A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010059

7.17.5 Applicant's Written Summary of Oral Submissions at Hearings - Appendix E - Bridge Design Philosophy

Rule 8(1)(c)

Infrastructure Planning (Examination Procedure) Rules 2010

Planning Act 2008

March 2021

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

The A1 in Northumberland: Morpeth to Ellingham

Development Consent Order 20[xx]

Appendix E - Bridge Design Philosophy

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CONTENTS

1 INTRODUCTION

1.1.1. This document is prepared in support of the matters raised at Issue Specific Hearing 1 relating to the draft DCO on 25 February 2021, and in particular queries relating to the design of structures within the Scheme.

2 JUNCTION OVERBRIDGES AND UNDERBRIDGE

2.1 INTRODUCTION TO DMRB DESIGN PROCESS – OPTIONS REPORTS

2.1.1. BD2/12 of the DMRB The Technical Approval of Highway Structures sets out the procedures for the options selection and approval of structures. Section 1.6 of BD 2/12 states that the objectives of the procedures are to ensure that any new structure is serviceable in use, economic to build and maintain, complies with the objectives of sustainability, has due regard to the environment, satisfactorily performs its intended function and that highway users, the public and any others who may be affected are protected from adverse effects resulting from any work carried out to any highway structure.

2.1.2. In addition to ensuring that the technical requirements of the DMRB as set out in BD 2 are delivered Highways England have prepared "*Roads to Good Design*." This document sets out 10 principles of good road design, which follow the themes of people, places and processes and includes the principle that good roads and structures design fits in context. The purpose of establishing these principles is to deliver "*better, more beautiful roads"* and ensure the aesthetic quality of structures and their integration into the landscape.

2.1.3. As part of the preliminary design, for the structures proposed along the A1 trunk road, an options study and preliminary design was undertaken to consider the possible forms of structures at the required locations. Structures options reports were developed to identify the design and construction factors for each option considered. The structures options reports set out the evaluation of each of the structures options and the preferred option based on this evaluation.

2.1.4. The overbridges along the A1 Trunk Road were designed to provide a 6m minimum headroom clearance over the carriageway. As a strategic route the Scheme successfully challenged whether full abnormal vehicle headroom clearance could be avoided.

2.1.5. The bridges proposed along the A1 trunk road will have metal parapets, the height of the parapets will be dependent on the usage of the structure. Where a structure carries a bridleway, the parapets proposed will be 1.8m high.

OPTION EVALUATION

2.1.6. The factors considered in the selection of the form of the overbridges for the Scheme with due regard to the objectives of BD 2 and Roads to Good Design as set out in 2.1.1 and 2.1.2 above comprised:

a. Buildability and safety;
b. Aesthetics and Landscape Integration;
c. Maintenance;
d. Value for Money.
a. A matrix analysis was used to evaluate the different options and determine the most suitable solution based on the foregoing factors. The consideration of these factors is set out in further detail below.

Buildability

2.1.7. It should be noted that three of the overbridge structures, at Highlaws Junction, West Moor Junction and Heckley Fence are on the online sections of the Scheme and as such cross the existing A1 carriageway. The other three overbridge structures at Fenrother Junction, Causey Park and Charlton Mires are on offline sections of the Scheme. Buildability is a particular consideration at the overbridges on the online sections in terms of minimising disruption to existing traffic on the A1 during construction of the bridges. This therefore requires that the proposed supports and foundations for the bridge are set back from the existing carriageway to avoid disruption while enabling these to be built safely. The choice of precast beams for the deck of each of these structures also allows for the beams to be lifted into place over the existing and proposed A1 carriageways with minimum disruption to traffic.

Aesthetics

2.1.8. A key factor in the selection of the structural form for the bridges was uniformity of appearance to create a family of structures and thereby create sense of identity for the Scheme. Notwithstanding that some of the overbridges are on the online sections while others are offline, they will all cross over the proposed dual carriageway. ~~Where the Scheme has identified a need to ensure good aesthetics is achieved~~.

