

A417 Missing Link
TR010056

6.4 Environmental Statement
Appendix 3.2 Option 30
Alternatives Technical Note

Planning Act 2008

APFP Regulation 5(2)(a)
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**The Infrastructure Planning
(Applications: Prescribed Forms
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A417 Missing Link

Development Consent Order 202[x]

**6.4 Environmental Statement
Appendix 3.2 Option 30 Alternatives Technical Note**

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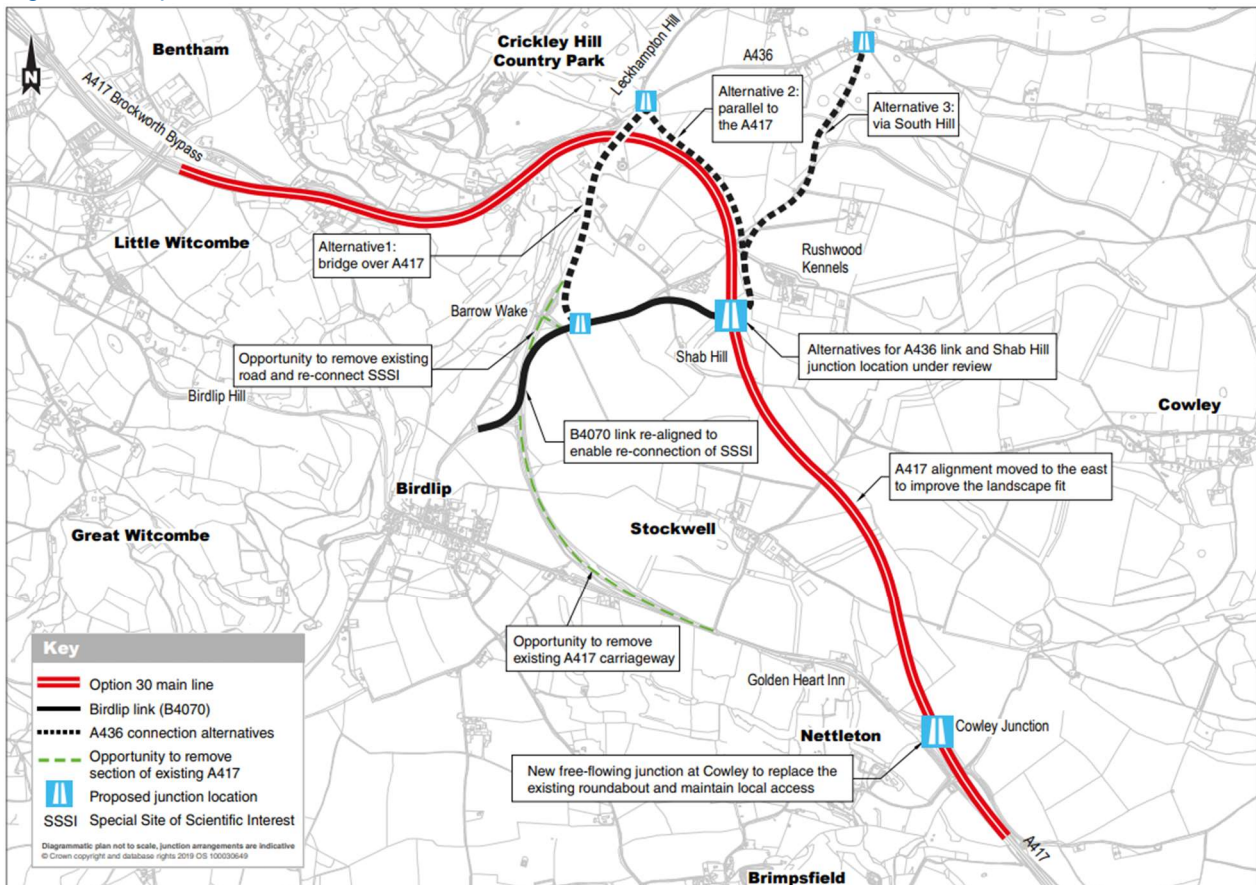
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Executive summary

In March 2019 Highways England announced Option 30 as the preferred route for improving the A417 Missing Link. Three alternative versions of Option 30 were presented in the Preferred Route Announcement (PRA), each differing in the way a connection between the A417 and A436 is provided. The three alternatives are shown in Figure 0.1.

