The London Borough of Merton

BISHOPSFORD ROAD BRIDGE REPAIR / REPLACEMENT WORKS

Options Report

70066777-001-RPT-002-00-ME
FEBRUARY 2020

CONFIDENTIAL

The London Borough of Merton

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PROJECT NO. 70053317

OUR REF. NO. 70066777-001-RPT-002-00-ME

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SUMMARY OF ABBREVIATIONS

Bttm	Bottom
BGS	British Geological Society
EA	Environment Agency
FRAP	Flood Risk Activity Permit
GI	Ground Investigation
GPR	Ground Penetrating Radar
HV	High Voltage
LV	Low Voltage
RTA	Road Traffic Accidents
SGN	Southern Gas Networks
TfL	Transport for London
UKPN	UK Power Networks
RC	Reinforced concrete

EXECUTIVE SUMMARY

This report summarises proposals developed for the repair and / or reconstruction of the multi-span arch structure forming Bishopsford Road Bridge which is located within the London Borough of Merton, it carries the single carriageway and footways of the A217 London Road over the River Wandle. The structure suffered partial collapse of the bridges north span during strengthening works (saddling) in summer 2019, although it is unclear whether the collapse is related to the strengthening works.

This report initially reviews options for reinstatement of an effective crossing of the River Wandle, and then subsequently reviews possible implementation methodologies for the works. The purpose of the report is to support decisions made by the London Borough of Merton for the repair or reconstruction of Bishopsford Road Bridge.

This study considers and evaluates the following options for the superstructure reconstruction works:

i)	Do minimum -	Line and partially infill north span, reconstruct saddle, subsequently restrict traffic to light vehicles only.
ii)	Partial Reconstruction -	Reconstruction of the northern and centre arches on a like-for-like basis, open to HA & HB traffic.
iii)	Reconstruction -	Demolish existing structure, reconstruct with two span structure.
iv)	Reconstruction -	Demolish existing structure, reconstruct with single span portal structure.

This study additionally considers the following construction methodologies for the works:

- Retention of the existing road closure and diversion route;
- Phased construction methodology and re-opening of Bishopsford Road Bridge

This report also incorporates; service record information sourced from C2 and C3 enquiries, details of site and construction constraints, preliminary geotechnical information, and high level cost estimates. Environmental constraints have not yet fully been developed in this version pending further site surveys and developed consultations with the Environment Agency (EA) in early 2020. Where available early details of proposed EA constraints are recorded.

This report recommends that reconstruction of the superstructure of Bishopsford Road bridge be undertaken using a single span reinforced concrete portal. Diversion / Temporary support of the services should be undertaken and the existing structure demolished to mitigate the currently increased flood risk. A more measured approach can then be taken with the Ground Investigation and continued discussion with the statutory undertakers while design takes place. The anticipated capital cost for this option will be £2,690,000 with an expected cumulative demolition / construction programme of 10-12 months and whole life costing of £770,284 (discounted).

It is recommended that prior to development of outline and detailed design proposals the London Borough of Merton consider the following key enabling works:

- Commissioning of a Ground Penetrating Radar (GPR) survey of existing utilities within the vicinity of the bridge and its immediate approaches, to enable identification and protection of these services during proposed demolition and reconstruction works.
- Commission a detailed Ground Investigation (GI) to determine design parameters for temporary and permanent works designs associated with the reconstruction works.
- Undertake an Unexploded Ordnance (UXO) desk study to determine risk at the site, prior to commencement of GI, demolition, and future piling works.
- Source C4 notices (detailed design stage and final cost estimates) from affected statutory undertakers for the proposed works including; BT Openreach, Southern Gas Network (SGN), Thames Water, and UK Power Networks (UKPN). Diversion of the services may comprise sourcing and fabrication of bespoke components, such as fibre optic cables, the lead in periods and statutory disruption notice periods of which will impact the critical path for the proposed works.
- Undertake advanced consultation with elected members, the local community, and the wider residents of the London Borough of Merton regarding the proposed reconstruction works
- Undertake a walkover environmental scoping survey at the earliest opportunity, to identify potential environmental and habitat constraints, and to ensure the London Borough of Merton discharge their statutory obligations. Aspects of this survey will be seasonal and therefore may additionally impact on the critical path for the works.
- Undertake pre-application consultation with the EA regarding the concept proposals to source initial feedback. WSP would recommend that the advance consultation accompanies early hydraulic modelling / simulation of the proposed concepts to identify any flood risk impacts downstream of the bridge. However, it is understood from the Borough of Merton that EA has confirmed that hydraulic modelling is not required in this case.

1. INTRODUCTION

1.1. PURPOSE

The London Borough of Merton has commissioned WSP to provide structural design services for the development of a feasibility study for bridge repair or replacement works at Bishopsford Road Bridge which suffered partial collapse during summer 2019. The feasibility study will be used to inform a business case application to be prepared by the London Borough of Merton for the proposed works in either the 2020 / 2021 or 2021 / 2022 fiscal years.

This report defines the options for the proposed repair or replacement works at Bishopsford Road Bridge, and proposals for implementation. The report additionally documents constraints on the proposed works, stakeholder consents required and high level cost estimates for the proposed options. The report concludes with a recommendation which satisfies the requirements of the London Borough of Merton and its key stakeholders.

1.2. BACKGROUND

The existing structure is aligned North-South over the river Wandle; it was constructed circa 1884 and comprises a three-span arch bridge, with a later reinforced concrete footway extension on the east (upstream) side. There is also an independent footbridge adjacent to the west (downstream) elevation of the bridge. The bridge superstructure is currently exhibiting multiple structurally significant defects and areas of collapse (at the structures north end) which has prevented the structure being retained in service by the London Borough of Merton. The bridge is currently closed to public access, and is partially protected from through flows from the River Wandle through the erection of dams which close off the north span of the bridge.

Further details of the defects observed within the bridge, during a special inspection undertaken by WSP during December 2019, is summarised in the following report:

- Bishopsford Road Bridge Repair / Replacement Study – Special Inspection Report, document ref: 70066777-001-RPT-001-00-GW, dated December 2019.

Works will be affected by:

- The bridges position within the River and its associated flood plain. The river at this location exhibits “flashy” behaviours, responding quickly to significant rainfall events. Minor weirs are present approximately 50m upstream of the bridge to regulate flows at this location.
- The bridge is located immediately adjacent to the Watermeads Nature Reserve, which is owned by the National Trust and form part of the Wandle Valley. The nature reserve seeks to support local wildlife including trout stocks within the river and provides a wetland habitat.
- The bridge is located immediately north west to Ravensbury Park which is owned by the London Borough of Merton. The park is a public open space.
- A number of residential dwellings are located immediately upstream and downstream of the bridge, which are sensitive to flooding following any elevated levels within the River Wandle.

- The bridge is located within a congested urban environment comprising; residential dwellings, commercial properties, and industrial areas within the vicinity of the bridge.
- The presence of the Imperial sports ground immediately South East of the bridge, which additionally accommodates Tooting and Mitcham United Football Club (KnK stadium).
- The presence of Mitcham Fire Station approximately 0.5 miles north of the bridge.
- The presence of Morden Hall Park Angling Club on the south west corner of the bridge.
- Significant statutory undertakers' apparatus located in the bridge deck and the bridge approaches.

The existing bridge comprises 3 No. brickwork arches with brickwork intermediate piers, abutments, and wingwalls. The bridge was widened at an unknown date, although the current Reinforced Concrete (RC) footway deck extension on the east (upstream) side was constructed in 2010 on the existing extended substructures to replace the previous deck. The footbridge widening works additionally incorporated new cut-waters to the upstream elevation of the intermediate piers to assist river flows through the structure. It is understood that the foundations of the bridge comprise spread foundations within the invert of the River Wandle. The structurally independent foot/cyclebridge on the west (downstream) side was constructed in 2008. Refer to Appendix D for details.

The clear square span of the arches are; 2.709m (north), 3.324m (centre), and 2.724m (south). The existing speed limit is 30mph and there is a pedestrian crossing point located immediately south of the bridge.

2. SITE DESCRIPTION AND DETAILS

2.1. LOCATION

The bridge is located at Grid Reference TQ 27171 67843, the sites approximate postcode is CR4 4BB. Maps showing the bridges location are shown in Figures 1 and 2, photographs of the bridge, and its immediate approaches are shown in Figures 3 and 4.

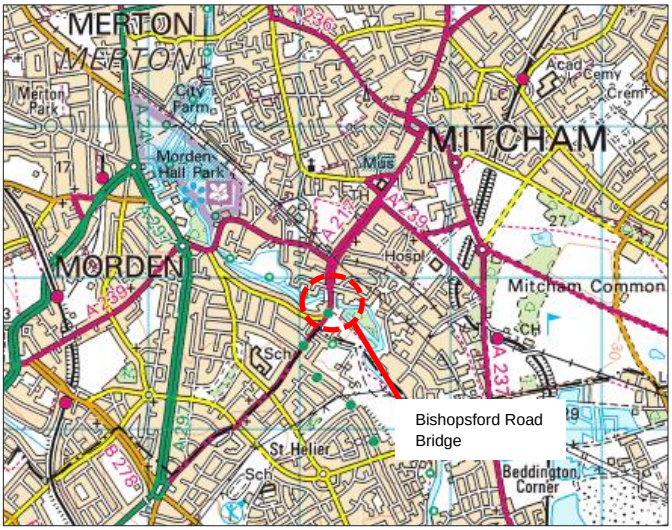

Figure 1 - OS location plan

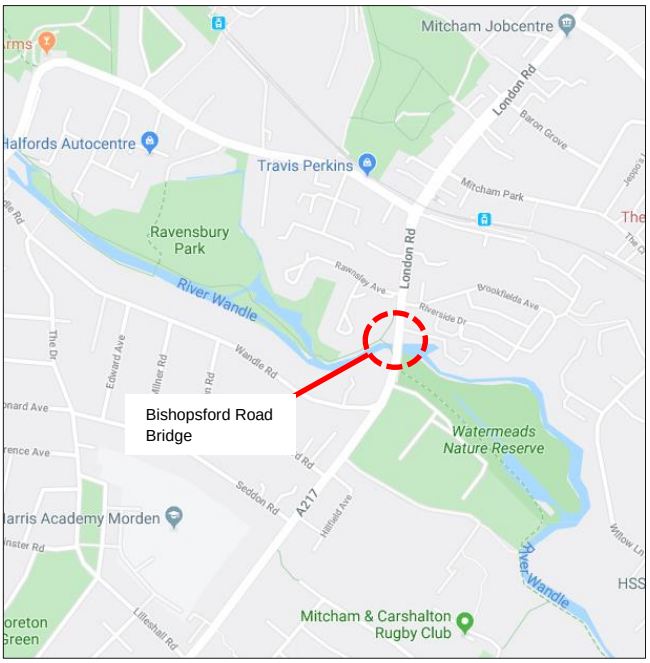

Figure 2 - Street view location plan

Figure 3 - East (upstream) elevation of bridge

Figure 4 - View across structure towards north
[Top - current view following collapse, Bttm – view prior to strengthening works]

Figure 5 - View across structure towards south
[Top - current view following collapse, Bttm – view prior to strengthening works]

2.2. HIGHWAY ALIGNMENT AND DETAILS

Prior to the summer 2019 strengthening works, the highway of Bishopsford Road crossed the bridge on a straight alignment, with a rising vertical alignment to the approaches and a change in vertical gradient at the centre point of the bridge. The pedestrian footways bifurcate at the bridge approaches to cross the footbridges adjacent to the original arch bridge.

A nominal cross-fall was provided to the carriageway to facilitate surface water run-off to highway gullies along each kerbline on the bridge approaches. Highway gullies are located approximately 50m beyond the bridge on both approaches and kerblines, no highway drainage provision is made across the bridge.

See Appendix B for a general arrangement drawing of the bridge.

Street lighting columns are present on the north east and south east corners of the bridge, however these assets are sufficiently far away that it is not anticipated they will be disturbed by the proposed works.

On-street parking is restricted on the bridge approaches or across the bridge, with parking prohibition notices erect of the bridge approaches preventing parking and loading between 0700 and 1900hrs Monday to Saturday, additional restrictions are in force preventing loadings between 0700 – 1000hrs and 1600 – 1900hrs Monday to Friday.

Figure 6 - Traffic restrictions on bridge approaches

Prior to the closures of the A217 London Road / Bishopsford Road, TfL operated bus routes which have been locally modified and re-routed as a result of the proposed works.

2.3. RIVER WANDLE DETAILS

The River Wandle passes through Bishopsford Road Bridge flowing east to west through the structure. Immediately upstream the alignment of the River Wandle merges from two channels

either side of an ait, flows within these two channels are regulated by weirs. See Figures 6 to 8.

Figure 7 - View upstream along the River Wandle from Bishopsford Road Bridge

Figure 8 - View upstream along the River Wandle from south east wingwall

Figure 9 - View of weir upstream of Bishopsford Road Bridge

Downstream of the bridge, the River Wandle continues as a single channel, with overhanging vegetation from the river banks.

Figure 10 - View downstream along the River Wandle from Bishopsford Road Bridge

Flow within the river is currently restricted by dams, which are used to close off and safeguard the partially collapsed northern span. See Figure 11. The resultant flow through the central and south span is fast flowing and turbulent in nature; temporary scour measures have subsequently been installed within these spans to safeguard the pier and abutment foundations against scour.

Figure 11 - East elevation showing temporary dam provision

Pre-application consultations are currently ongoing between the EA and the London Borough of Merton, and to date have identified the following anticipated constraints on the proposed works:

Flow Constraints

- Dams currently erected in the river are to be removed at the earliest opportunity to restore normal flow conditions, to date the EA have issued WRA 1991 notices requiring the river channel to be opened up within 8 weeks of the notice being served. Discussions are currently ongoing between the EA and the London Borough of Merton on measures which could be implemented to comply with the notice, and reduce the flood risk at site during the intervening period.
- Hydraulic simulation / modelling of proposed temporary measures to facilitate any early demolition of the existing structure may not be required, however the applicant will need to demonstrate maintenance of an effective apertures and no significant impact on the existing flood risk at site. A Flood Risk Activity Permit (FRAP) will however be required for temporary works necessary to facilitate demolition, supported by a Flood Action Plan specifically covering any demolition works and the management of flood risk.
- Hydraulic simulation / modelling may be avoided for permanent works if first principles are applied to demonstrate that the current flow regime, and therefore the associated flood risk in the surrounding area, is not impacted when compared to the existing bridge design. This could be achieved by comparing the cross-sectional area and flow capacities of the existing bridge with that of the proposed design.

  Where the aperture of the bridge is opened up, or increased through the omission of in-river piers, it must be demonstrated that increased flows through the structure do not exacerbate flood risk downstream of the bridge site. In-channel works to increase roughness such as islands and / or deflectors could be designed into the scheme to maintain flow conditions.

  Outputs of the EA's flood models for the River Wandle can be used to support the above assessment criteria.
- Any temporary in channel works (such as dams, through piping etc) are required to be kept clear of debris and removed in the event of heavy rainfall / a predicted flood event to ensure there is no impact on flood risk. Prior to installation of the temporary works the named permit operator is to be transferred to the Principal Contractor such that responsibility for this action and subsequent issue of commencement notices are with the same organisation for the duration of the works. The flood action plan will also

subsequently be owned and actioned by the Principal Contractor, along with any further FRAP applications submitted for consideration and review by the EA.

Water Quality Constraints

- Both demolition and permanent construction works should be undertaken in a manner that ensures no debris enter the channel, and that there is no impact on water quality.
- Gravel areas are present downstream of the site that are used by rheophilic fish species, such as chub and dace to spawn. A robust silt mitigation strategy, including monitoring, is required to ensure that fine sediments are not released during demolition and construction phases to protect these areas.

Flooding

- The bridge is located in flood zone 3, as defined by the EA's interactive flood map; indicating a high risk of flooding at the site. This will necessitate completion of a flood risk assessment for the works, considering the Environment Agency's standing guidance for flood risk assessments.

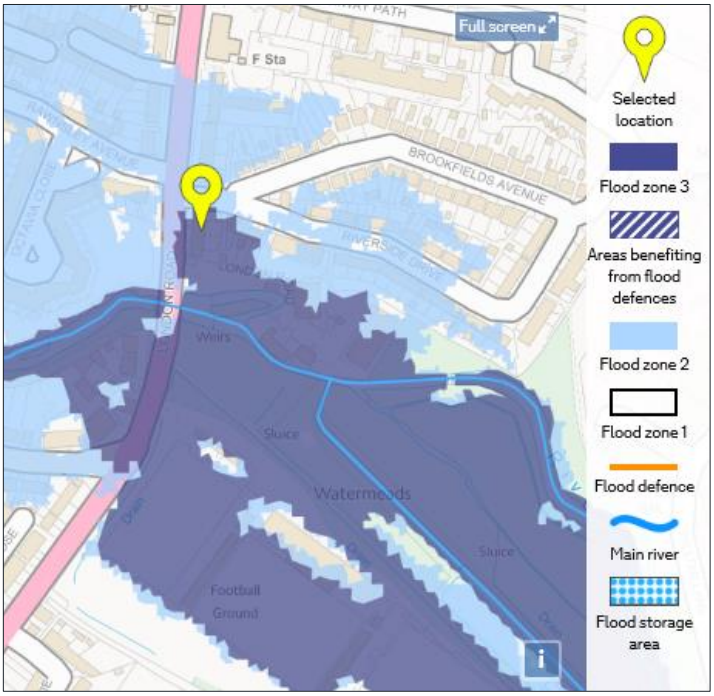

Figure 12 - Environment Agency Flood Risk Map

Habitat / Ecology Constraints

- A preliminary ecologic appraisal is required prior to commencement of any works to identify any habitat and ecological impacts. This appraisal is to incorporate an aquatic survey with a view at protecting fish stocks, and identify timing of works to consider the following key spawning periods:
    - i) Spawning of coarse fish species as water temperatures rise between March and June;

ii) Trout spawning in October / November, and subsequent winter periods where the trout's eggs remain in the gravels over winter.

