



**CONESTOGA-ROVERS
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December 17, 2014

Reference No. 089062

Mr. Beshad Moghaddam
Regulatory Compliance Manager
Northeastern University
360 Huntington Avenue
Boston, MA 02115

Dear Mr. Moghaddam:

Re: Verification Report
2013 Greenhouse Gas Report in accordance with 310 CMR 7.71
Northeastern University, Boston, Massachusetts (Facility AQ ID: 1190054)

1.0 Introduction

Northeastern University (Northeastern) retained Conestoga-Rovers & Associates (CRA) to undertake a verification of the Boston facility (Facility) Greenhouse Gas (GHG) Report (GHG Report) for the compliance period of January 1 to December 31, 2013. CRA has completed the verification in accordance with the requirements of 310 CMR 7.71: *Mandatory Greenhouse Gas Emissions Reporting Program* (310 CMR 7.71), The Climate Registry's (TCR's) *General Reporting Protocol* (GRP), Version 2.0 (March 2013), TCR's *General Verification Protocol* (GVP) for the Voluntary Reporting Program, Version 2.0 (June 2010) and the associated list of clarifications and corrections.

In accordance with 310 CMR 7.71, an entity that owns, operates, and/or controls a facility that meets the applicability criteria outlined in Section 3 and is required to report GHG emissions to the Massachusetts Department of Environmental Protection (MassDEP) according to Section 5, must have their GHG Report verified by a third-party verification body (VB) once every three years to ensure accuracy of the submission and verify compliance with 310 CMR 7.71. 310 CMR 7.71 defines a Massachusetts recognized VB as a verification body that meets the following criteria:

1. The organization must be recognized by TCR
2. The organization must be accredited by the American National Standards Institute (ANSI) to ISO 14065:2013
3. The organization must be aware of the relevant MassDEP reporting and verification regulations



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4. The organization must submit an application to the MassDEP demonstrating that the organization meets the above criteria

On December 23, 2011, CRA submitted an application to MassDEP to demonstrate meeting the above criteria. On January 10, 2012, MassDEP notified CRA that the application had been accepted and that CRA was approved to be a recognized VB.

CRA has prepared this Verification Report in accordance with ISO Standard *ISO 14064 Greenhouse gases - Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions* (ISO 14064-3) and with the requirements of 310 CMR 7.71 and TCR's GVP.

2.0 Verification Objective

The objective of the verification is to provide Northeastern and the MassDEP with assurance that the Facility's 2013 GHG Report contains no material discrepancy and was prepared in accordance with 310 CMR 7.71 and TCR's GRP.

3.0 Level of Assurance

CRA conducted the verification to a reasonable level of assurance. The verification statement is worded in a manner to meet the requirements set forth in 310 CMR 7.71, Section 7.

4.0 Verification Standards

CRA applied ISO 14064-3, The Climate Registry *General Reporting Protocol* Version 2.0, and 310 CMR 7.71 as the verification standards.



5.0 Verification Criteria

CRA applied the following criteria for this verification:

- ISO 14064 Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals, ISO, March 2006 (ISO 14064-1)
- ISO 14064 Greenhouse gases - Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions, ISO, March 2006 (ISO 14064-3)
- General Reporting Protocol Version 2.0, TCR, March 2013 (GRP), including any updates and clarifications published by TCR
- 2012 Climate Registry Default Emission Factors, TCR, April 11, 2014
- General Verification Protocol Version 2.0, TCR, June 30, 2010 (GVP), including any updates and clarifications published by TCR
- 310 CMR 7.71: Mandatory Greenhouse Gas Emissions Reporting Program, MassDEP

6.0 Verification Scope

The following sections describe the scope of the Verification.

6.1 Facility Emission Sources

Northeastern University is an educational institute located in Boston, Massachusetts with several buildings and sources of GHG emissions including natural gas and fuel oil #2 boilers, emergency generators, gasoline and diesel powered vehicles and refrigerant sources such as air conditioning systems. The Facility emission sources include those from:

Scope 1 Emissions (Direct Emissions)

- Stationary Combustion (Natural Gas) – Carbon Dioxide (CO₂), Methane (CH₄), and Nitrous Oxide (N₂O)
- Stationary Combustion (Fuel Oil #2) – CO₂, CH₄, and N₂O
- Mobile Combustion (Gasoline) – CO₂, CH₄, and N₂O
- Mobile Combustion (Diesel) – CO₂, CH₄, and N₂O
- Fugitive Emissions (Refrigerants) – Hydrofluorocarbons (HFCs)



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6.2 Geographical and Organizational Boundaries

The verification included the emission sources from the Facility located at the following address:

360 Huntington Avenue
Boston, Massachusetts 02115

It should be noted that Northeastern encompasses several buildings and areas of operations within the campus. For the purpose of this verification, all buildings and areas of operations owned and operated by Northeastern were included and considered as part of the Facility's operational boundary.

6.3 Reporting Period

The reporting period is between January 1, 2013 and December 31, 2013.

6.4 Use of this Report

This report has been prepared for the use of Northeastern and, upon request, MassDEP and TCR.

Statements from CRA's Verification Report, including the Verification Statement must reference the date of issuance of CRA's report, the applicable verification period and the associated programme for which the verification was conducted. The GHG assertion provided by CRA can be freely used by Northeastern for marketing or other purposes other than in a manner misleading to the reader. The CRA mark shall not be used by Northeastern in any way that might mislead the reader about the verification status of the organization. The CRA mark can only be used with the express consent of CRA and, then, only in relation to the specific time period verified by CRA.

