
GANNETT FLEMING MEMORANDUM

Date: January 27, 2016

To: Radnor Township

From: Gannett Fleming

Re: South Devon Avenue Culvert Field View

A field view was performed on November 23, 2015 of the above-referenced culvert located just South of Bo Connor Park and Warren Filipone Memorial Park which carries South Devon Avenue over Little Darby Creek in Radnor Township, Delaware County. The field view was performed to determine the need for the structure's repair, rehabilitation, or replacement. The field view was limited to observation of the above ground, visible and accessible elements. Elements below the water line or ground line were not assessed. Load ratings and structural plans of the existing bridge were not available at the time of field viewing.

Structure Description

The creek crossing is comprised of three independent superstructures supported on common abutments. The main superstructure is a concrete slab bridge that carries two 13'-0" lanes, with a 12" wide concrete curb and 9" wide brick barrier on each side with a 29'-6" out-to-out and 11'-0" clear span. The other two superstructures are 5'-0" out-to-out steel pedestrian bridges carrying the north and south sidewalks.

Little Darby Creek flows generally north to south in the vicinity of the culvert. Its alignment entering the culvert is generally tangent with a gradual transition from the natural streambed into paved streambed. The culvert is on a 90 degree skew.



*General View of Roadway and Pedestrian Bridges
Looking West*



North Pedestrian Bridge (South Pedestrian similar)

Structure Findings

The condition of the slab bridge, pedestrian bridges, as well as grouted stone masonry abutments and wingwalls were viewed to determine if any deficiencies could compromise the structure's integrity. Findings on the structure are summarized as follows:

Slab Bridge

The concrete slab superstructure of the main structure is in good condition with localized honeycombing and exposed aggregate. No spalls or exposed reinforcing steel is noted.



Under Deck View (H.C. in middle width)



Honeycombing and Exposed Aggregate

Both abutments and wingwalls are stone masonry, all are in good condition except for Wing A and Wing D.



Typical Masonry Abutment



Wing B (Wing C similar)

At Wing D, stones are missing from below the 12" diameter drainage pipe with more than 12" undermining; Wing A exhibits missing stone, missing mortar joints and water leakage at the groundline.



Missing Stones and Undermining in Wing D



Missing Stones and Mortar Joints in Wing A

Note that concrete aprons of varying width are present at both Wing B and Wing C (downstream wings). It is assumed that the aprons serve the purpose of splash block for ground water flows into the creek through drainage pipes. Both aprons are undermined up to 2'-0". Streambed under the bridge is paved with concrete and in good condition; water flow over the streambed is approximately 1" deep. A waterfall is formed at end of the paved streambed and a 2'-3" deep scour hole beyond the paved streambed between Wing B and Wing C is noticeable. There is no noticeable bank erosion.



2' Undermining under Wing B Apron



Large Scour Hole at end of Culvert

Pedestrian Bridges

The south pedestrian bridge features two (2) W12 stringers with five (5) W5 floor beams and a pressure-treated plywood stay-in-place form. Both stringers and floor beams exhibit heavy rust and delamination with minor section loss throughout; the plywood form is in fair condition.



South Pedestrian Bridge Elevation View



South Pedestrian Bridge Underdeck View

The north pedestrian bridge is composed of two (2) W8 stringers, concrete deck and plywood form, and is also supported by a built-up auxiliary timber T-beam (2x6 flange and stem). The W8 stringers are heavily rusted with 100% loss of webs and more than 50% loss of bottom flanges and are losing their carrying capacities. A large hole is noticeable in the concrete deck and plywood form. The stem of the built-up timber T-beam splits at middle depth from the end notch.



North Pedestrian Bridge Elevation View



North Pedestrian Bridge Underdeck View



100% Loss in Web of North Stringer



Large Hole in Deck and Horizontal Split in Stem of T-Beam

Railing posts for the north pedestrian bridge are either broken or rusted with total section loss. Railing and posts for the south pedestrian bridge are in fair condition.