These considerations are likely to result in a usable construction window for in-river works between late June and early October.

- A Water Framework Directive assessment and habitats screening assessment will be required to support the FRAP for the permanent construction works. The assessment should consider the work on physical habitat, water quality, fish and eels, macrophytes, and invertebrates.
- A number of juvenile fish have become stranded in water retained within the north span, prior to demolition works commencing recovery and trans-location of this fish stock will be required.
- Any percussive piling or in-river demolition techniques generating ground borne vibration will need to be assessed for its impact on river fish stocks. Consideration for the use of vibro or silent piling techniques should be made, as these input lower levels of noise and vibration into the water column and as such as less harmful to fish stocks.

  If percussive techniques are adopted for piling works, justification for their use over other less harmful methods will need to be included in the FRAP along with details of potential impacts upon aquatic ecology and mitigation measures proposed.

Consents Required

- Any demolition phase will require a FRAP application under the terms of the Environmental Permitting Regulations. As a minimum the application should contain:
  i) The formal application (parts B10, A, and A3 guidance on which can be found at https://www.gov.uk/guidance/flood-risk-activities-environmental-permits#bespoke-permits);
  ii) Detailed design drawings including topographical survey levels;
  iii) An ecological walkover survey;
  iv) Method of works identifying and mitigating environmental and flood risks (the environmental surveys noted above will supplement this);
  v) A Flood Action Plan specifically covering any demolition works and the management of flood risk, and
  vi) Proposals for preventing debris and silts from entering the channel, including water quality management proposals. This will be summarised as a silt mitigation strategy.
- The permanent works phase will require a second FRAP application under the terms of the Environmental Permitting Regulations. As a minimum the application should contain:
  i) The formal application (parts B10, A, and A3 guidance on which can be found at https://www.gov.uk/guidance/flood-risk-activities-environmental-permits#bespoke-permits);
  ii) Detailed design drawings including; topographical survey levels, general arrangements, sections, and any construction sequencing drawings;
  iii) An ecological walkover survey;
  iv) A Water Framework Directive Assessment;
  v) A habitats screening assessment;

vi) Method of works identifying and mitigating environmental and flood risks (the environmental surveys noted above will supplement this);
vii) A Flood Action Plan specifically covering any demolition works and the management of flood risk;
viii) Proposals for preventing debris and silts from entering the channel, including water quality management proposals. This will be summarised as a silt mitigation strategy (discussed above);
ix) Proposals for managing groundwater and contaminated land issues where piling is to be used within the works;
x) Details of hydraulic modelling, its outcomes, and any recommendations for the new structure where the bridge aperture is increased, or measures that significantly change the flow characteristics of the river. The modelling should demonstrate that the works will have no adverse impact on risk from the River Wandle both on and offsite, and downstream of the proposed bridge;
xi) Construction method statements, and
xii) Water quality monitoring proposals;

Design Considerations:

- Replacement of the existing structure using a clear span structure, allowing for the establishment of a natural river bed would be an environmental gain (subject to review of flood risks as noted above).
- Retention of a pier(s) within the river could have negative impacts which would be evaluated on an ecological and natural geomorphology basis, however there could be a benefit in retaining them due to reduction in disturbance to the watercourse, and retention of the existing flow area and hence flow conveyance.
- Consideration is to be made for naturalising any existing or proposed engineered sections of river bank to support bio-diversity at the site.
- Statutory consenting processes at the EA typically require that any exploratory investigation holes (boreholes and window samples) completed as part of ground investigation works within 8m of the watercourse will require granting of consents by the EA prior to commencement of the works. The consent application(s) will be required to be accompanied by the documents described within the consents required section above

Further to consultation between the London Borough of Merton and the Environment Agency in January 2020 (see Appendix G) it was identified that minor relaxation of these requirements may be possible, when considering the London Borough of Merton's Highway Authority role. Revised guidance received on the 21st January 2020 identified the following:

i) The only investigation holes which will require EA consents / permissions will be those executed within the river channel.

ii) As Highway Authority, the London Borough of Merton is classified as a risk management authority, and therefore FRAP's are not required for site investigation boreholes and trial pits within 8m of the top of the bank of an EA designated main river.

iii) No additional permits are required from the groundwater and contaminated land teams (note chalk based fresh water river), however they will require consultation for any site activities which require a FRAP.

iv) The minimum review period to be considered for FRAP applications relating to any ground investigation activities within the water course is three weeks.

2.4. PLANNING CONSENTS & HISTORICAL INTERESTS

Bishopsford Bridge currently lies within sub-area 6: Lower Mitcham - Watermeads and Station, of the Wandle Conservation area. Details of the conservation area and key features considered in the Conservation area are contained in Appendix H. Further details can be found on the London Borough of Merton's website noted below:

https://www.merton.gov.uk/planning-and-buildings/conservation-heritage/conservation-areas-list#areaw

Key features of the existing structure, which are of local historical significance, are identified in characteristic assessments undertaken during establishment of the conservation area. Features identified include the bridge parapets and historical plaques and markers integrated into the bridge elevations. See Figures 13 and 14.

Due to the local historical interest with the identified features it is an aspiration of the London Borough of Merton to map and recover these features prior to demolition works commencing, and where possible, subsequently incorporate these elements into any new structure. The London Borough of Merton has additionally expressed a desire to retain the large boundary wall between Bishopsford Road and Ravensbury Park to the north east of the bridge, due to local interest in it.

The bridges position within sub-area 6 of the Wandle conservation area will necessitate submission of Conservation Area Consent. It is anticipated that the London Borough of Merton acting as the applicant and approving authority. Planning applications are anticipated for the following aspects of the proposed bridge works:

i) Demolition works (if proposed)

ii) Proposals for the replacement structure (if proposed)

iii) Any remedial or strengthening works which materially affect the appearance of the bridge

Figure 13 - Historic mid-channel marker, west elevation above central span crown

Figure 14 - West (downstream) elevation – inset parapet feature

2.5. UTILITIES

2.5.1 EXISTING UTILITIES

Extensive existing utilities infrastructure is present at site, the routes of which are summarised in Figure 19. The following services are understood to be present within the bridge or its immediate vicinity:

East (Upstream) Footbridge

- A cluster of 6 No. steel service ducts are supported on the pier extensions, immediately upstream of the east footbridge parapet. BT Openreach services are contained in these ducts. See Figure 14.
- Additional BT Openreach service are incorporated into cast-in ducts within the in-situ concrete deck of the footbridge.

Arch Bridge

- Two Thames water mains are located in the vicinity of the east (upstream) side of the carriageway, after the June 2019 collapse only one main remains serviceable.
- Two South Gas Network (SGN) gas mains are located in the west (downstream) concrete verge across the bridge.
- Five number BT Openreach ducts are located in the west (downstream) concrete verge across the bridge, it is understood that three ducts are currently in use.
- Two UKPN electrical cables are located in the cast west (downstream) verge across the bridge, one service is a Low Voltage (LV) cable and the other a High Voltage (HV) cable.

West (Downstream) Footbridge

- Fourteen BT Openreach services are present / located adjacent to the footbridge, however it is not anticipated that these services will be impacted by any works.

A significant number of the services were damaged or placed at risk by the structural collapse, with the following emergency measures implemented to safeguard damaged services:

- SGN services were cut and capped within the bridge approaches, with the damaged section of the mains across the river becoming redundant. It is understood that pressure in an alternative distribution main have been increased to maintain supplies, however this is not considered a sustainable approach in the longer term due to leakage rates resulting from the pressure increase. See Figure 17.
- The Thames Water PE main adjacent to the East (Upstream) parapet has been retained in service, despite significant deformation due to the collapse. The cast iron main adjacent to the parapet has been damaged and decommissioned by Thames Water. See Figure 16.

  A back-up rider main has been installed to maintain services in the event that the PE main ruptures. See Figure 18. The rider back-up main is located over the East (Upstream) footbridge such that it is independent in the event the arch bridge collapses.
- BT Openreach have not diverted any services located within the arch bridge, these services remain in their existing location(s) within the existing arch and footbridges. See Figures 15.

Figure 15 - Steel ducts containing BT Openreach services on East (Upstream) elevation

Figure 16 - Thames Water services adjacent to east parapet of arch bridge

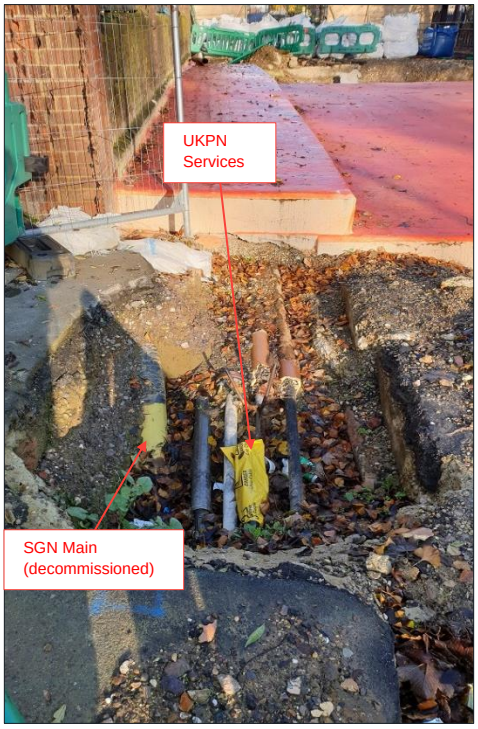

Figure 17 - Services adjacent to west parapet of arch span
(BT Openreach unless noted otherwise)

Figure 18 - Thames Water rider main – used to safeguard supplies through site
[Left - Main at north east wingwall, Right: Across east (upstream) footbridge]

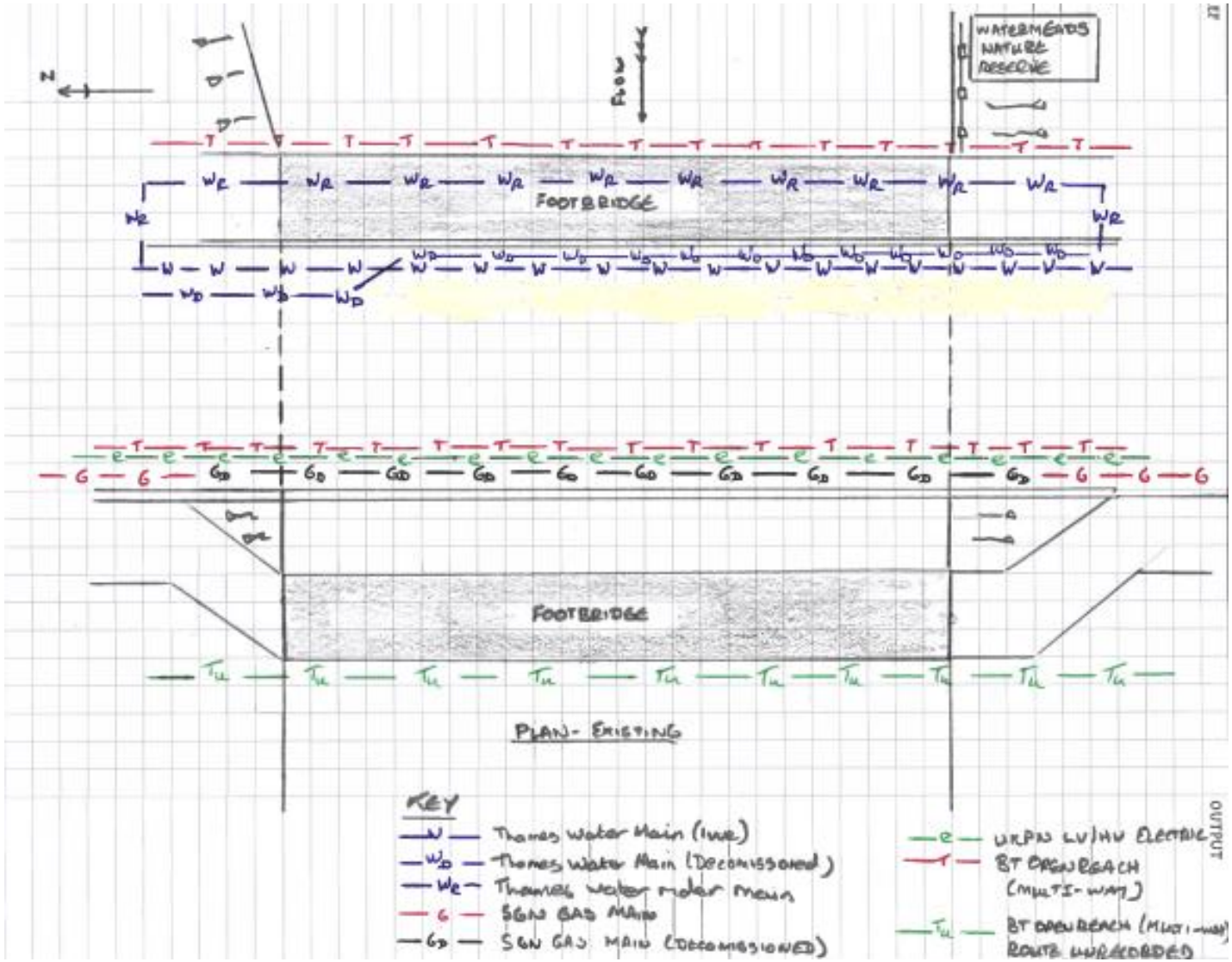

Figure 19 - Existing utilities routes at site

2.5.1 UTILITIES DIVERSIONS

BT Openreach

It is anticipated that the design proposals for any demolition, strengthening, or reconstruction of Bishopsford Road Bridge will need to consider the following constraints associated with BT Openreach infrastructure present at site:

- Programme for diversion of any fibre optic service owned by BT Openreach will need to consider BT's statutory obligations associated with disruption of services. Service diversions shall be fully constructed, and new cables installed ready for diversion of services prior to issue of service of notices of disruption. The minimum period of notice for service disruptions varies between thirty days and three months after serving of the notice, after which the switch-over of service routes may occur. This is a statutory period and cannot be shortened. No notice of disruption is required for diversion of multi-strand co-axial cables, where only minor disruption is caused.
- Where disruption occurs during switch-over, switch over to diversion routes shall be undertaken out-of-hours where possible, and avoid disruption-prohibition periods including Christmas (and other public holidays) or major local events (such as planned VE day anniversary celebrations).
- Where fibre optic cables are affected, fibre optic cables used for diversions may be bespoke fabrications with lead-in periods of up to 6 months for new cables depending on their type and source.
- Large multi-way copper cables (such as used at Bishopsford Road bridge) are not commonly used by BT Openreach, and therefore may require specialist fabrication with extended lead-in periods. The lead-in periods for this type of cable will be provided by BT Openreach on a case-by-case basis.
- For installation and commissioning of diversion routes of co-axial cable routes a shorter period (excluding trenching and duct installation) of 5-6 weeks could be anticipated.
- BT Openreach will only be undertaking diversion of co-axial cable routes until 2023 at which point this material will be phased out, with BT Openreach no longer using this material for diversion works.
- BT Openreach statutory requirement is a clearance of 10m between any piling / construction works and their infrastructure. These clearances may be reviewed by the overseeing BT Openreach engineer depending on the method of piling and monitoring method(s) proposed. Augered piling is considered more favourable than driven or vibration piling.
- Cost of each chamber reconstruction where affected by the works or traffic loading is circa £50,000. Chamber centres are not to exceed 100m governed by manual pulling capacity of cables and size of cable drum to be rotated during cable installation.
- Chambers accommodating a 90 degree change of direction will be required to accommodate a turning radius of 2000mm for fibre optic cables.

