Jacobs

Trams to Granton, BioQuarter and Beyond

South East Corridor
North Bridge Structures Report

The City of Edinburgh Council

August 2025

Trams to Granton, BioQuarter and Beyond
South East Corridor - North Bridge Structures Report

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1. Introduction

1.1 Purpose

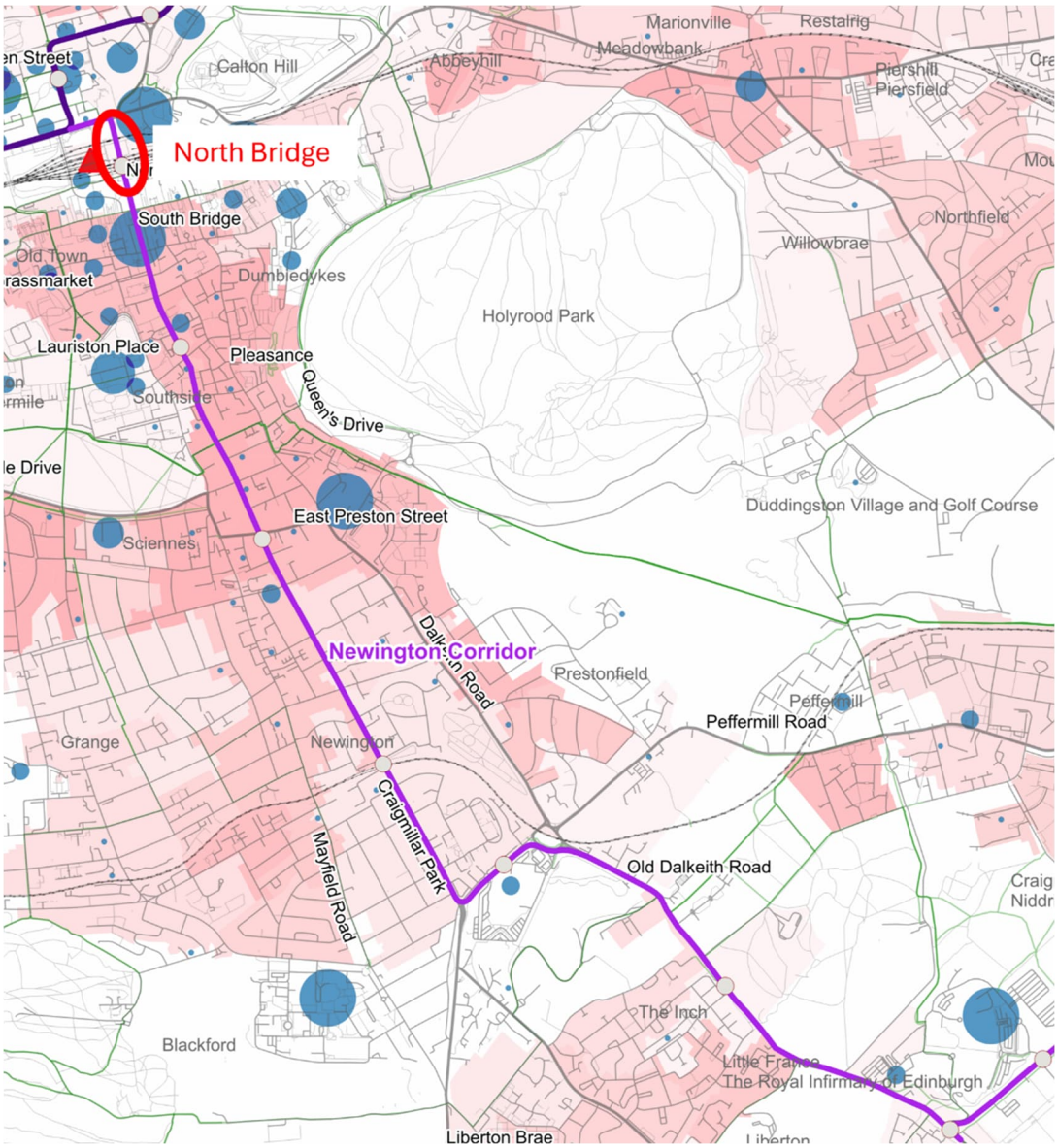
A north-south tram line is being considered as part of an expansion of the Edinburgh Tram network. Between the city centre and the south east, the proposed route would cross several recent and historic structures, one of these being North Bridge. This is an historic structure built in the 1890s. This report considers the structural viability of operating trams at street level along North Bridge.

The project is currently at Strategic Business Case and so considerations and recommendations made are to enable the adoption of the structure for Trams.

