VALIDATION REPORT FOR METHODOLOGY REVISION TO CDM METHODOLOGY AMS-III.Y "METHANE AVOIDANCE THROUGH SEPARATION OF SOLIDS FROM WASTEWATER OR MANURE TREATMENT SYSTEMS" (VER. 3.0, 2 MARCH 2012)

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Methodology Element Title	AMS-III.Y "Methane Avoidance Through Separation Of Solids From Wastewater Or Manure Treatment Systems" (Ver. 3.0, 2 March 2012)	
Version	3.8	
Methodology Element Category	Methodology	
	Methodology Revision	√
	Module	
	Tool	
Sectoral Scope(s)	Waste handling and disposal	

Report Title	Validation Report For Methodology Revision to CDM Methodology AMS-III.Y "Methane Avoidance Through Separation Of Solids From Wastewater Or Manure Treatment Systems" (Ver. 3.0, 2 March 2012)
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Client	NativeEnergy, Inc.
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Summary:

Conestoga-Rovers & Associates Limited (CRA) was commissioned to perform the second assessment in the VCS double approval process for the Methodology Revisions proposed by NativeEnergy, Inc. (NativeEnergy) to the CDM Methodology AMS.III-Y, "Methane avoidance through separation of solids from wastewater or manure treatment systems," Version 3. The proposed revision modifies both the applicability conditions and baseline emission quantification methods and relates to the means of quantifying and measuring the mass of separated solids (M_{ss}) produced by the separation system.

The scope of this verification is such that CRA, as an independent third party recognized as a Validation and Verification Body by the VCS (Registration Number 027) is responsible for assessing the Methodology Revision and any associated tools to ensure they are consistent with all relevant VCS rules and procedures. The assessment of the Methodology Revision and associated tools is completed using a double-approval process, according to the VCS Standard, and is necessary to provide assurance to stakeholders. First Environment Inc. Provided the first assessment.

CRA utilized the following criteria for validation:

- VCS Standard: VCS Version 3, 1 February 2012, v3.2
- VCS Methodology Approval Process, 1 February 2012, v3.3

The methodology assessment was performed according to the process in the VCS Program Guide Version 3.3 dated 1 May 2012.

The verification report and associated annexes document a total of seven findings which include:

- Four Corrective Action Requests (CARs)
- Three Clarification Requests (CLs)
- Zero Forward Action Requests (FARs)

Upon review of the documentation and explanations provided by the Methodology Developer, all findings were closed out in a clear and transparent manner.

TABLE OF CONTENTS

1 INTRODUCTION

NativeEnergy Inc. (Methodology Developer and/or NativeEnergy) commissioned Conestoga-Rovers & Associates Limited (CRA) to complete the second independent third-party verification for the registered Verified Carbon Standard (VCS) project entitled:

- Methodology Revision To CDM Methodology AMS-III.Y "Methane Avoidance Through Separation Of Solids From Wastewater Or Manure Treatment Systems" (Ver. 2, 30 October 2009)

CRA was provided the Methodology Revision (MR), dated 29 May 2012 as well as the first assessment completed by First Environment Inc., dated 1 June 2012.

1.1 Objective

The purpose of the methodology assessment is to have an independent third party conduct a second assessment of the MR to ensure conformance with VCS requirements. Specifically, the criteria states that the methodology revision must result in emission reductions that are:

- Relevant
- Complete
- Consistent
- Accurate
- Transparent
- Conservative

1.2 Scope and Criteria

CRA was contracted by the Verified Carbon Standard (VCS) on behalf of NativeEnergy Inc. (Methodology Developer) to perform the independent third party second assessment of the methodology revision (MR). CRA, utilizing a risk-based approach as part of the verification process, reviewed the completeness, conservativeness, and accuracy of the underlying evidence for the assumptions and claims made, and data sources used. The results of this investigation then, together with the results of the review of other areas, gave the necessary input for the verification opinion which is completed pursuant to guidance provided within the VCS Methodology Approval Process Version 3.3, and the VCS Standard Version 3.2. CRA and NativeEnergy have agreed that a reasonable level of assurance be applied to this assessment.

1.3 Summary Description of the Methodology Element

The MR is a revision to the VCS-approved CDM methodology AMS-III.Y, "Methane avoidance through separation of solids from wastewater or manure treatment systems," Version 3.0. The two objectives of the revision are:

- To extend the use of the methodology in cases where organic bedding is used in barns
- To revise the equations in AMS-III.Y for baseline emissions quantification to maintain the accuracy and integrity of the methodology, despite removal of the condition that excludes the use of organic bedding.

Supplemental monitoring parameters have been added as requested by First Environment to the original methodology revision submitted by NativeEnergy. CRA has requested additional monitoring parameters to further characterize the quality assurance / quality control (QA/QC) procedures for $D_{ss,bedding,y}$ and to more clearly define $P_{LT,y}$ such that it is consistent throughout each section of the methodology revision. A full list of clarification and corrective action requests can be found in Section 4 of this methodology assessment.

2 ASSESSMENT APPROACH

2.1 Method and Criteria

The assessment process included a conflict of interest check, selection of assessment team, desktop review of the MR and first assessment, follow-up discussions with NativeEnergy for supplemental information as needed, including corrective actions, and finally the creation of the validation report.

Prior to any assessment activities, a conflict of interest check throughout CRA and its affiliated companies was conducted to identify any potential conflicts of interest associated with the project. No potential conflicts were found for this project.

The audit team consisted of the following individuals, whom were selected based on their VCS methodology assessment experience and relevant experience in Sectoral Scope 13, Waste Handling and Disposal. Curricula vitae for each CRA Project Team Member have been provided as Annex A of this report.

CRA Project Team Position	CRA Project Team Member
Lead Auditor	Brent Boss, P. Eng.
Validation Team Member	Andrew Sousa, MSc.
Validation Team Member	Adam Loney, P. Eng.
Validation Team Member	Ryan Bayne, P. Eng, P.E., USDA-NRCS TSP
Independent Technical Reviewer	Jason Haelzle, P. Eng

The assessment process was initiated with an email from Sam Hoffer of the VCS on 16 July 2012, which contained both the Draft First Assessment Report prepared by First Environment and NativeEnergy's proposed VCS Methodology Revision to AMS III-Y. The audit team conducted a desktop review of the MR and first assessment as described in Section 2.2 below. The audit team issued a request for response to corrective actions and a request for clarification of items identified during the second assessment (See Section 4). This validation report documents the methodology assessment process and identifies its findings and results.

2.2 Document Review

The VCS verification process relies heavily upon documentation review. The primary document for review is the Methodology Revision (MR) to AMS-III.Y. The VCS provided CRA with the MR (v3.3) and first assessment completed by First Environment (v.1), and NativeEnergy provided the red-lined versions of the MR (v3.4, v3.5, v3.6, v3.7, and 3.8) as detailed below:

Document Date	*Date Issued to CRA*	*Version Number*	*Methodology*
1 June 2012	16 July 2012	1	AMS-III.Y
29 May 2012	16 July 2012	3.3	AMS-III.Y
29 May 2012	23 August 2012	3.4	AMS-III.Y
29 May 2012	31 August 2012	3.5	AMS-III.Y
13 September 2012	13 September 2012	3.6	AMS-III.Y
14 November 2012	14 November 2012	3.7	AMS-III.Y
21 December 2012	21 December 2012	3.8	AMS-III.Y

Each of the above submissions was reviewed by CRA. As part of the verification process, additional documentation supplemental to the Methodology Revision was requested and reviewed by CRA. This supplemental information included the following documents:

Date Issued to CRA	*Type of Document*
16 August 2012	• One PDF authored by Frans Vokey and one webpage from the Ontario Ministry of Agriculture, Food and Rural Affairs (September 2011) for further characterization of $SS_{bypass,y}$ • Online Bulk density and specific gravity chart for sand, produced by ASI (no date) • PDF of bedding specifications, authored by the Cornell Waste Management Institute (June 2008) • PDF of physical properties of solid and semi-solid manure, authored by members of the University of Saskatchewan and Prairie Swine

	Centre Inc. (2002) • PDF of manure production and characteristics produced by the ASAE (March 2005) • PDF of agricultural waste characteristics, authored by the United States Department of Agriculture (2008)

2.3 Interviews

The following table documents the communication between CRA and the project stakeholders.

Name of Interviewee	***Position and Company***	***Details of Items Discussed***
Sean Breen	Director-Project Origination-NativeEnergy, Inc.	• Brent Boss initialized email communication with Sean Breen on 14 August 2012 to deliver CRA's findings assessment for the VCS MR. Sean Breen provided NativeEnergy's responses to the findings on 16 August 2012, including references to documents used in the responses. • Brent Boss initialized email communication with Sean Breen on 22 August 2012 to request the update of the Methodology Revision as referenced in NativeEnergy's responses to findings. The red-lined version of the MR was received from Sean Breen on 23 August 2012. • Brent Boss, Ryan Bayne and Andrew Sousa initialized a conference call on 30 August 2012 to discuss the clarification and corrective action requests in the findings assessment.

2.4 Use of VCS-Approved Expert

A VCS-approved expert is not required since the MR is not a non-ARR AFOLU methodology element. Since there is no standardized method, CRA did not retain an expert for this methodology assessment.

2.5 Resolution of Any Material Discrepancy

Each CAR and CL raised by CRA was presented in individual tables in Section 4 of this report. The Methodology Developer was required to complete the appropriate responses and to provide, where necessary, documentation as evidence of their assumptions and/or responses.

A summary of the final results of the findings is presented as follows:

Finding Category	***Number of Findings***
CAR	4
CL	3
Total	**7**

2.6 Internal Quality Control

Upon completion of the verification assessment, and recommendation by the CRA Project Team, all Project Activity related materials were sent to the Independent Technical Reviewer. The Independent Technical Reviewer checked that the proper procedures have been followed and that all of the conclusions made by the CRA Project Team are just. Ultimately, the Independent Technical Reviewer issues a memorandum to the CRA Project Team based on their review. During review the Independent Technical Reviewer and the CRA Project Team were able to raise additional findings at which points the Methodology Developer/NativeEnergy must sufficiently address each of the additional findings should they occur. All findings were addressed by the Methodology Developer/NativeEnergy and subsequently closed out.

Documents provided to CRA by the Methodology Developer/NativeEnergy are filed according to the date received and the source of the information. All documentation is placed in a private, secure filing system with restricted access to safeguard confidentiality.

3 ASSESSMENT FINDINGS

3.1 Applicability Conditions

The MR proposes changes to the original requirements in AMS-III.Y for the assessment of the eligibility of manure management projects that use mechanical solid/liquid separation equipment.

NativeEnergy proposes the deletion of Condition 6(b), which states that "No organic bedding material is used in the animal barns or intentionally added to the manure stream."

The revision proposed by NativeEnergy relies on indirect quantification of the mass of solids separated and therefore is not affected by the introduction of organic bedding solids to the waste management system. Baseline emissions are calculated from the amount of manure produced and the fraction of solids separated from the solid/liquid separation equipment. Additional parameters are used to monitor the organic bedding solids that may bypass the separation equipment due to recycling and particle size reduction.