The following additional key contact details from advanced C3 consultation are noted for the affected utilities provider:

[redacted]
Network Alterations Project Engineer
PP10 Redhill GSC, 22 Claredon Road, Redhill, RH1 1QY
[redacted]

The following key infrastructure details have been noted as part of the C3 service diversion estimates:

- A 3-way plastic duct arrangement is present in the east footway extension; however it is understood that only one duct is in use. The service comprises a 3200 pair copper cable (of significant diameter), with little / no slack which would otherwise facilitate slewing or lifting of the service. This cable connects a main exchange with local distribution cabinets.
- Services within the independent ducts on the east (upstream) elevation incorporate both copper and fibre optic services.
- A 4-way steel duct arrangement and 1 No. single duct is present within the west verge of the arch bridge. These accommodate additional 3200 pair copper cables similar to the east footbridge.
- Diversion of the 3200 pair copper cables will be a protracted activity, with each strand of the cable requiring disconnection and re-connection. Periods for jointing at splices is anticipated to exceed three- four month durations alone, significantly impacting the works programme. Therefore, this may necessitate retention and temporary support of the cables during any planned works.
- The 14-way duct route identified beneath the west (downstream) footbridge is located below the invert of the River Wandle. Current records show that 10 of the 14 ducts are currently un-used and maybe available for use in any diversion works, this availability will however require confirmation at C4 design stage. However, jointing and switch-over working periods are likely to have significant impacts on the London Borough of Merton's programme aspirations.
- Where diversion is implemented, BT Openreach may seek retention of existing ducts if the structure is retained, or provision of new 6-way 100mm ducts in a single verge of any new construction works.

A copy of the C3 cost estimate for the following noted service diversion works is contained in Appendix A. The anticipated cost of the service diversion works is **£5,800.00 exc VAT** (£6,960.00 inc VAT) for design of service diversion works, and **£205,294.76 exc VAT** (£246,353.71 inc VAT) for diversion works. The lead in period for the works is 4 months (due to material order constraints), with a 3 month site duration of works. Since then further discussions have taken place on alternate options, and indicative costs have been provided for separate diversions of the cables on the upstream and downstream sides of the road. The upstream diversion costs are in the region of £120,000 ex VAT and the downstream £180,000. In both cases. Both require provision of the ducts and boxes by the LBM contractor.

The service diversion works would comprise:

- Diversion of the services contained within the arch bridge verge and upstream footbridge to the existing 14-way duct beneath the west footway.

It is therefore proposed that the Openreach services be retained in place during the works to avoid the lengthy disruptions to the project programme caused by the service diversions, the temporary works to enable this are as follows:

- Erection of temporary service gantries above the footprint of the east (upstream) footbridge and west (downstream) verge of the arch bridge to provide temporary support for the ducts in their current location during the works. The east (upstream) gantry would also support the BT Openreach services suspended from the bridge elevation, and diverted Thames Water mains.

  Due to an absence of slack services will be suspended on hangers from the temporary service gantries, at maximum 1000mm centres to maintain vertical profile of the services

Southern Gas Networks (SGN)

It is anticipated that the design proposals for any demolition, strengthening, or reconstruction of Bishopsford Road Bridge will need to consider the following constraints associated with SGN plant at site:

- An effective gas main is to be re-established at the crossing of the River Wandle at the earliest possible date, to reduce pressures on alternative supply mains which are currently operating at increased pressures.

  The gas main needs to be reconnected by August 2020 at the latest. If this is not a permanent solution, it could be supported by a temporary gantry (that also accommodates other services) or supported along the elevation of the west (downstream footbridge). The pipe(s) are expected to be 2 No. 6” ID (152mm) or 1 No. 12” ID (305mm)

The following additional key contact details from advance C3 consultation are noted for the affected utilities provider:

[redacted]
Engineering Manager – Surrey Depot, SGN
[redacted] psom, Surrey, KT19 9BA

The C3 cost estimate response is current still awaited,

The service diversion works will comprise:

- Provision of new temporary routes across the River Wandle, either on an independent temporary gantry or new ducts supported on the West (downstream) footbridge – both provided by the London Borough of Merton.
- Permanent diversion of all SGN services into either the remediated or reconstructed bridge in new ducts (to SGN specification and provided by the London Borough of Merton) within verge / hard strip areas.

Thames Water

It is anticipated that the design proposals for any demolition, strengthening, or reconstruction of Bishopsford Road Bridge will need to consider the following constraints associated with Thames Water infrastructure present at site:

- The permanent works are to make provision for accommodating the existing 5" (127mm) and 6" (152mm) diameter water mains.
- While diverted mains would otherwise be exposed boxing should be provided around the diverted and exposed services to provide frost protection.
- To maintain capacity within the supply network, the existing rider main is to be retained in use throughout the works until both existing mains are reinstated. The route of this rider main is to be reviewed in the event the east (upstream) footbridge is demolished as part of the works. As is the case for the gas main, it could be supported from a temporary structure or the downstream footbridge. Only one main can be worked on at a time to enable continuity of supply via the other main.
- Smooth bored ducts with a minimum ID of 250mm should be provided for both permanent the existing 5" (127mm) and 6" (152mm) diameter water mains. Ducts provided shall have horizontal vertical alignment – i.e. compensated for any residual pre-camber of a reconstructed deck, and shouldy extend a minimum of 300mm past the rear face of each bridge abutment.

The following additional key contact details from advance C3 consultation are noted for the affected utilities provider:

[redacted]
Senior Project Engineer, Thames Water
Clearwater Court, Vastern Road, Reading, Berkshire, RG1 8DB
[redacted]

A copy of the C3 cost estimate for the following noted service diversion works is contained in Appendix A. The anticipated cost of the service diversion works is **£451,731.68 exc VAT** (£542,078.02 inc VAT), this maybe reduced to **£370,419.97 exc VAT** (£444,503.96 inc VAT) where advanced payment is made for the works. To develop C4 design proposals Thames Water will require an advanced payment of **£277,814.98 exc VAT** (£333,377.98 inc VAT). The lead in period for the works and predicted works duration of site works was not recorded in the C3 returns.

The service diversion works will comprise:

- Provision of a new temporary routes for the 5" and 6" water mains, to the north of the bridge across an independent temporary gantry provided by the London Borough of Merton to accommodate both BT Openreach and Thames Water services. These routes will include localised trench working to a depth not exceeding 1.2m. Temporary services are to be boxed out to provide frost protection.

  Temporary diversion works will involve installation of 65m of 180mm diameter pipework as a temporary diversion of the 6" main, and 70m of 180mm diameter pipework as a temporary diversion of the 5" main. Intermediate pressure tee's will be installed on the existing mains beyond the bridge to facilitate the diversion works.

It is anticipated that diversion works will be implemented to facilitate demolition of the existing concrete saddling which will be required regardless of the option proposed.

- Removal of the temporary 3" lay flat main (rider main) following commissioning of the temporary diversion routes.
- Permanent diversion of all Thames Water services into either the remediated or reconstructed bridge in new ducts (as specified above) within verge / hard strip areas.

  Diversion works will involve installation of 60m of 180mm diameter pipework as a permanent diversion of the 6" main, and 65m of 180mm diameter pipework as a permanent diversion of the 7" main.

To facilitate the diversion works Thames Water has assumed that the London Borough of Merton will provide the following at the London Borough of Merton's cost:

- Access consents for third party land to the east (upstream) of the bridge for execution of service diversion works.
- Provision of a road closure and traffic management (or continuation of existing arrangements).
- Suitable temporary support gantries to support the services where they cross the River Wandle.
- All necessary foliage clearance works to implement the diversion works, including applicable heritage and ecology screening and licences.
- All necessary Environment Agency consents for the proposed works.

UK Power Networks (UKPN)

It is anticipated that the design proposals for any demolition, strengthening, or reconstruction of Bishopsford Road Bridge will need to consider the following constraints associated with UKPN infrastructure present at site:

- Diversion of the LV and HV networks is to be undertaken whilst retaining the existing HV and LV networks as operational.

The following additional key contact details from advance C3 consultation are noted for the affected utilities provider:

[redacted]
Field Engineer, UKPN SW London Area
[redacted]

A copy of the C3 cost estimate for the following noted service diversion works is contained in Appendix A. The anticipated cost of the service diversion works is **£8,603.99 exc VAT** (£10,324.79 inc VAT) including design of service diversion works. However this cost excludes necessary trenching, ducting, reinstatement works, and ducting / supports on the west (downstream) footbridge which is to be provided by the London Borough of Merton, and requires payment in advance.

The service diversion works will comprise:

- Permanent diversion of 1 No. LV and 1 No. HV electrical cables into new ducting provided by the London Borough of Merton, including jointing, fusing operations, and switching of routes. The approximate length of the diversion will be 35m; it will pass through Ravensbury Park and across the West (downstream) footbridge as shown in the Figures below.

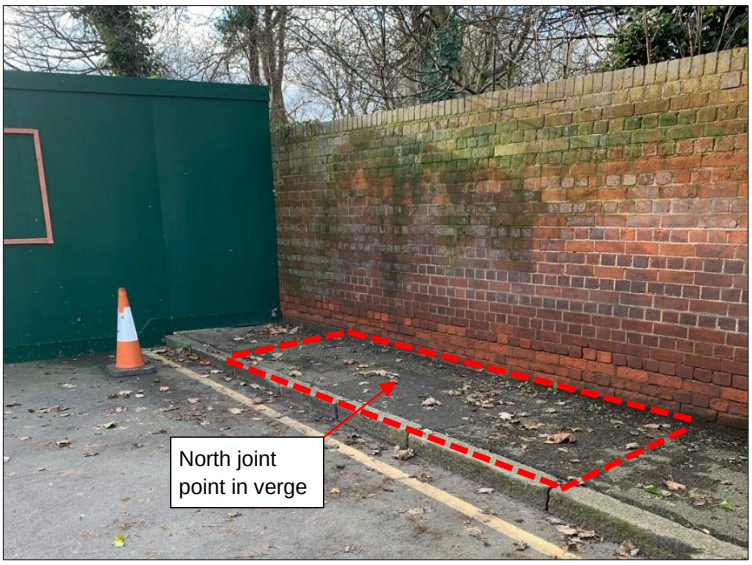

Figure 20 - Bishopsford Road: anticipate location for commencement of HV / LV diversion

Figure 21 - Proposed LV / HV diversion route through Ravensbury park and across River Wandle

Figure 22 - Proposed LV / HV diversion route across River Wandle

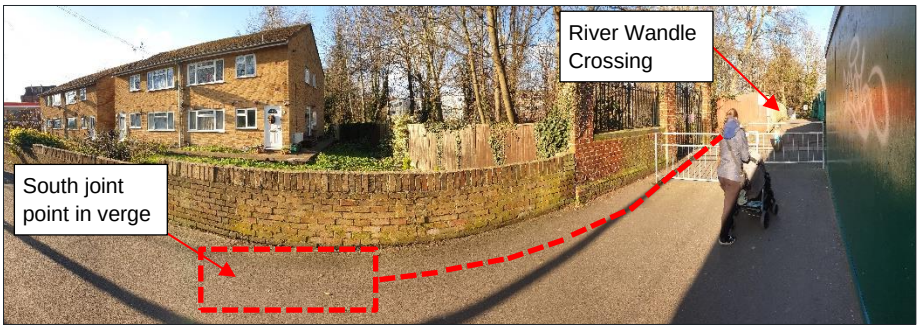

Figure 23 - London Road: anticipate location for commencement of HV / LV diversion

To facilitate the diversions works UKPN has assumed that the London Borough of Merton will provide the following at the London Borough of Merton's cost:

- All trenching, excavation works for joint holes, duct routes including draw pits, and reinstatement works associated with the proposed diversion works. This will include new ducts suspended on west elevation of the west (downstream) footbridge, including structural assessments of the bridge to confirm its robustness for the additional imposed dead loading.
- Provision of a road closure and traffic management (or continuation of existing arrangements).
- All necessary foliage clearance works to implement the diversion works, including applicable heritage and ecology screening and licences.
- All necessary Environment Agency consents for the proposed works.
- Parking for UKPN employees will be provided at site during execution of the works.

2.6. ADDITIONAL CONSTRAINTS

2.6.1 BOROUGH BOUNDARIES

Bishopsford Road Bridge lies within the south of the London Borough of Merton, close to the Borough's boundary within the London Borough of Sutton. See Figure 24. Whilst it is anticipated works will be undertaken within the authority of the London Borough of Merton, traffic diversion routes and / or site accommodation may cross the borough boundary line requiring engagement of the Borough of Sutton.

Figure 24 - Existing borough boundary

2.6.2 HIGHWAY BOUNDARY

The public highway of the A217 London Road / Bishopsford Road falls within the highway authority of the London Borough of Merton. The highway rights boundary is shown in Figure 25 and encompasses the arch bridge and the east (upstream) footbridge.

No highway access rights are recorded over embankment areas immediately east (upstream) of the bridge, nor west (downstream) of the bridge, therefore requiring third party consents in the event access to these areas are required.

The bridgeworks falls within permitted development rights of the public highway, however due to the bridges position with a designated conservation area it is anticipated that Conservation Area Consent will need to be sought for the proposed works. See section 2.4

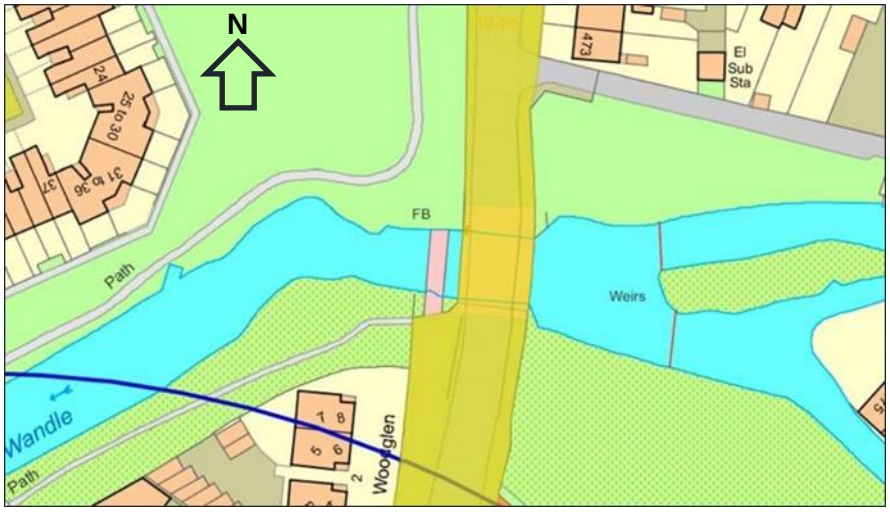

Figure 25 - Highway boundary extract

2.6.3 ADJACENT DEVELOPMENTS

The bridge is bound by a number of developments on each corner which will constrain the worksite boundary for any repair or reconstruction works. Adjacent developments include:

North East Corner:

A private residential development is present immediately north east of the bridge, access to the development and adjacent river bank area is via privately controlled security gates. Private vehicle and emergency vehicle access will need to be retained to this development during the proposed works. Additional residential properties; Nos. 463, 463a, 465, 467, 469 473, and 477 Bishopsford Road are present immediately north east of the bridge.

It is understood this area is owned by the National Trust, and subsequently leased to the private development company responsible for operation and maintenance of the estate.

Figure 26 - (L) Private residential access on north east corner of bridge
(R) Residential properties on Bishopsford Road

North West Corner:

A public space, Ravensbury Park, is located immediately north west of the bridge, and is separated from the A217 London Road by a large brickwork boundary wall. This park is retained from the former Ravensbury Park estate.

Figure 27 - (L) Ravensbury Park towards bridge
(R) Boundary wall between Ravensbury Park and A217 Bishopsford Road

South East Corner:

Immediately south east of the bridge, and forming the south east river bank, is Watermeads Nature Reserve which is owned and maintained by the National Trust. Access to this area is restricted and therefore cannot be considered as potential site accommodation or works lay-down areas. Immediately south of Watermeads nature reserve is Tooting and Mitcham Football club incorporating facilities associated with the KnK stadium, a 3,500 capacity football stadium, which is directly accessed from the A217 London Road. Located between the nature reserve and the football club is the Wandle Way, a public right of access along the banks of the River Wandle

Figure 28 - (L) Watermeads Nature Reserve Entrance (to east of bridge)
(C) Tooting and Mitcham Football Club entrance from London Road
(R) Entrance to Wandle Way immediately south east of bridge

South West Corner:

A number of developments are present to the south west of the bridge. A continuation of the Wandle trail is present across the west (downstream) footbridge, which connects Ravensbury Park to the A217 London Road. A gated access to Mordenhill Park Fishing Club is also present immediately adjacent to the east (downstream) footbridge.

Figure 29 - (L) Wandle Trail marker post in footway / cycleway
(C) Gated access to Mordenhill Park Fishing Club
(R) Signage on gated access to Mordenhill Park Fishing Club

Beyond the immediate crossing are a number of residential properties, Nos. 2, 4, 6, and 8 London Road, along with a refuelling station which is currently operated by Esso.

