4 Economic Case

4.1 Introduction

The Economic Case for the scheme has been considered in line with the principles set out in webTAG. The scheme has been considered as a With Scheme (WS) scenario against a Without Scheme (WoS) scenario. The details of the scheme included in the WS scenario are provided as part of the Strategic Case. This section provides information on:

- Section 4.2 – Economy impacts;
- Section 4.3 – Environment impacts;
- Section 4.4 – Social impacts;
- Section 4.5 – Public Account impacts;
- Section 4.6 – Summary of impacts of the core case; and
- Section 4.7 – Sensitivity tests.

4.1.1 Overview of the changes since the economic case presented in the OBC

The OBC report was submitted in January 2017 and the economic results were based on modelling forecasts that used TEMPro v7.0. Following revisions to the TEMPro datasets for Worcestershire and other counties and subsequent release of TEMPRo version 7.2 in February 2017, an addendum report to the Economic Appraisal report was submitted to the DfT in March 2017. DfT sought clarifications on the Economics Appraisal Report and a response was submitted in July 2017. In November, 2017 the DfT announced funding of £54.5m for the scheme and development of the Final Business Case (FBC).

As part of the FBC submission, DfT recommended further tests on the traffic modelling:

- To demonstrate the impacts of changes to TAG databook (May 2018 at the time of analysis undertaken) since the OBC ('Forthcoming changes to TAG values November 2016 released in July 2016);
- To see the impact of long term extrapolation of benefits; and
- To see changes to the Road Traffic Forecasts (2018) on freight growth.

The results of the above tests showed that the impacts on the traffic forecasts were negligible compared to the Core scenario reported in the addendum to the OBC in March 2017. As a result, the following changes and tests have been undertaken to the economic case:

- Update the economic benefits of the scheme using values from the latest TAG data book (May 2018 at the time of analysis) and TUBA software (v1.9.11);
- Update the accident benefits using latest version of COBALT; and
- Appraise the impact of long term extrapolation of benefits

Since the submission of the OBC in January 2017, the assumptions for the Central Case (Section 4.2 of OBC) have been superseded. The FBC reports on the Core scenario forecasts constrained to TEMPro v7.2 and the high and low growth sensitivity tests as reported in the addendum to the OBC submitted in March 2017; and additional sensitivity test on the long term extrapolation of benefits outlined above.

4.2 Core Case Economy Impacts

4.2.1 Assessment approach and key assumptions

DfT's Transport Appraisal Guidance (TAG) has been followed for the economic case of the A4440 Worcester SLR Phase 4 scheme. TUBA (Transport Users Benefit Appraisal), a DfT modelling appraisal tool has been used to compute an appraisal of transport schemes. Comparing the base (or Without Scheme scenario) to the scheme, TUBA assesses the difference in costs and travel time by journey purpose as well as change in fuel costs and CO_2emissions. TUBA summary analysis forms a benefit-cost ratio which quantifies the benefit received to the economy for every £1 invested in the scheme.

4.2.2 Key Modelling Assumptions

The TUBA economic appraisal takes outputs (demand, travel time and distance travelled with and without scheme) from the Highway and public transport models and uses the following standard economic parameters with the assumed parameter(s) for this assessment:

- Start of scheme preparation: 2018
- Scheme opening year: 2021
- Modelled year: 2021 and 2031
- Appraisal period: 60 years
- Price base and base year for discounting: 2010
- Discount rate: 3.5% for 30 years from scheme opening year and 3% thereafter
- Vehicle classes: HGV and three car classes (commuter, business, other)
- Annualisation factors – AM 655 hours, PM 700 hours, IP 1,518 hours and weekends 852 hours as set out in the Economic Assessment Report.
- Value of Time (VoT) – based on TAG data book released in May 2018
- TUBA version 1.9.11 that incorporates the changes to the VoT in line with TAG databook

Construction disruption costs associated with Traffic Management are included within the Present Value of Costs (PVC) whilst those associated with user delays are included in the PVB.

Scheme costs have 15% and 23% optimism bias for Standard infrastructure and the bridges respectively applied (stage 2).

4.2.3 Business users & transport providers

The key economic impact included in the present value of benefits is the time saving benefit. Dualling the A4440 Worcester SLR between Powick and Ketch and improving the roundabouts at each end will reduce travel times, especially during peak hours, thus commuters will value the savings derived from this road improvement scheme. It is expected that the highway network in the city centre too will benefit from reduced congestion as a result of the scheme thus benefitting public transport users too. The benefit is measured as a change in the road user cost due to the time savings for the users pre and post dualling. On a broader scale, the dualling of the A4440 Worcester SLR between Powick and Ketch will impact a wider consumer group through reduced congestion and improved traffic operations.

The benefits to public transport users have been modelled and quantified in this part of the economic assessment, even though the transport user benefits of the schemes will be largely for private car users.

This scheme generates £73.42 million of business user and transport provider travel time benefits, £2.38 million of vehicle operating cost benefits, £2m of user charges benefits to public transport business users and £-0.926 million of benefits during construction and maintenance. This equates to a total business user benefit of £74,888 million. Further details of the breakdown of these benefits are provided in the Transport Economic Efficiency (TEE) Table 4-1 below.

The Transport Economic Efficiency tables indicates car and freight vehicles take up over 99.8% of user benefits. It is envisaged that the reduced volumes of traffic in the City Centre will provide an improved highway network for buses to operate and give the opportunity for bus priority measures beyond that found under the current arrangement.

Table 4-1: TEE Table (£000s)

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**	
Travel time	62,896		62,896		0	0	
Vehicle operating costs	-81		-104		23	0	
User charges	12		0		15	-3	
During Construction & Maintenance	-495		-495				
COMMUTING	62,333	*(1a)*	62,298		38	-3	
Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**	
Travel time	90,163		90,163		0	0	
Vehicle operating costs	1,081		874		207	0	
User charges	105		0		132	-27	
During Construction & Maintenance	-1,108		-1,108				
NET NON-BUSINESS BENEFITS: OTHER	90,240	*(1b)*	89,928		339	-27	
Business					**BUS and COACH**		**RAIL**	
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	**Freight**
Travel time	73,423		39,988	33,435	0		0	
Vehicle operating costs	2,389		-202	2,588	3		0	
User charges	2		0	0	3		-1	
During Construction & Maintenance	-926		0	-926				
Subtotal	74,888	*(2)*	39,786	35,097	5	0	-1	0
Private sector provider impacts								
			Road	Bus	Rail			
Revenue	-478		0	-253.9327454	-223.5994823			
Operating costs	0		0	0	0			
Investment costs	0		0	0	0			
Grant/subsidy	0		0	0	0			
Subtotal	-478	*(3)*	0	-254	-224			
Other business impacts								
			Road	Bus	Rail			
Developer contributions	-5,694	*(4)*	-5694	0	0			
NET BUSINESS IMPACT	68,716	*(5) = (2) + (3) + (4)*						
TOTAL								
Present Value of Transport Economic Efficiency Benefits (TEE)	221,290	*(6) = (1a) + (1b) + (5)*						

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

4.2.4 Reliability impacts on Business users

The DfT gave advice for Local Transport Decisions Makers (2013) about how to quantify reliability benefits in this case. A qualitative assessment, based around the estimation of network stress has been undertaken using the traffic flows forecast from the traffic model. A comparison between the predicted Average Annual Daily Traffic (AADT) and the Congestion Reference Flow (CRF) is undertaken which provides a guide on the likely level of reliability impact of the scheme. Details of the reliability assessment undertaken is given in the 'A4440 Worcester Southern Link Road Improvements Phase 4 -Economic Assessment Report'.

The assessment undertaken is summarised in Table 4-2 which indicates there would be a moderate beneficial impact on reliability based on Tag guidance and assessments.

Table 4-2: Estimated Business User and Transport Provider Reliability Benefits (£000s)

	Scheme
Business Travel Time Benefits	73,423
Reliability Impact	Moderate Beneficial
Reliability Percentage	10%
Business User and Transport provider Reliability benefits	7,342

The importance of journey time reliability of business is illustrated by the following quote from Malvern Hills Science Park:

"The variability of journey times between MHSP and the MS is now a cause for concern and may limit the growth of MHSP. It is 9. 7 miles from here to Junction 7 of the MS and it can take anywhere from 16 minutes to 50 minutes, depending upon the time of day. For example, this means that the bulk of the journey from MHSP to Birmingham Airport is the first 9. 7 miles taking 50 minutes, with the remaining 34 miles taking just 35 minutes. The situation is now so bad that some tenants have taken to heading south to Junction 8 in order to head north on the MS. If we are to succeed as a business, we need this problem addressed in the very near future."

4.2.5 Wider impacts

Transport schemes have impacts and benefits beyond their direct effects on users. In determining the case for investment in transport, such impacts need to be considered alongside other assessments. Collectively these are known as wider impacts. The methodology adopted is in line with guidance in TAG Unit A2.1 and follows a similar process used in assessments of Wider Impacts (WIs) for previous SLR business cases. This section outlines key steps and assumptions in estimating the Wider Impacts that are additional to transport user benefits, as well as the results. The Wider Impacts Assessment is focused on the following three areas:

- Agglomeration – By reducing journey times, the relative agglomeration of business in this area will increase. This will have a direct impact on the productivity and GDP of the UK and is a central element to the estimation of Wider Impacts;
- Output change in imperfectly competitive markets – A reduction in the costs of transport allows businesses to operate more efficiently, improves their output and intensity of business practices, and hence allows for benefits; and
- Labour supply impacts – This captures tax revenues arising from the welfare effects to the UK economy of having a wider human resource pool. As travel costs are reduced, more workers will be attracted to the workplace from either new areas accessible by the scheme or areas that are already connected receiving an improved service.

The assessment approach is set out in **Appendix J**. The work shows that the:

- Agglomeration impacts were estimated for 2021 and 2031, profiled across the appraisal period between 2021 and 2081, and then discounted to 2010 prices and values. Overall the agglomeration impacts are estimated to be £18.434m.
- The value of imperfect competition impact is estimated at £10.749m.
- The value of the tax revenues from labour supply effects impact was estimated at £0.459m.

The total wider impacts of the A4440 SLR Phase 4 scheme is forecast to be £29.643m for the appraisal period (unchanged from the OBC forecast).

4.2.6 Regeneration

Further benefits of the scheme come from two sources. Firstly the unlocking of residential and commercial land around south Worcester, west Worcester and Malvern Hills. Secondly improving the accessibility across the region. There are no changes to the assumptions in the development assumptions since the OBC and the assumptions therefore remain unchanged.

Aligning with the Worcestershire SEP, the completion of the dualling of the A4440 Worcester SLR between M5 and Powick roundabout will address pinch points on the Worcester SLR allowing for the early delivery of housing and employment sites, as well as improving links with the wider road network, enhancing user experience by decreasing travel times and increasing reliability.

The SWDP targets delivery of 280 ha of employment land 28,400 new homes between 2006 and 2030. The scheme will contribute to unlocking strategic development sites will deliver a significant portion of these ambitious targets.

Specifically, Policy SWDP45/1 Broomhall Community and Norton Barracks Community (Worcester South urban extension) which will comprise 2,600 dwellings and 20 Ha employment together with supporting

services and facilities. This quantum of development could sustain more than 3,600 jobs and generate nominal GVA in the region of £195m per annum upon completion.

