

FIRST ASSESSMENT REPORT FOR SUBSTITUTION OF BITUMEN BINDER IN HOT ASPHALT PRODUCTION AND USAGE



Document Prepared By Stantec Consulting Ltd.

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Summary:

Stantec Consulting Ltd. was retained to complete the first assessment of the proposed Methodology entitled *Substitution of Bitumen Binder in Hot Asphalt Production and Usage, (Methodology Version 1.5)*. This Methodology provides procedures for the quantification of net greenhouse gas (GHG) emission reductions from the substitution of a solid sulphur product for the asphalt binder normally used in conventional hot mix asphalt paving mix.

Stantec assessed the Methodology against VCS program requirements found in the VCS Methodology Approval Process document, the *VCS Program Guide*, and the *VCS Standard*. An internal assessment document was used to conduct the assessment. During the initial assessment, Stantec found that the Methodology (v.1.0) contained non-conformances that affected the usability of the Methodology. In addition, the Module entitled *Estimation of Emissions from Storage, Drying and Hot-Mixing of Bitumen in Hot-Mix Asphalt Production Version 1.0*, (which was also undergoing first assessment) was deemed to be unnecessarily separated from the Methodology and was thus combined and included in Methodology Version 1.5.

As a result of Stantec’s findings, the developer amended the Methodology element documentation. The draft first assessment report, reflected in the body of the report, was completed on version 1.5, dated June 15, 2012. This final first assessment report was completed on the Methodology version 1.11 (January 23, 2014), following revisions of the Methodology made during the second assessment.

Stantec found that the Methodology, in its current form (version 1.11), contains no non-conformances that affect the usability of the Methodology.

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1 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Shell Global Solutions (Deutschland) GmbH to assess the proposed Methodology, hereafter referred to as the “Methodology”, prepared by Shell and Prasinio Group (formerly Leading Carbon), entitled *Substitution of Bitumen Binder in Hot Asphalt Production and Usage (Version 1.5, dated June 15, 2012)*.

The Module entitled *Estimation of Emissions from Storage, Drying and Hot-Mixing of Bitumen in Hot-Mix Asphalt Production Version 1.0*, (which was also undergoing first assessment) was deemed by the developer to be unnecessarily separated from the Methodology and has thus been combined and included in Methodology Version 1.5. Stantec agrees that the combined document is appropriate. The draft first assessment findings were based on Methodology Version 1.5. Additional assessment findings following the second assessment (related to Methodology Version 1.11) are noted in Section 6.

1.1 Objective

The objective of the Methodology assessment is to compare the proposed Methodology against the requirements of the criteria documents listed below in Section 1.2 and identify any non-conformances. The findings of this assessment are described in the report presented herein.

1.2 Scope and Criteria

The proposed Methodology assessed in this report is “*Substitution of Bitumen Binder in Hot Asphalt Production and Usage (Version 1.5, dated June 15, 2012)*”.

The Methodology was initially compared to the requirements of the following documents (VCS criteria current at the time of assessment):

- VCS Methodology Approval Process (Version 3.3, Feb, 2012);
- VCS Methodology Template (Version 3.1, Feb, 2012);
- VCS Standard (Version 3.2, Feb, 2012); and
- VCS Program Guide (Version 3.3, May, 2012).

The Methodology was also assessed for the principles of relevance, completeness, consistency, accuracy, transparency and conservatism in the context of the VCS program and industry practice.

Following the second assessment, Stantec reviewed additional edits made to the Methodology (version 1.11) in consideration of VCS criteria current as of April 1, 2014 and as noted:

- VCS Methodology Approval Process (Version 3.5, October 2013);
- VCS Methodology Template (Version 3.3, October 2013);
- VCS Standard (Version 3.4, October 2013); and
- VCS Program Guide (Version 3.5, October 2013).

1.3 Summary Description of the Methodology Element

This Methodology is based on the *Quantification Protocol for the Substitution of Bitumen Binder in Hot Mix Asphalt Production and Usage, Version 1.0* issued under the *Alberta Specified Gas Emitters Regulation*, developed by Shell Canada Ltd.

The proposed Methodology was developed to provide guidance on the quantification of greenhouse gas (GHG) emissions reductions achieved by the substitution of a proportion of the bitumen binder used in conventional hot asphalt paving for a sulphur product. The use of a sulphur product in place of a portion of bitumen binder reduces required quantities of aggregate and bitumen, reduces fuel consumption due to reduced mix production temperatures, and reduces emissions from the hot mix plant stack and paving.

A project is defined as an activity, initiative, or program to reduce GHG emissions compared to a known baseline scenario. The baseline scenario may be the existing condition or another scenario that the project developer has identified as being representative of the conditions had the project not proceeded.

The source of GHG emissions reductions arise from the avoided production of a proportion of the asphalt binder used in conventional asphalt paving mix, and reduced consumption of fossil fuels due to lower mix production temperatures. There is also the opportunity for GHG emission reductions from the avoided fugitive emissions of methane (associated with the handling and storage of asphalt) that would have been emitted from hot mix facilities where the baseline practice was the use of conventional paving mix.

Other upstream and downstream sources are excluded from analysis, and the justification for those excluded sources is provided in the Methodology. There are no relevant GHG sinks or reservoirs associated with the proposed project activity.

The baseline scenario for this project has been determined to be “the production of conventional hot mix asphalt”. Project proponents must demonstrate that this is the most reasonable and credible baseline for their project using the CDM tool “*Combined tool to identify the baseline scenario and determine additionality Version 03.0.1*”.

Project emissions include all emissions caused by the production of hot mix asphalt paving mix using a solid sulphur product (instead of asphalt binder). These emissions include extraction and processing of fuel used in hot mix production, production and processing of carbon black or other additives used in hot mix production, emissions due to the production and processing of bitumen, emissions due to the production and processing of aggregate and emissions due to the storage of bitumen, drying and hot mixing. For most of the emission sources, the Methodology specifies multiplying the activity level for project units (e.g., mass of bitumen consumed) by a project emission factor based on specific project fuel consumption and a generic CO₂ emission factor for fuel combustion.

