

# Memo

Date: Friday, February 22, 2019

Project: Main Street Extension – KCMO Streetcar

To: KC Streetcar South Main Extension PMT, Nick Stadem, File

From: Chad Hall, PE

Subject: Review of Structures (Main over Brush Creek and Main St over KC Terminal Railway near Union Station)

## Background

The proposed Kansas City Streetcar South Main Street Extension alignment runs along Main Street from the current southern terminus of the streetcar Starter Line alignment at Union Station to the UMKC campus between Volker Blvd and 51<sup>st</sup> Street south of Brush Creek. The proposed alignment travels over two existing structures; Main Street over Brush Creek between Ward Parkway and Volker Blvd and Main Street over KC Terminal Railway near Union Station.

To support the Phase 1 Preliminary Engineering effort, HDR conducted a high level review of the existing structure as-built drawings and completed field inspections of both structures. This effort was completed to provide guidance on alternative concept alignments across the structures to help identify potential fatal flaws at this level of design. Capacity calculations, detailed review of the structural plans and/or testing of existing structural materials were not completed as part of this design phase. Additional structural review will be required as the streetcar alignment design progresses.

## Main Street over Brush Creek:

The Phase 1 Preliminary Engineering effort investigated the capacity of this existing bridge as it related to the future expansion of the streetcar along Main Street to the south and across Brush Creek. The results of the site visit and assessment of both the existing bridge as well as the existing bridge plans provided the following information:

- The structure should be capable of supporting the live/dynamic loading of the streetcar.

The bridge was designed in 1991 to AASHTO standards and used a design of a HS-20 truck. It has been shown in the past that as long as a bridge was designed to HS-20 that it can handle the streetcar loading as well.

- Bridge was built in 1995. Typical life expectancy of a bridge of this type is approximately 75 years; therefore the structure should have more than 30 years of useful life remaining.
- The bridge deck could allow for placement of an embedded track slab if the 4.5" overlay thickness previously used on the Starter Line project was used on this structure. This would necessitate the use of the shallower 112 TRAM "block" rail section rather than a taller 115 RE or U-69 Girder Rail section. It is unlikely that the



structure can handle anything greater than 4.5-5" of thickness for embedded rails. The existing bridge has a 6.5" deck and 2" wearing surface. It was also designed to allow for an additional 1.5" wearing surface (1.5" more than is there today). The top mat of steel is 2.5" from the top of the 6.5" deck. The existing 2" wearing surface could be milled as well as an additional 1" of deck (leaving 1.5" to the deck rebar so it is not clipped when the deck is milled). A 4.5" wearing could then be applied to the milled surface to embed the rails. This would effectively add 1.5" to the existing top of deck and the bridge would still be within its original design tolerance. There is not room to mill more than possibly an additional 1/2" to get some extra depth.

The bridge is post-tensioned, therefore adding any more than 1.5" on top of the existing thickness (which is the maximum of the original design tolerance) would likely require additional strengthening which would be very complicated due to the structure type as well as the 43 degree skew and very large center span (additional DL could become an uplift concern if the limits of the original design are exceeded). Based on the existing plans, rails could be embedded but with a maximum depth of 4.5-5".

- OCS poles can be installed on the structure, though there are preferred locations for the pole foundations as noted below.

The bridge has spans of 65-105-65. It would be preferred to place the poles at the pier locations so the anchors could be drilled into the existing diaphragm. However, if tighter (approximately 80' for standard applications) spacing was needed then other structural designs could be considered (i.e. bolt the anchors through the deck and have plates on the inside of the box to secure them). Any proposed foundation locations outside of the pier locations would require more refinement of the design in future phases. Based on the aesthetic sidewalks and overlooks it may be preferred to place any OCS poles along the guideway(s) or the median.

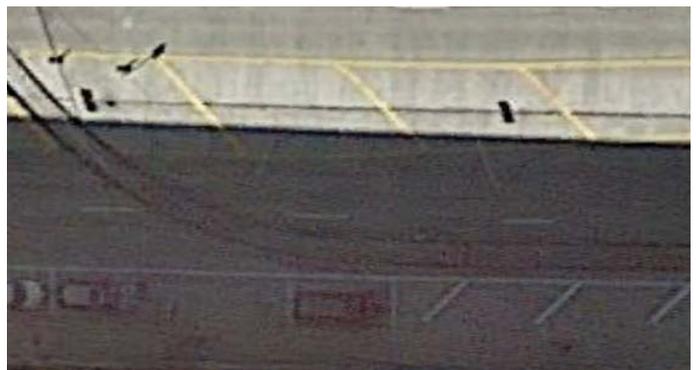
- As long as the proposed guideway(s) are located within the limits of the existing roadway and not on the sidewalk, there is not any further restriction on the placement of the guideway along the bridge section. The webs of the superstructure are evenly spaced and all use the same design throughout the limits of the current roadway so location of rails within this "window" should be uniform.