Figure 30 - Residential developments and refuelling station on London Road

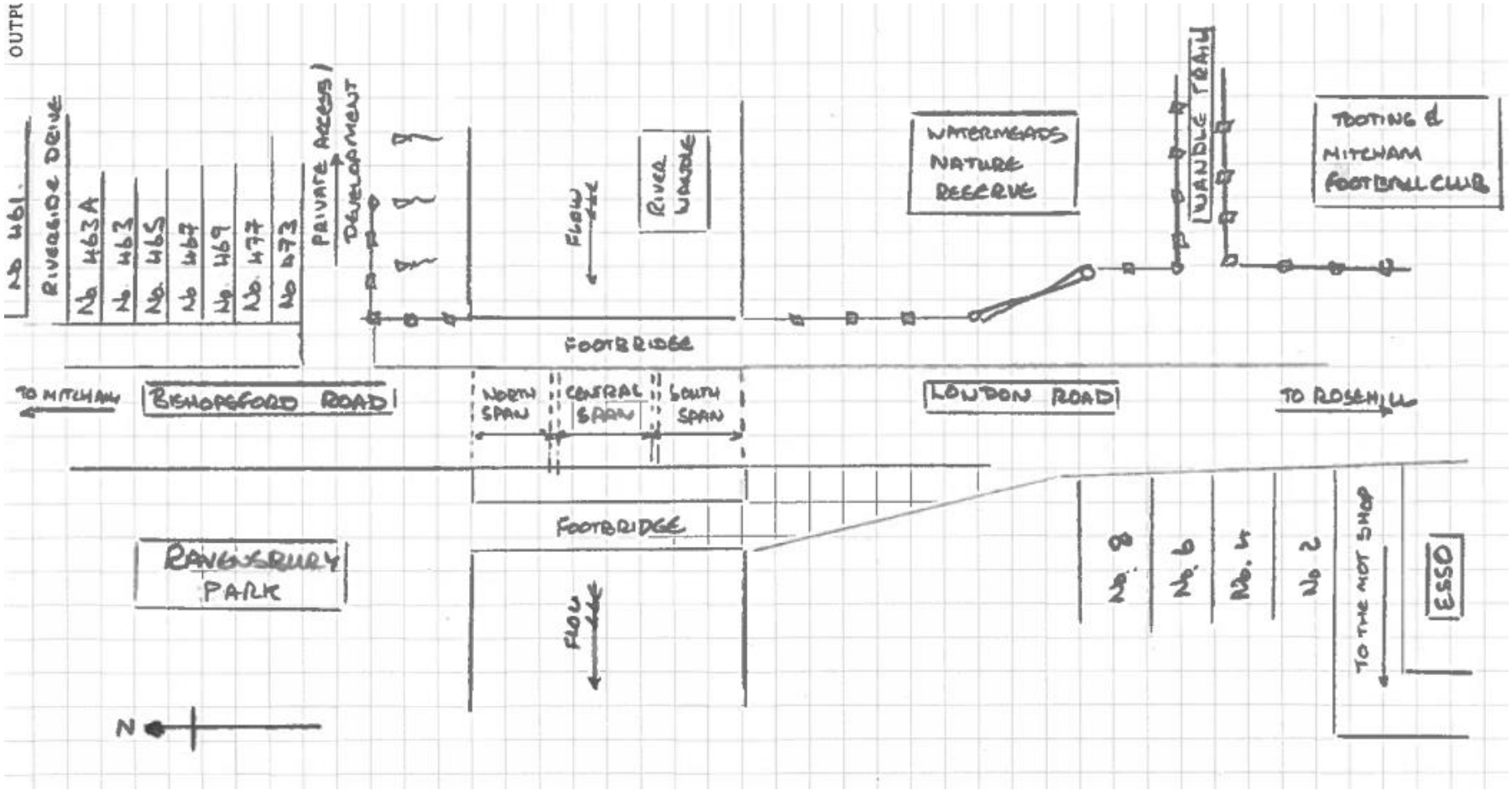

Figure 31 - Summary of developments adjacent to bridge

2.6.3 LONDON BUS ROUTES

Prior to its recent closure the A217 London Road / Bishopsford Road accommodated a number of London Bus routes including routes; 118, 280, and N133. Currently these routes cannot be accommodated across the bridge, with re-routing as follows:

- Routes 118 and N133 along the A239 Mordon Road towards St Helier Avenue around the on-going bridge closure. See Figure 33.
- Route 280 along the A239 Mordon Road and Wandle Road to circum-navigate the on-going bridge closure. See Figure 34.
- Route 718, a new proposed service running between Morden Station to Rosehill roundabout via Wandle Road, has been provided to accommodate the closure and will run until July 2020.

It is anticipated that upon completion of the bridgeworks the bus routes will be reinstated along their former routes as shown in Figure 32.

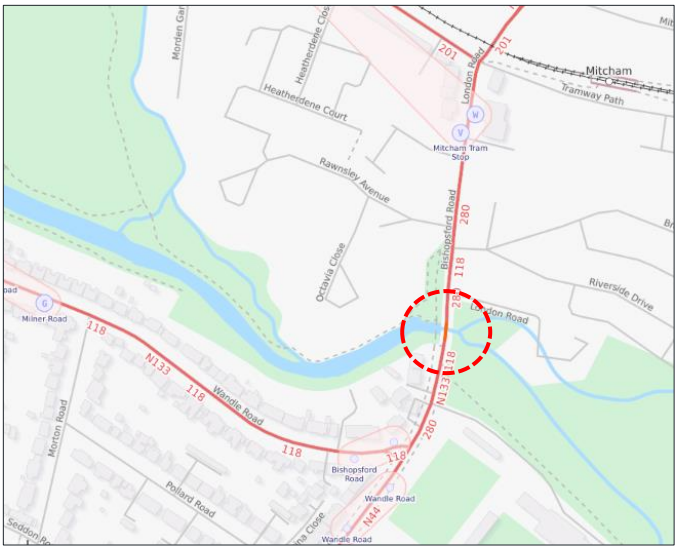

Figure 32 - London Bus routes previously operating over Bishopsford Road Bridge

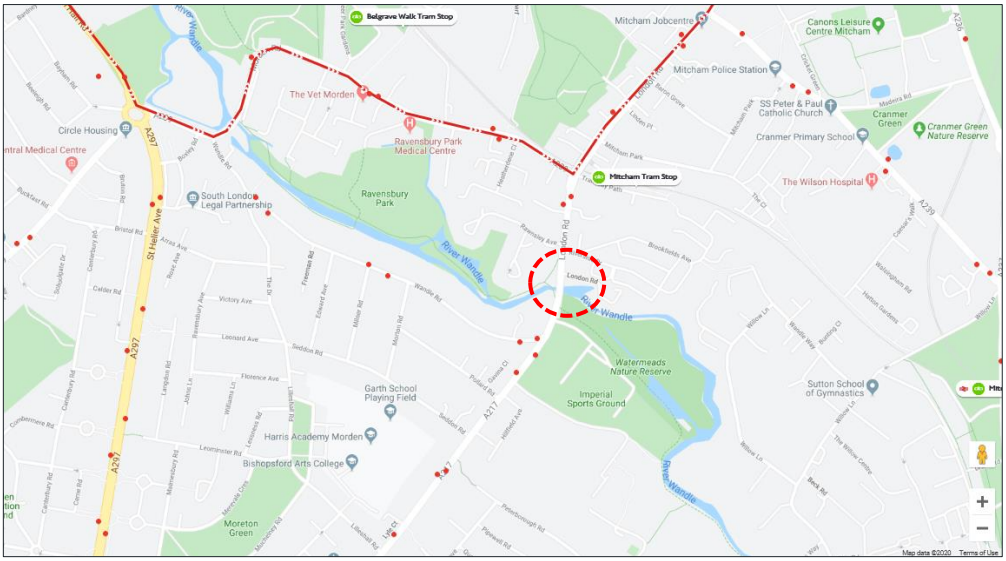

Figure 33 - London Bus Routes 118 / N133 current diverted operating route

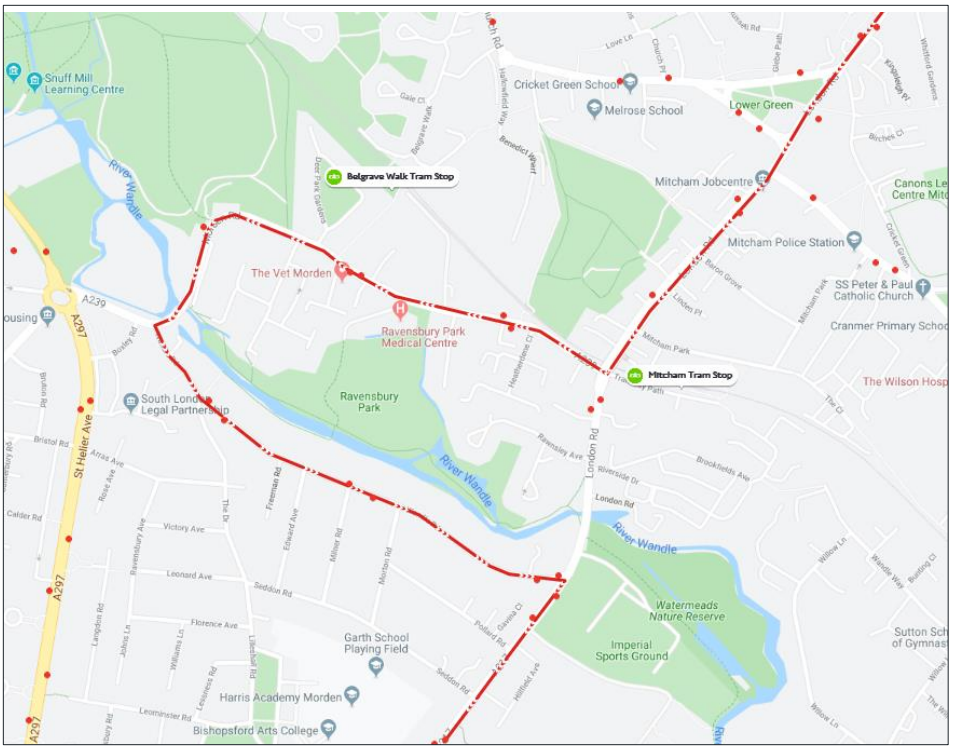

Figure 34 - London Bus Routes 280 current diverted operating route

2.6.4 NATIONAL CYCLE ROUTES

A number of key national cycle routes are currently impacted by the works at Bishopsford Road Bridge, see Figure 35. Routes include:

i) The Wandle Trail – This route crosses the west (downstream) footbridge linking Watermeads Nature Reserve and Ravensbury Park. It is anticipated that this link can be maintained regardless of the option considered for the works.

ii) National Route 20 - This route partly follows the Wandle Trail, and as such also crosses the west (downstream) footbridge. As above, It is anticipated that this link can be maintained regardless of the option considered for the works.

Figure 35 – National cycle route 20 and Wandle Trail alignment

2.7 GROUND CONDITIONS

A number of British Geological Society (BGS) historical boreholes are available for the immediate vicinity of the bridge, See Figure 36. These include borehole references; TQ26NE204, TQ26NE320, and TQ26NE387 which can be found in Appendix E. An additional borehole, reference TQ26NE451 is noted however these records are only available via paid subscription.

Historical boreholes and superficial deposit / bedrock mapping, as shown in Figures 37 to 38 identify the following anticipated ground conditions:

i) Made Ground
ii) Drift deposits (silts)
iii) London Clay
iv) Blackheath Beds (sedimentary rocks and pebbles)
v) Thanet Sands
vi) Upper Chalk Bedrock

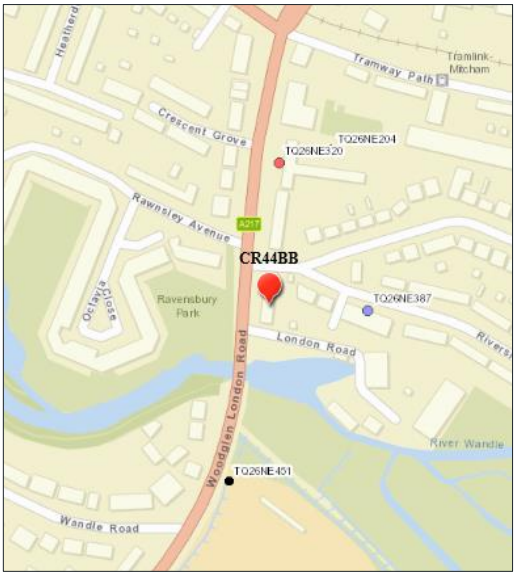

Figure 36 - BGS available borehole records for site

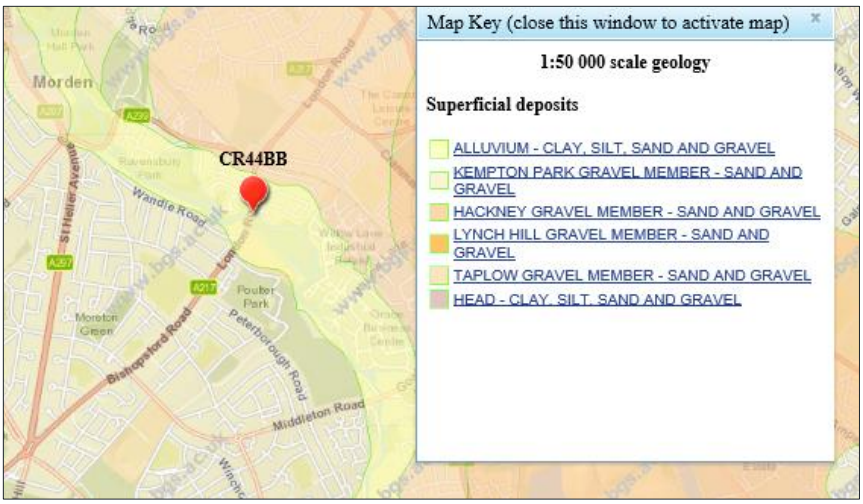

Figure 37 - BGS superficial deposits mapping for site

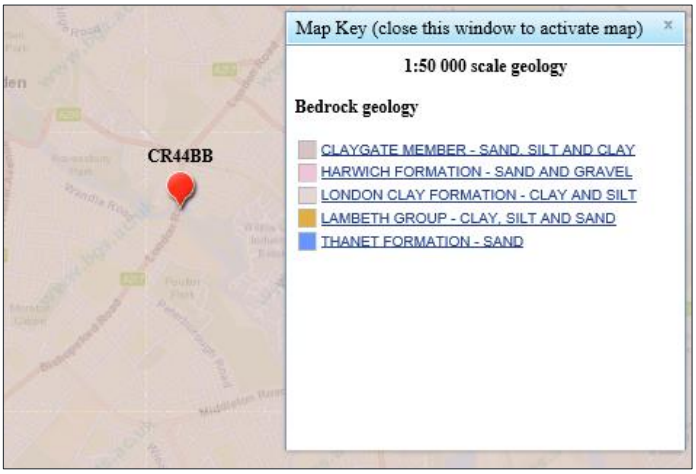

Figure 38 - BGS bedrock geology mapping for site

Further ground investigation works at the bridge site to support the bridgeworks designs (both permanent and temporary works). Ground investigation works within the river channel will require EA consents.

2.8 UNEXPLODED ORDNANCE

An unexploded ordnance assessment has not been carried out for the bridge location. A desktop study assessment will be required to be carried out prior to ground investigation works, and any further site investigations arising from the desk study completed prior to construction.

2.9 KNOWN PROTECTED HABITATS

The bridge is located in an environmental sensitive location; and is adjacent to public realm areas, and Watermeads nature reserve, owned and operated by the National Trust. The reserve encompasses both banks on the north side of the bridge although some of the area on the east side is leased to a development, refer to 2.6.3 above.

The nature reserve comprises a composition of woodland / scrubland, as well as amenity grassland and some mature trees. Further details of ground flora are contained in section H.2 of the Jacobs summary report contained in Appendix C.

It is noted that the proceeding strengthening (saddling works) was unable to secure consent for access to the areas of the Watermeads nature reserve for formation of storage and lay-down areas.

Specific habitats are reviewed as follows:

Bats

A number of bat boxes are present within Ravensbury Park suggesting the presence of bats within the immediate vicinity of the bridge. Prior to commencement of the works a review of the structure by a licenced bat specialist will need to be undertaken to confirm the potential for bat roots to be present with the structure. This evaluation should consider the fact that the structure is significantly submerged during flood events.

Previous evaluations undertaken by Jacobs during July 2008 (as recorded in report No. B0762500/BFRoad SI – refer to Appendix C) identified the opportunity for bat roosts in nearby trees. The tree stock adjacent to the bridge comprises semi-mature horse-chestnut trees, with splits towards the top of the stem, as well as lime trees (next to gate posts) which may provide a potential habitat for bat roosts. Although not anticipated as part of the works, any tree felling found to be necessary, should be undertaken in the presence of a licenced bat worker.

If additional street lighting is proposed as part of the scheme, further bat surveys will be required to identify whether bat flight routes are present along the River Wandle. If flight routes are found, they would impact such proposals.

Fish

The River Wandle is an established fresh water fisheries river, with fast flowing chalk based streams. Historical contamination from former industrial operations have been significantly

remediated reinstating water quality within the river promoting increase in increases in fish stocks within the river.

Wandle Trout are the predominant fish stock within the river, with instances of; chub, barbel, perch, roach and dace also recorded. Occasional recordings of eels have also been made in the river.

Fishing within the Watermeads Nature Reserve (upstream of the bridge) is restricted only to members of Morden Hall Park Angling Club who operate a return policy for catches to support the development of fish stock. Fishing from Ravensbury Park (downstream of the bridge) is permitted for those in possession of an Environment Agency rod licence.

Fishing is supported by regular weed cutting operations by the Environment Agency along the length of the River Wandle.

Birds

Areas of adjacent scrub and mature trees will provide suitable habitats for nesting birds, with a number of old bird nests noted in existing trees. Records also identify the presence of Blue Tit nests in nearby trees.

