check records are correct and correspond with claim
9	Crop masses are mis-represented	Supporting documentation for crop mass (e.g. yield monitors, weigh wagon records, bin counts, sales receipts, etc.)	Management review to check records are correct and correspond with claim

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#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
11	The 4R Plan was not properly followed and nitrogen application rates were understated	Supporting documentation for fertilizer application (e.g. readings from application equipment, insurance records, crop advisor records, custom application records, etc.) as well as a signed off 4R Plan	Management review to check records are correct and that the 4R plan was implemented as stated

4.1 Designing Controls

A strong control environment is essential to mitigating risks associated with NERP offset claims. Further, the presence of internal controls that are designed to prevent, detect and correct the potential for any misstatements in GHG quantification and claims is an important feature of the control environment. Properly designed controls in the Project Developer's system can mitigate the inherent risks of dealing with multiple farms, each with their own data and record systems, and data collection methods.

Internal controls are policies and procedures that are designed to ensure the GHG data is complete, accurate, valid and not subject to corruption (i.e. reliable). When designing controls, project developers need to consider segregation of duties between the individual responsible for collecting and processing offset credit agreements and supporting data; and the individual approving offset credit agreements and reviewing offset credit files for completeness of information.

Operationally, internal controls can include, but are not limited to, policy and procedures designed and implemented by the project developer in their data management system, such as:

- Front end assessments - a robust due diligence process that screens potential eligible farms/fields and accepts only those with sufficient GHG data and farm records/supporting documentation, according to the Nitrous Oxide Emissions Reductions Protocol to participate in the offset claim;
- Data input checks –performed on the data from the eligible farm that checks the detailed activities for each field are entered correctly from base records;
- Data reasonableness checks – checks over entered data that are designed to flag data outside of expected ranges, data entered in the wrong format, potential duplicate entries, ineligible combinations of activities etc. for management review;
- Data transformation checks – error checking during the process of collating, transferring, processing, calculating, estimating, aggregating or adjusting input data to detect deficiencies;
- Data output checks – on the distribution of the GHG information and accuracy of the GHG reporting to the GHG claim, to detect any discrepancies in GHG calculations;

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- Preventative/detective action procedures – implements risk assessment procedures, internal audits and reconciliation procedures[25] on data input, transformation and output processes to decrease project risk;
- Corrective action procedures – defines, in written procedures, steps to take to reconcile discrepancies discovered in the preventative/detective action system;
- Document control procedures – designed to ensure the most current documents, or those documents appropriate for the GHG offset vintages in question, are available for use in quantification and aggregation activities; and
- Records control procedures – designed to ensure that sufficient and appropriate records are available and readable when needed.

In addition, a number of other controls are recommended to ensure the underlying data supports the offset claim under the Nitrous Oxide Emissions Reductions Protocol. These include:

- Training of staff on the above procedures;
- Management review and approval of offset credit agreements;
- Farm inspection to ensure accuracy of farm records;
- Management review of field activities and equipment specifications to ensure they meet protocol requirements;
- Management review of offset credit files for completeness of information;
- Management review of reported data to ensure it is consistent with underlying offset credit data;
- Exception reports to identify duplicate records, incorrect emission factors, etc.; and
- Restricted user access to offset claim data and calculations.

5.0 Sufficient and Appropriate Evidence for Nitrous Oxide Emission Reductions Projects

Project developers need to collect quality evidence to support the GHG claim. *Sufficient* evidence answers the question of whether enough evidence has been gathered (quantity). *Appropriate* evidence answers questions of how reliable and relevant the evidence is (quality). Section 5.2.1 in the Nitrous Oxide Emissions Reduction Protocol (Appendix A) explicitly lists the minimum types of records that need to be collected and retained, indicating sufficient evidence for each data requirement. However, the issue of what constitutes appropriate evidence is more problematic and subject to interpretation, leading to potential inconsistency in verification opinions. One aspect of appropriate evidence is reliability, the other is how relevant the evidence is to support the particular data point in the protocol - it's important to ensure

[25] Reconciliation procedures detect anomalies in the data by cross-checking GHG data with project sources and other sources of data (e.g. land titles check against farm details)

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both are taken into consideration. In agricultural offset projects, the reliability of the evidence depends on the nature and source of the evidence.

The second aspect of appropriate evidence - relevancy of the evidence to support the protocol data requirement – requires technical knowledge regarding the sufficiency of the evidence to support the data point in the protocol. For example, a project developer will likely have gathered several pieces of evidence in their file for a particular farm. The relevance of the source of evidence for the particular data point needs to be understood by the verifier. Project developers need to specify why the sources of evidence are relevant for a particular data point and verifiers need to understand the characteristics of the evidence sources in order to judge appropriate evidence correctly. Since the protocol defines the types of evidence acceptable to prove eligibility or substantiate the quantification, the Project Developer needs to produce evidence that meets Protocol requirements.

A list of sufficient and appropriate evidence for each data requirement in the Nitrous Oxide Emissions Reductions Protocol is given in Appendix A, with an emphasis on primary and corroborating evidence.

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Appendix AD-A: Evidence Required for a Nitrous Oxide Emissions Reductions Project

The tables in this Appendix describe the data and documentation required to substantiate project, farm and field level eligibility. The tables also describe the data required to quantify the emission reduction and the supporting documentation required to substantiate the project data. For many aspects of the project, farm records will be the source of data, which must be substantiated with additional documentation (i.e. both the farm record and the supporting documentation are required).

The abbreviation AFSC refers to the Agriculture Financial Services Corporation, while the abbreviation CWB refers to the Canadian Wheat Board. APA refers to the Accredited Professional Advisor.

General Record Requirements

Requirement	Records	Why it is Required
Ownership of the farm fields being claimed in the project	Land title certificate for each field being claimed in the project for the first year the field is included; If ownership has changed, a new land title certificate must be obtained; AND If the project developer leases land for implementation of the project, one of the following: • Annual signed written lease agreements; or • Carbon transfer agreement's between land owner(s) and the project developer.	To confirm land ownership

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Requirement	Records	Why it is Required
Confirmation of annual farm enterprise boundary by the accredited professional advisor	Measurement of farm enterprise boundary size using imagery such as satellite data or aerial photos or country maps; Annual check of additions or removals of land title certificates under the farm enterprise boundary; AND Annual check of additions or removals of land lease agreements between the farm enterprise and other parties.	To confirm the entire farm enterprise is included in the offset project. To confirm that new lands added to the farm enterprise boundary are recorded and appropriately handled according to protocol requirements.
Location of the farm enterprise included in project	Legal land location(s) (Alberta Township System and GPS coordinates) of the entire farm enterprise boundary; AND EcoDistrict location(s) within the farm enterprise boundary, determined using the tool provided by Alberta Agriculture and Forestry	Entire farm enterprise boundary must be included in the project EcoDistrict locations required for emission reductions accounting
Use of irrigation if applicable	Supporting documentation for water usage on the field by farm operator including two of the following: • Water use records; • Photo evidence with GPS time stamp showing equipment used including model information; • Air photo or satellite imagery showing pivots; • Alberta irrigation program documents; • Detailed farm maps showing coverage of irrigation networks over project fields including type and model numbers for equipment being used; OR	Irrigation impacts N_2O emissions from agricultural soils. Irrigation status required to properly calculate project emission reductions

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Requirement	Records	Why it is Required
	Sign off by the accredited professional advisor who reviewed and collected supporting documentation that confirms the irrigation practice; AND Copy of supporting documentation reviewed by accredited professional advisor.	
Accredited professional advisor credentials	Confirmation that the accredited professional advisor has successfully completed the 4R accredited professional advisory training program provided by the Canadian Fertilizer Institute; Proof of accredited professional advisor's registration as a member of the Alberta Institute of Agrologists; AND Confirmation from the AIA that the accredited professional advisor meets the requirements of the practice standard for the greenhouse gas assessment and management practice area.	To ensure that the accredited professional advisor has training and credentials required under the protocol

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Baseline Record Requirements

Requirement	Records	Why it is Required
Types of crops grown in the three years used to establish the baseline	Farm records indicating the crop type grown for each field in the project; AND One of the following: • AFSC records, hail insurance records by field; • Signed records from a crop advisor that show the type of crop grown by field; or • Seed purchase receipts	To establish the crop types in the baseline and project
Crop mass (by crop) grown for each of the three years used to establish the baseline	Selection of an acceptable crop mass determination method, as provided by the protocol in Appendix I; and Supporting documentation to accompany the selected acceptable crop mass determination, as described in Table 12	For GHG quantification
Mass of nitrogen fertilizer applied by crop type across the full farm in each of the three years used for the baseline	Invoices showing quantify and composition of fertilizer purchased; AND One of the following: • Farm log of fertilizer application masses and dates by field; or • Custom application receipts indicating fertilizer mass and application dates.	For purposes of preparing the 4R Plan; total mass of nitrogen for GHG quantification

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Requirement	Records	Why it is Required
Quantity, composition and application date of manure applied by field for each year in the baseline	Manure management plans including either manure analysis or referenced manure nutrient values as outlined in section 5.1.2 of the protocol; AND One of the following: • Farm records indicating the manure applied by field; or • Feedlot records or custom application records indicating the manure applied by field	For GHG quantification
Baseline calculation records	Set of baseline calculations signed off by project developer and accredited professional advisor; AND Any supporting documentation required to support baseline calculations; AND If non-consecutive years are chosen for development of conventional baseline for a crop (and the crop was grown in un-used years), trend data on extreme weather events to demonstrate how the year is excluded will be required.	Project verification

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Project Record Requirements

Requirement	Records	Why it is Required
Locations of 4R management zones (fields/sub-fields) enrolled in the project	EcoDistrict location of each field/management zone determined using the tool provided by Alberta Agriculture and Forestry; AND Both of the following: • Legal land location (Alberta Township System and GPS coordinates) of each management zone; and • Location of each 4R management zone using satellite data or aerial photos	Key input to 4R plan to ensure the fields/subfields are in the same EcoDistrict
Crop type grown for each management zone	Farm records indicating the crop type grown for each management zone in the project (including indication of fields that were under perennial production or summerfallow for that cropping year); AND One of the following: • AFSC records, hail insurance records; or • Signed accredited professional advisor records of field observations for each field in the project. The accredited professional advisor must have reviewed and collected supporting farm records that confirm the types of crops/field activities for that year. These records must be maintained in a format that is readily available for verifiers to inspect.	Key input to 4R plan establish that the crop is grown in the project year

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Requirement	Records	Why it is Required
4R practices by management zone	4R plan signed by accredited professional advisor showing performance level BMPs applied to all management units • 4R plan detailing source BMPs by management zone, including the composition of fertilizers applied; and • 4R plan detailing rate BMP by management zone, based on annual soil testing and nutrient application recommendations; and • 4R plan detailing place BMP by management zone, including % band concentration calculations; and • 4R plan detailing time BMP by management zone, including fertilizer application dates.	To confirm that the proper reduction modifier is being applied in GHG emission reduction calculations. Ensure the proper BMPs are implemented in each performance level
Available nitrogen	Accredited professional advisor sign off on records outlining soil sampling methodology, sampling dates, sample handling, and location from which samples were collected. This information must be specific to 4R management zones. Soil sampling and nitrogen rate recommendations must be made at the intensity described below: • Annual soil testing for each field at the basic 4R implementation level; or • Annual soil testing required for each management zone at the intermediate 4R implementation level; or • Annual soil testing required for each sub-field management zone at the advanced 4R implementation level; AND Annual nitrogen balance calculation on each 4R management zone signed by accredited professional advisor; AND	Key input to 4R plan

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Requirement	Records	Why it is Required
	If soil testing cannot be completed for a given year (this is allowed a maximum of once in a crediting period for each farm), the following information is required: • Description of extreme soil or climatic soil conditions preventing soil sampling (weather trend data, time stamped photos of soil surface, etc.); and • Description of alternate tools used to develop fertilizer recommendations without soil sampling data.	
Quantity, composition and application date of nitrogen fertilizer applied by crop type included in the project	4R plan indicating the recommended quantity and composition of fertilizer for each management zone in the project, based on soil sampling, assessment of nitrogen from manure soil amendments in the previous year, and field conditions in the previous year (e.g., crop residue from a hail event); AND Invoices showing quantity and composition of fertilizer purchased; AND One of the following: • Farm log of fertilizer application dates by management zone (including manure); or • Custom application receipts indicating fertilizer application dates	Assess conformance to the 4R plan Total mass of nitrogen is used for GHG quantification

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Requirement	Records	Why it is Required
Soil temperature readings	In cases where fall nitrogen application occurs according to the 4R plan, the following records are required: • Soil temperature readings (at a depth of five centimetres or deeper) showing three consecutive days where the soil is less than 10^{O} Celsius; AND • Sign off from the accredited professional advisor that the fertilizer application occurred in accordance to the 4R plan and protocol requirements	To ensure that fall soil applications occur according to requirements of the protocol
Fertilizer placement equipment	Annual provision of date stamped photos of fertilizer spreading equipment and openers; AND Accredited professional advisor analysis of available nitrogen from crop residue from the previous year; AND One of the following: • Width of fertilizer openers and spacing to determine the per cent band concentration; or • Invoices or a letter from custom fertilizer application that indicates the type of opener and row spacing for each field	Assess conformance to the 4R plan as outline in Section 5.1.2 of the protocol

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Requirement	Records	Why it is Required
Quantity, composition and application date of manure applied by field	Manure management plans including either manure analysis or referenced manure nutrient values as outlined in section 5.1.2 of the protocol; AND One of the following: • Farm records indicating the manure applied by field; or • Feedlot records or custom application records indicating the manure applied by field; and • Laboratory analysis results determining manure nutrient content.	Assess conformance to the 4R plan total mass of nitrogen is used for GHG quantification
Crop mass by crop type, dry matter basis (for each EcoDistrict and 4R performance level)	Estimation of crop yield at the field level, which is used for evaluating the 4R plan (not used for GHG quantification); AND Selection of acceptable crop mass determination method used for GHG quantification; AND Supporting documentation according to the selected crop mass determination method in Appendix I of the protocol	Field level monitoring is used for evaluating the 4R plan Crop mass is used for GHG quantification
Additional supporting farm records	Farm records noting any extraordinary situations, such as remaining crop residue related to crop damage from hail, flooding, pest infestations, etc., AND Farm records indicating which fields were under	To support proof of 4R plan implementation or describe variances from the 4R plan

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Requirement	Records	Why it is Required
	summerfallow or other types of management preventing eligibility under the protocol (e.g. use of ineligible crops or fertilizer sources).	
Confirmation that 4R plan was conformed to by the farm operator	Annual sign off from the accredited professional advisor that the 4R plan was conformed to, including fields under summerfallow; AND Description of situations where 4R was not conformed to and why.	Implementation sign off by accredited professional advisor
Additional field passes	Accredited professional advisor analysis of additional equipment passes required per 4R management unit as a result of implementation of the 4R plan; AND Method A: Documented Fuel Use Method • Sale receipts including specification of fuel type; and Fuel logs and/or equipment use logs indicating date and fuel usage associated with additional passes Method B: Additional Pass Method • Area and location (supported with aerial photos or satellite data) of 4R management units receiving additional passes	Emissions associated with fuel usage from additional passes part of overall project emissions reductions claims

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Crop Mass Determination Record Requirements

Requirement	Records	Why it is Required
Mobile weighing devices	Calibration report demonstrating that equipment has been calibrated to manufacturer specifications, by a qualified third party, prior to harvest; AND A weight log of each load shall be maintained; AND Moisture determination result from each load in a moisture log	To determine crop mass on a dry matter basis for mass-based GHG reduction calculations
Fixed scale	Calibration report demonstrating that equipment has been calibrated to manufacturer specifications, by a qualified third party, prior to harvest; AND A weight log of each load shall be maintained; AND Moisture determination result from each load in a moisture log.	To determine crop mass on a dry matter basis for mass-based GHG reduction calculations

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Requirement	Records	Why it is Required
Commercial-scale certified by Industry Canada with accompanying scale tickets (i.e. elevator or grain processors)	Copy of method and calculations used to calculate bin volume measurements; AND A third party sign off will be made available reporting the bin is empty and recorded in a bin log before harvest (accredited professional advisor or their representative check); this must include photo, time stamped evidence; AND Bin moisture log for each load that enters the bin	To determine crop mass on a dry matter basis for mass-based GHG reduction calculations

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Appendix AE: Fed Cattle Best Practice Guide

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Best Practice Guide: The Preparation for and Verification of Fed Cattle Projects at Reasonable Level of Assurance

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June 12, 2015

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Disclaimer

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1.0 Introduction

Greenhouse gas (GHG) quantification and verification is a relatively new process compared to more established systems like financial accounting or environmental management systems. Accreditation programs for GHG verifiers have emerged only in the last few years, and the requirements for verification are evolving in many programs. Alberta has moved to a reasonable level of assurance for Offset Projects, as of January 1, 2012, and is updating protocols with more explicit guidance on the types and nature of evidence required to substantiate a claim to offset credits. The latest version of the Reducing Greenhouse Gas Emissions of Fed Cattle Protocol is an example of an updated protocol with more explicit requirements.

Given the current state of practice of GHG quantification and verification, and the ongoing evolution of the processes, procedures and requirements for such[26], the following needs for offset projects must be addressed in the short term:

1) Greater requirements for offset projects and project developer's measurement capabilities,
2) Quality control processes for data management systems and;
3) Supporting evidence used to compile the GHG claim – to enable the verifier to assess the completeness, accuracy, reliability, consistency, relevance, and transparency of the collected GHG data and information[27].

Further, verifiers will need to enhance their understanding of sufficient and appropriate evidence to support a GHG claim under the Reducing Greenhouse Gas Emissions of Fed Cattle Protocol in order to produce more consistent verification outcomes.

The purpose of this Best Practice Guide is to provide parties involved in creating compliance-quality Fed Cattle Offset Credits (i.e. participating feedlot operators, project developers/field agents and verifiers) with guidance on:

- GHG quantification considerations of Fed Cattle projects
- General risks and data-related risks in Fed Cattle projects
- Data integrity and controls to manage risks in Fed Cattle projects
- Sufficient and appropriate evidence for Fed Cattle projects.

The expected outcomes for those following this Best Practice Guide are:

- **Project Developers -** greater consistency in approach to GHG data and information quality controls and records management to support analytical testing under reasonable level of assurance; and,
- **Verifiers –** Clarity for verifiers on the requirements for verifying Fed Cattle offset projects leading to greater consistency in verification of Fed Cattle offset claims in the Alberta Offset System.

A companion document to this Best Practice Guide is the *Offset Data Management Principles for Agriculture* (DMP) document. This document provides the principles and framework behind data

[26] See Alberta's Technical Guide for GHG Verification at Reasonable Level of Assurance at http://environment.gov.ab.ca/info/library/8802.pdf.
[27] Technical Guidance for GHG Verification at Reasonable Level of Assurance (2013).

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management systems and illustrations of its application in an agricultural context. The purpose of the DMP document is to provide a high-level, principles-based approach to data management for the **data manager**[28].

The key questions proposed in the DMP document, and repeated here, can serve as a checklist for practitioners as they design and implement their data management systems for their fed cattle projects.

- Is there a **line of sight** between all **measurement** points and reporting?
- Is the data management system and its **controls** well documented?
- Are there sufficient controls at key risk areas in the data management system?
- Have the controls been designed appropriately?
- Does the data management system generate high quality evidence?
- Does the data management system and the associated controls appropriately manage risk along each line of sight taking into consideration the relative effect of the data on the assertion?
- Does the data management system also address changes to **static data**?
- Is there adequate **separation of duties** between different participants in the data management system?

2.0 Agricultural Livestock Offsets and Reducing Greenhouse Gas Emissions of Fed Cattle Offsets

There are unique aspects to agricultural livestock offset projects that need to be considered when quantifying and verifying GHG offset claims. Some aspects of agricultural livestock offsets are generated from sources (i.e. animals in feedlots, or manure handling and storage) that are typically not metered (i.e. mechanically measured). As a result, some of the parameters do not have the associated certainty and reproducibility that well-calibrated mechanical systems can achieve. Their reliance on biological systems, with inherent complexity in measurement, and changing variables due to disease, feeding practices and genetic diversity have resulted in the development of scientifically vetted and accepted estimation procedures, based on international and country relevant standards[29], to manage complexity, cost and reproducibility. Uncertainty in agricultural livestock protocols has been accounted for in the development of the quantification/estimation procedures and accepted by the regulator in Alberta.

In general terms, the approach to quantification in agricultural livestock offset protocols is:

GHG Emissions = Agricultural Activity * Emission Factor/Empirical Equations

The emission factor/empirical equations derived through standardized measurement and modeling developed by the IPCC and further refined in Canada's National Emissions Inventory manages the risk of inaccuracy by accepting that actually measuring greenhouse gas emissions at livestock operations is

[28] A data manager is any person that is involved in measurement, storage, manipulation, reporting, management, and control of data. A data manager can be a farmer that takes inventory of seed or head count of a shipment, a P.Ag. who reviews crop records or beef scale data, an aggregator that conducts calculations, the senior management that reviews the annual data, etc.

[29] Intergovernmental Panel on Climate Change Guidance and Canada's National Emissions Inventory Report quantification methodologies.

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infeasible, and that standardized quantification within the protocol can be applied to feedlot data to estimate reductions between baseline and project condition. Thus, for agricultural livestock projects, GHG data is a combination of feedlot feeding activities, manure management practices and animal performance data (e.g. kg of beef production etc.).

For Reducing Greenhouse Gas Emissions of Fed Cattle projects, the GHG data are manually or electronically recorded information gathered by feedlot operators in each animal grouping - such as number of days on feed, dry matter intake, diet composition, feed additives, management strategies or technologies employed, incoming and outgoing average weights, average daily gain etc. - that are used in the empirical formulas along with a series of emission factors (e.g. for storage emissions, enteric emissions, management systems, etc.) to run the equations outlined in the protocol.

The GHG data used in the calculations needs to be substantiated by evidence – a combination of feedlot records, third party records and physical evidence gathered by the project developer to support the GHG claim. The Reduced Carbon Intensity of Fed Cattle Protocol provides specific requirements and additional guidance on the types of records and evidence that need to be collected to substantiate that the GHG data underlying the claim is accurate (Appendix A).

At a reasonable level of assurance, project developers applying the Reduced Carbon Intensity of Fed Cattle Protocol will be exposed to rigorous testing by verifiers of the following processes:

- The control environment - defined as the overall system of internal checks by project developers to ensure all claims are accurate and fully supportable by records;
- Due diligence on feedlot eligibility – defined as consistent and transparent procedures on the acceptance of feedlots into the offset project; and,
- Data and record collection and management systems – defined as the framework developed for collecting, storing and retrieving feedlot specific records and calculations that support the claims made.

Project developers will be expected to establish, document and implement a quality assurance/quality control system to ensure that data integrity is maintained throughout the project and sufficient and appropriate records/evidence are documented to support the existence and accuracy of all eligible offset credit claims under the Reduced Carbon Intensity of Fed Cattle Protocol. Further, it is expected that the extent and nature of records collected to substantiate the GHG claim will increase as outlined in Appendix A. More guidance is offered in the next few sections.

At a high level, in order for a feedlot to be eligible in a Fed Cattle Project, it must meet a minimum set of requirements (Figure AE-1). These requirements can be used as part of a project developer's due diligence to screen eligibility of a feedlot to participate in the offset project.

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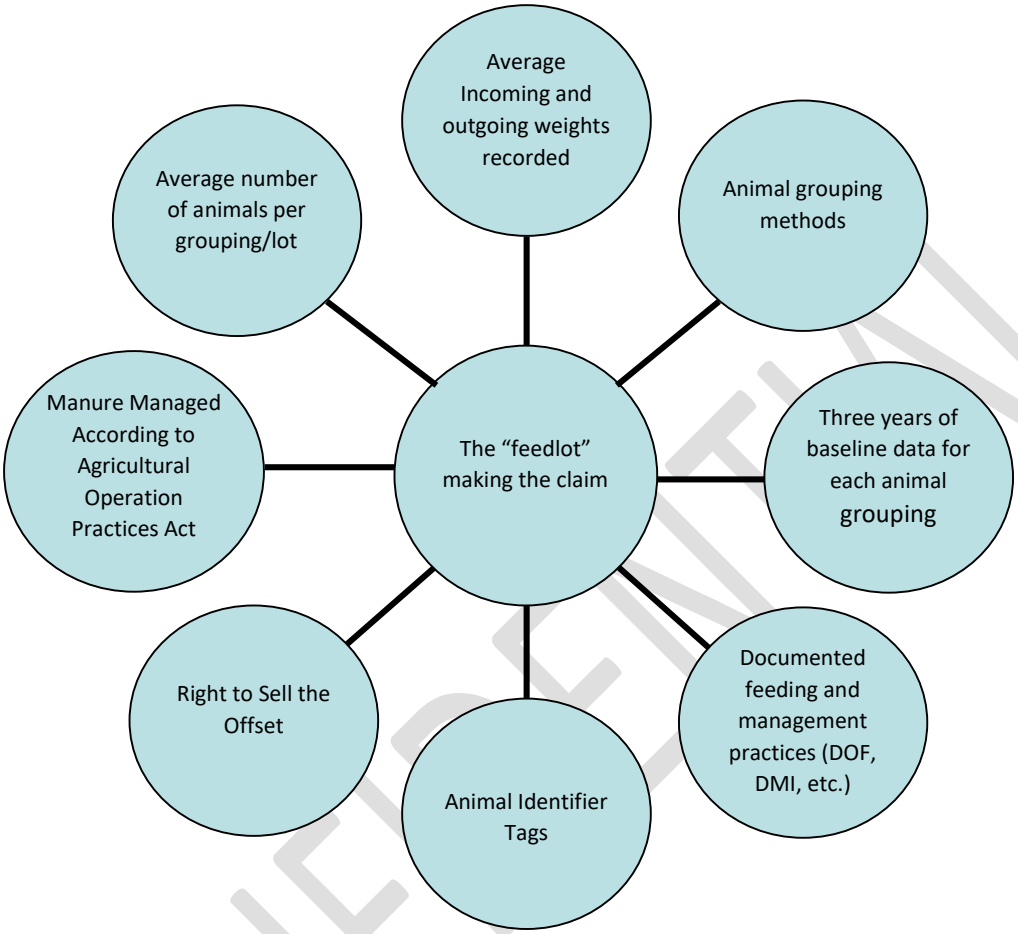


Figure AE- 1: Basic set of data requirements in order for a farmer's field to qualify under the Reducing GHG Emissions in Fed Cattle Protocol. Many of these data requirements will rely on the animal head*days calculations as required by the protocol

3.0 Roles and Responsibilities

3.1 Overview

The process for developing, verifying and registering Fed Cattle offsets is as follows:

Undertake Eligible Feedlot Activities

- Farming activity is undertaken by a feedlot operator which meets the eligible practices as defined by the Fed Cattle Protocol. A combination of strategies can be employed in the protocol to demonstrate a reduced carbon intensity of beef production in the project – these include alterations in feed formulation, use of feeding technologies (beta agonists, etc.), individual animal performance tracking, selection of more efficient animals and others. The protocol does not prescribe any single practice because it is recognized that feeding strategies can change over time, and innovations occur over time

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as well. What's important is the reduction in carbon intensity when comparing baseline and project animals.

Gathering Data

- The project developer contracts with the feedlot operator who has implemented innovations in the feedlot to access the feed and performance data for GHG quantification to determine the carbon intensity of the baseline (3 year average) and project year data (see Appendix A for eligibility requirements).
- The project developer visits the feedlot to ensure that the feedlot operator has the data required to support the innovative practices, including, for example, feedlot ration and nutrient analysis sheets and to gain a sense of the feedlot's data management system and controls. The project developer's observations are documented in an inspection record.
- The project developer gathers the data to support the GHG calculations (animal inventory and performance data) and the records that support the data, such as cattle agreements, and feedlot practices (e.g. existence of manure management records, feedlot ration and nutrient analysis sheets, third party animal performance data etc.). Furthermore, supporting data for cattle inventory will be gathered (e.g. number and weight of animals being fed, number of days on feed, average dry matter intake, etc.).
- The project developer reviews all of the supporting documentation for each individual offset claim to ensure it is eligible to be verified and registered as an offset credit in the Alberta Offset System. *Note: Claims that are ineligible due to a lack of supporting documentation must be excluded from the total offsets included in the project report.*
- The project developer enters the eligible offset credits into a data management system, quantifies the total offset credits and compiles an offset credit plan and report.
- The project developer engages an independent third party qualified to perform verification in the Alberta Offset System. *Note: Minimum requirements for verification qualifications are specified in the Specified Gas Emitters Regulation (SGER).*

Verification

- The verifier performs procedures over the offset project report at a reasonable level of assurance.
- The verifier will request project data to develop a verification plan
- The Verifier will conduct site visits to the feedlots enrolled in the project to observe data collection procedures and develop a general understanding of the project
- The verifier will conduct verification procedures to evaluate the evidence that supports the GHG Assertion at a reasonable level of assurance.
- The verifier will complete a verification statement and verification report that describes the verification findings

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Registration

- The project developer registers the verified offset credits.

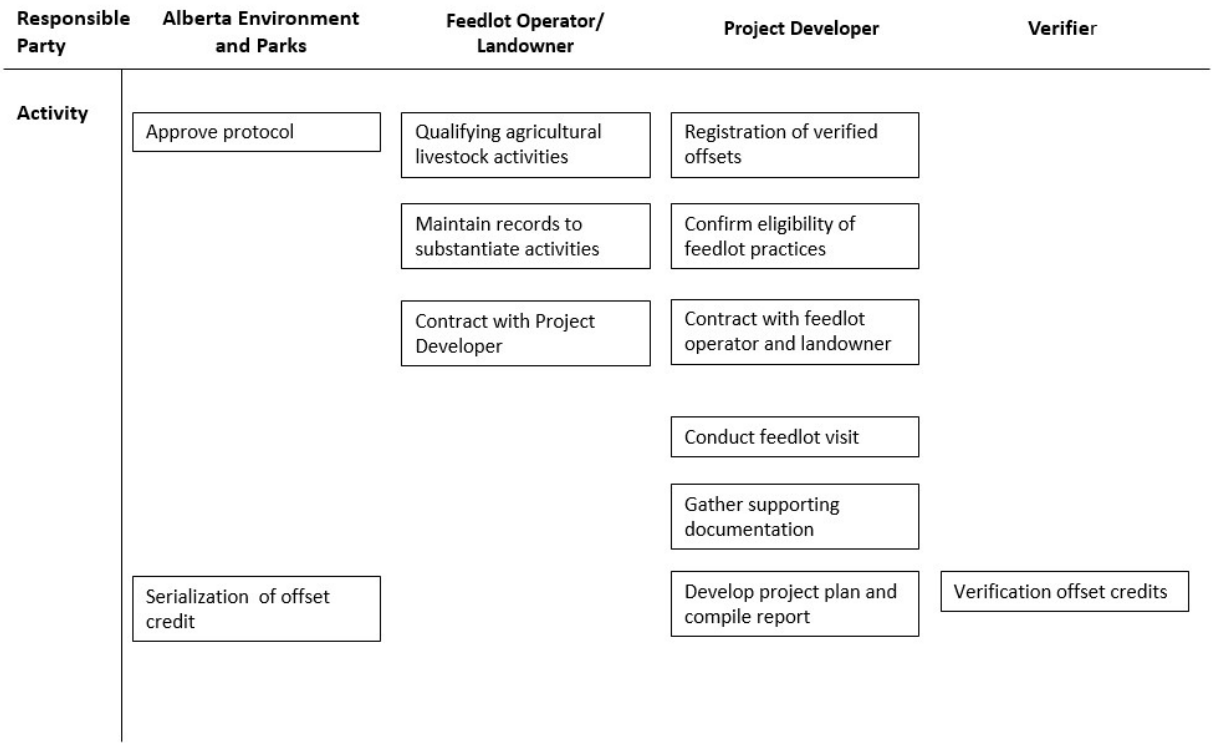


Figure AE- 2: Process for creating, aggregating, verifying and registering agricultural offset credits as it relates to each responsible party

3.2 Roles and Responsibilities

In the agricultural livestock offset credit system, there are six responsible parties involved in the development and verification of an offset project report ready for verification- Alberta Environment and Parks, feedlot operators, landowners, field agents, project developers and verifiers. The respective roles and responsibilities of each party are described below in Table AE-1. While there are six responsible parties, in some instances the feedlot operator and the project developer may be the same individual. Similarly, the field agent and project developer may be the same individual. Thus, there are multiple scenarios for the number of responsible individuals.

Table AE- 1: Roles and responsibilities and minimum documentation requirement for each responsible party

Responsible Party	Roles and Responsibilities	Minimum Documentation Requirement
Alberta Environment and Parks	• Approved protocols in place that identify the methodology for calculating offsets • Approved verification methodology in place • Due diligence processes in place for assessing and accepting verified offset project reports	• Approved protocols and related verification guidance
Feedlot Operator	• Feedlot practices performed in accordance with protocol requirements	• Detailed feedlot animal inventory and production performance records (i.e. lot closeout data) , required details can be found in Appendix A.
Project Developer/Field Agents	• Agreement to sell offsets on behalf of feedlot operator • Inspection of supporting documentation to confirm that the feedlot practices that occurred and the records of these practices meet the protocol requirements • Knowledge of feedlot practices • Calculate offset claims accurately • Establish a strong control environment • Maintain sufficient evidence to support claim	• Signed offset credit agreement • Land title certificate • Inspection records (may be used as a control at the discretion of the project developer) • Detailed listing of feedlot practices for each field included in offset claim by year • Process documentation relating to data management and record keeping for offset credits
Verifier	• Determine whether the overall emission reduction is fairly stated (reasonable assurance) • Team will consist of key agents as identified in the Guide to Verification • Subject matter expert part of team with knowledge of feedlot operations in Alberta	• All supporting documentation that is assigned to the project developer, field agent, landowner and feedlot operator may be requested throughout the assurance engagement to provide support for the agricultural livestock offset credit claim.
P.Ag/D.V.M[30]	• Provides expert opinion and sign-off as outlined in Appendix A of	• All supporting documentation related to ration sheets; review of statistical calculation on

[30] A Doctor of Veterinary Medicine (D.V.M.) or a professional agrologist with qualifications as a consulting nutritionist. The Alberta Institute of Agrologists can be contacted to determine whether a P.Ag. is a member in good standing with the Institute and has self-declared they are competent to practice nutritional consulting (http://www.albertaagrologists.ca). The Alberta Veterinary Medical Association can be contacted to determine the D.V.M is a member in good standing with the Association (http://www.abvma.ca).

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Responsible Party	Roles and Responsibilities	Minimum Documentation Requirement
	this document and Section 5 of the protocol.	generalized diets; animal groupings; animal head*days method for confirming averaged daily dry matter intake and days on feed for animal groupings.

Further information on the specific roles and responsibilities of field agents, project developers and verifiers is provided in the form of guidelines below.

3.3 Guidelines for Project Developers/ Field Agents

This section documents your roles and responsibilities in relation to gathering and managing agricultural Fed Cattle offset credit records and preparing the offset credit claim.

What is your role?

As a project developer/field agent, you are responsible for:

- Entering into offset credit agreements with the feedlot operator (in the case where you are not a feedlot operator, rather a project developer);
- Ensuring that the feedlot activities meet the protocol requirements for each individual offset claim included in your project report;
- Visiting (you or your field agent) multiple feedlots. At each feedlot, you will need to inspect all relevant farm records. You will ask questions about all feedlot practices and will inspect supporting documentation for the animal inventory and performance data.
- Documenting, if a field agent, all of your findings in an inspection record (see below for details regarding documentation requirements) and provide the project developer with your completed inspection record and other supporting documentation that may be requested to support the feedlot operators offset claim (see Appendix A);
- Gathering all supporting documentation to support the GHG calculations as outlined in the protocol; and,
- Ensuring the accuracy of the offset claim and supporting data.

What to expect – Project Developers?

- You will need to establish contact with a feedlot operator and confirm the eligibility of the feedlot for an offset credit under the protocol (Refer to Appendix A for eligibility criteria). You will explain the terms of your offset credit agreement.
- If using field agents, you will need to assign the field agent responsibility to either an employee or contractor. You will be responsible for ensuring that the field agent has sufficient knowledge and expertise to carry out their roles and responsibilities and providing direction to the agent on your inspection requirements.

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- You will need to collect the completed inspection records and farm records that relate to all individual offset claims included in your project report.
- You will need to gather the data for legal land location, GHG calculations (e.g. animal inventory and performance data, ration sheets and nutrient analysis for animal groupings as outlined in the Protocol) and the records that support the data, such as cattle agreements, feeding strategies and other information.
- You will need to review all of the supporting documentation for each individual offset claim to ensure it is eligible to be verified and registered as an offset credit in the Alberta Offset System. *Note: Feedlots that are ineligible due to a lack of supporting documentation must be excluded from the total offsets included in your project report.*
- You will need to maintain a data management system that contains all of the relevant supporting documentation for all the offset credits included in your project report.
- You will need to quantify the total offset credits and compile an offset credit plan and report.
- You will need to engage an independent third party qualified to perform verification in the Alberta Offset System. *Note: Minimum requirements for verification qualifications are specified in the Specified Gas Emitters Regulation and a Technical Guidance Document to Verification found at http://environment.gov.ab.ca/info/library/8802.pdf*.
- You will need to register the verified offset credits with the Alberta Emissions Offset Registry at *http://www.csaregistries.ca/albertacarbonregistries/home.cfm*.
- You will need to establish, document and implement a quality assurance/ quality control system to ensure that data integrity is maintained throughout the project and to support the existence and accuracy of all eligible offset credit claims.

What is a farm record?

- Records that the feedlot operator uses to document the farming activities that occurred in the feedlot or documents obtained from other parties such as ration formulation and nutrient analysis sheets, animal performance data, animal inventory data, animal identifier tags and others (See Appendix A).

How detailed do farm records need to be?

- Farm records should clearly describe the relevant information. For reducing the days on feed of beef cattle, records will include animal ID tag numbers, methods for establishing animal groupings, number in production and feeding management practices, existence of a manure management plan and others. The farm records reviewed need to include at minimum the records specified in the protocol.

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What is an inspection record?

- Records that document the feedlot visit including the details of the inspection of any feedlot practices including relevant documentation reviewed.

What data needs to be collected during a feedlot visit?

- The project developer/field agent must refer to Sections 4 and 5 in the protocol that describe data and farm records needed to be collected during a feedlot visit. At a minimum you will need to collect data and farm records related to feeding, cattle inventory and performance data (usually in the form of feedlot close out data for lots).

How long do farm records and inspection records need to be retained?

- AEP requires that all documents relating to all verified offset credits that have been registered in the Alberta offset system must be retained for 7 years after the project crediting period (e.g., if you claimed offsets for employing the protocol for the 2011 season and these were converted into offsets in 2014, records for the 2011 season would need to be kept until at least 2019).

Do you need to share your records with others?

- As a field agent, you will need to share the results of your inspection with the project developer. The project developer will need to see all records related to the practices occurring on the feedlot and will likely need to take copies of these documents. You will also be required to share this information with the verifier during a verification of the offset claim.
- As a project developer you will need to share the records and data supporting your offset project report with the verifier. This will also include access to any electronic database that you may use for managing the offset data.

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What is your role during verification?

- As project developer your initial role is to hire a verifier with appropriate verification experience in relation to agricultural projects. During the verification, you will be required to provide the verifiers with documentation describing your data management system, your project plan and project report and supporting records that substantiate your offset claim. The verifiers will examine your project report and supporting records and data and select a sample of the data to confirm claim related information. Based on the sample selected, the verifier may need to visit individual feedlots and interview feedlot operators, or field agents. As project developer, you will be asked to facilitate the verification process by making any necessary contacts with the feedlot operators or field agents. You may also be asked questions related to your knowledge of the feedlots and your data collection and quality control processes.
- During the verification, the verifier will select a sample of feedlots and lot/pens to confirm claim related information. In addition, the verifier may select a sample of field agents to interview about the data collection process. Therefore, if you are selected, you will be notified by the project developer and arrangements made to meet with you. You may be asked questions related to your knowledge of specific feedlots, including feeding practices, and farm records, and how you collected the feedlot data.

What is a data management system (DMS)?

The DMS is the system used by the project developer to collect and manage the data. You will need to establish and document data management and record keeping procedures, identifying key controls over the records associated with the offset credits, to mitigate the key risks relevant to the Reduced Days on Feed project. For a simple project with limited data, this may be as simple as a brief description of the controls, a spreadsheet and paper files for the collected records. For more complex projects with a large amount of data, the data management system may be comprised of a well-documented description of the system and controls, including a custom built database with electronic copies of farm records.

In order to support third party verification and the potential supplemental government audit, you must put in place data management and record keeping procedures that at minimum meets the following requirements:

- All records must be kept in areas that are easily located;
- All records must be legible, dated and revised as needed;
- All records must be maintained in an orderly manner;
- All documents must be retained for 7 years after the project crediting period, including raw data for the project (Required by AESRD);
- Electronic and paper documentation are both satisfactory; and,
- Copies of records should be stored in two locations and backed up regularly to prevent loss of data.

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What is the Project Developers role in ensuring data quality?

In order to ensure that the underlying data supports the Fed Cattle offset claim, you must create a strong control environment to mitigate the risks associated with Fed Cattle offset claims. A strong control environment will ensure the existence and accuracy of all eligible agricultural offset credit claims. In designing the controls to be put in place, you should ensure that there is segregation of duties between the individual responsible for collecting and processing offset credit agreements and supporting data and the individual approving offset credit agreements and reviewing offset credit files for completeness of information. Recommended controls include, but are not limited to:

- Management review and approval of offset credit agreements;
- Feedlot inspection to ensure accuracy of farm records;
- Management review of feedlot activities to ensure they meet protocol requirements;
- Management review of offset credit files for completeness of information prior to processing, particularly in relation to the quality of records supporting assertions;
- Management review of data entered into the database against feedlot records collected.
- Exception reports to identify duplicate records, incorrect emission factors, etc.;
- Restricted user access to offset claim calculations;
- Maintaining a record of all changes to data and calculations in the database; and
- Management review of reported data to ensure it is consistent with underlying offset credit data.

In addition, Section 5.5 of the Fed Cattle Protocol mentions the following:

- Ensuring that the changes to operational procedures continue to function as planned and achieve greenhouse gas reductions;
- Ensuring that the measurement and calculation system and greenhouse gas reduction reporting remains in place and accurate;
- Checking the validity of all data before it is processed, including emission factors, static factors, and acquired data;
- Performing recalculations of quantification procedures to reduce the possibility of mathematical errors;
- Storing the data in its raw form so it can be retrieved for verification;
- Protecting records of data and documentation by keeping both a hard and soft copy of all documents;
- Recording and explaining any adjustment made to raw data in the associated report and files; and
- A contingency plan for potential data loss.

3.4 Guidelines for Verifiers

The process of verification is to independently arrive at the same calculation as the project GHG assertion. Alberta Environment and Parks (AEP) have published a Technical Guide for Verification at Reasonable Level of Assurance[31]. The AEP Technical Guide is the primary resource for verifiers who are providing

[31] http://environment.gov.ab.ca/info/library/8802.pdf

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assurance services in the Alberta Offset System. For completeness sake, this section for Verifiers is included in this Best Practice Guide.

What is your Role as a Verifier?

As a verifier, your role is to answer three basic questions:

1. Has the project been implemented in accordance with the requirements of the Offset System Quantification Protocol, AEP Guidance Documents, Specified Gas Emitters Regulation and Legislation as amended?
2. Are the asserted greenhouse gas reductions over the reporting period fairly stated in all material respects?
3. Does the project satisfy the eligibility criteria outlined in the Program Rules and Guidance for Project Developers?

What to Expect?

- You and your firm will have expertise in the ISO 14064-3 verification standard and any other additional standards your profession requires. Verifiers shall be a member of a registered profession in Alberta (i.e. Chartered Accountants or Professional Engineers)[32].
- You have assembled a competent team to conduct the verification comprising:
    - A designated signing authority;
    - A lead verifier;
    - A peer reviewer; and
    - Technical subject matter experts.
- Your technical subject matter experts have an understanding of the operations and processes related to beef feeding operations as well as an understanding of the effect of management/technologies used in these systems on greenhouse gas sources and sinks.
- Your firm has conducted an evaluation of independence, and is arm's length and impartial in your role as an assurance provided to the project developer. At the end of the verification, a conflict of interest statement has been completed and submitted to the project developer and kept on file.
- You and your team have conducted an initial assessment of the project's subject matter (project greenhouse gas, production and performance data) as well as project developer's data management system and the extent of substantiating evidence and records to support the project and deemed it is appropriate to proceed with the assurance engagement.
- You and your team will have designed verification procedures for the project's GHG assertion based on conducting an initial planning exercise where you and your team have gone through a series of inquiries, observations and inspections of the project's operations, management practices, GHG data, data management system, records and controls to determine inherent, control, and detection risk in the GHG assertion.
- Based on the risk assessment above, you will have developed a verification plan with associated verification procedures that will drive the data and evidence collection for the assurance engagement. A boiled-down version of the verification plan is shared with the Project Developer so they know what to expect, but contains minimal detail so as not to bias the outcome of the verification. The plan has a balance between controls reliance and substantive testing.

[32] A CA or P.Eng. that meet the requirements of Section 18 of the Specified Gas Emitter's Regulation.

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- You will need to develop a sampling plan, using structured types of sampling procedures, based on the nature of the evidence type and analysis being done.
- You and your team will need to understand the nature of the evidence being gathered and what constitutes sufficient and appropriate evidence against a GHG data point in the protocol.
- You will need to let the project developer know when you will be coming to their offices to execute the verification, ensuring both you and your team, as well as the project developer have sufficient staff and resources available to you.
- You and your firm will need to have a documented quality management system (QMS) in place including the following:
    - A quality manual demonstrating compliance to ISO 14064-3 standard and other standards as required by your profession, as applicable to verification activities; and documented procedures for implementing the QMS;
    - Record control procedures;
    - Independence procedures;
    - Preventative action procedures (potential non-compliance activities)
    - Corrective action procedures (non-compliance activities)
- You and your team are aware of the mandatory procedures required by AEP in the Verification Guidance Document (Section 4.1.4.2 for Offset Projects) and have incorporated them into your Verification Plan.
- You will evaluate the evidence presented by the Project Developer, which will include documentation (minimum documentation requirements are described in Appendix A) and may also include observations made during the site visit, enquiry of the project developer and feedlot operator, confirmations (information received directly from third-parties), re-performance of calculations and analytical procedures.
- You will come to a conclusion regarding the material correctness of the GHG assertion- following the materiality assessment guidance in the AEP's Verification Guide, compile that into a Verification Statement and Report, and submit to the Project Developer.

Will I have to make site visits to the individual farms or operations?

You will need to visit the Project Developer's offices for physical inspections, as well as visit a number of feedlots to conduct the verification. The sampling of feedlots can be done on a risk basis. The procedure for determining the sample of feedlots to be visited needs to be documented in the verification plan and verification report.

What if I think there are fraudulent activities going on regarding a GHG Assertion and Project?

You are best advised to cease the verification, and seek legal counsel regarding the nature of the fraud. Depending on the legal counsel, you and your firm will need to decide whether to withdraw from the verification, or continue with the verification and notify AEP of the situation.

According to AEP's Verification Guidance Document - you are responsible to notify the Project Developer's senior management of the issues and intended course of action.

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4.0 Identifying and Mitigating Risks in Developing and Verifying Fed Cattle Projects

Identifying risks is the first step in designing risk assessment procedures and can help in the design and implementation of control measures to manage the risk of a misstatement of a GHG Offset claim. Documenting the risks can also help the verifier better understand the verification strategy needed to successfully verify Fed Cattle projects.

Unlike cropping projects, agricultural livestock offset projects tend to have less inherent risk because of the reliance on electronically recorded data at the feedlot level. The need to aggregate several feedlot operations together poses risks related to inconsistency of data collected and record keeping procedures.

To help guide project developers and verifiers in understanding risks in agricultural livestock offset projects in general, and Fed Cattle projects in particular, a risk matrix has been prepared. Table AE-2 provides guidance on the key risk areas associated with Fed Cattle offsets, the evidence required to support the GHG claim and possible controls that could be put in place by the project developers to mitigate these risks.

Table AE- 2: Risks Associated with Fed Cattle Projects

#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
1	Project Developer does not have assigned rights to emission reductions by the feedlot operator	Signed offset credit agreement that clearly states relationship between project developer and feedlot operator in respect to offset credits and feedlot practices	Management review and approval of offset credit agreements
2	Feedlot operator has already sold emission reduction rights on another registry or to another project developer	Signed offset credit agreement between project developer and feedlot operator that clearly states feedlot operator has no sold offset credits previously under the protocol	Management review of current Fed Cattle projects listed on the Alberta Registry
3	Feedlots claimed that do not exist in province of Alberta	Land title certificate for each feedlot included in the offset credits agreement	Management review of offset credit files for completeness of information
4	Data management system does not track required ownership, feedlot practices, etc.	Detailed listing of all feedlots included in offset claim by year that links to information required to establish ownership, eligibility, specific feedlot practices and offset credit claimed	Management review of data transparency (ie. Linkages are maintained both ways between base data and feedlot specific offset claims)

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#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
5	Insufficient controls over stored data	Process documentation relating to data management and record keeping for offset credits Secondary data source and "management processes for documenting any data validation processes and restricted access to project data	Restricted user access to offset claim calculations and data For feedlot data management systems, comparison with a secondary source of information. For example, animal weights are measured and recorded by the feedlot operator. The weights provided by the processing plant provide a secondary source of data for comparison. Although the weights are not expected to be an exact match, they should be within the same range
6	Incorrect formulae for calculating emission reductions	Process documentation relating to data management and record keeping for offset credits	Exception reports to identify duplicate records, incorrect emission factors records with values outside of expected parameters
7	Discrepancies between reported amounts of offsets and data management system	Process documentation relating to GHG calculations data management and record keeping for offset credits	Management review of reported data to ensure it is consistent with underlying offset credit data
8	The animals in the feeding/commercial agreements cannot be tracked and may not have been fed in the feedlot in question	Feedlot or third party records showing unique tag numbers for each animal. Lost tags must be removed from the project or the tag retired and a replacement issued.	Management review of files for completeness of information
8	The animals in the feedlot may not have had identifier tags	Feedlot or third party records showing unique tag numbers for each animal. Lost tags must be removed from the project or the tag retired and a replacement issued.	Management review of files for completeness of information

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#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
9	Animal groups are inconsistent between baseline and project	Documented method used to group cattle in the baseline and project	Management review of internal processes for grouping animals are consistent with documented method
10	The composition of each diet or classes of diet is unknown or unclear	Date stamped feedlot ration and nutrient analysis sheets that show diet ingredients on a dry matter basis Feedlot records that substantiate the approved diet fed to each pen	Review of diet records by qualified and recognized professionals to ensure it meets protocol requirements Management review of diet formulations and dry matter delivered to each pen
11	Manure management practices are inconsistent between baseline and project	Documentation showing that a permit from the Natural Resource Conservation Board (NRCB) is in place and no major changes in manure management have occurred	Management review of records to ensure permit exists

4.1 Designing Controls

A strong control environment is essential to mitigating risks associated with Fed Cattle offset claims. Further, the presence of internal controls that are designed to prevent, detect and correct the potential for any misstatements in GHG quantification and claims is an important feature of the control environment. Properly designed controls in the Project Developer's system can mitigate the inherent risks of dealing with multiple feedlots, each with their own data and record systems, and data collection methods.

Internal controls are policies and procedures that are designed to ensure the GHG data is complete, accurate, valid and not subject to corruption (i.e. reliable). When designing controls, project developers need to consider segregation of duties between the individual responsible for collecting and processing offset credit agreements and supporting data and the individual approving offset credit agreements and reviewing offset credit files for completeness of information.

Operationally, internal controls can include, but are not limited to, policy and procedures designed and implemented by the project developer in their data management system, such as:

- Front end assessments - a robust due diligence process that screens potential eligible feedlots and accepts only those with sufficient GHG data and farm records/supporting documentation, according to the Fed Cattle Protocol to participate in the offset claim;
- Data Input checks –performed on the data from the eligible feedlot that check the detailed activities for each animal grouping, are entered correctly from base records.

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- Data Reasonableness checks – checks over entered data that are designed to flag data outside of expected ranges, data entered in the wrong format, potential duplicate entries, ineligible combinations of activities etc. for management review.
- Data Transformation checks – error checking during the process of collating, transferring, processing, calculating, estimating, aggregating or adjusting input data to detect deficiencies.
- Data output checks – on the distribution of the GHG information and accuracy of the GHG reporting to the GHG claim, to detect any discrepancies in GHG calculations.
- Preventative/detective action procedures – implements risk assessment procedures, internal audits and reconciliation procedures[33] on data input, transformation and output processes to decrease project risk.
- Corrective action procedures – defines, in written procedures, steps to take to reconcile discrepancies discovered in the preventative/detective action system.
- Document control procedures – designed to ensure the most current documents, or those documents appropriate for the GHG offset vintages in question are available for use in quantification and aggregation activities.
- Records control procedures – designed to ensure that sufficient and appropriate records are available and readable when needed.

In addition, a number of other controls are recommended to ensure the underlying data supports the Offset claim under the Reducing Days on Feed in Beef Cattle Protocol. These include:

- Training of staff and field agents on the above procedures;
- Management review and approval of offset credit agreements;
- Feedlot inspection to ensure accuracy of farm records;
- Management review of offset credit files for completeness of information;
- Management review of reported data to ensure it is consistent with underlying offset credit data;
- Exception reports to identify duplicate records, incorrect emission factors, etc.; and
- Restricted user access to offset claim data and calculations.

For more fulsome guidance on underlying principles behind how data management systems are designed for integrity, as well concepts such as **data flow**, controls, supporting infrastructure, and how they are interconnected, please refer to the *Offset Data Management Principles for Agriculture,* referenced in the Introduction to this Guide.

5.0 Sufficient and Appropriate Evidence for Fed Cattle Projects

Project developers need to collect quality evidence to support the GHG claim. *Sufficient* evidence answers the question of whether enough evidence has been gathered (quantity). *Appropriate* evidence answers

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questions of how reliable and relevant the evidence is (quality). Table 7 in the Fed Cattle Protocol (Appendix A) explicitly lists the types and number of records that need to be collected and retained, indicating sufficient evidence for each data requirement. However, the issue of what constitutes appropriate evidence is more problematic and subject to interpretation, leading to potential inconsistency in verification opinions. One aspect of appropriate evidence is reliability, the other is how relevant the evidence is to support the particular data point in the protocol - it's important to ensure both are taken into consideration.

In agricultural livestock offset projects, the reliability of the evidence depends on the nature and source of the evidence. Table AE-3 provides guidance on a general hierarchy of evidence for agricultural livestock offset projects. This hierarchy can be used by project developers to assess reliability of the evidence needed to be collected and is largely reflected in the Table 7 of the Fed Cattle Protocol (Appendix A).

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Table AE- 3: General Hierarchy of Evidence

Evidence Strength	Source of Evidence	Key Characteristics	Examples of Evidence
Strongest ↑	Third party documentation given by third party directly to the verifier	External evidence is more reliable than internal evidence Evidence for commercial transactions - multiple parties with consideration (money/commodity) relying on the data	Google Earth accessed directly by verifier OR Statement of credentials and training of the Accredited Professional Advisor
	Third party documentation given by project developer to the verifier	Written responses received directly by the verifier from third parties normally provide evidence that is more reliable than that provided by other sources	Confirmation of harvest from the processing plant for beef cattle OR Land title certificates
	Internally generated documentation by the project developer with corroborating information	Corroborating information obtained from a source independent of the entity may increase the assurance the verifier obtains from evidence that is generated internally.	Farm records which show farming practices backed up by farm inspections e.g. animal weights measured with calibrated scales at the feedlot
	Internally generated documentation by the project developer without corroborating information	Corroborating information obtained from a source independent of the entity may increase the assurance the verifier obtains from evidence that is generated internally.	Farm records which show farming practices if the verifier can determine there is acceptable uncertainty in the measurement and acceptable data integrity in the recording and reporting of the data
Weakest	Affirmation	Documentary evidence is more reliable than oral evidence	Farmer/feedlot operator affirmation on farming practices

The second aspect of appropriate evidence - relevancy of the evidence to support the protocol data requirement – requires technical knowledge regarding the sufficiency of the evidence to support the data point in the protocol. For example, a project developer will likely have gathered several pieces of evidence in their file for a particular feedlot. The relevance of the source of evidence for the particular data point needs to be understood by the verifier. Project developers need to specify why the sources of evidence are relevant for a particular data point and verifiers need to understand the characteristics of the evidence

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sources in order to judge appropriate evidence correctly. Since the protocol defines the types of evidence acceptable to prove eligibility or substantiate the quantification, the Project Developer needs to produce evidence that meets Protocol requirements. The Verifier will determine if the evidence is reliable and relevant (i.e. appropriate to meet Protocol requirements).

A list of sufficient and appropriate evidence for each data requirement in the Fed Cattle Protocol is given in Appendix B, with an emphasis on primary and corroborating evidence.

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Appendix AE-A – Minimum Data Requirements for a Fed Cattle Project

Data Requirement	Minimum Records Needed	Why the Records are Required
Animal Inventory		
Animal Identifier Tags	▪ Feedlot records or third party records showing unique tag numbers for each animal recorded in animal inventory databases; and ▪ Feedlot records showing animals with lost tags were either removed from the project or the lost tag was retired and a replacement tag registered with that individual animal.	To ensure the animals in feeding/ commercial agreements are fed in the feedlot in question and can be tracked, if necessary, in and out of the feedlot and dead animals are confirmed as removed from the project.
Animal Groupings	▪ Documented procedures by the feedlot for methods used to sort and group animals to manage their production and performance. OR ▪ Documented procedures by the project developer, if using flexibility mechanism number one in Section 1.3 above, that show the animal grouping procedures for GHG calculations for baseline and project conditions.	The methods used to define an animal grouping (e.g lots or pens based on sex, age, weight, breed, or quality grid programs) must be similar between project and baseline conditions to ensure the offset calculations are valid and functionally equivalent.
Number in Production - for animal groupings – entry and exit numbers	▪ Feedlot inventory records (e.g. close-out data) that show the average number of animals in each grouping, taking into account animal entry and exit movements from the grouping; this is a weighted average approach using the animal head*days factor; and ▪ Feedlot records or shipping manifests or packing plant receipts that show the lots exited the feedlot destined for a packing plant. OR ▪ Third party managed data for production and performance, documenting weighted averages per animal grouping and shipping manifests to a packing plant or receipts	To ensure an accurate average number of head per animal grouping for offset calculation purposes and as evidence animals were being finished for market purposes and, so, being shipped to packing plants (i.e. not being backgrounded in the feedlot).

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Data Requirement	Minimum Records Needed	Why the Records are Required
	from a packing plant; with sign-off by an authorized signatory of the third party agency.	
Incoming and Outgoing Weights	▪ Feedlot records, date stamped, showing average incoming and outgoing weights for animal groupings; and ▪ Associated weigh scale tickets from a licensed scale at the feedlot per animal grouping; and Feedlot records or third party managed data showing corrected carcass weights for the animal groupings on an outgoing basis.	Animal groupings will be sorted by weight classes within gender and animal type (e.g. fall calves, yearlings, winter calves, etc.), thus the weights will need to be known. GHG reductions are calculated according to animal groupings and on a kilogram of live weight or kilogram of carcass weight basis, so an adjustment for production equivalency between baseline and project conditions will need to be made in accordance with the protocol.
Feeding Management		
Number of Days on Feed	Feedlot records or third-party-managed data, date stamped, that show the average number of days a group of animals spent on diets while in the feedlot; and if only feedlot records exist (i.e., no third-party-managed data): ▪ Sign-off by a P.Ag. or D.V.M who reviewed and collected supporting farm records that confirm the number of days on feed for each diet for baseline and project conditions.[34]	Required to calculate the enteric- and manure-based GHG emissions from feed intake of a particular diet for a particular period of time.

[34] Note – it is acceptable to streamline implementation of a project according to Flexibility Provision No. 3, in Section 1.3 of the protocol. In this case, the project developer can treat the entire time the cattle are in the feedlot as though they were on a > or equal to 85% concentrate diet. Ensure conservativeness, the 4 percent emission factor for methane emissions, needs to be applied in both the baseline and project conditions. The project developer must justify to the verifier how the required diet ingredients are statistically representative for the animals in the feedlot in question for both baseline and project conditions.