1.2 Location

The South East expansion of the Tram network would leave the existing route at Princes Street by Waverley Station, before turning right and traversing North Bridge and South Bridge, then continue south along the A7 and A701 turning onto Lady Road by Craigmillar Park. The route will then proceed round the Northeast side of Cameron Toll shopping centre and along Old Dalkeith Road to the Royal Infirmary and the BioQuarter. The South East route is illustrated in **Figure 1.1**, with the location of North Bridge circled and annotated.

Figure 1.1: North Bridge Location on the proposed South East Route



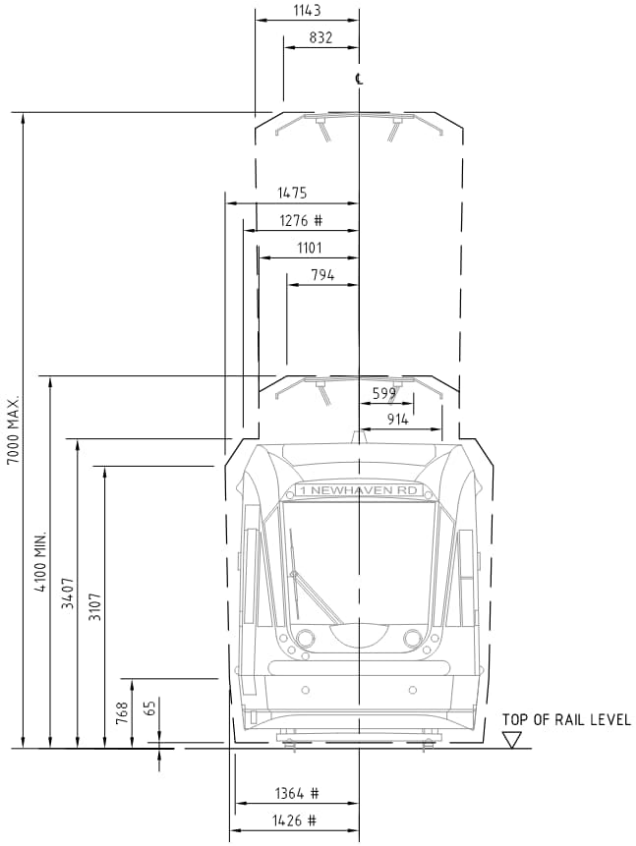
2. Scheme-Wide Considerations

It is anticipated that the proposed South East route would align with the City of Edinburgh Council's policies and aims, with the expansion of the Edinburgh Tram network aligning to the Council's City Mobility Plan. The following considerations under this section ensure that the proposed scheme meets its safety requirements, whilst its impact on the existing area remains beneficial to local community along the route.

2.1 Tramway Requirements

In keeping with the existing tramway clearances, the proposed scheme considers the dynamic kinematic envelope (DKE) for each tram, described in the Office of Rail Regulation's Guidance on Tramways document. This envelope factors in tolerances in the track gauge and alignment, while also making allowances for the effects of curvature. Clearances to other trams or structures are considered to be between the closest points of these envelopes. The dynamic kinematic envelope is illustrated in **Figure 2.1**.

Figure 2.1: Tram Dynamic Kinematic Envelope



2.2 Environmental

The area around North Bridge may be classed as a built-up urban environment with commercial properties at either end of the structure and Edinburgh Waverley beneath the structure. All services would need to be located and identified.

2.3 Local Heritage

North Bridge was constructed between 1894 and 1897, to replace the original North Bridge. This structure is Grade A Listed and is also surrounded by listed buildings to the North and the South. The structure is also located within a UNESCO World Heritage Site.

Since 2021, the structure has undergone major refurbishment work involving repairs to the concrete deck and steel girders. These changes and/or any future proposed works which affect the physical aesthetic of North Bridge would require consultation with Historic Environmental Scotland.

