M5 Junction 10 Improvements Scheme

Sustainability Statement

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Infrastructure Planning (Examination Procedure) Rules 2010

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The Infrastructure Planning (Examination Procedure) Rules 2010

M5 Junction 10 Improvements Scheme

Development Consent Order 202[x]

Sustainability Statement

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Executive Summary

In line with the Design Manual for Roads and Bridges (DMRB) GG103 “Introduction and general requirements for sustainable development and design”, integrating sustainable development into design enhances the performance of assets and infrastructure. According to GG103 guidance, projects shall monitor, evaluate and report on the application of sustainable development and good road design throughout the design lifecycle.

As part of the full design and project management services delivered by the Atkins on the M5 Junction 10 Improvements Scheme, (the “Scheme”), sustainability has been embedded throughout the design process. The strategic focus on sustainability, has been enabled through the application of Atkins’ award-winning Sustainability Framework Tool (SFT) based approach, called ‘seed’. This is a three- step process: “set targets, optioneer and document”, that provides design engineers with the tools required to incorporate sustainabiltiy into their existing processes and decision making. Atkins has applied this process to the Scheme by first developing a set of bespoke sustainability objectives, aligned with the DMRB GG103 guidance and in consideration of the sustainability requirements of key global, national, regional and local stakeholders for the Scheme. Targets are collaborately agreed for the set of sustainability objectives, to ensure design disciplines are clear of their objectives and to ensure that the sustainability outcomes the Scheme are aligned to key stakeholders’ own sustainability goals.

The progress on sustainability outcomes versus the objectives is monitored through all stages of design. Evidence as to how the Stage 3 prelimary design has helped achieve each sustainability objective was gathered through one-to-one calls with discipline leads and a detailed review of the design documents. Overall, it can be concluded that, of the 26 sustainability objectives set for the Scheme, the DF3 preliminary design is meeting or exceeding the target levels set for 15 objectives (58%). The number of objectives achieving the target level has increased as the project has progressed through its iterative design process. There are 11 objectives (42%) where the target level has not yet been achieved, primarily due to the status of the project as being at preliminary desgin stage. It is anticipated that the majority of these objectives will align with targets as the Scheme advances toward the construction phase. This progression provides an opportunity to further improve the sustainability performance of the Scheme by implementing sustainable design measures and more sustainable construction practices.

In order to improve the current sustainability performance of the Scheme, it will be imperative to continue undertaking sustainability performance assessments and fully embed sustainability in the Detailed Design and construction stages. This form of on-going sustainability assessment throughout the project lifecycle will also help ensure that performance against the sustainability targets is monitored and opportunities for improvements on the sustainability performance are both developed and carried through at each stage, thereby achieving or even surpassing the sustainability ambitions set out in this Statement.

1. Introduction

1.1. Scheme Background

1.1.1. Gloucestershire faces significant challenges to achieve its vision for economic growth. An adopted Joint Core Strategy (JCS) – a partnership between Gloucester City Council, Cheltenham Borough Council (CBC) and Tewkesbury Borough Council (TBC) has been formed to produce a coordinated strategic development plan to show how the region will develop during the period 2011 - 2031. This includes a shared spatial vision targeting 35,175 new homes and 39,500 new jobs by 2031.

1.1.2. Major development of new housing (c.9,000 homes) and employment land is proposed in the JCS in strategic and safeguarded allocations to the west and north-west of Cheltenham, much of which lies within TBC's boundary as the Local Planning Authority. This development, in turn, is linked to wider economic investment, including a government supported and nationally significant cyber business park (Cyber Central UK) adjacent to the Government Communications Headquarters (GCHQ) site in west Cheltenham, as part of the West Cheltenham development site.

1.1.3. The existing M5 Junction 10 only provides access and egress to and from the north, with no connectivity to M5 south; this causes existing traffic to cross Cheltenham through various routes to access and leave the M5 from the south using other M5 junctions. This contributes significantly to existing traffic flows across Cheltenham, with significant congestion at peak times. To unlock the housing and job opportunities, a highway network is needed that has the capacity to accommodate the increased traffic it will generate, within a sustainable transport context.

1.1.4. Upgrading M5 Junction 10 to an all-movements junction has been identified as a key infrastructure requirement to enable the housing and economic development proposed by the Gloucestershire Local Enterprise Partnership's Strategic Economic Plan and is central to the transport network sought by GCC in the adopted Gloucestershire Local Transport Plan. This planned housing and economic growth have been included in the adopted JCS. Improvements to M5 J10 are critical to maintaining the safe and efficient operation of the junction and enabling the planned development and economic growth around Cheltenham, Gloucester and Tewkesbury. A bid was submitted in March 2019 to Homes England to the Housing Infrastructure Fund (HIF), wherein an investment case was made for the following infrastructure improvements. Funding was successfully awarded by Homes England in March 2020:

- Element 1: Improvements to Junction 10 on the M5 and a new road linking Junction 10 to west Cheltenham.
- Element 2: A38/A4019 Junction Improvements at Coombe Hill.
- Element 3: A4019 widening, east of Junction 10.
- Element 4: An upgrade to Arle Court Park and Ride.

1.1.5. Elements 1 and 3 comprise the M5 Junction 10 Improvements Scheme (the Scheme). The upgrade to Arle Court Park and Ride (now known as the Arle Court Transport Hub) (Element 4) and the junction improvements at Coombe Hill (Element 2) were included as part of the package of improvements funded by Homes England. As they do not form part of the proposed improvement of M5 Junction 10, and are located some distance from the junction, GCC has decided to take these two elements forward as separate packages of work in order to accelerate the programme for these elements and will deliver them through separate planning strategies.

1.1.6. An application for a Development Consent Order (DCO) under S.22 of the Planning Act 2008 will be submitted (Spring 2023) for the construction of improvement works to M5 Junction 10, consisting of a new all-movements junction; the widening of the A4019 east of the junction to the Gallagher Retail Park Junction; and a new West Cheltenham Link Road (the Link Road from the A4019 to the B4634). A small section of the A4019 will also be widened to the west of the junction, ("the Scheme")

1.2. Purpose of the report

1.2.1. The purpose of this Sustainability Statement [SS] is to outline how sustainability principles have been included in the Stage 3 Preliminary Design for the Scheme. It sets out the approach to sustainability that has been embedded in the design of the Scheme through a set of specific sustainability objectives, indicators and targets, against which the current performance has been assessed and presented in this report.

1.2.2. The SS identifies key sustainability objectives that are yet to be met and should form a focus of the Detailed Design and construction stages of the Scheme. Risks and opportunities for sustainability performance during Detailed Design and onwards have been highlighted and recommendations have been provided as to how best the Scheme sustainability performance can be enhanced in the ensuing stages.

1.3. Requirements of the Sustainability Statement

1.3.1. In accordance with the Design Manual for Roads and Bridges (DMRB) GG103 "Introduction and general requirements for sustainable development and design[1]", integrating sustainable development into design enhances the performance of assets and infrastructure.

1.3.2. According to GG103 guidance projects shall monitor, evaluate and report on the application of sustainable development and good road design throughout the design lifecycle. Good road design makes roads safe and useful; is inclusive; makes roads understandable; fits in context; is restrained; is environmentally sustainable; is thorough; is innovative; is collaborative; is long lasting[2]. The goals of sustainable development require that the design shall aspire to:

1. improve the health, safety and wellbeing of those affected by road infrastructure.
2. improve land, water and air quality.
3. support a sustainable economy.
4. represent good 'whole life' value across the design life of road infrastructure.
5. embrace innovation.
6. reduce inequalities and ensure access to all.
7. use responsibly sourced materials that minimise adverse impacts on people and their environment.
8. be resource efficient and reflect a circular approach to the use of materials.
9. minimise greenhouse gas emissions.
10. be resilient to future climate change.
11. protect, and where possible enhance, the surrounding environmental and cultural context.
12. be shaped by the opinions of communities and road users.

1.3.3. In meeting the goals of sustainable development, projects shall demonstrate consistency with the requirements of GG103 guidance. This Sustainability Statement describes how sustainable development and good road design have been incorporated into the design of the Scheme to drive better outcomes across the five capitals as defined in the National Highways (NH) Sustainable Development Strategy (SDS)[3]: financial, natural, social, human and manufactured.

[1] National Highways, 2019, Design Manual for Roads and Bridges (DMRB) GG103 Introduction and general requirements for sustainable development and design. Available at: http://www.highwayssafetyhub.com/uploads/5/1/2/9/51294565/gg_103_introduction_and_general_requirements_for_sustainable_development_and_design-web.pdf

[2] National Highways, 2018, The road to good design. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/672822/Good_road_design_Jan_18.pdf#:~:text=The%20road%20to%20good%20design%20connects%20people%2C%20places,and%20support%20our%20aspirations%20for%20a%20network%20that

[3] National Highways, 2017, Sustainable Development Strategy. Available at: https://nationalhighways.co.uk/media/lbfgulq3/sustainable_development_strategy.pdf

2. Embedding Sustainability into the Scheme

2.1.1. This section lays out the overall approach to enhance sustainability performance during the design of the Scheme and gives a brief overview of the process and the tool that is used to capture the information.