The Methodology requires the proponent to monitor:

- mass of hot mix asphalt produced for the project;
- volume of each type of fuel combusted during the project for storage, drying and hot mixing of bitumen;
- mass of sulphur extender product consumed;
- percent of carbon black in sulphur extender (%CB);
- mass of bitumen consumed under project condition; and

- mass of aggregate consumed.

For emissions from the hot mix stack, the Methodology also allows that for projects where site specific stack emissions sampling data are available, the project proponent may calculate these emissions using the information within the Methodology. This information had formally been included in a new Module entitled *Estimation of Emissions from the Storage, Drying and Hot-Mixing of Bitumen in Hot-Mix Asphalt Production (Version 1.0)*. This Module had been undergoing a separate assessment under the VCS Methodology Approval Process.

Net GHG emission reductions are calculated as the difference between baseline emissions and project emissions.

2 ASSESSMENT APPROACH

2.1 Method and Criteria

Stantec reviewed the proposed Methodology against the requirements of the criteria listed in Section 1.2 above and documented any identified non-conformances in an internal assessment document based on the assessment criteria.

Stantec prepared this document specifically for the VCS program based on the VCS assessment report template. The internal assessment document was reviewed by the Stantec Peer Reviewer and the Lead Assessor prior to issuance.

2.2 Document Review

The Stantec team reviewed and identified the requirements of the VCS program by studying the documents listed in Section 1.2. Stantec then reviewed the Methodology with the VCS program requirements in mind.

After the initial review of the Methodology (Version 1.0), clarification questions were posed to the methodology developers and potential discrepancies with the VCS program requirements were identified. The methodology developer provided initial responses and an updated Methodology (Version 1.1). Following several iterations of questions and responses including those associated with the second assessment, the final assessment results contained within this report (Section 6) are based the version 1.11 of the Methodology.

2.3 Interviews

Stantec did not find it necessary to conduct any formal interviews other than discussions with the Methodology developers (Shell Canada and Prasino Group) during this initial assessment of the Methodology.

2.4 Use of VCS-Approved Expert

Stantec did not rely on a VCS-approved expert as part of this assessment, as this Methodology is not relevant to Agriculture, Forestry, and Land Use (AFOLU) projects.

2.5 Resolution of Any Material Discrepancies

During the draft assessment, potential material discrepancies found during the review of the Methodology were identified, where they existed. Shell and Prasino Group are responsible for addressing these

material discrepancies, in accordance with the *VCS Methodology Approval Process*. All discrepancies identified, and corrective actions taken are recorded in Table 4.1.

2.6 Internal Quality Control

Stantec is accredited with the American National Standards Institute (ANSI) (a member of the International Accreditation Forum) in accordance with ISO14065 (Accreditation ID #0805 issued to Stantec Consulting Ltd. for greenhouse gas (GHG) verification and validation). As part of the accreditation, Stantec developed a Validation and Verification Standard Operating Procedure (SOP) to be followed in conducting validation and verification projects. The quality control and assurance procedures described in the SOP were applied to this methodology assessment. A summary of the relevant quality control and assurance procedures includes the:

- development and use of standardized templates for assessment based on the most recent available GHG program guidance;
- review of internal sampling document and the final report by a Peer Reviewer: the Peer Reviewer is a Stantec employee knowledgeable in GHG estimation, validation, and verification, as well as being a senior practitioner within Stantec. The person fulfilling this role remains an independent reviewer during the course of the assessment;
- review of the internal sampling document and final report by the Lead Assessor: the Lead Assessor is a Stantec employee knowledgeable in GHG estimation, validation, and verification, and is responsible for managing the assessment; and
- the Stantec team members have successfully completed the ISO 14064-3 Greenhouse Gas Verification and Validation Training course.

3 ASSESSMENT FINDINGS

3.1 Applicability Conditions

Several clarifications and corrective actions were identified by Stantec with regards to the Applicability Conditions in the original Methodology and subsequently addressed in Version 1.5.. These are detailed in Table 4.1. The discussion below refers to Version 1.5.

The methodology has identified the project activities to which it applies and has established criteria that describe the conditions under which the methodology can (and cannot, if appropriate) be applied. It notes that this Methodology can be applied by hot mix asphalt plant operators that are using a sulphur extender to replace a portion of the conventional bitumen binder. Other applicability conditions include:

- Following industry best practices regarding handling, mix production temperatures, and disposal of off-specification asphalt;
- Following manufacturer's documentation for handling and use of the sulphur extender product;
- Ensuring that asphalt production temperatures are monitored at the plant outlet to ensure production in the appropriate temperature range; and
- That produced asphalt meets local legal and technical requirements. In the absence of local requirements, project proponents must demonstrate that asphalt produced under the project condition provides equivalent function to asphalt produced under the baseline condition.

Applicability conditions related to the use of stack testing data are also provided, and include:

- Stack sampling of emissions includes only mixing process emissions (i.e., no fuel combustion emissions at the sampling point);
- At least three years of baseline stack sampling data is available; and
- Stack sampling for the project case is conducted annually during the offset project.

Since the methodology has set adequate and appropriate applicability conditions, the methodology is in compliance with VCS rules.

Findings: Pass

3.2 Project Boundary

Several clarifications and corrective actions were identified by Stantec with regards to the Project Boundary in the original Methodology and subsequently addressed in Version 1.5. These are detailed in Table 4.1. The discussion below refers to Version 1.5.

The Methodology states that:

“...Sources, sinks and reservoirs (SSRs) included in the project and baseline quantification include those that are within the project site (the physical, geographic location of the hot mix asphalt production facility) as well as other that are off-site. A temporal project boundary includes the operation of an existing hot mix facility during the incorporation of a sulphur extender projects.”

Due to the limited applicability of the Methodology, an appropriate project boundary has been identified.

Methodology SSRs:

The Methodology identified extraction and processing of fuel used in hot mix production, production and processing of carbon black / other additives used in hot mix production, production and processing of bitumen, and production and processing of aggregate and storage or bitumen, drying and hot-mixing as the emission sources relevant to the offset project.

Emissions in the construction and decommissioning of the hot mix facility are considered outside of the scope of the methodology and have been excluded from quantification.

The Methodology requires a project proponent to justify the SSRs selected for quantification in a project plan.