7.0 Verification Plan

CRA developed a Verification Plan including a sampling plan based on a preliminary review of the data initially provided. CRA submitted the Verification Plan to Northeastern on October 13,



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2014, prior to CRA's Site visit on October 20, 2014. CRA's Verification Plan was revised, as required, throughout the course of the verification to address questions or initial concerns with data originally provided.

7.1 Facility Emissions Sources

The Facility emissions sources include the following main groups, as listed in the GHG Report:

<i>Source Group</i>	<i>Reported Emissions (tons CO₂e)</i>	<i>Percentage of Total Emissions (%)</i>	<i>Calculation Methodology</i>
Stationary Combustion			
Stationary Combustion: Natural Gas	33107.3	95.59%	<ul style="list-style-type: none"> Consumption based on third party invoices provided from National Grid CO₂, CH₄ and N₂O emissions are based on emission factors in TCR's GRP Tables 12.1, 12.8, and 12.9
Stationary Combustion: Fuel Oil #2	821.0	2.37%	<ul style="list-style-type: none"> For the boilers, consumption is based on purchased quantities in 2013 As fuel oil consumption is estimated based on purchased quantities, Simplified Estimation Methodologies (SEMs) were applied in accordance with 310 CMR 7.71 For emergency generators, the fuel oil consumption is based on emergency generator consumption rate and hours of operations CO₂, CH₄ and N₂O emissions are based on emission factors provided in Tables 12.1 and 12.9 of the GRP
Mobile Emissions			
Mobile Emissions: Gasoline	498.7	1.44%	<ul style="list-style-type: none"> Gasoline consumed in 2013 is based on purchased quantities from the Facility's on-site service station Mileage is estimated based on fuel economies specified in USEPA's fueleconomy.gov CO₂, CH₄ and N₂O emissions are based on emission factors provided in Tables 13.1 and 13.5 of the GRP



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<i>Source Group</i>	<i>Reported Emissions (tons CO₂e)</i>	<i>Percentage of Total Emissions (%)</i>	<i>Calculation Methodology</i>
Mobile Emissions: Diesel	95.1	0.27%	<ul style="list-style-type: none"> • Diesel consumed in 2013 is based on purchased quantities from the Facility's on-site service station • Mileage is estimated based on fuel economies specified in USEPA's fueleconomy.gov • CO₂, CH₄ and N₂O emissions are based on emission factors provided in Tables 13.1 and 13.7 of the GRP
<i>Fugitive Emissions</i>			
Fugitive Emissions: Refrigerant Emissions	114.2	0.33%	<ul style="list-style-type: none"> • Refrigerant recharges for campus chillers are based on refrigerant recharges documented in internal maintenance records • Refrigerant losses from other fugitive sources such as window air conditioners are estimated based on TCR SEMs approach

7.2 Assessment of Risk and Magnitude of Potential Errors, Omissions, or Misrepresentations

Based on CRA's review of the Facility's operations, the following table summarizes the potential risk and magnitude of potential errors, omissions or misrepresentations, as currently known:

<i>Potential Risk Area</i>	<i>Percentage of Emissions (% Change in Emissions from 2012 to 2013)</i>	<i>Risk Categorization (Inherent, Control, Detection)</i>	<i>Risk Level (High, Medium, Low)</i>	<i>Justification</i>
Stationary Combustion Sources – Natural Gas	95.59% (8.8% increase from 2012 to 2013)	Inherent	Low	The calculation methodology for stationary combustion emissions from natural gas is low in complexity. Therefore, CRA considers the inherent risk to be low.
		Control	High	The natural gas combustion emissions are based on third party invoiced amounts; therefore the potential for error is low. As CRA identified an approximate 8.8%



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Potential Risk Area	Percentage of Emissions (% Change in Emissions from 2012 to 2013)	Risk Categorization (Inherent, Control, Detection)	Risk Level (High, Medium, Low)	Justification
				increase in the total Facility emissions from 2012 to 2013 from the natural gas combustion emissions, CRA considers the control risk to be high.
		Detection	Low	CRA requested and reviewed a sample set of third party documentation that covered approximately 94% of the natural gas combustion emissions. In addition, CRA reviewed internal records of natural gas usage for 2013. CRA considers the detection risk to be low as CRA did not review 100% of the data available.
Stationary Combustion Sources – Fuel Oil #2	2.37% (1.9% decrease from 2012 to 2013)	Inherent	Low	The calculation methodology for stationary combustion emissions from fuel oil #2 is low in complexity. Therefore, CRA considers the inherent risk to be low.
		Control	Low/Medium	The Facility tracks fuel oil #2 usage based on internal and third party records. As there are many fuel oil #2 combustion sources, a potential discrepancy may exist in the internal records. Therefore, CRA considers the control risk to be low/medium.
		Detection	Low	CRA requested and reviewed third party documentation that covered approximately 60% of the fuel oil #2 combustion emissions. As the fuel oil #2 combustion emissions represents a small percentage of the total Facility emissions in comparison with the natural gas combustion emissions, CRA considers the detection risk to be low.
Mobile Combustion Sources – Gasoline	1.44% (0.037% decrease from	Inherent	Low	The calculation methodology for mobile combustion emissions from gasoline usage is low in complexity. Therefore, CRA considers the inherent risk to be low.



