



**Verified Carbon
Standard**

RECYCLING ROADWAYS FOR CARBON EMISSION REDUCTIONS - MIDSTATE RECLAMATION AND TRUCKING



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1 PROJECT DETAILS

1.1 Summary Description of the Project

The Cold-in-Place Recycling (CIR) using Foam Stabilized Base (FSB) and asphalt emulsion mixture projects aim to enlist road construction contractors in the United States of America with the purpose of reducing Greenhouse gas (GHG) emissions during the asphalt installation process by using FSB and asphalt emulsions in place of Hot Mix Asphalt (HMA). Prior to project implementation, the road construction projects would have utilized typical HMA or Warm Mix Asphalt (WMA) installation which has a significant GHG emission footprint associated with the mining of virgin aggregate, trucking the virgin aggregate to the mix plant, heating the mix to 310 °F, and then trucking the mixed product at high temperatures to the job site (further detailed in Sections 1.11 and 3.4).

FSB and asphalt emulsions, as compared to the baseline HMA or WMA scenario, greatly reduce GHG emissions by (further detailed in Section 1.11):

- 1) Recycling the existing roadway and eliminating the need for virgin aggregate mining.
- 2) Eliminating the need for long distance trucking of virgin aggregate.
- 3) FSB and asphalt emulsions do not need to be heated to high temperatures like HMA, which reduces GHG emissions related to electricity, diesel, or natural gas consumption at the mix plant and to-site delivery.

In-place recycling enables agencies to optimize the value of in-place materials and minimize the construction time and traffic flow disruptions, as well as to reduce vehicle emissions from long traffic queues. In-place recycling reclamation also reduces the number of construction vehicles moving in and out of the construction area and neighborhood truck traffic.

NCHRP Synthesis 421 documented the following benefits of in-place recycling to fix the structural distress in pavements; (a) reduces the use of natural resources; (b) eliminates materials generated for disposal; (c) reduces fuel consumption; (d) reduces greenhouse gas emissions by between 50% and 85%; (e) minimizes lane closure times; (f) improves driver safety by improving friction, providing lane widening, and eliminating overlay edge drop off; (g) maintains height clearances, which eliminates the need to adjust appurtenances; (h) addresses existing material deficiencies such as moisture damage; (i) reduces costs of preservation, maintenance, and rehabilitation; and (j) improves base support with a minimum of needed wearing course.

The project activity instance quantifies the reductions in GHG emissions associated with the use of FSB and/or asphalt emulsions as substitutes to HMA for a group of highway asphalt construction projects. This grouped project was completed by Midstate Reclamation and

Trucking, Inc. and subsidiary, Coughlin Company. The project instances consist of existing highway roads in need of repair to extend the usable lifespan for conveying vehicular traffic.

This project is developed as a grouped project within the United States of America. The project activity intends to add more instances over the 10 years of the first crediting period. During the first monitoring period, running from 27-April-2021 through 25-September-2021, the project activities included the following project instance locations:

1. Hettinger County, ND - North Dakota Highway 8 (ND 8) from ND 12 to ND 21
2. Chisago County, MN - US 61, from 0.2 miles north of US 8 to 0.1 mile west of US 35
3. Buena Vista County, IA - County Highway C63, from 50th Avenue to IA Hwy 110
4. Wright County, IA - IA 17, from 340th Street to S. Braden Avenue
5. Story County, IA - US 65, from 0.5 miles south of US 30 to IA 175 in Hubbard, IA
6. Boone County, IA - Lower Ledges Road and E52, from Lower Ledges Easterly 4.2 miles to Hwy. 17
7. Mower County, MN #1 - County State-Aid Highway System (CSAH) 2 (265th Street), from US 63 to the east county line; CSAH 3 (200th Street), from CSAH 7 (670th Avenue) to CSAH 8 (740th Avenue); CSAH 7 (140th Street), from CSAH 5 (640th Avenue) to CSAH 18 (140th Street)
8. Mower County, MN #2 - 555th Avenue, from 10th Place NE to 270th Street
9. Coffee County, TN - US-64, from west of Rutledge Road through Coffee County to west of I-24 in Grundy County
10. Porter County, IN - State Road (SR) 149, from US 12 to SR 130
11. Webster County, IA - IA 175, from Ash Street in Lohrville, IA to 4th Street in Gowrie, IA
12. Keokuk County, IA - IA 21, from IA 92 to 170th Street in What Cheer, IA
13. St. Louis County, MN - CSAH 5, between 1.2 miles north of MN 73 and CSAH 81
14. Sioux County, IA - Eagle Avenue (K30), from 390th Street to 450th Steet; K22, from 360th Street to 390th Street; 320th Street, from Elmwood Avenue to the East 0.5 miles
15. Sibley County, MN - CSAH 8, from 1,200-ft west of CSAH 17 to TH 169
16. Hennepin County, MN - CSAH 60, from 146-ft south of Fairway Drive to 200-ft south of I-494 bridge
17. Redwood County, MN - CSAH 101, from US 71/MN 19 to Minnesota River, North County Line
18. Madison County, TN - CSAH 8, from 1,200-ft west of CSAH 17 to US 169
19. Norman County, MN - CSAH 3, from US 75 in Shelly, MN to MN 9
20. Plymouth County, IA - Route C30, from Le Mars East to Route K 64; On Route K 64, from Route C38 north to Hwy 3

- 21. Ottertail County, MN – CSAH 67, from CSAH 58 to CSAH 8 West
- 22. Sanpete County, UT – US 89 from Fairview, UT to Utah County line
- 23. Elko County, NV – SR 232, from 5 miles south of Steeles Creek to US 93
- 24. Flathead County, MT – US 2, from Highline Boulevard to Pyramid Creek

This group of projects is submitted following VCS methodology VM0039, Methodology for Use of Foam Stabilized Base and Emulsion Asphalt Mixtures in Pavement Application V1.0. The methodology details the requirements for pavement projects within the United States that utilize FSB and asphalt emulsions in place of traditional HMA and determines the issuance of verified carbon unit credits (VCUs). Projects currently under design/construction and future projects will be added under this project description. An estimated annual average of 75,767 tonnes of GHG emissions reductions is anticipated, with a total of 757,665 tonnes over a 10-year crediting period.

<u>Audit Type</u>	<u>Period</u>	<u>Program</u>	<u>VVB Name</u>	<u>Number of years</u>
Validation/ Verification	2021 (27-April-2021 – 25-September- 2021)	VCS	SCS Global	0.41
<u>Total</u>	2021 (27-April-2021 – 25-September- 2021)	VCS	SCS Global	0.41

1.2 Sectoral Scope and Project Type

The project falls under Sectoral Scope 6: Construction and is a grouped project.

1.3 Project Eligibility

Eligible asphalt paving projects must occur in the United States of America and include the production and installation of FSB and/or asphalt emulsions using Cold Central Plant Recycling (CCPR), Cold In-place Recycling (CIR), and/or Full Depth Reclamation (FDR) processes. The grouped projects included under this project description include the production and installation of FSB or asphalt emulsions, use the CIR process, and are located in the United States of America.

1.4 Project Design

The project has been designed as a grouped project. New project instances will comply with the set of criteria listed below.

- The project includes a single location or installation only
- The project includes multiple locations or project activity instances, but is not being developed as a grouped project
- The project is a grouped project

Eligibility Criteria

As a grouped project, additional project instances may be included in this project description if the following requirements are met:

1. Project activities include the construction of any type of road and/or parking lot (including parking lot patching projects) in the United States.
2. Project activities must apply one or more of the following processes for road construction:
 - a. FSB produced using the CCPR process
 - b. FSB produced using the CIR process
 - c. FSB produced using the FDR process
 - d. Asphalt emulsions produced using the CCPR process
 - e. Asphalt emulsions produced using the CIR process
 - f. Asphalt emulsions produced using the FDR process
3. Production plants where the project activity occurs may serve multiple pavement types, including, but not limited to, roadways and parking lots.
4. Project activities may have an HMA or WMA surface *layer but* must have at least one FSB or asphalt emulsions base layer.
5. Are subject to the baseline scenario determined in the project description, which in this case (as specified in VM0039) is the continuation of reconstructing roadways with HMA pavement in the United States.
6. Project activities must adhere to the additionality tests defined in VM0039 including regulatory surplus and performance benchmark. Only projects that are demonstrated to emit less than the predetermined performance benchmark may be deemed additional and therefore claim emission reductions.
7. Be validated at the time of verification against the applicable set of eligibility criteria.
8. Be included in the monitoring report with sufficient technical, financial, geographic, and other relevant information to demonstrate conformance with the applicable set of eligibility criteria and enable evidence gathering by the validation/verification body.
9. Have evidence of project ownership, in respect of each project activity instance, held by the project proponent from the respective start date of each project activity instance (i.e., the date upon which the project activity instance began reducing or removing GHG emissions).

10. Have a project start date that is the same as or later than April 27, 2021.
11. Be eligible for crediting from the start date of the project activity instance through to the end of the project crediting period (only).
12. Only eligible for crediting from the start of the verification period in which they were added to the grouped project.
13. Not be or have been enrolled in another VCS project.
14. Adhere to the clustering and capacity limit requirements for multiple project activity instances set out in 3.6.8 - 3.6.9 of the VCS Standard (v4.4).

1.5 Project Proponent

Organization name	Global Emissionary, LLC
Contact person	Harold Green
Title	CEO
Address	PO Box 6, Phoenix, Maryland 21131
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1.6 Other Entities Involved in the Project

Organization name	Midstate Reclamation and Trucking
Role in the project	Asphalt Contractor, performed the asphalt construction
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Organization name	University of Maryland, Smart Construction Center
Role in the project	Technical Consultant, Methodology development

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Role in the project	Methodology and application development
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Telephone	
Email	jp@globalemissionairy.com

1.7 Ownership

The Project Proponent, Global Emissionairy, LLC, holds the rights of the GHG emissions savings achieved in the asphalt pavement construction projects performed by Midstate Reclamation and Trucking, Inc. using FSB and/or asphalt emulsion as conveyed via a sales and service agreement. This is consistent with VCS Standard Section 3.6.1 Ownership, Clause 3 which states:

3) Project ownership arising by virtue of a statutory, property or contractual right in the plant, equipment or process that generates GHG emission reductions and/or removals (where the project proponent has not been divested of such project ownership).

1.8 Project Start Date

The earliest construction start date for the 2021 grouped project instances included in this project description was 27-April-2021 and is the project start date for this grouped project. Emission reductions are realized once the final product is installed. The start date indicates the first day that the cold recycling mixture was paved and compacted. Evidence for each project instance will be provided to the VVB.

1.9 Project Crediting Period

The Project’s crediting period is 10 years-fixed beginning on the Project start date of 27-April-2021, and ending on 26-April-2031.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

- <20,000 tCO₂e/year
- 20,000 – 100,000 tCO₂e/year
- 100,001 – 1,000,000 tCO₂e/year
- >1,000,000 tCO₂e/year

For the purposes of assessing materiality, VCS projects are disclosed across two project categories: Project category reductions may be up to 300,000 tonnes CO₂e per year; Large Project category reductions comprise more than 300k tonnes CO₂e/year.

The Grouped Projects annual GHG reduction is anticipated to be between 20,000 – 100,000 tCO₂e, which is under the threshold for Large Projects and is therefore classified in the Project category. In addition, a 10-year fixed crediting period has been selected for the Grouped Projects.

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
2021	28,915
2022	35,250
2023	42,250
2024	50,750
2025	60,750
2026	72,750
2027	87,250
2028	104,500
2029	125,250
2030	150,000
2031	0
Total estimated ERs	757,665
Total number of crediting years	10
Average annual ERs	75,767

1.11 Description of the Project Activity

For over 40 years, FSB and asphalt emulsions have been used in road projects around the world when natural resources for virgin aggregate or funding to construct and maintain roads using HMA have been limited. In North America, where virgin aggregate has historically been easily accessible within proximity to project sites, FSB has not been as widely implemented as it has in other parts of the world. FSB has therefore been used on a very limited basis in the United States for the last 10 to 15 years. Most projects using FSB and asphalt emulsions in the United States are pilot projects funded by various state highway agencies. While these projects have proven successful, state highway administrations have been slow to accept and develop the protocol and practices for this approach in North America. Presently there are no national or regional standards for the production or application of FSB and asphalt emulsions, which serves as a major impediment to the acceptance and application of FSB and asphalt emulsions beyond the testing phase.

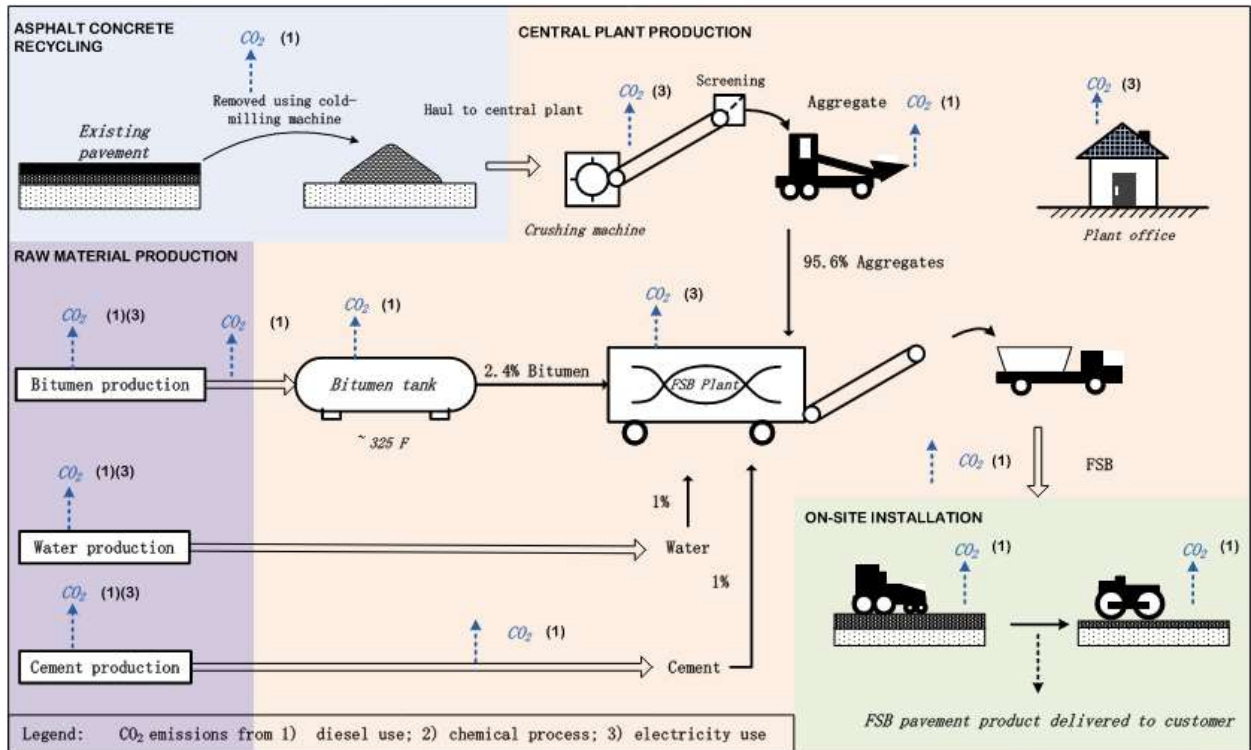
All project activity instances include roadway paving projects that utilize FSB and/or asphalt emulsion instead of HMA in the production and installation of asphalt pavement construction. GHG emission reductions are generated from producing and installing FSB and asphalt emulsions instead of HMA as follows:

FSB and asphalt emulsions consist of 50% less liquid asphalt/bitumen by weight and 2.5% less asphalt/bitumen by volume than required for HMA production, reducing the reliance on resources. No virgin aggregate is required, eliminating the energy and resources needed for excavating machines and trucking. In most applications, but especially in rural areas, the GHG emissions from trucking are significantly reduced. This is due to the fact that FSB and asphalt emulsions can be manufactured at or close to the project site.

Aggregates in FSB and asphalt emulsions do not have to be heated, while HMA liquid, which is roughly 2.2% of the total weight of the mix, needs to be heated up to 310 °F and kept at high temperatures during storage and transport. This results in significant GHG emissions from the electricity, natural gas, or diesel fuel used to heat, mix, store, and transport the HMA.

Introduction to the CCPR Process

The CCPR process rehabilitates roads by reusing reclaimed aggregate pavement (RAP) at a central plant location. Figure 1 below shows the typical arrangement of the main manufacturing/production technologies, systems and equipment involved in the CCPR paving process. The CCPR process begins by using a front loader to feed RAP into a mobile mixing plant that crushes, screens, then blends the unheated RAP with FSB or asphalt emulsions with a small amount of Portland cement (if applicable to the mix design) in a cold mixing process. This process creates an asphalt mixture that is transported to the jobsite using dump trucks. Once at the jobsite, the dump trucks pour the asphalt mixture into a paving machine that lays the mixture down onto the ground surface in a uniform layer. The final step in this paving process is compaction which is performed by rollers following behind the paving machine that perform multiple passes until the proper density is obtained.

Figure 1: Typical Arrangement of Equipment for CCPR


The cold recycling mix plant is the primary piece of equipment in this process that controls production rates. A typical diesel-powered mobile mixing plant can produce 220 tonnes/hour of recycled mix. When operating at a mixing capacity of 200 tonnes/hour, one truck load of 20 tonnes of cold recycling mix is produced every 6 minutes. This amount of material enables an approximately 560 foot long, 12 feet wide, and 6-inch-thick section of road to be paved every hour, or roughly one lane-mile per 10-hour workday at a 6-inch depth.

The mobile mix plant includes a screen deck to receive the appropriate gradation required by the specification, and an oversized particles removal system to ensure that all particles are of acceptable specification sizes. The calibrated conveyor collects the crushed aggregate particles from the screen deck, weighs the particles based on the mix design batches, and transfers them to the pugmill.

As the aggregate is transported on the conveyor, aggregate and cement weights are measured and transmitted from the conveyor to the pug mill by built-in calibrated mix plant computer. The computer also controls nozzles, which releases foam bitumen or asphalt emulsion that is proportional to the mix design, into the pug mill with the proportion of sprayed foamed bitumen or asphalt emulsion by percent weight of the aggregate that enters the pug mill.

