

Experience with Sustainable Bituminous Mixtures on Irish Regional and Local Road Network

Kevin West, Senior Engineer, Monaghan County Council
Declan Toner, Senior Executive Engineer, Monaghan County Council



An Roinn Iompair
Department of Transport



Contents

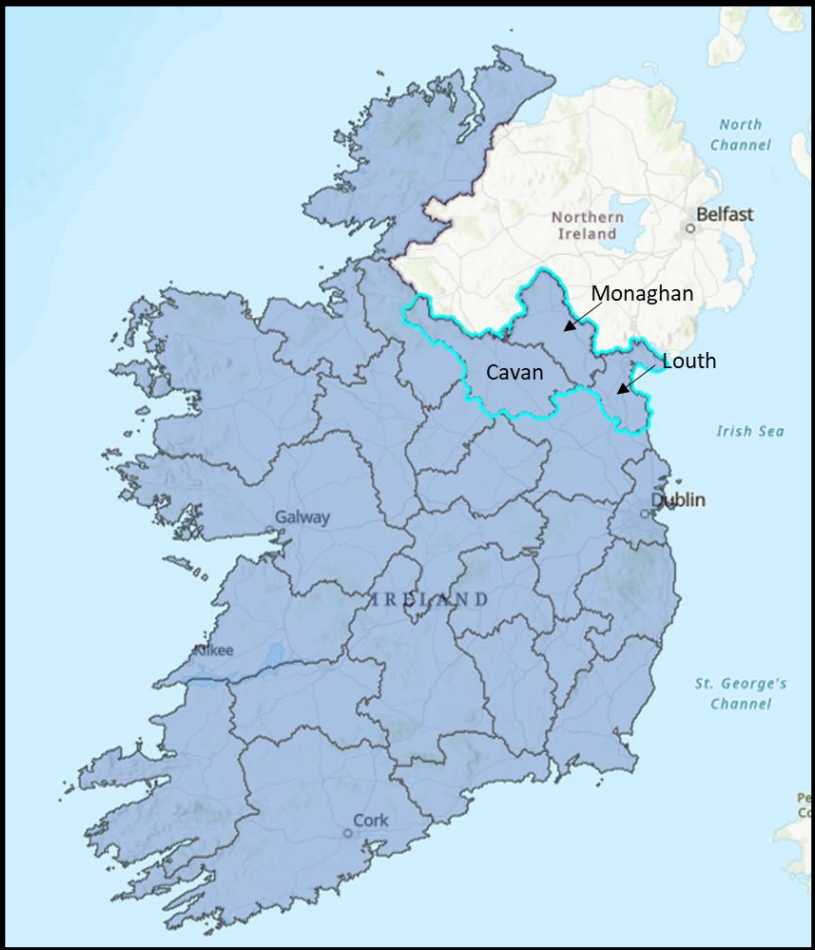
- Introduction
- Scheme Progression
- Working Group
- Case Study - Lough Egish Trial 2022
 - Mix & Pavement Design
 - Performance Monitoring – FWD, RSP, Cores
 - Environmental Benefits
- Video - 3 Mins



Introduction

- County Monaghan has approximately 104 km of national roads, 297km of regional roads, and around 2,082 km of local roads (including primary, secondary, and tertiary)
- Historically Local Authorities in Ireland uses Asphalt Millings as low values unbound granular material and have accumulated large stockpiles of asphalt millings.
- Reclaimed Asphalt Pavement (RAP) uses recycled aggregates, promoting environmental benefits and supporting circular economy goals.
- LEBM uses unheated aggregates, resulting in lower energy consumption and a smaller carbon footprint compared to HMA.
- This Pilot combines cold-mix technology with high recycled aggregate content to create a sustainable road-making material that meets performance standards and circular economy targets.