In addition, A4440 Worcester SLR Improvements Phase 4 will help to unlock the development of 2,150 dwellings, 5Ha of employment land and a range of supporting services and facilities including a neighbourhood centre as part of the Worcester West urban extension (see: Policy SWDP45/2 Temple Laughern – (Worcester West) urban extension). This quantum of development could sustain more than 900 jobs and generate nominal GVA in the region of £49m per annum upon completion.

Further, the SLR is considered critical to unlocking development at North East Malvern (see Policy SWDP 56), where 800 homes and 10ha of employment land will be delivered. This quantum of development could sustain more than 1,800 jobs and generate nominal GVA in the region of £97m per annum upon completion.

In total, these strategic development sites could generate 5,600 new homes and 35ha of employment land, supporting in excess of 6,300 jobs and providing GVA uplift of £340m per annum. Given the range of site-specific and complementary investments required to facilitate development at these sites, it would not be appropriate to attribute all of these regeneration impacts to dualling of the SLR. Nevertheless, the Scheme is considered to remove a critical barrier to development in the area. Within this context, the Scheme will play a key role in unlocking development and promoting investment and regeneration in South Worcestershire.

In the absence of the Scheme, development would not come forward as quickly or at the same scale, meaning South Worcestershire would not be able to capitalise on significant opportunities for growth and regeneration. The estimated 6,300 jobs and £340m annual uplift in GVA would not materialise.

Looking at accessibility, the Scheme will improve connectivity east to west and north to south across Worcestershire. Analysis of changes in average journey times demonstrates that trips between various parts of the county will significantly quicker and easier with delivery of the Scheme. In particular, trips between Malvern Hills and Redditch, Bromsgrove, Wyre Forest and Wychavon will all be quicker with Phase 4 of the SLR in place. Further, journeys between Wyre Forest and Worcester will also benefit from reduced journey times. This will mean that more jobs will be accessible to the workforce across Worcestershire, whilst simultaneously a larger, more skilled labour pool will be available to employers in the county. This could drive inward investment and business relocation as firms try to take advantage of improved labour catchments.

Linked to accessibility, the SEP outlines a priority to improve the routes across a wider geography. For example, there is a desire to enhance linkages with Herefordshire in order to create better access and augment strategic links between the two geographical areas. This aspect is mainly important for businesses trading and/or supplying other businesses or customers within the local geographic area. With enhanced links, trading and deliveries can be made more easily and more reliably. Given the strategic importance of the A4440 Worcester SLR linking Worcester, Worcestershire and Herefordshire with the M5, the benefits would span the West Midlands and beyond.

It is important to recognise that the ambition of the SEP is already being realised.

The ambition of the SEP is already being realised. The 2017 Annual Report of the LEP states the following, WLEP is

- 1st strongest growth in higher level workforce skills (Of all LEPs between 2010 – 2015)
- 1st highest growth in productivity (Of all LEPs between 2010 – 2015)

The 2016 Annual Report of the LEP states that “Worcestershire continues to climb the league tables due to our performance and is well on track to exceed our target to increase GVA by £2.9bn, enable over 21,500 new homes and create an additional 25,000 jobs all by 2025”.

The regeneration policy and prospect as mentioned in OBC still prevails.

4.3 Environment

The environmental surveys and assessment have been to inform an Environmental Statement for the scheme. Information is presented for the following technical areas:

- Noise;
- Air Quality;
- Greenhouse Gases;
- Landscape and Townscape;
- Heritage of Historic Resources;
- Biodiversity; and
- Water Environment.

This work is documented in full in the Environmental Statement for the OBC, in **Appendix H**. In addition to the Environmental Statement, TAG assessments have been undertaken and the workbooks are presented in **Appendix F**

The OBC for the current scheme was produced whilst EIA assessment work was ongoing. A preliminary ES was produced by CH2M to feed into the OBC. However, since the OBC was produced, further work has been completed to inform the full business case and another ES has been produced by TACP for this purpose, with more up to date information. Due to this, the information in the Environment Statement within the FBC is more up to date than the information contained within the OBC. This more recent TACP ES includes some differences with the conclusions from the preliminary ES used in the OBC, the main differences being in the air quality and landscape conclusions.

The Environmental Impact Assessment (EIA) procedures in European Union member states are based on the European Community Directive, 'The Assessment of the Effects of Certain Public and Private Projects on the Environment' (85/337/EEC) as amended by Council Directive 97/11/EC, Directive 2003/35/EC and Directive 2009/31/EC (subsequently replaced in 2011 by a new Codified EIA Directive 2011/92/EU) – collectively termed the 'EIA Directive. Following review, this new EIA Directive finally came into force on 15 May 2014 as Directive 2014/52/EU.

The Directive was implemented in the UK through the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 (SI No 1199). This has subsequently been superseded by the Town & Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2011 (SI No 1824) (hereafter referred to as the EIA Regulations).

Schedule 1 of the EIA Regulations identifies those developments for which environmental assessment is mandatory. The scheme for this application site does not fall into this category.

Schedule 2 of the EIA Regulations lists developments which require environmental assessment if the proposed scheme is likely to have significant effects on the environment 'by virtue of its nature, size or location'. The process of determining whether a Schedule 2 development requires an environmental impact assessment is referred to as "screening". Under Regulation 5 of the EIA Regulations the applicant may request a Screening Opinion from the relevant Planning Authority to determine whether the proposed development requires an EIA. Alternatively, the applicant can voluntarily prepare an EIA normally following consultation with the relevant planning authority.

The Local Planning Authority ((LPA)(Worcestershire County Council)) has been consulted with regards to the Environmental Impact Assessment (EIA). Following consultation with the LPA a Screening Opinion has not been sought because the scheme is located immediately adjacent to the River Teme Site of Special Scientific Interest (SSSI). The scheme's proximity to the SSSI increases the risk of significant impacts and hence the requirement for EIA. Further to this, the site lies within a Registered Battlefield (Battle of Worcester 1651) and flood plain. An Environmental Statement (ES) will therefore be prepared to accompany the Planning Application for the proposed scheme. A scoping report will be submitted to the LPA detailing the proposed scope of the ES and the consultation undertaken to date.

To inform both the scoping and the Environmental Statement, surveys have been undertaken at appropriate times of the year. These surveys include: ecological surveys; noise monitoring surveys; and air quality surveys. Figure 4-1 shows key designations in the vicinity of the scheme.

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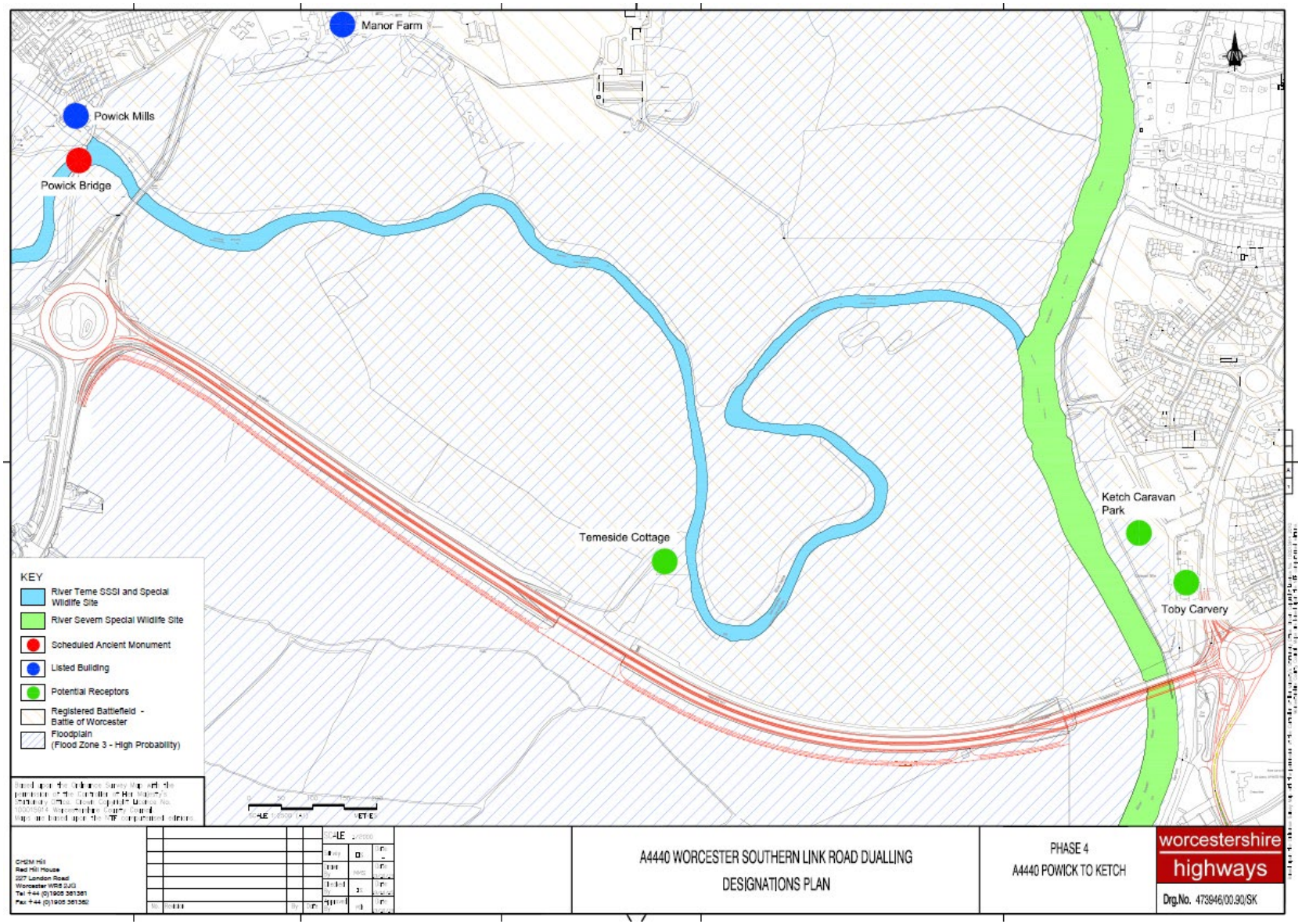
Figure 4-1: Key designations in the vicinity of the scheme.



4.3.1 Noise

The scheme has the potential to generate noise and vibration from its construction and operation as a result of the associated traffic movements. In addition, the existing noise climate needs to be considered to ensure that noise sensitive receptors are protected.

A noise monitoring survey was undertaken which monitored existing noise levels at a number of locations. The monitoring locations were established with Worcester Regulatory Services and included sensitive receptors, such as residential properties. The monitoring results were then used to inform the environmental assessment for the scheme. To the west of the River Severn the existing baseline environment is predominantly agricultural with a number of isolated properties. To the east is the St Peters residential estate, Ketch Caravan Park and Moorings and the Ketch Public House. Further to preparation of the Environmental Scoping report it has been identified that there is one Noise Important Areas within the scheme extents and two further just outside the extents.

Alterations to a road and changes to the noise climate also have the potential to bring with them claims under Parts I and II of the Land Compensation Act 1973. The assessment therefore:

- Examined the situation where the authority may have a duty to provide noise insulation (Part II claims); and
- Provided data through noise measurements prior to the alterations that could be used by the authority to compare with post completion measurements. These could be used to defend any claims under Part I of the Act.