2.2. Sustainability Framework Tool (SFT) Overview

2.2.1. Atkins has employed our three-step process for this Scheme as detailed below and illustrated in Figure 2-1 to provide our design engineers with the tools required to incorporate sustainability into their existing processes and decision making:

1. **Set Targets**: Develop a sustainability framework tool with project-specific objectives and measurable targets, aligned with Gloucestershire County Council's (GCC) sustainability objectives. This has enabled us to measure performance throughout the design.
2. **Optioneer**: Proactively optioneer designs, with rapid, iterative assessment of design options informing design development.
3. **Evidence**: Systematically document the process, with simple, easily digestible outputs, communicated internally to GCC, focusing on improvements in sustainability performance and progress against project-specific targets.

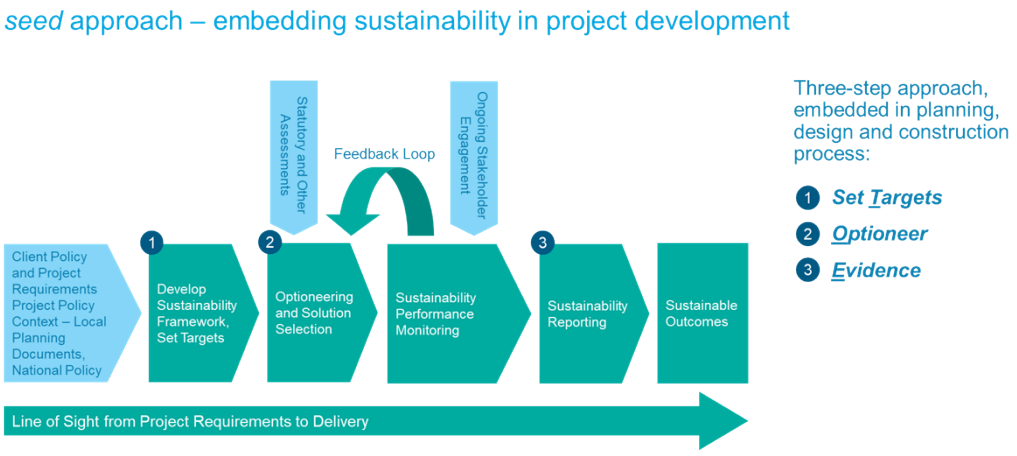

Figure 2-1 Summary of the SFT three step approach

2.2.2. The SFT is an Excel- based tool used to capture the sustainability performance of the Scheme. It has been used across wider NH Delivery Integration Partners (DIP) Schemes to help drive sustainability performance improvements via proactive optioneering, whilst collating and synthesising key supporting evidence. A bespoke version of the SFT has been developed for GCC and the Scheme to align with the NH's sustainability requirements as detailed in GG103[1], SDS[3] and The road to good design[2] guidance, along with sustainability priorities of the local county.

2.2.3. The SFT for the Scheme has been developed based on the Plan, Do, Check, Act principles of ISO14001, as a mechanism to ensure National Highway's sustainability requirements are central in delivering our programme of works.

- **Plan**: Integrating sustainability early. The SFT has been used to capture the agreed interpretation and definition of GCC's sustainability requirements for the M5 J10 scheme. The targets are translated into practical action plans required at a project level during the design stage.

- **Do**: Delivering sustainability outcomes. The SFT has been used to iteratively assess design options and solutions, recording decisions made and lessons learnt, and facilitating challenge.
- **Check**: Monitoring progress and driving performance improvement. The SFT includes visual Red, Amber, Green (RAG) indicators, with two additional levels to further encourage and showcase exceptional performance, as well as dashboards that summarise performance against targets. This has allowed a clear, consistent visualisation of progress and the documentation and communication of outcomes for the M5 J10 concept design.
- **Act**: Sharing lessons learned and best sustainability practices. The SFT is designed to enable monitoring and tracking of performance throughout the project lifecycle. Key lessons learnt, and best practices captured through the SFT have been shared between project staff and GCC and are designed to be more widely shared with other NH projects and the wider business.

2.2.4. The SFT additionally enables appropriate monitoring to be in place to drive better outcomes across the five capitals defined in the SDS: financial, natural, social, human and manufactured.

2.2.5. The SFT is a live document and is updated as the Scheme proceeds through the project lifecycle. This report presents the outputs of the SFT that has assessed the DF3 preliminary design. The tool helps collaboratively define the sustainability ambition for all our design projects using outcome-focused 26 sustainability objectives grouped under National Highway's SDS five capitals, indicators, targets, and monitor and deliver performance against these targets throughout the whole life of a project. This approach is central in ensuring that the sustainability goals are integrated within the design and appraisal process across the highway schemes, driving sustainable decisions through every aspect of the solution, from option selection and design development through to construction and hand-over.

2.2.6. By applying the bespoke SFT for the Scheme, we have been able to pull together sustainability outputs from across disciplines, aligning outcomes, influencing decisions and generating further innovation. This approach has integrated sustainability/ environmental assessment within the design process. Application of the SFT has provided clarity, assigned practical actions at a project level and avoided mystifying sustainability subjects. It has helped make sustainable planning and design simple, developing a process within which to challenge the teams and drive them to achieve the best sustainability performance, as demonstrated by the sustainable outcomes identified in Section 3.

2.3. Progress to date

2.3.1. The sustainability performance of the Scheme has been recorded through the Stage 3 preliminary design using the SFT-based approach, with the aim of carrying this process forward into later PCF stages of the Scheme.

2.3.2. First, the SFT was developed for the Scheme defining the sustainability objectives for the Scheme by the Sustainability Team. Following this, a series of one-on-one, pre-workshop calls were conducted through October 2020 with majority of the leads for the preliminary design, to explain the SFT and receive focused inputs on relevant objectives.

2.3.3. A Sustainable Development workshop was then conducted by the project Sustainability Team on 5th November 2020. Attendees included all the key design, environmental, and project management discipline leads working on the project. The target levels for each sustainability objectives were discussed and agreed during the workshop and recorded in the SFT. The workshop helped identify some key sustainability risks requiring mitigation measures to be put in place early in the design work. It also facilitated an interdisciplinary discussion to identify sustainability opportunities in design. Post the workshop, the minutes of meeting (MoM) capturing the key points from the workshop discussions was drafted and circulated to all the attendees for their review and comments which were incorporated.

2.3.4. The initial SFT was then populated using the inputs from pre-workshop calls, sustainability workshop discussions and reports on ProjectWise. The first draft of the SFT was sent out to the domain leads for the review comments in December 2020.

2.3.5. The sustainability team undertook a second round of update of the SFT based on the DF3 preliminary design in October 2022. A further review and update of the SFT was undertaken in October 2023 to capture the final DF3 design including the bus lane. This report presents the results of this October 2023 assessment of the DF3 design against the sustainability objectives.

3. Sustainability Framework Tool (SFT) Summary

3.1.1. This section contains the key findings gathered from the DF3 information update round, organised according to the five capitals. The information presented in the sections below reflects the key findings to the end of the preliminary design stage. It is expected that performance levels will increase as the design progresses into detailed design stage. In cases where assessments for DF3 have not been yet finalised or discussions, such as those regarding the construction phase, have not yet occurred, and therefore evidence has not been available, a note has been added to this effect.

3.1.2. The Table 3-1 below provides a summary of overall sustainability performance, listing the number of objectives where the scheme design performance is currently below the agreed target level, as well as where it is currently on track to exceed performance.

3.1.3. The Figure 3-1 provides a graphical representation of the Scheme sustainability target levels and current performance levels. The green circle indicates the agreed-upon minimum requirements for the target and performance levels, determined in consultation with the design and environmental discipline leads and representatives from GCC, based on the Scheme's priorities.

3.1.4. As highlighted in Table 3-1 and illustrated in Figure 3-1, four out of 11 sustainability objectives currently behind the performance target level are within the manufactured capital category. It is common for these gaps to exist during the preliminary design and it is expected for these objectives to meet the performance level (and therefore expectations) as the Scheme progresses toward the construction phase, for example through the development of a procurement strategy.

3.1.5. More detailed overview is provided in Appendix A.1 and supportive details on the performance on the sections 3-2 to 3-6 below.