The components are mixed in the pug mill before they exit the mix plant through the slewing conveyor that dumps the mix into a stockpile or directly into a waiting dump truck that transports the material to the job site. Once at the job site, the dump trucks unload the mix

material into a paver, which is calibrated to adjust the rate of pavement application based on the level of smoothness, desired layer thickness, and cross slope of the required pavement profile. The rollers follow the paver to compact the mix according to a pre-determined rolling pattern that dictates how many passes of each roller are required to achieve optimum density according to the approved mix design.

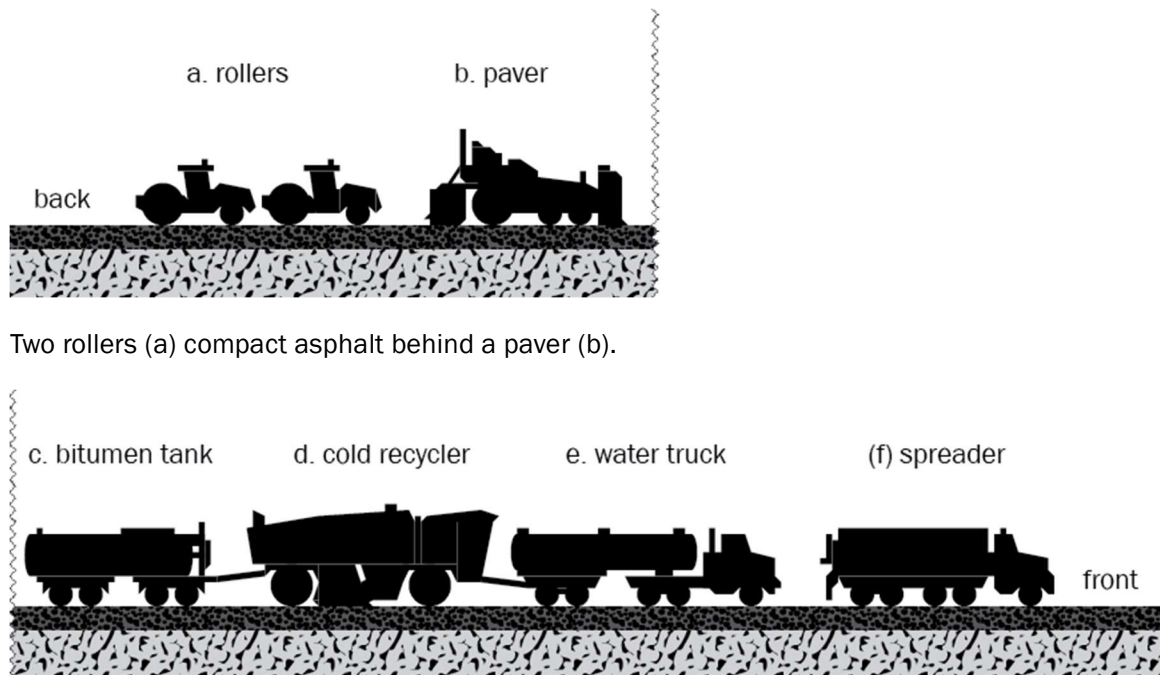
The quality control technician on the job site records the number of rollers passes, depth of material, gradation of crushed and screened aggregates from the calibrated conveyor belts, and density of the paved mat according to the pre-approved quality control plan.

Generally, two hours after the paving is completed using the CCPR process, traffic is allowed on to the pavement. The CIR mat is open for 3 to 10 days for complete curing before it receives surface treatment such as chip seal, micro surface, or HMA pavement.

Introduction to CIR and FDR Process

The CIR and FDR process rehabilitates roads by reusing existing pavement “in-place.” Reusing existing pavement eliminates the need to procure and haul new aggregate compared to traditional baseline projects. The CIR and FDR process consists of milling existing pavement into reclaimed aggregate pavement (RAP), sizing the RAP, mixing the new RAP with asphalt emulsions, placing the new material down, and compacting it. This process is executed with a “train” of equipment that drives down a roadway. The key difference between CIR and FDR is that CIR is only milling up a portion of existing pavement thickness while FDR mills up all existing pavement and some predetermined depth of the underlying sub-grade.

Figure 2: Arrangement of Equipment in a Midstate CIR Train



Two rollers (a) compact asphalt behind a paver (b).

A bitumen tank (c) is pulled by a cold recycler (d). The cold recycler is led by and is connected to a water truck (e). The all-in-one cold recycler shown in this diagram represents a pug mill, a crushing and screening machine, and a milling machine hooked up together. A stand-alone spreader (f) leads the train.

The arrangement of equipment in a CIR train can vary depending on the type of cold recycling equipment that a contractor uses. VCS methodology VM0039 shows an example arrangement of equipment where a bitumen tank leads a cold recycler (see Table 2 for GHG sources and sinks). In Midstate's CIR train, the bitumen tank (c) is instead pulled by a cold recycler (d), and this cold recycler does not include a paver in it. Instead, Midstate used a stand-alone paver (b). Because Midstate used a stand-alone paver, this group project description conservatively accounts for the emissions from the stand-alone paver in addition to the emissions from the cold recycler.

A 12' cold recycler is the standard and has an average life expectancy of about 5,000 operating hours or 5 years. All other equipment in the CIR train has an average life expectancy of 5 to 10 years. The age of equipment in specific project instances may vary. Midstate and each asphalt contractor has their own equipment that varies in age.

The cold-in-place recycling (CIR) process can pave a 2-mile long stretch of lane on a good day with reasonable pavement hardness. However, if the existing pavement contains a hard rock like granite, the length of the lane that can be paved using CIR may be reduced to a minimum of one mile.

CIR was performed in all project activity instances using either foamed asphalt or asphalt emulsions. The cold recycler train is the main piece of equipment used in the CIR process as shown in Figure 2 (d) cold recycler. The cold recycler includes a milling machine that can cut 3 to 4 inches deep and is connected to a crushing unit to size up the aggregate from millings. The treatment train also includes a screen deck to receive the appropriate gradation required by the specification, and an oversized particles removal system to ensure that all particles are of acceptable specification sizes. The calibrated conveyer collects the crushed aggregate particles from the screen deck, weighs the particles based on the mix design batches, and transfers them to the pugmill.

As the aggregate is transported on the conveyor, aggregate weights are measured and transmitted from the conveyor to the pug mill by built-in calibrated cold recycler computer. The computer also controls nozzles, which releases foam bitumen or asphalt emulsion that is proportional to the mix design, into the pug mill with the proportion of sprayed foamed bitumen or asphalt emulsion by percent weight of the aggregate that enters the pug mill. The Portland cement is already sprayed proportionately on the road before the CIR train, and it is combined with the aggregate from the milling machine.

The components are mixed in the pug mill before they are conveyed to the paver, which is calibrated to adjust the rate of pavement application based on the level of smoothness and

cross slope of the required pavement profile. The rollers follow the paver to compact the mix according to a pre-determined rolling pattern that dictates how many passes of each roller are required to achieve optimum density according to the approved mix design.

The quality control technician on the job site records the number of rollers passes, depth of milling at random locations, gradation of crushed and screened aggregates from the calibrated conveyor belts, and density of the paved mat according to the pre-approved quality control plan.

Generally, two hours after the paving is completed using the CIR process, traffic is allowed on to the pavement. The CIR mat is open for 3 to 10 days for complete curing before it receives surface treatment such as chip seal, micro surface, or HMA pavement.

Average Lifetime of Equipment

A 12' cold recycler is the standard and has an average life expectancy of about 5,000 operating hours or 5 years assuming an average use of 1,000 hours per year. All other equipment in the FDR/CIR train and the CCPR mix plant has an average life expectancy of 10 to 15 years however this can vary greatly based on the use (hours per year) and the quality of maintenance performed on the machinery. The age of equipment in specific project instances may vary.

Techniques Employed by Project Activities

All project activities included in the first monitoring period utilized the CIR cold recycling. Of the 24 projects in the first monitoring period, 10 were stabilized with FSB while 14 were stabilized with asphalt emulsions which can be referenced in Table 8.

1.12 Project Location

The grouped project instances have been or will be constructed within the United States of America. The first project activity instance is located on North Dakota Highway 8 (ND 8) from ND 12 to ND 21 in Hettinger County, North Dakota and covers approximately 24.6 miles. The Hettinger County, ND project instance will serve as the model project for the other project instances that are included in this Project Description. All 2021 grouped project instances are summarized in Table 1 below.

Table 1: 2021 CIR Project Instances

Project	State	Location Description	Length (Miles)
Hettinger County, ND	North Dakota	ND 8) from ND 12 to ND 21 in Hettinger County, North Dakota (Coordinates: 46° 11'24.5"N, 102° 28'36.6"W)	24.6
Chisago County, MN	Minnesota	US 61, from 0.2 miles north of US 8 to 0.1 mile west of US 35 (Coordinates: 45° 18'51.1"N, 92° 59'13.4"W)	2.03

Project	State	Location Description	Length (Miles)
Buena Vista County, IA	Iowa	County Highway C63, from 50th Avenue to IA Hwy 110 (Coordinates: 42° 38'00.7"N, 95° 16'35.9"W)	3.52
Wright County, IA	Iowa	IA 17, from 340th Street to S. Braden Avenue (Coordinates: 42° 36'25.6"N, 93° 54'08.7"W)	6.15
Story County, IA	Iowa	US 65, from 0.5 miles south of US 30 to IA 175 in Hubbard, IA (Coordinates: 42° 06'17.7"N, 93° 18'30.6"W)	16.48
Boone County, IA	Iowa	Lower Ledges Road and E52, from Lower Ledges Easterly 4.2 miles to Hwy. 17 (Coordinates: 41° 58'46.7"N, 93° 50'48.0"W)	4.21
Mower County (1), MN	Minnesota	<ul style="list-style-type: none"> County State-Aid Highway System (CSAH) 2 (265th Street), from US 63 to the east county line (Coordinates: 43° 44'22.7"N, 92° 27'55.2"W) CSAH 3 (200th Street), from CSAH 7 (670th Avenue) to CSAH 8 (740th Avenue) (Coordinates: 43° 38'42.4"N, 92° 38'43.3"W) CSAH 7 (140th Street), from CSAH 5 (640th Avenue) to CSAH 18 (140th Street) (Coordinates: 43° 33'32.5"N, 92° 44'46.6"W) 	11.10
Mower County (2), MN	Minnesota	555th Avenue, from 10th Place NE to 270th Street (Coordinates: 43° 42'43.5"N, 92° 56'21.4"W)	4.62
Coffee County, TN	Tennessee	US-64, from west of Rutledge Road through Coffee County to west of I-24 in Grundy County (Coordinates: 35° 16'43.7"N, 85° 55'24.9"W)	3.87
Porter County, IN	Indiana	State Road (SR) 149, from US 12 to SR 130 (Coordinates: 41° 33'41.5"N, 87° 07'30.9"W)	7.60
Webster County, IA	Iowa	IA 175, from Ash Street in Lohrville, IA to 4th Street in Gowrie, IA (Coordinates: 42° 16'00.6"N, 94° 25'07.6"W)	12.86
Keokuk County, IA	Iowa	IA 21, from IA 92 to 170th Street in What Cheer, IA (Coordinates: 41° 22'13.9"N, 92° 21'15.6"W)	3.83
St. Louis County, MN	Minnesota	CSAH 5, between 1.2 miles north of MN 73 and CSAH 81 (Coordinates: 47° 31'49.6"N, 92° 57'33.9"W)	8.80
Sioux County, IA	Iowa	<ul style="list-style-type: none"> Eagle Avenue (K30), from 390th Street to 450th Street; K22, from 360th Street to 390th Street (Coordinates: 43° 01'10.6"N, 96° 18'46.1"W) 320th Street, from Elmwood Avenue to the East 0.5 miles (Coordinates: 43° 03'15.6"N, 96° 23'31.4"W) 	9.45
Sibley County, MN	Minnesota	CSAH 8, from 1,200-ft west of CSAH 17 to TH 169 (Coordinates: 44° 27'51.6"N, 93° 59'10.8"W)	6.14

Project	State	Location Description	Length (Miles)
Hennepin County, MN	Minnesota	CSAH 60, from 146-ft south of Fairway Drive to 200-ft south of I-494 bridge (Coordinates: 44° 53'15.6"N, 93° 26'51.5"W)	2.77
Redwood County, MN	Minnesota	CSAH 101, from US 71/MN 19 to Minnesota River, North County Line (Coordinates: 44° 33'31.4"N, 95° 05'28.7"W)	1.61
Madison County, TN	Tennessee	CSAH 8, from 1,200-ft west of CSAH 17 to US 169 (Coordinates: 35° 45'53.7"N, 88° 40'40.9"W)	5.16
Norman County, MN	Minnesota	CSAH 3, from US 75 in Shelly, MN to MN 9 (Coordinates: 47° 27'16.0"N, 96° 39'56.1"W)	13.22
Plymouth County, IA	Iowa	<ul style="list-style-type: none"> Route C30, from Le Mars East to Route K 64 (Coordinates: 42° 46'45.5"N, 96° 05'54.9"W) On Route K 64, from Route C38 north to Hwy 3 (Coordinates: 42° 46'54.3"N, 96° 03'25.8"W) 	8.20
Ottertail County, MN	Minnesota	CSAH 67, from CSAH 58 to CSAH 8 West (Coordinates: 46° 36'12.6"N, 95° 21'50.4"W)	6.42
Sanpete County, UT	Utah	US 89 from Fairview, UT to Utah County line (Coordinates: 39° 43'45.9"N, 111° 28'31.6"W)	7.76
Elko County, NV	Nevada	SR 232, from 5 miles south of Steeles Creek to US 93 (Coordinates: 40° 55'52.1"N, 115° 01'56.3"W)	6.88
Flathead County, MT	Montana	US 2, from Highline Boulevard to Pyramid Creek (Coordinates: 48° 28'09.4"N, 113° 50'12.3"W)	13.90

1.13 Conditions Prior to Project Initiation

A project becomes an ideal candidate for repair using recycling techniques when it has major structural distresses, such as alligator (bottom-up) or longitudinal (top-down) cracking in existing HMA pavements or when the project has an extensive patching history and cannot restore ride quality to the desired value with nominal HMA overlay. Cold in-place recycling (CIR) or Cold Central Plant Recycling (CCPR) are widely used recycling techniques to fix the structural distresses in the pavements to extend the pavement life with minimal costs, traffic interruptions, and carbon emissions. The project becomes a good candidate for full depth reclamation (FDR) if the structural distress is caused by a poor existing subgrade condition. FDR will expose the subgrade and fix the entire pavement from the bottom layer up.

Pavement condition index (PCI), a commonly used rating system to evaluate ride quality, is measured by using either cores or a falling weight deflectometer (FWD) before making the decision on rehabilitation. CIR will be used if the PCI is within the fair range and FDR will be used if the PCI is in the poor to very poor range. State and local departments of transportation use PCI to evaluate and prioritize roadway construction projects with available funding to fix

damaged roadways, which ensure safe and efficient transportation for public use. The decision to initiate a project is completely independent of the contractor that ultimately performs the roadway improvements, which ensures that a project is never implemented to generate GHG emissions for the purpose of their subsequent reduction, removal, or destruction. Every project instance included within this grouped project description was initiated by an independent party for the purposes of rehabilitating an existing roadway to improve its value to the general public. The baseline scenario has the same existing conditions prior to project initiation and is further detailed in Section 3.4.

In-place recycling enables agencies to optimize the value of in-place materials and minimize the construction time and traffic flow disruptions, as well as to reduce vehicle emissions from long traffic queues. In-place recycling/ reclamation also reduces the number of construction vehicles moving in and out of the construction area and neighborhood truck traffic.

NCHRP Synthesis 421 documented the following benefits of in-place recycling to fix the structural distress in pavements; (a) reduces the use of natural resources; (b) eliminates materials generated for disposal; (c) reduces fuel consumption; (d) reduces greenhouse gas emissions by between 50% and 85%; (e) minimizes lane closure times; (f) improves driver safety by improving friction, providing lane widening, and eliminating overlay edge drop off; (g) maintains height clearances, which eliminates the need to adjust appurtenances; (h) addresses existing material deficiencies such as moisture damage; (i) reduces costs of preservation, maintenance, and rehabilitation; and (j) improves base support with a minimum of needed wearing *course*.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The incremental level of activity, the use of alternative asphalt mix designs and cold recycling installation, requires no new compliance with national, regional and local laws, statutes or regulatory frameworks as none of these currently exist in the United States.

However, in most cases, roadway owners establish construction specifications that offer detailed instructions on materials, procedures, and quality standards for individual projects. These specifications are distinct from legal or regulatory mandates. The specific construction specifications vary from project to project but typically include the following common procedures:

- **Materials:** The construction specifications define the allowable materials to be used in the cold recycling mix which typically includes RAP, portland cement, bituminous stabilizer, and water. Other additives may be applicable to future project instances. Evidence of materials used in the mix will be provided to the VVB.
- **Mix design:** The construction specifications outline laboratory procedures for testing various mix designs to determine the ideal composition in terms of raw material percentages that yield optimal density and tensile strength. The contractor

or an independent third-party laboratory submits the recommended mix design to the roadway owner for approval. This step is crucial for stakeholder engagement, ensuring consensus on the project mix design. All project-specific mix designs will be provided to the VVB.

- Installation Equipment: The construction specifications outline the necessary equipment for installation, including an in-place recycling unit, a paver, a vibratory double steel drum roller, and a second roller, a pneumatic tire roller. While other equipment is commonly used on projects, these four pieces of equipment are typically specified by the construction specifications. All installation equipment will be provided to the VVB.

Global Emissionary will provide the VVB with all applicable construction specifications for validation and all future verifications.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project instances under this grouped project are not registered and have not pursued registration under any other GHG program.

1.15.2 Projects Rejected by Other GHG Programs

The project instances under this grouped project have not been rejected by any other GHG Program.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project instances under this grouped project are not and will not be used in activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

- Yes No

1.16.2 Other Forms of Environmental Credit

The project instances under this grouped project have not received and are not seeking any other form of GHG-related environmental credit. The project activities are not currently eligible to participate in any other such programs. No double counting is ensured by contractual

agreements with the partner contractors. Evidence of the contractual agreements will be provided to the VVB for all current and future contractor partnerships.