Year	
2020	3 M
2022	
2023	LP12
2024	Annaki
2024	R197
2024	Monag
2024	
Tot	



Estimated O2 Saved (T)	Estimated CO2 Saved (%)
70.3	50.10%
61.7	40.90%
69.8	39.90%
132.1	87.20%
74.2	80.80%
150.3	81.00%
85.8	69.90%
644.3	64.26%



Afternoon Session : Cold Recycling

Scheme Progression

Year	Focus
2020	100% Rap, no virgin aggregates, familiarisation with the material characteristics
2022	R180 Lough Egish (Case Study) 80% RAP, 20% Virgin Aggregate
2023	Regional & Local (60mm overlay), stockpile control, compaction (NDG)
2024	Regionalisation to Monaghan, Cavan, Louth and Cork
2025	Development of Cold-mix Recycling Centre in county Varying the ratios of recycled aggregate to virgin aggregate Incorporating binder rejuvenator to assess the impact on reducing the use of virgin binder. (HVO, Warm-mix, Low-cost interventions – 5year Road Maintenance Strategy)
2026	Utilise 5,000T of cold-mix RAP as a regulating layer in Monaghan County Council's 2026 Restoration Improvement Programme. Achieve a 10% reduction in overall CO2 emissions compared to the exclusive use of HMA and WMA.



An Roinn Iompair
Department of Transport



Afternoon Session : Cold Recycling

Working Group



Afternoon Session : Cold Recycling

Working Group Focus

Develop an alternative “low carbon” pavement material for use on Ireland road network

Propose the most efficiency production method for use of the RAP feedstock

Mixture design and pavement design to optimise material use and maximise performance

Continuous assessment to determine performance and lifecycle costs

To propose a new mix specification for TII Series 900

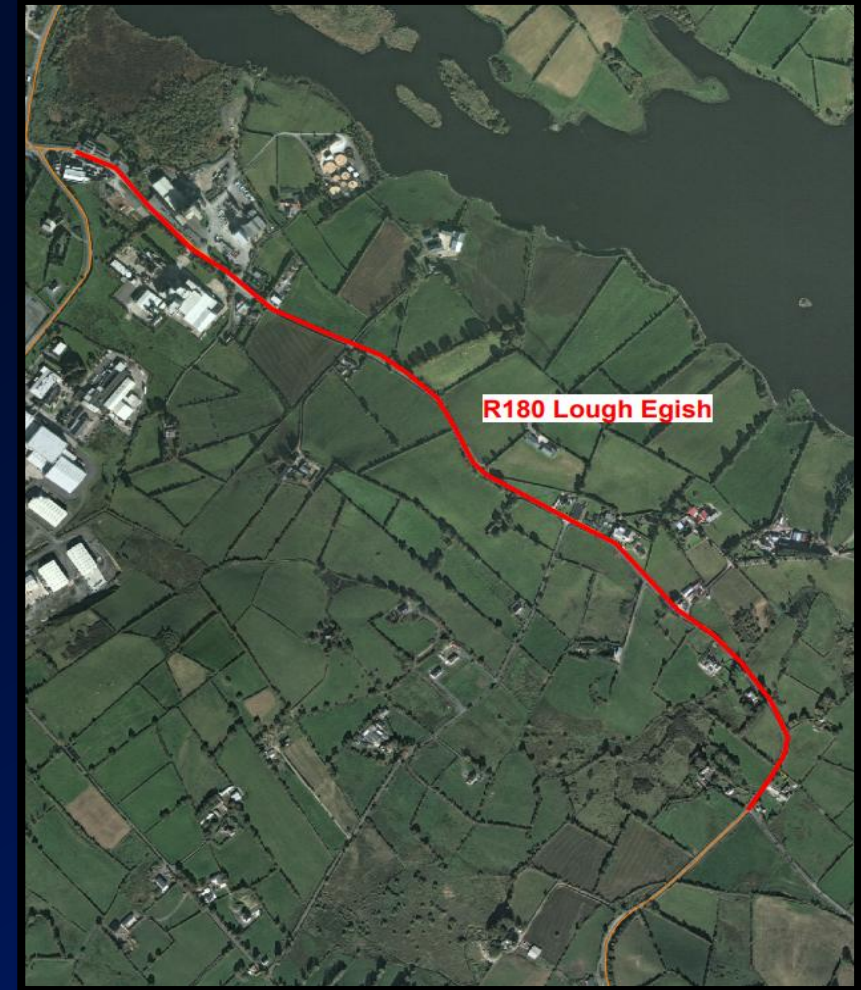


An Roinn Iompair
Department of Transport



Case Study – Site Selection

- The R-180 regional road in Monaghan was selected for the 2022 trial.
 - PSCI Rating 1-4
 - AADT 1,941
 - 12.2 % HGV's
- Non Destructive -
 - GPR - Ground Penetrating Radar testing
 - Falling Weight Deflectometer (FWD) testing
- Destructive testing was carried out to develop an appropriate pavement design:
 - Core samples of the existing pavement
 - Trial holes (c. 1m depth) at various locations identified from non-destructive test analysis
 - Trial Pits - Samples were taken of the granular layers in each trial pit and tested:
 - Gradation
 - Atterberg limits
 - Moisture Content
 - Optimum Moisture Content



Case Study – Laboratory Mix Design

Samples from RAP stockpile were provided to Colas Contracting Ltd.