3 DESIGN CRITERIA

3.1 HIGHWAY CONSTRUCTION

3.1.1 HIGHWAY CROSS SECTION

The highway cross-section across the replacement superstructure should replicate the existing in terms of horizontal and vertical alignments, and avoid any impacts on adjacent third party land / boundary walls / accesses, as far as reasonable possible.

Where remedial works options are implemented existing carriageway and footway/verge widths are to be maintained. Where reconstruction works are implemented the following provisions shall be made:

- A minimum carriageway width of 7.30m
- A minimum footway width of 2.50m is to be maintained adjacent to the east (upstream) parapet, and tied into the existing footway on the bridge approach. The footway is to be incorporated into the same structure as the carriageway, opposed to the existing condition where the footway is accommodated on an additional structure.
- The width of the west (downstream) verge will be varied to retain the footprint of the structure within the existing highway boundary extents defined in section 2.6.2; no widening of the structure beyond the highway boundary will be permitted.

3.1.2 LOADING

The departmental standards BD 37/01 and 21/01 as used to validate the previous strengthening of the structure in terms of HA and HB loading are not relevant for design of a new structure. A new structure would be designed for loads defined within BS EN 1991-2:2003. Load models 1 and 2 are the replacements for HA loading. Load Model 3 is the replacement for HB loading. Load model 3 is defined as choices of SV vehicles, with approximate equivalence as follows:

30 units HB ~ SV80; 37.5 units HB ~ SV100; 45 units HB ~ SV196.

For a new structure in this location, depending on the assessed capacity of other nearby river crossings SV80 is likely to be appropriate. SV100 and SV196 have the same axle weights, so with the short spans of the proposed structure would have very similar load effects.

3.1.3 PARAPETS

The existing parapets are non-compliant with the requirements of EN 1317, where re-construction is considered the parapets to the replacement superstructure are to have a minimum containment of N1, with a working with of W2. If standard horizontal rail parapets were adopted, Infill mesh would be provided to prevent climbing and to prevent debris from the highway being blown into the River Wandle. However, aesthetically this would not suit the location so either a vertical infill metal parapet or a masonry parapet could be adopted.

There are no approach or departure vehicle restraints to the existing parapets. This is considered reasonable given the urban environment and prevailing speed limit. Any design

would however need to consider such provision (or not) on the basis of risk, benefit and impact on the conservation area.

3.2 IMPACTS ON THE RIVE WANDLE FLOW CAPACITY

3.2.1 PERMANENT WORKS

The aperture provided by the bridge is to be retained upon completion of any proposed repair / refurbishment works as to maintain the existing capacity through the structure and avoid exacerbation of the flood risk either upstream or downstream of the bridge site.

Guidance on provisions for climate change effects are published by the EA on Table 1 on the following webpage which provides consideration for climate change in flood risk assessments. For the Thames region a 35% potential change is anticipated up to 2050, whereas a 70% overall change is anticipated up to 2080. The latter being within the proposed serviceable life of the bridge where reconstruction is considered. These considerations are only considered applicable where reconstruction is considered as a preferred option, and not where remedial / refurbishment works are chosen as the preferred option.

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#table-1

Consideration of the latter 70% climate change guidance has identified that raising of the deck soffit level, and therefore the accompanying highway levels, will be required to accommodate the increased flow levels whilst observing the existing river channel edges. Lesser 35% climate change can be accommodated without impacts on highway levels, if reconstruction with a two-span portal structure can be accommodated.

Preliminary discussions between the London Borough of Merton / Environment Agency / WSP during a scheme update meeting on the 16th January 2020 identified that climate change considerations could potentially be relaxed where their consideration would exacerbate existing flood risk downstream of the bridge, or where increased flow rates may result in scour of the downstream riverbanks located in Ravensbury Park (where the river alignment curves south). Further consultation will be required with the EA via the FRAP application permit to confirm this.

3.2.2 TEMPORARY WORKS

Temporary works affecting the either; the flow, water quality, flood risk, and fisheries of the River Wandle will be subject to the securing of FRAP for the works. To implement the works it is anticipated that the following temporary works affecting the River Wandle:

i) Portadams / Dam Works:

The existing dam provision at site will be extended to cross the full breath of the river both upstream and downstream of the river, to form an enclosed worksite. Dams will be formed from either modular dam systems (such as portadams) or through double wrapped sand bags. Large diameter pipework will be incorporated into, and penetrating through the face of the dams to permit river flows to be maintained however the aperture provided by the pipework will be less than that provided by the current two-span flow channel.

Figure 39 - Examples of dams formed in bagwork with through piping

Figure 40 - Bagwork dam components: bags (l), polypipe through piping (r)

Figure 41 - Portadam details: as-constructed (l), erection and construction (r)

ii) Over-pumping:

Future flood impact assessments may additionally identify the requirement for additional over-pumping provision for the mitigation of peak flows during flood events up to, and including storm events with a 1:100 years flood return period. It is anticipated that with the existing structure in place, the aperture provided by the through piping accommodated within the dams will only provide an aperture of circa 35% of the existing bridge aperture, leading to accumulation of flows immediately upstream of the bridge. This accumulation of flows increases the flood risk, in particular for nearby low-lying residential properties and sensitive environmental areas including Watermeads Nature Reserve. Over-pumping may be combined with silt traps to manage water quality issues in light of the sensitive and fisheries nature of the River Wandle. The rate of over pumping required will need to

determined once the option is selected and the temporary through pipe capacity aperture and determined.

Figure 42 - Example over-pumping plant

iii) Oil booms and silt traps

A key mitigation measure to be implemented by the works is the mitigation of the risk of contaminates, silt, and oil being accidentally discharged downstream of the bridge in the event of an accidental spill event. The works should consider the erection of oil booms and silt traps downstream of the silt to capture any contaminants in the event of accidental release. These elements of the works complement, but do not replace, cyclic water quality monitoring to be undertaken during the progress of the works.

Figure 43 - Example in channel silt trap and oil boom

iv) Temporary Service Bridges

Existing consultation undertaken at C3 enquiry stage has identified significant programme and cost implications from service diversion works. It may therefore be desirable to erect temporary service support structures to accommodate services within or near their existing locations. These temporary structures will be founded on temporary foundations excavated into either the bridge approaches or embankments of the River Wandle. Where constructed within the banks of the river, the consideration of reinforced granular or precast concrete foundations should be made, to mitigate contamination risk to the river. Recovered arisings should be held on site and re-used to avoid any environmental impacts. Mitigation planting may additionally be required where it is removed. Efforts should focus on the retention of trees at site, with temporary works built around any existing mature trees.

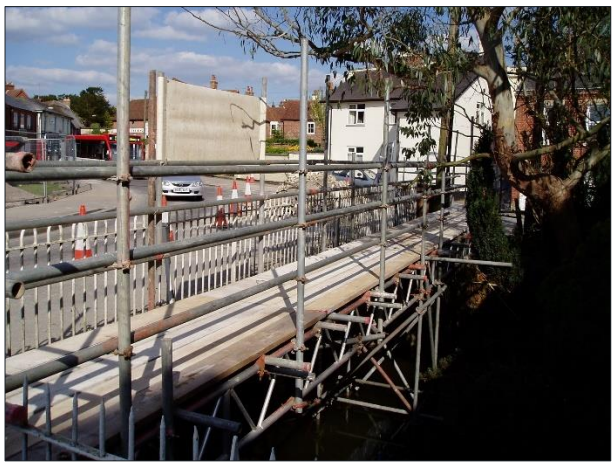

Figure 44 - Temporary service bridge (services beneath deck) incorporating emergency works access

3.3 ACCESS REQUIREMENTS AND CONSTRUCTION INTERFACE

A key project driver is the removal of the existing closures of the A217 London Road / Bishopsford Road as a result of the structural collapse. Options proposed should therefore seek to re-open the site to traffic at its earliest opportunity.

If the preferred option is to re-construct the bridge the completion of the permanent works is likely to take longer than a repair option (if feasible) would. In this scenario alternative mitigation measures maybe considered to reinstate some traffic flows through the worksite. This may be by staged construction such as, introducing a single traffic lane, construction of temporary bridges alongside the structure, or construction of temporary bridge above the worksite to accommodate through traffic flows whilst executing the works below.

Considering the land available, if temporary bridges are provided it is anticipated they will be Bailey Bridge modular type bridges, constructed above the existing bridge at a minimum of 1000mm vertical clearance above the proposed final permanent bridge deck level. Subject to available bearing capacity the bridge would be supported on spread foundations incorporated into the approaches to the river. Approach earth ramps would need to be constructed to manage level differences between the approach carriageway and the bailey bridge deck. The overall width of the temporary bridge would need to be restricted to half of the existing carriageway width in order to provide works and cranage access for the bridge reconstruction.

Figure 45 - Modular Bailey Bridge construction above existing bridge deck

Figure 46 - (L) Temporary ramp construction
(C) Temporary bridge, in-carriageway construction
(R) Trimmer beam used to achieve elevation above deck level

Erection of temporary structures to permit through passage of traffic, would require temporary traffic orders concerning both weight and width restrictions at site, and operation of a diversion route for large vehicles or HGV's. These orders would be necessary to ensure reliable passage of vehicles over narrower temporary structure and vertical alignment transitions between the existing road surface, the ramps and the bridge. Unless a one-way order was implemented two-way temporary traffic signals would therefore be needed to manage the opposing flows. These orders would need to be supplemented by additional enforcement of parking restrictions adjacent to the site, to permit the flow of vehicles past queuing vehicles where signals are used to regulate flows across the bridge.

Additional warning signage would be needed at both the site and across the wider highway network within the London Borough of Merton and Sutton.

Temporary structures may additionally serve dual purpose accommodating service diversions where vertical slewing is possible. In this event temporary service ducts can be suspended from the bottom flange of the temporary bridges.

Figure 47 - Service routes supported from temporary bridge

If a temporary bridge was considered desirable, it is recommended that:

- Consultation be undertaken with the London Fire Brigade, regarding potential impacts of queuing vehicles on access to Mitcham Fire Station immediately north of the bridge. This impact may require unbalanced timings of phases of temporary signals to prevent queue lengths reaching the fire stations.
- Road safety audits of the proposed temporary bridge arrangements, to ensure forward visibility is compliant with standards and measures are in place to deter unauthorised pedestrian accesses.
- Site trails of different public service vehicles (buses, refuse vehicles etc) prior to opening to ensure these essential services can transverse the site. These trails will be undertaken within the existing closure prior to opening.

The adoption of the bailey bridge has been discussed at length with the Borough of Merton and in spite of the short-term advantages it may provide, it has been rejected due to the following reasons:

- It would add considerably to the construction time for the final structure as contractors would have to work around the Bailey bridge to access the construction site. The aim is to get the permanent bridge open as soon as possible and as safely as possible.
- The Bailey bridge would not be able to take buses or anything much more than a car. It would also be single lane so would result in queuing traffic on either side, right outside people's houses. This might also interfere with the operation of Mitcham Fire Station (to the east) and Tooting and Mitcham Hub (to the west) as well as disturbing the amenity of the neighbours
- There would have to be considerable engineering works to arrange a ramp up to the bridge on either side.
- All of the above increases the costs and risks, particularly the Bailey bridge would slow down the construction of the end product

4 SUPERSTRUCTURE REPAIR AND REPLACEMENT OPTIONS

A number of options have been considered for the repair / refurbishment and / or reconstruction of Bishopsford Road bridge, these are outlined in subsequent paragraphs and summarised in Section 4.5. Options considered in this study include:

i) Do minimum - Line and partially infill north span, reconstruct saddle, subsequently restrict traffic to light vehicles only.

ii) Partial Reconstruction - Reconstruction of the northern and centre arches on a like-for-like basis, open to HA & 45 HB traffic.

iii) Reconstruction - Demolish existing structure, reconstruct with two span portal structure.

iv) Reconstruction - Demolish existing structure, reconstruct with single span portal structure.

The following criteria have been used to assess options for the design:

- Durability and serviceability;
- Health & Safety;
- Impact on statutory undertaker's plants and services;
- Environmental and sustainability;
- Programme (including duration of river disruption and road / lane closures);
- Buildability;
- Aesthetics;
- Capital cost;
- Whole life cost;
- Live load capacity achieved;
- Overall project risks

Sketches of the proposed options are contained within the options discussions.

Residual risks associated with each option are discussed at the end of this section.

4.1 OPTION 1 - LINE AND PARTIALLY INFILL THE NORTH SPAN, RECONSTRUCT SADDLE, SUBSEQUENTLY RESTRICT TRAFFIC TO LIGHT VEHICLES ONLY

Scope

This option would involve works to stabilise and utilise the existing structure, to extend its serviceable life in the short term and re-establish traffic flows through the site. It is anticipated that this option would have a maximum service life of 10 years, but would not restore the desired live load capacity of 40T & 45HB to carriageway areas.

The scope of works undertaken within this option would include:

Temporary Works

- Installation of dams across the channel with through piping and de-watering to provide access to the worksite;
- Installation of temporary shoring / props to the partially collapsed span to permit infilling of the northern span, the shoring / props will be sacrificial and cast into the north span infilling.
- Erection of temporary service bridges along each elevation, the erection of the north elevation bridge may require removal of the existing east (upstream) footbridge parapet to permit support of BT Openreach services.

Permanent Works

- Demolition of the failed concrete saddle to the bridge;
- Brickwork remedial works to reform the north east and north west spandrel walls, wingwalls, and north abutment where collapsed and exposing the embankment infill.
- Stitching and brickwork repair works to stabilise the north span against hydrostatic pressures during infilling works, and to address displacement along the longitudinal crack in the centre span.
- Excavation of invert silts within the north span, underpinning works to the bridge foundations (as appropriate), and formation of a binding course in advance of infilling.
- Installation of an Armco pipe former through the north span of the bridge, formwork and falsework to the elevations and props to the buried face of the north span will provide containment for the grouting works to this span.
- Installation of grout and venting points through the barrel of the north span, and subsequent staged grouting up of the north span around the Armco pipe.
- Reconstruction of the north pier cut-water to re-plumb the pier section providing support to BT Openreach services.
- Reconstruction of disturbed fill to approach embankments disturbed during the failure.
- Reconstruction of saddle to the bridge structure, incorporating reinstatement of the Thames Water services along their previously proposed alignment and waterproofing.
- Reinstatement of carriageway surfacing.
- Installation of scour protection measures to prevent re-occurrence of previous scour.

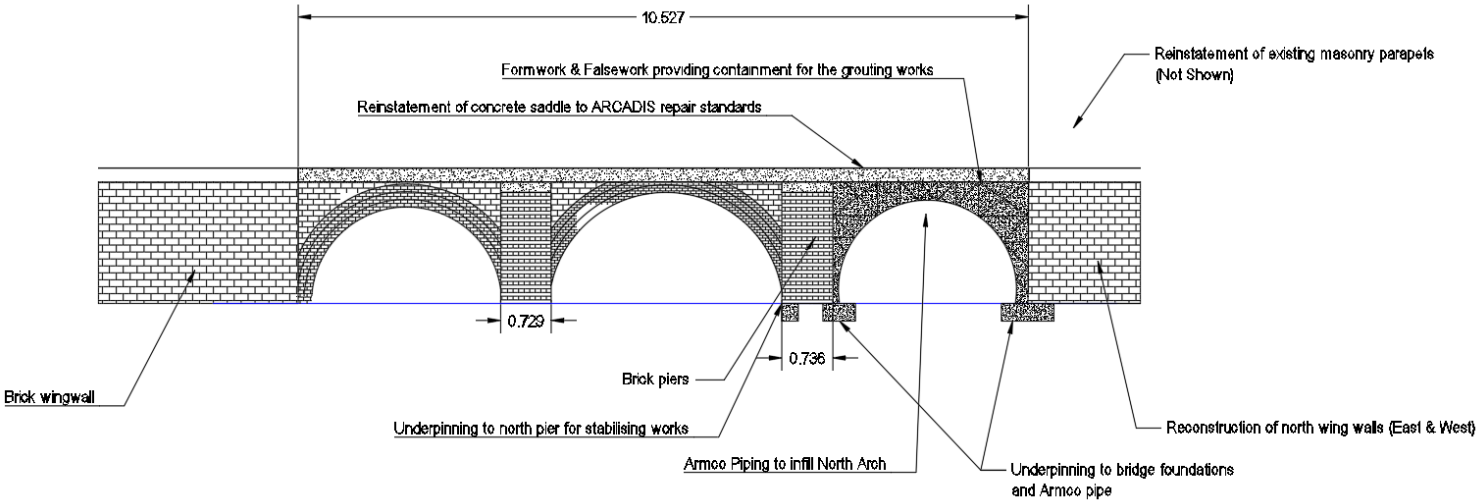

Figure 48 - Armco pipe installation into north arch

This option has the smallest scope and initial capital costs of the options considered, the superstructure will however require reconstruction after the 10 year period. The option will extend the working life of the bridge from 136 years to 146 years prior to reconstruction. Options 3 or 4 will subsequently be adopted at the end of the serviceable period.

Scope of maintenance works undertaken within this option would include:

i) Extensive re-pointing throughout the bridge where not previously addressed through the preceding strengthening works.

ii) Replacement of the east (upstream) footbridge parapet, which is removed to accommodate the proposed services bridge.