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Potential Risk Area	Percentage of Emissions (% Change in Emissions from 2012 to 2013)	Risk Categorization (Inherent, Control, Detection)	Risk Level (High, Medium, Low)	Justification
	2012 to 2013)	Control	Low	The Facility tracks fuel usage from the Facility's service station. As this emission sources represents a relatively small percentage of the Facility emissions, CRA considers the control risk to be low.
		Detection	Low	CRA requested and reviewed all internal records associated with gasoline usage for Facility vehicles in 2013. Therefore, CRA considers the detection risk to be low.
Mobile Combustion Emissions – Diesel	0.27% (0.088% increase from 2012 to 2013)	Inherent	Low	The calculation methodology for mobile combustion emissions from diesel usage is low in complexity. Therefore, CRA considers the inherent risk to be low.
		Control	Low	The Facility tracks fuel usage from the Facility's service station. As this emission sources represents a relatively small percentage of the Facility's emissions, CRA considers the control risk to be low.
		Detection	Low	CRA requested and reviewed all internal records associated with diesel usage for Facility vehicles in 2013. Therefore, CRA considers the detection risk to be low.
Fugitive Emissions: Refrigerant Loss	0.33% (0.32% decrease from 2012 to 2013)	Inherent	Low/Medium	The calculation methodology for fugitive emissions from refrigerant losses requires several inputs; which may result in higher complexity calculations. Therefore, CRA considers the inherent risk to be low/medium.
		Control	Low	The Facility reported fugitive emissions from Facility chiller units based on internal maintenance records. Fugitive emissions were also estimated for refrigerant sources (i.e. air conditioning units) based on SEMs. As these emissions represent a small percentage of the overall Facility emissions,



<i>Potential Risk Area</i>	<i>Percentage of Emissions (% Change in Emissions from 2012 to 2013)</i>	<i>Risk Categorization (Inherent, Control, Detection)</i>	<i>Risk Level (High, Medium, Low)</i>	<i>Justification</i>
				CRA considers the control risk to be low.
		Detection	Medium/High	CRA conducted a review of the methodologies and assumptions used in the calculations to estimate the fugitive emissions from refrigerant losses. CRA considers the detection risk to be medium/high.
Data Management Systems	N/A (6.7% overall increase from 2012 to 2013)	Inherent	Low	Low complexity in data management as the majority of the Facility's emissions are from natural gas combustion.
		Control	High	The control risk is considered to be high as the increase in Facility emissions from 2012 to 2013 is 6.7%.
		Detection	Low/Medium	CRA reviewed a sample set of data that represented over 90% of the Facility's emissions. As CRA did not review 100% of the available data set, CRA considers the detection risk to be low/medium.

7.3 Final Sampling Plan

CRA developed a sampling plan based on review of the objectives, criteria, scope, and level of assurance detailed above. The sampling plan is dynamic and was revised, as required, throughout the course of the verification process.



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The following table summarizes the final sampling plan of material sources:

<i>Data/Information Description</i>	<i>Data/Information Source</i>	<i>Collection Frequency</i>	<i>Sample size/Action</i>
General			
Detailed Process Overview	<ul style="list-style-type: none"> Facility Description and Facility Map 	N/A	N/A
Emission Calculations	<ul style="list-style-type: none"> Calculation spreadsheet References to Emission factors, calculations, and reporting methods 	N/A	N/A
Comparison of 2012 and 2013 GHG Reports	<ul style="list-style-type: none"> General review and comparison of Facility GHG emissions reported for 2012 and 2013 	N/A	<ul style="list-style-type: none"> 2012 and 2013 GHG Reports Rationale for increases/ decreases between 2012 and 2013 reporting years
Scope 1 Direct Emissions			
<i>Stationary Combustion – Direct emissions from stationary combustion</i>			
Stationary Combustion – Natural Gas	<ul style="list-style-type: none"> Third party invoices from National Grid 	Monthly invoices	January 2013 to January 2014 invoices covering approximately 94% of natural gas combustion emissions
Stationary Combustion – Fuel Oil #2	<ul style="list-style-type: none"> Third party invoices for fuel oil purchased Emergency generator logs with operating times Emergency generator fuel consumption rates and capacities 	<ul style="list-style-type: none"> Invoice per delivery of fuel oil Single document for emergency generator log 	Records that over approximately 60% of fuel oil #2 emissions
<i>Mobile Combustion Emissions</i>			
Mobile Combustion – Gasoline/Diesel	<ul style="list-style-type: none"> Internal logs of gasoline purchased from Facility 	<ul style="list-style-type: none"> Single documentation 	All 2013 Records



<i>Data/Information Description</i>	<i>Data/Information Source</i>	<i>Collection Frequency</i>	<i>Sample size/Action</i>
	service station <ul style="list-style-type: none"> • Facility description of maintenance of fuel meters and data management system for service station • Facility fleet vehicle inventory 		
<i>Fugitive Emissions – Refrigerants in Air Conditioning Units</i>			
Fugitive Emissions – Refrigerant	<ul style="list-style-type: none"> • Internal service records with refrigerant recharges on Facility chiller units • Estimation methodologies applied for other refrigerant units (i.e. window ACs) 	Record per maintenance/repair event	General methodologies and partial sample size

7.4 Materiality

Facility quantitative materiality for this verification is set at plus or minus 5 percent of the 2013 emissions as per the TCR GRP. An individual error, omission, misstatement or the aggregate effect of discrete errors, omissions, or misstatements may be considered material.

