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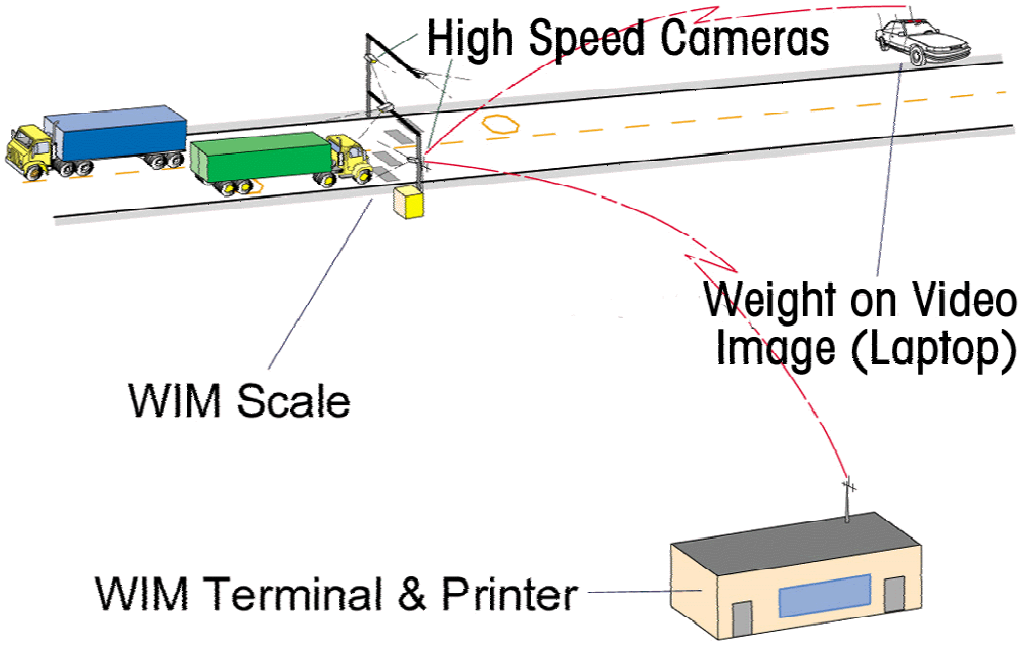

Weigh-in-Motion Update Reports

Energy and Greenhouse Gas Emission Reduction Quantification Plan

Government of New Brunswick – Department of Transportation

1 General

1.1 Background

The New Brunswick Climate Change Action Plan 2007-2012 provides a greenhouse gas (GHG) emissions reduction target of 1.2 million tonnes (Mt) CO_2e from transportation related activities. *The NB Climate Change Action Plan 2007-2012* also states that the Climate Change Secretariat aims to track and report on GHG emissions trends and progress regarding the implementation of all climate change initiatives in this action plan. Furthermore, the provincial authorities have decided to quantify the emission reductions according to the ISO 14064 framework.

This document quantifies the impact of the Department of Transportation's Weigh in Motion (WIM) project on GHG emission reductions. The project received $500,000 in funding through the Climate Action Fund (CAF) to install two new WIM scales. Since the project involved is expected to result in emission reductions below 25,000 tonnes of CO_2e, this specific quantification follows a track 2 quantification that is consistent with ISO 14064-2 principles, but one that does not go into the same level of detail and level of rigour to be compliant with ISO 14064-2[1] requirements. This is a simplified approach to estimating emissions that is meant to be easier and less time intensive to implement than the track 1 approach. Although track 2 projects are not eligible for generating tradable emission offsets (since they are not meant to be verified by a third party), the rationale behind the two-track approach is that smaller volume projects (such as this one) will not generate enough emission reductions to economically justify the cost and time required for project quantification, verification, serialization, and subsequent registration.

1.2 Best Practice Guidance

The Canadian Standards Association (CSA) has no official guidelines regarding truck idling; however, the US Energy Protection Agency (EPA) developed the EPA420-B-04-001[2], *"Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity".*

The other protocol covers the use and installation of WIM stations. According to International Road Dynamics Inc.[3] (IRD), the WIM manufacturer, the scale system meets and exceeds the specifications for type III and type IV WIM system presented in the American Society for Testing and Materials (ASTM) E1318-02. This system also conforms to the Canadian ITS architecture.