Impacts / Disruption

Parking: No anticipated impacts, beyond the existing works and ongoing closure, are anticipated.

Road Closures: The existing road closure will be retained, and extended in duration, to facilitate the proposed works. No proposed route through the worksite will be provided to accommodate either pedestrians or vehicles, however the west (downstream) footbridge will be retained in service to retain pedestrian access through the site.

River Wandle: During the temporary condition the aperture will be significantly restricted, with only through piping maintained through the centre and south spans. The provided aperture area provided by the centre and south spans is 13.425m^2, whereas it is anticipated that the achievable temporary aperture is 4.525m^2 (approximately one third of the original aperture). Hydraulic simulation of this constriction is recommended to consider accumulations of flows immediately upstream of the bridge and potential increased flood risk to nearby developments.

Analysis of the permanent condition will consider whether reduction of the north span capacity occurs following partial infilling, it is anticipated that loss

of aperture will be in part off-set through reduction in roughness co-efficient of the liner. The aperture of the centre and south span will be maintained as existing upon completion of the works.

Details of proposed scour protection measures will require consideration of existing environmental constraints, including trout spawning and egg laying, and roughness co-efficient of the existing river invert.

However, it is anticipated that works can be undertaken between April and September as not to impact on the trout spawning periods commencing in October.

Services: Minor lifting and temporary support of existing utilities crossing the bridge deck will be required to provide access to demolish the failed saddle. The saddle in footway areas will require advanced demolition to ensure that services can be accessed and supported prior to demolition of the main saddle areas. Services supported in existing locations include; BT Openreach and UKPN (HV and LV services).

Thames Water services will however require both temporary and permanent diversion. Temporary diversion will be via the east (upstream) service bridge, with permanent diversion through the saddle in the previously proposed positions.

SGN services are unaffected by these proposals (although service bridge foundations will be designed around the ends of the capped main), with only a permanent reinstatement upon completion of the works.

Boundaries: It is anticipated that the service bridges provided can be constructed within the existing highways boundary, however the foundation footprint of the east (upstream) service bridge may require access to areas controlled by the National trust, local disruption within the river banks may occur as a result of these works. It is anticipated that access to the national trust land to the east of the bridge will be required for the removal of the east (upstream) footbridge parapet.

Aesthetics: This option will create less of a positive impact on the conservation area than the existing structure did. However the upstream footbridge obscures much of the original elevation so it is only the view from the downstream footbridge that is affected.

<u>Key Assumptions</u>

This option has been developed considering the following key assumptions:

- The reduction in the north span aperture can be offset by capacity enhancements achieved through reduction in the roughness co-efficient of the span following integration of the Armco pipe.
- The Armco pipe will become load bearing following grouting, however the self weight of the supported collapsed arch and saddle will restrict the available live load capacity. As

such upon completion of the works the bridge will be restricted to use by light vehicles only.

- Temporary and permanent diversions of Thames Water assets will be undertaken, and it will be possible to support BT Openreach services in their current location. Insufficient slack exists in BT Openreach services to permit slewing or raising of the services.
- Significantly reduced apertures can be accommodated during the construction stage, mitigation measures such as over-pumping for peak flood events, will be developed subsequent to hydraulic simulation of the temporary works which will identify the requirement for these type of works.

Key Risks

Adoption of this option will realise the following key risks:

Table 1 – Option 1 schedule of key risks associated with option adoption		
Stage	**Risk**	**Mitigation Measures**
Construction	Reduced aperture will significantly exacerbate the flood risk upstream of the bridge, potentially affecting third party residential properties and protected habitats.	Hydraulic simulation of temporary works is to be undertaken in advance of FRAP application. Simulation is to consider a peak 1 in 100 year flood event. Where existing flood risk is shown to be increased additional mitigation measures will be considered (such as over-pumping via settlement tanks) to increase capacity through the works.
	Instability of structure during or upon completion of the works as a result of hidden defects.	Defects within the structure are currently considered a risk to structural integrity. Temporary polystyrene packing is to be installed within the span following de-watering to support the span and allow man access into the partially collapsed span for erection of the Armco pipes and permanent shoring. As shoring is introduced the packing is to be retreated permitting further shoring to be introduced. Shoring is to be retained and cast into the permanent works to avoid any potential instability, with additional support provided by the Armco liner. Grout infilling is to be used to fill the span and provide support to the collapsed span and line. These works will be supplemented by partial demolition and reconstruction of the north east and north west wingwalls and spandrels. Partial reconstruction of the abutment may additionally be required where significant support has been lost.
	Buildability of Armco liner around temporary (sacrificial) shoring works	Limited clearances within arch will lead to congestion when the geometry of the Armco liner and shoring is considered. Consideration of the fit of the liner around proposed sacrificial shoring will restrict the diameter of pipe which can be used in the works, which will impact significantly on the aperture retained in the span. Hydraulic simulation of the permanent works will need to be completed to determine flood risk impacts as part of the EA FRAP.
	Boundary	It is anticipated that the service bridges provided can be constructed within the existing highways boundary, however the foundation footprint of the east (upstream) service bridge may require access to areas controlled by the National trust. It is anticipated that access to the national trust land to the east of the bridge will be required for the removal of the east (upstream) footbridge parapet and hence prior permission is to be obtained.
In-service	Serviceable life extended beyond 120 years to 146 years before replacement.	Structure is formed in masonry and therefore is not considered fatigue susceptible. General and Principal inspections will be undertaken in accordance with DMRB standard BD63/17 incorporating touching distance inspection of soffit areas to aid early identification of any defects allowing extended management of the structure beyond 120 years serviceable life. The structure to be reconstructed after 10 year service life post refurbishment works to limit residual risk of extended serviceable lives proposed.
	Structure is inadequate to accommodate increases in river flows as a result of climate change effects.	Serviceable life of remediated structures is restricted to 10 years, and therefore climate change effects over this period is not considered significant. Reconstruction of the works

Table 1 – Option 1 schedule of key risks associated with option adoption		
Stage	**Risk**	**Mitigation Measures**
		at the end of the residual life will consider up to 70% climate change in line with existing EA published guidance.
	Parapets remain non-compliant with EN1317 upon completion of works.	Existing arrangement not changed, no significant RTA records at site, bridge on straight alignment reducing risks. Reconstruction in 10 years will consider compliant parapet in accordance with Highways England's DMRB.

Costs

The anticipated initial capital works costs for this proposed option is £880,000. This option represents the lowest capital works cost of the options considered.

Discounted whole life cost for this option is £2,554,228.

Whole life costing (WLC) analysis for this option can be found in Appendix F.

4.2 OPTION 2 – RECONSTRUCT NORTH AND CENTRAL SPANS ABOVE SPRINGING LEVEL ON A LIKE-FOR-LIKE BASIS, RECONSTRUCT SADDLE, AND OPEN TO HA & 45HB TRAFFIC

Scope

This option would involve works to address the existing structurally significant defects through reconstruction of the north and centre arches above springing levels. Works will also involve part reconstruction of the north pier beneath the BT Openreach services to adjust it's rotation, and reconstruction of the saddle of the centre and north span. It is anticipated that this option would have a maximum service life of 20 years, and would restore the desired live load capacity of 40T & 45HB to carriageway areas.

The scope of works undertaken within this option would include:

Temporary Works

- Installation of dams across the channel with through piping and de-watering to provide access to the worksite;
- Installation of temporary restraint ties (macalloy rods) to the south span to provide restraint against thrust forces during demolition of the centre and north span; alternatively provide restraint to the south pier to support the thrust forces from south span,
- Erection of temporary service bridge along west (downstream) elevation.
- Erection of temporary propping adjacent to east footway northern pier.
- Arch centering for northern and central spans

Permanent Works

- Demolition of the failed concrete saddle to the bridge above the northern and central spans.
- Removal of the northern pier of the eastern footway extension.
- Brick work reconstruction of northern pier of the eastern footway extension
- Removal of temporary propping
- Removal of central and northern arches, spandrel wingwalls and parapets above.
- Northern arch pier foundation stabilization work. Excavation of invert silts within the north span, underpinning works to the bridge foundations or reconstruction from bottom up with concrete foundations and brickwork pier
- Installation of scour protection measures to prevent re-occurrence of previous scour.
- Reconstruction of the northern and central arches.
- Brickwork reconstruction of the north east and north west spandrel walls, wingwalls, and north abutment.
- Reconstruction of saddle to the bridge structure
- Waterproofing saddle, lapping onto remaining part of existing saddle

- Reinstate Thames Water, UKPN, Openreach and SGN services on to new structure
- Remove temporary service bridge
- Place fill on approach to new structure
- Reinstatement of carriageway and footway construction.

This option will involve extension of the existing superstructure's serviceable life by a minimum of 20 years.

This option has the second lowest capital costs of the options considered, the superstructure will however require reconstruction after the 20 year period. This option will extend the working life of the bridge from 136 years to 156 years prior to reconstruction.

Scope of maintenance works undertaken within this option would include:

i) Refurbishment of the bridge substructure and brickwork parapets.

ii) Re-waterproofing of the bridge deck.

iii) Construction of new 300mm thick concrete deck over footway areas. Raised kerbs will be installed along kerb lines to accommodate the difference in construction levels between carriageway and footway areas, and to additionally provide a level of vehicle containment to footway areas.

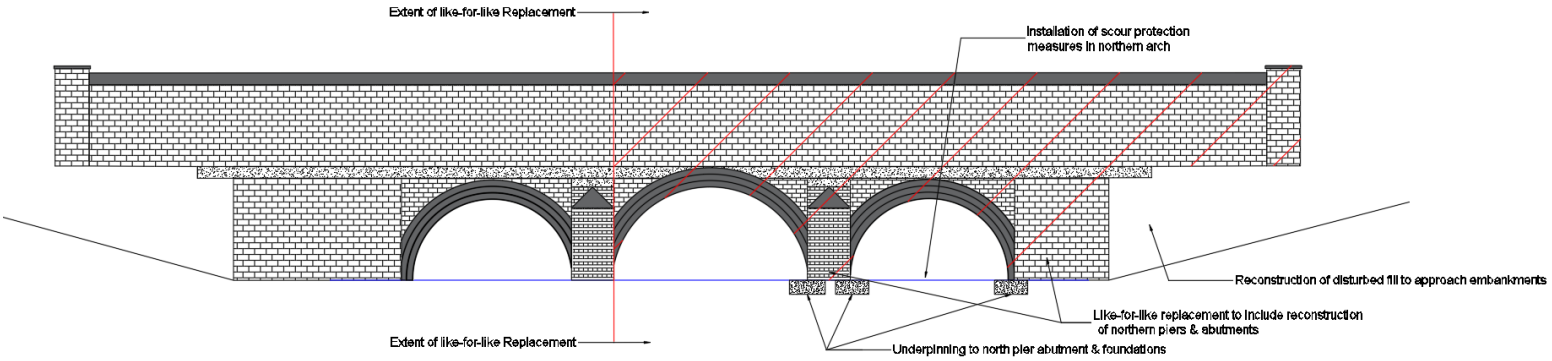

Figure 49 - Cross-section of proposed Option 2 works

Impacts / Disruption

Parking: No anticipated impacts, beyond the existing works and ongoing closure, are anticipated.

Road Closures: The existing road closure will be retained, and extended in duration, to facilitate the proposed works. No proposed route through the worksite will be provided to accommodate either pedestrians or vehicles, however the west (downstream) footbridge will be retained in service to retain pedestrian access through the site.

River Wandle: During the temporary condition the aperture will be significantly restricted, with only through piping maintained through the centre and south spans. The provided aperture area provided by the centre and south spans is 13.425m^2, whereas it is anticipated that the achievable temporary aperture is 4.525m^2 (approximately one third of the original aperture). Hydraulic simulation of this constriction is recommended to consider accumulations of flows immediately upstream of the bridge and potential increased flood risk to nearby developments.

Analysis of the permanent condition will not be considered as the aperture of the north, centre and south span will be maintained as existing upon completion of the works.

Details of proposed scour protection measures will require consideration of existing environmental constraints, including trout spawning and egg laying, and roughness co-efficient of the existing river invert.

Services: Lifting and temporary support of existing utilities crossing the bridge deck will be required to provide access to demolish the failed saddle. The saddle in footway areas will require advanced demolition to ensure that services can be accessed and supported prior to demolition of the main saddle areas. Services supported in existing locations include; BT Openreach and UKPN (HV and LV services).

Thames Water services will however require both temporary and permanent diversion. Temporary diversion will be via the eastern footway bridge, with permanent diversion through the saddle in the previously proposed positions.

SGN services are unaffected by these proposals (although service bridge foundations will be designed around the ends of the capped main), with only a permanent reinstatement upon completion of the works.

Boundaries: It is anticipated that the service bridge provided can be constructed within the existing highways boundary, local disruption within the river banks may occur as a result of these works. It is anticipated that access to the national trust land to the east of the bridge may be required for the removal of the east (upstream) footbridge parapet.

Aesthetics: This option will maintain the current aesthetic. However the upstream footbridge obscures much of the original elevation so it is only the view from the downstream footbridge that is affected.

Key Assumptions

This option has been developed considering the following key assumptions:

- Temporary and permanent diversions of Thames Water assets will be undertaken, and it will be possible to support BT Openreach services in their current location. Insufficient slack exists in BT Openreach services to permit slewing or raising of the services.
- Significantly reduced apertures can be accommodated during the construction stage, mitigation measures such as over-pumping for peak flood events, will be developed subsequent to hydraulic simulation of the temporary works which will identify the requirement for these type of works.
-

Key risks:

Adoption of this option will realize the following key risks:

Table 2 – Option 2 schedule of key risks associated with option adoption		
Stage	**Risk**	**Mitigation Measures**
Construction	Reduced aperture will significantly exacerbate the flood risk upstream of the bridge, potentially affecting third party residential properties and protected habitats.	Hydraulic simulation of temporary works is to be undertaken in advance of FRAP application. Simulation is to consider a peak 1 in 100 year flood event. Where existing flood risk is shown to be increased additional mitigation measures will be considered (such as over-pumping via settlement tanks) to increase capacity through the works.
	Instability of structure during or upon completion of the works as a result of demolition works.	During demolition and construction careful consideration should be made with regards to the stability of the southern arch. The southern pier and span need to be adequately supported during partial demolition of the structure.
	Demolition and construction debris entering the watercourse.	The dry dock and through piping shall be in place prior to any demolition works commencing; upon completion of the works the dry dock shall be cleared of all debris prior to the watercourse being returned to normal flow conditions via the removal of the portadams.
	Partial demolition of the concrete saddle will require the contained services within the saddle to be broken out; services remaining live must not be damaged during demolition or reconstruction.	Services are to be suspended in place by gantries spanning between the existing abutments following breakout to prevent rupture.
	Additional scour to the river bed caused by the increased flow velocities entering and exiting the through-piping.	Sedimat scour protection to be provided at inlets and outlets of the through piping to prevent scour and contain any sediment moving within the watercourse.
In-service	Serviceable life extended by 20 years before replacement.	The southern span is proposed to be retained. The southern span is formed in masonry and therefore is not considered fatigue susceptible. General and Principal inspections will be undertaken in accordance with DMRB standard BD63/17 incorporating touching distance inspection of soffit areas to aid early identification of any defects allowing extended management of the southern span beyond 120 years serviceable life.
	Existing masonry parapets are substandard, with the structure being replaced on a like-for-like basis, additional protection for the parapets is required for vehicle impacts.	Trief kerbs can be considered to improve vehicle containment. Otherwise consider constructing compliant parapet in accordance with Highways England's DMRB

Costs

The anticipated initial capital works costs for this proposed option is £1,860,000. This option represents the second lowest capital works cost of the options considered.

Discounted whole life cost for this option is £2,033,104.

Whole life costing (WLC) analysis for this option can be found in Appendix F.

4.3 OPTION 3 – DEMOLISH EXISTING STRUCTURE, RECONSTRUCT WITH TWO SPAN PORTAL STRUCTURE

Scope

This option would involve complete reconstruction of arch bridge and eastern footway extension. The new bridge deck width would be similar to the width of existing arch bridge plus eastern footway extension. The reconstruction work comprises new brick work or RC northern and southern abutments, wingwalls; RC central pier supported by piled foundation; two span continuous RC deck formed with precast RC beams.

The existing STATs that are not diverted will be supported on the temporary gantries on the north and south side of the structure during the reconstruction and will be diverted/ placed in the new RC deck and footways fill on both side of the bridge. It is anticipated that this option would have a service life of 120 years, and would provide the required live load capacity for a new bridge design.

The southern abutment could be extended and reused to support the new bridge deck. However, the partial reuse of the abutment is dependent on achieving the required capacity for the new bridge deck dead and design live loads. As the pier and other abutments would be new, it would seem logical to replace all substructures so all have like foundations; it is likely that the new bridge substructures would require piled foundations.

The scope of works undertaken within this option would include:

Temporary Works

- Installation of dams across the channel with through piping and de-watering to provide access to the worksite.
- Installation of temporary restraint ties (macalloy rods) to the south span to provide restraint against thrust forces during demolition of the centre and north span, alternatively provide restraint to the south pier to support the thrust forces from south span.
- Erection of temporary service bridges along each elevation, the erection of the north elevation bridge may require removal of the existing east (upstream) footbridge parapet to permit support of BT Openreach services.