3.2 Project Boundary

No changes were made to the original requirements in AMS-III.Y for describing the project boundary and identification of the sources, sinks and reservoirs.

3.3 Procedure for Determining the Baseline Scenario

No changes were made to the original procedure in AMS-III.Y for determining the baseline scenario.

3.4 Procedure for Demonstrating Additionality

No changes were made to the original procedure in AMS-III.Y for demonstrating additionality.

3.5 Baseline Emissions

The MR includes a modification for the measurement and calculation of baseline emissions such that the removal of volatile solids that are associated with organic bedding materials be accounted for by use of an approach to estimate the total amount of manure generated and the solids removal efficiency of the solid/liquid separation equipment. A corrective action was issued to NativeEnergy to elaborate on how separation of solids from manure treatment systems results in GHG emissions reductions (See Section 4, CAR #1).

The equations included in the MR are sourced from industry standards set by the American Society of Agricultural and Biological Engineers (ASABE). The proposed method of calculating the mass of suspended solids is represented below:

$M_{SS,y} = \Sigma_{LT} N_{LT,y} \times TS_{LT,y} \times P_{LT,y} \times EFF_{ss,p}$, where:

[1]

$TS_{LT,y}$ Annual amount of total solids excreted by one animal of livestock type LT managed by the management system in year *y* (kg);

P_{LT} Average percent of manure from animal type LT that is delivered to the separation process (%) in year y; and

$EFF_{SS,P}$ Separation efficiency of the project solids/liquid separation system in removing solids from the influent manure stream (kg separated solids/kg influent solids) (dry matter basis).

$N_{LT,y}$ Number of animals of livestock type LT in year y (number.

For U.S.-based project activities where herd-specific ration data are available, such data will be used to calculate $TS_{LT,y}$, as follows:

For lactating cows:

$TS_{LT,y} = [(DMI_{milk} \text{ X } 0.35) + 1.017] \text{ X } 365;$ [2]

For dry cows:

$TS_{LT,y} = [(DMI_{dry} \text{ X } 0.178) + 2.773] \text{ X } 365;$ [3]

For heifer cows:

$TS_{LT,y} = [(DMI_{heifer} \text{ X } 3.886) – (BW_{heifer} \text{ X } 0.029) + 5.641] \text{ X } 0.17 \text{ X } 365;$ and [4]

For beef cows:

$TS_{LT,y} = [DMI_{beef} \text{ X } (1 – DMD_{beef}/100) + 20.3 \text{ X } (0.06 \text{ X } BW_{AVG})] \text{ X } 365;$ where: [5]

DMI_{LT} = Dry matter intake by animal type ([lactating, dry, heifer or beef cows) (kg/day/animal);

BW_{heifer} = Average body weight for heifer cows (kg/animal) DMD_{beef} = Dry mater digestibility of total ration (% of DMI); and

BW_{AVG} = Average live body weight for feeding period for beef cows (kg)

A clarification was requested by CRA to verify the present day applicability of equations 2 through 5 shown above (See Section 4, CL#2). In addition, two corrective actions were requested by CRA to consolidate the definition of monitoring parameter $P_{LT,Y}$ throughout the methodology revision and provide the default values for total manure solids by animal type for US-based projects (See Section 4, CAR#2 & #3, respectively). Project activities outside of the US use country-specific values for total solids excretion, and when unavailable, IPCC default values for volatile solids excretion per animal type are used. The MR describes the changes to baseline emission equations for this setting.

The separation efficiency of the project separation system is determined through on-site measurements of flow rates and analytical laboratory analysis for solids content of the influent manure and liquid effluent streams. The efficiency is calculated as shown below:

$EFF_{ss,p} = (m_{Infi} \times \%TS_{Infi} - m_{LEffi} \times \%TS_{LEffi}) / (m_{Infi} \times \%TS_{Infl})$, where:

[6]

$EFF_{ss,p}$	Measured separation efficiency of the project separation system
m_{Infi}	Mass of manure influent (kg)
$\%TS_{Infi}$	Percent total solids of influent (dry basis)
m_{LEffi}	Mass of liquid manure effluent (kg)
$\%TS_{LEffi}$	Percent total solids of liquid effluent (dry basis)
$\%TS_{Infl}$	Percent total solids of influent (dry basis)

In the case where solids separation exists in the baseline scenario, the calculation of $EFF_{ss,p}$ for project activities needs to be adjusted to account for the removal of a portion of the mass of separated solids by the baseline separation equipment. In this case, the solids separation efficiency is adjusted as follows:

$EFF_{ss,} = (1-EFF_{ss,b}) \text{ X } EFF_{ss,p}$, *where:* [7]

EFF_{ss} = Adjusted separation efficiency of the project separation system; and

$EFF_{ss,b}$ = Measured separation efficiency of the baseline separation system.

Baseline emissions are also modified to include the proportion of separated solids that bypass the separation system as a result of recycling and particle size reduction, as well as the fraction of separated solids used in project barns for bedding in the baseline equation. These additional parameters reflect the potential for the decomposition of organic bedding such that particles are small enough to pass through the separation system and enter the anaerobic lagoon. The baseline emissions are calculated by:

$$BEy = (B_{o,w,y} \times M_{ss,y} \times (1 - (SS_{bypass,y} \times SS_{bedding,y})) \times VS_{ss,y} \times UF_b \times GWP_{CH4} \times D_{CH4} / 1000) \times \sum_{Bl,i} (MS_{Bl,i} \times MCF_{b,i})$$

; where, [8]

BE_y	Baseline emissions in year *y* (tCO_2-e);

$B_{o,w,y}$	Weighted methane-producing potential of the volatile solids separated by the project in year *y* (m^3 CH_4 per kg of VS);
$M_{ss,y}$	Mass (dry matter basis) of total separated solids in year *y* (kg);
$SS_{bypass,y}$	Fraction of separated solids in year y that bypass separation system as a result of recycling and particle-size reduction. The default values for $SS_{bypass,y}$ are 5% in cases where separated manure solids are used in the barn, and 0% otherwise;
$SS_{bedding,y}$	Fraction of separated solids in year y that are used in the project barns for bedding, which is equal to $(V_{ss,bedding,y} \times D_{bedding,y})/M_{ss,y,}$; where,
$V_{ss,bedding,y}$	Volume of separated solids used as bedding in the barns; and
$D_{bedding,y}$	Bulk density of separated solids;
$VS_{ss/y}$	Volatile solids content of the separated solids in year *y* on a dry matter basis (kg/kg);
UF_b	Model correction factor to account for model uncertainties (0.94);
GWP_{CH4}	Global Warming Potential of methane (value of 21);
D_{CH4}	Conversion factor of m^3 CH_4 to kilograms (0.67 kg per m^3 at 20°C and 1 atm pressure);
i	Index for baseline anaerobic manure management system
$MS_{BL/I}$	Fraction of manure handled in the baseline anaerobic manure management system *i* (fraction, mass basis); and
$MCF_{b/i}$	Methane conversion factor for the baseline anaerobic manure management system *i* as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10.

CRA issued a clarification finding to request further evidence that the default value for $SS_{bypass,y}$ of 5 percent, in cases where separated manure solids are used in the barn, ensures a conservative estimate of emissions (See Section 4, CL #1). An additional clarification was issued by CRA to clarify the use of the NRCS Agricultural Waste Field Handbook for QA/QC procedures applied for $V_{ss,bedding,y}$ (See Section 4, CL #3). CRA also issued a corrective action finding to NativeEnergy to incorporate into the equations parameters that will characterize how seasonal effects contribute to the overall emissions estimates, and to define the number of replicates used in QA/QC procedures (See Section 4, CAR #4).

CRA reviewed NativeEnergy's responses to findings and the red-lined MR (Version 3.8) to review that all formulae and calculation methods are accurate. CRA concluded that the approach to calculate baseline emissions is suitable, sufficient, and consistent with the VCS Standard.

3.6 Project Emissions

No changes were made to the procedure in AMS-III.Y for the quantification of project emissions.

3.7 Leakage

No changes were made to the procedure in AMS-III.Y for leakage emissions.

3.8 Quantification of Net GHG Emission Reductions and/or Removals

No changes were made to AMS-III.Y's original quantification method for determining net GHG emission reduction and/or removals. As stated in AMS-III.Y/Version 03.0, emission reductions achieved by the project activity are calculated through subtraction of the leakage and project emissions from baseline emissions.

3.9 Monitoring

The methodology revision describes requirements related to monitoring procedures, parameter measurement frequency, and QA/QC procedures for the collection, sampling and analysis of added parameters. Parameters have been added and defined to determine separation efficiency of the liquid/solid separation equipment, mass of solids produced by the animals and amount and density of recovered solids used as bedding in the barns. CRA has verified that the monitoring approach will collect the necessary data for emission reductions quantification and meets requirements specified in the VCS Standard.

3.10 Data and Parameters

Data parameters are specified in Section 9 of the MR and include a description of the data unit/parameter, unit of measurement, description of measurement methods and procedures, frequency of monitoring, the QA/QC procedures applied and additional comments necessary for project implementation. All data required for emission reduction calculations are included in the MR, as well as classification of parameters as monitored or not monitored. CRA concluded that all data and parameters in the MR are appropriate and sufficient to minimize uncertainty in the emission reduction calculations.

3.11 Use of Tools/Modules

The MR does not include the use of additional tools or modules beyond those incorporated in the underlying AMS-III.Y.

3.12 Adherence to the Project Principles of the VCS Program

The MR was developed in accordance with the requirements of the VCS Program principles as set out in the VCS Standard. The MR results in emission reductions that are relevant, complete, consistent, accurate, transparent and conservative.

3.13 Relationship to Approved or Pending Methodologies

The document assessed is a revision of Clean Development Mechanism (CDM) methodology AMS-III.Y. There are no other pending or approved methodologies that are similar in scope.

3.14 Stakeholder Comments

The MR did not receive any comments during the public stakeholder consultation process.

4 RESOLUTION OF CORRECTIVE ACTION REQUESTS AND CLARIFICATION REQUESTS

The Audit Team issued assessment findings to NativeEnergy on 14 August 2012, which included four corrective action and three clarification requests. NativeEnergy's responses are provided below along with reasoning of acceptance and close out for each finding.

Date:	08/14/2011		Raised by:	Brent Boss/ Andrew Sousa	
Type:	CAR	Number:	#1	Reference:	Section 2

Lead Auditor Comment:

NativeEnergy Inc. is requested to elaborate on the term "separation of solids from manure treatment systems results in GHG emissions reductions."

Methodology Developer Response: **Date:** 08/16/2011

The cited statement refers to the separation of solids from manure prior to its disposal in a manure treatment system (e.g. an anaerobic lagoon) that would result in methane emissions from the anaerobic decomposition of the volatile manure solids. By removing manure solids before they enter such a system, methane emissions are avoided.