[1] http://www.iso.org/iso/catalogue_detail?csnumber=38382
[2] http://www.epa.gov/otaq/smartway/transport/documents/tech/420b04001.pdf
[3] http://www.irdinc.com

1.3 Intended User of Quantification

Although the primary reason for this report is to comply with the Climate Action Fund regulations, there are three main users for this document:

- *The People of New Brunswick:* Report back to the people of New Brunswick on the impact of the actions taken to reduce GHG emissions.
- *Climate Change Secretariat:* Report on the greenhouse gas emissions reductions that have occurred due to this program as part of the *Climate Change Action Plan 2007-2012* reporting requirements.
- *NBDOT Maintenance and Traffic:* The methodology used in this document can be used to quantify GHG reductions from past and future emissions sites.

1.4 Project Proponent

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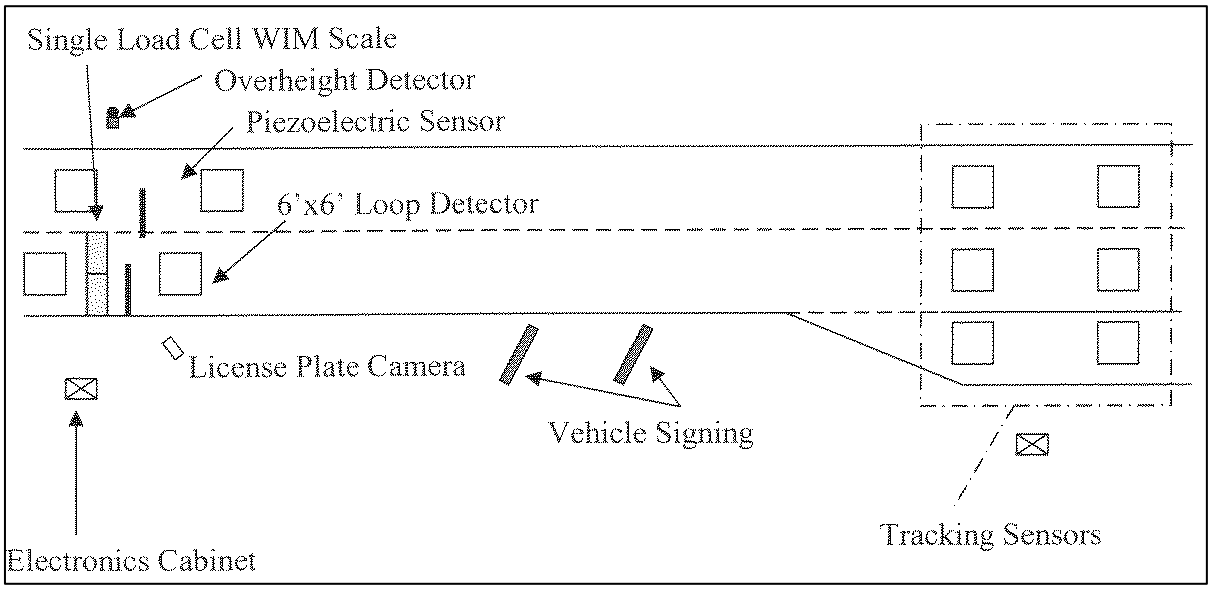
2 Project Description

The New Brunswick Department of Transportation (NBDOT) aims to reduce the number of trucks entering weigh scale stations and thus reduce GHG Emissions. NBDOT purchased two WIM stations that received funding through the CAF. The first station located at the Waweig stationary scale has been operational since November 2008. The second unit is purchased and planned to be installed on route 2 (Trans Canada Highway) eastbound near Salisbury by September 2010. The new WIM stations will reduce GHG emissions by decreasing the amount of trucks required to report to the weigh scale facilities.

2.1 Description of Technology

WIM devices measure the weight and dimension of vehicles that pass over its sensors and direct dimensionally non-compliant vehicles to the weigh station using variable message signs. A random selection of compliant vehicles is also directed to report to the weigh station for further inspection, but the majority are permitted to continue on their journey without having to slowdown or stop.