8.0 Verification Procedures

8.1 Methodologies Used to Access/Verify Emissions Data

CRA used the verification procedures detailed in the Verification Plan to assess the following:

1. Accuracy and completeness of annual GHG Report
2. Uncertainty of external data sources used
3. Emission assumptions
4. Accuracy of emission calculations
5. Inconsistencies between reported emissions and emissions calculation methodologies between reporting years



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6. Potential magnitude of errors and omissions

To sustain a risk-based assessment, the CRA Project Team identified and determined risks related to annual GHG emissions during both the desk reviews and the follow-up interviews. The CRA Project Team particularly focused on the accuracy and completeness of provided information. The components of the document review and follow-up interviews were:

- Document Review:
 - Review of data and information to confirm the correctness and completeness of presented information
 - Cross-checks between information provided in the GHG Report and information from independent background investigations
 - Determine sensitivity and magnitude analysis for parameters that may be the largest sources of error
 - Comparison of GHG Report from 2013 with GHG Report from previous reporting year(s)
- Follow-up Interviews:
 - On site
 - Via telephone
 - Via email

Through the document review CRA established to what degree the presented GHG Report documentation met the verification standards and criteria.

The CRA Project Team's document review during the review process comprised an evaluation of whether or not:

- The documentation is complete and comprehensive and follows the structure and criteria given in TCR's GRP, 310 CMR 7.71, and ISO 14064-1
- The methodologies are justified and appropriate
- The assumptions behind the inventory are conservative and appropriate
- The GHG emission calculations are appropriate and use conservative assumptions for estimating GHG emissions
- The GHG information system and its controls are sufficiently robust to minimize the potential for errors, omissions, or misrepresentations



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The CRA Project Team interviewed Facility personnel to:

- Cross-check information provided
- Test the correctness of critical formulae and calculations
- Review data management and recording procedures

8.2 Details of Site Visit

On October 20, 2014, Maggie Scott (lead verifier) of CRA completed a Site visit. During the Site visit, CRA reviewed the verification process, emission calculations and methodologies, and supporting documentation such as invoices, internal records, and maintenance records with Northeastern. Supporting documentation that was reviewed during the site visit included natural gas invoices and internal fuel records.

Following this review, CRA was escorted by Mr. Beshad Moghaddam (Regulatory Compliance Manager) and Mr. Joseph Ranahan about the Facility to physically view significant sources of emissions including the following:

- Central Steam Plant Boilers and corresponding natural gas meter
- Central Steam Plant emergency generator
- Selection of building boilers
- Facility service station where gasoline and diesel are dispensed
- Selection of natural gas meters

Mr. Moghaddam was present at all times during CRA's Site visit and was responsible for the Facility's 2013 GHG Report.

9.0 Verification Findings

The following subsections provide details of CRA's findings as well as CRA's conclusions.



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9.1 Verification Findings

The following present a summary of the independent quantifications from the document review:

<i>Emission Source Group</i>	<i>Facility Boundary and Emission Sources</i>
Scope Item Verified	Assessment of completeness and inclusion of all emission sources
Verification Procedure	<p>CRA reviewed supporting documents provided by Northeastern and completed a Site visit to verify the emission sources at the Facility. Specifically, CRA completed the following:</p> <ul style="list-style-type: none"> - Review of Facility operations, emission sources, and data management systems - Interviewed Facility personnel - Review of supporting documentation such as third party records and internal records and logs - Review of all reported emissions sources in the 2013 GHG Report including stationary combustion, mobile combustion, and fugitive emission sources
Verification Findings	<p>CRA reviewed information including a Facility map of buildings and sources, third party documentation of fuel usages including natural gas and fuel oil #2, and discussions with Facility personnel on the data management system and the operational boundary. In addition, CRA conducted a site visit to view a selection of sources to ensure that all relevant sources have been captured in the GHG Report. Based on CRA's review, all relevant emission sources were included in the 2013 GHG Report.</p>
Conclusion	Based on CRA's review, all sources of GHG emissions have been included in Northeastern's 2013 GHG Report.

<i>Emission Source Group</i>	<i>Stationary Combustion</i>
Scope Item Verified	Stationary Combustion – Natural Gas
Verification Procedure	<p>Review of Northeastern's calculations including methodology and review of data inputs into the relevant calculation equations. CRA also recalculated the emissions associated with natural gas based on Facility internal records and third party invoices and compared with Northeastern's emission estimates, including the as-entered totals in their 2013 GHG Report.</p>
Verification Findings	<p>Natural gas combustion emissions are the primary emissions from Northeastern, representing over 95% of the total emissions. Northeastern has 42 natural gas meters and corresponding accounts with National Grid. The Facilities Department manages 36 of these accounts and the remainder are managed by the Facility's Business Office. As the Facilities Department and Business Office are responsible for the payment of invoices for all natural gas</p>



