

A3 - Challenge Fund Bid 2015 – Cumberland Basin Complex

Executive Summary Case

Introduction

The Cumberland Basin Scheme was constructed between February 1963 and April 1965 and was officially opened to traffic on 14th April 1965. The overall cost of construction of the scheme was £2,650,000. In developing the layout and capacity of the junction, emphasis was originally placed on the ultimate requirements of local traffic demands and forming links with the City's other road systems. The final layout was chosen to satisfy the following requirements:

- The Cumberland Basin Complex was designed to deliver the projected traffic demands for twenty years, leading up to 1985, and to provide capacity for traffic flows up to 2.5 times the then existing traffic flows in 1965.
- The new proposed system would afford a free flow of traffic in all directions at all times, eliminating right hand turns across opposite traffic streams.
- Comprise an all-purpose route accommodating all vehicle movements, without any restriction on headroom or weight, and all pedestrian demands with reasonable segregation.
- Allow for the flow of vehicles to be maintained during construction.
- Cause minimum interference with navigation traffic into and out of the City Docks.
- Pay major regard to aesthetic considerations because of the close proximity of the scheme to the Avon Gorge (Triple SI Site) and the Clifton Suspension Bridge.

Overall Condition of Cumberland Basin Complex System

The whole of the Cumberland Basin infrastructure complex is now within its 50th year of performance and is thus approximately 42% of its original design live (120 years) has now elapsed. The overall Cumberland Basin structure complex has deteriorated much faster than originally designed given also that the projected traffic figures in 1963-1965 have now well outstripped the traffic figure for which the structure was originally designed (2.5 times the existing traffic flows in 1965), with a resultant consequential increase in structural component deterioration which would normally have been expected when originally designed and constructed in 1965.

Routine programmed detailed “hands on” Principal Inspections taken in recent years (particularly in 2013 & 14), by Consultants CH2MHILL, have identified that the following structural components are now “life expired” and require urgent renewal or refurbishment, rather than routine cyclical maintenance. These separate structural components can be summarised as follows:

- Structural Bearings, both Elastomeric and Roller Bearings.
- Waterproof Membrane throughout all bridge deck areas.
- Expansion Joints between all elevated structural deck areas.
- Sub-Standard Parapet system throughout.
- Avon Fixed Bridge – Half Joint Condition

Structural Bearings

A detailed inspection survey undertaken by EXSPAN in 2012, recommends the immediate replacement of all elastomeric bearings and the possible replacement and/or removal of the remaining roller bearings. In total there is in the region of 332 bearings, and it is estimated that the cost of replacement for all of these bearings would be in the region of 10 million pounds. If a bearing replacement programme were to be considered from normal Capital funding streams it is estimated it would take the Council in the region of 10 to 15 years to do this work which would not be acceptable from a structural integrity point of view and would also prolong the disruption, the certain congestion and traffic delays along these primary routes resulting in unacceptable negative affects to the local economy and increased pollution to the local environment throughout.

Waterproofing Membrane System

The original proprietary waterproofing sprayed on membrane system is now beginning to debond from the bridge concrete deck in many isolated areas, which has resulted in the formation of potholes in many locations. Bristol City Council has dealt with these occurrences on a reactive basis and have undertaken large pothole repairs (under lane closures), where it has been found that the complete layer of the sprayed on membrane has debonded from the concrete surface and thus the whole running course layer is moving laterally under traffic loading.

As this system is now life expired, it is expected that this pot hole formation defect will increase in frequency and numbers leading to potentially serious safety issues with live running traffic and resulting in much more traffic congestion and delays due to the resultant lane closures and associated traffic management, whilst dealing with this large extent of pot hole repairs.

If the bridge/viaduct waterproofing membrane replacement programme were to be considered from normal Capital fundings it is estimated it would take the Bristol City Council in the region of 10 to 15 years to do this work which would not be acceptable from a structural integrity point of view due to increase water ingress into the fabric of the structure. Such a waterproofing replacement programme would also prolong the disruption, the certain congestion and traffic delays along these primary routes resulting in unacceptable negative affects to the local economy and increased pollution to the local environment.

