DET NORSKE VERITAS

VCS Methodology Element Assessment Report as Second Validator

Quantifying N_2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction

Report for:

Michigan State University

DNV report number
2011-9689

DET NORSKE VERITAS

VERIFICATION REPORT

Date of first issue: 16 January 2012	Project No.: PRJC-300414-2011-CCS-USA
Approved by: Miguel Rescalvo Santandreu, Regional Manager Americas	Organizational unit: Det Norske Veritas (U.S.A.) Inc.
Client: Michigan State University	Client ref.: Neville Millar

Name of Methodology: Quantifying N2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction

Version: 1.4.6

Assessment Phases:

☒ Desk Review
☒ Follow up interviews
☒ Resolution of outstanding issues

Assessment Status

☐ Corrective Actions Requested
☐ Clarifications Requested
☒ Full Approval by DNV
☐ Rejected

In summary, it is DNV's opinion that the proposed VCS methodology element "Quantifying N2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction." as described in version 1.4.6, dated 25 January, 2012, meets all relevant VCS requirements for VCS methodology elements. Therefore, DNV recommends the methodology element for approval and requests that VCSA approve the methodology element.

Report No.:	Subject Group:	
2011-9689	Environment	

Report title:
Quantifying N_2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction

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1 ASSESSMENT STATEMENT

Det Norske Veritas (U.S.A.), Inc has performed the second assessment of the proposed Verified Carbon Standard (VCS) methodology element, “Quantifying N_2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction.” The assessment was performed on the basis of VCS criteria for methodology development.

The review of the methodology element documentation and the subsequent follow-up interviews has provided DNV with sufficient evidence to determine the fulfillment of the stated criteria.

The methodology element (ME) was prepared based on the requirements the latest version of VCS Standard version 3.1 issued, on July 15, 2011

The methodology element belongs to the sectoral scope 14, ALM project, ICM project type.

In summary, it is DNV’s opinion that the methodology “Quantifying N_2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction” described in the Methodology Element Documentation (MED), version 1.4.6, dated 25 January, 2012 meets all relevant VCS requirements for VCS methodology elements. Therefore, DNV recommends that VCSA approve the methodology.

2 INTRODUCTION

Michigan State University has commissioned Det Norske Veritas (U.S.A.), Inc (DNV) as the second validator to perform an assessment of the methodology "Quantifying N_2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction". This report summarizes the findings of the assessment of the methodology, performed on the basis of VCS criteria for methodologies. VCS criteria refer to VCS Version 3 and the subsequent VCS Program Documents /2//3/.

3 METHODOLOGY

The assessment consisted of the following three phases:

1. A desk review of the new methodology.
2. Follow-up interviews.
3. Resolution of outstanding issues and the issuance of the final assessment report and opinion.

The following sections outline each step in more detail.

3.1 Desk Review of the New Methodology

The documentation that was reviewed during the assessment is shown below:

/1/	Michigan State University, Methodology element documentation "Quantifying N_2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction", version 1.4.6, dated 25 January, 2012 (and previous versions)
/2/	VCSA, *VCS Requirements Document: VCS Standard - VCS Version 3*, 15 July 2011, v3.
/3/	VCSA, *VCS Procedural Document: Methodology Approval Process*, 15 July 2011, v3.1.
/4/	VCSA, *Agriculture, Forestry and Other Land Use Projects (AFOLU) Requirement*, 8 March, 2011, v3.0.
/5/	VCSA, *AFOLU Non-Permanence Risk Tool*, 8 March 2011, v3.0.
/6/	VCSA, *VCS Requirements Document: VCS Program Guide- VCS Version 3*, 8 March 2011, v3.0.
/7/	Akiyama, H., X. Yan, K. Yagi. 2010. Evaluation of effectiveness of enhanced-efficiency fertilizers as mitigation options for N_2O and NO emissions from agricultural soils: meta-analysis. Global Change Biol. 16:1837-1846.
/8/	Hoben, J.P., R.J. Gehl, N. Millar, P.R. Grace, G.P. Robertson. 2011. Non-linear nitrous oxide (N_2O) response to nitrogen fertilizer in on-farm corn crops of the US Midwest. Global Change Biol. 17:1140-1152.

/9/	IPCC (Intergovernmental Panel on Climate Change). 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme. IGES, Japan.
/10/	IPCC (Intergovernmental Panel on Climate Change). 2003. Good Practice Guidance for Land use, Land-use Change and Forestry. Prepared by the National Greenhouse Gas Inventories Programme. IGES, Japan.
/11/	ISU (Iowa State University Agronomy Extension). 2004. Corn nitrogen rate calculator: a regional (Corn Belt) Approach to nitrogen rate guidelines. http://extension.agron.iastate.edu/soilfertility/nrate.aspx
/12/	Sawyer J.E, E.D. Nafziger, G.W. Randall, L.G. Bundy, G.W. Rehm, B.C. Joern. 2006. Concepts and Rationale for Regional Nitrogen Rate Guidelines for Corn. Iowa State University Extension, Ames, IA.
/13/	T-AGG (Technical Working Group on Agricultural Greenhouse Gases). 2011. Using Biogeochemical Process Models to Quantify Greenhouse Gas Mitigation from Agricultural Management Projects. Report NI R 11-03 March 2011. Nicholas Institute for Environmental Policy Solutions, Duke University, Durham, NC.

3.2 *Follow-up Interviews*

	Date	Name	Organization	Topic
/14/	May - October 2011	Neville Millar	W.K. Kellogg Biological Station, Michigan State University	1. Methodology element's eligibility criteria. 2. Baseline approach and additionality. 3. Project boundary. 4. Emissions, including leakage. 5. Monitoring, data and parameters.
/15/	May - October 2011	G. Philip Robertson	W.K. Kellogg Biological Station and Dept. of Crop & Soil Sciences, Michigan State University	
/16/	May - October 2011	Adam Diamant	Electric Power Research Institute	

3.3 *Resolution of Outstanding Issues*

The objective of this phase of the assessment was to resolve any outstanding issues that needed to be clarified prior to DNV's positive conclusion on the methodology. The assessment findings relate to the methodology as documented and described in the initial MED /1/.

In order to ensure transparency, the issues raised and the ME developer's response are documented in Appendix A.

Findings established during the assessment can either be seen as a non-fulfillment of VCS criteria or where a risk to the fulfillment of ME objectives has been identified. Corrective Action Requests (CARs) are issued where:

- Mistakes have been made that have a direct influence on the methodology application.
- VCS-specific requirements have not been met.

A Clarification Request (CL) may be used where additional information is needed to fully clarify an issue.

3.4 Internal Quality Control

The assessment report underwent a technical review before DNV approved the methodology. The technical review was performed by a qualified technical reviewer in accordance with DNV's qualification scheme.

3.5 Assessment Team

Listed below are the members of the assessment team, their roles, and the nature of their involvement.

Role/Qualification	***Last Name***	***First Name***	***Type of involvement***					
			Desk review	Interviews	Reporting	Supervision of work	Technical review	Expert input
Project Manager	Silon	Kyle		√		√		
VCS Validator	Yang	Weidong	√	√	√			
Sector Expert	Green	Carly	√	√	√			√
Technical Reviewer	Aalders	Edwin					√	

4 ASSESSMENT FINDINGS

The findings of the assessment are stated in the following sections. The final assessment findings relate to the methodology as documented and described in the revised MED.

4.1 Applicability Conditions

The eligibility criteria for the methodology element are clearly defined in the MED. The eligibility criteria are defined as shown below /1/:

- Projects will be located on sites that have not been cleared of native ecosystems, and where eligible cropping systems must have been in place for at least 10 years prior to project implementation.
- Eligible cropping systems are those that:
  a. Are located in the United States of America, and
  b. Define and justify ex-ante how direct N_2O emissions will be calculated. The MED provides 2 calculation methodologies for direct N_2O emissions depending on the cropping system in place.
- The project proponent must demonstrate that the expected annual yield under the project scenario is similar to the baseline.
- The baseline crop area must encompass the project crop area.
- The methodology provides two methods for quantification of direct and indirect N_2O emissions, as well as for the assessment of additionality. The project must justify in the Project Document which method will be used, and the same method must be used for quantification and additionality.
- The project site must not be located on a site with organic soils.
- The cropping site must use synthetic or organic N fertilizers. All other N input sources are not quantified.
- The application of synthetic and organic N fertilizer at cropping site must follow Best Management Practices available for each US state via state departments of agriculture and from federal agencies such as the Natural Resources Conservation Service (NRCS) and the USDA Farm Service Agency.

4.2 Project Boundary

The spatial boundary of the project includes land area where fertilizer N is directly applied by the project proponent (i.e., the cropping area), as well as any additional soils and waters where byproducts of the fertilizer N input (such as the gases NH_3 and NO_x, and their products NH4+ and NO3-) are re-deposited. The project proponent is required to define the land area where fertilizer N is directly applied in the Project Document, but is not be required to define the specific areas where byproducts may be re-deposited. As the emissions associated the re-deposition of fertilizer N byproducts do not require knowledge of the specific area of re-deposition (these emissions are calculated using the mass of fertilizer applied to the cropping area in combination with default values from credible sources), DNV can confirm that the definition of the project boundary is adequate.

The sources and types of gases included are also clearly and properly defined in the MED /1/; the justification to include or exclude certain types of gases from different sources is reasonable.

4.3 Procedure for Determining the Baseline Scenario

The baseline scenario is defined by the N rate practice in use prior to project implementation. The MED allows for 2 approaches to determination of the N rate practice, both of which use a yield-goal calculation method to generate a baseline fertilizer N application rate, from which emissions of N_2O are calculated. Under approach 1, producer-specific management records for the specific crop are available and can be used to calculate the average N rate for at least the previous six years (five years for monocultures). Approach 1 is in accordance with the VCS Tool for AFOLU Methodological Issues, and is the preferred method. If producer-specific information is not available, Approach 2 determines the baseline N rate from county level data available from the United States Department of Agriculture – National Agricultural Statistics Service (USDA – NASS).

DNV can confirm that either approach to determining the baseline scenario is appropriate and complies with VCS rules and requirements.

4.4 Procedure for Demonstrating Additionality

The methodology applies a performance test approach to the demonstration of additionality. This approach includes a regulatory surplus test that requires that no mandatory statutes exist requiring a reduction fertilizer N input rates below the baseline scenario, and that the project adhere to Best Management Practices with regard to the application of synthetic and organic N fertilizers. The performance standard is defined by the fertilizer N rate applicable to the county in which the project site is located, which is calculated using data on crop yields at the county level for years in which the crop has been harvested in the project field and any nitrogen credit from previous soybean crops.

DNV can confirm that the procedure for demonstrating additionality is appropriate and corresponds to the requirements of VCS Version 3. It should be noted that DNV did not assess the methodology against the Standardized Methods for Baselines and Additionality, as these have not been formally adopted by the VCS.

4.5 Baseline Emissions

The baseline emissions consist of direct and indirect N_2O emissions associated with application of fertilizer N at the crop site, calculated in mega grams of carbon dioxide equivalents per hectare. Direct emissions are calculated using the mass of the nitrogen content of synthetic and organic fertilizer applied and the emission factor for baseline emissions from N inputs. The methodology allows for two methods to determine the emission factor. Under Method 1, the IPCC Tier 1 default is used. Under Method 2, the emission factor is calculated using a NCR derived (IPCC Tier 2) equation for baseline and project emissions. Indirect emissions encompass N_2O emissions produced from atmospheric deposition of N volatized as a result of fertilizer N application ($N_2O_{B\ volat,\ t}$), and N_2O emissions from leaching and runoff of fertilizer N ($N_2O_{B\ leach,\ t}$). The fraction of fertilizer N that volatizes as NH_3 and NO_x (for synthetic and organic fertilizers), and the fraction of N added to soils that is lost through leaching and runoff are determined from IPCC Tier 1 default values. Similarly the emission factor associated with each indirect emissions source is determined by IPCC Tier 1 default value.