<i>Emission Source Group</i>	<i>Stationary Combustion</i>
	<p>usage at the Facility, the internal records provided by Northeastern encompass all of the accounts/meters owned by the Facility. Both the Facilities Department and the Business Department maintain invoice data on spreadsheets which tabulates monthly invoices. CRA's original sampling plan required a sample size of third party data to cover 80-90% of the natural gas combustion emissions and documentation of internal record keeping. As an initial step, CRA reviewed the internal records (i.e. spreadsheets) of the monthly invoices and selected to review invoices for 11 accounts representing approximately 94% of the Facility emissions. CRA was able to review a higher sample size as based on a review of the internal records, it was determined that a small number of accounts, such as the Central Steam Plant, represent the majority of the natural gas usage at the Facility. Based on this evaluation, CRA determined whether there was a need to request for more invoices for review. CRA compared the amounts in the National Grid invoices with the internal records and found that there was less than 0.2% discrepancy in the quantities determined by CRA and usages reported by Northeastern. The discrepancy primarily resulted from the fact that Northeastern did not pro-rate the natural gas usage to the beginning and ending of the calendar year. As the discrepancy is low, it is CRA's opinion that there is a low control risk for discrepancies in the data used for the 2013 GHG Report.</p> <p>Northeastern applied emission factors from GRP Tables 12.1, 12.8 and 12.9. CRA is in agreement with the CO₂ emission factor used; however, it is CRA's opinion that the CH₄ and N₂O emission factors in Table 12.8 for natural gas boilers in the commercial sector are more appropriate than the Table 12.9 emission factors.</p> <p>CRA recalculated the natural gas combustion emissions based on the invoiced amounts of natural gas for the 11 accounts, which was 30,962 tons. In comparison to Northeastern's reported emissions of 30,730 tons, there was a discrepancy of 0.67% identified. This discrepancy resulted from a difference in natural gas usage based on pro-rated values and difference in emission factors used for the CH₄ and N₂O for some sources. As this discrepancy does not lead to a material error, no further action is required.</p>
Conclusion	CRA completed a full review of the natural gas combustion emissions, calculation methodologies, and supporting documentation. Based on CRA's recalculations, an approximate discrepancy of 0.67% was identified.
Scope Item Verified	Stationary Combustion – Boilers (Fuel Oil #2)



Emission Source Group	Stationary Combustion
Verification Procedure	Review of Northeastern's calculations including methodology and review of data inputs into the relevant calculation equations. CRA also recalculated the emissions associated with fuel oil #2 boilers based on Facility operating records and compared with Northeastern's emission estimates, including the as-entered totals in their 2013 GHG Report.
Verification Findings	<p>Northeastern has fuel oil #2 boilers across the campus (commercial and residential). As Northeastern is unable to track the exact usage of fuel oil at each of these locations, the usage is estimated based on deliveries of fuel oil at each location. The internal records are maintained by the Facilities Department and Business Office for various buildings across campus. Northeastern provided CRA the internal records and a sample size of third party records that represents 60% of the fuel oil #2 combustion emissions. As the fuel oil #2 combustion emissions represent 2.4% of the Facility's total emissions, CRA considers the sample size to be acceptable as the risk of a material error is lower for these emissions in comparison to the natural gas combustion emissions. Based on CRA's review of the third party invoices, there were no discrepancies identified in the fuel oil #2 usages reported for these boilers.</p> <p>CRA agrees with the emission factors used from GRP Tables 12.1 and 12.9. Based on CRA's recalculations, no discrepancies were identified in the emissions reported. As no discrepancies were identified, CRA did not request further data for review.</p> <p>CRA determined that the fuel oil #2 combustion emissions for these boilers are based on SEMs. Northeastern indicated that the emissions for these sources were not indicated as SEMs in their 2013 GHG Report. CRA considers this a qualitative material error, which was subsequently corrected by Northeastern.</p>
Conclusion	CRA completed a full review of the fuel oil #2 consumption and emissions from Facility boilers. No quantitative discrepancies were identified. CRA identified that the emissions for this source were not indicated as having been determined using SEMs in the 2013 report. This was a qualitative material error that was corrected by Northeastern in their 2013 GHG Report.
Scope Item Verified	Stationary Combustion – Emergency Generators (Fuel Oil #2)
Verification Procedure	Review of Northeastern's calculations including methodology and review of data inputs into the relevant calculation equations. CRA also recalculated the emissions associated with fuel oil #2 in the emergency generators based on Facility operating records and compared with Northeastern's emission estimates, including the as-entered totals in their 2013 GHG Report.
Verification Findings	Northeastern has 16 emergency generators throughout their campus. The



<i>Emission Source Group</i>	<i>Stationary Combustion</i>
	<p>emissions from their generators are based on the generator fuel consumption rates, emergency generator loading, and operating hours.</p> <p>For review, Northeastern provide Facility internal records with the operating hours, kilowatt size of the generator, fuel consumption rates and Facility calculation methodologies. Also, Northeastern provided a sample data set with the start and end run times, voltage, and amperage for the generator located at 716 Columbus Avenue. During the Site visit, CRA confirmed that operating logs are maintained at the locations of the emergency generators. CRA also reviewed the fuel consumption rates that were assigned to each generator. Although manufacturer specification sheets were not provided, CRA was able to compare the fuel consumption rates to generators of the same kilowatt size. CRA determined through this comparison that the fuel consumption rates are reasonable for each generator.</p> <p>For the sample set of data, CRA recalculated the quantity of fuel usage for the generator to be 68 gallons, while Northeastern reported 177 gallons. It appears that there may be discrepancy in the fuel consumption rate that was applied in the calculation. Based on the data provided by Northeastern, the fuel consumption rate for this generator is 28.9 gallons per hour at 100% load. Based on CRA' recalculation of the CO₂e emissions from the emergency generator, a 0.003% discrepancy was identified. CRA agrees with the emission factors used, which were from GRP Tables 12.1 and 12.9. As the emissions from this source represent less than 0.137% of the total Facility emissions, there is a low risk of a material error for this source. Therefore no further action is required.</p>
Conclusion	CRA completed a full review of the fuel oil #2 consumption and emissions from emergency generators. Based on CRA's recalculations, a discrepancy of 0.003% was identified. As the discrepancy does not result in a material error, no further action is required.