Documentation Provided by Methodology Developer:

None

Information Verified by Lead Auditor:

The CRA Project Team reviewed the statement provided by the Methodology Developer and found the statement to be inaccurate.

Reasoning for Non-Acceptance: **Date:** 08/27/2012

Based on the statement provided by the Methodology Developer, CRA requests further corrective action as to how the manure is disposed of, rather than transferred to he manure treatment system. Additionally, CRA notes that given the nature of these types of projects methane emissions are never completely "avoided" and thus CRA is requesting that the Methodology Developer utilize more descriptive wording within this statement that is reflective of the actual project situation. In addition, the revised description has not yet been translated into the methodology revision document and must be added in order to ensure completeness.

CAR#1 Remains Open.

Methodology Developer Response: **Date:** 08/31/2012

The cited statement is proposed to read: However, while separation of solids from manure prior to its transfer to anaerobic manure treatment systems results in GHG emission reductions, the use of solids in the barns ….

Documentation Provided by Methodology Developer:

None

Information Verified by Lead Auditor:

Based on the review of the updated statement, CRA is confident that the statement contains the correct terminology.

CAR #1 is closed out.

Date:	08/14/2011	Raised by:	Brent Boss/ Andrew Sousa
Reasoning for Non-Acceptance:			**Date:**
N/A			
Acceptance by Lead Auditor: Brent Boss			**Date:** 06/09/2012

Date:	08/14/2011		Raised by:	Brent Boss/ Andrew Sousa	
Type:	CL	Number:	#1	Reference:	Section 8.1
Lead Auditor Comment:					
NativeEnergy Inc. is requested to provide further evidence that the default value for $SS_{bypass,y}$ of 5%, in cases where separated manure solids are used in the barn, ensures a conservative estimate of emissions. This value will vary between farms based on manure composition and also seasonal conditions.					
Methodology Developer Response:				**Date:** 08/16/2011	

The following discussion provides the rationale for the adjustment factor for the mass of separated solids ($SS_{bypass,y}$) to account for any fraction of the solids which may pass through the separation system due to recycling and particle-size reduction. NativeEnergy agrees that the overall separation efficiency may vary from farm-to-farm due to differences in manure composition, but the $SS_{bypass,y}$ should not because it is a function of the composition of the solids already removed by the separator, as explained below. NativeEnergy has seen no evidence to suggest $SS_{bypass,y}$ will vary based on seasonal conditions.

In practice, separated volatile solids used in the project barns as bedding will either decompose aerobically over time or be inadvertently recycled through the separation system (e.g. bedding material kicked out of stalls into alley ways by livestock). Over time mechanical forces (e.g. from hooves, stall raking, recycling through the separator) will tend to breakdown the particle size of the previously separated solids so that a portion of the solids that are recycled through the separation process may eventually pass through the separator and go into the anaerobic manure management system.

To estimate the amount of manure solids bedding material that is kicked out of stalls and recycled through the separation system, consideration is given to sand-bedded dairy barns, which are subject to cows kicking sand out of stalls, yet not subject to loss of bedding due to decomposition. Estimates of the amount of sand kicked out of sand-bedded stalls per day typically fall in the 30 – 50 lb/day range.[1] Using 40 lb/day and a bulk density for moist sand of 130 lb/cf,[2] gives an estimated volume of 0.3 cf/day of sand, or about 112 cf/yr (4.2 cy/yr).

In the case of manure-solids bedding, bedding kicked out of the stalls will be recycled through the separation system. Results of a Cornell study on manure solids bedding show that particle-size distribution shifts to smaller particles for used compared to unused bedding. Specifically, used bedding has 10-15% less large particles (>2 mm) than unused bedding.[3] Thus, as a result of a greater fraction of smaller particles, one would expect a reduction in the amount of fiber removed from used bedding by a screen-based separation systems (e.g., screw press, rotary screen, etc.) when bedding is recycled through the system and a portion of the smaller, broken-down particles pass through the screens. Allowing for the fact that some of the manure fiber may in fact be recycled through the separation system multiple times, the conservative assumption is made that effectively double the amount of broken-down larger particles, or 25% of the recycled bedding material, eventually passes through the separation system and

Date:	08/14/2011	Raised by:	Brent Boss/ Andrew Sousa

is deposited in the anaerobic manure management system.
Equating the solids bedding volume kicked out of stalls by the cows to the sand bedding estimates, we would expect 25% * 4.2 cy/yr, or approximately 1 cy/yr per cow of separated solids bedding used in the barn ends up passing through the separator into the farm's manure storage facilities.

A typical solids content of used manure bedding is 45%.[4] The bulk density of manure solids at 45% solids content is ~370 lb/cy.[5] Thus the 1 cy/yr per cow of recycled bedding material that passes into the manure storage facilities equates to 45% X 370 = 166 lb (dry basis) of manure solids. Using a typical VS/TS ratio of 85%, this represents about 140 lb of volatile solids per year.

A typical lactating dairy cow excretes 6200 lb/yr (dry basis) of volatile solids[6] and about 50% of these solids are removed by a typical separator.[7] Thus of the total mass of separated solids, about 140/3200 = 4% would be expected to ultimately bypass the separation system. To be conservative, it is assumed that 5% of the mass of separated solids bypasses the system. Thus the default adjustment factor (SS_{bypass}) to account for the mass of separated solids bypassing the separation system is set to 5% in cases where manure solids are used as bedding material in the barns.

Documentation Provided by Methodology Developer:

None

Information Verified by Lead Auditor:

1) See http://www.omafra.gov.on.ca/english/livestock/dairy/facts/info_sandbed.htm (20 - 25 kg/day) or http://www.ansci.cornell.edu/pdfs/pdsandbed.pdf (250 lb/week)

2) See http://www.asiinstr.com/technical/Material_Bulk_Density_Chart_S.htm

3) Harrison, Ellen et al, Cornell Waste Management Institute, *Using Manure Solids as Bedding, Final Report, 2008, compare values from tables 4-6 and 4-7, pp 4-6 – 4-7* available at http://cwmi.css.cornell.edu/bedding.htm

4) Harrison, Ellen et al, see table 4-7, pg 4-7

5) Landry, Hubert, et al, Physical and Flow Properties of Solid and Semi-solid Manure as Related to the Design of Handling and Land Application Equipment, University of Saskatchewan, 2002, Table 3 , pp 10 – 11, available at www.engr.usask.ca/socieites/csae/PapersAIC2002/CSAE02-214.pdf

6) American Society of Agricultural Engineers, Manure Production and Characteristics, D.384-2, 2005, pg 2, table 1-b.

7) *Gooch, Curt A. et al*, Mechanical Solid-Liquid Manure Separation: Performance Evaluation on Four New York State Dairy Farms-A Preliminary Report, *2005, table 9, pg 12, available at* http://www.manuremanagement.cornell.edu/Pages/General_Docs/Papers/SLS_performance_eval_Gooch_etal_2005.pdf

Date:	08/14/2011	Raised by:	Brent Boss/ Andrew Sousa
Reasoning for Non-Acceptance:			**Date:** 08/27/2012

Based on the statement provided by the Methodology Developer, CRA requests further clarification as to the following:

a) The description provided above by the Methodology Developer is not sufficient in relation to the fact that $SS_{bypass,y}$ will vary seasonally. The Methodology Developer is requested to provide for a proper account of seasonal variations based on the amount of water and weather patterns.
b) For estimates of the amount of sand kicked out of sand-bedded stalls per day, all values should be based on animal weight (i.e., typically lbs/day/1,000 lbs of animal weight, as referenced from the AWMFH).
c) The sand bedding estimates vary by barn and farm. Sand usage is typically higher than other bedding sources on a volume basis; therefore, additional clarification as to the use of 1 cy/yr per cow is requested.
d) As an alternative source of data in relation to the amount of volatile solids, the AWMFH may be used. In comparing the values presented by the AWMFH and the American Society of Agricultural Engineers, it is evident that there is a fairly large discrepancy between these values (e.g., 6,200 lb/yr for dairy cows in ASAE and 7,665 lb/yr for dairy cows in AWMFH). This discrepancy has a potential effect on the overall emissions and thus CRA is requesting that the Methodology Developer consider all sources of default parameters to ensure conservativeness.
e) The math used throughout the last paragraph of the Methodology Developer's original response is not consistent and must be revisited.

CL#1 Remains Open.

Methodology Developer Response:	**Date:** 08/31/2012

Date:	08/14/2011	Raised by:	Brent Boss/ Andrew Sousa

a) Only separation systems exposed to outside weather will be subject to variations in water amounts and weather patterns. Such variations may make small changes in system performance, but these are likely negligible. For locations that experience freezing temperatures during winter, outside applications would have to suspend operations during winter to prevent damage to equipment. Accounting for these suspensions of operations would be done through the $P_{LT,y}$ factor in the calculation of baseline emissions. As a QA/QC check on the reasonableness of $P_{LT,y}$ during verification, a review of the electric usage of the project equipment, a monitored parameter under the base AMS.III-Y methodology, can be used to approximate the number of hours of equipment operation. The following language is proposed for addition to the QC/QA procedures for $P_{lt,y}$ in section 9.2: "Review of project records of electricity use by separation system to verify hours of operation are consistent with validated value of $P_{LT,y}$.

b) For a typical animal mass for a lactating cow of 1400 lb, the cited reference indicates 31 – 39 lb sand per day per 1000 lb animal mass.

c) The tendency toward higher volumetric usage of sand supports overall conservatism. The 1 CY/yr is based on typical volumes kicked from stalls in sand-bedded barns. To the extent this is higher than what one would expect with alternative bedding materials, it leads ultimately to a higher estimate of SS_{bypass}.

d) The use of the lower value of annual excretion rates between the two references results in conservatism in the calculation of SS_{bypass}, since this value is used as a divisor in calculation of this factor.

e) The correct math is 140 lb/3100 lb = 4.5%.

Documentation Provided by Methodology Developer:

As stated above.

Information Verified by Lead Auditor:

Based on a review of the updated QA/QC procedure and conservativeness of estimations, CRA accepts the default value of 5% for $SS_{bypass,y}$.

CL #1 is Closed Out.

Reasoning for Non-Acceptance:	**Date:** DD/MM/YYYY
N/A	
Acceptance by Lead Auditor: Brent Boss	**Date:** 06/09/2012

Date:	08/14/2011		Raised by:	Brent Boss/ Andrew Sousa	
Type:	CL	Number:	#2	Reference:	Section 8.1/ 9.2

Lead Auditor Comment:

Equations 2 through 5 were obtained from an article that is now 7-years old. As such, NativeEnergy Inc. is requested to provide a more recently published and peer-reviewed article as the basis for these calculations or an appropriate reference whereby these equations remain applicable.