Figure 1 - Typical Weigh in Motion Site layout



Shown in Figure 1, the WIM system is comprised of a series of in-road sensors and roadside electronics. In New Brunswick, all trucks are directed to the use the right hand lane on approach to a WIM site. The system measures and records speed, weight, length and other data for each vehicle in the driving lane. A license plate photo and overall vehicle photo is also recorded. If the vehicle is determined to be non-compliant or randomly selected for additional inspection, the signs display a message directing them to report to the weigh station. If a vehicle is determined to be compliant, the signs remain blank and the vehicle continues on its route. The left lane sensors detect and classify vehicles, identifying any trucks that were supposed to be in the driving lane and

sends visual/audible signals to enforcement staff at the weigh station, as well as a photo of the vehicle's license plate. Tracking sensor loops in the entrance ramp and on the main lane just past the entrance ramp detect whether a truck entered or bypassed the ramp as directed. The appropriate vehicle record is displayed on the operator display at the weigh station facility. At the weigh station, trucks are statically weighed and the specified weight, dimension, and operational regulations in the *Motor Vehicle Act* and *High Act* are enforced.

The WIM scale measures and stores the following variables:

- Axle weight
- Gross Vehicle Weight (GVW)
- Axle spacing
- Vehicle length
- Vehicle width
- Speed

2.2 Current Situation in New Brunswick

In New Brunswick, 13 in-ground stationary scale sites are used for weight enforcement throughout the province. Of these thirteen sites, three were equipped with WIM systems prior to this project. The CAF supports the addition of two new systems to the facilities at Waweig and Salisbury East.

In the 2008 fiscal year, Table 1 represents the number of vehicles that were required to enter the weigh scale stations. Since the scales generally operate for 8 hours a day, a third of the Average Annual Daily Truck Traffic (AADTT) is considered. For the non-WIM sites, trucks are only weighed and measured on static scales. The compliant trucks exit the station and enter the highway. The non-compliant trucks are required to stop and sometimes idle awaiting further inspection. The number of trucks that remained in the station after being weighed in a non-WIM site is presented in Table 2. After installing the WIM system, the average reduction of trucks that pull into the station is around 91%, and the average number of long term idling is reduced to 9%.

Table 1 - Stationary Scale Data (2008 - Fiscal Year)

Station	*WIM*	*Number of Trucks when Station is Open*	*Number of trucks that entered the station*	*Percentage*
Longs Creek East	YES	12,886	1,491	11.57%
Salisbury West	YES	40,124	2,686	6.69%
Deerwood Scales	YES	2,215	284	12.82%
Waweig	YES	199	20	10.05%
Salisbury East	NO	65,570	65,570	100.00%
Buctouche	NO	19,858	19,858	100.00%
Tidehead	NO	2,397	2,397	100.00%
Le Relais	NO	31,157	31,157	100.00%
St. Jacques East	NO	60,153	60,153	100.00%

Table 2 - Extra Idling at Non-WIM sites (2008 – Fiscal Year)

Station	*WIM*	*Number of Trucks that Pulled in into the station*	*Number of Trucks that were stopped for extra amount of time*	*Percentage*
Salisbury East	NO	65,570	2,336	3.56%
Buctouche	NO	19,858	2,066	10.40%
Tidehead	NO	2,397	472	19.69%
Le Relais	NO	31,157	1,488	4.78%
St. Jacques East	NO	60,153	3,822	6.35%

2.3 Co-benefits

According to the EPA guidelines, there are some other benefits to reducing truck idling:

- Reductions in the emissions of toxic air pollutants such as formaldehyde, and trace metals such as nickel.
- Reductions in emissions of carbon dioxide.
- Reductions in fuel consumption, decreased maintenance costs, and longer engine life which results in cost savings to the truck owner.
- Reductions in noise levels.

3 Selection and Justification of the Baseline Scenario

Vehicles and trucks operate non-stop on the highway system. The stations however, operate for a certain period per day. Usually scale operators vary the scale open times between day and night. When the station is not in operation, trucks are not required to stop; therefore, only truck data registered when the station is in operation is required.

There is no formal study on wait times in scale stations; however, an average time of 15 minutes is used in this methodology to conform to the EPA standards and guidelines.

The Business As Usual or "BAU" scenario occurs when all trucks are required to pull in and be weighed for a time of 5 minutes per truck, and 15 minutes for 9% of the vehicles for further inspection. The number of minutes is added together to produce a total idling time.

Two scenarios are considered for this:

1. BAU: Impose delays of 15 minutes on 9% of heavy trucks and 5-minute delays on 100% of the trucks.
2. WIM Scenario: Delays of 15 minutes on 9% of heavy trucks.

Table 3 outlines some of the barriers related to both scenarios.

