



The Institute of **Asphalt Technology**
Irish Branch

The use of Recycled Aggregates in a Granular Fill

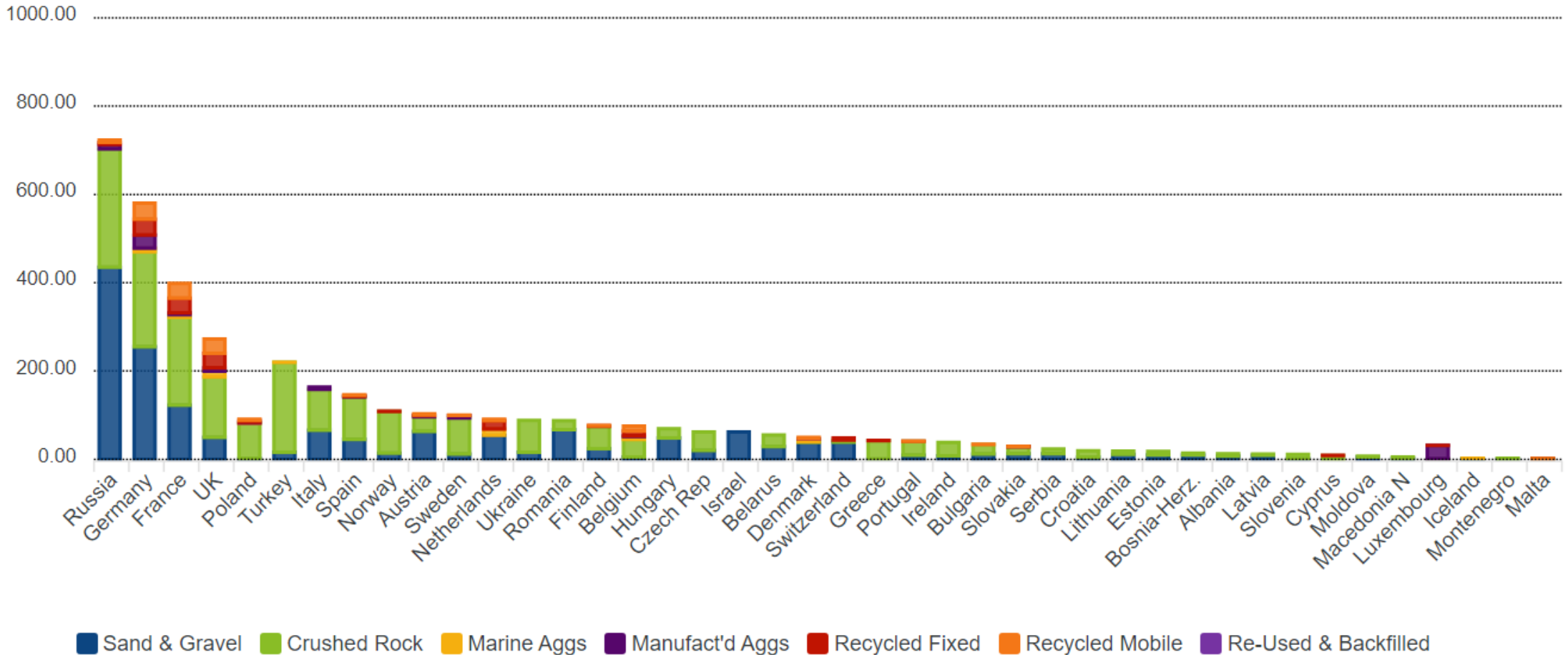


Use of Recycled material in construction – modern beginnings

- 1945 rebuilding of Europe
- Cheap construction material needed
- Recycling of concrete rubble following the bombing of Dresden

