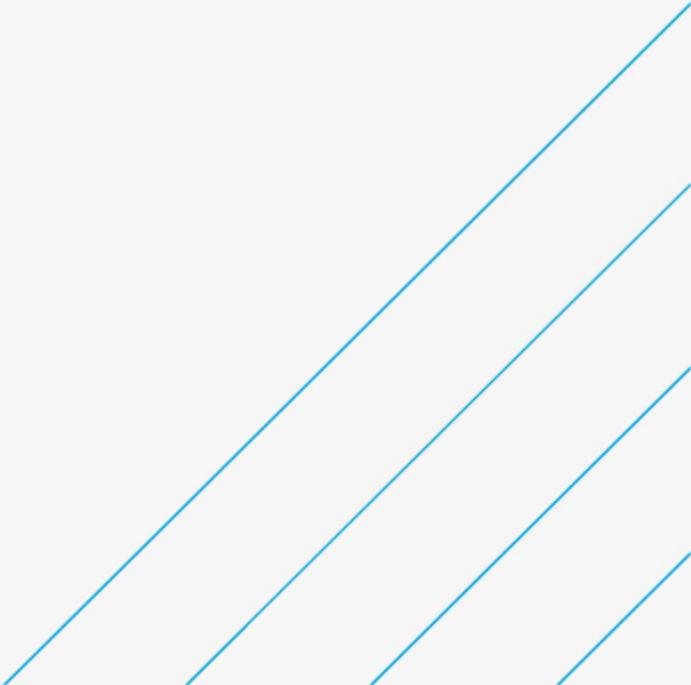


# West Cheltenham Transport Improvement Scheme (WCTIS) Phase 3 & 4: A40 Eastbound from Arle Court to TGI Fridays (A40/A4633)

Environmental Mitigation and Enhancement  
Review

5th May 2020

5188790



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# Appendix A. Assessment of mitigation options

## A.1. Introduction and Scope of the Work

The details presented in Appendix A (this appendix) summarise an assessment undertaken to review and mitigate the potential environmental effects posed by the West Cheltenham Transport Improvement Schemes (WCTIS) on the A40 (specifically Phases 3 & 4), and subsequently to identify and present environmental enhancements in the area.

- Section 2 of this appendix reviews the adverse effects that have been identified as part of the environmental assessments undertaken for the Business Case and presents the findings in the absence of mitigation.
- Section 3 reviews the mitigation measures available for each of the effects identified. Opportunities for environmental enhancements are also presented in this section. Enhancement opportunities have been considered both within the footprint of the project, and in adjacent areas.
- Section 4 reviews the options available to promote a positive modal shift away from car use (particularly single occupancy car use) in West Cheltenham to other forms of transport. Modal shift in this way is considered to be the most effective means of reducing the adverse effects of air quality, noise and greenhouse gas levels that have been identified.
- Section 5 summarises a review of the carbon footprint of the design to quantify the carbon footprint of the proposed construction methodology and materials and make recommendations on how this could be altered (and commitments made if possible) to make quantified carbon savings. The full report is provided as a separate appendix to the Business Case.
- Section 6 presents a summary of the mitigation exercise that has been undertaken, and presents the conclusions made.

## A.2. Summary of the Effects Identified

A summary of the effects identified from Phase 3 and 4 of the WCTIS Scheme is presented below, for the respective topic areas investigated. More details on these assessments are provided within Section 3.3 of the WCTIS Phase 3 and 4 Full Business Case for which this document is an appendix. The assessments provided in the Full Business Case provide greater detail about the assessment findings than the summaries provided in this section. The summaries in this section are presented in the absence of mitigation.

### A.2.1. Noise

The Scheme would have no significant, adverse environmental effects in the short term at most of the receptors considered, and in the short term at the remaining receptors considering additional contextual factors in accordance with DMRB 11:3:7 (marginal nature of impacts and results in the long-term). The Scheme would have no significant, adverse environmental effects on any receptor in the long term.

The Scheme is expected to result in increases in noise levels within noise important area (NIA 6036)<sup>1</sup>. Therefore, in accordance with DEFRA's Noise Action Plan: Roads (2 July 2019), the highway authority will be responsible for forming a view about what measures, if any, might be taken in order to assist with the implementation of the Government's policy on noise.

Analysis of the modelling data indicates that there are 22 No. properties on Miserden Road, south of the A40 between the Arle Court and Benhall where all of the qualifying criteria for works or grants under the Noise Insulation Regulations 1975 (as amended 1988) criteria are met. The highways authority will therefore have a duty to undertake sound insulation works or make grants in respect of the NIRs at these properties the noise is not reduced below the levels set out by the Noise Insulation Regulations 1975 (as amended 1988) criteria when post-scheme monitoring is undertaken.

### A.2.2. Air Quality

In the opening year, some marginal improvements in air quality may be found due to a reduction in congestion and greater vehicle efficiency. However overall, there would be a small increase in PM<sub>2.5</sub> and NO<sub>x</sub> emissions, with the Scheme, as a result of increases in road traffic movements across the traffic model area over the 60 year appraisal period due to a commensurate increase in total annual vehicle kilometres travelled.

In addition to this, the change in traffic data as a result of the Scheme has been analysed and will not result in any significant change to pollutant concentrations at selected sensitive receptors. There is no evidence to suggest that the Scheme would affect local air quality within the Cheltenham Borough Council Air Quality Management Area.

### A.2.3. Greenhouse Gases

There is an overall increase in CO<sub>2</sub> emissions with the Scheme over the 60 year appraisal period, due to a commensurate increase in total annual vehicle kilometres travelled. A decrease in CO<sub>2</sub> emissions in the 'with Scheme' scenario in the opening year of 0.1% compared with the 'without Scheme' scenario reflects an increase in average speed resulting in lower CO<sub>2</sub> emissions in the opening year only. In 2031, emissions of CO<sub>2</sub> are 0.7% higher in the 'with Scheme' when compared with the 'without Scheme' results.

Emissions of CO<sub>2</sub> will also occur as a consequence of the activities undertaken during the construction of the Scheme, and the embodied carbon in the materials used. Total emissions from the construction of the Scheme are estimated to be approximately 1,917 tonnes CO<sub>2</sub>e (carbon dioxide equivalent), based on early stage design information. Further details on this aspect are presented in Section 5 of this document.

### A.2.4. Landscape and Townscape

There would be some loss of trees and loss of strips of amenity grass, these are not expected to affect the overall landscape character or visual amenity of the area and there is not expected to be any loss of visual screening for receptors. Replacement planting of trees on a 2 for 1 basis within or just beyond the Scheme would be provided to limit any overall loss of vegetation in the area. Therefore, the effects of the Scheme are likely to be neutral (with no enhancement mitigation).

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<sup>1</sup> a local authority NIA covering approximately 1.2 km of the A40 between Telstar Way and Granley Road.

### A.2.5. Biodiversity

Habitats within Phases 3 and 4 of the Scheme are all within the urban landscape and planted or managed. None are considered to be rare or distinctive (in a biodiversity context). The Scheme will result in a net loss of some 'soft landscaped' habitats, but others will be retained, and areas will be planted to managed for nature conservation benefit. Surveys have identified potential for protected species including bats, hazel dormice, reptiles, otter, water vole, white-clawed crayfish and great crested newts. Pre-works surveys will identify mitigation appropriate to any protected species on the site.