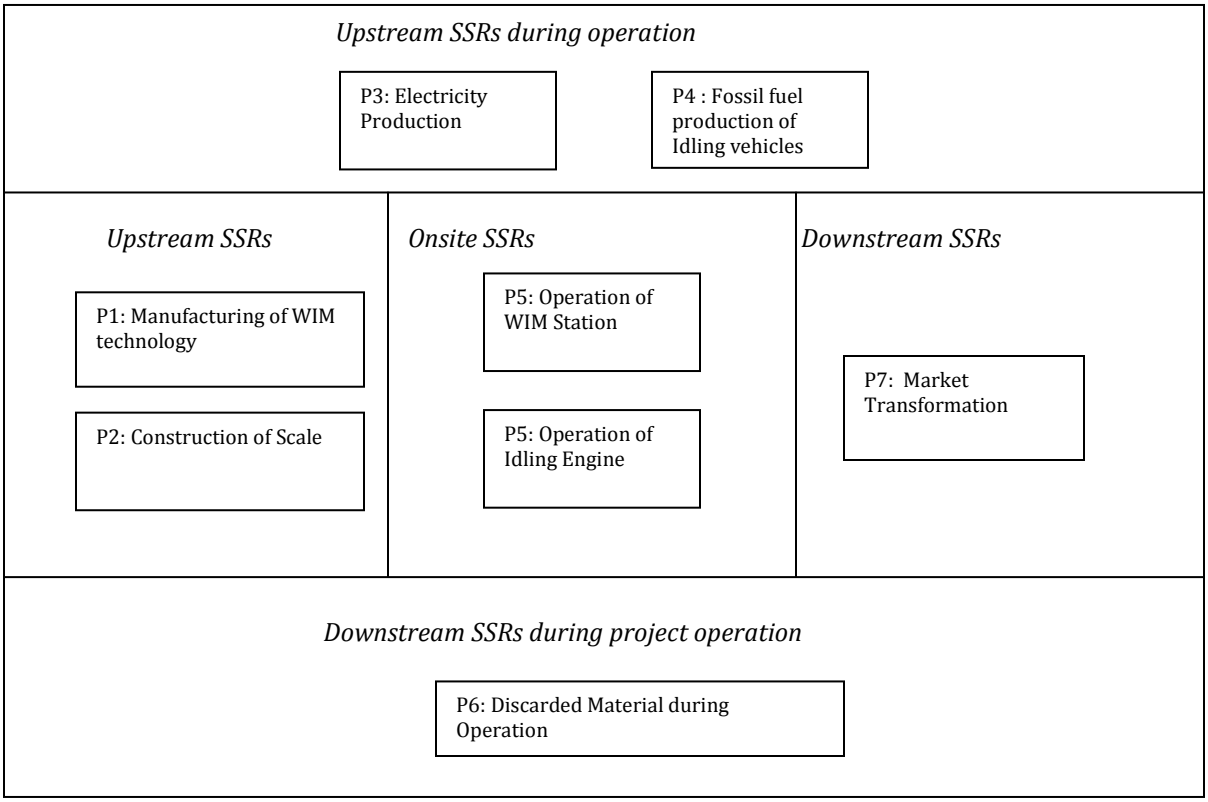
Table 3 - Barrier Analysis of Business as Usual Scenarios

Barriers	*BAU*	*WIM Scenario*
Regulatory barriers	No barriers	No barriers
Common practice barriers	Inefficient	No barriers, increases efficiency
Financial barriers	No barriers	Cost of WIM Site
Barriers due to the geographical location	No barriers	No barriers
Barriers due to public perception	Increased number of queued trucks	No barriers
Market barriers	Inefficient, and delays shipment of goods	No barriers
Technological barriers	No barriers	Lack of WIM Site

4 Sources, Sinks, and Reservoirs

Sources, sinks, and reservoirs (SSRs) are defined in order to determine the full breadth of emissions attributable to the project being implemented[4]. For this project, the SSRs are identified in Figure 2.

Figure 2 - Sources, Sinks, Reservoirs Associated with Project and Baseline



It is important to establish if the emission reductions resulting from the project are "owned", "related", or "affected". Emission reductions that are "owned" by the project proponent can be claimed for the purposes of emission reduction and be retired or sold. Emission reductions that are "related", alternatively, refer to those emissions that are affected by the project indirectly (e.g. emissions associated with manufacturing the equipment). Emission reductions that are "affected" generally refer to the wider impacts of fuller implementation of a policy or a program (i.e. the emission reduction benefits accrued with fuller adoption of the renewable energy or technology).