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

Yes

No

1.16.3 Supply Chain (Scope 3) Emissions

This section is not applicable as all claimed emission reductions and removals related to this project occurred prior to 01-January-2024. As future instances are incorporated into the grouped project, updated VCS guidance on this section will be monitored and incorporated as applicable.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The United Nations (UN) Sustainable Development Goals (SDG) provide a global sustainability framework for all developed and developing countries to implement which contributes to a more sustainable future for all. Several of the SDGs align with the grouped project instances, including SDG 9 – Target 9.4, SDG 12 – Target 12.5, and SDG 13.

- SDG 9 – Target 9.4 aims to upgrade infrastructure and retrofit industries to make them sustainable using increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes. The grouped project instances utilize CIR process technology to rehabilitate roadways through recycling of the existing roadway aggregate resulting in a significant reduction of virgin aggregate mining and greater resource-use efficiency.
- SDG 12 – Target 12.5 aims to substantially reduce waste generation through prevention, reduction, recycling, and reuse by 2030. The grouped project instances meet this design criteria through the CIR process by re-using asphalt millings onsite, greatly reducing wasted material.
- SDG 13 – aims to take urgent action to combat climate change and its impacts. While the grouped project instances do not directly correspond with an official SDG indicator, the very nature of the VCS Program aligns with this SDG through quantification of GHG emission reductions. The grouped project instances use the CIR process to greatly reduce CO₂ emissions as compared to the baseline HMA scenario as described in Section 4.

1.17.2 Sustainable Development Contributions Activity Monitoring

The grouped project instances implement CIR technology to rehabilitate roadway infrastructure by recycling the aggregate material of the existing roadway. This process results in significant

reductions in waste material, reductions in virgin aggregate mining and trucking, and reductions in CO2 emission as compared to the baseline HMA scenario. The current set of 2021 grouped project instances rehabilitated 191 miles of roadway infrastructure, reused 430,198 tonnes of asphalt millings which prevented mining of virgin aggregate, and prevented 28,915 tonnes of carbon from being released into the atmosphere. Table 2 below summarizes and quantifies the specific SDG targets met by the grouped project instances. Evidence of the project instances' SDG contributions are included in Appendix A.

Table 2: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	9.4	By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	Implemented activities to increase	The project has upgraded 191 miles of roadway infrastructure using more sustainable construction processes than the typical baseline scenario project.	The project has upgraded 191 miles of roadway infrastructure using more sustainable construction processes than the typical baseline scenario project.
2)	12.5	By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse	Implemented activities to increase	The project has reduced 430,198 tonnes of waste through the recycling and reuse of asphalt millings in roadway construction.	The project has reduced 430,198 tonnes of waste through the recycling and reuse of asphalt millings in roadway construction.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	The project has prevented the release of 28,915 tonnes of carbon into the atmosphere during the monitoring period.	The project has prevented the release of 28,915 tonnes of carbon into the atmosphere during the monitoring period.

1.18 Additional Information Relevant to the Project

Leakage Management

According to the applicable methodology, VM0039, it is reasonable to assume zero leakage because there is no difference in site preparation activities between baseline and project scenarios. Replacing HMA with FSB or asphalt emulsions for the pavement base layers does not entail a change in carbon efflux or carbon sink at the construction site.

Commercially Sensitive Information

The project specific detailed calculations and data is proprietary information and has been excluded from the public version of this document. All excluded information is part of Appendix A which has been provided to the VVB and Verra to ensure all emission reduction claims are true and accurate.

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

The proposed project involves substituting a layer of Hot Mix Asphalt (HMA) for a layer of FSB or asphalt emulsion cold recycled mix, a process that contributes to reducing environmental and socio-economic impacts compared to conventional practices. However, it is essential to acknowledge and address any potential negative consequences.

Environmental Impacts and Mitigation:

- *Energy Consumption:* The construction process, including equipment operation and transportation, consumes energy. However, this energy consumption is mitigated because cold recycling uses significantly less energy than traditional methods due to the reduced need for virgin materials and the lower temperature requirements for cold recycling.
- *Air Quality:* Any construction project involving heavy machinery will have associated emissions and could pose localized air quality impacts. This is mitigated through project implementation because the project emits significantly less emissions than the standard baseline practice.

Socio-Economic Impacts:

- *Traffic Disruptions:* Roadway construction projects often pose traffic disruptions to the public using the roadways due to the required trucking of significant amounts of aggregates

to rehabilitate the roadway. The project activities mitigate traffic disruptions because the roadway is being recycled in-place as opposed to trucking out old material and trucking in virgin aggregates. The project activities cause no net harm because construction traffic is significantly reduced compared to the business-as-usual scenario.

In summary, this project consistently demonstrates its commitment to the principle of "No Net Harm." Through efficient resource utilization, a substantial reduction in aggregate trucking, and proactive measures to mitigate air quality impacts, it effectively mitigates any environmental and socio-economic impacts. The tangible evidence of reduced emissions reinforces the assertion that this project causes no net harm. It is a practical example of more sustainable construction practices that not only minimize adverse impacts but also contributes positively to the environment and society.

2.2 Local Stakeholder Consultation

Local Stakeholder consultation was achieved during the project's solicitation process and through direct correspondence. The Project Proponent has identified the following stakeholders:

- Asphalt Contractor(s)
- Roadway owners
- General public/road users

Local stakeholder engagement begins when the roadway owner publicly posts the project for bidding and inquiries. This posting serves as a formal announcement and an invitation for participation, and it is available to the public for scrutiny. The entire bidding process itself constitutes an essential method for engaging stakeholders, with a predetermined period for inquiries and submissions. For the first set of 24 project instances the bidding process took place between 28-August-2020 and 23-June-2021.

As the entire process is publicly accessible, including the submission of bids and inquiries, all outcomes, including comments, questions, and concerns raised by contractors or other stakeholders, are part of the public record.

In addition to the public solicitation process, our projects are publicly listed on our website, which provides a platform for anyone to access project details and submit on-going comments or inquiries at: <https://globalemissionairy.com/contact/> or email contact@globalemissionairy.com.

We consider all inquiries and feedback received during the bidding and inquiry phase; however, no stakeholder feedback on any project instance has yet been received. If feedback is provided in the future or on future project instances the comments will be documented in the monitoring report along with details on any updates to the project design or justification, why updates were not appropriate.

2.3 Environmental Impact

In the case of the project's incremental use of cold recycling FSB or asphalt emulsion mixtures in lieu of Hot Mix Asphalt (HMA), no specific Environmental Impact Assessments (EIAs) were mandated.

This lack of mandated EIAs is primarily attributable to the nature of the project. Road repair and maintenance are essential components of modern infrastructure upkeep, and these activities are generally unavoidable to ensure public safety and functionality. The project's core objective revolves around the reduction of environmental and socio-economic impacts typically associated with traditional HMA practices. By substituting HMA with a more sustainable cold recycling approach, the project inherently reduces negative environmental effects, as detailed in Section 2.1.

It is important to emphasize that the project's intention is not to evade or bypass any required assessments but rather to proactively address environmental and socio-economic challenges associated with road construction. Through the adoption of more sustainable practices, the project aligns with responsible construction and infrastructure development, which inherently mitigates potential adverse impacts.

In summary, the incremental use of cold recycling as a substitute for HMA inherently aligns with principles of environmental responsibility. As a result, the reduction in negative impacts associated with HMA makes the need for specific EIAs for this incremental practice unnecessary.

2.4 Public Comments

This Project Description was listed on the Verra Registry and was available for public comment from 21-October-2022 to 20-November-2022. No comments were received.

2.5 AFOLU-Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The project is conducted under VCS methodology VM0039, "Methodology for Use of Foam Stabilized Base and Emulsion Asphalt Mixtures in Pavement Application," version 1.0 (VM0039). This methodology is located at <https://verra.org/methodology/vm0039-methodology-for-us-of-fsb-in-pavement-application-v1-0/>.

3.2 Applicability of Methodology

The methodology is applicable to the project(s) due to the following conditions:

- 1) Project activities include the construction of any type of road and/or parking lot (including parking lot patching projects) in the United States.
- 2) Project activities must apply one or more of the following processes for road construction:
 - a) FSB produced using the CCPR process
 - b) FSB produced using the CIR process
 - c) FSB produced using the FDR process
 - d) Asphalt emulsions produced using the CCPR process
 - e) Asphalt emulsions produced using the CIR process
 - f) Asphalt emulsions produced using the FDR process
- 3) Production plants where the project activity instance occurs may serve multiple pavement types, including, but not limited to, roadways and parking lots.
- 4) Project activities may have an HMA or WMA surface layer but must have at least one FSB or asphalt emulsions base layer.

Project instances will meet applicability conditions of VCS methodology VM0039. Project instances will include the construction, modification, and repair of road and/or parking lots in the United States. Project instances will use FSB and asphalt emulsions in CCPR, CIR, or FDR processes.

The initial set of grouped project instances for the first project monitoring period all utilized the CIR process on roadway construction projects within the United States of America to replace the baseline scenario, base layers using HMA, with base layers produced and installed using asphalt emulsions or FSB. During the first monitoring period there were no instances of CCPR or FDR processes, but these types of projects may be incorporated under future monitoring periods.

3.3 Project Boundary

The extent of the project boundary encompasses the stages from raw material acquisition to product installation and complies with the cradle-to-gate assessment principle (Sinden, 2008). The GHG impact of producing an asphalt mixture is calculated by adding up the following emission sources: 1) GHG associated with manufacturing each of the constituent and ancillary materials; 2) GHG from transporting materials from factory to mix plant or project site; 3) GHG from all forms of energy involved in producing the asphalt at mixing plant; and 4) GHG from all

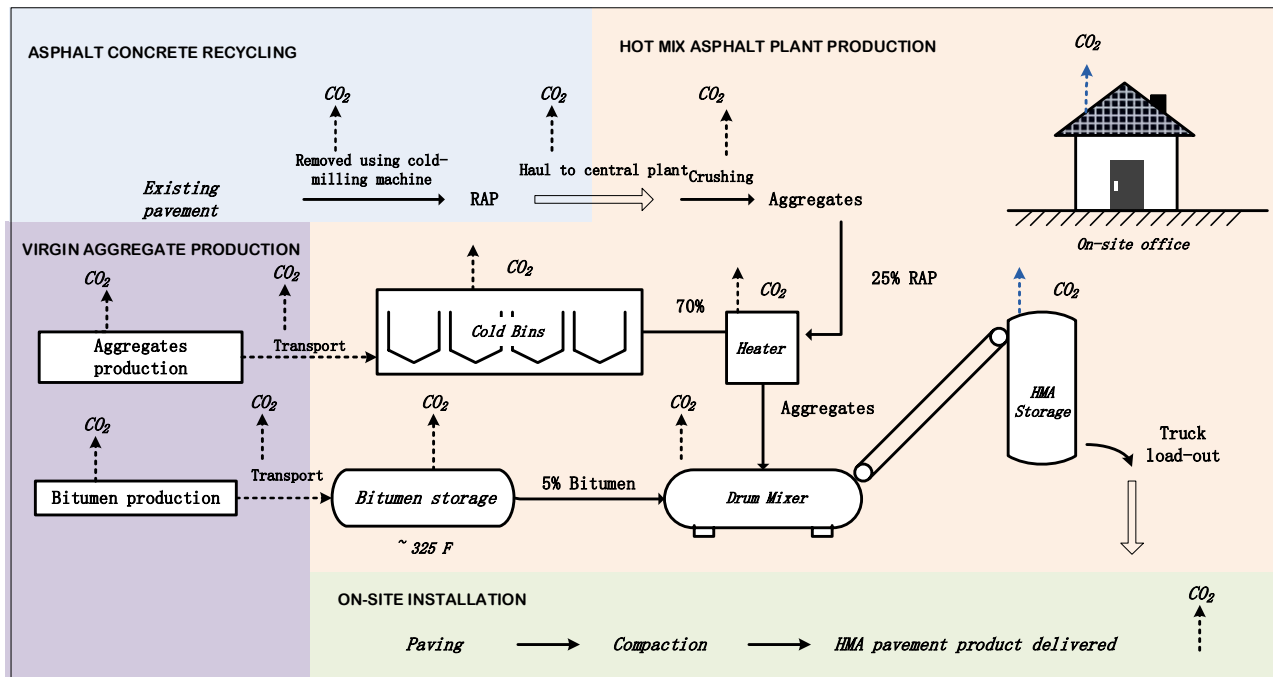
forms of energy involved in milling the existing pavement and placing new pavement, including relevant transport activities.

Maintenance and excavation of the new pavement are not included due to the high variability of practices in each region. The boundary also excludes GHG emissions associated with the production of capital goods with lifetimes longer than one year and the transportation of employees to and from their normal place of work.

Boundary for Baseline Emissions

The estimation of baseline emissions for HMA projects begins with the production of raw materials at manufacturer sites and ends with the delivery of the final pavement product to the customer. It includes all energy-consuming activities of equipment and machinery at supplier sites, the hot mix facility, the job site, and associated transportation. The emission sources covered within the system boundary include production materials, manufacturing equipment/vehicles, operation of the plant office, and transport and storage of input materials (Sinden 2008). Specifically, the boundary for HMA systems consist of energy consumption for quarrying/producing the mineral aggregates and bitumen binder, transportation to and at the HMA production plant, storage, heating of the individual components (including aggregates and bitumen binder), mixing, and the transportation and installation of the mix at the job site, as shown in Figure 3.

Figure 3: Diagram of Baseline HMA Production and Placement



Boundary for Project Emissions

There are three processes that the Grouped Projects can utilize: 1) Cold Central Plant Recycling (CCPR), 2) Cold in-place Recycling (CIR), and 3) Full-Depth Reclamation (FDR). CIR and FDR have the same boundary.

Boundary for CCPR

CCPR transports milled materials from an existing jobsite to a central plant where FSB or asphalt emulsions are processed through a pug mill. Production of FSB begins with the crushing of RAP, which diverts waste from landfills. Once the crushed pavement is sized, the unheated RAP is then blended with foamed bitumen (or asphalt emulsion) and a small amount of Portland cement in a cold mixing process. Table 3 shows the major processes included in the CCPR project. The boundary consists of energy consumption for milling the existing pavement, producing bitumen binder and water, transportation to and at the FSB production plant, heating of bitumen binder, mixing, transportation of materials and resources to the project site, and installation of the mix. Refer to Section 1.11, Figure 1 for a process diagram.

Boundary for CIR or FDR system

CIR or FDR uses one or more mobile recycling machines for milling, production, and placement in a continuous operation at the pavement site. It reconstructs the roadways by using special equipment to mill up the existing pavement, mix it with hot bitumen oil (or asphalt emulsions) and additives, and then immediately place it back down on the road by permanent placement with a paver and rollers. CIR and FDR allows a paving contractor to use the aggregate from the existing road and, by adding liquid asphalt cement (consisting of under 3% of the total volume), it reduces the emissions of new aggregate materials and new liquid asphalt cement that must be shipped from the producer's plant site. The project boundary includes production of bitumen, water, and cement, operation of recycler and rollers, and transportation and storage of input materials.

Project instances must incorporate FSB and/or asphalt emulsions in place of traditional asphalt mixes while delivering or exceeding the baseline project structural strength design parameters. For example, the project boundary for the first project instance replaces the second layer in the pavement design with asphalt emulsions. Although other GHGs have been reduced in this first project instance, VCS methodology VM0039 only calculates the reduction of CO₂ emissions.

Refer to Figure 2 in Section 1.11 for a detailed CIR process flow diagram and discussion of the equipment, systems, and flows of mass and energy. The geographic boundary for the grouped projects is the United States of America as shown in Figure 4.