The ES report found significant increases in the short term to noise levels and attempts to mitigate these adverse impacts through scheme design, for example the inclusion of low noise surfacing. Noise barriers were also considered as mitigations at two locations, however they were not included due to the adverse visual impacts that they would have. Of 1251 properties that were assessed, 1248 would experience a minor or negligible change in noise levels, which is classified as insignificant in the opening year of the scheme (2021). Three locations would experience moderate increases in noise in 2021, which would be considered significant. However, by 2036 all of the properties assessed are predicted to experience minor or negligible changes in noise level, which is considered not significant. It is unlikely that any dwellings along the route will be eligible under the Noise Insulation Regulations. Impacts at night are likely to be similar to day time impacts.

After assessment it was concluded that vibration impacts are unlikely.

The OBC assessment of noise stated that the A4440 Worcester SLR Improvements Phase 4 scheme is likely to create significant noise impacts in the short term. This is considered a pessimistic scenario, given the assessment undertaken for the ES.

4.3.2 Air quality

During operation, potential air quality impacts will be due to changes in traffic movements on the roads, giving rise to a change in the nature and location of vehicle emissions, with consequent impacts on local air quality.

Under the Local Air Quality Management regime Local Authorities have a duty to make periodic reviews of local air quality against the air quality objectives. Where this indicates that the objectives are not expected to be achieved, they are required to designate an Air Quality Management Areas (AQMA). An Air Quality Action Plan (AQAP) must then be formulated, outlining a plan of action to meet the air quality objectives in the AQMA.

A desk based search has been undertaken to determine whether there are any Air Quality Management Areas (AQMA) within close proximity of the scheme. There are three existing AQMA's within Worcester, these are:

1) Bridge Street/Dolday;

2) Lowesmoor/Rainbow Hill; and

3) St John's Centre.

Further assessment of deteriorated air quality is currently ongoing in the Butts, the Tything, the Cross and London Road, which may result in further future declarations of AQMA.

Consultation with Worcester Regulatory Services was carried out and an appropriate set of monitoring locations and an appropriate programme were agreed. This information along with the traffic data was used to produce the air quality section within the Environmental Statement. Air Quality Monitoring began at ten locations in May 2016 for 6 months. Modelling of air quality impacts with and without the scheme has also been completed and reported in full within the ES report.

An Air Quality Technical Note has been produced for the FBC. This note explains why there are differences between the air quality conclusions from the preliminary ES prepared by CH2M for the OBC and the ES produced after the OBC by TACP. It had been found that there were few major differences between the two reports that would change the conclusions drawn. One main difference was that the preliminary ES report produced by CH2M predicted negative impacts for air quality in Whittington, whereas the TACP ES report identified only benefits in this area. The Air Quality Note found that the preliminary ES report used to inform the OBC and the TPAC ES report, used different traffic models to base their air quality assessment on. The traffic volumes used by the TPAC ES had lower traffic flows predicted along Whittington road than in the traffic model used to produce the air quality conclusions within the preliminary ES report for the OBC. This meant that different receptors were identified in the two assessments and resulted in the differing conclusions.

Overall, with mitigations such as dust suppression and low site-speed limits the impact on air quality is expected to be low across all receptors within 350m of the scheme and there should be a net positive impact on air quality within the wider Worcester City area.

4.3.3 Greenhouse gases.

The assessment shows that there is an overall net increase in CO_2 emissions associated with the scheme due to an increase in traffic flows on the local road network.

The transport modelling work undertaken shows the following carbon benefits:

- Change in non-traded carbon over 60y (CO2e)-22,646
- Change in traded carbon over 60y (CO2e)-327

The total monetised dis-benefit is -£1.046m.

In summary, the A4440 Worcester SLR Improvements Phase 4 scheme is likely to have a slight adverse greenhouse gas impact. The greenhouse gas benefits/dis-benefits output by TUBA are shown in Table 4-3 and Table 4-4.

Table 4-3: CO2 emissions by time period (untraded)

Submode	Year	Emissions (tonnes) DM	Emissions (tonnes) DS	Emissions (tonnes) Increase	Cost £000s DM	Cost £000s DS	Cost £000s Increase
Am Peak	2021	418168	418447	279	17675	17686	12
AM Peak	2031	394676	394560	-116	14831	14827	-4
PM Peak	2021	413479	413478	-1	17476	17476	0
PM Peak	2031	385567	385529	-38	14489	14487	-1
Inter-Peak	2021	896585	896727	142	37896	37902	6
Inter-Peak	2031	67037	867374	336	32581	32594	13
Weekend	2021	491774	491948	174	20786	20793	7
Weekend	2031	475963	476169	206	17885	17893	8
AM Peak	Total	22206460	22202299	-4161	995292	995096	-196
PM Peak	Total	21510962	21509090	-1872	963637	963552	-85
Inter-Peak	Total	49246932	49264435	17503	2208769	2209559	790
Weekend	Total	26924989	26936165	11176	1207445	1207947	502

Table 4-4: CO2 emissions by time period (traded)

Submode	Year	Emissions (tonnes) DM	Emissions (tonnes) DS	Emissions (tonnes) Increase	Cost £000s DM	Cost £000s DS	Cost £000s Increase
Am Peak	2021	1212	1214	2	9	9	0
AM Peak	2031	3954	3957	3	149	149	0
PM Peak	2021	1342	1344	2	10	10	0
PM Peak	2031	4403	4408	5	165	166	0
Inter-Peak	2021	2140	2141	1	16	16	0
Inter-Peak	2031	7210	7217	7	271	271	0
Weekend	2021	1166	1167	1	9	9	0
Weekend	2031	4105	4109	4	154	154	0
AM Peak	Total	153796	153921	124	6466	6471	5
PM Peak	Total	170155	170363	208	7150	7159	9
Inter-Peak	Total	283073	283367	295	11934	11947	13
Weekend	Total	164284	164458	174	6956	6964	8

4.3.4 Landscape and townscape

The Malvern Hills is a designated Area of Outstanding Natural Beauty (AONB) and whilst the scheme is not in close proximity to the AONB it has the potential to impact upon setting and views. Impacts to users of the Public Right of Way (PROW) will need to be considered and a visual envelope will be established. Consultation with the relevant authorities will be required to ensure that their views are captured and any mitigation is developed into the design. The site sits within National Character Area Severn and Avon Vales.

Work was carried out as part of the TACP ES report, which includes a detailed assessment of the quality and value of the landscape and visual resources of the site, identification of the visual envelope of the site and to assess the effects of the scheme.

The context of the application site is predominantly rural fringe, although existing developments in the vicinity already influence the rural setting to a certain extent. Significant effects on the landscape features of the site would largely occur during construction, where there would be loss of vegetation along the existing southern embankment alongside other impacts. Significant visual effects of the scheme would be at Ketch Viewpoint, the Severn Way and Three Choirs National Trails and PROW in close proximity to the Scheme and Common Land on its southern side. Here, impacts during construction would be moderate/large adverse with those moderating to impact during operation after mitigation of moderate beneficial at the Ketch Viewpoint and would be slight adverse for the users of the Severn Way and Three Choirs Way.

Mitigation measures have been introduced through the CEMP to reduce construction related impacts on the landscape. Generally, mitigation reduces every identified impact on landscape character to Neutral after 15 years.

In summary, the A4440 Worcester SLR Improvements Phase 4 scheme is likely to have a slight to moderate adverse impact on the landscape but a neutral impact on the townscape.

4.3.5 Heritage of historic resources

The site of the proposed scheme and the area surrounding has a number of historical designations of at least local and in some cases national importance. To the north of the A4440 is the site of the First and Last battles of the English Civil War and a registered battlefield of national importance, which will be intersected by the north side of the scheme.. Powick Bridge, which played an important part in both battles, is still extant as a Scheduled Monument and Grade I Listed Building. The Old Bridge lies adjacent to the Grade II listed Powick New Bridge and sits by Powick Mills a Grade II* listed Hydro-electric plant. As

with the designated battlefield the impacts these assets will undergo will be negligible; no direct impact will occur and the proposed scheme will not overly change their current settings.

Non-designated assets within the area surrounding the scheme range from Mesolithic finds to Second World War aircraft landing obstacles. The creation of the dual carriageway, footbridge and the enabling works all have the potential to intersect and damage non-designated assets. World War Two defence features and assets at Temeside cottage will undergo direct impacts, though with proper mitigation the impact to these will be negligible. The footprint of the proposed scheme intersects with a possible Roman Road route from Gloucester to Worcester; if found and properly investigated this would be a beneficial impact as it would confirm the course of the road and provide insight into its use.

Alongside these known archaeological features, there is a potential for unknown archaeology and palaeoenvironmental remains. These could be valuable and provide a greater understanding of the history and past environment in the area. Further detailed assessment could potentially use Electro-Magnetic survey or geo-physics to determine the extent of below-ground archaeology. Trial trenching could be utilised after non-invasive techniques to further investigate any potential assets and the known archaeology in proximity of the scheme. The extent of archaeology will be limited adjacent to the A4440 because of previous construction and enabling works from the original construction of the A4440.

In summary, the A4440 Worcester SLR Improvements Phase 4 scheme is likely to have a slight adverse impact upon heritage of historic resources.

4.3.6 Biodiversity

The work to date indicates that the proposed scheme has the potential to affect the condition and function of ecological resources present on and surrounding the site. These may occur through direct impacts, such as loss of habitat or species, or indirect impacts such as disturbance effects. These issues will be identified and quantified in full within the Environmental Statement (ES).

Ecological surveys have been completed including:

- Ecological Appraisal;
- Bat Surveys;
- Otter Surveys;
- Great Crested Newt Surveys;
- Reptile Surveys; and
- Badger Surveys.

A desk based survey has been carried out to identify any statutory designated sites that could be impacted upon during both the construction and operation of the scheme.

There are three statutory designated sites within 2km of the scheme. These are:

1. The River Teme SSSI - is the second largest tributary of the River Severn, draining a hilly, predominantly rural catchment of Silurian and Devonian rocks. The notified channel is of special interest as a representative, near-natural and biologically-rich river type associated with sandstone and mudstones. It supports several protected species. The River Teme is located adjacent to the proposed scheme at its nearest point.
2. The Laugherne Brook is a designated Local Nature Reserve 0.3km to the north of the proposed scheme and comprises woodland, scrub, hay meadows and amenity grassland. It is a tributary of the River Teme.
3. Cherry Orchard is a designated Local Nature Reserve 1 km to the North of the proposed scheme. Cherry Orchard is situated in the Diglis area of Worcester on the River Severn flood plain to the south of the city. A mosaic of habitats has emerged through colonisation. Flower rich grassland and scrub dominate, contributing to the green corridor that extends into the city from the south.

Additionally, two non-statutory Local Wildlife Sites (LWSs) are located in close proximity to and are likely to be impacted by the proposed scheme, namely:

1. The River Severn flows under proposed scheme at Carrington Bridge. It is a major ecological corridor running north to south for the whole length of the county. Most of the river is tree lined and there are significant amounts of contiguous semi-natural habitat which augment the value of the watercourse itself, making the corridor extremely important in a county context. The Severn supports a rich and varied fauna including the rare club-tailed dragonfly, salmon and otters.
2. Carey's Brook is located approximately 0.3km south of the proposed scheme. In combination with small areas of contiguous semi-natural vegetation this brook forms a valuable wildlife corridor through the landscape. Information on associated species of interest is limited but otters are likely to be present.