3. Historical Data

3.1 Information Sources

North Bridge is a historical structure with relatively limited information available on the bridge. Alongside contacting the City of Edinburgh Council's structures team, Jacobs undertook a thorough investigation to locate historical records and written articles on the bridge's history. The sources found and referenced within this report are detailed below:

North Bridge Refurbishment:

- Refurbishment Brief
- SCAPE – Edinburgh North Bridge Refurbishment, Scope of Services

Drawings:

- HY622/101/09/01 North Bridge Repairs – Plan and Elevations
- HY622/101/09/02 North Bridge Repairs – Structural Details
- HY622/101/09/03 North Bridge Repairs – Site Boundary

Written accounts, literature and images:

- Listing for North Bridge, (Historic Environment Scotland, 1974)

3.2 Missing Information

The information above has been useful in gaining an overview of the structure and its history. This gives an indicative understanding of its structural form and extents. It is noted that:

- Jacobs has not been provided with any inspection or monitoring reports for the structure. Therefore, the current refurbed condition of the structure is unknown. Additionally, Jacobs has not been provided with any detailed information related to the extent of the refurbishment work.
  Following requests, Jacobs were advised via the project team that complete as-built records will only be available upon completion of the current refurbishment works.
- There is no available information on the foundations of the structure or their condition. Public geological maps and borehole logs are not available along the footprint of the bridge to give an indication of the expected ground conditions.

Subsequently, Atkins report 'Edinburgh North Bridge Refurbishment, Assessment-led Steelwork Strengthening – Approval in Principle' (AIP), May 2019, has been provided. This summarises Design Criteria and future loading specifications, including provision for tram. Chapter 4, Design Criteria, is included as Appendix A.

4. Existing Structure

4.1 Overview

North Bridge is a Grade A Listed structure that was constructed between 1894/95 to 1897 by Sir William Arrol & Co. The listing does not includes the War Memorial situated on the Eastern side of the structure, which is a separate Grade A listed structure. The current structure replaced the original North Bridge, which was taken down in 1896. The current North Bridge underwent major refurbishment in the 1930s. In the early 1990s re-painting was undertaken with new parapets and decorative cast iron covers installed. Since 2021, the structure has underwent major refurbishment work involving repairs to the concrete deck and steel girders. A general view of the structure prior to the refurbishment work is shown in **Figure 4.1.**

Figure 4.1: General view of Western Elevation (Source: City of Edinburgh Council)

4.2 Site Description

The structure is located in the city centre and crosses over Edinburgh Waverley Railway Station, with the central piers incorporated within the station. The bridge provides a key link between the New Town and Old Town. On the Northern side of the structure is the East End Junction where the A1 (Waterloo Place), A7 (North Bridge), A8 (Princes Street) and A900 (Leith Street) meet. This represents a major junction in the City Centre for private vehicles and bus routes. The structure supports four traffic lanes and two footpaths.

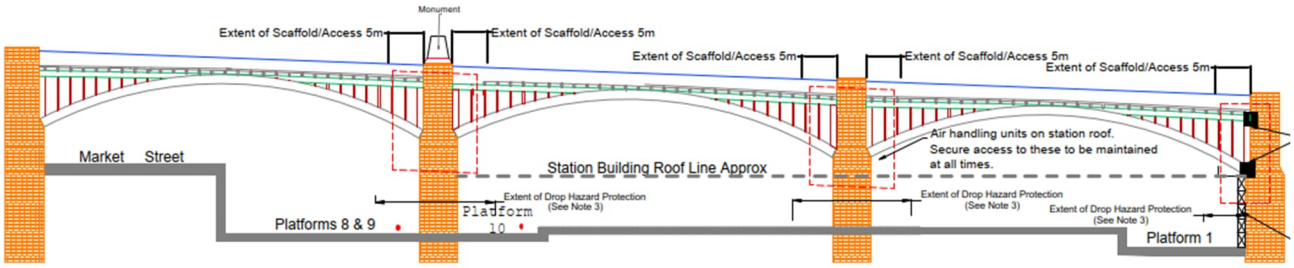
The structure is surrounded by Listed structures. On the Northern side, the Former General Post Office is Grade A Listed while the Balmoral Hotel is Grade B Listed. On the Southern side, the Scotsman Hotel is Grade A Listed and the Carlton Hotel is Grade B Listed. A general view across North Bridge is shown in **Figure 4.2**, with the four listed buildings also shown. On the Southwest side of the structure the Scotsman steps provide access between North Bridge and Market Street below, allowing pedestrians to travel between Edinburgh Waverley and North Bridge.

Figure 4.2: View across North Bridge (Looking South)

4.3 Structural Form

North Bridge is a three span arched steel girder structure. The structure has a total span of 160 metres, with each arch spanning 53 metres. The structure has a total width of 23 metres. The East Elevation is illustrated in **Figure 4.3**.

Figure 4.3: East Elevation of North Bridge (Source: drawing HY/622/101/09/01)



4.3.1 Foundations

In the absence of construction drawings relating to the structural foundations, a review of the British Geological Society records was undertaken. This found no borehole records for the structure's foundations.