Table 3: GHG Sources Included in Baseline and Project Scenario

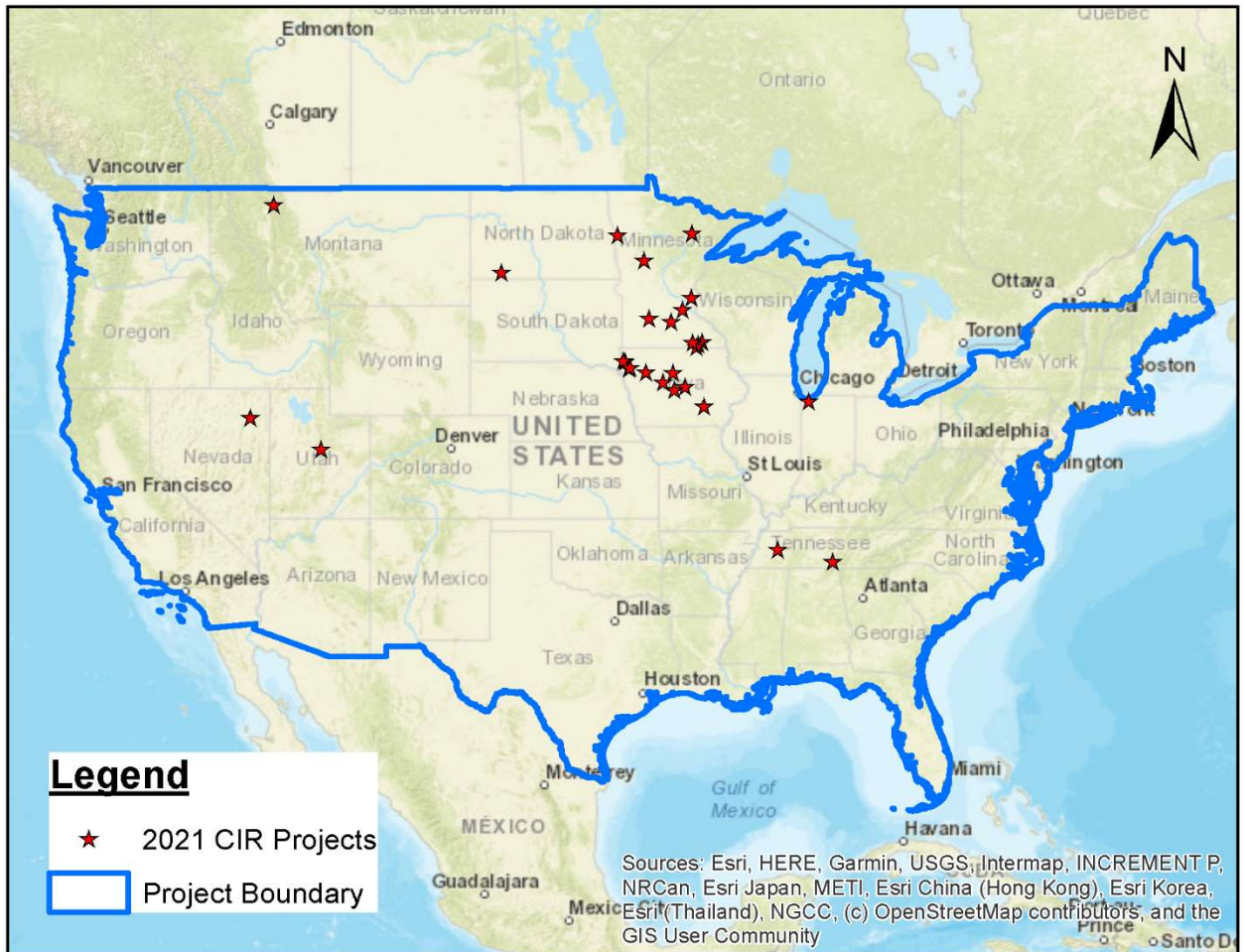
Source	Gas	Included?	Justification/Explanation	
HMA (Baseline)	Raw material acquisition	CO ₂	Yes	GHGs are released from energy consumption in material manufacture process.
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	
	Raw material transport	CO ₂	Yes	GHGs are released from fuel consumption for transporting materials from producers to central plant.
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	
	In-plant production	CO ₂	Yes	GHGs are generated from the usage of natural gas by the drum mixer, plant electricity (including electricity for plant office), and diesel equipment/vehicles operated for producing HMA at central plant.
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	
	To site transport	CO ₂	Yes	GHGs are released from fuel consumption for transporting materials from the central plant to construction site.
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	
	Installation	CO ₂	Yes	GHGs are released from diesel consumption by construction equipment/vehicles, including asphalt paving machine, backhoe, bobcat/loader, sweeper/broom, air compressor, roller, trucks, etc.
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	

Source	Gas	Included?	Justification/Explanation
	Maintenance	CO ₂	No GHGs from maintenance and rehabilitation are excluded due to uncertain traffic volume, failure type and repair options.
		CH ₄	No
		N ₂ O	No
	Excavation	CO ₂	No GHGs from excavation are excluded due to the uncertainty in determining pavement disposal options (e.g., landfill, recycling, remain in place).
		CH ₄	No
		N ₂ O	No
CCPR (Project Instance)	Raw material acquisition	CO ₂	Yes GHGs are released from energy consumption in material manufacture process.
		CH ₄	No
		N ₂ O	No
	Raw material transport	CO ₂	Yes GHGs are released from fuel consumption for transporting materials from producers to central plant.
		CH ₄	No
		N ₂ O	No
	FSB/Asphalt emulsions production	CO ₂	Yes GHGs are generated from the usage of electricity by plant office, bitumen heater and crusher and diesel equipment/vehicles operated for producing asphalt emulsions at the central plant.
		CH ₄	No
		N ₂ O	No
	To-site transport	CO ₂	Yes GHGs are released from fuel consumption for transporting materials from the central plant to construction site.

Source	Gas	Included?	Justification/Explanation	
	CH ₄	No	Not Applicable under methodology VM0039.	
		N ₂ O		No
	Installation	CO ₂	Yes	GHGs are released from diesel consumption by construction equipment/vehicles, including asphalt paving machine, backhoe, bobcat/loader, sweeper/broom, air compressor, roller, trucks, etc.
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	
	Maintenance	CO ₂	No	GHGs from maintenance and rehabilitation are excluded due to uncertain traffic volume, failure type and repair options.
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	
	Excavation	CO ₂	No	GHGs from excavation are excluded due to the uncertainty in determining pavement disposal options (e.g., landfill, recycling, remain in place).
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	
	CIR or FDR (Project Instance)	Raw material acquisition	CO ₂	Yes
CH ₄			No	Not Applicable under methodology VM0039.
N ₂ O			No	
Raw material transport		CO ₂	Yes	GHGs are released from fuel consumption for transporting materials from producers to the job site.
		CH ₄	No	Not Applicable under methodology VM0039.
		N ₂ O	No	

Source	Gas	Included?	Justification/Explanation
FSB/Asphalt emulsions Production & Placement	CO ₂	Yes	GHGs are released from fuel consumption by construction equipment/vehicles, including, but not limited to a cold recycler (e.g., Wirtgen 3800 CR), a cement spreader, a water truck, a bitumen truck, a vibratory roller and a pneumatic roller.
	CH ₄	No	Not Applicable under methodology VM0039.
	N ₂ O	No	
Maintenance	CO ₂	No	GHGs from maintenance and rehabilitation are excluded due to uncertain traffic volume, failure type and repair options.
	CH ₄	No	Not Applicable under methodology VM0039.
	N ₂ O	No	
Excavation	CO ₂	No	GHGs from excavation are excluded due to the uncertainty in determining pavement disposal options (e.g., landfill, recycling, remain in place).
	CH ₄	No	Not Applicable under methodology VM0039.
	N ₂ O	No	

Figure 4: Geographical Boundary and Project Instance Locations



3.4 Baseline Scenario

The baseline scenario for projects applying this methodology is the application of HMA, or the subcategory WMA, to surface and base layers of roads or parking lots during asphalt pavement construction. The emissions associated with the quarry, transportation, and production of HMA, or WMA serve as performance benchmarks.

CCPR, CIR, and FDR projects replace HMA or WMA base layers with FSB or asphalt emulsions. These processes typically outperform the performance benchmarks because they can reduce the emissions from producing bitumen and producing, transporting, and heating virgin aggregate.

3.5 Additionality

Project instance proponents follow two steps described in Section 6 of VM0039 to determine additionality. First, proponents must demonstrate regulatory surplus in accordance with the rules and requirements described in the latest version of the VCS Standard. No rules or

regulations mandating the use of FSB or asphalt emulsions to reduce CO₂e emissions exist. Therefore, all CO₂e reductions are regulatory surplus.

Regulatory surplus is established in this project through the following aspects: No regulatory requirement in the United States exists that requires FSB or asphalt emulsion using CCPR, CIR, or FDR in highway construction. The design of the asphalt construction project using asphalt emulsion with the CCPR, CIR, or FDR process was based on a design-build selection process, where the contractor proposed innovative design and construction methods.

Second, a performance benchmark determines emissions for patching and roadway scenarios. This performance benchmark depends on whether a project is a parking lot or roadway, the distance materials need to be hauled, and the year a project has been completed. Project performance exceeds the benchmark metric for baseline HMA projects when FSB or asphalt emulsion pavement layers used in the project meet or exceed structural numbers of the baseline HMA design, and the harvesting, mixing, installation, and hauling of FSB materials emit less CO₂ than corresponding HMA layers. Table 4 below demonstrates that each project instance emits less CO₂e than the performance benchmark and is therefore deemed additional.

Table 4: Performance Benchmark Evaluation

Project	Project Year/ Type	Crediting Baseline, CB (Kg CO ₂ e/tonne CIR)	Relation	Project Emission Intensity, (EI) (Kg CO ₂ e / Tonne Installed)	Result
14839 ND Hettinger	2021/Roadway	94.4	>	27.31	Additional
14796 MN Chisago	2021/Roadway	94.4	>	20.77	Additional
14797 IA Buena Vista	2021/Roadway	94.4	>	14.29	Additional
14798 IA Wright	2021/Roadway	94.4	>	13.76	Additional
14807 IA Story	2021/Roadway	94.4	>	10.29	Additional
14819 IA Boone	2021/Roadway	94.4	>	10.23	Additional
14826 MN Mower (1)	2021/Roadway	94.4	>	15.98	Additional

Project	Project Year/ Type	Crediting Baseline, CB (Kg CO ₂ e/tonne CIR)	Relation	Project Emission Intensity, (EI) (Kg CO ₂ e / Tonne Installed)	Result
14827 MN Mower (2)	2021/Roadway	94.4	>	15.38	Additional
14840 TN Coffee	2021/Roadway	94.4	>	28.48	Additional
14849 IN Porter	2021/Roadway	94.4	>	23.26	Additional
14855 IA Webster	2021/Roadway	94.4	>	14.97	Additional
14857 IA Keokuk	2021/Roadway	94.4	>	10.09	Additional
14873 MN St. Louis	2021/Roadway	94.4	>	23.51	Additional
14915 IA Sioux	2021/Roadway	94.4	>	14.13	Additional
14911 MN Sibley	2021/Roadway	94.4	>	27.60	Additional
14917 MN Hennepin	2021/Roadway	94.4	>	9.43	Additional
14960 MN Redwood	2021/Roadway	94.4	>	15.29	Additional
14979 TN Madison	2021/Roadway	94.4	>	26.30	Additional
14986 MN Norman	2021/Roadway	94.4	>	14.18	Additional
50061 IA Plymouth	2021/Roadway	94.4	>	15.56	Additional
50147 MN Otertail	2021/Roadway	94.4	>	19.90	Additional
30358 UDOT US89	2021/Roadway	94.4	>	43.36	Additional

Project	Project Year/ Type	Crediting Baseline, CB (Kg CO ₂ e/tonne CIR)	Relation	Project Emission Intensity, (EI) (Kg CO ₂ e / Tonne Installed)	Result
30405 NDOT SR232	2021/Roadway	94.4	>	47.26	Additional
30391 MTDOT – Hwy 2 Glacier	2021/Roadway	94.4	>	34.01	Additional

3.6 Methodology Deviations

The Project Description does not include any deviations from methodology VM0039.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

This project uses a patented paving technology to replace HMA in asphalt paving projects. The emission reductions and removals are achieved during the road construction process and therefore the project must be fully implemented before any emission reductions are realized. All projects included in this project description monitoring period have been fully implemented and the emission reductions have been achieved. During project implementation all required documentation was collected to ensure all emission reduction claims are true and accurate. Leakage is not considered an issue under VM0039 methodology and is therefore set at zero, refer to section 5.3 for more information related to leakage.

5 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As described in VM0039, baseline emissions have been predetermined by the performance benchmark for the crediting baseline, which have three strata of performance benchmarks based on project types and one-way distances between the HMA plant and job site. Stratum 1 is for patching projects with hauling distances less than 40 miles. Stratum 2 is for patching projects with hauling distances greater than 40 miles, and Stratum 3 is for roadway projects. The performance benchmark for the crediting baseline is adjusted annually based on the expected changes in the use of RAP for conventional HMA projects. Based on NAPA (2017), the use of RAP in HMA is expected to increase by 1.1% every year. This increase can reduce carbon emissions by 0.1 kg CO₂e/t (NAPA, 2012). Therefore, as shown in Table 5, the performance benchmark decreases by 0.1kg CO₂e/t annually for all three strata of performance benchmarks.

Table 5: Crediting Baseline for Estimation of Emission Reductions from 2014 to 2025

Year	Patching Project (<40mile)	Patching Project (>40mile)	Roadway Project
2014	121.9	142.4	95.1
2015	121.8	142.3	95.0
2016	121.7	142.2	94.9
2017	121.5	142.1	94.8
2018	121.6	142.0	94.7
2019	121.4	141.9	94.6
2020	121.3	141.8	94.5
2021	121.2	141.7	94.4
2022	121.1	141.6	94.3
2023	121.0	141.5	94.2

Year	Patching Project (<40mile)	Patching Project (>40mile)	Roadway Project
2024	120.9	141.4	94.1
2025	120.8	141.3	94.0

Note: Unit: kgCO_{2e}/t. 1kgCO_{2e} per tonne of output = 0.001 tCO_{2e} per tonne of output

The example calculation project, Hettinger, ND, as well as all the project instances in this grouped project monitoring period, are roadway projects that were constructed in 2021. Therefore, 94.4 kgCO_{2e}/t was used as the crediting baseline. As project instances are added under future monitoring periods the appropriate crediting baseline value will be applied based on each individual project start date according to Table 5 above.

5.2 Project Emissions

For the first project monitoring period, all of the grouped project instances utilized the CIR process to replace the baseline scenario HMA layers with asphalt emulsions or FSB layers. For that reason, there are no examples of CCPR projects, however those equations are included in this section for future project monitoring periods that will include CCPR instances. In addition, there were no FDR projects that occurred during the first monitoring period however the FDR process uses the same equations and calculations as CIR outlined below so those types of projects may be added under future monitoring periods. These equations shall be used on a project level basis and then aggregated for any given monitoring period year(s).

5.2.1 CIR or FDR Project Emissions

CIR or FDR emission intensity (CIR EI or FDR EI) represents the quantity of GHGs emitted from producing and installing one metric ton of FSB or asphalt emulsions using CIR or FDR. CIR EI or FDR EI is calculated using the following equation below:

$$CIR\ EI\ (or\ FDR\ EI) = EI_M + EI_{SD} + EI_I \ (Eq.\ 1)$$

Where:

CIR EI	=	Emission intensity of CIR (kgCO _{2e} /tonne)
FDR EI	=	Emission intensity of FDR (kgCO _{2e} /tonne)
EI _M	=	Emission intensity of raw material production (kgCO _{2e} /tonne)
EI _{SD}	=	To-site delivery emission intensity (kgCO _{2e} /tonne)
EI _I	=	On-site installation emission intensity (kgCO _{2e} /tonne)

Four materials are used in the production and installation of FSB/asphalt emulsions using CIR or FDR: Recycled Asphalt Pavement (RAP), cement, bitumen, and water. To calculate the emission intensity of raw material production, each raw materials emission factor and weight are multiplied together and divided by the amount of FSB or asphalt emulsions manufactured (project amount).

Emission Intensity of raw material production (EIM) is calculated using the following equation below:

$$EI_M = \frac{EF_M \times W_M}{Project\ Amount} \quad (Eq. 2)$$

Where:

EI_M	=	Emission intensity of raw material production (kgCO ₂ e/tonne)
EF_M	=	Raw material emission factor (kgCO ₂ e/tonne)
W_M	=	Raw material weight (kg)
Project amount	=	Amount of FSB/asphalt emulsions manufactured (tonnes)

For the example project calculation, Hettinger, ND project, EIM is calculated for RAP, cement, bitumen, and water. During the CIR or FDR process, RAP is recycled on-site by milling the existing asphalt pavement which is reused in the FSB/asphalt emulsion mixture. Therefore, the materials emission factor for RAP is zero. Similarly, water is not a manufactured material and therefore, has a materials emission factor of zero.

$$EI_M (RAP) = \frac{0.00 \frac{kgCO_2e}{kg} \times 49,930,033 \text{ kg}}{53,284.58 \text{ tonnes}} = 0.00 \frac{kg \text{ CO}_2e}{tonne}$$

$$EI_M (cement) = \frac{0.92 \frac{kgCO_2e}{kg} \times 273,253 \text{ kg}}{53,284.58 \text{ tonnes}} = 4.73 \frac{kg \text{ CO}_2e}{tonne}$$

$$EI_M (bitumen) = \frac{0.48 \frac{kgCO_2e}{kg} \times 1,568,106 \text{ kg}}{53,284.58 \text{ tonnes}} = 14.13 \frac{kg \text{ CO}_2e}{tonne}$$

$$EI_M (water) = \frac{0.00 \frac{kgCO_2e}{kg} \times 1,513,185 \text{ kg}}{53,284.58 \text{ tonnes}} = 0.00 \frac{kg \text{ CO}_2e}{tonne}$$

$$\mathbf{Total \text{ } EI_M = 0.00 + 4.73 + 14.13 + 0.00 = 18.85 \frac{kg \text{ CO}_2e}{tonne}}$$

To calculate the emission intensity of raw material to-site delivery, the number of trips to the site, the number of trips from production plant to job site, discount factor, and truck emission factor are multiplied together and divided by the amount of the FSB or asphalt emulsions

manufactured for the project. When hauling distance is not directly monitored, the distance is estimated using a map distance calculator. For conservativeness, a discount factor (DF) of 0.1 is applied when a map distance calculator is used to estimate hauling distance.

Emission Intensity of to-site delivery (EISD) is calculated using the following equation below:

$$EI_{SD} = \frac{Trips_S \times Distance_S \times (1 + DF) \times EF_T}{Project\ Amount} \quad (Eq. 3)$$

Where:

Trips	=	Number of trips from production plant to job site
Distances	=	Distance to site (miles)
DF	=	Discount factor
EF _T	=	Truck emission factor (kgCO ₂ e/mile)
Project amount	=	Amount of FSB/asphalt emulsions manufactured (tonnes)

For the example project calculation, the Hettinger, ND project, there were three materials delivered to the site: cement, bitumen, and water. RAP, also used in the CIR or FDR process however it is recycled on-site through milling of existing pavement, resulting in to-site delivery emission intensity of zero.

$$EI_{SD}(RAP) = \frac{0 \text{ trips} \times 0 \frac{\text{miles}}{\text{trip}} \times (1 + 0.1) \times 10.2 \frac{\text{kgCO}_2\text{e}}{\text{mile}}}{53,284.58 \text{ tonnes}} = 0.00 \frac{\text{kgCO}_2\text{e}}{\text{tonne}}$$

$$EI_{SD}(\text{cement}) = \frac{12 \text{ trips} \times 126 \frac{\text{miles}}{\text{trip}} \times (1 + 0.1) \times 10.2 \frac{\text{kgCO}_2\text{e}}{\text{mile}}}{53,284.58 \text{ tonnes}} = 0.32 \frac{\text{kgCO}_2\text{e}}{\text{tonne}}$$

$$EI_{SD}(\text{bitumen}) = \frac{55 \text{ trips} \times 316 \frac{\text{miles}}{\text{trip}} \times (1 + 0.1) \times 10.2 \frac{\text{kgCO}_2\text{e}}{\text{mile}}}{53,284.58 \text{ tonnes}} = 3.66 \frac{\text{kgCO}_2\text{e}}{\text{tonne}}$$

$$EI_{SD}(\text{water}) = \frac{80 \text{ trips} \times 7.5 \frac{\text{miles}}{\text{trip}} \times (1 + 0.1) \times 10.2 \frac{\text{kgCO}_2\text{e}}{\text{mile}}}{53,284.58 \text{ tonnes}} = 0.13 \frac{\text{kgCO}_2\text{e}}{\text{tonne}}$$

$$\text{Total } EI_{SD} = 0.00 + 0.32 + 3.66 + 0.13 = 4.11 \frac{\text{kgCO}_2\text{e}}{\text{tonne}}$$

On-site installation emissions intensity (EII) is derived from diesel consumption from the equipment used for the installation project. For CIR or FDR installation, this equipment typically includes a cold recycler (e.g., Wirtgen 3800 CR), cement spreader, water truck, bitumen truck, vibratory roller, pneumatic roller, skid steer, etc. A list of common emission factors used for FSB and asphalt emulsion CIR projects are provided in Appendix B of VM0039 as well as those used in this project as presented in Section 5.1.