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Data Requirement	Minimum Records Needed	Why the Records are Required
Composition of Each Diet or Classes of Diet	▪ Feedlot ration and nutrient analysis sheets, date stamped, that show the diet ingredients on a dry matter basis, including • Level of concentrates in the diet (%) • Total digestible nutrients (%) • Crude protein content (%) • Fat content (% ether extract) • Incidence and inclusion of feed additives or supplements that will reduce days on feed (e.g. beta-agonists) as part of the project activity OR Third-party-managed data that include all of the above, with sign-off by an authorized signatory of the third party agency; and, if feedlot records only (i.e. no third-party-managed data): ▪ Sign off by a P.Ag. or D.V.M. confirming the diet composition in the ration and nutrient analysis sheets. If the streamlining option in Section 1.3, Provision No. 5 is being applied (see footnote below), then: Documented procedures by the project developer on how the average diet ingredients for the groupings were derived; and, ▪ Justification and sign off by the P.Ag. or D.V.M on the representativeness of the average diets for the particular animal grouping, and how they are tracked to the animal grouping for the year in question.	Key diet ingredients are required for GHG emissions to ensure that calculations have taken into account: • The right enteric emission factor (EF – percent of gross energy intake lost as methane in the rumen) is being used depending on the concentrate level of the diet (i.e. an EF of 4% for diets > or = 85% concentrates and an EF of 6.5% for < 85% if fat content of the diet is below 4% D.M.) • The right gross energy (GE) content of the diets is being used depending on the fat level of the diets (i.e. 19.10 MJ per kg of DM fed if between 4 and 6%, or 18.5 MJ per kg of DM fed if less than 4%) Further, if the fat content of the diet is in the 4 to 6 % range, the right enteric emission factor (EF) is being used according to the concentrate level of the diet (i.e. > or = to 85% concentrates uses 3.2% EF while < 85% uses 5.8%)
Dry Matter Intake	▪ Feedlot records or third-party-managed data, date stamped, that document the average daily dry matter intake by animal grouping in the project; this includes:	Average Daily Dry Matter Intake is derived using

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Data Requirement	Minimum Records Needed	Why the Records are Required
	• Records showing kg of feed delivered to each animal grouping in the project for each diet/diet grouping. • Records/procedures showing the dry matter conversion of wet feed to dry, and, if feedlot records only (i.e. no third-party- managed data): ▪ Sign-Off by a P.Ag. or D.V.M who reviewed and collected supporting farm records that confirm the daily dry matter intake for each animal grouping in the baseline and project.	animal*head days records by: • Dry Matter Intake (kg / head / day) = (Total quantity of feed for a specific diet x dry matter content of diet) / animal head*days
Manure Management		
Manure Managed According to the *Agriculture Operation Practices Act* (AOPA)	▪ Feedlot documentation to show that a permit from the Natural Resource Conservation Board (NRCB) is in place and no major changes in manure management have occurred since the baseline period (for those operations built or expanded after 2002), including: • Manure Handling Plans or Nutrient Management Plans and record keeping systems for those operations that exceed the land base requirements; • Manure Storage and Collection Areas; • Application guidelines. OR ▪ Sign-off by a P.Ag. who collected and reviewed supporting farm records that confirm the manure management conforms to AOPA requirements and that no major changes in manure management have occurred since the baseline period.	Needed to demonstrate that no major changes in how manure is managed have occurred since the baseline period. Major changes include: • switching storage types • instituting a composting system • installing an anaerobic digester The intent is to verify that a permit is in place and is current and no major changes in manure handling have occurred. A major change is a signal to contact Alberta Environment and Sustainable Resource Development for

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Data Requirement	Minimum Records Needed	Why the Records are Required
		clarification on how to proceed
Legal Claim to the Offsets		
Location of the Feedlot Operation(s)	• Legal land description for the land parcel(s) upon which the feedlot(s) are located.	For registration and serialization of green house gas reductions when the project is registered on the Alberta Emissions Offset Registry
Proof animals existed at the feedlot in question for the project years	Feedlot records that demonstrate animals are entering and exiting the feedlot for each individual animal by RFID tag. If the feedlot operator is a corporation: • The seal of the corporation needs to be affixed to the documentation	To prove that the animals being fed in the project were at the feedlot in question and being finished for market.

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Appendix AF: RAH Best Practice Guide

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Best Practice Guide: The Preparation for and Verification of Reducing the Age at Harvest of Beef Cattle (RAH) Projects at Reasonable Level of Assurance

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Prepared By:

The Prasino Group

ICF International

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1.0 Introduction

Greenhouse gas (GHG) quantification and verification is a relatively new process compared to more established systems like financial accounting or environmental management systems. Accreditation programs for GHG verifiers have emerged only in the last few years, and the requirements for verification are evolving in many programs. Alberta has moved to a reasonable level of assurance for Offset Projects, as of January 1, 2012, and is updating protocols with more explicit guidance on the types and nature of evidence required to substantiate a claim to offset credits. The latest version of the Reducing the Age at Harvest of Beef Cattle Protocol (RAH) is an example of an updated protocol with more explicit requirements.

Given the current state of practice of GHG quantification and verification, and the ongoing evolution of the processes, procedures and requirements for such[35], the following needs for offset projects must be addressed in the short term:

4) Greater requirements for offset projects and project developer's measurement capabilities,
5) Quality control processes for data management systems and;
6) Supporting evidence used to compile the GHG claim – to enable the verifier to assess the completeness, accuracy, reliability, consistency, relevance, and transparency of the collected GHG data and information[36].

Further, verifiers will need to enhance their understanding of sufficient and appropriate evidence to support a GHG claim under the Reducing the Age at Harvest of Beef Cattle Protocol in order to produce more consistent verification outcomes.

The purpose of this Best Practice Guide is to provide parties involved in creating compliance-quality RAH Offset Credits (i.e. participating feedlot operators, project developers/field agents and verifiers) with guidance on:

- GHG quantification considerations of agricultural livestock offset projects/RAH projects
- General risks and data-related risks in RAH projects
- Data Integrity and Controls to Manage Risks in RAH Projects
- Sufficient and appropriate evidence for RAH projects.

The expected outcomes for those following this Best Practice Guide are:

- **Project Developers -** greater consistency in approach to GHG data and information quality controls and records management to support analytical testing under reasonable level of assurance; and,
- **Verifiers –** Clarity for verifiers on the requirements for verifying RAH offset projects leading to greater consistency in verification of RAH offset claims in the Alberta Offset System.

[35] Alberta has just released a Technical Guide for Verification at Reasonable Level of Assurance, and is updating the GHG Offset Quantification Protocols to prepare the system for reasonable level of assurance.
[36] Alberta Environment and Sustainable Resource Development, 2013. Technical Guidance for GHG Verification at Reasonable Level of Assurance.

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2.0 Agricultural Livestock Offsets and Reducing the Age at Harvest of Beef Cattle (RAH) Offsets

There are unique aspects to agricultural livestock offset projects that need to be considered when quantifying and verifying GHG offset claims. Some aspects of agricultural livestock offsets are generated from sources (i.e. animals in feedlots, or manure handling and storage) that are typically not metered (i.e. mechanically measured). As a result, some of the parameters do not have the associated certainty and reproducibility that well-calibrated mechanical systems can achieve. Their reliance on biological systems, with inherent complexity in measurement, and changing variables due to disease, feeding practices and genetic diversity have resulted in the development of scientifically vetted and accepted estimation procedures, based on international and country relevant standards[37], to manage complexity, cost and reproducibility. Uncertainty in agricultural livestock protocols has been accounted for in the development of the quantification/estimation procedures and accepted by the regulator in Alberta.

In general terms, the approach to quantification in agricultural livestock offset protocols is:

GHG Emissions = Agricultural Activity * Emission Factor/Empirical Equations

The emission factor/empirical equations derived through standardized measurement and modeling developed by the IPCC and further refined in Canada's National Emissions Inventory manages the risk of inaccuracy by accepting that actually measuring greenhouse gas emissions at livestock operations is infeasible, and that standardized quantification within the protocol can be applied to feedlot data to estimate reductions between baseline and project condition. Thus, for agricultural livestock projects, GHG data is a combination of feedlot activities, manure management practices and animal performance data (e.g. kg of beef production etc.).

For Reducing Age at Harvest in Beef Cattle projects, the GHG data are manually or electronically recorded information gathered by feedlot operators for each animal - age at harvest, number in production, live weight and carcass weight - that are used in the empirical formulas along with a series of emission factors (e.g. for enteric emissions) to run the equations and emission factors outlined in the protocol and calculate the emission reductions.

The GHG data used in the calculations needs to be substantiated by evidence – a combination of feedlot records, third party records and physical evidence gathered by the project developer to support the GHG claim. The Reducing Age at Harvest in Beef Cattle Protocol provides specific requirements and additional guidance on the types of records and evidence that need to be collected to substantiate that the GHG data underlying the claim is accurate (Appendix A).

At a reasonable level of assurance, project developers applying the Reducing Age at Harvest in Beef Cattle Protocol will be exposed to rigorous testing by verifiers of the following processes:

- The control environment - defined as the overall system of internal checks by project developers to ensure all claims are accurate and fully supportable by records;
- Due diligence on feedlot eligibility – defined as consistent and transparent procedures on the acceptance of feedlots into the offset project; and,

[37] Intergovernmental Panel on Climate Change Guidance and Canada's National Emissions Inventory Report quantification methodologies.

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- Data and record collection and management systems – defined as the framework developed for collecting, storing and retrieving feedlot specific records and calculations that support the claims made.

Project developers will be expected to establish, document and implement a quality assurance/quality control system to ensure that data integrity is maintained throughout the project and sufficient and appropriate records/evidence are documented to support the existence and accuracy of all eligible offset credit claims under the Reducing Age at Harvest in Beef Cattle Protocol. Further, it is expected that the extent and nature of records collected to substantiate the GHG claim will increase as outlined in Appendix A. More guidance is offered in the next few sections.

At a high level, in order for a feedlot to be eligible in a RAH Project, it must meet a minimum set of requirements (Figure AF-1). These requirements can be used as part of a project developer's due diligence to screen eligibility of a feedlot to participate in the offset project.

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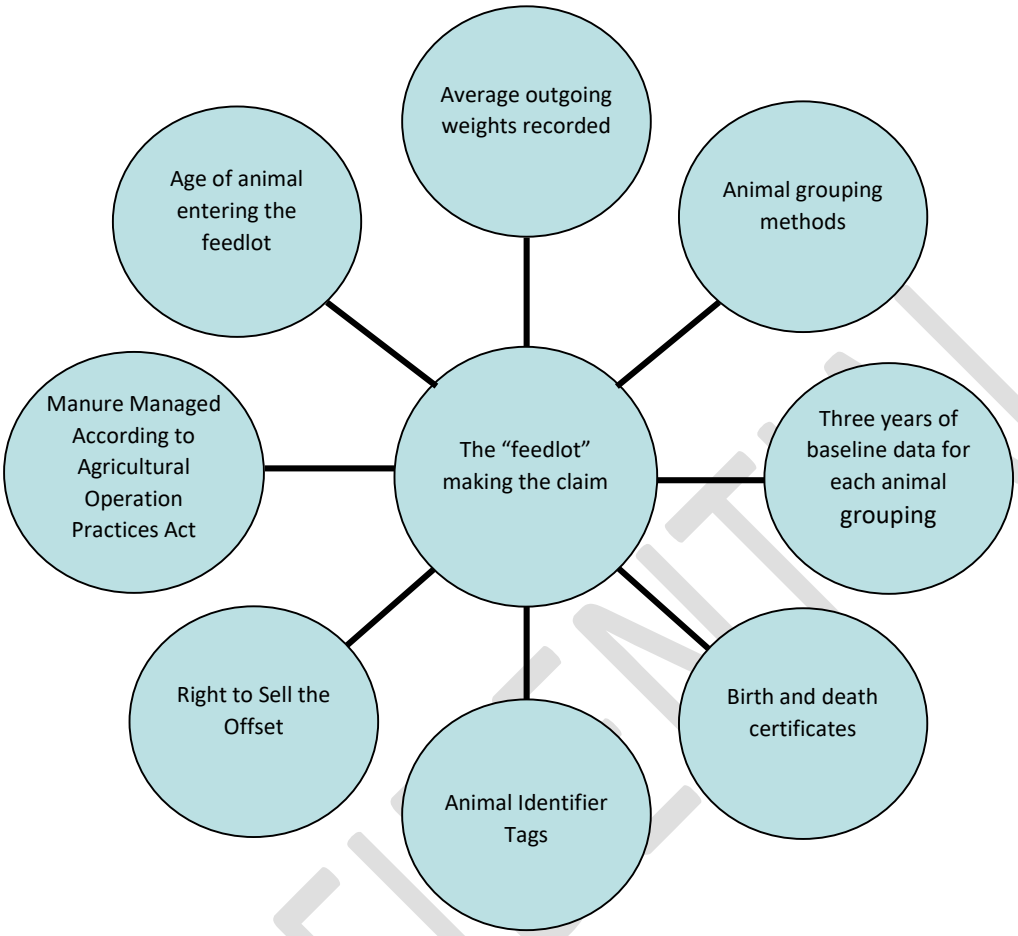


Figure AF- 1: Basic set of data requirements in order for a farmer's field to qualify under the Reducing Age at Harvest in Beef Cattle Protocol

3.0 Roles and Responsibilities

3.1 Overview

The process for developing, verifying and registering Reducing Age at Harvest in Beef Cattle offsets is as follows:

Undertake Eligible Feedlot Activities

- Farming activity is undertaken by a feedlot operator which meets the eligible practices as defined by the Reducing Age at Harvest in Beef Cattle Protocol. The protocol requires feedlot operators to reduce the number of days required to get a feeder calf from birth to harvest. The protocol applies to youthful cattle or those cattle under 24 months of age, which includes calf-fed or yearling-fed heifers, steers or bulls.

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Gathering Data

- The project developer contracts with the feedlot operator to access the age and performance data for GHG quantification to determine the carbon intensity of the baseline (3 year average) and project (see Appendix A for eligibility requirements).
- The project developer visits the feedlot to ensure that the feedlot operator has the data required to support the reduced age at harvest claim and to gain a sense of the feedlot's data management system and controls. The project developer's observations are documented in an inspection record.
- The project developer gathers the data to support the GHG calculations (animal age and performance data) and the records that support the data, such as cattle agreements, and feedlot practices (e.g. existence of manure management records, etc). Furthermore, supporting data for cattle inventory will be gathered (e.g. number and weight of animals being fed, age at harvest, etc.).
- The project developer reviews all of the supporting documentation for each individual offset claim to ensure it is eligible to be verified and registered as an offset credit in the Alberta Offset System. *Note: Claims that are ineligible due to a lack of supporting documentation must be excluded from the total offsets included in the project report.*
- The project developer enters the eligible offset credits into a data management system, quantifies the total offset credits and compiles an offset credit plan and report.
- The project developer engages an independent third party qualified to perform verification in the Alberta Offset System. *Note: Minimum requirements for verification qualifications are specified in the Specified Gas Emitters Regulation (SGER).*

Verification

- The verifier will request project data to develop a Verification Plan
- The Verifier will conduct site visits to the feedlots enrolled in the project to observe data collection procedures and develop a general understanding of the project
- The verifier will conduct verification procedures to evaluate the evidence that supports the GHG Assertion at a reasonable level of assurance.
- The verifier will complete a Verification Statement and Verification Report that describes the verification findings

Registration

- The project developer registers the verified offset credits with AESRD.

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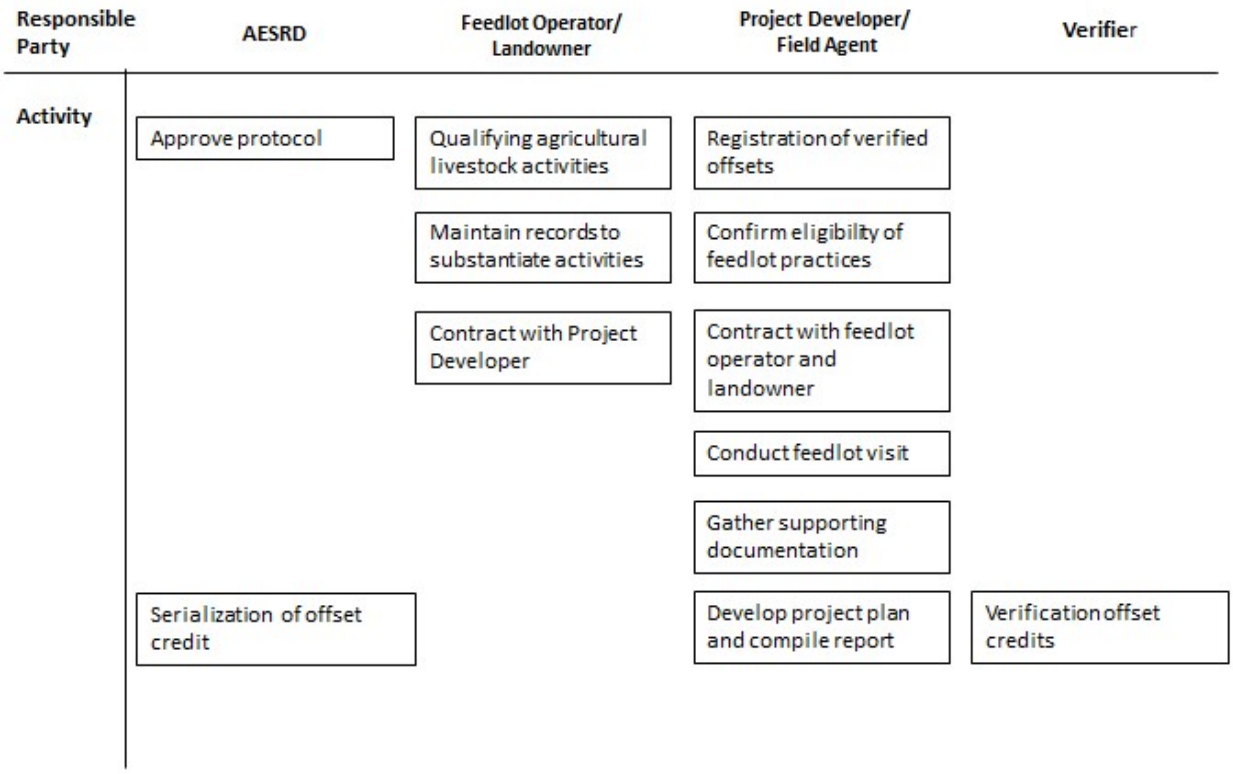


Figure AF- 2: Process for creating, aggregating, verifying and registering agricultural offset credits as it relates to each responsible party

3.2 Roles and Responsibilities

In the agricultural livestock offset credit system, there are six responsible parties involved in the development and verification of an offset project report ready for verification- AESRD, feedlot operators, project developers and verifiers. The respective roles and responsibilities of each party are described below in Table AF-1. While there are six responsible parties, in some instances the feedlot operator and the project developer may be the same individual. Similarly, the field agent and project developer may be the same individual. Thus, there are multiple scenarios for the number of responsible individuals.

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Table AF- 1: Roles and responsibilities and minimum documentation requirement for each responsible party

Responsible Party	Roles and Responsibilities	Minimum Documentation Requirement
AESRD	• Approved protocols in place that identify the methodology for calculating offsets • Approved verification methodology in place • Due diligence processes in place for assessing and accepting verified offset project reports	• Approved protocols and related verification guidance
Feedlot Operator	• Feedlot practices performed in accordance with protocol requirements	• Detailed feedlot animal inventory and production performance records (i.e. lot closeout data) , required details can be found in Appendix A.
Project Developer	• Agreement to sell offsets on behalf of feedlot operator • Inspection of supporting documentation to confirm that the feedlot practices that occurred and the records of these practices meet the protocol requirements • Knowledge of feedlot practices • Calculate offset claims accurately • Establish a strong control environment • Maintain sufficient evidence to support claim	• Signed offset credit agreement • Inspection records (may be used as a control at the discretion of the project developer) • Detailed listing of feedlot practices for each field included in offset claim by year • Process documentation relating to data management and record keeping for offset credits
Verifier	• Determine whether the overall emission reduction is fairly stated (reasonable assurance) • Verification team will be comprised of a Lead Verifier and technical experts and other verification staff, as described in AESRD Guide to Verification. •	• All supporting documentation may be requested throughout the assurance engagement to provide support for the agricultural livestock offset credit claim. Documentation includes legal land location; documented method of establishing birth dates; (if applicable) birth certificates, birth dates, calving records and RFDI tag numbers; (if applicable) CCIA registration and issued birth certificate; and documentation of the following: incoming/arrival age and weight, number and weight of

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Responsible Party	Roles and Responsibilities	Minimum Documentation Requirement
		animals in animal grouping, type of feeding regime, method used to group animals, method applied for statistical sampling, record of entry and exit in cattle grouping, outgoing weights of animals, age at harvest, proof of harvest, records of days on feeding regime, and commercial agreements for offset ownership claim.

Further information on the specific roles and responsibilities of field agents, project developers and verifiers is provided in the form of guidelines below.

3.3 Guidelines for Project Developers/ Field Agents

This section documents your roles and responsibilities in relation to gathering and managing agricultural Beef RAH offset credit records and preparing the offset credit claim.

What is your role?

As a project developer, you are responsible for:

- Entering into offset credit agreements with the feedlot operator (in the case where you are not a feedlot operator, rather a project developer);
- Ensuring that the feedlot activities meet the protocol requirements for each individual offset claim included in your project report;
- Visiting (you or your field agent) multiple feedlots. At each feedlot, you will need to inspect all relevant farm records. You will ask questions about all feedlot practices and will inspect supporting documentation for the animal inventory, age at harvest and performance data.
- Documenting, if a field agent, all of your findings in an inspection record (see below for details regarding documentation requirements) and provide the project developer with your completed inspection record and other supporting documentation that may be requested to support the feedlot operators offset claim (see Appendix A);
- Gathering all supporting documentation to support the GHG calculations as outlined in the protocol; and,
- Ensuring the accuracy of the offset claim and supporting data.

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What to expect – Project Developers?

- You will need to establish contact with a feedlot operator and confirm the eligibility of the feedlot for an offset credit under the protocol (Refer to Appendix A for eligibility criteria). You will explain the terms of your offset credit agreement.
- If using field agents, you will need to assign the field agent responsibility to either an employee or contractor. You will be responsible for ensuring that the field agent has sufficient knowledge and expertise to carry out their roles and responsibilities and providing direction to the agent on your inspection requirements.
- You will need to collect the completed inspection records and farm records that relate to all individual offset claims included in your project report.
- You will need to gather the data for legal land location, GHG calculations (e.g. animal inventory, age at harvest and performance data as outlined in the Protocol) and the records that support the data, such as birth and death certificates, number in production, incoming and outgoing weights and other information.
- You will need to review all of the supporting documentation for each individual offset claim to ensure it is eligible to be verified and registered as an offset credit in the Alberta Offset System. *Note:* Supporting documentation, as defined by the Protocol, must be on file to establish eligibility for each feedlot in the project..
- You will need to maintain a data management system that contains all of the relevant supporting documentation for all the offset credits included in your project report.
- You will need to quantify the total offset credits and compile an offset credit plan and report.
- You will need to engage an independent third party qualified to perform verification in the Alberta Offset System. *Note: Minimum requirements for verification qualifications are specified in the Specified Gas Emitters Regulation and a Technical Guidance Document to Verification found at* http://environment.alberta.ca/02275.html*.*
- You will need to register the verified offset credits with the Alberta Emissions Offset Registry at http://carbonoffsetsolutions.climatechangecentral.com/offset-registry
- You will need to establish, document and implement a quality assurance/ quality control system to ensure that data integrity is maintained throughout the project and to support the existence and accuracy of all eligible offset credit claims.

What is a farm record?

- Records that the feedlot operator uses to document the farming activities that occurred in the feedlot or documents obtained from other parties such as animal performance data, animal inventory data, animal identifier tags and others (See Appendix A).

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How detailed do farm records need to be?

- Farm records should clearly describe the relevant information. For reducing the age at harvest of beef cattle projects, records will include animal ID tag numbers, methods for establishing animal groupings, number in production, birth and death certificates, arrival dates and age of animals entering the feedlot, incoming and outgoing weights, existence of a manure management plan and others. The farm records reviewed need to include at minimum the records specified in the protocol.

What is an inspection record?

- Records that document the feedlot visit including the details of the inspection of any feedlot practices including relevant documentation reviewed.

What data needs to be collected during a feedlot visit?

- The project developer/field agent must refer to Sections 4 and 5 of the protocol that describe data and farm records needed to be collected during a feedlot visit. At a minimum you will need to collect data and farm records related to age at harvest, cattle inventory and performance data (usually in the form of feedlot close out data for lots).

How long do farm records and inspection records need to be retained?

- AESRD requires that all documents relating to all verified offset credits that have been registered in the Alberta offset system must be retained for 7 years after the project crediting period (e.g., if you claimed offsets for employing the reduced age at harvest protocol for the 2004 season and these were converted into offsets in 2010, records for the 2004 season would need to be kept until at least 2017).

Do you need to share your records with others?

- As a field agent, you will need to share the results of your inspection with the project developer. The project developer will need to see all records related to the practices occurring on the feedlot and will likely need to take copies of these documents. You will also be required to share this information with the verifier during a verification of the offset claim.
- As a project developer you will need to share the records and data supporting your offset project report with the verifier. This will also include access to any electronic database that you may use for managing the offset data.

What is your role during verification?

- As project developer your initial role is to hire a verifier with appropriate verification experience in relation to agricultural projects. During the verification, you will be required to provide the verifiers with documentation describing your data management system, your project plan and project report and supporting records that substantiate your offset claim. The verifiers will examine your project report and supporting records and data and select a sample of the data to confirm claim related information. Based on the sample selected, the verifier may need to visit individual feedlots and interview

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feedlot operators, or field agents. As project developer, you will be asked to facilitate the verification process by making any necessary contacts with the feedlot operators or field agents. You may also be asked questions related to your knowledge of the feedlots and your data collection and quality control processes.

- During the verification, the verifier will select a sample of feedlots and lot/pens to confirm claim related information. In addition, the verifier may select a sample of field agents to interview about the data collection process. Therefore, if you are selected, you will be notified by the project developer and arrangements made to meet with you. You may be asked questions related to your knowledge of specific feedlots and how you collected the feedlot data.

What is a data management system (DMS)?

The DMS is the system used by the project developer to collect and manage the data. You will need to establish and document data management and record keeping procedures, identifying key controls over the records associated with the offset credits, to mitigate the key risks relevant to the Reducing the Age at Harvest of Beef Cattle project. For a simple project with limited data, this may be as simple as a brief description of the controls, a spreadsheet and paper files for the collected records. For more complex projects with a large amount of data, the data management system may be comprised of a well-documented description of the system and controls, including a custom built database with electronic copies of farm records.

In order to support third party verification and the potential supplemental government audit, you must put in place data management and record keeping procedures that at minimum meets the following requirements:

- All records must be kept in areas that are easily located;
- All records must be legible, dated and revised as needed;
- All records must be maintained in an orderly manner;
- All documents must be retained for 7 years after the project crediting period, including raw data for the project (Required by AESRD);
- Electronic and paper documentation are both satisfactory; and,
- Copies of records should be stored in two locations and backed up regularly to prevent loss of data.

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What is the Project Developers role in ensuring data quality?

In order to ensure that the underlying data supports RAH offset claim, you must create a strong control environment to mitigate the risks associated with RAH offset claims. A strong control environment will ensure the existence and accuracy of all eligible agricultural offset credit claims. In designing the controls to be put in place, you should ensure that there is segregation of duties between the individual responsible for collecting and processing offset credit agreements and supporting data and the individual approving offset credit agreements and reviewing offset credit files for completeness of information. Recommended controls include, but are not limited to:

- Management review and approval of offset credit agreements;
- Feedlot inspection to ensure accuracy of farm records;
- Management review of feedlot activities to ensure they meet protocol requirements;
- Management review of offset credit files for completeness of information prior to processing, particularly in relation to the quality of records supporting assertions;
- Management review of data entered into the database against feedlot records collected.
- Exception reports to identify duplicate records, incorrect emission factors, etc.;
- Restricted user access to offset claim calculations;
- Maintaining a record of all changes to data and calculations in the database; and
- Management review of reported data to ensure it is consistent with underlying offset credit data.

3.4 Guidelines for Verifiers

The process of verification is to independently arrive at the same calculation as the project GHG assertion. Alberta Environment and Sustainable Resource Development (AESRD) have published a Technical Guide for Verification at Reasonable Level of Assurance[38]. The AESRD Technical Guide is the primary resource for verifiers who are providing assurance services in the Alberta Offset System. For completeness sake, this section for Verifiers is included in this Best Practice Guide.

What is your Role as a Verifier?

As a verifier, your role is to answer three basic questions:

4. Has the project been implemented in accordance with the requirements of the Offset System Quantification Protocol, AESRD Guidance Documents, Specified Gas Emitters Regulation and Legislation as amended?
5. Are the asserted greenhouse gas reductions over the reporting period fairly stated in all material respects?
6. Does the project satisfy the eligibility criteria outlined in the Program Rules and Guidance for Project Developers?

[38] http://environment.gov.ab.ca/info/library/8802.pdf

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What to Expect?

- You and your firm will have expertise in the ISO 14064-3 verification standard and any other additional standards your profession requires. Verifiers shall be a member of a registered profession in Alberta (i.e. Chartered Accountants or Professional Engineers)[39].
- You have assembled a competent team to conduct the verification comprising:
    - A lead verifier and/or a designated signing authority;
    - An independent peer reviewer; and
    - Technical subject matter experts.
- Your technical subject matter experts have an understanding of the operations and processes related to beef feeding operations as well as an understanding of the effect of management/technologies used in these systems on greenhouse gas sources and sinks.
- Your firm has conducted an evaluation of independence, and is arm's length and impartial in your role as an assurance provided to the project developer. At the end of the verification, a conflict of interest statement has been completed and submitted to the project developer and kept on file.
- You and your team have conducted an initial assessment of the project's subject matter (project greenhouse gas, production and performance data) as well as project developer's data management system and the extent of substantiating evidence and records to support the project and deemed it is appropriate to proceed with the assurance engagement.
- You and your team will have designed verification procedures for the project's GHG assertion based on conducting an initial planning exercise where you and your team have gone through a series of inquiries, observations and inspections of the project's operations, management practices, GHG data, data management system, records and controls to determine inherent, control, and detection risk in the GHG assertion.
- Based on the risk assessment above, you will have developed a verification plan with associated verification procedures that will drive the data and evidence collection for the assurance engagement. A preliminary verification plan that outlines only the scope, general process and planned timelines for the verification is shared with the Project Developer so they know what to expect, but contains minimal detail so as not to bias the outcome of the verification. The plan has a balance between controls reliance and substantive testing.
- You will need to develop a sampling plan, using structured types of sampling procedures, based on the nature of the evidence type and analysis being done.
- You and your team will need to understand the nature of the evidence being gathered and what constitutes sufficient and appropriate evidence against a GHG data point in the protocol.
- You will need to let the project developer know when you will be coming to their offices to execute the verification, ensuring both you and your team, as well as the project developer have sufficient staff and resources available to you.
- You and your firm will need to have a documented quality management system (QMS) in place including the following:
    - A quality manual demonstrating compliance to ISO 14064-3 standard and other standards as required by your profession, as applicable to verification activities; and documented procedures for implementing the QMS;
    - Record control procedures;
    - Independence procedures;
    - Preventative action procedures (potential non-compliance activities)

[39] A CA or P.Eng. that meet the requirements of Section 18 of the Specified Gas Emitter's Regulation.

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    - Corrective action procedures (non-compliance activities)
- You and your team are aware of the mandatory procedures required by AESRD in the Verification Guidance Document (Section 4.1.4.2 for Offset Projects) and have incorporated them into your Verification Plan.
- You will evaluate the evidence presented by the Project Developer, which will include documentation (minimum documentation requirements are described in Appendix A) and may also include observations made during the site visit, enquiry of the project developer and feedlot operator, confirmations (information received directly from third-parties), re-performance of calculations and analytical procedures.
- You will come to a conclusion regarding the material correctness of the GHG assertion- following the materiality assessment guidance in the AESRD's Verification Guide, compile that into a Verification Statement and Report, and submit to the Project Developer.

Will I have to make site visits to the individual farms or operations?

You will need to visit the Project Developer's offices for physical inspections, as well as visit a number of feedlots to conduct the verification. The sampling of feedlots can be done on a risk basis. The procedure for determining the sample of feedlots to be visited needs to be documented in the verification plan and verification report.

What if I think there are fraudulent activities going on regarding a GHG Assertion and Project?

You are best advised to cease the verification, and seek legal counsel regarding the nature of the fraud. Depending on the legal counsel, you and your firm will need to decide whether to withdraw from the verification, or continue with the verification and notify AESRD of the situation.

According to AESRD's Verification Guidance Document - you are responsible to notify the Project Developer's senior management of the issues and intended course of action.

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4.0 Identifying and Mitigating Risks in Developing and Verifying Reducing the Age at Harvest of Beef Cattle Projects (RAH)

Identifying risks is the first step in designing risk assessment procedures and can help in the design and implementation of control measures to manage the risk of a misstatement of a GHG Offset claim. Documenting the risks can also help the verifier better understand the verification strategy needed to successfully verify RAH projects.

Unlike cropping projects, agricultural livestock offset projects tend to have less inherent risk because of the reliance on electronically recorded data at the feedlot level. The need to aggregate several feedlot operations together poses risks related to inconsistency of data collected and record keeping procedures.

To help guide project developers and verifiers in understanding risks in agricultural livestock offset projects in general, and RAH projects in particular, a risk matrix has been prepared. Table AF-2 provides guidance on the key risk areas associated with RAH offsets, the evidence required to support the GHG claim and possible controls that could be put in place by the project developers to mitigate these risks.

Table AF - 2: Risks Associated with Reducing the Age at Harvest Projects

#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
1	Project Developer does not have assigned rights to emission reductions by the feedlot operator	Signed offset credit agreement that clearly states relationship between project developer and feedlot operator in respect to offset credits and feedlot practices	Management review and approval of offset credit agreements
2	Feedlot operator has already sold emission reduction rights on another registry or to another project developer	Signed offset credit agreement between project developer and feedlot operator that clearly states feedlot operator has not sold offset credits previously under the protocol	Management review of current RAH projects listed on the Alberta Registry
3	Feedlots claimed that do not exist in province of Alberta	Legal land description for each feedlot included in the offset credits agreement	Management review of offset credit files for completeness of information
4	Data management system does not track required ownership, feedlot practices, etc.	Detailed listing of all feedlots included in offset claim by year that links to information required to establish ownership, eligibility, specific feedlot practices and offset credit claimed	Management review of data transparency (ie. Linkages are maintained both ways between base data and feedlot specific offset claims)
5	Insufficient controls over stored data	Process documentation relating to data management and record	Restricted user access to offset claim calculations

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#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
		keeping for offset credits Secondary data source and "management processes for documenting any data validation processes and restricted access to project data	and data For feedlot data management systems, comparison with a secondary source of information. For example, animal weights are measured and recorded by the feedlot operator. The weights provided by the processing plant provide a secondary source of data for comparison. Although the weights are not expected to be an exact match, they should be within the same range
6	Incorrect formulae for calculating emissions reductions	Process documentation relating to data management and record keeping for offset credits	Exception reports to identify duplicate records, incorrect emission factors records with values outside of expected parameters
7	Discrepancies between reported amounts of offsets and data management system	Process documentation relating to GHG calculations data management and record keeping for offset credits	Management review of reported data to ensure it is consistent with underlying offset credit data
8	The animals in the feeding/commercial agreements cannot be tracked and may not have been fed in the feedlot in question	Feedlot or third party records showing unique tag numbers for each animal. Lost tags must be removed from the project or the tag retired and a replacement issued. Secondary records from the packing plant showing animals received from the feedlot.	Management review of files for completeness of information
8	The animals in the feedlot may not have	Feedlot or third party records showing unique tag numbers for	Management review of files for completeness of

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#	Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
	had identifier tags	each animal. Lost tags must be removed from the project or the tag retired and a replacement issued.	information
9	The age at harvest cannot be established or is under estimated	Feedlot or third party records showing the birth date of the animal and the date of harvest (i.e. date-stamped shipping manifests or packing plant receipts that show the individual animal was shipped directly to harvest with the correct CCIA tag)	Review of records by qualified and recognized professionals to ensure consistency and accuracy
10	Animal groups are inconsistent between baseline and project	Documented method used to group cattle for calculations in the baseline and project, including details on the incoming and outgoing weights	Management review of internal processes for grouping animals are consistent with documented method
11	The number of animals in production is reported incorrectly	Feedlot inventory records, feedlot records, shipping manifests of packing plant receipts or third party production or performance data with sign-off showing number of animals in a grouping	Review of records by qualified and recognized professionals to ensure consistency and accuracy
12	Manure management practices are inconsistent between baseline and project	Documentation showing that a permit from the Natural Resource Conservation Board (NRCB) is in place and no major changes in manure management have occurred	Management review of records to ensure permit exists
13	Animals that leave the feedlot are sent to backgrounding, not to harvest.	Shipping manifest, which documents the shipping destination	Review of records by qualified and recognized professionals to ensure accuracy

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4.1 Designing Controls

A strong control environment is essential to mitigating risks associated with RAH offset claims. Further, the presence of internal controls that are designed to prevent, detect and correct the potential for any misstatements in GHG quantification and claims is an important feature of the control environment. Properly designed controls in the Project Developer's system can mitigate the inherent risks of dealing with multiple feedlots, each with their own data and record systems, and data collection methods.

Internal controls are policies and procedures that are designed to ensure the GHG data is complete, accurate, valid and not subject to corruption (i.e. reliable). When designing controls, project developers need to consider segregation of duties between the individual responsible for collecting and processing offset credit agreements and supporting data and the individual approving offset credit agreements and reviewing offset credit files for completeness of information.

Operationally, internal controls can include, but are not limited to, policy and procedures designed and implemented by the project developer in their data management system, such as:

- Front end assessments - a robust due diligence process that screens potential eligible feedlots and accepts only those with sufficient GHG data and farm records/supporting documentation, according to the Reducing the Age at Harvest of Beef Cattle Protocol to participate in the offset claim;
- Data Input checks –performed on the data from the eligible feedlot that check the detailed activities for each animal grouping, are entered correctly from base records.
- Data Reasonableness checks – checks over entered data that are designed to flag data outside of expected ranges, data entered in the wrong format, potential duplicate entries, ineligible combinations of activities etc. for management review.
- Data Transformation checks – error checking during the process of collating, transferring, processing, calculating, estimating, aggregating or adjusting input data to detect deficiencies.
- Data output checks – on the distribution of the GHG information and accuracy of the GHG reporting to the GHG claim, to detect any discrepancies in GHG calculations.
- Preventative/detective action procedures – implements risk assessment procedures, internal audits and reconciliation procedures[40] on data input, transformation and output processes to decrease project risk.
- Corrective action procedures – defines, in written procedures, steps to take to reconcile discrepancies discovered in the preventative/detective action system.
- Document control procedures – designed to ensure the most current documents or those documents appropriate for the GHG offset vintages in question are available for use in quantification and aggregation activities.

[40] Reconciliation procedures detect anomalies in the data by cross-checking GHG data with project sources and other sources of data (e.g. land titles check against farm details)

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- Records control procedures – designed to ensure that sufficient and appropriate records are available and readable when needed.

In addition, a number of other controls are recommended to ensure the underlying data supports the Offset claim under the Reducing the Age at Harvest of Beef Cattle Protocol. These include:

- Training of staff and field agents on the above procedures;
- Management review and approval of offset credit agreements;
- Feedlot inspection to ensure accuracy of farm records;
- Management review of offset credit files for completeness of information;
- Management review of reported data to ensure it is consistent with underlying offset credit data;
- Exception reports to identify duplicate records, incorrect emission factors, etc.; and
- Restricted user access to offset claim data and calculations.

5.0 Sufficient and Appropriate Evidence for Reducing the Age at Harvest of Beef Cattle Projects

Project developers need to collect quality evidence to support the GHG claim. *Sufficient* evidence answers the question of whether enough evidence has been gathered (quantity). *Appropriate* evidence answers questions of how reliable and relevant the evidence is (quality). Section 5 in the Reducing the Age at Harvest of Beef Cattle Protocol (Appendix A) lists the types and number of records that need to be collected and retained, indicating sufficient evidence for each data requirement. However, the issue of what constitutes appropriate evidence is more problematic and subject to interpretation, leading to potential inconsistency in verification opinions. One aspect of appropriate evidence is reliability, the other is how relevant the evidence is to support the particular data point in the protocol - it's important to ensure both are taken into consideration.

In agricultural livestock offset projects, the reliability of the evidence depends on the nature and source of the evidence. Table AF-3 provides guidance on a general hierarchy of evidence for agricultural livestock offset projects. This hierarchy can be used by project developers to assess reliability of the evidence needed to be collected and is largely reflected in Section 5 of the Reducing the Age at Harvest of Beef Cattle Protocol (Appendix A).

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Table AF - 3: General Hierarchy of Evidence

Evidence Strength	Source of Evidence	Key Characteristics	Examples of Evidence
Strongest ↑	Third party documentation given by third party directly to the verifier	External evidence is more reliable than internal evidence Evidence for commercial transactions - multiple parties with consideration (money/commodity) relying on the data	Google Earth accessed directly by verifier CCIA birth certificates (if accessed from CCIA by verifier) OR Statement of credentials and training of the Accredited Professional Advisor
	Third party documentation given by project developer to the verifier	Written responses received directly by the verifier from third parties normally provide evidence that is more reliable than that provided by other sources	Confirmation of harvest from the processing plant for beef cattle OR Land title certificates Shipping manifests
	Internally generated documentation by the project developer with corroborating information	Corroborating information obtained from a source independent of the entity may increase the assurance the verifier obtains from evidence that is generated internally.	Farm records which show farming practices backed up by farm inspections e.g. animal weights measured with calibrated scales at the feedlot
↓ Weakest	Internally generated documentation by the project developer without corroborating information	Corroborating information obtained from a source independent of the entity may increase the assurance the verifier obtains from evidence that is generated internally.	Farm records which show farming practices if the verifier can determine there is acceptable uncertainty in the measurement and acceptable data integrity in the recording and reporting of the data
	Affirmation	Documentary evidence is more reliable than oral evidence	Farmer/feedlot operator affirmation on farming practices

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The second aspect of appropriate evidence - relevancy of the evidence to support the protocol data requirement – requires technical knowledge regarding the sufficiency of the evidence to support the data point in the protocol. For example, a project developer will likely have gathered several pieces of evidence in their file for a particular feedlot. The relevance of the source of evidence for the particular data point needs to be understood by the verifier. Project developers need to specify why the sources of evidence are relevant for a particular data point and verifiers need to understand the characteristics of the evidence sources in order to judge appropriate evidence correctly. Since the protocol defines the types of evidence acceptable to prove eligibility or substantiate the quantification, the Project Developer needs to produce evidence that meets Protocol requirements. The Verifier will determine if the evidence is reliable and relevant (i.e. appropriate to meet Protocol requirements).

Appendix A – Evidence Required for a Reducing the Age at Harvest of Beef Cattle Project

Data Requirement	Examples of Records	Why the Data are Required
Animal Inventory		
Animal Identifier Tags	▪ Feedlot records or third party records showing animals entering the project are registered with the CCIA and have a tag number. The unique tag numbers for each animal recorded in animal inventory databases. AND ▪ Feedlot records or third party records showing animals with lost tags were either removed from the project or the lost tag was retired and a replacement tag registered with the CCIA or an Alberta Registry for that individual animal.	To ensure only registered animals are used in the project. Note – if the Default Birth Date Method is used, animals must be registered with the CCIA, unless the Alberta Registry can produce similar Birth Certificates. To track the individual animal and prove age when the animal is harvested.
Birth and Death Certificates	▪ If the Default Birth Date Method is being used, feedlot or third party records showing CCIA Birth Certificates on file for each animal in the project; AND ▪ Feedlot or third party procedures showing that 28 days is added to the CCIA Birth Certificate according to the protocol requirements; OR If the Actual Birth Date Method is being used, collected records from the owner of the animal at the time of calving, matching the registered tag number of each animal to any tag inventory control system used by the cow-calf operator, to match individual calving records. AND, for all of the above:	To establish the birth and death dates of the registered animal to determine the age of the animal at harvest by either the default or actual birth date methods; and confirm the tagged animal has been harvested.

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Data Requirement	Examples of Records	Why the Data are Required
	▪ Feedlot or third party records that show the same Birth Date Method is applied in both baseline and project animals; AND ▪ Feedlot records or third party records like packing plant close out sheets and/or shipping manifests that show the individual animal was harvested with the correct CCIA RFID tag number listed. ▪ ORWhere cattle in the project have been exported for harvest outside of Alberta, documentation that shows all exported registered cattle leaving the province - and have an additional 0.25 months added to their harvest age as a result.	
Age of Animals Entering the Feedlot	▪ Feedlot records or third party records showing the birthdate and harvest date of registered animals The unique tag numbers for each animal recorded in animal inventory databases.	Needed to establish the age of the animals at harvest.
Animal Groupings	▪ Documented procedures by the feedlot regarding methods used to sort and group animals to manage their production and performance. ▪ Feedlot records that prove that these procedures are the same for both baseline and project conditions. ▪ Documented procedures by the project developer that show the GHG calculations are performed by animal grouping, comparing similar groups of animals in the baseline and project conditions. OR, the following may be substituted for the second bullet above: ▪ Sign-Off by a P.Ag. or D.V.M that the documented procedures have not changed from the baseline period onwards.	The methods used to define an animal grouping (e.g lots or pens based on sex, age, weight, breed, or quality grid programs) must be similar between project and baseline conditions to ensure the offset calculations are valid and functionally equivalent.
Number in Production - for animal groupings	▪ Feedlot inventory records (e.g. close out data) that show the average number of registered animals in each grouping, taking into account animal entry and exit movements from the	To ensure an accurate count of project animals per animal grouping for offset calculation purposes and that animals were being finished for market

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Data Requirement	Examples of Records	Why the Data are Required
– entry and exit numbers	grouping. This is a weighted average approach. ▪ Feedlot records and shipping manifests or packing plant receipts that show registered and tagged project animals in a grouping (by tag numbers) exited the feedlot destined for a packing plant. OR ▪ Third-party-managed production and performance data, with sign-off by an authorized signatory of the third party agency, documenting registered and tagged animals by shipment; and weighted averages per animal grouping and shipping manifests to a packing plant or receipts from a packing plant.	purposes and being shipped to packing plants (i.e. not backgrounded in the feedlot).
Incoming and Outgoing Weights	▪ Feedlot records, date stamped, showing average outgoing weights for registered and tagged animals within the animal groupings that are involved in the project. ▪ Associated weigh scale tickets from a licensed scale at the feedlot per animal grouping. ▪ Feedlot records showing a direct connection between the tagged and registered animal groupings and packing receipts.	Animal groupings will be sorted by weight classes within gender and animal type (e.g. fall calves, yearlings, winter calves, etc.) thus the weights will need to be known. The offset calculations function on an animal grouping basis to ensure meaningful comparisons between baseline and project conditions. GHG reductions are calculated on kilogram of carcass weight basis, so an adjustment for production equivalency between baseline and project conditions will need to be made, according to the protocol
Manure Management		

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Data Requirement	Examples of Records	Why the Data are Required
Manure Managed According to the *Agriculture Operation Practices Act* (AOPA)	▪ Feedlot documentation to show that a permit from the NRCB is in place and no major changes in manure management have occurred since the baseline period (for those operations built or expanded after 2002), including: • Manure Handling Plans or Nutrient Management Plans and record keeping systems for those operations that exceed the land base requirements; • Manure Storage and Collection Areas; • Application guidelines. OR ▪ Sign-off by a P.Ag. who reviewed and collected supporting farm records that confirm the manure management conforms to AOPA requirements and that no major changes in manure management have occurred since the baseline period.	Needed to demonstrate that no major changes in how manure is managed have occurred since the baseline period. Major changes include: • switching storage types • instituting a composting system • installing an anaerobic digester The intent is to verify that a permit is in place and is current and no major changes in manure handling have occurred. A major change is a signal to contact Alberta Environment and Sustainable Resource Development for more clarification on how to proceed.
Legal Claim to the Offsets		
Location of the Feedlot Operation(s)	▪ Legal land description for the land parcel(s) upon which the feedlot(s) are located.	For registration and serialization of greenhouse gas reductions when the project is registered on the Alberta Emissions Offset Registry.
Commercial Feeding Agreements	▪ Feedlot agreements/purchase receipts demonstrating that the registered animals in the project are under the control of the feedlot operator and were being fed at the feedlot in question.	To prove that the animals being fed in the project were at the feedlot in question and being finished for market.

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Data Requirement	Examples of Records	Why the Data are Required
	▪ Feedlot records or third-party-managed data that show the tag identifiers for each feeding agreement/purchase receipts. ▪ Feedlot agreements between any entities (e.g. custom feeding, feeding associations, financial institutions, etc) that may have a claim to the animal, showing the apportioning of offsets between claimants. If the feedlot operator is a corporation: ▪ The seal of the corporation needs to be affixed to the documentation.	To ensure the feedlot operator has addressed the rights to sell the offsets.

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Appendix AG: NERP Data Collection Sheet

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NERP Data Collection Sheet

The NERP data collection spreadsheet was created to assist project developers in gathering the required data and documentation to support a NERP project. The Data Collection Spreadsheet is broken into 14 separate tabs. Each of the tabs is listed below followed by a brief description. The full excel spreadsheet is available separately from CCEMC.

TAB	DESCRIPTION
Instructions	A brief overview of the spreadsheet structure.
Disclaimer	A disclaimer associated with this data collection spreadsheet.
Record Requirements	A list of the records required for each field for each year of the project. The producer needs to enter the type of record provided.
Producer Information	General Information (i.e. name, address, etc.)
Field 1	The field tabs ask for information on the producers fields and fertilizer application practices. Please complete these tabs field by field. If you have more than 10 fields you can add additional fields by right clicking on the tab for field 1 and selecting "move or copy". Once in the "move or copy" box select the tab you would like to copy and then check the "create a copy" box. If you are implementing the NERP protocol at the intermediate or advanced performance levels please treat each field tab as a sub-field.
Field 2	
Field 3	
Field 4	
Field 5	
Field 6	
Field 7	
Field 8	
Field 9	
Field 10	

COLOUR CODING	
When completing the spreadsheet you will notice that some of the cells are colour coded. The colours mean the following:	
	Producers do not need to fill in these cells
	These cells are optional

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Appendix AH: Fed Cattle Data Collection Sheet

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Fed Cattle Data Collection Sheet

The Fed Cattle data collection spreadsheet was created to assist project developers in gathering the required data and documentation to support a Fed Cattle project. The Data Collection Spreadsheet is broken into 14 separate tabs. Each of the tabs is listed below followed by a brief description. The full excel spreadsheet is available separately from CCEMC.

TAB	DESCRIPTION
Instructions	A brief overview of the spreadsheet structure.
Record Requirements	A list of the records required for each field for each year of the project. The producer needs to enter the type of record provided.
Producer Information	General Information (i.e. name, address, etc.)
Time Tracking	These tabs are for producers and aggregators to enter the actual time they spend on each project activity.
Grouping 1	The grouping tabs ask for information on the feedlot location and baseline/project feeding practices. Please complete these tabs by animal grouping. If you have more than 10 animal groupings you can add additional groupings by right clicking on the tab for grouping 1 and selecting "move or copy". Once in the "move or copy" box select the tab you would like to copy and then check the "create a copy" box. **Note:** The data collection spreadsheet has been set up to track data by animal grouping; however, under the Fed Cattle Protocol it is also possible to track data by individual animal.
Grouping 2	
Grouping 3	
Grouping 4	
Grouping 5	
Grouping 6	
Grouping 7	
Grouping 8	
Grouping 9	
Grouping 10	

COLOUR CODING	
When completing the spreadsheet you will notice that some of the tabs are colour coded. The colours mean the following:	
	Producers do not need to fill in these cells
	These cells are optional

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Appendix AI: RAH Data Collection Sheet

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RAH Data Collection Sheet

The RAH data collection spreadsheet was created to assist project developers in gathering the required data and documentation to support a RAH project. The Data Collection Spreadsheet is broken into 15 separate tabs. Each of the tabs is listed below followed by a brief description. The full excel spreadsheet is available separately from CCEMC.

TAB	DESCRIPTION
Instructions	A brief overview of the spreadsheet structure.
Record Requirements	A list of the records required for each field for each year of the project. The producer needs to enter the type of record provided.
Producer Information	General Information (i.e. name, address, etc.)
Time Tracking	These tabs are for producers and aggregators respectively to enter the actual time they spend on each project activity.
Individual Animal Tracking	This tab is intended for producers tracking their animals individually. It asks for information animal entry/exit dates, weights and associated information.
Grouping 1	The grouping tabs ask for information on the feedlot location and entry/exit dates, weights and associated information. Please complete these tabs by animal grouping. If you have more than 10 animal groupings you can add additional groupings by right clicking on the tab for grouping 1 and selecting "move or copy". Once in the "move or copy" box select the tab you would like to copy and then check the "create a copy" box.
Grouping 2	
Grouping 3	
Grouping 4	
Grouping 5	
Grouping 6	
Grouping 7	
Grouping 8	
Grouping 9	
Grouping 10	

COLOUR CODING	
When completing the spreadsheet you will notice that some of the tabs are colour coded. The colours mean the following:	
	Producers do not need to fill in these cells
	These cells are optional

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Appendix AJ: NERP Calculators

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Introduction

Two separate calculators were generated for the NERP. The first uses the conventional baseline (with three years of baseline data) and the second can be used for either of the two dynamic baseline approaches. When using either calculator, the user must enter a number of items including:

- The incremental volume of fuel consumed or the number of additional passes on each field to operate farm equipment according to 4Rs (L);
- The crop type;
- The ecodistrict;
- The mass of crop produced (kg);
- The kg of nitrogen (inorganic and organic) applied;
- The 4R plan level; and
- Whether or not the crop was irrigated

When using the conventional baseline calculator the user must enter this data for all three baseline years in addition to the project year (with the exception of the incremental volume of fuel or additional passes). In contrast, when using either of the dynamic baseline approaches only the present year's data is needed.

A screen shot of the project condition page from both of the calculators is included below for reference. Nevertheless, the original excel calculators are needed for full functionality. The calculators are available from CCEMC. Please note that the information provided in the tables below is artificial and therefore should be viewed with caution.

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Conventional Baseline Approach

Nitrous Oxide Emission Reduction Protocol - Sample Calculation for 1 Crop* (Spring Wheat)

*Note: this process would need to be repeated for each crop on the farm for an actual project by eco-district and performance level

Management Zone	Field 1		Year	2010
Crop	Spring wheat		Irrigated	No
Ecodistrict	737			
Crop Production	1617500	kg DM		
Inorganic Fertilizer N	32500	kg N		
Manure	50	kg N		
4R Plan Level	Basic		Reduction Modifier	0.85

Ecodistrict Factors		
Efeco ($kg\ N_2O$-N/kg N)	$FRAC_L$	P/PE
0.009	0.19	0.65

Constant Factors					
$FRAC_f$	EF_{VD} ($Kg\ N_2O$-N / kg N)	EF_L ($kg\ N_2O$-N /kg N)	N_2O GWP ($CO_2e/kg\ N_2O$)	$FRAC_m$	$FRAC_{Renew}$ (Annual Crops)
0.1	0.01	0.025	298	0.2	1.0

Crop Specific Factors						
Moisture (w/w)	Yield Ratio	AG Residue Ratio	AG Residue N Concentration (kg N/kg DM)	BG Residue Ratio	BG Residue N Concentration (kg N/kg DM)	Residue N (kg N)
0.14	0.30	0.45	0.006	0.25	0.010	28036.67

Indirect and Direct Emissions					
Manure Use ($kg\ N_2O$)	Synthetic Fertilizer and Lime Use ($kg\ N_2O$)	Manure Soil and Crop Dynamics ($kg\ N_2O$)	Inorganic Fertilizer Leaching (kg N)	Inorganic Fertilizer Volatilization (kg N)	Inorganic FertilizerSoil and Crop Dynamics ($kg\ N_2O$)
0.71	461.18	0.53	11501.97	3250.00	900.77

Total Emissions			
Total ($kg\ N_2O$)	Total ($kg\ N_2O$/kg crop)	Crop Event ($Kg\ CO_2e$/kg crop)	Per MZ ($t\ CO_2e$)
1158.90	0.00	0.21	345.35

Credits Summary					
MU Designation	Crop	Emission Reduction ($Kg\ CO_2e$/kg crop)	Credits ($t\ CO_2e$)	Emissions from Fertilizer and Lime Distribution ($t\ CO_2e$)	Net Credits ($t\ CO_2e$)
Field 1	Spring wheat	0.04	60.88	0.06	60.82

Nitrous Oxide Emission Reduction Protocol - Sample Calculation for 1 Crop* (Spring Wheat)

*Note: this process would need to be repeated for each crop on the farm for an actual project by eco-district and performance level

Management Zone	Field 1		Year	2010	
Crop	Spring wheat		Irrigated	No	
Ecodistrict	737		Dynamic Baseline	1	
Crop Production	1617500	kg DM	**Note**: If using Dynamic Baseline #2, the crop production value should be the five year average published by AFSC		
Inorganic Fertilizer N	32500	kg N			
Manure	0	kg N	Discount Factor	0.95	
4R Plan Level	Basic		Reduction Modifier	0.85	

Ecodistrict Factors

Efeco (kg N_2O-N/kg N)	$FRAC_L$	P/PE
0.009	0.19	0.65

Constant Factors

$FRAC_f$	EF_{VD} (Kg N_2O-N / kg N)	EF_L (kg N_2O-N /kg N)	N_2O GWP (CO_2e/kg N_2O)	$FRAC_m$	$FRAC_{Renew}$ (Annual Crops)
0.1	0.01	0.025	298	0.2	1.0

Crop Specific Factors

Moisture (w/w)	Yield Ratio	AG Residue Ratio	AG Residue N Concentration (kg N/kg DM)	BG Residue Ratio	BG Residue N Concentration (kg N/kg DM)	Residue N (kg N)
0.14	0.30	0.45	0.006	0.25	0.010	28036.67

Indirect and Direct Emissions

Manure Use ($kg N_2O$)	Synthetic Fertilizer and Lime Use ($kg N_2O$)	Manure Soil and Crop Dynamics ($kg N_2O$)	Inorganic Fertilizer Leaching (kg N)	Inorganic Fertilizer Volatilization (kg N)	Inorganic Fertilizer Soil and Crop Dynamics ($kg N_2O$)
0.00	461.18	0.00	11501.97	3250.00	900.77

Total Emissions

Total (non-manure emissions) ($kg N_2O$)	Total ($kg N_2O$/kg crop)	Crop Event ($Kg CO_2e$/kg crop)	Per MZ ($t CO_2e$)
1361.95	0.00	0.25	405.86

Credits Summary

MU Designation	Crop	Emission Reduction ($Kg CO_2e$)	Credits ($t CO_2e$)	Emissions from Fertilizer and Lime Distribution ($t CO_2e$)	Net Credits ($t CO_2e$)
Field 1	Spring wheat	57835.19	57.84	0.18	57.65

Appendix AK: Fed Cattle Calculator

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Introduction

The Fed Cattle Calculator was built to assist project developers in calculating potential emission reductions from the Fed Cattle Protocol. When using the calculator the user must enter a number of items including:

- Days on feed;
- Average number of head;
- Daily dry matter intake;
- Total gain for the grouping;
- Percent edible oils/fat content of the diet;
- Percent concentrates;
- Percent total digestible nutrients; and
- Crude protein.

A screen shot of the project condition page from the calculator is included below for reference. The original excel calculator is needed for full functionality. This calculator is available from CCEMC. Please note that the information provided in the tables below is artificial and therefore should be viewed with caution.

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Reducing Days on Feed in Beef Cattle - Sample Calculation for Fall Steers (500-600 lbs) Using the Method Described in the Protocol

*Note: this process would need to be repeated for each animal grouping for an actual project

Sample Project Data Set

Lot ID	Number of Head Out (#)	Pay Weight (lbs)	Total Head Days (Days)	Days on Feed - Deads Out (Days)	Average Number of Head (#)	DDMI - Deads Out (lbs DMI/hd/day)	In Weight - Deads Out (lbs/head)	Out Weight - Deads Out (lbs/head)	Gain - Deads Out (lbs)	Total Gain (kg)	Total Hot Carcass Weight Produced (kg)
Totals	5022.00	6289227.00	1190472.00		5127.48					1583445.94	918398.65
Averages				231.41		19.12	561.38	1260.66	699.27		

Edible Oil / Fat Content of Diet	3.50	%
Concentrates	85.00	%
Total Digestable Nutrients	79.00	%
Crude Protein	12.84	%

Year	2011

Default Factors

GE Diet (MJ/kg)	EF Enteric (%)	EC Methane (MJ/kg CH_4)	Urinary Energy	Ash (%)	B_o - Methane Producing Capacity (m^3 CH_4/kg VS Excreted)	Density of Methane (kg/m^3 CH_4)	CF Protein (kg feed protein/kg nitrogen)	MCF (%)
18.45	4.00	55.65	0.02	2.00	0.19	0.67	6.25	2.0

Default Factors Continued

Nitrogen Retention (kg N retained/kg intake)	CF Manure (kg N_2O-N/kg Nitrogen Excreted)	Frac Storage	EF Storage (kg N_2O-N/kg Nitrogen Excreted)	Frac Volatilization	EF Volatilization (kg N_2O-N/kg Nitrogen Excreted)	Frac Leach	EF Leach (kg N_2O-N/kg Nitrogen Excreted)	GWP of CH_4	GWP of N_2O
0.07	0.02	0.6	0.007	0.42	0.01	0.1	0.0250	25	298

Equations

Equation #1 - Enteric Methane Emissions (kg CH_4)	Equation #2 - Daily Volatile Solids Excreted in Manure (kg Volatile Solids/head/day)	Equation #3 - Manure Methane Emissions (kg CH_4)	Equation #4 - Daily Nitrogen Excreted in Manure (kg N Excreted/head/day)	Equation #5 - Direct N_2O Emissions from Manure (kg N_2O)	Equation #6 - Direct N_2O Emissions from Manure Decomposition (kg N_2O)	Equation #7 - Indirect N_2O Emissions from Volatilization of Manure (kg N_2O)	Equation #8 - Indirect N_2O Emissions from Leaching of Manure Nitrogen (kg N_2O)
136477.764	1.955	5905.858	0.166	6179.642	1297.725	1297.725	772.455

Project Emissions

Total CH_4 Emissions (kg CH_4)	Total N_2O Emissions (kg N_2O)	Project CH_4 Emissions Intensity (kg CH_4/kg Carcass Weight)	Project N_2O Emissions Intensity (kg N_2O/kg Carcass Weight)
142,383.622	9,547.547	0.155	0.010

Baseline Emissions

Baseline CH_4 Emissions Intensity (kg CH_4/kg Carcass Weight)	Baseline N_2O Emissions Intensity (kg N_2O/kg Carcass Weight)
0.159	0.011

Difference in Project and Baseline Emission Intensities

CH_4 Emissions (kg CH_4/kg Carcass Weight)	N_2O Emissions (kg N_2O/kg Carcass Weight)
0.004	0.001

Total Emission Reductions

Total CH_4 Emission Reductions (kg CH_4)	Total N_2O Emission Reductions (kg N_2O)	Total Emission Reductions (kg CO_2e)	Total Credits (tCO_2e)
3495.22	737.18	307060.32	307

Appendix AL: RAH Calculator

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Introduction

The RAH Calculator was built to assist project developers in calculating potential emission reductions from the RAH Protocol. When using the calculator the user must enter a number of items including:

- Average age at harvest;
- Number in production;
- Average live weight;
- Animal grouping; and
- Average carcass weight at harvest (with 4% shrink and 58% dressing).