### A.2.6. Historic Environment

The settings of two Listed Buildings and an associated 19th century pleasure ground will be changed during the construction phase and will result in a neutral effect. These are:

- Grade II Listed Lodge for Arle Court, NHLE 34717
- Grade II Listed gate piers, railings and gates to Arle Court, NHLE 34716

There is a very low chance of the Scheme resulting in the removal of unknown non-designated archaeological remains as excavation works are only occurring in areas of land previously disturbed by the construction of the A40. Whilst archaeological investigation works would provide a permanent record of these assets, investigation cannot mitigate the adverse effects. As effects from the Scheme were already seen as neutral, the Scheme is not considering any mitigation or enhancement measures for the Historic Environment.

### A.2.7. Water Environment

The Scheme would potentially encroach onto Hatherley Brook Floodplain Zones 2 and 3, meaning floodplain storage compensation may be required. Surface water runoff is assumed to be discharging to Hatherley Brook so potentially resulting in implications for surface water quality. The Scheme also requires a new retaining wall which could require foundations that could potentially impact groundwater flow and quality.

It should be noted that potential impacts on water quality could be under-represented by WebTAG scoring. Other methods (such as LA 113) are more sensitive and the overall significance could become higher. However, potential impacts on water quality caused by highway drainage entering watercourses or groundwater can be mitigated through SuDS pollution control measures. These solutions, particularly in relation to SuDS that attenuate runoff volumes, would also mitigate an increase in surface water flood risk or fluvial flood risk associated with more water entering a watercourse.

Applying mitigation proportionally to the level of risk would reduce the significance of effects to neutral.

## A.3. Mitigation Measures Identified

Section 3 summarises the potential mitigation measures identified for each of the topic areas and the reasoning why they may or may not be considered further as part of detailed design development.

### A.3.1. Noise

Outlined in the sub-headings below are measures considered to reduce noise emissions received at residential properties in close proximity to the Scheme, as a result of the works. In addition to the methods below, noise levels at receptors could be reduced through driving modal shift in transportation type through this area of Cheltenham. Further information into how this will be investigated is covered in Section A4.

#### A.3.1.1. Noise Barriers

The noise assessment has concluded that across the Scheme negligible to minor adverse increases are expected in the short term, and negligible adverse increases in the long term.

These are not considered to be significant, however, the increases particularly affect NIA 6036 (Benhall roundabout area) and mitigation is proposed in line with the highway authority's obligations to provide improvement in road traffic noise levels within NIAs. It has therefore been suggested that noise barriers for NIA 6036 should be considered in the following areas:

- Miserden Road, north of properties and adjacent to westbound carriageway of the A40;
- Campden Road, north of properties and adjacent to westbound carriageway of the A40;
- Sotherby Drive, south of properties and adjacent to the westbound carriageway of the A40 / northbound carriageway of Princess Elizabeth Way;
- Monks Croft/Benhall Gardens etc., south of properties and adjacent to eastbound carriageway of the A40 / southbound carriageway of Princess Elizabeth Way.

A well designed/optimised barrier, up to 3m in height, could potentially deliver improvements within and beyond the NIA considering line of sight to those parts of the road which cannot be screened. The potential improvements are shown in Figure 1.

**Figure 1 – Potential Positions for Noise Barriers**



Recently, further studies have found some success with vegetation planting of tree species such as Larch to reduce noise levels. However, these studies have been undertaken using very wide strips (>100m) of densely planted woodland, and this is not a feasible mitigation measure in the existing townscape where properties are in relatively close proximity to the road.

### **Landscape Effects**

In terms of landscape and visual effects, it is considered that the introduction of noise barriers is not a suitable mitigation measure because of the effects on landscape and visual amenity.

The A40 is bordered by narrow linear blocks of trees, shrubs and hedges which provide an attractive character. West of Benhall roundabout and around the roundabout itself, the road feels quite open due to the width of road and the set back of buildings. There are several attractive mature trees and where properties have views these are generally filtered by the vegetation.

East of Benhall roundabout, the proximity of the perimeter hedge of Miserden and Campden Roads and the buildings of Benhall Gardens give a more enclosed feel, but the presence of the vegetation prevent this being overbearing and retains the attractive quality of the area.

A 3m noise barrier would significantly impact on the views and general amenity of the area. It would alter the openness of the road, compromise the attractive appearance of the mature trees and, although a barrier would screen views of the road for some receptors, the subsequent view for these receptors may be considered to be less desirable than a filtered view of the road. The installation of a barrier is also likely to require the removal of existing vegetation in some locations.

Planting of the noise barriers, to both sides, could be an option to, in essence, screen the built noise barrier from view. However, there is little room for an adequate width of planting in much of this area and a thin 'vegetated screen' is unlikely to sit comfortably in the existing context.

In summary, because of the potential effects upon landscape and visual amenity as well as potential ecological implications of vegetation removal, noise barriers are not seen as a suitable mitigation measure to reduce noise in the area. It is suggested that the planting of more trees and shrubs in key locations may assist to further enhance the amenity of the area and psychologically 'disguise' the noise of the road through an 'out of sight, out of mind' approach.

#### **A.3.1.2. Noise Insulation of Properties**

Regulation 3 of the UK Noise Insulation Regulations 1975 (as amended 1988), imposes a duty on authorities to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible (residential) buildings, subject to meeting certain criteria, as follows:

- the property must be within 300m of the Scheme;
- the relevant noise level<sup>2</sup> is greater by at least 1 dB(A) than the prevailing noise level<sup>3</sup> and is not less than the specified level<sup>4</sup>, and
- noise caused or expected to be caused by traffic using or expected to use the highway makes an effective contribution to the relevant noise level of at least 1 dB(A).

It is important to note that the above refers to the effects of noise caused by a new or improved highway, and not to any effects on the wider road network as a result of the Scheme.

Initial analysis of the modelling data indicates that there are potentially 22 properties on Miserden Road, south of the A40 between Arle Court and Benhall where all of the above criteria could be met. Monitoring of the noise levels at the properties will be undertaken before and after the implementation of the Scheme to confirm if noise insulation is required for these properties to reduce noise levels at properties brought on by the Scheme.

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<sup>2</sup> "relevant noise level" means the level of noise, expressed as a level of L 10 (18-hour), one metre in front of the most exposed of any windows and doors in a facade of a building caused or expected to be caused by traffic using or expected to use any highway;

<sup>3</sup> "prevailing noise level" means the level of noise, expressed as a level of L 10 (18-hour), one metre in front of the most exposed of any windows and doors in a facade of a building caused by traffic using any highway immediately before works for the construction of a highway or additional carriageway, or for the alteration of a highway, as the case may be, were begun;

<sup>4</sup> "specified level" means a noise level of L 10 (18-hour) of 68dB(A).

### A.3.1.3. Noise Monitoring

As noted above, the Scheme will utilise noise monitoring before and after Scheme implementation to monitor the increase in noise at Miserden Road to understand whether noise insulation is required at the affected properties as a result of the Scheme. However, to demonstrate willing, and to inform assessment of the effectiveness of modal shift measures that may be produced later, GCC is committed to undertaking a phase of monitoring at properties after Scheme implementation to inform further noise reduction studies in the NIA.

## A.3.2. Air Quality

The key measures to reducing emissions will be reducing movements from carbonised single occupancy vehicles through the area and through driving modal shift. More information on how GCC plan to drive a positive modal shift and reduce traffic movements are provided in Section A4. In addition to driving modal shift, the sub-headings below explore other opportunities to mitigate and reduce air quality effects arising as a result of the Scheme.