Methodology Developer Response: **Date:** 08/16/2011

NativeEnergy respectfully submits that the cited reference by the American Society of Agricultural and Biological Engineers (ASABE) is an accepted industry standard for these type of data and is the most recent publication of the *Manure Production and Characteristics* standard by the ASABE. As evidence of its acceptance as a definitive reference, the very same source is in fact cited and used as the basis of calculations by the U.S. Department of Agriculture in Chapter 4 Agricultural Waste Characteristics of its *Part 651 Agricultural Waste Management Handbook*, the latest version of which was published in March 2008[8].

Documentation Provided by Methodology Developer:

None

Information Verified by Lead Auditor:

8) See references, pg 4-32 at http://www.info.usda.gov/OpenNonWebContent.aspx?content=31475.wba for the most current version of Chapter 4 Agricultural Waste Characteristics, *Part 651 Agricultural Waste Management Handbook,* March 2008.

Reasoning for Acceptance and Close Out: **Date:** 08/27/2012

Based on the review of the updated reference, CRA is confident that the equations be utilized within the methodology revision is accurate to current standards.

CL#2 is Closed Out.

Acceptance by Lead Auditor: Brent Boss **Date:** 08/27/2012

Date:	08/14/2011		Raised by:	Brent Boss/ Andrew Sousa	
Type:	CAR	Number:	#2	Reference:	Section 8.1/9.2
Lead Auditor Comment:					
The definition of monitoring parameter $P_{LT,y}$ varies from Section 8.1 and 9.2. NativeEnergy Inc. is requested to revise the methodology revision to ensure consistency.					
Methodology Developer Response:				**Date:** 08/16/2011	
NativeEnergy agrees to use identical definitions of this monitoring parameter in the final methodology revision document.					
Documentation Provided by Methodology Developer:					
None					
Information Verified by Lead Auditor:					
The CRA Project Team reviewed Version 3.4 of the MR and verified that the Methodology Developer updated the definition of monitoring parameter $P_{LT,y}$ in Section 8.1 and 9.2 to both read "*Average percent of manure from animal type LT that is delivered to the separation process in year y.*"					
Reasoning for Acceptance and Close Out:				**Date:** 08/27/2012	
Based on CRA's review of Version 3.4 of the MR, the definition as noted above has been translated into the methodology revision document. **CAR#2 is Closed Out.**					
Acceptance by Lead Auditor: Brent Boss				**Date:** 08/27/2012	

Date:	08/14/2011		Raised by:	Brent Boss/ Andrew Sousa	
Type:	CAR	Number:	#3	Reference:	Section 9.2

Lead Auditor Comment:

Default values as indicated must also be clearly presented within the methodology revision for transparency.

Methodology Developer Response: **Date:** 08/16/2011

NativeEnergy agrees to include tables of cited default values in the final version of the methodology revision.

Documentation Provided by Methodology Developer:

None

Information Verified by Lead Auditor:

The CRA Project Team reviewed Version 3.4 of the MR and verified that the Methodology Developer added the following default values as Table 1:

"*Table 1 - Default Values for Total Manure Solids by Animal Type for US-based Projects*

Animal Type	*Total Manure Solids Excretion (kg/animal/yr)*
Lactating Dairy Cow	*3248*
Dry Dairy Cow	*1788*
Heifer Dairy Cow	*1350*
Beef Cow – (Confinement)	*2409*"

Reasoning for Non-Acceptance: **Date:** 08/27/2012

Based on the statement provided by the Methodology Developer, CRA requests further corrective action to report Total Manure Solids Excretion on an animal weight basis. Additionally, consideration of other sources of data such as the AWMFH to ensure conservativeness must be considered.

CAR#3 Remains Open.

Methodology Developer Response: **Date:** 08/31/2012

The table will be modified to express excretion rates as kg/1000kg animal mass/yr.

Documentation Provided by Methodology Developer:

None.

Date:	08/14/2011	Raised by:	Brent Boss/ Andrew Sousa
Information Verified by Lead Auditor:			
Reasoning for Non-Acceptance:		**Date:** 11/09/2012	
The modified table was examined in NativeEnergy's 'CRA redline v3.3' of the MR. CRA requests that an additional column be added to Table 1 to express Total Manure Solids Excretion in lbs/1000 lbs animal mass/yr. **CAR #3 Remains Open.**			
Methodology Developer Response:		**Date:** 09/13/2012	
The numerical values for kg/1000kg and lb/1000 animal mass/yr are identical. To avoid confusion of having two columns with identical numbers, the unit label in the existing column heading of Table 1 is changed to read lb/1000lb.			
Documentation Provided by Methodology Developer:			
None			
Information Verified by Lead Auditor:			
Version 3.6 of the MR.			
Reasoning for Acceptance and Close Out:		**Date:** 09/13/2012	
Based on CRA's review of Version 3.6 of the MR, the numerical values in Table 1 reflect conservative estimates of total manure excretion in units of lb/1000 lbs animal mass / yr. **CAR#3 is Closed Out.**			
Acceptance by Lead Auditor: Brent Boss		**Date:** 09/13/2012	

Date:	08/14/2011		Raised by:	Brent Boss/ Andrew Sousa	
Type:	CAR	Number:	#4	Reference:	Section 9.2
Lead Auditor Comment:					
NativeEnergy Inc. is requested to provide evidence of the frequency of measurement of the efficiency of the project separation system. Given that this operation is intended for the Northeastern United States where the potential for both freezing and extreme heat conditions exist, the specific nature of this parameter must be further detailed. NativeEnergy Inc. is requested to incorporate into the calculations; variable(s) that will characterize how seasonal effects contribute to the overall emissions estimates. Additionally, definition of "multiple samples" must be added/clarified within the monitoring plan to reflect the exact number of replicates. NativeEnergy Inc. is requested to update the version number and date of the red-lined copy of the MR submitted to CRA on 23 August 2012.					

Date:	08/14/2011	Raised by:	Brent Boss/ Andrew Sousa

Methodology Developer Response:	**Date:** 08/16/2011

NativeEnergy can find no evidence that seasonal effects (i.e., temperature) impact the separation efficiency of manure separators. In addition, the separators are housed in an environment that is kept above freezing. The impact of seasonal temperature variation is reflected in the overall emissions estimates as it is a factor in determining the methane conversion factor used to calculate baseline emissions.

NativeEnergy will change the QA/QC procedures for $D_{ss,bedding,y}$ in the final methodology revision document to be: Quarterly measurements with use of highest quarterly value for annual calculations.

Reasoning for Non-Acceptance:	**Date:** 08/27/2012

Based on the statement provided by the Methodology Developer, CRA requests further corrective action to incorporate variable(s) that will characterize how seasonal effects contribute to the overall emissions estimates. Whether or not the separators are housed in an environment that is kept above freezing depends on if the system is housed in or out of a building.

CAR#4 Remains Open.

Methodology Developer Response:	**Date:** 08/31/2012

See response to CL #1, a).

Documentation Provided by Methodology Developer:

None.

Information Verified by Lead Auditor:

Redlined version of MR.

Reasoning for Non-Acceptance:	**Date:** 09/06/2012

Based on the response to CL#1a, CRA is confident that the modified QA/QC procedures for $P_{lt,y}$ will characterize the use of separation equipment and ensure it is protected from freezing. However, NativeEnergy Inc. is requested to update the version numbers and dates of the red-lined copies of the MR submitted to CRA on 23 & 31 August 2012.

CAR#4 Remains Open.

Methodology Developer Response:	**Date:** 9/13/2012

The version numbers red-lined copies of the MR submitted on 23 & 31 August 2012 have been changed to 3.4 & 3.5, respectively and the dates changed to 9/13/2012.

Documentation Provided by Methodology Developer:

Version 3.4, 3.5 and 3.6 of the MR.

Date:	08/14/2011	Raised by:	Brent Boss/ Andrew Sousa
Information Verified by Lead Auditor:			
Reasoning for Acceptance and Close Out:		**Date:** 09/13/2012	
Based on CRA's review of the updated version numbers CAR#4 is closed out. **CAR#4 is Closed Out.**			
Acceptance by Lead Auditor: Brent Boss		**Date:** 09/13/2012	

Date:	08/14/2011		Raised by:	Brent Boss/ Andrew Sousa	
Type:	CL	Number:	#3	Reference:	Section 9.2
Lead Auditor Comment:					
NativeEnergy Inc. is requested to clarify why the NRCS Agricultural Waste Field Handbook is used for the QA/QC procedures to be applied for $V_{ss,bedding,y}$ but not for all other manure characteristics.					
Methodology Developer Response:			**Date:** 08/16/2011		
$V_{ss,bedding,y}$ does not relate to manure characteristics; it is the volume of separated solids used annually in the project barn(s). The NRCS Handbook is cited because it contains a table of daily bedding requirements for dairy cattle (See Table 4-4, pg 4-11), which would be useful for doing reasonableness checks of project monitoring values against industry averages.					
Documentation Provided by Methodology Developer:					
Table 4-4, P. 4-11, NRCS Handbook					
Information Verified by Lead Auditor:					
The CRA Project Team has reviewed the NRCS Handbook including the relevant tables and sections as stated in the finding.					
Reasoning for Acceptance and Close Out:			**Date:** 08/27/2012		
Based on the information provided by the Methodology Developer, CRA is confident that the source of data utilized is proper for the intended project uses and will also yield to a reasonable check for future verification works. Thus the reference is suitable. **CL#3 is Closed Out.**					
Acceptance by Lead Auditor: Brent Boss			**Date:** 08/27/2012		

5 ASSESSMENT CONCLUSION

CRA was contracted by the Verified Carbon Standard (VCS) on behalf of NativeEnergy Inc. (Methodology Developer) to perform a second assessment of the methodology revision (MR) to ensure conformance with VCS requirements. The proposed methodology belongs to Sectoral Scope 13 – Waste Handling and Disposal. CRA utilized the VCS Standard: VCS Version 3, 1 February 2012, v3.2 and the VCS Methodology Approval Process, dated 1 February 2012, v3.3.

The MR has been reviewed and all corrective action and clarification requests have provided CRA with evidence to affirm that emission reductions are relevant, complete, consistent, accurate, transparent and conservative.

In summary, it is CRA's opinion that the MR titled Methodology Revision to Clean Development Mechanism Methodology AMS-III.Y "Methane avoidance through separation of solids from wastewater or manure treatment systems", Version 3.8, dated December 21, 2012, meets all relevant VCS requirements and is of a reasonable level of assurance.

6 REPORT RECONCILIATION

Following the review of the CRA Methodology Assessment Report, First Environment provided CRA with a recommendation that Table 1 in Section 8.1 of the methodology be removed and replaced with a statement that requires project developers to utilize the most up-to-date versions of the ASAE values as they may be updated from time to time. Prior to being removed, Table 1 included the current default ASAE values for heard ration data. CRA is in agreement with First Environment that this table is better to be left out of the methodology and in its place include a statement has been included that requires the most up-to-date values from the ASAE reference tables to be utilized when developing a project. No other reconciliations were made.

