4-Mile Walk, Duror

Replacement Bridge Optioneering Technical Note

The Highland Council

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Quality information

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1. Introduction

As an addition to the Riverside Way contract, AECOM has been appointed by The Highland Council to produce a short technical note that outlines structural options that could be considered for a replacement footbridge crossing a watercourse in Glen Duror. The footbridge is to replace a life-expired footbridge that has previously been removed and is to help connect parts of the proposed walking route through Glen Duror forestry plantation to Taigh Seamus a' Ghlinne, a historic bothy said to be the birthplace of James of the Glen.

1.1 Scope of Work

The scope of this short technical note is to outline options for a replacement footbridge at the previous bridge site, including an overview summary of potential next steps (surveys required, etc).

Limited information, essentially only the location of the previous structure, has been provided to inform the proposal of structural options. Given this limited information and the high level nature of this document, a number of assumptions have been made. These are recorded in the following sections and should be revisited and refined as part of any future works.

A site visit was carried out to assist with identifying potential options and constraints. As part of this, AECOM were requested to consider if there were any other obvious potential bridge sites up-to 500m either side of the previous bridge location.

2. Background

2.1 Structure Location

The previous bridge site is located off a public path through the Glen Duror forestry plantation.

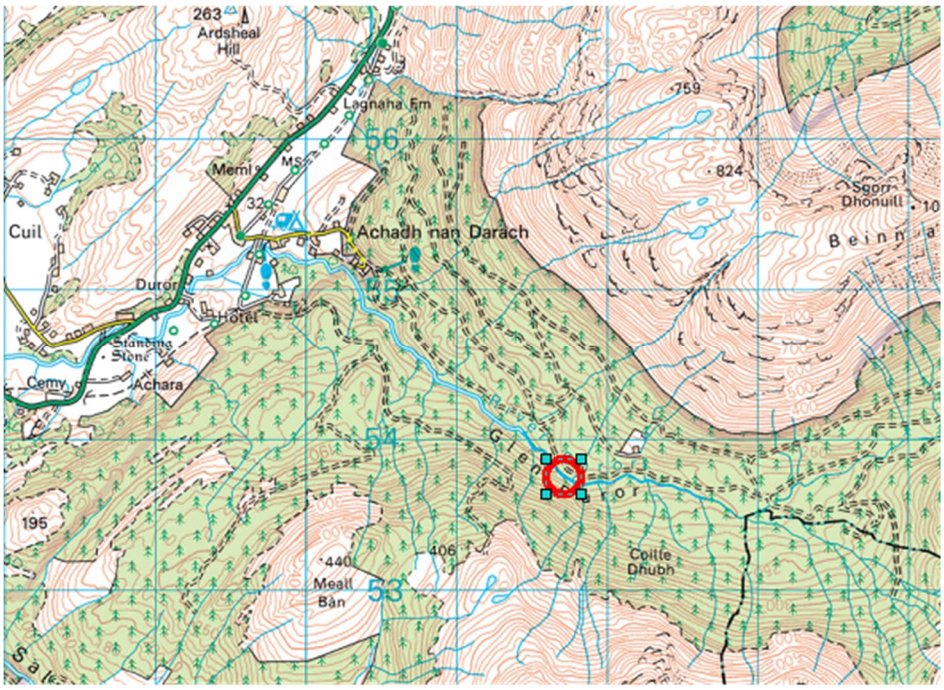

Figure 1 - Bridge site location

Figure 2 - Provided photo of previous bridge location

2.2 Site Visit

The site visit was carried out on 29/02/2024 by a Senior member of the Edinburgh Bridges team. Weather was cold and overcast, with rain showers at times. A staff member of The Highland Council attended the visit.

The previous bridge location was approached from the Glen Duror bothy car park, with 500m either side of the previous bridge location visually surveyed for potential alternate bridge locations. It is noted that the previous bridge location was partially hidden, with no obvious access track currently leading to it.

Figure 3 - Access track adjacent to previous bridge location

Figure 4 - View onto previous bridge location (circled)

Figure 5 - Previous bridge foundations

Figure 6 - Previous bridge alignment (north foundation at bottom of photo)

Figure 7 - Previous bridge superstructure (removed and lying on adjacent ground)

From the visual survey, there are no obvious alternate locations in the described area. In general, there is no access to the opposite side of the watercourse due to trees or significant changes in topography. In the 500m eastwards of the previous bridge site, there are two areas that initially appear to have potential for a future bridge site. However, both have significant local constraints that would require to be addressed.

