

UDC Project Narrative

for

Hull Street over Manchester Canal Bridge replacement

UPC 113290

PURPOSE

PROJECT PURPOSE:

The project will replace the Hull Street over Manchester Canal bridge. The current bridge is structurally deficient. It was determined after analysis that replacing the structure would be more cost-effective.

EXISTING BRIDGE DESCRIPTION:

The bridge structure carrying Hull Street over Manchester Canal (Virginia Str. No. 127-1858) is in the City of Richmond, 0.02 miles north of the intersection with East 1st Street. The original bridge structure was constructed circa 1920 and was rehabilitated in the early 2000's. There are no known plans of the original bridge. Existing bridge information is taken from a combination of repair plans, survey, and field visits. The bridge structure consists of two simply supported, concrete encased steel beam spans with span lengths of 20'-10", 20'-10" for a total length of approximately 41'-8" (face to face of backwall). The bridge is oriented in the northbound direction. When looking from Abutment A (south) towards Abutment B (north), the girders are numbered from left to right. Directly south/east of the bridge is a utility structure which carries electrical conduit across the canal.

The superstructure is approximately 65'-7" wide (out-to-out). The roadway width is approximately 50'-1" curb-to-curb with a 6'-6" sidewalk on both sides. The superstructure consists of approximately twelve (12) concrete encased steel beams under the roadway and one smaller concrete encased beam under each sidewalk and a reinforced concrete deck with asphalt overlay.

The bridge substructure units consist of one pier and two abutments, which are parallel to each other and are on an approximate 20-degree skew to the baseline. The pier is a tapered concrete wall pier supported on a timber pile foundation and had undergone concrete surface and reconstruction repairs in the early 2000's. The original abutments were on timber piles with a timber mat for supporting the concrete abutment seat/cap and allowed the approach roadway fill to spill through the piles. However, due to deterioration of the timber the abutments were underpinned with concrete in the early 2000's.

Hull Street is classified as an Other Principal Arterial with a current AADT of 17,000 vehicles based on VDOT's published traffic volume data for 2019. **Figure 1** shows a vicinity map of the subject bridge structure with roadway classifications taken from the VDOT 2014 Approved Functional Classification map available on the VDOT website.

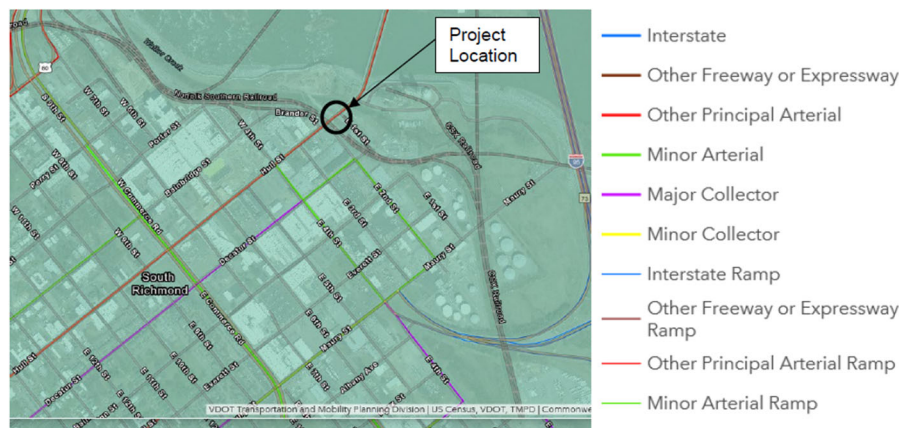


Figure 1- Roadway Classification Map

PROJECT CONSIDERATIONS

COORDINATION WITH OTHER PROJECTS:

- **HULL STREET STREETScape PROJECT:**
Improvements along the Hull Street corridor (aka Hull Street Streetscape) are under development as part of UPC 111703 and encompass the project limits of the Manchester Canal Bridge. As sidewalk replacement is part of the Manchester Canal Bridge replacement, coordination between the projects is being conducted. In recent coordination discussions, the bridge project will remove and replace the existing concrete sidewalks in-kind from the traffic signal at the Railroad Museum to the Floodwall. The Streetscape project will install street furniture from Manchester Road to the Floodwall.
- **MAYO BRIDGES REPLACEMENT PROJECT:**
This project has no connection with the Mayo Bridge project other than the water supply to the developments between the Manchester Canal and Floodwall needs to be maintained.