Figure 0.1: Option 30 alternatives



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Preliminary assessment was undertaken on the three alternatives in order for a recommendation to be made. Traffic flow models were used to assess the journey times and reliability of each option. The alternatives were also assessed for their environmental opportunities and their compliance with the National Policy Statement for National Networks (NPSNN). Furthermore, a WebTAG assessment and appraisal was undertaken and the three options were reviewed regarding their engineering and buildability benefits. Lastly, an economic assessment was undertaken to estimate the monetised benefits of each using scheme costs prepared by Highways England.

The results of the assessment are summarised in the form of a comparison matrix below in Table 0.1.

Table 0.1: Alternatives summary matrix (ranked from 1, comparative best performing, to 3 comparative lowest performing)

	Alternative 1	Alternative 2	Alternative 3
Traffic assessment	3	2	1
Environmental opportunities	3	1	2
NPSNN compliance	3	1	2
Engineering and buildability	3	1	2
Benefit cost ratios (ranked)	3	2	1



It is recommended that Alternative 2 is progressed as the preferred option for the A417 Missing Link scheme.

Alternative 1 provides the fewest benefits and therefore it is recommended that it is discounted. While Alternative 3 has benefits above that of Alternative 2 regarding traffic, it performs worse under environmental opportunities and compliance with NPSNN, particularly for landscape which is an important factor in the AONB. Alternative 2 has a number of advantages as a result of running alongside the A417 mainline, particularly regarding the environmental opportunities this presents. It also poses the lesser risk of non-compliance with the relevant tests set out in NPSNN, particularly as it would cause significantly less disruption to the local environment, landscape and ecology during construction. One of the key aims of the A417 Missing Link scheme is to be landscape led, and the selection of Alternative 2 matches this objective.