A screen shot of the project condition page from the calculator is included below for reference. Nevertheless, the original excel calculator is needed for full functionality. This calculator is available from CCEMC. Please note that the information provided in the tables below is artificial and therefore should be viewed with caution.

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Reducing the Age at Harvest of Beef Cattle - Sample Project Calculation

*Note: this process would need to be repeated for each animal grouping for an actual project

Average Age at Harvest	15.00	Months
Number in Production	2500.00	Head
Average Live Weight	618.20	Kg
Average Carcass Weight at Harvest (with 4% shrink and 58% dressing)	344.21	Kg

Animal Grouping	Yearling-fed Steers
Project Year	2011

Default Factors

Global Warming Potential of Methane (CH_4)	Global Warming Potential of Nitrous Oxide (N_2O)	Standard Carcass Weight (Kg)
25.00	298.00	345.00

Equations

Equation #1 - Enteric Emissions Intensity (kg CH_4/kg Carcass Beef / Year)	Equation #2 - Manure Methane Enteric Emissions Intensity (kg Manure CH_4 Produced / kg Carcass Beef / Year)	Equation #3 - Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg manure N_2O Produced/ kg Carcass Beef / Year)
0.530	0.006	0.010

Relative GHG Intensities

Enteric Emissions Intensity (kg CO_2e/ kg Carcass Beef / Year)	Manure Methane Enteric Emissions Intensity (kg Manure CO_2e Produced / kg Carcass Beef / Year)	Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg manure CO_2e Produced/ kg Carcass Beef / Year)
13.246	0.151	2.947

Normalization

Normalized Enteric Emissions Intensity (Kg CO_2e/ Kg Carcass Beef / Year)	Normalized Manure Methane Enteric Emissions Intensity (kg Manure CO_2e Produced / kg Carcass Beef / Year)	Normalized Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg manure CO_2e Produced/ kg Carcass Beef / Year)
13.277	0.151	2.953

Project Emissions

Enteric Emissions Intensity (Kg CO_2e/ Kg Carcass Beef / Year)	Manure Methane Enteric Emissions Intensity (kg CO_2e Produced / kg Carcass Beef / Year)	Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg CO_2e Produced/ kg Carcass Beef / Year)
4580.406	52.055	1018.895

Baseline Emissions

Enteric Emissions Intensity (Kg CO_2e/ Kg Carcass Beef / Year)	Manure Methane Enteric Emissions Intensity (kg CO_2e Produced / kg Carcass Beef / Year)	Indirect and Direct Manure Nitrous Oxide Emissions Intensity (kg CO_2e Produced/ kg Carcass Beef / Year)
6272.808	101.627	1836.259

Total Emission Reductions

Enteric Emission Reduction (tCO_2e)	Manure Methane Enteric Emission Reduction (tCO_2e)	Indirect and Direct Manure Nitrous Oxide Emission Reductions (tCO_2e)	Total Credits (tCO_2e)
4231.01	123.93	2043.41	6398.34

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Appendix AM: NERP Offset Project Plan

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Alberta Offset System

Offset Project Plan for XYZ Inc.'s

Nitrous Oxide Emission Reductions (NERP) Aggregation Project - Protocol Validation Study

(June 2015)

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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 Reductions in Agriculture Quantification Protocol v 1.1 April 2015. 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 Plan (OPP) produced as part of the larger Protocol Validation Study. It is meant to provide guidance to project developers on applying the OPP template (http://esrd.alberta.ca/focus/alberta-and-climate-change/regulating-greenhouse-gas-emissions/alberta-based-offset-credit-system/offset-credit-system-protocols/documents/OffsetProjectPlan-Feb2013.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.

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1 Project Scope and Site Description

1.1 Project Scope

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

Table AM- 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 re-deposition 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)
Credit Duration Period:	N/A - The NERP Protocol Validation Study is a non-commercial exercise. The Alberta offset system allows eligibility for 8 years, (e.g. January 1, 2011 to December 31, 2019), with the potential for an additional five years upon government approval.
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.
Estimated Emission Reductions/Removals:	Up to 2,500 t CO_2e/year (note – this is not a commercial exercise so tonnage is small and based on five fictitious farms)

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Table AM- 1: Project Details	
Applicable Quantification Protocol(s):	Alberta Environment & Parks Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.1, April 2015
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 1.3 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:	Submitted via the Spatial Locator Template to Alberta Environment and Parks.
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 prescribed through the 4R 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 Plan for the Protocol Validation Study. The verifier has no actual or perceived conflicts of interest associated with this project. Verification is expected to occur on an annual basis by a qualified third party.
Project Registration:	N/A – the NERP Protocol Validation Study is a non-commercial exercise. Therefore, the project will not be registered in

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Table AM- 1: Project Details	
	Alberta or in any other jurisdiction. However, it will be implemented according to ministerial guidelines.

1.2 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. Legal land descriptions for each of these farms are detailed in the special locator template required by Alberta Environment and Parks.

1.3 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)[41]. The Project complies with the Specified Gas Emitters Regulation Quantification Protocol for Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.1, April 2015.

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

Table AM- 2: 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 plan 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.	The activities are implemented under the Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions Protocol V1.1, April 2015.
Be registered on the registry.	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.

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2 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.	

3 Other Project Information

3.1 Conditions Prior to Project Initiation

Each of the participating sections of land has been in operation for a minimum of three years prior to the implementation of the Project. Prior to the implementation of the Project, a 4R Comprehensive Nitrogen Stewardship Plan (hereafter called the 4R Plan) according to the NERP Protocol, had not been exercised for the sections of land, and associated crops aggregated under this project.

3.2 Description of How the Project Will Achieve Greenhouse Gas Emission Reductions/Removals

According to the Government of Alberta Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions, the opportunity for generating direct and indirect emission reductions from this project is related to the implementation of a 4R Plan at a basic, intermediate or advanced level of performance, relative to the baseline conditions.

Application of nitrogen (from manure, biological fixation, fertilizer, etc.) is an important component of agricultural production. Such applications, however, can lead to emissions of N_2O. Beneficial practices for nitrogen management, which synchronize the availability of nitrogen (N) with the requirements of the crop, minimize the emissions of N_2O per unit of crop production.

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The protocol quantifies carbon offsets from projects which implement BMPs in the context of a comprehensive 4R Plan (Right Source, Right Rate, Right Time and Right Place™) for their farms. The implementation of a 4R Plan, including the BMPs specified in the 4R Plan, reduces the N_2O emitted per kg of crop grown.

Emissions reductions are compared using a functionally equivalent unit of emissions reductions per kilogram of crop produced.

3.3 Project Eligibility

The project meets the requirements of the Nitrous Oxide Emission Reductions Protocol. The applicability criteria, sources and sinks, and quantification methodologies for the NERP Validation Study have been determined in accordance with the Government of Alberta Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions (Version 1.1, April 2015) and the most recent version of the Technical Guidance for Offset Project Developers (Version 4.0, February 2013). As described in the protocol, the project must conform to or meet certain criteria. Table AM-3 describes how the protocol criteria are met and the relevant section of the Offset Project Plan.

Table AM- 3: Protocol Applicability Criteria

Applicability Criterion as per the Protocol[42]	How Criteria Are Met
Evidence that an Accredited Professional Advisor approved 4R Plan has been implemented on each farm being included in the project. All fields of a farm must be enrolled under the 4R program with a clear delineation of the farm enterprise boundary. To avoid leakage of nitrogen or crop yield, the entire farm enterprise must be under 4R management and must be incorporated into this protocol.	XYZ Inc. has a 4R Plan on each farm involved, within the data management system, signed off and approved by an accredited APA.
Carbon offset quantification is calculated on a mass basis using nitrogen inputs and crop mass per crop type; across the farm enterprise, in two ways: a. At the field level so long as the fields are in the same EcoDistrict and have the same crop type and 4R Plan performance level, or	Offsets are calculated on a mass basis by crop at the field or farm level depending on whether or not the farm spans more than one EcoDistrict.

[42] Draft Alberta Environment and Parks Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions (April 2015, Version: 1.1)

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Table AM- 3: Protocol Applicability Criteria	
Applicability Criterion as per the Protocol[42]	**How Criteria Are Met**
b. At the farm level so long as fields are in the same EcoDistrict and have the same crop type and 4R Plan performance level. The 4R nitrogen management must still occur according to the 4R Plan, with project documentation collected to show conformance to the Plan.	
The 4R Plan shall include a clear identification of the baseline and project condition.	The baseline and project condition are identified in the 4R Plan as per the quantification approach of dynamic baseline 1 for Farms #1 to #4 and the conventional baseline for Farm #5.
The 4R Plan shall have been designed and signed/sealed by an Accredited Professional Advisor (see Appendix D).	The 4R Plan has been signed by an APA using the form in Appendix D of the protocol.
All farms being included in the project are being implemented according to the 4R Plan and have received annual sign-off by the Accredited Professional Advisors.	All farms included have implemented a 4R Plan and received sign off.
Only annual crops are eligible for participation. Annual crop types, according to the list below, are the same in the baseline and project to ensure equivalency in residue nitrogen accounting: wheat, winter wheat, fall rye, barley, barley silage, corn, corn silage, pulses, canola, oats, flax, others.	Only annual crops have been included in the project.
Fields under summer fallow must be included in the 4R Plan, for considerations of crop rotation in the cropping program, but are excluded from the greenhouse gas accounting for that year since nitrogen is not applied. Lands under perennial forage, grazed by animals, including swath grazing and cattle on stubble are excluded from this protocol since 4R management does not occur. Forages grown for silage or baling are	Fields under summer fallow are documented as part of the 4R Plan. However, these fields have been excluded from the GHG accounting.

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Table AM- 3: Protocol Applicability Criteria	
Applicability Criterion as per the Protocol[42]	**How Criteria Are Met**
eligible. Burning of straw is not an eligible activity under the protocol.	
A farm where fields are receiving manure as fertilizer are eligible to participate under the protocol, but all other organic nitrogen sources are currently excluded from eligibility. Fields receiving other organic nitrogen sources (other than crop residue remaining from the previous year) must be included in the 4R Plan, but are excluded from greenhouse gas accounting for the year. When using manure as a soil amendment, the Project Developer must be able to determine nitrogen content of the manure for quantification under the protocol.	Fields where manure was applied were included and the nitrogen content of the manure documented in XYZ Inc.'s data management system.
Crops produced under irrigation in the baseline are also under irrigation in the project for the duration of the project.	Irrigated crops were irrigated in both the baseline and project.
The conventional baseline nitrous oxide emissions are based on the average three crop-type years prior to implementation of the 4R Plan. If a farm experiences a devastating year that results in 50 per cent less crop yield (from a five-year average), that year must be removed from the three-year average baseline and replaced with another crop year.	N/A – Dynamic baseline 1 was used for Farms #1 to #4. For Farm #5, no extreme events occurred.
In order to provide consistency and completeness to the greenhouse gas accounting under the protocol, farms in the project must have all fields enrolled in the 4R program and need to be part of the project and baseline greenhouse gas accounting. For the conventional baseline approach (i.e., historic baseline), any new lands/crops added to the farm will need to be part of a new project since they were not	All fields in the project were enrolled in the 4R program and part of the project and baseline GHG accounting.

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Table AM- 3: Protocol Applicability Criteria	
Applicability Criterion as per the Protocol[42]	**How Criteria Are Met**
part of the conventional baseline as defined by the farm enterprise boundary.	
When using the conventional baseline approach, all eligible crop types managed by the participating farm occurring in the baseline are included in the 4R Plan and in the quantification of emissions and reductions.	Dynamic baseline 1 quantification approach was used for Farms #1 through #4. For Farm #5, all eligible crops were included in the 4R Plan and in the quantification of emissions and reductions.
Project emission reductions must be calculated on a crop mass basis (using Canada's National Inventory Report quantification method as described in the protocol).	Emission reductions were quantified on a crop mass basis as per the protocol.
Determining the mass of each crop type produced on the farm is conducted according to the Acceptable Crop Mass Determination Methods outlined in Appendix I of the protocol.	The mass of each crop type was determined using the fixed scale method on the farms included in this project.
Bilateral agreements between parties are executed as written contracts and should consider the contracting guidance provided in the current Technical Guidance for Offset Project Developers.	Contracts have been written considering the *Technical Guidance for Offset Project Developers*, and are available at verification.
The quantification of reductions achieved by the project is based on actual measurement and monitoring as required in the protocol	Reductions were quantified based on actual measurement and monitoring as outlined in the protocol.
The project meets the eligibility criteria stated in section 7.0 of the Specified Gas Emitters Regulation. In order to qualify, emissions reductions must: a. Occur in Alberta; b. Result from actions not otherwise required by law; c. Result from actions taken on or after January 1, 2002; d. Be real, demonstrable and quantifiable; e. Have clearly established ownership including, if applicable, appropriate, documented transfers of carbon	The Project meets the requirements for offset eligibility as specified in the applicable regulation and guidance documents for the Alberta Offset System.

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Table AM- 3: Protocol Applicability Criteria	
Applicability Criterion as per the Protocol[42]	**How Criteria Are Met**
ownership from the land owner to land lessee; f. Be counted once for compliance; and g. Be implemented according to ministerial guidelines.	

3.4 Flexibility Mechanisms

The Protocol identifies four (4) flexibility mechanisms for Project developers in quantifying offsets. Table AM-4 below identifies which of these flexibility mechanisms has been applied in quantifying offsets from the project. A justification of why the flexibility mechanism has been exercised is also provided.

Table AM- 4: Summary of Flexibility Mechanisms Applied		
Flexibility Mechanism as per the Protocol[43]	**Exercised (Yes/No)**	**Justification**
In the conventional baseline, a Project Developer may choose to select non-consecutive years for crop types to set the baseline to match with data availability and to account for any extra-ordinary growing seasons. Trend data on extreme weather events to demonstrate how the excluded year is extraordinary will be needed for justification. Gaps between baseline seasons or gaps between the baseline period and project implementation period must be justified such that they are not contributing to an over-estimation of greenhouse gas emission reductions.	No	N/A
One of two Dynamic Baseline approaches may be employed by calculating the expected project emissions from the estimated baseline emissions and the application of the reduction modifiers outlined in Table 1 of the protocol: a. In order to provide consistency and completeness to the greenhouse gas accounting under this protocol, farms in the project must have all fields	Yes	Dynamic baseline one has been used in this project for Farms #1 through #4 and all fields were enrolled in the 4R program.

[43] Ibid

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Table AM- 4: Summary of Flexibility Mechanisms Applied		
Flexibility Mechanism as per the Protocol[43]	**Exercised (Yes/No)**	**Justification**
enrolled in the 4R program and need to be part of the project and baseline greenhouse gas accounting; b. Because the baseline is recalculated each year under the Dynamic Baseline flexibility mechanisms, additional land and crops acquired by the farm must be included in the project. When this occurs the project plan must be updated and these new lands and crops will be limited to the duration of the original project's crediting period; and c. Project Developers can begin using Dynamic Baseline One or Dynamic Baseline Two. However, Dynamic Baseline Two can only be used for a maximum of two years. A project cannot switch from Dynamic Baseline One to using the Dynamic Baseline Two.		
The Project Developer may exclude On-Site Fertilizer and Lime Distribution (Table 6 of the protocol - SS P7) from quantification where it can be demonstrated that no increased fuel use due to an additional fertilizer and lime application in the project condition relative to the baseline condition has occurred as a result of implementing the 4R Plan.	Yes	Emissions from fuel use in the project will not increase as a result of implementing the 4R Plan. The 4R Plan does not include an in-crop application of nitrogen fertilizer and thus fuel emissions will not be increased over baseline conditions. The APA has overseen the development and implementation of the 4R Plan and has signed off that no extra crop nitrogen application occurred.
The protocol applies to a single component (nitrogen management) of farm operations. As such, this protocol can be combined with other protocols where multiple projects are undertaken to lower overall greenhouse gas emissions from farm operations.	No	Reductions from other conservation cropping activities are addressed by a different project plan and project reporting.

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3.5 Project Technologies, Products, Services and the Expected Level of Activity

The 4R Plan and BMP Performance Levels for Drier Soils (P/PE Ratio of <1) are provided in Table AM-5 below. The performance level implemented in this project is the basic level.

Table AM- 5: BMP Performance Levels for Drier Soils

Performance Level	Right Source	Right Rate	Right Time	Right Place	Reduction Modifier [i]
Basic	• Ammonium-based formulation	• Apply nitrogen according to recommendation of 4R Plan [ii], using annual soil testing and recommendations developed within the 4R Plan	• Apply in spring; • Split apply; or • Apply after soil cools to 10^0C	Apply in bands / Injection	0.85
Intermediate	• Ammonium-based formulation • Use slow / controlled release fertilizers • Inhibitors; or • Stabilized N	• Apply nitrogen according to qualitative estimates of field variability (landscape position, soil variability) using annual soil testing and recommendations developed within the 4R Plan.			0.75
Advanced		• Apply nitrogen according to quantified field variability (e.g.,. digitized soil maps, grid sampling, satellite imagery, real time crop sensors) using annual soil testing and recommendations developed within the 4R Plan			0.75[44]

i - Scientific development and consensus of the reduction modifiers can be found in the following document: Climate Check, 2009. Decision Paper for Nitrous Oxide Emission Reduction Protocol. Prepared for Climate Change Central and Canadian Fertilizer Institute.

ii – The 4R Plan must account for all sources of nitrogen, including previous crop residues, synthetic fertilizer, manure or other organic fertilizers. The reduction modifier is not applied to nitrogen from manure. Fields receiving organic fertilizers other than manure are excluded for the quantification year in which they are applied.

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3.6 Identification of Risks

There are a number of issues associated with offset credits and the evidence that is required to support assurance. In their report titled "Scoping Study of Assurance Standards to Verify Agricultural Greenhouse Gas Offset Projects" (2011), KPMG identified a number of these risks and ways to mitigate them. Table AM-6 below was taken directly from KPMG's report and represents risks that are applicable to all agricultural offset credits. Table AM-7 presents' additional risks and control measures that are specific to the Nitrous Oxide Emissions Reductions Protocol. All of the below control measures have been applied in this project.

Table AM- 6: Risks Associated with Agricultural Offset Credits (Source: KPMG, 2011)

Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk	Action taken to mitigate risk
Project developer does not have ownership of emission reductions.	Signed offset credit agreement between project developer and land manager laying out terms for transfer of offset credits.	Management review[45] and approval of offset credit agreements.	Management review of agreements completed.
Land manager does not have the right to assign emission reductions to project developer.	Signed offset credit agreement between project developer and land manager laying out terms for transfer of offset credits.	Management review of offset credit files for completeness of information regarding ownership and leasing arrangements.	Management review of offset credit files completed.
Land manager has already sold emission reduction rights on another registry to another project developer.	Signed offset credit agreement between project developer and land manager that clearly states the land manager has not sold offset credits previously under the protocol.	Management review of current NERP projects listed on the Alberta Registry.	Management review of projects on registry completed.

[45] Defined as the analysis and evaluation of information prepared by one individual and reviewed by a second independent manager.

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Table AM- 6: Risks Associated with Agricultural Offset Credits (Source: KPMG, 2011)			
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**	**Action taken to mitigate risk**
Fields claimed that do not exist in province of Alberta.	Checks on the legal land location to ensure it exists in Alberta through web-based mapping provided by the Government of Alberta (e.g. provincial base map or AGRISID*).	Management review of offset credit files for completeness of information.	Management review of offset credit files completed.
Data management system does not track required ownership, farming practices, etc.	Detailed listing of all fields/farms included in offset claim by year that links to information required to establish ownership, eligibility, 4R Plans and offset credit claimed.	Management review of data transparency (i.e. Linkages are maintained both ways between base data and field specific offset claims).	Management review of data completed.
Insufficient controls over stored data.	Process documentation relating to data management and record keeping for offset credits.	Restricted user access to offset claim calculations and data.	User access to database and credit calculations restricted by program security settings.
Incorrect formulae for calculating sequestered amounts.	Process documentation relating to data management and record keeping for offset credits.	Exception reports to identify duplicate records, incorrect emission factors records with values outside of expected parameters.	Exception reports generated.
Discrepancies between reported amounts of offsets and data management system.	Process documentation relating to data management and record keeping for offset credits.	Management review of reported data to ensure it is consistent with underlying offset credit data.	Management review of data completed.

* http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag3254#f4

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Table AM- 7: Additional Risks Associated with the Nitrous Oxide Emissions Reductions Protocol (Source: KPMG, 2011)			
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**	**Action taken to mitigate risk**
Accredited Professional Advisor (APA) is not accredited.	Review of Professional Advisor's credentials/certificate to ensure they meet the requirements noted in Appendix C of the protocol.	Management check of Professional Advisor credentials against professional association records and Canadian Fertilizer Institute's training program.*	Management cross check with professional association records completed.
Field practices claimed differ from those that occurred or are not fully substantiated.	Inspection records completed by field agent and APA that confirms that the 4R practices in the Plan were implemented.	Management review of 4R practices data to ensure protocol requirements are met. AND Management review of offset credit files for completeness of 4R Plan/practices.	Management review of data and offset credit files for completeness.
Performance level implemented differs from performance level claimed.	4R Plan signed off by Accredited Professional Advisor.	Management review of 4R Plan to ensure it is signed off by Accredited Professional Advisor.	Management review of 4R Plan.

* http://growzone.cfi.ca - The Accredited Professional Advisor certification training program link.

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4 Inventory of Sources and Sinks

Table AM-8 below identifies all the sources, sinks and reservoirs (SSRs) as listed in the Government of Alberta Quantification Protocol for Agricultural Nitrous Oxide Emission Reductions (Version 1.1, April 2015). Specifically, the table states whether each source and sink is related, controlled, or affected by the project, whether they are included or not for quantification and whether they are included or not for the NERP Validation Study Project, with justification as to why.

Table AM- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	Controlled, Related, Affected	Incl. / Excl. in Protocol	Included / Excluded in Project (with justification)
Baseline Condition:			
Upstream Sources and Sinks During Baseline Operation			
B1 Seed Production	Related	Exclude	Excluded as per protocol
B2 Seed Transportation (Off-Site)	Related	Exclude	Excluded as per protocol
B5 Fertilizer and Lime Production	Related	Exclude	Excluded as per protocol
B6 Fertilizer and Lime Distribution (Off-Site)	Related	Exclude	Excluded as per protocol
B9 Pesticide Production	Related	Exclude	Excluded as per protocol
B10 Pesticide Distribution (Off-Site)	Related	Exclude	Excluded as per protocol
B17 Fuel Extraction and Processing	Related	Exclude	Excluded as per protocol
B18 Fuel Delivery	Related	Exclude	Excluded as per protocol
Onsite Sources and Sinks During Baseline Operation			
B3 Seed Distribution (On-Site)	Controlled	Exclude	Excluded as per protocol
B4 Seed Use	Controlled	Exclude	Excluded as per protocol
B7 Fertilizer and Lime Distribution (On-Site)	Controlled	**Conditional Inclusion in Protocol**	**Excluded** as per protocol flexibility mechanism
B8 Fertilizer and Lime Use	Controlled	Include	Included as per protocol
B11 Pesticide Distribution	Controlled	Exclude	Excluded as per protocol
B12 Pesticide Use	Controlled	Exclude	Excluded as per protocol

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Table AM- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	Controlled, Related, Affected	Incl. / Excl. in Protocol	Included / Excluded in Project (with justification)
B13 Soil Crop Dynamics	Controlled	Include	Included as per protocol
B14 Farm Operations	Controlled	Exclude	Excluded as per protocol
B15 Crop Product Transportation (On-Site)	Controlled	Exclude	Excluded as per protocol
Downstream Sources and Sinks During Baseline Operation			
B16 Crop Product Transportation	Related	Exclude	Excluded as per protocol
B17 Crop Product Processing	Related	Exclude	Excluded as per protocol
Other Sources and Sinks			
B20 Building Equipment	Related	Exclude	Excluded as per protocol
B21 Transportation of Equipment	Related	Exclude	Excluded as per protocol
B22 Testing of Equipment	Related	Exclude	Excluded as per protocol
Project Condition:			
Upstream Sources and Sinks During Project Operation			
P1 Seed Production	Related	Exclude	Excluded as per protocol
P2 Seed Transportation (Off-Site)	Related	Exclude	Excluded as per protocol
P5 Fertilizer and Lime Production	Related	Exclude	Excluded as per protocol
P6 Fertilizer and Lime Distribution (Off-Site)	Related	Exclude	Excluded as per protocol
P9 Pesticide Production	Related	Exclude	Excluded as per protocol
P10 Pesticide Distribution (Off-Site)	Related	Exclude	Excluded as per protocol
P17 Fuel Extraction and Processing	Related	Exclude	Excluded as per protocol
P18 Fuel Delivery	Related	Exclude	Excluded as per protocol
Onsite Sources and Sinks during Project Operation			
P3 Seed Distribution (On-Site)	Controlled	Exclude	Excluded as per protocol
P4 Seed Use	Controlled	Exclude	Excluded as per protocol

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Table AM- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	Controlled, Related, Affected	Incl. / Excl. in Protocol	Included / Excluded in Project (with justification)
P7 Fertilizer and Lime Distribution (On-Site)	Controlled	**Conditional Inclusion in Protocol**	**Excluded** as per protocol flexibility mechanism
P8 Fertilizer and Lime Use	Controlled	Include	Included as per protocol
P11 Pesticide Distribution	Controlled	Exclude	Excluded as per protocol
P12 Pesticide Use	Controlled	Exclude	Excluded as per protocol
P13 Soil Crop Dynamics	Controlled	Include	Included as per protocol
P14 Farm Operations	Controlled	Exclude	Excluded as per protocol
P15 Crop Product Transportation (On-Site)	Controlled	Exclude	Excluded as per protocol
Downstream Sources and Sinks During Project Operation			
P16 Crop Product Transportation (Off-Site)	Related	Exclude	Excluded as per protocol
P17 Crop Product Processing	Related	Exclude	Excluded as per protocol
Other Sources and Sinks			
P20 Building Equipment	Related	Exclude	Excluded as per protocol
P21 Transportation of Equipment	Related	Exclude	Excluded as per protocol
P22 Testing of Equipment	Related	Exclude	Excluded as per protocol

Figure AM-1 and Figure AM-2 below are process flow diagrams representing the project and baseline conditions respectively.

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Figure AM- 1: Process Flow Diagram for the Project Condition

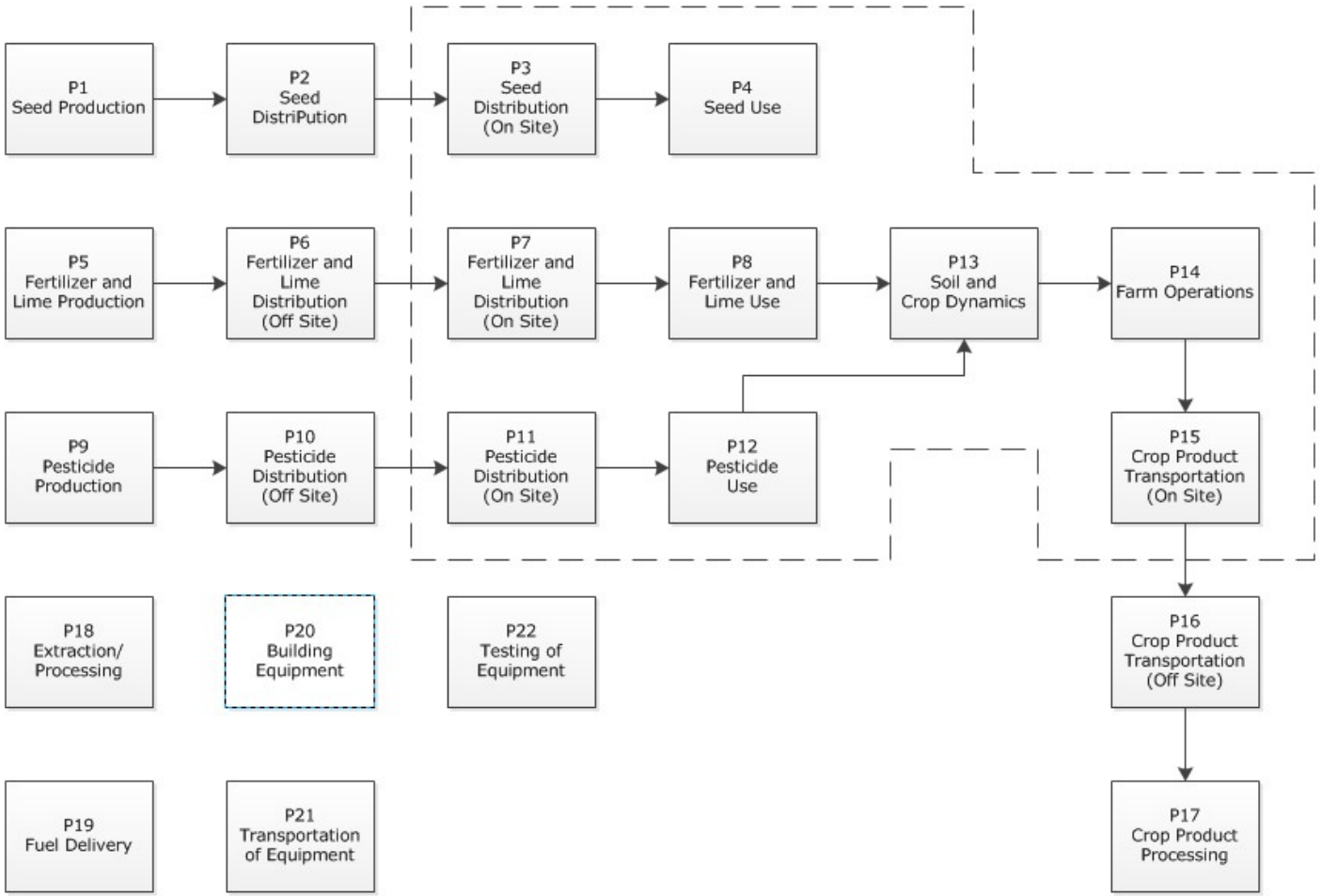
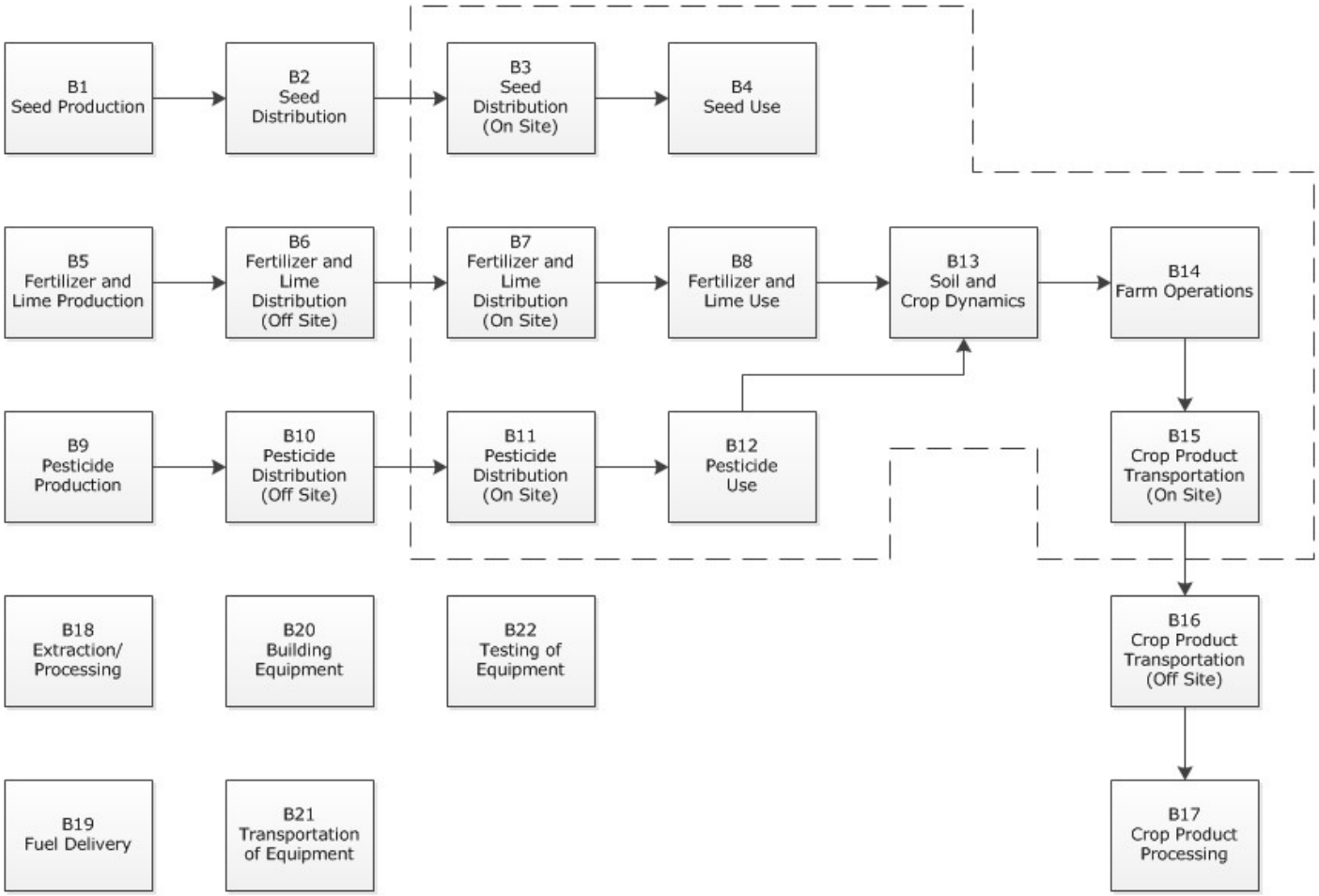


Figure AM- 2: Process Flow Diagram for the Baseline Condition



5 Identification of the Baseline and Project

5.1 The Baseline Condition

The Baseline Condition represents the nitrogen fertilizer application rates for each crop produced, and the GHG emissions per kg crop associated with these rates of amendment, in place before the beginning of the project.

The Protocol allows the baseline condition to be calculated in one of two ways: 1) using the historic benchmark approach which estimates the baseline GHG emissions based on three years of site-specific data from crop events on farm operations prior to the implementation of a 4-R plan; and 2) using one of two dynamic baseline approaches which estimate the likely baseline GHG emissions if a 4R Plan had not been implemented. Both dynamic baseline approaches are conservative in that they result in fewer credits being generated, on average, than when a conventional baseline is used. In this project, dynamic baseline one has been employed for Farms #1 through #5 and the conventional baseline has been employed for Farm #5. Comparable metrics are maintained between the baseline scenario and the project condition by calculating emissions per kg of crop produced.

For those growers with sophisticated nitrogen practices during baseline period, such as annual testing or variable rate application, incremental N_2O emission reductions are achieved through the application of a 4R Plan.

Table AM-9 below summarizes the baseline periods for each of the project sites aggregated under the NERP Validation Study and the baseline quantification approach used.

Table AM- 9: Baseline Period (Years) for Each of the Project Sites Aggregated

Farm:	Baseline Period:	Baseline Quantification Approach:
Farm #1	N/A	Dynamic Baseline #1
Farm #2	N/A	Dynamic Baseline #1
Farm #3	N/A	Dynamic Baseline #1
Farm #4	N/A	Dynamic Baseline #1
Farm #5	2008-2010	Conventional Baseline

5.2 The Project Condition

The project condition is defined by implementation of a 4R Plan. Quantifying N_2O in the project involves nitrogen inputs, time, placement, and the form of fertilizer, in addition to rate of fertilizer application.

To account for emission reductions achieved by project innovations (i.e. better nitrogen management), a reduction modifier is multiplied against the emissions calculated according to a

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method defined in the protocol, which is based on the National Emissions Inventory methodology for N_2O emissions from farmland.

The 4R Plan, with the associated BMPs required for each performance level, are implemented to achieve a reduction of N_2O emissions in the project as compared to the baseline scenario. As the performance level increases from basic to intermediate/advanced, the 4R Plan addresses more precisely field variability through the development of more sophisticated BMPs. The greater the performance level, the more potential there is for emission reductions as shown by a smaller reduction modifier. Emissions in the baseline and project conditions are calculated using functionally equivalent units of kilograms (kg) CO_2e per kg of crop produced on a dry matter basis. In this project the basic level is being employed.

6 Quantification Plan

Section 4 of the Alberta Quantification Protocol for Nitrous Oxide Emission Reductions defines the appropriate methodology in quantifying emission reductions from related projects.

6.1 Quantification Methodology

Total emission reductions associated with the project are the sum of the emissions reductions calculated for each crop event for each crop grown on the farms. The sequence of calculations for each crop event using the conventional approach is as follows:

1. The CO_2e emissions in the baseline and project conditions are calculated using functional units of kilograms (kg) CO_2e per kg of crop produced on a dry matter basis[46]. In the equations, the crop type will be referred to as crop i, representing the understanding that each project (farm) will consist of a number of crops.
2. The baseline condition (in this case, the conventional baseline) is expressed for each crop type as the three year average kg CO_2e per kg of crop produced.
3. Within a single EcoDistrict and a single 4R management level, project condition emissions are calculated for each crop type on an annual basis using the same functional units.
4. The sum of emissions from synthetic nitrogen fertilizer and crop residue (kg CO2e per kg crop produced) is multiplied by the appropriate reduction modifier for the selected 4R performance level to get the emission levels by project crop type. These emissions are

[46] Dry matter weight = (actual weight) x (100 - actual moisture content) / (100 - standard moisture content); for example, grain has standard bushel masses and moisture content. ie: barley = 48lb/bu and 15.5% moisture, wheat = 60lbs and 14.5% etc. For standard moisture contents, refer to http://www.munros.com/grain_calc.html (US units) or http://www.hgca.com/tools.output/114/114/Tools/Agronomy%20Calculators/Grain%20Moisture.mspx?fn=grainMoisture (Metric Units).

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then added to emissions associated with manure application, which are not multiplied by the reduction modifier.

5. The CO_2e reduction for each project crop type is calculated as the difference between the baseline emissions intensity and project emissions intensity (kg CO_2e per kg crop produced).
6. To derive the total emission reductions (kg CO_2e) for each crop type, multiply the reduction in number 5 above by the total mass of crop produced (kg crop produced) in the project.
7. If applicable, emissions reductions from multiple crop types are summed.
8. If applicable, emissions reductions from crops in each 4R management level and each EcoDistrict are summed.
9. Emissions from additional fuel use are subtracted from the above result to calculate total project emission reductions.

The sequence of calculations for each crop event using the dynamic baseline one quantification approach is as follows:

1. Calculate the total baseline CO_2e emissions for each crop type (tCO_2e) using the present years data following the steps outlined in the conventional approach.
2. Multiply the baseline emissions by one minus the reduction modifier for the selected performance level to determine the emission reductions
3. Apply the discount factor for the selected performance level to the emission reductions.

Please note the project developer will need to repeat the quantification of reductions in their entirety for each analytical unit and then sum the reductions across the entire farm enterprise to obtain the GHG claim for that year.

See Appendix A for a set of sample calculations that walk through the steps above for each of the baseline approaches.

6.1.1 Summary of Equations

Conventional Quantification Approach

$$\text{Emission Reduction} = [\sum_{\text{EcoDistrict j}} \sum_{\text{4R management level k}} [\text{Emissions Intensity}_{\text{Baseline jk}} - \text{Emissions Intensity}_{\text{Project jk}}] * \text{Crop Mass}_{\text{Project}}] - \text{Emissions}_{\text{Fert and Lime Dist}}$$

$$\text{Emissions Intensity}_{\text{Baseline}} = [\sum_{\text{crop i}} [(\text{Emissions}_{\text{Man use, i}} + \text{Emissions}_{\text{Manure Soil Crop Dyn, i}} + \text{Emissions}_{\text{Other Fert and Lime Use, crop i}} + \text{Emissions}_{\text{Other Fert Soil Crop Dyn, crop i}})/ \text{Crop Mass}_{\text{baseline i}}] * GWP_{N2O}$$

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$\text{Emissions Intensity}_{\text{Project}}$	=	$[\sum_{\text{crop i}} [\text{Emissions}_{\text{Manure Use, i}} + \text{Emissions}_{\text{Manure Soil Crop Dyn, i}} + ((\text{Emissions}_{\text{Other Fert and Lime Use, crop i}} + \text{Emissions}_{\text{Other Fert Soil Crop Dyn, crop i}}) * RM_{PL}) / \text{Crop Mass}_{\text{Project i}}] * GWP_{N2O}$
Crop i	=	Index number for tracking crop types, within an EcoDistrict and within a performance level
EcoDistrict j	=	Index number for tracking EcoDistrict types
4R Management Level k	=	Index number for tracking 4R management performance levels, within an EcoDistrict
$\text{Emissions Intensity}_{\text{Baseline}}$	=	Sum of the emissions under the baseline condition divided by baseline crop mass
$\text{Emissions Intensity}_{\text{Project}}$	=	Sum of the emissions under the project condition divided by project crop mass
$\text{Emissions}_{\text{Fert and Lime Dist}}$	=	Emissions under SS P7 Fertilizer and Lime Distribution (On Site)
$\text{Emissions}_{\text{Manure Soil Crop Dyn}}$	=	Emissions from manure under SS P13/B13 Soil Crop Dynamics
$\text{Emissions}_{\text{Manure Use}}$	=	Emissions from manure under SS P8/B8 Fertilizer and Lime Use
$\text{Emissions}_{\text{Other Fert Soil Crop Dyn}}$	=	Emissions from inorganic fertilizer and crop residues under SS P13/B13 Soil Crop Dynamics
$\text{Emissions}_{\text{Other Fert and Lime Use}}$	=	Emissions from inorganic fertilizer and crop residues and under SS P7 Fertilizer and Lime Use
RM_{PL}	=	Emissions Reduction Modifier. Values are 0.85 and 0.75, which correspond to the implementation of Basic or Intermediate/Advanced 4R Plans, respectively.
$\text{Crop Mass}_{\text{Baseline}}$	=	Crop Mass determined in the baseline for all crops based on a three year average, adjusted to a dry matter basis (conventional approach)
$\text{Crop Mass}_{\text{Project}}$	=	Crop Mass determined in the project for all crops, adjusted to a dry matter basis
GWP_{N2O}	=	Global warming potential value for nitrous oxide

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Dynamic Baseline One Quantification Approach

Emission Reduction	=	$[\sum_{\text{EcoDistrict j}} \sum_{\text{4R management level k}} (\text{Emissions Reduction}_{\text{crop i}})] - \text{Emissions}_{\text{Fert and Lime Dist}}$

$\text{Emissions Reduction}_{\text{crop i}}$	=	$\text{DF} * [\sum_{\text{crop i}} [\text{Emissions}_{\text{Other Fert and Lime Use, i}} + \text{Emissions}_{\text{Other Soil Crop Dyn, i}}) * (1-RM_{PL})]] * GWP_{N2O}$

Where:

- DF = The discount factor for Dynamic Baseline One (0.95 or a 5% discount factor)
- $Emissions_{Othe \quad Fert\ and\ Lime\ Use}$ = Sum of the emissions under the project condition SS P7 Fertilizer and Lime Distribution
- $Emissions_{Other\ Soil\ Crop\ Dyn\ i}$ = Sum of the emissions under SS B8 Fertilizer and Lime Use and B13 Soil Crop Dynamics for the Crop Event
- RM_{PL}= The emission reduction modifier as defined in Table 4.2 of the protocol, associated with the selected performance level.
- GWP_{N2O} = Global warming potential value for nitrous oxide

Table AM-10 below provides project specific details on how the protocol has been implemented in quantifying emission reductions from each project site included in this aggregated project. The table is based on the methodology defined in the protocol, and discusses the parameters introduced in the above equations. Please note that P7 – Fertilizer and Lime Distribution is not included in the table below since no extra fuel passes resulted from the project.

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Table AM- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project-Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
B8/P8 Fertilizer and Lime Use & B13/P13 Soil Crop Dynamics				
Calculating Nitrous Oxide Emissions (kg N_2O /kg crop)				
Manure Use Emissions				
Manure nitrogen use per crop ($N_{Manure\ crop\ i}$)	Kg of actual manure nitrogen applied	Direct measurement during application	Continuous	Direct measurement is the most accurate method
Emission factor related to local soil and climatic conditions (EF_{Eco})	Kg N_2O - N / kg N	Calculated using 0.022*P/PE-0.0048, where P/PE is the ratio of precipitation and irrigation to potential evapotranspiration for the area. Also integrates influence of texture, tillage, and topography.	N/A	Protocol Appendix A
Other (Inorganic Fertilizer and Crop Residue) Fertilizer and Lime Use Emissions				
Synthetic nitrogen fertilizer use per $crop_i$ ($NF_{N\ crop\ i}$)	Kg of actual N	Direct measurement during application	Continuous	Direct measurement is the most accurate method.

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Table AM- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project-Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Emission factor related to local soil and climatic conditions (EF_{Eco})	Kg N_2O - N / kg N	Calculated using 0.022*P/PE-0.0048, where P/PE is the ratio of precipitation and irrigation to potential evapotranspiration for the area. Also integrates influence of texture, tillage, and topography.	N/A	Protocol Appendix A, according to the EcoDistrict in which the participating crops/acres reside.
Manure Soil and Crop Dynamics Emissions				
Manure nitrogen use per crop ($N_{Manure\ crop\ i}$)	Kg of actual manure nitrogen applied	Direct measurement during application	Annually	Direct measurement is the most accurate method. (Note: No manure is applied in this project)
Fraction of manure nitrogen applied to soils that volatizes as NH_3-N and NO_x-N ($FRAC_m$)	unitless	Default factor set at 0.2 for commercial fertilizer.	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.
Emission factor for nitrous oxide from nitrogen redeposited after volatilization (EF_{VD})	Kg N_20 - N / kg N	Default factor set at 0.01 kg N_20 - N / kg N	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.

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Table AM- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project-Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Fraction of nitrogen lost in leachate ($FRAC_L$)	Estimated for each crop in each field/management zone (kg N)	The value for each eco-district within Alberta is listed in **Appendix A of the Protocol.**	N/A	As per Appendix A in the protocol which comes from Canada's 2014 National Inventory Report quantification method.
Emission factor for nitrous oxide from leachate (EF_L)	Kg N_20 - N / Kg N	Default factor set at 0.025	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.
Other (Inorganic Fertilizer and Crop Residue) Soil and Crop Dynamics Emissions				
Total amount of crop nitrogen that is returned to the cropland annually ($N_{res\ crop\ i}$)	Kg N	Calculated using the parameters provided in the section on "total amount of crop nitrogen that is returned to the cropland annually" below	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.

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Table AM- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project-Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Emission factor related to local soil and climatic conditions (EF_{Eco})	Kg N_2O - N / Kg N	Calculated using 0.022*P/PE-0.0048, where P/PE is the ratio of precipitation and irrigation to potential evapotranspiration for the area. Also integrates influence of texture, tillage, and topography.	N/A	Protocol Appendix A
Emissions of nitrous oxide from volatilization and re-deposition of NH_3 and NO_x per $crop_i$ ($N_{VD, crop\ i}$)	Kg N	Calculated using the parameters provided in the section on "indirect emissions of nitrogen from volatilization and re-deposition of NH_3 and NO_x per crop i" below	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.
Emission factor for nitrous oxide from nitrogen redeposited after volatilization (EF_{VD})	Kg N_20 - N / Kg N	Default factor set at 0.01 kg N_20 - N / kg N	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.

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Table AM- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project-Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Emissions from leaching of NO_2-N and NO_3-N per crop i ($N_{L,\ crop\ i}$)	Kg N	Calculated using the parameters provided in the section on "indirect emissions of nitrogen from leaching per crop i" below	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.
Emission factor for nitrous oxide from leachate (EF_L)	Kg N_20 - N / Kg N	Default factor set at 0.025	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.
Total Amount of Crop Nitrogen that is Returned to the Cropland Annually per Crop i				
Harvested annual dry matter production for crop i (Crop $Mass_{crop\ i}$)	Kg N	Directly measured using one of the crop mass determination methods in Appendix I	Annually	Direct measurement is the most accurate method.
Fraction of total dry matter production that is harvested (Yield Ratio)	Unitless Estimated for each field/management zone	Determined as per Appendix E (fifth column for the appropriate crop) of the protocol	Annually	The values come from the Holos methodology (produced by Agriculture and Agri-food Canada) which is based on the IPCC methodology but has been modified to account for Canadian specific conditions.
Fraction of total area under Crop i that is renewed annually ($FRAC_{renew\ crop\ i}$)	Unitless Estimated for each field/management zone	For annual crops $FRAC_{renew}$ = 1.	Annually	Values calculated based on values published by IPCC. Reference values adjusted periodically as part of internal IPCC review of its methodologies. The value is set at one to reflect that only annuals are allowed in the project condition.

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Table AM- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project-Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Ratio of above-ground residues dry matter to harvested production for Crop i ($R_{AG\ crop\ i}$)	Unitless Estimated for each field/management zone	Determined using Table E.1 in Appendix E of the protocol. The value is in the sixth column for the appropriate crop.	Annually	The values come from the Holos methodology (produced by Agriculture and Agri-food Canada) which is based on the IPCC methodology but has been modified to account for Canadian specific conditions.
Nitrogen content of above-ground residues for crop i ($N_{AG\ crop\ i}$)	Kg nitrogen / Kg dry matter Estimated for each crop in each field/management zone	Determined using Table E.1 in Appendix E of the protocol. The value is in the third column for the appropriate crop.	Annually	The values come from the Holos methodology (produced by Agriculture and Agri-food Canada) which is based on the IPCC methodology but has been modified to account for Canadian specific conditions.
Ratio of below-ground residues to harvested production crop i ($R_{BG\ crop\ i}$)	Unitless Estimated for each field/management zone	Determined using Table E.1 in Appendix E of the protocol. The value is in the seventh column for the appropriate crop.	Annually	The values come from the Holos methodology (produced by Agriculture and Agri-food Canada) which is based on the IPCC methodology but has been modified to account for Canadian specific conditions.
Nitrogen content of below ground residues for crop i ($N_{BG\ crop\ i}$)	Kg nitrogen / Kg dry matter Estimated for each crop in each field/management zone	Determined using Table E.1 in Appendix E of the protocol. The value is in the fourth column for the appropriate crop.	Annually	The values come from the Holos methodology (produced by Agriculture and Agri-food Canada) which is based on the IPCC methodology but has been modified to account for Canadian specific conditions.

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Table AM- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project-Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Indirect Emissions of Nitrogen from volatilization and Re-deposition of NH_3 and NO_x per Crop				
Synthetic nitrogen fertilizer use per $crop_i$ ($NF_{N\ crop\ i}$)	Kg of actual N	Direct measurement during application	Continuous	Direct measurement is the most accurate method.
Fraction of synthetic fertilizer N applied to soils that volatizes as NH_3 and NO_x-N	Unitless	Default factor set at 0.1 for commercial fertilizer.	Annually	As per Canada's National Inventory Report Quantification process as stated in Protocol
Indirect Emissions of Nitrogen from Leaching per Crop				
Synthetic nitrogen fertilizer use per $crop_i$ ($NF_{N\ crop\ i}$)	Kg of actual N	Direct measurement during application	Continuous	Direct measurement is the most accurate method.
Total amount of crop nitrogen that is returned to the cropland annually per crop i ($N_{res,\ crop\ i}$)	Kg N	Calculated using the parameters provided in the section on "total amount of crop nitrogen that is returned to the cropland annually" above	Annually	As per Canada's 2014 National Inventory Report quantification process as stated in Protocol.
Fraction of nitrogen lost in leachate ($FRAC_L$)	Estimated for each crop in each field/management zone (Kg N)	The value for each eco-district within Alberta is listed in **Appendix A of the Protocol.**	Monthly	As per Appendix A in the protocol which comes from Canada's 2014 National Inventory Report quantification method.

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See Section 7 and Section 8 for further details on the project monitoring plan and the data management system and records, including data process flow diagrams, QA/QC procedures, data security and other information management procedures.

6.2 Approved Methodological Deviations from the Quantification Protocol

No modifications to the procedures outlined in the protocol were applied to this project.

6.3 Records to Support the GHG Quantification

Tables AM-11 through AM-14 below outline the minimum records needed to support the project.

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Table AM- 11: General Record Requirements		
Record Requirement	***Examples of Records***	***Why it is Required***
Ownership of the farm fields being claimed in the project	• Land title certificate for each field being claimed in the project for the first year the field is included; and • If ownership has changed, a new land title certificate must be obtained; and • If the Project Developer leases land for implementation of the project, one of the following: ▪ Annual signed written lease agreements; or ▪ Carbon Transfer Agreements[i] between land owner(s) and the Project Developer.	To confirm land ownership
Confirmation of annual Farm Enterprise Boundary by the Accredited Professional Advisor	• Measurement of farm enterprise boundary size using imagery such as satellite data or aerial photos or county maps; • Annual check of additions or removals of land title certificates under the farm enterprise boundary; and • Annual check of additions or removals of land lease agreements between the farm enterprise and other parties.	To confirm the entire farm enterprise is included in the offset project. To confirm that new lands added to the farm enterprise boundary are recorded and appropriately handled according to protocol requirements.
Location of the Farm Enterprise included in Project	• Legal land location(s) (Alberta Township System and GPS coordinates) of the entire farm enterprise boundary; and • EcoDistrict location(s) within the farm enterprise boundary, determined using the tool[ii] provided by Alberta Agriculture and Forestry.	Entire Farm Enterprise Boundary must be included in the project. EcoDistrict locations required for emission reductions accounting.

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Table AM- 11: General Record Requirements		
Record Requirement	***Examples of Records***	***Why it is Required***
Use of Irrigation if applicable	• Supporting documentation for water usage on the field by farm operator including two of the following: ▪ Water use records; ▪ Photo evidence with GPS time stamp showing equipment used including model information; ▪ Crop insurance records noting use of irrigation; ▪ Air photo or satellite imagery showing pivots; ▪ Alberta Irrigation Program documents; ▪ Detailed farm maps showing coverage of irrigation networks over project fields including type and model numbers for equipment being used; or • Sign-off by the Accredited Professional Advisor who reviewed and collected supporting documentation that confirm the irrigation practice; and • Copy of supporting documentation reviewed by Accredited Professional Advisor.	Irrigation impacts nitrous oxide emissions from agricultural soils. Irrigation status required to properly calculate project emission reductions.
Accredited Professional Advisor credentials	• Confirmation that the Accredited Professional Advisor has successfully completed the 4R Accredited Professional Advisor training program provided by the Canadian Fertilizer Institute; and • Proof of Accredited Professional Advisor's registration as a member of the Alberta Institute of Agrologists; and • Confirmation from the AIA that the Accredited Professional Advisor meets the requirements of the Practice Standard for the Greenhouse Gas Assessment and Management Practice Area.	To ensure that the Accredited Professional Advisor has training and credentials required under the protocol

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Table AM- 12: General Record Requirements		
Record Requirement	**Examples of Records**	**Why Required**
Types of crops grown in the three years used to establish the baseline	• Farm records indicating the crop type grown for each field in the project; and • One of the following: ▪ AFSC records, hail insurance records by field; ▪ Signed records from a crop advisor that show the type of crop grown by field; or ▪ Seed purchase receipts	To establish the crop types in the baseline and project
Crop mass (by crop) grown for each of the three years used to establish the baseline	• Selection of an acceptable crop mass determination method, as provided by the protocol in Appendix I; and • Supporting documentation to accompany the selected acceptable crop mass determination, as described in Table 12 of the protocol.	For GHG quantification
Mass of nitrogen fertilizer applied by crop type across the full farm in each of the three years used for the baseline	• Invoices showing quantity and composition of fertilizer purchased; and • One of the following: ▪ Farm log of fertilizer application masses and dates by field; or ▪ Custom application receipts indicating fertilizer mass and application dates	For purposes of preparing the 4R Plan; total mass of nitrogen for GHG quantification
Quantity, composition and application date of manure	• Manure Management Plans including either manure analysis or referenced manure nutrient values as outlined in Section 5.1.2 above [i]; and • One of the following:	For GHG quantification

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Table AM- 12: General Record Requirements		
Record Requirement	**Examples of Records**	**Why Required**
applied by field for each year in the baseline	▪ Farm records indicating the manure applied by field; or ▪ Feedlot records or custom application records indicating the manure applied by field	
Baseline calculation records	• Set of baseline calculations signed off by Protocol Developer and Accredited Professional Advisor; and • Years used to calculate baseline values; and • Any supporting documentation required to support baseline calculations; and • If non-consecutive years are chosen for development of conventional baseline for a crop (and the crop was grown in un-used years), trend data on extreme weather events to demonstrate how the year is excluded will be required	Baseline calculations required for project verification

i - Manure management plans are a requirement for larger operations in Alberta under the Agricultural Operation Practices Act. The Plans need to record who manure is sold or given to and where it's being applied and at what rate. Nutrient content of the manure is in the Manure Management Plan as well.