The description of SSRs and the proponent ownership is listed in Table 4.

[4] A source means any process or activity that releases a greenhouse gas into the atmosphere, whereas a sink means any process, activity or mechanism that removes a greenhouse gas from the atmosphere and a reservoir means a physical unit or component of the biosphere, geosphere or hydrosphere with the capability to store or accumulate GHGs (from http://www.ec.gc.ca/creditscompensatoires-offsets/default.asp?lang=En&n=7CAD67C6-1&offset=12&toc=show).

Table 4 Description of SSRs attributed to project

SSR	*Description of SSR*	*Owned, related or affected*
P1	Manufacturing of WIM Technology	Related
P2	Construction of scale	Related
P3	Electricity production	Related
P4	Fuel production of idling engines	Related
P5	Operation of WIM site	Owned
P6	Discarded Material during Operation	Related
P7	Market transformation	Affected

Since this is a track 2 project, attention is only given to emissions that are "owned" by the project – in this case, the emissions directly attributable to the fuel used and combusted for the purposes of powering the engines required for vessel propulsion and use.

5 Quantification of GHG Emissions

5.1 Air Pollutant Emissions

This report used the EPA methodology outlined in section 1 to determine the reduction in GHG emissions. Long term idling represents any form of idling lasting longer than 15 minutes not endured in traffic by trucks in loading/unloading docks, at enforcement sites, in extreme weather conditions to keep the vehicle warm/cold, etc. The EPA guidelines specify the following parameters for 2008:

- NO_x =135 grams/hour
- $PM_{2.5/10}$ of 2.94 grams / hour

The methodology is based on EPA's Mobile 6.2 application and estimates the net emission reduction according to the following formula:

$$NER = (EFBASE * (ALIRT / CFG/LBS)) - (EFIRT * HP * (ALIRT / CFG/LBS))$$

Where,

- NER = Net emission reduction
- EF_{BASE} = Truck baseline emission factor (NO_x or PM in g/hr)
- AL_{IRT} = Estimated hours of use of the idle reduction technology (hr/day)
- $CF_{G/LBS}$ = Conversion factor for grams to pounds which is 454
- EF_{IRT} = Idle reduction technology emission factor (NO_x or PM in g/bhp-hr)
- HP = Average daily horsepower load (ranges from 4-8 hp depending on the technology; contact the technology manufacturer)
- AL_{IRT} = Estimated hours of use of the idle reduction technology (hr/day)

Eliminating $CF_{G/LBS}$ will keep the results in metric, reducing the formula to

$$NER = (EFBASE * ALIRT) - (EFIRT * HP * ALIRT)$$

5.2 Fuel Consumption Emissions

A survey of US heavy vehicle idling characteristics[5] found that idling heavy vehicles consume a rate of 3.2 litres of fuel per hour. When this consumption rate is multiplied by the number of idling hours from section 5.1, it produces the total volume of fuel consumption. To calculate the emissions, the volume of fuel is multiplied by the Environment Canada rates[6] presented in Table 5.

Table 5 - Environment Canada Fuel Emissions[6]

	Emission Factor (g/L fuel)		
	CO2	***CH4***	***N2O***
Emissions	2.6631	0.146	0.0826

This calculation can be summarized using the following equation:

*Fuel Consumption Emission = Fuel Consumption Rate * Idling Hours * Emission Factor*

The carbon dioxide equivalent (CO_2e) emissions were calculated using United Nations – Intergovernmental Panel on Climate Change (IPCC) report, *Working Group I Fourth Assessment Report "The Physical Science Basis*[7]. The factors in Table 6 were multiplied by the fuel consumption emissions to estimate CO_2e emissions.

Table 6 - Carbon Dioxide Equivalent[8]

	Carbon Dioxide Equivalent Factors		
	CO2	***CH4***	***N2O***
Equivalent factors	1	21	310

5.3 Estimated Baseline Emissions

The baseline scenario calculates the emissions produced by all trucks stopping at the static scale site. The Department of Public Safety (DPS) produced the data on the number of trucks monitored through operation hours. When operating, all trucks have to report to the weigh scale. The emissions for the Salisbury East and Waweig sites were calculated based on the following assumptions:

1. The number of trucks used is a third of the Annual Daily Truck Traffic (AADTT) as the scale stations are open eight hours a day.
2. All trucks have to stop for at least 5 minutes to be weighed.