4.3.2 Piers

The North Bridge Refurbishment brief advises that the upper sections of each pier are hollow, as manholes are located in the carriageway above each pier. It is thought that they provide access to either the service bays or the hollow section of the piers. Specific details or internal condition are not known.

The available information suggests the masonry comprises sandstone blocks. No geometry nor material properties of these structural elements has been provided to Jacobs. Whilst they are likely to be sourced

locally, intrusive investigations if not already undertaken as part of the refurbishments works, would need to be carried out to confirm, the material strength and masonry classification.

4.3.3 Arches

The bridge consists of three wide span arches, each constructed with six arched iron girders. The internal girders are typically 355 mm wide and 762 mm tall. The two outer girders are typically 533 mm wide and 1219 mm tall.

Anecdotal evidence suggests that a number of hidden spans, of masonry arch construction, continue North and South beyond the bridge abutments, hidden by the buildings which are located either side of North Bridge.

4.4 Structural Capacity

In the 1990s, a structural assessment was undertaken which determined that the capacity failed an assessment for 40t ALL. Between 2018 and 2019, Atkins assessed the structure for the proposed Assessment Tram Loading detailed in the Structures and Civil Engineering Requirements Specification for the Edinburgh Trams Network (Sections 3.71 to 3.76), as part of the initial North Bridge refurbishment works.

Jacobs are aware that the scope of the initial 2021 refurbishment works was expanded as the full extent of the structure's deterioration was uncovered. Nevertheless, it is understood that design load criteria are unchanged and are as given in the Atkins AIP, Section 4.2.

It is unknown whether the refurbishment work has extended beyond the bridge abutments (including concealed spans towards the High Street) and whether further strengthening is required in these locations.

4.5 Geotechnical Information

A review of the British Geological Society database found no available ground investigation records to inform the founding conditions of North Bridge structure.

Borehole records in proximity of South Bridge are available which indicate the rock level is elevated, suggesting North Bridge may also be founded upon rock, This assumption would need confirming. The bedrock beneath much of central Edinburgh belongs to the Kinnesswood Formation, a late Devonian to early Carboniferous unit composed of sandstones and cornstones.

4.6 Utilities

Should the present refurbishment works not have a comprehensive record of the structure's utilities, a survey would be required during the next phase of the project to determine the services present and their location.

It is currently unknown to Jacobs what services cross the structure within the service bays. Due to North Bridge being a significant main road through the city with businesses and private flats at either side of the structure, Gas; Water; Power; Streetlighting and Telecommunications etc. would be anticipated.

4.7 Drainage

Two drainage gullies are located at each of the three piers and at both abutments. It is thought that gullies feed into downpipes which run vertically down the faces of each pier and abutment. At the piers, and potentially at the north abutment, it is understood that the existing downpipes were cut off above station roof level at the time when the roof was installed. These downpipes are therefore thought to discharge directly onto/into the station roof drainage system.

During the next phase of the works the drainage should be located and mapped.

4.8 Network Rail

While City of Edinburgh Council are the primary authority responsible for the structure, Network Rail are a key stakeholder due to the bridge's location over Edinburgh Waverley Station. Any work to the underside of the structure would be subject to agreement with Network Rail.

5. North Bridge Tram Proposal

The intent is for North Bridge to carry two tram tracks in addition to the existing normal traffic, as part of a shared use solution. The spatial layout of the tramway across the structure has not yet been finalised and is subject to change. Whilst the spatial layout of the tramway along the bridge has not been finalised, it is assumed, that the double tram tracks will run centrally down the centre of the carriageway. OLE poles are assumed to be between, nothing the potential for battery tram operation on this section of the route.

At this point it is assumed that normal vehicle and bus traffic will be retained. Footpaths would be retained or extended if possible.

A tram stop is proposed around the location of this structure. This may use a staggered tram stop arrangement, with a platform on either side of the structure, or could be located on the structure itself. The exact location and details for this tram stop will be confirmed at the detailed design stage.