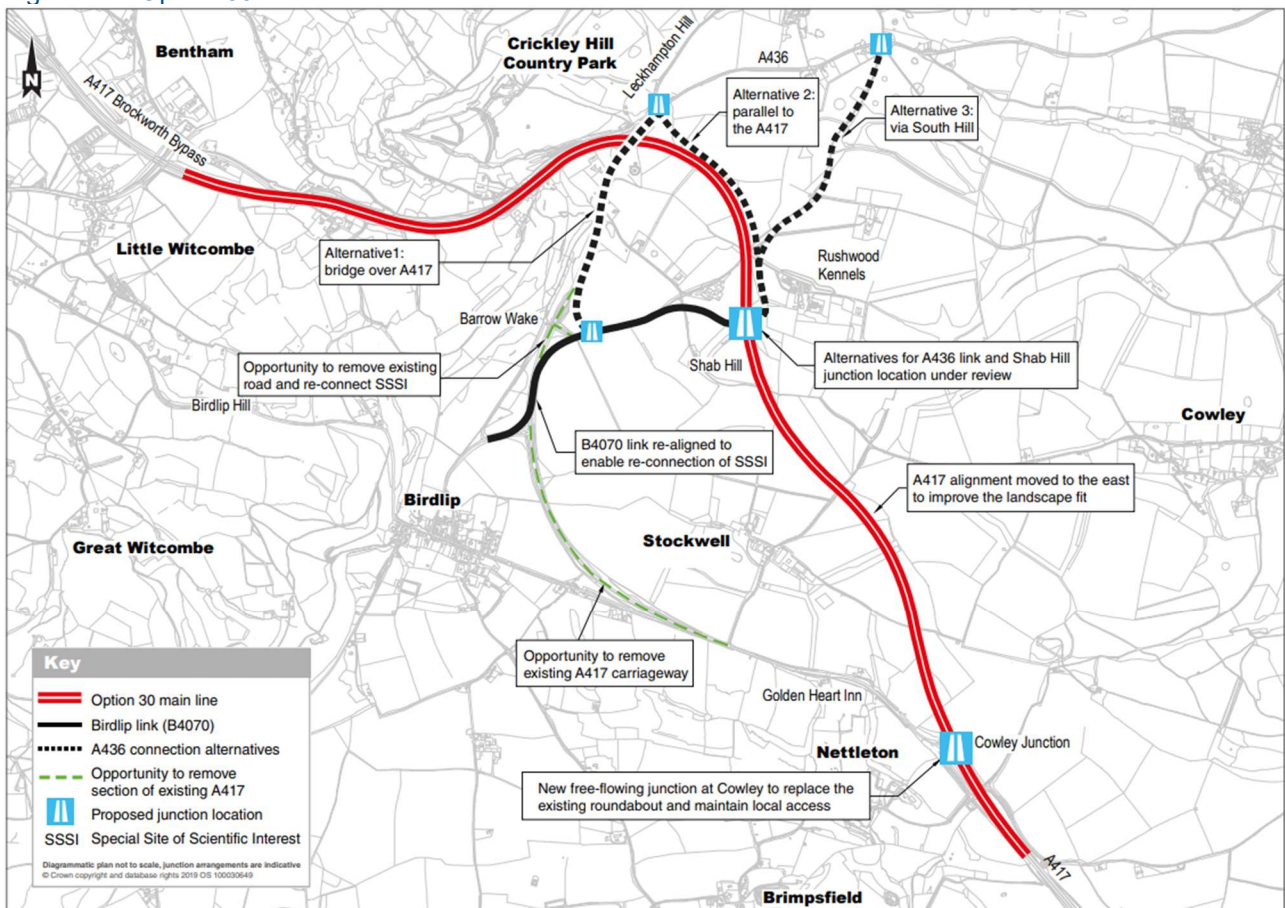
1 Introduction

In March 2019 Highways England announced Option 30 as the preferred route for improving the A417 Missing Link. Three alternative versions of Option 30 were presented in the Preferred Route Announcement (PRA), each differing in the way a connection between the A417 and A436 is provided.

This Technical Note provides a high-level summary of the benefits and opportunities associated with the three Option 30 alternatives, in regard to traffic, environment, engineering & buildability, and economics. The three alternatives, which are shown in Figure 1.1, are as follows:

- Alternative 1: bridge over A417;
- Alternative 2: parallel to the A417; and
- Alternative 3: via South Hill.

Figure 1.1: Option 30 alternatives



2 Traffic

2.1 Traffic flows

Forecast Annual Average Daily Traffic (AADT) flows at key locations around the scheme have been taken and Table 2.1 below shows a comparison of the AADT flows across the alternatives. The traffic assessment showed that each option would cause different changes to local flow rates as a result of the forecast reassignment of traffic

Table 2.1: Forecast AADT Flows on A417

Location	Forecast differences vs Do Minimum in design year (2039)		
	Alternative 1	Alternative 2	Alternative 3
A417 (Crickley Hill)	+ 10,900	+ 13,000	+ 14,900
A417 (south of Highwayman junction)	+ 12,300	+ 14,400	+ 12,800
Birdlip Hill	- 4,600	- 6,100	- 5,900
A436 (between Air Balloon and A435 junction)	- 3,700	- 2,900	+ 2,200
B4070	+ 1,800	+ 1,100	+ 700
Leckhampton Hill	+ 1,000	+ 3,400	- 2,100
A435 (north of A536 junction)	- 2,100	- 3,800	+ 100
Through Elkstone	- 1,700	- 2,900	- 2,400
Cowley Lane	+ 900	+ 900	+ 200
A46 (through Painswick)	- 500	- 200	+ 100

Alternative 1 would see a reduction in traffic on the A46 route through Painswick and on the A435 as traffic reassigns onto the B4070 / Leckhampton Hill route between Stroud and Cheltenham. Additionally, traffic routing between the A436 and the A417 is forecast to take alternative routes, resulting in increases in traffic in various locations including Cheltenham town centre, Cowley village and the B4425 through Bibury. Increases in traffic would also occur on Leckhampton Hill and on the B4070 between Stroud and Birdlip as a result of the removal of delays at the Air Balloon roundabout.

