

Proactive Management Review

Contract Year 13
April 2021 to March 2022





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Executive summary

Our supplementary PMR brochure highlights the case studies that we are submitting to the PMR panel for this qualifying year (CY13 April 2021 – March 2022).

As it has in the previous years, the brochure also includes a progress update on two case study submissions from CY12 – our sustainability roadmap and social value. It also includes a snapshot of some of the work and innovations that we're currently undertaking, and may consider for submission in the future.

Together with National Highways, our framework contractors and our supply chain we have achieved so much this year - from trialling ground-breaking new road surface techniques and advancing cutting-edge digital solutions, to conducting site safety tours with augmented reality digital glasses, the innovation we are applying across our network is industry leading.

This has been recognised externally by our industry peers where, over the course of the year, we were shortlisted for eight awards and went on to win four across areas such as innovation, safety, and sustainability.

Over the year we have successfully delivered a wide range of projects and work activities, including some large and challenging improvement schemes; the delivery of the junction 23 improvement scheme, the single biggest gyratory on the whole motorway network, was a great accomplishment.

Our safety stand downs last year were a fantastic success and helped to re-energise our focus on safety, following a rise in the 'all accident frequency rate' in the first half of the year.

The following case studies will showcase some of these activities, and more, high-lighting the outstanding work our teams have produced over the past year.

Project updates

In this section of the brochure, we've looked at two of the case studies submitted in CY12, and have provided an update on the progress that is being made in each area.

- 1 Sustainability roadmap
- 2 Social value

Sustainability roadmap

Within our sustainability roadmap, which is part of our sustainability strategy, ten priorities have been identified as key to our operations:

- **1** Energy
- 2 Water
- **3** Transport
- 4 Materials
- **5** Health
- 6 Pollution
- **7** Climate
- 8 Biodiversity
- **9** Diversity
- 10 Community

These priorities form the roadmap with actions outlining how they will be delivered. Progress is reviewed and the status updated on a quarterly basis to ensure their delivery. The sustainability roadmap is key to ensuring all parties with actions are working to the same plan, and ensuring environmental and social responsibility, whilst maintaining a healthy business.

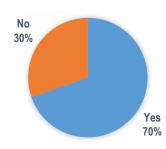
Following on from the work detailed in last year's PMR, below is an update on the following initiatives.

The green travel plan

Last year we submitted the first iteration of our green travel plan with work continuing this year. To onward develop the initial assessment, we released a green travel survey to all staff with 190 people completing it. It revealed that out of the 190, three travel by bicycle; two by bus and train; and 135 by car.

The results also showed that eight staff members are living at a different address for work in order to reduce their commute.

This pie chart shows the percentage of staff who would consider an electric vehicle (EV) if there were EV charging points at the depots.



In addition to information regarding staff commuting, we were also able to compare the pre-pandemic distance and time for staff who completed the survey, see below.

Driving Distance Totals	Miles	Kilometre	Time/Minutes	Time/Hours
1 Journey	4,219.84	6,791.19	7,079.71	118.00
1 day (2 journeys)	8,439.68	13,582.38	14,159.43	235.99
3 days	25,319.05	40,747.14	42,478.28	707.97
5 days	42,198.41	67,911.89	70,797.13	1,179.95

It reveals that the new hybrid working for office staff – three days per week in the office instead of five – saves 472 hours, or 16,879 miles every week, and this is only for the 190 staff who responded to the survey.

Not only is this valuable time saved for employees but it also saves 4,519.45kg CO2e.

The green travel plan also takes into account the business travel for our staff, which is calculated through staff expenses claimed.

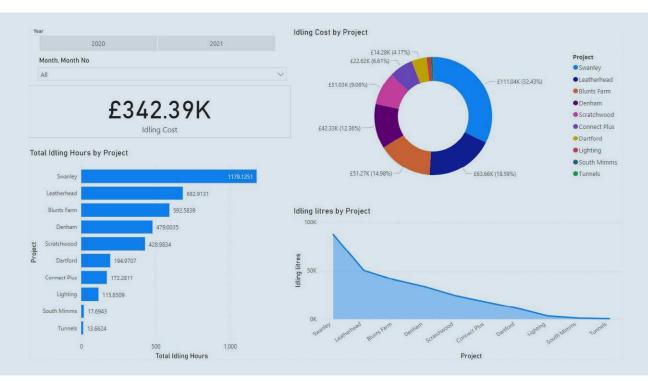
The chart below shows business mileage claims submitted by staff from April 2019 to December 2021, with the three orange bars showing dates when the UK was in full lockdown due to the pandemic. The business mileage during this time is significantly higher than recent periods. This is most likely due to vehicles not being shared; not using public transport and more work being undertaken during lockdown periods because of lower traffic levels.

Comparing April to December 2019, to April to December 2021, the kilometres claimed has dramatically reduced. We will continue monitor these claims into 2022 to analyse the downward trend.



Fuel reduction

Another transport priority and M25 goal is to 'reduce vehicle idling within CPS'. Since recruiting our sustainability data analyst, we have been able to analyse our data in more detail. As part of this we have created an idling dashboard which tracks and informs us which depots/vehicles and staff are idling the most and the costs this incurs.



In addition, we have also trialled electric hand tools, such as blowers, on the network. As well as the health and safety benefits of using these such as no vibrations or potential leakages, the main benefit for the sustainability team is the reduction in fuel usage. Even though the reduction is small, it all adds up. The hand tools will be rolled out during 2022.

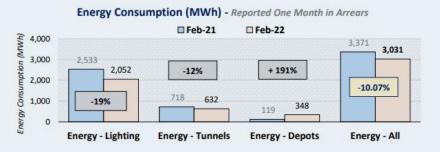


Reduction of energy

The M25 energy priority has two goals: 'reduce depot energy consumption' and 'reduce network energy consumption', and there have been several updates throughout 2021/22.

We have installed new LED lighting in Leatherhead which uses daylight harvesting to reduce lighting levels when there is bright sunlight from the windows. There are also several projects to remove, reduce and replace the lighting across the network and we have so far reduced the network energy by 6,220,388kWh.

The reduction in network energy is reported to National Highways at the monthly OPM, an example of which is shown below.



Network energy consumption comparing February in 2021 and 2022

PDA supply chain

To enhance our collaboration and communication with the PDA contractors, we have launched a PDA sustainability forum aimed at our smaller contractors, and in January this year, we held the first forum focussed on social value.

Our carbon emissions are reported quarterly to National Highways and this now includes PDA contractors. To encourage good quality data submissions and to understand their social value we now also score the contractors on the Balfour Beatty Jaggaer System. This enables us to track their performance and ensures we recognise the work they're doing.

Sustainability updates

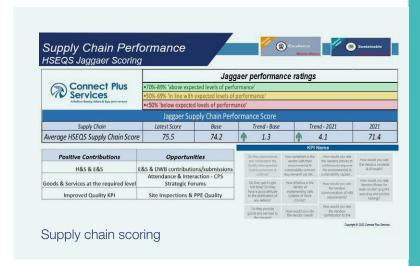
Since recruiting our sustainability analyst our database has grown significantly. We have developed a sustainability dashboard which holds our monthly reporting data allowing us to start granularly analysing the data and identifying where savings can be made. As well as the dashboard we are further developing our sustainability tool which will report what innovations and sustainable developments are being used within the M25.

For the UN sustainability goal 'Life below Water' and the M25 water priority we now have actions for continually monitoring depot water consumption to identify opportunities and water consumption savings. We can also analyse our data more granularly and identify trends and changes.

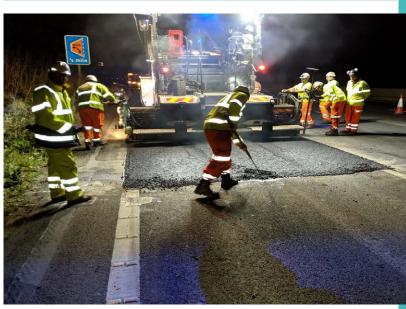
One such example is the identification of a leak in Leatherhead, which has now been rectified.

We are always seeking to identify other sustainable innovations and savings that can be implemented on the network. For example, in 2021, as a standard, we used 20% reclaimed asphalt pavement (RAP) when resurfacing on the network. The pavement asset team are currently developing a plan to use 30% RAP as standard.

We have also started a trial to use 50% RAP with tests ongoing. The image on the right shows 50% RAP being laid.







Social value

Over the past year we have continued to measure the social value of our project to effectively demonstrate our contribution to society, and establish a structured process for target setting, measurement and reporting on social, economic and environmental impact.

Our activity over the past year has included:

- Collection of data up to the end of the year, to ensure we have a full understanding of our baseline.
- A full review of our social value strategy to ensure it was up to date and providing meaningful targets. The themes, objectives and measures (TOMS) were updated in line with the new national TOMs. By widening our scope, we are better able to calculate the full spectrum of work that we are undertaking.
- Setting up quarterly internal social value forums to drive social value across the business. Each discipline shared the measures they will prioritise for 2022 and how this will be done.
- A designated social value staff member attending team meetings to increase awareness of social value topics and encourage volunteering. All staff members are entitled to two paid volunteering days each year.
- Embedding social value into the supply chain and engendering joint working. To do this we have held sustainability forums dedicated to social value for both the framework and predefined assets (PDA) sustainability forums. Contributing to social value is a requirement for the PDA Jaggaer supply chain scoring system. To track compliance by the PDA supply chain, a system has been developed on Aconex to record and calculate the value of their social value activities.



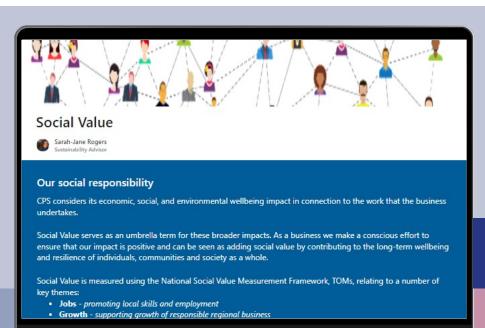
- Creating a social value page on Compass, the company intranet. The page highlights the key areas we are working on and advertises volunteering events that staff are able to get involved with, such as the Great British Spring Clean.
- Producing a clear volunteer form and procedure, to promote the use of staff volunteer days and to allow us to accurately capture activities. The form captures the name of those participating, the date of the activity, the number of hours spent volunteering, the location and a brief outline of the work undertaken with photographs. This data is used in the annual social value report.
- Company-wide fundraising events and the promotion of core charity work. For example, fundraising for the British Red Cross in relation to the Ukraine crisis. This work is communicated to the SLT to ensure match funding, which also contributes to social value figures.
- We've also been working with one of our parent companies, Balfour Beatty, to promote the seamless move from the social value portal to the Balfour Beatty sustainability portal.