The first is at an existing weir structure. Whilst it may be possible to cross at or near the weir, and potentially draw aesthetic benefit from it, access to the weir and associated infrastructure would have to be maintained, which is likely to be a considerable constraint. Access to the south side would also have to be established through the existing forestry area.

Figure 8 - Existing weir structure

The second point is approximately 100m east of the weir, where the topography flattens. The watercourse widens at this point, so piers or other supports would likely be required in the watercourse. It is assumed this would require the agreement of SEPA and potential impact on the local flood regime would have to be carefully considered. The new supports would be susceptible to impact from debris washed down the watercourse, with design, maintenance and potential flooding implications.

Figure 9 - Area of flatter topography

3. Constraints

Structural options suggested in this technical note are guided by identified site or technical constraints discussed in outline below. These are based on the information provided and listed in Sections 1 & 2.

No structural preferences have been expressed by the Client. The options presented below therefore consider the most likely technical solutions for the anticipated span and structure location. It is noted that whilst other technical options may be possible, including a stress-ribbon bridge or an arch structure, these have been discounted due to their higher initial construction cost and/or on-going maintenance requirements.

3.1 General Constraints

Structural options considered as part of this technical note consider, in outline, whole life costing. To assist future maintenance inspections and works by the ultimate structure owner, it is assumed that, where possible, the accessible faces of foundations will be suitably set back from the edge of the watercourse.

As the replacement footbridge would carry members of the public, it is assumed it will require to be designed in accordance with the structural Eurocodes and associated supporting documentation. For the purposes of this technical note, it is assumed this includes the Approval In Principle (AIP) process laid out in CG300 of the Design Manual for Roads and Bridges (LINK).

Interface with existing embankments, drainage routes, utilities and the like are not explicitly considered within this technical note. As none were obviously visible during the site visit, it is assumed that there are no public utilities or similar in the area that may affect structure options. As part of future works, a formal check for public utilities information, topographical site survey and geotechnical investigative work may be required.

Based on what can be seen of the previous bridge, a 1.5m wide structure is assumed at this stage. This may be reviewed and revised as part of future works.

3.2 Site Constraints

The main constraint is the presence of the watercourse and adjacent forestry plantation. Access through the forestry plantation is via a gravel path. The path appears to be in overall good condition. Rut lines in the gravel suggest the path has routinely been used by vehicle traffic, although no vehicles were seen during the site visit.

Figure 10 - Gravel access path

A small number of culverts and small-span underbridges carry the path at discrete points. As noted, the condition of the path suggests it has routinely been used by vehicle traffic so access for construction equipment should be possible. This should be confirmed as part of future work, once construction equipment type, weight and route to be used is known. Noted that road plates or similar may be required in places due to shallow cover to existing infrastructure.

Figure 11 - Existing small-span underbridge on access path

Figure 12 - Existing HDPE pipe culvert under access path

Access to the bridge location will have to be formed, as any previous route has been reclaimed by nature. It is currently unknown if any of the trees in the area adjacent to the previous bridge site are protected or are to be retained. Whilst unlikely given the forestry setting, this should be confirmed as part of future works.

It was observed that the abutments for the previous footbridge are still there. Whilst these may or may not be re-usable, their continued presence suggests that the previous location is likely to be suitable for a replacement footbridge. It is highlighted that some erosion of the adjacent watercourse bank was observed. Foundations options for any replacement bridge will need to consider this, and may be set further back due to this.

Figure 13 - Bank erosion adjacent to previous abutment

3.3 Technical Constraints

It is assumed the replacement structure will require to be designed in accordance with the structural Eurocodes and associated supporting documentation

It is assumed that the replacement structure will require to be designed for waterborne debris loading, such as trees that way be washed downstream.

It is assumed 1.150m high parapets in accordance with DMRB requirements will be provided (CD 353 - Design criteria for footbridges).

It is assumed that aesthetics are not a governing factor in option selection.

Providing the soffit level of the replacement footbridge is above the existing abutment level and there is no new work in the adjacent watercourse, it is assumed no approval from SEPA will be required. This should be confirmed as part of future works.

