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Report to: **Tamar Bridge and Torpoint Ferry Joint Committee**

Date: **24 November 2016**

Title: **Tamar Bridge Suspension System Remedial Work**

Portfolio Area **Cornwall Council: Transportation and Waste
Plymouth City Council: Transport**

Divisions Affected **all**

Relevant Scrutiny Committee: **Scrutiny Management Committee**

Relevant Portfolio Advisory Committee (Cabinet (executive) decisions):

| | | | |
|--|----------|---|---|
| Key Decision: | Y | Approval and clearance obtained: | Y |
| Urgent Decision: | Y | Date next steps can be taken: (e.g. referral on of recommendation or implementation of substantive decision) | Normally 10 calendar days after decision for Cabinet |
| Appropriate pre-decision notification given where an executive Decision? | | | N |

Author: **David List** Role: **General Manager**

Contact: **01752 812233** david.list@tamarcrossings.org.uk

Recommendations:

1. the report be noted;
2. a new capital item for Tamar Bridge Suspension System Remedial Work is included in the proposed 2017/2018 Revenue Estimates and Capital Programme with a budget provision of £6.0 million;
3. an update report be brought to the next meeting.

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1. Executive summary

- 1.1 This report sets out the issues identified with the Tamar Bridge suspension system through a series of special investigations and summarises the current position and preferred way forward.
- 1.2 Following a series of detailed inspections, it has been discovered that elements of the suspension system, referred to as cable band bolts and hanger bolts, have characteristics that are outside the acceptable specification range. With the exception of a small number of bolts that were replaced during the 1980s the vast majority of bolts are original items and now over 55 years old. The cable band bolts and hanger bolts are safety critical elements of the suspension system.
- 1.3 The bridge suspension system is fundamental to the function of the structure and the affected elements have limited redundancy. In order to reduce the risk of failure of one or more of these critical elements it is important that the defects are addressed as soon as possible.
- 1.4 Officers and consultants are in the process of finalising a technical solution for the remedial work but it is important to engage with a contractor at an early stage due to the very specialist nature of the scheme and high level access arrangements required to undertake the work. This early contractor engagement will lead the preferred procurement route.
- 1.5 It is recommended that a new capital item for the work is included in the proposed 2017/2018 Revenue Estimates and Capital Programme with a budget provision of £6.0 million.

2. Background

- 2.1 The Tamar Bridge suspension system is fundamental to the function of the structure as it supports the road deck, the two cantilever lanes and the stiffening truss. The suspension system comprises 2 no. main cables, 120 no. vertical hanger cables, hanger sockets and cable bands and 18 no. supplementary cables added during the strengthening and widening project in 1999-2001. Each cable clamp comprises either 6 no. or 8 no. cable band bolts and each vertical hanger comprises 4 no. high level and 4 no. deck level hanger bolts.
- 2.2 A small sample inspection of these critical elements (the cable band bolts and the hanger bolts) was undertaken in early 2014 in order to determine the overall condition of the bolts and to confirm their material properties.

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- 2.3 The results of this initial investigation and associated laboratory testing revealed some anomalies in the hardness values of the sampled bolts. As a result, it was decided that further limited in-situ hardness testing should be carried out on all of the areas of the south main cable that were readily accessible by mobile elevating work platforms.
- 2.4 The additional inspection and testing yielded similar unsatisfactory hardness results to the original limited sampling exercise and it was subsequently decided to extend the scope of the investigation to include full coverage of the structure meaning that every cable band bolt and hanger bolt would be tested.
- 2.5 Overall 1,310 no. bolts have been inspected and tested to date. There are a further 64 no. bolts that require inspection but due to different access arrangements they have not yet been checked. This will be completed in the near future. The results so far have established that approximately 20% of the bolts fall outside the acceptable specification range and will require replacement.
- 2.6 In addition to the bolts that fall outside of the specification range the inspection has also identified 6 no. cracked bolts. This type of defect was particularly unexpected and as a result additional investigation work is required. At present officers are making arrangements to remove one of the cracked bolts and replace it with a temporary new bolt. The cracked bolt will undergo forensic examination to determine the most likely cause of failure. This aspect of the investigation is currently ongoing and will be completed as soon as possible.
- 2.7 The access arrangements and temporary works requirements to undertake the bolt replacement scheme are complex and will be developed further taking into account the need to maintain traffic flow across the structure, ensuring the safety of users and member of the public and allowing the contractor to complete the works as efficiently as possible.
- 2.8 The outline temporary works requirements for the scheme have been determined according to the existing design, load capacities and safety factors of the structure. The safety factors in the design provide very limited redundancy of certain elements, and mean that each of the vertical hangers is necessary and it is not acceptable to remove one hanger or the associated bolts from the structure without making alternative provisions to carry load. As such the temporary works required at each hanger location will involve the installation of two additional temporary supports, one either side adjacent to the permanent hanger. The temporary supports will be used to relieve vertical load from the permanent hanger arrangement so that the permanent hanger and cable band bolts can be removed and