DNV can confirm that all equations and parameters for calculating baseline emissions are appropriate and in compliance with VCS rules and requirements.

4.6 Project Emissions

Project emissions consist of direct and indirect N_2O emissions associated with the crop site, calculated in mega grams of carbon dioxide equivalents per hectare. The calculation of direct and indirect emissions are identical to the calculations of baseline emissions discussed above.

DNV can confirm that all equations and parameters for calculating project emissions are appropriate and in compliance with VCS rules and requirements.

4.7 Leakage

The methodology states that leakage is not relevant for this project type, citing two reasons for this conclusion. First, the project lands are required to be maintained for commodity production so no production activities outside the project boundary are required to compensate for a productivity decline. As the applicability criteria require that the project maintain similar expectations of yield as in the baseline, productivity shifts are not expected. Furthermore, the MED cites credible research demonstrating that lowering N rates will not significantly change crop yields. If crop yields do not change, there is no reason to shift activity outside of the project area which could cause an increase in N fertilizer use and N_2O emissions.

DNV can confirm that this justification is acceptable, and that leakage is not a concern for this project type.

4.8 Quantification of Net Greenhouse Gas Emission Reductions

The net greenhouse gas (GHG) emission reductions are calculated by subtracting the project emissions per hectare from the baseline emissions per hectare, and multiplying the result by an uncertainty deduction and the leakage deduction (as described in Section 4.7, leakage is 0, so the leakage deduction does not affect NERs).

As mentioned, a confidence deduction is applied to the net emission reductions to account for associated uncertainty. The uncertainty is calculated as follows:

$$N2O\ Emissions(RED\ UNC) = [1\{0.63 * \exp(-40 * [NProj]^2)\}] * 100$$

Where

N_2O Emissions (RED UNC)	=	Uncertainty in N_2O emissions reductions associated with a reduction in N rate, %;
NProj	=	$F_{P\ SN,\ t} + F_{P\ ON,\ t}$ project N input, Mg N ha^{-1} yr^{-1}.

Based on the uncertainty percentage calculated above, the confidence deduction applied to the emission reductions is the conservativeness factor specified in the CDM Meth panel guidance on addressing uncertainty in its Thirty Second Meeting Report, Annex 14.

DNV can confirm that this approach is acceptable and that the approach has been clearly described.

4.9 Monitoring

The parameters to be monitored and the data/parameters available at validation are defined appropriately and clearly listed in the MED, which will ensure that the emission reductions from the project activity are estimated properly. The parameters to be monitored and the corresponding monitoring methods are outlined in Section 4.10 below.

Quality assurance measures have also been properly prescribed for all major monitoring activities to further ensure the accuracy and reliability of the emission reduction estimates.

4.10 Data and Parameters

Both monitored and unmonitored data and parameters used in the emissions calculations are clearly and appropriately defined in the MED, making it possible for the emission reductions to be estimated and verified.

The data unit, description, and sources of data for each parameter are described clearly. Baseline and project parameters that must be collected and archived are listed below:

Baseline Parameters	Description	Monitoring Frequency	Source
$M_{B\ SF}$, t	Mass of baseline synthetic N containing fertilizer applied	Project start	Project proponent records (Approach 1); Calculation (Approach 2)
$M_{B\ OF}$, t	Mass of baseline organic N containing fertilizer applied	Project start	Project proponent records (Approach 1)
$N_{CB\ SF}$	Nitrogen content of baseline synthetic fertilizer applied	Project start	Project proponent records (Approach 1); Calculation (Approach 2)
$N_{CB\ OF}$	Nitrogen content of baseline organic fertilizer applied	Project start	Project proponent records (Approach 1)
Baseline Crop yield	Crop yield (standard reporting method for particular crop, e.g., dry grain yield)	Project start	Project proponent records (Approach 1) or county level data (Approach 2)
Baseline Crop area	Area of crop(s) planted, from which baseline fertilizer N rate determined	Project start	Project proponent records (Approach 1 and 2)
$Frac_{GASF}$	Fraction of all synthetic N added to project soils	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier

	that volatilizes as NH_3 and NO_x		1 = 0.10)
$Frac_{GASM}$	Fraction of all organic N added to project soils that volatilizes as NH_3 and NO_x,	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier 1 = 0.20)
$Frac_{LEACH}$	Fraction of N added (synthetic or organic) to project soils that is lost through leaching and runoff, in regions where leaching and runoff occurs	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier 1 = 0.30)
EF_{BDM1}	Emission factor for baseline direct N_2O emissions from N inputs (Method 1)	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier 1 = 0.01)
EF_{BDM2}	Emission factor for baseline direct N_2O emissions from N inputs (Method 2)	Project start	Empirical research on producer fields throughout Michigan
EF_{BIV}	Emission factor for baseline N_2O emissions from atmospheric deposition of N on soils and water surfaces	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier 1 = 0.01)
EF_{BIL}	Emission factor for baseline N_2O emissions from N leaching and runoff,	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier 1 = 0.0075)
EF_{PDM1}	Emission factor for project direct N_2O emissions from N inputs (Method 1)	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier 1 = 0.01)
EF_{PDM2}	Emission factor for project direct N_2O emissions from N inputs (Method 2)	Project start	Empirical research on producer fields throughout Michigan
EF_{PIV}	Emission factor for project N_2O emissions from atmospheric deposition of N on soils and water surfaces	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier 1 = 0.01)
EF_{PIL}	Emission factor for project N_2O emissions from N leaching and runoff,	Project start	2006 IPCC Guidelines for National Greenhouse Gas Inventories (default Tier 1 = 0.0075)

Additional project parameters that must be monitored on an ongoing basis are listed below:

Project Parameter	Description	Monitoring Frequency	Source
$M_{P\ SF,\ t}$	Mass of project synthetic N containing fertilizer applied	Annually	Project proponent records
$M_{P\ OF,\ t}$	Mass of project organic N containing fertilizer applied	Annually	Project proponent records
$NC_{P\ SF}$	Nitrogen content of project synthetic fertilizer applied	Annually	Project proponent records
$NC_{P\ OF}$	Nitrogen content of project organic fertilizer applied	Annually	Project proponent records
Project Crop	Area of crop(s) planted, from which project fertilizer N	Start of each crediting	Project proponent

area	rate determined	period	records

Requirements for data and calculation reviews are clearly defined in the MED; these requirements are deemed proper by DNV to allow for uncertainties related to the emission reductions to be reduced in a reasonable manner.

4.11 Adherence to the Project-level Principles of the VCS Program

The MED was developed in line with the project-level principles of VCS Version 3, as elaborated above. It is also deemed by DNV that the principles of relevance, completeness, consistency, accuracy, transparency, and conservativeness are properly addressed in the MED.

4.12 Relationship to Approved or Pending Methodologies

DNV has reviewed existing methodologies and can confirm that none could be reasonably revised to serve the same purpose as the proposed methodology.

4.13 Comments by Stakeholders

DNV reviewed the comments and responses, and is of the opinion that the methodology developer has taken due account of all comments submitted and that all of the responses from the project developer are adequate.

4.14 Comments by First Validator

ESI completed the first assessment of the proposed methodology on 4 February, 2011. ESI requested new information and identified opportunities for improvement and non-conformance during the validation of the methodology element. MSU has submitted all new information that was requested, and all CARs/CLs raised during the course of the first validation were closed prior to the second validation. DNV concurs with all comments and consequent revisions by the methodology developer. The first assessment by ESI concluded that the proposed VCS methodology element "Quantifying N_2O Emissions Reductions in US Agricultural Crops through N Fertilizer Rate Reduction" meets all relevant requirements of the VCS. It should be noted that the first assessment was conducted relative to the rules and requirements of VCS 2007.1, and will need to be updated prior to approval by the VCS. It is DNV's opinion that the methodological changes made during the course of the first assessment will not conflict with the rules and requirements of VCS Version 3.

4.15 Evidence for DNV's Fulfillment of Eligibility Requirements

Det Norske Veritas (U.S.A.), Inc holds accreditation to perform validation for projects under sectoral scopes 3 (agriculture, forestry, other land use) under the American

National Standards Institute (ANSI). DNV, therefore, is eligible under the VCS Program to perform assessments for the MED, which falls under the sectoral scope 3.

Furthermore, Dr Carly Green, the sector expert on DNV's project team, is a VCSA-approved AFOLU expert in the araea of ALM.

4.16 Signature

Signed for and on behalf of:

Name of entity: Det Norske Veritas (U.S.A.) Inc.

Signature:

Name of signatory: Miguel Rescalvo

Date: *25 January 2012*

APPENDIX A

RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS

CAR 1 –

1.1 Clarifications and corrective action requests by assessment team

Monitoring

The proposed methodology (PM) states (page 3 and page 16) that "During the project crediting period, adherence to Best Management Practices (BMPs) for the management of synthetic and organic N fertilizer at the project site is required." And that "Uncertainty in on–farm practices relating to fertilizer N management will be low, as project proponents will be required to adhere to Best Management Practices (BMP). These practices will be monitored during project activity." The PM needs to define what monitoring/measurement need to be in place to ensure the above requirement is met and is verifiable.

1.2 Summary of methodology developer response

As specified in the PM, BMPs are defined by applicable state and federal programs and enforced by those entities. The PM requires that farmers keep records of agronomic practices relevant to BMPs. Project verifiers are expected to review these records in light of relevant state and federal programs based on the PM.

For example, Michigan agricultural producers are provided protection from nuisance litigation only if they adhere to Generally Accepted Agricultural and Management Practices (GAAMPs) for N fertilizer application as published by the Michigan Commission of Agriculture and Rural Development. The GAAMPS require for corn: 1) spring [not fall] N application; 2) N in ammonium [not nitrate] form be used under conditions of high leaching potential; and 3) split N applications, except on fine soils where it is optional. Farmer records of these practices, consistent with project documents such as custom application contracts or fertilizer sales records are sufficient to demonstrate protocol compliance.

In response to the concerns raised here, we propose to refine protocol language on page 3 (Fertilizer Nitrogen Management, 2nd paragraph) as follows: "During the project crediting period, adherence to Best Management Practices (BMPs) as they relate to the application of synthetic and organic N fertilizer at the cropping site are required. These BMPs are related to N fertilizer formulation (or N content of organic additions) and dates and methods of application."

1.3 Assessment Team Conclusion

The monitoring of the "adherence to BMPS" needs to be put in the tables under Section "Data and parameters monitored". Weidong Yang

1.4 Second Round - Summary of methodology developer response

The actions required for monitoring of the adherence to BMPs have been placed in the relevant tables, in "QA/QC procedures to be applied" in Section 9.2 (Data and parameters monitored). The text below has also been added.

"The formulation of the synthetic N containing fertilizer shall also be verified. From this the N content (% of mass) can be determined. Farmers' records shall be cross-checked with records from synthetic and organic N fertilizer suppliers. In case of discrepancies between the records of the farmers and those from suppliers of synthetic and organic N containing fertilizers, the most conservative value(s) shall be taken."

1.5 Second Round - Assessment Team Conclusion

This has been completed adequately and subsequently the outstanding CAR closed.

CAR 2 –

2.1 Clarifications and corrective action requests by assessment team

Emissions

The section titles of "Baseline Emissions" and "Project Activity Emissions" on page 9 and 12 of the PM are not accurate, as it is the baseline emissions and project activity emissions per ha that have been described in the two sections.

2.2 Summary of methodology developer response

We agree that further clarity is required. We propose to add a sentence in the Emissions Measurements section below the first paragraph as follows:

"Emissions for baseline and project period are calculated on a per hectare (ha) of land basis."