In comparison to Alternative 1, Alternative 2 would better alleviate rat running traffic through Elkstone and Birdlip, resulting in decreased traffic flow there. However, as a result of the more direct connection from the A417, it would see larger increases on Leckhampton Hill over Alternative 1.

Alternative 3 would also decrease traffic flow through Elkstone in Birdlip in comparison to Alternative 1. Unlike the other two alternatives, it would decrease traffic on Leckhampton Hill, as traffic would reassign onto the A436/A435 route between A417 south and Cheltenham. However, the impacts on routes to Stroud (A46 and B4070) are less pronounced than the other alternatives, and there would be an increase in traffic on the A436 between Ullenwood and Seven Springs due to reassignment onto the A436/A435 route between A417 south and Cheltenham.

2.2 Journey times and reliability

All three alternatives showed similar improvements to travel time and journey reliability on the mainline A417 following the replacement of the existing single carriageway section with a new dual carriageway. However, there were some comparable differences between the options when looking at the local road network.

On Alternative 1, journey times for traffic routing to/from Cheltenham via Leckhampton Hill would be improved by the removal of delays at the Air Balloon roundabout. Additionally, journey times on the westbound A436 approach to the Air Balloon roundabout during the evening peak would also improve. However, due to the proposal forming a less direct connection between the A436 and the A417, journey times compared with alternatives 2 and 3 would be longer along this corridor throughout most of the day. Alternative 1 would still see significant economic benefits over the existing situation as a result of the generally shorter journey times and improved reliability.

Alternative 2 would also see an improvement to journey times on the westbound A436 approach to the Air Balloon roundabout during the evening peak, as with Alternative 1, but would only incur a slight increase in journey times between the A436 and the A417. This means that Alternative 2 would provide improved economic benefits over Alternative 1 in regard to journey times and reliability.

Alternative 3 would provide the most direct connection between the A436 and the A417/M5 and therefore it would see the smallest increase in journey times along this corridor. As such, from the three options Alternative 3 would provide the largest economic benefits related to journey times and reliability. This is reflected in Table 2.2.

2.3 Accidents and wider impacts

The assessment shows that a reduction in the number of fatal and serious casualties would occur in all alternatives as a result of the conversion of the existing single carriageway section of the A417 to a modern dual carriageway, with associated junction improvements. There would be an increase in the number of accidents and slight casualties due to increases in traffic in the A417 corridor, however the net result is beneficial. The economic benefits for the alternatives are all similar, with insignificant monetary differences between them.

The wider impacts of the scheme have been assessed using the DfT's Wider Impacts in Transport Appraisal (WITA version 1.2.1.2 beta) software. The WITA analysis shows benefits primarily resulting from agglomeration of impacts and to a lesser extent from benefits associated with output changes in imperfectly competitive markets. Wider benefits also arise from labour supply impacts. The economic benefits for all three alternatives would be significant in comparison to the existing arrangement, with the largest benefits for Alternative 3, followed by Alternative 2, with Alternative 1 having the smallest.

2.4 Summary matrix

Table 2.2 below is a matrix which compares the alternatives under each category discussed in this section, with the exception of traffic flows.

Table 2.2: Traffic benefits summary matrix (ranked from 1, comparative best performing, to 3 comparative lowest performing)

	Alternative 1	Alternative 2	Alternative 3
Journey times and reliability	3	2	1
Accidents	-	-	-
Wider impacts	3	2	1
Overall (Traffic and economics)	3	2	1



The matrix demonstrates that Alternative 3 would be the best option from a traffic and economics perspective, followed by Alternative 2 and lastly Alternative 1.