5.1 Structural Form

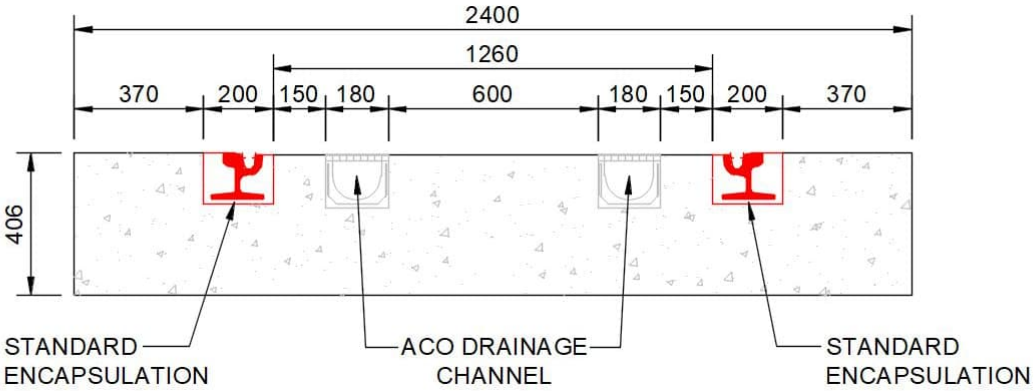
Although there has been scope creep on the initial 2021 refurbishment, design criteria remain unchanged. As such, the works inherently encompass future-proofing for use of the bridge by trams.

5.2 Proposed North Bridge Track Bed and Track Form

The tramway across the structure will consist of a double track line, with each track facilitating travel in one direction. These tracks will be standard gauge, with the tramway taking up approximately 6.5 metres of deck. The rails will be embedded within reinforced concrete track slabs to be flush with the adjacent vehicle running surface. The first stage of the slab construction will be a reinforced concrete pour across the whole width of the deck to function as a blinding layer to create a level top surface. This layer may include deeper shear keys to be poured transversely above the piers to allow a more even distribution of the longitudinal forces into the infill and subsequently the structure. The second stage of the reinforced concrete will then be poured with the embedded rails, this is the main track slab. It may be that two of these slabs are poured with a width of 2.4 metres each and normal road surfacing and tarmac is placed around them. Alternatively, the whole width of the deck may be covered in the second stage concrete pour, with this concrete making up the road surfacing. Both approaches have been deployed on the current route to Leith. In both cases, the first and second stage concrete need to have a minimum combined depth of 406mm.

The rails will be encapsulated, to provide vertical and lateral support to account for the dynamic loading from the trams. The concrete slabs will themselves be embedded within the granular fill layer, allowing the bridge deck to be raised to rail level. The longitudinal ACO drainage channels will provide drainage for the tramway, while also acting as derailment channels to prevent any derailed trams from colliding with the adjacent footpaths. A typical cross-section of a track slab is shown in **Figure 5.1**. This track slab section is based on the slabs used for the Edinburgh Trams network expansion to Newhaven. This is only indicative for this proposal, as a more refined design for the track slabs would be included as part of a detailed design for the structure.

Figure 5.1: Insert Track Slab Cross-Section



5.3 Access to Structure

Existing access for walking wheeling and cycling, along with public and private vehicles will be accommodated within the reprofiled carriageway cross section.

5.4 Parapets / Guardrails

The parapets will be retained as parts of the works. It is assumed that no other parapets/guardrails will be installed, in keeping with the minimal street scape furniture of Princess Street. If alternative tram containment is not provided, such as embedded ACO drainage channels, these parapets would need to be assessed for a potential tram collision, were trams not located centrally on the bridge. This shall be confirmed during the next phase.

5.5 Tram Utilities

Trams presently require Overhead Line Equipment (OLE) for power, with communication and signalling ducts also needed. The OLE would require additional vertical and lateral clearances and may be installed as per the existing network along Princes Street. These however could be negated were battery technology adopted to remove the need for additional overhead line infrastructure. The feasibility of this may be investigated along with the additional mass associated with such batteries, during the next phase.

5.6 Proposed Construction Sequence

The existing North Bridge carriageway is a significant through route, therefore total closure may not be feasible. As currently deployed on the structure for the refurbishment work, some form of temporary one- or two-way running would be established. Should a partial closure not be feasible, it may be advisable to close the road to allow for rapid construction. This however would cause significant disruption albeit for a shorter duration that works undertaken in parallel with partial closures. Therefore, a workable construction sequence with suitable traffic management would need to be carefully considered and specified.

The works would also be dependent upon the suitability of the existing structure to accommodate tram loading. This would need to be determined through advance works to inform the implementation of the appropriate solution. Moreover, the identified parameters may be available upon receipt of the contractor's refurbishment as-built records.

Advance Works:

1. Obtain the refurbishment as-built records including the H&S file.
2. Undertake intrusive testing to determine the strength of the abutment and piers.
3. Undertake a geotechnical and land quality assessment.
4. Undertake surveys to record the structures geometric details and the utilities on site.
5. Undertake a touching distance Inspection for assessment.
6. Undertake a structural assessment.