### A.3.2.1. Air Quality Pollutant Reduction through Planting

There are two main ways in which vegetation can affect air pollution. Firstly, vegetation can act as a sink by removing small amounts of pollution through deposition on the leaves, or absorption of gaseous pollutants through the stomata, however the quantities removed can vary. Well-designed planting schemes could remove a few percent of the primary particulate emissions. Secondly, densely packed vegetation can disperse pollution in a similar way to a solid barrier, resulting in lower concentrations downwind of the barrier but increased concentrations upwind. The density of planting, type of vegetation, coverage and tree species can all affect ambient concentrations of pollutants. In addition to removal and dispersion of pollution, it should be noted that some tree species are important sources of biogenic volatile organic compounds (BVOCs) which can lead to the formation of secondary pollutants including particulate matter and ozone, therefore potentially making pollution problems worse. (references: Air Quality Expert Group's 2018 report "Effects of Vegetation on Urban Air Pollution"<sup>5</sup>).

As there were no significant adverse effects on air quality identified with the Scheme there is no requirement for any further air quality mitigation measures. However, any additional planting of vegetation between a source and receptor (i.e. between the road and the residential housing) may potentially lead to a redistribution of pollution but does not remove it. Modest reductions in particulate matter concentrations of no more than a few percent can be achieved using city wide tree planting schemes to increase deposition rates, these will have no effect on NO<sub>2</sub> concentrations. Whilst the Scheme will be implementing new planting as part of the landscaping design, there is not sufficient space in the Scheme area for sufficient planting to drive any reduction in Air Quality Pollutants.

### A.3.2.2. Air Quality Monitoring

As reported in the business case and summarised in Section A2, over the 60 year life-time of the project, there are some negative effects on local air quality. Whilst these are not assessed as significant, additional monitoring will allow Cheltenham Borough Council (CBC) to better understand the effects of Scheme implementation, and the effects of future schemes in the area, as well as garner a better understanding of local air quality. Whilst not formally a mitigation measure, GCC is proposing to provide further air quality monitoring equipment to CBC to facilitate their examination of local air quality and help to understand the effectiveness of measures that come forward as part of the Modal Shift Action Plan discussed in Section A4.

## A.3.3. Greenhouse Gases

The mitigation of the effects of greenhouse gas (GHG) emissions is achieved through a reduction in the emissions of these gases at source. The sources relevant to the WCTIS project are the operation of petrol and diesel powered (carbonised) vehicles (and subsequent discharges of GHGs) during the operation of the Scheme, the operation of construction plant during the construction stage, and the embodied carbon in the materials used.

- Section A.4 (Modal Shift) describes the measures considered to reduce vehicle emissions during the operation of the Scheme, through promoting non-vehicular transport options, the use of electric vehicles (zero emissions), and the move from single occupancy vehicle use (car) to mass transit (bus).

<sup>5</sup> Effects of Vegetation on Urban Air Pollution, Air Quality Expert Group, 2018 Available from [https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1807251306\\_180509\\_Effects\\_of\\_vegetation\\_on\\_urban\\_air\\_pollution\\_v12\\_final.pdf](https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1807251306_180509_Effects_of_vegetation_on_urban_air_pollution_v12_final.pdf)

- Section A.5 (Carbon) describes the measures available to reduce the embodied carbon footprint of the Scheme, and the operation of construction plant.

### A.3.4. Landscape and Townscape

The removal of existing vegetation to implement elements of the WCTIS Phase 3 and 4 Scheme requires mitigation to prevent permanent adverse effects upon landscape character and visual amenity of the area. To mitigate these effects, landscaping plans will be produced as part of the detailed design which locate where new planting will be placed as part of the Scheme. This planting will be covered across the Scheme area, but key areas for revised planting lie adjacent to the new shared-use cycle way between Arle Court and Telstar Way, and between Miserden Road and the A40 to provide better visual screening of the A40.

In addition to this standard landscape planting, to ensure effects are neutral, the Scheme is also committed to provide enhancement as part of the Scheme design. As part of these works, the landscaping design will also look to improve the visual amenity in local community green spaces. Further tree planting and management of existing vegetation at Benhall Woods and Park has already been discussed with CBC as a means to provide enhancement to local visual amenity whilst also potentially providing greater ecological benefit. Further discussions with CBC and ongoing work to landscaping plans are required through the completion of detailed design, to complete these proposals, but it is expected that this revised planting and management at Benhall Woods and Park in combination with improvements immediately adjacent to the Scheme, could mean the overall effect of the Scheme on landscape character and visual amenity is beneficial.

### A.3.5. Biodiversity

As noted in Section A.2, there are potential temporary construction effects on protected species in proximity to the Scheme, but the extent of these effects will not be known until specific species surveys are completed. As a precautionary approach, because the presence and absence of these species from the Scheme is currently unknown, slight adverse effects have been predicted. As design progresses and we reach the appropriate time of year to undertake these species specific surveys, a better understanding of the effects of the Scheme on biodiversity will be known. Because of this, it is hard to list specific mitigation measures required for the Scheme until these surveys are undertaken, however some opportunities to provide ecological mitigation, and potentially enhancement are being investigated for the Scheme and are outlined in the sub-headings below.

#### A.3.5.1. Planting along the A40 adjacent to Miserden Road

As outlined above in the landscaping section, the strip of vegetation between the A40 and Miserden Road is important for visual screening of the A40 from the properties on Miserden Road. Whilst planting is being investigated as part of the landscaping design to provide greater screening, this screening vegetation could have the dual purpose of acting as a wildlife corridor if the right species mix is selected. Bats are known to inhabit the area as they have been cited in surveys undertaken for Phases 1 and 2 of the WCTIS UKCBP project, and thus, developing the landscape planting to utilise species that will increase foraging opportunities for bats will allow for tangible benefits in existing provision in the area. This opportunity for the Scheme to increase foraging opportunities for bats will be taken up by the Scheme, with this forming a key part of the ongoing landscape planting design.

#### A.3.5.2. Landscape and Habitat Management in Benhall Woods and Park

As noted in Section A.3.4 above, further planting and landscape management opportunities are to be developed in consultation with CBC for Benhall Woods and Park. The park provides opportunities for local ecological enhancement, such as the potential to create a wildflower meadow in some grassed areas of the park. Whilst further discussions are required during the ongoing design phase of the Scheme to agree this measure, this may provide an opportunity for landscape and ecological benefit in the local area and provide learning opportunities for local schools situated just 200m south of the Park.

Hatherley Brook flows east-west from the western Cotswolds, through Cheltenham, through Benhall Woods and Park and underneath the A40 under Phase 3 of the WCTIS-UKCBP Project before flowing through agricultural land down to the River Severn. The preliminary ecological appraisal completed for the Scheme found that there was one record of otter on Hatherley Brook within Benhall Woods and Park, but that there were no records of Water Vole being spotted in the location. A Habitat Management Plan will be created through the detailed design period in consultation with Cheltenham Borough Council and other local landowners, where practicable, to increase biodiversity of Hatherley Brook and encourage the presence of species such as water vole and otter. This Habitat Management Plan will also investigate the creation of

additional foraging and nesting opportunities for bats in the tree corridor in which Hatherley Brook flows through Benhall Woods and Gardens.

