# CASE STUDY — INNOVATION IN HIGHWAY MAINTENANCE

## Rubber-Modified Mastic Road Repair: 78% Lower Carbon per Square Metre of Routine Carriageway Repair and Ironwork Reinstatement

*Evidence submission — Local Highways Maintenance Transparency Report 2026/27 (Department for Transport)*

| | |
|---|---|
| **Authority** | Milton Keynes City Council (MKCC) |
| **Programme** | Rubber-modified mastic road repair — Roadmender Elastomac for routine defect repair and carriageway patching, and Black Gold Mastic for reinstatement around carriageway ironwork, delivered through the MKCC Infrastructure Term Services Contract (ITSC) |
| **Asset base** | 7.13 million m² of carriageway across all classes, from grid roads to unclassified estate roads, including block-paved surfaces |
| **The innovation** | Repair without excavation. A hot-applied mastic bound with recovered end-of-life tyre rubber replaces virgin bitumen and quarried aggregate; there is no percussive breaking out, no cut edge, no arisings and no second visit, and the repair is trafficable within minutes |
| **Indicative annual scale** | 2,800 carriageway defects and patches (26,500 m²) and 420 ironwork reinstatements; approximately 519 tonnes of material and 4,670 end-of-life tyres diverted from incineration or export |
| **Carbon position** | 78% lower carbon per m² of routine patching and 64% lower per ironwork reinstatement; approximately 291 tonnes $CO_2e$ avoided per annum on MKCC's conservative accounting boundary |
| **Wider outcomes** | Approximately 4,050 tonnes of arisings not generated and around 200 HGV tipper movements avoided; approximately 1,470 lane-hours of closure removed from the network; hand-arm vibration and respirable silica dust designed out of the routine repair task |
| **Transparency link** | Innovation and continuous improvement; whole-life cost and preventative asset management; decarbonisation and circular economy; safety of the workforce and the road user |

## 1. Background and strategic context

Routine defect repair and small-area patching is the highest-frequency intervention on the local highway network and, per square metre treated, one of the most carbon- and material-intensive. The conventional method has changed little in decades: saw-cut or break out a square around the defect, remove the arisings to a tip or recycling centre, and reinstate with hot-mix asphalt produced from virgin bitumen and quarried aggregate. Every one of those steps carries embodied carbon, a vehicle movement, a period of lane occupancy and a workforce exposure.

The Department for Transport's 2026/27 transparency reporting requirements ask local highway authorities to demonstrate that record levels of maintenance investment are delivering long-term outcomes for road users, and specifically to evidence the adoption of innovation and whole-life cost thinking rather than short-term reactive replacement. Reactive pothole repair is precisely where that expectation is hardest to meet, because the volume is high, the unit values are small and the repairs have historically been temporary.

MKCC has therefore taken its routine repair activity — the part of the service most often characterised as unavoidably reactive — and treated it as a decarbonisation and whole-life opportunity in its own right, rather than concentrating innovation solely on major resurfacing schemes. The vehicle for this is the Roadmender rubber-modified mastic system, deployed through the ITSC with Ringway Infrastructure Ltd under the NEC4 Term Service Contract.

## 2. The innovation

The programme combines two complementary applications of the same underlying material technology — a bituminous mastic in which the binder is derived from processed end-of-life tyre rubber rather than virgin fossil bitumen — applied to the two repair types that dominate routine carriageway activity:

- Elastomac for defect repair and carriageway patching — the material is heated and poured hot into and over the defect, where it flows into the void, bonds to the surrounding surface and forms a flexible, waterproof membrane across the treated area, dressed with high-PSV chippings to restore skid resistance. Because the repair is formed by overlay and penetration rather than by excavation and replacement, there is no cut edge, no box-out and no arisings. The material contains the equivalent of approximately nine end-of-life tyres per tonne and uses substantially less virgin material than an equivalent asphalt inlay.
- Black Gold Mastic for reinstatement around ironwork — the interface between a chamber or gully frame and the surrounding carriageway is the most common premature failure point on the network, because a rigid concrete haunch and a flexible pavement move differently under traffic and thermal cycling. The proprietary Black Gold mastic, made from approximately 65% recycled ingredients, reinstates the surround as a flexible, fully bonded, waterproof collar rather than a rigid ring, accommodating that differential movement instead of resisting it. The supplier reports a reduction of more than 50% in the carbon footprint of a manhole repair against conventional practice.
- Single-visit, immediately trafficable repair — both applications cure at approximately one minute per millimetre of depth and are open to traffic within around eight minutes of completion. There is no concrete cure period, no plating, no overnight closure and no return visit, which converts a two-visit operation into a one-visit operation and removes the associated mobilisation, traffic management and vehicle movements.