Table 3-1 Summary of Overall Sustainability Performance

Performance Level against Target Level	Number of Objectives
Exceeds expectations	2
Meets expectations	13
Behind expectations	11

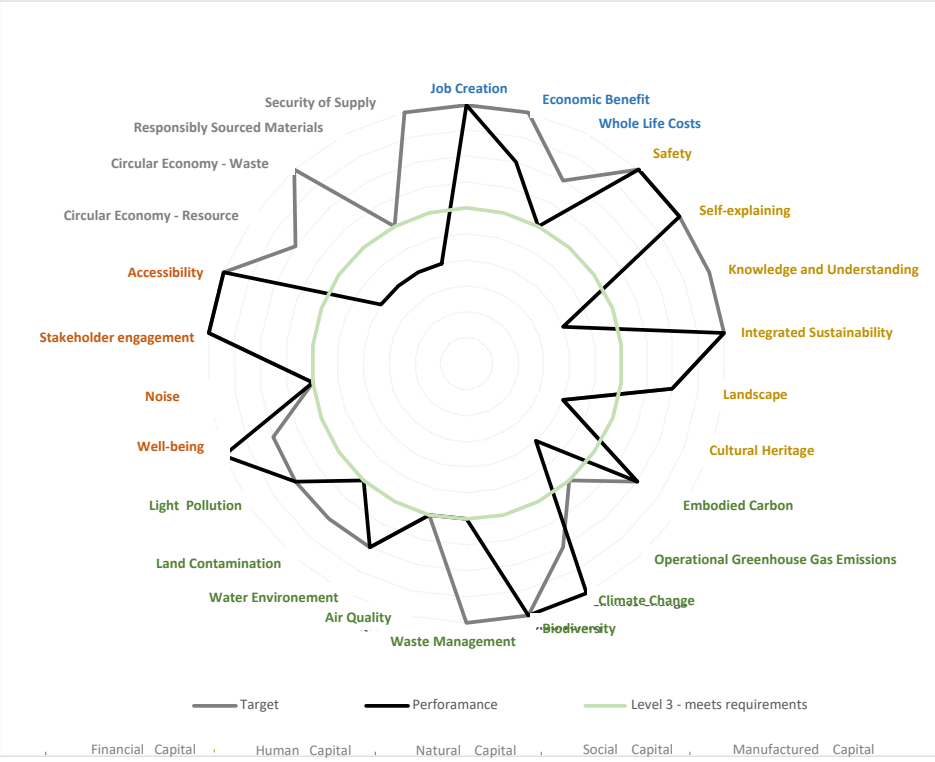

Figure 3-1 Overview of the current Sustainability Performance

3.2. Financial Capital

3.2.1. The Scheme is expected to perform exceptionally well from financial perspective (demonstrated in the target levels in the Table 3-2), as one of the primary objectives of the Scheme is unlocking the development and supporting economic growth within the region covered by the JCS.

Table 3-2 Sustainability Objectives on the Financial Capital

No	Sustainability Objective	Target Level	Performance Level
1.1a	Scheme results in an overall increase in jobs.	>250 (Major)	>250 (Major)
1.1b	Scheme delivers a benefit to the local economy.	Major Benefits	Moderate Benefits
1.2	Scheme uses whole life costing to inform all design decisions.	Moderate use and incorporation	Some use and incorporation

3.2.2. The current **job creation** reflects the number of employees in the design team and therefore the performance level is expected to reach the target level in subsequent stages once the contractor has been appointed. The construction of the Scheme will provide good opportunities in terms of providing temporary employment thus benefitting the local community. The working age group which includes around 65% of the population is anticipated to experience positive impacts associated with the scheme, through the creation of temporary employment opportunities during construction.

3.2.3. The Scheme also performs medium as per Value for Money (VfM) range and has a Benefit cost ratio (BCR) of 1.64 (Medium). The highway network under proposed scheme will also help unlock the major development of new housing and employment land opportunities proposed in the strategic allocations. The **economic appraisal** will be continuously refined during subsequent development Stages to give GCC and stakeholders a continued confidence in the economic justification for the scheme.

3.2.4. In terms of **benefits to the local economy**, the traffic modelling design considers the cost estimate assessment for maintenance cost, and the initial cost for constructing the infrastructure. The appraisal period is 60 years and the current cost benefit ratio report a medium value for money. In terms of Traffic Economic Efficiency (TEE), the scheme produces a high TEE totaling £0.97 million over the project lifetime, which includes £28.95 million of disbenefits associated with the construction of the scheme and -£42.43 million as the developer contributions. There are approximately £7 million of benefits accrued to Vehicle Operating Costs. The combined monetary impact of Greenhouse Gases and Air Quality results in £55.36 million of disbenefits, while the Scheme is anticipated to generate £1.85 million in benefits through noise reduction. Transport external costs were calculated using transport modelling and the Department for Transport's (DfT) TUBA tool. The assessment, which compared Scenario S with Scenario R, resulted in disbenefits totaling £332.60 million. From social cost perspective (in terms of accident rates), an assessment was carried out via the use of the DfT COBALT accident assessment software, and it resulted in £23.66 million of disbenefits for the P vs R Scenario. The Scheme is expected to generate a significant net land value uplift, with an estimated £602.95 million in net private value for housing and £26.47 million in net private value for commercial land

3.2.5. The Scheme considers **whole life costing** aspects for certain elements of the design, however, does not look at whole life costing of the entire Scheme as one entity. One of the examples being pavement where the whole life costing is an integral part of the pavement design and considers both direct cost and indirect cost in terms of road user delays. Additionally, high-level whole life cost for each developed option for structures have been considered in the decision-making. In addition to this, the use of LEDs is a good investment in the long term as it will result in reduced on-going maintenance and operational costs, including a significant reduction in traffic management and energy costs.

3.3. Human Capital

3.3.1. The Scheme is targeting to perform exceptionally well on most aspects of human capital (as demonstrated through the target levels in the Table 3-3) including health and safety, integrating sustainability, deploying robust processes to ensure continual improvement of the Scheme design and conserving the sense of people, place and context in the design. The Scheme intends to have no significant impacts in the area of cultural heritage, as detailed in paragraph 3.3.10 below. This has resulted in the target level of the Scheme in SFT to be under achieving. The potential loss of below ground heritage assets will be offset through a programme of recording via the material assessment, analysis and publishing of the information.

Table 3-3 Sustainability Objectives on the Human Capital

No	Sustainability Objective	Target Level	Performance Level
2.1	Minimise any adverse effects on health and safety due the Scheme, and enhance beneficial effects.	Major improvement	Major improvement
2.2	Ensure the roads are self-explaining and improve the understandability of the road.	Major improvement	Major improvement
2.3	Improving knowledge and understanding of sustainability across the (internal) project team.	100%	20-40%
2.4	Scheme has robust processes that create a continual cycle of improvement, with an in-depth understanding of people, place and context	Fully embedded	Fully embedded

No	Sustainability Objective	Target Level	Performance Level
2.5	Scheme conserves and enhances the character and quality of built and natural landscape.	Minor improvement	Minor improvement
2.6	Scheme minimises impact on significance of nearby cultural heritage sites and historic assets.	Minor negative impacts	Minor negative impacts

3.3.2. Improved Non-Motorised Use (NMU) routes have been introduced with further benefits to **human health and safety**. In more detail:

- An active travel corridor has been introduced along the length of the Link Road and the A4019 (within the extents of the Scheme). This provides traffic free space for cyclists and pedestrians to safely travel, with the objective of reducing additional car journeys induced by the Scheme and thereby reducing noise and air quality impacts, as well as providing exercise opportunities for people.
- The continuity of route provided, so that people can move safely. In addition to this, the inclusion of local access roads linked to the signalised junctions will enable local residents to retain an ease of access onto the A4019, particularly for turning right, with further benefits to safety.
- Further accessibility and safety will be provided through the proposed underpass underneath the A4019 which will provide traffic free access for pedestrians and equestrians across the A4019.

3.3.3. In regards to **human health**, replanting to roadsides will ensure that, in the long term, the Scheme would sit comfortably in the landscape and views and provide an enhancement of the environment to improve the experience for residents, pedestrians, cyclists and vehicles users. While there is an existing pedestrian walkway, the addition of 6m in width of dedicated walkway/cycleway will improve access to the natural setting around the A4019.

3.3.4. In addition to the above and in regards to **human health** during the construction phase, the use of best practice construction methods is intended to reduce disruption to users of sensitive receptors near the Scheme and minimise the effects on the community, especially those susceptible or vulnerable to health issues. Measures like clear signage and provision of access information for all users during construction and before operation is proposed for the Scheme. Traffic management will be implemented to maintain traffic flows during construction phase. To minimise any adverse effects, a Community Engagement Plan, outlining the methods in which the local and surrounding community will be engaged during construction of the Scheme including contact details for key site management has been recommended.

3.3.5. On compliance, the Scheme will conform with relevant DMRB guidance and aims to make the **road layout clear and consistent** with other parts of the road network. One of the main aims of the Scheme is to minimise the number of departures, avoiding any non-prescribed signs and following the widely used and understood DMRB guidance on road signs. Direction signing uses map type signs wherever possible to provide drivers with information about the layout ahead. Speed limits are clearly signed, and no U-turn signs are repeated along the A4019 to mitigate against illegal manoeuvres. In addition to this, improvements in the road alignment have been incorporated in the design to improve visibility e.g., by raising the existing vertical alignment in section to tie into the proposed gyratory.

3.3.6. Design leads have been participated to **sustainability workshops**, leading to increased understanding of critical sustainability concerns. The workshop helped identify some key sustainability risks requiring mitigation measures to be put in place early in the design work. It also facilitated an interdisciplinary discussion to identify sustainability opportunities in design. Following this, the Atkins Design for Life e-learning modules were introduced to

all design and environment leads, who were encouraged to complete in order to improve knowledge and understanding of embedding sustainability in design. The current completion rate of the Design for Life modules has been partially completed.