- Lab tests conducted include:
 - Moisture content of the RAP
 - RAP binder content and analysis of recovered binder
 - Grading of RAP aggregate
- Mix recipe:
 - % RAP
 - % corrective aggregate (if any)
 - % water (if any)
 - % emulsion to be added and % oil in the emulsion
- Mix performance tests:
 - % Air Voids content
 - ISTM Stiffness Modulus
 - Resistance to Rutting
 - Resistance to Water Sensitivity



Table 3 – Mix performance test results

Mix characteristic	Test Method	Laboratory Curing Regime	Results	Specification
Maximum dry density	EN 12697-5 Procedure A	N/A	2373 kg/m ³	N/A
Percentage of air voids	EN 12697-31 Gyratory compaction with setting of 600 kPa load, 1° angle, 12 revs/min. and 100 gyrations	N/A	6.2%	V _{max} 13,0
Stiffness Modulus	EN 12697-26, IT-CY at 20 °C, 124 ms	Conditioning for 14 days at 35 °C and 20 % R.H. The conditioning at test temperature over night, before testing.	2769 MPa	ITSM ₂₀₀₀
Resistance to Water Sensitivity	EN 12697-12, Method B	Conditioning all specimens for 7 days at 18 °C and 40 to 70 % R.H. Then conditioning "Dry" subset at 18 °C and 40 to 70 R.H. for further 7 days, while conditioning "Wet" subset in water at 18 °C for 7 days.	80	i/C _{min} 70
Resistance to Permanent Deformation	EN 12697-22, Procedure B at 45 °C, small device	Conditioning for 14 days at 35 °C and 20 % R.H. The conditioning at test temperature over night, before testing.	4.2%	PRD _{AIR} max 10,0



Case Study – Pavement Design

- ▶ IAPDM = Irish Analytic Pavement Design Method:
 - ▶ Cold-Mix RAP – Design Layer Stiffness $E = 1750$ MPa.
 - ▶ A.C. 20 70/100 – Design Layer Stiffness $E = 3100$ MPa.
- ▶ For overlay or inlay pavement designs, the input factors include:
 - ▶ The loading of the pavement (AADT/%HGV)
 - ▶ Design life of 20 years = 2.3 msa Design Traffic
 - ▶ Existing pavement structure (trial holes/trenches)
 - ▶ Stiffness modulus of the existing layers and foundation (FWD)
 - ▶ ISTM Stiffness Modulus of the proposed new pavement layers
- ▶ Output Proposed Pavement Options:
 - ▶ 50 - 150 mm of LEBM cold-mix
 - ▶ 50 -125 mm of AC 20 dense bin hot-mix

Southbound		Overlay Thickness (mm)	
From km	To km	LEBM L2	AC20 70/100
0	500	50	50
500	800	80	70
800	1475	145	125
1475	1900	145	125

Table 15: Overlay design thickness per homogeneous section - Northbound

Northbound		Overlay Thickness (mm)	
From km	To km	LEBM L2	AC20 70/100
0	500	50	50
500	800	80	70
800	1475	150	125
1475	1900	110	90

Chainage	Pavement Material
CH0 – CH500	AC20 dense bin Hot - Mix
CH500 – C1900	LEBM Cold-Mix RAP