Table AM- 13: Project and Dynamic Baseline Record Requirements		
Record Requirement	**Examples of Records**	**Why it is Required**
Locations of 4R management zones (fields/sub-	• EcoDistrict location of each field/management zone determined using the tool [ii] provided by Alberta Agriculture and Forestry; and • Both of the following:	Key input to 4R Plan To ensure the fields/subfields are in the same EcoDistrict

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Table AM- 13: Project and Dynamic Baseline Record Requirements		
Record Requirement	**Examples of Records**	**Why it is Required**
fields) enrolled in the project [i]	▪ Legal land location (Alberta Township System and GPS coordinates) of each management zone; and ▪ Location of each 4R management zone using satellite data or aerial photos	
Crop type grown for each management zone [iii.]	• Farm records indicating the crop type grown for each management zone in the project (including indication of fields that were under perennial production or summerfallow for that cropping year); and • One of the following: ▪ AFSC records, hail insurance records; or ▪ Signed Accredited Professional Advisor records of field observations for each field in the project. The Accredited Professional Advisor must have reviewed and collected supporting farm records that confirm the types of crops/field activities for that year. These records must be maintained in a format that is readily available for verifiers to inspect.	Key input to 4R Plan Establish that the crop is grown in the project year
4R practices by management zone	• 4R Plan signed by Accredited Professional Advisor showing performance level BMPs applied to all management units ▪ 4R Plan detailing source BMPs by management zone, including the composition of fertilizers applied; and ▪ 4R Plan detailing rate BMP by management zone, based on annual soil testing and nutrient application recommendations; and ▪ 4R Plan detailing place BMP by management zone, including % band concentration calculations; and	To confirm that the proper reduction modifier is being applied in GHG emission reduction calculations Ensure the proper BMPs are implemented in each performance level

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Table AM- 13: Project and Dynamic Baseline Record Requirements		
Record Requirement	**Examples of Records**	**Why it is Required**
	▪ 4R Plan detailing time BMP by management zone, including fertilizer application dates.	
Available nitrogen	• Accredited Professional Advisor sign-off on records outlining soil sampling methodology, sampling dates, sample handling, and location from which samples were collected. This information must be specific to 4R management zones. Soil sampling and nitrogen rate recommendations must be made at the intensity described below: ▪ Annual soil testing for each field at the basic 4R implementation level; or ▪ Annual soil testing required for each management zone at the intermediate 4R implementation level; or ▪ Annual soil testing required for each sub-field management zone at the advanced 4R implementation level; and • Annual nitrogen balance calculation on each 4R management zone signed by Accredited Professional Advisor; and • If soil testing cannot be completed for a given year (this is allowed a maximum of once in a crediting period for each farm), the following information is required: ▪ Description of extreme soil or climatic soil conditions preventing soil sampling (weather trend data, time stamped photos of soil surface, etc.); and ▪ Description of alternate tools used to develop fertilizer recommendations without soil sampling data.	Key input to 4R Plan

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Table AM- 13: Project and Dynamic Baseline Record Requirements		
Record Requirement	**Examples of Records**	**Why it is Required**
Quantity, composition and application date of nitrogen fertilizer applied by crop type included in the project	• 4R Plan indicating the recommended quantity and composition of fertilizer for each management zone in the project, based on soil sampling, assessment of nitrogen from manure soil amendments in the previous year, and field conditions in the previous year (e.g., crop residue from a hail event); and • Invoices showing quantity and composition of fertilizer purchased; and • One of the following: ▪ Farm log of fertilizer application dates by management zone (including manure); or ▪ Custom application receipts indicating fertilizer application dates	Assess conformance to the 4R Plan Total mass of nitrogen is used for GHG quantification
Soil Temperature Readings	In cases where fall nitrogen application occurs according to the 4R Plan, the following records are required: • Soil temperature readings (at a depth of five centimeters or deeper) showing three consecutive days where the soil is less than 10^{o} Celsius; and • Sign off from the Accredited Professional Advisor that the fertilizer application occurred in accordance to the 4R Plan and protocol requirements.	To ensure that fall soil applications occur according to requirements of the protocol.
Fertilizer placement equipment	• Annual provision of date stamped photos of fertilizer spreading equipment and openers; and • Accredited Professional Advisor analysis of available nitrogen from crop residue from the previous year; and • One of the following:	Assess conformance to the 4R Plan, as outlined in Section 5.1.2 above

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Table AM- 13: Project and Dynamic Baseline Record Requirements		
Record Requirement	**Examples of Records**	**Why it is Required**
	▪ Width of fertilizer openers and spacing to determine the per cent band concentration [iv]; or ▪ Invoices or a letter from custom fertilizer application that indicates the type of opener and row spacing for each field	
Quantity, composition and application date of manure applied by field	• Manure Management Plans including either manure analysis or referenced manure nutrient values as outlined in Section 5.1.2 above; and • One of the following: ▪ Farm records indicating the manure applied by field; or ▪ Feedlot records or custom application records indicating the manure applied by field; and • Laboratory analysis results determining manure nutrient content.	Assess conformance to the 4R Plan. Total mass of nitrogen is used for GHG quantification
Crop mass by crop type, dry matter basis (for each EcoDistrict and 4R performance level)	• Estimation of crop yield at the field level, which is used for evaluating the 4R Plan (not used for GHG quantification); and • Selection of acceptable crop mass determination method used for GHG quantification; and • Supporting documentation according to the selected crop mass determination method in Appendix I (see Table 12 in the protocol); and	Field level monitoring is used for evaluating the 4R Plan. Crop mass is used for GHG quantification.
Additional supporting farm records	• Farm records noting any extraordinary situations, such as remaining crop residue related to crop damage from hail, flooding, pest infestations, etc.; and	To support proof of 4R Plan implementation or describe variances from the 4R Plan

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Table AM- 13: Project and Dynamic Baseline Record Requirements		
Record Requirement	**Examples of Records**	**Why it is Required**
	• Farm records indicating which fields were under summerfallow or other types of management preventing eligibility under the protocol (e.g., use of ineligible crops or fertilizer sources)	
Confirmation that 4R Plan was conformed to by the farm operator	• Annual sign-off from the Accredited Professional Advisor that the 4R Plan was conformed to, including fields under summerfallow; and • Description of situations where 4R was not conformed to and why	Implementation Sign off by Accredited Professional Advisor
Additional Field Passes	• Accredited Professional Advisor analysis of additional equipment passes required per 4R management unit as a result of implementation of the 4R Plan; and <u>Method A: Documented Fuel Use Method</u> • Sale receipts including specification of fuel type; and • Fuel logs and or equipment use logs indicating date and fuel usage associated with additional passes <u>Method B: Additional Pass Method</u> • Area and location (supported with aerial photos or satellite data) of 4R management units receiving additional passes	Emissions associated with fuel usage from additional passes part of overall project emission reductions claims

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Table AM- 14: Crop Mass Determination Methods Records Requirements		
Record Requirement	**Examples of Records**	**Why Required**
Mobile weighing devices	• Calibration report demonstrating that equipment has been calibrated to manufacturer specifications, by a qualified third party, prior to harvest; and • A weight log of each load shall be maintained; and • Moisture determination result from each load in a moisture log	To determine crop mass on a dry matter basis for mass-based GHG reduction calculations
Fixed scale	• Calibration report demonstrating that equipment has been calibrated to manufacturer specifications, by a qualified third party, prior to harvest; and • A weight log of each load shall be maintained; and • Moisture determination result from each load in a moisture log	To determine crop mass on a dry matter basis for mass-based GHG reduction calculations
Commercial Scale certified by Industry Canada with accompanying scale tickets (i.e., elevator or grain processors)	• Copy of method and calculations used to calculate bin volume measurements; and • A third party sign off will be made available reporting the bin is empty and recorded in a bin log before harvest (Accredited Professional Advisor or their representative check); this must include photo, time stamped evidence; and • Bin moisture log for each load that enters the bin	To determine crop mass on a dry matter basis for mass-based GHG reduction calculations

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7 Monitoring Plan

XYZ Inc. has established and applied quality management procedures to manage data and information, including the assessment of uncertainty, relevant to the project and baseline scenario. Using transparency and accounting, XYZ Inc. has reduced as many uncertainties as possible that may be related to the quantification of GHG emission reductions or removal enhancements.

Those at XYZ Inc. who are responsible for the measurement work have been fully trained in all aspects of the field data collection, farmer interviews, and data analysis procedures. XYZ Inc. has developed Standard Operating Procedures (SOPs) for each step of the field measurements. These SOPs detail all phases of the field measurements and contain provisions for documentation, for verification purposes and so that field personnel can check previous results and repeat the measures in a consistent fashion. All of these procedures are included in XYZ Inc.'s process manual and associated documentation.

Copies (electronic and/or paper) of all field data, data analyses, and collected record/documentation; are uploaded into XYZ Inc.'s data management system. Copies of the measuring and monitoring reports are stored in a dedicated and safe place at XYZ Inc.'s office as well as on an offsite server.

The quantification plan used by XYZ Inc. involves collaboration of in-house agricultural expertise (APAs) as well as an IT team skilled in data management organization. The general approach to monitoring and data management is as follows: XYZ Inc.'s staff interview and collect data from farm operators who wish to claim offset credits generated through implementation of a 4R Plan, prepared cooperatively with an Accredited Professional Advisor – either an external party sourced by the farm operator, or XYZ Inc.'s APA staff. The collected data is then input into the agricultural data management organization's proprietary analytical database software, which stores and assesses a wide variety of farm, soil and cropping information. The analytical database is configured to collect and assess data specific to soil nitrogen management practices and 4R fertilizer systems, along with required records and documentation to support the assurance process. Details of the data collection and storage methodology are provided in the following sections.

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7.1 Farm-Level Data Collection

To initiate the project at a particular farm, the XYZ Inc. Aggregator will conduct an initial onsite meeting with the farm operator. During this initial onsite meeting, the XYZ Inc. aggregator will:

1. Obtain the consent of the farm operator, through a producer contract, to quantify and claim the emissions reductions generated by NERP 4R Plans at the farm.
2. Obtain confirmation of the farm operator's legal status as owner of the offsets.

3. Obtain the consent of the farm operator to access crop insurance information through Agriculture Financial Services Corporation (AFSC), if applicable, and record the policy number.
4. Arrange for an APA to work with the farm operator to develop the 4R Plan in accordance with the NERP.

7.2 Field-Level Data Collection

For each field that is managed according to a 4R Plan in a given year, the XYZ Inc. Aggregator will collect the following information:

1. The legal land description of each field to be included in the project.
2. Confirm the practices used on each field. The XYZ Inc. Aggregator will collect information from the farm operator regarding the crop, equipment and operating parameters for each field, and determine what the level of practice is.
3. Determine the soil EcoDistricts that the fields are located in, as outlined in Appendix A of the protocol.
4. Obtain APA signed-off copies of the 4R Plan and practices used on each field, including the certificate in Appendix D of the protocol, filled out by the APA. The field staff conduct field investigation and collect the supporting document and records from the farm operator regarding the crop, equipment and operating parameters for each field.

XYZ Inc. has the ability, if requested, to obtain crop insurance data on an annual basis from AFSC based on the policy numbers provided by farm operators. The information provided by AFSC includes:

1. Legal land descriptions
2. Number of acres insured
3. Crop type
4. Information on crop management practices including irrigation and tillage system
5. Yield data

Tables AM-15 through AM-19 below outline the full monitoring plan.

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Table AM- 15: Monitoring Plan for Crop Type	
Source / Sink Identifier or Name	B8/P8 – Fertilizer and Lime Use
Data parameter(s)	Crops grown for each field (basic level).
Estimation, Modeling, Measurement or Calculation approaches	AFSC records, hail insurance records, CWB records, crop advisor records, APA records, field visits and/or seed purchase receipts.
Data Unit(s)	Crop Type
Sources / Origin	Recorded for each farm.
Monitoring Frequency	Annual
Description and Justification of Monitoring Method	This is the most accurate and practical method of measuring this parameter. Furthermore, the data is supported by appropriate evidence to verify its accuracy.
Uncertainty	There is a low level of uncertainty associated with the above parameters (crop type) due to the possibility of mis-representation of the data/information. However, this uncertainty is greatly reduced by cross-comparison with the information found in the required supporting documentation.
Provide the Details for any deviations from protocol including the justification and rationale	This method complies with the guidelines outlined in Section 5 of the protocol.

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Table AM- 16: Monitoring Plan for Soil and Tissue Testing	
Source / Sink Identifier or Name	B8/P8 – Fertilizer and Lime Use
Data parameter	Fertilizer (manure and synthetic) rate requirements derived from field (basic level) soil sampling and testing
Estimation, Modeling, Measurement or Calculation approaches	Measured under the project condition – testing will be conducted at an accredited lab with a quality control/quality assurance program. Nutrient recommendations will be made.
Data Unit	Kg of N
Sources / Origin	Measured and recorded for each field
Monitoring Frequency	See Table AM-10 above for description - continuous
Description and Justification of Monitoring Method	This is the most accurate method of measuring this parameter assuming that staff are correctly trained and equipment is correctly maintained.
Uncertainty	There is a low level of uncertainty associated with the above parameters due to the APA developing the soil testing and tissue testing sampling plan. Accredited labs are used to analyse the soil and tissue samples with reported uncertainties in the 0.001% range.
Provide the Details for any deviations from protocol including the justification and rationale	This method complies with the guidelines outlined in Section 5 of the protocol.

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Table AM- 17: Monitoring Plan for Timing and Form of Nitrogen Inputs	
Source / Sink Identifier or Name	B8/P8 – Fertilizer and Lime Use
Data parameters	1. Amount of nitrogen fertilizer applied by crop type for each field (basic level), including: • The type of ammonium-based fertilizer applied; and • Timing of application 2. Amount of nitrogen contained in manure applied. 3. Amount of manure applied by crop type for each field (basic level) 4. Timing of manure spreading. 5. Results of soil tests tracking nutrient status of the soil. 6. Fertilizer nitrogen placement – place in bands either through injection or in concentrated sub-surface rows. The band must have a fertilizer spread that is not more than 30 per cent of the row laterally. 7. Amount of crop residue nitrogen.
Estimation, Modeling, Measurement or Calculation approaches	**Nitrogen Fertilizer** - Measured using GPS data or readings from application equipment. **Manure** – Measured and recorded in farm records which are supported by manure management plans, crop advisor records, feedlot records or custom application records. Crop available nitrogen for each year of manure application will be calculated following the steps outlined in the Alberta Nutrient Management Planning Guide. **Fertilizer Nitrogen Placement** – Percent band concentration will be calculated as follows: % Band Concentration = Width of Spread/Row Spacing* 100 where, *Width of spread* is determined by the type of opener; and *Row Spacing* is the distance between seed rows.

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Table AM- 17: Monitoring Plan for Timing and Form of Nitrogen Inputs	
	Correct placement is supported by date stamped photos of spreading equipment, openers and row spacing of fields. **Crop Residue Nitrogen** – Estimated in the default values outlined in Appendix E of the protocol. See Table AM-10 above for a more in-depth description
Data Units	• Kg of N • Kg of manure N • % band concentration
Sources / Origin	Measured and recorded for each farm.
Monitoring Frequency	See Table AM-10 above for description - continuous
Description and Justification of Monitoring Method	**Nitrogen Fertilizer** - This is the most accurate method of measuring this parameter assuming that equipment is correctly maintained. Fertilizer amount, timing and type is supported by AFSC records, hail insurance records, purchase receipts, custom application records, crop advisor records or APA records. **Manure** –Manure management plans are a requirement for larger operations in Alberta under the Agricultural Operation Practices Act. The plans need to record where manure is sold to or given to and where it's being applied and at what rate. Nutrient content of the manure is also recorded in the plans. **Fertilizer Nitrogen Placement –** The method used follows the approach outlined in the protocol.
Uncertainty	Fertilizer and manure application equipment are calibrated to deliver the appropriate amount of fertilizer per hectare. Calibration records, cross-references with the above data sources provide corroborating evidence to ensure uncertainties are reasonable. The seed bed utilization check confirms the placement of the fertilizer is appropriate.

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Table AM- 17: Monitoring Plan for Timing and Form of Nitrogen Inputs	
Provide the Details for any deviations from protocol including the justification and rationale	The above methods comply with the guidelines outlined in Section 5 of the protocol.

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Table AM- 18: Monitoring Plan for Yields	
Source / Sink Identifier or Name	B13/P13 – Soil Crop Dynamics
Data parameters	Crop mass for each field (basic level) on a dry matter basis.
Estimation, Modeling, Measurement or Calculation approaches	Measured and calculated using: • Water content of the crop at time of sale • Total volume of crop produced Supported by one of the acceptable crop mass determination methods outlined in appendix I of the protocol.
Data Unit	Kg DM
Sources / Origin	Measured and recorded for each farm.
Monitoring Frequency	See Table AM-10 above for description - continuous
Description and Justification of Monitoring Method	The acceptable crop mass determination methods are practical and accurate methods of measuring this parameter.
Uncertainty	Uncertainty in yield estimates is managed by calibrating the scale.
Provide the Details for any deviations from protocol including the justification and rationale	This method complies with the guidelines outlined in Section 5 and Appendix I of the protocol.

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8 Data Management System and Records

The following sections describe the data management system and data controls that XYZ Inc. applied in the Project. The data management system employed by XYZ Inc. ensures that all information collected is complete, accurate, valid and secure. Relevant land base and cropping information collected by XYZ Inc. is entered into the analytical database for the calculation of the GHG offset assertion. If applicable, the XYZ Inc. database staff will input the AFSC policy number for the farm operation. Once the details of a farm operation have been added to the database, the system generates a unique identifier for each field. Information is stored according to the name of the farm operation and the unique field identifier created for each field. The unique identifier will be linked to the farm identifier, and will be used to file all documentation associated with offset credits for that field. Documentation collected by the XYZ Inc. field agent will be maintained on file at XYZ Inc.'s office for a minimum of seven years from the date of the annual reductions/removals report in which the offsets are claimed, and up to seven years after the end of a project's crediting period.

8.1 Emission Reductions

The emission reductions generated on an annual basis under the project condition will be calculated using the methodology outlined in the Nitrous Oxide Emissions Reduction Quantification Protocol. The database has been designed to calculate the emission reductions based on the area, EcoDistrict and 4R practices entered for each field. The appropriate EcoDistrict emission factors, as well as indirect and direct emission coefficients and reduction modifiers, for each field are automatically selected based on the values provided in the NERP. Database reports will provide the calculated emission reductions per farm operation, per field and for the portion of the project managed by XYZ Inc.

8.2 Data Controls

The data monitoring and control plan utilized by XYZ Inc. was developed to address the following potential sources of error in the quantification process:

- Inaccurate details from farm operators
- Transcription error during data input into the databases
- Double-counting acres
- Changes to data in the system after it has been entered
- Calculation error due to database programming

The flow of data through the project, from collection to reporting is presented in Figure AM-3 below. The monitoring and controls for each of the six different data segments is outlined below.

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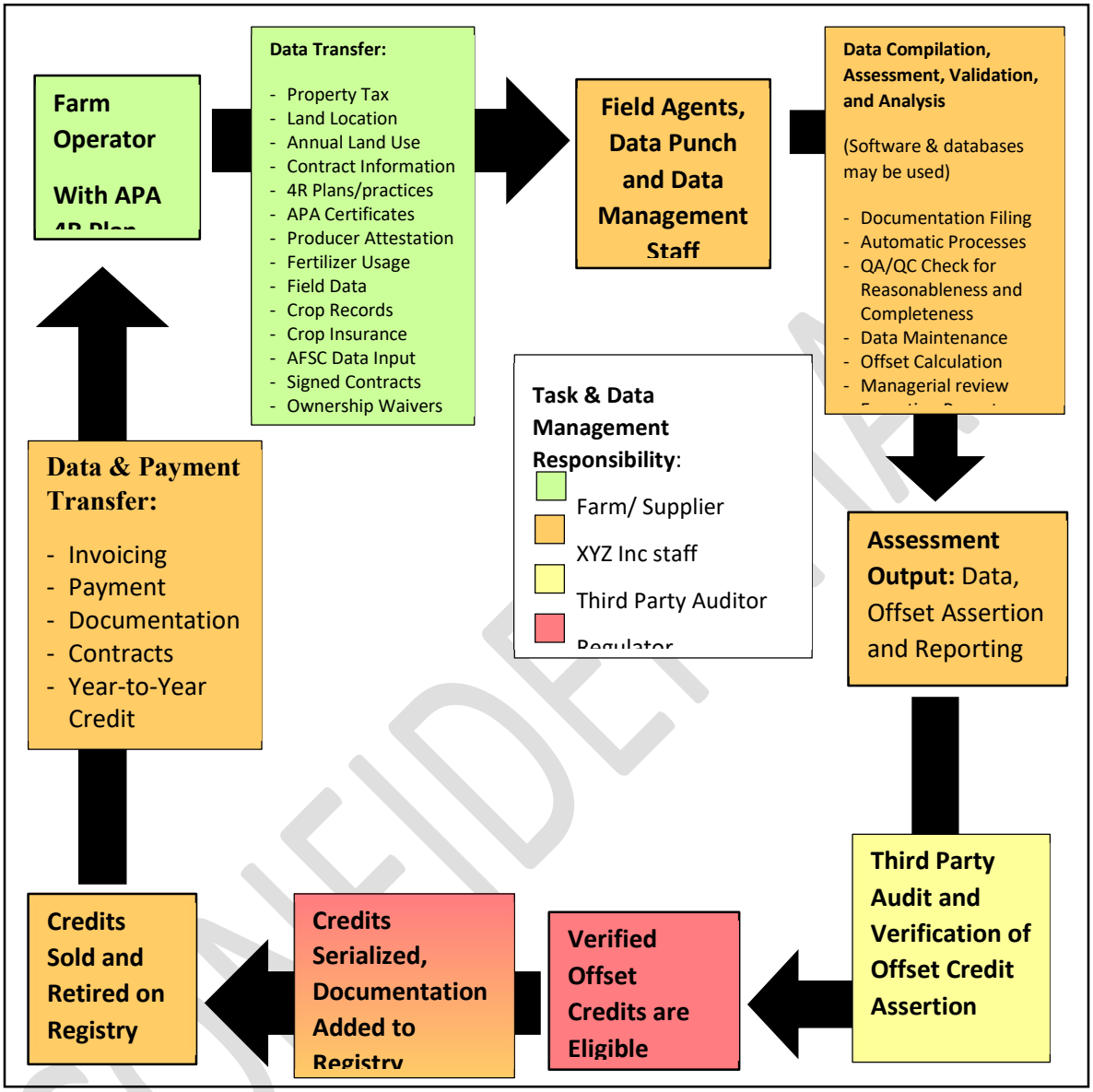


Figure AM- 3: Data Management Process Flow for NERP 4R Offset Assessment, Assertion and Reporting

8.2.1 Data Collection from Farm Operators (Data Transfer)

The primary component of both the monitoring and control plan during collection of data from the farm operator is the experience of XYZ Inc.'s staff. The staff are a combination of trained field agents who are Certified Crop Advisors or Professional Agrologists or agricultural specialists with numerous years of experience in the agricultural sector. They are familiar with the geographical areas in which they are working and collecting data. During data collection, the field staff check the data provided by the farm operator for reasonableness based on their expertise and knowledge of the individual farm. The one-on-one interview with the farm operator also provides

the field staff an opportunity to observe the farm's operating practices and ask questions if necessary.

For the purpose of this project, farm records are supported by the records and practices of the 4R Plan, which has been signed off by the APA. Implementation is assessed by either the farmer's selected APA, or a member of XYZ Inc.'s staff. The 4R Plan is designed to manage uncertainty and risk to insure business success by forecasting crop returns and prices based on:

- Analysis of past planting practice records and experience;
- Crop acreage; and
- Crop input management (to balance strong crop growth with minimization of over-usage and waste of applied nitrogen sources).

In addition, XYZ Inc.'s staff ensures that the data provided is accurate by requiring the land manager or farm operator to sign affirming that the data is correct to the best of his or her knowledge.

8.2.2 Data Input into Database (Data Compilation, Assessment, Validation and Analysis)

Data entry into the agricultural management database is performed by XYZ Inc. using the notes they collected during interviews with the farm operator. During the data input stage, the database generates a unique identifier for each field in the project. The unique identifier is used to link the electronic data with hard-copy documentation, and provides a method of monitoring the data to prevent double-counting of acres. For example, the database administrator can search the database for a legal land description and ensure that there is only one unique identifier associated with that location.

To ensure data accuracy, multiple procedures and controls are built into XYZ Inc.'s aggregation database. The first control is the generation of a summary report at the land manager or farm operator level, which highlights any errors in the data in red and informs the aggregators of the errors that need to be fixed. When the system administrator runs a procedure to move the data into an aggregation pool, only fields without errors will be added to the pool.

The actual data entry stage allows a second opportunity for the XYZ Inc.'s aggregators to check the reasonableness of the data and to follow up with the land manger or farm operator to resolve any problems. The risk of transcription error at the data entry stage is mitigated by the use of trained personnel to enter the data and the user interface has been designed to guide the user during data entry by providing dropdown lists, etc. as much as possible. In addition, data that is missing or incorrect on the data entry screen is highlighted alerting the aggregator of an error. The purpose of this control is to give the user immediate feedback at data entry that they may have made a mistake or they are missing information.

The database only accepts annual seeded crops that have been identified in the 4R Plan as acceptable through a white list (approved crop) check that flags any non-approved crop as an

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error in the system. Finally, the system has also been designed to not accept acreages larger than allowed by the legal land descriptor ensuring further quality assurance.

Also, once the data is moved into an aggregation pool it is locked and cannot be changed by anyone. To change data for a field that is in a pool, it must been removed from the pool, edited and then moved back into the Pool. This can only be done by a system administrator. Lastly, the user entering data must confirm that the backup documentation (contracts, proof of offset ownership, etc.) is in place.

8.2.3 Data Maintenance

Documentation collected by the aggregator will be maintained on file at XYZ Inc.'s office for a minimum of seven years from the end of the crediting period for this project. Documentation is filed according to the individual farm operation and field, using the unique field identifier generated by the database system.

Maintenance of electronic data integrity is accomplished by controlling access to the database. The electronic data associated with a farm or field can be edited by the aggregator or a database administrator until verification begins. Access to the data is controlled by a username and password. Subsequent to the start of a verification, no one but the system administrator can access the data.

8.2.4 Offset Calculation and Assertion

Offset calculations are performed automatically by the database using the methodology outlined in the NERP Quantification Protocol. The plan for monitoring the accuracy of the offsets calculated by the database is to have a manual check performed by XYZ Inc. personnel, and then management review and sign off. The manual check includes:

- Confirming that land being claimed is in the appropriate EcoDistrict by using the EcoDistrict look-up table provided by Alberta Agriculture and Forestry.
    - Within the database, GIS latitude/longitude coordinates have been added to every quarter section in Alberta allowing the system to cross-reference the latitude/longitude for each quarter section to identify the appropriate EcoDistrict.
        - All (100%) of the current pool's legal land descriptions submitted for aggregation are accounted for in the report.
- Cross-referencing AFSC data (where available) with the legal land description and crop masses.

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- Cross-referencing other sources on certain data points with the claimed performance level (e.g. Alberta Management Insights for yields, Agriculture and Agri-Food Canada's Annual Crop Inventory).
- Contacting the field agent or farm operator, referring to the backup documentation to resolve any discrepancies between AFSC data and the project data.
- Performing manual re-calculation of offsets for selected fields to ensure that the database programming uses the correct methodology.
- Identifying fields that have been confirmed to be correct for inclusion in the annual reductions/removals report using a checkbox built into the database.
- XYZ Inc. performs random manual re-calculation of offsets to ensure that the database programming uses the correct methodology.

The use of a manual check provides monitoring and quality control of the data at all stages of the project, and allows for feedback to improve the monitoring and control systems if necessary.

8.2.5 Reporting

The annual reductions/removals report consists of a summary table generated from the database which lists the offsets claimed by field. Only those fields which have been confirmed during the manual check will be included in the summary table.

8.2.6 Record Keeping

The record keeping practices of this project consist of:

- Electronic recording of values of logged primary parameters for each measurement interval;
- Printing of monthly back-up hard copies of all logged data;
- Retention of copies of logs and all logged data for a period of seven years; and
- Keeping all records available for review by a verification body for a period of seven years after the end of the crediting claims for the project.

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8.3 Quality Control and Assurance

XYZ Inc. has employed a number of quality assurance/quality control (QA/QC) procedures to add confidence that all measurements and calculations have been made correctly. XYZ Inc.'s QA/QC methodology is largely incorporated into its analytical database program. This program has internal checks and balances to safeguard against human error and data entry mistakes. These procedures are summarized in Table AM-19 below.

Table AM- 19: Quality Assurance/Quality Control Procedures and Plan

Area	XYZ Inc.'s Quality Assurance/Quality Control Procedure
Ensuring that changes to operational procedures continue to function as planned	Field agents visit the farm operation at least two or three times per year. At the field site visits they punch data into their tablets and upload to the main database information system. This information is checked by the database manager and flagged if deviations from the 4R Plan occur. The database manager alerts XYZ Inc. program manager and corrective actions are discussed with the farm operator and APA. If corrective actions cannot be implemented, then the program manager will decide if that field/operation will continue to participate in the project.
Ensuring the measurement and calculation system for GHG reporting remains in place and accurate	XYZ Inc.'s data management platform houses all coefficients and formulae needed for the calculations and has been programmed to perform the calculations based on Table 8 in the protocol.
Checking data validity	All acquired data undergoes a data filtering process prior to being processed (see Section 8.2). Emission factors and static factors have been programmed into XYZ Inc.'s data management platform and were checked at the time of development and reviewed by a technical expert.
Documenting errors and associated changes/updates in records and raw data	If duplicate records, incorrect emission factors or records with values outside of expected ranges are identified, they are updated or removed accordingly and the changes documented in an exception report. Likewise, any adjustments made to the raw data are recorded and explained.
Performing recalculations of quantification procedures to reduce the possibility of error	XYZ Inc.'s data management platform stores all coefficients and formulae needed for the quantification of emissions. The platform has been programmed to perform the calculations based on Table 8 in the protocol. When the platform was being created it was checked several times to ensure it was calculating emissions correctly and reviewed by a technical expert.

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Table AM- 19: Quality Assurance/Quality Control Procedures and Plan	
Area	XYZ Inc.'s Quality Assurance/Quality Control Procedure
Data storage	All logged data, copies of logs and records are kept in their raw form so they are available for review by a verification body for a period of seven years after the end of the crediting claims for the project.
Data and documentation record protection	All supporting evidence is scanned and uploaded into the carbon data analysis program. Likewise, back-up hard copies of all logged data are printed monthly.
Contingency plan for potential data loss	XYZ Inc. has taken several steps to avoid potential data loss, including backing up its electronic records on an offsite server and web-based cloud; as well as printing hard copies of all logged data. As a result, XYZ Inc. does not anticipate any data loss with a triple fail-safe mechanism.
Back-end controls	Management reviews and approves all agreements and records; and ensures completeness of farming activity information.

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9 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 plan 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 plan as of the _____ day of _____, 20_ ____.

Project Title: Enter name of project

Signature: _____

Date: Enter date

Name: Enter Name

Title: Enter title

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Appendix A – Sample Calculations

Sample EcoDistrict

In the below illustrations, the calculations are only shown for the canola grown on the farm. For this sample project, the farm has implemented the basic performance level. Furthermore, it is assumed that there were no additional fertilizer passes and therefore emissions from fertilizer and lime distribution are excluded.

The following factors for EcoDistrict 737 will be used to estimate emissions in the sample calculation:

EcoDistrict 737 (Bowden to Wetaskiwin) — area of annual crops is 142 352 ha or 142.352 km^2

- Black/Gray Chernozem, Medium texture, P/PE 0.65, F_{TILL} 0.9216, F_{TOPO} 0.16, no irrigation.
- EF_{Eco} 0.00903 kg N_2O-N kg^{-1} N (includes tillage, topography, irrigation, and texture), $FRAC_{LEACH}$ 0.19.

Conventional Approach

The step by step procedure for estimating the project emissions from canola for Farm #5 is provided below.

Step 1 - Calculate Nitrogen Inputs for the Crop Type

Crop Residues

According to the convention used in Canada's National Inventory Report, the values used to estimate direct and indirect nitrous oxide emissions from crop residues are based on the crop mass for the year of interest. Calculate the amount of crop residue N, above ground and below ground, accumulated in the year of interest for each crop.

Multiply the average crop mass for the year for each crop using the crop-specific factors from Table E-1, Appendix E in the protocol. For example, for the sample farm for canola:

$N_{res,Canola}$ = Crop Mass $_{Canola}$ * (1/Yield Ratio) * $Frac_{renew}$ * (($R_{AG\ Canola}$ * $N_{AG\ Canola}$) + ($R_{BG\ Canola}$ * $N_{BG\ Canola}$))

= 813,150 kg DM * 1/0.26 * 1/1 * ((0.60 * 0.008 kg N kg^{-1}DM) + (0.15 * 0.01 kg N kg^{-1}DM)

= 19,703.25 kg N

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MANURE: No manure is applied on this sample farm for the project year of interest. If manure were used on the farm, average manure nitrogen spread on each crop in the year of interest would be included as a source of nitrogen for the crop. That is, according to the convention used in Canada's National Inventory Report, it is assumed that all manure nitrogen is available in the year of application.

Step 2 - Calculate Direct Nitrous Oxide Emissions from Manure and Other Fertilizer and Lime Use (Under P8 Fertilizer and Lime Use)

DIRECT EMISSIONS FROM FERTILIZER

Calculate direct nitrous oxide emissions for each crop type in the year of interest by multiplying the amount of fertilizer nitrogen applied to the crop by the emission factor for the soil (EF_{ECO}). The EF_{ECO} value is provided as the EcoDistrict-specific factor for EcoDistrict 737 which integrates the average for the EcoDistrict of factors including F_{TOPO}, F_{TILL}, F_{IRRI}, and F_{TEXT}.

$Emissions_{\text{Synthetic Fert and Lime Use, Canola}} = N_{FN\ Canola} * EF_{Eco} * 44/28$

$= 41{,}500 \text{ kg N} * 0.00903 \text{ kg } N_2O\text{-N kg}^{-1} \text{ N} * 44/28$

$= 588.89 \text{ kg } N_2O$

Step 3 - Calculate Direct and Indirect Emissions from Soil and Crop Dynamics (Under P13 Soil and Crop Dynamics)

TOTAL DIRECT AND INDIRECT EMISSIONS FROM SYNTHETIC FERTILIZER SOIL AND CROP DYNAMICS

Calculate direct N_2O - N crop residue emissions for each crop type in the year of interest by multiplying the amount of crop residue nitrogen accumulated from the crop by the emission factor for the soil (EF_{ECO}).

$N_2O\text{-}N_{\text{res, Canola}} = N_{RES\ CANOLA} * EF_{ECO}$

$= 19{,}703.25 \text{ kg N} * 0.00903 \text{ kg } N_2O\text{-N kg}^{-1} \text{ N}$

$= 177.920 \text{ kg } N_2O - N$

Calculate the kg of nitrogen from volatilization and re-deposition of NH_3 and NO_x.

$N_{VD\ Canola} = (N_{Fert\ Canola} * FRAC_f)$

$= (41{,}500 \text{ kg N} * 0.1)$

$= 4{,}150 \text{ kg N}$

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VOLATILIZATION EMISSIONS FROM CROP RESIDUE

By convention of IPCC, crop residues are not included in the calculation of indirect nitrous oxide emissions from volatilization.

Calculate the kg of nitrogen from leaching of NO_2 and NO_3 NH_3.

$N_{L\ Canola}$ = $(N_{Fert\ Canola} + N_{Res\ Canola}) * FRAC_L$

= (41,500 kg N + 19,703.25 kg N) * 0.19

= 11,628.618 kg N

Calculate indirect N_2O - N emissions from volatilization for the crop type in the year of interest by multiplying the kg of nitrogen from volatilization and re-deposition of NH_3 and NO_x by the emission factor for volatilized nitrogen (EF_{VD}). The values for EF_{VD} are constant across Canada.

Calculate indirect N_2O - N emissions from leaching for the crop type in the year of interest by multiplying the kg of nitrogen from leaching by the emission factor for leached nitrogen (EF_L). The values for $FRAC_L$ are calculated for each EcoDistrict in Canada, and are provided in Table A-1, Appendix A of the protocol. The value for EF_L is constant across Canada, and currently is set as 0.025 kg N_2O-N kg N.

Calculate total Direct and Indirect Emissions from Synthetic Inorganic Fertilizer Soil and Crop Dynamics by summing the direct N_2O - N emissions from crop residue, indirect N_2O - N emissions from volatilization and indirect N_2O - N emissions from leaching for each crop management zone in the year of interest. Multiply the total by 44/28 to convert to nitrous oxide emissions.

$E_{SYNTHETIC\ SOIL\ AND\ CROP\ DYN,\ CANOLA}$ = **$((N_{RES\ CANOLA} * EF_{ECO}) + (N_{VD\ CANOLA} * EF_{VD}) + (N_{LCANOLA} * EF_L)) * 44/28$**

= **((**177.920 kg N_2O – N) + (4,150 kg N * 0.01 Kg N_2O-N / kg N) + (11,628.618 kg N * 0.025 Kg N_2O-N / kg N))*44/28

= (177.920 kg N_2O – N + 41.5 Kg N_2O-N + 290.715 Kg N_2O-N) *44/28

= 801.64 kg N_2O

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Step 4 – Total Nitrous Oxide Emissions for Crop Type

Total nitrous oxide emissions for each crop type in the year of interest are calculated by summing the direct and indirect nitrous oxide emissions under SS P8 Synthetic Fertilizer and Lime Use and P13 Inorganic Soil and Crop Dynamics.

Total N_2O Emissions = Emissions $_{\text{Synthetic Fert and Lime Use Canola}}$ +
Emission $_{\text{Soil Crop Dyn Canola}}$
= 588.885 kg N_2O + 801.641 kg N_2O
= 1,390.526 kg N_2O

CONVERT TO TOTAL CO_2E EMISSIONS FOR CROP TYPE

To convert total nitrous oxide emissions to total emissions on a carbon dioxide equivalent (CO_2e) basis, multiply the nitrous oxide emissions by the global warming potential. Refer to the Carbon Offset Emission Factors Handbook for global warming potential values.

Emissions CO_2e $_{\text{Canola}}$ = 1,390.536 kg N_2O * 298 kg CO_2e kg^{-1} N_2O
= 414,379.73kg CO_2e
= 414.38 Mg CO_2e or 414.38 tCO_2e

Step 5 – Determine Total CO_2e Emissions Intensity for Crop Type in the Project Year on a Dry Matter Basis (to Determine Emissions Intensity)

To express emissions on a dry matter basis, apply the reduction modifier corresponding to the performance level implemented (basic) and divide by the crop mass (DM) reported for the crop management zone.

Emissions Intensity $_{\text{Project Canola}}$ = (Emissions $_{\text{Fert and Lime Use Canola}}$ + Emissions $_{\text{Soil Crop Dyn Canola}}$)
* RM_{PL} / Crop Mass $_{\text{Project Canola}}$
= (414,379.73kg CO_2e *0.85)/813,150 kg
= 0.4332 kg CO_2e/kg canola

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Step 6 - Calculate Total CO_2e Reductions for the Crop Type on a Dry Matter Basis

To express reductions per kg crop produced for the crop type on a dry matter basis, subtract the emissions calculated on a dry matter basis for the project year for the crop type from the emissions calculated on a dry matter basis for the crop type in the baseline period.

Assuming the emissions for the baseline period are 0.5350 kg CO_2e/kg canola the reduction would be calculated as follows:

Emission Reduction $_{Canola}$ = (Emissions Intensity $_{Baseline\ Canola}$ – Emissions Intensity $_{Project\ Canola}$) * Crop Mass $_{Project\ Canola}$

= (0.5350 kg CO_2e / kg Canola – 0.3822 kg CO_2e / kg Canola) * 813,150 kg Canola

= 124,249.32 kg CO_2e

= 124.25 Mg CO_2e or 124.25 tCO_2e

Step 7 – Calculating Emission Reductions for a Full Farm across Crop, EcoDistricts and/or Performance Levels

Emission reductions should be calculated by crop for each performance level and EcoDistrict separately following the methodology presented in Section 4.1 of the protocol and demonstrated below. In order to calculate the total emission reductions for a farm the sum of the emission reductions by crop for each performance level and EcoDistrict is taken. For example, if the farm given in the example above employed 4R nutrient management on its canola in EcoDistricts 746 and 737 at the intermediate performance level and applied 4R nutrient management on its winter wheat grown in EcoDistrict 737 at both the basic and intermediate performance levels the emission reductions for each combination of crop, performance level and EcoDistrict would be calculated separately and then summed to get the total emission reduction for the farm. The table below illustrates this process.

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Table AM- 20: Calculated Emission Reductions by Crop, Performance Level and EcoDistrict

Crop	Performance Level	EcoDistrict	Emission Reductions (tCO_2e)
Canola	Intermediate	746	122.35
Canola	Intermediate	737	124.25
Winter Wheat	Basic	737	120.50
Winter Wheat	Intermediate	737	130.75
Total Emission Reductions for the Farm			**497.85**

Dynamic Baseline One Quantification Approach

Total emission reductions associated with the project are the sum of the emission reductions calculated for each crop type within each EcoDistrict and each performance level on the farm. Separate calculations must be made for areas where the EcoDistrict, 4R management level or crop differ. The sequence of calculation for each crop in the same EcoDistrict and under the same performance level using dynamic baseline one is as follows:

1. The baseline CO_2e emissions from SS B8 Fertilizer and Lime Use and SS B13 Soil Crop Dynamics for the crop event are calculated and summed following the quantification steps outlined in Section 4 of the protocol and presented in the example above using the present year's data.
2. The result of step 1 is multiplied by 1 minus the reduction modifier.
3. The result of step 2 is then multiplied by 0.95 to apply the 5% discount factor for dynamic baseline one to obtain the emission reductions.

Separate calculations must be made for areas where EcoDistricts differ, and also where 4R management levels differ. Reductions are then summed across the analytical units to derive the GHG claim for the farm. Note: Emissions from fertilizer and lime distribution have been excluded from the quantification as per the flexibility mechanism.

The following formulas summarize the quantification approach:

$$\text{Emission Reduction} = [\sum_{\text{EcoDistrict j}} \sum_{\text{4R management level k}} (\text{Emissions Reduction}_{\text{crop i}})] - \text{Emissions}_{\text{Fert and Lime Dist}}$$

Where:

$$\text{Emission Reduction crop I} = DF * [\sum_{\text{crop i}} [\text{Emissions}_{\text{Other Fert and Lime Use, i}} + \text{Emissions}_{\text{Other Soil Crop Dyn, i}}) * (1 - RM_{PL})]]$$

Discount Factor (DF) = 0.95 (5% discount factor) for Dynamic Baseline One

Reduction Modifier (RM_{PL}) = 0.85 for the basic performance level and 0.75 for the intermediate/advanced performance levels

$\text{Emissions}_{\text{Other Fert and Lime Use, I}}$ = Component of emissions under SS B8 Fertilizer and Lime Use

$\text{Emissions}_{\text{Other Soil Crop Dyn, I}}$ = Component of emissions under SS B13 Soil Crop Dynamics for crop event $_i$

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Emissions $_{\text{Fert and Lime Dist}}$ = Component of emissions under SS P7 Fertilizer and Lime Distribution (On Site)

The following is a sample calculation using the equations outlined above. The data used to perform the sample calculation is fictitious and does not represent real project data.

Step 1 – Calculate Total CO_2e Emissions for the Crop Type

Follow steps 1 through 4 for the conventional baseline approach presented above to calculate the total emissions for the crop type using the present year's data.

Step 2- Calculate Total CO_2e Reductions for the Crop Type by EcoDistrict and Performance Level using the Appropriate Reduction Modifier

Calculate the total CO_2e reductions by multiplying the emissions (from steps 1 through 4 of the conventional approach) by one minus the reduction modifier and then applying the appropriate discount factor.

Emission Reduction $_{\text{Canola}}$ = Discount Factor * (Emissions $_{\text{CO2e Canola}}$ * (1 – Reduction Modifier))

= 0.95 * (414.38 tCO_2e * (1 – 0.85))

= 59.05 tCO_2e

Calculating Emission Reductions for a Full Farm across Crops, EcoDistricts and/or Performance Levels

Emission reductions are calculated by crop for each performance level and EcoDistrict separately following one of the two methodologies presented above. In order to calculate the total emission reductions for a farm the sum of the emission reductions by crop for each performance level and EcoDistrict is taken.

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10 References

KPMG – Advisory. (2011). Scoping Study of Assurance Standards to Verify Agricultural Greenhouse Gas Offset Projects

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Appendix AN: Fed Cattle Offset Project Plan

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Alberta Offset System

Offset Project Plan for XYZ Inc.'s

Reducing GHG Emissions of Fed Cattle (Fed Cattle) Aggregation Project - Protocol Validation Study

(June 2015)

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Acknowledgements

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Disclaimers

The views and opinions expressed in this report are not necessarily those of Alberta Agriculture and Forestry, Agriculture and Agri-Food Canada, or the Climate Change Emissions Management (CCEMC) Corporation.

Note to Reader:

This document is a sample Offset Project Plan (OPP) produced as part of the larger Protocol Validation Study. It is meant to provide guidance to project developers on applying the OPP template (http://esrd.alberta.ca/focus/alberta-and-climate-change/regulating-greenhouse-gas-emissions/alberta-based-offset-credit-system/offset-credit-system-protocols/documents/OffsetProjectPlan-Feb2013.pdf) to a Reducing GHG Emissions of Fed Cattle Offset Project under the Alberta Offset System. Any reference to feedlot information, or offset credit information contained within this document is fictitious and intended for illustrative purposes only.

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1 Project Scope and Site Description

1.1 Project Scope

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

Table AN- 1: Project Details	
Project Title:	Offset Project Plan for XYZ Inc.'s Reducing GHG Emissions of Fed Cattle (Fed Cattle) Aggregation Project - Protocol Validation Study
Project Purpose and Objective(s):	The purpose of this project is to reduce direct and indirect GHG emissions from beef cattle associated with enteric fermentation and manure storage and handling. XYZ Inc. will aggregate five feedlots for this project. The broader goal of the Protocol Validation Study is to identify barriers that currently exist in implementing projects under the Fed Cattle protocol and design scalable approaches to adopting this protocol. The Fed Cattle protocol does not promote any one feeding strategy or combination of strategies required to improve feed efficiency. As a result, different feedlot operators may choose different techniques, but must demonstrate through documentation and records that their cattle are more efficiently utilizing their feed per unit gain of weight once the project is implemented. In the present project, individual animal sorting/selection, use of beta-agonists (Ractopamine Hydrocholoride) and feed management strategies are employed.
Project Start Date:	e.g. January 1, 2011
Credit Start Date:	N/A – the Fed Cattle Protocol Validation Study is a non-commercial exercise (e.g. January 1, 2011)
Credit Duration Period:	N/A – the Fed Cattle Protocol Validation Study is a non-commercial exercise (e.g. Alberta Offset System eligibility specifies 8 years (i.e. January 1, 2011 to December 31, 2019) with the potential for an additional five years upon government approval)
Expected Lifetime of the Project:	N/A – the Fed Cattle Protocol Validation Study is a non-commercial exercise (Commercial feedlots could continue

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Table AN- 1: Project Details	
	this exercise indefinitely, the activity is dynamic and can be stopped and restarted)
Estimated Emission Reductions/Removals:	Up to 2,500 t CO_2e/year (based on five feedlots and approximately 25,000 head of cattle in the project)
Applicable Quantification Protocol(s):	Government of Alberta Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle Protocol, Version 2.1, December 2014
Protocol(s) Justification:	All participating project sites are based in Alberta and have implemented innovative feeding programs and management strategies to increase feed use efficiency in beef cattle – a measure of reducing greenhouse gas emissions. The practices adopted are not commonly employed and therefore go beyond business as usual (BAU). 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 3.3 for Project Eligibility Criteria.
Other Environmental Attributes:	This project will not generate any other environmental credits. However, more efficient production of beef will result in less manure being produced and, as a result, less associated impacts from manure.
Legal Land Description of the Project and/or Other Unique Site Descriptions:	Feedlot #1: 01-01-010-01W4 Feedlot #2: 02-01-010-01W4 Feedlot #3: 03-01-010-01W4 Feedlot #4: 04-01-010-01W4 Feedlot #5: 05-01-010-01W4
Ownership:	As described in the Protocol, the owner of any offset credits generated under this protocol is the feedlot operator where the animals in the project spend the final stage prior to harvest. Proof of ownership over emission reductions is provided in the form of feeding agreements/shipping manifests/RFID tag relationships for the animals in the project to substantiate that feedlots fed the cattle in question. 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 feedlot operators.
Reporting and Verification Details:	N/A – this document is an example of an Offset Project Plan for the Protocol Validation Study.

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Table AN- 1: Project Details	
	This is the second mock-verification for this project. The verifier has no actual or perceived conflicts of interest associated with this project. The anticipated frequency of verification is every two years.
Project Activity:	See Table AN-3 below.
Project Registration:	N/A – the Fed Cattle 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.

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

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

Table AN- 2: Farm Coordinates			
Farm	Legal Land Description	Latitude	Longitude
Feedlot #1	01-01-010-01W4	53.521479	-113.215915
Feedlot #2	02-01-010-01W4	53.447117	-111.923904
Feedlot #3	03-01-010-01W4	50.387617	-112.438202
Feedlot #4	04-01-010-01W4	50.301725	-113.471405
Feedlot #5	05-01-010-01W4	51.214875	-111.931052

Note: the above coordinates are fictitious

1.3 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 Technical Guidance for Offset Project Developers (version 4.0 February 2013). The Project complies with the Specified Gas Emitters Regulation Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle Version 2.1, December 2014.

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Table AN- 3: Alberta Offset System Eligibility	
Criteria	**How this Project Meets the Requirement**
Start Date after Jan 1, 2002	The innovative feeding practices were implemented from 2011 onwards.
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 Reducing GHG Emissions of Fed Cattle Protocol.
Not Required By Law	The changes in practices were not required by law or regulation.
Clearly Established Ownership	Legal land descriptions for each feedlot included in the project were checked. The aggregator and land owner then signed an agreement clearly establishing the aggregator as the owner of the credits.
Counted Once for Compliance Purposes	e.g. 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 plan 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	The activity/activities is/are implemented under the Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle, Version 2.1, December 2014.
Be registered on the registry.	N/A – the Fed Cattle Protocol Validation Study is a non-commercial exercise. Therefore, the project will not be registered in Alberta or in any other jurisdiction.

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2 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	

3 Other Project Information

3.1 Conditions Prior to Project Initiation

Each of the participating feedlots has been in operation for a minimum of three years prior to the implementation of the Reducing GHG Emissions of Fed Cattle Aggregation Project - Protocol Validation Study.

The innovative feeding and management practices described herein have been undertaken by the participating feedlots to increase feed use efficiency in beef cattle. These practices include: individual animal sorting/selection, performance monitoring, use of beta-agonists (e.g. ractopamine hydrocholoride) and other feed management strategies. Five feedlots will participate in the Reducing GHG Emissions of Fed Cattle Aggregation Project - Protocol Validation Study.

3.2 Description of How the Project Will Achieve Greenhouse Gas Emission Reductions/Removals

According to the Alberta Environment Quantification Protocol for Reducing the Greenhouse Gas Emissions of Fed Cattle, Version 2.1, December 2014, the opportunity for generating direct and indirect emission reduction from the project is related to the implementation of strategies that increase the feed use efficiency in cattle.

Beef cattle release methane (CH_4) as a result of the digestion of feed materials in the rumen. These emissions are called enteric emissions and are a significant contributor to greenhouse gas emissions from agricultural activities. Other emission sources for cattle include methane and nitrous oxide (N_2O) which

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are generated from manure storage and handling within beef cattle operations. An increase in feed use efficiency compared to baseline animals results in a reduction of these emissions.

Over the time frame of this project, reductions have occurred from the following practices:

- Addition of ractopamine hydrochloride (e.g. Optaflexx)
- The implementation of individual animal performance management tracking and improved sorting for customized feeding by animal grouping
- Genetic improvements – breeding for animals which have naturally better feed conversion efficiencies
- Shifting away from corn dried distillers grains due to negative environmental impact of higher protein containing diets (increased N excretion)
- Changes to dietary roughage levels (movement to lower levels than those used previously (7-10% DM) depending on the relative cost of roughage and grain

As stated in the Alberta GHG Offset Quantification Protocol for Reduced Greenhouse Gas Emissions of Fed Cattle, the unique combination of these innovative feeding practices are the additional aspects of this project, resulting in efficiency gains and reduced greenhouse gas emissions. The integrated results of these strategies are captured by the accounting metrics in the protocol.

Emissions reductions are compared using a functionally equivalent unit of emissions reductions per kilogram of hot carcass weight.

3.3 Project Eligibility

The project meets the requirements of the Reducing GHG Emissions of Fed Cattle Protocol. The applicability criteria, sources and sinks, and quantification methodologies for the Fed Cattle Protocol Validation Study have been determined in accordance with the Government of Alberta Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle (Version 2.1, December 2014) and the most recent version of the Technical Guidance for Offset Project Developers (February 2013, Version 4.0). As described in the protocol, the project must conform to or meet certain criteria. Table AN-4 describes how the protocol criteria are met and the relevant sections addressed in this Offset Project Plan.

Table AN- 4: Protocol Applicability Criteria

Applicability Criterion as per the Protocol[47]	How Criteria Are Met
Diets and feeding strategies for animals in the baseline and project conditions can be demonstrated to show reduced greenhouse gas	The information system and ration formulation records demonstrate sufficient records and project level documentation as to the content and quantity of feed per animal grouping. This project uses a flexibility mechanism offered in the Reducing GHG Emissions of Fed Cattle Protocol (Section 1.3, mechanism #4).

[47] Alberta Environment Quantification Protocol for Reducing the Days on Feed for Beef Cattle, (July 2011, Version 2.0)

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Table AN- 4: Protocol Applicability Criteria	
Applicability Criterion as per the Protocol[47]	**How Criteria Are Met**
emissions of fed cattle in the finishing stages at a feedlot. Verifiable records (see Section 5) and project level documentation for the content and quantity of feed, including additives/technologies and animal performance per animal grouping, are necessary in order to quantify enteric and manure emissions.	This flexibility assumes the entire time the cattle are in the feedlot, for baseline and project, the lower (4%) emission factor for methane loss from the digestion of feedstuffs is applied (i.e. > or = to 85% concentrates). This ensures a conservative estimate in the streamlined approach. Generalized ration formulations, applying statistical categorization, are applied to streamline the complexity of the diets within each feedlot.
Animal grouping criteria for the quantification of emissions must be shown to be similar between the baseline and project conditions.	The animal groupings applied in the quantification are broken down by 100 lb incoming weight classes within each gender and whether the animals entering the feedlot are fall calves – heifers/steers or yearling calves-heifers/steers. There may be some mid-season animals entering the feedlots as well, and these are noted in the quantification procedures.
Manure must be managed in accordance with the requirements of the Agricultural Operation Practices Act for confined feeding operations.	For each of the feedlots, NRCB permits exist for the operations implemented. Manure management plans are in place. No major changes have occurred in manure management since the baseline years (average quantification for 2008, 2009 & 2010).
Sampling of baseline and project conditions is allowed under this protocol and must be done according to the statistical sampling methodology provided in Appendix B.	N/A – Sampling will not be done for the Fed Cattle Protocol Validation Study.
The quantification of reductions achieved by the project is based on actual measurement and monitoring as indicated by the proper application of the protocol.	The quantity of feed, ration formulation, animal weight, and days on feed are all measured and monitored as described in the process flow diagrams included in Sections 7 and 8.

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Table AN- 4: Protocol Applicability Criteria	
Applicability Criterion as per the Protocol[47]	**How Criteria Are Met**
The project must meet the eligibility criteria stated in Section 7 of the *Specified Gas Emitters Regulation.*	The emissions reductions meet the eligibility criteria stated in the SGER as demonstrated by Table AN-3, above.

3.4 Flexibility Mechanisms

The protocol identifies three flexibility mechanisms for project developers in quantifying offsets. Table AM- 4 below identifies which of these flexibility mechanisms has been applied in quantifying offsets from this project. A justification of why the flexibility mechanism has been exercised is also provided.

Table AN- 5: Summary of Flexibility Mechanisms Applied		
Flexibility Mechanism as per the Protocol[48]	**Exercised (Yes/No)**	**Justification**
Where the required data for the protocol vary across animal groupings (i.e. weight class, age, sex, breed, diets) in a feedlot, the animals may be grouped in discrete units for the purposes of calculating greenhouse gas emissions in the protocol rather than in groupings that occur in the feedlot. It is important to note that exercising this flexibility option will require documentary evidence that similar groupings between baseline and project were used for the calculations.	Yes	Incoming weights were used to group cattle according to 100 lb increments, and by gender and whether they were calf-fed, yearlings or mid-season, where applicable. For GHG calculation purposes, documentation is provided that shows similar groupings were compared for the GHG assertion.
Corn-dried distillers' grains and solubles have been identified as an acceptable source of dietary fat that suppresses methanogenesis in the rumen. If these grains and solubles are included in the project conditions, the diet that is signed off by a qualified animal nutritionist must ensure it continues to meet the dietary fat maximum of 4 to 6 per cent on a dry matter basis to reduce enteric emissions.	Yes	Ration sheets are signed off by a qualified animal nutritionist.
To streamline implementation and ensure conservativeness in the offset calculations, the project developer may	Yes	This flexibility Mechanism was employed. This ensures conservative emission reductions,

[48] Ibid

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Table AN- 5: Summary of Flexibility Mechanisms Applied		
Flexibility Mechanism as per the Protocol[48]	**Exercised (Yes/No)**	**Justification**
treat the entire time the cattle are in the feedlot as though they were on greater than or equal to 85% concentrate diet. To use this approach would be conservative for both baseline and project conditions because the 4 per cent emission factor, and not the 6.5 per cent emissions factor, for methane loss from the digestion of feedstuffs is applied.		since it is likely in the baseline period the diets had a greater amount of roughage present.

3.5 Project Technologies, Products, Services and the Expected Level of Activity

3.5.1 Beta-agonists (e.g. Optaflexx)

Beta-agonists increase muscle mass in cattle through increased protein synthesis with minimal effect on protein breakdown. They are repartitioning agents that are fed during the last 28 days of the finishing period (Basarab et al., 2009). Beta-agonists improve the efficiency of lean tissue growth and work by redirecting nutrients away from fat deposition to protein synthesis (Basarab et al., 2009). This results in increased muscle fibre size, lean meat yield, growth rate and feed conversion ratio (Schroaeder et al., 2005; Winterholler et al., 2007; Gonzalez et al., 2009 as cited in Basarab et al., 2009). Ultimately, through use of beta-agonists more lean meat yield is created for less feed. As a result, the feed-to-gain ratio decreases and there is an associated decrease in the GHG emissions associated with cattle production.

3.5.2 Other Innovative Feeding Technologies & Practices

In addition to the use of beta-agonists, emission reductions will also be generated through:

- The implementation of individual animal performance management tracking and improved sorting for customized feeding by animal grouping
- Genetic improvements – breeding for animals which have naturally better feed conversion efficiencies
- Shifting away from corn dried distillers grains due to negative environmental impact of higher protein containing diets (increased N excretion)
- Changes to dietary roughage levels (movement to lower levels than those used previously (7-10% DM) depending on the relative cost of roughage and grain

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3.6 Identification of Risks

There are a number of issues associated with offset credits and the evidence that is required to support assurance. In their report titled "Scoping Study of Assurance Standards to Verify Agricultural Greenhouse Gas Offset Projects" (2011), KPMG identified several of these risks and ways to mitigate them. Table AN-6 below was taken directly from KPMG's report and represents risks that are applicable to all agricultural offset credits. Table AN-7 presents' additional risks and control measures that are specific to the Fed Cattle Protocol. All of the recommended controls for mitigating each risk listed (see third column of Tables AN-6 and AN-7) were employed in this project on each feedlot/sub-project.

Table AN- 6: Risks Associated with Agricultural Offset Credits (Source: KPMG, 2011)

Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk	Action taken to mitigate risk
Project developer does not have ownership of emission reductions.	Signed offset credit agreement between project developer and feedlot operator are in place.	Management review[49] and approval of offset credit agreements.	Management review of agreements completed.
Feedlot operator has already sold emission reduction rights on another registry or to another project developer.	Signed offset credit agreement between project developer and feedlot operator that clearly states operator has not sold offset credits previously under the protocol.	Management review of current Fed Cattle projects listed on the Alberta Registry.	Management review of projects on registry completed.
Feedlot operations claimed that do not exist in province of Alberta.	Check the legal land location exists in Alberta through web-based programs.	Management review of offset credit files for completeness of information.	Management review for completeness completed.
Data management system does not track required ownership, farming practices, etc.	Detailed listing of all operations included in offset claim by year that links to information required to establish ownership, eligibility, specific feedlot information on practices and offset credit claimed.	Management review of data transparency (i.e. Linkages are maintained both ways between base data and feedlot operation specific offset claims).	Management review of data completed.
Insufficient controls over stored data.	Process documentation outlining linkages to data management and record keeping for offset credits.	Restrict user access to offset claim calculations and data.	User access to database and credit calculations restricted by program security

[49] Defined as the analysis and evaluation of information prepared by one individual and reviewed by a second independent manager.

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Table AN- 6: Risks Associated with Agricultural Offset Credits (Source: KPMG, 2011)			
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**	**Action taken to mitigate risk**
			settings.
Incorrect formulae for calculating emission reductions.	Process documentation relating to data management and record keeping for offset credits.	Exception reports to identify duplicate records, incorrect emission factors records with values outside of expected parameters.	Exception reports generated.
Discrepancies between reported amounts of offsets and data management system.	Process documentation relating to data management and record keeping for offset credits.	Management review of reported data to ensure it is consistent with underlying offset credit data.	Management review of data completed.

Table AN- 7: Additional Risks Associated with the Fed Cattle Protocol			
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**	**Action taken to mitigate risk**
The animals in the feeding/commercial agreements cannot be tracked and may not have been fed in the feedlot in question.	Feedlot or third party records showing unique tag numbers for each animal recorded in animal inventory databases and feedlot records showing animals with lost tags were removed from the project or the lost tag was retired and a replacement tag registered with that individual animal.	Management review of files for completeness of information.	Management review of files completed.
Animal groups are inconsistent between baseline and project.	Documented procedures by the project developer for methods used to group animals for greenhouse gas accounting purposes.	Management review of internal processes for grouping animals are consistent with documented method.	Management cross-check of procedures for grouping animals.
The average number of head per animal grouping cannot be established or is under estimated and/or the animals are not finished for market.	Feedlot inventory records (e.g. close-out data by lots) that show the average number of animals in each grouping, taking into account animal entry and exit movements from the grouping; this is a weighted average	Management review of records to ensure consistency and accuracy.	Management review of records.

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Table AN- 7: Additional Risks Associated with the Fed Cattle Protocol			
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**	**Action taken to mitigate risk**
	approach using the animal head*days factor. Also, feedlot records and shipping manifests or packing plant receipts that show the lots exited the feedlot destined for a packing plant. OR, third party managed data for production and performance, documenting weighted averages per animal grouping and shipping manifests to a packing plant or receipts from a packing plant; with sign-off by an authorized signatory of the third party agency.		
Incoming and outgoing animal weights are incorrect.	Feedlot records, date stamped, showing average incoming and outgoing weights for animal groupings and associated weigh scale tickets from a licensed scale at the feedlot per animal grouping. Associated weigh scale tickets from a licensed scale at the feedlot per animal grouping; and Feedlot records or third party managed data showing corrected carcass weights for the animal groupings on an outgoing basis	Management review of records to ensure consistency and accuracy.	Management review of records.
The number of days on feed reported is incorrect, where applicable.	Feedlot records or third-party-managed data, date stamped, that show the average number of days a group of animals spent on feed;	Management review or professional review of records to ensure consistency and accuracy.	Management or professional review of records.

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Table AN- 7: Additional Risks Associated with the Fed Cattle Protocol			
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**	**Action taken to mitigate risk**
	AND, if only feedlot records exist (i.e., no third-party-managed data): Sign-off by a P.Ag. or D.V.M who reviewed and collected supporting farm records that confirm the number of days on feed for baseline and project conditions.		
The composition of each diet or classes of diet is unknown or unclear.	Feedlot ration and nutrient analysis sheets, date stamped, that shows the diet ingredients on a dry matter basis (See protocol for complete requirements). OR, third-party-managed data that includes all of the above, with sign-off by an authorized signatory of the third party agency. AND, if feedlot records only (i.e. no third-party-managed data) sign off by a P.Ag. or D.V.M. confirming the diet composition in the ration and nutrient analysis sheets.	Management review or professional review of records by to ensure consistency and accuracy.	Management or professional review of records.
The reported average daily dry matter intake is incorrect.	Feedlot records or third-party-managed data, date stamped, that document the average daily dry matter intake by animal grouping in the project (See protocol for complete requirements). AND, if feedlot records only (i.e. no third-party- managed data) sign-off by a P.Ag. or D.V.M who reviewed and collected supporting farm records that confirm the daily dry matter	Management review or professional review of records by to ensure consistency and accuracy.	Management or professional review of records.