Habitats recorded within the proposed scheme extents comprise: built structures and hardstanding with no intrinsic ecological value; arable land, improved grassland, amenity grassland, ditches, ponds and hedgerows of importance within the immediate zone of influence only; semi-improved neutral grassland, tall ruderal vegetation, broadleaved woodland and scrub of local importance; standard trees of local, District and National importance; and watercourses of County and National importance for nature conservation.

Protected species surveys have been carried out for the proposed scheme, but the results so far indicate the following:

- A 'good' population of slow worm and a 'low' population of grass snake are present along the north verge of the A4440 between Carrington Bridge and Powick Roundabout;
- At least 10 badger setts are present within the proposed scheme area, including a main sett, an annex sett and at least 8 outlier setts;
- Otters are known to be present along the Rivers Severn and Teme. Footprints were recorded close to one of the outlier badger setts. This sett could potentially be used by otters as a holt;
- Value of habitats within the proposed scheme for otters was valued as low.
- Impacts of freshwater pearl mussel have been considered and are classified as medium value due to potential upstream effects related to salmon migration;
- No bat roosts have been recorded within the scheme extents. At least seven species of bat have been recorded foraging/commuting within the scheme extents, with the highest levels of activity along the River Severn corridor;
- Value of bat roost features have been classified as low and the value of the River Severn corridor for foraging bats has been classified as medium; and
- Suitable nesting bird habitat is present throughout the proposed scheme. Suitable nesting habitat for kingfisher has been recorded along the River Teme, but not along the River Severn.

Although the scheme is not expected to impact directly on any designated sites, there will potentially be some indirect effects to sites such as the River Teme SSSI and the Severn Estuary and River Clun Special Areas of Conservation. Indirect effects would also likely to impact on habitats within the area such as broadleaved woodland as well as on protected species such as nesting birds. With mitigation measures, the only residual impact would be on the River Teme SSSI, which would be slightly adverse in the short and medium term. Long term mitigations, for example 1.4 ha replacement woodland and habitat enhancement measures, are expected to achieve a net gain for biodiversity.

The scheme is likely to have an adverse impact upon designated sites, habitats and species during construction and operation primarily as a result of land take, pollution, species disturbance and increased road crossing mortality.

The impact on the River Teme SSSI/LWS from increased airbourne pollutants due to increased area of road surface was assessed in the ES report as being slightly adverse (with mitigation).

The ES report differs from the preliminary ES report as it uses DMRB terminology for valuing features, whereas the older report makes use of CIEEM terminology.

In summary, once mitigation and compensation measures have been put in place (which is outlined in the ES Nature Conservation chapter), the A4440 Worcester SLR Improvements Phase 4 scheme is likely to have a slight adverse impact upon biodiversity.

4.3.7 Water environment

The proposed scheme has the potential to impact upon three Water Framework Directive (WFD) waterbodies, including the River Severn (medium value), River Teme (high value) and Careys Brook (low value) which have been evaluated within a WFD assessment. The confluence of the River Severn and the River Teme is located approximately 580 metres upstream from the proposed scheme, to the north of Carrington Bridge. The River Teme is a SSSI and therefore a protected area for conservation which gives rise to its high value as a water receptor. The site lies within a surface water Nitrate Vulnerable Zone (NVZ). A groundwater body is identified under the WFD however the area is not designated as a groundwater Source Protection Zone (SPZ), nor are there any SPZs within 1km of the site.

In terms of land drainage and flood risk, residual effects have been determined to be negligible (with mitigation). This has been downgraded from 'minor adverse' effects within the preliminary ES report due to more information being known about site compounds and modelling undertaken showing negligible impacts as the flood mechanism is dominated by conveyance not flood storage. In addition, after the preliminary ES report was produced, changes were made to the permanent design to include widening of the embankment to south side. This design change avoided the impacts of working in the River Teme Floodplain.

The ES report Flood Risk Assessment found that the impact upon floodplain will be negligible but that a like-for-like compensatory area of floodplain will be provided anyway as this would provide part of the biodiversity benefits. Consultation with the Environment Agency, Severn Trent Water and WCC has been undertaken to ensure that the proposed flood mitigation and drainage strategy meets their requirements.

A Construction Environmental Management Plan (CEMP) has been prepared to ensure best practice measures are implemented and adverse impacts on the water environment are minimised during construction. Work activities should be carried out in a controlled manner through the adoption of best management practices and standard pollution measures in accordance with industry good practice regarding pollution prevention.

During the operation of the proposed scheme, impacts may include alteration of the run-off characteristics and patterns of surface water drainage within the site, presenting a potential increase in flood risk. Furthermore, the discharge of polluted road drainage (arising from collisions, general vehicle and road degradation and leaks of oil, fuel or other pollutants) may impact upon water quality. Impacts are also likely to the River Severn where there will be another bridge structure built next to the existing one, Carrington Bridge, to accommodate the dual carriageway. Physical impacts of the scheme were likely to be not significant. This is despite physical impacts to the drain flowing into Carey's Brook due to widening of the drain being identified.

Outfall 1 (to Carey's Brook) failed water quality assessment for soluble copper, sediment bound pollutants and the Environmental quality standard (EQS) for Copper. Filter drains and a Vortex Separator have been proposed as mitigation. These methods of treatment don't provide any removal of soluble copper therefore the impact after mitigation is Minor Adverse.

Drainage design has changed since the OBC and filter drains are now proposed within the scheme. A quantitative assessment for risks to groundwater has therefore been carried out within the ES report. In addition, twelve drainage catchments and three outfalls are now included within the scheme design.

The assessment has concluded that providing the recommended mitigation measures are adopted during construction and operation then the proposed scheme is likely to have a slight adverse impact to the water environment.

4.4 Social

Social assessments have been undertaken to support the development of the scheme. The assessments are provided in the following sections:

- Commuting and Other users and Reliability impacts on Commuting and Other users;
- Physical Activity;
- Journey Quality;
- Accidents;
- Security;
- Access to Services; and
- Severance.

A Social and Distributional Impacts has not been undertaken for this OBC, but will be considered in a subsequent business case.

4.4.1 Commuting and Other users

This scheme provides significant social benefits, generated primarily from travel time savings to commuters and other users, reliability and estimated reduction in number of accidents.

Economic impacts on commuters and other users have been assessed using outputs from the traffic model. These have been input into TUBA and the following (dis)benefits of each of the scheme options have been identified from the TEE tables given in Table 4-1. These are provided in Table 4-5 below.

Table 4-5: Commuters and Other users impacts (£000s)

Purpose	Impact	Scheme
Commuting	Travel time	62,896
	Vehicle operating costs	-81
	User charges	12
	During Construction & Maintenance	-495
	Total	62,333
Other	Travel time	90,163
	Vehicle operating costs	1,081
	User charges	105
	During Construction & Maintenance	-1,108
	Total	90,240
Total		152,573

4.4.2 Commuting and Other - Reliability Impacts

The same approach was adopted for calculating the reliability benefits for commuting and other users as for business users outlined in Section 4.2.3. It is expected reliability will add £15.30m to the benefits resulting from the scheme for commuting and other users. Table 4-6 shows the reliability benefits for commuting and other users.

Table 4-6: Estimated Commuting and Other User Reliability Benefits (£000s)

Commute Travel Time Benefits	62,896
Other – Travel Time Benefits	90,163
Total Social Travel Time Benefit	153,059
Reliability Impact	Moderate Beneficial
Reliability Percentage	10%
Business User and Transport provider Reliability benefits	15,306

4.4.3 Physical activity

There is a recognition of an interrelation between transport, the environment and health. One of the key aspects of transport and health relates to the propensity to make use of active travel modes, namely walking and cycling. Health implications of transport proposals can therefore be assessed by considering changes in the opportunities for increased physical activity through walking and cycling. More walking and cycling can also give benefits by improving the physical environment within communities, in turn helping to foster community spirit, with implications for health.

As a highway scheme, the A4440 Worcester SLR Phase 4 scheme is not overtly aimed at increasing opportunities for walking and cycling. Also, located as it is on the periphery of the city, there is not much current demand for walking and cycling movements in the area. This is unlikely to change as a result of the scheme, but notwithstanding this, the scheme will provide improvements to the walking and cycling environment that will encourage greater use, and generate some (limited) benefits.

The existing shared cycle and pedestrian path between Powick and Ketch Roundabout will remain present on the city side of the carriageway, but will be subject to significant enhancement. It is currently narrow in width (1.2m), so any improvements will be subject to environmental constraints. Recent pedestrian and cycle counts have shown that the current demand along and across the SLR is low (generally less than 10 pedestrians/cycles per hour). Pedestrian and cycle demand will increase with proposed development to the South of Worcester.

A new pedestrian/cyclist footbridge will be provided on the western side of Powick roundabout (Hams Way), this will provide a north south grade separated connection for pedestrians and cyclists to cross the SLR, replacing a current requirement to cross at-grade.

At the Ketch roundabout, an existing grade separated route that passes under the Carrington Bridge (Severn Way) will be upgraded and better linked to routes either side of the SLR, providing enhanced opportunities for north to south movements.

Assessment of the effects on physical activity have made use of guidance in TAG Unit A4.1 'Social Impact Appraisal' and TAG Unit A5.5 'Highway Appraisal', **Appendix A** 'Assessment of impact on active modes', and followed a proportional approach because the numbers of effected users and potential impacts are small. A completed TAG worksheet for physical activity, which highlights the key elements of the scheme that affect physical activity (grade separated pedestrian/cyclist crossings) is presented in **Appendix F**.

In summary, the A4440 Worcester SLR Phase 4 scheme is likely to have a neutral impact to physical activity.

4.4.4 Journey Quality

TAG Unit A4.1 'Social Impact Appraisal' defines journey quality as "a measure of the real and perceived physical and social environment experienced while travelling", noting that this includes various factors related to peoples' experience on journeys such as information provision and the perception of safety. Note though that 'journey quality' considered in this assessment do not include those covered elsewhere in the appraisal (such as severance, security, accidents, journey times, journey reliability, etc). There are three key elements to journey quality impacts:

- Traveller care – such as cleanliness, facilities, information and the general environment – this aspect only relates to public transport journeys, so is not taken further in this assessment;
- Travellers' views – pleasantness of surroundings en route – views are not considered from a landscape and visual impact point of view of the scheme as a whole, but from the perspective of travelers along the road. Commentary is made on this in the appraisal, but given that the scheme consists of works along an existing road corridor, the impacts are minimal; and
- Traveller stress – frustration, fear of accidents and route uncertainty.

The main journey quality impacts considered in this assessment therefore relate to 'traveller stress'. A completed TAG worksheet for journey quality is presented in **Appendix F**

- Frustration: When the scheme is in operation drivers will experience improvements in predictability of journey times; reduction in delays; and reduced stop starting which when combined will reduce levels of frustration for vehicle users. Slight to moderate beneficial;
- Fear of Accidents: Improvements in the road layout will reduce travellers' fear of accidents. Slight beneficial; and
- Route Uncertainty: Clear lane markings will assist route certainty for vehicle travellers. Overall therefore, the improvement in route certainty is considered to be Slight to moderate beneficial.

Once the proposed scheme is fully operational, the provision of improved signs and lane demarcation will reduce congestion, decrease the levels of frustration, fear of accidents and route uncertainty, overall resulting in an improvement in driver stress and thus journey quality.