7 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

CRA holds accreditation to perform validations and verifications as a Designated Operational Entity (DOE # E-0020) with the United Nations Framework Convention on Climate Change (UNFCCC) under the following Sectoral Scopes:

Scope 1: Energy industries (renewable - / non-renewable sources)

Scope 4: Manufacturing industries

Scope 5: Chemical industry

Scope 10: Fugitive emissions from fuels (solid, oil and gas)

Scope 12: Solvents used

Scope 13: Waste handling and disposal

CRA has completed less than ten previous methodology and project validations in Clean Development Mechanism (CDM) Sectoral Scope 13 (waste handling and disposal), however, the first assessment body (First Environment Inc.) has completed greater than ten previous methodology and project validations in ANSI Group 06 (Waste handling and disposal). Since one of the validation bodies has completed at least ten methodology and project validations, CRA is eligible under the VCS programme to perform assessments for the ME, which falls under Scope 13.

8 SIGNATURE

Signed for on behalf of Conestoga-Rovers & Associates Limited on January 9, 2013.

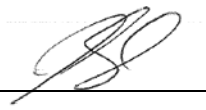
Name of entity: Conestoga-Rovers & Associates Limited

Signature: 

Name of Signatory: Brent Boss, P.Eng. (Lead Auditor)

Date: January 9, 2013

Name of entity: Conestoga-Rovers & Associates Limited

Signature: 

Name of Signatory: Jason Haelzle, P.Eng. (Technical Reviewer)

Date: January 9, 2013

ANNEX A

EDUCATION

B.Eng. Environmental Engineering (Co-op), University of Guelph, 2008

Other Training

40-Hour OSHA Health and Safety Training (as per OSHA 29 CFR 1910.120), 2006

EMPLOYMENT

2008-Present	Project Engineer Conestoga-Rovers & Associates
2007	Student Engineering Assistant, Conestoga-Rovers & Associates (8 months)
2006	Student Engineering Assistant, Conestoga-Rovers & Associates (8 months)
2005	Student Biomonitoring Technician, Ontario Ministry of the Environment (4 months)

AFFILIATIONS

Association of Professional Engineers of Ontario, Practicing Member (P.Eng.)

PROFILE OF PROFESSIONAL ACTIVITIES

Greenhouse Gas Validation/Verification Projects:

- Listed as a Key Team Member and Project Manager in the Greenhouse Gas Assurances (GGAS) Group and assisted in the successfully obtaining CRA's Designated Operating Entity (DOE) status with the UNFCCC effective as of May 28, 2010
- Lead the application and registration of CRA with the Verified Carbon Standard (VCS) as an accredited Validator/Verifier and is the primary contact and project resource for all VCS related project works and will be completing a validation of verification of a wind project located in Oklahoma as a Lead Auditing Team Member (2011)
- Currently in the process of completing a CDM validation as a Lead Auditor in Training for a carbon dioxide removal project activity at a hydrogen production facility in Argentina (2011). Work includes findings assessment preparation, site-visit, and validation report and validation opinion formation
- Conducted greenhouse gas verification assessments as a Lead Auditor in Training for three projects for Alberta Environment; a liquid natural gas plant in Boyle, Alberta (2011), a pulp mill (2011) in Fort Saskatchewan, Alberta, and a static-pile aerobic composting site (2009) in Edmonton, Alberta under the Alberta Offset System which included a site visit, review of the overall processes, record keeping practices and techniques, emission reduction calculations compliance, and a report on findings
- Currently in the process of completing two CDM validations as a Lead Auditor for landfill sites located in Los Angeles, Chile and in Tucumán, Argentina (2011). Work includes findings assessment preparation, site-visit, and validation report and validation opinion formation
- Currently in the process of completing a VCS validation and verification assignment as a Lead Auditor in Training for wind power project located in Dempsey Ridge, Oklahoma (2011). Work

includes findings assessment preparation, site-visit, and validation report and validation opinion formation and subsequent verification reports

- Currently in the process of completing a Swiss Charter verification as a Lead Auditor for a refrigerator recycling plant located in São Paulo, Brazil (2011). Work includes findings assessment preparation, site-visit, and verification report and verification opinion formation
- Experience with the validation process in preparation of Project Design Documents (PDD) for emission reduction projects related to landfill gas destruction under the Clean Development Mechanism (CDM) for the Manaus landfill (Manaus, Brasil)
- Performed greenhouse gas emission reductions calculations and prepared the Monitoring Report for the Aurà and CEAMSE landfill sites in Brasil and Argentina respectively. The reports were completed to UNFCCC standards and included a review of the overall process, record keeping practices and techniques and emission reduction calculation compliance
- Performed greenhouse gas emission reduction calculations using a modified first order kinetic landfill gas model for a municipal solid waste anaerobic digester under CDM requirements for various sites across the Canada and the USA as well as in Egypt. All of these Sites also included an assessment of emission reductions associated with cogeneration
- Completed assessment for emission reduction credits for a large-scale operation green-packaging project using sugar cane bagasse in Brasil under CDM biomass methodology AM0057 requirements. The project additionally generates electricity using the bagasse material
- Prepared detailed assessment of transferability of Alberta Offset System protocols to CDM protocols in relation to both cement and asphalt methodologies
- Conducted a greenhouse gas verification report for the Eastview Landfill Site in Guelph, Ontario. The report was complied in accordance with the requirements of the PERRL Initiative
- Developed a Project Information Note (PIN) for the emissions avoided through aerobic composting at the Orgaworld London and Ottawa, Ontario composting facilities as well as the City of Guelph Wet/Dry composting facility. Preparation of this document includes the quantification of emission reduction using the Alberta Offset System Protocols
- Developed several project documents under various emissions reporting standards for landfill operations in British Columbia including the Nanaimo Landfill and the Salmon Arm Landfill Sites and in Ontario at the Eastview Landfill Site. These reports have been prepared in accordance with ISO-14064 Part 2 standards using various GHG methodologies to quantity the emissions such as those from the UNFCCC and CAR

Design and Operations:

- Developed a detailed design and design and operations report for the landfill gas collection and control system for the Humberstone Landfill, Welland, Ontario, and the Stratford Landfill, Stratford, Ontario including the well field design, specification drawings including all relevant hydraulics, buried pipe and condensate trap sizing calculations
- Provides operational assistance for the Eastview Landfill including balancing of the well field, assessments of the leachate collection system and the operations of the utilization facility
- Provides operational support for organics processing facility's in London and Ottawa, Ontario including odour assessments involving the odour abatement equipment efficiencies and operations improvements to minimize fugitive odours
- Assisted in developing the model package (Design and Operations Report) for the Application for Amendment to Provisional Certificate of Approval for a Waste Disposal Site, for landfill sites which

apply under amended Ontario Regulations 232/98 and 347 for the Ontario Ministry of the Environment

- Assisted in preparation of a study regarding applicable wastewater treatment technologies and disposal options for an organics processing facility in Ontario
- Assisted with the submission of applications for Amendments Certificate of Approval for Air, Waste Disposal Site and Section 53 (Industrial Sewage Works) under the Environmental Protect Act (including formulation of a Design and Operations Report for the site) for source-separated organics aerobic composting facilities in London, Ontario and Ottawa, Ontario

Computer Aided Design:

- Performs day-to-day Auto-CAD drawings including process flow diagrams, general and civil scale drawings related to a variety of composting and landfill related projects

Solid Waste Management:

- Prepared cost estimates for the installation of landfill gas collection and control systems using both flaring and utilization technologies for international and Canadian landfills: Manaus landfill (Manaus, Brasil), and the Eastview landfill (Guelph, Ontario)
- Assisted with the preparation of successful proposals for a five-year contract to haul and process source-separated organics for the City of Toronto and a twenty-year contract to process source-separated organics for the City of Ottawa.
- Assisted in the completion of a 2007 Baseline Study of Canadian Landfills based on waste filing practices and leachate management considering nearly 90 landfill sites for Environment Canada

Modelling and Assessment:

- Experience with Scholl-Canyon and Rettenberger first-order landfill gas generation models for the prediction of landfill gas generation at several landfills in Canada, the United States of America (U.S.A.) and South America
- Experience with Scholl-Canyon and Rettenberger first-order landfill gas generation models as they apply to anaerobic municipal solid waste digesters for projects in the U.S.A.
- Performed landfill gas modelling and assessment for international landfills: Gonzàlez Catàn landfill and Ensenada landfill (Buenos Aires, Argentina), Aurà landfill (Belém, Brasil), Manaus landfill (Manaus, Brasil)
- Performed greenhouse gas emission reductions calculations and reporting for the Eastview landfill (Guelph, Ontario) and assisted with emission reductions calculations for the Merrick landfill (North Bay, Ontario) under the Pilot Emission Reductions, Removals, and Learnings (PERRL) initiative

Agricultural Engineering:

- Developed and assisted in implementing a monitoring methodology under the Climate Action Reserve (CAR) for the collection and utilization of methane gas produced in anaerobic diary manure digesters for various projects in California, U.S.A.
- Assisted in approvals process for Provincial certificates of approval for the utilization of leachate and ammonium sulphate as a non-agricultural source material (NASM) on agricultural lands for a composting facility's in both London and Ottawa, Ontario

Presentations:

- Prepared and delivered a 1 hour presentation entitled "Understanding the Clean Development Mechanism (CDM) Project Development Process" to the CRA community through a recorded

webinar conference. The presentation covered all aspect of project validation and verification from the perspective of a project developer as well as an independent party conducting validations or verifications of project activities

- Prepared a presentation on the current and future odour management at a composting facility operation within Ontario. The presentation was presented to local stakeholders, members of the MOE and the local Municipality

ANDREW SOUSA, MSC.

