Lower Thames Crossing

7.4 Project Design Report

Part F: Structures and Architecture

APFP Regulation 5(2)(q)

Infrastructure Planning

(Applications: Prescribed Forms and Procedure)

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Project Design Report Part F: Structures and Architecture

Contents

1. Project Design Report – introduction

1.1. Document structure

1.1.1. This Project Design Report (PDR) covers the general preliminary design for structures and architecture across the Project.

1.1.2. General design broadly covers the following areas:

a. Preliminary design: the tunnels and associated structures, including Portals

b. Preliminary design: bridges and viaducts

c. Preliminary design: Project enhanced structures

d. Preliminary design: Gammon Field Travellers' Site

1.1.3. The structures are grouped by type, then by geographic location following the route south to north.

1.2. Navigation

1.2.1. This document, Project Design Report Part F: Structures and Architecture, is one of 10 parts that cover the preliminary design aspects of the Project.

1.2.2. Each part has been assigned a colour, as outlined below, to assist with navigation between documents and for further information on other preliminary design aspects of the Project.

Part A: Introduction and Project Background

Part B: Policy Context and Project Design Process

Part C: Design Rationale

Part D: General Design South of the River

Part D: General Design North of the River - Tilbury to the A13 Junction

Part D: General Design North of the River - North of the A13 Junction to the M25

Part E: Design for Walkers, Cyclists and Horse Riders

Part F: Structures and Architecture

Part G: Design Evolution

Part H: References and Glossary

1.3. Structures and architecture overview

1.3.1. The Project will be experienced by large numbers of people in various ways. It includes people travelling along the route, those living in the towns and villages close to it, those who make recreational use of the landscape through which it passes and those who will be employed in its maintenance and operation. For all these people, the proposed bridges and structures along the Project route can be defined and experienced as a series of events with an underlying narrative which draws from its context and function.

1.3.2. The Project will have circa 50 new bridge structures. The majority of these are in the junctions. Each bridge should respond to its specific context, demonstrating sensitivity to the local landscape, heritage and local community. It seeks to enhance the place while being true to structural, architectural and environmental requirements and maintains a common language throughout.

1.3.3. The overarching design consideration is one of integration with the landscape, with acknowledgement of the wide variety of specific local characteristics such as marshes or chalk hills, or events on the horizon such as ancient churches or the River Thames. The landscape is not fixed, it is a changing seasonal scenery and a dynamic inter-related environment which needs to be understood and recognised in the design of the bridges. This principle has informed design decisions, from fundamental relationships between elements through to details and importantly has enabled opportunities for positive outcomes to be identified and included. Some of these will be significant for people travelling at speed along the Project route, others will be details experienced by those walking past, and others will affect the scale or extent of impacts on the landscape, biodiversity, or cultural heritage.

1.3.4. The design response therefore is that the Project route shall be a road that lies subservient within its – the landscape. The existing and proposed landscape will have a higher visual hierarchy than the road and the structures that support it. Bridges and structures should appear as fully and seamlessly integrated components within the landscape. This will minimise impacts on local communities and the environment and provide opportunities for enhancement where practicable and appropriate.

1.3.5. The landscape-led hierarchy has been reflected in the design of all structures. For example, in the section of the Project route that crosses the Mardyke, the road will be treated as a secondary element passing through the landscape, but the viaduct has been designed to be sympathetic with its context. The design of the viaduct should still be an engaging and elegant structure, which enhances the landscape, rather than detracting from it. Engagement with the design helps define the user experience and in turn forms a sense of place, highlighting an event; a passing of the road through the fens – a landscape feature that might otherwise have gone unnoticed.

1.3.6. This strategy is also mirrored in National Highways' 10 Design Principles of good road design, which drives a context-based design response to integrate structures and is key to ensuring a positive contextual intervention.

1.3.7. The preliminary design for structures and architecture in this document covers the following elements:

a. Bridges and viaducts

b. Retaining walls

c. Fences and acoustic barriers

d. Portals and associated buildings

e. Engineered earthworks

1.3.8. It does not include:

a. Roadside furniture (e.g. gantries, lighting, barriers)

b. Temporary works

c. Marine works

d. Local substations

1.3.9. This document also outlines the preliminary design for the Gammon Field Travellers' Site relocation (Section 6).

1.3.10. The designs and images shown in this document are preliminary, which are illustrative proposals of one possible design outcome. Proposals shown may be developed differently during detail design to comply with the Project requirements.

Illustrative view of Thong Lane green bridge north with the South Portal behind, showing integration into the landscape

2. Project-wide design approach

2.1. Introduction

2.1.1. The Project has presented to the National Highways Design Review Panel (NHDRP) throughout the development of the preliminary design.

2.1.2. In 2017, the NHDRP recommended that;

'The design of individual structures should be part of the overall consideration of how the scheme responds to the landscape. As important and visible features, they cannot and should not be hidden. Rather, their structure and design should make a positive and memorable contribution to the landscape and how it is experienced by people moving along the route and observing it from nearby.'

2.1.3. From this point, the Project adopted a landscape-led approach and utilised a common design language for the structural and architectural elements. This included a simplified material palette that complemented the landscape and local vernacular.

2.1.4. A Design Narrative was created which broke down the route into eight individual character areas and provided design responses in line with the local landscape character.

For further information on the National Highways Design Review Panel Process and the Design Narrative, please refer to Project Design Report Part B: Policy Context and Project Design Process.

For further information on the development of specific structures and architectural design on the Project, please refer to Part G: Design Evolution.

2.2. Routewide design rationale

2.2.1. Project structures have been designed to provide solutions in accordance with the landscape designs, as set out in the Project Design Report Parts D: General Design, to provide an inclusive contextual landscape-led design that:

a. Provides an attractive, purposeful, and meaningful connection for the people it is provided for

b. Provides a more useable, accessible, and safer infrastructure for all

c. Is environmentally sustainable, minimises impact on natural assets and improves access to green infrastructure where practicable

d. Is sympathetic to its historic and (known) future context

e. Responds positively and sensitively to landscape character, cultural heritage and the communities it serves

f. Balances the coordination of aesthetic, functional and technological considerations

g. Is of a consistently high quality

h. Has a coherent and distinctive design with a recognisable design language

2.3. Landscape integration

2.3.1. The Project will pass through a remarkably diverse range of landscapes within a relatively short distance. This includes the wooded high ground of the Kent Downs Area of Outstanding Natural Beauty (AONB); flat, open marshland close to the river; urban fringe farmland south of the A13; the open expanse of the fen landscape north of Orsett; and undulating wooded farmland alongside the M25. Enabling road users to experience this range of landscapes will enhance and add meaning to their journey.

2.3.2. The overall strategy of the landscape design proposals of the route are to reflect and enhance the surrounding landscape character. For example, woodland planting in the Kent Downs AONB would be appropriate, however woodland planting in the Orsett Fen landscape character could detract from the existing landscape.

2.3.3. The overall design response is that the Project route shall be a road that lies subservient within its context, the landscape. The existing and proposed landscape will have a higher visual hierarchy than the road and the structures that support it. These structures should be subservient to the surrounding landscape character with a minimal footprint. A non-contextual engineered road bridge will not be an appropriate design solution to every location.

2.3.4. There is an opportunity to integrate these large structures into the surrounding landscape, through careful and coordinated design between landscape and structures. This blurs the edges at the transition between the two (abrupt transitions should be avoided wherever practicable).

2.3.5. Vegetation and earthworks can be used to help blend the structure into the surrounding landscape, however the species type and pattern of vegetation, and height and form of earthworks must be appropriate to the surrounding landscape.

2.3.6. Landscape integration examples include:

a. Earthworks
b. Integration of green bridges
c. Hedgerows
d. Chalk cutting
e. Green/brown roofs

Aerial view of the existing landscape of the Kent Downs AONB, showing Brewers Road bridge

Earthworks

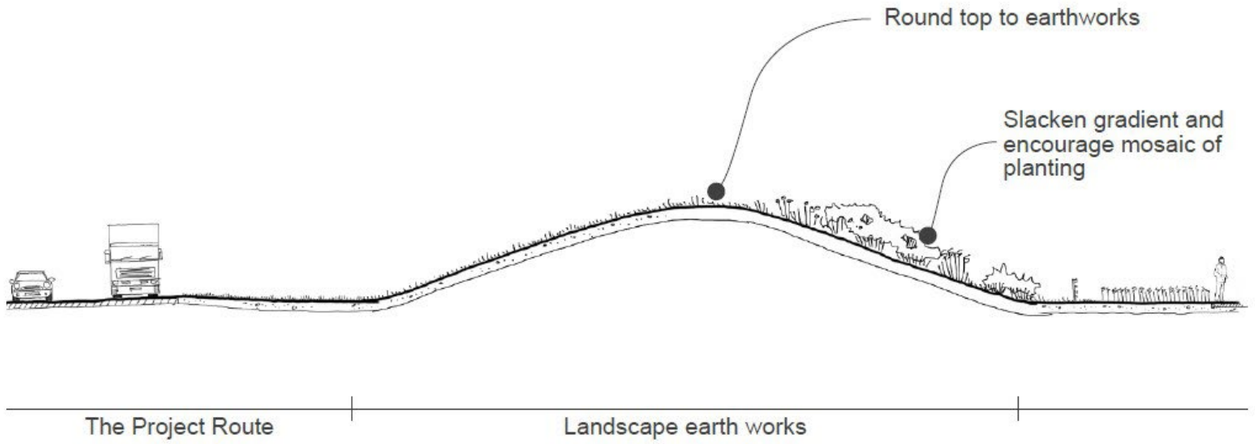
2.3.7. Landscape earthworks have been used as a key medium to integrate the Project and its variety of structures into the existing landscape fabric and respond to design requirements. Landscape, noise mitigation, ecological enhancements and placemaking features have been designed to respect the local topography.

Integration of green bridges

2.3.8. Green bridges have been designed to reflect the existing local landscape character through the choice of planting species and materials used. The character of existing roads, tracks and footpaths that lead up to each bridge has been used to inform the design. The bridges have been located to ensure connectivity of habitats and other sensitive landscapes that have been impacted by existing highways and the Project route.

Hedgerows

2.3.9. Hedgerows soften the appearance of the engineered earthworks and blends them into the existing landscape. This screens the interface between the toe of the earthworks and the existing ground, providing a boundary to highways assets, and integrating any fencing required at the highway boundary.



Cross section showing landscape earthworks

Illustrative view of the existing character of Hoford road, that is retained, looking towards Hoford Road green bridge

Example of a species rich hedgerow to soften engineered earthworks

Chalk cutting

2.3.10. The design of the engineered chalk cutting has been developed to include a series of terraces cut into the chalk face. The terraces will be at regular intervals and kept level. The road will descend past these terraces enhancing the experience and awareness of descending to, or ascending from, the tunnel. The chalk faces should be irregular in their structure and appearance, to help propagate and establish a mix of natural plant species over time.

Green/brown roofs

2.3.11. Green/brown roofs are proposed on the Tunnel Service Buildings (TSBs), to integrate them into the wider landscape and provide biodiversity and sustainability benefits.

Further details on the proposed preliminary landscape design can be found in Project Design Report Part D: General Design South of the River

Further details on the proposed preliminary landscape design can be found in Project Design Report Part D: General Design North of the River - Tilbury to the A13 Junction

Further details on the proposed preliminary landscape design can be found in Project Design Report Part D: General Design North of the River - North of the A13 Junction to the M25

Example of a steep chalk cut with an irregular cut face

Example of an extensive green roof with planting

Example of a extensive sedum green roof

2.4. Common material palette

2.4.1. It is proposed that all bridges and structures across the Project adopt a common material palette which has been reflected in the preliminary design. Material choice makes an important contribution to the integration of structures into the landscape, by harmonising the transition between landscape and structure and by minimising the perception of impact through the use of materials commonly found in the local landscape.

2.4.2. The Preliminary Design proposals have been in part influenced by the rich landscape of the Kent Downs AONB. This area is formed of diverse, special characteristics and qualities, which together distinguish it as a landscape of national and international importance. It is consistently highly valued by the public, individuals, institutions, organisations and experts alike. Due to this status, the Kent Downs AONB established its own guidance documents (Kent Downs, 2019), which offer advice and principles for the selection and use of colour for any development within its boundary.

2.4.3. In order to create an identifiable and common design language across the Project, the principles adopted from the Kent Downs AONB guidance were used as the basis for the bridge designs along the route and fed into the designs for the portals and TSBs. However, these are adopted to suit and reflect individual locations.

2.4.4. The colour palette, based on the AONB guidance, has been translated into a materials palette consisting of self-finished raw materials (e.g. not painted or coated). The chosen materials should be of high quality, contribute and add lasting value to the conservation and enhancement of the natural, built, and historic environment. They should consider whole-life operation, by minimising waste and the need for frequent maintenance and replacement.

2.4.5. Materials should also be influenced by the landscape context and a common material palette was developed for the Preliminary Design, which contributes to a Project-wide common design language.

2.4.6. This preliminary materials palette includes:

a. Gabions filled with local stone

b. Precast concrete

c. In situ concrete

d. Weathering steel

e. Sustainable paving systems

2.4.7. The palette may be developed to include different materials at detailed design.

Gabions filled with local stone

Precast concrete

Weathering steel

In situ concrete

Sustainable paving systems – grasscrete

3. Structures overview

3.1. Introduction

3.1.1. There are a number of structures required along the Project route. This includes:

a. Portals and tunnel service buildings

b. Utility structures

c. Fences

d. Bridges and viaducts

e. Retaining walls

f. Noise barriers

g. Highways structures

3.1.2. The interface between these structures and their adjacent landscape is important to the successful integration of the Project within the local context. The engineering, landscape and architecture proposals have been designed to work coherently, both functionally and aesthetically, forming a high-quality design.

3.1.3. The national significance of the Kent Downs AONB sets a minimum standard for the quality and design of all structures across the Project. Although each structure responds to its setting (including planting types and materials), it shall be of a high quality design that meets relevant design guidance, regardless of whether the structure is located within the Kent Downs AONB or not.

3.1.4. Within rural areas, the impact of structures will be softened by planting or earthworks or a combination of both. Planting typologies and species chosen, reflect the positive character of the existing landscape.

3.1.5. Structures also need to seamlessly integrate with other elements, such as fencing, retaining walls and other ancillary structures. For example, to reduce the visual clutter, where acoustic screens are required at bridges and viaducts, consideration has been given to an integrated solution with parapets.

3.1.6. In addition, to reduce any urbanising effect, the design of retaining walls that are of significant height should, where practicable, incorporate a series of terraces, rather than a single tall wall. The terraces of walls and gabions can also create additional areas of planting to help soften the appearance of structures, maximise opportunity for net environmental gain and help blend into the surrounding landscape.

3.1.7. The requirements that the Project structures must meet are found in the ‘Structures’ section of the Project Design Principles (Application Document 7.5). Additionally, the ‘Connecting Places’ Design Principles capture the requirements that a common design language should be developed, locally differentiated to respond to its context where appropriate, across the Project.

Using planting to integrate a gabion structure into the landscape

3.2. Routewide structural elements

Fencing and boundaries

3.2.1. Requirements for fencing propose to limit the variety of types, interfaces and visual impact on the existing and proposed landscape character. The detail of fences should be designed, coordinated and integrated into the existing landscape and be sympathetic, yet contribute, to their local landscape character. Fencing is included in the preliminary designs for the portals and bridges for safety and security reasons.

Environmental (acoustic) barriers

3.2.2. The purpose of environmental barriers is to provide noise and/or visual mitigation of impacts the Project creates for adjacent receptors. Throughout the scheme, the environmental barrier has been considered in the form of landscape earthworks, providing sufficient mitigation of a suitable type whilst integrating the barriers into the landscape, particularly in rural areas. However, where the use of landscape earthworks is constrained, such as where it would clash with utilities or there is a lack of suitable space, solid environmental barriers (which also provide replacement biodiversity and or habitat) have been considered.

3.2.3. The appearance of environmental barriers should be sympathetic to the local surroundings, local vernacular and materials, and should not become a visual detractor. However, the final choice of material for these barriers must also ensure it still meets its noise and visual mitigation requirements.

3.2.4. Environmental/acoustic barriers should also integrate with other types of fencing and structures (and any specific requirements they have) to reduce visual clutter. For example, where acoustic screens are required at bridges and viaducts, they have been integrated into the requirements for parapets.