In summary, the A4440 Worcester SLR Phase 4 scheme is likely to have a slight to moderate beneficial impact to journey quality for a large number of users, so a large beneficial effect overall.

4.4.5 Accidents

WCC's accident records show that between 01/01/2010 and 29/02/2016 there were the following accidents in the vicinity of the scheme:

- Severity slight: 42
- Severity serious: 1
- Severity fatal: 0

The transport modelling work shows that there will be an overall increase in vehicle demand from the Without Scheme to With Scheme scenario. This is likely to increase the forecast accident numbers associated with the 'junctions' as a result of the scheme and higher traffic volumes, but a decrease the number of accidents associated with the 'links' of the scheme as well as others parts of the network that are likely to experience reduction in traffic due to reassignment. The scheme should also attract traffic from less suitable routes/road standards.

The pedestrian/cyclist footbridge on the western side of Powick Roundabout will reduce the conflicts between motorists and pedestrians/cyclists crossing the Southern Link Road.

Accident Analysis was undertaken using the DfT's COBALT tool (v2018.1) for a 60-year assessment period. The casualty summary is given in Table 4-7 below. It shows that the scheme will reduce accidents and provide benefits of £4.9 million.

Table 4-7: Forecast Casualty Summary (60-yr assessment period)

Totals	**Fatal**	**Serious**	**Slight**
Total Without Scheme Casualties	51	506	4,587
Total With Scheme Casualties	49	484	4,560
Casualties Saved by Scheme	2	22	27

4.4.6 Security

TAG unit A4.1 notes that changes brought about in the implementation of a transport scheme may affect the security of users. This is especially so in the case of public transport schemes, where a number of guidelines exist in relation to bus and rail operations, especially at stops and stations. It goes on to indicate though that there are no formal guidelines for road users, but that a series of points to note when considering these security indicators are potentially common to all schemes, including in relation to road users. In particular, road users are more vulnerable to crime where users:

- Need to stop vehicles or travel at slow speeds (such locations could include the approaches to signals or in generally congested conditions); and
- Have to leave their vehicles (for example, at service stations, laybys and car parks).

The location and nature of the road (such as urban versus rural) affects the importance of each indicator.

The A4440 Worcester SLR Phase 4 scheme will not alter the existing road alignment at all, adding a new carriageway to the existing single carriageway currently extant. The alignment will remain relatively straight with good sight lines and no 'hidden' sections for pedestrians or stopped vehicles. Vehicles will have to slow to enter the roundabouts at Powick and Ketch, with some stoppages required depending on the amount of traffic and directions of turning movements at the time. Notably, no existing are located on this section of road, and no new service areas or lay-bys are proposed as part of the scheme. Surveillance provisions will remain the same as at present. The scheme will include a full lighting design to BS 5489, which will both enhance and extend the current road lighting layout.

Provision of new grade separated walking and cycling facilities at Powick (footbridge) and Ketch (underpass) roundabouts are included in the scheme, so these have been considered separately to the highway elements of the scheme. The new routes will be high standard provision, with good sight lines for users and lighting where needed. Note that the underpass at Ketch is not a subway, but an existing riverside footpath that passes underneath the existing Carrington Bridge. As such, it has an open aspect that will be enhanced by better connectivity to the existing highways to the north and south of Ketch roundabout.

A completed TAG worksheet for security of the highway itself, and a completed TAG worksheet for the walk/cycle facilities included in the scheme are presented in **Appendix F**.

For road users the impact of the A4440 Worcester SLR Phase 4 scheme on security is neutral. For walk/cycle users there is a slight beneficial impact to security. Overall, the assessment is neutral.

Distributional impacts of security are considered further in Section 4.4.8.

4.4.7 Access to services by public transport

The stretch of the Southern Link Road between Powick and Ketch Roundabout, which is the subject of A4440 Worcester SLR Phase 4 scheme, affects the bus services[1] 362, 364 and 365 (at Ketch Roundabout) and 44, 44 a/b/c, 363, 373 (at Powick Roundabout). The scheme reduces journey times along the A4440 Worcester SLR, but it is possible this may increase journey times north/south through the Ketch and Powick Roundabouts. The decongestion impact as a result of the additional capacity provided by the scheme will have small effects on the wider highway network, trip patterns could alter and as a result other bus services across the city will receive benefits.

The A4440 Worcester SLR improvement strategy is closely aligned to the Worcestershire Parkway project which is outlined in the Worcestershire Growth Deal as having £7.5 million allocated for its delivery. Worcestershire Parkway will provide Worcestershire with a new mainline station that will improve connectivity to a range of major centres. The Worcestershire Parkway rail station is currently scheduled to be completed by 2019, by which time it will incorporate a 500 space capacity car park. The A4440 Worcester SLR Phase 4 scheme will ensure that highway access to Worcestershire Parkway rail station is

[1] Correct at the date of OBC submission

enhanced. This will contribute to a reduction in greenhouse gas emissions as trips previously undertaken in their entirety by private car, instead choose to switch to rail services.

The enhancement to the cycle route along the SLR, together with significant enhancement of cycle facilities at the Powick Hams junction will deliver a much more attractive, direct route between Powick/west Worcester, upgrade of the grade separated pedestrian route at Ketch Roundabout and Worcestershire Parkway.

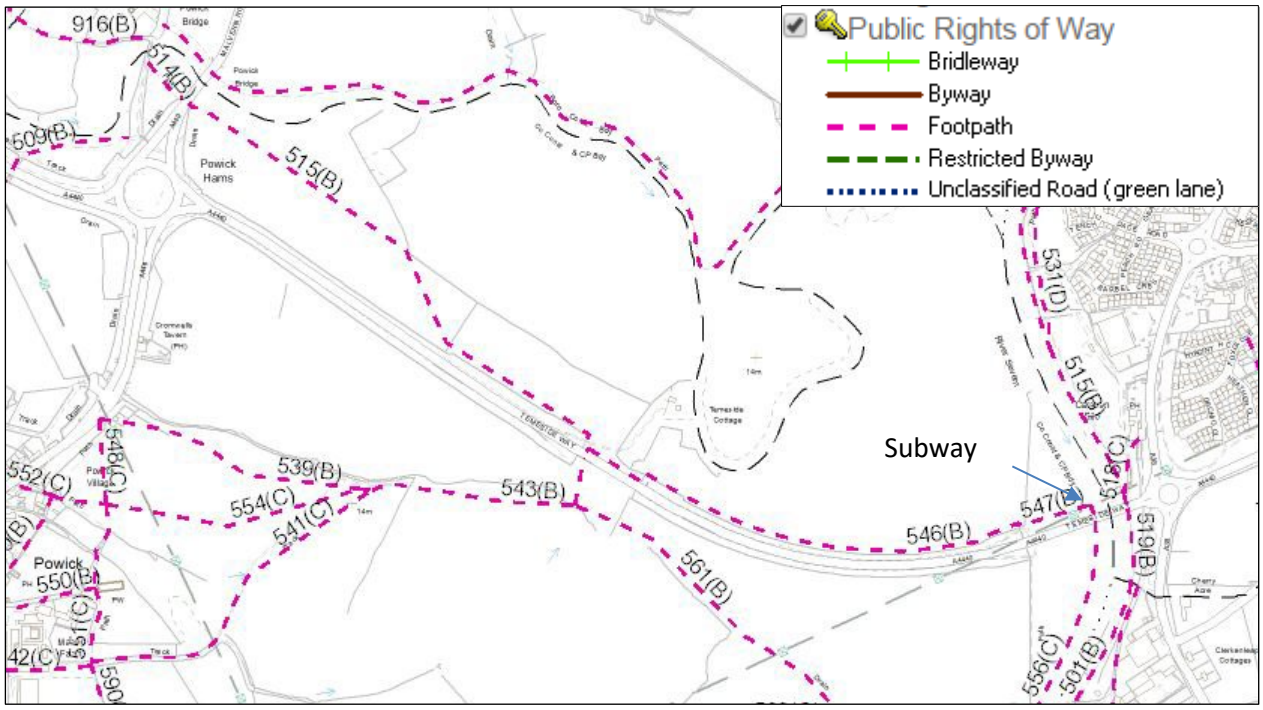
In summary, the A4440 Worcester SLR Phase 4 scheme will have a slight beneficial impact to accessibility.

4.4.8 Severance

Community severance is defined in TAG Unit A4.1 as the separation of residents from facilities and services they use within their community caused by substantial changes in transport infrastructure or by changes in traffic flows. Severance primarily concerns non-motorised modes, and particularly pedestrians, and Unit A4.1 notes that assessment should be based on pedestrians only.

Rights of way in the vicinity of the scheme are shown in Figure 4-2.

Figure 4-2: Public Rights of Way map



Source*: http://gis.worcestershire.gov.uk/website/Countryside/*

Access and rights of way near and across the scheme will be unaffected by the scheme on its completion, though there could be temporary diversions during construction. Two rights of way cross the A4440, centrally to the scheme and near Ketch roundabout (Severn Way). Both routes pass through Powick Hams Common Land and no changes will be made which would affect their use. Indeed, the latter route will be enhanced, with improved connections to north-south pedestrian routes at Ketch roundabout.

A pedestrian/cycle bridge will be provided on the western side of Powick Roundabout and, along with the aforementioned upgrade of the grade separated pedestrian route at Ketch Roundabout, will reduce the conflicts between motorists and pedestrians (and cyclists) crossing the Southern Link Road.

A completed TAG worksheet for severance is presented in **Appendix F**. Overall the scheme has a slight beneficial impact to severance

Distributional impacts of severance is considered further below.

4.4.9 Social Distributional Impact Assessment

Details of the distributional impact appraisal of the scheme can be found in the technical note: 'A4440 Southern Link Road Dualling: Phase 4 Distributional Impact Appraisal', contained in **Appendix K**.

Step 1 – Screening

The first step in the assessment process involves undertaking an initial screening of the key impacts. These are specified in TAG Guidance Unit A4.2. This is in order to identify those impacts that could potentially be affected by the proposals and any that are unlikely to be affected. Key outcomes and conclusions of the initial screening are summarised in Table 4-8.