Greenhouse Gases:

The greenhouse gases (GHGs) considered in this Methodology include Carbon Dioxide (CO₂), Methane (CH₄) and Nitrous Oxide (N₂O). Other GHGs (HFCs, PFCs, and SF₆) were excluded from quantification as these are not relevant to the Baseline or Project cases.

The methodology appropriately identifies the various sources that may be relevant and requires the project proponent to justify the sources selected for quantification. Further, the GHGs considered and those excluded are appropriate and consistent with VCS requirements.

Findings: Pass

3.3 Procedure for Determining the Baseline Scenario

Several clarifications and corrective actions were identified by Stantec with regards to the procedure for determining the baseline scenario in the original Methodology and subsequently addressed in Version 1.5. These are detailed in Table 4.1. The discussion below refers to Version 1.5.

The baseline scenario identified in this Methodology is the production of conventional hot mix asphalt. The developer has provided a general definition of hot mix asphalt operations to characterize the baseline.

The Methodology requires that project proponents demonstrate that this is the most reasonable and credible baseline for their project using the methodological tool “Combined tool to identify the baseline scenario and determine additionality” as published on the UNFCCC website. This is an appropriate tool.

The Methodology has only provided one method (*i.e.*, the project method) for determining the crediting baseline.

The approach for determining the baseline scenario is considered to be appropriate, adequate and in compliance with the VCS rules as proponents are to use an approved UNFCC tool to justify the baseline.

Findings: Pass

3.4 Procedure for Demonstrating Additionality

The Methodology states that “additionality will be assessed and demonstrated using the most recent version of the methodological tool “Combined tool to identify the baseline scenario and determine additionality and the “Tool for the demonstration and assessment of additionality V05.2.1” as published on the UNFCCC website.

The approach for determining additionality is considered to be appropriate, adequate and in compliance with the VCS rules, as the methodology requires proponents to use approved UNFCC tools to demonstrate additionality.

Findings: Pass

3.5 Baseline Emissions

Several clarifications and corrective actions were identified by Stantec with regards to the Baseline Emissions in the original Methodology and subsequently addressed in Version 1.5. These are detailed in Table 4.1. The discussion below refers to Version 1.5.

The Methodology states:

*“The baseline condition for this protocol is the production and usage of conventional hot mix asphalt. The composition of conventional hot mix asphalt (*i.e.* relative quantities of aggregate versus bitumen binder) will vary depending on the type of road paved (*i.e.* major highway, lower volume highway, city collector or lower volume road) and will be produced at a temperature ranging from 130 to a maximum of 155 degrees Celsius. Given that mix formulation and mix temperatures may vary from project to project, the baseline should be defined for each project, each type of hot mix asphalt and / or each type of road paved.”*

The emissions from production and handling of bitumen, aggregate and hot mix asphalt are calculated from direct measurement of the quantities of each component consumed and using emission factors published by Environment Canada, the Canadian Association of Petroleum Producers (CAPP), the Canadian Council of Ministers (CCME) of Environment, the US Environmental Protection Agency (EPA), the Intergovernmental Panel on Climate Change (IPCC) and other sources.

Emissions in the baseline scenario are generated due to the production of conventional hot mix asphalt and are calculated by summing the emissions from the following sources:

- extraction and processing of fuels used in hot mix production;
- production and processing of bitumen;
- production and processing of aggregate;
- storage of bitumen, drying and hot mixing;
- combustion of fuels used in hot mix production; and
- emissions due to the generation of electricity for operating the hot mix facility.

Emissions from hot mixing include the emissions associated with fuel combustion and process (fugitive) emissions. Emissions from fuel consumption are calculated using a heat equation, with aggregate moisture content also being considered. Hot mix stack emissions from bitumen use are accounted for by direct measurement of the quantity of bitumen consumed. Emissions from electricity use may be calculated using an emission factor.

Alternatively, emissions from bitumen processing during hot mixing may be determined from stack sampling conducted for conventional hot mix asphalt when stack testing data (CH₄ and CO₂ mass emission rates) as well as mass and production rates of hot mix asphalt are available. The mass emission rates of CH₄ and CO₂ and asphalt production tonnage during baseline stack testing to be used is the average of three years of annual (at minimum) stack testing data.

The procedure for calculating baseline emissions is considered to be appropriate, adequate and in compliance with the VCS rules, as the methodology provides adequate and appropriate calculations to quantify GHG emissions from the relevant baseline sources.

Findings: Pass

3.6 Project Emissions

Several clarifications and corrective actions were identified by Stantec with regards to the Project Emissions in the original Methodology and subsequently addressed in Version 1.5. These are detailed in Table 4.1. The discussion below refers to Version 1.5.

The methodology states:

The opportunity for generating carbon reductions with this methodology arises primarily from one, the avoided production of a proportion of the asphalt binder used in conventional asphalt paving mix, and two, reduced consumption of fossil fuels due to lower mix production temperatures. There is also the opportunity for greenhouse gas (GHG) emission reductions from avoided fugitive emissions of methane associated with the hot mixing of bitumen, aggregate and sulphur extender that would have been emitted

from hot mix facilities where the baseline practice was the use of conventional paving mix.

Emissions in the project scenario are caused by the production of hot mix asphalt, substituting a portion of the bitumen binder with a solid sulphur product (with or without a wax additive). Total project emissions are calculated by summing the emissions from the following sources:

- extraction and processing of fuels used in hot mix production;
- production and processing of bitumen;
- production and process of carbon black or other additives;
- production and processing of aggregate;
- combustion of fuels during hot mixing;
- storage of bitumen, drying and hot mixing; and
- emissions due to the generation associated with electricity use for operating the hot mix facility.

Similar to the baseline conditions, emissions from hot mixing include the emissions associated with fuel combustion and process emissions. Emissions from fuel consumption are calculated using a heat equation, with aggregate moisture content also being considered. Hot mix stack emissions from bitumen use are accounted for by direct measurement of the quantity of bitumen consumed. Alternatively, emissions from bitumen handling during hot mixing may be determined from stack sampling conducted during implementation of the project. Emissions from electricity use may be calculated using an emission factor.

The procedure for calculating project emissions is considered to be appropriate, adequate and in compliance with the VCS rules, as the methodology provides adequate and appropriate calculations to quantify GHG emissions from the relevant project sources.