DESIGN OPTIONS

STRUCTURAL DESIGN CONSIDERATIONS:

As with any proposed bridge replacement project, there are some primary design criteria that WRA establishes; among which are constructing bridge structures that are:

- Long-term low maintenance
- Structurally efficient with materials selected
- Providing for adequate clearances
- Cost effective

SUPERSTRUCTURE:

The superstructure for this option will utilize eight (8) structural stainless steel plate girders with a 24-inch-deep web at variable spacing of approximately 9'-0" and 8'-4". ASTM A709 50CR stainless steel is proposed to be utilized due to the proximity of water at this location and will exhibit greater corrosion resistance than other steels. The variable beam spacing allows for optimization of beam spacing to accommodate the staged construction. The superstructure will consist of a single, approximately 62-foot-long span, and will make use of semi-integral abutments. The benefit of this layout is that the shallow steel girders provide the thinnest potential superstructure (which allows the design to maximize the vertical clearances). Additionally, the total dead load will be the lightest of the options, which in-turn will reduce the foundation requirements for the new abutments. The proposed 24-in web depth will meet the AASHTO suggested composite section span-to-depth ratio (AASHTO Section 2.5.2.6.3) and the proposed bridge superstructure does meet minimum deflection criteria. The 24-inch web will also allow for most if not all the utilities to be above the bottom of girders.

Based on preliminary values and the roadway geometrics proposed, WRA anticipates that the proposed bottom of girders will be approximately 3.70 to 15.4 inches above an assumed canal ordinary high-water elevation of 22.67 feet for this option. These values could change depending on what elevation the canal water level is set to.

Based on the preliminary information, WRA developed the proposed transverse section presented in **Figure 2**.

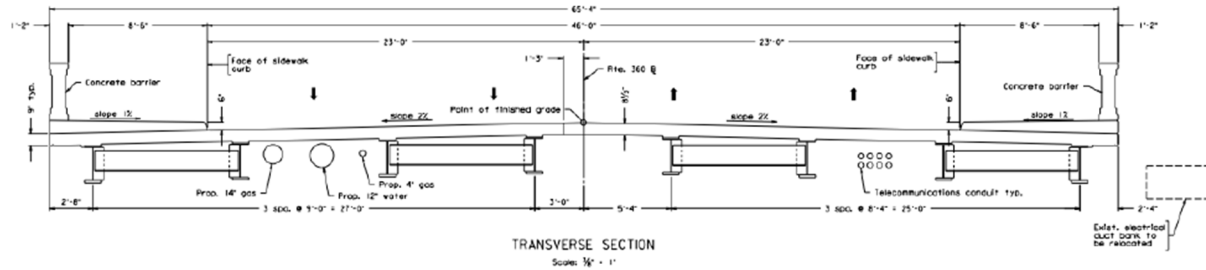


Figure 2-Proposed Transverse Section

SUBSTRUCTURE:

The proposed abutments will be semi-integral type abutments supported by deep foundations that will be flanked by angled wingwalls that will taper down following the approach roadway fill. There is an existing sheet pile wall located at the northwest corner of the existing bridge at the canal edge. In 2004, WRA performed repairs to the existing Manchester Canal bridge that added a concrete pile cap to the underside of the abutments. The proposed length of bridge is longer than the existing bridge length as it allows for construction of the abutments behind the existing abutments so that the 2004 repair and existing piles shall remain in place and act as a retaining wall to aid in construction and reduce height of the proposed abutments. Additionally, this would keep foundation construction well away from the existing sanitary force main buried in the canal. The concrete portion of the original bridge abutments will be removed. After review of the geological borings, WRA is proposing the use of deep foundations. Due to overhead power lines and tight staged construction, micropiles are the recommended pile type. Micropiles will allow for smaller equipment to access the area and not require as high of an overhead clearance to install.