Performance Monitoring

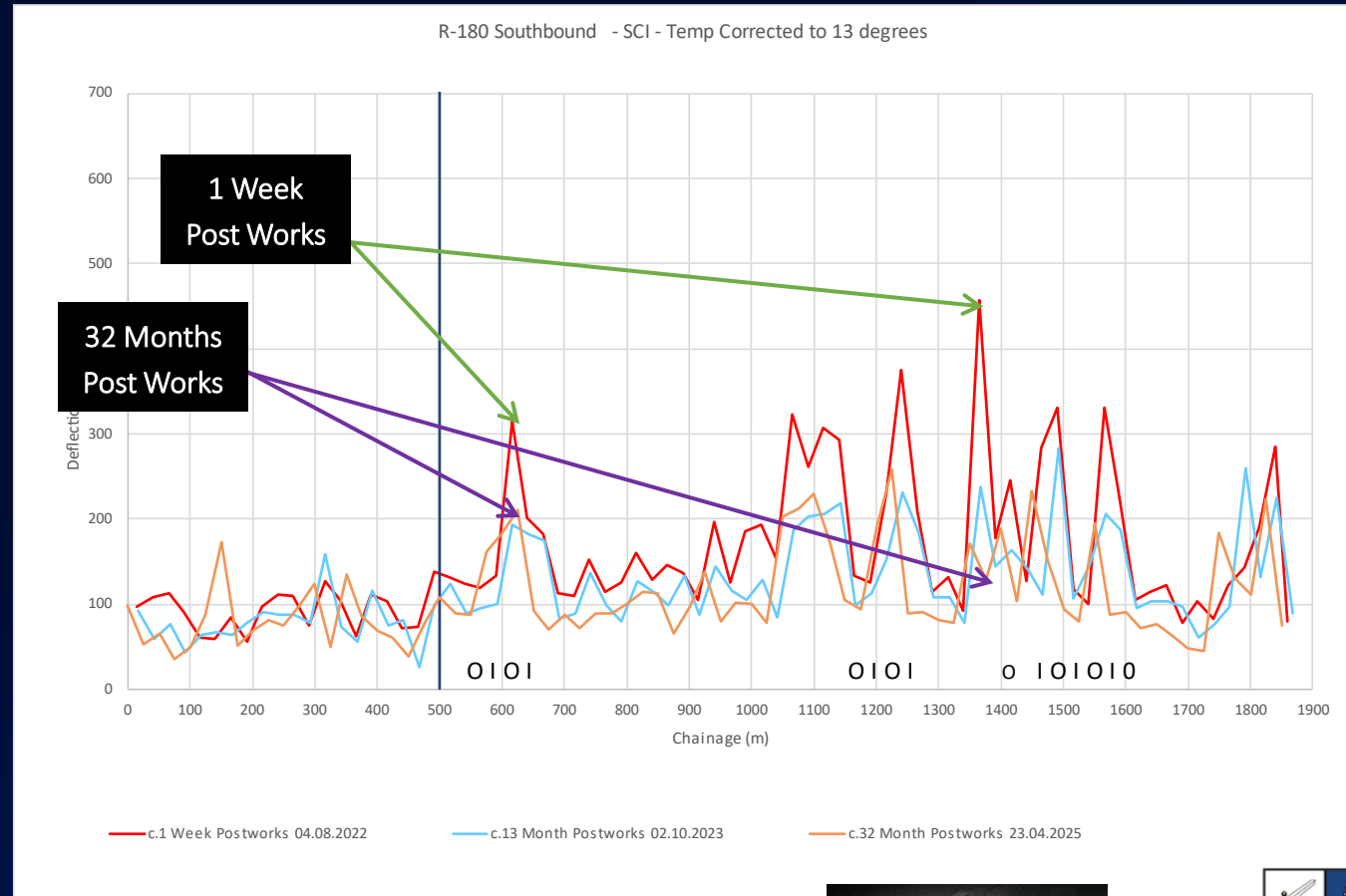
Monitoring to be Undertaken		Timeline After Construction										
		Before Works	3 Days	7 Days	14 Days	21 Days	2 Months	3 Months	6 Months	1 Year	2 Years	3 Years
Test	FWD Testing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Core Samples	X	X	X	X	X	✓	✓	✓	✓	✓	✓
	Profilometer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Visual Inspection	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Progress Photos	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓



Falling Weight Deflectometer Data

SCI – Pavement Load Spreading ability;

- ▶ Hot mix Section at its strongest immediately after construction
- ▶ Cold-mix section continuing to gain strength