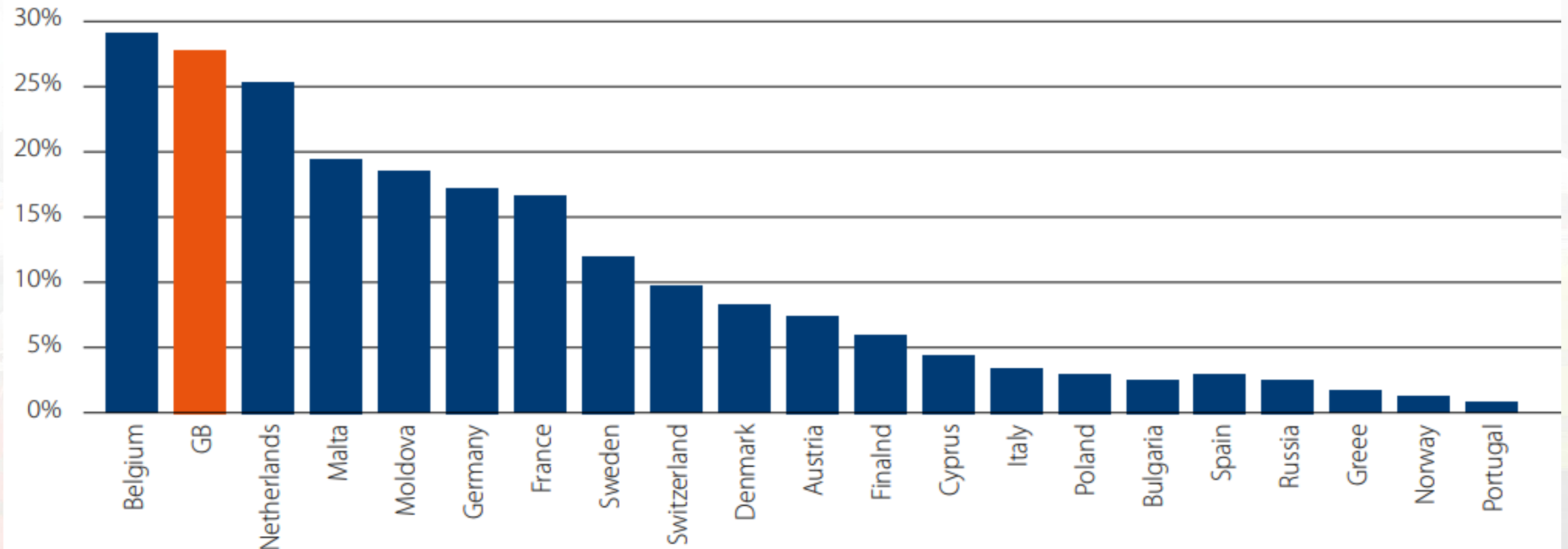


Aggregate Production Europe:2020



% Recycled Aggregate Europe:2020

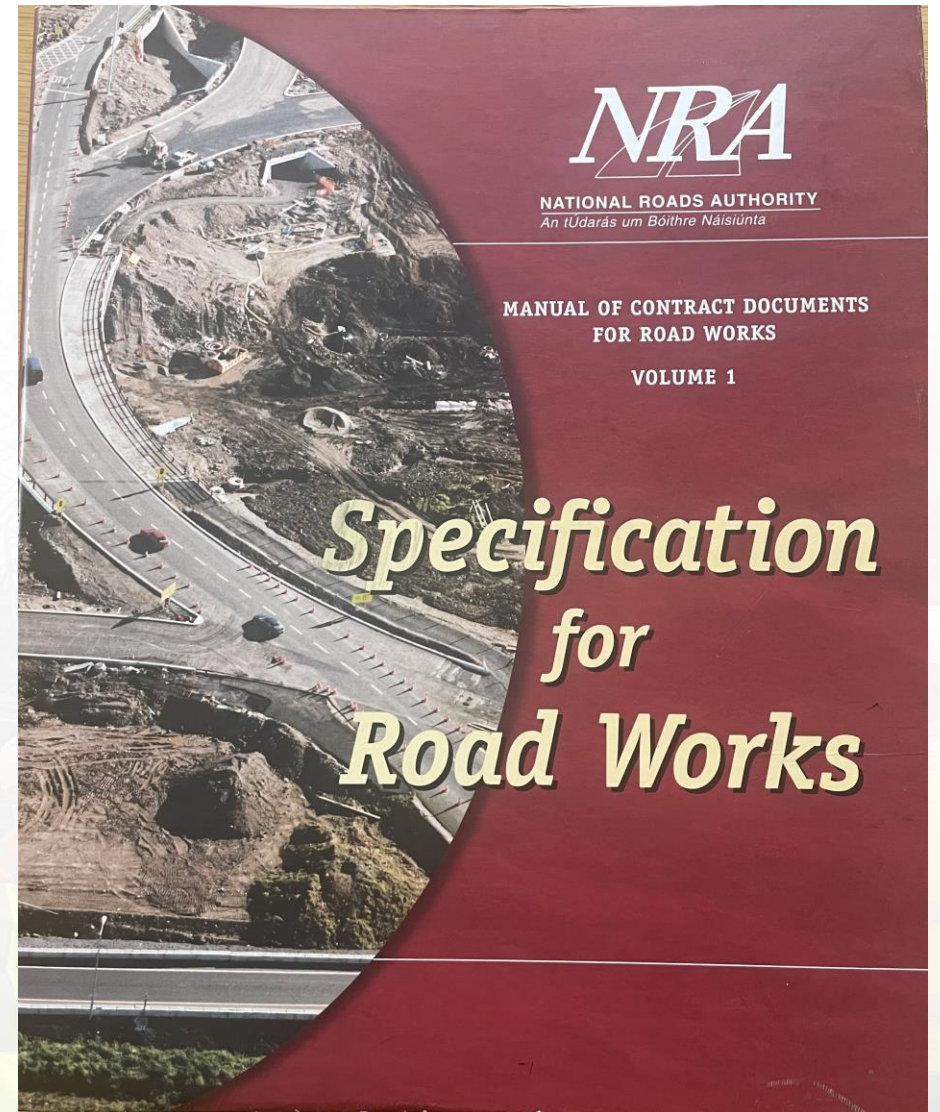
Figure 2. Share of recycled and secondary materials in total aggregates sales, 2020 (Source: UEPG, MPA calculations)