## **Main Street over KC Terminal Railway (near Union Station):**

As the Starter Line placed embedded guideway and special trackwork on the existing Main Street over KC Terminal Railway structure near Union Station, the Phase 1 Preliminary Design effort made the assumption that the structural capacity of the bridge could support an extension of the current NB alignment south through the limits of the bridge towards Pershing Road, as well as a second turnout on the structure. Beyond the structural capacity of the bridge, two factors were reviewed in relation to the proposed South Main Street Extension.

### **Special Trackwork Placement on Structure**

During the advancement of the concept alignments, multiple locations were considered for the placement of a cross-over location near the existing Starter Line terminus. One of the proposed locations was on the existing Main Street over Railroad structure at Union Station which would utilize the existing southern terminus turnout of the Starter Line and "S"-curve transition to the NB alignment. This approach would require installation of a new embedded turnout on the structure at the northernmost point of curve (PC) for the "S"-curve, which had been designed with the



required horizontal geometry to accept a future turnout during the Starter Line. The question was raised as to the location of the existing concrete beams at the PC of the existing streetcar rail that heads north from Union Station

(see picture), as this could adversely affect the ability to install an embedded switch machine “garage” which would hang below the existing bridge deck.

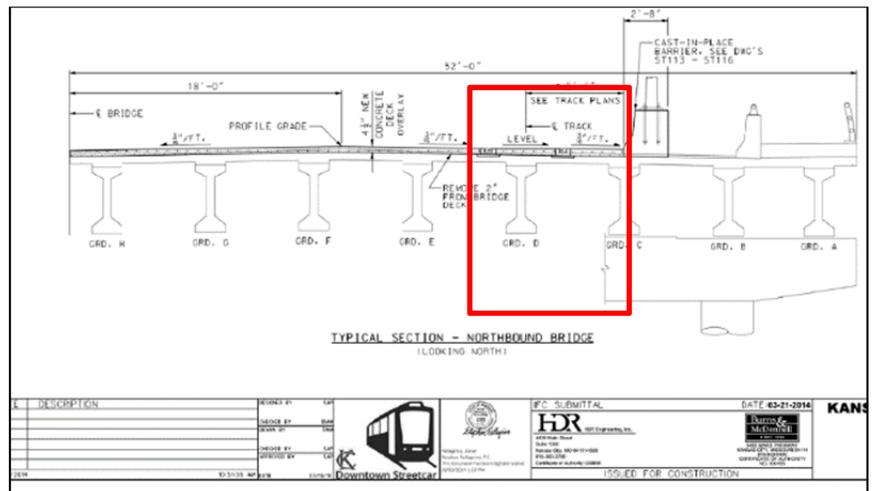


Assuming a similar switch garage as the Starter Line turnout, the depth needed for the turnout thicker than the slab on the existing bridge so the tracks would need to not straddle an existing girder (tracks need to be between girders for the garage to fit) so the box would fit and the switch box added to the rails at the existing track location.

Megan Dierks and Chad Hall of HDR completed a site visit on 11/30/18 to determine locations of the existing beams as it relates to this proposed switch location and the findings are noted below:

They confirmed what was shown on the existing streetcar plans from 2014 (see picture), that a prestressed concrete girder is directly below the existing tracks.

One track is on each side of the existing prestressed girder (East track is about 1.5-2’ from CL beam and the West track is 2.5-3’ west of CL beam). The streetcar tracks would likely need to move 2’-3’ west to allow the switch garage to fit between girders.



As it sits today the switch garage would conflict with the existing girders.

**Guideway Crossing of Existing South Expansion Joint:**

As the Starter Line southern terminus remains on the existing Main Street over Railroad structure, the proposed South Main Street Extension will be required to cross over the southern bridge expansion joint for both the SB and NB guideways. The SB guideway will cross the expansion joint at a near 90 degree angle. However, due to the alignment of the expansion joint, the NB guideway will cross at a skewed angle (approx. 30 degrees).

HDR reviewed the existing bridge details and the details used on the previous project for the embedded guideway track crossing the bridge expansion joint at the north end of this structure, as well as some of the other bridge joints on the Starter Line. For the south expansion joint of this particular bridge, the same details can be used as the Starter Line. The existing details placed the rubber boot around the rail and then the expansion joint material around the rail as it crosses the joint. No additional infrastructure should be required to traverse over these expansion joints.