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replaced. Once the replacement bolts have been installed, a pre-determined load will be applied to each bolt and checked. Once complete the load can be transferred from the temporary supports to the permanent hanger and the temporary support arrangement uninstalled. This process will be repeated at every hanger requiring intervention.

2.9 Temporary access arrangements will be required at every permanent hanger location requiring intervention. The access arrangements will be designed in such a way as to protect members of the public, bridge staff and personnel involved in the works. The details of the preferred access arrangements are difficult to determine at this point because there are a number of significant variables to consider such as:

- work at differing heights/locations;
- size of access;
- weight of access;
- access installation/removal methods;
- multiple methods of access dependent on locations;
- construction of bespoke access platforms;
- installation of temporary full or partial catwalks.

2.10 The preferred competitive dialogue procurement route will enable officers to engage with an experienced contractor at an early stage and this will enable the most safe and efficient access arrangements to be developed according to the Clients requirements, existing site constraints, programme and contractor preferred methodology.

2.11 Officers and consultants will continue to develop the outstanding details of the scheme whilst in parallel, and as a matter of priority, establish the principles of the procurement route with Cornwall Council commercial services team.

2.12 It is essential that this scheme is undertaken as soon as possible and work is currently anticipated to commence in Spring 2017 to make the most of the favourable weather conditions. At this stage officers have estimated that the work may take 12-18 months. However, the programme will be refined once a contractor is appointed.

2.13 The preliminary results of the full testing exercise indicate that at the very least a selective bolt replacement scheme is required. However, the widespread distribution of the substandard bolts means that high level access and complex temporary works will be required at virtually all 120 no. hanger locations and it is therefore likely to be more efficient in the long run to undertake a total bolt replacement scheme from the outset.

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2.14 The costs associated with the scheme are significant and reflect the highly specialist nature of the scheme, complex access arrangements and significant temporary works requirements. Below is an estimate of the costs associated with the project.

Summary of estimated fixed costs

Some of the costs are considered fixed, regardless of the scale of the works, and these costs are unlikely to vary significantly regardless of whether 1 no. bolt is replaced or all 1374 no. are replaced.

Professional services - £400,000

Including - outline scheme development, procurement process support, pre-site planning and CDM 2015 support, design, analysis and checking and site supervision support.

Contractor services - £1,000,000

Including - project preliminaries, pre-site planning, health and safety documentation, surveys, detailed access design, detailed temporary works design, off-site fabrication work, mobilisation and demobilisation.

Summary of estimated variable costs

Some of the costs are variable and are generally associated with the works on site and will vary according to quantity, duration, site programme or scale of the works. Estimated minimum and maximum costs are set out below:

| Item | est min | est max |
|---|-------------------|-------------------|
| Project management and site supervision | £50,000 | £100,000 |
| Traffic Management | £80,000 | £160,000 |
| Contractor site set up | £200,000 | £500,000 |
| Construction works | £735,000 | £1,800,000 |
| Weather delays | £75,000 | £150,000 |
| Sub total | £1,140,000 | £2,710,000 |
| Site contingency/risk allowance at 25% | £285,000 | £677,500 |
| Total | £1,425,000 | £3,387,500 |

The total estimated fixed and variable costs produces an estimated budget range for the project of £2,825,000 - £4,787,500. At this stage, without the appointment of a suitable contractor to assist with the development of the scheme, the urgent nature of the project programme and the rigorous governance arrangements, it is considered prudent to make a budget provision of £6 million to facilitate the anticipated range of possible solutions.