2.3 Assessment Team Conclusion

Accepted as the added sentence clarifies that the baseline/project emissions are in unitary expression and can avoid possible confusion.

CAR 3 –

3.1 Clarifications and corrective action requests by assessment team

Leakage

The PM states (page 15) that “Reduced N rates and the adoption of N rates based on economic optimization will not result in average, crop yield reductions. Therefore, with no reduction in productivity within the project boundary, there will be no associated requirement for increased production outside of the project boundary, which might then result in increased N fertilizer use and N_2O emissions.”

Given that the crop yield is one of the required monitoring parameters for the PM, the PM needs to consider including the following requirements:

1) Compare the project crop yield and the baseline crop yield.

2) Define criteria on how to calculate emission reductions when the project crop yield is lower than the baseline crop yield.

3.2 Summary of methodology developer response

Because project sites will be actively maintained for commodity production during the project crediting period, leakage risks are negligible for ALM projects involving cropland management activities. Crop producers are highly risk averse and so will not intentionally suffer reduced crop yields in exchange for marginally increased revenue associated with verified carbon units (VCUs) from reducing N fertilization rates. In short, the value of foregone bushels of corn and other crops are worth significantly more than expected revenue per hectare to be derived from a marginal increase in VCU credits.

Additionally, reducing N rates by adopting N rates based on economic optimization will not result in a reduction in crop yield. Extensive historical and current data from seven Midwestern states at typical crop-to-fertilizer price ratios suggest that there will be no significant change in crop yield as a result of lowering N fertilizer rate from current rates to the economic optimum (ISU 2004, Sawyer et al. 2006, Hoben et al. 2011). Consequently, with no reduction in productivity at the project site (and an increased profit margin), there will be no associated incentive for a shift of activity or increased production outside of the project site, which might in turn result in increased N fertilizer use and N_2O emissions. The leakage potential is therefore negligible.

To avoid unnecessary confusion, we propose to remove crop yield as a monitored parameter in the PM. Its presence in the current version of the PM is an artifact of an earlier version of the PM that would have permitted farmers, in the absence of fertilizer records, to back-calculate fertilizer use on a field-by-field basis. In a later revision we dropped this procedure in favor of using county-level yields to back-calculate fertilizer rates.

Changes in crop yield do not affect the N_2O emissions reduction calculation, which is based upon determination of baseline and project N fertilizer rate. There is therefore no need to compare baseline and project crop yields, which would be difficult to interpret in any case because of year to year variability due to weather and other factors not related to fertilizer use.

3.3 Assessment Team Conclusion

The following VCS requirements are relevant for the documentation of criteria and procedures for calculating leakage in methodologies.

VCS 2011 Section 4.4 Project Boundary
In identifying GHG sources, sinks and reservoirs relevant to the project, the methodology shall set out criteria and procedures for identifying and assessing GHG sources, sinks and reservoirs that are controlled by the project proponent, related to the project or affected by the project (i.e., leakage).

Therefore the methodology is required to set out criteria and procedures for identifying and assessing GHG sources, sinks and reservoirs that are affected by the project (i.e. leakage). It is not acceptable to assume that every project case will have zero leakage.

3.4 Second Round - Summary of methodology developer response

As we originally understood, CAR 3 was related to N rate reductions, potential crop yield reductions and leakage. Our response reflected this interpretation, and duly considered the two requirements put forward. We argued through the use of peer review literature that yields will not be decreased as a result of reducing N rate using economic optimization, and as such no yield (and therefore increased N rate) compensation will be required or take place outside the project boundary. From this we proposed that there will be no leakage associated with projects that use our methodology.

The revised requirements of CAR 3 now address broader issues of potential leakage within the PM, i.e., criteria and procedures for identifying and assessing all GHG SSRs within the Project Boundary. Below we address these concerns.

Please note that we make no assumption that every project case will have zero leakage, and propose to further clarify in our PM that justification for exclusion of SSRs is based upon de minimis principles and is supported by peer reviewed literature – an accepted mechanism for exclusion of these pools as presented in VCS v3.0 AFOLU requirements (section 4.3.3).

We have amended Table 1 to reflect our de minimis exclusion of CH_4 and CO_2 from the calculations.

In our PM, Table 1 provides a summary of the relevant GHGs and their sources within the project boundary during the baseline and project periods, and explanations regarding inclusion or exclusion of their quantification. These SSRs are identical during the baseline and project period. There is no evidence in the scientific literature that changes in fertilizer use in fertilized corn systems affects CH_4 fluxes. We therefore exclude consideration of CH_4 fluxes on this basis. Likewise, there is no evidence that reduced fertilizer use in these systems will stimulate CO_2 production (in fact there is some evidence that fertilizer reductions may reduce CO_2 production, but we do not make this claim). We thus omit CH_4 and CO_2 changes from our accounting.

Regarding the soil C pool:

We have amended section 5 (Project Boundary) of the PM to clarify that Annex B applies to all potential projects using this PM as a criterion to exclude the soil C pool.

Annex B contains references to peer reviewed literature that are used as justification for the exclusion. The use of peer reviewed literature is supported by VCS v3.0 as a mechanism for exclusion of this pool (section 4.3.3 of AFOLU requirements).

We have amended section 5 (Project Boundary) and Annex B to clarify that we do not include the soil C pool in our calculations as changes to the C pool will either be nil or positive – technically, de minimis (i.e., less than 5% of the total GHG benefit from N rate reduction).

We understand that the terms “de minimis” (section 4.3.3) and “conservative estimate” (section 4.3.4) are not synonymous as mechanisms for exclusion of the soil C pool.

The “Carbon pools” section now reads:

“Table 2 summarizes the carbon pools included in projects using this methodology

Soil carbon is the primary pool of concern for ALM methodologies. In accordance with VCS AFOLU requirements v3.0, methodologies targeting N_2O emission reductions need to account for any significant reductions in soil C stocks.

In this methodology reductions in N fertilizer rate resulting from project implementation will not result in decreases in soil C stock. Evidence presented in

Annex B in the form of peer reviewed literature details this rationale. Annex B can be used for projects using this methodology as a criterion to exclude the soil C pool."

We have also added a table (Table 2, below) in the PM to identify C pools and reasons for their inclusion/exclusion.

Carbon Pool	Included?	Justification/Explanation
Above ground woody biomass	No	Not relevant or subject to significant change – de minimis
Above ground non woody biomass	No	Not relevant or subject to significant change – de minimis
Below ground biomass	No	Not relevant or subject to significant change – de minimis
Litter	No	Not relevant or subject to significant change – de minimis
Dead wood	No	Not relevant or subject to significant change – de minimis
Soil	Yes	Change is nil or positive or (reduction is de minimis)
Wood products	No	Not relevant or subject to significant change – de minimis

VCS 2011 AFOLU Requirements Section 4.3 Project Boundary
4.3.3 Specific carbon pools and GHG sources, including carbon pools and GHG sources that cause project and leakage emissions, may be deemed de minimis and do not have to be accounted for if together the omitted decrease in carbon stocks (in carbon pools) or increase in GHG emissions (from GHG sources) amounts to less than five percent of the total GHG benefit generated by the project. The methodology shall establish the criteria and procedures by which a pool or GHG source may be determined to be de minimis. For example, peer reviewed literature or the CDM A/R methodological tool entitled "Tool for testing significance of GHG emissions in A/R CDM project activities" may be used to determine whether decreases in carbon pools and increases in GHG emissions are de minimis.

A procedure for determining that pools are de minimus is required to be included in the methodology.

Please also see our response to CAR 3 above.

We have amended section 5 (Project Boundary, see above) and Annex B to explicitly state that our PM uses peer reviewed literature (as presented in Annex B) as a criterion by which soil C can be considered de minimis for all projects that use our PM.

As we understand from the VCS AFOLU requirements v3.0 (section 4.6.2, below) this stipulation (and the relevance and integrity of the peer reviewed literature contained therein) will enable our PM to exclude leakage from all relevant GHG SSRs.

"Leakage that is determined, in accordance with Section 4.3.3, to be below de minimis (i.e., insignificant) does not need to be included in the GHG emissions accounting."

VCS 2011 AFOLU Requirements Section 4.6 Baseline Scenario
4.6.1 Methodologies shall establish procedures to quantify all significant sources of leakage. Leakage is defined as any increase in GHG emissions that occurs outside the project boundary (but within the same country), and is measurable and attributable to the project activities.

Market leakage is relevant to this project.

1) Market leakage occurs when projects significantly reduce the production of a commodity causing a change in the supply and market demand equilibrium that results in a shift of production elsewhere to make up for the lost supply.

Please see our previous response to CAR 3 (section 3.2).

Also, as detailed above, we apply item 4.6.2 to exclude leakage in accordance with item 4.3.3 (de minimis) using evidence from the peer reviewed literature. As noted below if item 4.6.2 is applied then the statement in item 4.6.11 holds, i.e., market leakage does not need to be included as it has been determined to be below de minimis in accordance with 4.3.3.

4.6.2 Leakage that is determined, in accordance with Section 4.3.3, to be below de minimis (i.e., insignificant) does not need to be included in the GHG emissions accounting. The significance of leakage may also be determined using the CDM A/R methodological tool entitled "Tool for testing significance of GHG Emissions in A/R CDM Project Activities."

This requirement needs to be included in the methodology to provide a procedure for demonstrating that leakage is *de minimus* on a project by project basis.

As discussed above, we have amended the PM to explicitly state that leakage is determined in accordance with section 4.3.3, thereby providing the procedure for demonstrating that leakage is de minimis on a project by project basis.

4.6.10 ALM projects setting aside land for conservation shall quantify activity shifting leakage emissions associated with the displacement of pre-project activities, unless determined to be de minimis in accordance with Section 4.3.3 and 4.3.4. Guidance on accounting for leakage associated with shifting of pre-project activities due to land conversions from agriculture to grassland is functionally similar to conversion of land to forest vegetation under ARR (see Section 4.3.3 and 4.3.4).

Not applicable for this project

We agree.

4.6.11 Market leakage in ALM projects involving cropland or grassland management activities is likely to be negligible because the land in the project scenario remains maintained for commodity production, and therefore does not need to be included in the GHG emissions accounting, unless determined to be above de minimis in accordance with Section 4.3.3.

If item 4.6.2 is applied then this statement holds.

As discussed above we have applied item 4.6.2 to exclude leakage in accordance with item 4.3.3 (de minimis) using evidence from the peer reviewed literature. Therefore, statement 4.6.11 holds and market leakage does not need to be included in GHG emissions accounting.

4.6.12 Where livestock are displaced to outside the project area, such activity shifting leakage shall be quantified to capture potential reductions in carbon stocks and potential increases in livestock-derived CH4 and N2O emissions from outside the project area.

Not applicable

We agree.

In summary the criteria and procedures presented for determination of leakage presented in the methodology do not meet the relevant VCS 2011 requirements listed above.

As detailed above, we believe that our proposed amendments and clarifications enable our PM to meet the relevant VCS v3.0 requirements.

3.5 Second Round – Assessment Team Conclusion

There is continued reference to Annex B when justifying that leakage is zero. I agree that referencing per reviewed literature is allowed by the VCS to demonstrate pools and leakage are di minimus. However the peer reviewed literature discussed in Annex B is presented in the context of soil C not leakage. Additionally this material is relevant for a project to present rather than a methodology.

CAR 4 –

4.1 Clarifications and corrective action requests by assessment team

Monitoring

In the table of "Data and parameters monitored" (page 17 of the PM), measurement procedures need to be defined under cell "Measurement procedures (if any)", and quality assurance to ensure the accuracy of the measurements need to defined as well under the "Any comment" cell in the table.