GEOMETRIC REQUIREMENTS AND APPROACH ROADWAY:

All proposed bridge replacement options evaluated would maintain a superstructure width of 65'-4" out-to-out which is similar to the existing structure width and would be similar to the existing curb to curb width of 50'-0". This proposed width would provide for 2 - 11'-0" lanes in each direction with a 1' shoulder and 8'-6" sidewalks on both sides. The proposed parapet will be similar in style to the existing railing. To achieve the maximum vertical clearance possible over the canal, the existing profile along Hull Street will be modified which will require adjustment of the existing slopes along the approach roadway and tying into Manchester Rd., First St. and the emergency access that is under construction currently at the site northwest of the bridge.

APPROACH SLAB:

The use of an approach slab was investigated for this structure however, as this is not an AASHTO requirement the approach slab was not incorporated due to the following reasons. As the structure depth is fairly small compared to the depth of a typical approach slab there would not be enough clearance to allow for the several utilities to pass through the backwall and clear the bottom of the approach slab. Due to the presence of the buried Combined Sewer Overflow (CSO) under the bridge, burying the utilities underground is not a viable option and would need to be placed on the bridge. The

alternative would be to construct a separate utility structure. See discussion on utility structure option below for additional information.

BRIDGE SKEW:

When laying out the geometry of the proposed structure varying degrees of skew were investigated. The existing skew is approximately 18+ degrees and does not match the ideal alignment of the canal at the crossing. A 25-degree skew was considered which aligns closer with the canal but does require that the length of the bridge be even longer. A 20-degree skew was chosen as it fits closely to what is existing now and does not need as long of a bridge, which helps to help mitigate costs.

HYDRAULIC AND HYDROLOGIC:

The bridge structure carrying Hull Street crosses over the Manchester Canal where water levels in the canal are gate controlled. Based on the 2020 survey the elevation of the water level is 23.17 feet. As the water level is controlled and not free flowing scour countermeasures will not be utilized. The area under and adjacent to the bridge is in a designated FEMA "Area with Reduced Flood Risk Due to Levee" due to proximity to the floodwall. The floodwall is located approximately 0.03 miles north of the canal. The bridge structure replacement design is not expected to impact the canal and flood risk area. The replacement structure will likely be a single span and remove the existing pier in the middle of the canal. Additionally, the bridge will be similar in width and a little longer in length as compared to the existing bridge. Considerations will be made when setting the roadway profile and selecting the bridge superstructure to not reduce and if possible, increase clear distance between the top of water and bottom of superstructure. Recent discussions have indicated that there is proposed work to the Manchester Canal and coordination will be needed to establish impacts to the project.

CONSTRUCTABILITY:

Construction of the replacement Manchester Canal bridge will require staged construction to maintain traffic through the area. As discussed above, construction of the Streetscape project with the Manchester Canal bridge may be coordinated which may reduce time and MOT costs and reduce impact to the traveling public. The Manchester Canal bridge will be constructed in two stages with Stage 1 replacing the western half of the bridge and Stage 2 replacing the eastern half. As is typical with staged construction, working within proximity to existing structures and live traffic presents some challenges. Care will need to be taken during the design phase and construction phase to provide an efficiently constructible structure.

ROADWAY:

A new profile was established along the Manchester Canal project limits to raise the proposed bridge. The profile created a hump vertical curve over the canal to maintain/increase the clearance of the proposed bridge but still tie into the existing elevation of the flood wall to the north and the railroad tracks to the south. A change in horizontal alignment was considered to soften the curve just south of the Mayo's bridge however that would have put a curve on the Manchester Canal bridge and therefore was discarded and the existing horizontal alignment will remain. Raising of the vertical profile will require tie-ins and reconstruction of the connections with Manchester Rd., First St., and an emergency access just north of the bridge on the west side.