An internal review of the work we do with schools, universities and apprentices, in a bid to promote increased engagement and provide useful and interesting sessions for those attending.

As a result of all these activities, there has been a notable increase in engagement with social value across the business. We are currently in the process of calculating the final figures but have already recorded a rise in volunteering days and the number of apprentices.

The social and local economic value delivered in the last year has been both significant and varied, with an extensive amount added in addition to the core project delivery. This achievement is worthy of recognition and celebration by all stakeholders, with a notable increase in communication within teams relating to social value. It is expected that there will be approximately £15million of added financial value associated from 2021 social value data – with 16% added value from the project.

This continues to grow annually, and we expect a target of 18% to be added for social value in 2022.



The social value page on Compass, the company intranet.

Case studies

The following case studies highlight some of the many innovations, industry best practices and new products that we are implementing and trialling across the network.

From dealing with the challenges we have faced over the past year, to pushing the boundaries in protecting the health of our workforce, these case studies provide an example of the range of work we're undertaking.



NEXT STEPS IN OUR DIGITAL STRATEGY

Technology is an increasingly important part of how we run and maintain the M25. The M25 team have developed a digital strategy that sets out how we use technology to improve how our works are delivered, how we respond to incidents and issues, run our back-office processes, and ultimately deliver improved performance for the road user.

Our digital vision identifies how we will work in 2025 and the steps that are required to reach that vision. Many digital initiatives have already been delivered and produced tangible improvements, such as the Unity app platform which is used to capture defects, scout jobs and run briefings for the teams. This, together with many other initiatives, is delivering improved efficiency, improved accuracy of data and, most importantly, improved safety. There are many more exciting improvements to come and the technology to deliver these is improving all the time.

■ The need

The use of technology to meet the mobility needs of the travelling public is continually evolving. To deliver the principals of our contract, secure efficiency savings and embrace digital opportunities, Connect Plus and Connect Plus Services, together with National Highways and our framework partners, evaluated five different operating model options.

The preferred and agreed option, was to establish a central community digital function that will set strategic direction, address key capability gaps and provide better visibility, alignment and governance for our digital activities, while working closely with our business functions.

Deliverables and benefits

As part of our ongoing strategy, below are some examples of projects we've started to implement across the business.



Safe to dig

Due to the number and scale of works on the M25 today, a significant number of permits are requested, the most critical of these being the 'Permit to Dig'.

These permits are vitally important as they are a requirement that allows contractors to work on the network, they are a critical safety step in the process to mitigate against utility strikes. On the M25, we currently receive approximately 35 requests per day.

A digital solution is currently in development that will significantly improve the process, digitising the request workflow and geolocating the permits on an easy to interrogate web interface. This is based on a similar solution that was utilised on the recent A14 works, operated by a Balfour Beatty Vinci joint venture. On that scheme, the utilisation of the digital solution reduced service strikes by 70%.



Dash cams in inspection vehicles

Historically safety inspections were conducted by two individuals. During the pandemic this wasn't possible, therefore the need arose to explore alternative single-driver options. We developed a solution where a driver was able to conduct safety tours with a simple dash cam, however the process of capturing and uploading the data for review was time consuming and inefficient.

After further investigation, we have now rolled out a four-camera dash cam solution to the safety inspection vehicle. This solution allows for the footage to be remotely accessed by anyone, providing a reduction in visits to the defect, saving on time, fuel and costs. The inspections can also be done at a speed closer to motorway speeds, therefore avoiding the need to be a slower moving vehicle on a live motorway, or to have to stop and capture details of defects – all of which mean an improvement in safety for the inspectors. Defects can also be shared with the depot and addressed more quickly, it is also much clearer to identify exactly what the defect is.



UtilityAR Remote Advisor Group Call Call finds Call

Digital glasses on the M25 - augmented reality

In August 2021, we began to trial the use of augmented reality glasses on the M25 network. The glasses work two ways by either allowing the user to receive instructions from a person who is remote from the site, or as a means of relaying information to another location, and/or person entirely.

The first scenario to undergo testing was with the tunnel maintenance team. The glasses were used by an expert engineer who remotely connected to an operative in location at the asset. Using augmented reality, the engineer was able to provide instructions on how to service the asset in location.

We are now in the process of undertaking a second trial with the incident support crews. It is often the case that when crews are called to an incident, damage has been caused to assets that would normally require specialist input from an engineer. This process can be lengthy, with crews having to wait for an engineer to arrive at the scene and pass the repair safe so that the road can be reopened.

By using the glasses, the crew are able to share sight of the repair remotely, enabling the engineer to pass the repair safe within a significantly shorter timeframe, allowing the road to reopen causing less disruption to the travelling public.

We have also used the glasses on safety tours. This means we no longer need to bring large groups of people onto site, as they can still get the benefit of seeing the site remotely.

As the successful trial comes to a close, there is a longer-term plan to role this technology out more widely and explore further areas that will benefit from this solution.



Sensat update

We are continuing to see strong benefits from conducting drone surveys of the M25 network, that can be easily viewed through a web browser and examined and used to collaborate with teams whatever their location or organisation.

Our initial drone scan covered the main ring of the M25. As part of our ongoing collaboration with Sensat, we will be undertaking a drone scan of the full 440km throughout 2022. Going forward this will be regularly refreshed to provide a comparison of the assets over time.

We're already seeing strong benefits from our work with Sensat to date, such as allowing teams to understand the network terrain and vegetation before going out to undertake works. This saves considerable time, as teams arrive at the location ready to complete their works and are clear on any potential issues or hazards. The teams across the M25 community are also able to save time on planning closures, designing traffic management and measuring assets. The Sensat platform can be used to collaborate on design for traffic management and ultimately agree this in advance, against a real-world visualisation, before arriving at the location.



The unity app

The unity app has replaced fieldGo as our new briefing app. With similar technology to fieldGo, our teams will use this new app to undertake inspections and briefings, as well as to report defects around our network.

The upgraded app includes new features, such as improved photo functionality and easier data entry, that will ensure we are continuously evolving on our digital journey.

One of the most important aspects of the new features is the crew messaging facility, developed in response to feedback received from our workforce. It will be a huge improvement in the way we are able to communicate with our operational teams.

We have presented the M25 digital strategy, together with updates on the project to the National Highways Digital Services Directorate, which includes the CIO.

We are engaging National Highways teams on a number of the initiatives and have received great feedback from senior team members, specifically regarding the digital glasses and their use on blended safety tours.

The National Highways team are aware of our digital projects and the wider digital strategy. Our work with Sensat was also the only project to be highly commended at this years National Highways Industry awards.

2 OMNICOM

As part of a longer-term plan to use technology to improve the efficiency of inspections on the network, the team on the M25 have explored solutions for using cameras to capture defect information on bridge joints.

The team identified a camera and computer vision solution that is being used in the railway industry today, which has then been modified for use in Highways and attached to an M25 maintenance vehicle.

The system will collect visual condition data via high specification cameras and review these with computer vision algorithms to return a set of classified defects.



■ The need

There are significant numbers of bridge joints around the network, which deteriorate over time and, in extreme cases, can fail leading to traffic incidents. It is critical that deterioration is closely monitored, and action taken at the appropriate time. Currently it is extremely difficult to get close to the bridge joints whilst the motorway is open, therefore inspections are dependent upon closures at specific intervals.

Deliverables

Working with Balfour Beatty Fleet, a framework to mount the cameras has been developed and, together with the solution, has now been installed onto one of the M25 maintenance vehicles.

Following this successful installation, we have started a pilot on the network to review a carefully selected set of bridge joints which will then be used to identify and categorise defects. The identification and categorisation will initially be undertaken by engineers, with the aim to ultimately teach the computer vision algorithms what it is they should be looking out for in future.

Benefits

Using a solution that allows for bridge joints to be inspected from a vehicle that is travelling at motorway speeds demonstrates significant safety benefits. Currently we must undertake inspections at night in lane closures or, where we have a concern about a bridge joint, we have to go to the roadside of a live motorway to photograph the joint, putting inspectors in harm's way. In addition, there is enormous benefit to the road user not only in preventing road closures to undertake the safety inspection, but in the event of a failure, further road closures would be required leading to significant disruption for the travelling public.

The Omnicom solution has already started to provide us with detailed images of bridge joints that would not have been possible without a road closure. These images are also being collected on a more regular basis and are beginning to provide us with a more comprehensive view of the degradation of defects on, and around, bridge joints. Once the pilot has been completed, we will be able to provide comprehensive data regarding the benefits of using this solution, versus manual inspections.

We believe that this is the first time that high specification cameras have been used with computer vision algorithms to monitor deterioration of bridge joints, on the SRN.

Once the initial pilot has been completed and the data collated, we will share our findings with National Highways and, where relevant, other Areas across the SRN.

The image below shows the information received to the computer in the asset team, from the cameras.



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MANAGING INNOVATION ON THE M25 & TRIALLING NEW MATERIALS

Innovation is one of our core pillars, and fundamental to the successful delivery, maintenance and operation of our contract with National Highways. It is therefore one of our key areas of focus.

How we manage innovation on the M25 is critical, that is why we work collaboratively with National Highways, CPS, our framework contractors and their supply chain to ensure it is embraced and embedded within our culture, giving rise to improvements in our delivery and productivity.

We manage innovation through our innovation process, ensuring any ideas that are put forward follow a consistent approach.

■ Innovation is a fundamental principal of our contract. We are continually exploring new and innovative ways to deliver safer, more reliable journeys for our customers while at the same time limiting disruption and providing a safer environment for our workforce.

To this end there is a continual drive to investigate developments in asset management techniques and technologies, looking at already available or emerging technologies both in the UK and from across the world. Additional benefits will include the effective management of the project lifecycle and reduction of the whole life carbon and cost impacts.