2.1.9. The choice of single span overbridge structures avoids intermediate piers in the central reservation and therefore creates an open aspect of the surrounding countryside for those driving on the A1.

2.1.10. The bridge decks comprise precast concrete beams with a reinforced concrete deck slab which cantilevers out beyond the beams. This cantilever will create a shadow on the beam which will reduce the visual depth of the bridge deck which will make the deck appear more slender and thereby enhance the visual appearance. The single precast beam spanning between the abutments and the vertical edge of the deck slab which has a constant depth will also provide for clean lines and a uniform appearance without interruptions.

Landscape Integration

2.1.11. The landscape within which the Scheme is to be constructed is formed substantially of open countryside, with few if any, notable buildings or built form. As such, the design of structures has sought to resist the temptation to provide iconic or gateway features, instead good design has achieved a scheme that integrates with the landscape and utilises structures that sit as low as is practicable limiting the prominence of the Scheme within the open countryside.

2.1.12. Where the Scheme has identified that a need to ensure good aesthetics is achieved is the re-instatement of landscape features that are typical of the wider landscape through woodland planting, the formation of a network of hedgerows to mitigate the Scheme, and opportunities for additional hedgerows to be planted, in agreement with the landowners.

2.1.13. Additionally, the replanting of the southern section of Coronation Avenue would replicate the existing feature which would be removed as a result of the widening of the existing A1, and which has been identified as substantially contributing to landscape character and the experience for the road user.

2.1.14. The Scheme and the associated junctions, including structures, has been designed within the engineering constraints of safely operating a road of this nature, to reflect local landform. For the most part, this has effectively avoided substantial cuttings and embankments that would otherwise have modified the landform and been at odds with the topography. This has had the benefit that the grade separated junctions are compact in scale, limiting the footprint and as a result avoiding the unnecessary removal of landscape features (woodland, hedgerows, watercourses). A further benefit is that structures associated with the junctions are also limited in number (the design of the junction requires only a single bridge structure) and scale, avoiding the need for additional supporting piers that disrupt the road user's view and contribute to additional and newly built forms within the landscape.

2.1.15. Elsewhere, overbridges have been orientated and designed so as to reflect local landform, avoiding extended bridge decks, and using embankment slopes that can be planted in order to provide screening to, and integration of, the junctions within the open countryside e.g. Heckley Fence overbridge.

2.1.16. It would be inappropriate to provide extensive woodland planting along the entire corridor, as this would in itself form a new and out of character feature within the landscape and create a green tunnel for road users. Instead, woodland has been focused around the junctions and overbridges to provide both screening and integration, tying into existing woodland and hedgerows where appropriate e.g. east of the Fenrother junction.

2.1.17. Opportunities have also been identified on Figure 7.8: Landscape Mitigation Masterplan Part A [APP-095] (update submitted at Deadline 4) for the profile of embankments to be softened (the toe of the slope extended so that slopes are less steep) subject to suitable fill being identified at the detailed design stage and available during construction. This would further integrate the Scheme within the landscape.

2.1.18. As a result of the above approach to landscape integration, the Scheme and its associated structures, would reflect local landform, limit its impacts on existing landscape features and afford opportunities to profile embankments and cuttings to reflect adjacent landform, whilst creating areas within which woodland, hedgerows and scattered trees would provide effective screening.

Maintenance

2.1.19. The structural form chosen for the deck of the overbridges comprises precast concrete beams. The choice of concrete will be more durable and require less maintenance than steel beams. The fabrication of the precast beams and the panels forming the reinforced soil walls for the abutments in factory conditions provides for improved quality control in comparison to casting the concrete on site thereby improving durability.

2.1.20. The structural form also provides for the bridge deck to be made integral with the abutments which thereby avoids the need for bearings and mechanical joints. This further reduces the maintenance requirements for the structure.

Value for Money

2.1.21. Many of the factors outlined in the foregoing in terms of ease of buildability and the reduced maintenance burden contribute to the proposed form of overbridge structure providing value for money in comparison to the alternatives considered. In addition, the reinforced soil walls for the abutments provides a more cost effective solution than an in situ concrete abutment.