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It is proposed that the item is funded by borrowing, and the associated revenue costs are incorporated in the proposed 2017/2018 Revenue Estimates and Capital Programme.

3. Outcomes/outputs

- 3.1 **Programme** - due to the critical nature of the works it is proposed to start the scheme on site in Spring 2017.
- 3.2 **Design Development** - consultants have developed the bolt replacement scheme as far as possible and without valuable input from an experienced contractor. It will be necessary to finalise the scope of works once a suitable contractor is appointed.
- 3.3 **Procurement** - the preferred procurement option will be through the Competitive Dialogue procedure (Regulation 30) and undertaken in accordance the New Public Contract Regulations 2015. This route should enable the appointment of a contractor by February 2017.

4. Options available and consideration of risk

The following options have been considered -

- 4.1 **Do nothing** – this option is not considered viable due to the safety critical nature of the suspension system. The risk of failure of these safety critical elements would remain high and that could compromise the provision of the crossing into the future.
- 4.2 **Undertake a partial bolt replacement** – while this is a viable option it is not the preferred option. Investigations have shown that approximately 20% of bolts do not comply with the relevant specification range. Implementing this option would mean that the risk of failure of the bolts that do not meet the required specification is mitigated. However, the remaining bolts will still be original items and over 55 years old. As these are considered hidden elements (i.e items that cannot be fully inspected without removal from the structure) some risk remains that bolt failures may occur in the future for other/age related reasons. In addition, discovering a number of cracked bolts, some of which are within the specification range, has introduced another dimension to the investigation and at this juncture it is too early to determine the cause of the cracking.
- 4.3 **Undertake full bolt replacement** – based on findings and assessment to date this is the preferred option as a full bolt

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replacement scheme will mitigate the risks specifically associated with these safety critical elements. The widespread distribution of the substandard bolts means that high level access and complex temporary works will be required at virtually all 120 no. hanger locations. As set out above, the high value elements of the project are the complex access arrangements and the temporary works required to temporarily relieve the load from each hanger cable while a bolt is replaced. This needs to be done regardless of whether one bolt or all bolts are being replaced.

5. Proposed Way Forward

It is recommended that a new capital item for the work is included in the proposed 2017/2018 Revenue Estimates and Capital Programme with a budget provision of £6.0 million.

6. Implications

| Implications | Relevant to proposals Y/N | Details and proposed measures to address |
|--|---------------------------|---|
| Legal/Governance | N | There are no legal implications arising directly from this report. |
| Financial | Y | <p>It is proposed that the item is funded by borrowing, and the associated revenue costs are incorporated in the proposed 2017/2018 Revenue Estimates and Capital Programme.</p> <p>Initial revenue funding of borrowing the £6m funding for the project is approximately £510,000 per annum. Costs will incrementally increase to this annual sum as the project progresses and then decrease over time as capital is repaid and interest liabilities reduce. Estimates and indicative forward budgets reflect programmed funding.</p> |
| Risk | N | |
| Comprehensive Impact Assessment Implications | | |
| Equality and Diversity | N | No issues identified. |

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|--------------------------------------|---|---|
| Safeguarding | N | No issues identified. |
| Information Management | N | No issues identified. |
| Community Safety, Crime and Disorder | N | No issues identified. |
| Health, Safety and Wellbeing | Y | The safe delivery of the service is critical. Key Performance Indicators (KPIs) monitor the level of accidents occurring on TBTF sites. |
| Other implications | | No other implications identified. |

Supporting Information

None

Background Papers:

None

Approval and clearance of report

All reports:

| Final report sign offs | This report has been cleared by OR not significant/not required | Date |
|--|--|-------------|
| Legal (if significant/required) | Simon Mansell | 15.11.16 |
| Finance Required for all reports | Leah Thomas, Interim Strategic Finance Manager | 16.11.2016 |
| Equality and Diversity | Not Required | |

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Cabinet/individual decision reports:

| Final report sign offs | This report has been cleared by | Date |
|-------------------------------|--|-------------|
| Head of Service | David List | 14/11/2016 |
| Corporate Director | | |