Findings: Pass

3.7 Leakage

A clarification was requested by Stantec with regards to the assessment of potential leakage in the original Methodology and subsequently addressed as detailed below.

The Methodology states that there are “*no known sources of leakage for this project activity*”. Through follow-up correspondence with the Shell Canada representative, the following information was provided on the potential for leakage:

“Sulphur acts as a bitumen extender; i.e., replaces up to 30% of the bitumen in a conventional asphalt mix. Not all roads will be paved with sulphur road technology. Any such replacement that does occur on the market won’t cause road bitumen feedstock to be manufactured elsewhere, and hence leakage is not material. There is no difference in the sulphur production in the baseline and project conditions. The fate of sulphur varies by region. In areas of excess sulphur production, it is typically stored in solid form (poured to block or pelletized) after being removed from natural gas and oil. In remote regions, the sulphur-containing components are often removed and re-injected into the ground as opposed to being stored above grade. Emissions from baseline sulphur

(molten and products) transportation are likely equivalent in the project and baseline, as the distance to sulphur processing facilities will remain the same.”

Stantec agrees with this information, as it is consistent with Stantec’s understanding of the oil and gas industry. This is considered to be appropriate, adequate and in compliance with the VCS rules.

Findings: Pass

3.8 Quantification of Net GHG Emission Reductions and/or Removals

Net GHG emission reductions are calculated as baseline emissions minus project emissions. This calculation is appropriate, adequate and in compliance with VCS requirements.

Findings: Pass

3.9 Monitoring

The monitoring procedures provided in the Methodology are identified for each monitoring parameter, including a description of the measurement method and the frequency of monitoring. The Methodology requires the proponent to monitor:

- mass of hot mix asphalt produced for the project;
- volume of each type of fuel combusted during the project for storage, drying and hot mixing of bitumen;
- mass of sulphur extender product consumed;
- percent of carbon black in sulphur extender (%CB);
- electricity use;
- mass of bitumen consumed under project condition; and
- mass of aggregate consumed.

For each of the parameters above, the Methodology outlines the appropriate measurement methods to use and QA/QC procedures to apply. The Methodology also provides the frequency of monitoring / data recording required.

The monitoring procedures are appropriate, adequate and in compliance with the VCS rules, as the methodology provides sufficient information for project proponents to develop a detailed monitoring plan.

Findings: Pass

3.10 Data and Parameters

Several clarifications and corrective actions were identified by Stantec with regards to Data and Parameters in the original Methodology and subsequently addressed in Version 1.5.. These are detailed in Table 4.1. The discussion below refers to Version 1.5.

The Methodology identifies the parameters to be monitored as part of the project as well as parameters that are not monitored. For each identified parameter, the Methodology provides a description of the parameter, the units and a data source.

The parameters that are not monitored (and hence known at validation) are included in Section 9.1. The methodology indicates that if data parameters listed are not available at the time of validation, the project proponent must provide a plan for determination and/or monitoring the data during the project. These parameters are as follows:

- CO₂, CH₄ and N₂O emission factors for fuel extraction and processing (kg/L, kg/m³ or other);
- mass of bitumen consumed under the baseline condition;
- emission factors for aggregate production (kg CO₂e per kg of aggregate);
- density of bitumen (kg/L);
- CO₂, CH₄ and N₂O emission factors for bitumen production (kg GHG/L, m³ or other);
- mass of aggregate (kg / tonne of hot mix asphalt produced);
- CH₄ emission factor for bitumen use in hot mixing (kg CH₄/kg bitumen);
- CO₂, CH₄ and N₂O emission factors for fuel combustion (kg/L, m³ or other);
- temperature of hot mix asphalt production (deg C);
- temperature of aggregate (deg C);
- temperature of bitumen (deg C);
- heating value of fuel (kJ/m³);
- fuel combustion and burner efficiency (%);
- volume of fuel combusted for aggregate drying (L. m³ or other/kg of aggregate);
- moisture content of aggregate (%); and
- CO₂ and CH₄ emission factors for the production of carbon black (kg GHG / kg of carbon black)
- Emission factors for electricity generation (kg CO₂e per kWh);
- Electricity used for operating a hot mix facility (kWh)
- Mass emission rate for CH₄ and CO₂ from the hot mix stack (kg/hour) – stack test
- Production rate of conventional hot mix asphalt (during stack testing period).

It is stated in the Methodology that emission factors may be obtained from regional or national sources, such as CAPP, Environment Canada, or the IPCC default values at the lower 95% confidence interval.

The parameters that were considered “accepted values” and required to be used included:

- specific heat capacity of bitumen: 2.093 KJ/kg deg C; and
- specific heat capacity of aggregate: 0.837 KJ/kg deg C.

References for these accepted values are provided in the Methodology’s Reference section.

The specifications for monitored data are considered to be appropriate, adequate and in compliance with the VCS rules, as the methodology provides sufficient information for project proponents to develop a detailed monitoring plan. The specifications for not monitored data are considered to be appropriate, adequate, and in compliance with VCS rules, as sufficient description and data sources are provided.

Findings: Pass

3.11 Use of Tools/Modules

The Methodology states that,

“Additionality will be assessed and demonstrated using the most recent version of the methodological tool ‘Combined tool to identify the baseline scenario and determine additionality’ and ‘Tool for the demonstration and assessment of additionality v05.2.1’ as published on the UNFCC website.”

The tools referenced are from UNFCC, an approved GHG program, are appear to be used appropriately in the context of the methodology,

During the course of the first assessment, the module was merged with the proposed methodology to form a methodology with an integrated quantification option for asphalt plants with stack testing data. Stantec agrees that the merger of the two documents is appropriate as the contents of the module were quite limited and were easily incorporated into the Methodology Version 1.5.

Findings: Pass

3.12 Adherence to the Project Principles of the VCS Program

Several corrective actions were identified by Stantec with regards to Adherence to the VCS Principles in the original Methodology and subsequently addressed in Version 1.5. These are detailed in Table 4.1. The discussion below refers to Version 1.5.