Example of timber fencing

Example of stock proof timber fencing for rural settings

An environmental barrier partly covered by vegetation, softening the appearance

A green wall structure which separates a public access route from the highway

3.3. Bridges and viaducts

3.3.1. There are circa 50 bridges and viaducts along the Project route. The preliminary design of each structure has been undertaken to respond to the requirements of the geometry needed to comply with the highway layouts and any adjacent constraints e.g. utilities, limitations on available land, landscape character, and operational considerations around maintaining live highways. This determined much of the principal geometry both under and over the bridges. The preliminary designs have been developed to ensure that sufficient structural space has been allowed to accommodate a degree of flexibility in the detailed designs, for example in locating appropriate support positions. The draft DCO includes (at article 6) limits of deviation. The limits of deviation are designed to ensure that the development consent, if granted, includes a proportionate amount of flexibility, allowing a degree of 'deviation' from certain aspects of the consented Project (preliminary design) as shown in the Works Plans (Application Document 2.6) and Tunnel Limits of Deviation Plans (Application Document 2.15). These are the documents which set the constraints by reference to which the limits of deviation are subsequently defined.

3.3.2. The designs are reasonably conservative and use normal span to depth ratios, with limitations on skew angles that give some tolerance for design development. A typical form of bridge using integral abutments has been adopted where possible to reduce maintenance requirements and consideration has also been given to the necessary spans for structures that cross existing roads (e.g. A2/M2 and M25) where piers may need to be positioned to keep lanes open during construction. Such constraints preclude use of other arrangements and materials which could improve aspects of the design by, for example, reducing its carbon footprint. Where longer span bridges or viaducts on bearings are needed, provisions for room for access to maintain these bearings has been considered.

3.3.3. The preliminary designs are developed to DMRB technical standards, relevant Eurocodes and National Highways guidance notes e.g. CD127, CD361 etc. Where bridges interface with other statutory bodies (e.g. crossings of rail) the detailed designs will also need to satisfy the particular requirements of these third parties. Structural options have been looked at for every structure. These investigated different span arrangements and some common forms of construction materials, before selecting the preliminary design which appears in the Book of Plans (Application Documents 2.1 to 2.18) and which is visualised in the Environmental Statement (Application Document 6.1). Generally, the preliminary design of many bridges is based on conventional composite steel beams and concrete deck forms but this does not preclude the use of other materials/forms being used at detailed design.

3.3.4. While the Project has sought to maintain flexibility for the final spans, forms and finishes of bridges and viaducts, it has also made commitments to their high quality design and common design language through the Project Design Principles (Application Document 7.5). Particular attention has been paid to project overbridges (see below) which will embody this design language and lend a common identity to the Project Route through materials and detailing. Project bridges will be required to use materials from the common material palette. These materials are yet to be finalised as they are subject to more detailed work on implications for construction, maintenance and operations. For example, whilst the use of weathering steel may remove painting requirements, its specification and use will be contingent on demonstrating its durability in the specific environmental conditions at each location.

3.3.5. At particularly sensitive locations and at key thresholds along the project route we have also designated some structures 'Project Enhanced Structures'. These have more detailed design requirements outlined in the Project Design Principles around their form and integration in the landscape. More information on each type of structure is given below.

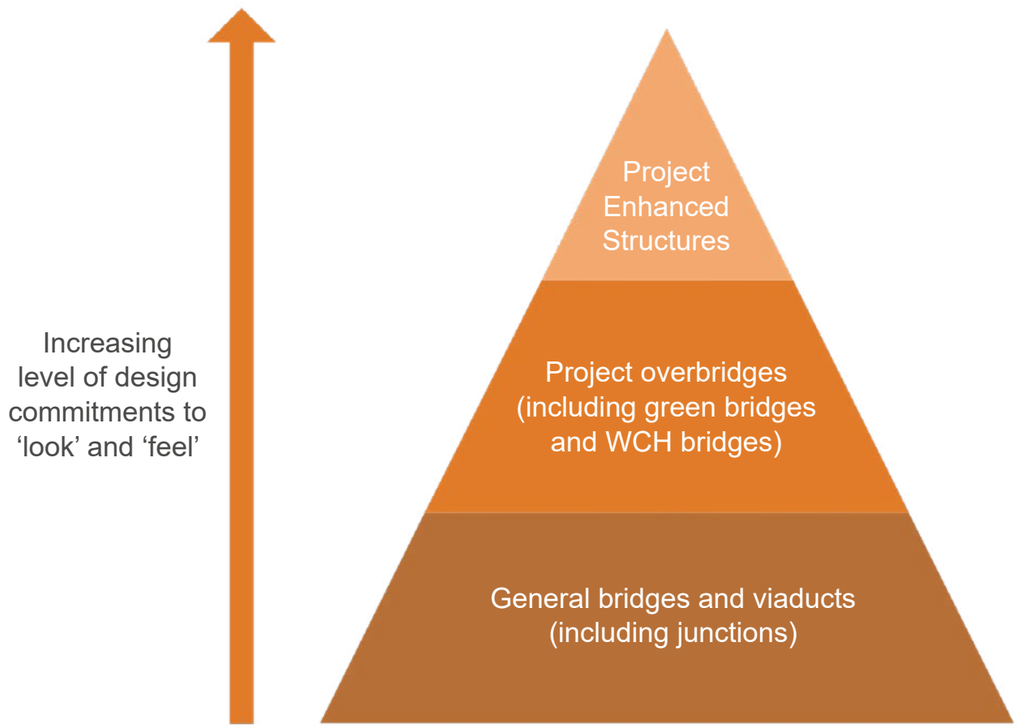


Diagram illustrating hierarchy of design commitments across different types of structures

3.3.6. Bridges and viaducts (excluding those in the junctions) along the Project route, as shown in the image on the right, include;

a. Project overbridges

b. Bridges for WCHs

c. Junction bridges and viaducts

d. Green bridges

e. Project enhanced structures

Structure Ref.		Structure Name	Type
BRN01	01	Brewers Road green bridge	Overbridge (Green)
BRN02	02	Thong Lane green bridge south	Overbridge (Green)
BRN14	14	Thong Lane green bridge north	Overbridge (Green)
BRN25	25	Tilbury Viaduct	Viaduct
BRN30	30	Muckingford Road green bridge	Overbridge (Green)
BRN31	31	Hoford Road green bridge	Overbridge (Green)
BRN32	32	Brentwood Road	Overbridge
BRN33	33	FP79 WCH bridge	Overbridge
BRN53	53	Rectory Road bridge	Overbridge
BRN59	59	Green Lane green bridge	Overbridge (Green)
BRN70	70	Orsett Fen viaduct	Viaduct
BRN71	71	Mardyke viaduct	Viaduct
BRN72	72	FP136 bridge	Overbridge
BRN73	73	North Road green bridge	Overbridge (Green)
BRN80	80	FP252 WCH bridge east	Footbridge
BRN82	82	FP252 WCH bridge west	Footbridge
BRN88	88	Thames Chase WCH bridge	Footbridge
BRN89	89	A127 WCH bridge east	Footbridge
BRN90	90	A127 WCH bridge west	Footbridge
BRN92	92	North Portal operational access bridge	Overbridge

Table 5–1. List of bridges, their structure reference and Type (grey shading indicates Project Enhanced Structure)

Table of bridges and viaducts (excluding those in the junctions), their structure reference and type (grey shading indicates Project Enhanced Structures)

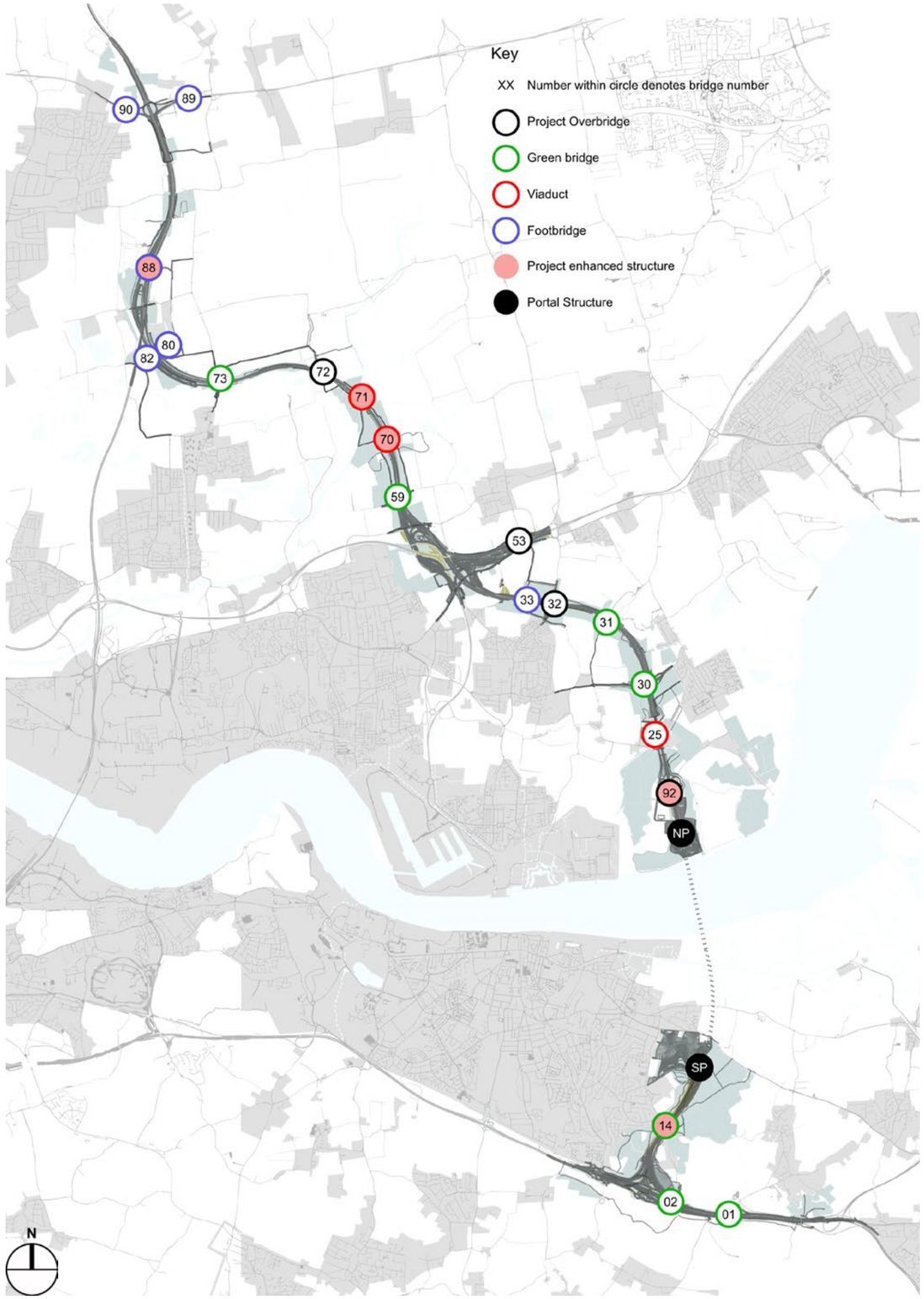


Diagram showing the location and type of project structures (bridges and viaducts, excluding those in the junctions)

3.3.7. Space allocation between parapets on the bridges has been carefully considered to meet the needs of multiple user groups and this will be developed further during detailed design. The different user types that may use these bridges include:

a. Walkers, cyclists and horse riders (WCHs)

b. Vehicles (road users)

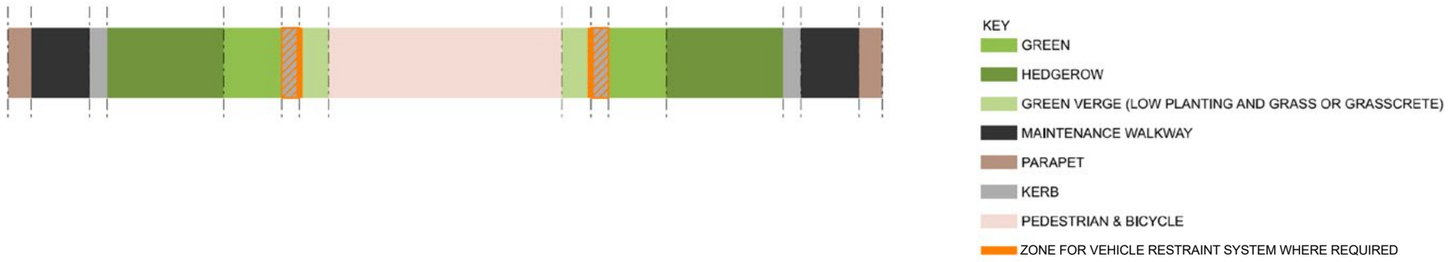
c. Vehicles (landowner)

d. Vehicles (maintenance)

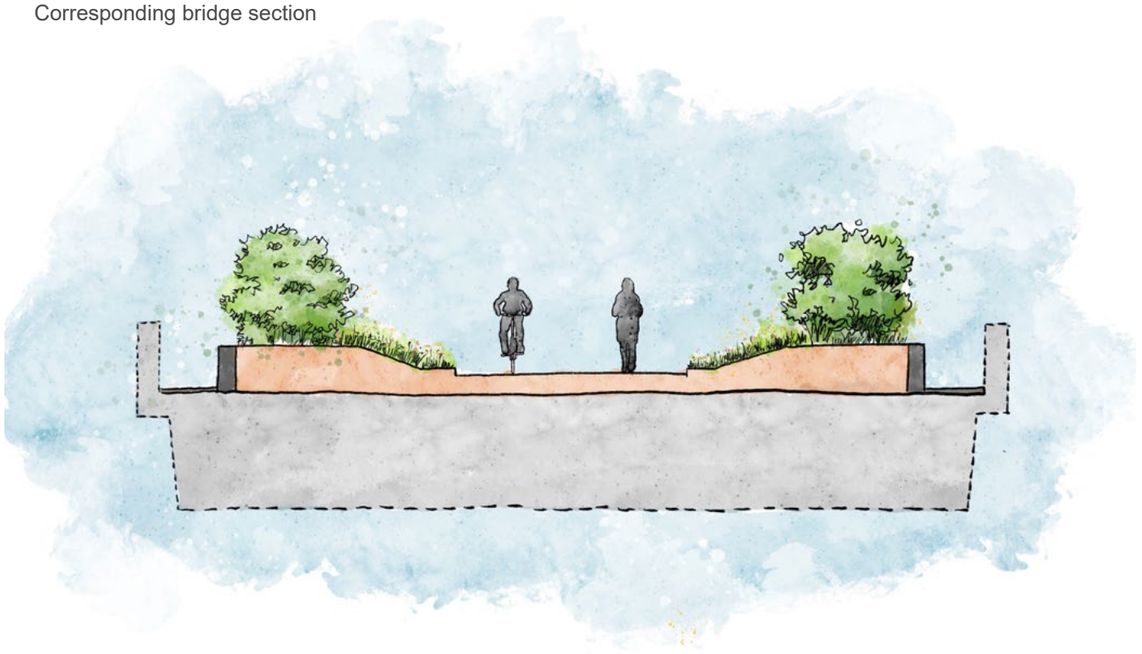
An example of how this space could be allocated is shown on the right.

3.3.8. Where appropriate, bridges have been designed with a dedicated allocation of space for WCHs, alongside vehicle users. Some of the bridges are for the exclusive use of WCHs. The cross sectional WCH widths have been reviewed against the relevant Design Manual for Roads and Bridges (DMRB) and reviewed against Local Transport Note (LTN) 1/20 Guidance (Department for Transport, 2020) and have widths appropriate for WCH routes.

Space allocation block diagram



Corresponding bridge section



Illustrative diagram showing an example of space allocation on a green bridge

Project overbridges

3.3.9. Project overbridges are located along the Project route and embody the common design language of the Project. They provide exemplar solutions for those living in the towns and villages close to them and those who use the landscape and routes for recreational purposes.

Bridges for WCHs

3.3.10. These specifically address the experience of walkers, cyclists and horse riders and reflect the cultural heritage of the area.

Junction bridges and viaducts

3.3.11. The form and requirements of structures in the junctions is highly bespoke and constrained by their scale, alignment, complexity, span and issues of constructability. At these locations there is also a blurring between the Project route as it interfaces with other strategic roads (A2, A13, M25). Therefore, the Project is adopting a more standard, yet flexible, approach to these structures where the focus should be on landscape and the greening of retaining wall structures to maximise the opportunity for net environmental gain and connectivity.

3.3.12. By their nature, viaducts are a significant engineered structure on the landscape. As a consequence, the design should be a high-quality design, aesthetic and integrate into the landscape, regardless of whether it is designated as a 'Project Enhanced Structure' or not (Tilbury Viaduct is one such example).