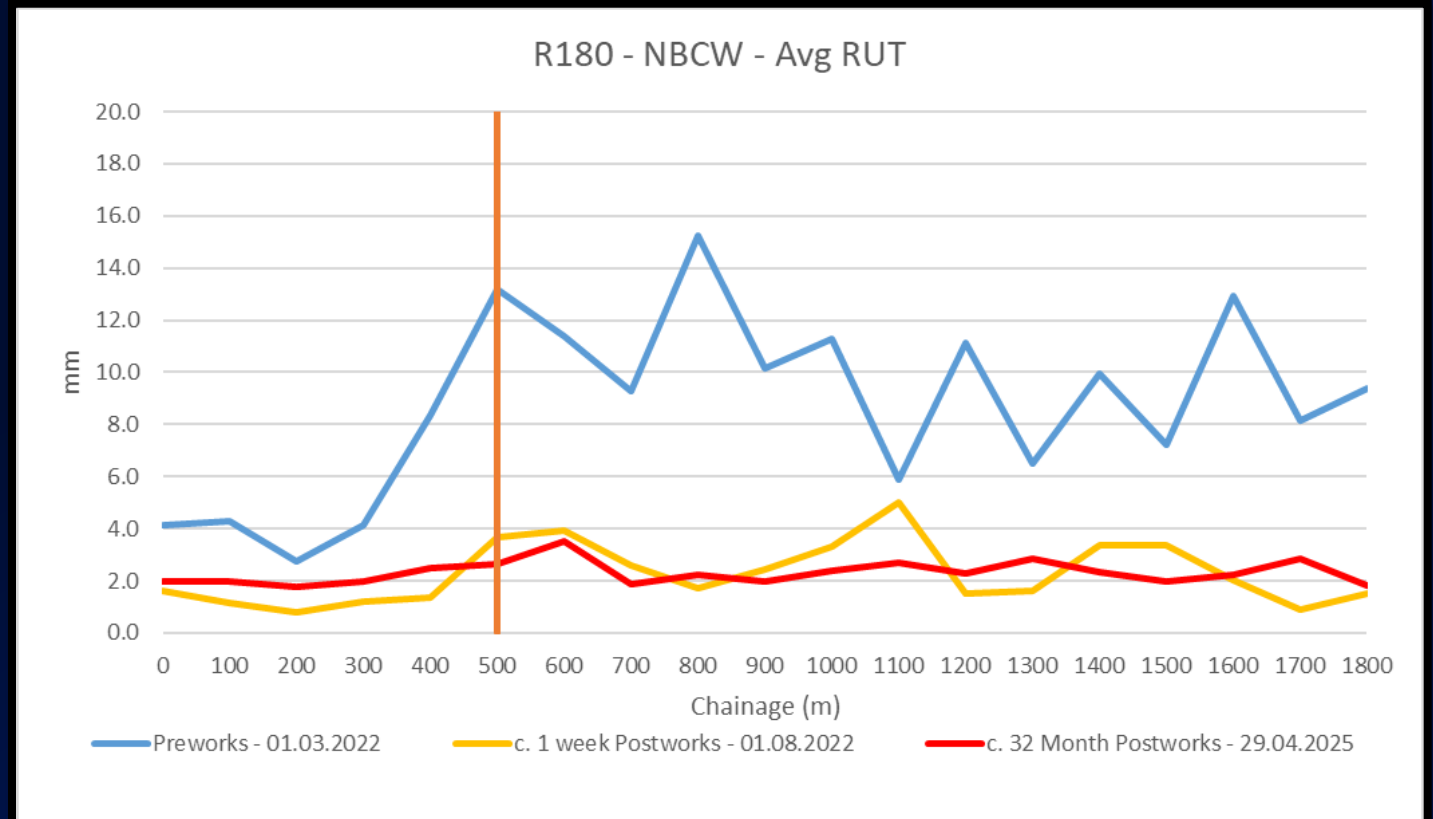


An Roinn Iompair
Department of Transport



Road Surface Profilometer (RSP)

- ▶ Resistance to rutting
- ▶ Negligible post works rutting observed (around 2mm)
- ▶ The hot-mix control section is similar to the cold-mix section
- ▶ No rutting was observed in the early life of the pavement



Afternoon Session : Cold Recycling

Core Data

- ▶ Slowly Continuous strength gain over time
- ▶ Difficulty in extracting cores – Appropriate method