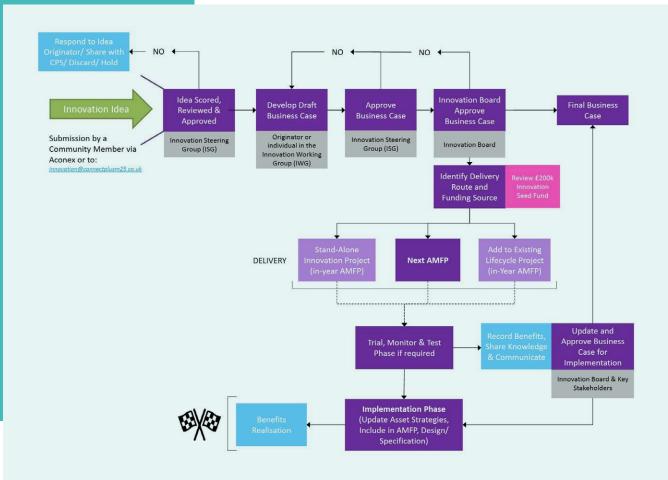
In this case study, we're focusing specifically on new materials and treatment techniques. Concrete surfacing is an ageing asset which accounts for 10% of our network and presents significant challenges, relating to noise mitigation and its life extension. The same challenges are being investigated by National Highways on the wider Strategic Road Network, who are monitoring our advanced progress, to inform their strategies for a potential wider rollout.

The need to mitigate the noise of concrete surfacing is a particular issue, noting the maintenance liabilities linked to concrete joint performance and original construction methodologies used i.e., joints in wheel tack zones etc. A thin surface course system overlay does mitigate the noise generated, but it also presents its own challenges with significant on-going maintenance liabilities.

This is why it is critical to have a strong and robust innovation process in place, to explore the use of alternative treatments and more durable, higher performing materials that are less prone to sudden failures and defect realisation.

The innovation process – setting the context

We manage innovation through a standardised and systemised approach, this is our innovation process. It ensures any ideas that are put forward follow the same consistent approach across the whole community.



We openly encourage and support innovation with our framework contractors and our wider supply chain partners. Our Innovation Steering Group continues to drive our innovation strategy across the project, working towards a vision of creating and maintaining a sustainable and supportive innovative community culture, by putting in place a strong and effective innovation programme.

Our aim is to make innovation a part of everything we do, from the products we use to the systems and processes we employ across the organisation. It is by being open to new ideas and solutions, and innovative longer-lasting materials that we will deliver value to our customers, our community, National Highways and the wider industry.

There are three main groups involved in managing innovation on the M25:

The innovation board includes members of the Connect Plus and CPS leadership teams. The board approves funding for all innovation business cases as well as identifying the delivery route and funding source for the projects.

We are committed to investing in innovation and have increased the available funds from $\mathfrak{L}200k$ to $\mathfrak{L}1m$ a year, with funds drawn down from the capital DBFO budget. Each year, a $\mathfrak{L}200k$ innovation seed fund is made available for in-year innovations.

The innovation steering group's purpose is to steer, champion and promote innovation, value, efficiencies and continuous improvement on the M25.

It is also the responsibility of the steering group to approve all business cases before they are presented to the innovation board.

The innovation working group was established in July 2019. The group is made up of a selection of individuals from across the M25 community. The objectives of the group include reviewing the current 30-year model, developing potential cost reductions for projects in the AMFP, and developing key innovation business cases.

Under the guidance of the steering group, the working group develops the innovation imperative and other innovations to help bridge the funding gap.

This year has seen us implement many new initiatives, trialling new materials on and off the network.

The trial of CL.941 (durable enhanced asphalt)

This product is an enhancement of the National Highways draft specification for CL.941 for use on the M25. The product is based on the approach of high binder content and lower voids and has shown clear benefits in terms of durability and surety of performance.

Material designs have been carried out by the two main contractors – Tarmac and FM Conway – and both have begun to lay materials on the network, with Conway laying both gritted and ungritted options in October last year, and Tarmac laying ungritted material in March.

Early life data has been promising and we're confident that it will lead to the interim use of Conway's material in the 2022/23 programme at selected sites. The real benefits from this material however are longer term, with fewer required interventions. The expected service life is 16-20 years compared with 9-12 years currently being achieved using Cl.942.

The next generation concrete surface (NGCS)

NGCS was developed in the United States under an extensive three-year research programme for new and existing concrete, and is a refinement of longitudinal diamond grinding. Research has identified that refinement to the blades significantly improves the noise performance, texture and durability of the surface.

The NGCS was installed in October last year, as part of the trials on the M1. Early life monitoring has been undertaken, primarily for noise and skid resistance (SPB, CPX, GT, SCRIM, PFT etc), with a report currently being drafted on the construction and early life performance. Data will be assessed and compared with that of other treatments that are applied directly to exposed concrete.

It is too soon to draw final conclusions, but we are confident that it will be part of a multi-layered strategy for managing concrete surfaces on the M25.

This is the first use of NGCS in the UK.

It is by
being open
to new ideas
and solutions,
and innovative
longer-lasting
materials that
we will deliver
value to our
customers, our
community,
National
Highways
and the
wider industry.

Anti-aging binder

Embrittlement through oxidation of bitumen can lead to a deteriorating performance and failure of asphalt layers. We are exploring a bitumen product that could potentially extend the life of surface course materials.

Once bitumen has hardened to the point of failure, it causes the surface course material to crack, ravel and fret. With the anti-aging binder, the bitumen oxidises at a reduced rate over time, taking longer for the bitumen to harden, therefore, extending the performance and durability of the surface course while protecting the binder course materials below.

We are currently receiving bitumen testing data from Shell (AgeSafe product), which is showing that the anti-aging binder has the potential to maintain initial properties through two pressure ageing vessel (PAV) cycles, compared to bitumen without the additive. We will also soon start to use AgeSafe additive in 942 material in the outer lanes in our programme of works for 2022/23, As detailed in the AMFP.

It is envisaged that long-life bitumen will extend the life of the pavement by between four and ten years, depending on the lane. Over the life of the contract this could lead to a significant saving in maintenance costs and interventions.

There are other trials taking place around the UK that incorporate this kind of approach and it will be important to track these alongside the trials on the M25.

Self-healing asphalt

Self-healing asphalt is an asphalt that has the ability to regenerate, it is therefore able to heal itself, in order to prolong life. The work we're undertaking is a collaboration with Nottingham university with trials due to commence later this year.

It works through the use of capsules that able to release oils into the asphalt mixture as microcracks develop. It is widely believed that this may be beneficial in slowing down the rate of deterioration, leading to extended life of asphalt layers, compared to a material without capsules.

Proof of concept will be required to commercialise the manufacture of the capsules for widespread use. The refinement of our innovation process is to the benefit of the contract as successful new innovations are eventually adopted by National Highways.

SES, the contract and performance team of National Highways have been consulted and informed on a monthly basis on the status and progress of each innovation initiative.



ROAD SPACE - THE FUTURE DIRECTION

It is essential that we continue the work we've already undertaken, to double the accuracy of road works information published 7-days in advance.

As part of the next step in the process, we are taking a data-led approach, and using innovative technology to deliver the next level of performance towards the 2025 target of 90% accuracy.

■ The need

National Highways' Strategic Business Plan sets out a target to achieve 90% accuracy for road works information published 7 days ahead of the works. This supports customer service by providing the travelling public with higher quality information on road closures. During 2021, within Area 5, performance improved from approximately 30% on this measure, to an average of 57%. We will need to adopt a strong and robust plan in order to drive further improvement towards the 2025 target.

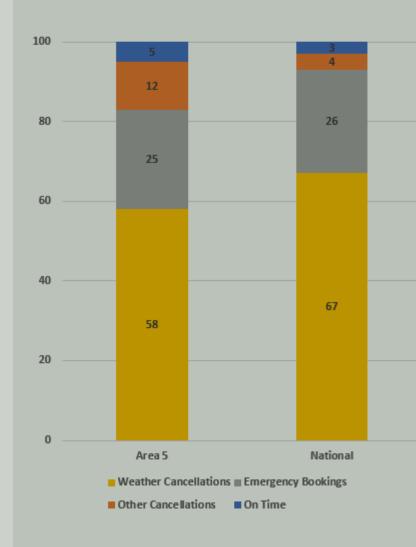
Deliverables

Our approach to making improvements and reaching the 7-day accuracy target has been led by data. y analysing the root causes of failure, we have identified specific actions that will drive our future performance improvements.

To gage our standing and compare our progress to other Areas, we have developed a graph that shows a comparison of the performance in Area 5, compared to the national performance.

The example below covers the period April 2021 to March 2022.

April 2021 to March 2022 Roadspace Accuracy % Area 5 vs National



There are some relevant and key points to bear in mind when making comparisons between Area 5 data and a national perspective.

- Emergency bookings represented a higher proportion of bookings in Area 5, compared to the national average figure.
- There were more 'reasons' for cancellations (other than weather) in Area 5 than the national average figure.

 These included resource issues, booking errors, contingency on bookings and 'not used', where the booking was just not actioned or used after being applied for.
 - Drilling into the "other cancellations" data, and understanding exactly what these issues are, will provide insight so that we can start the process for improvements.
- Area 5 had 17% of all road space bookings nationally in 2021, on just 6% of the strategic road network.

One of the opportunities available to us that we believe will improve performance in Area 5, is to reduce emergency booking numbers, as analysis of the data tells us that there are bookings in this category that are not true emergencies. We have already seen an improvement since we started to follow a stricter timescale waiver approval process. This is a request for any planned works which need to take place under the 30 days' notice.

In addition, we have also started to address the reasons behind the "other cancellations" category, this will also have a positive impact. The table below details cancellation reasons.



Based on this data, we identified specific areas where we believe improvements could be made:

- Contingency is responsible for 5.1% of failures in 2021.
 We will build on the good practice from other National Highways' Areas and only book contingency when required, as opposed to the current practice where contingency is booked for most works and cancelled if not required.
- Reducing the "not used" failures, responsible for 3.8% of failures in 2021.