Delivering both applications through the ITSC allows them to be programmed into existing routine maintenance and inspection-driven repair cycles rather than run as a separate initiative. Multiple defects and ironwork units can be addressed in a single visit under a single traffic management set-up, which is where much of the cost and carbon efficiency is realised in practice.

The method also changes the safety profile of the task. Removing percussive breaking out eliminates the principal source of hand-arm vibration exposure in routine repair and the respirable crystalline silica dust generated by cutting and breaking bituminous and concrete surfaces. It also removes the cutting operation itself from close proximity to shallow buried apparatus, reducing utility strike risk around ironwork in particular.

## 3. Results: carbon, materials and network availability

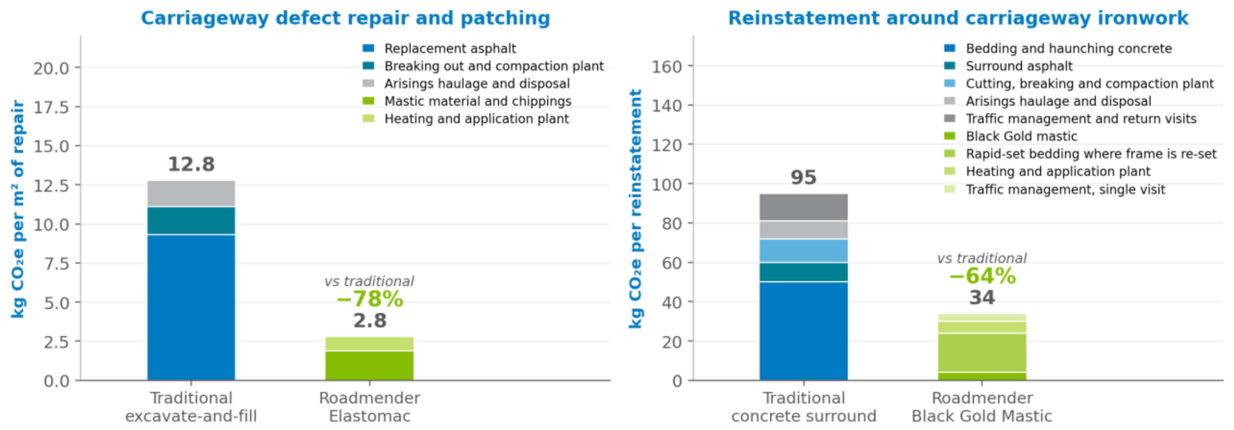
The comparison below is drawn per unit of work rather than per year, so that it holds regardless of the volume ultimately delivered. Both columns are built on the same accounting boundary: materials placed, arisings generated and disposed of, plant fuel, and site vehicle movements attributable to the repair.

| Measure | Traditional method | Roadmender mastic | Change |
|---|---|---|---|
| **Carbon — carriageway patching (kg $CO_2e/m^2$)** | 12.8 | 2.8 | −78% |
| **Carbon — ironwork reinstatement (kg $CO_2e$/unit)** | 95 | 34 | −64% |
| **Material placed (kg/m² of patch)** | 141 | 19 | −87% |
| **Of which virgin, non-recycled (kg/m²)** | 141 | 7 | −95% |
| **Arisings generated (kg/m² of patch)** | 141 | 0 | −100% |
| **Lane occupancy — ironwork (hours/unit)** | 5.0 | 1.5 | −70% |

| Measure | Traditional method | Roadmender mastic | Change |
|---|---|---|---|
| **Time to trafficking after completion** | 30–60 minutes (asphalt); up to 24 hours where concrete bedding is used | Approximately 8 minutes | — |
| **Site visits per ironwork reinstatement** | 1.5 average | 1.0 | −33% |

Applying those unit rates to an indicative full-year MKCC deployment gives the following annual position. Volumes are modelled from typical MK routine repair activity and are presented as indicative rather than as outturn; the basis is set out at section 7.

| Strand | Volume | Material (t) | Tyres diverted | Carbon avoided ($tCO_2e$) |
|---|---|---|---|---|
| **Carriageway patching — Elastomac** | 2,800 defects / 26,500 m² | 503 | 4,530 | 265 |
| **Ironwork reinstatement — Black Gold** | 420 units / 672 m² | 16 | 144 | 26 |
| **Total** | **—** | **519** | **4,674** | **291** |