3.3.7. The **design process** is driven by best-practice version control processes and building information management. The use of Navisworks is integrated into the design process, a 'federated model' which creates a whole-project view, modernises and expedites the design process, which would otherwise have to be checked with reference to multiple 2D drawings in PDF format. The model captures information from subsidiary models managed by individual disciplines, presenting information in a 3-dimensional 'fly-through' where input information can be presented as 'layers' which are toggled on and off. Navisworks has a robust system of version control so that past and present versions of the design can be quickly viewed for reference. Visual clashes are immediately obvious and facilitate quick resolution – the 'Clash Matrix' function is a specific facility in the model to flag issues. Design proposals can be discussed in light of constraints that could visually manifest (in particular, land constraints), and/or clashes with the requirements of other design aspects. Where clashes are found and need resolution, these are assigned owners and taken forward to be resolved by relevant disciplines. Additionally, to support integrated contribution to better design outcomes, standard processes like Transportation Deliver Work (TDW), Inter-Disciplinary Design Reviews (IDRs) have been undertaken to ensure that designers consider the implications of their designs on the other disciplines at all stages of delivery, particularly when design or data changes are being made.

3.3.8. The design conserves and enhances the character of the **built and natural landscape**. Consideration has been given to the landscape and planting design to ensure that it fits as naturally as possible in the existing design context with the aim of reducing visual impacts and ensure landscape integration. Embodied mitigation measures such as retention of vegetation, avoiding destruction of habitats and inclusion of SuDS, have been consistently considered throughout Scheme development. Attenuation ponds and a large flood storage area are proposed. Moreover, it is proposed that the vegetation removal is limited to where necessary for the works; where possible new road alignments should be adjusted during detailed design development to avoid mature trees and hedgerows. These measures would ensure that, in the long term, the Scheme would sit comfortably in the landscape and views and provide an enhancement of the environment to improve the experience for residents, pedestrians, cyclists and vehicles users.

3.3.9. The design minimises the impact of the Scheme on **cultural heritage assets** through the incorporation of embedded mitigation into the design. These include the lighting and noise mitigation design that mitigates visual and noise impacts to the settings of the rural heritage assets such as those near Millhouse Farm (Withybridge Lane) and the assets at Uckington. It also includes the design changes that were made earlier in development, removing the originally proposed new through-road along Moat Lane to avoid impacting the settings of the designated heritage assets at Moat House. Lighting design for the Moat Lane Junction has been developed to avoid encroaching into the visual setting of the designated assets at Moat House.

3.3.10. In regards to **cultural heritage assets** during the construction of the Scheme, this is expected to require the removal of the sub-surface archaeological remains located within the footprint of the Scheme alignment. Six known archaeological sites may be impacted by the construction works. Direct impacts to archaeological remains that will be removed as a result of the construction of the Scheme will be mitigated through a programme of excavation and recording commensurate with the significance of the remains and will form part of the Archaeological Management Plan (AMP). Indirect impacts to the settings of heritage assets during construction activities will be mitigated through an Environmental Management Plan (EMP), addressing the specific environmental impacts e.g., increase in noise levels through appropriate mitigation. There may also be opportunities to enhance the historic environment through the application of National Highways' Designated Funds for Users and Communities, to help protect the settings of designated heritage assets within the study area, particularly those at the Moat House Scheduled Monument, where future development is likely and could further erode the setting of those assets if not protected.

3.4. Natural Capital

3.4.1. The Scheme is targeting to perform well on most aspects of natural capital (as demonstrated through the target levels in the Table 3-4) and is set to deliver improvements in Natural capital, with further scope to explore opportunities, especially around biodiversity, carbon and climate change impact and waste management areas. These are areas that will be addressed further through the detailed design stage.

Table 3-4 Sustainability objectives on Natural Capital

No	Sustainability Objective	Target Level	Performance Level
3.1a	Scheme minimises the embodied carbon (greenhouse gas) emissions associated with the design and construction of the project	Moderate (10-20%)	Moderate (10-20%)
3.1b	Scheme minimises greenhouse gas emissions during operation and decommissioning.	No increase	Minimal increase
3.2	Resilience to current extreme weather and future climatic conditions specific to the local and surrounding area have been identified, assessed and incorporated into the scheme.	Moderately incorporated	Climate resilience fully incorporated
3.3	Scheme ensures there is no net biodiversity loss and encourages gains.	Major Biodiversity Net Gain	Major Biodiversity Net Gain
3.4	Scheme seeks to maximise landfill diversion (includes non-hazardous construction, demolition and excavation waste)	Zero waste to landfill	95%
3.5	Scheme ensures there are no significant adverse effects on air quality and seeks improvement where possible.	No/minimal impact	No/minimal impact
3.6	Scheme ensures there are no significant adverse effects on water environment and seeks improvements where possible.	Moderate improvements	Moderate improvements
3.7	Scheme ensures there are no significant adverse effects on land and soil quality and seeks improvement where possible. (Includes agricultural land)	Moderate improvements	No/minimal impact
3.8	Scheme seeks to limit the impact of light pollution resulting from the road network and improve where possible.	Moderate reduction	Moderate reduction

3.4.2. A comparison of the **embodied carbon** assessment carried out during DF2 and DF3 shows that the DF3 has a 26% higher impact compared to DF2 (as presented in Table A.2 in Appendix B). This is due to the updated material quantities used for the DF3, including the consideration of additional elements that had originally not been quantified at DF2, namely drainage, street furniture and fuel consumption from construction plant and equipment. Removing these three items from the calculation (Table A3 in Appendix B) reports a 17% reduction in embodied carbon between the DF2 and DF3 designs, which is what is considered to evaluate the performance level. This has been achieved primarily through greater efficiencies in materials requirements for bulk materials, road pavement and structures in the DF3 design, which has amounted to a ~45% reduction in embodied carbon.

3.4.3. Carbon assessments have been carried out for each of the developed option for structures and embodied carbon has been a factor considered in the decision-making. Examples of embodied carbon savings include 7% carbon savings for the Piffs Elm Interchange Bridge North and 23% carbon saving for the Piffs Elm Interchange Bridge South. Another

example is the West Cheltenham Link Road which was identified through traffic flow analysis to be reduced from dual carriageway down to single carriageway, which would result in a meaningful material saving with limited impact on traffic-based emissions due to congestion. Another design example that leads to material, and consequently, carbon reductions, is through the positioning of lighting columns between verge of pathway and motorway thus reducing number of columns rather than providing separate lighting for pathways.

3.4.4. It is expected that the **carbon impact** will also be reduced through effective waste management as the Scheme aims to achieve at least a 70% recycling / recovery rate for all construction, demolition, and excavation (CD&E) waste generated on-site, as per the Waste Framework Directive target. Emissions will be mitigated by applying Highways England's carbon reduction hierarchy: Avoid/ Prevent, Reduce and Remediate. Defined measures consistent with PAS 2080:2016 'Carbon Management in Infrastructure' will be followed for the operation stage. Off-site mitigation measures will be considered for managing carbon impacts.

3.4.5. In regards to **emissions of greenhouse gases once the Scheme is operational**, traffic levels are expected to increase across the local network through forecast growth, although the uptake of electric vehicles will reduce the emissions of greenhouse gases as the operational phase of the Scheme progresses. Additionally, the provision of an extensive walking and cycling route along the A4019 will support a shift of mode choice away from motorised transport for shorter journeys. A significant increase in use of the A4019 by pedestrians and cyclists is forecast and it is considered that the improvement in cycling and pedestrian facilities combined with the shift to electric vehicles will support a reduction in carbon emissions. Emissions produced during the operation of the Scheme will have a negligible impact on the county's overall carbon emissions and will not affect UK's ability to meet its carbon targets.

3.4.6. The **vulnerability of the Scheme to climate change** considered climate variables including extreme temperatures and rainfall and hazards (flooding, snowstorms), and how they are expected to change over the lifetime of the project (more extreme weather events and warmer wetter winters and hotter drier summers). Climate vulnerability impacts are not expected to significantly affect the construction of the Scheme. The vulnerability of the Scheme to climate change once it is operational, particularly in relation to future extremes of temperature and the management of heavier rainfall, has been considered through the development of the design. It is not considered that the Scheme will experience significant adverse effects from climate change.

3.4.7. In terms of **flood risk management**, the drainage infrastructure is designed with consideration of the predicted future changes in precipitation, both changes to volume and peak intensity from extreme events. With regard to pluvial flood risk on the road surface, the surface water drainage system is designed to control runoff rates up to 1 in 100-year return period with allowance for climate change. In line with the NPPF, the design flood for the Scheme is the 1% annual exceedance probability event (1 in 100-year return period) with an allowance for future climate change. All projects on motorways and all-purpose trunk roads have been designed to remain operational and safe for users in times of flood, to result in no net loss of floodplain storage, to not unduly impede water flows, and to not materially increase flood risk elsewhere unless accepted by the landowner.

3.4.8. The Scheme is targeting establishing a major **Biodiversity Net Gain (BNG)** and is looking at landscape and water management measures to implement this. Habitat creation measures aim to achieve a net gain in biodiversity and contribute to the Gloucestershire Nature Recovery Network. An area of farmland to the southeast of the motorway junction will be transformed into an area supporting wetland habitats, scrub, woodland and species-rich grassland, whilst also fulfilling its role as a flood storage area. The embankments along the Link Road will be planted with blocks of woodland and hedgerows with trees. The A4019 planting comprises hedgerows and trees to the north and south, as well as trees within the central reserve and areas of species rich grassland. This will create a more robust habitat network than is currently the case, and have been quantified as exceeding the 10% threshold for biodiversity net gain for all habitat types present.