EDUCATION

MSc	Molecular Science, Ryerson University, 2010
BSc	Applied Chemistry & Biology (Co-operative), Ryerson University, 2008
Other Courses:	40-Hour HAZWOPER OSHA Training (per 29 CFR 1910.120), 2012 WHMIS Training, 2012 Maxxam Lab OPS Bootcamp, 2012

EMPLOYMENT HISTORY

2012-Present	Environmental Scientist Conestoga-Rovers & Associates, Waterloo, ON
2010-12	Medical Microbiology Laboratory Technologist Hospital for Sick Children, Toronto, ON
2008-10	Environmental Microbiology Graduate Student, Ryerson University/Environment Canada, Toronto/Burlington, ON

PROFILE OF PROFESSIONAL ACTIVITIES

Environmental Site Assessment & Due Diligence

- Project team member for ongoing Remedial Investigation activities at a Superfund Site in Ohio
- Conduct investigative and remedial activities for a chemical manufacturing facility in Ontario
  - Project team member for Annual Monitoring Reports
  - Co-author of monthly Progress Reports, consisting of assessment and management of analytical data
- Participation in groundwater remediation activities including water level monitoring and sampling events at industrial and agricultural facilities in Ontario

Project Chemist / Quality Control Officer

- Responsible for monitoring analytical data generated by subcontract laboratories, and ensuring that all aspects of sample processing are conducted in accordance with CRA's rigorous QA/QC program
- Perform validation of analytical data and prepare data review memos and summary tables
- Act as liaison between laboratory services vendor and CRA project staff
- Ensure sampling requirements are fulfilled by field activities as regulated under O. Reg. 153/04 and O. Reg. 558/00

Greenhouse Gas Validation / Verification

- Team member for the batch verification process regulated by The Climate Registry

- Team member for the validation of a methodology revision to the United Nations Framework Convention on Climate Change (UNFCC) Clean Development Mechanism (CDM) Methodology AMS.III-Y for the Verified Carbon Standard (VCS)
- Responsible for preparing verification plans and reports for industrial facilities regulated under O. Reg. 452/09 and Oil and Gas facilities regulated under the Alberta Specified Gas Baseline Emissions Intensity Application and Alberta Specified Gas Compliance Reporting

Medical Microbiology (Hospital for Sick Children)

- Project leader in the development, testing and implementation of DNA-based technologies for the characterization and quantification of bacterial populations in the gastrointestinal tract of mice and humans
- Project team member in a study involving the characterization of the mechanism of infection for the pathogen *Escherichia coli* serotype O157:H7

Environmental Microbiology (Environment Canada / Ryerson University)

- Project leader for a study utilizing a wave flume to investigate the relationship between wave action and the transport of bacteria in freshwater beach environments
- Project team member for the development of a ceramic-based diffusion system to monitor microbial responses to concentration gradients of sodium hypochlorite and antimicrobials
- Project team member in a study to determine the applicability of a bioremediation strategy involving horizontal gene transfer for the degradation of toluene in fractured rock

PUBLICATIONS

Published Refereed Papers

- Rodrigues DM, Sousa AJ, Johnson-Henry KC, Sherman PM, and Gareau M. July 2012. *Probiotics are effective for the prevention and treatment of Citrobacter rodentium-induced colitis in mice.* Journal of Infectious Diseases, p. 99.
- Rodrigues DM*, Sousa AJ*, Hawley SP, Vong L, Gareau MG, Kumar SA, Johnson-Henry KC, Sherman PM. June 2012. *Matrix metalloproteinase 9 contributes to gut microbe homeostasis in a model of infectious colitis.* BMC Microbiology, p. 105.
- Gareau MG, Ho NK, Brenner D, Sousa AJ, Lebourhis L, Mak TW, Girardin SE, Philpott DJ, Sherman PM. October 2011. *Enterohaemorrhagic, but not enteropathogenic, Eshcherichia coli infection of epithelial cells disrupts signaling responses to tumour necrosis factor-alpha.* Microbiology, p. 2963.
- Wolfaardt GM, Hendry MJ, Birkham T, Bressel A, Gardner MN, Sousa AJ, Korber DR, Pilaski M. May 2008. *Microbial response to environmental gradients in a ceramic-based diffusion system*. Biotechnology & Bioengineering, p. 141.

*co-first-author

ADAM LONEY, P.ENG.

EDUCATION

B.Sc. Eng. University of Guelph, Environmental Engineering, 1996

Other Courses:
- 40-Hour OSHA HAZWOPER Training and 8-Hour Annual OSHA Refresher (1999 and 2000–2009, respectively)
- Testing Industrial Air Emissions, 2000
- Chemical Hydrogeology, University of Waterloo, 2002
- Environmental Microbiology, 2002
- Industrial Processes, 2004
- Environmental Economics, 2006
- Industrial Ecology, 2007
- ISO 14064 Part 1 – Greenhouse Gas Inventories, 2008
- ISO 14064 Part 2 – Greenhouse Gas Projects, 2008
- ISO 14064 Part 3 – Greenhouse Gas Verification, 2010

EMPLOYMENT

2005-Present	Associate – Sustainability, Compliance, and Air Groups Conestoga-Rovers & Associates
1999-05	Project Manager, Conestoga-Rovers & Associates
1998-99	Project Engineer, Conestoga-Rovers & Associates
1998	Research Assistant, Agriculture and Agri-Food Canada
1996-97	Environmental and Quality Assurance Technician, Golden Town Apple Products

AFFILIATIONS

Professional Engineer, Association of Professional Engineers of Ontario

Michigan Board of Professional Engineers Fundamentals of Engineering Exam, April 1999

PROFILE OF PROFESSIONAL ACTIVITIES

Life Cycle Assessment, Greenhouse Gas Emissions Reporting, and Validation, and Verification

- Project Manager and technical advisor for the preparation and verification of applications for funding to Sustainable Development Technology Canada for various clients, including the preparation of life cycle assessments
- Project Manager for the preparation of a web-based, database-driven Environmental Footprint Calculator for a large cement, aggregate, and construction company in Canada

- Lead verifier, verification team member, and independent peer reviewer for verifications and verification audits of greenhouse gas inventories and projects in Alberta and British Columbia
- Lead validator for a greenhouse gas project being completed under the Clean Development Mechanism of the Kyoto Protocol at a hydrogen plant in Argentina
- Project Manager for review and assessment of greenhouse gas emissions from the upstream oil and gas industry for Environment Canada
- Peer Reviewer for the preparation of a Greenhouse Gas Inventory for a large North American potato chip producer
- Lead technical advisor for the preparation of a Greenhouse Gas Inventory for a large North American waste company
- Lead technical advisor for the preparation of Greenhouse Gas Emissions assessments for several clients
- Senior Technical Advisor for the assessment of reporting requirements under the USEPA Mandatory Greenhouse Gas Reporting Rule for clients in the petroleum industry

Air Emissions Sampling, Permitting, and Reporting

- Project Manager for numerous air emissions (including Greenhouse Gas Emissions) assessments for clients in Canada reporting under the National Pollutant Release Inventory (NPRI) and the Greenhouse Gas Reporting Program
- Project Manager, Project Coordinator, and project engineer on numerous air permit applications and air emissions reports for numerous clients throughout Ontario
- Project Coordinator for the Ontario Ambient Air Monitoring Sites for Environment Canada's Canadian National Air Toxics Measurement Program in 2004/2005. Responsible for coordination of all aspects of the sampling and reporting activities for over 10 ambient air monitoring sites in Ontario
- Conducted sampling and reporting for numerous air emission source testing projects in Canada, the United States, and Puerto Rico, including specialized field gas chromatography sampling
- Lead technical advisor for ambient air monitoring programs at multiple sites in Ontario and New Brunswick
- Project Manager and Coordinator for air emissions activities associated with multiple facilities for an automotive parts manufacturer in Ontario, including preparation of Ontario Ministry of the Environment Director's Order appeal documents, Certificate of Approval (Air) Applications, Ontario Regulation 127 and National Pollutant Release Inventory reporting, and source sampling

Agriculture-Related Experience

- Primary researcher for preparation of a paper regarding the evaluation of swine manure treatment processes for Agriculture and Agri-Food Canada
- Researcher for the evaluation of a prototype cattle manure treatment technology for Agriculture and Agri-Food Canada
- Project Manager for assessment of environmental issues associated with an aerobic composting operation

Environmental Due Diligence and Remediation

- Project Manager for ongoing Remedial Investigation/Feasibility Study (RI/FS) activities at a Superfund Landfill Site in Ohio

- Project Manager for RCRA corrective action and Ohio Voluntary Action Program activities at a former refractory manufacturing facility in Ohio
- Conduct investigative and remedial activities for a chemical manufacturing facility in Ontario including:
  - Project management, technical and field support relating to the remediation of contaminated off-Site Municipal Aquifer
  - Project Manager for the design and construction of a $4.2 million dollar ammonia treatment system for contaminated groundwater
  - Project Coordinator for annual ambient air monitoring program downwind of the Site
  - Project Coordinator for the 1998 through 2004 Annual Environmental Reports
  - Project Engineer for surface water monitoring programs, primary author of monthly Progress Reports, assessment and management of analytical data
  - Supervise and conduct field activities such as groundwater sampling, groundwater elevation monitoring, surface water sampling, surficial soil sampling, and waste water sampling air and odour sampling
- Project Manager for a large indoor contaminated soil excavation and groundwater collection trench installation at a former wallpaper manufacturing facility in Ontario
- Project Manager and Project Coordinator for a large site assessment, plant demolition, and contaminated soil and groundwater remediation project at a former airplane manufacturing facility in Ontario
- Project Manager and Phase I auditor for a large multi-site due diligence project at pulp and paper, mining, and port facilities in the Province of Newfoundland and Labrador
- Project Manager and Project Coordinator for several litigation support projects in the United States, including preparation of expert reports, expert witness support, and completion of potentially responsible party searches
- Project Manager and Assessor for numerous Phase I and II Environmental Site Assessments and Environmental Compliance Audits in the United States and Canada
- Project Manager for activities at a large chemical manufacturer in Ontario, including wastewater treatment system optimization, compliance audit, Certificate of Approval (Air) Application preparation, asbestos survey, and ongoing compliance assistance
- Project Manager for an AS/SVE and bioremediation project at an industrial site in New Jersey
- Project Manager/Coordinator for facility-wide environmental and health and safety compliance audits and environmental monitoring programs for two large automotive manufacturing sites in Ontario
- Managing and preparation of Phase I and Phase II Site Assessments for numerous property transfers in the United States and Canada
- Project engineer for an Engineering Evaluation and Cost Assessment (EE/CA) for the remediation of a lead-acid battery disposal area in Michigan

J. RYAN BAYNE, P.E., P.ENG

EDUCATION

B.Sc. (Eng.) Environmental Engineering, University of Guelph, 2003

Other Courses/
Trainings: 40-Hour HAZWOPER OSHA Training (as per 29 CFR 1910.120), April 2003
8-Hour Refresher HAZWOPER OSHA Training (as per 29 CFR 1910.120), Annually
Ontario Fundamentals of Nutrient Management Planning, July 2004
Ontario Nutrient Management Planning - Applications using NMAN Software, July 2004,
Ontario Non-Agricultural Source Material Strategy Planner, August 2004
Ontario Nutrient Management Regulations and Protocols Course, November 2004
Iowa State University Comprehensive Nutrient Management Plan (CNMP) Development Course (Nationwide Certification), November 2004
NRCS Conservation Planning Modules 1-5, December 2004
NRCS Introduction to Water Quality Course, February 2005
NRCS Nutrient Management Considerations in Conservation Planning, April 2005
National Resource Inventory (NRI) Rangeland Field Study Training, June 2005
NRCS Conservation Planning Modules 6-8, October 2005
NRCS Pest Management Considerations in Conservation Planning, January 2006
NRCS Agricultural Waste Management Systems – Level 2, January 2006

EMPLOYMENT

2012 - Present	Project Manager, Project Engineer Conestoga-Rovers & Associates, Waterloo, ON
2005 -12	Project Manager, Project Engineer, Conestoga-Rovers & Associates, Lansing, MI
2003-05	Project Engineering Assistant, Conestoga-Rovers & Associates, Waterloo, ON
2002	Student Engineering Assistant, Inspec-Sol (8 months)
2001	Student Engineering Assistant, Conestoga-Rovers & Associates (8 months)
2000	Student Engineering Assistant, AMEC Earth and Environmental (4 months)