*Modelled on MKCC's conservative boundary: material substitution, avoided arisings, plant and site vehicle movements only. No carbon credit is claimed for the end-of-life tyres diverted, and no allowance is made for avoided re-intervention. Basis, factors and sources are set out at section 7.*

*Figure 1 — carbon per unit of work by method and component. Both panels use the same boundary; the ironwork panel is per reinstatement, the patching panel per square metre treated.*

Beyond carbon, the material consequences are significant in their own right. At the indicative volumes above the method avoids the generation of approximately 4,050 tonnes of arisings — material that would otherwise be excavated, loaded, hauled and processed — which equates to roughly 200 twenty-tonne tipper movements removed from the network and from the council's waste stream. Approximately 4,670 end-of-life tyres are consumed as a raw material rather than exported or incinerated. On network availability, the shift to single-visit, immediately trafficable ironwork reinstatement removes approximately 1,470 lane-hours of closure — around 61 lane-days — from a network on which the grid road system leaves limited diversionary capacity.

## 4. Attribution: separating verifiable savings from supplier claims

Carbon claims for proprietary repair materials are frequently reported at headline level and on generous boundaries. To provide a defensible evidence position, MKCC has calculated its own figure on a deliberately narrow boundary and has recorded where that departs from the numbers reported elsewhere in the sector.

Buckinghamshire Council's published trial of the same material system reported a saving of 48 tonnes $CO_2e$ from 134 defects across 1,268 m² using approximately 24 tonnes of material — a rate of about

37.9 kg $CO_2$e per m². Applied to the MKCC patching volume of 26,500 m², that rate would produce a reported saving of approximately 1,000 tonnes $CO_2$e. MKCC reports 265 tonnes for the same volume, approximately 26% of that figure. The difference is deliberate and is accounted for as follows:

- No carbon credit is taken for the end-of-life tyres diverted. The 4,674 tyres are reported as a circular-economy output only, not converted into an avoided-emissions figure, to prevent double counting against the producer's own reporting and against national waste accounting.
- No allowance is made for avoided re-intervention. A sealed, waterproof, flexible repair should fail less often than a cut-edge asphalt patch, and avoided repeat visits are a real carbon saving — but MKCC holds no local performance evidence yet, so the benefit is excluded from the reported figure and will be quantified from the monitoring programme described at section 6.
- The boundary is restricted to the repair itself — materials placed, arisings, plant fuel and site vehicle movements. Upstream manufacturing of the mastic is included as a conservative production factor; no wider supply chain or end-of-life credits are taken on either side of the comparison.

The reported 291 tonnes $CO_2$e should therefore be read as a floor rather than a best estimate. It is the portion of the benefit that MKCC can evidence from its own delivery records and from published emission factors, and it is the figure MKCC will report and hold available for DfT evidence sampling.

## 5. How this evidences the transparency report requirements

- Innovation and continuous improvement — the council has applied a novel material technology to the highest-volume, lowest-profile part of the maintenance service, where innovation is hardest to introduce, rather than confining it to capital resurfacing. The method removes excavation from routine repair altogether, which is a change of process and not simply a change of product.
- Whole-life cost and preventative asset management — the repair is sealed and waterproof at the point of completion, addressing water ingress and the freeze-thaw cycle that drives repeat failure at patch edges and around ironwork. Reinstating ironwork with a flexible bonded collar rather than a rigid concrete ring treats the actual failure mechanism at that interface. Both shift routine repair from a repeating reactive cost toward a durable intervention.
- Decarbonisation and the circular economy — a 78% reduction in carbon per square metre of routine repair and a 64% reduction per ironwork reinstatement, achieved by substituting recovered end-of-life tyre rubber for virgin bitumen and by eliminating excavation, arisings and disposal. This supports MKCC's wider net zero commitments and reduces the council's demand on primary quarried materials.
- Safety of the workforce and the road user — percussive breaking out and surface cutting are designed out of the task, removing the dominant hand-arm vibration exposure and the respirable crystalline silica dust risk from routine repair, and reducing the risk of striking shallow buried apparatus. For the road user, single-visit, immediately trafficable repair removes lane closures and repeat disruption at the same location.
- Evidence quality and verifiability — figures are calculated on a stated, conservative boundary with every parameter and emission factor recorded at section 7, are traceable to ITSC delivery records at scheme level, and are deliberately reported below the rate published by comparable authorities for the same material. Assumptions are declared rather than embedded.