For Sufficient capacity and sufficient deck construction depth or Sufficient capacity but insufficient deck construction depth:

1. Set-up site compound and install the required road diversions.
2. Ensure no utilities lie under roadway and divert if necessary.
3. Remove existing deck surfacing and excavate to required track slab depth.
4. Install track form and rebuild the deck surface, regrading if appropriate the approaches to the structure.
5. Reopen the structure.

For Insufficient capacity and sufficient deck construction depth or Insufficient capacity and insufficient deck construction depth:

1. Set-up site compound and install the required road diversions.
2. Ensure no utilities lie under roadway and divert if necessary.
3. Remove existing deck surfacing.
4. Demolish existing deck and recast a new deck with capacity to accommodate the required loadings.
5. Install track form and rebuild the deck surface, regrading the approaches to the structure.
6. Reopen the structure.

This general construction sequence is only indicative, with the assumption that the current foundations would be capable for supporting the track slabs and imposed tram loading, if not these would also require replacing.

5.7 Design Loads

To remain in accordance with the design loads used for the rest of the tram structures on the network, the design actions for North Bridge would be applied according to the amendments to BD 37/01 detailed in Sections 3.71 to 3.76 of Structures and Civil Engineering Requirements Specification for the Edinburgh Trams Network. This specifies that 0.5 of the Type RL loading model given in the now withdrawn BD 37/01 be used for the tram design.

This is recommended as no equivalent load model to RL is provided in the Eurocodes. This design load model will be subject to approval from the TAA and a departure from standard required.

It should be noted that braking and traction forces are much more significant in rail loading models, compared to similar vehicle models. This may result in tension and other unexpected forces acting through the bridge. A mechanism analysis would need to be undertaken to understand the failure mechanisms of the structure under tram loading.

The key documents to be used for design are:

- BD 37/01 Loads for Highway bridges
- ULE 90130-SW-SW-SPN-00049 V2 (Structures and Civil Engineering Requirements Specification for the Edinburgh Trams)

BS EN 1317 and CD 377 would be consulted for the parapet design.

In addition to the above, the design for North Bridge shall comply with the relevant parts of:

- Eurocodes and associated UK National Annexes
- British Standards
- Execution or Product Standards referenced in British Standards or Eurocodes
- Published Documents (PDs)
- The Design Manual for Roads and Bridges (DMRB)
- The Manual Contract Document for Highways Works (MCHW)
- CIRIA
- Disability Discrimination Act (DDA) 1995/Equality Act 2010
- Cycling by Design 2021
- Office of Rail Regulation Guidance on Tramways
- Edinburgh Tram Design Manual

5.8 Third Party Interfaces

The following Third-Party Interfaces have been identified:

- City of Edinburgh Council
- Transport for Edinburgh
- Network Rail and Waverley Station
- Historic Environment Scotland
- Key stakeholders such as business owners
- Utility companies
- Scottish Environment Protection Agency (SEPA)
- Nature Scot
- Sustrans

5.9 Checking Level

It is considered that due to the relative complexity of this form of structure, a full independent Category 3 level check would be required. This shall be confirmed by the TAA prior to commencement of the detailed design stage.

6. Constraints

Carrying trams across North Bridge would result in additional loads being applied to the structure, for which it was not originally designed. Whilst this raises various concerns about the known extents, condition, capacity and behaviour of the structure, it is noted that current refurbishment works inherently encompass future-proofing for use of the bridge by trams.

6.1 Lack of Information

There is lack of verified information available to provide the engineering details of North Bridge. While Jacobs have investigated historical information, these sources predate the enhanced and dynamic refurbishment works underway, or if the full scope of the initial refurbishment works has extended to the concealed spans.

This lack of information extends to the founding conditions of the bridge. Whilst it is assumed the structure is founded like the adjacent South Bridge on rock, this would need to be confirmed. Additionally, there is no information of the material properties of the masonry or infill used, nor the reported hollow upper sections of each pier.

6.2 Utilities

Trams presently require Overhead Line Equipment (OLE) to provide power with communication and signalling ducts also needed. The OLE requires additional vertical and lateral clearances. An option may be the introduction of battery technology to replace and remove the need for additional overhead infrastructure to support the trams. The feasibility of this should be investigated along with the additional mass associated with batteries, were this option considered reasonable.

The existing utilities across the structure would remain.

6.3 Access

Access to the underside of the structure would require agreement with Network Rail and would be facilitated through Edinburgh Waverley Railway Station. Construction sequences and maintenance patterns would need to be agreed with Network Rail.

If it is discovered that there are masonry arches at both ends of the structure, this would impact the construction and maintenance of the tramway as buildings would potentially need to be accessed. Stakeholder engagement and relationships will be crucial throughout the planning, design, construction and operation and maintenance of the tram route.