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Table AN- 7: Additional Risks Associated with the Fed Cattle Protocol			
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**	**Action taken to mitigate risk**
	intake for each animal grouping in the baseline and project.		
Manure management practices are inconsistent between baseline and project.	Documentation showing that a permit from the Natural Resource Conservation Board (NRCB) is in place and no major changes in manure management have occurred since the baseline period (See protocol for complete requirements) OR, sign-off by a P.Ag. who collected and reviewed supporting farm records that confirm the manure management conforms to AOPA requirements and that no major changes in manure management have occurred since the baseline period.	Management review or professional review of records by to ensure consistency and accuracy.	Management or professional review of records.

4 Inventory of Sources and Sinks

Table AN-8 below identifies all the sources, sinks and reservoirs (SSRs) as listed in the Government of Alberta Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle (Version 2.1, December 2014). Specifically, the table states whether each source and sink is related, controlled, or affected by the project, whether they are included or not for quantification and whether they are included or not for the Fed Cattle Protocol Validation Study Project, with justification as to why. This project will not deviate in any way from the applicable SSs as listed in the protocol.

Tables AN-8 and AN-9 below are process flow diagrams representing the project and baseline conditions, respectively.

Table AN- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	Controlled, Related, Affected	Incl. / Excl. in Protocol	Included / Excluded in Project (with justification)
Baseline Condition:			
Upstream Sources and Sinks During Baseline Operation			
B1a Cattle Husbandry	Related	Exclude	Excluded, as per protocol
B1b Cattle Production	Related	Exclude	Excluded, as per protocol
B2 Cattle Transportation	Related	Exclude	Excluded, as per protocol

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Table AN- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	Controlled, Related, Affected	Incl. / Excl. in Protocol	Included / Excluded in Project (with justification)
B3 Feed Production	Related	Exclude	Excluded, as per protocol
B4 Feed Transportation	Related	Exclude	Excluded, as per protocol
B5 Production of Other Agricultural Inputs	Related	Exclude	Excluded, as per protocol
B6 Transportation of Other Agricultural Inputs	Related	Exclude	Excluded, as per protocol
B7 Fuel Extraction and Processing	Related	Exclude	Excluded, as per protocol
B8 Fuel Delivery	Related	Exclude	Excluded, as per protocol
B16 Electricity Usage	Related	Exclude	Excluded, as per protocol
Onsite Sources and Sinks During Baseline Operation			
B9 Farm Operation	Controlled	Exclude	Excluded, as per protocol
B10 Feed Consumption	Controlled	**Include**	**Included, as per protocol**
B13 Manure Storage and Handling	Controlled	**Include**	**Included, as per protocol**
B14 Manure Transportation	Controlled	Exclude	Excluded, as per protocol
B15 Land Application	Controlled	**Include**	**Included, as per protocol**
Downstream Sources and Sinks During Baseline Operation			
B11 Finished Cattle Transportation	Related	Exclude	Excluded, as per protocol
B12 Slaughter, Processing and Distribution	Related	Exclude	Excluded, as per protocol
Other Sources and Sinks			
B17 Development of Site	Related	Exclude	Excluded, as per protocol
B18 Building Equipment	Related	Exclude	Excluded, as per protocol
B19 Transportation of Equipment	Related	Exclude	Excluded, as per protocol
B20 Construction on Site	Related	Exclude	Excluded, as per protocol
B21 Testing of Equipment	Related	Exclude	Excluded, as per protocol

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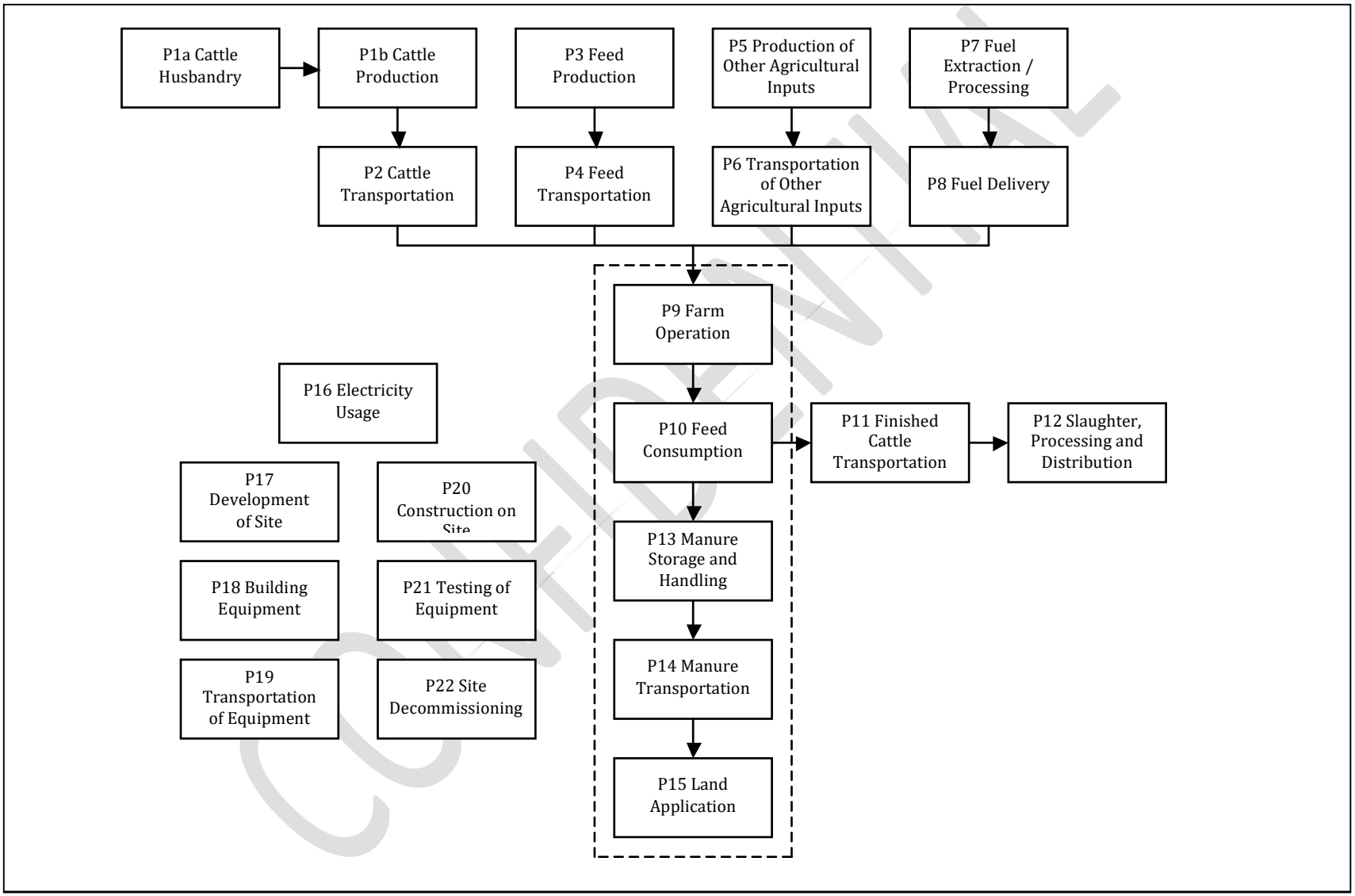
Table AN- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	Controlled, Related, Affected	Incl. / Excl. in Protocol	Included / Excluded in Project (with justification)
B22 Site Decommissioning	Related	Exclude	Excluded, as per protocol
Project Condition:			
Upstream Sources and Sinks During Project Operation			
P1a Cattle Husbandry	Related	Exclude	Excluded, as per protocol
P1b Cattle Production	Related	Exclude	Excluded, as per protocol
P2 Cattle Transportation	Related	Exclude	Excluded, as per protocol
P3 Feed Production	Related	Exclude	Excluded, as per protocol
P4 Feed Transportation	Related	Exclude	Excluded, as per protocol
P5 Production of Other Agricultural Inputs	Related	Exclude	Excluded, as per protocol
P6 Transportation of Other Agricultural Inputs	Related	Exclude	Excluded, as per protocol
P7 Fuel Extraction and Processing	Related	Exclude	Excluded, as per protocol
P8 Fuel Delivery	Related	Exclude	Excluded, as per protocol
P16 Electricity Usage	Related	Exclude	Excluded, as per protocol
Onsite Sources and Sinks during Project Operation			
P9 Farm Operation	Controlled	Exclude	Excluded, as per protocol
P10 Feed Consumption	Controlled	**Include**	**Included, as per protocol**
P13 Manure Storage and Handling	Controlled	**Include**	**Included, as per protocol**
P14 Manure Transportation	Controlled	Exclude	Excluded, as per protocol
P15 Land Application	Controlled	**Include**	**Included, as per protocol**
Downstream Sources and Sinks During Project Operation			
P11 Finished Cattle Transportation	Related	Exclude	Excluded, as per protocol

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Table AN- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	Controlled, Related, Affected	Incl. / Excl. in Protocol	Included / Excluded in Project (with justification)
P12 Slaughter, Processing and Distribution	Related	Exclude	Excluded, as per protocol
Other Sources and Sinks			
P17 Development of Site	Related	Exclude	Excluded, as per protocol
P18 Building Equipment	Related	Exclude	Excluded, as per protocol
P19 Transportation of Equipment	Related	Exclude	Excluded, as per protocol
P20 Construction on Site	Related	Exclude	Excluded, as per protocol
P21 Testing of Equipment	Related	Exclude	Excluded, as per protocol
P22 Site Decommissioning	Related	Exclude	Excluded, as per protocol

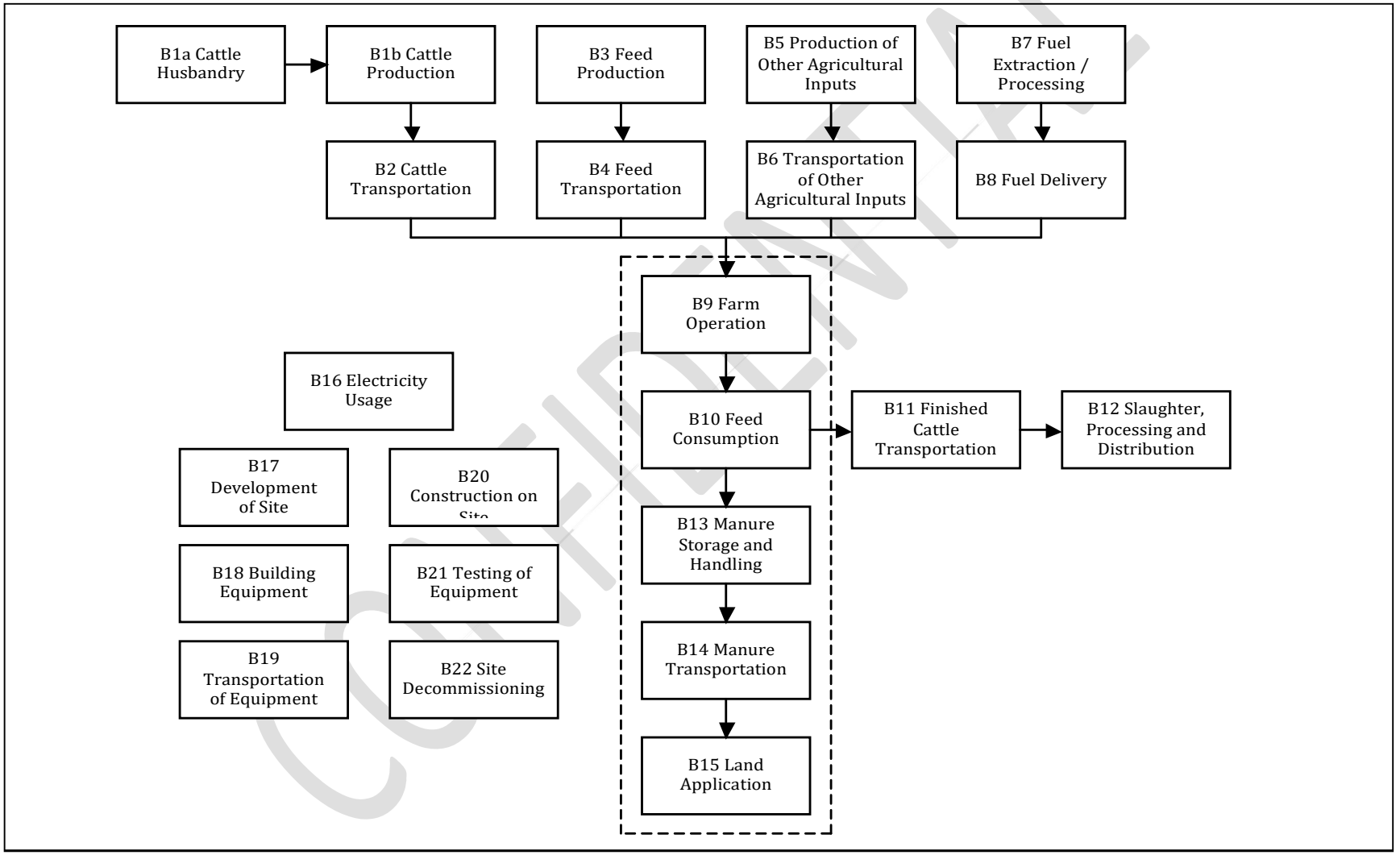
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Figure AN- 1: Process Flow Diagram for the Project Condition



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Figure AN- 2: Process Flow Diagram for the Baseline Condition



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5 Identification of the Baseline and Project

5.1 The Baseline Condition

The baseline condition for projects applying the Fed Cattle Protocol is defined by the diet and time period required to complete a finishing diet regimen, before implementing changes in the feedlot that increase the efficiency of bringing cattle to market.

This baseline is defined using a static historic baseline approach. This means that the 3-year average level of emissions calculated under the baseline condition (2008-2010) is held constant over the life of the project and compared to the project level emissions over time.

The level of service provided in the baseline and project conditions are accounted for as emissions in both cases are calculated based on the total hot carcass weight of animals harvested (kg CO_2e / kg hot carcass weight). As such, both conditions are functionally equivalent.

Table AN-9 below summarizes the baseline periods for each of the project sites aggregated under the Fed Cattle Protocol Validation Study.

Table AN- 9: Baseline Period (Years) for Each of the Project Sites Aggregated

Feedlot:	Baseline Period:
Feedlot #1	2008-2010
Feedlot #2	2008-2010
Feedlot #3	2008-2010
Feedlot #4	2008-2010
Feedlot #5	2008-2010

5.2 The Project Condition

As stated in Section 3.2, the project condition is defined by the implementation of an integrated set of feeding technologies and strategies that result in increased feeding efficiencies and decreased greenhouse gas emissions for cattle on finishing diets before being ready for market. The unique combination of feeding strategies utilized by each feedlot increases the feed conversion efficiency of cattle during the later stages of finishing. These practices demonstrate a reduction in greenhouse gas emissions while maintaining or improving carcass weight and lean meat yield.

Specifically, all project sites included under this aggregated project have implemented the use of beta agonists (e.g. ractopamine hydrochloride or Optiflexx) and are applying a number of techniques including:

- The implementation of individual animal performance management tracking and improved sorting for customized feeding by animal grouping
- Genetic improvements – breeding for animals which have naturally better feed conversion efficiencies

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- Shifting away from corn dried distillers grains due to negative environmental impact of higher protein containing diets (increased N excretion)
- Changes to dietary roughage levels (movement to lower levels than those used previously (7-10% DM) depending on the relative cost of roughage and grain

In order to maintain functional equivalence between the baseline and project conditions, an adjustment is applied to equalize baseline and project on the basis of emissions intensities per kg of hot carcass weight produced.

6 Quantification Plan

Section 4 of the Alberta Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle defines the appropriate methodology in quantifying emission reductions from related projects.

6.1 Quantification Methodology

The following equations serve as the basis for calculating the emission reductions from the project, using the emission profiles of the baseline and project conditions. Note that only sources, sinks and reservoirs (SSRs) determined to be relevant to this project are included here.

6.1.1 Summary of Equations

$$Emission_{Reduction} = \sum \text{Cattle Grouping i [Emissions Intensity Baseline} - \text{Emissions Intensity Project]} * \text{total carcass weight produced in the project}$$

$$Emissions\ Intensity_{Baseline} = \sum \text{cattle grouping i [(Emissions Cattle, i} + \text{Emissions Manure, i)/ group carcass weight i]}$$

$$Emissions\ Intensity_{Project} = \sum \text{cattle grouping i [(Emissions Cattle, i} + \text{Emissions Manure, i)/ group carcass weight i]}$$

Where:

- Cattle Grouping i = Index number for tracking cattle groupings
- **Emissions Intensity** $_{Baseline}$ = sum of the emissions under the baseline condition, divided by hot carcass weight produced
- **Emissions Intensity** $_{Project}$ = sum of the emissions under the project condition, divided by hot carcass weight produced.
- **Emissions** $_{Cattle}$ = emissions under B10/P10 Feed Consumption for each grouping of cattle
- **Emissions** $_{Manure}$ = emissions under B13/P13 Manure Storage and Handling and B15/P15 Land Application for each grouping of cattle

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The following formulae were used to quantify emission reductions from the project for each SSR. The formulae are the same as those provided in the protocol. A sample calculation using the equations is provided in Appendix A.

6.1.2 B10/P10 Feed Consumption

Equation 1: Calculating Enteric Methane Emissions

$$Cattle\ Enteric\ Methane\ (kgCH_4) = \sum Number\ Production_i * DOF * DDMI_i * GE_{Diet} * (EF\ Enteric_i/100\%)/EC_{Methane}$$

Where

- $Number\ Production_i$ = The average number of head in each animal grouping/lot. It can be estimated using the animal head*days factor.
- $DOF\ (Days\ on\ Feed)$ = The average number of days that the animal grouping is being fed a specific diet. It can be estimated using the animal head*days factor.
- $DDMI_i\ (Dry\ Matter\ Intake)$ = Calculated by dividing the total kg of dry matter delivered to the pen/lot for the days on that diet by the animal head*days for that diet.
- $GE_{Diet}(Gross\ Energy\ Content\ of\ Diet)$ = A default factor based on the concentration of edible oils/fats. See Table 10 below or Table 8 in the protocol for values.
- $EF\ Enteric_i(Enteric\ Emissions\ Factor)$ = A default factor based on the level of concentrates in the diet and edible oil/fat content. See table 10 below or Table 8 in the protocol for values.
- $EC_{Metha}\ \ (Methane\ Energy\ Content)$ = A default factor of 55.65 MJ per kg of methane.

6.1.3 B13/P13 Manure Storage and Handling and B15/P15 Land Application

Manure-Based Methane Emissions from Cattle:

Equation 1: Calculating Daily Volatile Solids Excreted in Manure

$$VS_i\ (Kg\ volatile\ solids/animal/day) = [(DDMI_i *\ GE_{Diet} * (1 - (TDN_i/100\%)) + (UE *\ DDMI_i * GE_{Diet})] * (1 - (Ash/100\%)/GE_{Diet})$$

Where:

- $DDMI_i\ (Dry\ Matter\ Intake)$ = Calculated by dividing the total kg of dry matter delivered to the pen/lot by the animal head*days for a specific diet.
- $GE_{Diet}(Gross\ Energy\ Content\ of\ Diet)$ = A default factor based on the concentration of edible oils/fats. See table 10 below or Table 8 in the protocol for values.

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- TDN_i $(Total\ Digestible\ Nutrients) =$ The total digestible nutrients for the diet provided to each grouping of cattle expressed as a percentage. It is used to calculate the daily volatile solids excreted in cattle manure.
- UE $(Urinary\ Energy) =$ A default factor based on the level of concentrates in the diet. See table 10 below or Table 8 in the protocol for values.
- $Ash =$ A default factor based on the type of diet. See Table 10 below or Table 8 in the protocol for values.

Equation 3: Calculating Manure Methane Emissions for the Project (Handling, Storage, and Application)

$$\boldsymbol{M}anure\ CH_4\ (kg\ CH_4) = \sum Number\ Production_i * DOF_i * VS_i * Bo * \rho_{Methane} * (MCF/100\%)$$

Where:

- $Number\ Production_i =$ The average number of head in each animal grouping/lot. It can be estimated using the animal head*days factor.
- DOF $(Days\ on\ Feed) =$ The average number of days that the animal grouping is being fed a specific diet. It can be estimated using the animal head*days factor.
- VS_i $(Volatile\ Solids) =$ The calculated average daily volatile solids excreted for each of the feeding periods in each animal grouping
- Bo $(Methane\ Producing\ Capacity) =$ The maximum methane producing capacity for manure. It is a constant of 0.19m^3 CH_4/kg VS_i excreted.
- $\rho_{Methane}(Density\ of\ Methane) =$ The density of methane at normal temperature (20^{0}C) and pressure (1 Atm), which is 0.67 kg/m^3.
- MCF $(Methane\ Conversion\ Factor) =$ A factor specific to each manure management system. Two percent for solid storage systems would apply in this protocol.

Manure-Based Nitrous Oxide Emissions from Cattle:

Equation 4: Calculating Daily Nitrogen Excreted in Manure

$$NEx_i(kg\ nitrogen\ excreted/animal/day) = DDMI_i * (CP_i/100\%)/CF_{Protein} * (1 - NR)$$

Where:

- $DDMI_i$ $(Dry\ Matter\ Intake) =$ Calculated by dividing the total kg of dry matter delivered to the pen/lot by the animal head*days for a specific diet.
- $CP_i(Crude\ Protein) =$ A component in the diet fed to each grouping of cows that is required and is expressed as a percentage (%)
- $CF_{Protein}(Protein\ Conversion\ Factor) =$ A default coefficient which represents the mass of dietary protein which is converted to dietary nitrogen and is equal to 6.25 kg of protein per kg of dietary nitrogen.
- NR $(Nitrogen\ Retention) =$ The fraction of nitrogen intake that is retained by each animal grouping and is equal to 0.07 kg N retained/kg N consumed.

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Equation 5: Calculating Direct Nitrous Oxide (N_2O) Emissions from Manure

$$Manure\ N_2O_{Direct}(kg\ N_2O) = \sum Number\ Production_i * DOF_i * NEx_i * CF_{Manure} * (44/28)$$

Where:

- $Number\ Production_i$ = The average number of head in each animal grouping/lot. It can be estimated using the animal head*days factor.
- $DOF\ (Days\ on\ Feed)$ = The average number of days that the animal grouping is being fed a specific diet. It can be estimated using the animal head*days factor.
- $NEx_i\ (Nitrogen\ Excreted) =$ The average amount of nitrogen excreted by each animal grouping expressed as kg of nitrogen/head/day from Equation 4 above.
- CF_{Manure} = Use 0.02 kg N_2O-N per kilogram of nitrogen excreted.
- $44/28\ (Conversion\ Factor) =$ A quotient used to convert N_2O-$N_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

Equation 6: Calculating Direct Nitrous Oxide (N_2O) Emissions from Manure Storage

$$Manure\ N_2O_{Direct\ Storage}(kg\ N_2O) = \sum Number\ Production_i * DOF_i * NEx_i * Frac_{Storage} * EF_{Storage} * (44/28)$$

Where:

- $Number\ Production_i$ = The average number of head in each animal grouping/lot. It can be estimated using the animal head*days factor.
- $DOF\ (Days\ on\ Feed)$ = The average number of days that the animal grouping is being fed a specific diet. It can be estimated using the animal head*days factor.
- $NEx_i\ (Nitrogen\ Excreted) =$ The average amount of nitrogen excreted by each animal grouping expressed as kg of nitrogen/head/day from Equation 4 above.
- $Frac_{Storage}$ = The fraction of total nitrogen excreted for each animal grouping that is managed in a particular manure management system and is set at 0.6.
- $EF_{Storage}(Storage\ Emissions\ Factor)$ = An emission factor related to the direct N_2O emissions from a manure management system and set at 0.0007 kg N_2O-N/kg nitrogen excreted.
- $44/28\ (Conversion\ Factor) =$ A quotient used to convert N_2O-$N_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

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Equation 7: Calculating Indirect Nitrous Oxide (N_2O) Emissions from Volatilization of Manure

$$Manure\ N_2O_{Indirect\ Volatilization}(kg\ N_2O) = \sum Number\ Production_i * DOF_i * NEx_i * Frac_{Volatilization} * EF_{Volatilization} * (44/28)$$

Where:

- $Number\ Production_i$ = The average number of head in each animal grouping/lot. It can be estimated using the animal head*days factor.
- $DOF\ (Days\ on\ Feed)$ = The average number of days that the animal grouping is being fed a specific diet. It can be estimated using the animal head*days factor.
- $NEx_i\ (Nitrogen\ Excreted)$ = The average amount of nitrogen excreted by each animal grouping expressed as kg of nitrogen/head/day from Equation 4 above.
- $Frac_{Volatilization}$ = The fraction of manure N that is lost as volatilized NO_x and NH_3 and is set at 0.42.
- $EF_{Volatilization}$ = An emission factor related to the indirect N_2O emissions from atmospheric deposition of nitrogen in soils/water surfaces and is set at 0.01 kg N_2O-N/kg N deposited.
- $44/28\ (Conversion\ Factor)$ = A quotient used to convert N_2O-$N_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

Equation 8: Calculating Indirect Nitrous Oxide (N_2O) Emissions from Leaching of Manure Nitrogen

$$Manure\ N_2O_{Indirect\ Leaching}(kg\ N_2O) = \sum Number\ Production_i * DOF_i * NEx_i * Frac_{Leaching} * EF_{Leaching} * (44/28)$$

Where:

- $Number\ Production_i$ = The average number of head in each animal grouping/lot. It can be estimated using the animal head*days factor.
- $DOF\ (Days\ on\ Feed)$ = The average number of days that the animal grouping is being fed a specific diet. It can be estimated using the animal head*days factor.
- $NEx_i\ (Nitrogen\ Excreted)$ = The average amount of nitrogen excreted by each animal grouping expressed as kg of nitrogen/head/day from Equation 4 above.
- $Frac_{Leachin}$ = The fraction of manure N that is added to soils in regions where leaching and runoff occurs. It is set at 0.1.
- EF_{Leac} = An emission factor for N_2O emissions from N leaching and runoff and is set at 0.025 kg N_2O-N/kg N leached.
- $44/28\ (Conversion\ Factor)$ = A quotient used to convert N_2O-$N_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

Table AM- 10: Measurement and Estimation Procedures for Each Quantification Parameter below provides project specific details on how the protocol has been implemented in quantifying emission reductions from each project site included under this aggregation project. The table is based on the methodology defined in the protocol, and discusses the parameters introduced in the above equations.

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Table AN- 10：Measurement and Estimation Procedures for Each Quantification Parameter

Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
B10 Feed Consumption				
Calculating Enteric Emissions within each Animal Grouping				
Animal Head*Days	Each distinct grouping of animals is uniquely identified with a lot identification number. Head*days are adjusted to account for any animals removed from a lot during the stay in the feedlot	Animal head*days is the sum of the product of the number of days an individual animal is in the feedlot.	Continuously tracked and reconciled as finishing diets are completed and animal movement/deaths are accounted for.	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. This procedure is in alignment with the quantification protocol, Section 4.3.
Number of Cattle in Grouping i / Number Production $_i$	Head*days are adjusted to account for any animals removed from a grouping and tracked head*days are used to determine number in production.	Number in production is extrapolated from head*days, where, Number in production (head) = animal head*days / days on feed	Continuously tracked and reconciled as finishing diets are completed and animal movement/deaths are accounted for.	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. This procedure is in alignment with the quantification protocol, Table 8.

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Days on Feed for Cattle in Grouping i / DOF	Each distinct grouping of animals is uniquely identified with a lot identification number. Days on feed are adjusted to account for any animals removed from a lot during a specified finishing diet	Days on feed is calculated by referencing the average in date and the average out date for each lot, and utilizing the feedlots head*days inventory method, Where: Days on feed (days) = animal head*days/average number of animals in production	Continuously tracked and recorded as each finishing diet is completed and animal movement/deaths are accounted for.	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. This procedure is in alignment with the quantification protocol, Table 8.
Average Weight of Cattle Sent to Harvest	Each distinct grouping of animals is uniquely identified with a Lot Identification Number. Average weight is adjusted to account for any animals removed from a lot during a specified finishing diet.	Direct measurements of the weight of animals at the feedlot.	As each finishing diet is completed and animal movement/deaths are accounted for, average weight is recorded.	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. Measurements are taken by weigh scales at the feedlot. This procedure is in alignment with the quantification protocol, Table 8.

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Dry Matter Intake for Cattle in Grouping i / $DDMI_i$	Each distinct grouping of animals is uniquely identified with a lot identification number. Daily dry matter intake is adjusted to account for any animals removed from a lot during a specified finishing diet.	Based on weighed truckloads of feed to each bunk, and utilizing the feedlot's head*days inventory method, Where: Dry matter intake (kg/head/day) = (total quantity of feed for a specific diet x dry matter content of diet / animal head*days	Daily dry matter intake is continuously tracked and reconciled finishing diet is completed and animal movement/deaths are accounted for.	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. Measurements on truck loads are taken by weigh scales at the feedlot, or load cells on the trucks. This procedure is in alignment with the quantification protocol, Table 8.
Level of Concentrates	Each distinct grouping of animals is uniquely identified with a lot identification number and ration formulations are tracked accordingly.	Based on ration formation records for each finishing diet, prepared and signed off by a D.V.M.	Continuously tracked and recorded as each new finishing diet is commenced.	Rations and performance procedures are prepared by veterinarians, mixed at the feedlots, recorded on feed sheets or e-sheets, and delivered to animals for feeding. This procedure is in alignment with the quantification protocol, Tables 8 and 9.

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Default value Gross energy content (GE) of the diet GE_{Diet}	Default Factor	Based on concentration of edible oils/fats and records tracked by the information system. • 19.10 MJ per kg of dry matter feed if the edible oil/fat concentration is between 4.0 and 6.0 percent. • 18.45 MJ per kg of dry matter feed if the edible oil/fat concentration is less than 4 percent.	Based on dry matter intake.	Measurements on truck loads are recorded on feed sheets or electronically at each feedlot. This procedure is in alignment with the quantification protocol, Table 8. Default value taken from IPCC, 2006 guidance (Section 10.4.2).

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Emission Factor for Enteric Emissions for Each Feeding Regime in Grouping $_i$ / EF Enteric$_i$	Default Factor	Based on ration formulation and records tracked by XYZ Inc. and feedlot information systems. A default factor, depending on level of concentrates in the diet: For diets with less than 4% edible oils/fat (DM basis): • 4.0% for diets with greater than or equal to 85% concentrates • 6.5% for diets with less than 85% concentrates For diets with edible oils/fats in the 4 to 6 per cent range: • 3.2 per cent for diets with greater than or equal to 85 per cent concentrates • 5.8 per cent for diets with less than 85 per cent concentrates	Based on level of concentrates. The level of concentrates are recorded as each new finishing diet is commenced.	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. Rations and performance procedures are prepared by veterinarians, mixed at the feedlots, and delivered to animals for feeding. A generalized ration formulation procedure for use in the quantification of this project is given in Table 11. This procedure is in alignment with the quantification protocol, Tables 8. Set based on best available science and in reference to the IPCC, 2006 guidance.

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Energy Content of Methane / EC Methane	Default factor of 55.65 MJ per kg of methane.	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Conversion factor taken from IPCC, 2006 guidance (Section 10.3.2).
B13 Manure Storage and Handling				
Calculating Daily Volatile Solids Excreted for each animal grouping				
TDN_i (Total Digestible Nutrients)	Each distinct grouping of animals is uniquely identified with a lot identification number and ration formulations are tracked accordingly.	Based on ration formation records for each finishing diet. Tracked by XYZ Inc. and feedlot information systems.	Continuous (as each new finishing diet is commenced).	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. Rations and performance procedures are prepared by veterinarians, mixed at the feedlots, and delivered to animals for feeding. A generalized ration formulation procedure for use in the quantification of this project is given in Table 11. This procedure is in alignment with the quantification protocol, Tables 8 and 9.

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
UE (Urinary Energy)	Default Factor: 0.04 for diets with < or 85% concentrates; and 0.02 for diets with > or = 85% concentrates.	Based on level of concentrates	The level of concentrates are recorded as each new finishing diet is commenced.	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC, 2006 guidance (Section 10.4.2).
ASH	Default Factor	Default factor of 2% used for grain based diets.	N/A	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC, 2006 guidance.
Calculating Methane Emissions from Manure Storage and Handling for each feeding regime within each animal grouping				
Maximum Methane Producing Capacity for Manure Produced / Bo	Default Factor: 0.19 m^3 CH_4 / kg $_{VS\ Excreted}$	Based on mass of Volatile Solids excreted – a calculated value based on feed ingredients and average DDMI.	N/A	This procedure is in alignment with the quantification protocol, Table 8 Conversion factor taken from IPCC, 2006 guidance (Table 10A-5).
$\rho_{Methane}$ (Density of Methane)	Default Factor: 0.67 kg/m^3	Physical property of gas	N/A	Physical property of gas at STP This procedure is in alignment with the quantification protocol, Table 8

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MCF (Methane Conversion Factor)	Default Factor: One per cent for pasture, range, and/or paddock systems or 2 per cent for solid storage systems. Two percent would apply in this protocol.	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8 Set based on best available science and in reference to the IPCC, 2006 guidance.

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Calculating Nitrogen Excreted by the Livestock in each Animal Grouping				
Percent Crude Protein in Diet for Each Feeding Regime in Cattle in Grouping i / CP_i	Each distinct grouping of animals is uniquely identified with a lot identification number and ration formulations are tracked accordingly.	Based on ration formation records for each finishing diet.	Continuous (as each new finishing diet is commenced).	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. Rations and performance procedures are prepared by veterinarians, mixed at the feedlots, and delivered to animals for feeding. A generalized ration formulation procedure for use in the quantification of this project is given in Table 11. This procedure is in alignment with the quantification protocol, Table 9.
$CF_{protein}$ Conversion from Mass of Dietary Protein to Mass of Dietary Nitrogen	Default Factor: 6.25 kg $_{feed\ protein}$ / kg $_{nitrogen}$	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Conversion factor taken from IPCC, 2006 guidance (Section 10.5.2).
Fraction of Annual Nitrogen Intake Retained / $Nitrogen_{Retention}$	Default Factor: 0.07 kg $_{retained}$ / kg $_{intake}$	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Factor taken from IPCC, 2006 guidance, Table 10.20

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Calculating Direct Nitrous Oxide Emissions from Manure Decomposition				
CF_{Manure} (Conversion Factor)	Default Factor: 0.02 kg N_2O-N / kg Nitrogen Excreted	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC.
44/28 (Conversion Factor)	Default Factor: molecular mass ratio of N_20 to N_20 as N. Use the quotient of 44 divided by 28 to convert (N_2O-N) emissions to N_2O emissions.	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8.
Calculating Direct Nitrous Oxide Emission from Manure Storage				
$Frac_{Storage}$ - Storage Emissions Factor (MS_α - Management System)	Default Factor: 0.6	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
$EF_{Storage}$ (Storage Emissions Factor)	Default Factor: 0.007 kg N_2O-N / kg Nitrogen Excreted	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC
B15 Land Application				
Calculating Indirect Nitrous Oxide Emissions from Manure Volatilization				
$Frac_{Volatilization}$ (MS_{β} - Management System)	Default Factor: 0.42	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC
$EF_{Volatilization}$	Default Factor: 0.01 kg N_2O-N / kg Nitrogen Deposited	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC

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Protocol Parameter / Variable	Project-specific data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications
Calculating Indirect Nitrous Oxide Emissions from Manure Nitrogen Leaching in the Soil Profile				
$Frac_{Leaching}$ (MS_y - Management System)	Default Factor: 0.1	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC
EF_{Leach}	Default Factor: 0.025 kg N_2O-N / kg $_{Nitrogen\ Leached}$	N/A	N/A	This procedure is in alignment with the quantification protocol, Table 8. Set based on best available science and in reference to the IPCC
P10 Feed Consumption				
See description for B10 above. Methodology does not change from Baseline Condition calculation.				
P13 Manure Storage and handling				
See description for B13 above. Methodology does not change from Baseline Condition calculation.				
P15 Land Application				
See description for B15 above. Methodology does not change from Baseline Condition calculation.				

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See Section 7 and Section 8 for further details on the project monitoring plan and the data management system and records, including data process flow diagrams, QA/QC procedures, data security and other information management procedures.

6.2 Approved Methodological Deviations from the Quantification Protocol

There were no methodological deviations from the quantification protocol.

6.3 Records to Support the GHG Quantification

Table AN-11 below outlines the minimum records needed to support the project.

Table AN- 11: Minimum Date Requirements to prove Reduced Greenhouse Gas Emissions of Fed Cattle

Data Requirement	Minimum Records Needed	Why the Records are Required
Animal Inventory		
Animal Identifier Tags	▪ Feedlot records or third party records showing unique tag numbers for each animal recorded in animal inventory databases; and ▪ Feedlot records showing animals with lost tags were either removed from the project or the lost tag was retired and a replacement tag registered with that individual animal.	To ensure the animals in feeding/ commercial agreements are fed in the feedlot in question and can be tracked, if necessary, in and out of the feedlot and dead animals are confirmed as removed from the project.
Animal Groupings	▪ Documented procedures by the feedlot for methods used to sort and group animals to manage their production and performance. OR ▪ Documented procedures by the project developer, if using flexibility mechanism number one in Section 1.3 above, that show the animal grouping procedures for GHG calculations for baseline and project conditions.	The methods used to define an animal grouping (e.g lots or pens based on sex, age, weight, breed, or quality grid programs) must be similar between project and baseline conditions to ensure the offset calculations are valid and functionally equivalent.
Number in Production - for animal groupings	▪ Feedlot inventory records (e.g. close-out data) that show the average number of animals in each grouping, taking into account animal entry and exit movements from the grouping;	To ensure an accurate average number of head per animal grouping for offset calculation purposes and as evidence animals were being finished

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Table AN- 11: Minimum Date Requirements to prove Reduced Greenhouse Gas Emissions of Fed Cattle		
Data Requirement	**Minimum Records Needed**	**Why the Records are Required**
– entry and exit numbers	this is a weighted average approach using the animal head*days factor; and ▪ Feedlot records or shipping manifests or packing plant receipts that show the lots exited the feedlot destined for a packing plant. OR ▪ Third party managed data for production and performance, documenting weighted averages per animal grouping and shipping manifests to a packing plant or receipts from a packing plant; with sign-off by an authorized signatory of the third party agency.	for market purposes and, so, being shipped to packing plants (i.e. not being backgrounded in the feedlot).
Incoming and Outgoing Weights	▪ Feedlot records, date stamped, showing average incoming and outgoing weights for animal groupings; and ▪ Associated weigh scale tickets from a licensed scale at the feedlot per animal grouping; and Feedlot records or third party managed data showing corrected carcass weights for the animal groupings on an outgoing basis.	Animal groupings will be sorted by weight classes within gender and animal type (e.g. fall calves, yearlings, winter calves, etc.), thus the weights will need to be known. GHG reductions are calculated according to animal groupings and on a kilogram of live weight or kilogram of carcass weight basis, so an adjustment for production equivalency between baseline and project conditions will need to be made in accordance with the protocol.
Feeding Management		
Number of Days on Feed	Feedlot records or third-party-managed data, date stamped, that show the average number of days a group of animals spent on diets while in the feedlot; and if only feedlot records exist (i.e., no third-party-managed data):	Required to calculate the enteric- and manure-based GHG emissions from feed intake of a particular diet for a particular period of time.

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Table AN- 11: Minimum Date Requirements to prove Reduced Greenhouse Gas Emissions of Fed Cattle		
Data Requirement	**Minimum Records Needed**	**Why the Records are Required**
	▪ Sign-off by a P.Ag. or D.V.M who reviewed and collected supporting farm records that confirm the number of days on feed for each diet for baseline and project conditions.[50]	
Composition of Each Diet or Classes of Diet	▪ Feedlot ration and nutrient analysis sheets, date stamped, that show the diet ingredients on a dry matter basis, including • Level of concentrates in the diet (%) • Total digestible nutrients (%) • Crude protein content (%) • Fat content (% ether extract) • Incidence and inclusion of feed additives or supplements that will reduce days on feed (e.g. beta-agonists) as part of the project activity OR Third-party-managed data that include all of the above, with sign-off by an authorized signatory of the third party agency; and, if feedlot records only (i.e. no third-party-managed data): ▪ Sign off by a P.Ag. or D.V.M. confirming the diet composition in the ration and nutrient analysis sheets. If the streamlining option in Section 1.3, Provision No. 5 is being applied (see footnote below), then: Documented procedures by the project developer on how the average diet ingredients for the groupings were derived; and, ▪ Justification and sign off by the P.Ag. or D.V.M on the representativeness of the average diets	Key diet ingredients are required for GHG emissions to ensure that calculations have taken into account: • The right enteric emission factor (EF – percent of gross energy intake lost as methane in the rumen) is being used depending on the concentrate level of the diet (i.e. an EF of 4% for diets > or = 85% concentrates and an EF of 6.5% for < 85% if fat content of the diet is below 4% D.M.) • The right gross energy (GE) content of the diets is being used depending on the fat level of the diets (i.e. 19.10 MJ per kg of DM fed if between 4 and 6%, or 18.5 MJ per kg of DM fed if less than 4%) Further, if the fat content of the diet is in the 4 to 6 % range, the right enteric emission factor (EF) is being used according to the concentrate level of the diet (i.e. > or = to 85%

[50] Note – it is acceptable to streamline implementation of a project according to Flexibility Provision No. 3, in Section 1.3 of the protocol. In this case, the project developer can treat the entire time the cattle are in the feedlot as though they were on a > or equal to 85% concentrate diet. Ensure conservativeness, the 4 percent emission factor for methane emissions, needs to be applied in both the baseline and project conditions. The project developer must justify to the verifier how the required diet ingredients are statistically representative for the animals in the feedlot in question for both baseline and project conditions.

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Table AN- 11: Minimum Date Requirements to prove Reduced Greenhouse Gas Emissions of Fed Cattle		
Data Requirement	**Minimum Records Needed**	**Why the Records are Required**
	for the particular animal grouping, and how they are tracked to the animal grouping for the year in question.	concentrates uses 3.2% EF while < 85% uses 5.8%)
Dry Matter Intake	▪ Feedlot records or third-party-managed data, date stamped, that document the average daily dry matter intake by animal grouping in the project; this includes: • Records showing kg of feed delivered to each animal grouping in the project for each diet/diet grouping. • Records/procedures showing the dry matter conversion of wet feed to dry, and, if feedlot records only (i.e. no third-party- managed data): ▪ Sign-Off by a P.Ag. or D.V.M who reviewed and collected supporting farm records that confirm the daily dry matter intake for each animal grouping in the baseline and project.	Average Daily Dry Matter Intake is derived using animal*head days records by: • Dry Matter Intake (kg / head / day) = (Total quantity of feed for a specific diet x dry matter content of diet) / animal head*days
Manure Management		
Manure Managed According to the *Agriculture Operation Practices Act* (AOPA)	▪ Feedlot documentation to show that a permit from the Natural Resource Conservation Board (NRCB) is in place and no major changes in manure management have occurred since the baseline period (for those operations built or expanded after 2002), including: • Manure Handling Plans or Nutrient Management Plans and record keeping systems for those operations that exceed the land base requirements; • Manure Storage and Collection Areas; • Application guidelines. OR ▪ Sign-off by a P.Ag. who collected and reviewed supporting farm records that confirm the manure management conforms to AOPA requirements and that no major	Needed to demonstrate that no major changes in how manure is managed have occurred since the baseline period. Major changes include: • switching storage types • instituting a composting system • installing an anaerobic digester The intent is to verify that a permit is in place and is current and no major changes in manure handling have occurred.

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Table AN- 11: Minimum Date Requirements to prove Reduced Greenhouse Gas Emissions of Fed Cattle		
Data Requirement	**Minimum Records Needed**	**Why the Records are Required**
	changes in manure management have occurred since the baseline period.	A major change is a signal to contact Alberta Environment and Sustainable Resource Development for clarification on how to proceed
Legal Claim to the Offsets		
Location of the Feedlot Operation(s)	• Legal land description for the land parcel(s) upon which the feedlot(s) are located.	For registration and serialization of greenhouse gas reductions when the project is registered on the Alberta Emissions Offset Registry
Proof animals existed at the feedlot in question for the project years	Feedlot records that demonstrate animals are entering and exiting the feedlot for each individual animal by RFID tag. If the feedlot operator is a corporation: • The seal of the corporation needs to be affixed to the documentation	To prove that the animals being fed in the project were at the feedlot in question and being finished for market.

7 Monitoring Plan

XYZ Inc. has established and applied quality management procedures to manage GHG data and associated information/documentation including the assessment of uncertainty relevant to the project and baseline scenario. Using transparency and accounting, XYZ Inc. has reduced as many uncertainties as possible that may be related to the quantification of GHG emission reductions or removal enhancements. Copies (electronic and/or paper) of all data, data analyses, and documentation as well as copies of the measuring and monitoring reports are stored in a dedicated and safe place at XYZ Inc.'s office.

The following tables detail the monitoring plans for each parameter required for the quantification of emission reductions as per the protocol. The tables provide additional detail to the information provided in Table AN-10 of this Offset Project Plan. Data collection and management process flow diagrams for each parameter are included in Section 8. All processes and procedures used by XYZ Inc. are recorded and stored in the process documentation manual on site in XYZ Inc.'s offices.

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Descriptions of data quality assurance/control points are further described in Section 8.

7.1 Measured Parameters

Table AN-12 below shows the monitoring plan for gathering the feed components of the diets according to sections 1.2, 4.2 and Table 6 of the protocol.

Table AN- 12: Monitoring Plan for Parameters Related to Ration Composition	
Source / Sink Identifier or Name	B10/P10, B13/P13, B15/P15
Data parameters	1. % of Concentrates in the diet 2. Daily Dry Matter Intake (DDMI) 3. % of Total Digestible Nutrients 4. % of Ether Extract (fat content) 5. Feed Composition (incidence and inclusion of feed additives or supplements) 6. % Crude Protein
Estimation, Modeling, Measurement or Calculation approaches	Measurement as specified in Table AN-10. The generalized ration procedure used for quantification is outlined below. For <u>each ingredient</u> included in the <u>finishing diet</u> during the evaluated period: I_1, % (Ingredient 1) = $(X_1*Y_1 + X_2*Y_2 ...+ X_n*Y_n) / (T)$ I_2, % (Ingredient 2) = $(X_1*Y_1 + X_2*Y_2 ...+ X_n*Y_n) / (T)$ I_n, % (Ingredient n) = $(X_1*Y_1 + X_2*Y_2 ...+ X_n*Y_n) / (T)$ Where: I_i - Ingredient in the generalized ration (%) X_i - is the percentage of the ingredient inclusion in each finishing diet fed during the evaluated period Y_i - is the number of days feeding the finishing diet (without changes) during the evaluated period. T - Total days of the evaluated period. Once the generalized ration composition is determined, crude protein, TDN, etc. are determined using the National Research Council (NRC) nutrient requirement for beef cattle tables for the ingredients/levels in the

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Table AN- 12: Monitoring Plan for Parameters Related to Ration Composition	
	generalized ration composition as following: $CP= \sum(I_1* CP_1+ I_2*CP_2…+I_n*CP_n)$ $DIP= \sum(I_1* DIP_1+ I_2*DIP_2…+I_n*DIP_n)$ $TDN= \sum(I_1* TDN_1+ I_2*TDN_2…+I_n*TDN_n)$ $NEm= \sum(I_1* NEm_1+ I_2*NEm_2…+I_n*NEm_n)$ $NEg= \sum(I_1* NEg_1+ I_2*NEg_2…+I_n*NEg_n)$ $eNDF= \sum(I_1* eNDF_1+ I_2*eNDF_2…+I_n*eNDF_n)$ $EE= \sum(I_1* EE_1+ I_2*EE_2…+I_n*EE_n)$ $C= \sum(I_1* C_1+ I_2*C_2…+I_n*C_n)$ $R= \sum(I_1* R_1+ I_2*R_2…+I_n*R_n)$ Where: I_i - %, Ingredient inclusion in the generalized ration. CP_i - %, Crude protein level as per National Research Council (NRC) nutrient requirement for beef cattle tables DIP_i - %, Digestible protein level as per National Research Council (NRC) nutrient requirement for beef cattle tables TDN_i - %, Total digestible nutrients level as per National Research Council (NRC) nutrient requirement for beef cattle tables NEm_i - mcal/lb, net energy maintenance level as per National Research Council (NRC) nutrient requirement for beef cattle tables NEg_i - mcal/lb, net energy gain level as per National Research Council (NRC) nutrient requirement for beef cattle tables $eNDF_i$ - % of DM, effective neutral detergent fiber level as per National Research Council (NRC) nutrient requirement for beef cattle tables EE_i - %, Ether extract level as per National Research Council (NRC) nutrient requirement for beef cattle tables C_i - %, Concentrate level as per National Research Council (NRC) nutrient requirement for beef cattle tables R_i - %, Roughage level as per National Research Council (NRC) nutrient requirement for beef cattle tables

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Table AN- 12: Monitoring Plan for Parameters Related to Ration Composition	
Data Unit	1. Concentrates (%) 2. Daily Dry Matter Intake (kg/head/day) 3. Total Digestible Nutrients (%) 4. Ether Extract/Fat Content of Diet (%) 5. Feed Composition (incidence and inclusion of feed additives or supplements) 6. Crude Protein (%)
Sources / Origin	Measured and recorded for each feedlot
Monitoring Frequency	See Table AN-10 above for description – continuously tracked and reconciled throughout the year.
Description and Justification of Monitoring Method	The generalized ration procedure allows for data capture of the major feed indices in the ration components that contribute to enteric methane and manure-based methane and nitrous oxide emissions.
Uncertainty	The generalized and averaged diet ingredients allow for a moderate level of uncertainty. Further, data process flows and controls are presented in the figures below.
Provide the Details for any deviations from protocol including the justification and rationale	This method complies with the continuous metering described in Table 2.4 of the protocol and industry standards (National Research Council (NRC) methodologies.

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Table AN-13 shows the monitoring plan for the cattle inventories and is consistent with section 4.3 and Table 6 in the protocol.

Table AN- 13: Monitoring Plan for Parameters Related to Population Statistics	
Source / Sink Identifier or Name	B10/P10, B13/P13, B15/P15
Data parameters	1. Lot Identification Number 2. Lot Description (sex, species, etc.) 3. Landed Live Weight (Total Weight In) 4. Number of Head In 5. Number of Deaths while on Specified Regimen 6. Number of Head Out 7. Average In Date 8. Average Out Date 9. Average Daily Dry Matter Intake 10. Average Gain 11. Average Number of Head 12. Days on Feed 13. Exiting Live Weight (Total Weight Out)
Estimation, Modeling, Measurement or Calculation approaches	See Table AN-10 above for description – continuously tracked and reconciled throughout the year.
Data Unit	1. Lot Identification Number (#) 2. Lot Description (qualitative description of sex, species, etc.) 3. Landed Live Weight (kg) 4. Number of Head In (#) 5. Number of Deaths While on Specified Regimen (#) 6. Number of Head Out (#) 7. Average In Date (date) 8. Average Out Date (date) 9. Average Daily Dry Matter Intake (kg) 10. Average Gain (kg) 11. Average Number of Head (#) 12. Days on Feed (days) 13. Average Weight of Cattle Sent to Harvest (kg)
Sources / Origin	Measured and recorded for each feedlot
Monitoring Frequency	See Table AN-10 for a description of the continuous monitoring methods. Inventories are reconciled as part of the monitoring process.
Description and Justification of Monitoring Method	Close-out sheets and animal inventories using head*days are standard industry practice. Averages based on frequent data collection allow for more moderated estimates.

Table AN- 13: Monitoring Plan for Parameters Related to Population Statistics	
Uncertainty	Dead cattle are removed from the calculations and numbers reconciled. Data filters are described in Section 6.2.1. Data flow charts are presented in Section 8.
Provide the Details for any deviations from protocol including the justification and rationale	N/A - This method complies with the continuous metering described in Table 2.4 of the protocol and industry standards.

7.2 Supporting Records and Documentation

Table AN-14 shows the monitoring plan for identifying cattle according to sections 1.2 and 5 of the protocol.

Table AN- 14: Monitoring Plan for Parameters Related to Unique Cattle Identification	
Source / Sink Identifier or Name	N/A – eligibility criteria
Data parameters	Animal ID tag registered with the Canadian Cattle Identification Agency (CCIA) or Alberta Registry
Estimation, Modeling, Measurement or Calculation approaches	Each animal receives a unique ID tag, either at the cow-calf operation or upon entry to the feedlot. This number is used to track the animal.
Data Unit	Unique number assigned by the CCIA or Alberta Registry.
Sources / Origin	Canadian Cattle Identification Agency master database/Alberta Registry master database. Numbers are then scanned electronically into feedlot and the feedlot management consultant's database.
Monitoring Frequency	Upon entry to feedlot
Description and Justification of Monitoring Method	Uses approved 3rd party agencies to assign numbers. Electronic scanning at the feedlot and by the feedlot management consultant.
Uncertainty	If the cattle ID tag falls off, the animal is removed from the project.
Provide the Details for any deviations from protocol including the justification and rationale	N/A - This method complies with the continuous metering described in Table 2.4 of the protocol and industry standards.

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8 Data Management System and Records

The following sections describe the data management system and data controls that XYZ Inc. applied in the Project. The data management system used by XYZ Inc. ensures that all information collected is complete, accurate, valid and secure. All data is entered by qualified database managers, into the analytical database for the calculation of the GHG assertion. Random management checks occur on entered feedlot information to control the chances of errors occurring. Professionals familiar with the data fields from the feedlot close out data sheets apply filtering techniques, described in Section 8.2 below to quality assure inconsistent numbers are removed. Once the details of a feedlot are entered into the database, a unique identifier is applied and will be used to file all supporting evidence and documentation to that feedlot. Documentation collected by YYZ Inc. will be maintained on file at XYZ Inc.'s offices for a minimum of seven years after the end of a project's crediting period.

8.1 Feedlot Data and Evidence Collection

According to the protocol, cattle inventory data are useful to track each animal grouping within a feedlot. This is an integral part of the yardage calculations feedlots use to track the average number of head.days and the average daily dry matter intake for each animal grouping in their close-out sheets. Therefore, this is a practical and useful procedure to facilitate the calculations and justify verification of an assertion – and XYZ Inc. has used this approach in their project. In the project the data collected to support each of the critical data points listed in section 5.1 of the protocol are the following:

- All animals in the project have an ID tag registered with the Canadian Cattle Identification Agency (CCIA) or a unique identifier;
- The methods used to group cattle are similar for baseline and project;
- The records of entry and exit are included in the close out data received from the feedlots for each animal grouping;
- The records for average daily dry matter intake for each animal grouping are also in the close out data;
- The composition of the diets are received from the feedlot management consultants and signed off by a D.V.M/total mixed diet including any additives fed to the cattle groupings;
- The number of days on feed for each animal grouping are recorded in the close out data sent by the feedlot;
- The legal land locations of the feedlots are given in section 1 of this project plan; and,
- Copies of the feeding agreements for cattle in the project are collected by the feedlot management consultants and the aggregation data managers, where applicable.

Section 8.2 introduces the data management systems, data process flows and data controls for this project.

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8.2 Data Controls

XYZ Inc. has a number of data controls applied to its data management systems. Each data control point is identified by a circled letter in the process flow diagrams below. Several data filters and controls are applied upfront to the electronic feedlot close out sheets to remove missing data or errors in data punching that occur at the feedlots. Specifically, upon receiving the feedlot's close-out data, the feedlot management consultants filter the data and exclude the following based on expected errors or inconsistencies:

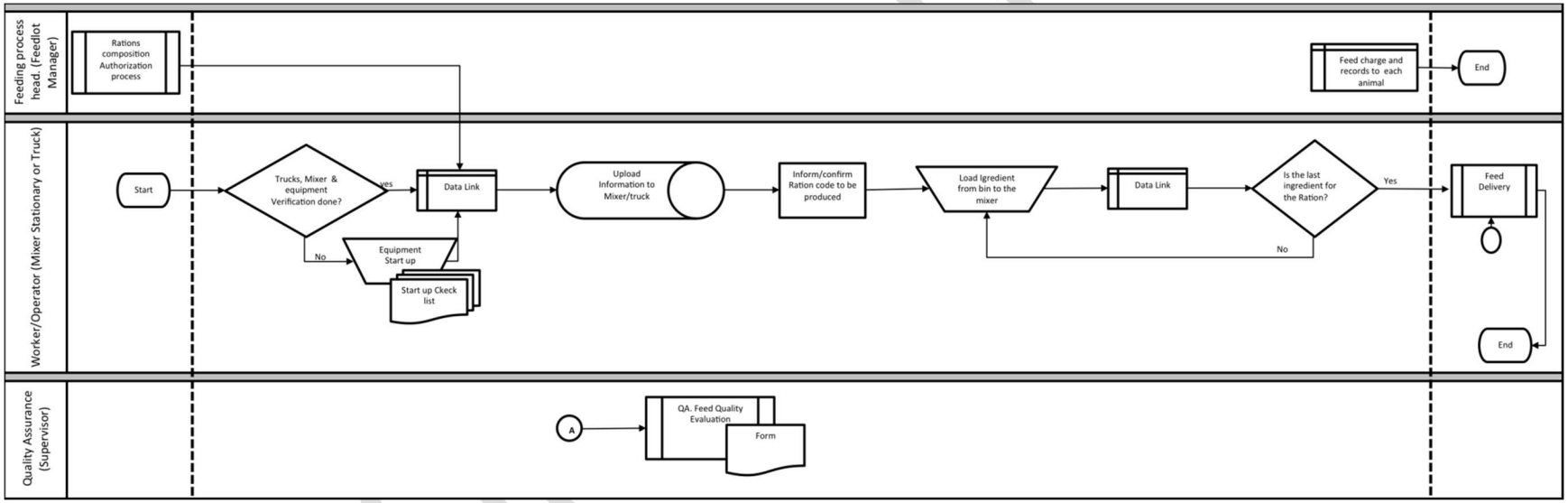
- Lots with an average out date of prior to January 1, 2008
- Lots with less than 10 animals/lot
- Lots/animals that do not have carcass weight data
- Daily Dry Matter Intake of less than 1 lb/day
- Days on Feed less than 20 days
- Days on Feed more than 400 days
- More head sold than purchased
- Dressing percentage more than 70%
- Average weight of dead animals more than 2,000 lbs

Figures 3 through 8 describe the data process flows and data controls used by XYZ Inc. in more detail. XYZ Inc. uses a carbon data analysis program to transfer the e-data received from the feedlot management operator to the platform to calculate the carbon reductions. Evidence to support the data used in the GHG calculations are also scanned and uploaded into the carbon data analysis program for aggregation of the carbon reductions. XYZ Inc. stores the close-out data from the feedlot management operators in the carbon data analysis program platform. The carbon data analysis program is used to extract the data for each animal grouping from each feedlot and perform baseline calculations, and carbon offsets for the project year. The carbon data analysis program stores all coefficients needed for the calculations and performs the calculations based on Table 6 in the protocol.

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Figure AN- 3: Data Process Flow – Feed Manufacturing

The feeding process used at the feedlot begins with the ration composition developed by XYZ Inc. and electronically sent to the feedlot manager. The feedlot manager authorizes the feed formulation process at the feedlot. The operator of the mixer then proceeds to follow the ration formulation and takes the necessary steps (as shown in the diagram below) to ensure the ration is mixed properly and delivered to the trucks that will take the diet to the animal groupings. Most of the data links are electronically provided and controlled through the system. At control point "A" there's a quality control check to ensure rations are properly mixed. A ration code is produced which is linked to a feed bin ready for truck delivery. At the end of the process the feedlot manager reviews the feed charge and records (recipes) prepared that day.



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Figure AN- 4: Data Process Flow – Feed Delivery

The delivery process begins with the feedlot manager issuing a feedlot delivery order for an animal grouping to the truck driver. The truck driver does a truck and equipment verification to ensure everything is in working order. The information on the transfer of feed inventory is uploaded to inform the truck driver which feed bin he or she needs to access. At control point "A" the driver does a radio confirmation of the bin number. The truck driver loads the right amount of ration according to the feed delivery order by the manager and proceeds to haul the feed order to the appropriate animal grouping. The diagram below shows the process for reloading the feed delivery trucks where it is needed (point "B"). Once the truck is finished its deliveries for this feed order the total feed delivered is transferred to the feed inventory and recorded. There is a quality control step at control point "C" where a supervisor reviews the delivery, accuracy and feed distribution for the day.