Relevance:

The Methodology considered the emission sources during production of hot-mix asphalt for both the baseline (conventional) and project (sulphur substitute) scenarios. However, for several SSRs, the criteria used to determine the relevance was not fully described. This has been corrected in the final assessed version of the methodology.

Completeness:

The Methodology contains the equations and known parameters required to calculate baseline and project emissions, and Stantec considers the content adequately complete for its purpose.

Consistency:

The Methodology demonstrated consistency by providing calculation methodologies that used project activity level data to calculate both the baseline emissions and project emissions. The Methodology contains a figure for Baseline SSRs as well as Project SSRs.

Accuracy:

In section 9.4 (Uncertainty Assessment), the Methodology requires that the project proponents apply the appropriate confidence deductions, as per VCS requirements. Section 9.4 includes indication that meters used in quantification should be calibrated to manufacturer's specifications. The Methodology includes a discussion regarding uncertainty in measurements which should also support accurate data collection by proponents.

Transparency:

The Methodology encourages transparency in that it requires project proponents to justify the SSRs included for quantification for a project.

Conservativeness:

The Methodology demonstrates conservativeness by suggesting that many of the SSRs be excluded for simplification as "the emissions are likely higher under the baseline condition".

Findings: Pass**3.13 Relationship to Approved or Pending Methodologies**

The Methodology indicates that it is based on the *Quantification Protocol for the Substitution of Bitumen Binder in Hot Mix Asphalt Production and Usage, Version 1.0* issued under the *Alberta Specified Gas Emitters Regulation*. The Methodology indicates that it is not based on any pending or approved CDM, VCS, or CAR methodologies.

The Methodology developer provided a list of all existing CDM methodologies with the same sectoral scope and provided evidence to support that existing CDM methodologies within the same sectoral scope could not be reasonably revised. This is consistent with VCS requirements.

Findings: Pass**3.14 Stakeholder Comments**

According to the VCS website for the proposed Methodology (http://v-c-s.org/methodologies/bitumen_hot_mix_asphalt_production) no stakeholder comments were received during the public review period, which occurred from January 5, 2012 until February 3, 2012.

Findings: Pass**4 RESOLUTION OF CORRECTIVE ACTION REQUESTS AND CLARIFICATION REQUESTS**

Stantec developed Correction Action Requests and Clarification Requests relevant to Methodology Version 1.1. Both pending and addressed requests (addressed between Version 1.0 and 1.1) are provided in Table 4.1. New items related to Version 1.3 are presented in **bold**.

Note that Corrective Action Requests are intended to be actions made to the Methodology document. Clarification Request responses may also be provided to Stantec in letter form, outside the Methodology document if deemed warranted.

Table 4.1 Summary of Corrective Actions

Assessment Findings	Corrective Action or Clarification Request	Response
<p>Applicability Conditions</p>	<p>What does “conventional” hot mix mean (no definition is provided or referenced)? Does the use of different types of plants or RAP affect the “applicability” of this Methodology?</p> <p>Consider adding the term “during normal plant operation” when referring to stack sampling to ensure sampling should be representative of conditions during the project.</p> <p>The criteria requires at least three years of stack data for conventional hot mix asphalt, but does not specify how many years of stack data for sulphur extender asphalt is required. Whether there are any restrictions with respect to plant type (drum or batch). Depending on the design of the plant, it may not be possible to perform stack sampling on only mixing emissions (i.e., combustion emissions are present). Also, need to know whether there are any restrictions with respect to the stack testing methodologies or testing procedures.</p>	<p>“Conventional hot mix is a broad term, referring to the business-as-usual approach to which the bitumen binder substitution benefits are compared. The majority of roads are still constructed in this BAU fashion, with the actual operating temperature varying by local project conditions. Hot mix may or may not contain RAP. A higher % of RAP, all other things equal, would limit the GHG benefit of bitumen replacement, but would not entirely obviate it since some virgin asphalt is still required. The use of RAP would also still require a high asphalt mix temperature, so the mix plant temperature reduction – and related emissions reductions benefits - would still be possible. Therefore, the methodology in question would still be applicable, with the net GHG benefit depending on specific project conditions. Definition of Hot Mix Asphalt in Section 3 Definitions, page 8, has been modified to include an elaboration on conventional hot mix as explained above.” (Stantec’s findings: Satisfactory, clarification is considered sufficient for use in the industry)</p> <p>Added ‘during normal plan operation’ on page 10. (Stantec’s findings: Satisfactory, provides some direction to proponents on acceptable testing)</p> <p>Added “In the project condition, stack sampling by a third party is required once annually during the offset project itself to generate the data required. It is the responsibility of the project proponent and third party sampler to determine the length of each test and analysis methodology that ensure the accuracy of the sampling procedure.” Justification should be provided. It is the responsibility of project proponents to ensure that the plant design allows for measurement of stack emissions resulting from hot mix stacks for any type of plant design. Additional clarification is added, Section 4, p.9, point 7. (Stantec’s findings: Satisfactory as proponents are directed to define and justify an appropriate sampling program.)</p>
<p>Project Boundary</p>	<p>The GHG sources are not identified as controlled, related or affected.</p> <p>Figure 1 shows the project process flow diagram and identifies ALL potential SSRs shown in Table 4. (A figure showing the baseline process</p>	<p>“Information as to whether the SSR is controlled, related or affected has been provided next to the SSRs in Table 4, page 13.” (Stantec’s findings: Satisfactory)</p> <p>“Clarification on project boundary and included/excluded SSRs are added in Section 5, page 10.” (Stantec’s findings: Satisfactory, missing SSRs</p>