## A.4. Modal Shift

This section presents the opportunities considered to promote a positive modal shift away from carbonised single occupancy transport in West Cheltenham to other forms of transport. Modal shift in this way is considered the most effective means of reducing the adverse effects of air quality, noise and greenhouse gas levels that have been identified, as a consequence in the reduction of vehicles numbers (particularly petrol and diesel powered vehicles).

GCC are already progressing with schemes to help drive a positive modal shift in the local area. The Park and Ride at Arle Court being a prime example where a scheme has been put in place to drive modal shift and prevent negative air quality effects in the centre of Cheltenham. This Park and Ride, which has had some minor improvements scheduled as part of the WCTIS Phase 1 works, is also due additional upgrades in the future. The forward plan for the site, see it change from a Park and Ride to a 'Park and Interchange' with significant capacity and infrastructure improvements to increase its viability for reducing local vehicular transport flows through the Phase 3 and 4 works area. Design work on these larger improvements are yet to commence, however, it can be expected that these improvements will have a meaningful effect in reducing traffic flows through this area of West Cheltenham.

Additionally, GCC is also progressing with cycling improvements in West Cheltenham to encourage greater use of non-motorised transport. GCC is currently promoting through a business case the West Cheltenham Walking and Cycling Improvement scheme (WCWCI) across the Scheme area. The WCWCI scheme is a series of cycling improvements being put in place to increase active travel capacity between Arle Court and Cheltenham train station (via Griffiths Avenue) to help create a modal shift away from vehicular traffic. The Scheme provides safe, hard surface, off-highway cycling capacity, with priority over smaller junctions to facilitate smooth travel towards the train station and also Cheltenham town centre.

This scheme in itself links in with another cycle improvements scheme being funded by Highways England in the local area. The B4063 cycleway scheme runs from London Road in Gloucester (near to Gloucester Railway and Bus Stations) for almost 10km through the areas of Longlevens, Churchdown, and Staverton to connect to the improvements put forward as part of the WCWCI scheme starting near Arle Court. These cycling improvements will provide a safe active travel link between existing residential areas between Gloucester and Cheltenham to city centres and onward travel opportunities (by connecting Gloucester and Cheltenham railway stations). The development and implementation of these already planned proposals will encourage active transport as a means to travel to local centres and transport links.

### A.4.1. West Cheltenham Modal Shift Working Group

To build on some of the current work undertaken by GCC to drive modal shift, Phase 3 and 4 of the WCTIS-UKCBP project are triggering the creation of a West Cheltenham Modal Shift Working Group to investigate potential initiatives to drive this modal shift.

Table 1 below presents the opportunities considered at this initial stage and outlines what initiatives will come under further consideration of the Working Group. Some of the opportunities identified are not proposed to be taken forwards for further consideration on this Scheme. For some of the opportunities this is a consequence of how the Scheme is being funded. Only those measures that could be implemented as part of the capital cost for the Scheme can be taken forwards in the Business Case. The measures that would be implemented as revenue funded measures are outside the scope of the funding and would therefore have to be considered separately. Such measures have therefore not been taken forwards as part of the Business Case for this Scheme.

**Table 1 – Opportunities Identified to Promote Modal Shift**

Modal shift initiative	Further comment	Initiative to be taken forwards for further consideration
Inclusion of dedicated routes for cyclists and pedestrians e.g. WCWCI. Designed to reduce numbers of vehicle movements (of any type).	Key part of wider design across all WCTIS Schemes. Aligns with the £1.6million realigned funding for cycling and walking. Options for cyclists will be improved further through the proposed B4063 Gloucester to	Yes. Likely to be developed through the WCWCI Scheme. Further opportunities in the local area will

Modal shift initiative	Further comment	Initiative to be taken forwards for further consideration
	Cheltenham Cycle link.	continue to be investigated.
<p>Improved awareness of the alternative transport options, such as the P&amp;R Scheme, as well as cycle and pedestrian routes.</p> <p>Designed to reduce vehicle numbers, but also promote a switch from single occupancy car use to mass transit vehicle use (bus). The bus could ultimately have zero carbon and GHG emissions.</p>	Options for cyclists will be improved further through the proposed B4063 Gloucester to Cheltenham Cycle link.	Yes, but only for the capital cost aspects of this initiative.
<p>Review of the costing for use of the P&amp;R parking and shuttle bus to make its use more attractive.</p> <p>Designed to promote a switch from single occupancy car use to mass transit vehicle use (bus).</p>	The option was considered but as it would be revenue funded, rather than a capital cost, then it cannot be taken forwards as part of this Business Case.	No
<p>Increased number of charging points at the P&amp;R for electric vehicles.</p> <p>Designed to promote (and support) the move from carbonised vehicles to electric vehicles by providing additional charging infrastructure.</p> <p>Also designed to increase the attractiveness of the P&amp;R to electric vehicle users so as to promote a switch from single occupancy car use to mass transit vehicle use (bus).</p>	This will be investigated as part of the improvements to the Park and Ride being considered through a separate funding stream.	Yes
<p>Improved facilities at the P&amp;R (if not already available), such as suitably sheltered / all-weather waiting areas.</p> <p>Designed to increase the attractiveness of the P&amp;R to all vehicle users so as to promote a switch from single occupancy car use to mass transit vehicle use (bus).</p>	Funding is already in place to provide for such facilities through a separate funding mechanism. Whilst improvements may take 5-10 years to come to fruition. The nature of the negative effects of the scheme being calculated over a 60 year appraisal period however, mean that a large extent of the emissions identified by the assessment could be reduced.	Yes
<p>'Boris-bike' style hire cycle initiative – Could have docking stations and specific subsidised parking spaces at the P&amp;R.</p> <p>Designed to reduce numbers of vehicle movements (of any type).</p>	The option was considered but is not feasible as part of the current Business Case due to the large number of cycle hubs that would be required outside of the extents of the WCTIS Scheme (in other parts of Cheltenham for example).	No
<p>Car share scheme</p> <ul style="list-style-type: none"> <li>- Promotion of car sharing schemes with local employers. A common scheme in which employees from different companies can have access to.</li> <li>- Access to some of the spaces within the P&amp;R car park for people who are</li> </ul>	An extension on this is the inclusion of signage promoting car sharing displayed through the Scheme. A similar approach has been applied elsewhere in Cheltenham.	Yes, for aspects of this that are capital funded.

Modal shift initiative	Further comment	Initiative to be taken forwards for further consideration
<p>subsequently completing their journey in a car share. For people whose remaining journey into Cheltenham isn't well served by the P&amp;R bus.</p> <p>Designed to reduce numbers of vehicle movements (of any type).</p>		
<p>Multiple occupancy (2+) lane at specific times.</p> <p>Designed to reduce numbers of single occupancy vehicles.</p>	<p>The option was considered, but not taken forward on the basis that the Scheme has been presented to stakeholders to date as the creation of new lanes for all vehicles.</p>	<p>No</p>
<p>Restricting access to particular groups of vehicles at peak times. For example, HGVs over 7.5 tonnes.</p> <p>Designed to reduce the numbers of vehicles. Depending on which group of vehicles were targeted this option could a particular reduction on noise or air quality impacts.</p>	<p>The option was considered, but not taken forwards on the basis of the challenge in implementing a weight limit on routes, within the timeframe of the WCTIS Scheme. Would require further consultation to support the required Traffic Regulation Order (TRO).</p>	<p>No</p>

## A.5. Carbon

Cheltenham Borough Council has declared a Climate Emergency and is committed to becoming a Net Zero Carbon borough by 2030. This ambition has an impact on the development of new infrastructure, in that:

- Carbon emissions from construction work carried out prior to 2030 should be reduced as far as possible, in line with emission reduction pathways set out by CBC; and
- Operation, maintenance and use of the infrastructure after 2030 must be carbon neutral<sup>6</sup>.