4.2 Summary of methodology developer response

Agreed. We propose to add details of the appropriate measurement procedures to the relevant tables as follows, with the exclusion of project crop yield as detailed in CAR 3:

Mass of project synthetic N containing fertilizer applied

Generally accepted field application methods using calibrated applicators of known capacity for fertilizer mass or volume determination.

Mass of project organic N containing fertilizer applied

Generally accepted methods using calibrated applicators of known weight/volume for liquid and solid organic material application.

Nitrogen content of project synthetic fertilizer applied

Generally accepted procedures for sampling, handling and analysis of bulk fertilizer.

Nitrogen content of project organic fertilizer applied

Generally accepted sampling and handling procedures for organic materials. Laboratory analysis for total N using total Kjeldahl Nitrogen [TKN] or total N by combustion).

Area of crop(s) planted, from which project fertilizer N rate determined

As per requirements of VCS version 3 "Project location for AFOLU projects shall be specified using geodetic polygons to delineate the geographic area of each AFOLU project activity and provided in a KML file."

Information on accepted methods for sampling and handling, and measuring mass and N content of fertilizer can be found in state university agricultural extension documents.

Regarding quality assurance, data for monitored parameters are derived from farmer records that are used for compliance with a myriad of farm-related programs, including state and federal BMPs. These farmer records also are consistent with project documents required for verification during the project period. See CAR 1 for further discussion. To falsify or inaccurately present these data would constitute fraud, and likely would be punishable under existing local, state and federal laws. As required by the PM, we expect third-party project verifiers to determine if a project conforms to the PM.

4.3 Assessment Team Conclusion

This additional text is acceptable.

CAR 5 –

5.1 Clarifications and corrective action requests by assessment team

Eligibility Requirements

It is not clear what the eligible cropping systems are (page 2). Are there crops that are not eligible? Please list the eligible crops.

5.2 Summary of methodology developer response

As noted in the Cropping System section (page 4), there are no N-fertilized crops that are ineligible. We believe listing all eligible crops would be unwieldy and suggest that this in unnecessary in light of a revised eligibility statement (see CAR 6 response):

"Method 1 is applicable with all agricultural crops in the US where the product is harvested for food, livestock fodder, or for another economic purpose."

"Method 2 is eligible in the NCR of the US with corn row–crop systems including continuous corn and rotations that include a corn component such as corn–soybean or corn-soybean-wheat."

To clarify this earlier in the document (as suggested), we propose to insert on page 2 (Requirements for Eligibility) the statement "Eligible cropping systems are defined in the section Geographic Location and Cropping System"

5.3 Assessment Team Conclusion

This clarification is acceptable.

CAR 6 –

6.1 Clarifications and corrective action requests by assessment team

Geographic Location

It is not clear how the geographic location (page 3) and the cropping system (page 4) 'Methods' relate (if at all). The various combinations should be clearly described.

6.2 Summary of methodology developer response

We agree that more clarity is warranted. We propose to combine the sections on Geographic Location and Cropping System into one section entitled "Geographic Location and Cropping System" to read:

"Method 1 is applicable with all agricultural crops in the US where the product is harvested for food, livestock fodder, or for another economic purpose."

"Method 2 is eligible in the NCR of the US with corn row–crop systems including continuous corn and rotations that include a corn component such as corn–soybean or corn-soybean-wheat."

6.3 Assessment Team Conclusion

This clarification is acceptable.

CAR 7 –

7.1 Clarifications and corrective action requests by assessment team

Project Area

The use of the terms crop area, project area and project boundary are confusing. It appears in the Project Boundary section of the methodology that the definition of project boundary is different for direct and indirect emissions. It is good practice to consistently define the project boundary. What is the basis for selecting the project area? Please explain if it is actually on a crop by crop basis as the diagram on page 4 suggests

7.2 Summary of methodology developer response

Agreed. A project boundary is not just a physical boundary, but also encompasses a temporal boundary and a greenhouse gas (GHG) and carbon (C) pool assessment boundary.

Based on this, we propose to remove the text related to *Direct emissions* and *Indirect emissions* in the Spatial boundary section. We believe Figure 1 in conjunction with its description is sufficient to clarify the spatial boundary, along with the previous definitions of *Direct N_2O emissions* and *Indirect N_2O emissions* provided in the Definitions section.

Both direct and indirect N_2O emissions are included within the spatial boundary of the project. Direct N_2O emissions are emitted directly from the site to which N fertilizer has been added (e.g., a producers crop field), and indirect N_2O emissions are produced beyond the site to which fertilizer N has been applied, but as a result of the application of N fertilizer at the crop site.

7.3 Assessment Team Conclusion

Can a landowner include one crop only or is all his land included? The selection of the project boundary is linked to leakage and management approaches. If a landowner can select individual crops and exclude other areas, the land owner could increase nitrogen inputs on crops not included to compensate.

7.4 Second Round - Summary of methodology developer response

To clarify, a project proponent can choose to enroll one field containing one crop if the land is otherwise eligible.

As discussed in our previous (section 3.2) and updated (section 3.4) responses to CAR 3, market leakage is negligible and does not need to be included in the GHG emissions accounting for our PM, as we are applying item 4.6.2 to exclude leakage in accordance with item 4.3.3 (de minimis).

We understand that market leakage would encompass all crops owned or rented by a project proponent, including the scenario above.

A producer will already be fertilizing the non-project crop at N rates for optimal or maximum yield, and so increases in N rate would not increase these yields, rather they would represent an increased expenditure on fertilizer with no gain.

7.5 Second Round – Assessment Team Conclusion

The methodology proponent has provided enough evidence to support their statement that the producer will be already applying N rates to optimize yield and the cost of fertilizer will limit this occurring. This response is adequate to close this concern.

CAR 8 –

8.1 Clarifications and corrective action requests by assessment team

Uncertainty General

There is no approach presented to calculate uncertainty, nor is there a concise list of the parameters to which uncertainty applies. These items should be included.

8.2 Summary of methodology developer response

For the approach used to calculate uncertainty, please see the response to CAR 12.

As far as we are aware, there is no VCS requirement to include a concise list of the parameters to which uncertainty applies. However, we offer the following observations for further consideration:

- Annex F, Table FI provides information on uncertainty ranges for IPCC Tier 1 emissions factors for direct and indirect N_2O emissions and volatilization factors. Further details on these factors also can be found in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Revision Nov. 2008 - Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application.

- Annex G provides more information on the derivation of the NCR-specific emission factors and a reference to the peer reviewed paper (Hoben et al. 2011) that provides a statistical evaluation of the uncertainty of N_2O emissions and details of the conservative approach for calculating the Tier 2 emission factor.

8.3 Assessment Team Conclusion

According to Section 4.1 of the VCS2011 "Methodology elements shall be guided by the principles set out in Section 2.4. They shall **clearly state the assumptions, parameters and procedures that have significant uncertainty, and describe how such uncertainty shall be addressed.** Where applicable, methodology elements shall provide a means to estimate a 95 percent confidence interval. **Where the width of the confidence interval exceeds 30% of the estimated value, an appropriate confidence deduction shall be applied**. Methods used for estimating uncertainty shall be based on recognized statistical approaches such as those described in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. **Confidence deductions shall be applied using conservative factors** such as those specified in the CDM Meth Panel guidance on addressing uncertainty in its Thirty Second Meeting Report, Annex 14."

Therefore the methodology should **clearly state the assumptions, parameters and procedures that have significant uncertainty, and describe how such uncertainty shall be addressed.**

8.4 Second Round - Summary of methodology developer response

Below we detail how uncertainty is incorporated into our PM. We propose to add new text, including assumptions, criteria and equations to section 8.4 in the PM document. The approach used to analyze the data has been revised from previous to incorporate our new uncertainty analysis, and as such the NCR emission factor (in equations [6] and [15] in sections 8.1 and 8.2, respectively), has been slightly amended.

Please also note that the principle of conservativeness also needs to be taken into account during calculations of uncertainty as detailed in our previous responses. This is recognized by the VCS Standard v3.1 (section 2.4 Principles):

"Note – Accuracy should be pursued as far as possible, but the hypothetical nature of baselines, the high cost of monitoring of some types of GHG emissions and removals, and other limitations make accuracy difficult to attain in many cases. ***In these cases, conservativeness may serve as a moderator to accuracy in order to maintain the credibility of project GHG quantification."***

Our proposed text is as follows:

8.4 Summary of GHG Emission Reduction and/or Removals

Methodologies and procedures adopted to calculate emissions of N_2O have been refined over many years, and are conservative in nature. Here we outline assumptions, parameters and procedures that relate to uncertainty in N_2O emissions in the PM. We focus on the derivation of the regional NCR emissions factor used in equation [6] and [15] in sections 8.1 and 8.2, respectively. More detailed information on field sampling and laboratory analytical techniques is given in Hoben et al. (2011).

Annex F (Table FI) provides information on uncertainty ranges for IPCC Tier 1 emissions factors for direct and indirect N_2O emissions and other factors used in the PM. Use of these IPCC emissions factors is widely accepted as a mechanism for calculating N_2O emissions – they are science driven and used in many currently accepted AFOLU methodologies for calculating N_2O emissions. Further details on these factors, their derivation and their robustness for use in N_2O emissions calculations can also be found in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Revision Nov. 2008 - Chapter 11: N_2O

Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application.

Application of N fertilizer

The PM monitors five parameters during the project period. Four of these relate directly to the calculation of N rate applied at the project site. These are detailed, along with their measurement and QA/QC procedures, in section 9.2 of the PM.

All of these parameters are assumed to have negligible uncertainty, unless otherwise determined by verification.

Derivation of Regional (NCR) Emissions factor

Daily N_2O emissions

Values for daily N_2O emissions have negligible uncertainty; field and laboratory sampling and analytical techniques have been refined over many years to standardize methodologies and minimize analytical uncertainty. We used standard methods to measure daily emissions as described in Hoben et al. (2011).

Annual N_2O emissions

We determined cumulative emissions by interpolating daily emissions between sampling days. This was carried out using linear interpolation – a broadly accepted mechanism in the scientific peer reviewed literature. In brief, the sum of the rate of N_2O emissions on two successive sampling days was divided by two (averaged), and this average rate was multiplied by the period (in days) between the two measurements, then added to the previous cumulative emissions total. This can be represented by

$$C_B = C_A + [(D_A + D_B) / 2] * (B-A) \qquad (19)$$

Where:

C_B	=	Cumulative N_2O emissions as of day B (g N_2O-N ha^{-1});
C_A	=	Cumulative N_2O emissions as of day A (g N_2O-N ha^{-1});
D_A	=	Daily gas flux on day A (g N_2O-N ha^{-1} d^{-1});
D_B	=	Daily gas flux on day B (g N_2O-N ha^{-1} d^{-1});
B	=	Day of latest emissions measurement (day of year);
A	=	Day of previous emissions measurement (day of year).

Cumulative annual emissions (g N_2O-N ha^{-1} yr^{-1}) of N_2O for each field replicate were calculated from daily N_2O emissions (g N_2O-N ha^{-1} d^{-1}) measured in each block (4) at each N rate (6, including zero) at each site during the year for all site years (8), to give a total of 192 cumulative annual N_2O emissions data points (4 * 8 * 6). These individual cumulative annual emissions, calculated directly from daily N_2O emissions with negligible uncertainty, are also assumed to have negligible uncertainty.

The best-fit line that defines the mathematical relationship between N rate (Mg N ha^{-1} yr^{-1}) and N_2O emissions (g N_2O-N ha^{-1} yr^{-1}) for all 192 data points is:

$$N_2O \text{ emissions} = 670 * \exp(6.7 * \text{N rate}) \quad (20)$$

Where, N rate is the equivalent of $F_{B\ SN,\ t} + F_{B\ ON,\ t}$ for baseline N input (equation [2]) and $F_{P\ SN,\ t\ +\ FP\ ON,\ t}$ for project N input (equation [11]).