Underbridges

2.1.22. The factors considered in the selection of the structural form for Burgham underbridge are similar to those outlined in the foregoing for the overbridges. Burgham underbridge is on an off line section of the Scheme however the bridge crosses the existing Burgham Park Road. From a buildability perspective the precast beam deck enables the bridge deck to be constructed while reducing the disruption to traffic using Burgham Park Road while the use of precast concrete deck beams and an integral structure provides for ease of maintenance.

3 RIVER COQUET

EXPANSION OF DMRB DESIGN PROCESS – OPTIONS REPORTS

3.1.1. As part of the PCF Stage 3 design, for the River Coquet Bridge, an options study and preliminary design was undertaken to consider the possible forms of the structure. A structures options report was developed to identify and discuss the design and construction considerations for each option considered, the evaluation of each of the options and the recommendation of a preferred structure option based on the evaluation.

DESIGN PANEL

3.1.2. A meeting was held with the HE Design Panel on 27th November 2015, at an early stage in the scheme option development. The panel considered the Scheme as a whole but focussed on the key considerations in designing a new bridge to span the River Coquet. The panel considered that there was no appetite or necessity for a landmark or iconic bridge and instead some members of the panel stated that the team should focus on matching the form of the existing bridge.

EXISTING BRIDGE

3.1.3. The existing A1 carriageway crosses the River Coquet and Coquet valley on a three span underbridge in a straight horizontal alignment, whose deck is made up of three cell concrete box girder of variable depth. The configuration of the existing bridge comprises a central span which frames the river while each side span carries the bridge deck from the pier to an abutment which is located where the road alignment intersects with the landform at the top of the river valley slopes thereby minimising the size and visual appearance of the abutments. The existing bridge was commissioned in the late 70s and build in 1980.

DRIVING FACTORS / CONSTRAINTS

3.1.4. The site of the existing and proposed bridges lies within the impact zone for a Site of Special Scientific Interest (SSSI) and an area of high landscape value. The fish fauna of the River Coquet is diverse with presence of salmon and trout being particularly significant. The birdlife associated with the Coquet includes large numbers of common sandpipers, grey and yellow wagtails which nest and feed in high densities along or near the river. Many species of insects are dependent on the river, among these caddis flies, black flies, mayflies and stoneflies. Red squirrels are also found in the area at the location of the proposed bridge.

3.1.5. ~~For the new bridge, due considerations have been made concerning the overall appearance.~~ Views of the existing and proposed bridges in elevation are limited by the vegetation within the river valley and the lack of adjacent developments which would afford a view of the structures.

3.1.6. The primary factor in consideration of structural form for the new River Coquet bridge was therefore selecting a form which complemented the existing bridge hence a three span structure similar to the existing bridge was proposed with two concrete piers and abutments located at the top of the valley slopes.

3.1.7. The ground instability to the north side of the valley required that the north abutment be moved further north than the existing bridge abutment, to avoid instability issues within the north approach embankment. This resulted in the elongation of the north span. The proposed bridge is separated from the existing by an air gap of 6m. This will allow light to spill through the gap between the structures to the valley and river below to provide for vegetation growth beneath and around the bridges.

3.1.8. The other factors considered in the selection of the structural form of the River Coquet Bridge were similar to that for the overbridges and with due regard to the objectives of BD 2 and Roads to Good Design comprised:

a. Buildability;
b. Aesthetics and Landscape Integration;
c. Maintenance and durability;
d. Sustainability and Impact on the Environment;
e. Value for Money including duration and cost of construction;
f. Health and Safety.;

Buildability

3.1.9. The existing River Coquet Bridge was built by cantilevering out from both piers. This has resulted in the curved form of the existing bridge deck with the deeper deck depth at the piers being required to carry the loads of the cantilevers before the decks were joined at midspan and before the cantilevers were supported at the abutments. Temporary tower cranes were located adjacent to each abutment to supply materials to the bridge deck during construction.