A high-level assessment has been carried out to determine the likely scale and key sources of carbon emissions during the construction stage of the WCTIS project. This section presents a summary of that high-level assessment. The full report is available as a separate appendix to the Business Case.

The assessment undertaken used information provided by the design team on material types and quantities, and estimations of construction plant use. These were entered into the Highways England Carbon Tool to produce carbon emissions for each component.

### A.5.1. Structure of the Carbon Assessment

The assessment was based on early design information and anticipated methods of procurement and construction. The following aspects of the Scheme were assessed<sup>7</sup>:

- Product stage; including raw material supply, transport and manufacture; and
- Construction process stage; including transport to/from works site and construction /installation processes.

The following aspects were not assessed due to lack of information at this stage of the Scheme:

- Land use change during construction;
- Use of the infrastructure by the end-user (road user);
- Operation and maintenance (including repair, replacement and refurbishment);
- Land use during operation;
- GHG emissions potential of recovery including reuse and recycling; and
- GHG emissions potential of benefits and loads of additional functions associated with the study system.

Emissions were calculated using Highways England's Carbon Tool. The Carbon Tool is spreadsheet-based and provides space to input material and non-material construction information. The Tool then uses pre-programmed carbon factors to calculate an itemised and overall emissions total. Whilst there are a number of greenhouse gases with a range of Global Warming Potentials (GWPs)<sup>8</sup>, all emissions are presented as their carbon dioxide equivalent (CO<sub>2</sub>e).

Material quantities per component, and an estimate of construction plant requirements, were provided by the design team, based on the current design.

The following assumptions were made on construction practices:

- Materials and waste will be transported by diesel-fuelled heavy goods vehicles (HGV);
- Materials will be sourced regionally, represented by a transport distance of 100 km;
- Waste will be sent to landfill; and
- Waste will be processed locally, represented by a transport distance of 50 km.

<sup>6</sup> 'Carbon neutral' and 'Net Zero Carbon' mean that any emissions of greenhouse gases (GHGs) are balanced by removals of GHGs from the atmosphere, so that there is no overall contribution to climate change.

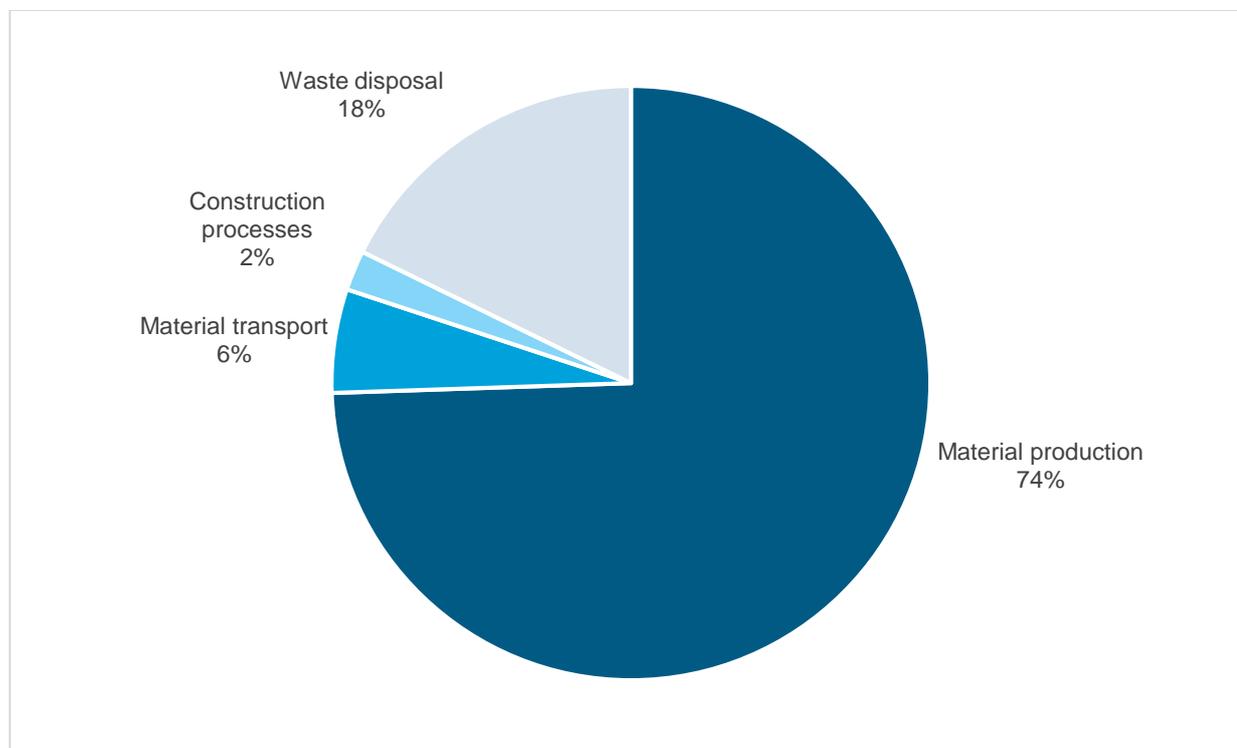
<sup>7</sup> aligned with those in DMRB, Vol. 11, S. 3, Part 14 Climate LA 114

<sup>8</sup> The following six gases are currently required for most national reporting under the Kyoto Protocol: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>).

## A.5.2. Summary of the Findings

Total emissions from the construction of the Scheme are estimated to be approximately **1,917 tonnes CO<sub>2</sub>e**, based on early stage design information (Figure 2).

**Figure 2 - Carbon emissions from construction**



The report proposed these potential opportunities to reduce the carbon footprint of the Scheme.

### A.5.2.1. Build Less

- Explore alternative solutions which can deliver Scheme objectives, including meeting transport demand, but which will require less extensive or no construction work. For all design elements, robustly challenge the need for them and consider how their scale could be reduced.
- Maximise the re-use and refurbishment of existing assets and on-site resources, to minimise resource consumption and waste production. Consider how the life of existing assets could be extended, rather than removing and replacing.
- Avoid disturbance / removal of existing vegetation and soils as far as possible, to reduce loss of carbon to the atmosphere.
- Consider how materials which are key emission sources can be reduced. Currently, it appears that these are the cement and plywood formwork (used at construction stage). Consider whether the design can be changed to reduce the quantities of these two materials. Note that if reducing these materials would increase use of another, it will be important to assess whether the net effect is a carbon benefit.
- Incorporate elements into the Scheme which will encourage a reduction in user emissions, for example modal shift to more sustainable forms of transport. Note that the carbon benefits of any additional infrastructure, e.g. cycle paths and footpaths, should be weighed against the carbon cost of additional
- construction activities to ensure the best whole-life carbon approach is taken.

### A.5.2.2. Build Clever

- Specify the use of recycled materials rather than virgin alternatives, for example: recycled aggregate, or recycled plastic materials. As an example, if the imported fill material were from recycled rather than virgin sources, it would save approximately 6 tCO<sub>2</sub>e. Note that the benefits of using recycled materials should be

weighed against potential carbon costs. For example, local virgin material may have a lower overall carbon impact than recycled material sourced from a great distance.