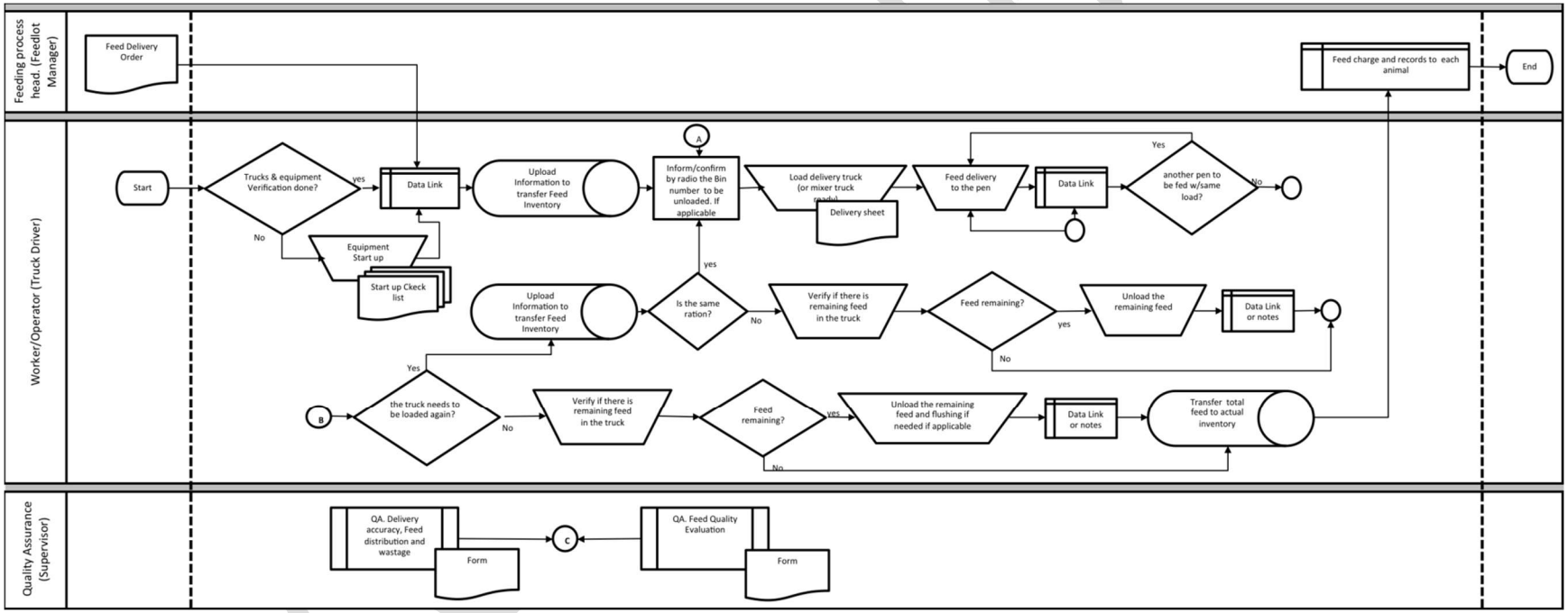
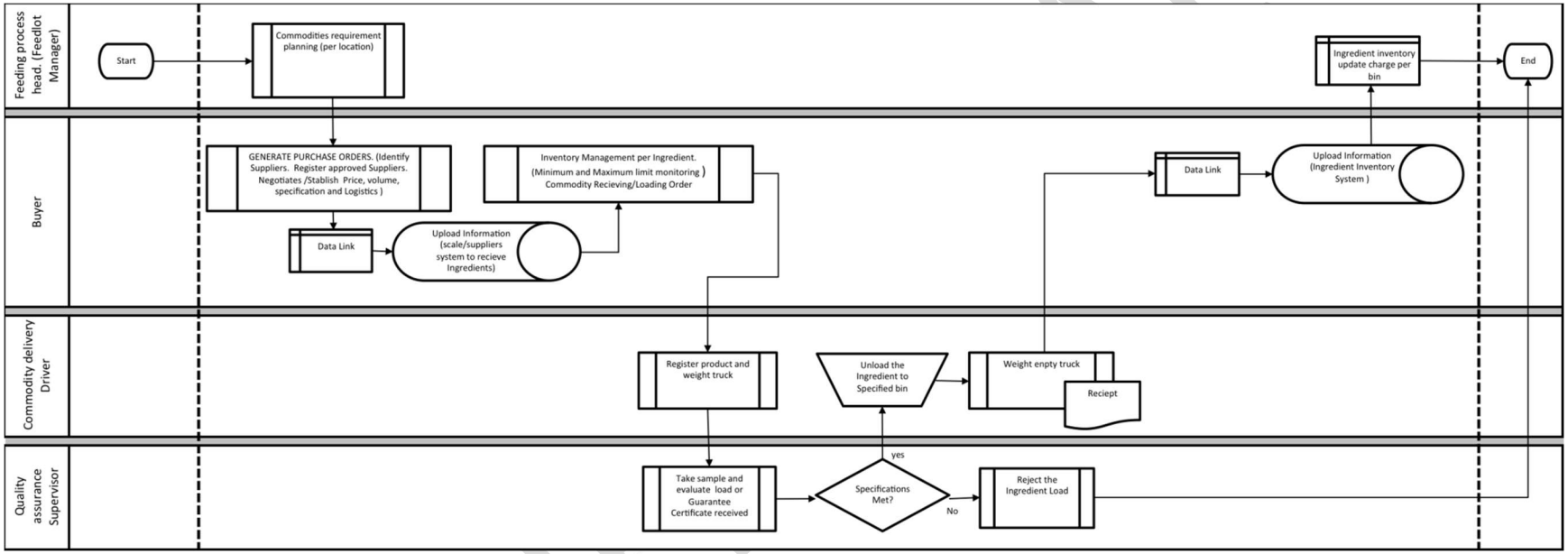


Figure AN- 5: Data Process Flow – Quality Process for Ingredients

For added information the following diagram shows the quality assurance process for receiving feed ingredients at the feedlots. As ingredients arrive a supervisor takes a sample or reviews quality certificates accompanying the ingredients and ensures specifications are met.



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Figure AN- 6: Data Process Flow – Close out Data/Animal Inventories

The following diagram shows the entire process used by feedlots to procure, manage and run the operation to finish cattle and finally ship to the packing plants. As described in section 4.3 of the protocol – Cattle Inventories and Data Collection – the diagram shows the steps taken to monitor cattle according to the yardage and inventory system of the feedlot. As cattle are shipped and managed in the feedlot a number of accompanying documents are linked to the animal as illustrated in the diagrams. All of this information is electronically recorded and stored in the feedlot records. The close out reports are transferred to XYZ Inc. for offset calculations.

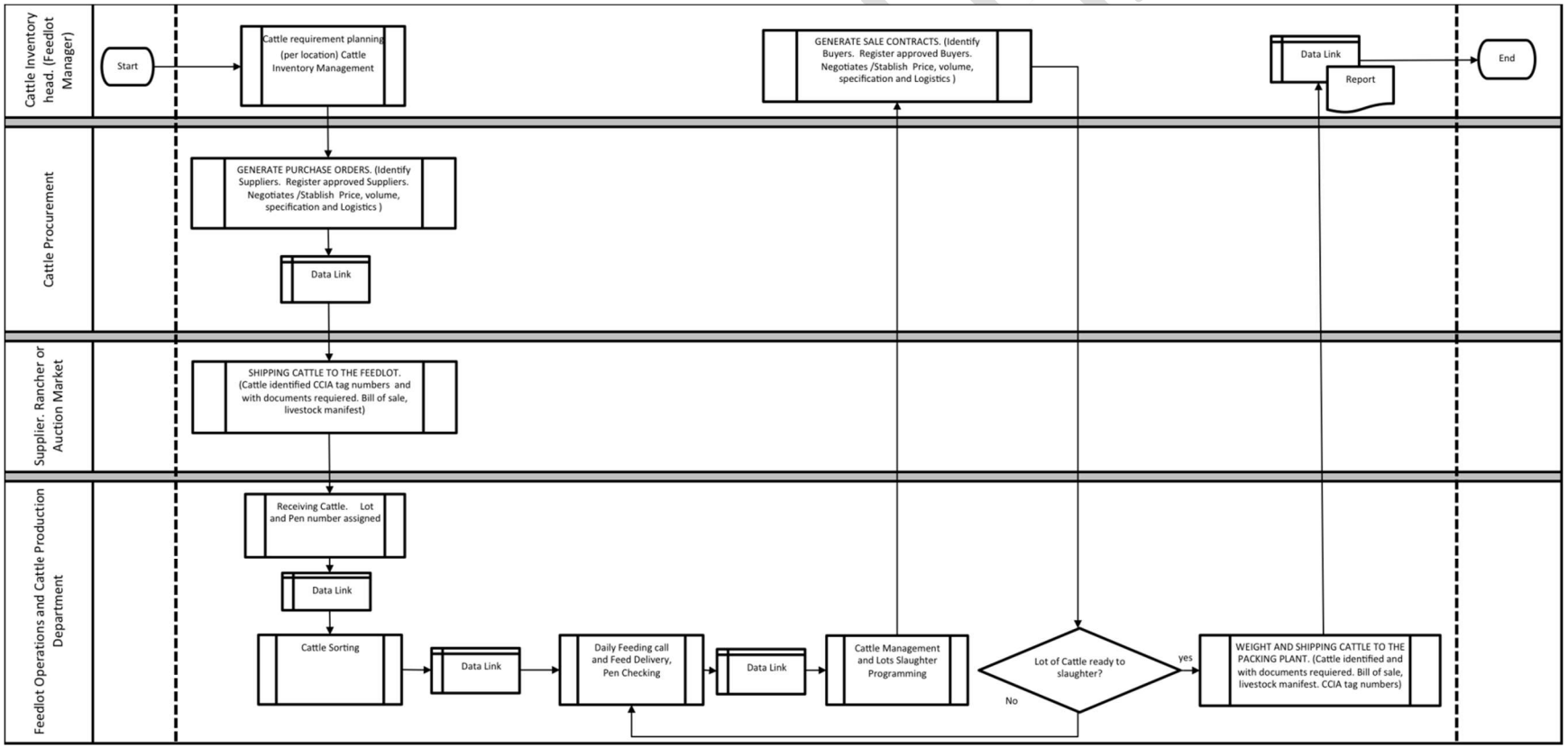


Figure AN- 7: Data Process Flow – Unique Cattle Identification

For added information, this diagram illustrates the process used for unique cattle identification at the feedlot.

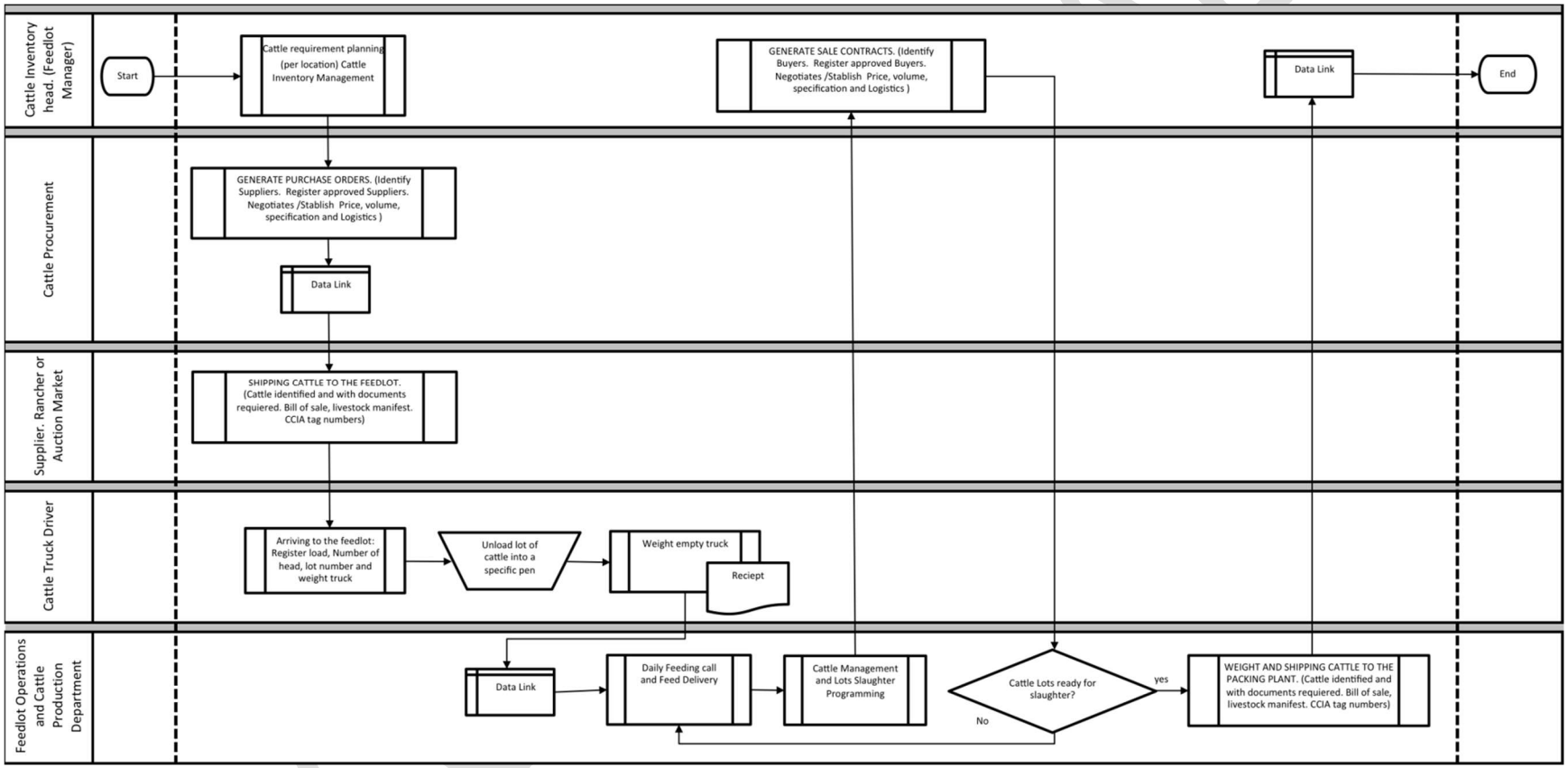
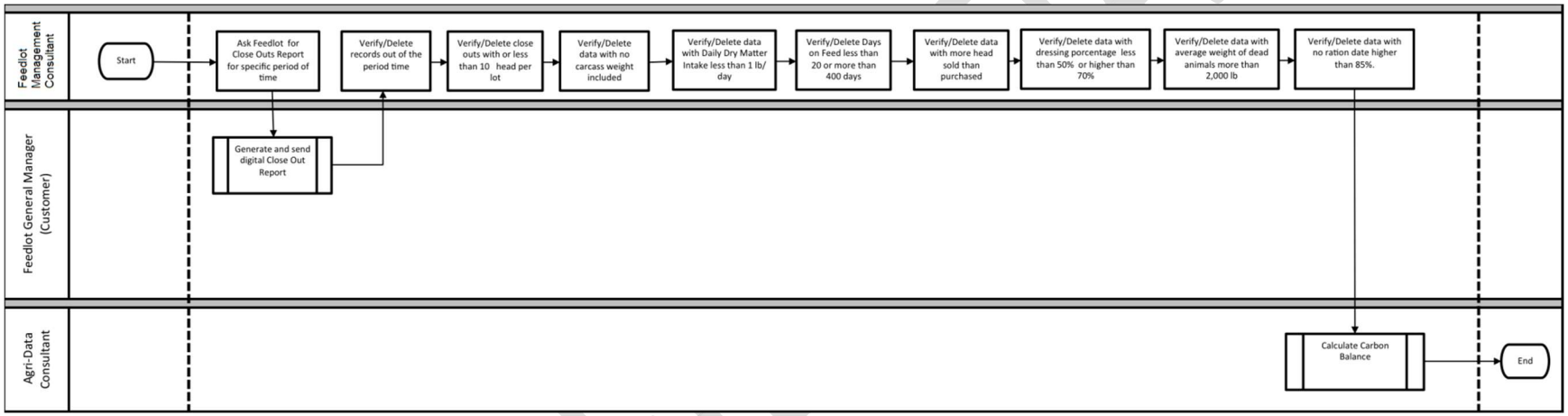


Figure AN- 8: Data Process Flow – XYZ Inc.'s Database Validation Criteria

This figure illustrates the filtering and quality control procedures that XYZ Inc.'s veterinarians apply to the digital close-out sheets they receive from the feedlot manager. Once the close-out reports are quality-approved, they are transferred electronically to XYZ Inc.'s carbon data analysis program platform.



The carbon data analysis program manager at XYZ Inc. receives the close-out reports and uploads them into the carbon data analysis program platform. The carbon data analysis platform's programming extracts the data from the close-out reports needed for the calculations for each animal grouping.

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8.3 Record Keeping

Record keeping practices for the Project consist of:

- Electronic recording of values of logged primary parameters for each measurement interval;
- Printing of monthly back-up hard copies of all logged data;
- Retention of copies of logs and all logged data for a period of 7 years after the end of the crediting period; and
- Keeping all records available for review by a verification body for a period of 7 years after the end of the crediting period.

8.4 Quality Control and Assurance

XYZ Inc. has employed a number of quality assurance/quality control procedures (QA/QC) to add confidence that all measurements and calculations have been made correctly. XYZ Inc.'s QA/QC methodology is largely incorporated into its analytical database program. This program has internal checks and balances to safeguard against human error and data entry mistakes. These procedures are outlined in Table AN-15 below.

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Table AN- 15: Quality Assurance/Quality Control Procedures and Plan	
Area	**XYZ Inc.'s Quality Assurance/Quality Control Procedure**
Offset Credit Data Management and Record Keeping	XYZ Inc.'s data process flows are provided in section 8.2 of this document. Each data control point is identified by a circled letter in the process flow diagrams (Figures 3 through 8).
Restriction of user access to offset claim calculations and data	XYZ Inc.'s data management system is password protected, limiting access to those individuals who are familiar with the system and the DOF protocol quantification methodology.
Data filtering procedures	Section 8.2 of this document describes the data filters and controls applied to the electronic feedlot close out sheets to remove missing data, inconsistencies or errors in data punching in data.
Ensuring that changes to operational procedures continue to function as planned	The ration compositions used at participating feedlots are control checked to ensure proper mixing. Specifically, a ration code is produced which is linked to a feed bin ready for truck delivery. The feedlot manager then reviews the feed charge and records (recipes) prepared that day (see Figure 3, in Section 8.2). Furthermore, when the feed ingredients are received at the feedlot a supervisor will take a sample or review the quality certificates accompanying the ingredients to ensure specifications are met (Figure 5, Section 8.2). XYZ Inc. obtains a copy of the manure management plan and NRCB permits for manure handling and storage. Each year XYZ Inc. investigates whether the manure handling, storage and management procedures have significantly changed. In the event of a significant change, XYZ Inc. will contact Alberta Environment and Parks for further direction.
Ensuring the measurement and calculation system for GHG reporting remains in place and accurate	XYZ Inc.'s data management platform houses all coefficients and formulae needed for the calculations and has been programmed to perform the calculations based on Table 8 in the protocol.
Statistical sampling procedures	The only statistical sampling and processing that occurred in this project was the generalized ration procedure for each feedlot (see Section 7.1, Table 12).
Checking data validity	All acquired data undergoes a data filtering process prior to being processed (see Section 8.2). Emission factors and static factors have been programmed into XYZ Inc.'s data management platform and were checked at the time of development and reviewed by a technical expert, and signed off.

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Table AN- 15: Quality Assurance/Quality Control Procedures and Plan	
Area	**XYZ Inc.'s Quality Assurance/Quality Control Procedure**
Documenting errors and associated changes/updates in records and raw data	If duplicate records, incorrect emission factors or records with values outside of expected ranges are identified, they are updated or removed accordingly and the changes documented in an exception report. Likewise, any adjustments made to the raw data are recorded and explained.
Performing recalculations of quantification procedures to reduce the possibility of error	XYZ Inc.'s data management platform stores all coefficients and calculations needed for the quantification of emissions. The platform has been programmed to perform the calculations based on Table 8 in the protocol. When the platform was being created it was checked several times to ensure it was calculating emissions correctly and reviewed by a technical expert.
Data storage	All logged data, copies of logs and records are kept in their raw form so they are available for review by a verification body for a period of seven years (see Section 8.3).
Data and documentation record protection	All supporting evidence is scanned and uploaded into the carbon data analysis program. Likewise, back-up hard copies of all logged data are printed monthly.
Contingency plan for potential data loss	XYZ Inc. has taken several steps to avoid potential data loss, including backing up its electronic records on an offsite server and web-based cloud; as well as printing hard copies of all logged data. As a result, XYZ Inc. does not anticipate any data loss with a triple fail-safe mechanism.
Back-end controls	Management reviews and approves all agreements and records; and ensures completeness of feedlot activity information, consistency with underlying data, and linkages between base data and claims. When this check is complete, a report is kept on file.

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9 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 plan 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 plan as of the _____ day of _____, 20__ ___.

Project Title: Enter name of project

Signature: _____

Date: Enter date

Name: Enter Name

Title: Enter title

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10 Appendix AN-A – Sample Calculation

The following section provides a sample calculation. All generic emission factors and project specific inputs used in the sample calculations are presented in Table AN-16 below.

Table AN- 16: Relevant Data for the Sample Calculation

Parameter	Source	Value		Units
		*Baseline**	*Project*	
General Information Relevant to Unique Grouping of Animals				
Animal head*days	Data from Project Site	4,679,721	1,186,550	-
Average Number in Production	Data from Project Site	20,783.98	5,127.48	Head
DOF (Days on Feed)	Data from Project Site Records	225.16	231.41	Days
Average Gain	Data from Project Site Records	668.08	699.27	lbs
Average Daily Gain	Data from Project Site Records	2.97	3.02	lbs
Total Hot Carcass Weight Produced	Data from Project Site Records	3,692,403.54	950,067.56	kg
Calculating Cattle Enteric Methane Emissions (kg CH_4)				
Average DDMI (Daily Dry Matter Intake)	Ration Formulation Records	19.97	19.12	lbs DM/head/day
Concentrates	Ration Formulation Records	85	85	%
GE Diet (Gross Energy Content of Diet)	Ration Formulation Records	18.45	18.45	MJ/kg
EF Enteric (Enteric Emissions Factor)**	Default factor from Protocol, based on level of concentrate	4	4	%
EC Methane (Methane Energy Content)	Default factor from Protocol	55.65		MJ/kg CH_4
Calculating Daily Volatile Solids Excreted by Cattle (for calculating Manure Methane) (kg VS)				
TDN_i (Total Digestible Nutrients)	Ration Formulation Records	79	79	%
UE (Urinary Energy)	Default factor from Protocol, based on level of concentrate	0.02	0.02	
ASH	Default factor from Protocol, based on constituents of baseline and project	2 (grain based diet)		%

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Table AN- 16: Relevant Data for the Sample Calculation			
	specific rational formulation records.		
Calculating CH_4 Emissions from Cattle Manure Handling, Storage, and Application (kg CH_4)			
Bo (Methane Producing Capacity)	Default factor from Protocol	0.19	m^3 CH_4/kg VS excreted
$\rho_{Methane}$ (Density of Methane)	Default factor from Protocol	0.67	kg/m^3 of CH_4
MCF (Methane Conversion Factor)	Default factor from Protocol and is based on manure management system at each site.	MCF value of 1.6% for this project was derived by assuming that 40% of the manure was produced on pasture while 60% of the manure was produced in feedlot and stored in solid form.	%
Calculating Nitrogen Excreted in Cattle Manure – for use in calculating N_20 Emissions (kg NE)			
CP (Crude Protein)	Ration Formulation Records	13.50 | 12.84	%
$CF_{protein}$ (Protein Conversion Factor)	Ration Formulation Records	6.25	kg Crude Protein/kg of N
NR (Nitrogen Retention)	Default factor from Protocol	0.07	kg N retained/kg N intake
Calculating Direct Nitrous Oxide (N_2O) emissions from Manure Decomposition (kg N_2O)			
CF (Conversion Factor)	Default factor from Protocol	0.02	kg N_2O-N per kilogram of nitrogen excreted
44/28 (Conversion Factor)	Default factor from Protocol	Default factor 44/28 to convert $(N_2O\text{-}N)_{(mm)}$ emissions to $N_2O_{(mm)}$emissions	
Calculating direct nitrous oxide (N_2O) emissions from manure storage (kg N_2O)			
$FRAC_{Storage}$ (Management System)	Default factor from Protocol	0.6	
EF (Storage Emissions Factor)	Default factor from Protocol	0.007	kg N_2O-N/kg nitrogen excreted
Calculating indirect emissions from manure volatilization (kg N_2O)			
$FRAC_{Volatilization}$ (Management System)	Default factor from Protocol	0.42	
$EF_{Volatilization}$ (Storage Emissions Factor)	Default factor from Protocol	0.01	kg N_2O-N/kg

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Table AN- 16: Relevant Data for the Sample Calculation			
			nitrogen volatilized
Calculating indirect nitrous oxide (N_2O) emissions from manure N in the Soil Profile (kg N_2O)			
$FRAC_{Leach}$ (Management System)	Default factor from Protocol	0.1	
EF_{Leach} (Storage Emissions Factor)	Default factor from Protocol	0.025	kg N_2O-N/kg nitrogen leached

*Animal head days are higher due to 3 years of operations, averaged over that time period.
** Same Ym or enteric emission factor is applied even though roughage levels in the diet (Ym =6.5%) have decreased over time. Conservative approach and outlined in the Interpretive Guide available from Alberta Agriculture and Forestry.

Tables AN-17 and AN-18 below use the example data in Table AN-16 above to calculate emission reductions following the hot carcass weight approach outlined in the Reducing GHG Emissions of Fed Cattle Protocol.

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Table AN- 17: Reducing GHG Emissions of Fed Cattle Protocol – Sample Emission Reduction Calculations
Equation 1 Cattle Enteric Emissions =[Number Production * DOF * $DDMI_i$ * GE_{Diet} * (EF $Enteric_i$ / 100%) / $EC_{Methane}$]
Enteric Emissions $_{BASELINE}$ = [((20,783.98 head) x (225.16 days) x ((19.97 lbs DMI/hd/day) / (2.2046 lbs/kg)) x (18.45 MJ/kg DM diet) x (4/100))/(55.65 MJ/kg CH_4)] = **562,159.31 kg CH_4**
Enteric Emissions $_{PROJECT}$ = [((5,127.48 head) x (231.41 days) x ((19.12 lbs DMI/hd/day)/(2.2046 lbs/kg)) x (18.45 MJ/kg DM diet) x (4 /100))/(55.65 MJ/kg CH_4)] = **136,469.43 kg CH_4**
Equation 2 Daily Volatile Solids Excreted in Cattle Manure = VS_i = [($DDMI_i$ * GE_{Diet} * (1 – (TDN_i / 100%))) + (UE * $DDMI_i$ * GE_{Diet})] * ((1 – (ASH / 100%)) / GE_{Diet})
Volatile Solids $_{BASELINE}$ = [((19.97 lbs DM/hd/day/ 2.2046 lbs/kg) x (18.45 MJ/kg DM of diet x (1-(79/100))) + (0.02 x ((19.97 lbs DM/hd/day)/(2.2046 lbs/kg)) x 18.45 MJ/kg DM of diet)] x [(1-(2/100))/18.45 MJ/kg DM of diet] = **2.04 kg Volatile Solids/hd/day**
Volatile Solids $_{PROJECT}$ = [((19.12 lbs DM/hd/day/ 2.2046 lbs/kg) x 18.45 MJ/kg DM of diet x (1-(79/100))) + (0.02 x ((19.12 lbs DM/hd/day)/(2.2046 lbs/kg)) x 18.45 MJ/kg DM of diet)] x [(1-(2/100))/18.45 MJ/kg DM of diet] = **1.95 kg Volatile Solids/hd/day**
Equation 3 Cattle Manure Handling, Storage, and Application Methane Emissions = [Number $Production_i$ * DOF_i * VS_i * Bo * ρ Methane * (MCF / 100%)]
Manure CH_4 $_{BASELINE}$ = [(20,783.98 head) x (225.16 days) x (2.04 kg volatile solids excreted/hd/day) x (0.19 m^3 CH_4/kg VS) x (0.67 m^3/kg) x (1.6/100)] = **19,444.58 kg CH_4**
Manure CH_4 $_{PROJECT}$ = [(5,127.48 heads) x (231.41 days) x (1.95 kg volatile solids excreted/hd/day) x (0.19 m^3 CH_4/kg VS) x (0.67 m^3/kg) x (1.6/100)] = **4,712.69 kg CH_4**
Equation 4 Excreted Nitrogen = NEx_i = $DDMI_i$ * (CP_i / 100%) / $CF_{protein}$ * (1 – NR)
Nitrogen Excreted $_{BASELINE}$ = [((19.97 lbs DM/hd/day)/(2.2046 lbs/kg)) x ((13.50/100)/6.25 kg feed protein /kg N) x (1-0.07 kg N retained/kg N consumed)] = **0.18 kg N excreted/hd/day**
Nitrogen Excreted $_{PROJECT}$ = [((19.12 lbs DM/hd/day)/(2.2046 lbs/kg)) x ((12.84/100)/6.25 kg feed protein /kg N) x (1-0.07 kg N retained/kg N consumed)] = **0.17 kg N excreted/hd/day**
Equation 5 Manure N_20_{direct} = [Number $Production_i$ * DOF_i * NEx_i * CF_{manure} * (44 / 28)]

Table AN- 17: Reducing GHG Emissions of Fed Cattle Protocol – Sample Emission Reduction Calculations
Manure $N_2O_{direct\ BASELINE}$ = [(20,783.98 head) x (225.16 days) x (0.18 kg N excreted/hd/day) x (0.02 kg N_2O-N/kg N excreted) x (44/28)] = **26,473.85 kg N_2O**
Manure $N_2O_{direct\ PROJECT}$ = [(5,127.48 head) x (231.41 days) x (0.17 kg N excreted/hd/day) x (0.02 kg N_2O-N/kg N excreted) x (44/28)] = **6,339.57 kg N_2O**
Equation 6 Manure $N_2O_{direct\ storage}$ = [Number Production$_i$ * DOF$_i$ * NEx$_i$ * FRAC$_{Storage}$* EF$_{Storage}$ * (44 /28)]
Manure $N_2O_{direct\ storage\ BASELINE}$ = [(20,783.98 head) x (225.16 days) x (0.18 kg N/hd/day) x (0.6) x (0.007 kg N_2O-N/kg nitrogen excreted) x (44/28)] = **5,559.51 kg N_2O**
Manure $N_2O_{direct\ storage\ PROJECT}$ = [(5,127.48 head) x (231.41 days) x (0.17 kg N/hd/day) x (0.6) x (0.007 kg N_2O-N/kg nitrogen excreted) x (44/28)] = **1,331.31 kg N_2O**
Equation 7 Manure $N_2O_{Indirect\ volatilization}$ = [(Number Production$_i$)*(DOF$_i$)*(NEx$_i$)*(FRAC$_{Volatilization}$)*(EF$_{Volatilization}$)*(44/ 28)]
Manure $N_2O_{indirect\ volatilization\ BASELINE}$ =[(20,783.98 head) x (225.16 days) x (0.18 kg N/hd/day) x (0.42 kg $N_2$0-N/kg nitrogen excreted) x (0.01 kg N_2O-N/kg nitrogen excreted) x (44/28)] = **5,559.51 kg N_2O**
Manure $N_2O_{indirect\ volatilization\ PROJECT}$ =[(5,127.48 head) x (231.41 days) x (0.17 kg N/hd/day) x (0.42 kg $N_2$0-N/kg nitrogen excreted) x (0.01 kg N_2O-N/kg nitrogen excreted) x (44/28)] = **1,331.31 kg N_2O**
Equation 8 Manure $N_2O_{indirect\ leaching}$ = [(Number Production$_i$)*(DOF$_i$)*(NEx$_i$)*(FRAC$_{Leaching}$)*(EF$_{Leaching}$)*(44 / 28)]
Manure $N_2O_{indirect\ leaching\ BASELINE}$ = [(20,783.98 heads) x (225.16 days)*(0.18 kg N/hd/day)*(0.1)*(0.025 kg N_2O-N/kg nitrogen excreted)*(44/28)] = **3,309.23 kg N_2O**
Manure $N_2O_{indirect\ leaching\ PROJECT}$ = [(5,127.48 heads)*(231.41 days)*(0.17 kg N/hd/day)*(0.1)*(0.025 kg N_2O-N/kg nitrogen excreted)*(44/28)] = **792.45 kg N_2O**

Table AN- 18: Final Calculation Steps					
Factor	**Total Methane Emissions (kg CH_4)**	**Total Nitrous Oxide Emissions (kg N_2O)**	**Total Hot Carcass Weight Produced (kg)**	**CH_4 Emissions Intensity (kg CH_4/kg Hot Carcass weight)**	**N_2O Emissions Intensity (kg N_2O/kg Hot Carcass weight)**
Baseline	581,603.89	40,902.1	3,692,403.54	0.158	0.011
Project	141,182.12	9,794.64	950,067.56	0.149	0.010
			Difference	0.009	0.001
			Total Emission Reductions (kg CO_2e)[1]	496,885.33	
			Total Credits (t CO_2e)	**496.89**	

[1] ((0.009 x 950,067.56) x 25) + ((0.001 x 950,067.56) x 298), where 25 is the global warming potential (GWP) of methane and 298 is the GWP of nitrous oxide.

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Appendix AO: RAH Offset Project Plan

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Alberta Offset System

Offset Project Plan for XYZ Inc.'s

Reducing the Age to Harvest of Beef Cattle Aggregation Project - Protocol Validation Study

(March 2014)

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Disclaimers

This report has been produced independently by The Prasino Group at the request of the Climate Change Emissions Management (CCEMC) Corporation as specified under contract. 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 Plan (OPP) produced as part of the larger Protocol Validation Study. It is meant to provide guidance to project developers on applying the OPP template (http://environment.gov.ab.ca/info/library/8524.pdf) to a Reduced Age to Harvest Offset Project under the Alberta Offset System. Any reference to feedlot information, or offset credit information contained within this document is fictitious and intended for illustrative purposes only.

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1 Project Scope and Site Description

1.1 Project Scope

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

Table AO- 1: Project Details	
Project Title:	Offset Project Plan for XYZ Inc.'s Reducing the Age to Harvest of Beef Cattle Aggregation Project - Protocol Validation Study
Project Purpose and Objective(s):	The purpose of this project is to reduce direct and indirect GHG emissions from beef cattle associated with enteric fermentation and manure storage and handling. XYZ Inc. will aggregate five feedlots for this project. The broader goal of the Protocol Validation Study is to identify barriers that currently exist in implementing projects under the RAH protocol and design scalable approaches to adopting this protocol. The RAH protocol does not prescribe the harvest age or production practices for raising beef cattle. As a result, different feedlot operators may choose different techniques, but must demonstrate through documentation and records that there is a reduction in the age of the harvested cattle.
Project Start Date:	e.g. January 1, 2011
Credit Start Date:	N/A – the RAH Protocol Validation Study is a non-commercial exercise (e.g. January 1, 2011)
Credit Duration Period:	N/A – the RAH Protocol Validation Study is a non-commercial exercise (e.g. Alberta Offset System eligibility specifies 8 years, with the potential for an additional five years upon government approval)
Expected Lifetime of the Project:	N/A – the RAH Protocol Validation Study is a non-commercial exercise (Commercial feedlots could continue this exercise indefinitely, and this activity is dynamic and can be stopped and restarted)
Estimated Emission Reductions/Removals:	Up to 25,000 t CO_2e
Applicable Quantification Protocol(s):	Government of Alberta Quantification Protocol for Reducing the Age at Harvest of Beef Cattle Version 2.0, July, 2011
Protocol(s) Justification:	All participating project sites are based in Alberta and have implemented strategies to reduce the age of harvest of beef cattle. The practices adopted are not commonly employed and therefore go beyond business as usual (BAU). As a result, the project is additional. The Project and all aggregated sites also

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Table AO- 1: Project Details	
	align with all applicability requirements stated in the Protocol. Refer to Section 3.3 for Project Eligibility Criteria.
Other Environmental Attributes:	This project will not generate any other environmental credits. However, more efficient production of beef will result in less manure being produced and as a result less associated impacts from manure and water use.
Legal Land Description of the Project and/or Other Unique Site Descriptions:	Feedlot #1: 01-01-010-01W4 Feedlot #2: 02-01-010-01W4 Feedlot #3: 03-01-010-01W4 Feedlot #4: 04-01-010-01W4 Feedlot #5: 05-01-010-01W4
Ownership:	As described in the Protocol, ownership of offset credits generated under this protocol is assigned to the project developer. The project developer for this project is XYZ Inc. Proof of ownership over emission reductions is provided in the form of purchase records, commercial agreements/shipping manifests/RFID tag relationships for the animals in the project to substantiate the feedlots fed the cattle in question, in addition to agreements between the participating feedlot operators and the project developers. XYZ Inc. is the aggregator and sole owner of all offsets arising from this project.
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 March 2014. The verifier has no actual or perceived conflicts of interest associated with this project. This is the first project plan and first verification of emission reductions for this project. The anticipated frequency of verification is annually (projects over 15,000 tonnes per year) or every two years (projects under 15,000 tonnes per year).
Project Activity:	See Table AO-3 below.
Project Registration:	N/A – the RAH 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.

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

This project is an aggregation of emission reductions across five feedlots in Alberta. The location of these feedlots is provided below:

Table AO- 2: Farm Coordinates

Farm	Legal Land Description	Latitude	Longitude
Feedlot #1	01-01-010-01W4	53.521479	-113.215915
Feedlot #2	02-01-010-01W4	53.447117	-111.923904
Feedlot #3	03-01-010-01W4	50.387617	-112.438202
Feedlot #4	04-01-010-01W4	50.301725	-113.471405
Feedlot #5	05-01-010-01W4	51.214875	-111.931052

Note: the above coordinates are fictitious

1.3 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 Technical Guidance for Offset Project Developers (version 4.0, February 2013). The Project complies with the Specified Gas Emitters Regulation Quantification Protocol for Reducing the Age at Harvest of Beef Cattle Version 2.0, July, 2011.

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Table AO- 3: Alberta Offset System Eligibility	
Criteria	**How this Project Meets the Requirement**
Start Date after January 1, 2002	The changes in beef cattle rearing practices were implemented after January 1, 2002.
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 Reducing the Age at Harvest of Beef Cattle Protocol.
Not Required By Law	The changes in practices were not required by law or regulation.
Clearly Established Ownership	Legal land descriptions for each feedlot included in the project were checked. The aggregator and land owner then signed an agreement clearly establishing the aggregator as the owner of the credits.
Counted Once for Compliance Purposes	e.g. 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 plan 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	The activity is implemented under the Quantification Protocol for Reducing the Age at Harvest of Beef Cattle, Version 2.0, July, 2011.
Be registered on the registry.	This document supports the registration on the registry of tonnes serialized by XYZ Inc.

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2 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	

3 Other Project Information

3.1 Conditions Prior to Project Initiation

Each of the participating feedlots have been in operation for a minimum of three years prior to the start date of the Reducing the Age at Harvest Aggregation Project - Protocol Validation Study.

The beef cattle rearing practices described herein have been undertaken by the participating feedlots to reduce the age at harvest. These practices include: increased genetic marker testing, changes in veterinary regimes, adjustments to feeding regimes, and reducing the number of animals that showed characteristics of being less efficient.

The quantification of emission reductions is based on the cumulative effect of all these practices together, thus the effect on individual practices was not estimated. All of the feedlot feeding regimes are materially consistent with the typical feeding regimes for beef cattle, as described in the protocol. Five feedlots will be participating in the Reducing the Age at Harvest Aggregation Project - Protocol Validation Study. The study will run until March 2014.

3.2 Description of How the Project Will Achieve Greenhouse Gas Emission Reductions/ Removals

Beef cattle, release methane (CH_4) as a result of the digestion of feed materials in the rumen. These emissions are called enteric emissions and are a significant contributor to greenhouse gas emissions from agricultural activities. Other emission sources for cattle include methane and nitrous oxide (N_2O) which are generated from manure storage and handling within beef cattle operations. A reduction in the age beef cattle are harvested due to changes in feeding and veterinary regimes, genetic marker testing, and a

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reduction in the number of less efficient animals, collectively contribute to the reduction of methane and nitrous oxide emissions.

Greenhouse Gas Emission Reductions for this project will be quantified using the Government of Alberta Quantification Protocol for Reducing the Age at Harvest of Beef Cattle, Version 2.0, July 2011. Under this protocol, direct and indirect emission reductions are generated through the use of innovative feeding, veterinary, and genetic marker testing practices, as well as reducing the number of less efficient animals. The unique combination of these practices is the additional aspect of this project, resulting in reduced greenhouse gas emissions. The integrated results of these strategies are captured by the accounting metrics in the protocol. Emissions reductions will be compared using a functionally equivalent unit of emissions reductions per kilogram carcass weight as per the protocol.

3.3 Project Eligibility

The project meets the requirements of the Reducing the Age at Harvest Protocol. The applicability criteria, sources and sinks, and quantification methodologies for the RAH Protocol Validation Study have been determined in accordance with the Government of Alberta Quantification Protocol for Reducing the Age at Harvest of Beef Cattle (Version 2.0, July 2011) and the Technical Guidance for Offset Project Developers (Version 4.0, February 2013). As described in the protocol, the project must conform to or meet certain criteria. **Error! Reference source not found.** describes how the protocol criteria are met and the relevant sections of the enclosed Offset Project Plan.

Table AO- 4: Protocol Applicability Criteria

Applicability Criterion as per the Protocol[51]	How Criteria Are Met
All cattle in the baseline and project condition must be registered with the Canadian Cattle Identification Agency (CCIA) and have a birth certificate issued by the agency.	All cattle included in this project are registered through the Canadian Cattle Identification Agency (CCIA) and have a birth certificate.
Cattle must have an established birth date. This can be done in two ways – either through a default approach, which assumes that the date registered with the CCIA is the date of first calf born (this method is discounted to reflect the variation in calf age) or the documented approach, where the actual birth date is backed up with calving records from the ranching operations.	This project uses the default approach. Therefore, the date registered with the CCIA will be discounted and used as the date of first calf born as per the protocol.
A legal land location of the feedlot where the animal is finished prior to harvest.	Contractual agreements for aggregation of the GHG emission reductions exist between feedlot owner and XYZ Inc. The ownership information includes a current land title certificate stating the legal land location.

[51] Alberta Environment Quantification Protocol for Reducing the Age at Harvest of Beef Cattle, (July 2011, Version 2.0)

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Table AO- 4: Protocol Applicability Criteria	
Applicability Criterion as per the Protocol[51]	**How Criteria Are Met**
Animal grouping criteria used by the feedlot. These criteria must be the same in the baseline and project condition as these grouping comparisons are used to prove that the number of days it takes animals to finish their feeding cycle (from calf to harvest) is reduced in the project.	The animal groupings applied in the quantification are broken down by gender (heifer or steers), animal type (e.g. fall calves, yearlings, etc.) and weight (100 lb. (45.36 kg). weight classes).
The quantification of reductions achieved by the project is based on actual measurement, monitoring and estimations are applied according to the methodology outlined in this protocol.	The age at harvest, number of head in production and average live weight are all measured and monitored as described in Sections 7 and 8. Any animal groupings that did not have sufficient data to quantify the offsets were omitted from the project.
The method of establishing the average age at harvest does not result in bias in emission reduction calculations from selecting the most favorable pens/groupings.	Sampling of the project and baseline must be done according to the method outlined in Appendix B of the protocol.
The quantification of emissions related to the baseline and project condition must be functionally equivalent. That is, the metric for comparison must have the same production level and/or quality of products and/or services. The common unit for comparison of emission levels for this protocol is kg CO_2e/hd/yr normalized for the carcass weight of animals in both the baseline and project conditions.	The baseline and project condition are functionally equivalent and use the specified unit of kg CO_2e/hd/yr normalized for the carcass weight of the animals included in the baseline and project.
Manure must be managed according to the *Agricultural Operation Practices Act* requirements for confined feeding operations.	For each of the feedlots, NRCB permits exist for the operations implemented after 2002. Manure management plans are in place. No major changes have occurred in manure management since the baseline years.
The project must meet the eligibility criteria stated in section 7.0 of the *Specified Gas Emitters Regulation.*	The emissions reductions meet the eligibility criteria stated in the SGER as demonstrated by Table AO-3, above.

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3.4 Flexibility Mechanisms

The protocol identifies two flexibility mechanisms for project developers in quantifying offsets. Table AM-4 below identifies which of these flexibility mechanisms has been applied in quantifying offsets from this project. A justification of why the flexibility mechanism has been exercised is also provided.

Table AO- 5: Summary of Flexibility Mechanisms Applied		
Flexibility Mechanism as per the Protocol[52]	**Exercised (Yes/No)**	**Justification**
For feedlots where the age to harvest varies across groups of animals, these animals can be grouped in discreet units and tracked individually. In this case, the baseline condition may need to be calculated relative to the group that historically had the longest time to harvest.	No	N/A
Operations using feeding cycles materially different from those outlined in the protocol may calculate custom emissions factors based on their particular feeding cycles using a relevant method, such as the IPCC (tier 2); or CowBytes™. Justification and rational for the method chosen must be provided in the offset project plan.	No	N/A

3.5 Project Technologies, Products, Services and the Expected Level of Activity

3.5.1 Innovative Feeding, Veterinary and Genetic Market Testing Practices

In this project, emission reductions will be generated through increased genetic marker testing, changes in veterinary regimes, adjustments to feeding regimes, and reducing the number of animals that showed characteristics of being less efficient. These practices present an opportunity to manage the production chain in order to shorten cattle lifespans and reduce the time they spend idle on roughage based diets, producing unnecessary CH_4 and manure (and associated CH_4 and N_2O emissions). According to Basarab et al. (2009), "optimizing the gain during each feeding period, decreasing the length of the backgrounding period, increasing the proportion of grain in backgrounding diets and reducing the numbers of days cattle spend on unproductive and poor quality pastures" can all result in a reduced age at harvest of youthful beef cattle.

[52] Alberta Environment Quantification Protocol for Reducing the Age at Harvest of Beef Cattle, (July 2011, Version 2.0)

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3.6 Identification of Risks

There are a number of issues associated with offset credits and the evidence that is required to support assurance. In their report titled "Scoping Study of Assurance Standards to Verify Agricultural Greenhouse Gas Offset Projects" (2011), KPMG identified several of these risks and ways to mitigate them. Table AO-6 below was taken directly from KPMG's report and represents risks that are applicable to all agricultural offset credits. Table AO-7 presents' additional risks and control measures that are specific to the Reduced Age at Harvest Protocol. These measures have been implemented throughout each feedlot/sub-project.

Table AO- 6: Risks Associated with Agricultural Offset Credits (Source: KPMG, 2011)

Risk	Evidence to provide a reasonable level of assurance	Recommended control to mitigate risk
Project developer does not have ownership of emission reductions	Signed offset credit agreement between project developer and feedlot operator is in place	Management review[53] and approval of offset credit agreements
Feedlot operator has already sold emission reduction rights on another registry or to another project developer	Signed offset credit agreement between project developer and feedlot operator that clearly states operator has not sold offset credits previously under the protocol	Management review of current RAH projects listed on the Alberta Registry
Feedlot operations claimed that do not exist in province of Alberta	Check the legal land location exists in Alberta through web-based programs	Management review of offset credit files for completeness of information
Data management system does not track required ownership, feedlot practices, etc.	Detailed listing of all operations included in offset claim by year that links to information required to establish ownership, eligibility, specific feedlot information on practices and offset credits claimed	Management review of data transparency (i.e. Linkages are maintained both ways between base data and feedlot operation specific offset claims)
Insufficient controls over stored data	Process documentation outlining linkages to data management and record keeping for offset credits	Restricted user access to offset claim calculations and data
Incorrect formulae for calculating emission reductions	Process documentation relating to data management and record keeping for offset credits	Exception reports to identify duplicate records, incorrect emission factors

[53] Defined as the analysis and evaluation of information prepared by one individual and reviewed by a second independent manager

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Table AO- 6: Risks Associated with Agricultural Offset Credits (Source: KPMG, 2011)		
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**
		records with values outside of expected parameters
Discrepancies between reported amounts of offsets and data management system	Process documentation relating to data management and record keeping for offset credits	Management review of reported data to ensure it is consistent with underlying offset credit data

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Table AO- 7: Additional Risks Associated with the Reducing the Age at Harvest Protocol		
Risk	**Evidence to provide a reasonable level of assurance**	**Recommended control to mitigate risk**
The animals in the feeding/commercial agreements cannot be tracked and may not have been fed in the feedlot in question	Feedlot or third party records showing unique tag numbers for each animal. Lost tags must be removed from the project or the tag retired and a replacement issued.	Management review of files for completeness of information
The age at harvest cannot be established or is under estimated	Feedlot or third party records showing the birth date of the animal and the date of harvest (i.e. date-stamped shipping manifests or packing plant receipts that show the individual animal was shipped directly to harvest with the correct CCIA tag)	Review of records by qualified and recognized professionals to ensure consistency and accuracy
Animal groups are inconsistent between baseline and project	Documented method used to group cattle for calculations in the baseline and project, including details on the incoming and outgoing weights	Management review of internal processes for grouping animals are consistent with documented method
The number of animals in production is reported incorrectly	Feedlot inventory records, feedlot records, shipping manifests of packing plant receipts or third party production or performance data with sign-off showing number of animals in a grouping	Review of records by qualified and recognized professionals to ensure consistency and accuracy
Manure management practices are inconsistent between baseline and project	Documentation showing that a permit from the Natural Resource Conservation Board (NRCB) is in place and no major changes in manure management have occurred	Management review of records to ensure permit exists

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4 Inventory of Sources and Sinks

Table AO-8 below identifies all the sources, sinks and reservoirs (SSRs) as listed in the Government of Alberta Quantification Protocol for Reducing Age at Harvest in Beef Cattle (Version 2.0, October 2011). Specifically, the table states whether each source and sink is related, controlled, or affected by the project, whether they are included or not for quantification and whether they are included or not for the RAH Protocol Validation Study Project, with justification as to why.

Figure AO-1 and Figure AO-2 below are process flow diagrams representing the project and baseline conditions, respectively.

Table AO- 8: Baseline & Project Sources, Sinks and Reservoirs

GHG Source, Sink, or Reservoir	Controlled, Related, Affected	Incl. / Excl. in Protocol	Included / Excluded in Project (with justification)
Baseline Condition:			
Upstream Sources and Sinks During Baseline Operation			
B1a Cattle Husbandry	Related	Exclude	Excluded, as per protocol
B1b Cattle Production	Related	**Include**	Included because emissions from baseline to project are materially different
B2 Cattle Transportation	Related	Exclude	Excluded, as per protocol
B3 Feed Production	Related	Exclude	Excluded, as per protocol
B4 Feed Transportation	Related	Exclude	Excluded, as per protocol
B5 Production of Other Agricultural Inputs	Related	Exclude	Excluded, as per protocol
B6 Transportation of Other Agricultural Inputs	Related	Exclude	Excluded, as per protocol
B7 Fuel Extraction and Processing	Related	Exclude	Excluded, as per protocol
B8 Fuel Delivery	Related	Exclude	Excluded, as per protocol
B16 Electricity Usage	Related	Exclude	Excluded, as per protocol
Onsite Sources and Sinks During Baseline Operation			
B9 Farm Operation	Controlled	Exclude	Excluded, as per protocol
B10 Feed Consumption	Controlled	**Include**	Included because emissions from baseline to project are materially different

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Table AO- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	**Controlled, Related, Affected**	**Incl. / Excl. in Protocol**	**Included / Excluded in Project (with justification)**
B13 Manure Storage and Handling	Controlled	**Include**	Included because emissions from baseline to project are materially different
B14 Manure Transportation	Controlled	Exclude	Excluded, as per protocol
B15 Land Application	Controlled	**Include**	Included because emissions from baseline to project are materially different
Downstream Sources and Sinks During Baseline Operation			
B11 Finished Cattle Transportation	Related	Exclude	Excluded, as per protocol
B12 Slaughter, Processing and Distribution	Related	Exclude	Excluded, as per protocol
Other Sources and Sinks			
B17 Development of Site	Related	Exclude	Excluded, as per protocol
Baseline Condition:			
B18 Building Equipment	Related	Exclude	Excluded, as per protocol
B19 Transportation of Equipment	Related	Exclude	Excluded, as per protocol
B20 Construction on Site	Related	Exclude	Excluded, as per protocol
B21 Testing of Equipment	Related	Exclude	Excluded, as per protocol
B22 Site Decommissioning	Related	Exclude	Excluded, as per protocol
Project Condition:			
Upstream Sources and Sinks During Project Operation			
P1a Cattle Husbandry	Related	Exclude	Excluded, as per protocol
P1b / B1b Cattle Production	Related	**Include**	Included because emissions from baseline to project are materially different
P2 Cattle Transportation	Related	Exclude	Excluded, as per protocol
P3 Feed Production	Related	Exclude	Excluded, as per protocol

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Table AO- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	**Controlled, Related, Affected**	**Incl. / Excl. in Protocol**	**Included / Excluded in Project (with justification)**
P4 Feed Transportation	Related	Exclude	Excluded, as per protocol
P5 Production of Other Agricultural Inputs	Related	Exclude	Excluded, as per protocol
P6 Transportation of Other Agricultural Inputs	Related	Exclude	Excluded, as per protocol
P7 Fuel Extraction and Processing	Related	Exclude	Excluded, as per protocol
P8 Fuel Delivery	Related	Exclude	Excluded, as per protocol
P16 Electricity Usage	Related	Exclude	Excluded, as per protocol
Onsite Sources and Sinks during Project Operation			
P9 Farm Operation	Controlled	Exclude	Excluded, as per protocol
P10 Feed Consumption	Controlled	**Include**	Included because emissions from baseline to project are materially different
P13 Manure Storage and Handling	Controlled	**Include**	Included because emissions from baseline to project are materially different
P14 Manure Transportation	Controlled	Exclude	Excluded, as per protocol
P15 Land Application	Controlled	**Include**	Included because emissions from baseline to project are materially different
Downstream Sources and Sinks During Project Operation			
P11 Finished Cattle Transportation	Related	Exclude	Excluded, as per protocol
P12 Slaughter, Processing and Distribution	Related	Exclude	Excluded, as per protocol
Other Sources and Sinks			
P17 Development of Site	Related	Exclude	Excluded, as per protocol
P18 Building Equipment	Related	Exclude	Excluded, as per protocol
P19 Transportation of Equipment	Related	Exclude	Excluded, as per protocol

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Table AO- 8: Baseline & Project Sources, Sinks and Reservoirs			
GHG Source, Sink, or Reservoir	**Controlled, Related, Affected**	**Incl. / Excl. in Protocol**	**Included / Excluded in Project (with justification)**
P20 Construction on Site	Related	Exclude	Excluded, as per protocol
P21 Testing of Equipment	Related	Exclude	Excluded, as per protocol
P22 Site Decommissioning	Related	Exclude	Excluded, as per protocol

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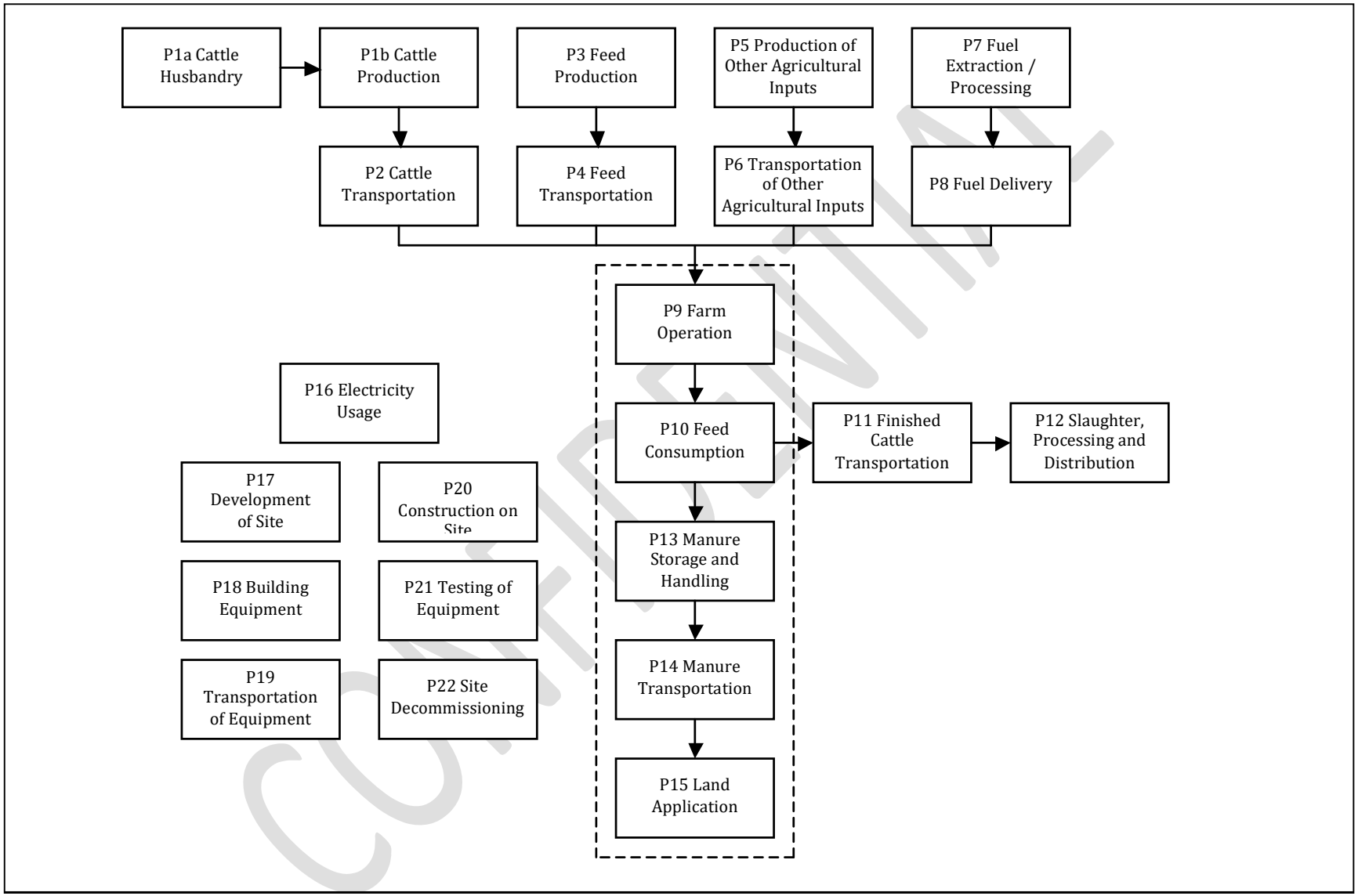


Figure AO- 1: Process Flow Diagram for the Project Condition

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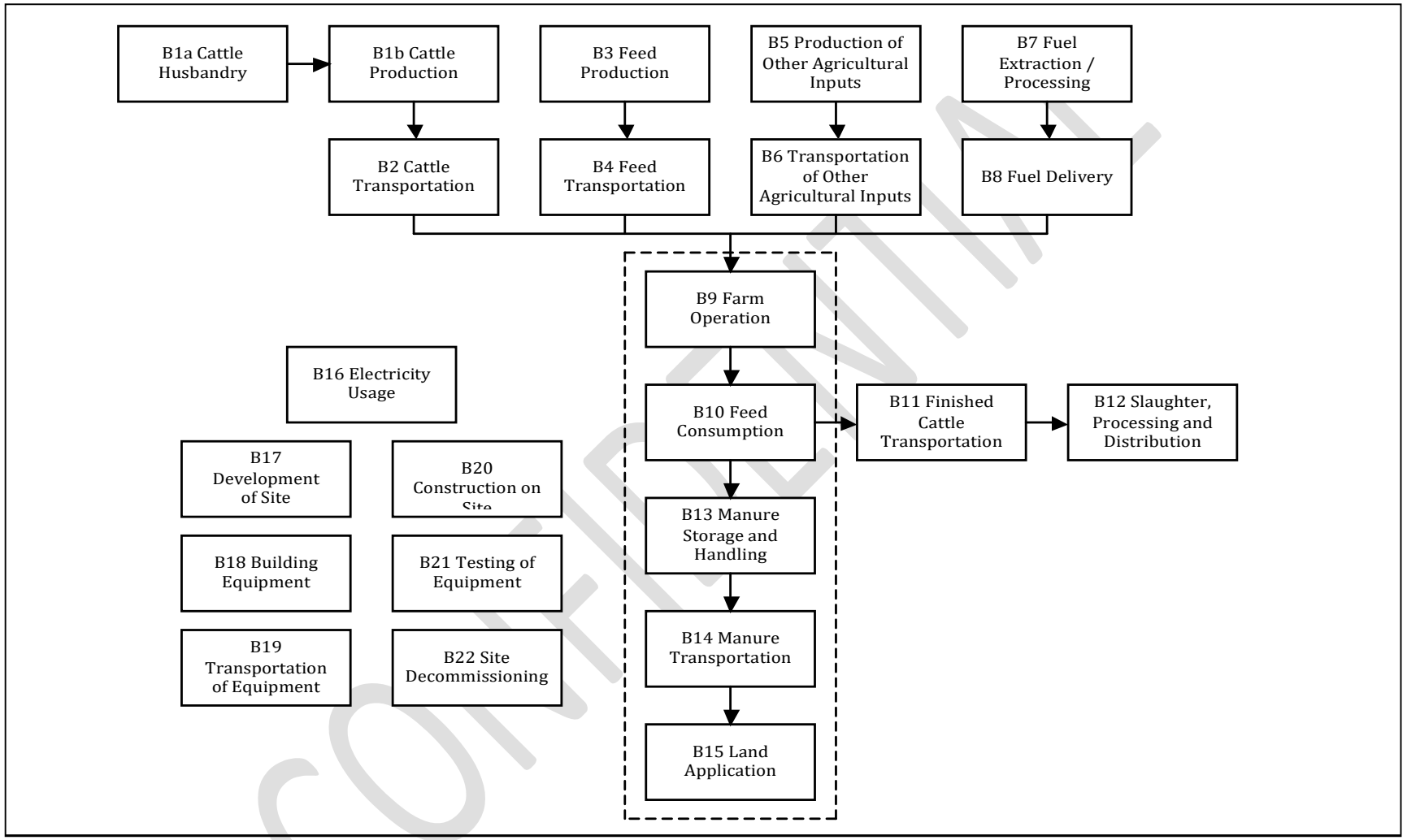


Figure AO- 2: Process Flow Diagram for the Baseline Condition

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5 Identification of the Baseline and Project

5.1 The Baseline Condition

The baseline condition for projects applying the Reducing the Age at Harvest Protocol is defined by the practices in the feedlot that are used before implementing practices that reduce the age of cattle at harvest.