3 Environment

3.1 Environmental opportunities

A high-level review was undertaken of the potential environmental opportunities of three alternatives. The methodology applied does not follow a standard approach to environmental appraisal or assessment based on published guidance, and the review should therefore not be read as a formal appraisal or assessment. Instead, it allows comparison between the potential environmental opportunities of each alternative against the environmental baseline.

Biodiversity

Alternative 3 performs the worst of the three options, as it would result in additional severance of habitats compared to Alternatives 1 and 2. Alternative 2 would result in the least amount of severance of bat and potential dormouse habitats when compared to Alternative 1 and 3 while also presenting more opportunities for biodiversity where the existing A417 is removed.

Landscape and visual

Of the three alternatives, Alternative 2 provides the most landscape opportunities due to it running alongside the mainline A417. It also allows for potential de-trunking of a much longer length of the A417 around Barrow Wake when compared to Alternatives 1 and 3, together with associated restoration and enhancement of landscape, ecology and access routes. It also has more opportunities compared to Alternative 3 given the potential for less extensive impacts on existing vegetation/woodland within the High Wold landscape, and on NMU routes and visual receptors. An advantage of Alternatives 2 and 3 is that they remove the need for the A436 overbridge, which could be an intrusive structure across the cutting at the top of the scarp slope. Due to this feature, Alternative 1 performs the worst of the three for landscape opportunities.

Population and health

While Alternative 1 would result in the least adverse impacts in journey lengths for walkers, cyclists and horse riders using public rights of way, Alternative 2 would have the most opportunities for community land and facilities, private property, and associated land take. Alternatives 2 and 3 also allow for the de-trunking of the A417 between Birdlip and the Air Balloon, which would result in more opportunities in terms of amenity benefits for walkers, cyclists and horse riders when compared to Alternative 1.

Cultural heritage

In regard to cultural heritage, Alternative 2 provides the most opportunities in comparison to the other options, as it concentrates the archaeological impact on an area already impacted by the Option 30 route alignment. Alternative 3 provides more opportunities for heritage when compared to Alternative 1, but not as many when compared to Alternative 2, as it includes an additional area of land outside of what would already be archaeologically impacted by the Option 30 route alignment.

Water

Alternative 2 currently has the most water related opportunities when compared to Alternatives 1 and 3 as it involves only one major cutting (mainline). Alternative 3 has the least opportunities as it involves an additional, long cutting through South Hill, which may intersect groundwater flow.

Summary matrix

Table 3.1 contains a matrix which allows comparison between the potential environmental opportunities of each alternative against the baseline.

Table 3.1: Environmental opportunities summary matrix (ranked from 1, comparative best performing, to 3 comparative lowest performing)

	Alternative 1	Alternative 2	Alternative 3
Biodiversity	3	1	2
Landscape and visual	3	1	2
Population and health	3	1	2
Cultural heritage	3	1	2
Water	2	1	3
Overall	3	1	2



The environmental review showed that overall, the option that would offer the most environmental opportunities is Alternative 2. This is due to it outperforming the other alternatives across all categories, particularly for landscape due to its alignment alongside the proposed mainline A417.

3.2 NPSNN Compliance

The following section will discuss the accordence of each alternative with the National Policy Statement for National Networks (NPSNN).

Air quality

The three alternatives contain no locations where predicted annual mean NO₂ concentrations are above the air quality objective of 40µg/m³, which means that they are all fully compliant with the requirements of the NPSNN. At this stage no alternative design option is considered to perform better than the others in terms of compliance with the requirements of the NPSNN.

Biodiversity

For their effects on the nearby SSSIs, Alternatives 2 and 3 would contain slightly less risk of non-compliance with NPSNN. Furthermore, Alternative 2 also poses the lesser risk of non-compliance relevant to the protection of other habitats and species than the other two options. Lastly, all three alternatives would have similar adverse effects on woodland and veteran trees. This means that Alternative 2 performs best for NPSNN compliance under biodiversity.