Table 4.1 Summary of Corrective Actions

Assessment Findings	Corrective Action or Clarification Request	Response
	<p>flow and SSRS was not included). Although the Methodology states “Emission sources included or excluded from the project boundary are presented in Table 4), the project boundary in Figure 1 does not include all of the SSRs to be quantified (and deemed to be “included”) as part of the “project”.</p> <p>For completeness and consistency, a figure for baseline and project should be included.</p> <p>Transportation and storage of molten sulphur: This is identified as a “related” SSR in the Baseline. Although not quantified, the methodology states that “emissions are based on the quantity of sulphur used in the project condition, therefore an equivalent quantity of sulphur would be transported in both the project and baseline condition.” Why is molten sulphur included in the baseline and other SSRs like transportation of wax additives, or transportation and storage of carbon black, are not? “Transportation of sulphur product” is also listed as related SSRs. To be consistent with Figure 1 – should this be sulphur product be called sulphur extender?</p> <p>What about fugitive emissions associated with the handling and storage of asphalt (bitumen) that would have been used in the baseline scenario of a conventional hot mix facility? It is unclear how these emissions are quantified.</p> <p>Indirect emissions from the generation</p>	<p><i>have been added)</i></p> <p>“Baseline process flow diagram is added in Section 5, page 12”. <i>(Stantec’s findings: Satisfactory)</i></p> <p>“Molten sulphur is a by-product of fossil fuels production and is transported to specialized facilities for further processing in the baseline condition. Transportation of other additives does not occur in the baseline, and hence excluded. “Transportation of sulphur product” SSR is listed in the baseline list of SSRs in Table 4, and is intended to refer to an SSR box in the baseline process diagram (which has been just added as part of this corrective round of edits), “Transportation of sulphur extender” in the project list of SSRs correctly refers to the box in the project process flow diagram. In the baseline the sulphur product would not be considered a sulphur extender as it is sold for other uses in this scenario.” <i>(Stantec’s findings: Satisfactory. Explanation seems reasonable in that regardless of whether or not the project was taking place, the molten sulphur would have had to be shipped to the processing plant.</i></p> <p>“These emissions are excluded for simplification. This is conservative as the emissions are likely higher under the baseline condition.” (Stantec’s findings: Satisfactory; however this justification has not been included in the Methodology). “This response was in reference to ‘Upgrading and Storage of Bitumen (off-site)’ – 5th row of table 4. ‘emissions associated with handling and storage of asphalt (bitumen)’ has been changed to “emissions associated with the hot mixing of bitumen, aggregate and sulphur extender” in Section 2 Summary Description of the Methodology. Fugitive emissions associated with hot mixing are addressed in Baseline Emissions and Project Emissions sections in this table.</p> <p>Clarification added to ‘Upgrading and Storage of Bitumen (off-site)’ SSR in Table 4.” <i>(Stantec’s finding: Satisfactory)</i></p> <p>“Electricity Generation SSR in both baseline and project</p>

Table 4.1 Summary of Corrective Actions

Assessment Findings	Corrective Action or Clarification Request	Response
	<p>of electricity used in the hot mix facility have been considered (and excluded) from the Methodology. However, the Methodology poses several unclear questions: <i>“Covered under proposed GHG Regulations? This would depend on the jurisdiction. Maybe a flexibility mechanism here”</i>, which should be clarified.</p> <p>“Fuel extraction / processing” has been included in the Methodology as a related SSR which needs to be quantified. However, no criteria has been included in the Methodology to provide guidance as to when a SSR is considered “material” and should be quantified (Is an SSR material when it is a %of the total emissions? A difference from baseline? A value?)</p> <p>The project consists of substituting Sulphur Extended Asphalt Modifier (SEAM) pellets, OR a <u>similar solid sulphur product</u> (composed of small quantities of plasticizer and H₂S scavenger additives) as well as carbon black and wax additives, in place of bitumen. Therefore, why is “production of molten sulphur” listed as an SSR if it is a <u>solid sulphur product</u> used in the project? A description of the overall process should be provided for clarity.</p> <p>For all the products which are used as substitutes for bitumen above (sulphur, carbon black and wax), why is only the SSR quantified in the project scenario “Production/Processing of carbon black or other additives”? What criteria has been used to determine that this SSR should be included and the others excluded (or does other additives potentially include all)? Please clarify.</p> <p>No justification for the GHG types</p>	<p>was reviewed, included in quantification and justified in Table 4, pages 14, 17. New Equations 12 & 22, were added on page 22 & 24 respectively, and Equations 1 & 13 were edited to reflect the change. New data tables were added to Section 9.1, pages 32, 33 & 34, and to Section 9.2, page 37, 38.” (Stantec’s findings: Satisfactory)</p> <p>“Generic criteria for the inclusion or exclusion of any SSR is difficult to outline on the protocol/methodology level. It is the responsibility of the project developer to demonstrate what SSRs are material or not apart from the protocol’s instruction. Fuel Extraction/Processing emissions are usually small compared to other emission sources in the project, but they are included in quantification to ensure accuracy and transparency.” (Stantec’s findings: Satisfactory)</p> <p>“The initial state of sulphur in either the baseline or project conditions is always molten, as it’s sourced as a by-product in molten form from fossil fuel production and processing to the project’s site. Therefore, production of molten sulphur is always the case for that SSR. Solid sulphur products (SEAM pellets or similar products) are produced at a later stage at described by the project process flow diagram. Emissions from this latter stage are accounted for in the ‘Sulphur Extender Production’ SSR. Since the overall process can vary from project to project, it has not been included in the methodology. The overall process is project-specific and should be outlined by the developer in the project plan document.” (Stantec’s findings: Satisfactory)</p> <p>“Emissions from production of wax additives are immaterial as quantity of wax added to the sulphur extender product is negligible. “Other additives” included with carbon black refer to those that might be used in the production of sulphur product, such as small quantities of plasticizer and H₂S scavenger, besides carbon black.” (Stantec’s findings: Satisfactory. Stantec conferred with an internal geotechnical engineer, who confirmed that wax would account for approximately 0.2 to 0.5% of the asphalt cement by mass. This supports that the source can be considered immaterial.</p> <p>“Refrigerants are never applicable to the substitution of a proportion of the bitumen binder used in conventional hot asphalt paving for a sulphur product. Only the gases</p>