Part of the project includes replacement of the existing concrete sidewalks and mill and overlay of the roadway. Limits for these will be from the floodwall to the traffic signal at the Railroad Museum. The sidewalks will be replaced in kind while making minor improvements to smooth out transitions. Note that there is a brick approach into the Railroad Museum that is within the limits of the sidewalk replacement and consideration will need to be made whether this is to remain brick or be replaced with concrete.

RIGHT OF WAY AND EASEMENTS:

Survey shows that right-of-way is not adequate to accommodate the proposed structure, specifically the wingwalls and slope grading. However, the property is owned by the City Public Works (CPW) and therefore should not pose an issue. On the southeast corner near the structure the property is privately owned near the end limits of the proposed bridge. It is likely that a temporary construction easement will be needed to build the new structure and wingwalls.

UTILITIES:

There are several utilities located near and on the existing Manchester Canal bridge. There are overhead utilities going across the bridge that the Contractor will need to take caution to not get within 10 feet of the line while driving piles or placing beams. The City indicated that it is likely these lines will remain. Note that some of these lines go to the existing light poles that are intended to be moved as part of the Streetscape project and coordination will need to occur with the Streetscape project. In the canal running under the bridge is a sanitary force main that appears to be closer to the south abutment based on the survey. Care will need to be taken for any excavation that may occur in the canal in this span. Directly to the east of the existing bridge there is a Dominion Energy power bank bridge. This bridge may interfere with the current design of the eastern wingwalls, and these lines may need to be relocated and the existing duct bridge removed. Discussions need to occur with the utility owners to determine what lines can be permanently moved and which ones will need to remain active during construction. A fire hydrant location within the sidewalk just northeast of the bridge which will need to be relocated.

Connected to the outside of the west side of the existing bridge is a 14" gas main supplying Dupont that will be replaced with a 14" line and would need to remain active during construction. There is another gas main of unknown size on the bridge that will be replaced with a 4" gas line to supply the future developments. The new 4" gas line does not need to go across Mayo's bridge. The existing 12" water line on the bridge will be replaced with an insulated 12" line. Coordination with the City will need to be made to determine if this line may be temporarily shut down during construction and with the proposed line on the Mayo's bridge. In addition, there are an unknown number of telecommunication lines attached under the existing bridge. Due to the short superstructure length, special utility connections may be needed for utilities supported on the bridge.

MATERIALS:

The new bridge will have concrete railings, concrete sidewalks, and concrete deck. The proposed materials mimic those of the existing bridge. A picture of the existing bridge is shown in **Figure 3**.



Figure 3 - Hull St over Manchester Canal looking south (Nov. 2021)

MAINTENANCE OF TRAFFIC:

Staged construction of Hull St. will be utilized to maintain one lane of traffic in each direction. An additional stage was added to allow for construction of the sidewalk after the bridge is built to accommodate the wider sidewalk width without increasing the bridge width. The original staging plan that was originally set will remain as it accommodates the utility relocations. The current plans propose shifting southbound traffic to the current left northbound lane for Stage I to facilitate removal and construction of the west half of the bridge in the southbound lanes. Pedestrian traffic would be closed on the west side and remain accessible on the east side. Stage 2 will shift one lane in each direction to the west side to perform removal and reconstruction of the east half. Pedestrian traffic will be shifted to the west as well.

PUBLIC OUTREACH

Public Works conducted a Virtual Public Engagement from April 7, 2022 to May 12, 2022 for the Hull Street Corridor for the Hull Street Streetscape and the Hull St over Manchester Canal Bridge Replacement projects.

Comments were received from the public via the City's website. The use of the proposed end treatment is a result of input from this public engagement.