PROFESSIONAL DESIGNATIONS AND AFFILIATIONS

Registered Professional Engineer: Michigan, Wisconsin, Ontario

American Society of Agricultural and Biological Engineers (ASABE)

Technical Service Provider, USDA-NRCS – TSP-04-4479

PROFILE OF PROFESSIONAL ACTIVITIES

Agricultural

- Project Coordination for the completion of an ID/IQ, A&E contract for the Utah USDA-NRCS. Activities include landowner interviews, site investigation, survey and site data collection, contract liaison with government agency representatives, and management, quality control and assurance. After completion of the field work and data collection, waste management systems were designed to meet the requirements of the Utah USDA-NRCS and landowner goals
- Project Management and development on environmental and operational improvements developed multiple dairy operations in the state of Florida for USDA-NRCS. Activities Landowner interviews, site survey and investigation, site soil sampling, waste management system, engineering design and CNMP development
- Field Engineer and USDA-NRCS liaison for the reconstruction of the Hanksville irrigation water diversion for the NRCS, Utah. Design of the $8 million project included extensive surveys, geotechnical investigation, ecological study and visual management simulations. Tasks included field investigation, data collection, and liaison with government agency representatives and CRA design staff
- Manage/coordinate the completion of IDIQ Architecture and Engineering (A&E) services contract for the Michigan USDA-NRCS. Activities included contract liaison with government agency representatives, and providing technical services including site review, soil/manure sampling, and engineering design development
- Project coordination in the completion of IDIQ CNMP services contract for USDA-NRCS in Wisconsin. Activities included interviewing the landowner, site survey and review, waste management system review and other conservation practice design, GIS/GPS collection and processing, figure development, and CNMP Development
- Project management in the completion of over 50 CNMPs for all types of agricultural operations, including dairy, beef, swine, and poultry. Activities included interviewing the landowner, site survey and review, waste management system review and other conservation practice design, figure development, and CNMP Development
- Project coordination and management in a California National Resource Inventory (NRI) Rangeland Health Field Study. Collected data regarding Rangeland species composition, yield estimations, and other health indicators using specific NRI protocol. Assisted in the coordination of three teams of field personnel
- Project coordination for the auditing services of all activities associated with biosolids land application and historical document review for the City of Toronto. Project activities included liaison with client, project budgeting and staffing, site C of A review, land application, and odor monitoring to ensure compliance with provincial regulations, and historical file review

Renewable Energy Projects

- Project Management/Coordination on farm evaluations and feasibility studies for suitability of anaerobic digesters on livestock operations. Activities Landowner interviews, site walk through and reviews, biogas potential of manure and other available organic sources, technology review, budgeting, cost estimation, and potential pay back on investment
- Project Engineer for the research and development of a report evaluating renewable energies technologies in Canada and across the world. The evaluation of these technologies included a review of public-private partnerships, private-sector only uptake, and government regulatory/incentive

supports for renewable energy technologies by region. In addition this evaluation included reviewing the objectives and policies of governments and how these have impacted the evolution of green energy generation and conservation in relation to electrical supply, market conditions, and a determination of the effectiveness

- Project Coordination on farm evaluations and feasibility studies and design for anaerobic digesters on livestock operations in Vermont. Activities Landowner interviews, site walk through and reviews, evaluation of existing agricultural waste system and required updates and changes to the system to accommodate the anaerobic digester, biogas potential of manure and other available organic sources, technology review, budgeting, cost estimation, and potential pay back on investment

Litigation Support, Site Assessment, and Due Diligence

- Coordinated oversight of Plaintiffs' field sampling activities on behalf of the Joint Defense in a litigation against several large poultry companies in northeastern Oklahoma. Activities included oversight of litter and soil sampling conducted by the Plaintiffs' technical representatives and GPS surveying
- Supervising Engineer for over ten Environmental Site Assessments, Phase II (ESA II), site investigations conducted on various Hydro One real-estate sites throughout Ontario. Responsibilities included environmental drilling and well installation oversight, on-site changes and additions to the work plan based on site conditions, well development, environmental soil, groundwater, sediment and surface water sampling, and surveying
- Team member in the completion of over 500 door-to-door Private Well Survey. The survey consisted of water quality and quantity questions answered by the home owner, water levels and bottom of wells readings, and the random sampling of about 50 wells for water quality analysis
- Assisted in the completion of Phase I due diligence for receiver in the sale of one of the largest hog operations in Canada. Activities included technical review of Nutrient Management Plans (NMPs) and facilities

Environmental and Geotechnical

- Supervising Engineer for installation of monitoring wells around the Hylebos Channel in Tacoma, Washington. Responsibilities included environmental drilling and well installation oversight, on-site changes and additions to the work plan based on site conditions, well development, environmental soil, groundwater, sediment, and surface water sampling, and surveying
- Operation of soils and concrete testing laboratories, laboratory testing including but not limited to Proctor tests, Atterberg limits, grain-size analysis, hydrometer, and moisture content
- Density testing of both soils and asphalt using Troxler and Humboldt Nuclear Density Gauge on various construction sites
- Performed various field activities including sampling (surface water, groundwater, surface soil, subsurface soil, and confirmatory wipe sampling), equipment maintenance, well installation oversight, hydrogeologic investigation, and construction oversight
- Project engineer responsible for supervision and coordination of field investigations including drilling and sampling programs conducted at municipal and industrial facilities

EDUCATION

B.Sc. Environmental Engineering, University of Guelph, 1999

Other Training

Managing Federal Grants and Cooperative Agreements for Recipients, 2005

Ontario Non-Agricultural Source Material Strategy Planner, 2004

Ontario Nutrient Management Regulations and Protocols Course, 2004

Pennsylvania Comprehensive Nutrient Management Planner, 2004

New York State Comprehensive Nutrient Management Plan Certification, 2003

Natural Resources Conservation Service (NRCS) Training Modules 1-5, 2003

USDA Conservation Planning Level III Training and Certification, 2003

Natural Resources Conservation Service (NRCS) Training Modules 1-5, 2003

New York State Comprehensive Nutrient Management Planner, 2003

NRCS Agricultural Waste Management Systems - A Primer; 2003

NRCS-NY Conservation Planner, 2003

Introduction to Water Quality Course, 2003

NRCS Nutrient and Pest Management Considerations in Conservation Planning, 2003

NRCS Agricultural Waste Management Systems - Level II, 2003 - Maryland Nutrient Management Planning, 2003

Ontario NMAN Refresher Course, 2003

Pennsylvania P. Index Training, 2003

Pennsylvania Introduction to RUSLE Training, 2003

St. Croix Field Olfactometry Training (Nasal Ranger), 2003

University of Tennessee CNMP Development Course (Nationwide Certification), 2003

Ontario Fundamentals of Nutrient Management Planning, 2002

Ontario Nutrient Management Planning Applications using NMAN Software, 2002

EMPLOYMENT HISTORY

1995-	Principal/Vice-President
Present	Conestoga-Rovers & Associates, Waterloo, ON
	Named CRA Principal/Vice President, 2010
	Named CRA Associate, 2002

PROFESSIONAL REGISTRATIONS/AFFILIATIONS

Registered Professional Engineer: Ontario

Member, American Society of Agricultural Engineers

Member, American Agricultural Law Association

PROFILE OF PROFESSIONAL ACTIVITIES

Waste to Energy Recovery Systems

- Providing technical advice to a 12,000-cow dairy operation in regards to manure treatment technologies, anaerobic digestion, and potential for electricity generation and biomethane upgrading for commercial use. The study involves market assessments, process flow diagrams, mass and energy balances, technology recommendations, end product review, and assessment of biogas upgrading, utilization and system implementation.
- Assisted with an economic assessment of commercially available and/or emerging green energy technologies in the agricultural, food processing, and rural sectors throughout North America and Europe. The project included a jurisdictional scan to identify opportunities for government intervention to stimulate green energy. The energy technologies were further analyzed through a SWOT, existing barriers, overall economic impact, and greenhouse gas emission reduction potential.
- Assisted the successful negotiation with the California Regional Water Quality Control Boards for the acceptance compacted clay lined lagoon digesters. This project included geotechnical assessments, technology review and engineering assessment of the digester related components. This project also involves the review and impact assessment of adding off-farm organics.
- Assisting in a research study to develop a county-based model to determine the feasibility of a cooperative co-substrate digestion system including livestock operations and other organics, locating of a facility based on heat users, electric service, and proper zoning by-laws. The research study will also include bench-scale studies on the biogas production of various wastes.
- Completion of nutrient management activities associated with the digestate from an Induced Blanket Reactor located on a 1,000 head diary operation currently researching conditioning of biomethane for use in vehicles.

Engineering Design

- Project manager for the completion of 20 waste management system designs for dairy facilities and beef feedlots in Utah including lagoons, storm water retention ponds, water control structures, heavy use area protection, pipelines, pumping stations, composting, and solid/liquid separation.
- Project manager for the completion of seven preliminary designs for engineering projects in Florida including freestall barns, storm water retention ponds, heavy use area protection, irrigation conveyance, composting, and solid/liquid separation for four dairy and three poultry operations. Activities included liaison with government agencies, site survey, geologic investigations, waste management system review, and analysis of other conservation practices.
- Assisted the completion of three final designs for engineering projects in Tennessee including waste storage ponds on two dairy operations, silage leachate collection, evaluation of existing waste storage ponds, and extension or installation of a drag hose manure pipeline transfer system on three dairy operations.
- Project assistance in the completion of an A & E contract for USDA-NRCS in Indiana to perform field assessment and engineering design of approximately 100 grassed waterways. Project activities included liaison with government agency representatives for initial project setup, including budgeting and staffing, field investigation, and technical assistance in the design of grassed waterways.
- Project management for the engineering design of 300-cow dairy operation in Kenton, Delaware. Project activities included liaison between government agency and the dairy operator, preliminary design, project budgeting and staffing, survey, detailed design of solid, slurry, and liquid storages,

manure transfer system, clean water diversion, and irrigation system; and nutrient management planning.

- Project engineering relating to a variety of Nutrient Management Plans/Nutrient Management Strategies in Ontario.
- Project engineering related to environmental and manure treatment technologies.
- Initiated contact with several commodity boards to discuss pilot studies involving Innovative Manure Management and Treatment Technologies.

Soil and Water Conservation Practices Engineering Design for USDA-NRCS

- Project management and coordination for survey, design, layout and checkout of 19 irrigation systems and 7 animal watering facilities in Utah.
- Project manager for the completion of 14 surveys and 7 design packages for irrigation systems in West Virginia including layout, stakeout, design and check out of irrigation systems for truck crops and orchards..
- Project manager for the completion of 7 designs for irrigation systems in Hawaii including layout, stakeout, design and check out of irrigation systems for various fruit and horticultural operations. Systems range in size from 0.5 acres to 60 acres..
- Managed/coordinated indefinite delivery, indefinite quantity contracts in Mississippi/ Alabama to complete animal waste management system designs, and other soil and water conservation practices with the activities including contract liaison with government agencies.
- Assisted in the completion of engineering services contract for USDA-NRCS in Indiana to perform design of approximately 100 grassed waterways. Activities included project budgeting and staffing, field investigation, and technical assistance in the design of grassed waterways.