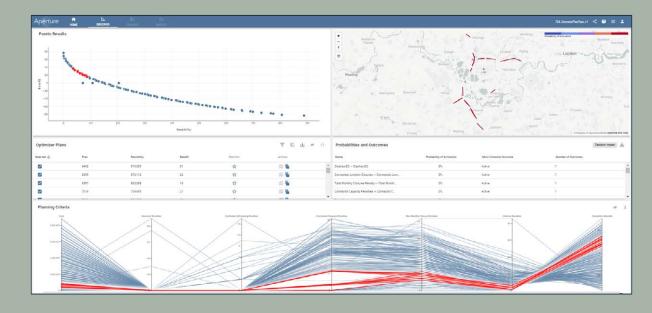
 We aim to do this through better utilisation of cone time information from cone time apps.
- Booking errors, responsible for 2.8% of failures in 2021.
 We will be introducing a road space booking 'licence'. Anyone wishing to book roadspace must be in possession of a licence, renewable annually by completing an e-learning programme.
- Unplanned bookings, responsible for 12% of failures in 2021.
 We aim to root out the planned work being booked as unplanned.
- Cancelled unplanned bookings, responsible for 3% of failures in 2021. We will enforce a more rigorous 'timescale waiver' process.

A significant piece of work we are undertaking that will help us to meet our 7-day accuracy target, is Optimatics.

Optimatics is a programme optimisation tool that will enable us to plan our delivery programme more efficiently in the future, and in consideration of road space constraints. In addition, applying optimisation to our programme planning approach, will:

- Bring cost savings from reduced traffic management by sharing roadspace more frequently. We estimate a reduction of approximately £10m per year.
- Reduce the cost impact of weather-related cancellations
- Reduce waste in the road space booking process due to rework as a result of clashes. We estimate a reduction of 24,000 annual road space bookings by 30%.
- Bring an improved understanding of diversion route utilisation and improved work planning for our supply chain. This will improve our stakeholder relationships with fewer refused diversion requests and improved resource planning.

Below is a screen shot of the Optimatics system. Although the data used in the example is not correct, in essence, it is showing us the checks that the system undertakes to get the best option for booking work, including 'rules' that are set by us.



We are still very much at the beginning of our Optimatics journey but the potential improvements for this are huge. We have already run the programme as a test, using data from last year and matched it against the AMFP to assess the optimisation benefits.

Our next steps will be to develop a new programme planning process to embed use of the optimiser on current/future programme data, and to demonstrate the savings that we can build into forward investment plans.

2021 has demonstrated that by focusing on performance data and process improvement, we can improve road space booking accuracy. 7-day accuracy improved last year from 30% to 57% - with performance in January 2022 reaching an all-time high of 64%. With the improvements we have already identified,

our target for 2022 is to achieve a 10% performance increase over last year, that will bring us close to 70%.

Considering that Area 5 has a disproportionately high density of road closures compared to the rest of the country, this is a particularly challenging target, but one that we are confident we can meet.

We are sharing our development of Optimatics with National Highways. We also actively take part in network occupancy groups nationally to share our improvements and to learn from others.



LONG-TERM DETERIORATION MODELLING

This case study is centred around our in-house modelling and investment planning capability, together with the key processes, tools and people involved, and what it is we're aiming to achieve through the use, improvement and implementation of our decision support tools (DST).

The whole modelling piece aligns with key asset management obligations and overarching commitments. The time and effort we put into this is a showcase of our priorities:

- Data Driven and intelligent decision making
- Prioritisation and whole life costing
- Short, medium and long-term planning and lifecycle optimisation

■ The Need

DSTs sit at the heart of what we do and support our long-term planning. They enable us to hold data centrally, test "what-if" scenarios and the long-term viability of our asset management strategies against hand back requirements. They are therefore the cornerstone of our asset management service, and key to this is continuous improvement.

Our new structure under the asset management office is designed to address this. Our commitment to improvement actions in the following months and year, are well aligned to our imperatives. Improved predictions, improved response, more accurate representation of asset condition, and data driven need definition will support programming and provide safety for the travelling public, resulting in overall improved customer satisfaction.

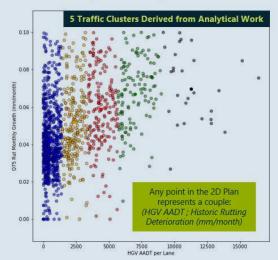
The integration of DST and better modelling outputs into our value management (VM) workshops, enables the business to test our proposed programmes against a multitude of dimensions – one being customer satisfaction and network occupancy.

DERIVATION OF DETERIORATION CURVES - Paved Areas

[1] Unsupervised K-means Clustering

Rutting Deterioration versus HGV AADT by Lane

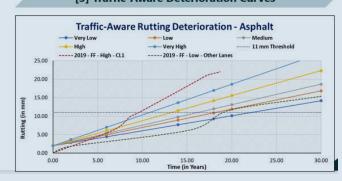
FF Rut Monthly Variation Against Lane HGV Traffic



[2] 6 HGV Traffic Clusters

	6th Cluster Derived Based on Engineering Judgment			
Traffic Level	HGV AAD	Network Length (%)		
1 rainc Level	Minimum	Maximum	2,700 lane.km Samp	
Extremely Low	0	500	22.3%	
Very Low	500	1,452	25.7%	
Low	1,452	3,390	20.7%	
Medium	3,390	5,800	14.9%	
High	5,800	9,361	12.8%	
Very High	9,361	n/a	3.5%	

[3] Traffic-Aware Deterioration Curves



We continue to put a lot of focus on improving our DST and our continuously growing capability to identify deterioration patterns and define, refine and optimise asset ageing rules.

Deliverables

We continue to put a lot of focus on improving our DST and our continuously growing capability to identify deterioration patterns and define, refine and optimise asset ageing rules. Agile assets, together with other secondary DSTs where and if required, is used by the asset management office to drive the derivation of asset needs. By engaging with our framework community and the wider engineering community, this feeds into our three cycles of investment reviews.

These models in brief, help us develop the AAMP, the 5 Year AMFP and the 30 Year AMFP (This reads OK). What we have reinforced this year, is the fact that these tools not only supplement, inform and support our community but also provide a platform to consult and engage with them. We have taken steps to further embed modelling into our standardised processes and procedures.

Agile assets is the key DST that we are utilising for investment planning – it is a tool that hosts our pavements, structures and mechanical and engineering portfolio/asset stock.

In the past 12 months, we have undergone a series of reviews and enhancements of agile assets, including:

- Finessing deterioration logic and drawing in feedback from Atkins and TRL (pavements).
- Refining deterioration logic and treatment logic for the structures asset stock to better reflect network knowledge.
- Improving reporting and clearer outputs.
- Designing probabilistic models centralised around Monte-Carlo simulations, probabilistic bespoke tools and combined intelligence to cross validate agile asset outputs.
- Refining and implementing a new governance process that revolves on DST implementation, and which is centralised around the DST governance forum.

Benefits

It's difficult to quantify 'financial benefits' at this stage in the process. as the main benefits are more qualitative than quantitative. The continuous improvement of the DST capabilities enhances confidence around the long-term forecast we provide. This gives us, and National Highways, a much greater assurance on the level of lifecycle investment required to maintain the network in a safe and serviceable condition. With time and continuous improvement, the more accurate the forecasting will become, ultimately allowing for a smooth handover between the two organisations.

From an innovation perspective, having accurate forecasts allows us to understand to a greater level of granularity the areas where innovative solutions and operational efficiencies have the greatest impact.

As we further embed modelling into our standardised processes and procedures, it is being shared with National Highways, and could ultimately be used in other Areas.



GADE VALLEY VIADUCT

The Gade Valley viaduct is a continuous 11 span structure, approximately 440 meters long, carrying dual 4-lane carriageways of the M25 between junctions 20 and 21.



- Case Study A

 The contractual model
- □ Case Study B
 Network rail interface
- Case Study CSocial value
- Case Study DMinor bearings intervention

The viaduct is composed of twin decks of eight steel box girders topped with a concrete slab, and spans over the West Coast Mainline, Grand Union Canal, River Gade and a local authority road.

The works are jointly funded by National Highways and Connect Plus and procured from the COFA 2 Framework (phase 2). Strengthening works on the viaduct started in 2016, and Phase 1 completed in July 2019. Phase 2 commenced in October 2019 and is scheduled to complete later this year. The team, which includes Connect Plus, Octavius Infrastructure Ltd (formally Osborne Infrastructure), Connect Plus Services and National Highways, have worked seamlessly, sharing knowledge to create innovative and efficient solutions.

The following case studies details some of the programmes and initiatives that we have undertaken during the course of the project. Including:

- Re-painting the external elevations, including span 11 a section that crosses over what is reputed to be the busiest four line track in Europe, and a strategic cargo route into and out of London.
- How the team has embraced social value, and that during the course of the project, over £14m of social value has been added.
- Developing techniques to extend the service life of bearings without major intervention, such as jacking the structure.
- Developing an innovative contractual model, to nullify the contractual discussions around associated risk ownership, that jointly incentivised National Highways, Connect Plus and Octavius Infrastructure to deliver the works as safely and efficiently as possible during the COVID pandemic.

A

The Gade Valley Viaduct Case Study

Phase 2 The Contractual Model

The need

The Gade Valley Viaduct phase 2 contract was awarded to Osborne Infrastructure Ltd in October 2019. Jointly funded by **National Highways and Connect** Plus, the contract was called off from Connect Plus' COFA 2 improvements framework. The works were awarded on a NEC3 **ECC Option E (cost reimbursable)** arrangement, as an immediate start was required by National Highways. From the outset, it was agreed to convert to an Option C (target cost) contract in March 2020, by which time a robust programme and price could be developed and agreed.

During the procurement of this option C contract, the COVID-19 pandemic hit. Due to the unprecedented nature of the pandemic, it was mutually agreed to continue using the option E arrangement until more was known.

Further attempts were made to convert, however each time the pandemic worsened creating further uncertainty and risk. A final attempt was made during December 2020 / January 2021, however the UK was again placed into lockdown, with new variants and restrictions providing too much risk and uncertainty, which proved extremely difficult to quantify and reasonably assign owners.

Deliverables

Taking note of the concerns expressed from all parties at the time, Connect Plus developed a new contractual model which collectively and jointly incentivised National Highways, Connect Plus and Octavius to focus on the same common goal; driving programme and commercial efficiencies, whilst also providing sufficient flexibility to ensure the health, safety, and wellbeing of the personnel onsite was fully considered during the pandemic.