3.4.9. In terms of **waste** to landfill, existing infrastructure would be re-used and refurbished preferentially, over new infrastructure where possible. At construction stage the Scheme

will seek to achieve a 95% recovery rate/diversion from landfill for the wastes generated during construction.

3.4.10. In regards to **air quality**, the redesign of the M5 Junction 10 will result in a redistribution of traffic on the existing road network and therefore there will be a balance between raised impacts in some areas and lowered impacts in others. Any air quality impacts once the Scheme is complete and operational are identified as not significant and no mitigation measures have been recommended. Any air quality impacts due to construction would be temporary and are expected to be minimised by the application of best practice and appropriate mitigation measures. Construction plant emissions shall be minimised by designing for efficient construction processes as part of design development. During construction, plant emissions should be managed via the EMP, which should specify plant operator efficiency requirements.

3.4.11. In respect of the **water environment**, an assessment was carried out considering the impacts (both construction and operation) on surface water quality, surface water hydromorphology, groundwater and flood risk from rivers, surface water and groundwater. A drainage strategy has been developed to allow for management of volumes and quality of any surface runoff from the highway. The drainage strategy consists of nine drainage catchments along the M5, A4019 and the Link Road. To avoid direct discharge of highway runoff into surface watercourses, sustainable drainage systems (SuDS) have been incorporated into the design. This will provide improvements to surface watercourses compared to the current road drainage. There is potential for erosion along the River Chelt which may impact proposed fences, public right of way and bridge abutments associated with the Link Road Bridge over the River Chelt. To ensure sustainability of the crossing, bank protection will be implemented under the structure. The details of the bank protection will be determined at detailed design. However, at this stage of the assessment, a worst-case scenario has been assessed. In regards to groundwater, embedded mitigation e.g., consideration of scheme specific groundwater levels incorporated into piling design and methodology, piling risk assessment and safe disposal of water, will be adhered to throughout the construction and operation of the Scheme.

3.4.12. Additionally and in regards to the **water environment**, two areas of land are identified for flood compensation requirements for the Scheme. This includes a large (>190,000 m^3) flood storage basin between the M5 motorway and Withybridge Lane, and ~2,775 m^3 of compensatory floodplain immediately east of the Link Road. From an ecology and landscape perspective, the larger flood storage basin will be a source of permanent wetland area thus contributing to biodiversity net gain.

3.4.13. Construction activities such as earthworks, piling, installation of drainage and other below ground services could potentially introduce new **sources of contamination** (i.e., from spillages and leaks) and disturb and mobilise existing sources of contamination, which may pose a risk to human health and controlled waters receptors. New sources of contamination may also be present during operation, e.g., from accidental spills and leaks. However, these will be managed through the new highway drainage design so that impacts to surrounding watercourses are avoided. A ground investigation has been completed for the Scheme. Chemical testing data was assessed, and a generic quantitative risk assessment (GQRA) completed which concluded that it was unlikely that there was an unacceptable risk to human health from soils.

3.4.14. The primary issue identified in the Scheme area in terms of **soil quality** is the Thaumasite Sulphate Attack (TSA) which has already led to remedial works to the structure at Piffs Elm Interchange Bridge. TSA is an aggressive ground condition that poses a corrosion risk to buried concrete structures and therefore all new structures will need to be designed with this risk in mind. As a mitigation measure, a geotechnical risk register has been developed as a live document to capture the Scheme risks and deployed mitigation measures to enable appropriate design activities.

3.4.15. The **lighting** for the Scheme has been optimised and over designing is avoided to minimise potential light pollution effects to find a balance between safety and the environment. Therefore, street lighting along the Link Road will be limited to the two new junctions and the sections of the Link Road adjacent to the junctions. Wildlife-friendly lighting is to be implemented throughout the Scheme, where lighting is required. The Link Road will not be lit, apart from a short section at the junctions at the northern and southern

ends. The lighting design along the A4019 has been designed to provide two dark corridors to provide mitigation for lighting impacts to bats.

3.5. Social Capital

3.5.1. The Scheme targets are set to perform well on the aspects of social capital like stakeholder engagement and accessibility and acceptably well on noise (as demonstrated through the target levels in the Table 3-5). The Scheme intends to perform reasonably well in the area of wellbeing of affected communities, since GCC identifies the wellbeing of users as one of the important aspects for the Scheme and wants the Scheme to be ambitious on social well-being.

Table 3-5 Sustainability objectives on Social Capital

No	Sustainability Objective	Target Level	Performance Level
4.1	Scheme improves the well-being of road users and communities affected by the network.	Moderate improvement	Major improvement
4.2	Scheme ensures there are no significant adverse noise effects and seeks improvement where possible.	No significant adverse impacts	Moderate adverse impacts
4.3	Scheme seeks to involve a diverse range of local stakeholders and maximises opportunities for stakeholder engagement at each PCF stage.	Full engagement (100%)	Fully engagement
4.4	Scheme incorporates the accessibility needs and ensures social inclusion of all road users and stakeholders	Fully incorporated	Fully incorporated

3.5.2. Improved Non-Motorised Use (NMU) routes have been introduced as part of the design, which is expected to have a **beneficial outcome to residents' and wide communities' well-being**. The Scheme design includes an active travel corridor along the length of the Link Road and the A4019 (within the extents of the Scheme). This provides traffic-free space for cyclists and pedestrians with the objective of reducing car journeys through the Scheme and thereby reducing noise and air quality impacts, as well as providing safe exercise opportunities. The continuity of route enables people to move safely without the need to use vehicles for walkable distances. In addition to this, the inclusion of local access roads linked to the signalised junctions will enable local residents to retain an ease of access onto the A4019, particularly for turning right, with further benefits to safety. Further accessibility and safety will be provided through the proposed underpass underneath the A4019 which will provide traffic free access for pedestrians and equestrians across the A4019, with the bridleway AUC1 extended from the north of the A4019 through the underpass and connecting to Withybridge Lane to the south of the A4019.

3.5.3. In addition to the enhancements to NMU access, public transport accessibility will benefit from improved traffic flow, the renewal of bus stop infrastructure, and the inclusion of a bus lane along a section of the eastbound A4019. These in turn will lead to increased ease of movement with further **benefits to wellbeing and community access**. Additionally, space for a bus lane on A4019 has been considered to accommodate increased capacity in future and support further development in the area.

3.5.4. The **well-being** of local communities can be impacted by appropriate landscaping. Mitigation planting has been proposed with appropriately sized banks of planting to provide screening whilst avoiding the introduction of uncharacteristic large blocks of woodland.

3.5.5. There are a number of Noise Important Areas (NIA) within the Scheme area, and the Scheme has the potential to affect the **local noise climate**, both during construction and operation. The potential impacts of noise during the construction stage will be minimised

through the implementation of best practice measures during construction, and the siting of construction compounds away from properties where possible. During construction, local residents will be kept informed of the progress of the works, and when the noisiest activities will be taking place. Noise barriers have been proposed within the NIAs where existing noise levels exceed the SOAEL, to reduce noise impacts of the Scheme during operation. New road surfacing (that is free from potholes and other wear and tear) throughout the Scheme will also reduce noise and vibration levels from traffic during operation.

3.5.6. **Extensive stakeholder engagement** has been undertaken for the Scheme, with residents as well as relevant authorities. The statutory consultation ran for 10 weeks from 8 December 2021 until 15 February 2022. A total of 579 survey responses were received during the consultation period, with 74% of survey respondents agreeing or strongly agreeing with the proposed improvements to M5 Junction 10. Design changes made in response to the feedback received includes the rearrangement of proposed new junction locations on the A4019, addressing residents' concerns around safety and access, allowing right turns off the A4019 at the Gallagher Retail Park junction and extending the segregated footway and cycleway on the A4019 and Junction 10 (within the Scheme boundary). In addition to the consultation, individual design teams have engaged with the relevant local authority representatives; for example, the heritage team engaged with the county archaeologist on a regular basis and any public engagement is part of the wider public consultation program undertaken by the stakeholder engagement team. The stakeholder engagement plan for the Scheme has been agreed with GCC and is outlined in the Stakeholder Engagement and Communications Plan (SECP)..

3.5.7. In regards to the **social inclusion of the all the stakeholders**, the consultation materials have been developed in collaboration with the GCC communications team and include the following: website with an interactive mapping page, consultation brochure, consultation survey, leaflet drop (for local residents and businesses), posters to advertise in local businesses and community facilities, stakeholder letters and emails (tailored to specific individuals and groups as identified in stakeholder mapping), and e-newsletters (available on council and Highways England website and /or social media channels).

3.6. Manufactured Capital

3.6.1. For manufactured capital objectives and performance, although the Scheme is targeted to perform reasonably well on an overall basis, because the Scheme is currently in the preliminary stage of design, the performance level for the manufactured capital performance is significantly below target (as demonstrated through the target levels in the Table 3-6). This is due to the status of the project at preliminary design stage. Being behind performance targets at this stage is expected, and performance is anticipated to improve in subsequent phases, when more detailed planning and contractor involvement will develop.