Previous Specifications: NRA/TII

Materials:

- 6C, 6F2, CL 803
 - Commonly used in late 90's early 00's as a granular fill
 - M50 Galway exit to Red Cow
- EN 12620 Aggregates for Concrete
- EN 13043 Aggregates for Bituminous



TII SHW

- CC-SPW-00800
- Replaces old Series 800

Changes

- What was
 - CI 803/804/806/808/809
- Is now
 - UGM A CI803/4/6
 - UGM Ac CI 808
 - UGM Am CI 809

All up to 30% Recycled content

UGM B up to 100% Recycled Content

TII Publications



Road Pavements – Unbound and Hydraulically Bound Mixtures

CC-SPW-00800
August 2022

UGM Specification requirements

- Liquid Limit: natural material only
- Methylene Blue: research underway
- Water Soluble Sulphates
- Oxidisable Sulphides
- Crushed and Broken
- Flakiness Index
- LAAV
- Water Absorption
- M.S.S.V

Constituents	UGM A / Ac / Am	UGM B / Bc / Bm
	% by mass	% by mass
Rc - Concrete, concrete products, mortar Concrete masonry units	No limit	No limit
Ru - Unbound aggregate, natural stone Hydraulically bound aggregate	No limit	No limit
Ra - Bituminous materials	≤ 30	No limit
Rg - Glass	≤ 1	≤ 5
Rb - Clay masonry units (i.e. bricks and tiles) Calcium silicate masonry units Aerated non-floating concrete	≤ 1	≤ 2
X - Cohesive (i.e. clay and soil) Miscellaneous: metals (ferrous and nonferrous), non-floating wood, plastic and rubber Gypsum plaster	≤ 1	≤ 2
FL - Floating material	≤ 1	≤ 1

UGM Specification requirements: Performance

Density

Parameter	Test Method	Test Frequency	Requirements	
Relative Compaction	Nuclear Density Gauge (See Annex A)	Minimum of 5 locations within each 1000 m ² or part thereof laid each day	Average	≥ 97% MDD
			Single location	≥ 92% MDD

UGM Specification requirements: Performance

Falling Weight: Deflectometer Design Level 2

Characteristic	Test Method	FWD Test Spacing	Requirements		
			IAPDM Performance Category	Surface Modulus (MPa)	
				Rolling Average*	Minimum
Layer Stiffness	Refer to Section 2.4.2.2.1	Seating drop + 3 drops at 25m station spacing in the left wheel path of each lane	S1	≥ 100	≥ 70
			S2	≥ 200	≥ 120
			S3	≥ 300	≥ 175