Table 4-8: Initial Screening Outcomes

Impact Area	Conclusion	Next Step
User Benefits	SLR Phase 4 provides significant user benefits that will affect a range of social groups.	Progress to Step 2
Noise	SLR Phase 4 seeks to reduce traffic congestion and in conjunction with this noise, however it is anticipated that there may be some localised negative impacts for properties adjacent to areas in which traffic increases are expected.	Progress to Step 2
Air Quality	The rationale for air quality is based upon the same principles as those associated with noise.	Progress to Step 2
Accidents	Based on the alterations in traffic flows that are recorded within the modelled area it can be concluded that there is potential for distributional impacts in relation to accidents.	Progress to Step 2
Security	SLR Phase 4 will incorporate enhancements to lighting and landscapes. Informal pedestrian routes will be improved.	Progress to Step 2
Severance	There are anticipated to be significant benefits for the local communities that are situated in close proximity to the proposed bridge crossings. The remainder of benefits are widespread as a result of the traffic reductions that are anticipated along the radial routes and in the city centre.	Progress to Step 2
Accessibility	SLR Phase 4 is expected to have some limited impact upon accessibility as a result of travel time savings and improved crossing facilities.	Progress to Step 2
Affordability	The existing analysis available suggests that overall there will be little impact in terms of affordability. Consequently conducting further analysis was considered to be disproportionate.	AST Overall Assessment**:** **Neutral:** No further screening required

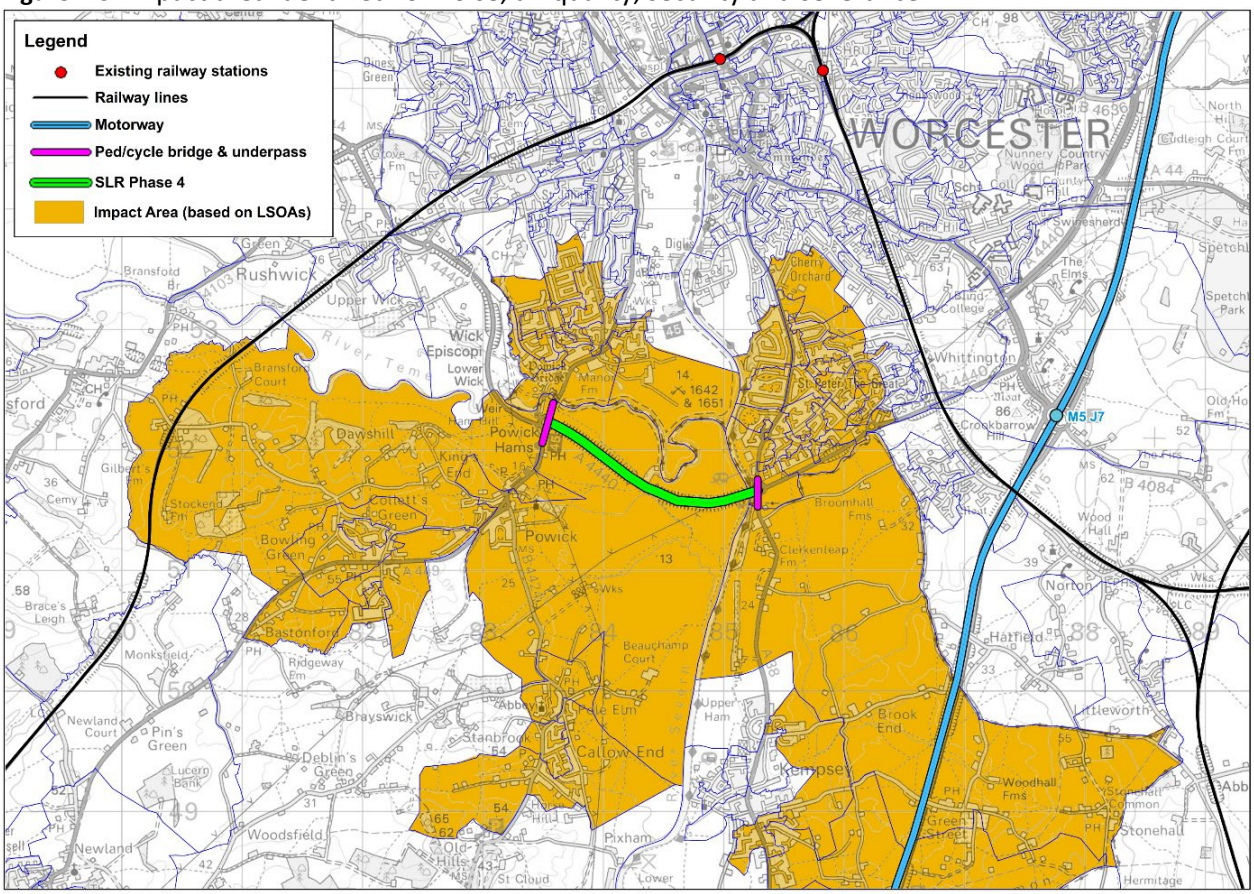
Step 2a: Confirmation of areas impacted by the intervention

The proposals involve dualling of the A4440 SLR between the Ketch and Powick roundabouts. Due to the strategic nature of this route in the context of Worcestershire traffic flows, it is plausible to anticipate impacts to extend across a relatively large geographical area.

- **User Benefits:** As part of the appraisal investigation of the scheme, a detailed modelling exercise has been undertaken using the WTM. This established the changes in costs of travel for users in terms of time-based costs and financial costs across the network. Taking into account the changes across the network, the extent of the model is required to fully represent the area of impact for user benefits as a result of the proposals. However, for the purposes of distributional analysis the geographical area of impact has been limited to Worcestershire.
- **Noise:** In order to determine the impact area for noise, the WTMs have been utilised to calculate changes in the Annual Average Daily Traffic (AADT). This approach demonstrates that there are number of changes that are dispersed widely across the modelled area. There are however more concentrated impacts to properties situated adjacent to areas in which traffic flows are expected to increase significantly, namely those in close proximity to the A4440 SLR. Figure 4.3 shows the extent of the impact area for noise (note that this area extends well to the south of the A4440 SLR due to the low population impacting the LSOA boundaries).

- **Air Quality:** The area of impact for air quality was defined using the same methodology as described above for noise, consequently the area of impact is considered to be the same.
- **Accidents:** As with user benefits the extent of the model is required to fully represent the area of impact for accidents as a result of the proposals. However, for the purposes of distributional analysis the geographical area of impact has been limited to Worcestershire.
- **Security:** The area of impact for security is local to the SLR Phase 4 intervention itself. The key areas of interest are the highway alignment between the Ketch roundabout and Powick roundabout, along with the proposed footbridges and the routes that immediately adjoin these. The area defined in Figure 4-3 is considered adequate to represent the impact area for security.
- **Severance:** There are localised impacts for communities that are adjacent to the locations of the proposed bridge crossings of the A4440 SLR. Beyond these localised impacts, the AADT flow changes calculated by the WTMs indicate that traffic reductions will occur across the wider highway network. The area defined in Figure 4.3 is considered adequate to represent the impact area for severance.
- **Accessibility:** As a result of the widely dispersed impacts associated with decongestion the Worcestershire region has been identified as the area of impact for accessibility.

Figure 4-3: Impact area identified for noise, air quality, security and severance



Step 2a: Identification of social groups in the impact area

This section provides an assessment of the social groups affected by the proposals, based on the potential impacts identified in the screening assessment in Step 1 and the 'affected areas' identified in Step 2a. The social groups considered in relation to each impact follow the guidance provided in TAG Unit A4.2. Details are presented in **Appendix K** through a series of GIS maps of the scheme and surrounding areas. Table 4-9 summarises the identification of social groups in the area, with respect to impacts.

Step 2c: Identification of amenities in the impact area

Based on the anticipated impacts of SLR Phase 4, the locations of a series of amenities in the impact areas have been identified, including schools/nurseries, playgrounds, parks and open spaces, hospitals, care homes/day centres and community centre. Details are presented in **Appendix K** through a series of GIS maps of the scheme and surrounding areas.

Step 3: Appraisal

The impacts and impact areas identified in Steps 1 and 2 were considered as to whether they are likely to significantly affect the social groups/establishment, which determined the scale of appraisal necessary for each impact. The resulting Matrix of Distributional Impacts is presented in Table 4-10.

Table 4-9: Step 2 Output Summary

			User Benefits	**Noise**	**Air Quality**	**Accidents**	**Security**	**Severance**	**Accessibility**	**Local Authority**	**England**
Resident population in impact area	Income distribution quintiles	0-20%	10%	0%	2%					10%	20%
		20-40%	17%	0%	10%					17%	20%
		40-60%	20%	20%	30%					20%	20%
		60-80%	29%	11%	26%					29%	20%
		80-100%	24%	69%	32%					24%	20%
		Children (<16>		17%	17%	18%	17%	17%	18%	18%	19%
		Young adults (16-24)				11%			11%	11%	13%
		Older people (70+)		16%		13%	16%	16%	13%	13%	12%
		People with a disability					17%	17%	18%	18%	18%
		Black Minority Ethnic					3%		4%	4%	15%
		No car households						10%	17%	17%	26%
		Households with dependent children							28%	28%	29%
		Indicator population in the impact area	566,169	13,838	56,888	566,169	13,838	13,838	566,169	566,169	53,012,456
	Amenities present within	Schools/ Nurseries		✓	✓	✓	✓	✓	✓		

	the impact area										
		Playgrounds		✓	✓	✓	✓	✓	✓		
		Parks and open spaces		✓	✓	✓	✓	✓	✓		
		Hospitals				✓			✓		
		Care homes/day centres		✓	✓	✓	✓	✓	✓		
		Community centres			✓	✓			✓		

Table 4-10: Distributional Impacts: Appraisal Matrix

	0-20%	20-40%	40-60%	60-80%	80-100%	Are the impacts distributed evenly?	Key impacts – Qualitative statements
User benefits	✓✓	✓✓	✓✓	✓✓✓	✖✖	No	There are a high level of user benefits and they are distributed relatively evenly between all income groups, except in the least deprived areas.
Noise			✖✖	✖✖	✖✖✖	No	The area in the immediate vicinity of scheme which will see increases in noise does not contain any income deprived communities
Air Quality (NO2)		✓✓✓	✓✓✓	✖✖	✖✖	No	In the area of impact, residents in the relatively deprived income 20%-40% & 40%-60% quintiles experience benefits.
Affordability						N/A	Not assessed.
Accessibility	✓	✓	✓	✓	✓	Yes	Impacts are small, but considered to be sufficiently widespread that all income groups will stand to benefit on a relatively equal basis.

AST Entry	**Social groups**						**User groups**				
Impact	**Children and young people**	**Older people**	**Carers**	**Women**	**Disabled**	**BME**	**Pedestrians**	**Cyclists**	**Motor cyclists**	**Young male drivers**	**Qualitative statement (including any impact on residential population and identified amenities**
Noise		✖									Some adverse impacts to properties near to the scheme, but no significant concentrations of children in the areas affected.
Air Quality											Largely neutral air quality impacts, with some benefits and adverse impacts to near to the scheme, but no significant concentrations of children in the areas affected.
Accidents							✓✓	✓✓			Slight overall decrease in accidents is spread across the network. New bridge and underpass crossings will provide greater protection to the most vulnerable user groups.
Security	✓	✓		✓		✓					Enhanced lighting and formalised pedestrian and cycle routes benefit all potential users, especially south of the scheme.
Severance	✓	✓	✓		✓						Bridge crossings will benefit all potential users, especially south of the scheme.
Accessibility	✓	✓	✓	✓	✓	✓					Impacts are small, but considered to be sufficiently widespread that all income groups will stand to benefit on a relatively equal basis.

4.5 Public Accounts

4.5.1 Broad Transport Budget

Information and the scheme costs is presented in Section 6. Table 4-11 shows the Public Accounts (PA) tables. Further details are presented in the Economic Assessment Report in **Appendix J**.

Table 4-11: Public Accounts (PA) table

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue	0		0			
Operating Costs	2,521		2,521			
Investment Costs	13,395		13,395			
Developer and Other Contributions	-5,694		-5,694			
Grant/Subsidy Payments	0		0			
NET IMPACT	10,222	*(7)*	10,222			
Central Government Funding: Transport						
Revenue	0		0			
Operating costs	0		0			
Investment Costs	39,955		39,955			
Developer and Other Contributions	0		0			
Grant/Subsidy Payments	0		0			
NET IMPACT	39,955	*(8)*	39,955			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-2,069	*(9)*	-2,317	283	-35	
TOTALS						
Broad Transport Budget	50,177	*(10) = (7) + (8)*				
Wider Public Finances	-2,069	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

4.5.2 Indirect Tax Revenues

Indirect tax revenues, as shown in Table 4-11 are calculated from summing the total kilometre change and applying the marginal external cost value (in pence/car km). This is translated in the pounds/car km, discounted and is summed to £2.069m over the 60 year appraisal period.