This baseline is defined using a static historic baseline approach. This means that the 3-year average level of emissions calculated under the baseline condition (2008-2010) is held constant over the life of the project and compared to the project level emissions over time.

Emissions in the baseline and project conditions are calculated based on the total carcass weight of animals' harvested (kg CO_2e/hd/yr). As such, the baseline and project conditions are functionally equivalent.

Table AO-9 below summarizes the baseline periods for each of the project sites aggregated under the RAH Protocol Validation Study.

Table AO- 9: Baseline Period (Years) for Each of the Project Sites Aggregated

Feedlot:	Baseline Period:
Feedlot #1	2008 - 2010
Feedlot #2	2008 - 2010
Feedlot #3	2008 - 2010
Feedlot #4	2008 - 2010
Feedlot #5	2008 - 2010

5.2 The Project Condition

The project condition is defined by the implementation of practices that reduce the age of beef cattle at harvest. The project activities must be new to each of the participating feedlots.

Specifically, in the case of the RAH Protocol Validation Study, emission reductions will be generated through increased genetic marker testing, tailored veterinary regimes, implementation of adjustments to feeding regimes, and reducing the number of animals that showed characteristics of being less efficient.

In order to maintain functional equivalence between the baseline and project conditions, an adjustment is applied to equalize baseline and project on the basis of emissions intensities per kg of carcass weight produced.

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6 Quantification Plan

Section 4 of the Alberta Quantification Protocol for Reducing Age at Harvest for Beef Cattle defines the appropriate methodology in quantifying emission reductions from related projects.

6.1 Quantification Methodology

The following equations serve as the basis for calculating the emission reductions from the project, using the emission profiles of the baseline and project conditions. Note that only sources, sinks and reservoirs (SSRs) determined to be relevant to this project are included here.

6.1.1 Summary of Equations

$$Emission_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$$

$$Emissions_{Baseline} = Emissions_{Cattle} + Emissions_{Manure}$$

$$Emissions_{Project} = Emissions_{Cattle} + Emissions_{Manure}$$

Where:

- $Emission_{Baseline}$ = Sum of the emissions under the baseline condition
- $Emissions_{Cattle}$ = Emissions under B1b Cattle Production and B10 Feed Consumption
- $Emissions_{Manure}$ = Emissions under B13 Manure Storage and Handling and B15 Land Application

- $Emissions_{Project}$ = Sum of the emissions under the project condition
- $Emissions_{Cattle}$ = Emissions under P1b Cattle Production and P10 Feed Consumption
- $Emissions_{Manure}$ = Emissions under P13 Manure Storage and Handling and P15 Land Application

The following formulae were used to quantify emission reductions from the project for each SSR. The formulae are the same as those provided in the protocol. A sample calculation using the equations is provided in Appendix A.

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6.1.2 P1b/B1b Cattle Production and P10/B10 Feed Consumption

The relevant greenhouse gas applicable to these SSR's is methane (CH_4). The general equations for these SSR's, as presented in the protocol, are:

Equation 1: Enteric Emissions from Cattle

$$Emissions_{Cattle} = \sum (EF_{Enteric} * Mass_{Production} * Number_{Production}) \text{ (For each animal grouping)}$$

The Emissions Factor ($EF_{Enteric}$) is calculated using the formula provided below. The normalized standard carcass weight ($Mass_{Production}$) of 345 kg is imbedded within this calculation.

Equation 2: Calculating Enteric Emissions Intensity in the Project and Baseline Conditions

$$Kg\ enteric\ CH_4\ Produced/kg\ carcass\ beef/year = 0.162\ e^{0.079x}$$

Where

- x = *the three year average lifespan (in months) for the project and baseline conditions*

Note: Emissions are converted to carbon dioxide equivalents by multiplying by the global warming potential for methane (21).

6.1.3 P13/B13 Manure Storage and Handling and P15/B15 Land Application

The relevant greenhouse gases applicable to these SSR's are methane (CH_4) and nitrous oxide (N_2O). The general equations for these SSR's, as represented in the protocol, are:

Equation 3: Manure Emissions

$$Emissions_{Manure} = \sum (EF\ Manure_{N20} * Mass_{Production}); (EF\ Manure_{CH4} * Mass_{Production}) * (Number_{Production})$$

The Emissions Factors ($EF_{Manure\ N2O}$ and $EF_{Manure\ CH4}$) are calculated using the formulas provided below. The normalized standard carcass weight ($Mass_{Production}$) of 345 kg is imbedded within these calculations.

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Equation 4: Calculating Manure Methane (CH4) Enteric Emissions Intensity in the Project & Baseline Conditions

$$kg\ manure\ CH_4\ Produced/kg\ carcass\ beef\ /year = 0.0005\ e^{0.1659x}$$

Where

- $x =$ *the three year average lifespan (in months) for the project and baseline conditions*

Equation 5: Calculating Indirect and Direct Manure Nitrous Oxide (N2O) Emissions Intensity in the Project & Baseline Conditions

$$kg\ manure\ N_2O\ Produced/kg\ carcass\ beef\ /year = 0.0011\ e^{0.1464x}$$

Where

- $x =$ *the three year average lifespan (in months) for the project and baseline conditions*

Note: Emissions are converted to carbon dioxide equivalents by multiplying by the global warming potentials for methane (21) and nitrous oxide (310).

6.1.4 Calculating Average Carcass Weight for Baseline and Project

The average carcass weight of the cattle produced under the baseline and project conditions are calculated using the following equation:

Equation 6: Calculating Average Carcass Weight

$$Average\ carcass\ weight = average\ live\ weight * shrunk\ weight * dressing\ percentage$$

Where

- *Shrunk weight = 96 percent of live weight*
- *Dressing percentage = 58 percent of shrunk weight*

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6.1.5 Correcting for Average Carcass Weight and Calculating Emission Reductions

Equation 7: Correcting for Average Carcass Weight in Determining Emission Reduction Intensities

$$kg\ CO_2e/head/year =$$

$$[(baseline\ emissions\ kg\ CO_2e) * (345\ kg\ \ carcass\ weight/head)\ \ /\ (average\ baseline\ carcass\ weight\ kg/head)]$$

$$[(project\ emissions\ kg\ CO_2e) * (345\ kg\ \ carcass\ weight/head)/\ (average\ project\ carcass\ wight\ kg/head)]$$

Equation 8: Calculating Emissions Reduced in the Project

$$Manure\ N_2O_{Direct}(kg\ N_2O) = [baseline\ emissions\ (kg\ CO_2/head/year) - project\ emissions\ (kg\ CO_2\ e\ /head/year)]\ *\ number\ of\ head\ in\ the\ project$$

Table AO-10 below provides project specific details on how the protocol has been implemented in quantifying emission reductions from each project site included under this aggregation project. The table is based on the methodology defined in the protocol, and discusses the parameters introduced in the above equations.

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Table AO- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications and Frequency
B1b Cattle Production and B10 Feed Consumption				
Emissions $_{Cattle}$ = ∑ (EF $_{Enteric}$ *Mass $_{Production\ i}$ * Number $_{Production\ i}$) (For each animal grouping)				
Age at Harvest	Each animal in each grouping is tagged. Third-party records show the animal was shipped directly to harvest with its CCIA tag number.	Calculated using the default birth date and the dates of harvest found in third-party shipping manifests or packing plant receipts.	Continuously (at harvest)	Tracked by and extracted from each participating feedlot's close out reports and packing receipts. Information is compiled in XYZ Inc.'s data platform. This procedure is in alignment with Table 10 in the quantification protocol.
Mass of Cattle Produced / Mass $_{Production\ i}$	Each animal in each grouping is tagged. Feedlot records show average incoming and outgoing weights for the tagged animals. Tags are linked to packing receipts so carcass weights can be determined.	Direct measurement of kg of carcass beef produced within each grouping of animals.	Continuously (at harvest)	Tracked by and extracted from each participating feedlot's close out reports and packing receipts. Information is compiled in XYZ Inc.'s data platform. Kg of carcass beef is calculated by using the adjustment for dressing percentage (Equation 6 in Section 6.1.4 above). This procedure is in alignment with Table 10 in the quantification protocol.
Enteric Emission Intensity Factor / EF $_{Enteric\ i}$	kg CH_4 / kg carcass beef	Calculated using equation in Table 7 of the protocol; based on average age (months) of animals in the group.	N/A	Calculated in XYZ Inc.'s data platform using the equations provided in Table 7 of the protocol. This procedure is in alignment with Table 10 in the quantification protocol.

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Table AO- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications and Frequency
Number of Cattle in Grouping i / Number $_{\text{Production i}}$	Each distinct grouping of animals is uniquely identified with a lot identification number. Head.days are adjusted to account for any animals removed from a Lot during a specified finishing diet and tracked head.days are used to determine number in production.	Number in production is extrapolated from head.days, where, Number in production (head) = animal head.days / days on feed	Continuously tracked and reconciled as finishing diets are completed and animal movement/deaths are accounted for.	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. This procedure is in alignment with Table 10 in the quantification protocol.

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Table AO- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications and Frequency
B13 Manure Storage and Handling and B15 Land Application				
Emissions $_{Manure}$ = ∑ (EIF Manure $_{N20}$ * Mass $_{Production}$); (EIF Manure $_{CH4}$ * Mass $_{Production}$) * (Number $_{Production}$)				
Age at Harvest	Each animal in each grouping is tagged. Third-party records show the animal was shipped directly to harvest with its CCIA tag number.	Calculated using the default birth date and the dates of harvest found in third-party shipping manifests or packing plant receipts.	Continuously (at harvest)	Tracked by and extracted from each participating feedlot's close out reports and packing receipts. Information is compiled in XYZ Inc.'s data platform. This procedure is in alignment with Table 10 in the quantification protocol.
Mass of Cattle Produced / Mass $_{Production\ i}$	Each animal in each grouping is tagged. Feedlot records show average incoming and outgoing weights for the tagged animals. Tags are linked to packing receipts so carcass weights can be determined.	Direct measurement of kg of carcass beef produced within each grouping of animals.	Continuously (at harvest)	Tracked by and extracted from each participating feedlot's close out reports and packing receipts. Information is compiled in XYZ Inc.'s data platform. kg of carcass beef is calculated by using the adjustment for dressing percentage (Equation 6 in Section 6.1.4 above) This procedure is in alignment with Table 10 in the quantification protocol.
Emission Intensity Factor for Manure Handling, Storage and Land Application / EF Manure $_{CH4}$	kg CH_4 / kg carcass beef	Calculated using equation in Table 7 of the protocol; based on average age (months) of animals in the group.	N/A	Calculated in XYZ Inc.'s data platform using the equations provided in Table 7 of the protocol. This procedure is in alignment with Table 10 in the quantification protocol.

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Table AO- 10: Measurement and Estimation Procedures for Each Quantification Parameter				
Protocol Parameter / Variable	Project Specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications and Estimation Justifications and Frequency
Emission Intensity Factor for Manure Handling, Storage and Land Application / EF Manure $_{N2O}$	kg CH_4 / kg carcass beef	Calculated using equation in Table 7 of the protocol; based on average age (months) of animals in the group.	N/A	Calculated in XYZ Inc.'s data platform using the equations provided in Table 7 of the protocol. This procedure is in alignment with Table 10 in the quantification protocol.
Number of Cattle in Grouping i / Number $_{Production\ i}$	Each distinct grouping of animals is uniquely identified with a lot identification number. Head.days are adjusted to account for any animals removed from a Lot during a specified finishing diet and tracked head.days are used to determine number in production.	Number in production is extrapolated from head.days, where, Number in production (head) = animal head.days / days on feed	Continuously tracked and reconciled as finishing diets are completed and animal movement/deaths are accounted for.	Tracked by and extracted from each participating feedlot's close out reports and the information system; compiled in XYZ Inc.'s data platform. This procedure is in alignment with Table 10 in the quantification protocol.
P1b Cattle Production				
	See description for B1b above. Methodology does not change from Baseline Condition calculation.			
P10 Feed Consumption				
	See description for B10 above. Methodology does not change from Baseline Condition calculation.			
P13 Manure Storage and Handling				
	See description for B13 above. Methodology does not change from Baseline Condition calculation.			
P15 Land Application				
	See description for B15 above. Methodology does not change from Baseline Condition calculation.			

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6.2 Approved Methodological Deviations from the Quantification Protocol

There were no methodological deviations from the quantification protocol.

7 Monitoring Plan

XYZ Inc. has established and applied quality management procedures to manage data and information, including the assessment of uncertainty, relevant to the project and baseline scenario. Using transparency and accounting, XYZ Inc. has reduced as many uncertainties as possible that may be related to the quantification of GHG emission reductions or removal enhancements.

Those at XYZ Inc. who are responsible for the measurement work have been fully trained in all aspects of relevant data collection, feedlot operator interviews, and data analysis procedures. XYZ Inc. has developed Standard Operating Procedures (SOPs) for each step of the measurements and livestock management activity calculations. These SOPs detail all phases of the data collection and measurements, and contain provisions for documentation, both for verification purposes and so that field personnel can check previous results and repeat the measures in a consistent fashion between project years and the baseline. All of these procedures are included in XYZ Inc.'s process manual and associated documentation.

Copies (electronic and/or paper) of all site data, data analyses, collected record/documentation, and models; emission reduction calculations; and copies of the measuring and monitoring reports are stored in a dedicated and safe place at XYZ Inc.'s office as well as on an offsite server.

The quantification plan used by XYZ Inc. involves the collaboration of in-house livestock management knowledge as well as an IT team skilled in data processing and management. The general approach to monitoring and data management is as follows: XYZ Inc.'s staff (otherwise known as aggregators) interview and collect data from feedlot operators who wish to claim offset credits generated through reduced age at harvest livestock management practices. The collected data is then input into the livestock data processing team's proprietary analytical database software, which stores and assesses a wide variety of livestock feeding and age classification information. The analytical database is configured to collect and assess data specific to manure and enteric methane management practices, feedlot management, and cattle grouping classifications, along with the required records and documentation to support the assurance process. Details of the data collection and storage methodology are provided in the subsequent sections.

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7.1 Operation-Level Data Collection

In order to begin the offset project at a particular feedlot operation, XYZ Inc.'s aggregation staff will initially conduct an on-site meeting with the feedlot operation manager. During this meeting, the aggregator will:

a) Obtain the consent of the feedlot operator, through a producer contract, to quantify and claim the emissions reductions generated by reduced age at harvest livestock management practices at the facility.
b) Confirm that the feedlot operator has legal ownership of the offset credits generated and request documentation to confirm the feedlot operator's legal status as owner of the offsets. A copy of the documentation will be retained in the operation's project file. The documentation may be in the form of:
    a. Power of Attorney
    b. Lease agreements indicating that the operator has ownership of offsets
    c. Commercial agreements to claim offset ownership
    d. Other documentation of similar quality addressing feedlot operations
c) If possible at this point, obtain a signed document by the feedlot operator that he/she is following reduced age at harvest offset protocol plans.

7.2 Feedlot-Level Data Collection

For each feedlot or animal grouping that is managed using RAH plans and practices in a given year, XYZ Inc.'s staff will collect a variety of information, outlined in the following tables: **Error! Reference source not found.**, AO-12 and AO-13. These datasets reflect the three primary types of data necessary for certification of feedlot operations under RAH practices. This data collectively enables the effective accounting of emissions under a reduced age at harvest project, as compared to a standard-practice baseline. Each greenhouse gas assertion must be supported by appropriate evidence under a reasonable level of assurance.

7.3 Measured Parameters

Table AO-11, AO-12 and AO-13 below show the monitoring plans for age at harvest, mass of cattle produced and number in production according to Table AO-10 of the protocol.

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Table AO- 11: Monitoring plan for age at harvest	
Source / Sink Identifier or Name	B1b/P1b , B10/P10, B13/P13, B15/P15
Data parameter	1. Age at Harvest
Estimation, Modeling, Measurement or Calculation approaches	Calculated using the default birth date and the dates of harvest found in third-party shipping manifests or packing plant receipts. See Table AO-10 above for description – continuously tracked and reconciled throughout the year.
Data Unit	1. Age (months)
Sources / Origin	Measured and recorded for each animal grouping on each feedlot
Monitoring Frequency	Continuous, for individual animal movement within feedlot systems. See Table AO-10 for a description of the continuous monitoring methods.
Description and Justification of Monitoring Method	Birth dates are determined when cattlemen insert a Radio Frequency Identification (RFID) tag in the ear of the animal and subsequently register the birth date of the animal that carries the tag. RFID tags are identified both through scanning and through visual ear tag number.
Uncertainty	Third party records are used to show the animal was harvested. If the cattle ID tag falls off, the animal is removed from the project.
Provide the Details for any deviations from protocol including the justification and rationale	N/A - This method complies with the protocol.

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Table AO- 12: Monitoring plan for parameters related to mass of cattle produced	
Source / Sink Identifier or Name	B1b/P1b , B10/P10, B13/P13, B15/P15
Data parameter	1. Mass of cattle produced (average live weight)
Estimation, Modeling, Measurement or Calculation approaches	Calculated using average outgoing weights for cattle in each grouping as recorded on source records. See Table AO-10 above for description – continuously tracked and reconciled throughout the year.
Data Unit	1. Weight (kgs)
Sources / Origin	Measured and recorded for each animal grouping on each feedlot.
Monitoring Frequency	Continuous, for individual animal movement within feedlot systems. See Table AO-10 for a description of the continuous monitoring methods.
Description and Justification of Monitoring Method	Close-out sheets and feedlot records showing incoming and outgoing weights are standard industry practice. Averages based on frequent data collection allow for more moderated estimates.
Uncertainty	Deads are removed from the calculations and numbers reconciled. Carcass weight (yield) is calculated using the shrink and yield percentages of live weight as defined in the protocol.
Provide the Details for any deviations from protocol including the justification and rationale	N/A - This method complies with the protocol.

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Table AO- 13: Monitoring plan for parameters related to number in production	
Source / Sink Identifier or Name	B1b/P1b , B10/P10, B13/P13, B15/P15
Data parameter	1. Number of cattle in production
Estimation, Modeling, Measurement or Calculation approaches	Calculated using head days. See Table AO-10 above for description – continuously tracked and reconciled throughout the year.
Data Unit	1. Number of cattle in production (#)
Sources / Origin	Measured and recorded for each animal grouping on each feedlot
Monitoring Frequency	Continuous, for individual animal movement within feedlot systems. See Table AO-10 for a description of the continuous monitoring methods.
Description and Justification of Monitoring Method	Close-out sheets and animal inventories using head.days are standard industry practice. Averages based on frequent data collection allow for more moderated estimates.
Uncertainty	Deads are removed from the calculations and numbers reconciled.
Provide the Details for any deviations from protocol including the justification and rationale	N/A - This method complies with the protocol.

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7.4 Supporting Records and Documentation

Table AO-14 shows the monitoring plan for tracking cattle according to section 5 of the protocol.

Table AO- 14: Monitoring Plan for Parameters Related to Unique Cattle Identification	
Source / Sink Identifier or Name	N/A – eligibility criteria
Data parameters	Animal ID tag registered with the Canadian Cattle Identification Agency (CCIA) or Alberta Registry
Estimation, Modeling, Measurement or Calculation approaches	Each animal receives a unique ID tag, either at the cow-calf operation or upon entry to the feedlot. This number is used to track the animal.
Data Unit	Unique number assigned by the CCIA or Alberta Registry.
Sources / Origin	Canadian Cattle Identification Agency master database/Alberta Registry master database. Numbers are then scanned electronically into feedlot and the feedlot management consultant's database.
Monitoring Frequency	Upon entry to feedlot
Description and Justification of Monitoring Method	Uses approved 3rd party agencies to assign numbers. Electronic scanning at the feedlot and by the feedlot management consultant.
Uncertainty	If the cattle ID tag falls off, or the animal dies prior to harvesting, the tag is "retired" with the CCIA.
Provide the Details for any deviations from protocol including the justification and rationale	N/A - This method complies with the protocol.

8 Data Management System and Records

The data management system employed by XYZ Inc. ensures that all information collected is complete, accurate, valid and secure. Relevant livestock and feedlot management information collected by XYZ Inc. is entered into the analytical database for the calculation of the GHG offset assertion.

Once the details of a feedlot operation have been added to the database, a unique identifier is generated for each feedlot and animal grouping. Information is stored according to the name of the feedlot operator and the unique identifier created for each feedlot and animal grouping. The unique identifier will be linked to the operator identifier, and will be used to file all documentation

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associated with offset credits for that operator. Documentation collected by XYZ Inc. will be maintained on file at XYZ Inc.'s office for a minimum of seven years from the date of the Annual Reductions/Removals report in which the offsets are claimed, and up to seven years after the end of a project's crediting period.

8.1 Emission Reductions

The emission reductions generated on an annual basis under the project condition will be calculated using the methodology outlined in the Reducing the Age at Harvest of Beef Cattle Quantification Protocol. The database has been designed to calculate the emission reductions based on the number of animals, age at harvest and average live weight entered for each feedlot. Enteric and manure methane emissions are automatically calculated using the age at harvest in months and the emission factors provided in the RAH Protocol. Database reports will provide the calculated emission reductions per feedlot operation, and by animal grouping. Publication of the emission reduction reports also includes validation checks using the AB RAH Data Collection spreadsheet and the AB RAH Excel Based Calculation Template developed specifically for RAH projects. The publication step acts as a validation check to the calculations made within the database.

8.2 Feedlot Data and Evidence Collection

According to the protocol, cattle inventory data are useful for tracking each animal grouping within a feedlot. This is an integral part of the yardage calculations feedlots use to track the average number of head days and the absolute age of each animal. Therefore, this is a practical and useful procedure to facilitate the calculations and justify verification of an assertion – and XYZ Inc. has used this approach in their project. In the project the data collected to support each of the critical data points listed in Section 5.1 of the protocol are the following:

- Legal land location of the feedlot where the animal spends the final stage prior to harvest;
- Documented method for establishing birth dates of cattle for baseline and project;
- Radio Frequency Identification (RFID) tag numbers for each calf based upon birth records that are registered with the Canadian Cattle Identification Agency (CCIA) or an Alberta registry;
- CCIA registration to support the default birth month calculations
- Incoming or arrival age and weight of animals entering the feedlot;
- The number and weight of animals being fed in the designated animal groupings according to the feeding regimes in Table 8 of the Reduced Age at Harvest Protocol (e.g. calf-fed, yearling-fed, steers, in animal groupings);
- Methods used to group cattle in the baseline and project;
- Method applied for statistical sampling of animal groupings in the feedlot(s);
- Records of entry and exit for cattle in each grouping;
- Outgoing weights of animals and age at harvest for youthful animals;
- Proof of harvest of youthful animals; and
- Copies of commercial agreements for offset ownership claims.

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Section 8.3 introduces the data management systems, data process flows and data controls for this project.

8.3 Data Monitoring and QA/QC Plan

The data monitoring and quality assurance/ quality control plan utilized by XYZ Inc. was developed to address the following potential sources of error in the quantification process:

- Inaccurate details from feedlot operators
- Transcription error during data input into the databases
- Double-counting animals
- Including cattle that do not qualify for inclusion in the project
- Changes to data in the system after it has been entered
- Calculation error due to database programming

The flow of data through the project, from collection to reporting is presented in **Error! Reference source not found.** below. The monitoring and QA/QC (Quality Assurance/ Quality Control) plan for each of the six different data segments is outlined below.

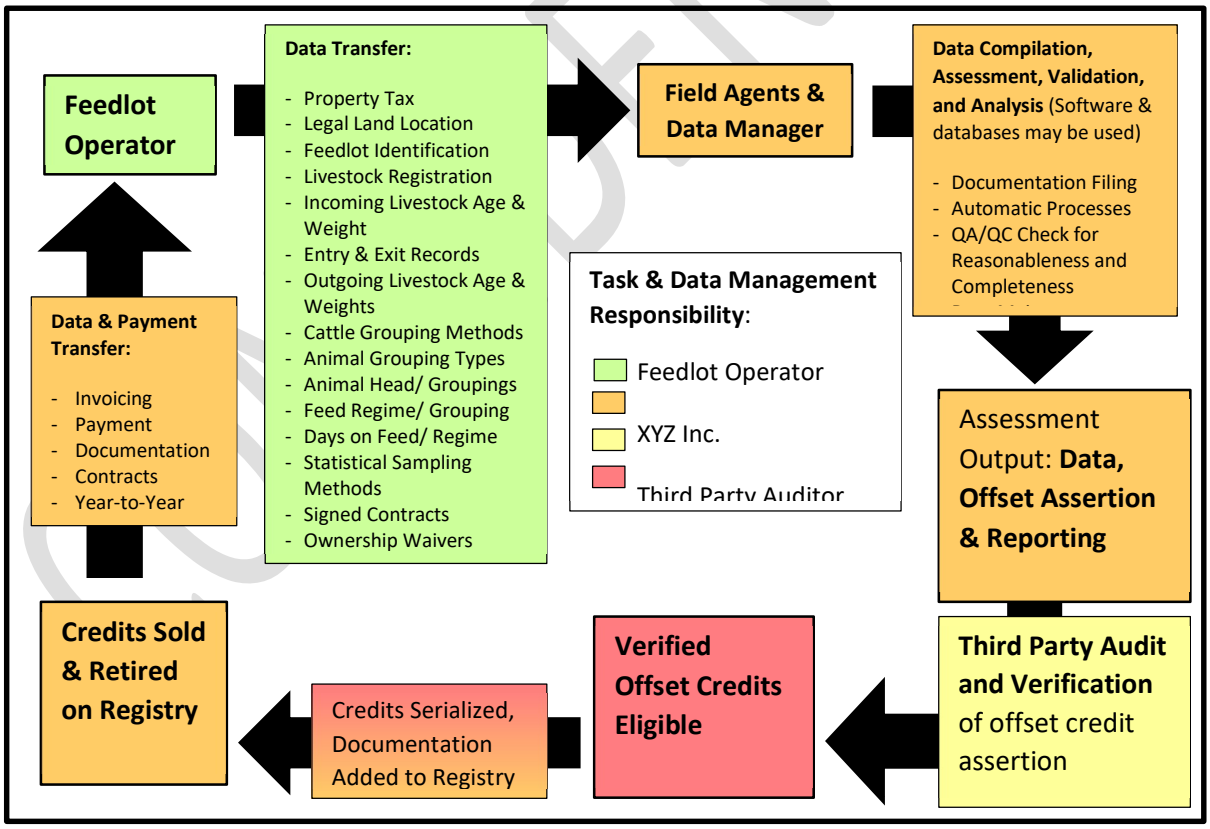


Figure AO- 3: Data Management Process Flow for Reduced Age at Harvest Offset Assessment, Assertion and Reporting

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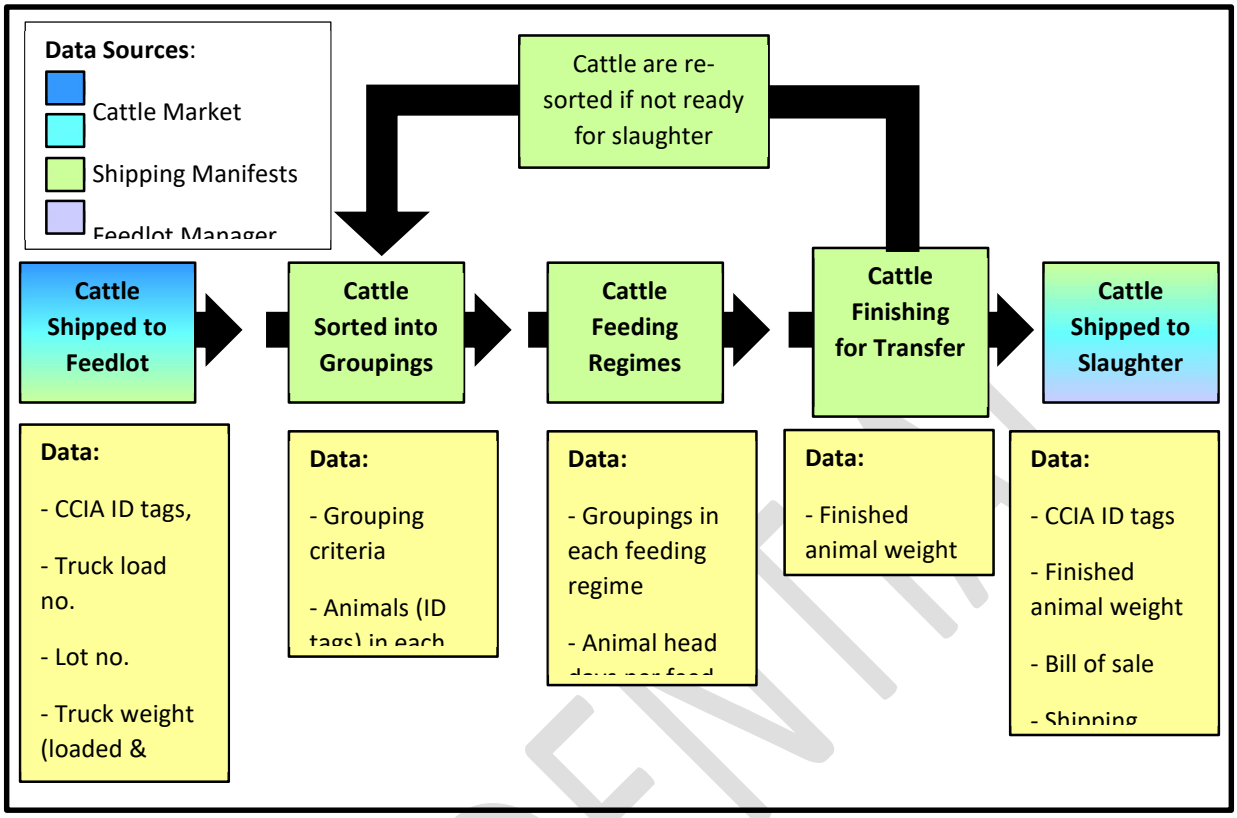


Figure AO- 4: Cattle Management Process Flow and Data Sourcing for Feedlot Cattle in Reduced Age at Harvesting Offset Assertion

8.3.1 Data Collection from Feedlot Operators (Data Transfer)

The primary component of both the monitoring and QA/QC plan during collection of data from the feedlot operator is the experience of the aggregators. The aggregators are Professional Agrologists or agricultural specialists with numerous years of experience in the agricultural sector. They are familiar with the geographical areas and farming activities in which they are working and collecting data. During data collection, the aggregators check the data provided by the feedlot operator for reasonableness based on their expertise and knowledge of the individual feedlot facility. The one-on-one interview with the feedlot operator also provides the aggregators an opportunity to observe the feedlot's operating practices and ask questions if necessary.

For the purpose of this project, feedlot operator attestation and feedlot records are supported by the records and practices of feedlot management systems/agencies. The feedlot management systems must manage uncertainty and risk to ensure business success by forecasting livestock returns and prices based on analysis and past finishing practice, records and experience, planning and quantification of feedlot management, to balance strong cattle production with a minimization of over-use and waste for economic and environmental reasons.

In addition, the XYZ Inc. ensures that the data provided is accurate by requiring the feedlot operator to sign documentation affirming that the data is correct to the best of his or her knowledge.

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8.3.2 Data Input into Database (Data Compilation, Assessment, Validation and Analysis)

Data entry into the agricultural management database is performed by the aggregators using the notes they collected during interviews with the feedlot operator. During the data input stage, the database generates a unique identifier for each animal, feedlot and animal grouping in the project. The unique identifier is used to link the electronic data with hard-copy documentation, and provides a method of monitoring the data to prevent double-counting of animals and feeding practices over time. For example, the database administrator can search the database for a specific cattle tag and ensure that there is only one unique feeding regime associated with that animal at any single time.

To ensure data accuracy, multiple procedures and controls are built into XYZ Inc.'s aggregation database. The first control is the generation of a summary report at the producer level, which highlights any errors in the data in red and informs the aggregators of the errors that need to be fixed. When the system administrator runs a procedure to move the data into an aggregation pool, only feedlots without errors will be added to the pool.

The actual data entry stage allows a second opportunity for XYZ Inc. to check the reasonableness of the data and to follow up with the feedlot operator to resolve any problems. The risk of transcription error at the data entry stage is mitigated by the use of trained personnel to enter the data and the user interface has been designed to guide the user during data entry by providing dropdown lists, etc. as much as possible. In addition, data that is missing or incorrect on the data entry screen is highlighted alerting XYZ Inc. of an error. The purpose of this control is to give the user immediate feedback at data entry that they may have made a mistake or they are missing information.

The database only accepts feedlot animals and feeding regimes that have been approved by XYZ Inc. as acceptable through a white list (approved procedure) check that flags any non-approved data as an error in the system. Also, once the data is moved into an aggregation pool it is locked and cannot be changed by anyone. To change data for a feedlot that is in a pool, it must been removed from the pool, edited and then moved back into the pool. This can only be done by a system administrator. Lastly, the user entering data must confirm that the backup documentation (contracts, proof of offset ownership, etc.) is in place.

8.3.3 Data Maintenance

Documentation collected will be maintained on file at XYZ Inc.'s office for a minimum of seven years from the date of the annual reductions/removals report in which the offsets are claimed. Documentation is filed according to the individual feedlot operation and animal, using the unique animal and feedlot identifiers generated by the database system.

Maintenance of electronic data integrity is accomplished by controlling access to the database. The electronic data associated with a feedlot or animal can be edited by XYZ Inc. or a database administrator until verification begins. Access to the data is controlled by a username and

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password. Subsequent to the start of a verification, no one but the system administrator can access the data.

8.3.4 Offset Calculation and Assertion

Offset calculations are performed automatically by the database using the methodology outlined in the Reduced Age at Harvest Quantification Protocol. The plan for monitoring the accuracy of the offsets calculated by the database is to have a manual check performed by XYZ Inc. personnel. The manual check includes:

- Verifying land titles to ensure ownership of facilities that are generating credits
    - A computer-generated report will be created from the pool of aggregated land locations that are under verification and will be sent by XYZ Inc. for submission to Alberta Land Titles.
        - All (100%) of the current pool's legal land descriptions submitted for aggregation are accounted for in the report.
    - Company XYZ pre-verifies four items on the document to match the aggregated pool database report:
        - Legal land description matches.
        - The date/year of title registration matches.
        - The owner's name on the title matches, or if indicated in the pool report as "rented" or "leased", that the title name matches the landowner agreement.
- Verifying animal transfer records with external records from third parties.
    - A computer-generated report will be created from the pool of aggregated feedlot facilities that are under verification.
        - Animal transfer records will be cross-compared between calving facilities (backgrounders), shipping companies, slaughterhouses and the CCIA Canadian Cattle Inspection Agency (where applicable) to ensure that all reported livestock RFID tags, ages, weights and dates of transfer are accurate.

If a discrepancy appears to exist between farm records and any other data, cross-referencing is performed. Below is an example of how data is cross referenced for certain data points.

- Cross-referencing land titles (where available) with the legal land description, facility and operation listing.
- Cross-referencing other sources on certain data points with the claimed performance level (e.g. Alberta Management Insights for livestock production).
- Contacting the feedlot operator, or referring to the backup documentation to resolve any discrepancies between baseline and the project data.
- Performing manual re-calculation of offsets for selected facilities or animal groupings by using the AB RAH Excel Based Calculation Spreadsheet to ensure that the database programming uses the correct methodology.

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The use of a manual check provides monitoring and quality control of the data at all stages of the project, and allows for feedback to improve the monitoring and QA/QC systems if necessary.

8.3.5 Reporting

The annual reductions/removals report consists of a summary table generated from the database which lists the offsets claimed by feedlot. Only those feedlots which have been confirmed during the manual check will be included in the summary table.

8.3.6 Record Keeping

The record keeping practices of this project consists of:

- Electronic recording of values of logged primary parameters for each measurement interval;
- Printing of monthly back-up hard copies of all logged data;
- Retention of copies of logs and all logged data for a period of 7 years after the end of the crediting period; and
- Keeping all records available for review by a verification body for a period of 7 years after the end of the crediting period.

8.3.7 Quality Control and Assurance

XYZ Inc. has employed a number of quality assurance/quality control procedures (QA/QC) to add confidence that all measurements and calculations have been made correctly. XYZ Inc.'s QA/QC methodology is largely incorporated into its analytical database program. This program has internal checks and balances to safeguard against human error and data entry mistakes. These procedures are outlined in 15 below.

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Table AO- 15: Quality Assurance/Quality Control Procedures and Plan	
Area	**XYZ Inc.'s Quality Assurance/Quality Control Procedure**
Offset Credit Data Management and Record Keeping	XYZ Inc.'s data process flows are provided in section 8.3 of this document.
Restriction of user access to offset claim calculations and data	XYZ Inc.'s data management system is password protected, limiting access to those individuals who are familiar with the system and the RAH protocol quantification methodology.
Data filtering procedures	Section 8.3.2 of this document describes the data filters and controls applied to the electronic feedlot close out sheets to remove missing data, inconsistencies or errors in data entry.
Ensuring that changes to operational procedures continue to function as planned	The reductions in harvest age at participating feedlots are control checked to ensure proper animal finishing has occurred. Specifically, an animal code is produced, which is linked to an animal grouping and feed regime from time of entry in the feedlot, until the animal is ready for truck delivery to the packing plant. The feedlot manager then reviews the animal groupings and feed regimes as they are organized and changed throughout each animal's lifecycle. Furthermore, when the animals are received at the feedlot a supervisor will take measurements or review the certificates accompanying the animals to ensure all data requirements are met. XYZ Inc. obtains a copy of the manure management plan and NRCB permits for manure handling and storage. Each year XYZ Inc. investigates whether the manure handling, storage and management procedures have significantly changed. In the event of a significant change, XYZ Inc. will contact AESRD for further direction.
Ensuring the measurement and calculation system for GHG reporting remains in place and accurate	XYZ Inc.'s data management platform houses all coefficients and formulae needed for the calculations and has been programmed to perform the calculations based on Table 7 in the protocol.
Statistical sampling procedures	The only statistical sampling and processing that occurred in this project was the generalized ration procedure for each feedlot.
Checking data validity	All acquired data undergoes a data filtering process prior to being processed (see Section 8.3.2). Emission factors and static factors have been programmed into XYZ Inc.'s data management platform and were checked at the time of

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Table AO- 15: Quality Assurance/Quality Control Procedures and Plan	
Area	**XYZ Inc.'s Quality Assurance/Quality Control Procedure**
	development and reviewed by a technical expert, and signed off.
Documenting errors and associated changes/updates in records and raw data	If duplicate records, incorrect emission factors or records with values outside of expected ranges are identified, they are updated or removed accordingly and the changes documented in an exception report. Likewise, any adjustments made to the raw data are recorded and explained.
Performing recalculations of quantification procedures to reduce the possibility of error	XYZ Inc.'s data management platform stores all coefficients and calculations needed for the quantification of emissions. The platform has been programmed to perform the calculations based on Table 7 in the protocol. When the platform was being created it was checked several times to ensure it was calculating emissions correctly and reviewed by a technical expert.
Data storage	All logged data, copies of logs and records are kept in their raw form so they are available for review by a verification body for a period of seven years.
Data and documentation record protection	All supporting evidence is scanned and uploaded into the carbon data analysis program. Likewise, back-up hard copies of all logged data are printed.
Contingency plan for potential data loss	XYZ Inc. has taken several steps to avoid potential data loss, including backing up its electronic records on an offsite server and web-based cloud; as well as printing hard copies of all logged data. As a result, XYZ Inc. does not anticipate any data loss with a triple fail-safe mechanism.
Back-end controls	Management reviews and approves all agreements and records; and ensures completeness of feedlot activity information, consistency with underlying data, and linkages between base data and claims. When this check is complete, a report is kept on file.

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9 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 plan 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 plan as of the _____ day of _____, 20_____.

Project Title: Enter name of project

Signature: _____

Date: Enter date

Name: Enter Name

Title: Enter title

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10 Appendix AO-A – Sample Calculation

Table AO-16 below provides a summary of the data that is needed to calculate the GHG emission reductions for each feedlot. These calculations should be repeated for each feedlot included in the quantification. Tables AO-17 and 18 show the step by step calculations as outlined in the protocol and in Section 6.1 above. The baseline years are 2008 to 2010 and the project year is 2011. The data used to perform the sample calculation is fictitious and does not represent real project data. Furthermore, in Table AO-17 the baseline data provided is for 2009; however, the overall calculations in Table AO-18 use the average of three years of baseline data.

Table AO- 16: Data for Yearling-Fed Steers

Year	Number in Production	Average Weight (kg)	Average Age at Harvest (months)
2008	2600	621.3	20
2009	3000	620.8	19
2010	2300	619.1	18
2011	2500	618.2	15

Table AO- 17: Relevant Data for Sample Calculation for One Grouping of Animals

	Source	Calculation	Value		Units
			2009 Baseline (19 months)	*Project (15 months)*	
			Steers	***Steers***	
General Information					
Number of Head	Data from Project Site	n/a	3000	2500	head
Information Relevant to Weight Conversion of Animals (Mass $_{Production}$)					
Average Live Weight in kg	Data from Project Site	n/a	620.4	618.2	kg
Average Carcass Weight (with 4% shrink and 58% dressing)	Data from Project Sites	Live weight *.96*.58	345.66	344.21	kg

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Table AO- 17: Relevant Data for Sample Calculation for One Grouping of Animals					
	Source	Calculation	Value		Units
			2009 Baseline (19 months)	*Project (15 months)*	
			Steers	***Steers***	
Parameter: Calculating Cattle Enteric Methane Emissions (kg CH_4)					
Relative Methane Intensity of Enteric Emissions	Defined in Protocol	.162 $e^{.079 *(age in months)}$	0.727	0.530	kg CH_4/kg carcass beef/yr
Relative GHG Intensity	Defined in Protocol	(.162 $e^{.079 *(age in months)}$)*21	15.267	11.130	kg CO_2e/kg carcass beef/yr
Normalize the Baseline to 345 kg Carcass Weight	Defined in Protocol	(Relative GHG Intensity*345 kg)/actual weight(kg)	15.238	11.156	kg CO_2e/kg carcass beef/yr (normalized)
Enteric Methane Emissions (Baseline)	Defined in Protocol	Normalized baseline weight * 345 kg	5257.11	n/a	kg CO_2e/kg Carcass Beef/yr
Enteric Methane Emissions (Project)	Defined in Protocol	normalized project weight * 345 kg	n/a	3848.82	kg CO_2e/kg Carcass Beef/yr
Parameter: Calculating Manure Methane Emissions (kg CH_4)					
Relative Methane Intensity of Manure Emissions	Defined in Protocol	.0005 $e^{.1659 *(age in months)}$	0.012	0.006	kg CH_4/kg carcass beef/yr
Relative GHG Intensity	Defined in Protocol	(.0005 $e^{.1659 *age in months}$) *21	0.252	0.126	kg CO_2e/kg carcass beef/yr

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Table AO- 17: Relevant Data for Sample Calculation for One Grouping of Animals					
	Source	Calculation	Value		Units
			2009 Baseline (19 months)	*Project (15 months)*	
			Steers	***Steers***	
Normalize the Baseline to 345 kg Carcass Weight	Defined in Protocol	(Relative GHG Intensity*345 kg)/actual weight(kg)	0.252	0.126	kg CO_2e/kg/ carcass beef/yr (normalized)
Enteric Methane Emissions (Baseline)	Defined in Protocol	normalized baseline weight * 345	86.94	n/a	kg CO_2e/kg/ head/yr
Enteric Methane Emissions (Project)	Defined in Protocol	normalized project weight * 345	n/a	43.47	kg CO_2e/kg/ head/yr
Parameter: Calculating Manure Nitrous Oxide Emissions (kg N_2O)					
Relative Nitrous Oxide Intensity of Manure Emissions	Defined in Protocol	$.0011\ e^{.1464}$ *(age in months)	0.018	0.010	kg N_2O/kg carcass beef/yr
Relative GHG Intensity	Defined in Protocol	$(.0011\ e^{.1464}$ *(age in months)$)$*310	5.58	3.10	kg CO_2e/kg carcass beef/yr
Normalize the Baseline to 345kg carcass weight	Defined in Protocol	(Relative GHG Intensity*345 kg)/actual weight(kg)	5.57	3.11	kg CO_2e/kg/ carcass beef/yr (normalized)
Enteric Methane Emissions (Baseline)	Defined in Protocol	normalized baseline weight * 345	1921.65	n/a	kg CO_2e/kg/ head/yr

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Table AO- 17: Relevant Data for Sample Calculation for One Grouping of Animals					
	Source	**Calculation**	**Value**		**Units**
			2009 Baseline (19 months)	***Project (15 months)***	
			Steers	***Steers***	
Enteric Methane Emissions (Project)	Defined in Protocol	normalized project weight * 345	n/a	1072.95	kg CO_2e/kg/ head/yr

Table AO- 18: Final Example Calculation			
Factor	**2008 to 2010 Average Baseline (kg CO2e/kg Carcass Beef/Year)**	**Total Project (kg CO2e/kg Carcass Beef/Year)**	**Total Tonnes of Emission Reductions [(Emissions $_{Baseline}$ - Emissions $_{Project}$)*2500*0.001]**
Enteric Methane Emissions	5257.11	3848.82	3520.73
Manure Methane Emissions	86.94	43.47	108.68
Manure Nitrous Oxide Emissions	1921.65	1072.95	2994.60
Total Tonnes of Emission Reductions for 2,500 head (tCO_2e)			**6624.01**

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11 References

Basarab, J. A., Baron, V. S., & Okine, E. K. (2009). *Discovering nutrition related opportunities in the carbon credit system for beef cattle.*

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Appendix AP: NERP Offset Project Report

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Alberta Offset System

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

(June 2015)

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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 Reductions in Agriculture Quantification Protocol v 1.1 April 2015. 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://esrd.alberta.ca/focus/alberta-and-climate-change/regulating-greenhouse-gas-emissions/alberta-based-offset-credit-system/offset-credit-system-protocols/documents/OffsetProjectReport-Feb2013.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.

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Project Document Information

Project Developer: XYZ Inc.

Date: June 3, 2015

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

Project Scope and Site Description

Project Scope

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

Table AP- 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
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.

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Table AP- 1: Project Details	
Actual Emission Reductions/Removals Achieved:	January 1 - December 31, 2011: 2337 t CO_2e
Applicable Quantification Protocol(s):	Alberta Environment & Parks Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.1, April 2015
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:	Submitted via the Spatial Locator Template to Alberta Environment and Parks.
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 prescribed through the 4R 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 second mock-verification for this project. The verifier has no actual or perceived conflicts of interest

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Table AP- 1: Project Details	
	associated with this project. Verification is expected to occur on an annual basis by a qualified third party.
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.

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. Legal land descriptions for each of these farms are detailed in the special locator template required by Alberta Environment and Parks.

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)[54]. The Project complies with the Specified Gas Emitters Regulation Quantification Protocol for Quantification Protocol for Agricultural Nitrous Oxide Emissions Reductions, Version 1.1, April 2015.

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

Table AP- 2: 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 Protocol V1.1, April 2015.
Be registered on the registry.	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.

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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	

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 re-deposition 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.

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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.

Greenhouse Gas Calculations

The greenhouse gas reductions/removals from this aggregated project were calculated on a crop by crop and ecodistrict 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 two flexibility mechanisms. Specifically, dynamic baseline one was used for farms one through four and on-site fertilizer and lime distribution emissions were excluded (SS B7 and P7). Farm #5 applied the conventional baseline approach.

Summary of Equations

Conventional Quantification Approach

Emission Reduction = $[\sum_{\text{EcoDistrict j}} \sum_{\text{4R management level k}} [\text{Emissions Intensity}_{\text{Baseline jk}} - \text{Emissions Intensity}_{\text{Project jk}}] * \text{Crop Mass}_{\text{Project}}] - \text{Emissions}_{\text{Fert and Lime Dist}}$

$\text{Emissions Intensity}_{\text{Baseline}}$ = $[\sum_{\text{crop i}} [(\text{Emissions}_{\text{Man use, i}} + \text{Emissions}_{\text{Manure Soil Crop Dyn, i}} + \text{Emissions}_{\text{Other Fert and Lime Use, crop i}} + \text{Emissions}_{\text{Other Fert Soil Crop Dyn, crop i}}) / \text{Crop Mass}_{\text{baseline i}}] * \text{GWP}_{\text{N2O}}$

$\text{Emissions Intensity}_{\text{Project}}$ = $[\sum_{\text{crop i}} [\text{Emissions}_{\text{Manure Use, i}} + \text{Emissions}_{\text{Manure Soil Crop Dyn, i}} + ((\text{Emissions}_{\text{Other Fert and Lime Use, crop i}} + \text{Emissions}_{\text{Other Fert Soil Crop Dyn, crop i}}) * \text{RM}_{\text{PL}}) / \text{Crop Mass}_{\text{Project i}}] * \text{GWP}_{\text{N2O}}$

Crop i	=	Index number for tracking crop types, within an EcoDistrict and within a performance level
EcoDistrict j	=	Index number for tracking EcoDistrict types
4R Management Level k	=	Index number for tracking 4R management performance levels, within an EcoDistrict

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$\text{Emissions Intensity}_{\text{Baseline}}$	=	Sum of the emissions under the baseline condition divided by baseline crop mass
$\text{Emissions Intensity}_{\text{Project}}$	=	Sum of the emissions under the project condition divided by project crop mass
$\text{Emissions}_{\text{Fert and Lime Dist}}$	=	Emissions under SS P7 Fertilizer and Lime Distribution (On Site)
$\text{Emissions}_{\text{Manure Soil Crop Dyn}}$	=	Emissions from manure under SS P13/B13 Soil Crop Dynamics
$\text{Emissions}_{\text{Manure Use}}$	=	Emissions from manure under SS P8/B8 Fertilizer and Lime Use
$\text{Emissions}_{\text{Other Fert Soil Crop Dyn}}$	=	Emissions from inorganic fertilizer and crop residues under SS P13/B13 Soil Crop Dynamics
$\text{Emissions}_{\text{Other Fert and Lime Use}}$	=	Emissions from inorganic fertilizer and crop residues and under SS P7 Fertilizer and Lime Use
RM_{PL}	=	Emissions Reduction Modifier. Values are 0.85 and 0.75, which correspond to the implementation of Basic or Intermediate/Advanced 4R Plans, respectively.
$\text{Crop Mass}_{\text{Baseline}}$	=	Crop Mass determined in the baseline for all crops based on a three year average, adjusted to a dry matter basis (conventional approach)
$\text{Crop Mass}_{\text{Project}}$	=	Crop Mass determined in the project for all crops, adjusted to a dry matter basis
GWP_{N2O}	=	Global warming potential value for nitrous oxide

Dynamic Baseline One Quantification Approach

Emission Reduction	=	$[\sum_{\text{EcoDistrict j}} \sum_{\text{4R management level k}} (\text{Emissions Reduction}_{\text{crop i}})] - \text{Emissions}_{\text{Fert and Lime Dist}}$

$\text{Emissions Reduction}_{\text{crop i}}$	=	$DF * [\sum_{\text{crop i}} [\text{Emissions}_{\text{Other Fert and Lime Use, i}} + \text{Emissions}_{\text{Other Soil Crop Dyn, i}}) * (1-RM_{PL})]] * GWP_{N2O}$

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Where:

- DF = The discount factor for Dynamic Baseline One (0.95 or a 5% discount factor)
- $Emissions_{Other\ Fert\ and\ Lime\ Use}$ = Sum of the emissions under the project condition SS P7 Fertilizer and Lime Distribution
- $Emissions_{Othe\ \ Soil\ Crop\ Dyn\ i}$ = Sum of the emissions under SS B8 Fertilizer and Lime Use and B13 Soil Crop Dynamics for the Crop Event
- RM_{PL}= The emission reduction modifier as defined in Table 4.2 of the protocol, associated with the selected performance level.
- GWP_{N2O} = Global warming potential value for nitrous oxide

Sample Calculations

Sample Ecodistrict

In the below illustrations, the calculations are only shown for the canola grown on the farm. For this sample project, the farm has implemented the basic performance level. Furthermore, it is assumed that there were no additional fertilizer passes and therefore emissions from fertilizer and lime distribution are excluded.

The following factors for EcoDistrict 737 will be used to estimate emissions in the sample calculation:

EcoDistrict 737 (Bowden to Wetaskiwin) — area of annual crops is 142 352 ha or 142.352 km^2

- Black/Gray Chernozem, Medium texture, P/PE 0.65, F_{TILL} 0.9216, F_{TOPO} 0.16, no irrigation.
- EF_{Eco} 0.00903 kg N_2O-N kg^{-1} N (includes tillage, topography, irrigation, and texture), $FRAC_{LEACH}$ 0.19.

Conventional Approach

The step by step procedure for estimating the project emissions from canola for Farm #5 is provided below.

Step 1 - Calculate Nitrogen Inputs for the Crop Type

Crop Residues

According to the convention used in Canada's National Inventory Report, the values used to estimate direct and indirect nitrous oxide emissions from crop residues are based on the crop mass for the year of interest. Calculate the amount of crop residue N, above ground and below ground, accumulated in the year of interest for each crop.

Multiply the average crop mass for the year for each crop using the crop-specific factors from Table E-1, Appendix E in the protocol. For example, for the sample farm for canola:

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$N_{res,Canola}$ = Crop Mass $_{Canola}$ * (1/Yield Ratio) * $Frac_{renew}$ * (($R_{AG\ Canola}$ * $N_{AG\ Canola}$) + ($R_{BG\ Canola}$ * $N_{BG\ Canola}$))

= 813,150 kg DM * 1/0.26 * 1/1 * ((0.60 * 0.008 kg N kg^{-1}DM) + (0.15 * 0.01 kg N kg^{-1}DM)

= 19,703.25 kg N

MANURE: No manure is applied on this sample farm for the project year of interest. If manure were used on the farm, average manure nitrogen spread on each crop in the year of interest would be included as a source of nitrogen for the crop. That is, according to the convention used in Canada's National Inventory Report, it is assumed that all manure nitrogen is available in the year of application.

Step 2 - Calculate Direct Nitrous Oxide Emissions from Manure and Other Fertilizer and Lime Use (Under P8 Fertilizer and Lime Use)

DIRECT EMISSIONS FROM FERTILIZER

Calculate direct nitrous oxide emissions for each crop type in the year of interest by multiplying the amount of fertilizer nitrogen applied to the crop by the emission factor for the soil (EF_{ECO}). The EF_{ECO} value is provided as the EcoDistrict-specific factor for EcoDistrict 737 which integrates the average for the EcoDistrict of factors including F_{TOPO}, F_{TILL}, F_{IRRI}, and F_{TEXT}.

Emissions $_{Synthetic\ Fert\ and\ Lime\ Use,\ Canola}$ = $N_{FN\ Canola}$* EF_{Eco} * 44/28

= 41,500 kg N* 0.00903 kg N_2O-N kg^{-1} N * 44/28

= 588.89 kg N_2O

Step 3 - Calculate Direct and Indirect Emissions from Soil and Crop Dynamics (Under P13 Soil and Crop Dynamics)

Total Direct and Indirect Emissions from Synthetic Fertilizer Soil and Crop Dynamics

Calculate direct N_2O - N crop residue emissions for each crop type in the year of interest by multiplying the amount of crop residue nitrogen accumulated from the crop by the emission factor for the soil (EF_{ECO}).

N_2O-N $_{res,\ Canola}$ = $N_{res\ canola}$ * EF_{ECO}

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= 19,703.25 kg N * 0.00903 kg N_2O-N kg^{-1} N

= 177.920 kg N_2O – N

Calculate the kg of nitrogen from volatilization and re-deposition of NH_3 and NO_x.

$N_{VD\ Canola}$ = ($N_{Fert\ Canola}$ * $FRAC_f$)

= (41,500 kg N * 0.1)

= 4,150 kg N

Volatilization Emissions from Crop Residue

By convention of IPCC, crop residues are not included in the calculation of indirect nitrous oxide emissions from volatilization.

Calculate the kg of nitrogen from leaching of NO_2 and NO_3 NH_3.

$N_{L\ Canola}$ = ($N_{Fert\ Canola}$ + $N_{Res\ Canola}$) * $FRAC_L$

= (41,500 kg N + 19,703.25 kg N) * 0.19

= 11,628.618 kg N

Calculate indirect N_2O - N emissions from volatilization for the crop type in the year of interest by multiplying the kg of nitrogen from volatilization and re-deposition of NH_3 and NO_x by the emission factor for volatilized nitrogen (EF_{VD}). The values for EF_{VD} are constant across Canada.

Calculate indirect N_2O - N emissions from leaching for the crop type in the year of interest by multiplying the kg of nitrogen from leaching by the emission factor for leached nitrogen (EF_L). The values for $FRAC_L$ are calculated for each EcoDistrict in Canada, and are provided in Table A-1, Appendix A of the protocol. The value for EF_L is constant across Canada, and currently is set as 0.025 kg N_2O-N kg N.

Calculate total Direct and Indirect Emissions from Synthetic Inorganic Fertilizer Soil and Crop Dynamics by summing the direct N_2O - N emissions from crop residue, indirect N_2O - N emissions from volatilization and indirect N_2O - N emissions from leaching for each crop management zone in the year of interest. Multiply the total by 44/28 to convert to nitrous oxide emissions.

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Emissions $_{\text{Synthetic Soil and Crop Dyn, Canola}}$ = **$((N_{res\ canola} * EF_{ECO}) + (N_{VD\ canola} * EF_{VD}) + (N_{Lcanola} * EF_{L})) * 44/28$**

= ((177.920 kg N_2O – N) + (4,150 kg N * 0.01 Kg N_2O-N / kg N) + (11,628.618 kg N * 0.025 Kg N_2O-N / kg N))*44/28

= (177.920 kg N_2O – N + 41.5 Kg N_2O-N + 290.715 Kg N_2O-N) *44/28

= 801.64 kg N_2O

Step 4 – Total Nitrous Oxide Emissions for Crop Type

Total nitrous oxide emissions for each crop type in the year of interest are calculated by summing the direct and indirect nitrous oxide emissions under SS P8 Synthetic Fertilizer and Lime Use and P13 Inorganic Soil and Crop Dynamics.

Total N_2O Emissions = Emissions $_{\text{Synthetic Fert and Lime Use Canola}}$ + Emission $_{\text{Soil Crop Dyn Canola}}$

= 588.885 kg N_2O + 801.641 kg N_2O

= 1,390.526 kg N_2O

Convert to Total CO_2e Emissions for Crop Type

To convert total nitrous oxide emissions to total emissions on a carbon dioxide equivalent (CO_2e) basis, multiply the nitrous oxide emissions by the global warming potential. Refer to the Carbon Offset Emission Factors Handbook for global warming potential values.

Emissions CO_2e $_{\text{Canola}}$ = 1,390.536 kg N_2O * 298 kg CO_2e kg^{-1} N_2O

= 414,379.73kg CO_2e

= 414.38 Mg CO_2e or 414.38 tCO_2e

Step 5 – Determine Total CO_2e Emissions Intensity for Crop Type in the Project Year on a Dry Matter Basis (to Determine Emissions Intensity)

To express emissions on a dry matter basis, apply the reduction modifier corresponding to the performance level implemented (basic) and divide by the crop mass (DM) reported for the crop management zone.

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Emissions Intensity $_{\text{Project Canola}}$ = (Emissions $_{\text{Fert and Lime Use Canola}}$ + Emissions $_{\text{Soil Crop Dyn Canola}}$)

* RM_{PL} / Crop Mass $_{\text{Project Canola}}$

= (414,379.73kg CO_2e *0.85)/813,150 kg

= 0.4332 kg CO_2e/kg canola

Step 6 - Calculate Total CO_2e Reductions for the Crop Type on a Dry Matter Basis

To express reductions per kg crop produced for the crop type on a dry matter basis, subtract the emissions calculated on a dry matter basis for the project year for the crop type from the emissions calculated on a dry matter basis for the crop type in the baseline period.

Assuming the emissions for the baseline period are 0.5350 kg CO_2e/kg canola the reduction would be calculated as follows:

Emission Reduction $_{\text{Canola}}$ = (Emissions Intensity $_{\text{Baseline Canola}}$ – Emissions Intensity $_{\text{Project Canola}}$) * Crop Mass $_{\text{Project Canola}}$

= (0.5350 kg CO_2e / kg Canola – 0.3822 kg CO_2e / kg Canola) * 813,150 kg Canola

= 124,249.32 kg CO_2e

= 124.25 Mg CO_2e or 124.25 tCO_2e

Step 7 – Calculating Emission Reductions for a Full Farm across Crop, EcoDistricts and/or Performance Levels

Emission reductions should be calculated by crop for each performance level and EcoDistrict separately following the methodology presented in Section 4.1 of the protocol and demonstrated below. In order to calculate the total emission reductions for a farm the sum of the emission reductions by crop for each performance level and EcoDistrict is taken. For example, if the farm given in the example above employed 4R nutrient management on its canola in EcoDistricts 746 and 737 at the intermediate performance level and applied 4R nutrient management on its winter wheat grown in EcoDistrict 737 at both the basic and intermediate performance levels the emission reductions for each combination of crop, performance level and EcoDistrict would be calculated separately and then summed to get the total emission reduction for the farm. The table below illustrates this process.