- Specify low-carbon material alternatives, particularly for those materials which contribute a large proportion of emissions. The options for low-carbon alternatives are increasing rapidly, with frequent innovations. Some examples to consider include:
  - low-carbon cement alternatives;
  - aggregate alternatives, including carbon-negative aggregates made from CO<sub>2</sub>;
  - warm- and cool-mix asphalt;
  - recycled plastic asphalt; and
  - vegetated retaining wall solutions.
- To support the above, it may be required to challenge technical standards or framework specified materials in order to facilitate alternative solutions.
- Design for off-site and modular construction. This method of manufacture and assembly typically requires less heavy machinery and less energy than standard on-site construction, and wastage is minimised. It is also easier in controlled environments to make positive changes such as improving energy efficiency and sourcing renewable energy.
- Design for efficient on-site construction. Consider how easy the design is to build, and whether it is possible to design out the need for certain plant or intensive processes.
- Design for zero carbon operation (excluding the vehicles). The Scheme should be passive (non-energy consuming) where possible, with renewable technologies to supply energy needs where not.
- Design for low-carbon maintenance. Preferentially select long-life options which will require as little maintenance and infrequent replacement as possible.
- Design with deconstruction in mind, taking a 'circular' approach where all elements could be disassembled, and materials reused at end of life. Consider the Scheme as a 'material bank' which will be a source of materials rather than waste at the end of its life.
- Work with the supply chain to understand the carbon impact of products / materials and challenge them to make improvements to products and services in line with GCC's net zero ambition.

#### A.5.2.3. Build Efficiently

- Recycle wastes rather than sending to landfill. Based on current data, this would save an estimated 329 tCO<sub>2e</sub>, 17% of overall construction emissions.
- Avoid materials which come in disposable packaging, particularly that which cannot be recycled. Work with supply chain to develop alternative packaging and delivery options.
- Specify materials sourced as locally as possible, to reduce transport. Sourcing materials from within an average distance of 30 km, rather than 100 km, would reduce emissions by 76 tCO<sub>2e</sub> (c. 4% total emissions). During design, consider whether elements which cannot be sourced locally can be designed out or a different solution used.
- Use more sustainable means of transporting materials to site. As an example, if all materials were brought in by rail rather than HGV, this could save in the region of 94 tCO<sub>2e</sub>, an 87% reduction in transport emissions.
- Use local workforce to reduce emissions from commuting and business travel. Make use of video conferencing and other digital technologies to reduce vehicle trips.
- Mandate preparation of a construction workforce travel plan which maximises vehicle sharing and reduces trip numbers. Encourage the contractor to make use of smart scheduling software.
- Use renewable energy onsite, for example solar lighting, and fuel cell electric welfare units.
- Mandate use of electric and other low-carbon construction plant as standard on the Scheme. To make best effect of this measure, plant should be charged from renewable sources. Diesel should be used as a last resort when no renewable option is available. Avoiding the use of diesel on-site would reduce emissions by 42 tCO<sub>2e</sub> (2% total emissions).
- Mandate use of electric vehicles (EVs) to transport workers and provide EV charging points at site. As with construction plant, electricity should be generated from renewable sources.

#### A.5.2.4. Remediate

It will not be possible to reduce carbon emissions to zero using the measures above. To achieve a Net Zero Carbon scheme, the residual emissions from construction will need to be offset through the life of the Scheme, either through on-site measures or third-party projects.

- Maximise vegetation cover to enhance carbon sequestration. Give careful thought to the species selected, as sequestration rates vary, and also to how vegetation will be managed on an ongoing basis. Vegetation which requires frequent intervention (grass cutting, hedge trimming) may generate more emissions than it sequesters, and vegetation that degrades then decomposes over time will also result in increased emissions, rather than sequestration.
- Install renewable energy technologies which exceed the consumption requirements of the Scheme and feed into the National Grid to offset emissions.
- Use wood for permanent design elements. This can provide a long-term store for carbon in the built environment.
- Once opportunity to reduce and sequester carbon emissions within the Scheme boundary has been maximised, consideration may need to be given to financing third-party projects. In order of preference, these could be:
  - Collaborative approach: work with the local Wildlife Trust, nature partnerships and other groups trying to achieve similar goals, to support local projects by incorporating them into the Scheme.
  - Green funds: provide funding for local third-party landowners to plant and manage woodland and other beneficial land-uses for sequestration and implement renewable energy technologies.
  - External offset: purchased through external offset companies, these might include renewable energy projects, energy efficiency projects, landfill gas recovery, and community projects.

#### A.5.3. Outcomes of the Design Workshop

Upon completion of the assessment, a design workshop was held with the project management and design teams to investigate each of the potential carbon reduction opportunities outlined under the principles above, and to identify if there were practical carbon savings that could be made. The findings from this workshop are outlined under the headings below.

##### A.5.3.1. Build Less

###### Explore alternative solutions which can deliver Scheme objectives:

As outlined by the traffic modelling for the Scheme, summarised in the WCTIS Phase 3 and 4 Full Business Case, there is an existing congestion issue along the A40 between Arle Court and Benhall Gardens (including at Benhall Roundabout). This currently leads to increases to journey times, increases in driver stress and has a negative effect on the local economy and workers using the road on a day to day basis. The 'Do Nothing' scenario will limit economic growth in the future year scenario, and potentially affect the deliverability of Joint Core Strategy strategic allocations for housing and employment.

A review of the potential options to provide capacity improvements were undertaken at project commencement. This found that eastbound capacity improvements from M5 J11, through to Griffiths Avenue were the most successful way of providing this additional capacity to alleviate the existing congestion and help to assist the deliverability of strategic allocations. Following initial environmental review of the WCTIS Phase 3 and 4 Scheme, traffic modelling was undertaken on a range of eastbound widening options varying in length between Benhall Roundabout and Griffiths Avenue to ensure the benefit was maximised compared to the construction work area. This modelling found that an additional eastbound lane along the Phase 4 area to Griffiths Avenue provided less benefit in respect of the design objectives against cost and potential environmental implications than finishing the additional eastbound lane at Benhall Gardens. This led to the design of the current Scheme, where the additional eastbound lane stops at Benhall Gardens. In this respect, the Scheme had already driven the 'Build Less' principle prior to the construction carbon review being undertaken, with the best option to meet strategic objectives already sought.

The option of not constructing a new retaining wall from Telstar Way to Benhall Roundabout to incorporate the cycleway, with this either being lost or leading to the removal of the row of oak trees was also considered briefly at the Concept Design Stage. It was felt that retaining and ultimately improving cycling provision as part of the Scheme would provide a greater carbon reduction and community benefit than avoiding construction activities

in this location. After consultation with CBC it was agreed that the loss of the trees running parallel to the highway in this location was not favourable in respect to the visual impact of the works, and therefore it was not possible to avoid the requirement for the retaining wall in this location.

**Maximise the re-use and refurbishment of existing assets and on-site resources:**

The design team has incorporated re-use of assets where possible and safe to do so. The opportunity to re-use the existing surface course for the eastbound A40 carriageway is being investigated as part of ongoing design development. A final decision will be made based on the condition of the existing surface course, and the locations of the longitudinal joints to the newly surfaced area. If the newly surfaced area joins with the existing surface within the wheel track of vehicles, the surface will need to be replaced due to health and safety considerations. In this scenario however, the pulled up existing surface course will be recycled by the contractor.