Permanent Works

- Removal of east footway deck, piers and cut-waters.
- Removal/cutting of east footbridge piles.
- Complete demolition of the concrete saddle to the bridge.
- Complete removal of the arches and spandrel walls.
- Removal of existing substructure including piers, abutments and wingwalls.
- Prepare the river bed for the new substructure support including any required piling for the pier and abutments.
- Reconstruct the substructure foundation.
- Construct the abutments, pier and wingwall.

- Place the new concrete deck including utility ducts and pipes.
- Waterproofing of the new deck.
- Reconstruction of fill to approaches of the new substructure.
- Reinstatement of the Thames Water, UKPN, Openreach and SGN services along their previously proposed alignment.
- Reinstatement of carriageway surfacing.

This option will achieve the structure's serviceable life of 120 years. Upon implementation of the works, the bridge would restore full live load capacity.

Scope of maintenance works undertaken within this option would include:

i) Re-painting of all steel elements forming the parapet.

ii) Re-waterproofing of the existing bridge deck.

iii) Replacement of bearing (pending on detail design) after 50 years

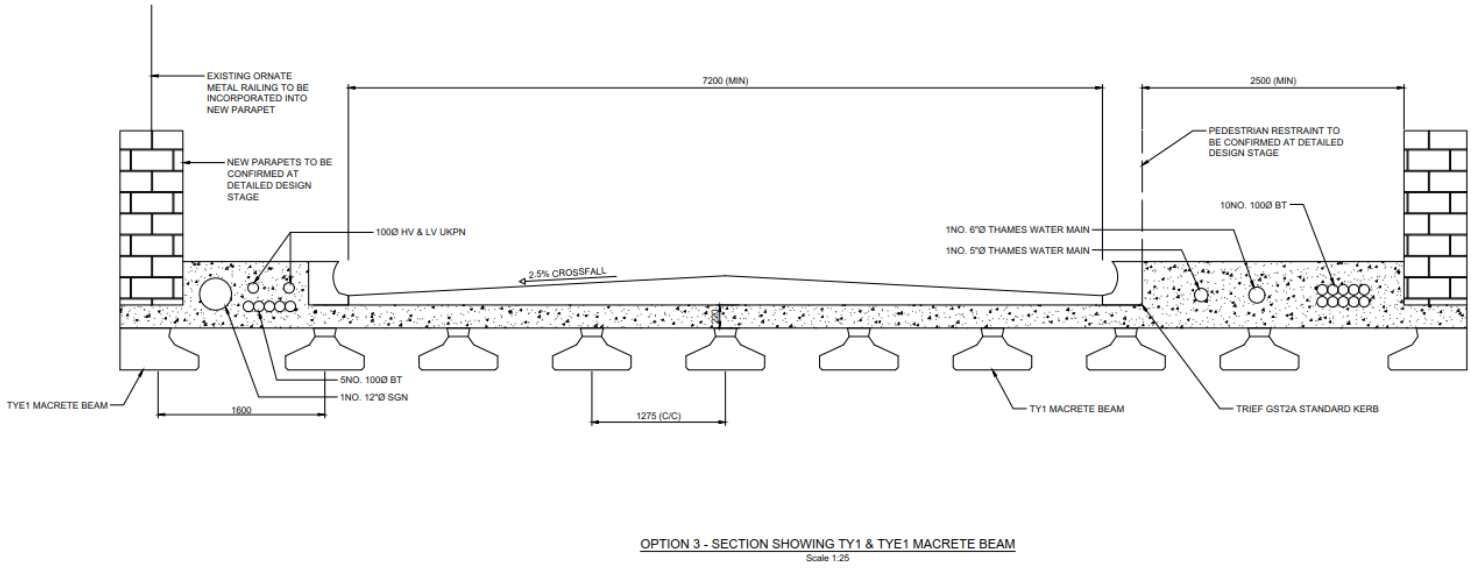

Figure 50 - Cross-section of proposed Option 3 works

Impacts / Disruption

Parking: No anticipated impacts, beyond the existing works and ongoing closure, are anticipated.

Road Closures: The existing road closure will be retained, and extended in duration, to facilitate the proposed works. No proposed route through the worksite will be provided to accommodate either pedestrians or vehicles, however the west (downstream) footbridge will be retained in service to retain pedestrian access through the site.

River Wandle: During the temporary condition the aperture will be significantly restricted, with only through piping maintained through the centre and south spans. The provided aperture area provided by the centre and south spans is 13.425m^2, whereas it is anticipated that the achievable temporary aperture is 4.525m^2 (approximately one third of the original aperture). Hydraulic simulation of this constriction is recommended to consider accumulations of flows immediately upstream of the bridge and potential increased flood risk to nearby developments.

Analysis of the permanent condition will consider whether increase of the structure aperture is meeting the EA climate change requirements. However due to larger span aperture the hydraulic modelling of the river should be done to check the effect of significant aperture increase and its effect on downstream structures.

Details of proposed scour protection measures will require consideration of existing environmental constraints, including trout spawning and egg laying, and roughness co-efficient of the existing river invert.

Services: Lifting and temporary support of existing utilities crossing the bridge deck will be required to provide access to demolish the failed saddle. The saddle in footway areas will require advanced demolition to ensure that services can be accessed and supported prior to demolition of the main saddle areas. Services supported in existing locations include; BT Openreach and UKPN (HV and LV services).

Thames Water services will however require both temporary and permanent diversion. Temporary diversion will be via the east (upstream) service bridge, with permanent diversion through the saddle in the previously proposed positions.

SGN services are unaffected by these proposals (although service bridge foundations will be designed around the ends of the capped main), with only a permanent reinstatement upon completion of the works.

Boundaries: It is anticipated that the service bridges provided can be constructed within the existing highways boundary, however the foundation footprint of the east (upstream) service bridge may require access to areas controlled by the National trust, local disruption within the river banks may occur as a result of

these works. It is anticipated that access to the national trust land to the east of the bridge will be required for the removal of the east (upstream) footbridge parapet.

Aesthetics: This option will 'tidy up' the upstream elevation by integrating the services and footbridge into the main structure. Even numbers of spans are not as satisfactory as odd numbers due to the effect of the unresolved duality, which will be visible from both elevations, as will the change from a character structure to one that is unavoidably utilitarian. It is considered that from the upstream side the effect is neutral, and from the downstream footbridge it is negative.

Key Assumptions

This option has been developed considering the following key assumptions:

- A further topographic survey will be undertaken to include the areas immediately surrounding the bridge to allow reliable design development
- The increase in the spans aperture is in line with climate change requirements and down steam flood modelling.
- Temporary and permanent diversions of Thames Water assets will be undertaken, and it will be possible to support BT Openreach services in their current location. Insufficient slack exists in BT Openreach services to permit slewing or raising of the services.

Key risks:

Adoption of this option will realise the following key risks:

Table 3 – Option 3 schedule of key risks associated with option adoption		
Stage	**Risk**	**Mitigation Measures**
Construction	Service diversions requiring unexpected additional lead-in time	Services traced by GPR and confirmed where required by trial hole. Full liaison with statutory undertakers, use of existing downstream footbridge or temporary structures to support diverted services. Temporary structures used to support existing services where possible to save diversion.
	Contamination of Watercourse during demolition	River flow to be piped through the work site,or diverted though alternate spans for as short a period as possible. Encapsulation structures to be used to capture debris and dust to prevent contamination of watercourse. Silt traps to be employed to capture suspended solids within pumped discharged water. Biodegradable oils used for plant operated within or over the watercourse. Spill kits to be available on site at all times to contain and spills and mitigate effects.
	Instability of existing structure during demolition, leading to collapse, injury or flooding	Temporary works to be installed to stabilise structure. Full and thorough method statements to be prepared well in advance, reviewed by competent people, and communicated to all involved. Close supervision to ensure it is adhered to or work paused if problems occur which prevent completion in accordance with it. Adoption of exclusion zones to keep people out of harms way.
	Contamination of Watercourse during construction, piling for the central pier being the most challenging activity to manage	River flow to be piped through the work site, or diverted though alternate spans for as short a period as possible. As much of the structure shall be pre-cast as practicable permanent formwork adopted and joints sealed and checked prior to placement of in-situ concrete. Biodegradable oils used for plant operated within or over the watercourse. Spill kits to be available on site at all times to contain and spills and mitigate effects.
	Re-waterproofing and concreting works will require services to be raised from deck, water and gas main pipe joints may potentially rupture as a result causing leakage.	At design stage affected statutory undertakers will be engaged further to determine constraints against lifting of services, and any modifications required to safeguard against leakages. Temporary service bridges are to be provided to support modified services during works preventing damage.
	Delivery and installation of large pre-fabricated components within an urban environment with significant on-street parking. - The width between the highway boundaries may restrict the type / size or lifting capacity of the crane, particularly if services are present which prevents loading from outriggers being applied to the footways.	Parking will be restricted to allow safe access for plant. Size of pre-fabricated elements to be reduced as far as is reasonably practicable. Crane type, size and position to be considered during design to ensure a viable solution is available.
In-service	Access / egress for inspection	Access to watercourse compromised by adjacent land use; means of safe access will need to be determined during design. Access to deck soffit will need to be carried out at times of lower flow. Concrete design solution minimises future maintenance liabilities and enhances durability of structure mitigating future maintenance liabilities.

Table 3 – Option 3 schedule of key risks associated with option adoption		
Stage	**Risk**	**Mitigation Measures**
	Accidental vehicle loading to footways could lead to crushing of services	Services located within footway construction will either be provided with steel sleeves or be encased within concrete. Where required by statutory undertakers services can be accommodated within the deck construction between longitudinal precast beams to provide additional protection against accidental vehicle loading.
	Vehicle Containment	As the speed limit is 30mph vehicle containment can either be achieved through suitable design of masonry parapets, or as shown by Trief kerbs. Detailing of structure to incorporate effective waterproofing membrane will influence this selection

Costs

The anticipated initial capital works costs for this proposed option is £2,690,000.

Discounted whole life costing for this option is £770,284.

Whole life costing (WLC) analysis for this option can be found in Appendix F.

4.4 OPTION 4 – DEMOLISH EXISTING STRUCTURE, RECONSTRUCT WITH SINGLE SPAN PORTAL STRUCTURE

Scope

This option would involve complete reconstruction of arch bridge and eastern footway extension. The new bridge deck width would be similar to the width of existing arch bridge plus eastern footbridge. The reconstruction work comprises new brick work northern and southern abutments, wingwalls; single span RC deck formed with precast RC beams.

This option is similar to option 3 without having a pier at centre span. The advantages of having single span structure are elimination of the piling work in the river and lower maintenance cost in the long-term. However due to larger span the water hydraulic modelling of the river should be done to check the effect of significant aperture increase and its effect on downstream structures. Considering the EA requirement for climate change, construction of a single island in midspan, could help in the reduction/management of water flow.

The existing STATs that are not diverted will be supported on the temporary gantries on the north and south side of the structure during the reconstruction and will be diverted/ placed in the new RC deck and footways fill on both side of the bridge. It is anticipated that this option would have a service life of 120 years, and would restore the required live load capacity for the new bridge design.

The scope of works undertaken within this option would include:

Temporary Works

- Installation of dams across the channel with through piping and de-watering to provide access to the worksite;
- Installation of temporary restraint ties (macalloy rods) to the south span to provide restraint against thrust forces during demolition of the centre and north span, alternatively provide restraint to the south pier to support the thrust forces from south span.
- Erection of temporary service bridges along each elevation, the erection of the north elevation bridge may require removal of the existing east (upstream) footbridge parapet to permit support of BT Openreach services.

Permanent Works

- Removal of east footway deck and piers cut-water.
- Complete demolition of the concrete saddle to the bridge.
- Complete removal of the arches and spandrel walls.
- Removal of existing substructure including piers, abutments and wingwalls.
- Prepare the river bed for the new substructure support including any required piling for the abutments.
- Reconstruct the substructure foundation.
- Construct the abutments and wingwall.
- Place the new concrete deck including utility ducts and pipes.

- Waterproofing of the new deck.
- Reconstruction of fill to approach the new substructure.
- Reinstatement of the Thames Water, UKPN, Openreach and SGN services along their previously proposed alignment.
- Reinstatement of carriageway surfacing.

This option will involve extension of the existing superstructures serviceable life by 120 years. Upon implementation of the works the overall capacity of the bridge will be to the required live load capacity for the new bridge design.

Scope of maintenance works undertaken within this option would include:

i) Re-painting of all steel elements forming the parapet.

ii) Re-waterproofing of the existing bridge deck.

iii) Replacement of bearing (pending on detail design) after 50 years

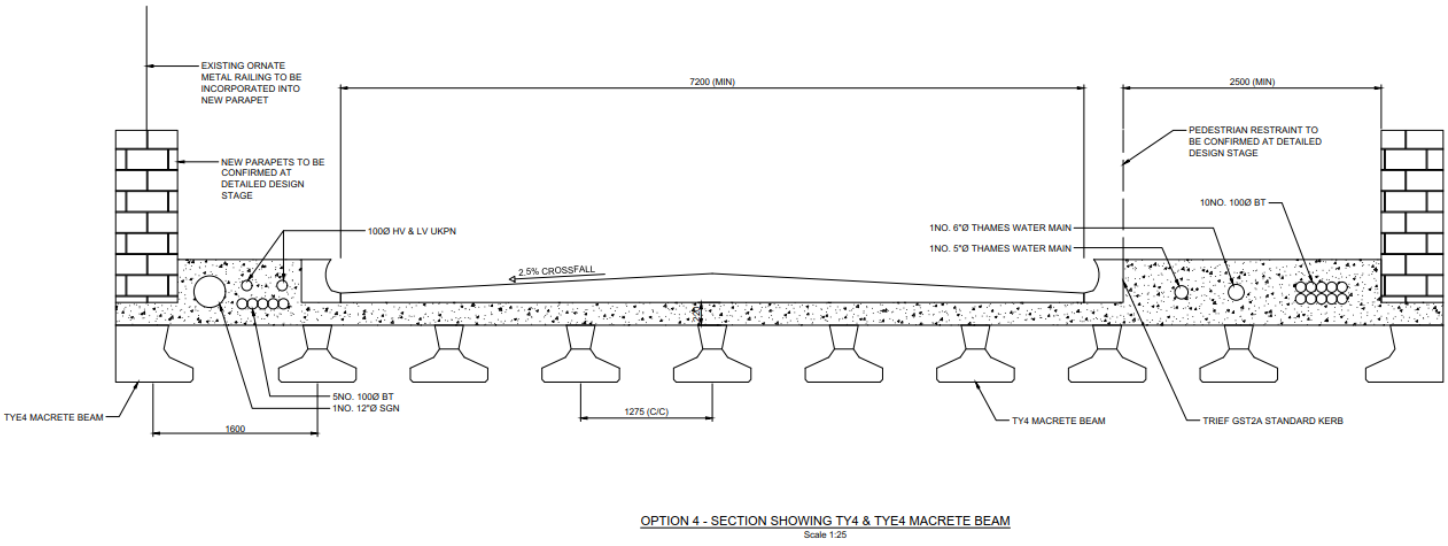

Figure 51 - Cross-section of proposed Option 4 works

Impacts / Disruption

Parking: No anticipated impacts, beyond the existing works and ongoing closure, are anticipated.

Road Closures: The existing road closure will be retained, and extended in duration, to facilitate the proposed works. No proposed route through the worksite will be provided to accommodate either pedestrians or vehicles, however the

west (downstream) footbridge will be retained in service to retain pedestrian access through the site.

River Wandle: During the temporary demolition condition the aperture will be significantly restricted, with only through piping maintained through the centre and south spans. The provided aperture area provided by the centre and south spans is 13.425m^2, whereas it is anticipated that the achievable temporary aperture is 4.525m^2 (approximately one third of the original aperture). Hydraulic simulation of this constriction is recommended to consider accumulations of flows immediately upstream of the bridge and potential increased flood risk to nearby developments.

Analysis of the permanent condition will consider whether increase of the structure aperture is meeting the EA climate change requirements. However due to larger span total span of the single aperture, hydraulic modelling of the river should be carried out to check the effect of significant aperture increase and on downstream levels. Construction of an island or retention of the piers brick piers, (which would also reduce disturbance of the river bed), could help in maintaining the current flow regime.

Details of proposed scour protection measures will require consideration of existing environmental constraints, including trout spawning and egg laying, and roughness co-efficient of the existing river invert.

Services: Lifting and temporary support of existing utilities crossing the bridge deck will be required to provide access to demolish the failed saddle. The saddle in footway areas will require advanced demolition to ensure that services can be accessed and supported prior to demolition of the main saddle areas. Services supported in existing locations include; BT Openreach and UKPN (HV and LV services).

Thames Water services will however require both temporary and permanent diversion. Temporary diversion will be via the east (upstream) service bridge, with permanent diversion through the saddle in the previously proposed positions.

SGN services are unaffected by these proposals (although service bridge foundations will be designed around the ends of the capped main), with only a permanent reinstatement upon completion of the works.