Illustrative view of a Project overbridge

Illustrative view of a WCH bridge

Illustrative view of junction bridges and viaducts

Green bridges

3.3.13. There are a number of bridge locations along the Project route where it is important to ensure connectivity of sensitive landscapes and habitats for animals such as bats, badgers and dormice, as well as mitigating landscape severance and providing an improved experience for WCHs. There are seven green bridges across the Project:

a. Brewers Road green bridge (Work No. 1D)

b. Thong Lane green bridge south (Work No. 1H)

c. Thong Lane green bridge north (Work No. 3B)

d. Muckingford Road green bridge (Work No. 6B)

e. Hoford Road green bridge (Work No. 6C)

f. Green Lane green bridge (Work No. 7M)

g. North Road green bridge (Work No. 8D)

3.3.14. These green bridges have been designed to reflect the existing local landscape character through the choice of planting species and materials used. Within the constraints of the DMRB, the character of existing roads, tracks and footpaths that lead up to these bridges has been used to inform the design.

3.3.15. At Hoford Road for example, the bridge design reflects its landscape and historical setting, by recreating the sunken character of the existing protected lane in the design of the route over the bridge.

3.3.16. Where bridges have multiple user types, and where physically practicable, the alignment of the road or footpath should be located to the outer edge of the bridge to maximise the area of adjacent landscaping whilst still providing a suitable connection. WCH routes across the bridge provide safe connections into the existing network, minimising crossing of traffic, whilst enhancing local footpath connectivity.

3.3.17. Further details on the preliminary structural design elements of green bridges can be found in this PDR, Section 5.1.

Bridges within the AONB

3.3.18. Bridges located within the rich landscape of the Kent Downs AONB will form a key gateway to the Project route from the south where the A2/M2 joins the alignment. The proposed structures and landscape between will also act together to perform as landmarks signalling entry through the Kent Downs AONB.

3.3.19. The structures also visibly demonstrate the provision of new areas of planting which embed the character of the AONB and will ensure connectivity of habitats. Feature planting on the bridges shall be visible on the horizon to reconnect the Kent Downs AONB visually and physically as drivers and their passengers approach.

3.3.20. The bridges located within the Kent Downs AONB will need to demonstrate an exceptional level of quality experienced by both users of the A2/M2 and those moving within the Kent Downs AONB which includes animals and WCH's.

Further details on the proposed preliminary landscape designs for green bridges can be found in Project Design Report Part D: General Design South of the River

Further details on the proposed preliminary landscape designs for green bridges can be found in Project Design Report Part D: General Design North of the River - Tilbury to the A13 Junction

Further details on the proposed preliminary landscape designs for green bridges can be found in Project Design Report Part D: General Design North of the River - North of the A13 Junction to the M25

Further details on the routes for WCH's, including the proposed preliminary designs and connectivity across green bridges, can be found in Project Design Report Part E: Design for Walkers Cyclists and Horse Riders

Illustrative aerial of Thong Lane green bridge north

Illustrative view on Thong Lane green bridge north

Illustrative aerial of Thong Lane green bridge south

Project Enhanced Structures

3.3.21. While the Project is committed to providing high quality design solutions for every structure across the Project, certain structures have been identified where the design and appearance of specific parts of the Project infrastructure is particularly important. This is due to the wider impact and connectivity benefits they have, not just for those using or looking at the structures, but within the surrounding landscape and environment. These are designated as Project Enhanced Structures.

3.3.22. The Project Enhanced Structures located along the route are:

a. The South Portal (including cutting, short tunnel approach ramp and retaining walls, and the Tunnel Service Building incorporated within the cut and cover tunnel structure) (Work No. 3C).

b. The North Portal (including tunnel approach ramp and retaining walls, and the Tunnel Service Building above the cut and cover tunnel structure) (Work No. 5A).

c. Thong Lane green bridge north (Work No. 3B)

d. North Portal operational access bridge (Work No. 5E)

e. Mardyke and Orsett Fen Viaducts (Work No. 8B)

f. Thames Chase WCH bridge (Work No. 9O)

3.3.23. These structures have the potential to enhance the aesthetic quality of the road, its relationship with the places it passes through and are integral to its function and the experience of all those that use it.

3.3.24. The location of Project Enhanced Bridges at the start and end of the route become landmark structures telling road users that they are on the main Project route. They also represent key moments for people crossing or living close to the route. Similarly, the Project Enhanced Portals mark the entrance and exit from the tunnel. All the structures should share a consistent design approach, materials (where relevant) and the requirements of which are captured in the ‘Structures’ section of the Project Design Principles (Application Document 7.5).

3.3.25. Some of these structures also restore previously broken links across the landscape or provide new recreational routes and therefore improve connectivity for those using them.

Illustrative view of the South Portal and Thong Lane green bridge north

Illustrative view of the North Portal and North Portal operational access bridge

Illustrative view of the Mardyke and Orsett Fen Viaducts

Illustrative view of the Thames Chase WCH bridge

4. Portals and tunnels

4.0.1. This section covers the Project portals and tunnels, along with associated service buildings. It outlines details of how topography, ground conditions, operation, and construction have shaped their form and location.

4.1. Introduction

4.1.1. The river crossing for the Project is achieved by twin bored tunnels approximately 4.25km in length, under the River Thames.

4.1.2. The tunnels and portals comprise the following elements:

a. An approach ramp, to the tunnels entrance

b. The tunnels portal (or tunnels entrance)

c. A cut and cover tunnels structure

d. A TSB integrated within the cut and cover tunnels structure

e. The tunnels headwall, where cut and cover tunnels structure transitions to bored tunnels structure

f. Twin bored running tunnels

4.1.3. The tunnels portals mark the transition from the external road environment to the tunnels environment under the River Thames. Their significance in the landscape makes them Project Enhanced Structures as their external appearance forms a substantial feature on the adjacent and surrounding landscape. It is therefore important that the integration of these large structures is carefully considered.

4.1.4. The portals comprise an approach ramp and associated retaining walls leading to the tunnels entrance, the first part of which is a cut and cover structure that has an integrated TSB. The TSBs contain provision for mechanical and electrical plant, control and welfare facilities, maintenance and emergency response/ incident activities.

4.1.5. The portals respond to the local landscape characteristics. Although the settings are very different, both portal designs share similar design aspects, such as materials, internal TSB arrangements and a common design feature at the transition to the tunnel.

4.1.6. The setting of the South Portal is chalk sloping farmland, where the approach ramp is in a deep cutting to achieve the required level before crossing the River Thames. The southern TSB is therefore one level below ground level, with the roof at the same level to the adjacent landscape.

4.1.7. The North Portal is located in predominantly flat marshland. Owing to existing ground conditions, the design is a long and linear arrangement, which transitions from the tunnels to grade level. It then rises on an earth embankment to the Tilbury Viaduct that crosses the Tilbury Loop railway line.

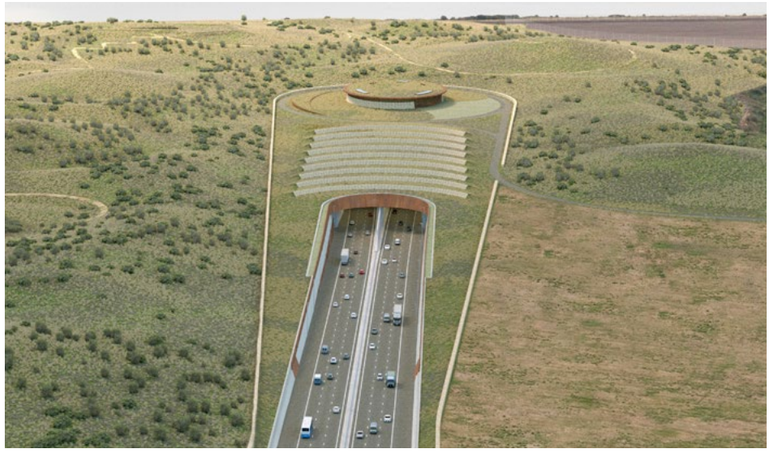
4.1.8. Both portals share a common design language with a ‘feature ribbon’, that has the appearance of weathering steel, forming a compound curve, marking the key threshold transition between the external environment and the running tunnels under the River Thames.

4.1.9. They also feature green/brown roofs, and gabion faced cladding (with locally sourced stone). The portal structures have been integrated into the surrounding landscape, using these common design features and material palette, which reduces the impact that these large civil engineered structures will have on the landscape.

The appearance and integration of the portals in the landscape since preferred route announcement (PRA) can be found in Project Design Report G: Design Evolution

Illustrative visual of the tunnels

South Portal



North Portal

4.2. Engineering and operational requirements

4.2.1. The Project proposals include twin bored tunnels approximately 4.25km in length, with a cut and cover section of tunnels and an open ramp section at either end. The tunnels portals are the locations where the open ramp meets the cut and cover tunnel. A TSB has been located above the cut and cover section of tunnels at either end.

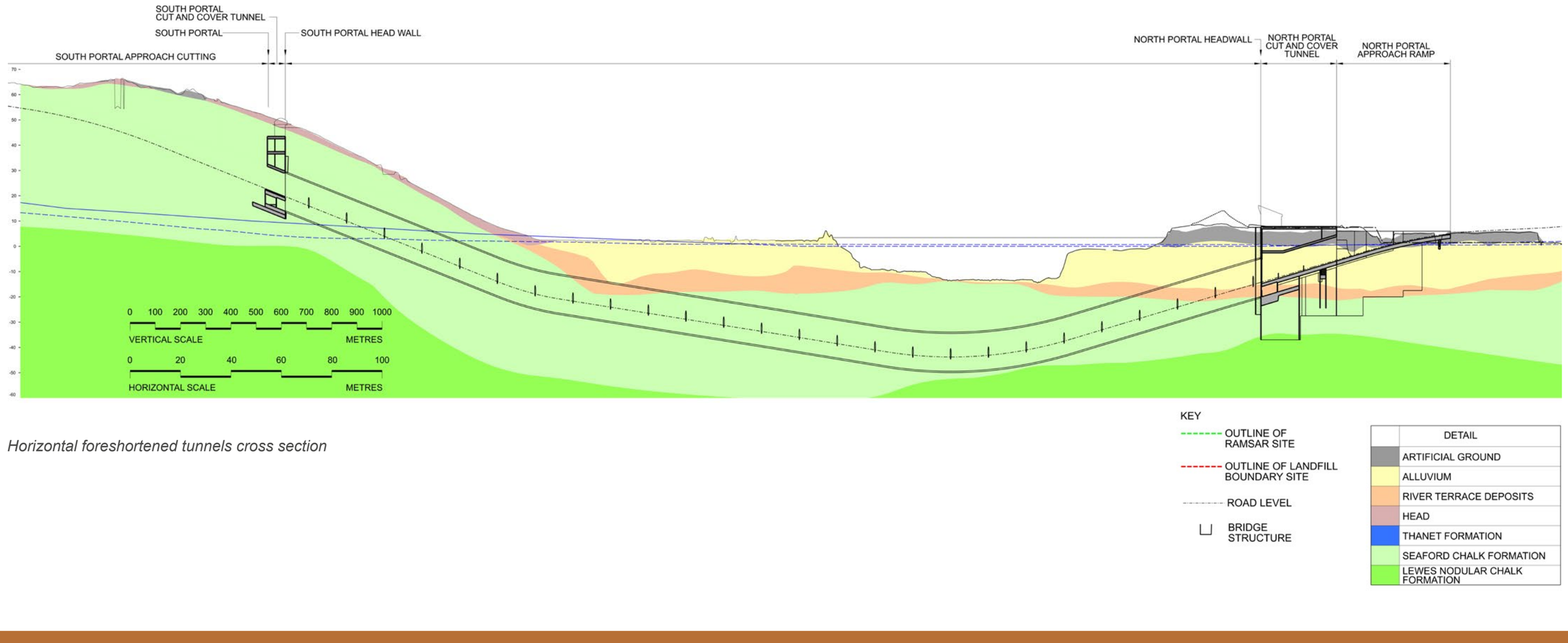
4.2.2. The size of each of the twin tunnels has been designed to accommodate three lanes of traffic, and the external diameter of each tunnel bore is approximately 16.4m with a maximum road gradient of 4% within the tunnel. The twin bores would typically be spaced at between 0.5 and 1 times tunnel diameter.

4.2.3. Cross-passages connecting each tunnel have been designed for emergency evacuation, emergency incident responder access as well as maintenance works. Connecting cross-passages are provided between the tunnel bores at approximately 150m centres, subject to standards and consultation with emergency responders.

4.2.4. The size of the proposed tunnel bore has enough headroom to accommodate all vehicles capable of using the normal road network, therefore it is not necessary to provide for over height vehicle detection systems or mitigation for re-routing oversized vehicles.

4.2.5. The design includes stop barriers provided on the approach to both tunnels, with space provided in the central reserve for vehicles to be turned around onto the opposing carriageway in the event of an unplanned tunnels closure. Emergency vehicle and maintenance vehicle access is provided from the local road network to the TSBs located at either end of the tunnel, and from these buildings to the carriageway in both directions.

4.2.6. For further information on the limits of deviation (LOD's) please refer to the Tunnel Limits of Deviation Plans (Application Document 2.15).



Horizontal foreshortened tunnels cross section

4.3. Tunnel Service Building operational scope

4.3.1. The TSBs ultimately service the running tunnels ensuring they can operate and be maintained safely throughout their life cycle. The operational accommodation within both north and south TSBs contains provision for either (or both) to be developed as the main functioning control facility.

4.3.2. The internal arrangement of mechanical and electrical plant rooms has been developed in conjunction with the MEPH requirements with spatial provision to allow the greatest degree of flexibility with the internal arrangement during the next detailed design stage. The design has largely been based on the Design Manual for Roads and Bridges (DMRB) standard BD 78/99 Chapter 12 'Tunnel service buildings and plant rooms' (now superseded by CD 352). Vehicle parking for several service and incident vehicles has been provided externally.

4.3.3. Provision for operational team welfare, equipment, and fuel storage has also been considered. Provision has also been made to include operational space for plant and operatives to maintain the tunnels. Provision for vertical access for maintenance operatives, service and equipment to the technical galleries (including the sump pump below the highway) have been provided by stairs, lift and access shafts.

4.3.4. The operational criteria, shown to the right, was used in developing the preliminary design:

4.3.5. The criteria (working assumption) illustrates 6-15 persons over 3 x 8-hour shifts (24 hours / 7 days, all year), with up to 40 persons at any one time if in 'Emergency Operation' mode. Maintenance operation would be scheduled at different times, depending on the maintenance regime required, so broadly agreed that the total number of operatives at the TSB would not exceed 40 persons at any one time.

4.3.6. As the operational scope develops during the detailed design stage, it is important that all maintenance and operational structures are considered within the context of the adjacent landscape surrounding the portal (in particular, the 'Maintenance Operation' mode activities identified above); which should also include compliance with the Project Design Principles.