Table 4.1 Summary of Corrective Actions

Assessment Findings	Corrective Action or Clarification Request	Response
	<p>which are included or excluded have been provided.</p> <p>The methodology does not contain a requirement for proponents to justify the baseline and project SSRs selected for quantification. Please include such a requirement.</p> <p>In Table 4, N₂O is indicated to be quantified for Storage of Bitumen, Drying, and Hot Mixing, but a quantification methodology is not provided. Please justify its exclusion with text in the methodology.</p>	<p>that are relevant to the SSRs in this methodology are included (CO₂, CH₄, N₂O).” (Stantec’s findings: Satisfactory; however this information should be included in the Methodology). “A footnote was added after Table 4 in the method”. (Stantec’s findings: Satisfactory).</p> <p>“Note added in Section 5: “Project proponents must justify the baseline and project SSRs selected for quantification in their project.” at end of first paragraph”. (Stantec’s findings: Satisfactory as the methodology now specifies that proponents must justify selection of SSRs).</p> <p>N₂O is included in this SSR as it is relevant to the fuel combustion portion (see equation 5 and 18). A note has been added to the justification of Table 4 to clarify this. (Stantec’s findings: Satisfactory).</p>
<p>Baseline Emissions</p>	<p>It is unclear as to how the GHG emission reductions from fugitive emissions are quantified in the baseline.</p> <p>The Methodology is unclear as to why the emissions for fuel extraction and procession would be considered relevant or material. The Methodology should provide the criteria for inclusion of “relevant” SSRs.</p>	<p>“Fugitive emissions in the baseline condition are CH₄ emissions in ‘Storage of Bitumen, Drying and Hot Mixing’ SSR, and they are accounted for in Equation 6, page 20.” (Stantec’s findings: This is at odds with the statement above that indicates that fugitive emissions were not quantified. Please clarify in the Methodology whether fugitive emissions from bitumen storage are quantified. If stack testing data are used, how are fugitive storage emissions included?) “This response is in reference to ‘Storage of Bitumen, Drying and Hot Mixing’ (13th row of table 4). Storage occurs twice in PFD and emissions from the second are only accounted as they are a mechanism by which reductions occur in this project type. Fugitives when heated (ON-SITE SSR – INCLUDED) are significantly more than those upstream offsite which are not heated (EXCLUDED).” (Stantec’s findings: Satisfactory)</p> <p>“Clarification added to “Storage of Bitumen, Drying and Hot Mixing” SSR in Table 4, and to Section 2 Summary Description of the Methodology, p.8.” (Stantec’s findings: Satisfactory)</p> <p>“Generic criteria for the inclusion or exclusion of any SSR is difficult to outline on the protocol/methodology level. It is the responsibility of the project developer to demonstrate what SSRs are material or not apart from the protocol’s instruction. Fuel Extraction/Processing emissions are usually small compared to other emission sources in the project, but they are included in quantification to ensure accuracy and transparency.” (Stantec’s findings: Satisfactory)</p>

Table 4.1 Summary of Corrective Actions

Assessment Findings	Corrective Action or Clarification Request	Response
	<p>Confirm that the emission factors in Appendix A, Table A-2 only represent emissions from hot mixing, or hot mixing and storage. If these factors include combustion emissions, then there may be an issue with double-counting fuel combustion emissions.</p>	<p>Stack emissions testing is only used rarely as it is expensive. This is the reason why emissions factors were developed by such bodies as the US EPA, and are the default approach in offset protocols. The emissions factor for CH₄ emissions from bitumen relate to the methane released during hot mixing, and are separate from any CH₄ emissions that may result from asphalt mix fuel combustion. <i>(Stantec’s findings: Satisfactory)</i></p>
Project Emissions	<p>It is unclear as to how the GHG emission reductions from avoided fugitive emissions are quantified in the project.</p>	<p>“Fugitive emissions in the project condition are CH₄ emissions in ‘Storage of Bitumen, Drying and Hot Mixing’ SSR, and they are accounted for in Equation 19, page 24.” <i>(Stantec’s findings: This is at odds with the statement above that indicates that fugitive emissions were not quantified. Please clarify in the Methodology whether fugitive emissions from bitumen storage are quantified. If stack testing data are used, how are fugitive storage emissions included?)</i></p> <p>“Fugitive emissions from handling are not captured. It is assumed that CH₄ emissions from this source would not be significant. CH₄ emissions become of significance when the bitumen is heated, creating the conditions for greater amounts of methane release.</p> <p>Original fugitive emission response was in reference to the upstream storage SSR, not the on-site storage SSR.</p> <p>Clarification added to “Storage of Bitumen, Drying and Hot Mixing” SSR in Table 4, and to Section 2 Summary Description of the Methodology, p.8.” <i>(Stantec’s findings: Satisfactory)</i></p>
Leakage	<p>The Methodology states that there are “no known sources of leakage for this project activity”; however in Methodology Version 1.0, there was a lack of guidance around how leakage was assessed and quantified.</p>	<p>Through follow-up correspondence with the Shell Canada, information was provided on the non-existent potential for leakage (as detailed in Section 3.7 of this report)” <i>(Stantec’s findings: Satisfactory)</i></p>
Data and Parameters	<p>Confirm that only CH₄ emissions are produced during hot-mixing, and clarify in the Methodology whether these emissions are equivalent to the “fugitive emissions” for baseline and project.</p>	<p>“CH₄ is the primary fugitive emission during hot-mixing and the only GHG included in quantification. CO₂ and N₂O fugitive emissions are negligible.” <i>(Stantec’s findings: This response is at odds with the methodology for estimating emissions using stack sampling data. If CO₂ is expected from the hot mix stack, should Equation 6 be modified to include CO₂ emissions?)</i> “CH₄ fugitive emissions are distinct from the CO₂ generated by fuel combustion in the mix plant, CO₂ is not a fugitive emission. Fugitive emission response in Project Boundary section of this table was in reference to the upstream storage SSR, not the on-site storage SSR. Clarification added to “Storage of Bitumen, Drying and Hot Mixing” SSR in Table 4.” <i>(Stantec’s findings: Satisfactory)</i></p>