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Table AP- 3: Calculated Emission Reductions by Crop, Performance Level and EcoDistrict

Crop	Performance Level	EcoDistrict	Emission Reductions (tCO_2e)
Canola	Intermediate	746	122.35
Canola	Intermediate	737	124.25
Winter Wheat	Basic	737	120.50
Winter Wheat	Intermediate	737	130.75
Total Emission Reductions for the Farm			**497.85**

Dynamic Baseline One Quantification Approach

Total emission reductions associated with the project are the sum of the emission reductions calculated for each crop type within each EcoDistrict and each performance level on the farm. Separate calculations must be made for areas where the EcoDistrict, 4R management level or crop differ. The sequence of calculation for each crop in the same EcoDistrict and under the same performance level using dynamic baseline one is as follows:

4. The baseline CO_2e emissions from SS B8 Fertilizer and Lime Use and SS B13 Soil Crop Dynamics for the crop event are calculated and summed following the quantification steps outlined in Section 4 of the protocol and presented in the example above using the present year's data.
5. The result of step 1 is multiplied by 1 minus the reduction modifier.
6. The result of step 2 is then multiplied by 0.95 to apply the 5% discount factor for dynamic baseline one to obtain the emission reductions.

Separate calculations must be made for areas where EcoDistricts differ, and also where 4R management levels differ. Reductions are then summed across the analytical units to derive the GHG claim for the farm. Note: Emissions from fertilizer and lime distribution have been excluded from the quantification as per the flexibility mechanism.

The following formulas summarize the quantification approach:

$$\text{Emission Reduction} = [\sum_{\text{EcoDistrict j}} \sum_{\text{4R management level k}} (\text{Emissions Reduction}_{\text{crop i}})] - \text{Emissions}_{\text{Fert and Lime Dist}}$$

Where:

$$\text{Emission Reduction crop I} = DF * [\sum_{\text{crop i}} [\text{Emissions}_{\text{Other Fert and Lime Use, i}} + \text{Emissions}_{\text{Other Soil Crop Dyn, i}}) * (1 - RM_{PL})]]$$

Discount Factor (DF) = 0.95 (5% discount factor) for Dynamic Baseline One

Reduction Modifier (RM_{PL}) = 0.85 for the basic performance level and 0.75 for the intermediate/advanced performance levels

$\text{Emissions}_{\text{Other Fert and Lime Use, I}}$ = Component of emissions under SS B8 Fertilizer and Lime Use

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Emissions $_{\text{Other Soil Crop Dyn, I}}$ = Component of emissions under SS B13 Soil Crop Dynamics for crop event $_{i}$

Emissions $_{\text{Fert and Lime Dist}}$ = Component of emissions under SS P7 Fertilizer and Lime Distribution (On Site)

The following is a sample calculation using the equations outlined above. The data used to perform the sample calculation is fictitious and does not represent real project data.

Step 1 – Calculate Total CO_2e Emissions for the Crop Type

Follow steps 1 through 4 for the conventional baseline approach presented above to calculate the total emissions for the crop type using the present year's data.

Step 2- Calculate Total CO_2e Reductions for the Crop Type by EcoDistrict and Performance Level using the Appropriate Reduction Modifier

Calculate the total CO_2e reductions by multiplying the emissions (from steps 1 through 4 of the conventional approach) by one minus the reduction modifier and then applying the appropriate discount factor.

Emission Reduction $_{\text{Canola}}$ = Discount Factor * (Emissions $_{\text{CO2e Canola}}$ * (1 – Reduction Modifier))

= 0.95 * (414.38 tCO_2e * (1 – 0.85))

= 59.05 tCO_2e

Calculating Emission Reductions for a Full Farm across Crops, EcoDistricts and/or Performance Levels

Emission reductions are calculated by crop for each performance level and EcoDistrict separately following one of the two methodologies presented above. In order to calculate the total emission reductions for a farm the sum of the emission reductions by crop for each performance level and EcoDistrict is taken.

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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 AP- 4: Total Emissions

Year	Farm	Farm Size (acres)	N_20 (t CO_2e)	Total (t CO_2e)
2011	Farm #1	10,900	545.00	545
2011	Farm #2	6,023	301.16	301
2011	Farm #3	9,320	466.00	466
2011	Farm #4	7,473	373.66	373
2011	Farm #5	6,520	652.00	652
			Total	**2337**

Note: the above values and farms are fictitious

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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

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Appendix AQ: Fed Cattle Offset Project Report

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Alberta Offset System

Offset Project Report for XYZ Inc.'s Reducing GHG Emissions of Fed Cattle (Fed Cattle) Aggregation Project - Protocol Validation Study

(June 2015)

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Acknowledgements

Initiated by Alberta Agriculture and Forestry, funding for this cost-shared project was provided by Agriculture and Agri-Food Canada and the Climate Change Emissions Management (CCEMC) Corporation.

Disclaimers

The views and opinions expressed in this report are not necessarily those of Alberta Agriculture and Forestry, Agriculture and Agri-Food Canada, or 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://esrd.alberta.ca/focus/alberta-and-climate-change/regulating-greenhouse-gas-emissions/alberta-based-offset-credit-system/offset-credit-system-protocols/documents/OffsetProjectReport-Feb2013.pdf) to a Reducing GHG Emissions of Fed Cattle Offset Project under the Alberta Offset System. Any reference to feedlot information, or offset credit information contained within this document is fictitious and intended for illustrative purposes only.

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Project Document Information

Project Developer: XYZ Inc.

Date: June 12, 2015

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

Project Scope and Project Description

Project Scope

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

Table AQ- 1: Project Details	
Project Title:	Offset Project Report for XYZ Inc.'s Reducing GHG Emissions of Fed Cattle (Fed Cattle) Aggregation Project - Protocol Validation Study
Project Purpose and Objective(s):	The purpose of this project is to reduce direct and indirect GHG emissions from beef cattle associated with enteric fermentation and manure storage and handling. XYZ Inc. will aggregate five feedlots for this project. The broader goal of the Protocol Validation Study is to identify barriers that currently exist in implementing projects under the Fed Cattle protocol and design scalable approaches to adopting this protocol. The Fed Cattle protocol does not promote any one feeding strategy or combination of strategies required to improve feed efficiency. As a result, different feedlot operators may choose different techniques, but must demonstrate through documentation and records that their cattle are more efficiently utilizing their feed per unit gain of weight once the project is implemented. In the present project, individual animal sorting/selection, use of beta-agonists (Ractopamine Hydrocholoride) and feed management strategies are employed.
Project Start Date:	e.g. January 1, 2011
Credit Start Date:	N/A – the Fed Cattle Protocol Validation Study is a non-commercial exercise (e.g. January 1, 2011)

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Table AQ- 1: Project Details	
Credit Duration Period:	N/A – the Fed Cattle Protocol Validation Study is a non-commercial exercise (e.g. Alberta Offset System eligibility specifies 8 years (i.e. January 1, 2011 to December 31, 2019) with the potential for an additional five years upon government approval)
Reporting Period	January 1, 2011 – December 31, 2011
Expected Lifetime of the Project:	N/A – the Fed Cattle Protocol Validation Study is a non-commercial exercise (Commercial feedlots could continue this exercise indefinitely, the activity is dynamic and can be stopped and restarted)
Actual Emission Reductions/Removals:	January 1, 2011 – December 31, 2011: 2141 t CO_2e
Applicable Quantification Protocol(s):	Government of Alberta Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle Version 2.1, December 2014
Protocol(s) Justification:	All participating project sites are based in Alberta and have implemented innovative feeding programs and management strategies to increase feed use efficiency in beef cattle – a measure of reduced greenhouse gas emissions. The practices adopted are not commonly employed and therefore go beyond business as usual (BAU). 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 3.3 for Project Eligibility Criteria.
Other Environmental Attributes:	This project will not generate any other environmental credits. However, more efficient production of beef will result in less manure being produced and as a result less associated impacts from manure.
Legal Land Description of the Project and/or Other Unique Site Descriptions:	Feedlot #1: 01-01-010-01W4 Feedlot #2: 02-01-010-01W4 Feedlot #3: 03-01-010-01W4 Feedlot #4: 04-01-010-01W4 Feedlot #5: 05-01-010-01W4
Ownership:	As described in the Protocol, the owner of any offset credits generated under this protocol is the feedlot operator where the animals in the project spend the final stage prior to harvest. Proof of ownership over emission reductions is provided in the form of feeding agreements/shipping manifests/RFID tag

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Table AQ- 1: Project Details	
	relationships for the animals in the project to substantiate that feedlots fed the cattle in question. 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 feedlot operators.
Reporting and Verification Details:	N/A – this document is an example of an Offset Project Report for the Protocol Validation Study. This is the second mock-verification for this project. The verifier has no actual or perceived conflicts of interest associated with this project. The anticipated frequency of verification is every two years
Project Activity:	See Table AQ-3 below.
Project Registration:	N/A – the Fed Cattle 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.

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

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

Table AQ- 2: Farm Coordinates			
Farm	**Legal Land Description**	**Latitude**	**Longitude**
Feedlot #1	01-01-010-01W4	53.521479	-113.215915
Feedlot #2	02-01-010-01W4	53.447117	-111.923904
Feedlot #3	03-01-010-01W4	50.387617	-112.438202
Feedlot #4	04-01-010-01W4	50.301725	-113.471405
Feedlot #5	05-01-010-01W4	51.214875	-111.931052

Note: the above coordinates are fictitious

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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 Technical Guidance for Offset Project Developers (version 4.0 February 2013). The Project complies with the Specified Gas Emitters Regulation Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle Version 2.1, December 2014.

Table AQ- 3: Alberta Offset System Eligibility

Criteria	How this Project Meets the Requirement
Start Date after Jan 1, 2002	The innovative feeding practices were implemented from 2011 onwards.
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 Reducing GHG Emissions of Fed Cattle Protocol.
Not Required By Law	The changes in practices were not required by law or regulation.
Clearly Established Ownership	Legal land descriptions for each feedlot included in the project were checked. The aggregator and land owner then signed an agreement clearly establishing the aggregator as the owner of the credits.
Counted Once for Compliance Purposes	e.g. 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 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.	The activity/activities is/are implemented under the Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle, Version 2.1, December 2014.
Be registered on the registry.	N/A – the Fed Cattle Protocol Validation Study is a non-commercial exercise. Therefore, the project will not be registered in Alberta or in any other jurisdiction.

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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	

Project Description

XYZ Inc. is a local project aggregator located in Red Deer, Alberta. XYZ Inc. aggregates GHG emission reductions created by multiple feedlot operators in order to provide the volume of GHG reductions typically required by interested buyers. In this case, the Reducing GHG Emissions of Fed Cattle Protocol Validation Study is an aggregation of five participating feedlots. Each of these feedlots has implemented innovative feeding programs and management strategies that increase feed use efficiency in beef cattle, resulting in a decrease of enteric and manure storage/handling emissions. All of the feedlots included in the project are located in Alberta. The location of each of the feedlots is provided in Table AQ-2 above.

The GHG emission reductions have been generated in accordance with the Reducing GHG Emissions of Fed Cattle Protocol. Each participating feedlot has provided information on their feeding programs and management practices for each animal grouping. This data was then entered into XYZ Inc.'s software and reviewed by the data management team. Evidence has also been collected from each feedlot to confirm their eligibility to participate in the project.

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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.

Greenhouse Gas Calculations

Section 4 of the Alberta Quantification Protocol for Reducing Greenhouse Gas Emissions of Fed Cattle defines the appropriate methodology in quantifying emission reductions from related projects.

Quantification Methodology

The following equations serve as the basis for calculating the emission reductions from the project, using the emission profiles of the baseline and project conditions. Note that only sources, sinks and reservoirs (SSRs) determined to be relevant to this project are included here.

$$Emission_{Reduction} = \sum \text{Cattle Grouping i [Emissions Intensity Baseline} - \text{Emissions Intensity Project]} * \text{total carcass weight produced in the project}$$

$$Emissions\ Intensity_{Baseline} = \sum \text{cattle grouping i [(Emissions Cattle, i} + \text{Emissions Manure, i)/ group carcass weight i]}$$

$$Emissions\ Intensity_{Project} = \sum \text{cattle grouping i [(Emissions Cattle, i} + \text{Emissions Manure, i)/ group carcass weight i]}$$

Where:

- Cattle Grouping i = Index number for tracking cattle groupings

- **Emissions Intensity** $_{\text{Baseline}}$ = sum of the emissions under the baseline condition, divided by hot carcass weight produced

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- **Emissions Intensity** $_{Project}$ = sum of the emissions under the project condition, divided by hot carcass weight produced.

- **Emissions** $_{Cattle}$ = emissions under B10/P10 Feed Consumption for each grouping of cattle

- **Emissions** $_{Manure}$ = emissions under B13/P13 Manure Storage and Handling and B15/P15 Land Application for each grouping of cattle

Sample Calculations

The greenhouse gas reductions/removals from this aggregated project were calculated on a net reduction basis for each of the five feedlots. The methodologies used follow the methodologies outlined in the offset project plan. Three flexibility mechanisms were applied (as described in the offset project plan):

1) The more conservative Ym was applied (4% rather than 6.5%) in both baseline and project for the time the cattle were in the feedlot prior to harvest. This ensures conservative emission reductions since it is likely that in the baseline period the diets had a greater amount of roughage present.
2) Cattle were grouped according to 100 lb increments and by gender and whether they were calf-fed, yearlings or mid-season.
3) Corn-dried distillers' grains and solubles were fed in the project; however, the diet continued to meet the dietary fat maximum of 4 to 6 percent on a dry matter basis.

The sample calculations below are for 500-600 lb fall steers. The baseline years are 2008 to 2010 and the project year is 2011.

Table AQ- 4: Relevant Data for the Sample Calculation for Feedlot #1 – 20,784 head in the baseline and 5,127 head in the project

Parameter	Source	Value		Units
		*Baseline**	*Project*	
General Information Relevant to Unique Grouping of Animals				
Animal head*days	Data from Project Site	4,679,721	260,910	-
Average Number in Production	Data from Project Site	20,783.98	1,127.48	Head
DOF (Days on Feed)	Data from Project Site Records	225.16	231.41	Days
Average Gain	Data from Project Site Records	668.08	699.27	lbs

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Table AQ- 4: Relevant Data for the Sample Calculation for Feedlot #1 – 20,784 head in the baseline and 5,127 head in the project				
Average Daily Gain	Data from Project Site Records	2.97	3.02	lbs
Total Hot Carcass Weight Produced	Data from Project Site Records	3,692,403.54	207,418.49	kg
Calculating Cattle Enteric Methane Emissions (kg CH_4)				
Average DDMI (Daily Dry Matter Intake)	Ration Formulation Records	19.97	19.12	lbs DM/head/ day
Concentrates	Ration Formulation Records	85	85	%
GE Diet (Gross Energy Content of Diet)	Ration Formulation Records	18.45	18.45	MJ/kg
EF Enteric (Enteric Emissions Factor)**	Default factor from Protocol, based on level of concentrate	4	4	%
EC Methane (Methane Energy Content)	Default factor from Protocol	55.65		MJ/kg CH_4
Calculating Daily Volatile Solids Excreted by Cattle (for calculating Manure Methane) (kg VS)				
TDN_i (Total Digestible Nutrients)	Ration Formulation Records	79	79	%
UE (Urinary Energy)	Default factor from Protocol, based on level of concentrate	0.02	0.02	
ASH	Default factor from Protocol, based on constituents of baseline and project specific rational formulation records.	2 (grain based diet)		%

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Table AQ- 4: Relevant Data for the Sample Calculation for Feedlot #1 – 20,784 head in the baseline and 5,127 head in the project				
Calculating CH_4 Emissions from Cattle Manure Handling, Storage, and Application (kg CH_4)				
Bo (Methane Producing Capacity)	Default factor from Protocol	0.19		m^3 CH_4/kg VS excreted
$\rho_{Methane}$ (Density of Methane)	Default factor from Protocol	0.67		kg/m^3 of CH_4
MCF (Methane Conversion Factor)	Default factor from Protocol and is based on manure management system at each site.	MCF value of 1.6% for this project was derived by assuming that 40% of the manure was produced on pasture while 60% of the manure was produced in feedlot and stored in solid form.		%
Calculating Nitrogen Excreted in Cattle Manure – for use in calculating N_20 Emissions (kg NE)				
CP (Crude Protein)	Ration Formulation Records	13.50	12.84	%
$CF_{protein}$ (Protein Conversion Factor)	Ration Formulation Records	6.25		kg Crude Protein/kg of N
NR (Nitrogen Retention)	Default factor from Protocol	0.07		kg N retained/kg N intake
Calculating Direct Nitrous Oxide (N_2O) emissions from Manure Decomposition (kg N_2O)				
CF (Conversion Factor)	Default factor from Protocol	0.02		kg N_2O-N per kilogram of nitrogen excreted
44/28 (Conversion Factor)	Default factor from Protocol	Default factor 44/28 to convert (N_2O-N)$_{(mm)}$ emissions to $N_2O_{(mm)}$emissions		
Calculating direct nitrous oxide (N_2O) emissions from manure storage (kg N_2O)				
$FRAC_{Storage}$ (Management System)	Default factor from Protocol	0.6		
EF (Storage Emissions Factor)	Default factor from Protocol	0.007		kg N_2O-N/kg

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Table AQ- 4: Relevant Data for the Sample Calculation for Feedlot #1 – 20,784 head in the baseline and 5,127 head in the project			
			nitrogen excreted
Calculating indirect emissions from manure volatilization (kg N_2O)			
$FRAC_{Volatilization}$ (Management System)	Default factor from Protocol	0.42	
$EF_{Volatilization}$ (Storage Emissions Factor)	Default factor from Protocol	0.01	kg N_2O-N/kg nitrogen volatilized
Calculating indirect nitrous oxide (N_2O) emissions from manure N in the Soil Profile (kg N_2O)			
$FRAC_{Leach}$ (Management System)	Default factor from Protocol	0.1	
EF_{Leach} (Storage Emissions Factor)	Default factor from Protocol	0.025	kg N_2O-N/kg nitrogen leached

*Animal head days are higher due to 3 years of operations, averaged over that time period.
** Same Ym or enteric emission factor is applied even though roughage levels in the diet (Ym =6.5%) have decreased over time. Conservative approach and outlined in the Interpretive Guide available from Alberta Agriculture and Forestry.

Tables AQ-5 and AQ-6 below use the example data in Table AQ-4 above to calculate emission reductions following the hot carcass weight approach outlined in the Reducing GHG Emissions of Fed Cattle Protocol.

Table AQ- 5: Reducing GHG Emissions of Fed Cattle Protocol – Sample Emission Reduction Calculations
Equation 1 Cattle Enteric Emissions =[Number Production * DOF * $DDMI_i$ * GE_{Diet} * (EF $Enteric_i$ / 100%) / $EC_{Methane}$]
Enteric Emissions $_{BASELINE}$ = [((20,783.98 head) x (225.16 days) x ((19.97 lbs DMI/hd/day) / (2.2046 lbs/kg)) x (18.45 MJ/kg DM diet) x (4/100))/(55.65 MJ/kg CH_4)] = **562,159.31 kg CH_4**
Enteric Emissions $_{PROJECT}$ = [((1,127.48 head) x (231.41 days) x ((19.12 lbs DMI/hd/day)/(2.2046 lbs/kg)) x (18.45 MJ/kg DM diet) x (4 /100))/(55.65 MJ/kg CH_4)] = **30,008.22 kg CH_4**
Equation 2 Daily Volatile Solids Excreted in Cattle Manure = VS_i = [($DDMI_i$ * GE_{Diet} * (1 – (TDN_i / 100%))) + (UE * $DDMI_i$ * GE_{Diet})] * ((1 – (ASH / 100%)) / GE_{Diet})

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Table AQ- 5: Reducing GHG Emissions of Fed Cattle Protocol – Sample Emission Reduction Calculations
Volatile Solids $_{BASELINE}$ = [((19.97 lbs DM/hd/day/ 2.2046 lbs/kg) x (18.45 MJ/kg DM of diet x (1-(79/100))) + (0.02 x ((19.97 lbs DM/hd/day)/(2.2046 lbs/kg)) x 18.45 MJ/kg DM of diet)] x [(1-(2/100))/18.45 MJ/kg DM of diet] = **2.04 kg Volatile Solids/hd/day**
Volatile Solids $_{PROJECT}$ = [((19.12 lbs DM/hd/day/ 2.2046 lbs/kg) x 18.45 MJ/kg DM of diet x (1-(79/100))) + (0.02 x ((19.12 lbs DM/hd/day)/(2.2046 lbs/kg)) x 18.45 MJ/kg DM of diet)] x [(1-(2/100))/18.45 MJ/kg DM of diet] = **1.95 kg Volatile Solids/hd/day**
Equation 3 Cattle Manure Handling, Storage, and Application Methane Emissions = [Number Production$_i$ * DOF$_i$ * VS$_i$ * Bo * ρ Methane * (MCF / 100%)]
Manure CH_4 $_{BASELINE}$ = [(20,783.98 head) x (225.16 days) x (2.04 kg volatile solids excreted/hd/day) x (0.19 m^3 CH_4/kg VS) x (0.67 m^3/kg) x (1.6/100)] = **19,444.58 kg CH_4**
Manure CH_4 $_{PROJECT}$ = [(1,127.48 heads) x (231.41 days) x (1.95 kg volatile solids excreted/hd/day) x (0.19 m^3 CH_4/kg VS) x (0.67 m^3/kg) x (1.6/100)] = **1,036.27 kg CH_4**
Equation 4 Excreted Nitrogen = NEx$_i$ = DDMI$_i$ * (CP$_i$ / 100%) / CF$_{protein}$ * (1 – NR)
Nitrogen Excreted $_{BASELINE}$ = [((19.97 lbs DM/hd/day)/(2.2046 lbs/kg)) x ((13.50/100)/6.25 kg feed protein /kg N) x (1-0.07 kg N retained/kg N consumed)] = **0.18 kg N excreted/hd/day**
Nitrogen Excreted $_{PROJECT}$ = [((19.12 lbs DM/hd/day)/(2.2046 lbs/kg)) x ((12.84/100)/6.25 kg feed protein /kg N) x (1-0.07 kg N retained/kg N consumed)] = **0.17 kg N excreted/hd/day**
Equation 5 Manure N_20_{direct} = [Number Production$_i$ * DOF$_i$ * NEx$_i$ * CF$_{manure}$ * (44 / 28)]
Manure $N_2O_{direct\ BASELINE}$ = [(20,783.98 head) x (225.16 days) x (0.18 kg N excreted/hd/day) x (0.02 kg N_2O-N/kg N excreted) x (44/28)] = **26,473.85 kg N_2O**
Manure $N_2O_{direct\ PROJECT}$ = [(1,127.48 head) x (231.41 days) x (0.17 kg N excreted/hd/day) x (0.02 kg N_2O-N/kg N excreted) x (44/28)] = **1,394.01 kg N_2O**
Equation 6 Manure $N_2O_{direct\ storage}$ = [Number Production$_i$ * DOF$_i$ * NEx$_i$ * FRAC$_{Storage}$* EF$_{Storage}$ * (44 /28)]
Manure $N_2O_{direct\ storage\ BASELINE}$ = [(20,783.98 head) x (225.16 days) x (0.18 kg N/hd/day) x (0.6) x (0.007 kg N_2O-N/kg nitrogen excreted) x (44/28)] = **5,559.51 kg N_2O**

Table AQ- 5: Reducing GHG Emissions of Fed Cattle Protocol – Sample Emission Reduction Calculations
Manure $N_2O_{direct\ storage\ PROJECT}$ = [(1,127.48 head) x (231.41 days) x (0.17 kg N/hd/day) x (0.6) x (0.007 kg N_2O-N/kg nitrogen excreted) x (44/28)] = **292.74 kg N_2O**
Equation 7 $$\text{Manure } N_2O_{\text{Indirect volatilization}} = [(\text{Number Production}_i)*(DOF_i)*(NEx_i)*(FRAC_{Volatilization})*(EF_{Volatilization})*(44/28)]$$
Manure $N_2O_{indirect\ volatilization\ BASELINE}$ =[(20,783.98 head) x (225.16 days) x (0.18 kg N/hd/day) x (0.42 kg $N_2$0-N/kg nitrogen excreted) x (0.01 kg N_2O-N/kg nitrogen excreted) x (44/28)] = **5,559.51 kg N_2O**
Manure $N_2O_{indirect\ volatilization\ PROJECT}$ =[(1,127.48 head) x (231.41 days) x (0.17 kg N/hd/day) x (0.42 kg $N_2$0-N/kg nitrogen excreted) x (0.01 kg N_2O-N/kg nitrogen excreted) x (44/28)] = **292.74 kg N_2O**
Equation 8 $$\text{Manure } N_2O_{\text{indirect leaching}} = [(\text{Number Production}_i)*(DOF_i)*(NEx_i)*(FRAC_{Leaching})*(EF_{Leaching})*(44/28)]$$
Manure $N_2O_{indirect\ leaching\ BASELINE}$ = [(20,783.98 heads) x (225.16 days)*(0.18 kg N/hd/day)*(0.1)*(0.025 kg N_2O-N/kg nitrogen excreted)*(44/28)] = **3,309.23 kg N_2O**
Manure $N_2O_{indirect\ leaching\ PROJECT}$ = [(1,127.48 heads)*(231.41 days)*(0.17 kg N/hd/day)*(0.1)*(0.025 kg N_2O-N/kg nitrogen excreted)*(44/28)] = **174.25 kg N_2O**

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Table AQ- 6: Final Calculation Steps					
Factor	**Total Methane Emissions (kg CH_4)**	**Total Nitrous Oxide Emissions (kg N_2O)**	**Total Hot Carcass Weight Produced (kg)**	**CH_4 Emissions Intensity (kg CH_4/kg Hot Carcass weight)**	**N_2O Emissions Intensity (kg N_2O/kg Hot Carcass weight)**
Baseline	581,603.89	40,902.1	3,692,403.54	0.158	0.011
Project	31,044.49	2,153.74	207,418.49	0.150	0.010
			Difference	0.008	0.001
			Total Emission Reductions (kg CO_2e)[1]	103,294.41	
			Total Credits (t CO_2e)	**103**	

[1] ((0.009 x 950,067.56) x 25) + ((0.001 x 950,067.56) x 298), where 25 is the global warming potential (GWP) of methane and 298 is the GWP of nitrous oxide.

Greenhouse Gas Assertion

The total GHG emissions reductions reported here reflect the cumulative reduction of all five feedlots (25,000 head of cattle) included in this project.

Table AQ- 7: Total Emissions by Feedlot - January 1 – December 31, 2011				
Project Year	**Feedlot**	**CH_4 (t CO_2 e)**	**N_20 (t CO_2 e)**	**Total (t CO_2 e)**
2011	Feedlot #1	162	265	427
	Feedlot #2	173	232	405
	Feedlot #3	194	233	427
	Feedlot #4	215	235	450
	Feedlot #5	206	226	432
			Total	**2,141**

Note: The above values are fictitious

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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

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Appendix AR: RAH Offset Project Report

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Alberta Offset System

Offset Project Report for XYZ Inc.'s

Reducing the Age to Harvest of Beef Cattle Aggregation Project - Protocol Validation Study

(March 2014)

Disclaimers

This report has been produced independently by The Prasino Group at the request of the Climate Change Emissions Management (CCEMC) Corporation as specified under contract. 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 Reduced Age to Harvest Offset Project under the Alberta Offset System. Any reference to feedlot information, or offset credit information contained within this document is fictitious and intended for illustrative purposes only.

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Project Document Information

Project Developer: XYZ Inc.

Date: March 14, 2014

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

Project Scope and Project Description

Project Scope

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

Table AR- 1: Project Details	
Project Title:	Offset Project Plan for XYZ Inc.'s Reducing the Age to Harvest of Beef Cattle Aggregation Project - Protocol Validation Study
Project Purpose and Objective(s):	The purpose of this project is to reduce direct and indirect GHG emissions from beef cattle associated with enteric fermentation and manure storage and handling. XYZ Inc. will aggregate five feedlots for this project. The broader goal of the Protocol Validation Study is to identify barriers that currently exist in implementing projects under the RAH protocol and design scalable approaches to adopting this protocol. The RAH protocol does not prescribe the harvest age or production practices for raising beef cattle. As a result, different feedlot operators may choose different techniques, but must demonstrate through documentation and records that there is a reduction in the age of the harvested cattle.
Project Start Date:	e.g. January 1, 2011
Credit Start Date:	N/A – the RAH Protocol Validation Study is a non-commercial exercise (e.g. January 1, 2011)
Credit Duration Period:	N/A – the RAH Protocol Validation Study is a non-commercial exercise (e.g. Alberta Offset System eligibility specifies 8 years, with the potential for an additional five years upon government approval)

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Table AR- 1: Project Details	
Reporting Period	January 1, 2011 – December 31, 2011
Expected Lifetime of the Project:	N/A – the RAH Protocol Validation Study is a non-commercial exercise (Commercial feedlots could continue this exercise indefinitely, and this activity is dynamic and can be stopped and restarted)
Actual Emission Reductions/Removals:	Up to 25,000 t CO_2e
Applicable Quantification Protocol(s):	Government of Alberta Quantification Protocol for Reducing the Age at Harvest of Beef Cattle Version 2.0, July, 2011
Protocol(s) Justification:	All participating project sites are based in Alberta and have implemented strategies to reduce the age of harvest of beef cattle. The practices adopted are not commonly employed and therefore go beyond business as usual (BAU). As a result, the project is additional. The Project and all aggregated sites also align with all applicability requirements stated in the Protocol.
Other Environmental Attributes:	This project will not generate any other environmental credits. However, more efficient production of beef will result in less manure being produced and as a result less associated impacts from manure and water use.
Legal Land Description of the Project and/or Other Unique Site Descriptions:	Feedlot #1: 01-01-010-01W4 Feedlot #2: 02-01-010-01W4 Feedlot #3: 03-01-010-01W4 Feedlot #4: 04-01-010-01W4 Feedlot #5: 05-01-010-01W4
Ownership:	As described in the Protocol, ownership of offset credits generated under this protocol is assigned to the project developer. The project developer for this project is XYZ Inc. Proof of ownership over emission reductions is provided in the form of purchase records, commercial agreements/shipping manifests/RFID tag relationships for the animals in the project to substantiate the feedlots fed the cattle in question, in addition to agreements between the participating feedlot operators and the project developers.

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Table AR- 1: Project Details	
	XYZ Inc. is the aggregator and sole owner of all offsets arising from this project.
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 March 2014. The verifier has no actual or perceived conflicts of interest associated with this project. This is the first project report and first verification of emission reductions for this project. The anticipated frequency of verification is annually (projects over 15,000 tonnes per year) or every two years (projects under 15,000 tonnes per year).
Project Activity:	See Table AR-3 below.
Project Registration:	N/A – the RAH 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.

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

This project is an aggregation of emission reductions across five feedlots in Alberta. The location of these feedlots is provided below:

Table AR- 2: Farm Coordinates

Farm	Legal Land Description	Latitude	Longitude
Feedlot #1	01-01-010-01W4	53.521479	-113.215915
Feedlot #2	02-01-010-01W4	53.447117	-111.923904
Feedlot #3	03-01-010-01W4	50.387617	-112.438202
Feedlot #4	04-01-010-01W4	50.301725	-113.471405
Feedlot #5	05-01-010-01W4	51.214875	-111.931052

Note: the above coordinates are fictitious

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 Technical Guidance for Offset Project Developers (version 4.0, February 2013). The Project complies with the Specified Gas Emitters Regulation Quantification Protocol for Reducing the Age at Harvest of Beef Cattle Version 2.0, July, 2011.

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Table AR- 3: Alberta Offset System Eligibility	
Criteria	**How this Project Meets the Requirement**
Start Date after January 1, 2002	The changes in beef cattle rearing practices were implemented after January 1, 2002.
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 Reducing the Age at Harvest of Beef Cattle Protocol.
Not Required By Law	The changes in practices were not required by law or regulation.
Clearly Established Ownership	Legal land descriptions for each feedlot included in the project were checked. The aggregator and land owner then signed an agreement clearly establishing the aggregator as the owner of the credits.
Counted Once for Compliance Purposes	e.g. 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 plan 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	The activity is implemented under the Quantification Protocol for Reducing the Age at Harvest of Beef Cattle, Version 2.0, July, 2011.
Be Registered on the Registry	This document supports the registration on the registry of tonnes serialized by XYZ Inc.

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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 jabot@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	

Project Description

XYZ Inc. is a local project aggregator located in Red Deer, Alberta. XYZ Inc. aggregates GHG emission reductions created by multiple feedlot operators in order to provide the volume of GHG reductions typically required by interested buyers. In this case, the Reducing the Age to Harvest of Beef Cattle Protocol Validation Study is an aggregation of five participating feedlots. Each of these feedlots has implemented changes in beef cattle rearing practices that reduce the age at harvest of beef cattle. This results in a decrease of enteric and manure storage/handling emissions. All of the feedlots included in the project are located in Alberta. The location of each of the feedlots is provided in Table AR-2 above.

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The GHG emission reductions have been generated in accordance with the Reducing the Age to Harvest of Beef Cattle Protocol. Each participating feedlot has provided information on their cattle rearing practices for each animal grouping. This data was then entered into XYZ Inc.'s software and reviewed by the data management team. Evidence has also been collected from each feedlot to confirm their eligibility to participate in the project.

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.

Greenhouse Gas Calculations

Quantification Methodology

The following equations serve as the basis for calculating the emission reductions from the project, using the emission profiles of the baseline and project conditions. Note that only sources, sinks and reservoirs (SSRs) determined to be relevant to this project are included in the calculations.

$$Emission_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$$

$$Emissions_{Baseline} = Emissions_{Cattle} + Emissions_{Manure}$$

$$Emissions_{Project} = Emissions_{Cattle} + Emissions_{Manure}$$

Where:

- $Emission_{Baseline}$ = Sum of the emissions under the baseline condition
- $Emissions_{Cattle}$ = Emissions under B1b Cattle Production and B10 Feed Consumption
- $Emissions_{Manure}$ = Emissions under B13 Manure Storage and Handling and B15 Land Application

- $Emissions_{Project}$ = Sum of the emissions under the project condition
- $Emissions_{Cattle}$ = Emissions under P1b Cattle Production and P10 Feed Consumption
- $Emissions_{Manure}$ = Emissions under P13 Manure Storage and Handling and P15 Land Application

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Greenhouse Gas Calculations

Table AR-4 below provides a summary of the data that is needed to calculate the GHG emission reductions. The baseline years are 2008 to 2010 and the project year is 2011. The data used to perform the sample calculation is fictitious and does not represent real project data.

Table AR- 4: Data for Yearling-Fed Steers

Year	Number in Production	Average Weight (kg)	Average Age at Harvest (months)
2008	2600	621.3	20
2009	3000	620.8	19
2010	2300	619.1	18
2011	2500	618.2	15

Table AR- 5: Relevant Data for Sample Calculation for One Grouping of Animals

	Source	Calculation	Value		Units
			2009 Baseline (19 months)	*Project (15 months)*	
			Steers	***Steers***	
General Information					
Number of Head	Data from Project Site	n/a	3000	2500	head
Information Relevant to Weight Conversion of Animals (Mass $_{Production}$)					
Average Live Weight in kg	Data from Project Site	n/a	620.4	618.2	kg
Average Carcass Weight (with 4% shrink and 58% dressing)	Data from Project Sites	Live weight *.96*.58	345.66	344.21	kg
Parameter: Calculating Cattle Enteric Methane Emissions (kg CH_4)					

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Table AR- 5: Relevant Data for Sample Calculation for One Grouping of Animals					
	Source	Calculation	Value		Units
			2009 Baseline (19 months)	*Project (15 months)*	
			Steers	***Steers***	
Relative Methane Intensity of Enteric Emissions	Defined in Protocol	$.162\ e^{.079\ *(\text{age in months})}$	0.727	0.530	kg CH_4/kg carcass beef/yr
Relative GHG Intensity	Defined in Protocol	$(.162\ e^{.079\ *(\text{age in months})})*21$	15.267	11.130	kg CO_2e/kg carcass beef/yr
Normalize the Baseline to 345 kg Carcass Weight	Defined in Protocol	(Relative GHG Intensity*345 kg)/actual weight(kg)	15.238	11.156	kg CO_2e/kg carcass beef/yr (normalized)
Enteric Methane Emissions (Baseline)	Defined in Protocol	Normalized baseline weight * 345 kg	5257.11	n/a	kg CO_2e/kg Carcass Beef/yr
Enteric Methane Emissions (Project)	Defined in Protocol	normalized project weight * 345 kg	n/a	3848.82	kg CO_2e/kg Carcass Beef/yr
Parameter: Calculating Manure Methane Emissions (kg CH_4)					
Relative Methane Intensity of Manure Emissions	Defined in Protocol	$.0005\ e^{.1659\ *(\text{age in months})}$	0.012	0.006	kg CH_4/kg carcass beef/yr
Relative GHG Intensity	Defined in Protocol	$(.0005\ e^{.1659\ *\text{age in months}})\ *21$	0.252	0.126	kg CO_2e/kg carcass beef/yr

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Table AR- 5: Relevant Data for Sample Calculation for One Grouping of Animals					
	Source	Calculation	Value		Units
			2009 Baseline (19 months)	*Project (15 months)*	
			Steers	***Steers***	
Normalize the Baseline to 345 kg Carcass Weight	Defined in Protocol	(Relative GHG Intensity*345 kg)/actual weight(kg)	0.252	0.126	kg CO_2e/kg/ carcass beef/yr (normalized)
Enteric Methane Emissions (Baseline)	Defined in Protocol	normalized baseline weight * 345	86.94	n/a	kg CO_2e/kg/ head/yr
Enteric Methane Emissions (Project)	Defined in Protocol	normalized project weight * 345	n/a	43.47	kg CO_2e/kg/ head/yr
Parameter: Calculating Manure Nitrous Oxide Emissions (kg N_2O)					
Relative Nitrous Oxide Intensity of Manure Emissions	Defined in Protocol	$.0011\ e^{.1464}$ *(age in months)	0.018	0.010	kg N_2O/kg carcass beef/yr
Relative GHG Intensity	Defined in Protocol	$(.0011\ e^{.1464}$ *(age in months)$)*21$	5.58	3.10	kg CO_2e/kg carcass beef/yr
Normalize the Baseline to 345kg carcass weight	Defined in Protocol	(Relative GHG Intensity*345 kg)/actual weight(kg)	5.57	3.11	kg CO_2e/kg/ carcass beef/yr (normalized)
Enteric Methane Emissions (Baseline)	Defined in Protocol	normalized baseline weight * 345	1921.65	n/a	kg CO_2e/kg/ head/yr

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Table AR- 5: Relevant Data for Sample Calculation for One Grouping of Animals					
	Source	**Calculation**	**Value**		**Units**
			2009 Baseline (19 months)	***Project (15 months)***	
			Steers	***Steers***	
Enteric Methane Emissions (Project)	Defined in Protocol	normalized project weight * 345	n/a	1072.95	kg CO_2e/kg/ head/yr

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Table AR- 6: Final Example Calculation			
Factor	**2008 to 2010 Average Baseline (kg CO2e/kg Carcass Beef/Year)**	**Total Project (kg CO2e/kg Carcass Beef/Year)**	**Total Tonnes of Emission Reductions [(Emissions $_{Baseline}$ - Emissions $_{Project}$)*2500*0.001]**
Enteric Methane Emissions	5257.11	3848.82	3520.73
Manure Methane Emissions	86.94	43.47	108.68
Manure Nitrous Oxide Emissions	1921.65	1072.95	2994.60
Total Tonnes of Emission Reductions for 2,500 head (tCO_2e)			**6624.01**

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Greenhouse Gas Assertion

Table AR-7 below provides the total GHG emissions reductions, reflecting the cumulative reduction of the feedlots included in this project (approximately 12,500 head).

Table AR- 7: Total Emissions by Feedlot

Reporting Period: January 1 – December 31, 2011				
Project Year	**Feedlot**	**CH_4 (t CO_2 e)**	**N_20 (t CO_2 e)**	**Total (t CO_2 e)**
2011	Feedlot #1	3,629.41	2,994.60	6,624
	Feedlot #2	1,933.71	1,179.97	3,113
	Feedlot #3	3,986.79	2,391.10	6,377
	Feedlot #4	2,926.52	1,700.56	4,627
	Feedlot #5	2,417.14	1,474.96	3,892
			Total	**24,634**

Note: The above values are fictitious

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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

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Appendix AS: Briefing Note

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Protocol Validation Studies of Agricultural Emission Reduction Projects
Key Findings and Recommendations

Issue:

Alberta Environment and Sustainable Resource Development has approved a suite of offset protocols applicable to the agricultural sector but, with the exception of the Conservation Cropping Protocol, these have had a disappointing rate of uptake. Both entities capable of generating offsets for the registry, and those willing to purchase offset credits are interested in improving the rate of adoption of agricultural offset protocols, and optimizing the GHG reduction opportunity.

Approach:

With the ultimate goal of improving the quantity of offsets generated from agricultural practice change, Agriculture and Rural Development (ARD) and the Climate Change and Emissions Management (CCEMC) Corporation have invested significant resources and engaged a broad set of stakeholders in a set of protocol validation studies (PVSs). The studies aim to:

- Validate, through pilots, how key agricultural protocols can be applied in the field - identifying barriers to adoption, and finding solutions to commercialize them at scale;
- Provide guidance to producers, aggregators and verifiers on the implementation of the protocols to ensure consistent outcomes; and,
- Demonstrate how verification to a reasonable level of assurance can be accomplished.

Findings:

1. Additional clarity on requirements for verifying agricultural offset projects, including sufficient and appropriate evidence standards, is needed. Standardization of record management, GHG data and information controls would ease verification and government audit processes and reduce credit revocation risk.
    - Recommend adoption of Best Practice Guides for implementing and verifying protocols.
2. Increased transaction costs associated with the move to “reasonable level of assurance”, and economic barriers for aggregators and producers impair adoption and prevent new entrants. Cost/benefit analyses show protocol adoption rates and avoided emissions both rise with carbon credit value. Otherwise the increased costs in supplying offsets will result in market failure.
    - Recommend policy adjustments to increase the nominal price for carbon.

Conclusion:

Agricultural protocols offer excellent potential to incent improved practice and avoided emissions and to generate offset credits at scale, but producers, aggregators and verifiers need standardized tools and improved carbon values to be successful.

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Annex 1. The Protocol Validation Study (PVS) Process

Background:

The Alberta agriculture sector has access to more than eight offset protocols for generating credits from avoided biologically-based greenhouse gas emissions (GHG) under the Alberta Offset System. Nevertheless, to date, only one or two of the agricultural protocols have been adopted by project developers and only one at scale (e.g. the Tillage System Management Protocol now called Conservation Cropping (CCP)). The desired outcome for Alberta Agriculture and Rural Development, as well as the CCEMC Biological GHG Management Program is to realize further potential to lower GHG emissions by increasing adoption of these offset protocols.

The CCP has features that make it more amenable to adoption - a performance standard baseline and a standardized quantification approach. These aspects streamline the quantification, accounting and data requirements, enabling easier adoption of these biological-based offsets – and reduce risk for stakeholders in the system. In contrast, the remaining seven, non-adopted protocols have static historic baselines, requiring the establishment of a three-year average baseline for each project. This is a more complex undertaking that is contingent on past data and record collection of a sufficient quality to establish a baseline, and/or a three year time delay before credits can accrue and the investment in the infrastructure required to bring forward compliance-based offsets is realized. Further, It is possible that some animal and/or cropping operations may not currently have all the information needed to calculate and substantiate the GHG reductions according to these protocols.

Given this challenge and the additional challenges associated with the economics of implementing agricultural carbon projects (e.g. cost-effectiveness, the quantity of reductions needed to reach economies of scale, market perceptions and volatility of agricultural commodity prices), Alberta Agriculture and Rural Development (ARD) and the Climate Change and Emissions Management (CCEMC) Corporation have undertaken a set of PVS.

Current Situation:

The PVS studies are a capacity-building initiative designed to gather learnings from the application and validation of four protocols[55]. Specifically, the PVS studies emulate the process of aggregating participating producers under the provisions of the protocols to bring forward "offsets" that can be tested in a mock verification exercise to a reasonable level of assurance. Aggregation companies present in the Alberta Offset System were asked to submit an Expression of Interest under an RFI process administered by Alberta Innovates Bio Solutions (AI Bio)[56] to voluntarily participate in the study. A number of criteria were posed in the RFI, including demonstrating the companies have invested time and resources towards assessing the protocol in question. The rest of the criteria used in the process are available upon request. The PVS Evaluation Committee[57] evaluated the EOI's and selected the most qualified aggregation

[55] The 4 protocols, chosen by ARD and CCEMC based on a ranking system are: Nitrous Oxide Emission Reduction(NERP); Beef Reduced Days on Feed (DOF); Beef Reduced Age at Harvest (RAH); and, Conservation Cropping (CCP).

[56] The Biological GHG Management Program, launched in June 2012, is administered by Alberta Innovates Bio Solutions (Al Bio) with funding from the Climate Change and Emissions Management (CCEMC) Corporation.

[57] The PVS Evaluation Committee comprised members from Alberta Agriculture and Rural Development and CCEMC.

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companies to participate in the study.

In short, the objectives of the PVS studies include:

- Validating, through small-scale pilots, how the protocol requirements can be applied in the field, including identifying barriers to adoption of the protocols, and finding solutions;
- Providing guidance to producers, aggregators and verifiers on consistent implementation of the protocols at a commercial scale; and,
- Demonstrating how verification to a reasonable level of assurance can be accomplished following the available protocols.

The PVS studies are being implemented in 4 Phases (see Table AS-1 below). Phase 1 is the design phase, where planning documents and the process outlined below were shared with stakeholders in the Alberta Offset System at an Orientation Workshop[58] .Phase 2 is the Implementation phase. Phase 3 is the reporting stage and includes a stakeholder workshop held August 8th, 2013. A robust, multi-perspective discussion occurred on possible solutions (see Annex 2/3). Phase 4 (not shown here) is the continuation of the PVS studies for the DOF, RAH and NERP protocols for the second year funded by CCEMC.

Table AS- 1: Development and Implementation of the PVS Studies

Task Description	Results
Phase I – PVS Design Finalization • Create Protocol Validation Study Design Document • Issue RFI for aggregators; select aggregator partners for each project area • Communicate results of selection process to stakeholders • Host a kick-off meeting with each of the selected aggregators	A Design document for the studies was developed and circulated at the orientation workshop held in Edmonton on September 12, 2012. These documents were also used to lay out the timelines and deliverables with the potential aggregators and verifiers. The RFI was issued and cooperating aggregators selected Sept 30, 2012. The results of this selection process were communicated and a kick-off conference call was held with the aggregators in the latter part of 2012.
Phase II – Implementing the PVS • Build data collection guidelines, calculators and offset documentation templates • Enroll cooperating producers and select verifiers. • Collect baseline data/documentation and economic data for 2011 and 2012 project year calculations • Aggregate all qualified project reductions • Identify and address barriers to implementation within each of the studies	Data management guidelines and templates 4 PVS were developed and submitted in March and April 2013. OPPs and OPRs were developed and submitted in mid-2013 depending on the study. Dr. Paul Thomassin from McGill University collected economic data and created an aggregator benefit cost report and model; as well as a producer model. Several meetings with the aggregator and Dr. Thomassin were facilitated. Validation of the economic models were completed with the aggregators. Verifiers contracted to complete a mock-verification. An excel-based calculation module was completed on all 4 protocols.

[58] See Annex 2 for the Agendas and list of attendees.

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Phase III – Reporting on PVS • Validate the emission reductions • Complete case studies on cost/benefits for extension purposes • Host Interim workshop to report back to stakeholders	Mock-verification/pre-validations were submitted by mid-year 2013. Best practice guides created with input from the verifier companies. This was an additional deliverable that was created based on identified need for further verification guidance. Stakeholder workshop held August 8th 2013 to share findings and discuss solutions going forward.

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Annex 2. The Protocol Validation Study (PVS) Needs-Assessment and Stakeholder Engagement

Needs-Assessment:

The lead up to identifying the need for the PVS started in early 2012. Alberta Agriculture and Rural Development's Agri-flexiblity Offset Project, the initiative funding these studies, has objectives to implement at least one additional agricultural protocol over the course of the next few years. Over this time period, ARD, the Farmer's Advocate Office, Alberta Environment and Sustainable Resource Development and aggregator companies have had several discussions regarding the Jan 1, 2012 policy direction of 'go-forward tonnes and reasonable assurance'.

In September 2012, a Kick-Off workshop with stakeholders was held to discuss the intent and direction of the PVS (see below for Agenda and list of attendees). It was well-attended, with representatives of the carbon supply chain – aggregators, verifiers, scientists, protocol developers and supporting stakeholders. The objectives, outcomes, phases and timelines of the PVS were clearly laid out, and stakeholders were cautiously optimistic about engaging in the study.

Post September 2012, 3 volunteer aggregator companies were selected through AIBio's RFI process: Agritrend (DOF/NERP), FailSafe (RAH) and Carbon Credit Solutions (CCP). These volunteer aggregators worked with two verifiers to complete a mock-verification on each project type. Aaron Schroeder of ICF Consulting conducted the mock-verifications for DOF, NERP and RAH; while Chris Ridley-Thomas of KPMG completed the mock-verification for CCP. The aggregators also worked with the Project Team and Dr. Paul Thomassin to conduct a cost-benefit analysis on each of the protocols.

On August 8, 2013 an interim-reporting workshop to stakeholders was held to present and discuss the findings of the first year of the protocol validation studies. The meeting was well attended by project developers, aggregators, verifiers and others working within the Alberta Offset System (see attached). The project team presented a number of tools that were developed as part of the study and discussed the first year's mock-verification and cost-benefit analysis findings with the group. In general, the group was positive about the progress of the studies and the evidence it created to support the need for change in some areas. Several issues were discussed, including inconsistent verification outcomes, uncertainty regarding sufficient and appropriate evidence, the new technical guidance for Verification at Reasonable Level of Assurance[59], and difficulty with implementing the four protocols in question (both from an economic and barrier to adoption standpoint (see details in Annex 3).

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[59] http://environment.gov.ab.ca/info/library/8802.pdf

Protocol Validation Studies
Orientation Workshop

Date:

- **Sept 12th 2012**

Meeting Place:

- Alberta Innovates-Technology Futures Building; 350 Karl Clark Road, Edmonton Alberta

Objectives:

- Orient Stakeholders to existence of ARD and CCEMC Protocol Validation Studies
- Bring stakeholders to common understanding of Purpose, Objectives and Steps
- Inform potential primary stakeholders of the opportunity to participate in the Studies

Agenda:

Time:	Description
10:00	**Welcome and Introductions– Sheilah Nolan (ARD) and Susan Wood-Bohm (AI Bio Solutions)** • *Introductions* • *Go over Objectives of the Day*
10:15	**Purpose of Protocol Validation Studies –Sheilah Nolan and Susan Wood-Bohm (AI Bio Solutions)** • **Background** ○ *Barriers Analysis; Challenges to Protocol Adoption* ○ *CCEMC Biological Emissions Reduction Report Findings* • **Proposed Outcomes and Deliverables of PVS**
10:45	**Protocol Validation Study Design –KHK Consulting** • **Project Steps and Timelines** ○ *Case Study – ADFI*-Dairy Farmers of Canada Dairy Pilot Learnings* • **Role of Primary Stakeholders** ○ *Benefits of Participating* ○ *Data Confidentiality* ○ *Mock Verification*
11:00	**BREAK**
11:15	**Open Floor Question and Answer/Discussion Period – Facilitated by KHK Consulting**
12:00	**Process for Request for Qualifications/Interest – KHK Consulting** • **Criteria for Evaluation; Timelines; Expectations**
12:15	**Open Floor Question and Answer/Discussion Period – Facilitated by KHK Consulting**
12:30	**Networking Lunch**

*Atlantic Dairy and Forage Institute

Canada CCEMC Climate Change and Emissions Management (CCEMC) Corporation Alberta Innovates Bio Solutions Alberta Government

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September 12, 2012 PVS Workshop - Participants

Amanda Stuparyk	C-3	Attended
Arron Best	AB ARD	Attended
Blair McClinton	Viterra	Attended
Bob Coulter	First Carbon Credits Corp.	Attended
Bruce Love	Preferred Carbon	Attended
Candace Vinke	Prasino Group	Attended
Carlene Godwin	AIA	Attended
Dan Heaney	Random Cross	Attended
Diane McCann-Hiltz	AB ARD	Attended
Graham Gilchrist	Farmer's Advocate	Attended
Jack Holdsworth	Failsafe	Attended
Karen Haugen-Kozyra	Prasino Group	Attended
Keith Driver	Prasino Group	Attended
Paul Jungnitsch	AB ARD	Attended
Ron Axleson	Intensive Livestock Working Group	Attended
Sheilah Nolan	AB ARD	Attended
Susan Wood-Bohm	Alberta Innoates BioSolutions	Attended
Timo Makinen	Shell Thiogro	Attended
Tom Goddard	AB ARD	Attended
Ty Faechner	ARECA	Attended
Zoia Komirenko	AB ARD	Attended
Garth Boyd	Prasino Group	Attended
Ray Farrow	Preferred Carbon	Attended
John Zylstra	AB ARD	Attended
Kirk Andries	CCEMC Bio GHG Management Program	Attended
Diane Staley	Prasino Group	Attended
Tanya Maynes	C3	Attended
Kevin Pattison	AgriTrend	Attended

Protocol Validation Studies
Interim Workshop

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Date:

- **August 8th 2013**

Meeting Place:

- Alberta Innovates-Technology Futures Building - Main Floor Auditorium, 350 Karl Clark Road, Edmonton, Alberta

Proposed Objectives for Workshop:

- Status Report on Findings and Tools developed from the four PVS to date
- Share latest developments on carbon policies in Canada and the U.S.

Materials:

- Draft documents on the four studies were distributed to those who registered

Final Agenda

Time:	Description
10:00	**Welcome, Introductions and Refresher on Protocol Validation Studies** - Sheilah Nolan (Alberta Agriculture and Rural Development) and Susan Wood-Bohm (Alberta Innovates - Bio Solutions)
10:35	**Nitrous Oxide Emissions Reduction Protocol (NERP)** - Aaron Schroeder (ICF Marbek), Paul Thomassin (McGill University) and Karen Haugen-Kozyra (KHK Consulting)
11:15	**BREAK**
11:30	**Reduced Age at Harvest Protocol** - Aaron Schroeder, Paul Thomassin and Karen Haugen-Kozyra
12:10	**NETWORKING LUNCH**
12:45	**Reduced Days on Feed Protocol** - Aaron Schroeder, Paul Thomassin and Karen Haugen-Kozyra
1:30	**Conservation Cropping Protocol** - Paul Thomassin and Karen Haugen-Kozyra
2:10	**OPEN DISCUSSION**
2:45	**Update on Canada and US Carbon Policies** - Karen Haugen-Kozyra and Keith Driver (Prasino Group)
3:15	**Next Steps**
3:30	**Adjourn**

Please see reverse for Discussion Questions. Feel free to add written comments and leave these at the registration table.

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August 8 2013 - PVS Interim Workshop Participants

Name	Company
Bob Coulter	First Carbon Credits Corp.
Rita Middleton	First Carbon Credits Corp.
Jack Holdsworth	Failsafe
Bill Dorgan	AgriTrend
Alastair Handley	Carbon Credit Solutions
Richard Kennedy	CROP
Sheilah Nolan	AB ARD
Tom Goddard	AB ARD
Josie van Lent	Dean, Lakeland College
John Lunty	Crop Technology Program Lakeland College
Mel Mathison	Environmental Sciences Lakeland College
Susan Wood-Bohm	AI Bio Solutions
Laurie Vaughn-Evans	AI Bio Solutions
Amanda Stuparyk	C3
Tanya Maynes	C3
Dr. Susan Markus	AB ARD
Jared Ward (by conference call)	Sask Env
Carlene Godwin	AIA
Zoia Komirenko	AB ARD
Paul Jungnitsch	AB ARD
Clint Dobson	Alberta Livestock and Meat Agency
Geoff Montgomery	AARD
Ron Axleson	Intensive Livestock Working Group
Clyde Graham	Canadian Fertilizer Institute
Bruce Ringrose	ClimateCheck
Karen Haugen-Kozyra	KHK Consulting
Candace Vinke	Prasino Group
Garth Boyd	Prasino Group
Paul Thomassin University	McGill
Aaron Schroeder	ICF-Marbek
Dan Heaney	Random Cross
Nelson Lee	EBA Engineering
Duncan Kenyon	Pembina
Jonathan Scarth	Deltawaterfowl

Annex 3. Findings and Recommendations of the Protocol Validation Studies

One of the main successes of the first year of the PVSs is the creation of a set of tools that can be used by project developers and aggregators to provide increased certainty for a successful project. A brief description of each of these tools is provided in Table AS-2 below.

Table AS- 2: Tools Created as Part of the Protocol Validation Studies

Tool	Brief Description
Best Practice Guides	• Best practice documents for implementing and verifying agricultural offset projects at reasonable level of assurance – targeted at project developers, verifiers and government auditors.
Data Collection Templates	• Templates for offset project data collection/compilation
GHG Calculators	• Excel based emission reduction calculators
Sample Offset Project Plans and Reports	• Examples that can be used as a template/for reference
Cost-Benefit Analyses Documents	• Aggregator calculation modules, including sensitivity analysis for break even carbon, tonnage or price • Producer calculation modules, allowing assessment on engagement success with a project at a certain scale

In particular, the creation of the best practice guides is significant since these documents address a number of the issues identified by the PVSs. Specifically, the best practice guides provide the following specific to the protocols in question:

a. Provide further clarity on the requirements for verifying agricultural offset projects in order to increase consistency across verification/government audits; and
b. Provide further clarity on record management and GHG data and information quality controls to increase consistency amongst project developers.

Another success is the completion of the cost-benefit analysis reports. These documents provide a detailed analysis of the costs associated with developing a project under each of the four protocols and the associated circumstances under which the protocols are profitable. Specifically, three scenarios were analysed: expected, optimistic and pessimistic. For each of these scenarios the number of credits, the price of carbon and the discount rate was varied.

Key challenges identified through the Protocol Validation Studies include the following:

1. *Some protocols penalize early adopters* – For example, the small number of growers who have the records needed to support the NERP are already efficient at managing applied nitrogen, eliminating the opportunity for further emission reductions. As a result, the protocol penalizes early adopters. A similar problem exists with the RAH protocol.
2. *The price of carbon is a barrier* - At current Technology Fund prices, several project types are no longer profitable. The transaction costs of the offset system have gone up as the system continues to demand more rigour with reasonable level of assurance; however, the technology fund price has not increased proportionately. This is making it increasingly difficult to get farmers engaged enough to supply the information that is required to generate credits. Furthermore, it is

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threatening the financial viability of being an aggregator. A number of scenarios were calculated in the Cost-Benefit analysis, using escalating conservative carbon prices[60] and conservative expected tonnage estimated by the aggregator-project team[61]. The following table presents an aggregator's average annual return at net present value from the 8 year period analysis.

Protocol	Optimistic	Expected	Pessimistic
NERP	$281,471.67	-$31,462.20	-$258,333.14
DOF	$281,884.25	$104,056.11	-$55,759.94
CCP	$244,901.45	$68,454.49	-$88,824.93
RAH	$665,747.16	$178,503.01	-$119,296.31

3. *Inconsistencies in Verification* – Lack of standardization and verifier accreditation has led to inconsistency amongst verifiers. This is creating confusion amongst project developers on what is considered sufficient and appropriate evidence, and increases risk of failure of ex poste audit impacting fungibility of offsets.
4. *Credit Revocation Risk* – Lack of standardization in the verification process introduces the risk that verifiers and auditors may come to different conclusions. This is a significant challenge and risk for project developers.

Challenges, Solutions and Implications

At the Interim workshop a number of suggestions and possible solutions were raised for addressing the above issues. Table AS-3 below summarizes these solutions and their implications.

Table AS- 3: Possible Solutions to the Challenges Identified in the Protocol Validation Studies

Issue	Solution	Implications
Inconsistent Verification Outcomes Credit Revocation Risk	8. Adopt the Best Practice Guides 9. Training to verifiers for verifying a project type 10. Accreditation of Verifiers (ANSI, SCC) 11. Permanent auditors on staff at AESRD 12. Test the verification process on problematic protocols	• Other Registries/Programs have protocol-specific verification guides to reduce uncertainty • Other Registries/Programs train verifiers on a specific project type • Other Registries/Programs accredit verifiers on a specific project type • Consistency/continuity improved and familiarity with project types and evidentiary requirements • Conduct a test on common project types to see how the outcomes of a group of verifiers

[60] Price increases ranged: $13 for first 2 years; Lower $20's in years 3 and 4; $30's in years 5 to 7

[61] For Optimistic, Expected and Pessimistic tonnes, respectively - NERP – 75,000; 50,000; 25,000; DOF (escalating) – 10 to 50,000; 10 to 25,000; 4 to 6,000; CCP (escalating) – ; 120 to 160,000; 100 to 140,000; 90 to 100,000; RAH – (escalating) 60 to 75,000; 40 to 50,000; 25,000 across the board.

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Issue	Solution	Implications
	13. Verifiers submit verification plans on all new project types for review 14. Government auditors shadow verifiers while verifying projects – to observe	differ; could be used to build common understanding • Would create an opportunity to ensure a similar approach across verifiers in mid-term, while a plan for training is being developed. • Auditors would get comfortable with the verification techniques and processes used by specific firms; help to avoid the two-tier project quality
Economic Barriers to Entry and Continued Engagement by Aggregators Implementation Barriers	3. Increase the price of carbon to achieve more projects at scale 4. Accept recommendations for streamlining the 4 protocols to make them more implementable	• An increase would make more agricultural project types financially feasible for both aggregators and producers. • Over the next couple of months, protocols will be edited with streamlined accounting approaches (note DOF already moved to AESRD with edits).
Continued Auditor General Scrutiny	1. Auditor General meeting in 2014 to present PVS findings and implemented recommendations	• Demonstrate commitment to continuous improvement for robust and high quality projects.

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