Normal Operation	No. Ops.
Vehicle Recovery	2
Traffic Offices	2
Incident Support	2
Tunnel Maintenance	5
Motorway Maintenance	3
Security	1
Total	**15**

Normal Ops Total **15**

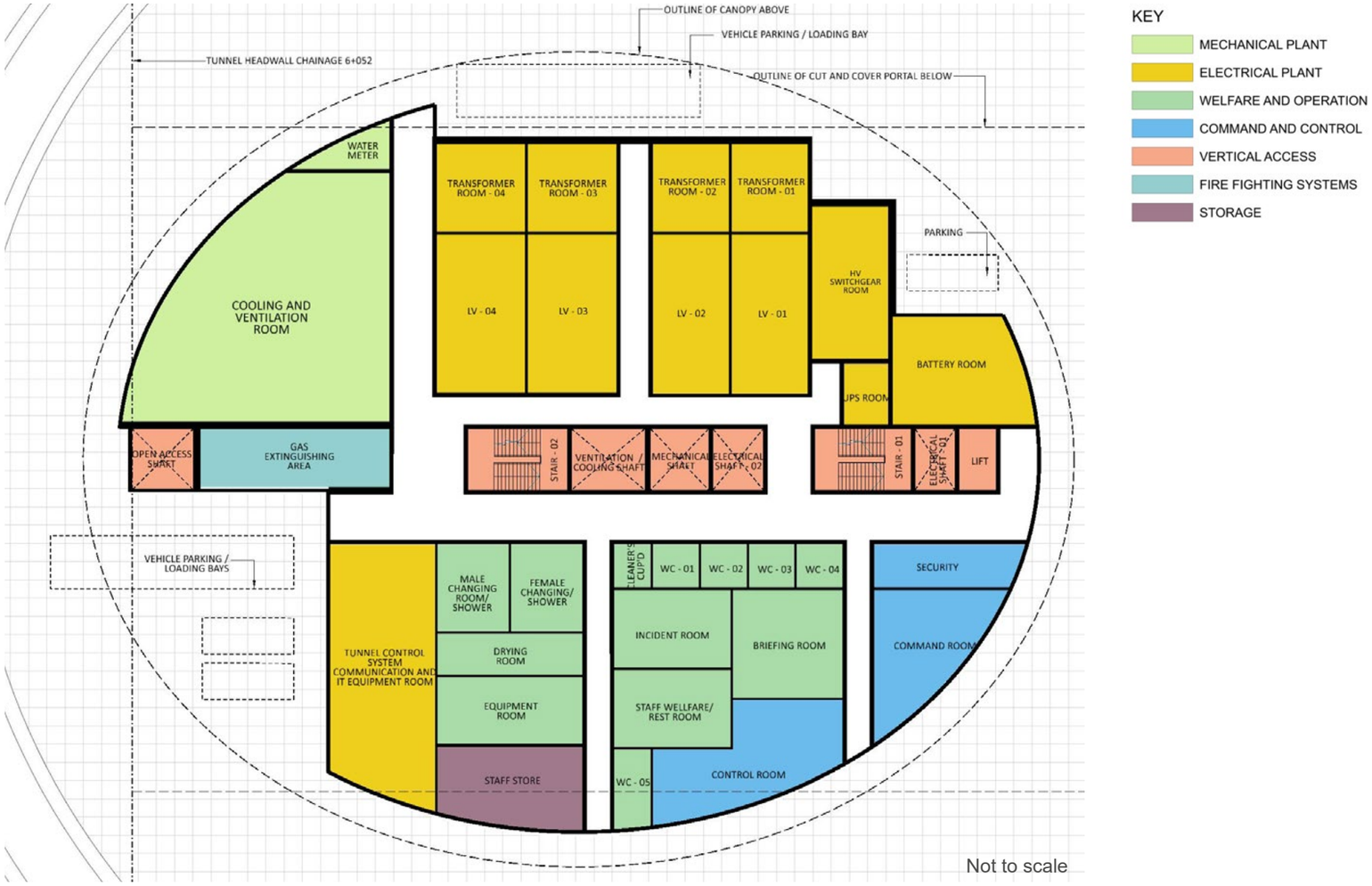
Emergency Operation	
Control Room	2
Fire	4
Ambulance	4
Police	4
Traffic Officers	4
Support Staff	5
Total	**23**

Normal + Emergency 38

*Allow for **40 persons** at anytime

Maintenance Operation	
Sub-Contractors	
Additional Maintainers	
Sub-Contract	
Wall Washing	
Ventilation	
Linework	
Comms Network	
Signs / Signals	
TECM	
AQMs	
Roads	
Total	**50**

The TSB operational criteria



Proposed North Portal TSB surface level plan

4.4. Southern tunnels entrance

Preliminary Design: South Portal and TSB

4.4.1. The South Portal site is located within an area of land that slopes from the A2 to A226 (Gravesend Road), and down to the marshes on the south bank of the River Thames. The location is within a context of large fields of open chalk arable farmland, a rolling topography with smaller dry valleys running down the slope. Older roads crossing the site are often sunken and lined by hedgerows.

4.4.2. Between the small village of Thong (on Thong Lane) and St Mary's Church, Chalk on the A226, the portal site opens up to the exposed suburban edges of Gravesend to the west and Shorne Woods Country Park to the east. The position within a new cutting, on a former airfield (Gravesend Airport) located on high ground with expansive views, forms a potential vantage point to the South Portal and River Thames beyond.

4.4.3. The South Portal TSB location is set by the portal head wall and tunnels aperture which have been sited south of the A226 (Gravesend Road), currently a local golf course and farmland. The South Portal head wall is located approximately 350m south of the A226, which ensures the cutting for construction remains above the ground water table in order to safeguard the Ramsar wetland site.

4.4.4. The portal is located close to the peak of a hill that falls away to the north, consequently the cutting approaching the portal is deep to allow the highway to descend to the required level to cross beneath the River Thames while adhering to the standards on gradient. This allows the form and profile of the cuttings to create a seamless transition between the M2/A2/A122 Lower Thames Crossing Junction and the South Portal.

4.4.5. The proposed cutting leading from Thong Lane green bridge north to the portal aperture and access road is a series of stepped earth embankments, exposing the white chalk running parallel to the surrounding landscape. These engineered slopes leading to the TSB gently taper away at approximately 30-degrees from the access road and highway rising to ground level, maintaining a sense of light and openness. The exposed chalk material provides a sense of place for the road user, creating an identifying moment along the Project route.

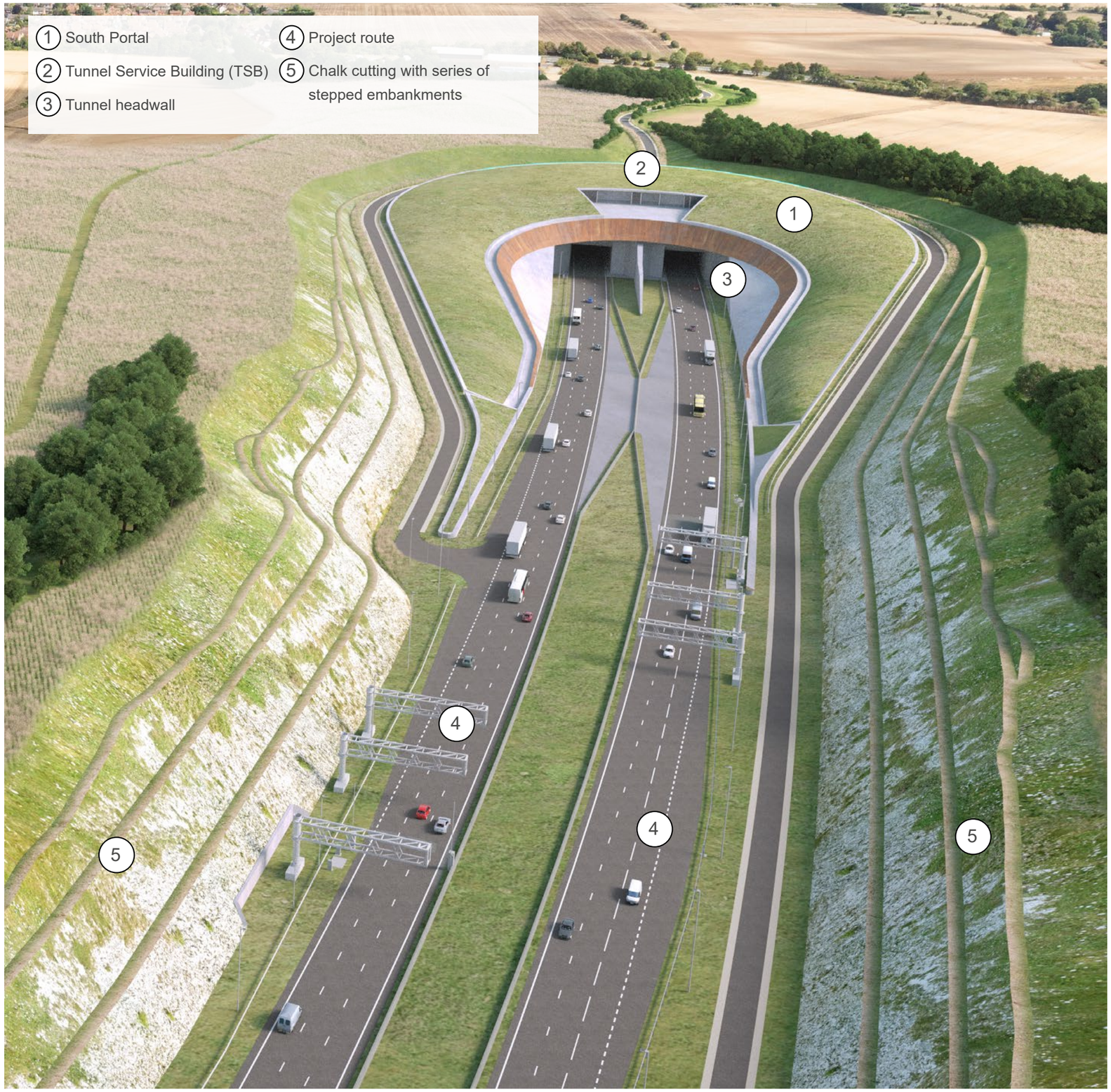
South Portal location

4.4.6. In the immediate vicinity of the South Portal, the cutting flattens out into a broader bowl. This modulation serves two functions. Firstly, it provides the width to incorporate the access roads (at acceptable gradients) and to include the TSB within the cutting. Secondly, the gentler contours are more in keeping with the rolling hill character of the area, an approach strengthened by the rounded contours of the earth-bunded TSB.

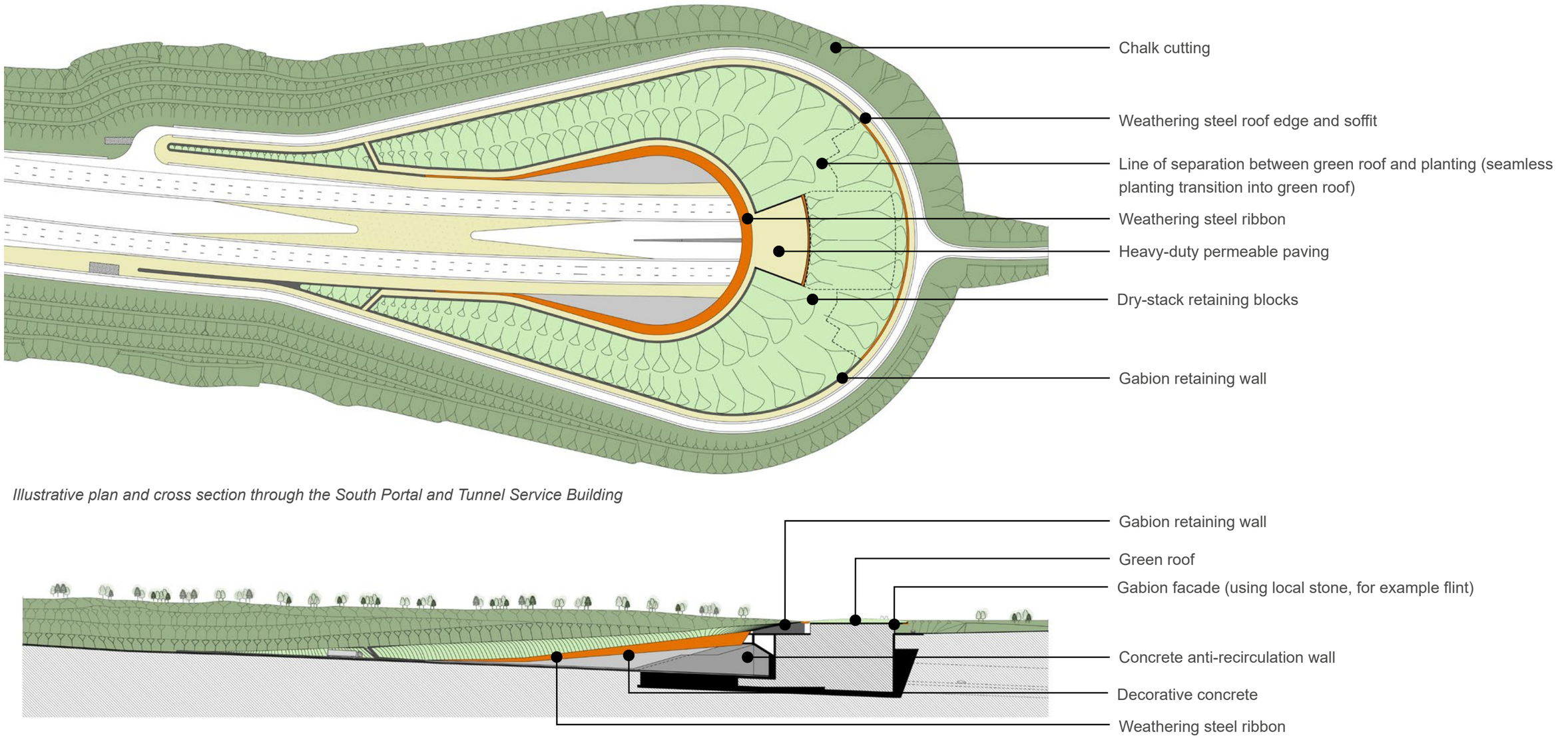
4.4.7. The portal structure is contained within the cutting, concealing it from the wider landscape; the top few metres of cutting faces are graded back to allow establishment of grassland to prevent visually exposed edges impacting views across this landscape. Beneath these views, and within the cutting, the well-defined engineered slopes integrate with the portal aperture to form a ribbon, with the appearance of weathering steel, announcing the portal entrance threshold before it transitions into the running tunnels.

4.4.8. Concrete walls taper from full height (approximately 16m) at the tunnels entrance over a length of approximately 60m to the highway level. The finish of these structural concrete retaining walls should be consistent along the entire length. Setting out of formwork and associated bolt holes, should be carefully considered to achieve a regularised pattern. Construction joints also need to be carefully planned as does the consistency of concrete batches. Consistency of appearance in terms of colour and overall surface texture should take precedence.

4.4.9. Dry-stack retaining blocks are proposed to create a double-curvature form between the highway, concrete retaining wall and the feature ribbon. Gabion walls (filled with locally sourced stone) are proposed to frame the feature ribbon and provide an access maintenance walkway with permeable paving.



Illustrative view of the South Portal and features



Illustrative plan and cross section through the South Portal and Tunnel Service Building

Example of chalk cutting

Example of green roof

Example of permeable paving

Example of earth sheltered structure

Example of weathering steel

Example of dry-stack retaining blocks

South Portal materials

4.4.10. To retain open views across the landscape north of Thong Lane, the South Portal TSB has been arranged over two levels and the roof level is consistent with the surrounding topography, reducing the visual impact of the engineered structures and fully integrating the TSB within the surrounding landscape. To provide natural screening to operational activity at the TSB, the entry level of the building and access road is set at approximately 6m below the adjacent grade.

4.4.11. The main portal control room within the TSB faces south giving the possibility of providing external aspects overlooking the highway with an associated maintenance walkway and cantilevered roof structure. Other staff accommodation and welfare facilities have been sited to take advantage of this southern aspect.

4.4.12. To promote the conservation and enhancement of the natural, built and historical environment, gabions (filled with locally sourced stone) are used as an external surface feature to enclose the external walls, with integrated access and maintenance doors and louvres as required. An extensive green/ brown roof is established with species rich grassland, to blend into the surrounding landscape and combined with the gabions to further promote biodiversity and maximise opportunity for net environmental gain. The roof eaves and edge framing the grassland green roof are formed in the same material as the ‘feature ribbon’. This has the appearance of weathering steel, in common with the tunnels aperture and Project Enhanced Structures.

4.4.13. To create a quality aesthetic experience for the user and wider community these materials and components are common to both portals and contribute to a common design language, not just at the portals but across the Project as a whole.