Plan Development

- Project Manager for Annual Reporting, Nutrient Management Planning and Waste Management Engineering for a 15,000 head dairy and 17,000 associated acres of cropland in California. Activities include a detailed technical review of all manure management and handling practices, irrigation system review, and development of recommended land application practices in accordance with the state and local regulations.
- Project Manager for Annual Reporting, Nutrient Management Planning and Waste Management Engineering for over 20 dairies ranging in size from 400 to 6000 head operations in the central valley of California. Activities include a detailed technical review of all manure management and handling practices, irrigation system review, and development of recommended land application practices in accordance with the state and local regulations.
- Project management for the completion of IDIQ CNMP services contract for USDA-NRCS in Wisconsin. Activities included contract liaison with government agency representatives, and providing technical review including site review, soil/manure sampling, and CNMP development.
- Project management for the completion of CRP services contract for USDA-NRCS in Wisconsin. Activities included contract liaison with government agency representatives, and providing technical review including site review and CRP development.
- Project management for the completion of IDIQ NMP services contract for USDA-NRCS in North Dakota. Activities included contract liaison with government agency representatives, and providing technical review including site review and NMP development.

- Project assistance with the completion of IDIQ Conservation Reserve Program (CRP) services contract for USDA-NRCS in Oklahoma. Activities included project budgeting and staffing, technical assistance throughout Oklahoma.
- Project assistance for a contract in California under the USDA-NRCS Wetland Reserve Program (WRP) and Wildlife Habitat Incentive Program (WHIP). Project activities included approximately 45 wetland monitoring assessments and 15 wildlife habitat assessments in the Sacramento Valley.
- Project management for completion of a CNMP and conservation plan on 2,400-cow dairy operation in Dublin, Texas. Activities included liaison between government agency and dairy operator; preparation and completion of data gathering on operation including facility review, soil sampling, sensitive feature assessment, etc.; regulatory review and compliance audit; GPS/GIS figure development; CNMP development, conservation plan development for dryland cropland, irrigated cropland, and rangeland.
- Project coordination for the completion of approximately 200 conservation plans for the USDA-NRCS CRP throughout Texas with three project teams in West, Central, and South Texas. Activities included liaison between government agency, internal personnel, and land owners; provided technical expertise in residue management and nutrient/pest management; and prepared contractual documentation.
- Project management and coordination for the completion of a number of NMPs on beef, poultry, and hog operations through Southwestern Ontario. Activities included liaison between government agency and livestock producer, data acquisition, completion of field activities, and NMP development.
- Project management for the completion of nutrient management strategies for Woodbine and Mohawk horse tracks in Ontario. Project activities included liaison with client, budgeting and staffing, data acquisition, field activities, and report generation.

Due Diligence/Risk Assessment/Auditing Services

- Project manager for the assessment of approximately 300 Murphy-Brown operations in North Carolina as part of a consent decree with the Waterkeeper alliance. This project involved a comprehensive review of all aspects of site operations and land application areas surrounding production facilities.
- Project manager of a Phase I due diligence in the sale of the second largest hog operation in Canada. Activities included liaison with client, government officials and contractors, project staffing and budgeting, technical review of Nutrient Management Plans (NMPs), and reporting.
- Project manager for the auditing services for all activities associated with biosolids land application and historical document review for the City of Toronto. Project activities included liaison with client, project budgeting and staffing, site C of A review, land application, and odour monitoring to ensure compliance with provincial regulations, and historical file review.
- Project Coordination for the completion of Phase I due diligence for Murphy Farms on the potential purchase of numerous hog operations in Ontario. Project activities included project oversight, staffing, field coordination, and technical review.

Training Development

- Project manager for the development of a 4-week training course of agricultural enforcement officers in Ontario. The project activities included liaison with client, government officials and contractors, project staffing and budgeting, and development of training modules for all commodity groups, farm practices and regulations.

- Project manager for the completion of numerous new and revised factsheets in Ontario for nutrient management and engineering regulations. Project activities included development and review of outdoor confinement area factsheets and technical review of factsheets pertaining to milkhouse washwaters, oil/gas wells, and concrete quality.
- Conducted several Nutrient Management presentations at County Cattleman's, Pork, Dairy, and Crop Producers Annual Meetings educating producers on the impacts and implementation of pending regulations.
- Project input relating to the Clean Water Expo at Canada's Outdoor Farm Show. The expo was developed to educate producers and the public on the importance of clean water and protection of water through best management practices and engineering assistance.

Agriculture Conferences and Meetings

- Compost Council of Canada Annual Conference
- New York State Water Quality Symposium
- Grey/Bruce Farmers Week
- Simcoe Ag Info Days
- Southwest Ag-Conference
- Farm Smart Agricultural Conference
- Ontario Federation of Agriculture (OFA) Annual Convention
- Integrated Solutions to Manure Management Conference
- National Conference on Agricultural Nutrients and Their Impact on Rural Water Quality
- Attended several OMAF Nutrient Management Stage II Stakeholder Meetings
- Attended several OMAF Nutrient Management Stage II Consultation Meetings

Remediation Site Investigation and Remediation

- Project Manager relating to the investigation and quarterly groundwater sampling associated with elevated nitrate levels for a confidential client in Hinkley, California.
- Project engineering relating the site remediation of gasoline-contaminated site in Listowel, Ontario. Activities included cleanup oversight, confirmatory/stockpile soil sampling and analysis, technical review, report development, and liaison between client and contractors.
- Project engineer responsible for conducting and supervising the full-scale implementation of potassium permanganate (KMnO4) injection program for the remediation of a VOC plume at a GM facility located in Ypsilanti, Michigan. The project included installation of 55 monitoring/injection locations, injection of KMnO4 solution, continued monitoring, detailed evaluation of the distribution of permanganate solution, extent of remediation achieved, and fate of reaction by-products.
- Project engineer for remedial investigation/feasibility study and remedial design and construction oversight for a groundwater collection system at a chemical plant site in Schenectady, New York.
- Project engineer responsible for conducting several hundred residential basement surveys to determine the air quality of homes located in and area affected by a TCE plume of shallow groundwater contamination. Subsequent air sampling was conducted within several residential homes by means of summa canisters.
- Project engineer responsible for the co-ordination of field activities involving oversight of mud rotary drilling techniques, continuous VOC sampling, stockpile removal, and health and safety at a Superfund site located in New York State.

- Project engineer responsible for the installation, supervision, and testing of bedrock extraction and monitoring well networks at a site located in Niagara Falls, New York.
- Supervised cable tool drilling activities along with the installation of extraction wells in for a site located in the Tacoma, Washington. Performed pumping tests on the installed and developed wells. Also responsible for air quality monitoring during the assessment activities at this site.
- Project engineering related to a Time-Critical Removal Action at a former drum recycling facility Superfund site located in Wisconsin primarily impacted by lead and polychlorinated biphenyls.
- Project engineering relating to the remediation of a former refinery in Bossier City, Louisiana, including: collection and evaluation of data for preparation of a historical indoor air analytical database, preparation of RI Work Plan, and associated plans for excavation and removal of lead impacted soils including Health and Safety Plans, Project Specifications, and Final Report.
- Field support for the Fields Brook Superfund Site located in Ohio. The project includes screening for radioactive contamination, construction of an on-site landfill, water diversion, sediment removal from a creek system, dewatering, and restoration of wetland areas.
- Assisted with a comprehensive environmental compliance assessment of a large automotive manufacturing facility in Michigan in the areas of permitting, emergency response, database management, and monitoring and reporting activities for multi-media environmental conditions.
- Project engineer responsible for conducting and analyzing hydrogeologic investigations to determine aquifer characteristics including single well response tests and constant rate and step drawdown pumping tests in unconfined, confined, and fractured aquifers.
- Project engineer responsible for conducting and supervising several groundwater sampling programs involving low flow purging methods utilizing a combination of bladder pumps and peristaltic pumps.
- Project engineer for the long-term monitoring programs and subsequent reporting at various landfill sites throughout Ontario.
- Project engineer responsible for supervision of bedrock injection testing to determine aquifer hydraulic conductivity.
- Project engineer responsible for supervision and coordination of field investigations including drilling and sampling programs conducted at hazardous waste sites and industrial facilities.
- Project engineer responsible for supervision and implementation of groundwater monitoring and sampling programs undertaken in conjunction with hydrogeologic investigations.
- Project engineering related to the preparation of Environmental Site Assessment Reports for several MTO patrol yard sites in Ontario.
- Performed various field activities including sampling (surface water, groundwater, surface soil, subsurface soil, and confirmatory wipe sampling), equipment maintenance, well installation oversight, hydrogeologic investigation, and construction oversight.
- Assisted in preparation of various documents and technical reports including: Proposals, RCRA Facility Investigation (RFI) Work Plans and Reports, Remedial Investigation/Feasibility Study (RI/FS) Work Plans and Reports, Expert Witness Reports, Remedial/Site Investigation Work Plans and Reports, Health and Safety Plans (HASP), Remedial Action Plans (RAP) and Reports (RAR), Progress Reports, Operation, Maintenance, and Annual Monitoring Reports, Subcontractor Contract Specifications and Cost Analysis, and Data Management and Analysis.

Air Quality Assessment

- Air emissions assessment, permits, and Certificate of Approval (Air) for a variety of manufacturing facilities including, particle board, metal, coating, chemical, and automotive industries.

- Air permit preparation for Uniroyal Chemical located in Naugatuck, Connecticut.
- USEPA Clean Air Act Title V permitting assessments for industrial facilities.

Litigation Support

- Project manager for the completion of field sampling oversight on several poultry operations - State of Oklahoma vs. Tyson Foods, Inc. et al.
- Project engineer for activities in support of litigation Review of deposition testimonies regarding PCE/TCE contamination at several locations in California.
- Project engineer for activities in support of litigation determination of PCE groundwater contamination in the vicinity of a former dry cleaning site located in California. Responsible for historic data review and assessment, interpretation of hydrogeologic and chemistry data, determination of contaminant fate and transport, and preparation of technical expert reports and presentation materials.
- Project engineer responsible for activities in support of expert testimony for the Maybrook Lagoon Site litigation.
- Project engineer responsible for activities in support of expert testimony for several sites involved in the Consumers Energy litigation.
- Project engineer responsible for activities in support of expert testimony for several sites involved in Unysis vs. Wausau, Case Number L-1434-94-B litigation.
- Project engineer responsible for activities in support of expert testimony for sites involved in the Condea Vista litigation.
- Andritz Sprout-Bauer, Inc. vs. Beazer East, Inc.
- Koppers v. Aetna (Phase II) and Koppers v. INA, et al.