## 6. Next steps

Four actions will move this from an indicative position to a fully evidenced one. First, the 2026/27 outturn will be reported against actual ITSC delivery records — treated areas, material tonnages and unit rates — replacing the modelled volumes used here. Second, a 24-month monitoring programme will track the repeat-defect rate at treated locations against a matched sample of conventional patches, which is the evidence needed to bring avoided re-intervention into the whole-life and carbon case. Third, MKCC will seek verified product carbon data — an Environmental Product Declaration or PAS 2080 aligned figure — from the supplier to replace the conservative production factors used in this assessment. Fourth, the application will be extended where the evidence supports it: to crack and joint sealing, speed table and kerb channel repair, and, subject to trafficking and skid resistance assessment, to footway and Redway defects.

Two further opportunities sit alongside the programme. The carbon and network availability benefits of ironwork reinstatement apply equally to statutory undertakers' reinstatements under the Specification for the Reinstatement of Openings in Highways, and MKCC will raise the method with utilities operating in Milton Keynes through the street works coordination process. Separately, the council will consider whether a material carbon or circularity measure should be introduced into the ITSC performance regime, so that low-carbon repair methods are incentivised through the contract rather than adopted case by case.

## 7. Basis and provenance of the figures

Every figure in this case study is either a published third-party value, a standard emission factor, or an MKCC modelling assumption. They are separated below so that each can be challenged or replaced independently.

| Parameter | Value used | Source / basis |
|---|---|---|
| **Treated area per defect** | 9.5 m² | Derived from Roadmender published trial (1,268 m² across 134 defects) |
| **Mastic placed per m²** | 19 kg | Derived from the same trial (approximately 24 t across 1,268 m²) |
| **End-of-life tyres per tonne of material** | 9 | Derived from the same trial (216 tyres, approximately 24 t); supplier states approximately 7 per tonne |
| **Traditional patch construction depth** | 60 mm inlay | MKCC routine repair practice |
| **Compacted asphalt density** | 2.35 t/m³ | Standard value for dense bituminous macadam |
| **Asphalt production and supply factor** | 66 kg $CO_2$e/t | Typical published factor for hot-mix asphalt including bitumen |
| **Mastic production and supply factor** | 95 kg $CO_2$e/t | MKCC conservative assumption pending a verified EPD; includes heating fuel |
| **C30 concrete factor** | 140 kg $CO_2$e/t | Typical published factor for ready-mixed structural concrete |
| **Arisings haulage and disposal** | 12 kg $CO_2$e/t | MKCC assumption, local haulage distance plus processing |
| **Annual patching volume** | 2,800 defects / 26,500 m² | MKCC indicative modelling — approximately 40% of typical annual routine repair volume, being the proportion assessed as suitable for mastic repair |
| **Annual ironwork reinstatements** | 420 units at 1.6 m² average | MKCC indicative modelling |
| **Black Gold recycled content** | Approximately 65% | Supplier published figure |
| **Ironwork carbon reduction** | 64% | MKCC bottom-up calculation; supplier publishes 'more than 50%' |
| **Traditional ironwork lane occupancy** | 5.0 hours | MKCC assumption including concrete cure or plated return on approximately 50% of units |

Volumes shown as indicative are modelling assumptions and are not outturn figures. They are presented to demonstrate the scale of the opportunity on the Milton Keynes network and will be replaced by measured ITSC delivery data in the 2026/27 outturn report. Unit carbon rates are not volume-dependent and stand on the parameters above irrespective of the volume ultimately delivered.

On cost, indicative unit-rate comparison suggests a like-for-like saving on the repair rate in the region of 10–20% against conventional excavate-and-fill patching, before any allowance for avoided re-intervention, avoided disposal charges or avoided repeat traffic management. Actual rates are held in the ITSC price list and the outturn cost position will be reported alongside the delivery data rather than estimated here.

*Prepared by MKCC Highways Service — September 2026. Material and process information: Roadmender Asphalt (Billian UK Limited) published product and installation documentation. Comparator trial data: Buckinghamshire Council published trial of the Roadmender mastic system. Delivery: Ringway Infrastructure Ltd under the MKCC Infrastructure Term Services Contract. Supporting calculations and delivery records are held by the Highways Service and available to DfT on request.*