The standard error (SE) associated with N_2O emissions, is:

$$N_2O \text{ emissions}_{(SE)} = 58 * \exp(10 * \text{N rate}) \quad (21)$$

Figure G1 (Annex G) shows this relationship and associated errors, as calculated using Mathematica (version 8, Wolfram Research Inc., 2011).

N_2O emissions reductions

Raw N_2O emissions reduction values were obtained by subtracting cumulative annual emissions of lower N application rates from cumulative annual emissions of higher N application rates (i.e., 0, 45, 90, 135, 180, and 225 kg N ha^{-1} yr^{-1}) within the same block, site, and year. This emissions difference was then divided by the difference in rate between the N rate pairs. Thus, we obtained 32 values (4 blocks * 8 site years) for the emission reductions for each of the 15 pairs (e.g., 45 → 0, 90→ 0, 90 → 45, etc.).

To best define the interpolation of the empirical data for emissions reductions - N_2O emissions $_{(RED)}$ - many types of function were tested, including linear and exponential functions with various parameter combinations. The function below (Equation [22]) derived from equation [20] above) was also tested.

$$N_2O \text{ emissions}_{(RED)} = 0.67 * \{\exp(6.7 * N_{Base}) - \exp(6.7 * N_{Proj})\} / (N_{Base} - N_{Proj}) \quad (22)$$

Where:

N_2O emissions $_{(RED)}$ = N_2O emissions reductions, g N_2O-N ha^{-1} yr^{-1};

N_{Base} = $F_{B\ SN,\ t}$ + $F_{B\ ON,\ t}$ baseline N input, Mg N ha^{-1} yr^{-1};

N_{Proj} = $F_{P\ SN,\ t}$ + $F_{P\ ON,\ t}$ project N input, Mg N ha^{-1} yr^{-1}.

Equation (22) outperformed all linear functions and works as effectively as more complex exponential functions.

Emissions factors

The emissions factor for N_2O is defined as the fraction of N applied that is released as nitrogen in N_2O (N_2O-N) at a non-zero N rate minus the N_2O-N emitted at zero N rate.

The emissions factors for baseline and project calculations were obtained by dividing the reduction function (equation 22) by 1 * 10^6 (to convert g N_2O-N / Mg N rate to Mg N_2O-N / Mg N rate) and multiplied by 100 (to convert to a percentage). The equation was formatted for the PM to compare baseline and project N rates to zero N rate. Thus, the emissions factors are:

$$EF_{Base} = 0.067 * \exp([6.7 * N_{Base}] - 1) / N_{Base} \quad (23)$$

$$EF_{Proj} = 0.067 * \exp([6.7 * N_{Proj}] - 1) / N_{Proj} \quad (24)$$

Where:

EF_{Base} and EF_{Proj} are equivalent to EF_{BDM1} (from Equation [2]) and EF_{PDM1} (from equation [11]), respectively.

Emissions reduction uncertainty

The standard error equation (21) is useful for describing uncertainty in annual emissions but cannot be used to accurately describe uncertainty for emissions reductions in the range of smaller N rate reductions (10 – 20 kg N ha^{-1} yr^{-1}).

Instead the 32 values (4 blocks * 8 site years) for the emission reductions for each of the 15 pairs (e.g., 45 → 0, 90→ 0, 90 → 45, etc.) were used to obtain variability of the mean using the Bootstrap method (Monte Carlo algorithm with case re-sampling, Mathematica - version 8, Wolfram Research Inc., 2011). For each pair of N fertilizer rate reductions a random sample of 32 'baseline' values was taken and replaced with a random sample of 32 'project' values to compute a mean reduction. This process was repeated 100,000 times and the overall standard error of the means were calculated.

The standard error of the means were then multiplied by 1.645 (critical value of normal one-sided test at 95% confidence) and divided by the average emissions reduction to give the fraction of the average that is within the 95% confidence interval. These values are plotted along with the best-fit function in Annex G (Figure G2):

N_2O Emissions $_{(RED\ UNC)}$ $(1 - \{0.63 * \exp(-40 * [N_{Proj}]^2)\}) * 100$ (25)

Where:

N_2O Emissions $_{(RED\ UNC)}$ Uncertainty in N_2O emissions reductions associated with a reduction in N rate, %;

N_{Proj} = $F_{P\ SN,t} + F_{P\ ON,t}$ project N input, Mg N ha^{-1} yr^{-1}.

Within the empirical N rate data range (0 – 225 kg N ha^{-1} yr^{-1}) the highest uncertainty was ~90%. There is no evidence to suggest that higher N rates would generate uncertainties above 100%, therefore the Gaussian function was used to constrain uncertainty below 100%.

Project proponents will use equation (25) to calculate emissions reductions uncertainties (%) for a project. Confidence deductions as a result of uncertainty will be applied using the conservative factors specified in the CDM Meth Panel guidance on addressing uncertainty in its Thirty Second Meeting Report, Annex 14.

8.5 Second Round - Summary of methodology developer response

The additional material presented does not clarify the uncertainty assessment nor is required in the methodology document itself.

CAR 9 –

9.1 Clarifications and corrective action requests by assessment team

Uncertainty Activity Data

It is not clear how uncertainty relating to Activity Data used in Approach 2 is estimated. The approach to applying uncertainty to the calculations should be described clearly.

9.2 Summary of methodology developer response

First, a clarification here may be necessary. Both Approach 1 and Approach 2 rely on project-level data for determining the baseline N rate. Approach 1 uses field-level management records collected and maintained by the farmer. Approach 2 uses county-level management records that are derived from individual field-level management records. For Approach 2, crop yield data obtained from crop producers in each county of each state are collected and verified by field and office enumerators from each of the state offices of the USDA's National Agricultural Statistics Service (NASS). The techniques used by NASS to collect and verify this information is designed to minimize uncertainty in the reported data. The average yield data for each crop in each county is published annually in state agricultural statistics documents and is available online at http://www.nass.usda.gov.

The average crop yield value at the county level, along with equations for determining N fertilizer rate recommendations based on yield goal estimates for the same crop is used to back-calculate N fertilizer rates for the individual producer without N rate records (see Annex C). Yield-goal based fertilizer recommendations are published by state departments of agriculture and land grant university agriculture departments and are widely available and used throughout the NCR as well as the rest of the U.S.

9.3 Assessment Team Conclusion

Field records for Approach 1 are noted to be more accurate than Approach 2 (see Assessment Team Conclusion to CAR 15). Therefore, the uncertainty needs to be quantified and incorporated into the methodology.

9.4 Second Round - Summary of methodology developer response

We are aware of the language in the VCS v3.0 that stipulates absolute quantification of uncertainty for proposed methodologies. We also strongly believe that the principle of conservativeness must be taken into account when issues of uncertainty in relation to GHG emissions from agriculture are being debated. We understand that the degree to which conservativeness can counter increased uncertainty is somewhat subjective, but we believe that Approach 2 is an illustrative example of where this principle needs strong recognition. Conservativeness as recognized by the VCS is a fundamental principle of the ISO that provides the basis for, and guides the application of, the VCS rules and requirements. Please see CAR 8 (section 8.4): "*conservativeness may serve as a moderator to accuracy in order to maintain the credibility of project GHG quantification.*"

We agree that using Approach 2 (county scale records) is likely to lead to greater uncertainty in calculating the baseline N rate than using Approach 1 (site-specific records). As discussed in section 9.2, county level yield records are collected and analyzed using techniques that minimize data uncertainty. However, although the average county yield data for a particular crop is an accurate reflection of the reported yields, this value can be considered conservative (an underestimate) when compared to the average yields of medium to large-scale commercial farm operations that will constitute the majority of the projects using this methodology. The average county yield includes many small-holder, part-time, and ‘hobby’ farm yields that are significantly lower than those in the medium- to large-scale operations with their greater financial reserves. Since yields reported by this method will be conservative, the average fertilizer-N rates calculated from back calculation will also be conservative.

As previously noted, Approach 2 is also conservative by design and eliminates the potential for over-estimation of N_2O emissions from the baseline period by incorporating N credits from legumes, cover crops, and manures. A lower baseline N rate limits the potential for substantial N rate reductions without a crop productivity decline (a major disincentive for altering N management practice and project adoption).

Therefore, we propose that the conservative nature of Approach 2 fully compensates the uncertainty inherent in the generation of the baseline N rate – therefore no uncertainty reduction should be required for project proponents using Approach 2 to generate baseline N rates and subsequently baseline N_2O emissions.

9.5 Second Round – Assessment Team Conclusion

Further clarification with the methodology proponent lead to increased understanding that the Approach 1 has zero uncertainty as it is based on actual data. Approach 2 is conservative and therefore uncertainty is effectively embedded in this approach. The response and approach is adequate and consistent with eh requirements of the VCS.

CAR 10 –

10.1 Clarifications and corrective action requests by assessment team

Uncertainty Natural Variability

The uncertainty related to NCR direct emissions equation presented in Annex G needs to be reported and incorporated into the methodology.

10.2 Summary of methodology developer response

Please refer to response to CAR 12 below in addition to the information provided below.

Please note that Figure G4 in the PM was redrawn from Figure 6a in Hoben et al. (2011). Figure G4 shows the model curve for the ***average daily flux***, with 95% confidence intervals. Figure 6a shows the model curve for the average daily flux, with 95% confidence intervals, and also the observed "raw averages" for each N rate.

Figure G4 also shows the overall exponential relationship between N rate at our field sites and daily N_2O emissions. The equations used in the PM (6) and (15) (method 2) represent the overall relationship between the ***annual emissions factors*** and N fertilizer rate, derived from the daily N_2O emissions equation presented in Figure G4 and Figure 6a from Hoben et al. (2011).

Equations (6) and (15) used in method 2 replace the IPCC default (Tier 1, Method 1) emission factor of 0.01, and are represented by the terms EF_{BDM2} and EF_{PDM2} for calculating direct emissions of N_2O from baseline and project activities respectively, in the NCR.

To counter the increased and expected inherent heterogeneity (i.e., uncertainty around the mean) of N_2O emissions at higher N rates, the best-fit exponential model response curve used for Method 2 direct N_2O emissions (Annex G [eqn. G3] and Hoben et al. 2011 [Fig. 6a]) from which the emissions factor relationship (eqn. G5) is derived, calculates substantially lower N_2O fluxes compared to the raw average N_2O fluxes at each N rate (diamonds in Fig. 6a).

For example, at the highest N rate investigated (225 kg N ha^{-1} yr^{-1}), the model data used to determine the emissions factor (EF_{BDM2} and EF_{PDM2}) uses an average N_2O flux that is ~30% lower than the calculated raw field data. In the PM, the higher the N rate, the larger this reduction in N_2O emissions calculated using the model when compared to the raw field data. We believe this systematic underestimation using model data constitutes a conservative approach to estimating N_2O fluxes and related emissions reductions, and is fully compensatory emissions reduction mechanism for the increasing variability of N_2O emissions at higher N rates and the decreasing confidence in N_2O emissions at these rates.

Furthermore, the method in the PM for calculating annual N_2O emissions at each N rate from which the emission factor is derived is conservative for the following reasons:

1. The calculation uses the lowest daily N_2O flux measured over all sites and years from the relevant period, as the daily flux from which the cumulative emissions for early spring (March-April) and late fall (October – November) are calculated. The use of this lowest flux to calculate cumulative emissions during these periods underestimates actual emissions over these times; and,

2. The calculation assumes that fluxes of N_2O from frozen soils to the atmosphere are nil, including during soil freeze–thaw cycles during the winter period (December – February). This assumption underestimates the actual fluxes that likely will have occurred during this time, and constitutes a very conservative approach to calculating overall N_2O fluxes. Please see page 11 of Hoben et al. (2011) for further discussion.