Boundaries: It is anticipated that the service bridges provided can be constructed within the existing highways boundary, however the foundation footprint of the east (upstream) service bridge may require access to areas controlled by the National trust, local disruption within the river banks may occur as a result of these works. It is anticipated that access to the national trust land to the east of the bridge will be required for the removal of the east (upstream) footbridge parapet.

Aesthetics: This option will 'tidy up' the upstream elevation by integrating the services and footbridge into the main structure. With a single span it is considered that the effect on this elevation is positive. On the downstream side from the footbridge the effect is considered slightly negative, but from further away it is likely to be neutral considering the obscuring effect of the footbridge.

Key Assumptions

This option has been developed considering the following key assumptions:

- A further topographic survey will be undertaken to include the areas immediately surrounding the bridge to allow reliable design development
- The increase in the span aperture is in line with climate change requirements and down steam flood modelling. Construction of an island, or retention of the river piers, might be required in order to maintain the current rate of water flow.
- Temporary and permanent diversions of Thames Water assets will be undertaken, and it will be possible to support BT Openreach services in their current location. Insufficient slack exists in BT Openreach services to permit slewing or raising of the services.

Key risks:

Adoption of this option will realise the following key risks:

Table 4 – Option 4 schedule of key risks associated with option adoption		
Stage	**Risk**	**Mitigation Measures**
Construction	Service diversions requiring unexpected additional lead-in time	Services traced by GPR and confirmed where required by trial hole. Full liaison with statutory undertakers, use of existing downstream footbridge or temporary structures to support diverted services. Temporary structures used to support existing services where possible to save diversion.
	Contamination of Watercourse during demolition	The omission of the central pier; river flow to be piped through the work site, or diverted though alternate spans for as short a period as possible. Encapsulation structures to be used to capture debris and dust to prevent contamination of watercourse. Silt traps to be employed to capture suspended solids within pumped discharged water. Biodegradable oils used for plant operated within or over the watercourse. Spill kits to be available on site at all times to contain and spills and mitigate effects.
	Instability of existing structure during demolition, leading to collapse, injury or flooding	Temporary works to be installed to stabilise structure. Full and thorough method statements to be prepared well in advance, reviewed by competent people, and communicated to all involved. Close supervision to ensure it is adhered to or work paused if problems occur which prevent completion in accordance with it. Adoption of exclusion zones to keep people out of harms way.
	Contamination of Watercourse during construction	River flow to be piped through the work site, or diverted though alternate spans for as short a period as possible. As much of the structure shall be pre-cast as practicable permanent formwork adopted and joints sealed and checked prior to placement of in-situ concrete. Biodegradable oils used for plant operated within or over the watercourse. Spill kits to be available on site at all times to contain and spills and mitigate effects.
	Re-waterproofing and concreting works will require services to be raised from deck, water and gas main pipe joints may potentially rupture as a result causing leakage.	At design stage affected statutory undertakers will be engaged further to determine constraints against lifting of services, and any modifications required to safeguard against leakages. Temporary service bridges are to be provided to support modified services during works preventing damage.
	Delivery and installation of large pre-fabricated components within an urban environment with significant on-street parking. - The width between the highway boundaries may restrict the type / size or lifting capacity of the crane, particularly if services are present which prevents loading from outriggers being applied to the footways.	Parking will be restricted to allow safe access for plant. Size of pre-fabricated elements to be reduced as far as is reasonably practicable. Crane type, size and position to be considered during design to ensure a viable solution is available.
In-service	Access / egress for inspection	Access to watercourse compromised by adjacent land use; means of safe access will need to be determined during design. Access to deck soffit will need to be carried out at times of lower flow. Concrete design solution minimises future

Table 4 – Option 4 schedule of key risks associated with option adoption		
Stage	**Risk**	**Mitigation Measures**
		maintenance liabilities and enhances durability of structure mitigating future maintenance liabilities.
	Accidental vehicle loading to footways could lead to crushing of services	Services located within footway construction will either be provided with steel sleeves or be encased within concrete. Where required by statutory undertakers services can be accommodated within the deck construction between longitudinal precast beams to provide additional protection against accidental vehicle loading.
	Vehicle Containment	As the speed limit is 30mph vehicle containment can either be achieved through suitable design of masonry parapets, or as shown by Trief kerbs. Detailing of structure to incorporate effective waterproofing membrane will influence this selection

Costs

The anticipated initial capital works costs for this proposed option is £2,690,000.

Discounted whole life costing for this option is £770,284.

Whole life costing (WLC) analysis for this option can be found in Appendix F.

4.5 OPTIONS EVALUATION SUMMARY TABLE

A summary of the key points for each option considered in this study is contained in Table 5.

Table 5 – Options Comparison

Criteria	**Do minimum –** retain and refurbish the existing superstructure	**Partial reconstruction** – reconstruct north and central spans, retain south span	**Reconstruction –** A new two-span concrete structure	**Reconstruction –** A new single span concrete structure
Scope of construction works	Temporary Works Installation of dams across the channel with through piping and de-watering to provide access to the worksite; Installation of temporary shoring / props to the partially collapsed span to permit infilling of the northern span, the shoring / props will be sacrificial and cast into the north span infilling. Erection of temporary service bridges along each elevation. Permanent Works Demolition of the failed concrete saddle to the bridge; Brickwork remedial works to reform the north east and north west spandrel walls, wingwalls, and north abutment where collapsed Stitching and brickwork repair works to stabilise the north span against hydrostatic pressures during infilling works, and to address displacement along the longitudinal crack in the centre span. Excavation of invert silts within the north span, underpinning works to the bridge foundations (as appropriate), and formation of a binding course in advance of infilling. Installation of an Armco pipe former through the north span of the bridge. Installation of grout and venting points through the barrel of the north span, and subsequent staged grouting up of the north span around the Armco pipe. Reconstruction of the north pier cut-water to re-plumb the pier section providing support to BT Openreach services. Reconstruction of disturbed fill to approach embankments disturbed during the failure. Reconstruction of saddle to the bridge structure, incorporating reinstatement of the Thames Water services along their previously proposed alignment and waterproofing. Reinstatement of carriageway surfacing. Installation of scour protection measures to prevent re-occurrence of previous scour.	Temporary Works • Installation of dams across the channel with through piping and de-watering to provide access to the worksite; • Installation of temporary shoring / props to the partially collapsed span to permit infilling of the northern span, the shoring / props will be sacrificial and cast into the north span infilling. • Erection of temporary service bridge along west elevation. • Erection of temporary propping for the deck adjacent to the northern pier of the east footway • Arch centrering for northern and central spans Permanent Works • Demolition of the failed concrete saddle above the northern and central spans • Reconstruction of the northern pier of the eastern footway extension. • Removal of temporary propping • Removal of northern and central arches, spandrel, wingwalls and parapets above • Reconstruction of foundations (in concrete) and pier (in brickwork) or underpinning of the northern arch pier • Installation of scour protection measures (concrete invert) • Reconstruction of north and central arch barrels in brickwork • Reconstruction of spandrel and wingwalls in brickwork • Placement of new concrete saddle • Waterproofing saddle, lapping onto remaining part of existing saddle • Reinstate / relocate services from temporary locations into / on to new deck • Place fill on approaches to structure • Remove temporary service bridges • Reinstate carriageway and footway construction • Clear site and re-open road	Temporary Works • Installation of dams across the channel with through piping and dewatering to provide access to the worksite • Installation of temporary restraint ties (macalloy rods) to the south span or struts to the south pier to provide restraint against thrust forces during demolition of the centre and north span, alternatively provide restraint to the south pier to support the thrust forces from south span. • Erection of temporary service bridges along each elevation. Permanent Works • Removal of east footway deck, piers and cutwaters • Complete demolition of concrete saddle • Complete removal of arches and spandrel walls and wingwalls • Removal of temporary restraints for south span • Complete removal of piers and abutments • Reconfigure through piping, (twice) and prepare river bed for piling for central pier and abutments • Construct new substructures, within phased pipe relocations. • Place deck beams and cast deck slab • Construct parapets and waterproof deck • Remove dams and pipes from watercourse • Reinstate / relocate services from temporary locations into / on to new deck • Place fill on approaches to structure • Remove temporary service bridges • Reinstate carriageway and footway construction • Clear site and re-open road	Temporary Works • Installation of dams across the channel with through piping and dewatering to provide access to the worksite • Installation of temporary restraint ties (macalloy rods) to the south span or struts to the south pier to provide restraint against thrust forces during demolition of the centre and north span, alternatively provide restraint to the south pier to support the thrust forces from south span. • Erection of temporary service bridges along each elevation. Permanent Works • Removal of east footway deck, piers and cutwaters • Complete demolition of concrete saddle • Complete removal of arches and spandrel walls and wingwalls • Removal of temporary restraints for south span • Removal of abutments (piers to remain) • Prepare piling platforms for abutment foundations • Construct new abutments • Place deck beams and cast deck slab • Construct parapets and waterproof deck • Remove dams and pipes from watercourse • Reinstate / relocate services from temporary locations into / on to new deck • Place fill on approaches to structure • Remove temporary service bridges • Reinstate carriageway and footway construction • Clear site and re-open road
Durability and serviceability	This option will increase the serviceable life by only 10 years, after which reconstruction would be required. Extensive re-pointing throughout the bridge will be required where not previously addressed through the preceding strengthening works. Parapets remain non-compliant with EN1317 upon completion of works General and Principal inspections to be carried out in accordance with BD63/17. Live load capacity will not be to the desired level of 40T or 45units HB.	• The anticipated service life of the entire structure will be limited by the service life of the retained southern span, which would be less than a full reconstruction. • General and Principal inspection to be carried out in accordance with BD63/17.	• A piled structure will be less sensitive to scour, removing restrictions in the watercourse will allow the river flow to slow down and reduce scour; formation level for substructures will be designed to allow for scour, or measures incorporated during foundation construction • Target design life of 120 years, life to major maintenance is circa 20 years (metallic parapet elements) • General and Principal inspection to be carried out in accordance with BD63/17 but will be easier with clearer span arrangement.	
Health and Safety	• Multiple phases of work within watercourse to install and remove dams and pipes • Work around/ protection of statutory undertaker's plant required. • Work within water required to underpin foundations, installation of Armco pipe • Ongoing future maintenance liabilities	• Multiple phases of working within the watercourse • Requirement to work under propped eastern footway deck structure • Underpinning below water levels within bed gravels • Work around existing statutory undertaker's services. • Ongoing future maintenance liabilities with retained span	• Installation of temporary restraints to south pier • Multiple phases of working within watercourse to install, reconfigure (twice) and remove the dams and pipes. • Work around / protection of statutory undertaker's plant required. • Work within watercourse required for pier construction (risk of flooding) • Lifting of elements for temporary service bridges • Lifting of pre-cast elements	• Installation of temporary restraints to south pier • Two phases of working within watercourse to install, and remove the dams and pipes. • Work around / protection of statutory undertakers plant required • Lifting of elements for temporary service bridges • Lifting of pre-cast elements
Impact on statutory undertakers' plant	Minor lifting and temporary support of existing utilities crossing the bridge deck will be required to provide access to demolish the failed saddle. The saddle in footway areas will require advanced demolition to ensure that services can be accessed and supported prior to demolition of the main saddle areas. Services supported in existing locations include; BT Openreach and UKPN (HV and LV services). Thames Water services will however require both temporary and permanent diversion. Temporary diversion will be via the east (upstream) service bridge, with permanent diversion through the saddle in the previously proposed positions. SGN services are unaffected by this proposal	• Services (SGN, UKPN, Thames Water and BT) supported by the original structure will need temporary support or diversion during construction • Services (BT and Thames Water) supported by the eastern footway deck and piers can remain in place • Services reinstated into new arch structure will be (as currently) encased in concrete saddle • The existing eastern footway can be used to supported diverted services	• Services (SGN, UKPN, Thames Water and BT) supported by the original structure will need temporary support or diversion during construction • Services (BT and Thames Water) supported by the eastern footway deck and piers will need temporary support or diversion during construction • Any services temporarily supported in place will hamper construction, particularly piling and placement of beams • SGN services will be reinstated on the new structure after construction • UKPN services should be diverted via the downstream footbridge • The Thames Water service that passes through the saddle will need disconnection and reinstatement over the new deck, at which point the rider main can be decommissioned • BT services within the downstream verge will need careful extraction and supporting from a temporary structure or diversion to the ducts below the downstream footbridge. • BT services supported by the eastern footway deck /piers and the • Thames Water rider main should be supported from a temporary structure until it can be decommissioned.	
Programme (incl road closures)	• Overall works duration anticipated to be 3 months (low) • It is anticipated that works can be undertaken between April and September as not to impact on the trout spawning periods commencing in October.	• Overall works duration: medium	• Overall works duration: long	• Overall works duration: long

Buildability	• Limited clearances within arch will lead to congestion when the geometry of the Armco liner and shoring is considered • Challenging access to the northern pier for underpinning work • Diversion route as existing	• Works significantly affected by waterflows; many activities required while 'in-river'' – higher risk of being flooded out & work being stopped. • Standard construction materials, readily available, no significant lead-ins • Small to moderate sized plant required due to smaller units (bricks) used • Construction of brick arches requires skilled labour • Diversion route as existing	• Challenging access to the central pier foundation • Small precast elements that can be lifted by modest sized plant • Any services temporarily supported in place will hamper construction, particularly piling and placement of beams • Some beams will need sliding sideways after initial landing to move them under the temporary service bridges • Diversion route as existing •	• Foundations can be constructed from the river bank • Larger pre-cast elements than other options, requiring larger cranes than other options • Some beams will need sliding sideways after initial landing to move them under the temporary service bridges • Any services temporarily supported in place will hamper construction, particularly piling and placement of beams • Diversion route as existing
Aesthetics	• Aesthetics worse than existing due to additionally cluttered appearance of northern span	• Aesthetics maintained as existing	• Improved aesthetics from upstream, negative from downstream	• Improved aesthetics from upstream, neutral from downstream
Environmen-tal and sustainability	• Although this option utilises the current structure as much as possible, it would need replacement in future leading to less efficient use of materials • Lots of work within the watercourse over a longer period, so high on disturbance to riverbed	• Vernacular materials used, so maintains the current aesthetic • If option needs later further replacement, then a less efficient use of materials • Lots of work within the watercourse over a longer period, so high on disturbance to riverbed	• New structures, so no need for further works in short to medium term • No use of materials for shorter term solutions.	
Capacity	Less than desired 40T capacity	Desired 40T capacity is achievable	LM1, LM2 and LM3 SV80 (equivalent to 40T and 30HB)	LM1, LM2 and LM3 SV80 (equivalent to 40T and 30HB)
Capital cost	£880,000 exc VAT	£1,860,000 exc VAT	£2,690,000 exc VAT	£2,690,000 exc VAT
Whole life cost (discounted)	£2,554,228 exc VAT	£2,033,104 exc VAT	£770,284 exc VAT	£770,284 exc VAT

5. CONCLUSION AND RECOMMENDATIONS

The report has provided a description of the site and summarised the main constraints on the design and construction process that arise from the site layout, space available, the services present and the ecology and flow characteristics of the River Wandle. Four options have been identified and considered with respect to these constraints. Two of these options retain parts of the existing structure; two involve demolition of the existing arch structure and upstream footway extension and subsequent replacement with a new structure which provides the same carriageway and footway widths.

Any of the options would require further preliminary design development before the structure outline can be confirmed and an Approval in Principle prepared. For options 3 and 4, involving the construction of a new structure further topographic survey is likely to be required such that the space around the site can be understood, clearance from existing trees and structures known in respect to confirming the clear space for lifting operations relevant to the design and the topography of the river channel known such that parameters such as foundation levels can be appropriately determined.

Broadly speaking, construction tasks that involve an interface with statutory authorities and those that take place within a watercourse have more risks outside the direct mitigation of the designer. As such options which reduce requirements for these are likely to be preferred. For example high flows within the watercourse can have a significant effect on progress, particularly while temporary works are in place, even if they do not constitute a flood event. Similarly, options which minimise maintenance requirements are likely to be preferred as carrying out the maintenance tasks takes expenditure and is potentially disruptive to the travelling public.

Option 1 has the advantage of least initial cost and least work affecting the services but has significant disadvantages in that it does not restore the full structural capacity and will likely require effectively option 3 or 4 to be implemented in the medium term. It therefore just defers the construction of a new bridge so the cost per year of service does not look so favourable.

Option 2 has the advantage of reduced capital cost (when compared with options 3 or 4) but involves a lot of work phases within the watercourse and it's service life will likely be limited by the retained southern span.

Options 3 and 4 are relatively similar in respect to the activities required that interface with the services. Option 3 has the advantage of most readily retaining the existing road levels, but a significant disadvantage in the need for the central pier and more phases of work, and ground investigation, within the watercourse than option 4. One of the key areas to develop for either of these options is how the services can be best integrated into the design to provide a durable solution and de-clutter the appearance of the structure. In this respect, option 4 with the deeper single span deck may prove to be more accommodating than option 3.

On a whole life cost basis options 3 and 4 are preferred over 1 and 2. There is less to separate options 3 and 4, however based on the advantages of lesser work within the watercourse and

fewer phases of watercourse management offering a programme advantage, option 4 is the recommended option.