4.6 Summary of impacts of the core scenario

4.6.1 Value for Money Statement

Table 4-12 sets out the Value for Money Statement for the A4440 Worcester SLR Improvements Phase 4 scheme for the Core Scenario.

Table 4-12: Value for Money Statement – Core Case

Criteria	**A4440 Worcester SLR Phase 4 scheme**
Value for Money	The scheme offers: Very **High** Value for Money (unadjusted), Very **High** Value for Money (adjusted)
NPV	The scheme has a NPV of: £ 176,427,305
Initial BCR	The scheme has an initial BCR of 4.516
Adjusted BCR (With reliability and output change for imperfectly competitive markets)	The scheme has an adjusted BCR 12.7
Summary of the benefits and costs	Benefits • Highway transport user benefits associated with improved journey times • Reliability benefits • Regeneration benefits • Wider impacts benefits • Dependency development benefits
Significant non-monetised impacts	None
Key risks, sensitivities and uncertainties underlying the appraisal	None

4.6.2 Analysis of Monetised Costs and Benefits (AMCB) Tables

Table 4-13 sets out the Analysis of Monetised Costs and Benefits for the A4440 Worcester SLR Improvements Phase 4 scheme under the core scenario.

Table 4-13: Analysis of Monetised Costs and Benefits (£000s)

Noise	-491	*(12)*
Local Air Quality	-155	*(13)*
Greenhouse Gases	-1,011	*(14)*
Journey Quality	0	*(15)*
Physical Activity	0	*(16)*
Accidents	4,903	*(17)*
Economic Efficiency: Consumer Users (Commuting)	62,333	*(1a)*
Economic Efficiency: Consumer Users (Other)	90,240	*(1b)*
Economic Efficiency: Business Users and Providers	68,716	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	2,069	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	226,605	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	50,177	*(10)*
Present Value of Costs (see notes) (PVC)	50,177	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	176,427.305	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	4.516	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Combining the present value of scheme costs, it is possible to calculate a benefit cost ratio; that is, the ratio of benefits and costs where a value of one shows a project 'break-even' point where for every £1 invested in the scheme, there are £1 benefits received. Therefore, any BCR above one shows value for money in terms of receiving medium benefit for every £1 of invested cost.

Table 4-13 shows the summary results from the economic appraisal, just including benefits for the user and provider (time savings and vehicle operating costs, both fuel and non-fuel). Car Other and business users are estimated to be the main beneficiaries of the scheme with the highest benefits (41% and 31% respectively) of the total benefits and Car commuters see slightly lower impact with 28.0% of the total benefits (maybe because commuters do not receive inter-peak benefits). The scheme shows a **Very High** value for money with a BCR of **4.51**.

4.6.2.1 Adjusted BCR

The quantified benefits of reliability and output change in imperfectly competitive markets should not be included in a BCR calculation, however these can be included in an adjusted BCR. This is shown in Table 4-14. Adding both these additional benefits increases the schemes value for money to an **adjusted BCR** of **12.7** (**Very High** value for money).

Table 4-14: Analysis of Monetised Costs and Benefits with adjusted BCR (Cost/Benefits figures in £000)

Present Value of Benefits (PVB)	226,605
Present Value of Costs (PVC)	50,177
Reliability Benefits	22,648
Wider Benefits	26,610
Dependency Development Benefits	361,164
Adjusted PVB	637,027
Adjusted Net Present Value (NPV)	586,850
Adjusted Benefit to Cost Ratio (BCR)	12.70

4.6.3 Appraisal Summary Table (AST)

Table 4-15 is the Appraisal Summary Table for the Core Scenario.

Table 4-15: Core Case Appraisal Summary Table

Appraisal Summary Table

Date produced:	05/12/2018	**Contact:**	
Name of scheme:	A4440 Worcester Southern Link Road Phase 4	**Name**	Nigel Hudson
Description of scheme:	The scheme comprises of dualling the A4440 Worcester SLR from Ketch Roundabout to Powick Roundabout and associated structures and improvements for NMUs.	**Organisation**	Worcestershire County Council
		Role	SRO (business case)

Impacts		Summary of key impacts	Assessment: Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The scheme will deliver time saving benefits to business trips. The TUBA outputs have been has been utilsed to provide these results. The scheme, and the additional vehicle trips it attracts, results in a re-distribution of trips compared to the Do Minimum scenario.which results in a decrease in the number of trips on the radial routes through Worcester city centre and an increase in trips on the SLR.	**Value of journey time changes(£)** £73.420 **Net journey time changes (£)** 0 to 2min: £11.697m; 2 to 5min: £58.928m; > 5min: £16.854m	Not applicable	£74.89	Moderate Beneficial - evenly spread except moderate adverse for least deprived quintile of income domain
	Reliability impact on Business users	Car business and good vehicle travel times will benefit from reliability improvements as traffic flows and congestion are reduced. This has not been separated out into user class so quantification is given under the social benefits.	Taken 10% of total user time saving benefits proportioned to businesses by share of total time savings proportioned to share of time savings for commuters and other purposes	Not applicable	£7.342m	
	Regeneration	The scheme is expected to unlock development at two key sites: West Worcester Urban Extension (WWUE) and North East Malvern. This will support the delivery of 28,400 new dwellings and 280ha of employment land targetted by the adopted SWDP. The scheme is expected to improve employment opportunities across the county, by increasing the size of the accessible work force to employers and increasing the number of accessible jobs for labour market participants.	At a high level, around 7,800 dwellings and 77 ha employment land is contingent on this scheme (based on cost proportionality from the SWIDP). The net increase in accessible workforce for firms in the regeneration area will be 711. The net increase in accessible jobs for labour market participants in the regeneration area will be 755.	Large beneficial	Not applicable	
	Wider Impacts	Wider economic impacts including agglomeration, output change for imperfectly competitive markets and tax revenues from labour supply impacts have been evaluated for the scheme. The methodology adopted is in line with guidance in WebTAG Unit A2.1, and is based on demographic data as well as generalised travel demand and costs for business and commuting trips.	Results indicate that there would be additional Wider Impacts attributable to the scheme in all three assessed areas: agglomeration, £18.434m, imperfectly competitive markets, £10.749m and labour supply impacts, £0.459m.	Not applicable	£29.643m	
Environmental	Noise	The increase in noise at some locations is caused by an increase in traffic, and on some links there is also an increase in traffic speed due to the relieving of congestion. The reductions in noise are caused by a reduction in traffic flow on some links. Night time impacts are likely to be similar to those from the day. No properties are likely to be eligible for noise insulation.	Households experiencing increased daytime noise in forecast year: 159 Households experiencing reduced daytime noise in forecast year: 23 Households experiencing increased night time noise in forecast year: 62 Households experiencing reduced night time noise in forecast year: 12	Not used for noise (ref: Unit A3, para 2.4.2)	-£0.49m	Slight adverse - evenly spread across upper three income domain quintiles (no impact on two lower income domain quintiles)
	Air Quality	There are three AQMAs within 5km of the scheme. The scheme is expected to have positive and negative effects for air quality: a beneficial impact on air quality associated with the reduction of congestion and with the redistribution of traffic volumes on the existing road network (which is expected to reduce traffic on the A449 and in the city centre and St Johns); a negative impact due to the increase of traffic flows on the dualled road, and other links in the wider network. The scheme is likely to have a mostly positive impact in Worcester city centre and in its existing and potential AQMAs, and an adverse impact on air quality at some receptors located along the SLR. The scheme has the potential to generate one new exceedance of the NO2 limit in Whittington, in proximity of the junction with the M5. The WebTAG scores are slightly adverse, indicating a net worsening aggregated over the 4,852 receptors assessed for this. Of the 258 properties assessed in detail, the scheme is likely to reduce the level of exceedance for a number where the EU Limit Value for nitrogen dioxide is breached in Worcester City.	A total of 42 receptors out of 258 assessed will be potentially exposed to 'Moderate' or 'Substantial' changes in air quality, according to the IAQM significance criteria. 33 will have significant beneficial effects, and 9 will have adverse effects. **WebTAG Scores:** - Change in NO_2 in the Opening Year: +115 μgm^{-3} (+2.56% compared to Do Minimum) - Change in PM_{10} in the Opening Year: +63 μgm^{-3} (+4.65% compared to Do Minimum)	Beneficial in terms of EU Compliance	-£155,688	Neutral impact overall - two upper income quintiles have adverse impacts, lowest quintile no impact, middle two quintiles have benefits - numbers of affected households small in all areas
	Greenhouse gases	Overall there is a net increase in CO2 emissions associated with the scheme due to an increase in traffic flows on the local road network. CO2 emissions have been calculated using TUBA.	Change in non-traded carbon over 60y (CO2e): -30,290 Change in traded carbon over 60y (CO2e): -178	Not applicable	-£1.401m	
	Landscape	Predominantly rural fringe landscape character with some features of good quality. Landscape character impacts are likely as a result of loss of predominantly roadside vegetation including some mature trees within the scheme's footprint. These short term impacts can be mitigated by replacement planting. Potential for visual impacts relating to changes in recognisable views of Malvern Hills AONB as a result of additional highway features including new bridges. Cumulative adverse landscape effects are likely due to combining the increased scale of the existing road along with the proposed mixed use development area into the rural fringe land to the south of the site (by others) and therefore extending the urban fringe south into the rural landscape.	Not Applicable	Likely to be slight to moderate adverse	Not Applicable	
	Townscape	The scheme is adjacent to the southern urban edge of Worcester. The quality of the townscape character has not been established, but there is likely to be no direct impacts on Townscape.	Not Applicable	Likely to be neutral	Not Applicable	
	Historic Environment	The scheme has the potential to affect the setting of a nationally significant registered Battlefield (Battle of Worcester, September 1651), a Scheduled Monument and Grade I listed building, a Grade II and Grade II* listed building.Thiis should be a minor impact overall, as it will only slighty add to the setting impact presented by the current A4440. There is an, as yet, unqunatified potential for artefactual or ecofactual remains associated with the battlefield and other periods to exist within the footprint of the scheme.	Conclusively despite thedesignated assets in close proximity, there is only a minor impact expected to the setting the cultural heritage resource and there is expected to be a minor impact to unknown archaeology resulting from the construction and operation.	Likely to be slight adverse	Not applicable	
	Biodiversity	Ecology surveys are in progress. The scheme is adjacent to a Site of Special Scientific Interest (River Teme SSSI) and within a Local Wildlife Site (River Severn LWS) and therefore there is potential for impacts during both construction and operation. A good population of slow worm and a low population of grass snake are present within the north verge. The slow worm population will be lost without mitigation. At least five badger setts are present within or near to the proposed scheme footprint. At least four of these setts will be lost to the proposed scheme. Otters are known to be present along the Rivers Severn and Teme - resting sites may be lost and foraging/commuting routes disrupted. At least seven species of bat have been recorded within the proposed scheme footprint. Bat foraging/commuting habitats will be lost/severed. Bird nesting habitat will be lost. The following habitats present within the proposed scheme boundary are likely to be lost without avoidance or compensation measures; broadleaved and mixed woodland, semi-improved grassland, scrub, tall ruderal and mature trees.	Not possible at this stage.	Likely to be slight adverse	Not possible at this stage	
	Water Environment	The land adjacent to the proposed scheme is subject to a high risk of fluvial flooding due to its location within a floodplain of the River Severn (comprises Flood Zone 3, as shown on the Enviroment Agency's website). There is also the potential for some surface water flooding from rainfall. The scheme has the potential to impact upon three Water Framework Directive (WFD) waterbodies, including the River Severn (medium value), River Teme (high value) and Careys Brook (low value) which have been evaluated within a WFD assessment. The River Teme is a SSSI and therefore a protected area for conservation which gives rise to its high value as a water receptor. Potential impacts of the scheme include upon water quality, flood risk and physical impacts. An outline Flood Risk Assessment (FRA), preliminary Drainage Strategy and HAWRAT assessment have been completed as part of the Environmental Statement. A Construction Environmental Management Plan (CEMP) will be prepared to ensure best practice measures are implemented and adverse impacts on the water environment are minimised during construction. The inclusion of grass ditches and a vortex separator has been proposed to reduce the impacts of sediment pollution from routine road runoff during operation.	Not possible at this stage.	Likely to be slight adverse	Not possible at this stage	
Social	Commuting and Other users	The TUBA outputs have been has been utilsed to provide these results. The scheme, and the additional vehicle trips it attracts, results in a re-distribution of trips compared to the Do Minimum scenario.which results in a decrease in the number of trips on the radial routes through Worcester city centre and an increase in trips on the SLR.	**Value of journey time changes(£)** £153.06m **Net journey time changes (£)** 0 to 2min: £28.385m; 2 to 5min: £111.252m; > 5min: £38.257m	Not applicable	£152.57m	Moderate Beneficial - evenly spread except moderate adverse for least deprived quintile of income domain
	Reliability impact on Commuting and Other users	Commuters and other users will benefits from increased reliability from the scheme as traffic flows are increased and congestion decreased	Taken 10% of total user time saving benefits proportioned to businesses by share of total time savings proportioned to share of time savings for commuters and other purposes	Not applicable	£15.306m	
	Physical activity	The Powick footbridge and Ketch underpass will provide pedestrians and cyclists safe, grade separated, access across the SLR, replacing current at-grade facilities. Numbers affected are low and improvements small, so the impact is 'neutral' overall, but locally important for affected movements.	Not applicable	Neutral	Not applicable	
	Journey quality	Traveller Stress: Slight to moderate beneficial Route uncertainty: Slight to moderate beneficial Fear of accidents: Slight beneficial	Not applicable	Large beneficial	Not applicable	Not assessed
	Accidents	The transport modelling work shows that there will be an overall increase in vehicle demand from the Without Scheme to With Scheme scenarios. This is likely to increase the forecast accident numbers from the junctions as a result of the scheme and higher traffic volumes, but a decrease the accident numbers forecast for the links of the scheme as well as others parts of the network that are likely to experience reduction in traffic due to reassignment. The scheme should also attract traffic from less suitable routes/road standards.	Not Applicable	Likely to be neutral	£4.903m	Not assessed
	Security	The scheme will not alter the existing alignment which is relatively straight with good sight lines and no 'hidden' sections for pedestrians or stopped vehicles. No service areas or lay-bys proposed as part of the scheme, whilst surveillance provisions are considered to be broadly consistent with the baseline.Proposed walk/cycle crossings will be designed to minimse security concerns, but represent an improvement over the existing facilities, and numbers affected are comparatively small.	Not applicable	Neutral	Not applicable	Not assessed
	Access to services	There are no public transport services which run along the Phase 4 SLR stretch but there are bus services which run north/south at Powick and Ketch roundabout which are likely to experience a increase in journey times. However, improvements to the wider network and trip patterns as a result of the scheme will outweigh any disbenefits. The enhancement to the cycle route along the SLR, together with significant enhancement of cycle facilities at the Powick Hams junction will deliver a much more attractive, direct route between Powick/west Worcester, upgrade of the grade separated pedestrian route at Ketch Roundabout and Worcestershire Parkway.	Not applicable	Slight beneficial	Not applicable	Not assessed
	Affordability	No material change to the cost of transport in Worcester, although there is potential for a slight reduction associated with decongestion on the local highway network.	Not applicable	Not applicable	Not applicable	Not required
	Severance	The affected population is assumed to be in communities located immediately south of the A4440. The benefit is indicated as slight, in spite of the numbers concerned, because the location of the development area is more closely aligned with SLR Phase 3, and its Crookbarrow Way footbridge. There is also potential for the Ketch underpass to used for access to employment within the SWUE.	Not applicable	Slight beneficial	Not applicable	Slight beneficial - new crossings will provide local benefits, no particular vulnerable groups affected
	Option and non-use values	Option values can apply to roads, but only where material and significant changes are made in road networks. This does not apply to this scheme.	Not applicable	Not applicable	Not applicable	
Public Accoun	Cost to Broad Transport Budget	Costs include risk and optimism bias at 44% and for QRA. Costs to include 88% from Central Government and 12% from Local Developers.		Not applicable	£50.177m	
	Indirect Tax Revenues	Based on an increase in vehicle km and increase in fuel consumption from higher capacity and utilisation, resulting in a gain in tax		Not applicable	£2.069m	