* Rolling average of 5 consecutive FWD stations

- EPA Articles 27 & 28
- Producer Register under the National Decision
- Restrictions on Use
- Sample every 2,000tns
 - Table 1. Allowable Inputs
 - Table 2. Solid Pollutant Limiting Values (PLV's)
 - Table 3. Leachate PLV's
 - Certificate of Conformity



EXPLANATORY NOTE ON NATIONAL END-OF-WASTE DECISION
FOR RECYCLED AGGREGATES.

DECISION REFERENCE NO: EoW-N001/2023

VERSION: 1.0 - 17TH OCTOBER 2023

Project

- Assess the performance of Recycled Concrete Aggregate as a replacement for natural aggregate in a granular material

Methods of Analysis

- **Laboratory**
 - Compliance with Spec requirements
 - Mechanical
 - Chemical
- **Field trial**
 - Falling Weight Deflectometer
 - Pre and post construction assessments
 - Relative Density
 - Nuclear density reading every 10m
 - Visual Inspection



- Returned concrete allowed to set
- Mix of concrete strengths from 10N to 90N
- Rock-breaking of hardened concrete

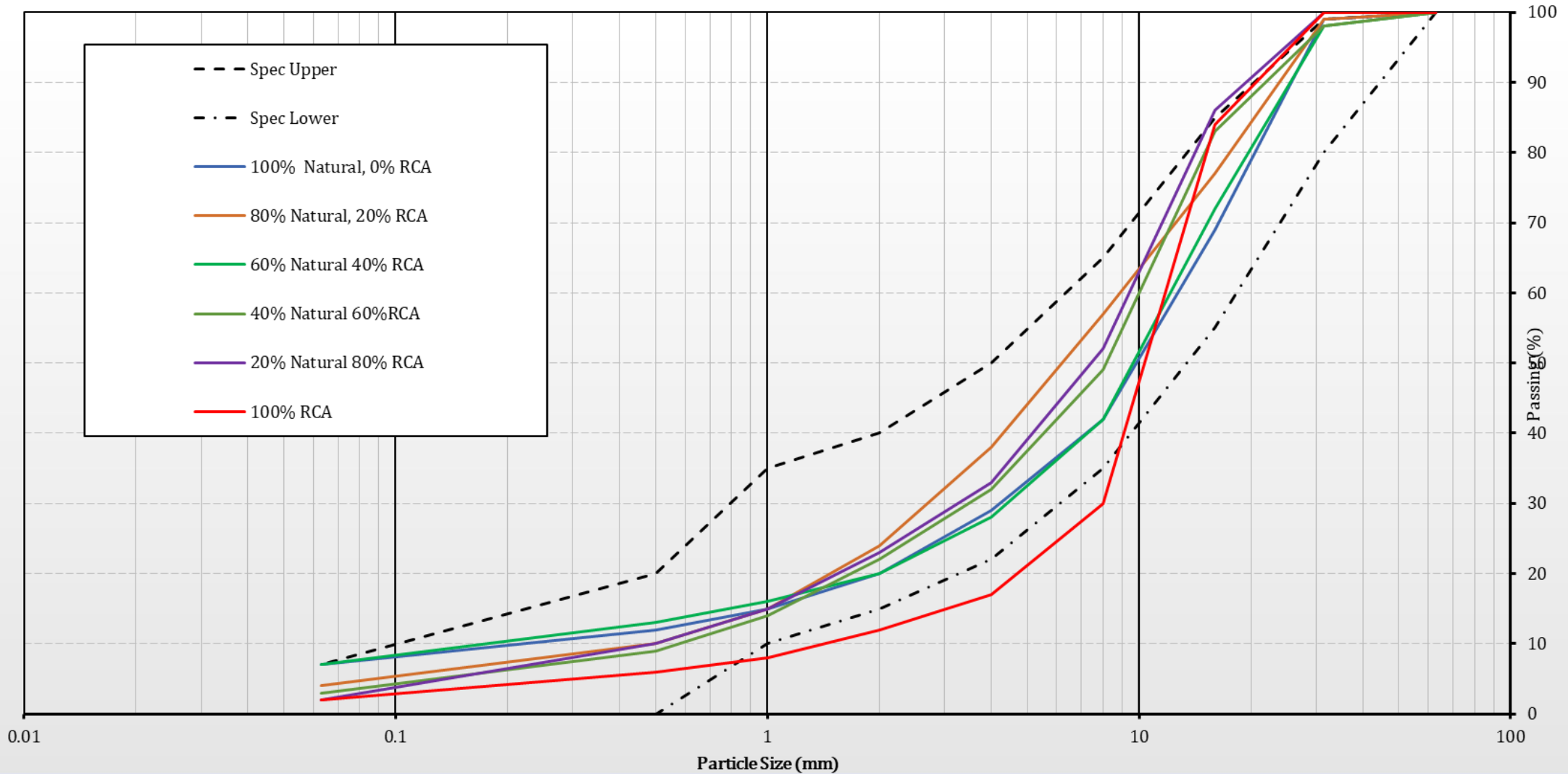


- Crushing and screening
- Jaw Crusher
- Screened over 32mm screen mesh
- Blending at required proportions with limestone CI804



Lab results

% Recycled	0%	20%	40%	60%	80%	100%	TII Spec
Test							
L.A.A.V	17	19	19	21	23	28	30
F.I	16	16	12	11	6	4	35
M.Blue	0.2	0.2	0.2	0.2	0.2	0.2	1*
W.A	0.2	1.4	2.6	3.3	4.8	6.3	2
M.S.S	2	3	4	5	5	6	24
O.M.C	2.7	4.3	6.3	7.8	9.8	8.1	Declared
L.L	17	24	24	28	38	46	20
P.I	Non/Plastic	Non/Plastic	Non/Plastic	Non/Plastic	Non/Plastic	Non/Plastic	Non/Plastic



Field Trial

- Pre-works FWD
- Field trial: 4 x 100m x 3.5m wide on
 - 300mm Crushed rock 6F2
 - 100m CI 804
 - 100m UGM A 20% recycled concrete
 - 100m UGM A 30% recycled concrete
 - 100m UGM A 40% recycled concrete
 - 150mm depth for all new layers