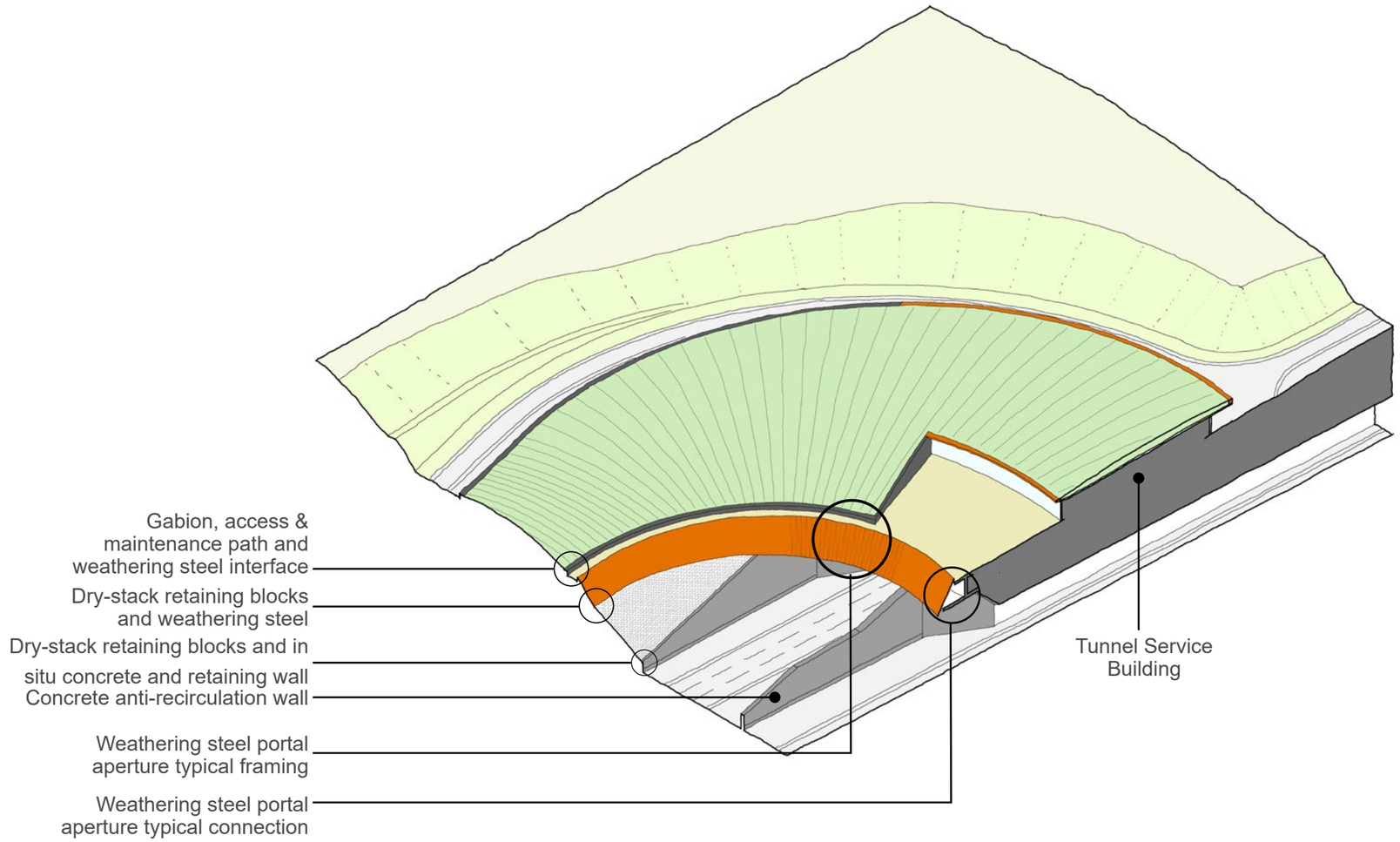


Illustration of the South Portal and Tunnel Service Building

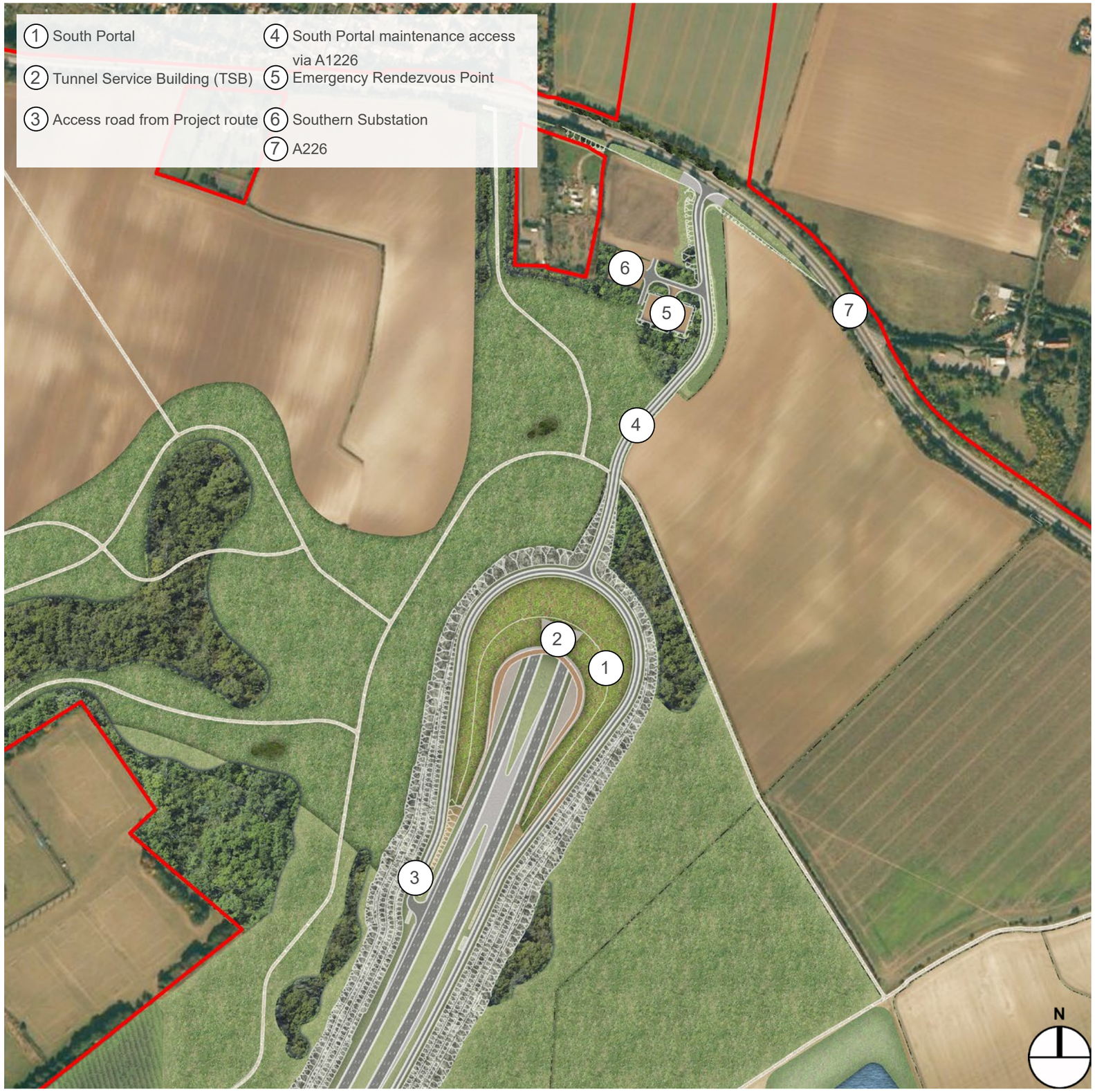
South Portal access

4.4.14. Sunken out of view and enabling resilience in operation, access is provided from both sides of the Project access road that wraps around the TSB with vehicle access at the north end connecting to the A226 (Gravesend Road). Hostile-vehicle mitigation bollards have been proposed in front of the TSB, adjacent to the road leading directly from the A226.

4.4.15. Access control barriers have also been proposed along the access road. The deep cutting enables the route and associated traffic and infrastructure (signage gantries and lighting columns) to be concealed in views across the landscape. Security fencing is set slightly below the top of cutting so as to be concealed from the wider landscape.

South Portal maintenance access

4.4.16. The A226 (Gravesend Road) to the north of the portal TSB provides direct access; additional access is also provided via access road off the Project route, leading to the new M2/A2/A122 Lower Thames Crossing junction. External parking has been provided for a variety of vehicles (depending on operational requirements).



Preliminary design of the South Portal and access

Preliminary Design: southern substation and Emergency Rendezvous Point (RVP)

4.4.17. A new substation is to be provided off the portal access road, south of the A226 and behind some existing agricultural farm sheds. This provides safe access from the A226 (via the portal access road) and only requires a short additional road to access the substation. There is an existing earth bund built on the farmland immediately behind the agricultural sheds with a cutting providing direct farm access to the fields. The substation fits between this access cutting and an adjacent line of densely planted trees. To further reduce visual impact from the surrounding landscape, additional earth bunds around the substation compound have been designed to a height of 2–3m using 1:4 slopes, allowing for the additional planting of woodland on the earth bunds.

4.4.18. An Emergency Services Rendezvous Point (RVP) has been identified adjacent to the southern substation, directly off the South Portal access road from the A226. This has been based on the current working assumption of 50 x 35m. Earth bunding and woodland planting have been designed around the site to mitigate the visual impact and integrate the compound into the surrounding landscape.

South substation and RVP maintenance access

4.4.19. Access to the substation and RVP is directly off the portal access road from the A226 (Gravesend Road). The substation access road crosses an adjacent farm access to the nearby fields.

Illustrative plan showing the proposed south substation and RVP

4.5. Northern tunnels entrance

Preliminary Design: North Portal and TSB

4.5.1. The North Portal and TSB will be located within the setting of Tilbury Marshes, a predominantly flat landscape of low lying, drained marshlands on the north bank of the River Thames. The site, also the location for the proposed park, Tilbury Fields, is within an area significantly affected by previous and ongoing landfill and spoil placement, creating flat-topped areas elevated several metres above the natural level. The ongoing landfill and spoil placement works form not only a constraint on the portal location but also impacts on constructability of the portal and its interface with the neighbouring artificial landscape.

4.5.2. The retention of the flat, open landscape character between the railway and river is a key consideration in the design of the portal and its landscape setting. The TSB has been integrated into the portal, arranged within a single level building over the cut and cover box which provides a mainly at grade (+7.83m above ordnance datum (AOD)) building set above future flood level. It is located to the north of the tunnels headwall and has also been set above flood levels to comply with DMRB standards. The location also allows for a greater distance between the running tunnels and facilitates provision, where a suitable width access core leads to the technical gallery level below (the operational highway level).

4.5.3. Proposals aim to be multi-functional, resilient, and sustainable, (e.g. use of low carbon technologies etc.) allowing for future adaptation of updated technical requirements.

North Portal location


1 North Portal
2 Tunnel Service Building (TSB)
3 Project route
4 North Portal operational access bridge
5 Emergency Services Rendezvous Point
1
2
3
4
5

Illustrative plan and cross section through the North Portal and TSB


Example of a gabion facade


Example of a gabion facade


Example of flint stone


Example of a gabion retaining wall


Example of a gabion retaining wall


Example of a gabion retaining wall


Example of concrete


Example of patterned concrete

North Portal materials

4.5.4. Structural in situ concrete walls forming the cutting which lead to the portal have been designed at a minimal height (5.96m AOD), with the adjacent earth land forms tapering away to maintain a sense of open and light space. These integrate with the portal aperture forming a ribbon, with the appearance of weathering steel, which marks the entrance of the portal structure before transitioning to the running tunnels. A gabion wall is proposed to frame the feature steel ribbon and provide an access maintenance walkway surfaced with permeable paving. Gabion walls are further used to frame the boundary on the cut and cover tunnels structure between the tunnels aperture feature ribbon and access road around the TSB.

4.5.5. The approach ramp walls are a substantial feature in scale, ranging from 1.0m high at the top of the ramp to 12m high, at the bottom of the ramp, over a length of 450m. The finish of these in-situ structural concrete retaining walls should be consistent along the entire length. Setting out of formwork and associated bolt holes, finishes and texture should be carefully considered to achieve a regularised pattern. Construction joints also need to be carefully planned as does the consistency of concrete batches. Consistency of appearance in terms of colour and overall surface texture should take precedence.

4.5.6. The proposed TSB has been designed at grade (+7.83m AOD) and also one level below grade, utilising the cut and cover tunnels structure for the storage of water and associated mechanical plant. Elliptical in form, approximately 54 x 65m, it forms a substantial built feature within the landscape, not too dissimilar in scale than the adjacent historic forts.

4.5.7. The elliptical roof supports an extensive brown/green roof, slightly rising in the middle creating a gesture within the landscape, the form of which compliments the adjacent proposed landforms. The roof eaves, fascia and edge framing the roof are formed in the same material that has the appearance of weathering steel as the feature ‘ribbon’ as over the tunnels aperture.

4.5.8. The proposed Tilbury landforms will act as a boundary marked by a gabion wall at low-level along the perimeter of the portal and approach ramp walls, providing a controlled and managed interface with the surrounding landscape.

4.5.9. This gabion wall is a logical juncture to integrate a security fence, providing a secure enclosure to the portal with access gates (across the access road). Careful consideration is required in terms of form, colour, pattern, and materials (for example weathering steel, as used elsewhere). The design of the fence should be set below the line of sight, using the landforms to conceal it from the wider landscape to retain the contrast between the proposed landforms and the engineered portal structure.

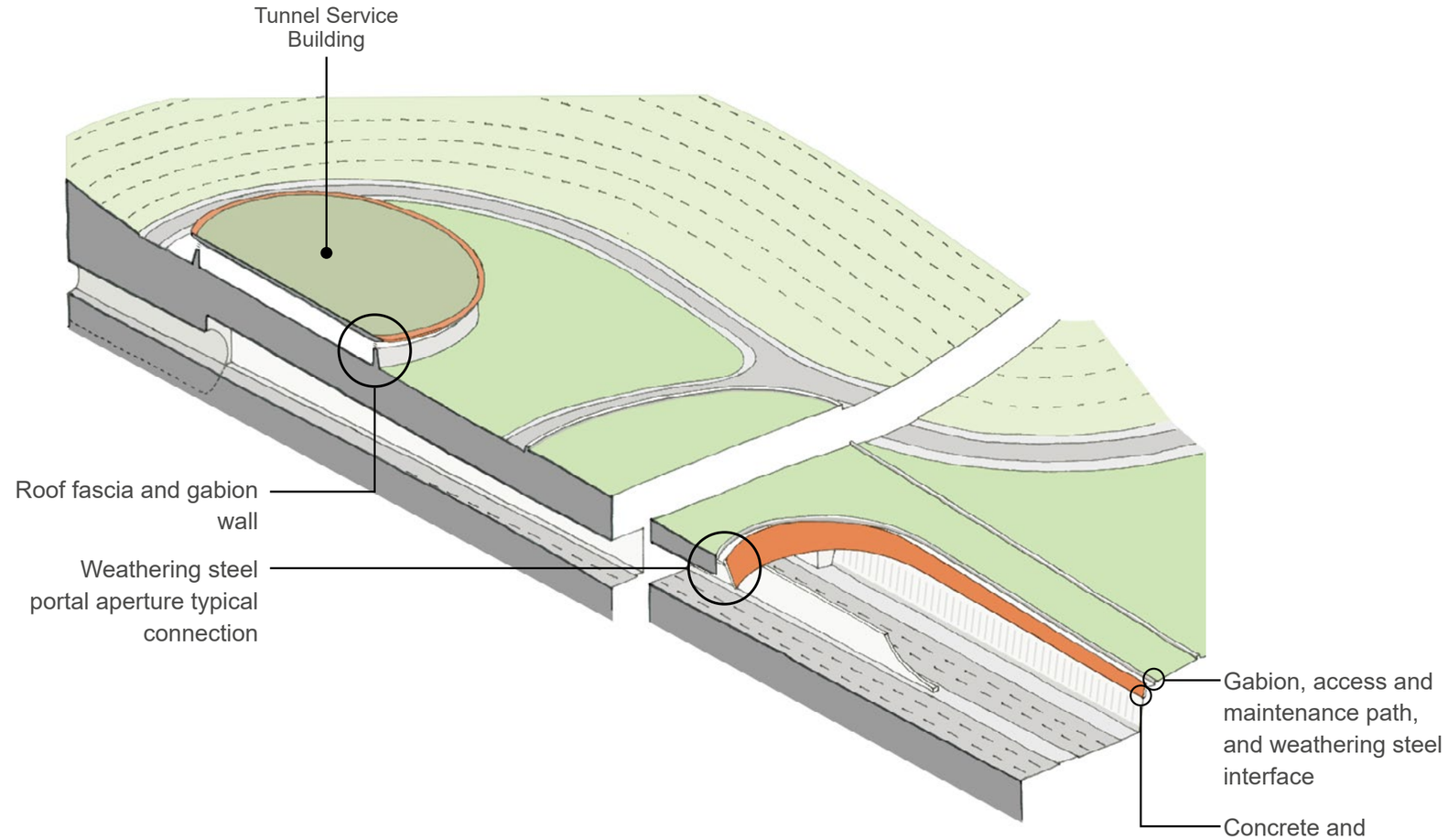


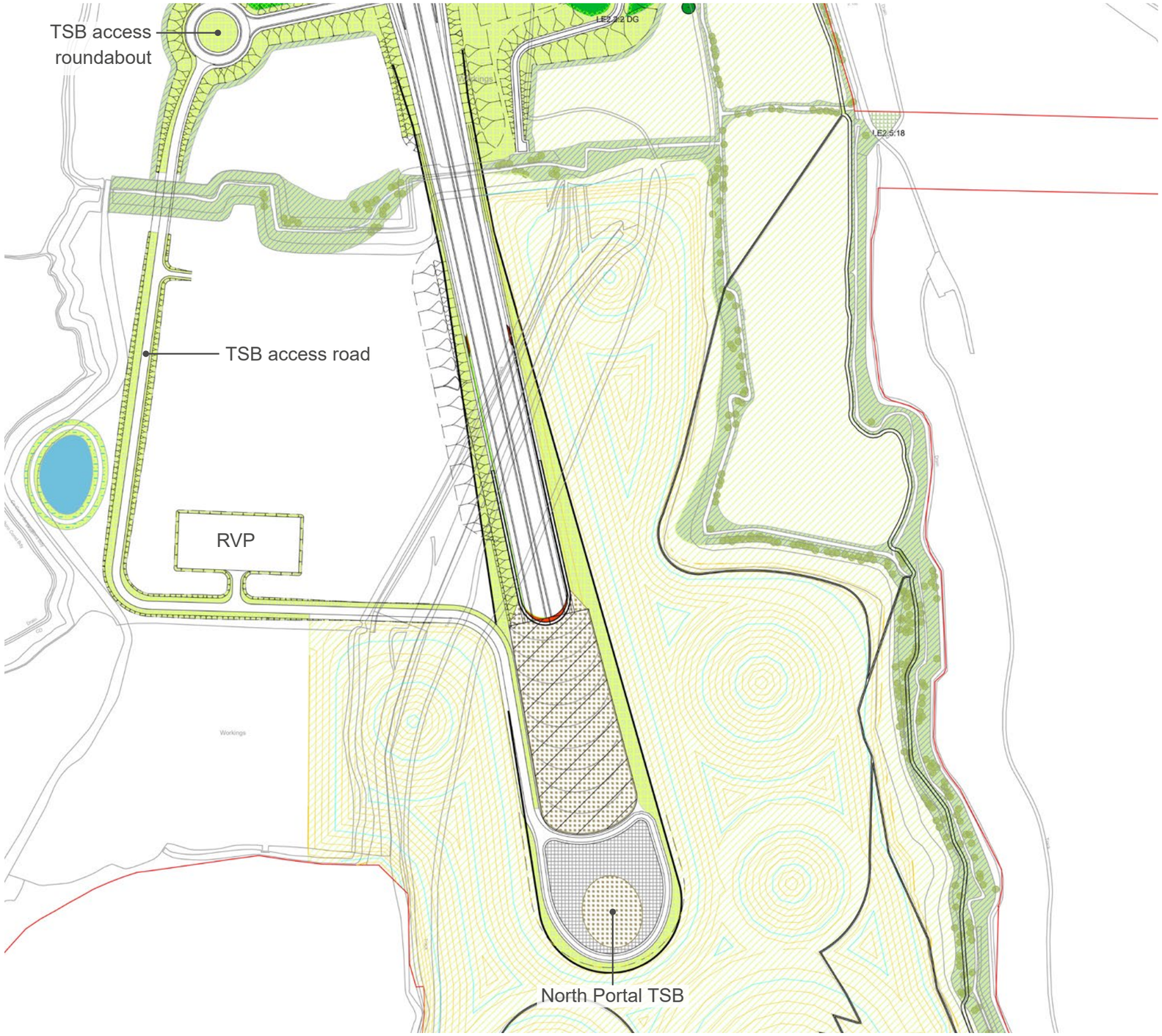
Illustration of the North Portal and Tunnel Service Building