<i>Emission Source Group</i>	<i>Mobile Combustion</i>
Scope Item Verified	Mobile Combustion – Gasoline and Diesel
Verification Procedure	Review of Northeastern's calculations including methodology and review of data inputs into the relevant calculation equations. CRA also recalculated the emissions associated with consumption of gasoline and diesel based on mileage records and compared with Northeastern's emission estimates, including the as-entered totals in their 2013 GHG Report.
Verification Findings	Northeastern has an on-Site service station that dispenses gasoline and diesel. Northeastern has an electronic system which tabulates the amounts of each fuel



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<i>Emission Source Group</i>	<i>Mobile Combustion</i>
	<p>dispensed for each Facility vehicle. These records were provided to CRA for review. Facility personnel indicated that the dispensers are maintained per manufacturer specifications and are inspected weekly. Based on the electronic logs, departments responsible for vehicles are invoiced for the gasoline and diesel purchased.</p> <p>CRA reviewed approximately 91% of the electronic records of gasoline and diesel quantities invoiced to the various Facility departments.</p> <p><u>Diesel Combustion</u></p> <p>For the mobile diesel combustion emissions, CRA estimates that the diesel usage was 9,110.5 gallons. CRA agrees with the emission factors used by Northeastern which included the CO₂ emission factor from GRP Table 13.1 and CH₄ and N₂O emission factors from Table 13.7 for diesel agricultural equipment as this diesel equipment are primarily used for Facility maintenance. Based on CRA's calculations, the total carbon dioxide equivalent (CO₂e) emissions are 94 tons, while Northeastern reported 95.1 tons (overall discrepancy of approximately 0.003%). The potential discrepancy results from CRA's estimate of usage for January as no records were provided for January. CRA calculated the average monthly usage based on the usages provided for the other months and then applied the average for January. This is a reasonable approach as a review of the data indicate that the diesel usage is fairly consistent throughout the year.</p> <p>As the potential discrepancy is 0.003%, there is a low risk of a material error for the mobile diesel combustion emissions.</p> <p><u>Gasoline Combustion</u></p> <p>For the mobile gasoline combustion emissions, CRA estimates that the gasoline usage was 54,330 gallons. Similar to the diesel usage, CRA estimated the January gasoline usage as records were not provided. CRA calculated the average monthly usage based on the usages provided for the other months and then applied the average for January. This is a reasonable approach as a review of the data indicates that the gasoline usage is fairly consistent throughout the year.</p> <p>CRA agrees with the CO₂ emission factor from GRP Table 13.1 used by Northeastern. To simplify the calculations, Northeastern applied conservative CH₄ and N₂O emission factors from Tables 13.5 for gasoline light trucks (model year 1987-1993). Northeastern also applied an estimated fuel economy of 10 miles per gallon.</p>



<i>Emission Source Group</i>	<i>Mobile Combustion</i>
	<p>It is CRA's opinion that it would be more appropriate to assess the required emission factors for each type of vehicle and corresponding model year. Also, per the guidance of the GRP, the fuel economies for each vehicle should be based on the data provided in www.fueleconomy.gov or actual mileage records if available. To assess potential discrepancies, CRA recalculated the emissions based on the maximum and minimum emissions scenarios. For the maximum emission scenario, CRA applied a conservative value in fuel economy for vehicles based on a Ford Truck (25 miles per gallon according to fueleconomy.gov) and the CH₄ and N₂O emission factors from Table 13.5 (gasoline light trucks for model years of 1987 to 1993). For the minimum emissions scenario, CRA applied a fuel economy of 10 miles per gallon for Chevy, Dodge, and Ford cars/trucks and CH₄ and N₂O emission factors from Table 13.5 (gasoline passenger cars for 2011 model year). Based on this evaluation, CRA determined that the maximum potential discrepancy in the gasoline combustion emissions is 0.07%. Therefore, there is a low risk of a material error.</p>
Conclusion	<p>CRA completed a full review of the gasoline and diesel consumption and emissions for Northeastern's mobile fleet and determined that the potential discrepancy is less than 0.1%. As the emissions from this source represents 1.7% of the total Facility emissions, there is a low risk for a material error. Therefore, no further action is required.</p>

<i>Emission Source Group</i>	<i>Fugitive Emissions</i>
Scope Item Verified	Fugitive Emissions – Refrigerant Recharges
Verification Procedure	<p>Review of Northeastern's calculations including methodology and review of data inputs into the relevant calculation equations. CRA also recalculated the emissions associated with refrigerant losses and compared with Northeastern's emission estimates, including the as-entered totals in their 2013 GHG Report.</p>
Verification Findings	<p>Northeastern operates various refrigerant chillers and air conditioning units across their campus. For the campus chillers, internal maintenance and repair records provide the amounts of each refrigerant that has been recharged at the Facilities. CRA reviewed these records and recalculated the emissions and found a slight difference in values calculated by CRA and Northeastern based on rounding.</p> <p>For other sources such as window air conditioning units, miscellaneous window units, and mobile air conditioning units, fugitive emissions were estimated based on the TCR's GRP guidance. It is CRA's opinion that Northeastern's methodologies applied in the fugitive emissions estimates for refrigerant loss are consistent with TCR's GRP. Based on CRA's recalculation, a minor discrepancy of less than 0.02% was identified.</p>



<i>Emission Source Group</i>	<i>Fugitive Emissions</i>
	As this source represents approximately 0.34% of the total Facility emissions, it is CRA's opinion that there is a low risk of a material error in the reported emissions. Therefore, no further action is required.
Conclusion	CRA reviewed the methodologies and a sample set of data used by Northeastern to calculate the fugitive emissions from refrigerant losses. Based on CRA's review and recalculations based on the sample set of data provided, it is CRA's opinion that there is low risk of a material error in the emissions reported for this source.