An innovative incentivised option E arrangement was created. A "project budget" was established by pooling the contractor's forecast defined cost, their fee, and the risk allowances for both the contractor and employer from the project risk register. A tiered incentive was introduced whereby the greater the efficiencies against this project budget, the larger the saving to both National Highways and Connect Plus and in turn, the larger a bonus payment to the contractor. In addition, 50% of any bonus payment to the contractor was subject to KPI criteria which included stretch targets in leadership, community behaviours, innovation and value, health safety and wellbeing, quality, contract and commercial, and finally environmental. This ensured that the contractor was incentivised to not only find savings, but to also deliver wider value for the Area 5 community.



This model removed the focus on administering change for the purpose of adjusting the target cost, which often adds very little value, and instead enabled all parties to collectively target and drive efficiencies. It also neutralised the extremely contentious issue around ownership of the vast number of present and future COVID-19 risks, especially at a time where new variants were being discovered. The model facilitated the collective ownership of the pandemic, as opposed to allocating risks to single parties.

To achieve the higher end of the incentive, significant efficiencies needed to be found to bring the costs in below the contractor's forecast defined cost plus fee, including the accommodation of all materialised risk. The incentive steadily reduced the higher the outturn cost, until no incentive was due if 20% of the risk allowances were used.

Benefits

Removing single party ownership of COVID enabled the integrated project team to make the right decisions regarding working practices to ensure the health, safety and wellbeing of those onsite. Split shifts were adopted for a period of approximately 10 weeks to ensure social distancing for those onsite, whilst also providing resilience should there be an outbreak. Additional welfare and the provision of onsite testing were other measures that we adopted. Each of these were reviewed and agreed collectively throughout the works, in the knowledge that this was a joint issue with regards to the incentive model.

The works are nearing completion at Gade Valley and the current forecast shows significant efficiencies have been achieved. Octavius are set to trigger the maximum bonus payment, this means that more than £1m is likely to be saved by both National Highways and Connect Plus. Octavius are also predicting a KPI score greater than 90%, meaning it is not just monetary savings that have been generated.

Significant value has also been generated for National Highways, Connect Plus and the Area 5 community across the previously mentioned pillars.

It should also be remembered that this has all been achieved during an unprecedented global pandemic, a time where outturn costs on major projects have increased dramatically. The strengthening works have been completed to programme - i.e. no slippage on a circa two-and-a-half-year programme. Only site demobilisation works remain. This is an industry leading performance.

This model has since been adopted on other National Highways improvements projects delivered under the COFA 2 framework, often at the request of National Highways. It has also been proposed as one of the preferred commercial models for the COFA 3 framework, the procurement of which has just commenced.

National Highways have been engaged throughout and duly approved the use of this new model. Taking note of the concerns expressed from all parties at the time, Connect Plus developed a new contractual model.



The Gade Valley Viaduct Case Study

Network Rail interface



Part of the Gade Valley Viaduct crosses over the West Coast Mainline railway. Access is challenging at the best of times when operating within Network Rail's boundary, however, this section of track is reputed to be the busiest four-line track in Europe, therefore, the challenges are even greater.

The protective coating on the external elevations had come to the end of its life, we therefore had to remove the existing coating, before replacing it with a new coating system.

Deliverables and benefits

We challenged the requirement to apply the standard multi-coating system as specified in the Specification for Highways works instead, opting to use a single coat application. To specify this, together with a surface preparation method of ultra high pressure (UHP) jetting, a departure from standards was agreed with SES. Having the approvals in place has allowed for cost efficient delivery of the coatings. This shorter timeframe meant a reduction in the time spent working in the Network Rail environment. Our original intent was to utilise an abnormal possession of 100hrs which would give us enough time to complete the removal of the existing coating and replace with the new, however, compensation to Network Rail for this type of access could potentially have reached £4.5m.

We developed an alternative plan to use Saturday night rules of the route possession, combined with a 50-hour Christmas abnormal possession, which allowed the project team to avoid schedule 4 compensation.

We were lucky to have colleagues with rail experience within our project team to help and advise on the best way forward, and as a result we've negotiated up to 40 rules of the route. Each possession provided a very short working window, on average 2 hrs 20mins on a Saturday evening, but with thorough planning and efficient working, to date we have completed most of the possessions, including over Christmas.



We remain on target to fully complete by the end of May this year.

The single coat application has been successfully applied, and the UHP has efficiently removed existing coatings. Production is tracked and the methodology during short possessions has consistently been modified to best suit efficiency.

Possession records, lessons learnt and details of the challenges we faced, will be fed back and shared with the wider community so that, moving forward, we can better understand the risks when working in areas where there is a rail interface.

Example of tracking available possession working times to forward plan delivery



The Gade Valley Viaduct Case Study

C Embracing social value

The need

Measuring our social value allows us to understand and manage the contribution that we make to society, according to the principles laid out within the Public Services (social value) Act 2012. Our social value approach aligns with National Highways' imperatives.

Deliverables and benefits

The Gade Valley team have shown a strong commitment to social value and have truly embraced the spirit of giving. Not only have the team committed their time and skills to help charities and community groups, but they have also raised funds, donated surplus site materials and furniture, and sponsored tickets for award ceremonies to help celebrate success.

Up to the end of March 2022 -£14,288,411.80 of social value has been added to the project, including local economic value.

This includes:

Local value

67 Job creations (of which 63 local hires). £11,551,767.00 Local spend. **£2,568,997.00** Value contributed to local hires and job creation.

Employment, education and skills

- 1,848 People hours learning interventions delivered.
- 11 Work placements and 32 apprenticeship weeks completed.
- 198 People hours spent on education engagement activities.

Sustainability

239 People hours spent protecting and improving the environment. Solartainer and Hydrogen Tower lights used instead of generators. HVO fuel used instead of diesel, reducing carbon emissions by 97%.

Social, wellbeing and community

358 People hours volunteering in the community.

£66,480.00 Community donations. £29,640.00 Community fundraising. As the project is drawing to a close the team agreed to donate preloved site furniture and appliances to local charities.

These included:

- The Sunnyside Rural Trust together with the Dacorum Active hub, who are relaunching their Community Café. The furniture and appliances will help them to achieve this. Separately the Sunnyside Trust will also use some of the donations at their North church site.
- Gaddesden Place is a dedicated RDA centre giving children and adults with special needs and disabilities the opportunity to ride and have fun. The donation will provide much needed facilities for the volunteers.
- The Frogmore Paper Mill is the birthplace of paper's industrial revolution. Recently the organisation suffered a fire at the mill, which was started deliberately. The furniture and white goods donated, has helped them in a time of need.

Donating has become second nature to the team, understanding the greater purpose and the power of their presence not just to deliver the project but to raise awareness of issues both locally and nationally. In addition to those mentioned above, below are some of the other charities and community groups who have benefited from the support of the Gade Valley team:

- The Retreat, Kings Langley
- The Kings Langley Cricket Club
- Waterside Day Centre, Kings Langley
- The Dacorum Community Trust, Hemel Hempstead
- Connect Dacorum, Hemel Hempstead
- Cancer Research
- Apex In the Community, Hemel Hempstead

The team also have also enjoyed working with local schools and recently teamed up with other potential employers at the Kings Langley School careers fair.

The event was structured to give each school year an allocated time to browse the fair and chat to employers from a number of industry sectors. Students were able to see what the 'world of work' may offer them and to talk to professionals directly, which will hopefully go some way towards many of them knowing what they have to achieve in order to pursue their chosen career pathway.

Results from the feedback questionnaire offered to students and the teaching staff was very positive, with a huge number of comments received from those who attended. The information advice and quidance councillor from the school wrote to the team to offer her "grateful thanks for our support".

In another positive supporting role. the team at Gade Valley worked with local astronomer Dr Gerard Sheldon. to successfully construct a 'Human Sundial', which means people in the village of Kings Langley can now tell the time just by looking where their shadow falls.

Encouraged by his teacher wife, Dr Sheldon wanted to help local school children to embrace science and learn about how the earth moves in relation to the sun.

With the support of the Parish Council the human sundial has now been created within Kings Langley Common and is available for young and old to enjoy. The clever layout of numbers and letters mean that when you stand on a spot that represents the month of the year, your shadow falls over markers that indicate the time. Brilliantly clever as well as being a beautiful feature!

It is a great example of supporting the communities in which we work and helping to inspire our future engineers with the enjoyment of science.

The Gade Valley Viaduct Case Study

D Minor bearings intervention

The need

Typically, bearings have a service life of around 25-30 years and therefore many of the bearings around the M25, and indeed on other parts of the strategic network, have exceeded their life expectancy. This presents an enormous affordability challenge, and so any opportunity to extend the bearing service life comes with a significant financial benefit, as well as further benefits to health, safety and sustainability. To put things into perspective, replacing a single bearing at **Gade Valley Viaduct will cost** approximately £250K.

Deliverables and benefits

Having completed the Aktins bearing toolkit inspection for 165 bearings at Gade Valley Viaduct, we could assess the merits of carrying out minor interventions. This would give the project team the data required to determine which bearings had perhaps deteriorated beyond the point of extending their service life.

Early contractor involvement (ECI) allowed the team to develop ground-breaking techniques in dealing with common issues. For example, water ingress under sliding surfaces, polishing plates, replacing guide stripes, and removing rust jacking. Having determined the techniques and materials

to be used, the project team were instructed to carry out minor interventions on 156 bearings at Gade Valley, with the remaining nine being ringfenced for major intervention in the form of replacement.

We now have the evidence to show that the structure is moving more freely than previously, demonstrating the bearings are now operating as intended. Bearing condition has improved which provides an opportunity for deferring major intervention. In addition to being of benefit to the customer, this opportunity also saves money, is more sustainable and reduces health and safety risks, as well as reducing impacts on the travelling public.



Clockwise from top left; Rust jacking of sliding plates; Typical guide damage; Reinstating guides; Cleaned and polished bearing.







OUR CARBON STRATEGY

The UK Government has committed to a Net Zero economy by 2050. In response, National Highways have their own Net Zero Plan.



A significant part of our sustainability team's workload is to understand, analyse and reduce the amount of greenhouse gases (GHG) that we are emitting. Understanding our impact on the world in terms of climate change directly links to the GHG emissions emitted by the work we do now and in the future.

In 2021 we laid down the foundations upon which our carbon strategy was developed earlier this year. Our aim is to reduce our carbon emissions in line with National

Highways Net Zero Plan. In order to reduce our emissions effectively, over the past year we have been focused on developing data capture and analysis techniques, so that we can more accurately understand where our GHG are coming from, to enable us to more easily engage with other areas of the business and make change. We will only succeed in our aim to reduce carbon by working collaboratively as one community and engaging with designers, asset managers and service delivery.