Table 3-6 Sustainability Objectives on Manufactured Capital

No	Sustainability Objective	Target Level	Performance Level
5.1a	Scheme seeks to minimise resource-use during construction, operation (non-user) and maintenance.	5-10% (Moderate reduction)	No reduction
5.1b	Scheme seeks to minimise waste generation during construction, operation (non-user) and maintenance.	>10% (Major reduction)	No reduction
5.2	Scheme maximises use of responsibly sourced materials that minimise adverse impacts on people and their environment	10-20%	<10%
5.3	High risk materials due to security of supply are identified and the information is used within optioneering.	Fully used and incorporated	Minimal use and incorporation

3.6.2. The Principal Contractor is expected to aim to achieve at least a 70% recycling / recovery rate for all construction, demolition and excavation (CD&E) **waste** generated on–site, as per the Waste Framework Directive target. This can be achieved by arranging for the source segregation of recyclable waste and the provision of appropriate recycling facilities. Achieving this recycling target will minimise impacts to the environment and human health, reduce energy and carbon and improve the overall sustainability of the Scheme. The target will also enable reduced costs associated with material procurement and waste storage, collection, management and disposal. The design, as submitted, includes the reuse of a minimum of approximately 201,765 tonnes/ 148,409 m^3 of potential waste on site which would substitute the use of primary materials (representing the reuse onsite of at least 70% of total potential waste) with the majority of the remaining potential waste requiring management offsite also expected to be recovered/recycled. At construction stage the Scheme will seek to achieve a 95% recovery rate/diversion from landfill for the wastes generated during construction. The mitigation measures also include maximising potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required; and exploring alternative lower carbon options to deliver the Scheme objectives (i.e. shorter route options with smaller construction footprints). Additional measures include the application of low-carbon solutions (including technologies, materials and products) to minimise **resource consumption** during the construction, and construct efficiently, using techniques that reduce resource consumption over the life cycle of the Scheme.

3.6.3. For **material procurement**, the use of the proximity principle for material assets and the management of waste is anticipated to be deployed at subsequent construction and maintenance stages of the Scheme. Discussions are expected to be conducted with the supply chain during the procurement and construction stage to the define sustainable approach to materials such as use of reusable packaging, return of unused materials and prioritization of responsibly sourced materials for the Scheme. These expectations are not mapped into the performance level at this design stage but if acted on, will improve the overall performance of the scheme over the project life.

3.6.4. Where possible, detailed design and procurement measures would be specified to enable **local sourcing of materials**. Local contractors would be used where possible, reducing the distance driven by employees. Due to the DMRB guidelines, the contractor has more flexibility in terms of material selection now, as the standards are moving away from specifications and are becoming more performance based. As above, these expectations are not mapped into the performance level at this stage.

3.6.5. No risk was confirmed by the project teams on the **security of material supply**, however, as there are number of smaller schemes ongoing in the area, availability of materials is considered as a worst case to be a key constraint, although these schemes may also provide sources of aggregate or soil for use in the Scheme. Further information on the risks associated with material supply chain will be developed at the next stage of design.

4. Risks and Opportunities

4.1.1. By embedding sustainability in the design, a number of key risks and opportunities have been identified and are recommended to be addressed at the next design stage and/or construction.

4.2. Key Risks

4.2.1. As detailed in Section 3 of this report, there are 15 (58%) sustainability objectives and target levels that are already currently being achieved based on the preliminary Stage 3 design (on the assumption that the current design will be constructed). The environmental and social risks identified below will need to be appropriately mitigated in order to ensure targets currently being met in Stage 3 are still being achieved during Detailed Design and Construction.

Environmental Risks

4.2.2. Risks to the environment have been limited through the embedded mitigation in the preliminary design, and the further essential mitigation measures identified. Risk should be limited further through the detailed design and construction phases. The design teams work closely with the key environmental experts to ensure that wherever possible there are no significant adverse impacts to the environment; water environment, land and soil quality, light pollution, air quality and biodiversity loss.

4.2.3. During detailed design, it is recommended that project teams should continue to adhere to these principles, ensuring that no further impacts are created and where possible enhancements to different environmental aspects should be built into the design.

4.2.4. The construction stage also poses a risk to the environment. For instance, shortcomings in construction practices can have a detrimental impact on multiple aspects of the environment, some of which include:

- Chemicals leaking into water sources, impacting water quality and fish species.
- Removing archaeological artefacts without appropriate surveys first or without recording the artefact.
- Using diesel generators for long periods of time will temporarily impact the air quality of the area, potentially affecting the health and safety of working conditions.
- Not adhering to the waste hierarchy, resulting in large quantities of material being sent to landfill.

4.2.5. Therefore, it is essential that contractors adhere to best practice guidance and follow all procedures outlined in the EMP documentation.

Social Risks

4.2.6. The construction stage poses a risk to achieving some of the social objective targets. For instance, shortcomings in construction practices that can have a detrimental impact on multiple aspects of society, some of which include the following. However, the practices implemented through the Scheme's EMP should prevent these from occurring:

- Working during unsociable hours (especially with no prior notice) will increase the noise disturbance on those living around the construction site. Working hours should be agreed and communicated to residents in advance of construction commencing.
- Using unsociable lighting during construction, especially during the evening will increase disturbance on those living in close proximity to the construction site.

- Not being respectful of the surrounding area, for example increased litter during construction.

4.3. Key Opportunities

4.3.1. As detailed in Section 3 of this report, there are 11 (42%) examples where the target level has not yet been achieved at this preliminary design stage. There is thus an opportunity to improve the sustainability performance of the Scheme by implementing sustainable design measures and more sustainable construction practices.

4.3.2. Some of the sustainability targets are reliant on implementation of sustainability measures at the next (detailed) design stage and throughout construction to ensure they are achieved for the Scheme. It will be essential that the key opportunities listed below are fully considered by the Principal Contractors.

Key opportunities are noted below, with further detail provided in subsequent sections aligning to particular sustainability topics:

4.3.3. TOP OPPORTUNITY: Embankment options that avoid the need for importing large quantities of soils need to be considered, for example:

- Steepening the embankment slopes from the 1:3 slope in the DF3 design, to a steeper slope. This would reduce the volume of materials required, and also the footprint of the embankment.
- Reducing the vertical height of the embankment from that shown in the DF3 design. This would also reduce the volume of materials required for the embankment. Assuming the slope angle is 1:3 or steeper, then reducing the vertical height of the embankment would also reduce its footprint.

4.3.4. This will lead to embodied carbon reduction with a knock-on beneficial effect on the transportation related emissions.

- A whole-life carbon calculation may be required to confirm that the alternative options make a meaningful carbon reduction.
- Consideration of importing soil from local schemes.

Financial Capital

Job Creation and Economic Benefits

4.3.5. Job creation due to the Scheme should be continuously monitored throughout Detailed Design and construction by:

- Keeping a record of all those working on the Detailed Design stage of the Scheme. For the Detailed Design stage, it is likely that many employees will not be working full time and so a full-time equivalent (FTE) figure should be calculated and recorded. It is noted that so far through Stage 3 design, a total of more than 250 FTE have been involved in the Scheme and this is expected to increase in Detailed Design and construction.
- The construction stage is likely to contribute the most to job creation on the Scheme. The contractor will need to keep the number of workers under review to ensure this objective is achieved.
- In addition, where possible, the contractor should use the local skills base and resources as part of the construction workforce, offering apprenticeships and training to young people in the local area.

4.3.6. In terms of benefits to the local economy, the Detailed Design and construction stage have an important role to play in this by:

- Capturing in more detail and providing an update on the wider economic impacts of the Scheme on the local economy during the Detailed Design.

- Encouraging the contractor to use SMEs in the surrounding area as potential suppliers to the Scheme.

Human Capital

Robust Processes

4.3.7. Within Project teams, there are opportunities to reduce the risk of error, lower the resourcing and time requirements and provide a single repository for documentation throughout the Detailed Design:

- Use the digital DCO online tool to collect all relevant documentation for the DCO such as EIA.

Natural Capital

Embodied Carbon Emissions

4.3.8. Top opportunity: embankment options that avoid the need for importing large quantities of soils need to be considered. Knock on carbon savings from transportation and construction will also be achieved. A whole-life carbon calculation may be required to confirm that the alternative options make a meaningful carbon reduction. In the case that importing material is required, understanding of available soils in the area e.g., from other major projects within close proximity to the scheme, is advised to reduce as practically possible any transport related carbon emissions.

4.3.9. In line with relevant policies in both national and local level, there have been commitments to net zero carbon emissions. It is therefore recommended that carbon reduction is a key focus of design and construction. It is recommended that Whole Life Carbon Modelling is implemented on the Scheme to better identify carbon hotpots and implement low-carbon practices where possible. PAS 2080 compliance should also be considered.

4.3.10. The carbon calculations undertaken at this stage considered the embodied and operation carbon impact of the Scheme. For the construction phase, the transportation of materials to site have been taken into consideration, however emissions from construction processes have not been considered at this stage due to absence of data.

4.3.11. Embodied carbon emissions can be reduced during the next stage of design through the following suggestions:

- Any opportunities to reduce the volumes of materials should be considered, as reducing material volumes is likely to have the highest potential to reduce carbon emissions in the design. Particular attention should be given to reducing the quantities of high impact materials such as concrete and steel. Low-carbon alternatives to traditional materials should be considered wherever possible.
- Explore the opportunity to depart from Hot Rolled Asphalt (HRA) standard and use Warm Mix Asphalt (WMA), which is has less carbon intensity, as an alternative.
- Any efforts to reduce the volumes of materials in the design will have positive knock-on effects in the transportation stage, as lower quantities may result in fewer journeys and therefore a lower overall carbon impact.
- Any opportunities to utilise recycled or site-won materials in the design should be explored wherever possible as these could substantially reduce the overall carbon impact.
- Where possible, materials should be sourced locally rather than being imported from abroad.