[5] http://pubsindex.trb.org/view.aspx?type=CO&id=746406
[6] http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=AC2B7641-1#section5
[7] http://www.ipcc-wg1.unibe.ch/publications/wg1-ar4/wg1-ar4.html
[8] Table 2-14 : http://www.ipcc-wg1.unibe.ch/publications/wg1-ar4/wg1-ar4.html

3. 9% of these trucks will be required to be inspected for at least 15 minutes. The assumption is that a truck is idling at that time.

The total air pollutant emissions produced for these two sites are between 7 and 805 Kg NO_x and 0.05 to 17.5 Kg PM as indicated in Table 7. The emissions presented in Table 8 from Fuel consumptions were 0.14 and 44.11 Kg of CO_2e for Waewig and Salisbury East.

Table 7 - Baseline Scenario for Air Pollutant Emissions

Site	*Trucks*	*100% stop for 5 minutes*	*9% stop for Additional 15 minutes*	*Total time (hr)*	*NO_x (Kg)*	*PM (Kg)*
Waweig	199	995	90	18	2.4402	0.0531
Salisbury East	65,570	327,848	29,506	5,956	804.0480	17.5104

Table 8 - Baseline Scenario for Fuel Consumption Emissions

Site	*Total time (hr)*	*Fuel Consumption Rate (Litres / hr)*	*Total Fuel Consumption (Litres)*	*CO2 (Kg/Litres)*	*CH4(Kg)*	*N_2O(Kg)*	CO_2e *(Kg)*
Waewig	18	3.20	58	0.1373	0.0000	0.0000	0.1413
Salisbury East	5,954	3.20	19,052	42.8732	0.0069	0.0035	44.1151

5.4 Estimated Project Emissions

The estimated emissions with the installation of the WIM are calculated based on the assumption that 9% of the trucks have to idle for at least 15 minutes. For the estimates, the potential emissions are measured for the Salisbury site. The air pollutant emissions vary between 0.05 and 13 kg of NO_x and 0 to 0.3 Kg of PM as outlined in Table 9, whereas Table 10 outlined the fuel consumption emissions that ranged from 0.0096 to 0.7327 Kg of CO_2e.

Table 9 - Emissions after WIM site installation

Site	*Trucks*	*100% stop for 5 minutes*	*9% stop for Additional 15 minutes*	*total time (hr)*	*NO_x (Kg)*	*PM (Kg)*
Waweig	199	0	18	0	0.0403	0.0009
Salisbury East	65,570	0	5,901	98	13.2779	0.2892
Potential emissions						

Table 10 - Fuel Consumption Emissions after WIM Installation ation

Site	Total time	Fuel Consumption Rate (Litres / hr)	Total Fuel Consumption (Litres)	CO2 (Kg/Litres)	CH4(Kg)	N_2O(Kg)	eCO_2(Kg)
Waewig	0	3.20	1	0.0093	0.0000	0.0000	0.0096
Salisbury East Potential	98	3.20	313	0.7120	0.0001	0.0001	0.7327

5.5 Final GHG Emission Reductions

The total reduction in emissions for the project is between 93% and 98.3% and as outlined in Table 11 and Table 12.

Table 11 - GHG Emission Reductions after Installing the WIM Site

Reductions	NO_x	%	PM	%
Waweig	2.40	98.35%	0.0523	98.35%
Salisbury East (potential reduction)	790.77	98.35%	17.2212	98.35%

Table 12 - Reduction in Fuel Consumption Emissions

Station	CO2	%	CH4	%	N2O	%	eCO2	%
Waweig	0.13	93%	0.0000	93.20%	0.0000	93.20%	0.13	93.20%
Salisbury East (potential reduction)	42.16	100%+	0.0067	98.34%	0.0035	98.34%	43.38	98.34%

6 Summary

NBDOT purchased two WIM stations that received funding through the CAF. The first station located at the Waweig stationary scale has been operational since November 2008. The second unit is purchased and planned to be installed on route 2 (Trans Canada Highway) eastbound near Salisbury by September 2010. Emissions were estimated based on two scenarios, with or without WIM. Calculating the air pollutant and fuel consumption estimates were based on EPA, Environment Canada, and IPCC methodologies. The installation of WIM stations reduced the idling emissions by 93% in Waweig, with a potential reduction of 98% in Salisbury.