9.2 Summary of Errors, Omissions, Misstatements or Non-Compliances Identified

Quantitative materiality for this verification is set at plus or minus 5 percent of the reported emissions as per the MassDEP. The quantitative aggregated magnitude of errors, omissions, and misstatements for the Facility's 2013 MassDEP GHG Report is 0.75 percent, which is less than the materiality threshold of 5 percent.

9.3 Corrections Made to GHG Report

As the discrepancy between CRA's recalculated emissions and Facility's reported emissions is less than the 5 percent material discrepancy threshold, Northeastern was not required to make any corrections to the values reported in their 2013 GHG Report. However, two qualitative material errors were identified that required correction to the report. CRA considers the following two emission sources to be based on SEMs in accordance with TCR's GRP and 310 CMR 7.71. As this was not indicated in Northeastern's 2013 GHG Report, Northeastern was required to make the following revisions to the report.

1. Fuel oil #2 emissions calculated for the Facility boilers are estimated from delivered quantities of fuel instead of actual usage.
2. Fugitive emissions were estimated for some refrigerant emission sources.



9.4 Summary of Comparison with Calculated Emissions from Previous Year

<i>Scopes</i>	<i>Total 2012 (tCO₂e)</i>	<i>Total 2013 (tCO₂e)</i>
Scope 1	32,471.75	34,636.19

There was an increase of 2,164.43 tCO₂e (6.6 percent increase) from 2012 to 2013. The increase in emissions is directly related to the increase in natural gas consumption from 2012 to 2013, which was approximately 8.8 percent and a decrease of fuel oil #2 consumption of approximately 1.9 percent. The emission sources reported in 2012 and 2013 were the same with the exception of one new natural gas combustion source; however, this source of emissions represents a relatively small percentage of the total emissions (less than 0.1 percent). It is CRA's opinion that the increase in Facility emissions from 2012 to 2013 has been properly justified.

9.5 Data Management Systems

Northeastern's documentation and records are tracked primarily by the Facilities Department and the Business Office. It is noted that it is the Facilities Department that is responsible for the preparation and submission of the GHG Report.

Third party invoices are used to assess natural gas and fuel oil #2 consumption at the Facility. In addition, Northeastern maintains internal records of the fuel purchases based on the invoiced quantities.

Mobile combustion emissions are based on records maintained by the Business Office for the Facility's service station. The amounts of gasoline and diesel dispensed by the service station are electronically logged and then invoiced to the various departments for the vehicles that are operated by each department.

Fugitive emissions from refrigerant losses are based on internal records for refrigerant recharges and also estimated based on an estimated number of refrigerant units (i.e. air conditioning units, refrigeration units, etc.) and unit capacities.



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The information requested for review during the GHG verification process was readily provided by Northeastern. Based on CRA's review of this information, the Facility's data management system is adequate for the purpose of GHG reporting as required by 310 CMR 7.71.

9.6 GHG Data and Information

CRA reviewed the following data that was provided by Northeastern to develop the 2013 GHG Report and that was requested by CRA:

- National Grid invoices that covers 94 percent of natural gas combustion emissions
- Third party invoices for fuel oil #2 deliveries that cover approximately 60 percent of fuel oil #2 combustion emissions
- Internal records for diesel and gasoline quantities dispensed in 2013
- Inventory of Facility vehicles
- Calculation methodologies for fugitive emissions estimated for refrigerant losses
- Internal maintenance/repair records for Facility chiller units with quantities of refrigerant recharges
- Calculation methodologies for emergency generator emission calculations
- Emergency generator operating hours and fuel consumption rates

10.0 Verification Team

10.1 Roles and Responsibilities

Lead Verifier – Ms. Maggie Scott, P. Eng. – Ms. Scott led the verification and was responsible for development of the verification plan. Ms. Scott reviewed the risk assessment, recalculation of raw data, data management and draft findings. Ms. Scott prepared and signed the verification statement and verification report. Ms. Scott conducted a Site visit of the Facility.

Peer Reviewer – Mr. Adam Loney, P. Eng. – Mr. Loney conducted a peer review of the verification plan, risk assessment and verification report and findings.

10.2 Qualifications

Lead Verifier/Project Manager – Maggie Scott, B.Sc.E. - Ms. Scott is an Intermediate Engineer with 10 years of experience in environmental consulting. Ms. Scott is an air emissions engineer



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with expertise in air compliance and permitting. Ms. Scott has worked on numerous air projects in various industrial facilities including chemical processing plants, metal foundries, paper and plastic facilities, polymer production and research facilities, and petroleum processing facilities. Her experience includes performing greenhouse gas emissions inventory and verification projects, air emissions inventories, air compliance and permitting assessments, air permit applications, air dispersion modeling using US EPA AERMOD, noise and vibration assessments, indoor air quality monitoring and assessments, ambient air monitoring, and stack testing. Ms. Scott has been involved with over 50 verification projects in Massachusetts as a lead verifier, verifier, or support team member.

Peer Reviewer – Adam C. Loney, P. Eng. - Mr. Loney is a Principal with CRA in the Sustainability, Compliance, and Air Departments and is the Manager of CRA's Greenhouse Gas Assurance Services Group. Mr. Loney has over 14 years of practical experience with compliance assessment; greenhouse gas emissions assessment, validation, and verification; life cycle analysis; air quality and ambient air quality monitoring and water and wastewater assessment, and is a licensed professional engineer in the Province of Ontario.