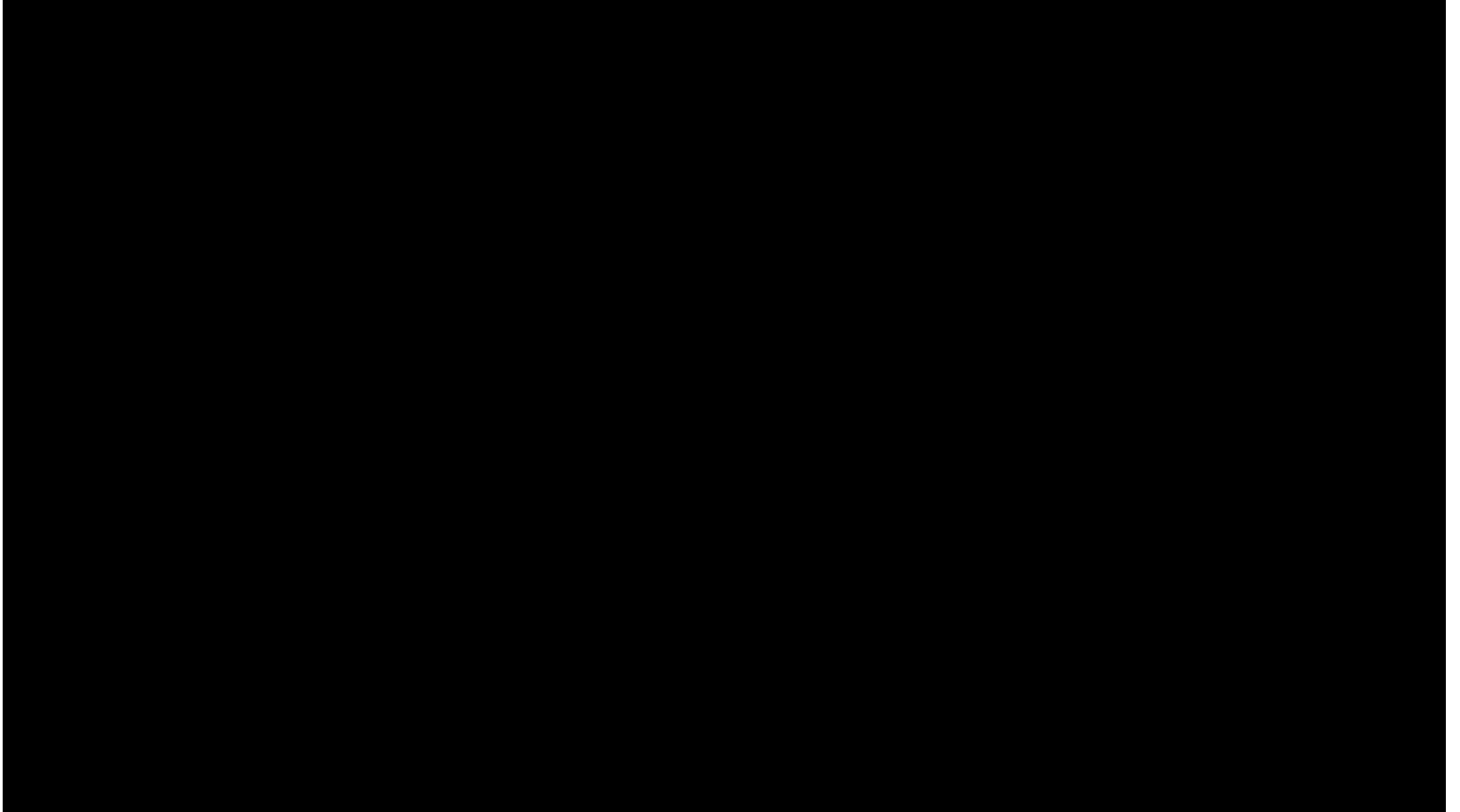


Field Trial

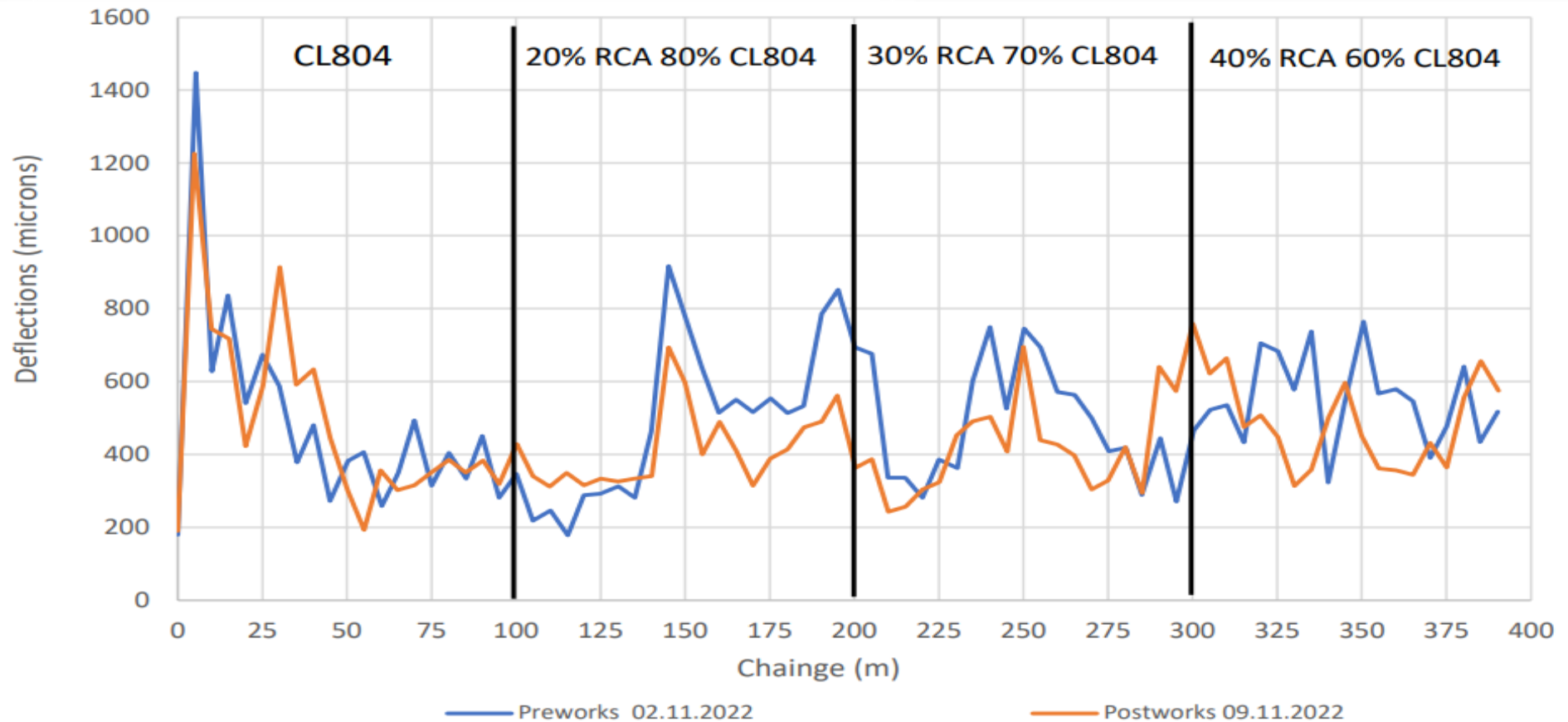
- Placed by Paver
- Compacted as per TII requirements
- In-situ samples for grading comparison
- Density testing
- Post-works FWD