CORE LOG						Client: Monaghan County Council Project No: 22/133			
						Road No: R180		Date Cored: 14/08/2024	
						Section: 2022 RAP Trial Site		Direction: WB	
						Procedure Used: EN12697-36: 2022 - Clause 4.1			
Layer No.	Top (mm)	Bottom (mm)	Thickness (mm)	Material	Layer Condition		<p>Core 2B</p>		
1	0	10	10	SD					
2	10	75	65	LEBM					
3	75	145	70	LEBM					
Average Voids Content (%)	Average Bulk Density (kg/m³)					<div> <div>Core No:</div> <div>2B</div> </div> <div> <div>Chainage (m):</div> <div>1325</div> </div> <div> <div>Core Diameter (mm):</div> <div>150</div> </div> <div> <div>Core Depth (mm):</div> <div>145</div> </div> <div> <div>Easting:</div> <div>678788</div> </div> <div> <div>Northing:</div> <div>812709</div> </div> <div> <div>Operator:</div> <div>AH</div> </div>			
18	1991								
17	1987								
15	2054								
16	2023								
Core Material: Stone Mastic Asphalt; SD= Surface Dressing; HBM= Heavy Bitumen Macadam; DBM= Dense Bitumen Macadam; LMC= Lean Mix Concrete; HDM= Heavy Duty Macadam; HFS=High Friction Surface Course Right Wheel Path; HS= Hard Shoulder									

HTSF504, Rev5, 19022024

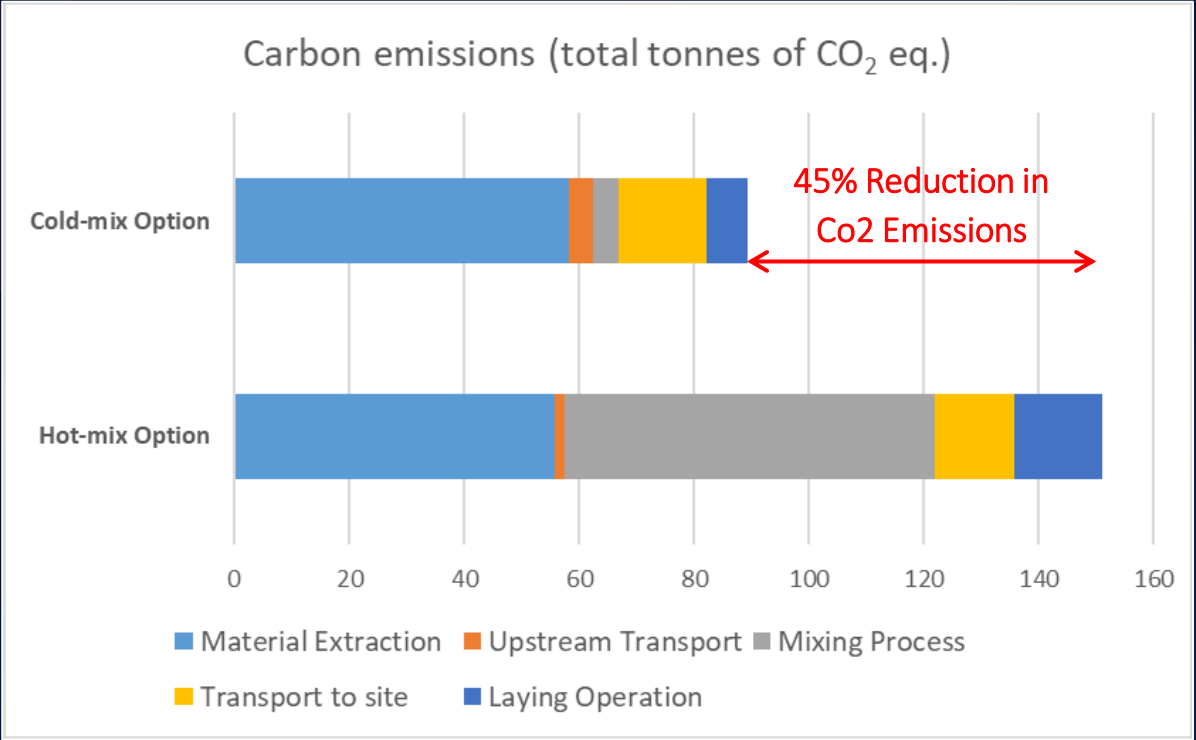
8/2024

Carbon Savings

2022 Trial – R180 Lough Egish, Co. Monaghan



Pavement Solution	Material Extraction	Upstream Transport	Mixing Process	Transport to site	Laying Operation	Total
Hot-mix Option	55.9	1.5	64.6	13.8	15.4	151.2
Cold-mix Option	58.3	4.2	4.5	15.1	7.3	89.4



Afternoon Session : Cold Recycling



Video <https://youtu.be/5Q1CYSQsdFI>



An Roinn Iompair
Department of Transport



Afternoon Session : Cold Recycling

Kevin West – kwest@monaghancoco.ie
Declan Toner – dtoner@monaghancoco.ie

THANK YOU