Mr. Loney's professional practice encompasses all aspects of environmental engineering, with special emphasis on corporate sustainability, greenhouse gas emissions inventories and abatement, air emissions permitting/modelling, and life cycle assessment. Mr. Loney has been a lead auditor, team member, technical expert, and/or independent technical reviewer on more than 50 greenhouse gas validation and verification projects completed under programs including the United Nations Framework Convention on Climate Change Clean Development Mechanism, The Gold Standard, The Climate Registry, the Carbon Disclosure Project, and the Verified Carbon Standard as well as the programs administered by the governments of Alberta, British Columbia, Massachusetts, and Ontario.

Specific project experience in the sustainability arena includes the preparation of greenhouse gas and air emissions inventories for numerous industrial facilities and municipalities, life cycle assessments for products and processes. Mr. Loney was the Project Manager for the development of a customized software package designed to evaluate the environmental footprint of the industrial operations of a client in the aggregate and cement industry with over a hundred individual facilities. Mr. Loney has served as the project manager and senior technical advisor in the preparation of greenhouse gas and criteria air contaminant inventories for numerous clients in the industrial and municipal sectors. Mr. Loney has also completed life



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cycle assessments for a number of clients under the Sustainable Development and Technology Canada grant program.

11.0 Verification Statement

The Verification Statement has been provided as Attachment A.

12.0 Limitation of Liability

Because of the inherent limitations in any internal control structure, it is possible that fraud, error, or non-compliance with laws and regulations may occur and not be detected. Further, the verification was not designed to detect all weakness or errors in internal controls so far as they relate to the requirements set out above as the verification has not been performed continuously throughout the period and the procedures performed on the relevant internal controls were on a test basis. Any projection of the evaluation of control procedures to future periods is subject to the risk that the procedures may become inadequate because of changes in conditions, or that the degree of compliance with them may deteriorate.

The verification opinion expressed in this report has been formed on the above basis.

CRA's review of the 2013 GHG Report included only the information discussed above. While the review included observation of the systems used for determination of the 2013 GHG Report, CRA did not conduct any direct field measurements and has relied on the primary measurement data and records provided by Northeastern as being reliable and accurate. No other information was provided to CRA or incorporated into this review. CRA assumes no responsibility or liability for the information with which it has been provided by others.

The information and opinions rendered in this report are exclusively for use by Northeastern. CRA will not distribute or publish this report without Northeastern's consent except as required by law or court order. The information and opinions expressed in this report are given in response to a limited assignment and should only be evaluated and implemented in connection with that assignment. CRA accepts responsibility for the competent performance of its duties in executing the assignment and preparing this report in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.



**CONESTOGA-ROVERS
& ASSOCIATES**

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All of which is respectfully submitted,

CONESTOGA-ROVERS & ASSOCIATES LIMITED

Maggie Scott

Adam Loney

MS/ro/1

Encl.

Attachment A

Verification Statement

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION



Greenhouse Gas Reporting Program

Verification Statement

Facility Name: Northeastern University

MA Facility AQ ID: 1190054

Facility Address: 360 Huntington Avenue, Boston, Massachusetts 02115

This Verification Statement documents that Conestoga-Rovers & Associates Inc. (CRA) (Verification Body) has conducted verification activities in compliance with ISO 14064-3 and the Massachusetts GHG Reporting Program 310 CMR 7.71(7). This statement also attests to the fact that CRA (Verification Body) provides reasonable assurance that Northeastern University's (Facility's) reported greenhouse gas emissions from January 1, 2013 through December 31, 2013 are verifiable and meet the requirements of Massachusetts GHG Reporting Program, 310 CMR 7.71.

GHG reporting requirements against which verification was conducted (check all that apply):

- Massachusetts GHG Reporting Program 310 CMR 7.71
- The Climate Registry's *General Reporting Protocol*
- Others (specify):

Verification criteria (check all that apply):

- Massachusetts GHG Reporting Program 310 CMR 7.71(7)
- The Climate Registry's *General Verification Protocol*
- Others (specify):

Facility Emission Sources Exempt from Verification Pursuant to 310 CMR 7.71(7)(c):

Check all exemptions that apply and identify the emission sources that are exempt from verification:

40 CFR Part 75 CO₂ emissions

Emission sources:

310 CMR 7.70(10) CO₂ Emissions Offset Projects or corresponding provisions of the CO₂ Budget Trading Regulations of any other state

Emission sources:

The Climate Registry's voluntary reporting program

Emission sources:

Total Emissions Reported by Facility (including emissions exempt from verification as indicated above):

Scope 1 Emissions: 34636.18518 metric tons CO₂e, consisting of metric tons of each GHG as follows:


34332.33953 CO₂ 1.20997 CH₄ 0.52983 N₂O 0.0837 HFCs 0 PFCs 0 SF₆


Biogenic CO₂ (stationary & mobile combustion only): 0 metric tons CO₂

Comment:

Verification Body Attestation:

I certify that I have personally examined the greenhouse gas emissions report for this facility and am familiar with the information contained in that report and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including possible fines and imprisonment.

 Signature:	Review of 310 CMR 7.71 (1) through (8)	Attended Live or Recorded Webinar Training?
Print Name: Maggie Scott Lead Verifier	Date Completed: 03/08/2011 (MM/DD/YYYY)	Date Completed: 03/08/2011 (MM/DD/YYYY)

 Signature:	Review of 310 CMR 7.71 (1) through (8)	Attended Live or Recorded Webinar Training?
Print Name: Adam Loney Independent Peer Reviewer	Date Completed: 09/13/2012	Date Completed: 09/13/2012