The need

Greenhouse gas emissions are the primary cause of global climate change, it is widely recognised that to avoid the worst impacts of climate change, we need to urgently reduce emissions. Transport represents 28% of the UK's GHG emissions.

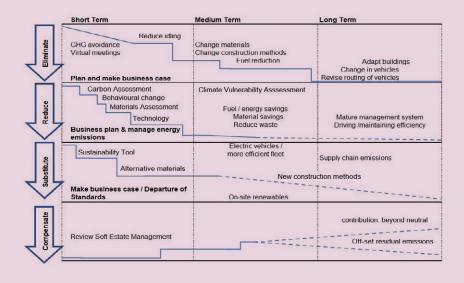
GHG emissions are of critical interest to all our stakeholders, who expect us to have a comprehensive sustainability and carbon strategy in place, to help us reduce our impacts. When considering National Highways' imperatives, from a 'delivery' perspective, lowering carbon emissions can also reduce costs, additionally, we can lay more warm mix asphalt in a single shift, compared to hot mix asphalt, because of the reduced cooling times.

Reducing carbon emissions can also be beneficial to other National Highways imperatives such as safety. At one of our depots, we have trialled hand tools that reduce fossil fuel use in addition to significantly reducing the potential for hand and arm vibration syndrome, compared to their fossil fuelled counterparts.

Setting the context

This last year we have built on the work we started in 2020/21, laying down the foundations for our carbon management plan, which will be written in 2022/23.

Early last year we developed our carbon reduction hierarchy, shown here, to help us identify which areas of the business we should be focusing our efforts on, in order to reduce carbon emissions. The most effective and obvious way is to eliminate it entirely, ie. not produce it in the first place, however this is not always possible.



In order to develop a plan to eliminate or reduce carbon emissions, we focused on data collection, concentrating on:

- 1. Identifying the source of our emissions, and if we are collecting all the data.
- 2. Improving the quality of our data.
- 3. Improving data analysis and using this knowledge to make change.

This focus will provide us with the foundation needed for drafting a thorough and robust carbon strategy.

1. Identify the source of our emissions

To develop a carbon reduction strategy in line with our hierarchy above, we first needed to identify all sources of our data, and develop a means of presenting and interrogating that data.

Sustainability Analyst

The employment of a sustainability analyst has provided a focal point for data analysis, enabling us to develop dashboards and reporting mechanisms to manage our data, allowing for better analysis.

PDA supply chain

Whilst emissions from service delivery and the COFA/framework schemes were within the existing scope of our sustainability data collection, historically we did not collect PDA supply chain data.

An engagement strategy was developed to bring the PDA supply chain on board in terms of data collection. Working with the supply chain manager, we launched PDA sustainability forums, where we outlined our vision in a dedicated carbon forum. They were then trained to use our existing Aconex carbon reporting tool.

Service delivery fuel idling

Service delivery fuel usage has always been reported but when we looked at the Masternaught telematics system data, we identified an issue of fleet idling, resulting in the emission of unnecessary greenhouse gases. To give momentum to tackling this issue, reducing fuel idling is one of our business plan strategy objectives.



Work with designers to develop carbon assessment in design

We believe that a key potential means of reducing carbon, is through making changes to design and relating it to our carbon reduction hierarchy. Last year the sustainability team began engaging with the designers and asset managers by attending team meetings, webinars and one to one meetings, to encourage them to consider the carbon impact of materials.

Project

£111.04K (32.43%)

Swanley

Leatherhead

Blunts Farm

Scratchwood

Connect Plus

Denham

Dartford

Lighting

2. Improve the quality of our data

Improve the data quality from our supply chain

By analysing the data, we identified that there were data quality issues and different parameters, which both COFA and renewal supply chains were reporting, resulting in varied data quality. In addition to holding dedicated carbon sustainability forums, we also held data quality workshops, both as a group and one-to-one, to improve the quality of data and standardise the reporting.

£22.62K (6.61%)

We then went through a similar exercise with the PDA supply chain with whom we also have the facility to score the quality of data on a monthly basis, through the supply chain management system – Jaggaer.

£31.03K (9.06%)

£42.33K (12.36%)

Fuel idling dashboard

The sustainability team are working with the fleet manager and service delivery area managers to establish why drivers are leaving their engines running. To understand the scope of the issue, a fuel idling dashboard was created using PowerBi. Going forward, this dashboard report will be monitored at the monthly depot managers meeting to ensure a continued focus on changing driver behaviour and reducing idling.



£14.28K (4.17%)

Carbon tool for design

This year we launched our carbon tool for design. The tool is completed by our design team as part of every scheme from street lighting to resurfacing.

The current tool is based on National Highways' carbon tool taking the format of materials, energy, transport and waste. Using these categories, we can identify higher carbon factors, and seek lower carbon materials or methods of working.

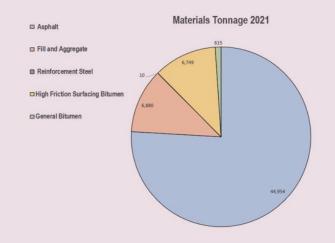


3. Improve data analysis and use this knowledge to make change

Carbon assessment to reduce scheme impacts

The sustainability team now report design carbon footprints to our designers, so they can identify high carbon materials and seek to change them where possible. In 2022/23 the tool will be developed further to show the carbon graphically as shown here, and to enable designers to compare the carbon footprint of different materials side by side.

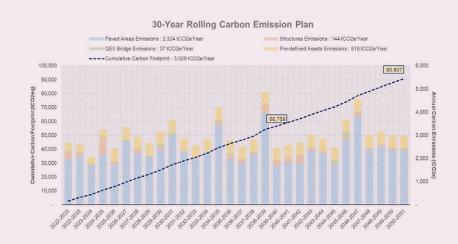
To improve design carbon assessment, we are increasing the range of design materials and carbon footprints by working with our supply chain and the National Highways carbon team. These carbon reduction measures will be reported to National Highways at preliminary and detailed design stages for improvement schemes.



AMFP material profile

A profile of carbon emissions, projected to be released by manufacturing the construction materials for pavement schemes, was inserted into the 2021 AMFP submission. During 2021, working with the asset managers, we developed a profile for most of the PDA assets.

The graph shows the 30-year profile inserted into the 2022 AMFP submission. By understanding the profile of our emissions, we can work with the asset managers and designers to reduce them. The most carbon-intensive activities derived from our scope (i.e., pavement, bridges, and ancillaries) are reflected in our carbon profile.



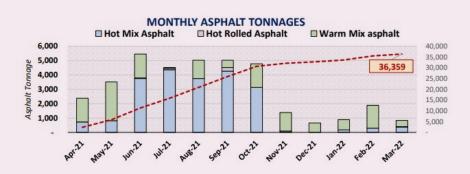
We estimate that the average annual embodied carbon of construction materials, used to maintain our network, will approach 4,700tCO2e / year. Further efforts will aim to integrate emissions from assets not included in the scope at this stage, such as drainage and geotech, to derive a more comprehensive carbon baseline. In addition, it is with no surprise that the cradle-to-gate embodied carbon of pavement schemes - covering the treatment of 3,000 lane/km of both concrete and asphalt roads - represents 75% of GHG emitted from the construction materials used to maintain our network. This is why we are actively exploring long-life pavement opportunities available on the market, and increasingly moving towards using greener surfacing techniques, such as reclaimed aggregates, to reduce such carbon emissions.

In this regard, we are working closely with our supply chain to implement cutting-edge industry developments with great potential for reducing embodied carbon (e.g., bio-binders, artificial aggregates). The AMFP carbon profile shows the baseline of our carbon emissions, and we only expect this to reduce over time with lower carbon alternatives.

The work we undertook for the AMFP carbon profile, was a collaborative effort across our community.

Reviewing methods of construction

As well as reducing carbon by changing the materials we use, we are also looking at construction methods, as a means of identifying how changes can be made – by changing pavement laying from predominantly hot mix to warm mix, for example. By analysing the data, we were able to identify that most pavement materials were laid using hot mix methods. Using the graph shown here, we were able to prompt the designers and project managers to ensure that most of the pavement material is now laid as warm mix.





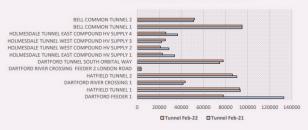
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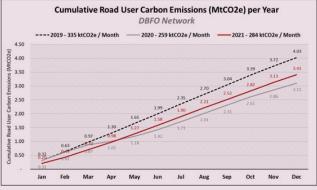
Linking the carbon tool on Aconex

The designers carbon tool mirrors our works carbon tool which collates the construction data. As shown on the left, the forms are mirrored on Aconex. The forms can be linked and will eventually allow us to compare the predicted with the actual carbon emissions, so that we can begin to analyse and query any differences.

Structure Name	Year of replacement	No. Iuminaires	Energy Savings kWh	Carbon Savings kgCO2e	Carbon Savings tCO2e
Bell Common Tunnel	2030	1356	1,249,500.00	265,306.34	265.31
Dartford East Tunnel	2024	849	833,000.00	176,870.89	176.87
Dartford West Tunnel	2024	648	833,000.00	176,870.89	176.87
Hatfield Tunnel	2030	2014	2,499,000.00	530,612.67	530.61
Holmesdale Tunnel	2022	2900	2,082,500.00	442,177.23	442.18
				1,591,838.01	1,591.84

Tunnel Breakdown Feb 21 vs Feb 22





Source: Connect Plus January 2022

Tunnel lighting upgrade

Working closely with the asset managers in 2021, we were informed of a plan to upgrade tunnel lighting from standard SON to LED replacements. The plan was sent over to the sustainability team.

As the team were able to calculate the carbon savings from the energy savings, they discovered potentially huge carbon emission savings per year.

Earlier this year, Holmesdale Tunnel lighting was replaced with LED, and other tunnels on the network will follow over the coming years. Not only are there huge energy savings in replacing the bulbs, there is also a cost saving, as shown here.

Calculated road user emissions

Pre-pandemic (2019), we estimated that road users from our network emitted \sim 4.0 MtCO2e per year. It was found that network-wide, 79% of GHGs are emitted on the orbital M25 (as opposed to link roads), and that 52% of network emissions are released by passenger cars and delivery vans (as opposed to HGVs, whose carbon conversion factor is five times that of light vehicles).