6.4 Disruption

The structure provides key access in the city centre, not only for private vehicles but also for various bus routes. While alternative routes around the structure are available, these would need to be assessed in accordance with City of Edinburgh Council. This would then inform the proposed options for the tramway across the structure.

7. Recommendation

7.1 Recommendation

As part of Trams to Granton, BioQuarter and Beyond, this report has reviewed the information obtained/made available to Jacobs with the view of considering the viability or otherwise of a tram route utilising North Bridge. This 130-year-old multi-span arch girder viaduct provides a key connection between the New and Old Towns, across the Waverley Valley. This study has considered the publicly available historical drawings and written records on the structure and the surrounding environment.

The overarching finding is that tram can be delivered across North Bridge. The structure is currently being refurbished; assumed design loads inherently encompass future-proofing for use of the bridge by trams.

Receipt of the completed or draft as-built refurbishment records, including the H&S file for North Bridge, along with the latest version of the Approval In Principal for assessment, will be beneficial in confirming the deck's construction depth, structural capacity and viability for tram loading, along with the structure's material properties and foundation details.

Appendix A includes Chapter 4 (Design Criteria) of Atkin's report 'Edinburgh North Bridge refurbishment, Assessment-led Steelwork Strengthening – Approval in Principle'. Section 4.2 indicates that, in terms of loading, future provision for tram has been made.

> **4.2 Heavy or high load route requirements and arrangements being made to preserve the route, including any provision for future heavier loads or future widening.**
>
> The design of strengthening works will ensure that a vehicle up to the equivalent of an SV 150 vehicle (150t) can cross the bridge under a temporary traffic restriction with no other vehicles on the same span, as per section 4.1.4. This is understood to satisfy the City of Edinburgh Council aspirations for this route and is an improvement on the current situation whereby all abnormal loads are excluded from the North Bridge. In addition, the coincident action of an SV 100 vehicle and 40/44t Assessment Live Loading (ALL) will be considered.
>
> The previous assessment gave consideration to future use of the bridge as a tram route but tram loading in two lanes, in combination with 40/44t ALL in the other two lanes, was found to be less onerous than 40/44t ALL in all lanes. The design of steelwork strengthening for the loads stated in 4.1 (in Appendix A) will therefore inherently encompass future-proofing for use of the bridge by trams.

Going forward, a Principal Inspection is recommended to obtain an understanding of the condition and geometric layout of the structure. This will also inform an understanding of the condition of the concealed spans. A Principal Inspection would help inform an updated structural assessment for the bridge once the detailed alignment of the tram route is known.

While this report has presented ground investigation data around the structure, these records are not located beside the principal bridge supports. As there is no data around the structure's foundations, some investigation to determine their extent and depth, may be required.

A utility survey to establish the bridges services would be needed and the available space for tram service ducts.

Once these tasks have been undertaken, a more comprehensive appraisal for North Bridge can be undertaken.

The proposed works may be constructed in phases under traffic management, with 50% of the existing deck remaining operational at all times to ensure continued access for private, commercial and emergency vehicles, over the structure.

Appendix A. North Bridge Refurbishment – Design Criteria

ATKINS

Edinburgh North Bridge Refurbishment

Assessment-led Steelwork Strengthening - Approval In Principle

The City of Edinburgh Council

May 2019

Notice

This document and its contents have been prepared and are intended solely for The City of Edinburgh Council and Balfour Beatty information and use in relation to North Bridge Refurbishment.

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Job no.	5166471
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4. Design Criteria

4.1. Actions

For all elements requiring strengthening as per the results of the structural assessment, new sections and bolted connections will be designed to carry the worst case combination of the following actions as determined from the Structural assessment AIP (NBR-ATK-SBR-HY622_101_9-_BX-DO-CB-000001), Structural assessment report (NBR-ATK-SBR-HY622_101_9-_BX-DO-CB-000101) and subsequent refinement Technical Notes (NBR-ATK-SBR-HY622_101_9-_BX-DO-CB-000105 and NBR-ATK-SBR-HY622_101_9-_BX-DO-CB-000106[1]).

4.1.1. Permanent actions

All dead and superimposed dead loads for the existing road layout on the bridge shall be in accordance with BD 21/01. This shall include for the self-weight of new permanent access platforms based on the loading assumptions provided in the separate AIP for the Design of Access Platform, doc. ref.: NBR-ATK-SBR-HY622_101_9-_BN-DO-CB-000001.