North Portal maintenance access

4.5.10. Access to the TSB for emergency vehicles is via the proposed North Portal operational bridge (see Section 5.2 of this document) across the Project route (between the portal culvert and the Tilbury Viaduct). It has direct access via north and south on-slips provided and two roundabouts, with integrated drainage retention ponds, for vehicle turning. Local access is provided by a single access road from the operational bridge roundabout to Station Road to the north, leading to West Tilbury, Chadwell St Mary and the A1089. This local access is constrained by the Tilbury Loop railway line, being only one of three roads crossing the railway (between the two forts), all having level crossings. For this reason, the most expedient vehicle access should be considered from the Project route. External parking has been provided for a variety of vehicles (depending on operational requirements).

Emergency Services Rendezvous Point (RVP)

4.5.11. An RVP has been identified on the North Portal access road, re-utilising a temporary construction phase substation foundation, approximately 110 x 50m (the current working assumption is 50 x 35m). This is located where the access road turns from east-west to north-south.



Preliminary design of the North Portal access and RVP

4.6. Preliminary Design response summary to the 10 Principles of Good Design

4.6.1. Some examples of how the proposed design of the Portals and associated TSBs respond to the 10 Principles of Good Design are described below:

Is inclusive

4.6.2. The inclusion of WCH routes adjacent to the portal structures offers beneficial access to open space around the tunnels infrastructure. In the south, the WCH routes create a looping route, linking East Gravesend to Thong and Claylane Wood along with Shorne Woods Country Park. In the north, the proposed Tilbury Fields provides new WCH routes from the park entrance at Station Road that run alongside the North Portal, offering views and vistas from the proposed landforms leading to Two Forts Way and the River Thames.

Fits in context

4.6.3. The portal structures and TSBs have been designed to sit contextually within the landscape. The South Portal structure and TSB have been set one level below the existing ground level, such that the extensive green roof is level with the existing adjacent landscape. The North Portal has been designed on a single level, as a restrained elliptical formed building, clad in locally sourced stone with an extensive green/ brown roof of the same species planting mix as the adjacent fields.

Is restrained

4.6.4. The portals have been designed to integrate with the surrounding landscape design as far as technically practicable. The above-ground structures and external building footprint have been kept to a minimal footprint, so as not to dominate the landscape.

Is environmentally sustainable

4.6.5. The portals and associated TSBs have been integrated into the surrounding landscape using a restrained material palette reflective of the local character area (e.g. gabions with locally sourced stone, weathering steel, dry stack retaining walls that allow plant propagation and establishment over time). Both have green/brown roofs, to establish the same adjacent planting mixes, helping to promote environmental net gain and biodiversity.

Is long lasting

4.6.6. The portals and TSBs have been designed to a 120 year design life. Proposed materials have been selected based on longevity, low maintenance and ‘self-finishing’ (e.g. weathering steel). Green/brown roofs have been conceived as self-maintaining, only relying on natural rainfall and seasonal conditions once established.

5. Bridges & viaducts

5.0.1. The overall bridge strategy is described in Section 3.3.

5.0.2. Key considerations that have influenced the preliminary designs of bridges include:

a. Creation of a relevant, recognisable and positive experience for users

b. Minimise loss of existing trees and maximise new opportunities for areas of planting

c. Reconnect severed habitat and woodland

d. Ensure that the local landscape character is retained

Illustrative aerial view of Thong Lane green bridge north

5.1. Project bridges

Green bridges

5.1.1. Roads running through the landscape provide connectivity for humans but are barriers to wildlife searching for food, shelter and mates. The use of crossing structures can enhance habitat connectivity and help animal movements. They provide safer solutions that reduce the risk of collisions with motorists by directing animals away from the carriageway, therefore reducing traffic mortality rates.

5.1.2. Factors affecting the effectiveness of bridge structures, such as crossings for animals, include:

a. Placement

b. Noise levels

c. Light levels

d. Vegetative cover

e. Moisture

f. Temperature

g. Time

h. Human disturbances.

5.1.3. The human use of wildlife crossing structures and human activities near the crossing structures can also reduce animal use.

5.1.4. However, there is a balance to be considered which is dependent on location, as full separation can also lead to neglect or abuse. To be effective at each location, consultation with relevant authorities ensure crossing proposals are appropriate to their context.

5.1.5. Of the structures proposed, seven bridges have been identified as green bridges:

a. Brewers Road green bridge (Work No. 1D)

b. Thong Lane green bridge south (Work No 1H)

c. Thong Lane green bridge north (Work No. 3B)

d. Muckingford Road green bridge (Work No. 6B)

e. Hoford Road green bridge (Work No. 6C)

f. Green Lane green bridge (Work No. 7M)

g. North Road green bridge (Work No. 8D)

5.1.6. Green bridges also provide other benefits which include:

a. Reduction of surface water runoff.

b. Carbon separation and storage.

c. Greater ecological connectivity across urban regenerated sites.

d. Increased biodiversity.

e. Increased quality and quantity of green and blue infrastructure.

f. Improved air quality.

g. Increased accessibility to green open spaces.

h. Wildlife can thrive on and within the land surrounding green bridges.

i. Improved health and wellbeing of those using them.

j. Increased positive experience of those using the Project route.

k. Increased asset lifespan by giving it value for those using green bridges throughout the bridges lifespan.

l. Enhanced built environment.

m. Emphasised sense of place and enhanced local aesthetic.

Additional considerations for structures within the AONB

Brewers Road green bridge

5.1.7. Brewers Road green bridge replaces an existing bridge crossing over the A2. It is located between Shorne Woods Country Park and Brewers Wood in the north and Cobham and Ashenbank Woods in the south. Running parallel to the south of the A2 is the High Speed 1 (HS1) rail line and there is a separate bridge structure that crosses this line.

5.1.8. The extents of this green bridge have been developed in response to the landscape context. It is designed to provide the maximum benefit to landscape connectivity, reconnecting woodlands within the Kent Downs AONB. Its location on the site of the existing bridge removes the need for changes to the alignment of Brewers Road and enables the new and old to merge before the bridge reaches HS1. This also minimises any associated landscape and vegetation impacts.

5.1.9. A vegetated zone is proposed on the eastern side of the bridge which provides a safer route for small mammals crossing the bridge between woodlands in the north and Cobham Hall and Cobham Hall golf course in the south, across the HS1 bridge. The width of the green zone has been defined by the ability to successfully integrate into the landscape before HS1 in the south-east corner, yet still provides reasonable habitat connectivity. A small badger underpass is provided immediately to the north of the bridge to allow animals to cross Brewers Road and then use the green bridge. The proposal also includes badger fencing which is used to direct the animals to this underpass.

5.1.10. A green zone on the western side of the bridge was considered, however this would direct animals into an island surrounded by Brewers Road, HS1, A2 slip road and the A2, which would result in animals having a high chance of mortality. However, a narrow strip of green, with a hedgerow, has still been provided on this side of the bridge to screen the road for users of the bridge and provide a visual connection between opposing wooded landscapes on either side of the A2.

5.1.11. Options to carry a WCH route over the HS1 structure were explored and found to require disproportionate structural works. As a result, it is proposed that the WCH route narrows and merges with the existing verge, which has been upgraded along its length, to where the route heads east towards Cobham Hall.

5.1.12. The overall increase in width of the A2/M2 Corridor has been kept to a minimum as far as technically practicable. This has been achieved by utilising the existing space of the A2 median between the existing carriageways. However, with the required additional slip roads, this results in a slightly increased width to the south and narrow reservations for structural elements of the bridges, and associated road restraint systems, for the highway.

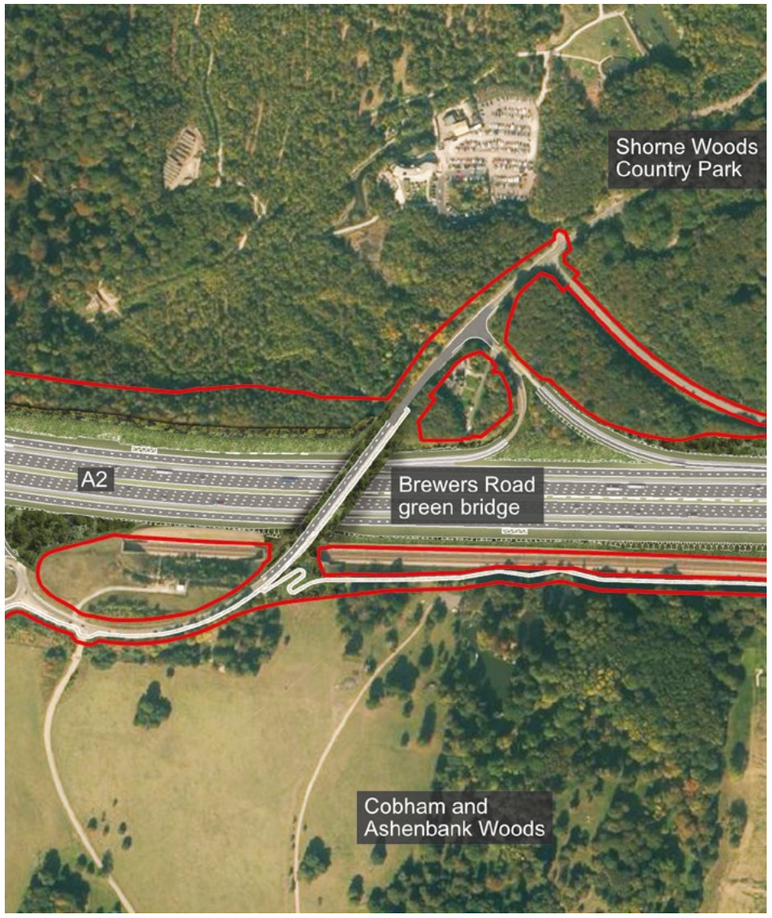
5.1.13. Existing retaining walls along the A2, supporting areas of woodland, lie directly adjacent to the existing bridge abutments. In the Preliminary Design, these are modified to accommodate the new bridge. The removal of the existing bridges and construction of the proposed bridge structure is required whilst the A2 remains operational.

5.1.14. HS1 runs parallel to the south of the A2 in a cutting. While Brewers Road green bridge crosses both the A2 and HS1, the separate and independent bridge structure over the railway line is a significant constraint. The Preliminary Design has sought to reduce the impact on the existing HS1 bridge structure and as a result, the operational railway. The new bridge structures have been designed to be independent of the HS1 bridge, with supports installed up to the edge of the A2 where the existing pier is currently located. The tie-in of the road, paths and landscape is designed to use these new structures rather than any of the existing structures for support.

5.1.15. The Preliminary Design also includes maintenance access steps to the north abutment on the eastern side. These are integrated into the abutments and the existing modified retaining wall, which is to be visually consistent with the Project-wide abutment design.

Further details on the proposed preliminary landscape design can be found in Project Design Report Part D: General Design South of the River

Further details on the routes for WCH's, including the proposed preliminary designs and connectivity across green bridges, can be found in Project Design Report Part E: Design for Walkers Cyclists and Horse Riders



Brewers Road location

Thong Lane green bridge south

5.1.16. Thong Lane green bridge south replaces an existing bridge which currently crosses the A2, on the boundary of the AONB. In order to accommodate additional slip roads required to form the M2/A2/A122 Lower Thames Crossing Junction, the proposals include widening of the A2 corridor near the junction. This affects the existing Thong Lane bridge and consequently a longer replacement bridge (Thong Lane green bridge south) is required. It is designated as a green bridge to provide continuity of vegetation and habitat. It also forms an important link between the village of Thong and Shorne Woods Country Park in the north, across the A2, through to Ashenbank Wood and onto Jeskyns Community Woodland in the south.

5.1.17. Thong Lane and the existing bridge are aligned diagonally across the A2. The proposal includes the realignment of Thong Lane to run perpendicular to the A2. This realignment begins north of the Inn on the Lake hotel, whose access road will consequently be realigned. However, the structure has been designed to keep the level of the road as low as reasonably practicable to reduce any impact on the existing landscape in the north. In the south, Thong Lane will terminate at a new connector road running parallel to the A2. This connector road will link Thong Lane to crossings of HS1 at Halfpence roundabout and Scotland Lane (byway NS195).

5.1.18. The Preliminary Design for the new bridge provides routes for WCHs and is part of the Darnley Trail. Scalers Hill Stables is to the south and horse riders would use this bridge to get to Shorne Woods Country Park, as would cyclists using realigned National Cycle Route (NCR) 177.

5.1.19. The location of the vegetated zone on the bridge has been driven by the connectivity of the landscape from Gravelhill Wood, north-west of the bridge, to Jeskyns Community Woodland, south-west of the bridge. The proposal requires a small wildlife underpass to allow wildlife to move safely to the south of Thong Lane, then to the green bridge over HS1 and onto Jeskyns Community Woodland. This avoids them being funnelled into an island created by A2 junction slip roads. The bridge design includes a hedgerow to the eastern side to prevent views down onto the A2 by WCHs on the bridge and provide visual connectivity of woodland for users of the A2.

5.1.20. The introduction of the new slip roads to the south of the existing A2 alignment reduces the space between the road and HS1. Consequently, retaining walls and the bridge abutment will line the southern side of the A2. The limited space available at the south abutment results in a requirement for a vertical retaining wall which extends along the elevation to the roundabouts to the east and west. Flared parapets are proposed to improve the connectivity of green onto the island between the M2/A2/A122 Lower Thames Crossing Junction slip road and A2, which continue along the head of the retaining wall to the existing roundabout in the east.

5.1.21. At the north end of the bridge, the design proposes stepped retaining walls on the western side which taper down to integrate the structure and the vegetation on the bridge with the landscape. On the east, the site is constrained by the existing access road to the Inn on the Lake. The differences in level between this access road, the bridge and the A2 are significant within a small area, therefore a retaining wall is proposed parallel to Thong Lane. The bridge parapet continues along the road to provide a safe edge for WCHs using the footpath.

Further details on the proposed preliminary landscape design can be found in Project Design Report Part D: General Design South of the River

Further details on the routes for WCH's, including the proposed preliminary designs and connectivity across green bridges, can be found in Project Design Report Part E: Design for Walkers Cyclists and Horse Riders

Thong Lane green bridge south

Appearance

5.1.22. The constraints in the existing landforms and the aspiration to minimise disruption to the adjacent woodland requires forms for both Brewers Road green bridge and Thong Lane green bridge south that respond to the local context.