Emission Intensity of on-site installation equipment (EI_I) is calculated using the following equation below:

$$EI_I = \frac{EF_{EQ} * HR_{EQ}}{Project\ Amount} \quad (Eq. 4)$$

Where:

EI _I	=	Emission intensity of pavement installation (kgCO ₂ e/tonne)
EF _{EQ}	=	Equipment emission factor (kgCO ₂ e/tonne)
HR _{EQ}	=	Equipment operation hours (hour)
Project amount	=	Amount of asphalt emulsions manufactured (tonne)

Where equipment operation hours are not directly available, labor hours (HR_{LA}) or running speed of cold recycler (S) may be used to approximate equipment operation hours according to the two equations below. Labor hours must be documented in the project daily log for verification. Conversion factors (CF) for commonly used equipment are listed in Section 5.1.

$$HR_{EQ} = HR_{LA} \times CF \quad (Eq. 5)$$

Where:

HR _{EQ}	=	Equipment operation hours (hour)
HR _{LA}	=	Labor hours (hour)
CF	=	Conversion factor

The running speed of the cold recycler can be read from the screen on the machine. The water truck and bitumen truck are connected to the cold recycler to supply it with binding agents, and the rollers normally follow the train of equipment to compact the newly produced layer. Therefore, they can be assumed to run at the same speed as the cold recycler.

$$HR_{CR} = \frac{L}{S} \quad (Eq. 6)$$

Where:

HR _{CR}	=	Operation hours of the cold recycler (hour)
S	=	Running speed of the cold recycler (mile/hour)
L	=	Project Length (lane-miles)

Note that CIR and FDR projects may include more than one installation project because FSB and asphalt emulsion produced from CIR or FDR could be placed in a number of road sections.

Where there are $l = 1, \dots, N$ road sections using FSB and asphalt emulsion using the same CIR or FDR machinery, the emission intensity of multiple CIR or FDR projects (MCIR EI or MFDR EI) must be calculated according to Eq. 7 below. Please note that this equation may only be applied if the multiple road sections utilize the same constituent mix design. In the case of this first monitoring period, each of the 24 instances had varying mix designs and therefore are treated as separate installations according to Eq. 1.

$$MCIR\ EI\ (or\ MFDR\ EI) = EI_M + \frac{\sum_i^N EI_{SD,i} \cdot project\ amount_i + \sum_i^N EI_{I,i} \cdot project\ amount_i}{\sum_i^N project\ amount_i} \quad (Eq. 7)$$

For the example project calculation, the Hettinger, ND project, there were a total of nine pieces of construction equipment used during the CIR installation process. First, the labor hours reported in the daily timesheet logs were summed together for each piece of construction equipment over the entire project duration. Then, using Eq. 5, the labor hours were multiplied by the conversion factor to calculate the equipment operation hours. Finally, to calculate the emission intensity of pavement installation, the equipment emission factor and the corresponding equipment operating hours were multiplied together and divided by the amount of the FSB or asphalt emulsions manufactured for the project. The total amount of asphalt emulsions manufactured for the Hettinger, ND project was 53,383.52 tonnes and serves as the project amount data input. Table 6 summarizes the equipment used during the on-site installation and their data inputs for HRLA, CF, HREQ, EFEQ, and EI_I for the Hettinger, ND project. Each of the individual installation equipment emission intensities were then summed together to obtain the total installation equipment emission intensity for the Hettinger, ND project instance of 4.35 kgCO₂e/tonne.

$$\begin{aligned} Total\ EI_I &= 1.76 + 0.26 + 0.20 + 0.08 + 0.12 + 0.12 + 0.12 + 0.84 + 0.84 \\ &= 4.35 \frac{kgCO_2e}{tonne} \end{aligned}$$

Table 6: Emission Intensity of Installation Equipment Summary

Equipment	Labor Hours, HRLA	Conversion Factor, CF	Equipment Operating Hours, HREQ	Equipment Emission Factor, EFEQ	On-site installation Emission Intensity, EI _I
	(Hours)	(Hours)	(Hours)	(Kg CO ₂ e/Hr)	(Kg CO ₂ e/Hr)
Cold recycler, Wirtgen 12'	158	0.66	104	901.4	1.76
Milling machine, Others	158	0.66	104	132.3	0.26

Equipment	Labor Hours, HR _{LA}	Conversion Factor, CF (Hours)	Equipment Operating Hours, HR _{EQ} (Eq. 5)	Equipment Emission Factor, EF _{EQ}	On-site installation Emission Intensity, EI _I (Eq. 4)
	(Hours)	(Hours)	(Hours)	(Kg CO _{2e} /Hr)	(Kg CO _{2e} /Hr)
Paver, Wheeler Machinery	158	0.50	79	134.7	0.20
Skid Steer Loaders, John Deere	158	0.33	52.1	77.6	0.08
Rollers, Dynapac	158	0.59	93.2	70.1	0.12
Rollers, Dynapac	158	0.59	93.2	70.1	0.12
Rollers, Dynapac	158	0.59	93.2	70.1	0.12
Water Trucks, Freightliner	158	1.00	158	284.6	0.84
Water Trucks, Freightliner	158	1.00	158	284.6	0.84

Using Eq. 1, the overall CIR or FDR emission intensity for the example project calculation, Hettinger, ND, is the sum of the raw material emission intensity, the to-site delivery emission intensity, and the installation equipment emission intensity. This comes out to 26.84 kgCO_{2e}/tonne.

$$CIR\ EI = 18.85 + 4.11 + 4.35 = 27.31 \frac{kgCO_2e}{tonne}$$

All other 2021 project instance variables are summarized in Table A.1 of Appendix A. As future project instances are incorporated into this group project description, additional appendices will be added to define and document all required variables.

5.2.1 CCPR Project Emissions

CCPR emission intensity (CCPR EI) represents the quantity of GHGs emitted from producing and installing one metric ton of FSB and asphalt emulsions using CCPR. It is the summation of raw material production emission intensity (EI_M), to-plant delivery emissions intensity (EI_{PD}), to-site delivery emissions intensity (EI_{SD}), in-plant production emission intensity (EI_P), and on-site installation emission intensity (EI_I). CCPR EI is calculated using the following equation below:

$$CCPR\ EI = EI_M + EI_{PD} + EI_{SD} + EI_P + EI_I \text{ (Eq. 8)}$$

Where:

CCPR EI	=	Emission intensity of CCPR (kgCO ₂ e/tonne)
EI _M	=	Emission intensity of raw material production (kgCO ₂ e/tonne)
EI _{PD}	=	Emission intensity of to-plant delivery (kgCO ₂ e/tonne)
EI _{SD}	=	Emission intensity of to-site delivery (kgCO ₂ e/tonne)
EI _P	=	Emission intensity of in-plant production (kgCO ₂ e/tonne)
EI _I	=	Emission intensity on-site installation (kgCO ₂ e/tonne)

To calculate the emission intensity of raw material production, each raw materials emission factor and weight are multiplied together and divided by the amount of FSB or asphalt emulsions manufactured (project amount).

Emission Intensity of raw material production (EI_M) is calculated using the following equation below:

$$EI_M = \frac{EF_M \times W_M}{Project\ Amount} \text{ (Eq. 9)}$$

Where:

EI _M	=	Emission intensity of raw material production (kgCO ₂ e/tonne)
EF _M	=	Raw material emission factor (kgCO ₂ e/tonne)
W _M	=	Raw material weight (kg)
Project amount	=	Amount of FSB/asphalt emulsions manufactured (tonnes)

To calculate the to-plant delivery emission intensity, the number of trips and distance from the raw material supplier to CCPR mix plant, discount factor, and truck emission factor are multiplied together and divided by the amount of the FSB or asphalt emulsions manufactured using CCPR for the project. When hauling distance is not directly monitored, the distance is estimated using a map distance calculator. For conservativeness, a discount factor (DF) of 0.1 is applied when a map distance calculator is used to estimate hauling distance.

Emission Intensity of to-plant delivery (EI_{PD}) is calculated using the following equation below:

$$EI_{PD} = \frac{Trip_P \times Distance_P \times (1 + DF) \times EF_T}{Project\ Amount} \text{ (Eq. 10)}$$

Where:

EI _{PD}	=	Emission Intensity of to-plant delivery (kg CO ₂ e/tonne)
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Trip _P	=	Number of trips from raw material supplier to job site
Distance _P	=	Distance from raw material supplier to CCPR mix plant (miles)
DF	=	Discount factor
EF _T	=	Truck emission factor (kg CO ₂ e/mile)
Project amount	=	Amount of FSB/asphalt emulsions manufactured (tonnes)

To calculate the emission intensity of raw material to-site delivery, the number of trips from production plant to job site, discount factor, and truck emission factor are multiplied together and divided by the amount of the FSB or asphalt emulsions manufactured using CCPR for the project. When hauling distance is not directly monitored, the distance is estimated using a map distance calculator. For conservativeness, a discount factor (DF) of 0.1 is applied when a map distance calculator is used to estimate hauling distance.

Emission Intensity of to-site delivery (EI_{SD}) is calculated using the following equation below:

$$EI_{SD} = \frac{Trip_S \times Distance_S \times (1 + DF) \times EF_T}{Project\ Amount} \quad (Eq. 11)$$

Where:

EI _{SD}	=	Emission Intensity of to-site delivery (kgCO ₂ e/tonne)
Trips _S	=	Number of trips from production plant to job site
Distances _S	=	Distance to site from CCPR mix plant (miles)
DF	=	Discount factor
EF _T	=	Truck emission factor (kgCO ₂ e/mile)
Project amount	=	Amount of FSB/asphalt emulsions manufactured (tonnes)

In-plant production emission intensity (EI_P) includes the emissions from diesel and or electricity consumption by mix plant equipment, vehicles, and plant office. The diesel consumption emissions are typically attributed to mixing machines, loaders, and dump trucks. Their emissions are calculated using equations 12 and 13. A list of common emission factors used for FSB and asphalt emulsion FDR or CIR projects are provided in Appendix B of VM0039 as well as those used in this project as presented in Section 6.1. Electricity consumption emissions are typically attributed to the bitumen heater, RAP crusher, and plant office. Their emissions are calculated using equation 15.

Emission intensity of in-plant production (EI_P) is calculated using the following equation below:

$$EI_P = EI_D + EI_E \quad (Eq. 12)$$

Where:

El _P	=	Emission Intensity of in-plant production (kgCO ₂ e/tonne)
El _D	=	Emission intensity of diesel consumption (kgCO ₂ e/tonne)
El _E	=	Emission intensity of electric consumption (kgCO ₂ e/tonne)

Emission Intensity of in-plant diesel consumption (El_D) is calculated using the following equation below:

$$EI_D = \frac{EF_{EQ} * HR_{EQ}}{Project\ Amount} \quad (Eq. 13)$$

Where:

El _D	=	Emission intensity of diesel consumption (kgCO ₂ e/tonne)
EF _{EQ}	=	Equipment emission factor (kgCO ₂ e/tonne)
HR _{EQ}	=	Equipment operation hours (hour)
Project amount	=	Amount of asphalt emulsions manufactured (tonne)

Where equipment operation hours are not available, labor hours (HR_{LA}) can be used to approximate equipment operation hours according to the below equation. Conversion factors (CF) for commonly used equipment are listed in Section 6.1.

$$HR_{EQ} = HR_{LA} \times CF \quad (Eq. 14)$$

Where:

HR _{EQ}	=	Equipment operation hours (hour)
HR _{LA}	=	Labor hours (hour)
CF	=	Conversion factor

Emission Intensity of in-plant electricity consumption (El_E) is calculated using the following equation below:

$$EI_E = \frac{EF_{EL} * C_{EL}}{Project\ Amount} \quad (Eq. 15)$$

Where:

El _E	=	Emission intensity of electricity consumption (kgCO ₂ e/tonne)
I	=	Electricity emission factor (kgCO ₂ e/kWh)
C _{EL}	=	Electricity consumption (kWh)
CCPR Project amount	=	Amount of CCPR mix manufactured (tonne)

On-site installation emissions intensity (EI_I) is derived from diesel consumption from the equipment used for the installation of the CCPR pavement layer. For CCPR installation, this equipment typically includes milling machines, loaders, pavers, rollers, and trucks. A list of common emission factors used for FSB and asphalt emulsion projects are provided in Appendix B of VM0039.

Emission Intensity of on-site installation equipment (EI_I) is calculated using the following equation below:

$$EI_I = \frac{EF_{EQ} * HR_{EQ}}{Project\ Amount} \quad (Eq. 16)$$

Where:

EI _I	=	Emission intensity of pavement installation (kgCO ₂ e/tonne)
EF _{EQ}	=	Equipment emission factor (kgCO ₂ e/tonne)
HR _{EQ}	=	Equipment operation hours (hour)
Project amount	=	Amount of asphalt emulsions manufactured (tonne)

Note that CCPR projects may include more than one installation project because FSB and asphalt emulsions produced in central plants could be placed in a number of road areas. Where there are $l = 1, \dots, N$ installation projects using FSB and asphalt emulsions from the same manufacturing process, the emission intensity of multiple CCPR projects (MCCPR EI) must be calculated according to Eq. X below. Please note that this equation may only be applied if the multiple road sections utilize the same constituent mix design, otherwise the road sections shall be treated as individual projects according to Eq. 8.

$$MCCPR\ EI = EI_M + EI_{PD} + EI_P + \frac{\sum_i^N EI_{SD,i} project\ amount_i + \sum_l^N EI_{I,l} project\ amount_l}{\sum_l^N project\ amount_l} \quad (Eq. 17)$$

Where:

MCCPR EI	=	Emission intensity of multiple CCPR projects (kgCO ₂ e/t)
EI _M	=	Emission intensity of raw material production (kgCO ₂ e/t)
EI _{PD}	=	Emission intensity of to-plant delivery (kgCO ₂ e/t)
EI _P	=	Emission intensity of in-plant production (kgCO ₂ e/t)
EI _{SD}	=	To-site delivery emission intensity (kgCO ₂ e/t)
EI _I	=	On-site installation emission intensity (kgCO ₂ e/t)
Project amount	=	Amount of FSB and asphalt emulsions manufactured (t)

5.3 Leakage

Leakage is not considered an issue under VM0039 methodology and is therefore set at zero. It is reasonable to assume zero leakage because there is no difference in site preparation activities between baseline and project scenarios. Replacing HMA with FSB or asphalt emulsions for the pavement base layer does not entail a change in carbon efflux or carbon sink at the construction site.

5.4 Estimated Net GHG Emission Reductions and Removals

Net GHG emission reductions for FSB and asphalt emulsions are the emission intensity differences adjusted by the weight differences. A default correction factor (θ) of 1.02 for FSB and 1.17 for asphalt emulsions is applied for all project instances. For projects that have a different structural layer coefficient and material density, the correction factor must be calculated as follows:

A correction factor (θ) is calculated as follows:

$$\theta = \frac{0.0025 * DE}{LC} \text{ Eq. 18}$$

Where:

DE	=	Density of FSB or Asphalt Emulsions (lb/cu. Ft)
LC	=	Layer coefficient of FSB or Asphalt Emulsions

Net GHG emission reductions for a single FSB project must be calculated as follows:

$$ER_{FSB-CCPR} = \left(\frac{CB}{\theta_{FSB}} - CCPR EI \right) * \frac{Project Amount}{1,000} \text{ Eq. 19}$$

Where:

$ER_{FSB-CCPR}$	=	Net emission reductions of FSB using CCPR (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/t)
θ_{FSB}	=	Correction factor
CCPR EI	=	Emission intensity of CCPR project (kgCO ₂ e/t)
Project amount	=	Amount of FSB or asphalt emulsion manufactured (t)

$$ER_{FSB-CIR} = \left(\frac{CB}{\theta_{FSB}} - CIR\ EI \right) * \frac{Project\ Amount}{1,000} \quad Eq. 20$$

Where:

$ER_{FSB-CIR}$	=	Net emission reductions of FSB using CIR (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/t)
θ_{FSB}	=	Correction factor for FSB (default value is 1.02)
CIR EI	=	Emission intensity of CIR project (kgCO ₂ e/t)
Project amount	=	Amount of FSB manufactured (t)

$$ER_{FSB-F} = \left(\frac{CB}{\theta_{FSB}} - FDR\ EI \right) * \frac{Project\ Amount}{1,000} \quad Eq. 21$$

Where:

$ER_{FDR-FDR}$	=	Net emission reductions of FDR (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/t)
θ_{FSB}	=	Correction factor
FDR EI	=	Emission intensity of CIR project (kgCO ₂ e/t)
Project amount	=	Amount of FSB or asphalt emulsions manufactured (t)

Net GHG emission reductions for multiple FSB projects with the same project mix design must be calculated as follows:

$$ER_{FSB-CCPR} = \left(\frac{CB}{\theta_{FSB}} - MCCPR\ EI \right) \cdot \sum \frac{project\ amount_i}{1,000} \quad Eq. 22$$

Where:

$ER_{FSB-CCPR}$	=	Net emission reductions of FSB using CCPR (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/t)
θ_{FSB}	=	Correction factor for FSB (default value is 1.02)
MCCPR EI	=	Emission intensity of multiple CCPR projects (kgCO ₂ e/t)
Project amount	=	Amount of FSB manufactured (t)

$$ER_{FSB-C} = \left(\frac{CB}{\theta_{FSB}} - MCIR\ EI \right) \cdot \sum \frac{project\ amount_i}{1,000} \quad Eq. 23$$