4.7 Sensitivity tests – Long Term Benefit

4.7.1 Sensitivity tests – Long Term Benefits

DfT published updated guidance on Cost Benefit Analysis in May 2018 that includes a new section on assessing longer term benefits of a scheme 20 years from scheme appraisal year. For this Full Business Case, the scheme appraisal year is 2018. A 2038 forecast model of the core scenario was therefore developed to assess the long-term benefits of the scheme and appraised using TUBA. The TEE, PA and AMCB tables has been calculated for Core Scenario using three model forecast years (2021, 2031 and 2038) and shown in Table 4-16 to Table 4-19 below.

The results show that the Long term PVB have increased while compared to the standard Core Scenario and the BCR also increases to 4.713.

Table 4-16: Public Accounts (PA) table - Long term extrapolation of benefits Core Scenario (Figures in £000)

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue	0		0			
Operating Costs	2,521		2,521			
Investment Costs	13,395		13,395			
Developer and Other Contributions	-5,694		-5,694			
Grant/Subsidy Payments	0		0			
NET IMPACT	10,222	*(7)*	10,222			
Central Government Funding: Transport						
Revenue	0		0			
Operating costs	0		0			
Investment Costs	39,955		39,955			
Developer and Other Contributions	0		0			
Grant/Subsidy Payments	0		0			
NET IMPACT	39,955	*(8)*	39,955			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-3,095	*(9)*	-3,289	208	-14	
TOTALS						
Broad Transport Budget	50,177	*(10) = (7) + (8)*				
Wider Public Finances	-3,095	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

Table 4-17: TEE Table - Long term extrapolation of benefits Core Scenario (Figures in £000)

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and LGVs		Passengers	Passengers		
Travel time	61,157		61,157		0	0		
Vehicle operating costs	-657		-679		23	0		
User charges	13		0		16	-3		
During Construction & Maintenance	-495		-495					
COMMUTING	60,018	*(1a)*	59,983		39	-3		

Non-business: Other	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and LGVs		Passengers	Passengers		
Travel time	99,564		99,564		0	0		
Vehicle operating costs	-880		-1,084		205	0		
User charges	119		0		146	-27		
During Construction & Maintenance	-1,108		-1,108					
NET NON-BUSINESS BENEFITS: OTHER	97,695	*(1b)*	97,372		350	-27		

Business					BUS and COACH		RAIL	
User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers	Freight
Travel time	78,743		40,803	37,939	0		0	
Vehicle operating costs	859		-1,375	2,232	3		0	
User charges	3		0	0	3		-1	
During Construction & Maintenance	-926		0	-926				
Subtotal	78,678	*(2)*	39,428	39,245	6	0	-1	0

Private sector provider impacts			Road	Bus	Rail
Revenue	-348		0	-259.1327333	-89.26645998
Operating costs	0		0	0	0
Investment costs	0		0	0	0
Grant/subsidy	0		0	0	0
Subtotal	-348	*(3)*	0	-259	-89

Other business impacts			Road	Bus	Rail
Developer contributions	-5,694	*(4)*	-5694	0	0
NET BUSINESS IMPACT	72,636	*(5) = (2) + (3) + (4)*			

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	230,350	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Table 4-18: AMCB Table - Long term extrapolation of benefits Core Scenario (Figures in £000)

Noise	-491	(12)
Local Air Quality	-155	(13)
Greenhouse Gases	-1,667	(14)
Journey Quality	0	(15)
Physical Activity	0	(16)
Accidents	4,903	(17)
Economic Efficiency: Consumer Users (Commuting)	60,018	(1a)
Economic Efficiency: Consumer Users (Other)	97,695	(1b)
Economic Efficiency: Business Users and Providers	72,636	(5)
Wider Public Finances (Indirect Taxation Revenues)	3,095	- (11) - sign changed from PA table, as PA table represents costs, not benefits
Present Value of Benefits (see notes) (PVB)	236,034	(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)
Broad Transport Budget	50,177	(10)
Present Value of Costs (see notes) (PVC)	50,177	(PVC) = (10)
OVERALL IMPACTS		
Net Present Value (NPV)	185,857	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	4.704	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

The quantified benefits of reliability and output changes in imperfectly competitive markets included in the adjusted BCR as shown in Table 4-19 results in additional benefits increasing the schemes value for money to an **adjusted BCR** of **12.9** (**Very High** value for money)

Table 4-19: Adjusted BCRs based long term extrapolation of benefits (Figures in £000)

	Long term extrapolation of benefit test
Present Value of Benefits (PVB)	236,034
Present Value of Costs (PVC)	50,177
Reliability Benefits	23,946
Wider Impact Benefits	26,610
Housing Dependency Benefits	361,164
Adjusted PVB	647,755
Adjusted Net Present Value (NPV)	597,577
Adjusted Benefit to Cost Ratio (BCR)	12.91

*Note: Figures in £000. *2010 price based and discounted*

4.7.2 Sensitivity tests – High and Low Growth

In addition to the core scenario, uncertainty tests were carried out to assess the benefits of the scheme under low and high traffic growth scenarios around the Core scenario. The results of the TUBA analysis and other monetised impacts for each scenario is shown in Table 4-20.

Table 4-20: Economic Sensitivity tests (2010 prices and values £000s)

Category	Low Growth	Core Scenario	High Growth
Noise	-491	-491	-491
Local Air Quality	-155	-155	-155
Greenhouse Gases	-3,500	-1,011	-6,725
Journey Quality	0	0	0
Physical Activity	0	0	0
Accidents	-2,051	4903	6,001
Economic Efficiency: Consumer Users (Commuting)	29,059	62,333	16,736
Economic Efficiency: Consumer Users (Other)	48,638	90,240	15,693
Economic Efficiency: Business Users and Providers	35,585	68,716	26,936
Wider Public Finances (Indirect Taxation Revenues)	7,036	2,069	15,854
Present Value of Benefits (see notes) (PVB)	114,121	226,605	73,850
Broad Transport Budget	50,177	50,177	50,177
Present Value of Costs (see notes) (PVC)	50,177	50,177	50,177
OVERALL IMPACTS			
Net Present Value (NPV)	63,944	176,427	23,672
Benefit to Cost Ratio (BCR)	2.274	4.516	1.472