We thus believe the PM incorporates a very conservative approach to estimating N_2O fluxes due to the systematic underestimation of daily and annual N_2O fluxes. By extension the emission factors derived in our PM are very conservative and justified with regard to the requirements for new AFOLU methodologies. We believe our approach is a fully compensatory emissions reduction mechanism for the increasing variability of N_2O emissions at higher N rates and the decreasing confidence in N_2O emissions at these rates.

10.3 Assessment Team Conclusion

Whilst the additional information provided is appreciated, the uncertainty either embedded in each parameter/model (making it conservative) or directly applied (see VCS 2011 Section 4.1) should be reported in and the approach to making a confidence deduction (if required) explained.

10.4 Second Round - Summary of methodology developer response

Please see CAR 8 (section 8.4) for revised uncertainty analysis.

10.5 Second Round – Assessment Team Conclusion

Response to CAR8 is also relevant here. CAR 10 is closed

CAR 11 –

11.1 Clarifications and corrective action requests by assessment team

Annex B

According to the Tool for AFOLU Methodological Issues, the carbon pools that shall be included in the monitoring plan for the baseline and project for ALM activities are “Above ground woody (Required) and Soil (required). Annex B has not demonstrated insignificant (>5% of the total CO2e benefits from reduction in

N2O emissions) impact on the soil C pool. Furthermore use of the CDM tool to justify its exclusion should be used, including consideration of the applicability criteria of the tool in accordance with the Tool for AFOLU Methodological Issues.

11.2 Summary of methodology developer response

We break our response here into two parts: 1. Requirement to include above ground woody biomass; and, 2. Use of CDM tools to determine applicability and justify exclusion of soil C.

1. According to the "Voluntary Carbon Standard Guidance for Agriculture, Forestry and Other Land Use Projects (18 November 2008)" – Page 18 (ALM) -- "Soil carbon is the primary pool of concern for ALM, although activities that include a woody biomass component (e.g., agroforestry, silvipasture, orchards) also need to consider aboveground woody biomass C stocks."

Also, we note that in VCS AFOLU requirements version 3.0 (Section 4.3.1, Table 2) above ground non-tree (non-woody) biomass is labeled N for ALM projects, i.e., "Carbon pool does not have to be included, because it is not subject to significant changes or potential changes are transient in nature."

2. We were not aware that VCS requires the use of the CDM tool "Procedure to determine when accounting of the soil organic carbon pool may be conservatively neglected in CDM A/R project activities – EB33 Report, Annex 15 (Version 01)."

Regardless, we believe it is appropriate and conservative to exclude the soil C pool as detailed in section II (Procedure) of the CDM tool. As we understand the CDM tool, we can exclude the soil C pool from the proposed PM because the baseline C stock in projects established on cropland and grassland (as defined in the Good Practice Guidance for Land Use, Land-use Change and Forestry (IPCC, 2003)) where a similar land use has been present for at least 10 years (a requirement for project eligibility) are at a steady-state or quasi-steady-state.

Furthermore, peer-reviewed scientific literature presented in Annex B supports this exclusion. In brief, N fertilizer can increase soil C stocks by increasing crop growth and associated rates of production of crop residues. Because the PM will not result in significant declines in crop growth (i.e., yield) there will not be any associated decline in residue inputs. Consequently, there can be no associated decline in soil C stocks.

In contrast, available evidence suggests that excess N can speed decomposition (Parton et al. 2007) and thereby lower (Khan et al. 2007) or maintain (Russell et al. 2009) C stocks that might otherwise increase. This suggests that projects that use the PM may actually promote increased soil C sequestration. While this may be the case, the PM does not include a way to take credit for such increases in soil C. Given the evidence presented above, the PM does not require soil C pools to be monitored, and their exclusion will lead to a conservative estimate of the number of VCUs to be generated by a project.

Thus we believe it is not necessary to use the Tool for testing significance of GHG emissions in A/R CDM project activities EB31 Report, Annex 16 (Version 01).

11.3 Assessment Team Conclusion

The VCS AFOLU requirements version 3.0 (Section 4.3.1, Table 2) state that Soil carbon pool shall be included in the project boundary.
These requirements (Section 4.3.3) also state that 'Specific carbon pools and GHG sources, including carbon pools and GHG sources that cause project and leakage emissions, may be deemed *de minimis* and do not have to be accounted for if together the omitted decrease in carbon stocks (in carbon pools) or increase in GHG emissions (from GHG sources) amounts to less than five percent of the total GHG benefit generated by the project. **The methodology shall establish the criteria and procedures by which a pool or GHG source may be determined to be *de minimis*.** For example, **peer reviewed literature or the CDM A/R methodological tool *Tool for testing significance of GHG emissions in A/R CDM project activities* may be used** to determine whether decreases in carbon pools and increases in GHG emissions are *de minimis*.'

There is a requirement for the methodology to clearly state the criteria and procedure to demonstrate that a pool is *de minimis*. The methodology provides a possible justification using literature. Does the methodology propose that Annex B applies to all potential projects using this methodology to exclude the soil C pool? Criteria and Procedures need to be presented.

11.4 Second Round - Summary of methodology developer response

Please see our updated response to CAR 3 (section 3.4).

We propose to apply item 4.6.2 to exclude leakage in accordance with item 4.3.3 (de minimis) using evidence from the peer reviewed literature contained in Annex B. If item 4.6.2 is applied to exclude leakage, then the statement in item 4.6.11 holds, i.e., market leakage does not need to be included as it has been determined to be below de minimis in accordance with 4.3.3.

11.5 Second Round – Assessment Team Conclusion

The additional references to the peer reviewed literature presented in the updated version of the methodology are sufficient to close this CAR.

CAR 12 –

12.1 Clarifications and corrective action requests by assessment team

Calculation of Emission Reductions

The approach to calculating emission reductions does not include consideration of uncertainty and the risk buffer.

12.2 Summary of methodology developer response

In addition to the information presented below, please also refer to our responses to CAR 9 and 10 regarding uncertainty.

We do not believe risk buffers apply to the PM. As stipulated in the Voluntary Carbon Standard Guidance for Agriculture, Forestry and Other Land Use Projects (18 November 2008) – Page 17, Footnote 19:

"The project crediting period for ALM projects focusing exclusively on emissions reductions of N_2O, CH_4 and/or fossil-derived CO_2 shall not exceed 10 years, renewable at most two times."

"Such ALM emissions reductions projects **are not subject to non-permanence risk (or buffer withholding** [emphasis added]), and therefore shall follow the VCS Program rules governing non-AFOLU projects in terms of an acceptable crediting period (i.e., a maximum of 10 years which may be renewed at most two times.)"

The PM is specific to ALM projects that focus exclusively on emissions reductions of N_2O, and therefore is not subject to non-permanence risk or buffer withholding. Furthermore, irrespective of this exclusion, N_2O emission reductions associated with reducing N fertilizer rate are permanent and cannot be reversed – i.e., the practice of not adding N to the crop is irreversible. Therefore, use of this methodology does not require any buffer or other risk mitigation mechanism be used.

12.3 Assessment Team Conclusion

I accept the response for risk, however the calculation for uncertainty is still required (see response to CAR 8). Carly Green

12.4 Second Round - Summary of methodology developer response

Please see CAR 8 and CAR 9 for revised uncertainty analysis.

12.5 Second Round – Assessment Team Conclusion

Conclusion pending discussion with methodology developer

CAR 13 –

13.1 Clarifications and corrective action requests by assessment team

Additionality

The VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v1.0 is a comprehensive tool that covers barrier analysis, investment analysis, and common practice analysis. Please describe why this tool was not applied.

13.2 Summary of methodology developer response

The approach to demonstrating additionality in the PM is based on the use of a performance standard. This kind of approach is explicitly permitted by the VCS and is considered to be valid alternative to the use of the additionality tool identified in the CAR. The performance standard approach included in the PM already was reviewed and approved as part of the first validation of the PM conducted by Environmental Services Inc. and again through direct discussions with personnel at the Verified Carbon Standard. For more information on this, please refer to CAR 24 of the first validation report, dated February 2, 2011.

Also, please note that the VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v1.0 (section 1.1.2) states:

"Project proponents proposing new baseline methodologies **may incorporate this tool** [emphasis added] in their proposal. Project proponents **may also propose other approaches** [emphasis added] for the demonstration of additionality as set out in the most recent version of the VCS for consideration under the VCS double approval process.

As described above, the PM incorporates a performance standard approach to assessing project additionality as permitted by the VCS.

13.3 Assessment Team Conclusion

Whilst Section 4.6 – Additionality of the VCS 2011 states that "Methodologies shall use a project test, performance test and/or technology test approach to additionality" **the above question was posed by the validator to get a better understanding of the methodology developers reasoning behind the proposed performance approach. Further clarification in this context would be useful.**

13.4 Second Round - Summary of methodology developer response

The major driver behind proposing our performance standard approach is to create a site-specific (project scale) test for additionality that is straightforward to implement, transparent to all stakeholders, underpinned by BAU practices that define the baseline, and consistent with the standards adopted by the VCSA.

To meet additionality requirements, the methodology proposes the creation of the performance benchmark. Project developers pass the performance test by being below a threshold value that represents a BAU application of N fertilizer - identical to the baseline N application rate at a project field. Reductions in rate, and therefore N_2O emissions, below the BAU value result in project additionality. This performance benchmark could effectively act as a future sectoral baseline for VCS agricultural crop N management projects in the US. Annex E details the science and rationale supporting our proposed approach.

We believe that if adopted the performance standard will help remove the current necessity for costly and time consuming site-specific evaluations of additionality. We expect it to help promote more widespread adoption of practices that increase N use efficiency in agricultural crop production, reduce reactive N in the environment and reduce GHG emissions associated with agricultural without compromising agricultural productivity.

13.4 Second Round – Assessment Team Conclusion

The approach presented by the methodology proponent presents a performance based approach to assess additionality based on a per unit output basis in that fertilizer application rates (the project input) are set for particular regions based on historical yields (output). The approach presented is logical and appears to meet the requirements of the VCS.

CAR 14 –

14.1 Clarifications and corrective action requests by assessment team

Additionality

The PM presents a Performance Standard Test for the assessment of additionality. Annex D states that reductions in N fertilizer rate and therefore N2O emissions below the BAU rate at the project site (Approach 1), or below the BAU value in the county where the project is to be conducted (Approach 2) will result in project additionality. Whilst this is true if Approach 1 is used to establish the BAU, application of Approach 2 to develop the BAU would not necessarily demonstrate additionality due to the course spatial nature of the data. Individual land managers may have reduced application rates due to other factors (i.e. such as fertilizer prices) and this may be masked at the individual site level by applying the county average. Please explain how Approach 2 would result in conservative application rates at the crop level and how demonstration of additionality is achieved.

14.2 Summary of methodology developer response

Please also refer to our responses to CAR 9, 10 and 15 for discussions on baseline and uncertainty.

A conservative baseline N rate for Approach 2 is achieved by including N credits from legumes, cover crops and manures during the baseline period. This mechanism reduces the baseline N rate value calculated using back-calculation from county yield estimates, and introduces substantial disincentives for project proponents to game the PM.

It is extremely unlikely that crop producers would have adopted any pre-emptive strategy to boost N_2O-related emissions reductions and offset credits. However, the conservative approach outlined above effectively eliminates the use of N rate data derived from any historical practices solely adopted to artificially increase baseline N rates.

Crop producers may have reduced their N application rates historically due to a variety of factors, including a response to higher than average fertilizer prices. Any reductions in N rate made by a farmer prior to the project period would reduce the baseline N rate estimate as calculated based on the PM. In doing so, they would be reducing N_2O emissions and other N pollutants for which they would not be compensated by the VCS or any other similar program of which we are aware.