Other existing assets on the Scheme include signage and the Vehicle Restraint System (VRS). As the layouts of the junctions are changing, it is not possible to refurbish the majority of the existing signage on the Scheme. Likewise, the VRS is based on a performance specification and needs to be signed off by the installer/contractor which cannot be done through re-use. It is expected however that both signage and the removed VRS system will be recycled by the contractor.

**Avoid disturbance / removal of existing vegetation and soils as far as possible:**

The protection of existing vegetation and soils has been embedded in the design from the very early concept design stage. The additional eastbound lane required between Arle Court and Telstar Way would substantially reduce the space available for the existing shared-use path in this location. When the project made the decision to improve the capacity of this shared-use cycleway, maintaining the asset close to the highway would have led to substantial new earthworks on the embankment, and removal of a large extent of the existing belt of mature trees and shrubbery in this location. To avoid this, a design solution was found to run the new shared-use cycleway along the bottom of this embankment across grassed areas, thereby avoiding the requirement for new earthworks and revisions to retaining wall structures, and allowing the existing vegetation to be retained.

As noted already above, the avoidance of disturbing existing vegetation also assisted in the decisions about the length of the new A40 eastbound lane, and the layout of the proposed works between Telstar Way and Benhall Roundabout. This has been designed to maintain the existing oak trees in this location.

From the actions taken above, it is clear that avoiding the removal and disturbance of vegetation has played a key role in the design process.

**Consider how materials which are key emission sources can be reduced. Currently, it appears that these are the cement and plywood formwork (used at construction stage):**

The amount of concrete required for the Scheme has been reduced as far as possible through the ‘Build Less’ measures outlined in the sections above.

**Incorporate elements into the Scheme which will encourage a reduction in user emissions:**

As noted above, the Scheme includes increased cycling provision compared to existing. These improvements form part of a wider network of improvements under the WCWCI Scheme to provide better active travel potential in West Cheltenham. This has factored into some design decisions, such as the requirement for a retaining wall between Telstar Way and Benhall Roundabout, however, the additional capacity improvements are likely to have a positive community impact beyond their potential driving of modal shift, and thus were maintained as part of the Scheme.

**A.5.3.2. Build Clever**

**Specify the use of recycled materials rather than virgin alternatives:**

Following consultation with the design team, it was agreed that further investigation into the use of recycled materials rather than virgin alternatives would be explored during ongoing design development. Initial comments noted that the quality of recycled material may not reach the same design standards as virgin material in some cases, and that the current design would possibly need to be revisited to allow for such a specification to be made to the contractor, as well as balancing potential increased maintenance requirements and cost.

**Specify low-carbon material alternatives, particularly for those materials which contribute a large proportion of emissions:**

For design security (at this stage in the design process), standard cement and aggregates will be utilised for the Scheme, with significant reductions in quantity already made under the ‘Build Less’ principle. However, as an outcome of this construction carbon review, the tender process for the works will now include a quality question to investigate how the use of low-carbon alternatives could be used on the Scheme without affecting guarantees of quality, as well as an optional pricing model to allow the contractor to price both the standard method, and using these low carbon alternatives. This will encourage the contractor to build new relationships and knowledge of suppliers of low carbon materials, whilst providing confidence to them that including such measures would not be detrimental to their success in bidding for the works. It will also drive value engineering in the existing design, and allow GCC to select contractors that provide a balance of carbon reductions and cost.

Whilst the use of Hot Rolled Asphalt will be included in the specification for the highway (as it is the framework specified surfacing material to drive down maintenance requirements), further investigation will be given to the use of recycled plastic asphalt for the surfacing of the cycleways included within the Scheme during the detailed design. It is felt that due to the lower load stresses placed on the cycleway from traffic and increased likelihood of durability, this may be a real option for carbon reduction and increased sustainability for the project.

**Design for off-site and modular construction:**

The Scheme already incorporates pre-cast concrete units for the retaining wall between Telstar Way and Benhall Roundabout and for concrete drainage materials. Further opportunities will be investigated for off-site modular construction as the detailed design progresses.

**Design for efficient on-site construction:**

Following review of the Scheme design, there were limited improvements beyond the base design to drive efficiency in on-site construction through the removal of processes.

**Design for zero carbon operation (excluding the vehicles). The Scheme should be passive (non-energy consuming) where possible, with renewable technologies to supply energy needs where not:**

The built up nature of the area and existing traffic flows mean that street lighting is a requirement of the design. Likewise, the junctions at Telstar Way and Benhall Roundabout are signalised to facilitate traffic flow in line with the objectives of the Scheme. There is not sufficient space locally to utilise renewable energy to power these assets due to the health and safety specifications they must meet. Opportunities to use LED powered street lighting and signage will be explored to reduce carbon emissions from the operation of these assets.

**Design for low-carbon maintenance:**

This has already been factored into the design process for this point, with materials chosen for roles such as the retaining wall selected because of the known longevity such structures are known to provide.

**Design with deconstruction in mind, taking a ‘circular’ approach where all elements could be disassembled, and materials reused at end of life. Consider the Scheme as a ‘material bank’ which will be a source of materials rather than waste at the end of its life:**

The primary materials proposed to be used in the Scheme are concrete (for the retaining wall and culverting), steel (for the lighting, signage and VRS) and highways aggregate and surfacing. Each of these materials is relatively easy to recycle, and ultimately should be available for re-use in future schemes. Materials that are more difficult to recycle such as composite plastics will be avoided where possible.

**Work with the supply chain to understand the carbon impact of products / materials and challenge them to make improvements to products and services in line with GCC’s net zero ambition:**

The measures already outlined above in respect of quality questions for the tender will encourage contractors to investigate opportunities for carbon reduction and will help contractors to understand the carbon impacts of their activities.

### A.5.3.3. Build Efficiently

#### **Recycle wastes rather than sending to landfill:**

Following the workshop, it was agreed that the contractor should recycle all concrete wastes (such as kerbing), and that this requirement would form part of the tender specification. In addition, a quality question to investigate other material recycling opportunities will be included within the tender for the works, as well as an optional pricing model to allow the contractor to price both the standard method, and that for recycling specific materials (rather than sending to landfill). This will allow for a cost analysis of the expense of recycling various materials on the-Scheme.

#### **Avoid materials which come in disposable packaging, particularly that which cannot be recycled:**

Whilst the merit in this measure was evident to the design team, it was not possible to identify a suitable way in which it could be enforced. In light of this, it will be picked up as something to discuss with the contractor once selected, to ensure they are considering reducing packaging waste wherever possible and recycle it wherever practicable.

#### **Specify materials sourced as locally as possible, to reduce transport:**

This opportunity was discussed at length in the workshop. Due to competition law, it was acknowledged that it is difficult to set strict targets without prior review of local material suppliers and their location. It was however agreed that for certain key materials (such as aggregates and concrete), a review of local material suppliers and their proximity to the Scheme would be completed prior to the commencement of the tender. This would allow for an optional pricing item to be produced for these materials to be sourced locally and a price then given to locally sourced items against the contractor's 'best price'.

#### **Use more sustainable means of transporting materials to site:**

The use of alternative forms of transport for materials, such as rail, was unfortunately determined to be impractical logistically for the construction works due to the Scheme's location and timescales for the start of construction activities. Whilst using lower emissions vehicles would technically be feasible for the haulage of materials, the likely large increase in cost of such a measure against the carbon savings achieved was seen as less attractive as a solution to drive carbon reduction than sourcing materials locally (and incurring fewer vehicles miles).