Landscape and visual

All three options carry a risk of non-compliance with NPSNN, however Alternative 2 includes additional enhancement opportunities over the other options. Alternative 3 performs the worst of the three due to the significant predicted effects it would have on the High Wold AONB landscape.

Population and health

Alternative 1 represents the greatest risk of non-compliance against NPSNN due to adverse effects predicted for a number of receptors in relation to land use. Alternative 3 is also predicted to have potential impacts on community and residential receptors, which means that it falls behind Alternative 2 in regard to compliance against NPSNN. While Alternative 2 does contain risks of non-compliance, the potential benefits outweigh the potential risks.

Cultural heritage

Alternative 2 presents the greatest probability of meeting the relevant tests contained within the NPSNN, as enhancements to the significance of a number of heritage assets have been identified. Alternative 1 poses the greatest risk of non-compliance against NPSNN due to potential adverse effects to the setting of two designated heritage assets during the construction and operation stage. Alternative 3 contains features that pose a greater risk of non-compliance with the relevant tests set out within the NPSNN in comparison to Alternative 2, although this alternative is considered more likely to meet the relevant tests than Alternative 1.

Noise

At this stage it is considered that all alternative design options present equivalent risk of non-compliance in meeting the relevant tests set out within the NPSNN. However, appropriate design of mitigation and enhancement measures would be considered at Preliminary Design to ensure impacts on receptors are reduced.

Water

In relation to flood risk and water quality it is not currently possible to differentiate between the alternative design options as they currently present equal probability of non-compliance with the relevant tests set out within the NPSNN.

Summary matrix

Table 3.2 contains a summary matrix that compares the performance of the three alternatives against the relevant tests set out within the NPSNN.

Table 3.2: NPSNN compliance summary matrix (ranked from 1, comparative best performing, to 3 comparative lowest performing)

	Alternative 1	Alternative 2	Alternative 3
Air Quality	-	-	-
Biodiversity	3	1	2
Landscape and visual	2	1	3
Population and health	3	1	2
Cultural heritage	3	1	2
Noise	-	-	-
Water	-	-	-
Overall	3	1	2



Under the relevant tests set out in the NPSNN, Alternative 2 poses the lesser risk of non-compliance of the three options. Alternatives 1 and 3 are predicted to both incur impacts that would significantly affect their chances of compliance, with Alternative 1 performing poorly regarding biodiversity, population, human health and cultural heritage impacts and Alternative 3 performing poorly regarding landscape impacts.

4 Engineering and buildability

4.1 Comparison of options

One of the main differentiators between the options is that Alternative 3 would provide a better earthworks balance with less surplus material for the overall scheme, however assessment shows that this option would generate a larger percentage of unusable material due to it crossing an area of woodland, which makes Alternative 2 a better option in this regard.

As it runs alongside the proposed route of the A417, Alternative 2 would also be the least disruptive option in terms of construction impact on road users, the community, the environment, and local ecology. In these categories, Alternative 1 performs the worst, although Alternative 3 is likely to encounter more environmental and ecological constraints due to crossing through an existing woodland area. Alternative 1 performs the best in regard to land take and impact on utilities, which is a result of the option following the existing A417.

4.2 Summary matrix

Table 4.1 below is a matrix which compares the alternatives in regard to engineering and buildability.

Table 4.1: Engineering & buildability summary matrix (ranked from 1, comparative best performing, to 3 comparative lowest performing)

	Alternative 1	Alternative 2	Alternative 3
Construction length	3	1	2
Land take	1	2	3
Cut/fill balance & earthworks	3	1	2
Programme	-	-	-
Temporary traffic management	3	1	2
Utilities impact	1	2	3
Environment & community impact	3	1	2
Structures	3	1	2
Overall	3	1	2



Table 4.1 shows that Alternative 2 is the best option in regard to engineering and buildability, performing better than the other two options in all but two categories. Alternative 1 performs best in land take and utilities impact but worst in the remaining categories, making Alternative 3 the second best option behind Alternative 2 for engineering and buildability.