4. Structural Options

No structural preferences have currently been expressed by the Client. The options presented below therefore consider the most likely technical solutions for the anticipated span and structure location. It is noted that whilst other technical options may be possible, including a stress-ribbon bridge or an arch structure, these have been discounted due to their higher initial construction cost and/or on-going maintenance requirements.

4.1 Structural Form

Assuming that the abutments are set back from the edge of the watercourse, behind the line of the previous foundations, an overall structural span of around 10-15m is required. Taking cognisance of site constraints, a single span structure is proposed, matching the previous structure.

For a single span of around 10-15m, structural options include beam & slab, truss girder and through-truss forms. Refer Figure 14, 15 & 16 respectively. The construction depth of the proposed solution is of less importance as the access path connection each side must be re-established and will likely require some local re-grading of earthworks regardless of which option is selected.

Use of a beam & slab or through-truss solution is therefore proposed as most appropriate.

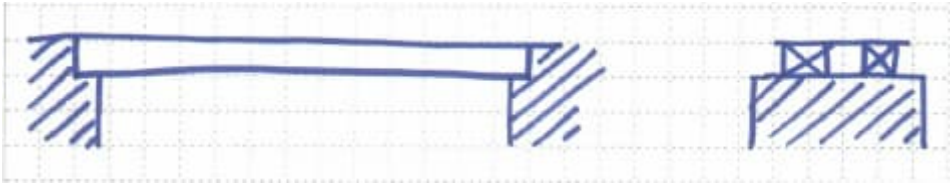

Figure 14 - Beam & slab

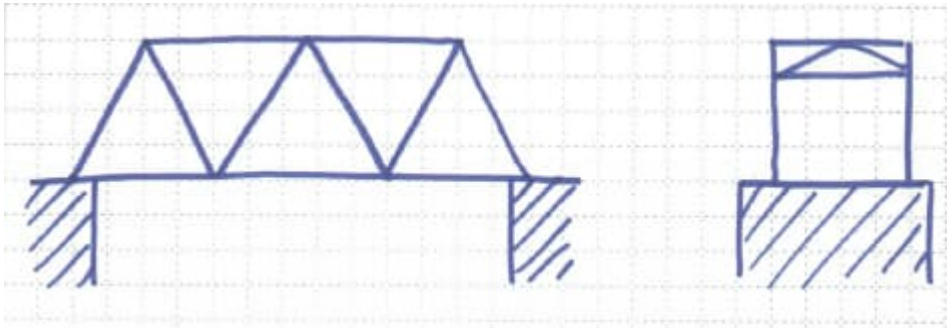

Figure 15 - Truss girder

Figure 16 – Through-truss

4.2 Material Choice

Material choices for the above structural options include timber, steel and plastic/polymer. Due to the forestry setting, it is likely that a timber option will prove to be the optimal choice. The design life and durability will depend upon the type and grade of timber selected. This should be considered as part of future works, as more durable hardwood options may not be locally available.

Abutments are likely to be concrete pad footings, similar to those provided for the previous structure.

Connecting paths to the access route are likely to be formed of gravel. These may have geotextile membranes or similar underneath to assist with drainage and settlement.

5. Summary and recommendations

5.1 Structural solution

It is recommended that a single span beam & slab or through-truss structure with concrete pad foundations be considered for use at the site of the previous bridge location. It is recommended that 'off-the-shelf' solutions from industry suppliers should be considered, as bespoke designs will be more expensive for the anticipated span. An example 'off-the-shelf' solution is shown below.

Figure 17 - Example 'off-the-shelf' bridge solution

A site survey will be required to confirm the required span and allow connection details to the existing access routes to be developed. Any site restrictions regarding protected trees or other environmental factors, including liaison with SEPA if required, should also be confirmed.

5.2 Indicative outline construction costs

Indicative outline construction cost for an 'off-the-shelf' bridge solution is around £2k/m^3. For a 10m span, estimated cost of the replacement superstructure would therefore be around £30k.

Estimated cost for new concrete pad footings each side is £5k, say.

Estimated cost for new access path connections each side is £10k, say.

Estimated cost of site preliminaries and site access is £15k, say.

Total estimated construction costs around £60k, say.

The above costs are outline estimates and provided for illustration purposes only. Costs should be confirmed by potential suppliers as part of future works. Noted the above exclude any allowance for Client procurement and management costs, costs associated with scheme development, gaining technical approval, surveys etc. No contingency or optimism bias is included.