Recycled Aggregate in a Granular Fill - Trial



FWD Plots



In-situ Density Testing

- Calibration of Gauge
- Test every 10m



Field trial conclusions

- Deflectometer and laboratory analysis proves natural aggregate Granular Fill containing RCA with different mechanical properties is,
 - Compliant with Specification Requirements
 - Gives equivalent performance to natural aggregates
 - Provides Carbon savings
 - Drilling and blasting
 - Primary crushing
 - Potential for a thinner layer?
 - Strength growth?



Conclusions

- Collaboration
 - Article 27 RAP
 - Departure and validation process
 - Encouraged by TII & EPA
- Circular economy
 - Preserve finite resource
 - Culture change
- Supply chain
 - Customer requirements for carbon reduction
 - Incoming regulations



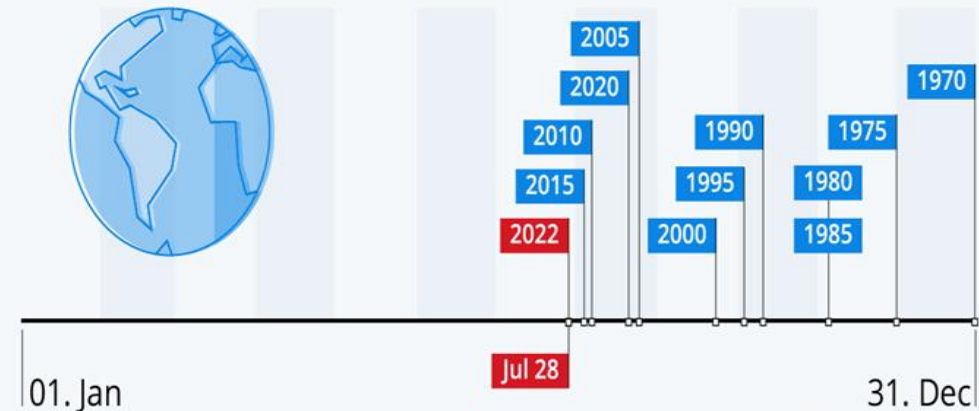
Earth overshoot day

“the date when humanity’s demand for ecological resources and services in a given year exceeds what the Earth can regenerate in that year”

- Earth Overshoot Day is?
 - 25th July
- Ireland Overshoot day?
 - 21st April
- How we live for the remainder of the year will be over exploiting the Earth.

Earth Overshoot Day Is Coming Sooner and Sooner

Historical dates of Earth Overshoot Day



Earth Overshoot Day marks the date when humanity's demand for ecological resources in a given year exceeds what Earth can regenerate in that year.

Source: Global Footprint Network