We calculated how the pandemic contributed to the reduction of road user emissions in 2020, with persistent effects in 2021. 920,000 tCO2e and 620,000 tCO2e were 'avoided' in 2020 and 2021 respectively as shown, due to reduced traffic levels. Although 2021 saw less lockdown disruptions than 2020, traffic levels and therefore carbon emissions, are still far below pre-pandemic levels. Further calculations will be done in 2022 to identify if the trend of lower post-pandemic emissions continues.

By reducing our carbon emissions, we are not only helping to reduce potential climate change, but we're also working more cost-effectively as well as improving the safety of our workforce.

By working with the whole business, attending team meetings, engaging with individual asset managers, and talking with service delivery, we have been able raise the carbon agenda across the business and bring it to the forefront of people's minds. Carbon reduction can only be achieved by working collaboratively and in partnership with our colleagues, our community and key stakeholders. With our sustainability data analyst in place, we are able to provide data to other areas of the business, so that they can understand the carbon footprint and how they can influence it using the tools we have developed.

The work we've undertaken has provided a foundation to enable us to draft our first carbon strategy, written earlier this year. The strategy will now be finalised and executed via a carbon management plan.

We will seek to share best practice and, by collaborating with National Highways and our supply chain, we will ensure we are all working towards the same goal. This will continue as we move forward and make plans to change the 'business as usual' materials and construction methods we use, so that we can reduce our carbon emissions even further.

We believe that we are leading the way in the Southeast with our carbon strategy and, following a request from National Highways, we will be working with the region to share our findings. Moving forward, the work we have undertaken could be shared and used across the SRN.

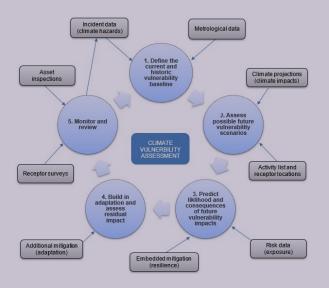
National Highways are aware of the project and information is being continually shared.

CLIMATE VULNERABILITY

In 2020/2021 we undertook a climate vulnerability assessment to understand the current position and future direction for climate change impacts and adaptation on the M25 network.

Climate related impacts are already being recorded within Area 5, and climate projections suggest that this will become increasingly more frequent and damaging if no adaptations are implemented. The assessment identified and summarised the potential impacts of climate change and severe weather on our activities and, based on this information, set out a framework for minimising risk to the assets we manage and the operation of our project facilities.

During 2021/2022, the sustainability team have worked closely with our asset managers to understand what impacts are already occurring; what impacts are expected and what adaptation and mitigation is in place or planned. Potential impacts identified in the initial assessment have been discussed and planned for appropriately. Records of severe weather events such as flooding and storms with high winds have been identified.



■ The need

Climate change is happening now, and if it continues to increase at the predicted rates, impacts will be felt locally, as well as globally. It is an imperative subject and has the potential to affect our network, so it is essential that impacts are adapted to, or are appropriately mitigated to ensure the safety of our customers and colleagues during delivery.

Climate related impacts are already being experienced on the M25. According to climate projections released by the UK Climate Impacts Programme, they will, without mitigation and adaptation, become increasingly more frequent and more damaging. The need for the climate vulnerability assessment is to ensure the safety of the M25 and its assets for our road users.

It is expected that the M25 network will experience hotter and drier summers, as well as warmer and wetter winters. It is also expected (less certain, but possible) that climate change will increase the frequency and severity of extreme weather events, such as heavy rainfall, storms and heatwaves. We are already being impacted by storms and increased rainfall in the winter.

The first image on the following page, plots all flood incidents around the network, while the second image shows those that scored a flood severity index of 7 or above. Calculating the density of the most severe flood incidents reveals several particularly incident prone areas, where the density of incidents between 2009 and 2021 is more than one per km2.

Overview of approach to the climate vulnerability assessment

The worst areas, listed in order from the most to least dense, (count of incidents per km2) are:

- M25 Junction 9 (Leatherhead)
- M25 Junction 10 (A3)
- M25 Junction 11 to Junction 12 (M3)
- M25 Junction 2a (Wrotham)
- M25 Junction 20 to Junction 21 (M1)

Managing how we deal with, and plan for these flooding events is critical.

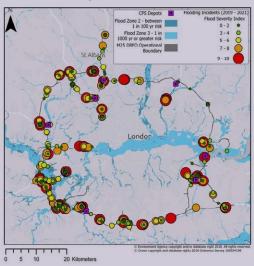
The Department for Transport publishes road safety data, including detailed information about the circumstances of road accidents that cause injury and are reported to the police. This is useful for climate vulnerability because it records the weather conditions at the time of each accident.

In 2019 17% of serious or minor accidents occurred during rain or windy conditions. The value rises to 25% for fatal accidents. The two images bottom right show road traffic accident data between 2016 and 2020, filtered to identify fatal and severe accidents on the network occurring during rain or high wind. Using this data, density plots have been created to identify hotspots.

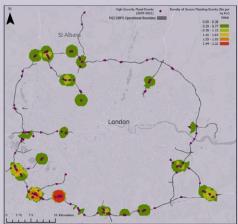
This again highlights the need for the climate vulnerability assessment to identify and plan for incidents such as these, as well as understanding and analysing what can be done to reduce these accidents in hotspot areas.

Climate related impacts are already being recorded within Area 5 and climate projections suggest that this will become increasingly more frequent and damaging if no adaptations are implemented.

Map of flooding incidents

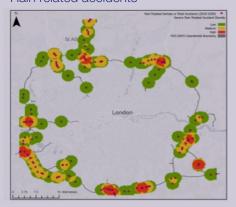


Density of severe flooding incidents

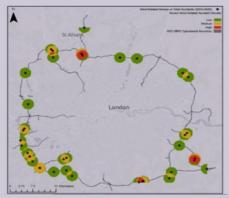


NB - Severe flooding incidents defined as those with an FSI of 7 or abo

Rain related accidents



Wind related accidents



Deliverables and benefits

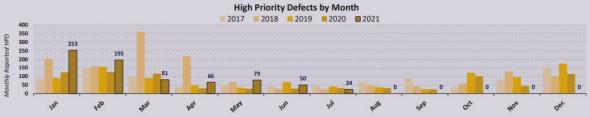
We have updated the climate vulnerability assessment, adding more detail about specific impacts, as well as updating information about impacts that are already being recorded.

For example, concrete buckling, as seen in the images

below, was experienced during a hot period last summer. Buckling is a real time threat to the network and is incredibly difficult to plan for. The network is closely monitored for these defects and there is a reactive programme to repair buckling defects as and when they appear.



Exposed concrete sections which buckled due to temperature. Left photo – 21/07/2021 M25 B Carriageway MP 56/4+70. Right photo – 23/07/2021 M25 A Carriageway MP 145/4



High priority defects by month for pavements

In addition to concrete buckling, we experienced other impacts from higher summer temperatures including overheating of both an MS4 sign and a comms box. Both failed due to overheating in strong sunlight, with cool air unable to reach inside.

The issue with the comms box led to a traffic signals failure on a major junction roundabout, which lasted approximately seven hours. The comms box was refitted with a fan, allowing cool air to circulate preventing further instances of overheating. After this incident, we responded quickly to assess critical locations and install fans in numerous other comms boxes where required. These are examples of where climate change is already affecting the network and what we have done to adapt to these impacts.

Through early engagement with our asset managers and service delivery teams, the sustainability team now have a deeper understanding of the issues we face, and we are able to document them, prioritise, identify how to mitigate and, more importantly, plan for the future.

In addition, through our assessments we have discovered that there are some possible benefits arising from climate change. For example:

- Warmer summer months allow for longer working periods
- Warmer winters could potentially reduce winter maintenance requirements eg. road salting/freeze thaw damage repairs
- Warmer winters could also potentially bring safer and improved winter driving, reducing traffic disruption caused by accidents.

To highlight the potential reduction of winter maintenance requirements, the chart above shows the high priority defects over the past five years for pavements, including potholes. The figure shows peaks in January 2021 and March 2018. In both these months, there were large amounts of snowfall (in 2018 it was 'the beast from the east') and ice cover which significantly increased the total number. With warmer wetter winters predicted, it is expected that the number of defects of this kind will reduce.

Not only do we benefit by assessing a changing climate, but carrying out annual reviews of our assessment allows us to improve understanding of climate impacts, enabling us to develop early mitigation and adaptation techniques. Starting our adaption and mitigation early, benefits asset management before the impacts are keenly felt.

This work highlights the benefits of collaboration between the sustainability team, asset managers, service delivery and our supply chain. We believe we are leading the way in assessing impacts on the strategic road network, and there is a lot of learning available from this assessment which could be shared with other Areas. Climate change is a significantly important topic and engaging with others about what the future holds is essential.

National Highways have reviewed the climate vulnerability assessment as part of the maintenance operational environmental management plan, which is submitted annually to National Highways for review. Additionally, the environment and sustainability team have given climate vulnerability presentations throughout the year where National Highways have been present.

HEALTHIER HIGHWAYS

At Connect Plus, we recognise the need to improve worker health protection in line with our strategic themes of 'promoting health' and 'leading in safety'.

Through a collaborative partnership with Steve Perkins Associates (experts in risk-based health leadership and culture transformation) we will develop a strategic health leadership framework to improve the protection of health for all M25 workers.



■ The need

Safety is both an imperative and a value for National Highways. There is rightly a strong focus on work-related accident prevention across the SRN, but much more could be done on work-related ill-health prevention. The Health and Safety Executive estimates that each year 3,500 construction workers die from occupational cancer; there are 5500 new cases of occupational cancer; and at any one time there are 74.000 construction workers with work related ill-health ranging from musculoskeletal disorders to lung disease, and noise-induced hearing loss to stress.

Highways construction and maintenance involves a wide range of health exposure hazards including; respirable crystalline silica, other respirable dusts and particulates, noise, vibration, welding fumes, isocyanates, VOCs, manual handling, diesel exhaust emissions and solar radiation. Unfortunately, awareness of these hazards and their associated health risks is generally poor across

the industry. Connect Plus recognises this situation needs to be addressed, and has embarked upon work to begin the journey to 'value health like safety' across the M25 network.