Where:

$ER_{FSB-CIR}$	=	Net emission reductions of FSB using CIR (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/t)
θ_{FSB}	=	Correction factor for FSB (default value is 1.02)
$MCIR EI$	=	Emission intensity of multiple CIR projects (kgCO ₂ e/t)
<i>Project amount</i>	=	Amount of FSB manufactured (t)

$$ER_{FSB-F} = \left(\frac{CB}{\theta_{FSB}} - MFDR EI \right) \cdot \Sigma \frac{project\ amount_i}{1,000} \quad Eq. 24$$

Where:

$ER_{FSB-FDR}$	=	Net emission reductions of FSB using FDR (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/t)
θ_{FSB}	=	Correction factor for FSB (default value is 1.02)
$MFDR EI$	=	Emission intensity of multiple FDR projects (kgCO ₂ e/t)
<i>Project amount</i>	=	Amount of FSB manufactured (t)

Net GHG emission reductions for a single asphalt emulsion project must be calculated as follows:

$$ER_{AE-CC} = \left(\frac{CB}{\theta_{AE}} - CCPR EI \right) * \frac{Project\ Amount}{1,000} \quad Eq. 25$$

Where:

$ER_{FSB-CCPR}$ (tCO ₂ e)	=	Net emission reductions of asphalt emulsions using CCPR
CB	=	Crediting baseline (kgCO ₂ e/t)
θ_{AE}	=	Correction factor
$CCPR EI$	=	Emission intensity of CCPR project (kgCO ₂ e/t)
<i>Project amount</i>	=	Amount of FSB or asphalt emulsion manufactured (t)

$$ER_{AE-CI} = \left(\frac{CB}{\theta_{AE}} - CIR EI \right) * \frac{Project\ Amount}{1,000} \quad Eq. 26$$

Where:

ER_{AE-CIR}	=	Net emission reductions of asphalt emulsions using CIR (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/tonne)
θ_{AE}	=	Correction factor for asphalt emulsion (default value is 1.17)
$CIR EI$	=	Emission intensity of CIR project (kgCO ₂ e/tonne)

Project amount = Amount of asphalt emulsions manufactured (tonne)

$$ER_{AE-F} = \left(\frac{CB}{\theta_{AE}} - FDR EI \right) * \frac{Project Amount}{1,000} \quad Eq. 27$$

Where:

ER_{FDR} = Net emission reductions of FDR (tCO₂e)

CB = Crediting baseline (kgCO₂e/t)

θ_{AE} = Correction factor

FDR EI = Emission intensity of CIR project (kgCO₂e/t)

Project amount = Amount of FSB or asphalt emulsions manufactured (t)

Net GHG emission reductions for multiple asphalt emulsion projects with the same project mix design must be calculated as follows:

$$ER_{AE-CCP} = \left(\frac{CB}{\theta_{AE}} - MCCPR EI \right) \cdot \Sigma \frac{project amount_i}{1,000} \quad Eq. 28$$

Where:

$ER_{AE-CCPR}$ = Net emission reductions of asphalt emulsions using CCPR (tCO₂e)

CB = Crediting baseline (kgCO₂e/t)

θ_{AE} = Correction factor for asphalt emulsion (default value is 1.17)

MCCPR EI = Emission intensity of multiple CCPR projects (kgCO₂e/t)

Project amount = Amount of asphalt emulsions manufactured (t)

$$ER_{AE-CIR} = \left(\frac{CB}{\theta_{AE}} - MCIR EI \right) \cdot \Sigma \frac{project amount_i}{1,000} \quad Eq. 29$$

Where:

ER_{AE-CIR} = Net emission reductions of asphalt emulsions using CIR (tCO₂e)

CB = Crediting baseline (kgCO₂e/t)

θ_{AE} = Correction factor for asphalt emulsion (default value is 1.17)

MCIR EI = Emission intensity of multiple CIR projects (kgCO₂e/t)

Project amount = Amount of asphalt emulsions manufactured (t)

$$ER_{AE-FDR} = \left(\frac{CB}{\theta_{AE}} - MFDR EI \right) \cdot \Sigma \frac{project amount_i}{1,000} \quad Eq. 30$$

Where:

ER_{AE-FDR}	=	Net emission reductions of asphalt emulsions using FDR (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/t)
θ_{AE}	=	Correction factor for asphalt emulsion (default value is 1.17)
$MFDR EI$	=	Emission intensity of multiple FDR projects (kgCO ₂ e/t)
<i>Project amount</i>	=	Amount of asphalt emulsions manufactured (t)

The example project calculation, Hettinger, ND, utilized asphalt emulsions installed through CIR and uses a default Correction Factor, $\theta_{AE}=1.17$. This project, as well as all 2021 project instances, were completed in the year 2021 which corresponds to a Crediting Baseline value of 94.4 per Section 5.1. Applying these values along with those summarized in the preceding sections to Eq. 7, results in a net emission reduction of 2,843 tonnes of CO₂ for the example project calculation.

$$ER_{AE-CIR} = \left(\frac{94.4}{1.17} - 27.31 \right) * \frac{53,284.58}{1,000} = 2,843 \text{ tonnes of CO}_2 \text{ (net reduction)}$$

The same procedure outlined in Section 5.1 and 5.2 were applied to all 2021 project instances which resulted in an overall 28,915 tonnes of CO₂ net reduction for the first monitoring period. Table 7 below provides ex-ante estimate of net GHG emission reductions from the potential expansion of the project activity.

Table 7: Ex-ante Estimate of Overall Project Activity Emissions

Year	Estimated baseline emissions (tCO ₂ e)	Estimated project emissions (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
2021 (27-April-2021 to 25-September-2021)	38,808	9,893	0	28,915
2022 (26-September-2021 to 31-December-2022)	46,500	11,250	0	35,250
2023 (01-January-2023 to 31-December-2023)	55,750	13,500	0	42,250
2024	67,000	16,250	0	50,750

(01-January-2024 to 31-December-2024)				
2025 (01-January-2025 to 31-December-2025)	80,250	19,500	0	60,750
2026 (01-January-2026 to 31-December-2026)	96,250	23,500	0	72,750
2027 (01-January-2027 to 31-December-2027)	115,250	28,000	0	87,250
2028 (01-January-2028 to 31-December-2028)	138,250	33,750	0	104,500
2029 (01-January-2029 to 31-December-2029)	165,750	40,500	0	125,250
2030 (01-January-2030 to 31-December-2030)	198,500	48,500	0	150,000
2031 (01-January-2031 to 26-April-2031)	0	0	0	0
Total	1,002,308	244,643	0	757,665

6 MONITORING

6.1 Data and Parameters Available at Validation

6.1.1 Parameters available at validation for CCPR

Data / Parameter	EF _M
Data unit	kgCO ₂ e/kg
Description	Material Emission Factor
Source of data	Portland Cement Association EPD (12-March-2021) CMUGDI (2008)
Value applied:	RAP: 0 Cement: 0.922 Bitumen: 0.48 Water: 0 Crushed Rock: 0.056 Sand: 0.005 Manufactured Aggregates: 0.006
Justification of choice of data or description of measurement methods and procedures applied	<p>The cement material emission factor is based on the Portland Cement Association Environmental Product Declaration published 12-March-2021. This EPD is applicable to North American cement mixes produced between 12-March-2021 and 12-March-2026.</p> <p>CMUGDI (2008) is comprised of national economic input-output models and publicly available resources use and emission data, which has been accessed over 1 million times by researchers or business users.</p>
Purpose of Data	Calculation of project emissions
Comments	Data to be updated when the material emissions factor is updated in a VM0039 benchmark is reassessment.
Data / Parameter	EF _T
Data unit	kgCO ₂ e/mile

Description	Truck's emission per mile travelled
Source of data	The Climate Registry (TCR 2023)
Value applied:	10.2
Justification of choice of data or description of measurement methods and procedures applied	Emission factors from The Climate Registry are compiled from publicly available data sources and updated each year to ensure that project proponents have the most accurate and up-to-date greenhouse gas data.
Purpose of Data	Calculation of project emissions
Comments	Data to be updated when the diesel emissions factor is updated in a VM0039 benchmark reassessment

Data / Parameter	EF _{EQ}
Data unit	kgCO ₂ e/hr
Description	Equipment emission per hour
Source of data	EPA (2012). "Engine Certification Data for Heavy Truck, Buses, and Engines." < http://www.epa.gov/oms/certdata.htm#largeng >.
Value applied:	Cold Recycler, Wirtgen 12': 901.4 Milling machine, Others: 132.3 Paver, Wheeler Machinery: 134.7 Skid Steer Loaders, John Deere: 77.6 Rollers, Dynapac: 70.1 Water Truck, Freightliner: 284.6
Justification of choice of data or description of measurement methods and procedures applied	The engine emission information is from the EPA off-road engine certification database and stratified by equipment type, engine make, and horsepower rating. The database created for equipment emission estimation is presented in Appendix B of VM0039 Methodology.

Purpose of Data	Calculation of project emissions
Comments	Data was collected one time and must be updated when equipment emission factors are updated in a VM0039 benchmark reassessment

Data / Parameter	EF _{EL}
Data unit	kgCO ₂ e/kWh
Description	Electricity emission factor
Source of data	EPA (2017)
Value applied:	Refer to EPA's eGRID summary tables for electricity emission factors for different regions. (Please note that no electric consumption is applicable to the first monitoring period as all equipment used diesel fuel)
Justification of choice of data or description of measurement methods and procedures applied	Emission factors from eGRID summary tables are compiled by the EPA and updated each year to ensure that project proponents have the most accurate and up-to-date greenhouse gas data. The calculation of electricity emission must use region-specific emission factors.
Purpose of Data	Calculation of project emissions
Comments	The project proponent must use the most recent eGRID summary tables available. Please note that no electric consumption is applicable to the first monitoring period as all equipment used diesel fuel.

Data / Parameter	CF
Data unit	Between 0 and 1
Description	Conversion factor: the percentage of equipment operating time in the total labor time

Source of data	Liu et al. (2016)
Value applied:	Milling machine: 0.66 Backhoe: 0.33 Loader: 0.33 Sweeper: 0.55 Paver: 0.50 Roller: 0.59 Truck: 1
Justification of choice of data or description of measurement methods and procedures applied	Three projects were observed on-site to count the effective operation time of each piece of equipment. The percentage utilization (PU) was calculated using the effective operation time divided by the total labor hours. The average PU values are 0.55 for the asphalt-milling machine; 0.10 for the backhoe; 0.10 for the bobcat/loader; 0.4 for the sweeper/broom; 0.10 for the excavator; 0.33 for the paver and 0.45 for the roller. Different PUs will produce different amounts of GHG emissions. According to a study by Lewis et al. (2009), the emission rate of idling equipment is about one quarter of the emission rate of the operating equipment. This difference is simplified and incorporated into the emission calculation as an average conversion factor (CF), which equals $PU+0.25(1-PU)$.
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	DF
Data unit	Between 0 and 1
Description	For conservativeness, a discount factor (DF) must be applied when a map distance calculator is used to estimate hauling distance. DF is equal to 0 if using actual logged miles.
Source of data	On-site observations
Value applied:	0.1

Justification of choice of data or description of measurement methods and procedures applied	Ten projects were observed on site to count the distance between map and equipment odometer. Hauling distance = Map distance × (1+DF)
Purpose of Data	Calculation of project emissions
Comments	N/A

6.1.2 Parameters available at validation for CIR or FDR

Data / Parameter	EF _T
Data unit	kgCO ₂ e/mile
Description	Truck's emission per mile travelled
Source of data	The Climate Registry (TCR 2023)
Value applied:	10.2
Justification of choice of data or description of measurement methods and procedures applied	Emission factors from The Climate Registry are compiled from publicly available data sources and updated each year to ensure that project proponents have the most accurate and up-to-date greenhouse gas data.
Purpose of Data	Calculation of project emissions
Comments	Data to be updated when the diesel emissions factor is updated in a VM0039 benchmark reassessment

Data / Parameter	EF _M
Data unit	kgCO ₂ e/kg
Description	Material Emission Factor
Source of data	Portland Cement Association EPD (12-March-2021) CMUGDI (2008))

Value applied:	RAP: 0 Cement: 0.922 Bitumen: 0.48 Water: 0 Crushed Rock: 0.056 Sand: 0.005 Manufactured Aggregates: 0.006
Justification of choice of data or description of measurement methods and procedures applied	<p>The cement material emission factor is based on the Portland Cement Association Environmental Product Declaration published 12-March-2021. This EPD is applicable to North American cement mixes produced between 12-March-2021 and 12-March-2026.</p> <p>CMUGDI (2008) is comprised of national economic input-output models and publicly available resources use and emission data, which has been accessed over 1 million times by researchers or business users.</p>
Purpose of Data	Calculation of project emissions
Comments	Data to be updated when the material emissions factor is updated in a VM0039 benchmark is reassessment.

Data / Parameter	EF _{EQ}
Data unit	kgCO ₂ e/hr
Description	Equipment emission per hour
Source of data	EPA (2012). "Engine Certification Data for Heavy Truck, Buses, and Engines."< http://www.epa.gov/oms/certdata.htm#largeng >.
Value applied:	Cold Recycler, Wirtgen 12': 901.4 Milling machine, Others: 132.3 Paver, Wheeler Machinery: 134.7

	Skid Steer Loaders, John Deere: 77.6 Rollers, Dynapac: 70.1 Water Truck, Freightliner: 284.6
Justification of choice of data or description of measurement methods and procedures applied	The engine emission information is from the EPA off-road engine certification database and stratified by equipment type, engine make, and horsepower rating. The database created for equipment emission estimation is presented in Appendix B of VM0039 Methodology.
Purpose of Data	Calculation of project emissions
Comments	Data was collected one time and must be updated when equipment emission factors are updated in a VM0039 benchmark reassessment

6.2 Data and Parameters Monitored

6.2.1 Data and Parameters Monitored for CCPR

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Data acquired through monitoring.
Description of measurement methods and procedures applied	The data can be obtained from plant production records.
Frequency of monitoring/recording	Once per project instance
Value applied:	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.

Monitoring equipment	Truck scales or plant production reports.
QA/QC procedures applied	Cross-checking of reported quantity versus trucking manifest to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of ladings for each project instance or using total plant production weight and applying the mix design percent composition to break total mix weight into constituent raw materials.
Comments	N/A

Data / Parameter	Distance _p
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the mix plant
Source of data	Data derived from monitoring
Description of measurement methods and procedures to be applied	To-plant delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance mix plant.
Frequency of monitoring/recording	Once per project instance
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	Distance that trucks travelled to supply raw materials to the mix plant measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions

Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	Distances
Data unit	Miles
Description	The total miles that trucks travelled to supply CCPR mix to the job site.
Source of data	Data derived from monitoring
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the mix plant and the project installation location.
Frequency of monitoring/recording	Once per project instance
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	Distance that trucks travelled to CCPR mix to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between mix plant address and the project installation location.
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	C _{EL}
Data unit	kWh

Description	Electricity consumption of the mix plant
Source of data	Data derived through monitoring
Description of measurement methods and procedures to be applied	The use of electricity can be obtained from the mix plant's utility bills
Frequency of monitoring/recording	Utility bills must be collected monthly or quarterly
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	Utility provider electricity meters
QA/QC procedures to be applied	Cross-checking reported consumption versus utility bills to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	Not applicable – the consumption is reported directly on utility bills.
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Global Emissionary and the individual road contractor
Description of measurement methods and procedures to be applied	Data can be reported according to plant production records
Frequency of monitoring/recording	Once per project instance
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however

	the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	Scales
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Road contractor
Description of measurement methods and procedures to be applied	Can be obtained from daily equipment hour logs.
Frequency of monitoring/recording	Once per project instance
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus daily logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summing the daily logs across the duration of the project.
Comments	N/A

Data / Parameter	HR _{LA}
Data unit	Hours
Description	The total labor hours of on-site installation equipment use
Source of data	Road contractor
Description of measurement methods and procedures to be applied	Can be obtained from daily timesheet logs.
Frequency of monitoring/recording	Once per project instance
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus daily logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summing the daily logs across the duration of the project.
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. Ft
Description	Density of FSB or asphalt emulsion mix
Source of data	Road contractor
Description of measurement methods and procedures to be applied	Density data can be obtained from project specifications, mix design, or testing.
Frequency of monitoring/recording	Once per project instance

Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	VM0039 or updated research documentation
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32 Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions

Calculation method	N/A
Comments	N/A

6.2.2 Data and Parameters Monitored for CIR and FDR

The tables below have been completed for all data and parameters to be monitored during the project crediting period using the example project, North Dakota, Hettinger, instance as a representative value applied. The values provided are used to estimate the net GHG emissions and removals for the example project crediting period in Section 4 above. Data and parameters determined or available at validation are included in Section 5.1 (Data and Parameters Available at Validation) above. Refer to Section 6 for the data/parameters monitored for every project instance within the first monitoring period.

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 49,930,033 Kg Cement: 273,253 Kg Bitumen: 1,568,106 Kg Water: 1,513,185 Kg
Monitoring equipment	Truck scales

QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Global Emissionary and the individual road contractor
Description of measurement methods and procedures to be applied	Data can be reported according to plant production records
Frequency of monitoring/recording	Once per project instance
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future CCPR instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	L
Data unit	Miles
Description	Length of damaged pavement
Source of data	Road contractor
Description of measurement methods and procedures to be applied	The data can be obtained from project records.
Frequency of monitoring/recording	Once per project instance
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported mileage versus map or project plans.
Purpose of data	Calculation of project emissions
Calculation method	Measuring distances using online mapping or project plans that report length.
Comments	All projects within the first monitoring period were able to track labor hours to estimate equipment operating hours therefore this variable was not used but may be used in future monitoring periods.

Data / Parameter	Distances
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site

Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 126 miles Bitumen: 316 miles Water: 7.5 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	S
Data unit	Miles per hour
Description	Running speed of the cold recycler
Source of data	Road contractor
Description of measurement methods and procedures to be applied	The data can be obtained from project records.
Frequency of monitoring/recording	Once per project instance
Value applied	The values applied will vary based on each individual project instance. With this being a grouped project there will be future instances added over the project crediting period however the values cannot be accurately estimated until those projects are completed and incorporated into future monitoring periods.

Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported speed versus drivers log to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	Averaging out reported cold recycler speeds.
Comments	All projects within the first monitoring period were able to track labor hours to estimate equipment operating hours therefore this variable was not used but may be used in future monitoring periods.

Data / Parameter	DE
Data unit	lb./cu. Ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Road contractor
Description of measurement methods and procedures to be applied	Data can be obtained from project specifications.
Frequency of monitoring/recording	Once per project instance
Value applied	129.3 lb./cu. Ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
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Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance

Value applied	Cold recycler, Wirtgen 12': 104 hours Milling machine, Others: 104 hours Paver, Wheeler Machinery: 79 hours Skid Steer Loaders, John Deere: 52.1 hours Rollers, Dynapac: 93.2 hours Rollers, Dynapac: 93.2 hours Rollers, Dynapac: 93.2 hours Water Trucks, Freightliner: 158 hours Water Trucks, Freightliner: 158 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

6.3 Monitoring Plan

The monitoring plan details the procedures for collecting and reporting all data and parameters listed in Section 5.2. The Project Proponent’s monitoring plan consists of the collection of project data relating to travel distances, energy and equipment usage, quantity of asphalt materials produced, asphalt material composition, and equipment type and usage.

The Data/Parameters from Section 5.2 are listed below:

Wm (weight of raw materials)

Project amount (quantity of FSB and AE)

HReq (total operating hours of onsite installation equipment)

Distance (total truck travel miles to supply raw materials)

DE (density of FSB or AE CIR mix)

LC (layer coefficient of FSB or AE)

Project Proponent and Data Collection Control:

Project data collection was conducted for each project instance by obtaining project documents from the asphalt contractor under Midstate. The asphalt contractor foreman collects documents from asphalt vendors and tanks providing Portland cement at the job site, such as

timecards, pay items, material tickets, and weight documentation. The asphalt contractor personnel, that report to the foreman, are responsible for collecting all data monitored at the asphalt production facility and the construction site.

The foreman collects information on all materials received and for all roads constructed as pay items. Examples of pay items include the quantities of raw materials used, tons of materials produced, and the number of square yards paved per day. The foreman reconciles his or her informal checks through a visual inspection while walking on the site, as tanks arrive and deliver asphalt and cement, with material tickets to ensure accuracy. If any amount was returned for any reason, this amount was deducted from the total quantities from the project at the end of each working day.

The foreman also collects physical timecards for each crew member and transfers them into a working Excel spreadsheet for permanent recordkeeping. Timecards are sent to the main office to be stored as physical records. Daily, the foreman scans all project records, including timecards, pay items, material tickets, and bills of lading, and emails them to the project manager at the main office. Timecards display the total operating hours of onsite installation equipment.

At the main office, all documents that include physical copies and electronic versions are reconciled by the cost payable division, and payments are issued directly to the vendors. The original documents are generally delivered to the office every two weeks. The physical paper copies of all aforementioned documents are kept in the office for no less than two years after the job has been completed.

The asphalt contractor's server retains separate project folders for each project for four years, where all pertinent data for each project is stored. The electronic versions of the documents are stored by the asphalt contractor indefinitely.

Additional Quality Control Procedures:

The communication process and handling of changes and obstacles on-site involve the Owner's representative, the prime contractor's representative, and the QC representative. Minor changes in the process and test results will be communicated to the agency for permission to proceed. However, if there is any major change or obstacle, work will be halted until all responsible parties' on-site address and resolve the issue collectively. In such cases, the issue will typically be escalated to the design team.

No major changes were noted in these projects, but minor modifications were made to the mix designs. These modifications were documented by a QC technician who then provided them, along with the original design documents, to the Global Emissionary team.

The asphalt mix composition undergoes testing at several stages, including before and during its production and before, during, and after its installation.

Project Proponent Data Collection and Quality Control:

The data required for quantifying and reporting GHG emissions is typical of the data that asphalt contractors are required to monitor, collect, and have on hand as part of any asphalt installation project. Once Midstate completes a road project, Global Emissionary works with them to collect detailed information on each project instance. If the project is deemed a viable candidate for earning carbon credits, Global Emissionary verifies all the information on the data intake form with extensive backup documentation collected for each project instance.

Global Emissionary uses an Excel spreadsheet data intake form to collect information for each project instance. This includes engineering plans, project drawings, asphalt mix designs (CIR only), material bill of lading receipts, and equipment operator timesheets. In addition, information is collected from Midstate and the asphalt contractors as described in Section 5.3. The data intake form is a summary form that allows for an initial calculation of GHG emission reductions. This provides a consistent baseline for data calculations across all projects.

The data stored in the main office project folders are then sent to Global Emissionary for further emissions calculations. The information from data intake forms is manually entered into Excel spreadsheets used for calculations from the methodology equations. These spreadsheets are backchecked by another staff member to ensure the transcription of data and the correct calculation of formulas. Global Emissionary also analyses the data and cross-checks the testing data for consistency. For example, the density of the pavement found in the mix designs is cross-checked with the specifications for conformance to project documents. Global Emissionary verifies the bill of lading of raw materials with tonnages produced for that job by back calculating the individual proportions of raw materials required to produce the same tonnage using job mix formula (mix design). If the data provided by the contractor had any discrepancies or missing information, the Global Emissionary team communicates with the contractor to obtain the corrected data required.

After completing the calculations in spreadsheets and writing project descriptions, Global Emissionary stores the calculations at two electronic data storage networks. The data drives are also archived to preserve the data indefinitely in case of future reference requirements.

Calibration of Equipment:

All direct measurements are conducted with calibrated measurement equipment according to relevant industry standards. Equipment calibration procedures following manufacturers' procedures, are as follows:

The weigh bridge of the conveyor belts in the CIR train is calibrated for every job.

Pumps and injectors are calibrated at the shop at the end of each season to ensure accurate measurement of weights and proportions of liquids.

The totalizer on the computer is verified with a pre-known density of the RAP for every hour of the operation of the machine as it moves on the road to verify tolerances of weights and rate of pre-spread Portland cement on the pavement.

Quality control and assurance practices are used to verify weights, densities, amount of asphalt, and water added to further justify the calibration of the equipment.

A third-party independent lab is hired to perform quality control testing on these jobs and the results are documented.

Calibration of all contractor's equipment is the contractor's responsibility to ensure all quantities are measured correctly and the product meets project specifications. Project specifications are the main method that owners use to hold contractors accountable. Only when project specifications are met do contractors get paid.

Superintendents of the team are trained by vendors on calibrating the equipment, and they train some of the crew who operate the equipment on a regular basis.

For indirect measurements for all project instances, the structural layer coefficient comes from the VM0039 Methodology and is a reasonably conservative estimate used by state Departments of Transportation. (See the footnote on page 25 of the methodology).

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Sections 6.1.1 through 6.1.24 summarize all data and parameters monitored during the first monitoring period running from April 27, 2021 through September 25, 2021. Data and parameters determined or available at validation which remain fixed throughout the project crediting period are included in Section 5.1 (Data and Parameters Available at Validation) above. The first monitoring period only consisted of project instances that utilized the CIR process with asphalt emulsions or FSB. Under future project monitoring periods, new project instances may include the CCPR or FDR processes as well depending on the contractors projects during that subsequent monitoring period.

14839 ND Hettinger Data and Parameters Monitored

Data / Parameter	W _M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers

Description of measurement methods and procedures applied	The bill of lading receipts was supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 49,930,033Kg Cement: 273,253 Kg Bitumen: 1,568,106 Kg Water: 1,513,185 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.

Frequency of monitoring/recording	Once per project instance
Value applied	53,284.58 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 104 hours Milling machine, Others: 104 hours Paver, Wheeler Machinery: 79 hours Skid Steer Loaders, John Deere: 52.1 hours Rollers, Dynapac: 93.2 hours Rollers, Dynapac: 93.2 hours Rollers, Dynapac: 93.2 hours Water Trucks, Freightliner: 158 hours Water Trucks, Freightliner: 158 hours
Monitoring equipment	N/A

QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 126 miles Bitumen: 316 miles Water: 7.5 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. Ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	129.3 lb./cu. Ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).

Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14796 MN Chisago Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 3,553,328 Kg Cement: 20,865 Kg Bitumen: 82,499 Kg Water: 170,233 Kg
Monitoring equipment	Truck scales

QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	3,826.93 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours

Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 9.24 hours Paver, Wheeler Machinery: 7 hours Skid Steer Loaders, John Deere: 4.62 hours Rollers, Dynapac: 8.26 hours Rollers, Dynapac: 8.26 hours Water Trucks, Freightliner: 14 hours Water Trucks, Freightliner: 14 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site

Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 30 miles Bitumen: 30 miles Water: 2 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. Ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	131.0 lb./cu. Ft
Monitoring equipment	N/A

QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14797 IA Buena Vista Data and Parameters Monitored

Data / Parameter	W_M
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Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 6,301,161 Kg Cement: 0 Kg Bitumen: 130,453 Kg Water: 245,602 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions

Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	6,677.22 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 15.7 hours Milling machine, Others: 15.7 hours Paver, Wheeler Machinery: 11.9 hours Skid Steer Loaders, John Deere: 7.84 hours Rollers, Dynapac: 14 hours Rollers, Dynapac: 14 hours

	Water Trucks, Freightliner: 23.8 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 67 miles Water: 8 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions

Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. Ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	126.63 lb./cu. Ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are

and procedures to be applied	virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14798 IA Wright Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 10,702,529 Kg Cement: 0 Kg

	Bitumen: 206,049 Kg Water: 491,785 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	11,400.36 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{Eq}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 26.1 hours Paver, Wheeler Machinery: 19.8 hours Skid Steer Loaders, John Deere: 13 hours Rollers, Dynapac: 23.3 hours Rollers, Dynapac: 23.3 hours Water Trucks, Freightliner: 39.5 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site

Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 118 miles Water: 6 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. Ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance

Value applied	129.07 lb./cu. Ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14807 IA Story Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 28,874,020Kg Cement: 0 Kg Bitumen: 428,518 Kg Water: 1,286,207 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A
Data / Parameter	Project amount

Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	30,588.74 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 58.1 hours Paver, Wheeler Machinery: 44 hours Skid Steer Loaders, John Deere: 29 hours

	Rollers, Dynapac: 51.9 hours Rollers, Dynapac: 51.9 hours Water Trucks, Freightliner: 88 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 48 miles Water: 8 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site

Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	129.81 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology

Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14819 IA Boone Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance

Value applied:	RAP: 8,660,306 Kg Cement: 0 Kg Bitumen: 128,231 Kg Water: 510,700 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	9,299.24 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions

Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 17.2 hours Paver, Wheeler Machinery: 13 hours Skid Steer Loaders, John Deere: 8.58 hours Rollers, Dynapac: 15.3 hours Rollers, Dynapac: 15.3 hours Water Trucks, Freightliner: 26 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles

Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 71 miles Water: 4.5 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.

Frequency of monitoring/recording	Once per project instance
Value applied	125.85 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A

Comments	N/A
14826 MN Mower (1) Data and Parameters Monitored	
Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 25,391,689 Kg Cement: 0 Kg Bitumen: 630,403 Kg Water: 870,081 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	26,882.38 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 51.3 hours

	Milling machine, Others: 51.3 hours Paver, Wheeler Machinery: 38.9 hours Skid Steer Loaders, John Deere: 25.7 hours Rollers, Dynapac: 45.9 hours Rollers, Dynapac: 45.9 hours Water Trucks, Freightliner: 77.8 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 102 miles Water: 12 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software

QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	121.37 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless

Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14827 MN Mower (2) Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.

Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 10,674,889 Kg Cement: 0 Kg Bitumen: 253,250 Kg Water: 234,544 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	11,163.68 tonnes
Monitoring equipment	N/A

QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 21.5 hours Milling machine, Others: 21.5 hours Paver, Wheeler Machinery: 16.3 hours Skid Steer Loaders, John Deere: 10.7 hours Rollers, Dynapac: 19.2 hours Rollers, Dynapac: 19.2 hours Water Trucks, Freightliner: 32.5 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 87 miles Water: 9 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories

Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	120.94 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.

Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14840 TN Coffee Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 17,067,885 Kg Cement: 191,734 Kg Bitumen: 523,518 Kg Water: 427,475 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions

Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	18,210.61 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology

Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 31.7 hours Paver, Wheeler Machinery: 24 hours Skid Steer Loaders, John Deere: 15.8 hours Rollers, Dynapac: 28.3 hours Rollers, Dynapac: 28.3 hours Water Trucks, Freightliner: 48 hours Water Trucks, Freightliner: 48 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance

Value applied	RAP: 0 miles (recycled on-site) Cement: 82 miles Bitumen: 64 miles Water: 6 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	120.6 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A

Comments	N/A
Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14849 IN Porter Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers

Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 24,374,835 Kg Cement: 139,951 Kg Bitumen: 615,362 Kg Water: 559,878 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.

Frequency of monitoring/recording	Once per project instance
Value applied	25,690.03 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 51.3 hours Milling machine, Others: 51.3 hours Milling machine, Others: 51.3 hours Paver, Wheeler Machinery: 38.9 hours Skid Steer Loaders, John Deere: 25.7 hours Rollers, Dynapac: 45.9 hours Rollers, Dynapac: 45.9 hours Rollers, Dynapac: 45.9 hours Water Trucks, Freightliner: 77.8 hours
Monitoring equipment	N/A

QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 37 miles Bitumen: 154 miles Water: 8 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	130.97 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).

Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14855 IA Webster Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 31,050,570 Kg Cement: 0 Kg Bitumen: 631,573 Kg Water: 658,235 Kg
Monitoring equipment	Truck scales

QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	32,340.38 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours

Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 88.1 hours Paver, Wheeler Machinery: 66.8 hours Skid Steer Loaders, John Deere: 44.1 hours Rollers, Dynapac: 78.8 hours Rollers, Dynapac: 78.8 hours Water Trucks, Freightliner: 134 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location

and procedures to be applied	
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 113 miles Water: 12 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	131.23 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.

Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14857 IA Keokuk Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg

Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 8,480,370 Kg Cement: 0 Kg Bitumen: 112,890 Kg Water: 208,063 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions

Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	8,801.32 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 19.5 hours Paver, Wheeler Machinery: 14.8 hours Skid Steer Loaders, John Deere: 9.74 hours Rollers, Dynapac: 17.4 hours Rollers, Dynapac: 17.4 hours Water Trucks, Freightliner: 29.5 hours

Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 55.2 miles Water: 3 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site

Comments	N/A
Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	130.85 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer

	coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14873 MN St. Louis Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 18,345,135 Kg Cement: 103,365 Kg Bitumen: 474,666 Kg Water: 453,955 Kg

Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	19,377.12 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
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Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 37.3 hours Milling machine, Others: 37.3 hours Paver, Wheeler Machinery: 28.3 hours Skid Steer Loaders, John Deere: 18.6 hours Rollers, Dynapac: 33.3 hours Rollers, Dynapac: 33.3 hours Water Trucks, Freightliner: 56.5 hours Water Trucks, Freightliner: 56.5 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site

Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 84.7 miles Bitumen: 202 miles Water: 6 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance

Value applied	124.7 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14915 IA Sioux Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 20,010,921 Kg Cement: 0 Kg Bitumen: 422,340 Kg Water: 480,436 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A
Data / Parameter	Project amount

Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	20,913.70 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 50.2 hours Paver, Wheeler Machinery: 38 hours Skid Steer Loaders, John Deere: 25.1 hours

	Rollers, Dynapac: 44.8 hours Rollers, Dynapac: 44.8 hours Water Trucks, Freightliner: 76 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 49 miles Water: 7 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site

Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	125.95 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology

Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14911 MN Sibley Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance

Value applied:	RAP: 16,207,157 Kg Cement: 93,812 Kg Bitumen: 570,991 Kg Water: 416,126 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	17,288.09 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions

Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 33.2 hours Milling machine, Others: 33.2 hours Paver, Wheeler Machinery: 25.1 hours Skid Steer Loaders, John Deere: 16.6 hours Rollers, Dynapac: 29.6 hours Rollers, Dynapac: 29.6 hours Water Trucks, Freightliner: 50.3 hours Water Trucks, Freightliner: 50.3 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
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Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 68 miles Bitumen: 143 miles Water: 4 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project

and procedures to be applied	specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	123.24 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions

Calculation method	N/A
Comments	N/A

14917 MN Hennepin Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 12,644,414 Kg Cement: 0 Kg Bitumen: 182,662 Kg Water: 234,544 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance

Comments	N/A
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Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	13,061.62 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.

Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 20.5 hours Paver, Wheeler Machinery: hours Skid Steer Loaders, John Deere: 15.5 hours Rollers, Dynapac: 18.3 hours Rollers, Dynapac: 18.3 hours Water Trucks, Freightliner: 31 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 24 miles Water: 4 miles

Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	126.77 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
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Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14960 MN Redwood Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to

	provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 4,070,628 Kg Cement: 0 Kg Bitumen: 72,811 Kg Water: 85,121 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	4,228.56 tonnes

Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 12.2 hours Paver, Wheeler Machinery: 9.25 hours Skid Steer Loaders, John Deere: 6.11 hours Rollers, Dynapac: 10.9 hours Rollers, Dynapac: 10.9 hours Water Trucks, Freightliner: 18.5 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 219 miles Water: 6 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories

Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	126.34 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.

Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14979 TN Madison Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 15,962,645 Kg Cement: 175,876 Kg Bitumen: 393,618 Kg Water: 393,428 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions

Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	16,925.57 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology

Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 31.8 hours Milling machine, Others: 31.8 hours Paver, Wheeler Machinery: 24.1 hours Skid Steer Loaders, John Deere: 15.9 hours Rollers, Dynapac: 28.5 hours Rollers, Dynapac: 28.5 hours Water Trucks, Freightliner: 48.3 hours Water Trucks, Freightliner: 48.3 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location

Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 145 miles Bitumen: 42 miles Water: 9 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	128.40 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions

Calculation method	N/A
Comments	N/A
Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

14986 MN Norman Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.

Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 26,441,452 Kg Cement: 0 Kg Bitumen: 571,926 Kg Water: 446,389 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe

and procedures to be applied	to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	27,460.77 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 58.2 hours Paver, Wheeler Machinery: 44.1 hours Skid Steer Loaders, John Deere: 29.1 hours Rollers, Dynapac: 52.1 hours Rollers, Dynapac: 52.1 hours Water Trucks, Freightliner: 88.3 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents

Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 59 miles Water: 12 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	123.9 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).

Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

50061 IA Plymouth Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 17,517,599 Kg Cement: 0 Kg Bitumen: 411,263 Kg Water: 423,692 Kg
Monitoring equipment	Truck scales

QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	18,352.55 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours

Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 45.7 hours Milling machine, Others: 45.7 hours Paver, Wheeler Machinery: 34.6 hours Skid Steer Loaders, John Deere: 22.9 hours Rollers, Dynapac: 40.9 hours Rollers, Dynapac: 40.9 hours Water Trucks, Freightliner: 69.3 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site

Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 36.6 miles Water: 6.6 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	127.36 lb./cu. ft
Monitoring equipment	N/A

QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	FSB: 0.32
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

50147 MN Ottertail Data and Parameters Monitored

Data / Parameter	W_M
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Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 11,805,128 Kg Cement: 0 Kg Bitumen: 276,065 Kg Water: 253,458 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions

Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	12,334.65 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 36 hours Paver, Wheeler Machinery: 27.3 hours Skid Steer Loaders, John Deere: 18 hours Rollers, Dynapac: 32.3 hours Rollers, Dynapac: 32.3 hours Water Trucks, Freightliner: 54.5 hours

Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 0 miles Bitumen: 373 miles Water: 6.5 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site

Comments	N/A
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Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	118.51 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer

	coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

30358 UDOT US89 Data and Parameters Monitored

Data / Parameter	W _M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 13,862,902 Kg Cement: 249,104 Kg Bitumen: 528,834 Kg Water: 813,337 Kg

Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	15,454.18 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
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Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 52.9 hours Paver, Wheeler Machinery: 40.1 hours Skid Steer Loaders, John Deere: 26.4 hours Rollers, Dynapac: 47.3 hours Rollers, Dynapac: 47.3 hours Water Trucks, Freightliner: 80.1 hours Water Trucks, Freightliner: 80.1 hours Water Trucks, Freightliner: 80.1 hours Water Trucks, Freightliner: 80.1 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site

Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 129.5 miles Bitumen: 95 miles Water: 7 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance

Value applied	133.88 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

30405 NDOT SR232 Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.
Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 11,071,898 Kg Cement: 248,841 Kg Bitumen: 409,875 Kg Water: 749,026 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A
Data / Parameter	Project amount

Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	12,479.64 tonnes
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 36 hours Paver, Wheeler Machinery: 27.3 hours Skid Steer Loaders, John Deere: 18 hours

	Rollers, Dynapac: 32.2 hours Rollers, Dynapac: 32.2 hours Water Trucks, Freightliner: 54.6 hours Water Trucks, Freightliner: 54.6 hours Water Trucks, Freightliner: 54.6 hours Water Trucks, Freightliner: 54.6 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions
Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 172.4 miles Bitumen: 196 miles Water: 14 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software

QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	126.23 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless

Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance
Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

30391 MTDOT - Hwy 2 Glacier Data and Parameters Monitored

Data / Parameter	W_M
Data unit	Kg
Description	The weight of each raw material used to produce FSB or asphalt emulsions.
Source of data	Bill of lading receipts from material suppliers
Description of measurement methods and procedures applied	The bill of lading receipts were supplied by the shipment carriers to the on-site project staff accepting the raw materials. The bill of lading reports the net tonnage of raw material delivered by each shipping truck. All net tonnage is then summed together to provide the total amount of raw material used for each project instance.

Frequency of monitoring/recording	Once per project instance
Value applied:	RAP: 37,205,870 Kg Cement: 442,933 Kg Bitumen: 1,039,371Kg Water: 1,064,736 Kg
Monitoring equipment	Truck scales
QA/QC procedures applied	Ensuring that the project instance raw material tonnage reported by Midstate is cross-checked with the supporting documentation of bill of lading receipts.
Purpose of data	Calculation of project emissions
Calculation method	Performing a summation of all individual raw material weights reported in the bill of lading for each project instance
Comments	N/A

Data / Parameter	Project amount
Data unit	tonnes
Description	Output quantity of FSB and asphalt emulsions
Source of data	Data provided by the paving contractor
Description of measurement methods and procedures to be applied	Data can be reported according to production log to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety and meet the intended design life.
Frequency of monitoring/recording	Once per project instance
Value applied	39,752.91 tonnes
Monitoring equipment	N/A

QA/QC procedures to be applied	Cross-checking of reported amount versus production logs to confirm quality measurement
Purpose of data	Calculation of project emissions
Calculation method	Summation of plant production logs.
Comments	N/A

Data / Parameter	HR _{EQ}
Data unit	Hours
Description	The total operating hours of on-site installation equipment
Source of data	Equipment operating hours are approximated by labor hours reported on equipment operator timesheets and conversion factors defined in the VM0039 Methodology
Description of measurement methods and procedures to be applied	Where equipment operation hours are not available, labor hours can be used to approximate equipment operation hours. Labor hours are documented in the project daily log for verification.
Frequency of monitoring/recording	Once per project instance
Value applied	Cold recycler, Wirtgen 12': 101 hours Paver, Wheeler Machinery: 76.6 hours Skid Steer Loaders, John Deere: 50.5 hours Rollers, Dynapac: 90.4 hours Rollers, Dynapac: 90.4 hours Water Trucks, Freightliner: 153 hours Water Trucks, Freightliner: 153 hours Water Trucks, Freightliner: 153 hours Water Trucks, Freightliner: 153 hours
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking reported values versus operator timesheet documents
Purpose of data	Calculation of project emissions

Calculation method	Summing the labor hours reported for each piece of installation equipment and multiplying by the conversion factors (CF) defined in Section 5.1.1
Comments	N/A

Data / Parameter	Distance
Data unit	Miles
Description	The total miles that trucks travelled to supply raw materials to the job site
Source of data	To-site delivery mileage is obtained by mapping out the driving distance between each raw material supplier and the project instance site
Description of measurement methods and procedures to be applied	To-site delivery mileage is obtained from online mapping software by determining the driving distance between each of the raw material suppliers and the project instance location
Frequency of monitoring/recording	Once per project instance
Value applied	RAP: 0 miles (recycled on-site) Cement: 277 miles Bitumen: 250 miles Water: 12 miles
Monitoring equipment	Distance that trucks travelled to supply raw materials to the job site measured using online mapping software
QA/QC procedures to be applied	Confirming the reported distance matches actual mapping distance between each raw material supplier's address and the project instance site
Purpose of data	Calculation of project emissions
Calculation method	Using online mapping service to determine driving distance between each raw material supplier's address and the project instance site
Comments	N/A

Data / Parameter	DE
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Data unit	lb./cu. ft
Description	Density of FSB or asphalt emulsion CIR mix
Source of data	Density testing reports generated by independent third-party laboratories
Description of measurement methods and procedures to be applied	State Departments of Transportation (DOTs) require all project instances to include density testing to ensure that project specifications are being met and that the roads are safe to handle vehicular traffic without posing a risk to public safety.
Frequency of monitoring/recording	Once per project instance
Value applied	133.45 lb./cu. ft
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus theoretical density to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	LC
Data unit	Unitless
Description	Layer coefficient of FSB or asphalt emulsions
Source of data	The standard layer coefficients for FSB and asphalt emulsions were used per Footnote 6 of the VM0039 Methodology
Description of measurement methods and procedures to be applied	The composition and structural properties of central plant recycled cold mix and cold in-place recycled paving materials are virtually the same; the range of structural layer coefficients recommended for recycled cold mixes (0.25 to 0.35) is also applicable for cold in-place recycled mixes. On average, various Departments of Transportation are considering a structural layer coefficient of 0.32 for FSB and of 0.30 for asphalt emulsion mixes (Schwartz and Khosravifar, 2013).
Frequency of monitoring/recording	Once per project instance

Value applied	Asphalt Emulsion: 0.30
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-checking of reported data versus DOT commonly used coefficients to confirm quality measurement.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

7.2 Baseline Emissions

Baseline emissions for the first monitoring period running from 27-April-2021, to 25-September-2021 are calculated using Eq. 8 and Eq. 9 below. The crediting baseline (CB) and correction factors (θ_{AE} or θ_{FSB}) variables are determined and available at validation as defined in Section 5.1. Since all projects in the first monitoring period took place in the year 2021, all project instances use the CB value of 94.4 tonnes CO₂e/tonne CIR as shown in Table 8 below. The Project Amount variables are monitored and have been defined in Section 6.1 above for each project instance.

Baseline GHG emission reductions for a single asphalt emulsion project must be calculated as follows:

$$BE_{AE-Y} = \left(\frac{CB}{\theta_{AE}} \right) * \frac{Project\ Amount}{1,000} \quad Eq. 8$$

Where:

BE_{AE-Y}	=	Baseline Emissions of asphalt emulsions using process Y (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/tonne)
θ_{AE}	=	Correction factor for asphalt emulsion (default value is 1.17)
Project amount	=	Amount of asphalt emulsions manufactured (tonne)
Y	=	Cold recycling process (CCPR, CIR, or FDR)

Baseline GHG emission reductions for a single FSB project must be calculated as follows:

$$BE_{FSB-Y} = \left(\frac{CB}{\theta_{FSB}} \right) * \frac{Project\ Amount}{1,000} \quad Eq. 9$$

Where:

$BE_{FSB-CIR}$	=	Baseline Emissions of FSB using process Y (tCO ₂ e)
CB	=	Crediting baseline (kgCO ₂ e/tonne)
θ_{FSB}	=	Correction factor for asphalt emulsion (default value is 1.02)
Project amount	=	Amount of FSB manufactured (tonne)
Y	=	Cold recycling process (CCPR, CIR, or FDR)

Table 8: 2021 Baseline Emissions

Project	Crediting Baseline, CB (kg CO ₂ e/tonne CIR)	Correction Factor, θ (unitless)	Project Amount (Tonnes)	Baseline Emissions (Tonnes CO ₂)
14839 ND Hettinger	94.4	1.17 (Asphalt Emulsions)	53,284.58	4,299
14796 MN Chisago	94.4	1.17 (Asphalt Emulsions)	3,826.93	308
14797 IA Buena Vista	94.4	1.02 (FSB)	6,677.22	617
14798 IA Wright	94.4	1.02 (FSB)	11,400.36	1,055
14807 IA Story	94.4	1.02 (FSB)	30,588.74	2,830
14819 IA Boone	94.4	1.02 (FSB)	9,299.24	860
14826 MN Mower (1)	94.4	1.02 (FSB)	26,882.38	2,487
14827 MN Mower (2)	94.4	1.02 (FSB)	11,162.68	1,033

Project	Crediting Baseline, CB (kg CO ₂ e/tonne CIR)	Correction Factor, θ (unitless)	Project Amount (Tonnes)	Baseline Emissions (Tonnes CO ₂)
14840 TN Coffee	94.4	1.17 (Asphalt Emulsions)	18,210.61	1,469
14849 IN Porter	94.4	1.17 (Asphalt Emulsions)	25,690.03	2,072
14855 IA Webster	94.4	1.02 (FSB)	32,340.38	2,993
14857 IA Keokuk	94.4	1.02 (FSB)	8,801.32	814
14873 MN St. Louis	94.4	1.17 (Asphalt Emulsions)	19,377.12	1,563
14915 IA Sioux	94.4	1.17 (Asphalt Emulsions)	20,913.70	1,687
14911 MN Sibley	94.4	1.17 (Asphalt Emulsions)	17,288.09	1,394
14917 MN Hennepin	94.4	1.17 (Asphalt Emulsions)	13,061.62	1,053
14960 MN Redwood	94.4	1.17 (Asphalt Emulsions)	4,228.56	341

Project	Crediting Baseline, CB (kg CO ₂ e/tonne CIR)	Correction Factor, θ (unitless)	Project Amount (Tonnes)	Baseline Emissions (Tonnes CO ₂)
14979 TN Madison	94.4	1.02 (FSB)	16,925.57	1,566
14986 MN Norman	94.4	1.17 (Asphalt Emulsions)	27,459.77	2,215
50061 IA Plymouth	94.4	1.02 (FSB)	18,352.55	1,698
50147 MN Otertail	94.4	1.17 (Asphalt Emulsions)	12,334.65	995
30358 UDOT US89	94.4	1.17 (Asphalt Emulsions)	15,454.18	1,246
30405 NDOT SR232	94.4	1.17 (Asphalt Emulsions)	12,479.64	1,006
30391 MTDOT - Hwy 2 Glacier	94.4	1.17 (Asphalt Emulsions)	39,752.91	3,207
Total Baseline Emissions (tonnes CO₂e) =				38,808

*Note: Baseline Emissions column has been rounded down for conservativeness.

7.3 Project Emissions

The first monitoring period only consisted of project instances that utilized the CIR process with asphalt emulsions or FSB. Under future project monitoring periods, new project instances may include the CCPR or FDR processes as well depending on the contractors' projects during that subsequent monitoring period.

Project emissions for the first monitoring period running from 27-April-2021, to 25-September-2021 are calculated using Eq. 10 below. The Project Amount variables are monitored and have been defined in Section 6.1 above for each project instance.

Baseline GHG emission reductions for a single asphalt emulsion project must be calculated as follows:

$$PE_Y = (Y EI) * \frac{Project Amount}{1,000} \text{ Eq. 10}$$

Where:

PE_Y = Project Emissions for process Y (CCPR, CIR, or FDR) (tCO₂e)

Y EI = Total Emission intensity of process Y (CCPR, CIR, or FDR) (kgCO₂e/tonne)

Project amount = Amount of FSB or asphalt emulsions manufactured (tonne)

Table 9: 2021 Project Emissions

Project	El _M kg CO ₂ e/tonne	El _{SD} kg CO ₂ e/tonne	El _I kg CO ₂ e/tonne	CIR EI kg CO ₂ e/tonne	Project Amount (Tonnes)	Project Emissions (Tonnes CO ₂ e)
14839 ND Hettinger	18.85	4.10	4.35	27.31	53,284.58	1,456
14796 MN Chisago	15.37	0.49	4.90	20.77	3,826.93	80
14797 IA Buena Vista	9.38	0.85	4.06	14.29	6,677.22	96
14798 IA Wright	8.68	1.43	3.66	13.76	11,400.36	157
14807 IA Story	6.72	0.53	3.04	10.29	30,588.74	315
14819 IA Boone	6.62	0.66	2.95	10.23	9,299.24	96
14826 MN Mower (1)	11.26	1.42	3.30	15.98	26,882.38	430
14827 MN Mower (2)	10.89	1.17	3.33	15.38	11,162.68	172

Project	El _M kg CO ₂ e/tonne	El _{SD} kg CO ₂ e/tonne	El _I kg CO ₂ e/tonne	CIR El kg CO ₂ e/tonne	Project Amount (Tonnes)	Project Emissions (Tonnes CO ₂ e)
14840 TN Coffee	23.51	1.45	3.53	28.48	18,210.61	519
14849 IN Porter	16.52	2.03	4.71	23.26	25,690.03	598
14855 IA Webster	9.37	1.24	4.36	14.97	32,340.38	485
14857 IA Keokuk	6.16	0.39	3.54	10.09	8,801.32	89
14873 MN St. Louis	16.68	2.67	4.16	23.51	19,377.12	456
14915 IA Sioux	9.69	0.60	3.83	14.13	20,913.70	296
14911 MN Sibley	20.86	2.60	4.15	27.60	17,288.09	478
14917 MN Hennepin	6.71	0.21	2.50	9.43	13,061.62	124
14960 MN Redwood	8.27	2.40	4.62	15.29	4,228.56	65
14979 TN Madison	20.74	1.49	4.07	26.30	16,925.57	446
14986 MN Norman	10.00	0.79	3.39	14.18	27,459.77	390
50061 IA Plymouth	10.76	0.50	4.31	15.56	18,352.55	286
50147 MN Ottertail	10.74	4.49	4.66	19.90	12,334.65	246
30358 UDOT US89	31.29	2.17	9.89	43.36	15,454.18	671
30405 NDOT SR232	34.15	4.76	8.35	47.26	12,479.64	590

Project	El _M kg CO _{2e} /tonne	El _{SD} kg CO _{2e} /tonne	El _I kg CO _{2e} /tonne	CIR El kg CO _{2e} /tonne	Project Amount (Tonnes)	Project Emissions (Tonnes CO _{2e})
30391 MTDOT - Hwy 2 Glacier	22.82	3.83	7.35	34.01	39,752.91	1,352
Total Project Emissions (tonnes CO_{2e}) =						9,893

Note: Project Emissions column has been rounded up for conservativeness.

7.4 Leakage

Leakage is not considered an issue under VM0039 methodology and is therefore set at zero. It is reasonable to assume zero leakage because there is no difference in site preparation activities between baseline and project scenarios. Replacing HMA with FSB or asphalt emulsions for the pavement base layer does not entail a change in carbon efflux or carbon sink at the construction site.

7.5 Net GHG Emission Reductions and Removals

The net GHG emission reductions and removals for the first monitoring period running from 27-April-2021, to 25-September-2021 are summarized in Table 10 below. Since all projects in the first monitoring period took place in the year 2021, all project instances use the CB value of 94.4 tonnes CO_{2e}/tonne CIR as shown in Table 5 above.

Table 10: Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO _{2e})	Project emissions or removals (tCO _{2e})	Leakage emissions (tCO _{2e})	Net GHG emission reductions or removals (tCO _{2e})
2021 (27-April- 2021 - 25- Sept-2021)	38,808	9,893	0	28,915
Total	38,808	9,893	0	28,915

The estimated ex-ante GHG emission reductions and the achieved emission reductions for this monitoring period are below.

<u>Year</u>	<u>Ex-ante emissions reductions/removals</u>	<u>Achieved emissions reductions/removals</u>	<u>Percent difference</u>	<u>Justification for the difference</u>
2021 (27-April-2021 – 25-Sept-2021)	28,915	28,915	0.0	No difference.

APPENDIX A: 2021 PROJECT INSTANCE SUPPORTING DOCUMENTATION