Expansion Joint System

As with all other elements on the Cumberland basin complex the 28 No. bridge expansion joints between structural component decks have long ceased to function as they had originally had been designed. The general construction of these expansion joints are of the steel mechanical joints construction variety which allowed for longitudinal deck expansion through connected interlocking sliding steel plates (with interlocking teeth), at deck level as well as incorporating a drainage outfall system by the incorporation of water catchment drainage trays situated below the joint at deck soffit level. Over the working life of the various structures on the Cumberland Basin complex these mechanical joints have become locked/seized into one position due to the continuing discharge of grit and stone residue from the carriageways. It has become impossible to free these older mechanical joints and thus Bristol City Council had began a planned programme of removal of these mechanical joints with the intention of the phased replacement of these expansion joints with more modern type of asphaltic plug joints. This programme of joint replacement had already begun in 2008, however it has become apparent that some of the newer asphaltic joints has also begun to fail due to the nature of the flexible material and the shallow depth of

plug construction. It is proposed therefore to use a deeper types of asphaltic plug joints for future joint replacement works as it is considered that these proposed expansion joints would be more appropriate in this situation.

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Sub Standard Parapets

The whole of the Cumberland basin network has the same sub-standard parapet system throughout on all elevated sections and also on all ground bearing sections throughout, some 4km. This parapet rail system is of simple infill panel construction and does not comply to existing parapet standards. The steel components throughout are heavily corroded, especially within the lower level hollow rectangular horizontal sections. Bristol City Council has in the past only reacted to the many RTC's throughout the Cumberland Basin Complex and have replaced sections of panels on a purely reactive basis. The whole of the parapet system was also repainted in 2002.

This current bid proposal entails the incorporation of the installation of a high containment safety kerb, in the footways and margins along with an overall traffic management scheme to reduce the speed limit to 40mph which will bring the parapet design characteristics down to category N1, thus allowing Bristol City Council to replace the existing parapet rail system with some minor alterations to the edge beam anchorage detail.

Avon Fixed Bridge

There are serious concerns about the structural intergrity of this "half jointed" fixed bridge. Recent Principal inspection in 2014 has indicated that this bridge requires urgent structural attention. The CH2MHILL Principal Inspection Report has yet to be compiled and issued to Bristol City Council, but advance internal notifications from CH2MHILL have indicated that there are major structural defects associated with the following structural elements on Avon fixed bridge:

- Miscellaneous concrete repairs to half joints - 40% of previous repairs deemed to be now failing.
- Major concrete repairs to bridge piers, estimated to be 30 to 40% of exposed pier faces.
- Major concrete repairs to main cantilevered bridge spans.
- Major concerns as to the structural integrity of the pre stressed tendons within voided spans.
- Overall Major extent of soffit concrete repairs.
- Bearing replacment throughout.
- Parapet replacement to full extent of bridge.
- Expansion Joint replacement throughout.
- Major Drainage repairs and rerouting off the structure.

It was recommended within the recent 2014 Principal Inspection Report that within the next two years approximately £486,000 of urgent structural repairs would be required to allow to bridge to remain fully open to traffic. In the event of these urgent capital works not being completed within this two year timeframe the bridge would most probably need to be fully closed or at the very least be load or speed

restricted, with the “knock on” catastrophic affects to the whole of the Cumberland Basin Complex network as well a bringing the City to a general traffic standstill. The option “to do nothing” or the “bare minimum” is not available here as should a “half joint” fracture and fail on this bridge the multile deck arrangement would fully collapse and the bridge would fail catastrophically. It will not be possible to phase out and programme these urgent structural works over the next 10 to 15 years, as may be possible for the remainder of the other structures which form part of the Cumberland Basin Complex and thus these repairs to Avon fixed bridge are now critical to the overall viability of the Cumberland Basin Complex.

This current bid proposal will hopefully facilitate successful implementation of these urgent structural works to the bridge within the critical two year timeframe that is now required and thus this bridge will be in a structurally sound condition to ensure a fully serviceable working life for the remaining 70 years, with proper cyclical programmed maintenance as normal.

Overall Summary

From the above described component structural conditions it is not possible to replace the number and scale of these structural components under the normal financial model of Capital funding allocation for up to 15 years. These components will ultimately fail before the critical replacement or renewal programmed works have been completed, which will result in parts of the network being closed or put under emergency restrictions. The other potential scenario is that Bristol City Council could be faced with dealing with a number or series of structural failures all occurring at the same time which would ultimately bring the whole Cumberland Basin Network to a standstill, which would ultimately be catastrophic for the economy of the City.

The whole Cumberland Basin Complex has deteriorated much more than its intended design life cycle (120 years), due in the main to the massive increase of traffic numbers than from the original design. The proposed works now being recommended will help to bring this whole network back to how it should be at this stage of its design life cycle (50th year), given the structure back the original intended full 70 years (120 year design life) before consideration will need to be further given for total replacement. Full intervention within the next three years will stop the rate of decline and will bring the complex back into a maintainable condition allowing further programmed routine maintenance using 21st century methods and more robust materials and components, which will perform better.