3.1.10. The presence of the SSSI was a key factor in the selection of the structural form of the proposed bridge in terms of minimising the impact of construction on the SSSI.

3.1.11. The alternative construction method proposed for the River Coquet Bridge is to launch or push the bridge deck across the valley from the south side rather than constructing the bridge using the same methods as the existing or alternatively lifting large sections of bridge deck into position using a crane. The beams comprising the bridge deck would therefore be constructed on level ground behind the south abutment on the line of the proposed southbound carriageway. This is a much quicker means of constructing the bridge deck in comparison to that utilised for the existing bridge and has a number of environmental and safety benefits including:-

a. Significantly reducing the amount of working at height required;
b. Avoiding the need for tower cranes and temporary props at each pier;
c. Reducing the amount of lifting required over the river valley;
d. Reducing the programme duration for constructing the bridge deck;
e. Reducing the environmental impact on the SSSI.

It is proposed that the launching system uses a temporary king-post cable stay system, avoiding the use of temporary piers. Compared to the use of temporary piers, this option offers the following advantages:

a. No additional work required within the river valley;
b. Reduce the flood risk associated with working within the river valley;
c. Avoid the need for installing a temporary pier within the area of slope instability and its associated risks.

Aesthetics

3.1.12. Launching the bridge deck from one abutment to the other requires the bridge deck to be a constant depth and the span lengths require the bridge deck to comprise steel plate girders rather than concrete. In this respect the proposed bridge will differ from the existing however the limited views of the structures in elevation effectively negate the requirement for the form of the structures decks to match visually.

3.1.13. The proposed deck slab of the new bridge cantilevers out beyond the girders. This will create a shadow which will reduce the visual depth of the bridge deck and enhance the visual slenderness. There will also be no stiffeners on the outside face of the steel girders other than at the piers. The avoidance of stiffeners and the vertical edge of the deck slab which has a constant depth will provide for clean lines and a uniform appearance.

Landscape Integration

3.1.14. The design of the River Coquet bridge has adopted a suitable approach to the design in terms of its integration with the landscape. The wooded valley within which the new structure would be constructed screens views to the bridge from the surrounding landscape, and as a result it would remain a relatively discrete new feature of the landscape. The construction of the bridge, in parallel with the existing bridge to the west, ensures that where change is perceived it is within the context of the existing bridge, and the design avoids vertical elements that would otherwise highlight the presence of the bridge.

3.1.15. Whilst some woodland would be removed in order to construct the bridge, this would be minimised, and importantly the profile of the woodland along the edge of the valley slopes would be largely retained, avoiding large sections of this woodland being removed and awareness of the structure becoming visible.

Maintenance and durability

3.1.16. The steel girders comprising the bridge deck of the new bridge will be fabricated in weathering steel to avoid the need for painting of the steelwork during construction and re-painting at intervals thereafter.

Sustainability and Impact on the Environment

3.1.17. As set out in the foregoing the choice of a bridge which is constructed by launching reduces the impact on the environment through the reduction of works to construct the bridge deck which is required to be undertaken in and from the river valley together with the reduced

duration of activities in or over the river valley. The choice of weathering steel reduces future maintenance work required in or over the river valley in comparison to a structure with painted steelwork.

Value for Money including duration and cost of construction

3.1.18. Given the constraints imposed by the steep sided valley, the resulting size and scale of the bridge and the fact that the construction of the bridge is on the critical path for the construction of the Scheme as a whole, the construction cost of the River Coquet Bridge is heavily dependent on the construction method chosen. The choice of a launched bridge deck results in a shorter construction programme and reduces the temporary works required for the construction of the bridge deck which therefore reduces the overall construction cost.

Health and Safety

3.1.19. The choice of a launched solution for construction of the bridge deck reduces the amount of work required at height, avoids the requirement to lift sections of the bridge deck using a crane in the river valley and reduces the overall duration of the bridge deck construction all of which reduce the health and safety risks during construction.

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