4.1.2. Snow, Wind and Thermal actions

Thermal actions in accordance with BD 37/01, applied in load combination 3 of that standard, shall be taken into account where this proves to be more onerous than load combination 1, except for 'vertical temperature gradient' (i.e. differences in temperature between the top surface and other levels within the superstructure), which will be ignored for open spandrel steel arch deck.

Load combination 2, which considers wind effect has been undertaken as the encapsulated scaffolding structure will impose lateral pressures on the bridge during the construction phase only. As the structure is an open spandrel steel arch, wind affects during the service life of the structure shall not be considered.

Snow actions shall not be considered.

4.1.3. Actions relating to normal traffic under AW regulations and C&U regulations

40/44t Assessment Live Loading in accordance with BD 21/01.

4.1.4. Actions relating to General Order Traffic under STGO regulations

The passage of a single SV150 vehicle in accordance with BD 86/11 shall be considered without any other actions from normal traffic under AW and C&U Regulations.

4.1.5. Footway or footbridge variable actions

Pedestrian loading on footpaths in accordance with clause 5.36 of BD 21/01, relative to the existing footpath widths.

4.1.6. Actions relating to Special Order traffic, provision for exceptional abnormal indivisible loads including location of vehicle track on deck cross-section

No consideration of Special-Order traffic shall be made.

[1] All refinements of structural analysis to be incorporated in assessment AIP (NBR-ATK-SBR-HY622_101_9-_BX-DO-CB-000001) at a future date.

4.1.7. Accidental actions

Accidental wheel/vehicle loading on footpaths shall be considered for 40/44t Assessment Live Loading where this is the most onerous loading for any member in question.

4.1.8. Action during construction

The weight of temporary scaffold platforms, including working loads for major refurbishment shall be allowed for construction stages. The loads to be accounted are presented in TQ-010.

The live load during the construction phase will be limited to 40T assessment live load in accordance with BD 21/01 along with pedestrian load on the both footpaths in accordance with clause 5.36 of BD 21/01.

4.1.9. Any special action not covered above

The weight of live loading on new permanent access platforms (including personnel, tools and materials to be used in future inspection and maintenance) will not be accounted for in the design of steelwork strengthening. It is considered that by accounting for an extensive scaffolding system as per section 4.1.8, which is thought to be over and above what would be required for future maintenance works once the permanent platforms are in place, would sufficiently encompass the live loading that might be applied on the platforms.

The effects of load redistribution during the replacement of bracing members and joints shall be considered for all affected elements. Where a member or joint is to be replaced, effects shall be assessed before (Construction Phase) and after (Service Life) replacement. The actions to be considered during the Construction Phase shall be: Permanent, 40/40t Assessment Live Load, Pedestrian, Construction, Thermal, and actions due to permanent access platforms.

4.2. Heavy or high load route requirements and arrangements being made to preserve the route, including any provision for future heavier loads or future widening.

The design of strengthening works will ensure that a vehicle up to the equivalent of an SV 150 vehicle (150t) can cross the bridge under a temporary traffic restriction with no other vehicles on the same span, as per section 4.1.4. This is understood to satisfy the City of Edinburgh Council aspirations for this route and is an improvement on the current situation whereby all abnormal loads are excluded from the North Bridge. In addition, the coincident action of an SV 100 vehicle and 40/44t Assessment Live Loading (ALL) will be considered.

The previous assessment gave consideration to future use of the bridge as a tram route but tram loading in two lanes, in combination with 40/44t ALL in the other two lanes, was found to be less onerous than 40/44t ALL in all lanes. The design of steelwork strengthening for the loads stated in 4.1 above will therefore inherently encompass future-proofing for use of the bridge by trams.

4.3. Minimum headroom provided

Headroom clearance under the bridge will not be affected as part of the steelwork strengthening and is currently well in excess of minimum requirements.

4.4. Authorities consulted and any special conditions required

- ***Statutory Consultees***

- The City of Edinburgh Council Structures Department. Conditions are specified in the contract for the project.
- The City of Edinburgh Council Planning Department. Listing Building Consent for the proposals has been obtained.

- ***Other consultees***

- Historic Environment Scotland via CEC Planning Department. No objections to the proposals have been made.

4.5. Standards and documents listed in the Technical Approval Schedule

See Appendix A. These documents are current as of 22 December 2017, at the earliest, as defined as the Contract Reference Date in clause 14 of the Preamble to the Specification for the project.

4.6. Proposed Departures relating to departures from standards given in 4.5

None.

4.7. Proposed Departures relating to methods of dealing with aspects not covered by standards in 4.5

None.