To be additional, projects developers must exceed a performance threshold that represents business–as–usual, the value of which is identical to the baseline calculation value for N fertilizer rate. Both Approach 1 and Approach 2 rely on project-level data for determining the baseline N rate, and use data that is the result of the common practice of applying N fertilizer rates based on recommendations derived from yield goal estimates. Approach 1 uses field-level, N rate management records collected and maintained by the farmer. Approach 2 uses county-level, crop yield management records derived from individual field-level management records. Both approaches generate a BAU baseline N rate and additionality is demonstrated by reducing N fertilizer rates below this level during the project period.

Therefore, Approach 2 is conservative and demonstrates additionality, and thus is appropriate for meeting the performance standard in the PM to assess project additionality.

14.3 Assessment Team Conclusion

Section 4.6 of the VCS 2011 states that new methodologies shall demonstrate additionality by:

- Developing a full and detailed procedure for demonstrating and assessing additionality directly within the methodology;
- Developing a full and detailed procedure for demonstrating and assessing additionality in a separate tool, which shall be approved via the methodology approval process, and referencing and requiring the use of such new tool in the methodology.

And more specifically that a performance test must have the following aspects:

4.6.2 Performance Test
Step 1: Regulatory Surplus
The project shall meet with the requirements on regulatory surplus set out under the project test (see Section 4.6.1).

Step 2: Performance Benchmark
The GHG emissions generated (or carbon sequestered) per unit output (emphasis added) by the project shall be below (or above, for sequestration) the benchmark approved under the VCS Program for the product, service, sector or industry and which is established to ensure that the project's performance is not business as usual.

The performance test does not meet this requirement as the basis of the current proposed performance test are not on a per unit output basis (crop yield), but rather on a per unit input basis (fertilizer rates).

The methodology should present criteria and procedures for demonstrating additionality using the performance test that is based on a per unit output that is below the benchmark approved under the VCS Program for the sector/industry. This criteria and procedure should be presented in the methodology or as a separate tool.

14.4 Second Round - Summary of methodology developer response

Following discussions with VCS we understand that VCS currently have no approved performance benchmark for crop based agriculture in relation to N fertilizer rate management. Our PM is attempting to create this benchmark from which future projects can determine their additionality.

Initially, we want to clarify that our performance benchmark (step 2 in the performance test for additionality) is an output based metric, and does meet the requirements of VCS v3.0.

To calculate baseline N_2O emissions, a baseline N fertilizer rates is required. This N rate is determined from producer management records (Approach 1), and is an average value calculated from historical N rates applied to the same crop type in the same field as the proposed project. Annex C (Approach 1) provides an example of this calculation.

The N rate applied during the baseline period, and therefore the baseline N_2O emissions is derived from previous known crop yields. These yields are either from site specific management records (Approach 1) or county level records (Approach 2). Therefore, the baseline emissions are based upon output, and the performance benchmark can be defined as N_2O emissions per unit of previous yield (e.g., bushels of corn). Annex C (Approach 2) provides an example of how baseline N rate and therefore baseline N_2O emissions are calculated from previous crop yield. In this example county yield records are used however the same calculations apply to site specific records.

Therefore N rates during the baseline period serve as a proxy for output (yield), and reduced N rates during the project period constitute a reduction in emissions intensity and are de facto additional. There is no requirement for project yield to be monitored as project N rate serves as the metric for determining additionality.

From our earlier response to CAR 3 (section 3.2):

"Changes in crop yield do not affect the N_2O emissions reduction calculation, which is based upon determination of baseline and project N fertilizer rate (*and derived from crop yield*) [parentheses added]. There is therefore no need to compare baseline and project crop yields"

To clarify the procedure by which a project can show additionality, we propose to incorporate criteria and equations into section 7 (Procedure for Determining Additionality). These equations and supporting information are also detailed in Annexes C and E.

Below we outline how our approach can be considered to function as a sectoral performance benchmark.

Producers have historically applied N fertilizer on the basis of expected yields, *not* known yields. This "yield-goal" approach to determine N fertilizer rate has been common practice throughout the US since the 1970s. The approach is endorsed by agricultural departments of U.S. land grant universities, and state and federal agricultural organizations. These organizations are the most common source of external information and advice for producers, and this network serves as the foundation for producer BAU practice. This association between the various organizations and the producers who adopt practices based upon this information constitutes a sector-wide approach for calculating baseline N fertilizer rates, and by extension, emissions of N_2O. Please see Annex E for further information.

Our performance benchmark therefore is flexible and allows site specific records (field scale) to be used to determine additionality – similar to a project benchmark. The calculation mechanism, with equations that vary slightly from state to state and that are based on soils and other conditions, can be used across a broad geographic range within the US, where N rates have historically been based on application of yield-goal approaches.

Please see CAR 9 (section 9.4) for uncertainty discussions regarding Approach 2.

145 Second Round – Assessment Team Conclusion

See response to CAR 13. This CAR is closed

CAR 15 –

15.1 Clarifications and corrective action requests by assessment team

Baseline N Application Rates

The N application rates determined using Approach 2 should have an associated reported uncertainty due to the course spatial nature of the data applied at the project level. There may be significant opportunity for the over estimation of N emissions in the baseline using this approach.

15.2 Summary of methodology developer response

Please also refer to our responses to CAR 9, 10 and 14 for discussions on baseline and uncertainty.

As noted in CAR 14, Approach 2 is conservative by design and eliminates the potential for over-estimation of N_2O emissions from the baseline period by incorporating N credits from legumes, cover crops, and manures. A lower baseline N rate limits the potential for substantial N rate reductions without a crop productivity decline (a major disincentive for altering N management practice and project adoption).

The use of crop yield data from USDA – NASS must be consistent with the crop rotation history of the proposed project site(s). For example, a project field in which corn has been grown in alternate years with soybean for the last six years (2005 – 2010; starting with corn) must use USDA – NASS data for corn yield for the relevant county for the years 2005, 2007 and 2009 for a project start date of

2011. This requirement reduces the uncertainty in baseline calculation, as county crop yield records for an individual year reflect the prevailing environmental and economic conditions at that time. This requirement also reduces the potential for gaming because project proponents cannot select historical data that could have the effect of artificially increasing the baseline. Moreover, if data demonstrating the crop rotation history on the project site cannot be verified, the proposed project is ineligible to generate N_2O emissions reductions under the PM.

15.3 Assessment Team Conclusion

The methodology section 'Data Uncertainty Assessment' – Activity Data states 'In determining baseline N rate values using Approach 2, the uncertainty in activity data will be increased as the values are generated from data presented at a higher spatial aggregation (county level for crop yield, and state level for fertilizer N rate recommendation algorithms).'

The uncertainty should be specified and the approach to incorporating this uncertainty in the calculations presented.

15.4 Second Round - Summary of methodology developer response

Please see CAR 9 (section 9.4) for uncertainty discussions regarding Approach 2.

15.5 Second Round – Assessment Team Conclusion

The response to CAR 9 is relevant to this CAR and is sufficient to close this issue.

CAR 16 –

16.1 Clarifications and corrective action requests by assessment team

Management Practices Nitrogen Inhibitors

The methodology should take into consideration the possible use of nitrogen inhibitors. The use of nitrogen inhibitors may reduce the rate of nitrogen lost from the system. The Tier 1 does not take this into consideration and therefore the accounting approach could overestimate the actual N losses. This may not lead to conservative estimates.

16.2 Summary of methodology developer response

The PM, consistent with both Tier 1 and Tier 2 approaches, does not exclude the use of nitrogen (nitrification) inhibitors (NI) or enhanced efficiency fertilizer (EEF) technology. The use of NIs are fully credited when NIs result in lower N fertilizer rates, which is their intent (to increase crop nitrogen use efficiency so less fertilizer need be applied).

We do not believe exclusion of NIs as a specific credited management practice will lead to non-conservative estimates of N_2O emissions reductions. Rather, any additional credits that potentially could be generated by using this technology alongside N fertilizer rate reduction would generate extra credits already credited by reducing N rates.

In addition to the PM meeting VCSA requirements for conservatism, a further reason to exclude explicit credits for the use of NIs is the lack of consistent, non-confounded, and reliable evidence across a wide range of environmental conditions in the US that NIs actually are effective. Evaluation of the long-term effects of NIs and EEFs in field applications could offer exciting opportunities to reduce agricultural N_2O emissions and other N pollutants. However, at this time predictions of their effectiveness for reducing N_2O emissions and generating agricultural offset credits are premature (Akiyama et al. 2010).

16.3 Assessment Team Conclusion

Response accepted and closes this CAR. Carly Green

CAR 17 –

17.1 Clarifications and corrective action requests by assessment team

Management Practices Crop Residues

The Protocol effectively ignores N emissions from crop residues by saying they are incorporated in the suggested application rates (i.e. the PM assumes that recommended rates incorporate N inputs from crop residues). Please justify this assumption, as exclusion of losses from crop residues is not a conservative approach.

17.2 Summary of methodology developer response

As noted in our responses to earlier public comments (National Wildlife Federation, reply 5), when farmers determine baseline N fertilizer rate applications at project sites, legume (and other) N residue credits will have been included and taken into account. For example, in Michigan, N credits from legume and cover crops typically are ~30 lb N per acre, which means that yield-goal-based fertilizer recommendations for succeeding crops will have been reduced by this amount.

Using Approach 1 to generate the baseline N rate integrates the producer’s consideration of the N contribution made by crop residues based upon the rotation. For example, farmers growing corn as part of a corn-soybean rotation will have credited residues left over from a previous years’ soybean crop. Conversely, where the preceding crop had no residue (corn silage, for example), fertilizer recommendations will have been increased.

With Approach 2, residue credits are likewise inherent but at the county level. Including residue credits otherwise would have the undesirable effect of artificially inflating baseline N rates and associated N_2O emissions.

During the project period, residue N from the eligible crop grown at the project site will not be directly counted towards total N input to the crop rotation based on the PM. N in crop residue is not an external input – it is recycling of N already added to the system. To include this residue N would be double-counting, which would not be a conservative approach.

Residues N from crops grown outside the project site, on the other hand, are included in the PM as an external source of N.

17.3 Assessment Team Conclusion

The explanation provided increased understanding and is sufficient to close this issue. Carly Green

CAR 18 –

18.1 Clarifications and corrective action requests by assessment team

Tier 1 vs. Tier 3 Accounting Approaches

In response to the Fertilizer Institute query related to Tier 1 and Tier 3 reporting of N emissions, please provide a clear explanation of the differences between the Tier 1 approach presented in the Protocol and the Tier 3 approach used by the US to report Nitrogen Emissions. Please explain why the Tier 3 approach was not used in the Protocol.

18.2 Summary of methodology developer response

As described in the IPCC Good Practice Guidance (IPCC 2003), methodologies to calculate emissions of N_2O from agricultural soils can fall under three main tiers:

Tier 1 consists of equations and default emission factors provided in the IPCC Guidelines (IPCC 2006) and IPCC Good Practice Guidance; Tier 2 uses the IPCC Guidelines default equations but requires country-specific parameters that better account for local climate, soil, management, and other conditions; and, Tier 3 methods are based on more complex models and inventory systems, typically using more disaggregated activity data.

We did not use a Tier 3 approach in the PM because:

- Scientifically and practically, tier 1 and tier 2 approaches are the most appropriate to use at the local (field) scale.

- Our empirical field studies provide strong evidence that emission factors (tier 2) are robust across a wide range of environmental conditions.

- We are unaware of any VCS requirement that the PM developed for site specific projects use the same accounting methods used in their country's national GHG inventory.