5.1.23. The design includes a variation in soil depths to allow the creation of rich and diverse planting, including small trees and shrubs, along the length of the bridge. This provides connectivity of habitats and woodland and increases the wooded character across the corridor as experienced by users of the A2. This is also enhanced by the design of the parapets, which are designed like a balustrade, in order to show vegetation behind the parapet and increase transparency and connection between the opposing areas of woodland. This design feature is only used on these two bridges which sets them apart from other green bridges on the Project.

5.1.24. The bridges along the A2 are also longer than those on the Project route and as such, require a different approach to the structural design. The bridge deck has been designed to be supported on bearings rather than integrated into the piers and as a result have a different visual appearance and maintenance requirements.

5.1.25. The narrow reservation widths of the proposed A2 do not allow for separate road restraint systems to be installed at the outer pier locations at Brewers Road green bridge. This may result in the piers being more solid in appearance to comply with safety standards.

Barriers and retaining walls

5.1.26. At both Thong Lane and Brewers Road green bridges, there are steep existing and proposed retaining walls immediately adjacent to the bridges. Although it would be preferable to provide retaining structures that integrate a growing medium, which provides more visible green and mitigates against biodiversity loss, it would be difficult to establish vegetation in the north facing elevations.

5.1.27. There are a number of retaining walls and acoustic screens required along the A2/M2 Corridor, many of which interface with other structures, such as bridges. Where practicable, barriers and retaining walls have been combined to provide an integrated solution.

Illustrative aerial view of Thong Lane green bridge south

5.2. Project Enhanced Structures – bridges and viaducts

Introduction

5.2.1. The overall design strategy for Project Enhanced Structures is described in Section 3.3 of this document

5.2.2. Project Enhanced Structures (including the portals as discussed in Section 4 of this document) represent key moments along the proposed Project route. The proposed Thong Lane green bridge north and the Thames Chase WCH bridge are proposed new structures at the most southerly and northerly end of the Project route respectively, and 'bookend' the route for vehicle users.

5.2.3. The Project Enhanced Structures – bridges and viaducts include:

a. Thong Lane green bridge north (Work No. 3B)

b. North Portal operational access bridge (Work No. 5E)

c. Mardyke and Orsett Fen Viaducts (Work No. 8B)

d. Thames Chase WCH bridge (Work No. 9O)

Illustrative view of the South Portal and Thong Lane green bridge north

Illustrative view of the North Portal and North Portal operational access bridge

Illustrative view of the Mardyke and Orsett Fen viaducts

Illustrative view of the Thames Chase WCH bridge

Thong Lane green bridge north

5.2.4. Thong Lane green bridge north is located south of the South Portal and replaces a stretch of country lane linking Gravesend to the village of Thong, a Conservation Area. While many of the existing roads in the area are sunken and lined with hedgerows, Thong Lane is not. It is on a former airfield site (Gravesend Airport) and therefore is on higher ground with expansive views, which form a potential vantage point to the proposed South Portal and River Thames beyond.

5.2.5. Key considerations that have influenced the bridge design include:

a. Located on the South Portal approach, the design should form a relevant and recognisable experience for users exiting or joining the Project route.

b. The proposed bridge and the cutting leading to the South Portal should be designed with one consistent design approach and aesthetic.

c. The Preliminary Design should enhance the character of the country lane that forms the approach to the adjacent Conservation Area.

d. The Preliminary Design should form a positive experience for WCHs using the bridge.

e. It should minimise loss of natural habitat and trees whilst maximising opportunities for new areas of planting.

f. It should reconnect habitat and woodland severed by the Project.

g. To integrate engineering solutions with landscape proposals in a way that ensures this bridge and its approaches are treated as a sensitive part of a landscape context driven masterplan.

5.2.6. The Project route crosses Thong Lane between the urban eastern edge of Gravesend at Riverview Park and the village of Thong. At this location, the Project route is set within a new cutting, approximately 10 or 11m below ground level as it leads towards the tunnels portal. Consequently, a new bridge at ground level is required to allow Thong Lane to continue across the Project route.

Thong Lane green bridge north location

5.2.7. This new bridge requires a design approach which is appropriate to its setting, adjacent to a Conservation Area and the Kent Downs AONB. It is also the first independent structure experienced by users accessing the Project route from the south and therefore forms a gateway to the South Portal and signifies the start of the Project route. It is designed to have a common design language with the South Portal, whereby the material used to give the appearance of weathering steel in the 'feature ribbon' of the South Portal is reflected in the sweeping steel parapet on the bridge.

5.2.8. The bridge has been designed as a wide green bridge and provides an important visual and physical connection of woodland between Shorne Woods Country Park on the east and Claylane Woods on the west and is intrinsic to the wider strategy for the M2/A2/A122 Lower Thames Crossing Junction.

5.2.9. As part of the proposed WCH strategy Thong Lane green bridge north forms a connecting feature of two new looping walks and cycle routes, as well as a significant point on the new connections between the A2 and A226. As part of these improvements to WCH connectivity, WCH routes will cross Thong Lane green bridge north to both north and south of Thong Lane. Rather than run parallel and adjacent to the highway, these routes will meander through the green spaces on the bridge, separated from both Thong Lane and the parapet by planting. This helps to reduce awareness of the Project below and creates a sense of separation from Thong Lane. The bridge is also part of an important WCH link from Riverview Park to both Shorne Woods Country Park and Jeskyns Community Woodland, therefore the experience of crossing the bridge has been designed to be consistent with moving through woodland. These routes have been designed to be integrated within the bridge design.

5.2.10. Although Thong Lane crosses the Project alignment at an angle, the bridge has been orientated perpendicular to the cutting to provide a more efficient structure, reducing span lengths and therefore structural depths. The location of the bridge has been defined by the reconnection of Thong Lane, the location of technology structures on the Project route and the overhead high voltage powerline diversions.

5.2.11. However, Thong Lane retains its existing diagonal route across the structure. The width of vegetation at the south-east of the bridge has been designed to be a minimum of 20m to ensure that habitat connectivity through the south of the bridge is maintained.

Illustrative view from Riverview Park towards Thong Lane green bridge north

Illustrative view from Thong towards Thong Lane green bridge north

Abutments

5.2.12. The Project route in this area is formed within a new cutting that deepens from the A2 junction towards the South Portal exposing the undulating rolling chalk hill topography.

5.2.13. With the bridge approximately 10–11m above the proposed Project road level (road surface to bridge surface), traditional abutments would be both abrupt and over dominate the new exposed chalk landscape. Therefore, structural abutments have been designed to embrace this new landscape character and be integrated and hidden within the stepped cutting form which stretches north from the M2/A2/A122 Lower Thames Crossing Junction to the South Portal. The design was developed with the intention that there would be no exposed concrete abutments and that the exposed cutting runs beneath the bridge, resulting in a contextually responsive design.

Beams, deck and parapet

5.2.14. Piers, beams, deck, parapet and landscape interfaces have been designed together to provide a better holistic solution and avoid abrupt transitions between different structural elements. This, combined with the local context and user experience have been considered together to achieve a better outcome in terms of visual impact.

Illustrative aerial view of Thong Lane green bridge north

Illustrative visual of Thong Lane green bridge over the Project route from the perspective of users on the Project route

North Portal operational access bridge

5.2.15. The North Portal operational access bridge marks the threshold to the northern tunnels entrance as well as the entrance to Tilbury, Essex and beyond. It has a similar relationship to the North Portal and tunnels that Thong Lane green bridge north has to the South Portal, ‘bookending’ the subterranean crossing under the River Thames.

5.2.16. It is also important that the material palette and design language read as one with the North Portal.

5.2.17. As this will be one of the highest built structures within the environment, careful consideration will be required as to the development of structural form and how the design integrates within the proposed Tilbury Fields landscape.

5.2.18. As shown in the illustrative views, the proposed design has sought to integrate the structure into the surrounding landscape by inclusion of stepped gabion terraces.

Illustrative views of the North Portal operational access bridge

Mardyke & Orsett Fen Viaducts

5.2.19. The Mardyke and Orsett Fen Viaducts represent a key moment along the Project as the route crosses through a fenland landscape. The structures in this location will be distinct linear elements above a flat open landscape and will require a contextually led design response to allow views out to the wider landscape for both road users and WCHs. These views out to the surrounding higher landscape help retain the character of the fenland.

5.2.20. These structures demonstrate sensitivity to the landscape, heritage and local community context, whilst seeking to enhance the place they connect while being true to structural necessities.

5.2.21. The following issues have also influenced the design:

a. Preservation of wide open views

b. Endeavouring to ensure the structure is not detrimental to the existing landscape character and ensuring a balance between the span and deck thickness.

c. Not impeding open landscape desire lines

d. Not impeding existing agricultural access

e. Not impeding existing WCH access

f. Reducing impact on (fenland) flood resilience, typically minimising foundation footprint

5.2.22. The Project route continues north from Green Lane green bridge through the Orsett/Mardyke Fen, spanning four water bodies, two of which are considered by the Environment Agency to be main rivers. The first and more significant is the Mardyke, the second is the Golden Bridge Sewer, a field drainage ditch that flows into the Mardyke immediately to the south of the Project route. The geometry of these two converging water bodies is a major constraint to the structural setting out of the viaduct.

5.2.23. Parallel to the Mardyke on the eastern side, is bridleway BR219 also known as the Mardyke trail. This follows the course of the Mardyke from Bulphan Fen to the M25. The requirement to provide adequate headroom where the viaduct crosses the bridleway is a constraint. Similarly, to the south of the viaduct there is a requirement for clearance to allow farm vehicles, including combine harvesters, to pass beneath.

5.2.24. The preservation of open views from BR219 that prioritise continuity of landscape is important. Equally, the user experience looking along the length of the viaduct from beneath and the rhythm and form of the viaduct have been given consideration, through the setting out and type of structure.

5.2.25. The Mardyke and Orsett Fen Viaducts have been designed as a series of elegant arches that span the flat fenland landscape between embankments. The setting out of these haunched structural supports for the viaducts will allow the structure to span the Mardyke, BR219 and the Golden Bridge Sewer without the need for diversions or level changes. To this end, the Preliminary Design of the southern end of the viaducts proposes two longer spans in the middle and equal shorter spans at either end where the viaduct meets the embankments. This reduces the impact on the fenland and flood resilience by requiring fewer points of contact with the ground. At the northern section of the viaducts, it is proposed there are equal spans.

Illustrative view of the Mardyke Viaduct

Abutments

5.2.26. The abutment structures can be disruptive to the continuation and perspective of the landscape, therefore the design of the abutments are proposed to include integrated solutions where landscape is prioritised.

5.2.27. It is proposed that the design of abutments incorporate a series of structures and terracing rather than a single tall wall, that could increase the urbanising effect. The terracing of walls can also create additional areas of planting to help soften the appearance of the viaducts by blending them into the surrounding landscape. It also maximises opportunity for environmental net gain.

5.2.28. Where access is required from viaduct level to a maintenance gallery it is proposed that it is integrated into the abutment designs so that it forms part of the landscape and is not a visually prominent feature.

Pier, beam and deck structure

5.2.29. A haunched solution is proposed, as this offers the opportunity for greater spans being achieved. While other structural options can span this distance, the structural depth required to achieve this would be considerably greater than that at the centre of the haunched equivalent. This would restrict headroom available over the WCH routes, maintenance access tracks and restrict farm vehicles crossing beneath the viaducts.

5.2.30. At the northern end of the structure, this solution offers the opportunity for the use of long spans that allows the support structure to be located clear of the two watercourses and bridleway, without adversely impinging on the bridleway headroom.

5.2.31. A crucial part of the landscape character is the long open views across flat farmland to distant hills and it is important that the viaduct design preserves these views. Due to the reduced structural depth in mid-span and the lower number of supports the haunched solution requires, there is less to obstruct the view through the viaduct when seen from a perpendicular view point.

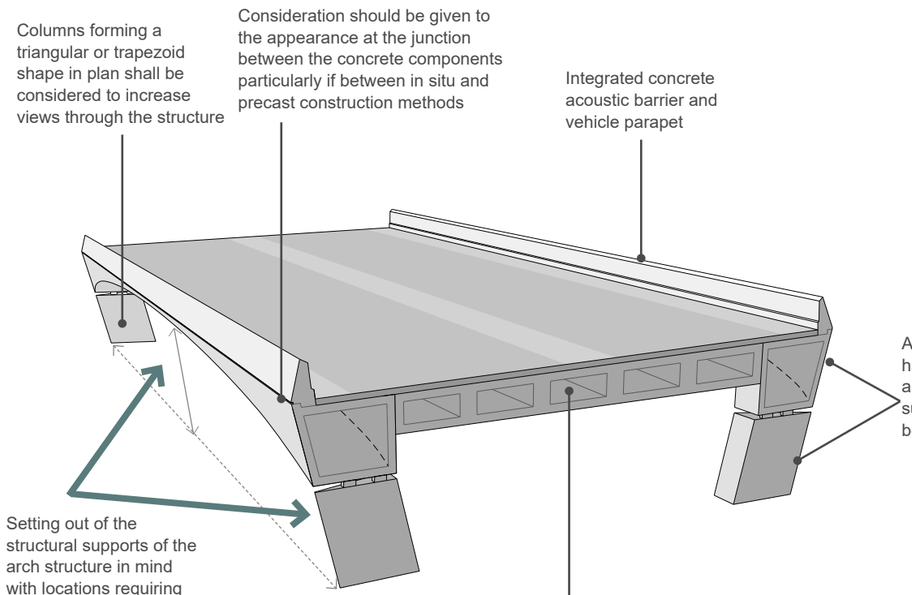
5.2.32. By using a pair of haunched primary beams with a shorter spanning transverse structure, the vertical supports and secondary structure maximise views at an oblique angle.

Barriers

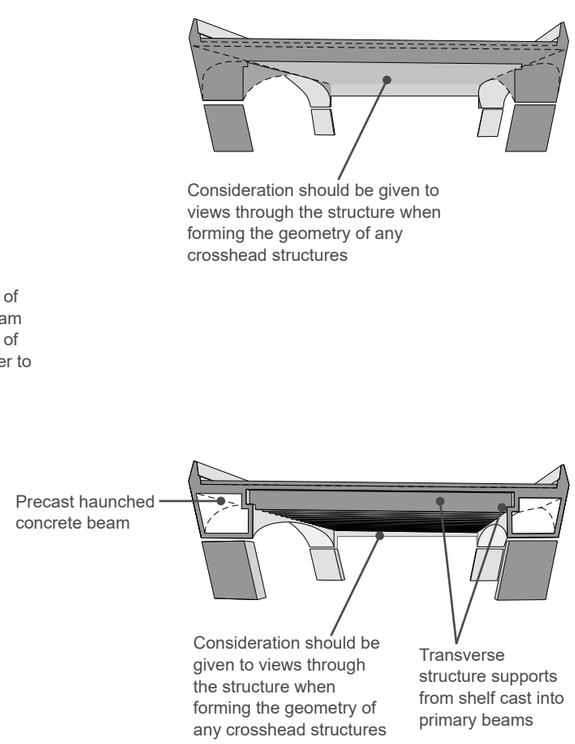
5.2.33. An acoustic barrier is required along the length of the viaducts. It is proposed that this is combined with the vehicular parapet (barrier to the edge of the bridge incorporating the road restraint system), to reduce the overall width of the bridge.

5.2.34. The internal face has been designed to have a profile of the tried and tested concrete vehicle restraint system (VRS), whilst the external face is a bespoke textured finish.

5.2.35. The name of the viaducts will be graphically represented in the finished material of the outer face of the parapet, to promote a sense of place for WCHs as they approach.



Illustrative architectural concept sketch



Illustrative solution utilising a more rationalised precast component structure

Thames Chase WCH bridge

5.2.36. Thames Chase Forest Centre is divided into two halves by the M25. Access between these two land parcels is via a culvert beneath the M25, at the north of the site. Access to this culvert is difficult for pedestrians and impossible for cyclists and horse riders. The culvert is being lengthened by the creation of new lanes for the Project, prompting Thames Chase Trust to request a new crossing. The resultant Thames Chase WCH bridge, located at the south of the site, provides a more accessible connection between the two halves of Thames Chase Forest Centre and supplements the existing access. It will also provide a visual link for users and increase their awareness of the whole area of the Thames Chase Forest Centre.