#### **Use local workforce to reduce emissions from commuting and business travel:**

The specification for the construction works contract already includes the requirement to use local labour for construction.

#### **Mandate preparation of a construction workforce travel plan which maximises vehicle sharing and reduces trip numbers:**

Upon discussion, it was agreed that this was a simple measure to include within the pre-works conditions of the commencement of the construction works contract to drive carbon efficiencies.

#### **Use renewable energy onsite, for example solar lighting, and fuel cell electric welfare units:**

The construction compound for the Scheme is connected to the mains electricity network and therefore, fuel cell welfare units are not deemed necessary. However, following the workshop, it has been agreed that the specification for the works will include a requirement for lighting for construction works to be provided via existing mains connections or battery powered wherever practicable, with diesel powered generators to be avoided where possible.

#### **Mandate use of electric and other low-carbon construction plant as standard on the Scheme:**

It was agreed that the use of low carbon and electrically powered construction plant would be discussed with the contractor when selected. However, it was not seen as a practical solution to place requirements about electric and low carbon plant as part of the tender specification due to the low availability of such equipment and therefore the likely impact on cost compared to the carbon reduction savings it would achieve.

**Mandate use of electric vehicles (EVs) to transport workers and provide EV charging points at site. As with construction plant, electricity should be generated from renewable sources:**

It was agreed that the specification for construction works would be updated to mandate the requirement for the use of electric 'pool vehicles' during the works and for an electric vehicle charging point to be provided at the site compound to encourage travel to site via electric vehicle.

**A.5.3.4. Remediate****Maximise vegetation cover to enhance carbon sequestration:**

The Scheme already incorporates plans to provide additional planting to provide mitigation for potential landscape effects from the Scheme. This new planting will be focused along the Scheme boundary, but also at the local Benhall Woods and Park, where new tree and shrubbery planting will be developed in consultation with the CBC tree officer. Details of this landscaping work are not yet available as it is being developed as part of the ongoing design development, but will provide additional sequestration than what is proposed in the existing local environment prior to Scheme implementation.

**Install renewable energy technologies which exceed the consumption requirements of the Scheme and feed into the National Grid to offset emissions:**

Unfortunately, there is insufficient space within the Scheme's locality to facilitate renewable energy generation that would help to offset the carbon effects of the Scheme during construction and in operation.

**Use wood for permanent design elements:**

Following discussions in the design workshop, no practical uses of wood to replace other materials could be identified for the Scheme.

**Use of third party projects to drive carbon reductions:**

Whilst not currently utilising third parties, the Scheme is looking to promote local biodiversity at Benhall Woods and Park in the form of a Habitat Management Plan as part of the Scheme to enhance the local environment. Currently, this was to be developed in consultation with CBC and GCC's ecologist, but including other third party organisations will be considered.

## A.6. Summary of the Mitigation Exercise Undertaken

The assessment presented in this appendix was undertaken to investigate the options available to mitigate the potential environmental effects outlined in Section A2 for the WCTIS on the A40.

Measures to mitigate these effects were reviewed at two levels:

- Direct mitigation of the effect through the provision of noise barriers and landscaping.
- Indirect mitigation targeting the source (origin) of the effect, through measures to promote a positive modal shift away from carbonised single occupancy transport. As well as measures to reduce the carbon footprint of the project at construction stage.

In addition to these mitigation measures, opportunities for environmental enhancements were also identified.

### A.6.1. Direct Mitigation

- Noise - direct mitigation measures in the form of noise barriers and planting strips were considered to reduce the increased noise levels identified. Whilst noise modelling identified that 3m high noise barriers would provide a reduction in noise levels at properties adjacent to the Scheme, the potential effects of such barriers on landscape and visual amenity as well as potential ecological implications of vegetation removal, meant that noise barriers are not considered as a suitable mitigation measure to reduce noise in the area. Barriers in the form of planting is only effective where the planting is in excess of 100m in depth. There is no opportunity for such planting in the Scheme.
  - The assessment of the effect of noise has been undertaken to date for the Scheme through noise modelling. In order to gain greater understanding of the noise levels, GCC is committed to undertake noise monitoring adjacent to the Miserden Road properties before and after the implementation of the Scheme.
- Air quality – the potential for planting to provide a direct mitigation of adverse air quality has been considered, although was not deemed practicable in the surrounding landscape context.
  - As with the noise assessment, monitoring of air quality is proposed as a next step to better understand the effects of the implementation of the Scheme, and the effects of future schemes in the area, as well as garnering a better understanding of local air quality.
- Landscape – whilst effects from the Scheme were considered to be neutral for landscape, the detailed design will develop a landscaping design to mitigate potential negligible changes to visual amenity from the additional traffic lane and the loss of three to four trees. This design will incorporate additional planting along Miserden Road and between Arle Court and Telstar Way.
- Biodiversity – specific species surveys will be undertaken in 2020 to better understand the Biodiversity of the Scheme. Following this, suitable Best Practice Measures and Precautionary Methods of Working will be applied during construction to prevent any harm to protected species. The surveys will inform whether a license is required. To directly mitigate the loss of any foraging and/or nesting resource that may be lost through the removal of some trees related to the Scheme, additional planting along Miserden Road will cater for increased foraging opportunities and provide potential commuting routes for local fauna.

### A.6.2. Indirect Mitigation

- Modal shift – the review of options as part of the West Cheltenham Modal Shift Working Group to promote a positive modal shift away from single occupancy car use identified the following options to be taken forwards for further consideration:
  - Inclusion of dedicated routes for cyclists and pedestrians. Although this will be developed through the WCWCI rather than the WCTIS Scheme.
  - The capital cost aspects of improving awareness of the alternative transport options, such as the P&R scheme, cycle and pedestrian routes, and car share schemes.
  - Increasing the number of charging points at the P&R for electric vehicles.
  - Improving the facilities at the P&R (if not already available), such as suitably sheltered / all-weather waiting areas.
- Reduction in carbon footprint at construction – A design workshop concluded that opportunities for carbon reduction were possible to implement on the Scheme through a variety of different methods, as summarised below:

- Agreement to add measures to the works specification to drive carbon reductions such as: use of local labour, use of electric pool vehicles on site, use of mains and battery powered lighting and recycling of concrete based waste and un-used materials;
- Inclusion of quality questions and optional pricing models about opportunities for the use of low-carbon and recycled materials and increased material recycling to drive cost efficiency in carbon reductions;
- Further investigation through the ongoing design process for the use of low-carbon alternatives such as recycled plastic asphalt to understand its viability for use in the construction of the Scheme.
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### A.6.3. Environmental Enhancements

Opportunities for environmental enhancements were identified in relation to landscape and biodiversity in areas adjacent to the Scheme, in particular Benhall Woods and Park, and Hatherley Brook. Further planting and landscape management opportunities are to be developed in consultation with CBC for Benhall Woods and Park, with the park identified as having potential opportunities for local ecological enhancement, such as wildflower meadows within existing grassed areas of the park.

For Hatherley Brook a Habitat Management Plan will be created through the detailed design period, in consultation with Cheltenham Borough Council and other local landowners where practicable, to increase biodiversity of the brook and encourage the presence of species such as water vole and otter. This Habitat Management Plan will also investigate the creation of additional foraging and nesting opportunities for bats in the tree corridor in which Hatherley Brook flows through Benhall Woods and Gardens.