■ Deliverables and benefits

- We're continuing to share regular communications across the community, sharing Healthier Highways messages using community e-newsletters, health and safety forums and health and safety stand down events. In addition, we've launched our Healthier Highways Microsoft Team for downloading resources to the whole community, including our framework contractors. As a result, membership sign ups have increased to 200.
- We ran a successful trial of our Healthier Highways workshop for operatives at one of the depots. This covered the dust awareness toolbox talk video, an Eave active hearing protection demonstration and interactive

engagement using our 'good health conversations' playing cards. The operatives from CPS and Jackson Civil Engineering gave highly positive feedback with 100% recommendation rate and 100% rating for usefulness of the content.

In addition, we delivered a wider roll-out of over 100 packs of the 'good health conversations' playing cards across the community, supported by a lunch and learn online training session.

• A new trial of a supervisors' noise awareness modular training course was delivered live, online. It incorporates a practical session, using the dust toolbox talk video followed by a short test.

The trials, undertaken by both CPS and our framework contractors, yielded very positive feedback with 94% highly met rating for our objectives and 92% rating for recommending the course to colleagues.

- We continue to award a quarterly prize to the winner of our health protection 'don't walk by' submission. During 2021, following the introduction of this specific award, health submissions doubled with the largest category now being solutions, further up the hierarchy of controls than just PPE. We also saw the ratio of health:safety submission numbers change during the year from the historic 20:80 to a health high of 34:66.
- We successfully embedded improved working with water spray controls and vacuum extraction for planing dust suppression with framework contractor checks and supply chain improved risk assessments and maintenance schedules.

In addition, we provided industry guidance on planing dust control to both the UK and European planing associations in order to share good practice with the wider sector.

 We designed, specified and delivered a large personal air monitoring programme in partner ship with CPS to assess the level of health risk from dust (road film) in all M25 road tunnels, where it is disturbed during various types of tunnel works.

The programme demonstrated that the health risk for many tunnel tasks was low and we were able to clearly identify those tasks where the risks were higher. Thus, we can limit the PPE requirements to those types of tasks, which minimises productivity reductions, whilst still ensuring appropriate protection of worker's health.

 We continued the community-wide trial of Eave active noise control and measurement system obtaining structured feedback and case studies of hearing protection and noise source location benefits.

The trial demonstrably improved hearing protection for operatives with real-time measurement of in-ear and

external noise levels. We also identified previously unknown cases of excessive noise sources on site, such as a telehandler at a Jackson site on the M11 at Woodford. Surprisingly, the trials also led us to discover that machinery noise from a new Tarmac planer was producing levels that were below the requirement for mandatory hearing protection, demonstrating how improved machinery can lead to the elimination of noise risk.

- We planned and have started a trial of new HAV Sentry vibration monitoring gloves.
 They directly measure vibration levels experienced by operatives.
 This gives a significant improvement in accuracy over on-tool time calculations and tool manufacturer data.
- We launched a new project looking at improving the quality and effectiveness of health risk assessments, which are both widely acknowledged as poor in construction.
- We launched a new 'Health
 by Design' project aiming to help
 designers better understand, assess
 and control health risks in the design
 stage, before they even get to site.
 This comprised two workshops with
 representatives from contractor and
 designer organisations from within
 the community, CPS (principal
 design authority) and Steve Perkins
 Associates' hygienists
 and ergonomists.

The workshops were a great success and the M25 design community are already making improvements to their internal processes, to better consider health risks at the design stage.

 We developed a bespoke health culture assessment tool combining the Hudson Evolutionary Model of Safety Culture Development with the BOHS HI Standard for Worker Health Protection. This was used to provide an ongoing assessment of health protection culture for the community. Using the tool, we have measured an improvement in health culture from our 2019 baseline of reactive (2.2/5.0) to calculative (3.2/5.0) this year. These measurements have been conducted by surveying the community health and safety forum attendees.

- We're thrilled that overall there
 has been an increased awareness
 of Healthier Highways across the
 National Highways supply chain,
 and that the work our teams have
 undertaken throughout the year
 has been recognised by our peers
 resulting in two award wins during
 2021-22. These were:
- o Highways Awards Best site safety initiative
- National Highways Industry Awards
 Safety: Outstanding contribution to health, safety and wellbeing

Our work on improved working with water spray controls and vacuum extraction for planing dust suppression has been widely shared. We provided industry guidance on planing dust control to both the UK and European planing associations in order to share good practice with the wider sector.

In addition – our team joined National Highways and the rest of the industry at Highways UK 2021 to deliver a panel discussion on strategic health protection in the sector.

National Highways teams in the Southeast region are aware of the work we're undertaking.

Looking ahead

This part of the brochure highlights some of the fantastic projects and innovations that our teams are currently working on.

It is our belief that some of these projects will progress throughout the year, and potentially develop into full case studies, showing real benefits in the future.

- **1** M4 Access truck
- 2 QEII Dartford digital twin
- 3 Dartford Integrated Delivery Team
- 4 THEIA
- 5 Alchera
- 6 Automatic cone laying machine
- 7 Unity app



M4 Access truck

We have received board approval to purchase a bespoke truck, in the style of an airport scissor lift lorry, for use on the M4 elevated pier refurbishment works, as well as other pier works on the network. The unit will allow us to mobilise quickly on the A4, allowing us to deliver concrete repairs at night.

The purpose of the truck is to provide access to some of the pier soffits that cannot be reached from the cantilever scaffold, due to having to maintain a minimum height clearance of 5.1 metres, for vehicles on the A4.

The area is also subject to strict environmental noise control and this methodology allows us to undertake our works at night while causing minimal disruption. In addition, the short set up time means there are huge reductions in the overall programme.

QEII Dartford digital twin



Over the next 6 years we are planning to invest up to £10m painting the QE2 Bridge. This will not be a full repaint but a targeted approach to ensure the current paint system is maintained and fit for the future.

Trials were conducted late summer 2021 to ascertain the most efficient and appropriate methodology for the works. We also looked at how health, safety and wellbeing could be improved whilst conducting these works.

One of the actions to reduce time on site and to aid planning for the works was to produce a 3D model of the bridge. This was undertaken by using not only the traditional Lidar survey techniques, but also drones to fly around the bridge taking hi resolution photos to add to the model. The model now enables us to move to any part of the bridge to look at the current state of the paintwork. It also allows for on screen markups for identified areas of concern, a CSV file can then be downloaded giving the location and size of the highlighted area and an overall area of works needed. Using this model has potentially saved approximately two months of physical site visits.

As we now have a base model, we are continually looking at other enhancements, for example, adding as built information which can be accessed by clicking on certain areas, and maybe future surveys using the same drone flight co-ordinates which would enable us to compare details over time.

The Dartford integrated delivery team

We are setting up a command centre at Dartford to deliver the integrated programme of renewals. This is a stepchange in the delivery process, building on learning from one of our parent companies where it has been successfully implemented.

The Dartford assets are packed into a short, heavily congested section of the network with limited access and high traffic volumes. Analysis shows that delays to work are being seen primarily during two key phases of the lifecycle process - feasibility, and implementation. We believe that improving asset knowledge is key to improving predictability, together with creating a shared knowledge pool to drive efficient delivery through an integrated working platform.

In the space industry, a mission control centre includes all key personnel who manage space flights from the point of launch until landing. Imagine if we could create that same ethos for Dartford with the M25 community, helping us to become fit for the future and driving efficient, effective and predictable delivery through the creation of "mission control".

The key to its success will be the integration of all parties involved in delivering works at Dartford together, providing clarity on the mission and empowerment through data-led decision making. We hope to achieve a step change in the predictability of the AMFP delivery for Dartford to support our vision of achieving excellence on the M25.

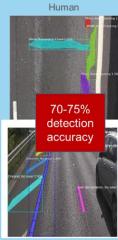
THEIA

We are seeking to improve the way in which assets are surveyed and analysed for distresses and defects, together with how we schedule repair tasks. The benefits of improving the analysis part of this process include increased consistency, greater throughput of M25 network survey data per hour. and an increase in the automation of many of the tasks associated with network survey and distress detection. The team are working with Atkins who currently hold a sector-leading automated asset condition assessment capability, through its THEIA computer vision environment.

THEIA is a highly advanced machine learning system. It has previously been trained on a 30km trial video survey on the M25 as part of a 'proof of concept' investigation, which demonstrated the accuracy of automated pavement distress and defect detection that can be achieved after only a few short training cycles. The M25 team are now looking to build on this work and have asked Atkins to further improve the THEIA detection and categorisation algorithm, with the aim of processing the entire M25 network.

Pavement condition

Road marking condition





Alchera

The M25 is working with Alchera, an SME company that specialises in artificial intelligence, to understand how we can use M25 data to be more efficient in the use of our closures. Following a successful proof of concept, we're now starting a second phase of work to develop a portal that will provide data on predicted flows of traffic on the network, directly alongside the Pay Mech implications of the closure timings.

This will allow planners to adjust dates with start and end times, by understanding whether the vehicle count is likely to be below the threshold levels for starting a closure, and the impact on Pay Mech of making these changes. Once rolled out and embedded, this innovation will allow the M25 to be more efficient with closures, reducing the overall number and improving the experience for road users.

Automatic cone laying machine

The automatic cone laying machine (ACLM) has been in development for the past few years. During this period the product has undergone a thorough and rigorous testing regime with modifications made accordingly. The current product has changed considerably from the original prototype as a result of this, and we have five of them on order, with two due for delivery very soon. A final inspection of the completed ACLM together with handover is scheduled for later this month.

The handover will take place at North Weald Airfield where we have booked three days to allow for a full demonstration of the vehicle, familiarisation and extensive driver training. There will also be an opportunity for others across the business to join the event.

Employing a machine centric approach to this task will help reduce the amount of time our crews are exposed to live highways environments whilst laying traffic cones, and we're confident that this will have a huge impact on improving safety and efficiency.



Unity app

The Unity app has replaced fieldGo as our new briefing app. With similar technology to fieldGo, our teams will use this new app to undertake inspections and briefings, as well as to report defects around our network.

The upgraded app includes new features, such as improved photo functionality and easier data entry, that will ensure we are continuously evolving on our digital journey.

One of the most important of the new features is the crew messaging facility, developed in response to feedback received from our workforce. It will be a huge improvement in the way we are able to communicate with our operational teams.

Connect Plus

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