5 Appraisal summary

This chapter provides a summary of the WebTAG assessment and appraisal undertaken on the three alternatives. The assessments are summarised in WebTAG Appraisal Summary Tables (ASTs), which have been produced for all three options to collate the assessments and appraisals summarised within this report.

5.1 Environmental appraisal

Quantitative results

Table 5.1 provides a summary of the quantitative environmental appraisal undertaken for air quality, noise and greenhouse gases in line with WebTAG guidance.

Table 5.1: Summary of environmental results

Item	Alternative 1	Alternative 2	Alternative 3
Air quality	-1.00	-0.80	-0.70
Noise	0.70	1.00	1.00
Greenhouse Gases	-1.00	-0.81	-0.82

Note: all monetary values have been removed to protect commercial sensitivity and are expressed as a proportion of the greatest value to allow comparison

All three alternatives would have an overall negative impact on local and regional air quality but with no new exceedances and a predicted improvement in air quality at properties within the Birdlip AQMA and Oxford AQMA near the ARN. Negative monetary impacts are also predicted regarding greenhouse gases, due to a rise in the number of vehicle vehicles travelled relative to the Do Minimum scenario. Net monetary benefits for noise are predicted as a result of the A417 moving away from properties.

Qualitative results

Table 5.2 provides a summary of the qualitative environmental appraisal undertaken for landscape, historic environment, biodiversity and the water environment in line with WebTAG guidance.

Table 5.2: Summary of qualitative environmental results

Item	Alternative 1	Alternative 2	Alternative 3
Landscape	Large adverse	Large adverse	Large adverse
Historic environment	Large adverse	Large adverse	Large adverse
Biodiversity	Large adverse	Large adverse	Large adverse
Water environment	Very large adverse	Very large adverse	Very large adverse

The three alternatives cannot be differentiated by the qualitative environmental WebTAG assessment that was undertaken. All of them are predicted to have large adverse effects on landscape, historic environment, biodiversity, and very large adverse effects on the water environment. This is largely due to the alignment of the mainline A417 staying the same for all three options.

5.2 Social appraisal

Quantitative results

Table 5.3 provides a summary of the quantitative social appraisal undertaken for commuting and other users, reliability impact on commuting and other users, and accidents in line with WebTAG guidance.

Table 5.3: Summary of quantitative social results

Item	Alternative 1	Alternative 2	Alternative 3
Commuting and other users	0.83	0.95	1.00
Reliability impact	0.92	0.97	1.00
Accidents	0.98	1.00	0.98

Note: all monetary values have been removed to protect commercial sensitivity and are expressed as a proportion of the greatest value to allow comparison

Qualitative results

Table 5.4 provides a summary of the qualitative environmental appraisal undertaken for physical activity, journey quality, security, access to services, affordability, severance and option and non-use values in line with WebTAG guidance.

Table 5.4: Summary of qualitative social results

Item	Alternative 1	Alternative 2	Alternative 3
Physical activity	Neutral	Neutral	Neutral
Journey quality	Slight beneficial	Slight beneficial	Slight beneficial
Severance	Neutral	Neutral	Neutral

5.3 The three alternatives cannot be differentiated by the qualitative social WebTAG assessment that was undertaken. Summary

Overall, while the three alternatives show differing environmental and social effects from the appraisal, they can't be separated in regard to their overall qualitative results. The quantitative results are factored into the economic assessment which is detailed in Section 6.

6 Economics

This chapter provides a summary of the economic assessment and appraisal undertaken on two scheme options under consideration at PCF Stage 2.

6.1 Estimation of costs

Highways England has prepared cost estimates for all scheme options. The expenditure profiles are based upon cost estimates for each financial year prepared in Q1 2016 prices and then inflated to outturn costs using Highways England projected construction related inflation. These costs have then been rebased to 2010 calendar year profiles for economic calculations, using the Gross Domestic Product (GDP)-deflator series as published in the WebTAG Databook. The costs exclude all recoverable VAT and all historic costs have been removed.