4.3.12. Embodied carbon emissions can be reduced during the construction stage by implementing the below sustainable practices:

- Alternative methods of transportation (compared to traditional road freight) should also be explored (with realistic consideration of feasibility and total

impact) in order to transport large quantities of materials more efficiently e.g. rail over road.

- Any opportunities to optimise the construction process by reducing the plant machinery and vehicles required and/or their time on site should also be explored, as well as choosing electric or hydrogen plant machinery and vehicles, and using renewable energy wherever possible on site.

Water environment

4.3.13. There are opportunities to enhance the water environment throughout the Detailed Design and construction stages.

4.3.14. During the Detailed Design:

- Work is required to determine the specific requirements of bank protection under the Link Road River Chelt Bridge. This work will include a scour assessment to determine the need for bank protection and further consultation with the Environment Agency.
- More detailed assessment is required to model bank reprofiling in the Scheme's Hydraulic model to confirm initial assessments into the impacts on flood risk.
- Landscape plans should be developed to ensure appropriate riparian and aquatic vegetation are implemented.
- The detailed design of the large flood storage basin can be used to further enhance the biodiversity credentials of this area. From an ecology and landscape perspective, the flood storage basin will be a source of permanent wetland area thus contributing to biodiversity net gain. Any enlargement would also further reduce flood risk downstream.

4.3.15. In addition to the standard, best practice mitigation measures required during construction, there is potential for construction impacts on the River Chelt. Engagement with the Environment Agency will be crucial to determine appropriate mitigation in relation to sensitive fish species.

Waste Management

4.3.16. With regard to the diversion of waste from landfill, there will be key measures incorporated during next stage of design which will help achieve this:

- The design should consider using materials that can be recycled or reused at the end of their design life.
- During Detailed Design, any waste that is unlikely to be reused on the Scheme should be identified and this communicated to the contractors as early as possible. Collaboratively, efforts should be made to identify alternative solutions for waste management, such as local recycling centres.

4.3.17. Diverting waste from landfill will primarily be the responsibility of the contractor during the construction stage and the following best practices should be implemented:

- Construction waste materials should be recycled or re-used on site where possible; and any on-site or off-site re-use should follow appropriate regulatory requirements (e.g. via a Materials Management Plan or other relevant approaches).
- Limiting the use of imported fill materials. If importing fill materials is necessary, then other programmes and schemes of work in the local area that are generating fill material as waste should be considered. This should help with preservation of natural resources and reduction in overall carbon emissions.
- Any materials that are to be exported off-site should, where possible, be reused preferably by local projects. Disposal of waste to landfill or recycling centre should be conducted in accordance with relevant legislation and duty of care.

Social Capital

4.3.18. On social capital, all of the targets have been achieved, however there are still opportunities to both maintain and improve the performance as the Scheme progresses. Such opportunities include continued stakeholder engagement and consideration of the impact of the scheme to wellbeing during construction e.g. through ensuring accessibility is maintained and noise, light and air pollution is minimized.

Manufactured Capital

Construction Energy Consumption

4.3.19. Construction energy consumption can be reduced by key measures implemented at the next stage of design:

- The design should consider the use of prefabricated materials and lightweight modular elements where possible, as these typically allow for more rapid construction, thus reducing energy consumption on site. The use of these types of material will also facilitate easier and safer construction.

4.3.20. Construction energy consumption can be reduced during the construction stage by implementing the below sustainable practices:

- The use of more efficient machinery (plant machinery and vehicles) and equipment for the construction phase, as well as optimising the work delivered in time shifts. Where possible, electric machinery and reduced vehicle use on site should be implemented to reduce carbon emissions as far as possible.
- Investigation into the possibility of connecting construction equipment to the mains supply, rather than using diesel generators (which are more energy intensive) should occur in order to reduce energy consumption and create a healthier work environment for construction workers. In addition, using batteries or local renewable energy generation (solar PV or wind energy) on the construction site should be explored.
- Carefully consider construction programme to minimise unnecessary fuel usage from plant equipment.

Circular Economy – Resource Use and Waste Generation

4.3.21. Circular economy principles should be identified throughout the next stage of design:

- Calculations should continue to be developed as the design progresses, ensuring that the design can accommodate as much as possible of the waste generated from the Scheme.
- To reduce the amount of waste generated on the Scheme, the Design Team should continue to explore ways of retaining what is already there, including materials and structures.
- With other major projects within close proximity to the scheme, there is potential for greater collaboration between projects and material use across the sites.

Responsibly Sourced Materials

4.3.22. Responsibly sourced materials should be specified during the next stage of design stage:

- Consider materials that go beyond BAU standards. This will be difficult to achieve due to the safety restrictions but should be fully considered and discussed should there be any specific materials that are identified and deemed suitable for the Scheme.
- Ensure that the design specifies the use of sustainable materials. Where possible, the design also should identify local sources for materials to avoid long transportation distances, and associated carbon emissions.

4.3.23. Responsibly sourced materials are primarily the responsibility of the contractors during the construction stage:

- In terms of materials, the contractors should recognise the need to use all materials in the most appropriate and sustainable manner, whether this is achieved through using recycled material, certified materials or locally sourced materials.
- There is no comprehensive list of what constitutes 'responsible practice' when selecting and approving suppliers. Some key principles listed below are considered to be good practice are logically and ethically consistent that the principles apply equally to the organisation making these purchasing decisions as well as its suppliers. For instance, the contactor should ensure that all their suppliers have a criterion for responsible sourcing of materials, such as the accreditation scheme BRE BES 6001 or Considerate Constructors or adhere to ethical standards within their organisations (including ensuring against the use of child labour and modern slavery).

Security of Supply

4.3.24. The security of supply of high-risk materials can be controlled to some extent during next stage of design by implementing the following suggested actions:

- Conduct a more detailed analysis of the types of high-risk materials It is suggested that a risk matrix is produced to identify the risk (likelihood and severity of impact) of key materials being unavailable, and the mitigation that should be implemented to reduce this.
- Early engagement with the contractors will be essential to ensure that all high-risk materials are identified, and this should better enable the contractors to plan and, if needed, source materials that might pose a lower risk to the Scheme delivery.

4.3.25. The security of supply of high-risk materials will primarily be the responsibility of the contractor during the construction stage and the following best practices should be implemented:

- Early engagement should occur between the contractor and all suppliers to ensure that materials will be available to deliver the Scheme on time and to budget. Contractors should identify and engage with suppliers of particularly high-risk materials as early as possible to ensure supply can be secured.
- Contingency planning should also occur between contractors and their suppliers to help mitigate risks.

5. Conclusion

5.1.1. Overall, it can be concluded that out of the 26 sustainability objectives set for the Scheme, the current design is meeting or exceeding the target levels set for 15 objectives (58%). Of these, the following 5 are achieving the highest target and performance levels demonstrating that the current design has resulted in an exceptional sustainability performance and/or has led to a major improvement (compared to specific baselines associated with each objective):

- **Safety**: Minimise any adverse effects on health and safety and enhance beneficial effects.
- **Well-being:** Scheme seeks to improve the well-being of road users and communities affected by the network.
- **Climate Chage:** The Scheme seeks to be resilient to current extreme weather and future climatic conditions specific to the local and surrounding area
- **Stakeholder Engagement:** Scheme seeks to involve a diverse range of local stakeholders and maximises opportunities for stakeholder engagement at each stage.
- **Accessibility**: Scheme incorporates the accessibility needs and ensures social inclusion of all road users and stakeholders.

5.1.2. However, as there are 11 (42%) examples where the target level for a sustainability objective has not yet been achieved at this current design stage, there is an opportunity to further improve the sustainability performance of the Scheme by implementing sustainable design measures and more sustainable construction practices. In order to improve the current sustainability performance of the Scheme, it will be imperative to continue undertaking sustainability assessments and fully embed sustainability into the Detailed Design and construction stages. This form of ongoing sustainability assessment throughout the project lifecycle will help ensure that opportunities for sustainability improvements are carried through and developed at each stage.

5.1.3. Several recommendations have been made for further sustainability measures to be pursued and implemented through the Detailed Design and construction stages of the Scheme. The main opportunities for enhanced sustainability performance economic benefits, embodied carbon emissions, construction energy consumption, waste management, circular economy principles, responsibly sourced materials, and security of supply. Some of the sustainability targets are reliant on sustainability measures implemented at the next design stage and throughout construction to ensure they are achieved for the Scheme. It will thus be essential that the key opportunities discussed in this Report are fully considered by the Principal Contractor through the detailed design and construction stage.