Table 4.1 Summary of Corrective Actions

Assessment Findings	Corrective Action or Clarification Request	Response
	<p>Provide criteria to ensure the most accurate data and parameters are used.</p> <p>Provide references for the “accepted values” for specific heat capacity of bitumen and aggregate.</p>	<p>“Problems with data accuracy are inherently addressed in this methodology for a couple of reasons. Because the inputs into road-building are metered to ensure mix specifications are met, there is a high degree of certainty in the measurements of binder and aggregate employed.” <i>(Stantec’s findings: Satisfactory; however, this information should be provided in the Methodology. In addition, in Section 9.2, the Methodology has not identified QA/QC procedures for most of the monitored parameters. Please identify the minimum QA/QC procedures to ensure accurate and representative data is collected. “Text added to Section 9.4) In addition, in Section 9.2, the Methodology has not identified QA/QC procedures for most of the monitored parameters. Please identify any calibration activities including frequency to ensure accurate and representative data is collected.) Meter calibration would be performed in accordance with manufacturers’ specifications by the road building contractor. Any time material is delivered for road-building projects, the mass and quality of inputs is closely checked to ensure the mix formulation is followed. As gross quantities of materials are used (kgs and tonnes), fine resolution measurement is not required, and so is not employed. List added to section 9.3”. (Stantec’s findings: Satisfactory)</i></p> <p>“Reference added in Section 10 References and Other Information, page 39.” <i>(Stantec’s findings: Satisfactory)</i></p>
<p>Adherence to the Project Principles of the VCS Program</p>	<p>The methodology does not adhere to all the VCS program principles (mainly Completeness, Accuracy and Transparency) set out in the VCS standard. Correction of other items identified in this table will rectify this.</p>	<p>“All other items identified in this table have been addressed above.</p> <p>Problems with data accuracy are inherently addressed in this methodology for a couple of reasons. Because the inputs into road-building are metered to ensure mix specifications are met, there is a high degree of certainty in the measurements of binder and aggregate employed. Operating temperatures are also closely monitored due to worker health & safety regulatory requirements, and to ensure no wastage of fuel. Fuel quality specifications are provided upon purchase, and these provide the parameters necessary to calculate fuel GHG intensity. The costs of all the inputs into the road are also borne by the contractor, and so are closely monitored and recorded to ensure appropriate payments and cost recoveries are made. The nature of road-building projects therefore provides a high degree of confidence in the data used with the methodology in question, and significant uncertainties are addressed.” <i>(Stantec’s findings: Satisfactory; however this information should be provided in the Methodology)</i></p>

Table 4.1 Summary of Corrective Actions

Assessment Findings	Corrective Action or Clarification Request	Response
<p>Relationship to Approved or Pending Methodologies</p>	<p>The methodology stated that there are currently no approved or pending methodologies within the Manufacturing Industries, Construction or Transportation sectoral scopes. Upon review of the VCS website, there is a Methodology called “Methodology for Fuel Switch to Renewable Biomass for Thermal Applications”, undergoing second assessment. This Method falls under the Manufacturing Industries sectoral scope and was open for public comment from 6-July-2010 until 4-August-2010.</p> <p>It is unclear how the sectoral scope “transportation” is related (or even at all similar) to the Methodology. Reference to Transportation should be removed (or the additional transportation methodologies must be listed).</p> <p>Not all CDM and/or CAR methodologies in the relevant sectors have been listed in the methodology document.</p>	<p>“Added as previously noted.” (<i>Stantec’s findings: Satisfactory</i>).</p> <p>“Methodology has been updated to include approved or pending VCS methodologies within the appropriate sectoral scopes.” (<i>Stantec’s findings: Satisfactory; however, Table 3 of the Methodology indicates that small scale methodologies listed are not applicable to the use of sulphur concrete in precast applications. Please revise (referring to the wrong methodology.) “Updated”. (Stantec’s findings: Satisfactory)</i>.</p> <p>“Reference to Transportation as a sectoral scope has been removed from the Methodology.” (<i>Stantec’s findings: Satisfactory</i>)</p> <p>“Methodology has been updated to include all relevant methodologies (within VCS or CDM).” (<i>Stantec’s findings: Satisfactory</i>)</p>
<p>Compliance with VCS Methodology Template</p>	<p>The proposed methodology (Bitumen Binder, Version 1.0) has been completed using the VCS Methodology Template. The VCS website lists the current Version as: Version 3.1 Issued: 1 February 2012. However, the template Version 3.0 was used for this Methodology. The most current template was not used.</p>	<p>“Although an earlier version of the template was used, I compared the two templates and the same information is required. Ben Block (VCS) also confirmed that the use of template Version 3.0 was ok as the changes were minor.” (<i>Stantec’s findings: Satisfactory</i>)</p>

5 ASSESSMENT CONCLUSION

Stantec conducted an assessment of the Methodology entitled “*Substitution of Bitumen Binder in Hot Mix Asphalt Production and Usage (version 1.5)*” against the criteria of the VCS program identified in Section 1.2 of this draft report.

Following the final review of the Methodology, it is the considered opinion of Stantec that the Methodology does not contain non-conformances that would affect the usability of the Methodology in the VCS program. The Corrective Action and Clarification requests for Methodology Versions 1.0 through 1.5 are provided in Table 4.1.

Stantec reviewed version 1.11 (January 23, 2014) of the Methodology following the second assessment. The conclusion of this review is presented in Section 6.

6 REPORT RECONCILIATION

The draft first assessment report was conducted on Methodology version 1.5 (June 15, 2012). Following the issuance of the second assessment report by First Environment (version 1, dated February 18, 2014), Stantec reviewed the revised Methodology (version 1.11, January 23, 2014) to assess for consistency with VCS requirements. Stantec requested clarification on the implementation of the VCS comments in the revised Methodology and is satisfied that all comments have been addressed. Stantec also notes a reference to concrete products in Section 6 of the Methodology; however, this is considered to be an immaterial qualitative discrepancy. Following the assessment of the Methodology (version 1.11), Stantec considers the Methodology to be appropriate, adequate for use, and consistent with VCS rules.

7 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

Stantec is accredited with the American National Standards Institute (ANSI), a member of the International Accreditation Forum (IAF), in accordance with ISO14065 (Accreditation ID #0805 issued to Stantec Consulting Ltd. for greenhouse gas (GHG) verification and validation). Stantec is an approved validator/verifier under the VCS program for 11 scopes, including scope 4 (Manufacturing Industries), scope 6 (Construction), and scope 7 (Transport).

Stantec has not conducted over 10 validations or protocol assessments under the VCS program.

8 SIGNATURE

Signed for and on behalf of:

Name of entity: _____ *Stantec Consulting Ltd.* _____

Signature: _____  _____

Name of signatory: _____ *Vicki Corning, P.Eng.* _____

Date: _____ *April 17, 2014* _____