Table 6.1: Estimated total costs

	Alternative 1	Alternative 2	Alternative 3
Estimated total cost	0.98	1.00	0.99

Note: all monetary values have been removed to protect commercial sensitivity and are expressed as a proportion of the greatest value to allow comparison

6.2 Economic assessment results

The overall monetised economic impacts of the scheme with each of the three alternatives are summarised in the Analysis of Monetised Costs and Benefits (AMCB) table, which includes results from the TUBA, COBALT and QUADRO programs, as well as the assessments undertaken for journey time reliability, noise, air quality, greenhouse gases and wider economic benefits. The AMCB is shown in Table 6.2. As per WebTAG all costs and benefits reported in this section are in 2010 prices, discounted to 2010.

Table 6.2: Analysis of costs and benefits

Item	Alternative 1	Alternative 2	Alternative 3
Accidents (not assessed by TUBA)*	0.98	1.00	0.98
Roadworks (not assessed by TUBA)**	-1.00	-1.00	-1.00
Greenhouse Gases (not assessed by TUBA)***	-1.00	-0.81	-0.82
Noise (not assessed by TUBA)****	0.69	0.96	1.00
Air Quality (not assessed by TUBA)*****	-1.00	-0.80	0.71
Economic Efficiency: Consumer Users (Commuting)	0.84	0.92	1.00
Economic Efficiency: Consumer Users (Other)	0.79	0.99	1.00
Economic Efficiency: Business Users and Providers	0.87	0.92	1.00
Wider Public Finances (Indirect Taxation Revenues)	0.95	1.00	0.95
Present Value of Benefits (PVB)	0.88	0.96	1.00
Broad Transport Budget Present Value of Costs (PVC)	0.98	1.00	0.99
OVERALL IMPACTS			
Net Present Value (NPV)	0.62	0.88	1.00
Initial Benefit to Cost Ratio (BCR) (ranked from 1 comparative best to 3 comparative worst)	3	2	1
Reliability Benefits	0.96	0.99	1.00
Wider Economic Benefits	0.78	0.90	1.00
Adjusted BCR (ranked from 1 comparative best to 3 comparative worst)	3	2	1

Note: all monetary values have been removed to protect commercial sensitivity and are expressed as a proportion of the greatest value to allow comparison

The analysis of monetised costs and benefits shows that Alternatives 2 and 3 have better BCRs than Alternative 1, with Alternative 3 having a slightly better BCR than Alternative 2.

7 Conclusion and recommendation

7.1 Comparison of alternatives

Table 7.1 below provides a summary of the assessment that has been undertaken on the three A436 alternatives. Each section in this report has identified the alternative with the most benefits/opportunities within that category, and these results are summarised in the matrix.

Table 7.1: Alternatives summary matrix (ranked from 1, comparative best performing, to 3 comparative lowest performing)

	Alternative 1	Alternative 2	Alternative 3
Traffic assessment	3	2	1
Environmental opportunities	3	1	2
NPSNN compliance	3	1	2
Engineering and buildability	3	1	2
Benefit cost ratios	3	2	1

Most benefits/opportunities	←→	Fewest benefits/opportunities	Minimal differences between options
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The assessment that has been undertaken shows that Alternative 1 provides the fewest benefits and therefore it is recommended that it is discounted.

While Alternative 3 has benefits above that of Alternative 2 regarding traffic, it performs worse under environmental opportunities and compliance with NPSNN, particularly for landscape which is an important factor in the AONB. Furthermore, it is only slightly ahead of Alternative 2 regarding traffic and BCR ratio which does not outweigh its potential environmental impacts.

It is therefore recommended that Alternative 2 is progressed as the preferred option for the A417 Missing Link scheme. This option has a number of advantages as a result of running alongside the A417 mainline, particularly regarding the environmental opportunities this presents. It also poses the lesser risk of non-compliance with the relevant tests set out in NPSNN, particularly as it would cause significantly less disruption to the local environment, landscape and ecology during construction. One of the key aims of the A417 Missing Link scheme is to be landscape led, and the selection of Alternative 2 matches this objective.