- Tier 3 approaches are more appropriate to be used at the national level; they do not yet provide the necessary spatial specificity to apply at the local (field-scale) level that constitutes projects within the PM.

- Tier 3 approaches lack simplicity and transparency for stakeholders.

As noted by a recent expert report (T-AGG 2011):
"Given the complexity of most process-based models and the amount of data they require, running them accurately and consistently requires a certain level of sophistication and expertise. Setting up the full process models and running them for individuals projects is complex, requires substantial expertise, may be prone to error or bias, and may be cost prohibitive for a project. One of the primary challenges in using these models for determining baseline and quantifying GHG impacts at farm-or regional-scales is to standardize how the technology can be made available to non-expert users such as project developers, consultants, and verifiers, in quantification protocols or program guidelines."

18.3 Assessment Team Conclusion

Whilst I was interested in understanding the Tier 3 approach applied by the US, this is not discussed here are requested. There are Tier 3 approaches in other countries that are field based (local scale). The response indicates that the Tier 3 approach applied by the US has not been made accessible (is too complex) for project developers. This seems to be an adequate reasoning however in the ex-post scenario there is a heavy reliance on default values with no monitoring or validation of these figures. This is not consistent with other VCS methodologies in the AFOLU sector. How does the methodology deal with this?

18.4 Second Round - Summary of methodology developer response

The data and parameters monitored during the project period are shown in the "Monitoring Procedure" section (9.2) of the PM.

Emissions of N_2O are monitored and validated during the project period. This is carried out indirectly by quantifying and validating the amounts and N content of the synthetic and organic fertilizer applied to the project site. The annual N input to the project site is used as the proxy for estimating N_2O emissions and compared against the baseline N rate (i.e., linked to crop yield, as detailed in CAR 14, section 14.4). The N rates are incorporated into emissions factors that allow calculation of N_2O emissions.

Emissions of N_2O are not required to be directly measured from the project field site(s). Rather they are estimated using emissions factors that are derived from empirical emissions measured directly from agricultural crops. In the NCR the N_2O emissions factor is derived from actual field measurements of N_2O fluxes from commercial farmer fields (Tier 2), as detailed in Hoben et al. (2011). In the US, outside the NCR, the emissions factor used is the accepted IPCC value taken from peer reviewed publications that analyzed hundreds of field studies of N_2O emissions conducted globally (Tier 1).

As mentioned in our previous response (section 18.2), Tier 3 approaches are based upon more complex process models that are not directly derived from empirical field data. These models require validation from empirical field data to potentially be useful, but also suffer from major issues of uncertainty, bias and impracticality that our previous response highlighted. We therefore have chosen to adopt Tier 1 and Tier 2 approaches in our PM.

Irrespective of the approach (Tier) used to quantify emissions, measuring emissions of N_2O directly during the project (or baseline) period is neither practical nor economically viable. Typically the equipment used to measure and analyze N_2O fluxes from the soil in agricultural cropland is expensive (from a time, cost, and expertise perspective). Therefore robust and reliable indirect estimates serve as the most appropriate quantification of actual emissions. To this end, emissions factors derived from empirical data are the most appropriate to use at the project (field) scale.

Other VCS methodologies in the AFOLU sector do not directly measure GHG emissions during the project period. They model or apply emissions or other factors and equations to estimate emissions, as we do here.

VCS Standard v3.1 highlights the issue of practicality in its note in section 2.4 (Principles), below:

"Accuracy should be pursued as far as possible, but the hypothetical nature of baselines, ***the high cost of monitoring of some types of GHG emissions and removals***, and other limitations make accuracy difficult to attain in many cases. In these cases, conservativeness may serve as a moderator to accuracy in order to maintain the credibility of project GHG quantification.”

18.5 Second Round – Assessment Team Conclusion

The methodology proponent has explained that the approach used is based on peer reviewed science and is reported to be conservative. Given that these figures are used in National accounts to the UNFCCC, top down and bottom up accounting approaches are consistent which is comforting.
The requirement to monitor the BMPs by the project is adequate to close this issue.

CAR 19

19.1 Clarifications and corrective action requests by assessment team

The proposed methodology must be prepared in accordance with the VCS Version methodology template.

19.2 Second Round - Summary of methodology developer response

Our PM is now prepared using the VCS version 3 template.

19.3 Second Round – Assessment Team Conclusion

The CAR is closed

CAR 20

20.1 Clarifications and corrective action requests by assessment team

The applicability condition for Cropping Area currently allows the baseline crop area to be greater than the project area. As the methodology involves a comparison of emissions on a per hectare basis, this applicability criterion is not necessary.

20.2 Second Round - Summary of methodology developer response

Sentence (below) has been removed from Cropping Area in section 4.

“In other words, the project crop area must be equal to or less than the baseline crop area.”

20.3 Second Round – Assessment Team Conclusion

CAR 21

21.1 Clarifications and corrective action requests by assessment team

The methodology justifies the exclusion of leakage based on the assumption that crop yields will not decline. To support this conclusion, the methodology must demonstrate the expectation of non-declining yields.

21.2 Second Round - Summary of methodology developer response

Section 4 and Section 9.2 have been updated to require the expectation of constant yields

21.3 Second Round – Assessment Team Conclusion

The revised text is sufficient to close the CAR.

CAR 22

22.1 Clarifications and corrective action requests by assessment team

The demonstration of additionality does not conform to the draft VCS guidelines on standardized baselines. DNV encourages the methodology developer to consider the draft guidelines in the additionality assessment, though this is not a requirement as they are still in draft form. If this is not addressed, there is the potential that the baseline approach in this methodology will have to be re-addressed when the guidelines are formally adopted.

22.2 Second Round - Summary of methodology developer response

As the guidelines are currently in draft form, we prefer to move forward with the current additionality demonstration.

22.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 23

23.1 Clarifications and corrective action requests by assessment team

The regulatory additionality test states that projects pass this test if there is no regulatory requirement to reduce fertilizer N rates below the common practice rate. The test should also require evidence that use of the project fertilizer is safe and legal.

23.2 Second Round - Summary of methodology developer response

Regulatory requirement section has been expanded to reference BMPs.

Regulatory Surplus Test in Section 7 now reads:

"Project developers pass the Regulatory Surplus Test if:

1. There is no mandatory law, statute or other regulatory framework in place at the local, state, or federal level, requiring producers to reduce fertilizer N input rate below that of a BAU or common–practice scenario, and; 2. They adhere to

Best Management Practices (BMPs) with regards to the application of synthetic and organic N fertilizer at the project site (see section 4 – Fertilizer Nitrogen Management)."

Relevant text in section 4 reads:

"During the project crediting period, adherence to 'Best Management Practices' (BMPs) as they relate to the application of synthetic and organic N fertilizer at the project site is required. These BMPs are related to N fertilizer formulation (or N content of organic additions) and dates and methods of application."

23.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 24

24.1 Clarifications and corrective action requests by assessment team

The methodology provides a discussion of implementation barriers in the procedure for demonstrating additionality. If a performance test is used, the VCS requires discussion of the regulatory surplus test and the performance standard. The discussion of implementation barriers is not necessary and should be removed.

24.2 Second Round - Summary of methodology developer response

We are maintaining the Performance Standard approach to additionality. The section on Implementation Barriers previously in section 7 (before Performance Standard Test) has been removed.

24.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 25

25.1 Clarifications and corrective action requests by assessment team

In section 9.2, the methodology must state the monitoring frequency of each parameter. The frequency should correspond to the choice of static or dynamic baseline.

25.2 Second Round - Summary of methodology developer response

The monitoring frequencies have been added to the parameter tables in Section 9.2

25.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 26

26.1 Clarifications and corrective action requests by assessment team

The methodology should clearly state if the project proponent is required to reassess the baseline each year (dynamic) or have a static (fixed) baseline for a period of time.

26.2 Second Round - Summary of methodology developer response

The baseline is fixed for the baseline period for both Approach 1 (site specific) and Approach 2 (county). The text below has been added to Section 6 under Selection of baseline scenario.

"The emission baseline is fixed for the first crediting period for Approach 1 and Approach 2. At any second and subsequent credit periods, the baseline assessment will be conducted in accordance with the VCS guidance on baseline."

26.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 27

27.1 Clarifications and corrective action requests by assessment team

The methodology should clearly state if the project proponent is required to reassess the baseline each year (dynamic) or have a static (fixed) baseline for a period of time.

27.2 Second Round - Summary of methodology developer response

The baseline is fixed for the baseline period for both Approach 1 (site specific) and Approach 2 (county). The text below has been added to Section 6 under Selection of baseline scenario.

"The emission baseline is fixed for the first crediting period for Approach 1 and Approach 2. At any second and subsequent credit periods, the baseline assessment will be conducted in accordance with the VCS guidance on baseline."

27.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 28

28.1 Clarifications and corrective action requests by assessment team

In Section 9.1, the methodology states that the source of data for EF_{BDM2} is empirical research on producer fields throughout Michigan. Please clarify whether this value is applicable to all projects that use the methodology. If it is, MD must provide evidence that this value is representative of a wider geographical region than Michigan.

28.2 Second Round - Summary of methodology developer response

Clarifying text and reference (below) added to the "Any comment" section of parameter EF_{BDM2} in Section 9.1.

"Parameter only valid in North Central Region of the US (Annex G; Hoben et al. 2011)."

28.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 29

29.1 Clarifications and corrective action requests by assessment team

The methodology should provide a definition of the terms crop site and project site so that the difference between the two is clear.

29.2 Second Round - Summary of methodology developer response

For clarity and consistency, the term "crop site" has been amended to "project site" throughout the document where appropriate.

29.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 30

30.1 Clarifications and corrective action requests by assessment team

In equation C2 in Annex C, Y_t should be defined as the project start date.

30.2 Second Round - Summary of methodology developer response

Clarifying text (below) has been added for the term Y_t in Equation C2 in Annex C.

"Y_t = Project start date (year)"

30.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 31

31.1 Clarifications and corrective action requests by assessment team

The methodology should make clear that the data source (i.e. the Method selected - county level or project level) used for demonstrating additionality and for project accounting should be the same.

31.2 Second Round - Summary of methodology developer response

Clarifying text added (below) in section 4 under Geographic Location and Cropping System

"The same method must be applied to the calculation of both baseline and project direct N_2O emissions, and used for the assessment of additionality."

31.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 32

32.1 Clarifications and corrective action requests by assessment team

The calculations of direct and indirect emissions both have the parameters $F_{B\ SN,\ t}$ and $F_{P\ ON,\ t,}$ however they are defined differently. The mass is adjusted for volatilization of NH_3 and $NO_{x,}$ under indirect emissions, but not in the calculation of direct emissions. It is DNV understanding that the volatilization is accounted for by multiplying the mass by FracGasF. If this is correct, please remove the phrase "adjusted for volatilization as NH_3 and NO_x" from the definition of these parameters.

32.2 Second Round - Summary of methodology developer response

Definitions have been corrected and are now consistent

32.3 Second Round – Assessment Team Conclusion

This CAR is closed.

CAR 33

33.1 Clarifications and corrective action requests by assessment team

The methodology states that leakage is not relevant for this project type, and states the following as justification, "Since the project lands are required to have been maintained for commodity production for at least ten years prior to the project, no production activities outside the project boundary are required to compensate for a productivity decline." Please elaborate on the link between the length of time that the lands have historically been in production and the need to compensate for possible productivity declines. Alternatively, please delete the reference.

33.2 Second Round - Summary of methodology developer response

Text has been amended (below) in section 8.3 to reflect VCS version 3.

"Leakage risks are negligible for ALM projects involving cropland management activities because the land in the project scenario remains maintained for commodity production. Therefore, no production activities outside the project boundary are required to compensate for a productivity decline."

33.3 Second Round – Assessment Team Conclusion

This CAR is closed.

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