Appendices

Appendix A. Scheme Sustainability Performance – SFT Extract

A.1. Overview of the sustainability targets and performance for the Scheme

No	Five Capitals	Themes defined by NH	Core Objectives	M5 J10 Client Scheme requirements	Suggested Target	Target Level	Performance Level
1.1a	Financial	Supporting Economic Growth	Capacity supports national and local economic growth	Support economic growth and facilitate growth in jobs and housing by providing improved transport network connections in west and north-west Cheltenham.	The Scheme results in an increase in jobs and has a benefit on GDP.	>250 (Major)	>250 (Major)
1.1b	Financial	Supporting Economic Growth	Capacity supports national and local economic growth	Support economic growth and facilitate growth in jobs and housing by providing improved transport network connections in west and north-west Cheltenham.	The Scheme supports regeneration, spatial development, enhances diversity and equality and participation. The Scheme leads to Improvement/no reduction on character and quality of the built and natural landscape Improvement/no deterioration of nearby cultural heritage sites and historic assets.	Major benefits	Moderate benefits
1.2	Financial	Is Long Lasting	Route operation is a good Investment in the Long Term	Support economic growth and facilitate growth in jobs and housing by providing improved transport network connections in west and north-west Cheltenham.	Design has long term durability and takes into consideration whole life costing to inform design decisions. Consideration of population growth (higher demand), climate change (extreme weather), demographic change (aging population) and	Moderate use and incorporation	Some use and incorporation

No	Five Capitals	Themes defined by NH	Core Objectives	M5 J10 Client Scheme requirements	Suggested Target	Target Level	Performance Level
					technology (More efficient & lower emission vehicles) has also been demonstrated.		
2.1	Human	Makes roads safe, useful and understandable	Improves Safety	Provide safe access to services for the local community and including for users of sustainable transport modes within and to west and north-west Cheltenham.	The design will improve the safety of road users and road workers. Safety has been considered throughout the design process.	Major improvement	Major improvement
2.2	Human	Makes roads safe, useful and understandable	Improves Safety	Provide safe access to services for the local community and including for users of sustainable transport modes within and to west and north-west Cheltenham.	The design will improve the understandability of the road network.	Significant improvement	Significant improvement
2.3	Human	Sustainability Leadership	Improving knowledge and understanding of sustainability	-	Improve knowledge and understanding of sustainability across the (internal) project team. All design engineers to have completed at least one Design for Life module. Across the team ensure someone has done each module.	100% completion rate	Part complete
2.4	Human	Thoroughly delivering sustainability	Integrated approach to Sustainability	Enhance the transport network in the west and north-west of Cheltenham area with the resilience to meet current and future needs.	Through the design we have financially accounted for the triple bottom line and whole lifecycle in terms of Environment, Economic and Social Costs and Benefits	Fully embedded	Fully embedded

No	Five Capitals	Themes defined by NH	Core Objectives	M5 J10 Client Scheme requirements	Suggested Target	Target Level	Performance Level
2.5	Human	Fits in with the Context	Protects and supports national and local regeneration, landscape, cultural heritage sites and historic features	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	The design conserves and enhances the character and quality of built and natural landscape.	Minor improvement	Minor improvement
2.6	Human	Fits in with the Context	Protects and supports national and local regeneration, landscape, cultural heritage sites and historic features	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	The design minimises the impact on nearby cultural heritage sites and historic assets.	Minor negative impacts	Minor negative impacts
3.1a	Natural	Carbon Management	Reducing Carbon	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	Iterative carbon assessment completed, carbon workshop carried out, opportunities identified, progress to embed in design tracked. This includes reduction in carbon footprint of the embodied carbon emissions associated with the design and construction of the Scheme.	Moderate reduction (10- 20%)	Moderate reduction (10- 20%)
3.1b	Natural	Carbon Management	Reducing Carbon	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity	Iterative carbon assessment completed, carbon workshop carried out, opportunities identified, progress to embed in design tracked. This includes	No increase	Minimal increase

No	Five Capitals	Themes defined by NH	Core Objectives	M5 J10 Client Scheme requirements	Suggested Target	Target Level	Performance Level
				net gain and meets climate change requirements.	reduction in carbon footprint during operation and decommissioning		
3.2	Natural	Climate Change	Climate Resilience	Enhance the transport network in the west and north-west of Cheltenham area with the resilience to meet current and future needs.	Resilience to current extreme weather and future climatic conditions specific to the local and surrounding area have been identified, assessed and incorporated into the scheme.	Moderately incorporated	Climate resilience fully incorporated
3.3	Natural	Biodiversity	To support and improve biodiversity associated with the road network.	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	The design ensures there is no net biodiversity loss and encourages gains.	Major biodiversity net gain	Major biodiversity net gain
3.4	Natural	Environmentally sustainable waste and materials management	Minimising waste and the need for new materials	Enhance the transport network in the west and north-west of Cheltenham area with the resilience to meet current and future needs.	Zero waste to landfill (excluding hazardous waste)	Zero Waste to landfill	90-95%
3.5	Natural	Air Quality	To support wider Government initiatives targeted at improving air quality	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets	Minimise any adverse air quality impacts where feasible	No/minimal impacts	No/minimal impacts

No	Five Capitals	Themes defined by NH	Core Objectives	M5 J10 Client Scheme requirements	Suggested Target	Target Level	Performance Level
				climate change requirements.			
3.6	Natural	Water	To support wider Government initiatives targeted at improving air quality	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	Minimise any adverse impacts on water quality where feasible	Moderate improvement	Moderate improvement
3.7	Natural	Land Contamination	To support wider Government initiatives targeted at improving air quality	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	Minimise any adverse impacts on soil quality where feasible	Moderate improvement	No/minimal impacts
3.8	Natural	Light Pollution	To support wider Government initiatives targeted at improving air quality	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	Minimise any adverse impacts on light pollution where feasible	Moderate reduction	Moderate reduction

No	Five Capitals	Themes defined by NH	Core Objectives	M5 J10 Client Scheme requirements	Suggested Target	Target Level	Performance Level
4.1	Social	Well-being	Increased well-being and collaboration	Provide safe access to services for the local community and including for users of sustainable transport modes within and to west and north-west Cheltenham.	The Scheme explores opportunities to improve the well-being of road users and communities affected by the network.	Moderate improvement	Major improvement
4.2	Social	Noise	Consider and mitigate all impacts of noise	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	The Scheme uses all opportunities to improve the noise produced by the network.	No significant adverse impacts	Moderate adverse impacts
4.3	Social	Stakeholder engagement	To ensure all stakeholder requirements are considered	-	Scheme seeks to involve a diverse range of local stakeholders and maximises opportunities for stakeholder engagement at each PCF stage.	Full engagement	Full engagement
4.4	Social	Is Inclusive	Accessibility	Provide safe access to services for the local community and including for users of sustainable transport modes within and to west and north-west Cheltenham.	Scheme incorporates the accessibility needs and ensures social inclusion of all road users and stakeholders	Fully incorporated	Fully incorporated

No	Five Capitals	Themes defined by NH	Core Objectives	M5 J10 Client Scheme requirements	Suggested Target	Target Level	Performance Level
5.1a	Manufactured	Circular Economy	Implement a circular approach	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	Scheme seeks to minimise resource-use during construction, operation (non-user) and maintenance.	5-10% Moderate reduction	No reduction
5.1b	Manufactured	Circular Economy	Implement a circular approach	Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.	Scheme seeks to minimise waste generation during construction, operation (non-user) and maintenance.	Significant reduction (>10%)	No reduction
5.2	Manufactured	Responsible Sourcing in Supply Chain	Responsible Sourcing in supply chain	-	Scheme maximises use of responsibly sourced materials that minimise adverse impacts on people and their environment	10-20%	<10%
5.3	Manufactured	Security of Supply	Managing the risk from security of supply	-	High risk materials due to security of supply identified and the information used within the optioneering.	Fully used and incorporated	Minimal use and incorporation

Appendix B. Embodied Carbon Comparison

A.2. Embodied carbon comparison between DF2 and DF3

Category	Total Emissions (tCO2e) – DF2	Total Emissions (tCO2e) – DF3	Percentage Change
Bulk Materials, Road Pavements & Civil Structures / Retaining Walls	48,241	26,520	-45%
Fencing, barriers & road restraints systems	819	886	8%
Drainage*	-	722	N/a
Earthworks	19,456	35,370	82%
Street Furniture and Electrical Equipment*	-	20	N/a
Waste	8,132	961	-88%
Construction plant & equipment (fuel consumption)*	-	32,021	N/a
Total	**76,648**	**96,500**	**26%**

^Note: Materials for the categories have been grouped together to enable comparison between DF2 and DF3. This is due to differences in the carbon models.

*Carbon emissions from Drainage, Street Furniture and Electrical Equipment, Construction plant and equipment (fuel consumption) have not been quantified during DF2.

A.3. Embodied carbon comparison between DF2 and DF3 (where data is available for both design stages)

Category	Total Emissions (tCO2e) – DF2	Total Emissions (tCO2e) – DF3	Percentage Change
Bulk Materials, Road Pavements & Civil Structures / Retaining Walls	48,241	26,520	-45%
Fencing, barriers & road restraints systems	819	886	8%
Earthworks	19,456	35,370	82%
Waste	8,132	961	-88%
Total	**76,648**	**63,717**	**-17%**

^Note: Materials for the categories have been grouped together to enable comparison between DF2 and DF3. This is due to differences in the carbon models.

Carbon emissions from Drainage, Street Furniture and Electrical Equipment, Construction plant and equipment (fuel consumption) have not been quantified during DF2 and have therefore been excluded from this table.

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