5.2.37. The key considerations that have influenced the design of the Thames Chase WCH Bridge are:

a. To provide a visually unobtrusive WCH bridge across the M25 by limiting the visual depth and the size of support members

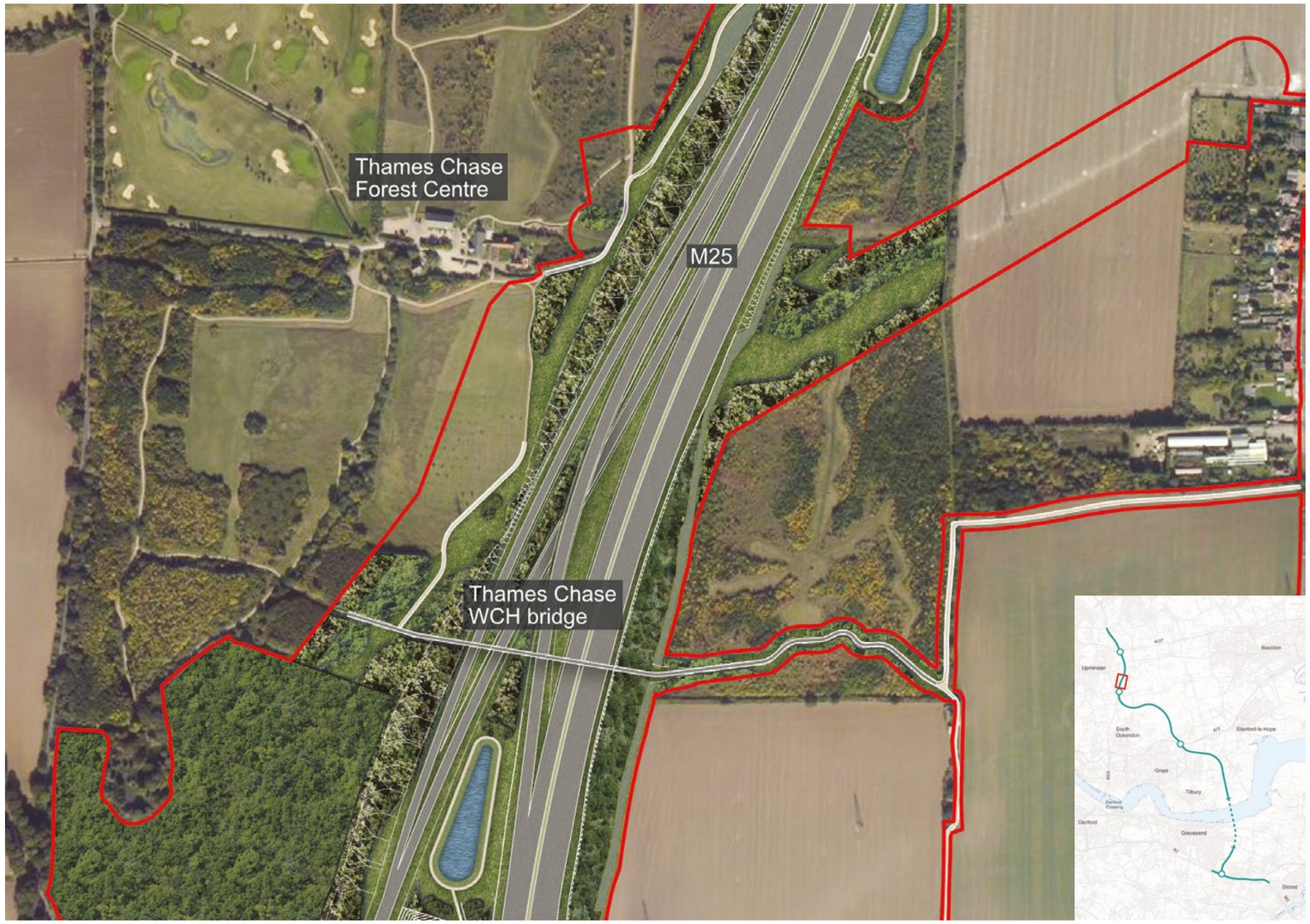
b. To provide a crossing that is appropriate to the woodland context

c. To provide a safe and pleasant crossing environment that helps shield the bridge users from the road noise below

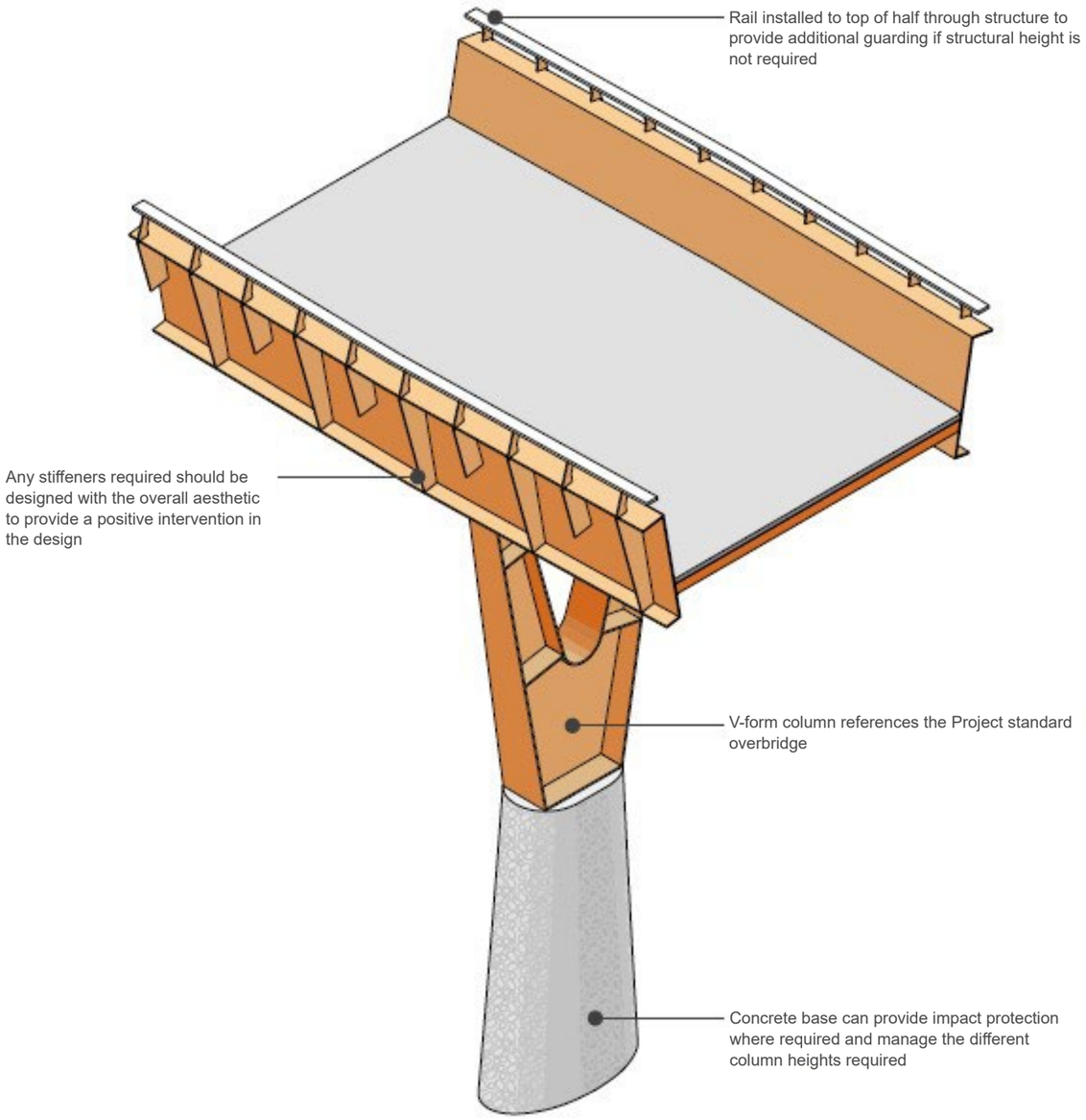
5.2.38. FP230 runs through the forest on the west side of the M25 to meet Ockendon Road, but due to the creation of new slip roads, FP230 will be diverted over the M25. This will allow access to Ockendon Road on the eastern side and in doing so improve the connection between the two sides of Thames Chase Forest Centre. Footbridges located within the Thames Chase Forest Centre, over the M25, form the gateway to the Project route from the north, which specifically addresses the experience of WCHs and the cultural heritage of the area.

5.2.39. The existing tree lined cutting has been widened to the west to accommodate the new slip roads between the M25 and the Project. The new Thames Chase WCH bridge has been designed to span the cutting at the southern end of Thames Chase Forest Centre where the topography allows for minimal earthworks, which in turn minimises disruption to the trees on either side.

5.2.40. Because of its location, this bridge is required to span a large number of lanes of traffic. The new slips at different levels to the M25 and each other, result in columns of differing heights required to support the bridge deck.



Thames Chase WCH location



Illustrative WCH bridge design considerations

Example of using the structure to form the parapet and integrate graphics

Example of how perforations could be achieved through structure

Example of a perforated steel bridge – Rio Arga Aranzadi Park

Abutments

5.2.41. The abutments design adopts a bank seat arrangement, where the wide sloping vegetated faces of the M25 cutting continues uninterrupted beneath the bridge. Compared to a traditional abutment, this arrangement allows for better integration into the local setting.

5.2.42. The tops of the existing cutting are fringed with trees. Where the cutting is widened, this has been reinstated so that from the M25, the bridge disappears into the trees rather than be visibly grounded by a connection to a heavy supporting structure. This bridge has been designed to be significantly higher than either of the FP252 bridges to the south.

Pier, beam and deck structure

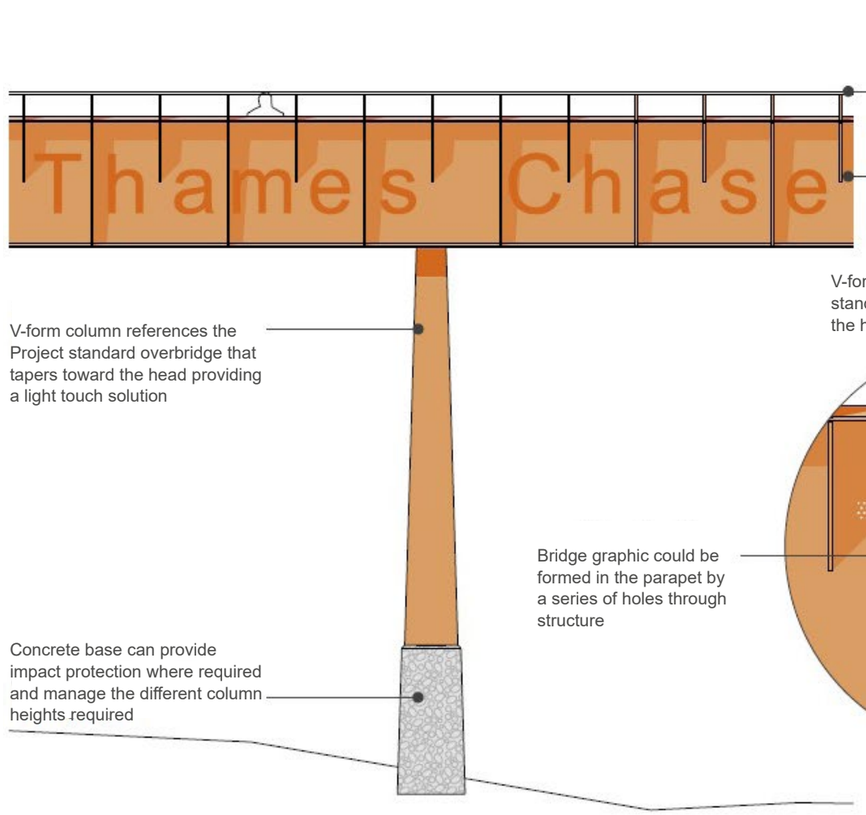
5.2.43. It is proposed that a half-through structure could be used to form the pedestrian parapet reducing the overall depth of the Thames Chase WCH bridge. This allows the bridge deck level to be lower while maintaining the same clearance, which beneficially reduces the impact on the surrounding landscape on the approach to the bridge.

5.2.44. The beam elements of the bridge are proposed to be made of a material with the appearance of weathering steel. Any structural stiffeners that may be required would be incorporated into the aesthetic design and continued across the length of the bridge to ensure visual consistency. A rail has been provided at the top of the parapet to provide the safe and correct level of guarding.

5.2.45. It is proposed that the name of the crossing is incorporated into the structure through the use of perforations within the structural steel.

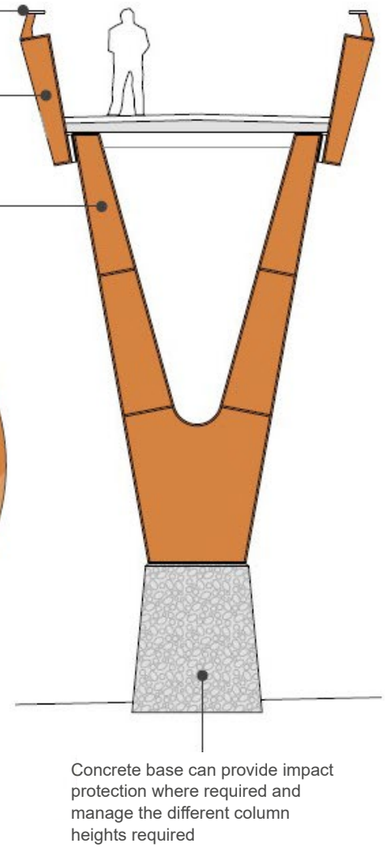
5.2.46. The columns have been designed in two parts with a weathering steel V shaped structure sat atop a concrete base, that can be designed for impact loading where required. Due to the differing levels below the bridge, each of these columns is a different height. However, the V structures will all be identical, with the concrete base changing to accommodate the difference.

5.2.47. Provision for safety refuge and seating points at each pier will be developed at detail design.



Illustrative WCH bridge part elevation

Illustrative proposed parapet graphic



Illustrative column elevation

Illustrative view of the Thames Chase WCH bridge

5.3. Preliminary Design response summary to the 10 Principles of Good Design

5.3.1. Some examples of how the proposed design of the bridges and viaducts responds to the 10 Principles of Good Design are described below:

Is inclusive

5.3.2. Where required and practicable, existing WCH routes have been integrated with the bridge structures, providing continuity of open space around the Project route. WCH routes in the south create a looping route, linking Thong and Claylane Wood, along with Shorne Woods Country Park to East Gravesend. In the north, a series of legacy WCH routes have been reconnected and enhanced, including Thames Chase WCH bridge.

Fits in context

5.3.3. The bridges and viaducts have been designed to sit contextually within the landscape. A simple material palette has been chosen, reflective of the local vernacular and character. For example, the preliminary design material palette has included gabions with locally sourced stone, weathering steel, and timber clad vehicle restraint systems (VRS) along with integrated placemaking in the form of the bridge name incorporated with the bridge parapet structure.

Is restrained

5.3.4. The bridge structures have been designed to integrate with the surrounding site context and proposed landscape design. Supporting abutments have been terraced and stepped back, to allow a more graceful transition to the natural landscape environment.

Is environmentally sustainable

5.3.5. The bridge structures and associated abutments have been blended into the surrounding landscape. For example, supporting abutments have been terraced and stepped back, to allow a more graceful transition to the natural landscape environment that allow plant propagation and establishment over time. This helps promote environmental net gain and biodiversity.

Is long lasting

5.3.6. The main structures bridges and viaducts have been designed to a 120 year design life, to minimise the maintenance required over the operational highway. The proposed preliminary design materials have been selected based on longevity, low maintenance and' self-finishing' where possible. For example, this could include weathering steel, locally sourced stone facings and/ or gabion structures to integrate the abutments into the adjacent landscape. .

6. Gammon Field Travellers Site

6.1. Introduction

6.1.1. The existing Gammon Field Travellers' Site comprises 21 pitches arranged in three clusters. It is located on the western side of the A1089 to the south of the junction with the A13. It is separated from the urban fringe by arable farmland and from the A13 by Blackshots public open space. Each pitch has an area of hardstanding and an amenity building. There is also a small office building and associated utilities.

6.1.2. The creation of a new slip road connecting the A1089 northbound to the Project route northbound has been designed requiring the land occupied by the existing site. A replacement site is to be provided.

6.1.3. Several different locations for a relocated traveller's site were explored throughout the consultation process. Through this engagement it was established that the traveller community do not wish to move far from their existing site. A parcel of farmland directly to the west (bordering the existing site) is proposed as the location of the new travellers' site.

Existing aerial view of the travellers' site and A13 junction

Illustrative aerial view of the travellers' site and proposed A13 junction

6.1.4. An indicative site plan, pitch layout, amenity block/ day room and site office have been designed in accordance with current guidance Designing Gypsy and Traveller Sites – Good Practice Guide (Department for Communities and Local Government, 2008) and through consultation with both Thurrock Council and the travellers'. Appropriate mitigation for noise and visual screening is also accommodated in the design of the site.

6.1.5. The layout and design of the travellers' site (Work No. 7R) is controlled through Requirement 12 of the draft DCO (Application Document 3.1), with the preliminary design being secured through the Project Design Principles (Application Document 7.5).

Not to scale

Indicative site plan designed through consultation with Thurrock Council and the travellers'

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