Section Loss in N. Railing Post of North Pedestrian Bridge



Broken Railing Post in N. Railing of North Pedestrian Bridge

Conclusions

Both superstructure and substructure of the main structure carrying South Devon Avenue are in good condition, with no apparent defects noted in the paved streambed.

Both downstream wingwalls (Wing B and Wing C) that support the south pedestrian bridge are in fair condition with a few missing mortar joints and undermining of concrete aprons. The Superstructure of the south pedestrian bridge is in fair condition with heavy rust in stringers and floor beams.

The Superstructure of the north pedestrian bridge and Wing D are in poor condition. Wing A is in fair condition.

Two of five railing posts of the north pedestrian bridge are ineffective due to either excessive damage or 100% section loss at the base. The rest of the railing posts are in fair condition with heavy rust at the base.

Safety Features

The lane width and alignment is adequate for the roadway type and posted speed limit. Brick parapets for the roadway bridge are not crashworthy or compliant with PennDOT standards. If the brick parapets are to remain, then they should be positively protected with guide rail on all four approaches. In order to install the guide rail, the curb line may have to be straightened on the "park" side of the street to accommodate post placement. At a minimum, hazard markers need to be placed at all four approach corners.

The pedestrian bridges railings are a hazard and should be replaced with the PennDOT Standard Aluminum Pedestrian Railing in BC-716M or approved equivalent.

Environmental

South Devon Avenue crosses Little Darby Creek which supports protected water uses for Cold Water and Migratory Fishes (CWF/MF) according to Title 25, Chapter 93 of Pennsylvania State Code. The stream is an approved Pennsylvania Fish and Boat Commission Trout Stocked Fishery and does not support a naturally reproducing trout population. Therefore, seasonal construction restrictions will be required and no instream work may occur between March 1 and June 15. A PNDI database search was conducted and no state or federal endangered species were identified as a result of the search. No known historic or archaeological sites are known to exist at or near the site of the bridge according to the Pennsylvania State Historic Preservation Office's Cultural Resources GIS website.

It appears that rehabilitation of the bridge, including the addition of scour protection would require a PADEP General Permit #11 for Maintenance, Testing, Repair, Rehabilitation or Replacement of Water Obstructions and Encroachments. It is assumed that federal authorization for this activity can be authorized by PASPGP-4 that will be issued by PADEP.

If wetlands are present, and greater than 0.05 acres of impacts are expected, GP-11 does not apply and A Joint Chapter 105/Section 404 Permit may be required

Geotechnical

The existing bridge and south pedestrian bridge will be rehabilitated and therefore no Geotechnical Investigation is necessary. However, the replacement of the deteriorated superstructure of North Pedestrian Bridge and rebuild of Wings A & D that supports the pedestrian bridge is recommended.

A Site Geology Map, extracted from the Geologic Quadrangle Maps of Pennsylvania, indicates that the South Devon Avenue structure is underlain by Mafic Gneiss (mgp). According to *Engineering Characteristics of the Rocks of Pennsylvania*, the Mafic Gneiss (mgp) is described as medium to fine grained with up to 30% quartz. The geotechnical investigation will consist of drilling two borings to a maximum depth of 30 ft below the ground surface. Rock will be cored for 5 ft if encountered. Laboratory testing will be conducted on the recovered samples as necessary. Following the subsurface investigation and the laboratory testing GF will prepare a brief memo with recommendations.

Recommendations

Based on the field assessment and finding, it is recommended to replace the deteriorated superstructure and substructure of the north pedestrian bridge and rehabilitate the remaining structure. The major works are listed below:

- Replace superstructure and substructure of north pedestrian bridge.
- Repoint missing mortar joints in abutments and wingwalls.
- Repair/Repaint the south pedestrian bridge, update railing to meet the current standards.
- Fill the scour hole at outlet and in front of concrete apron of wingwalls B & C with riprap.
- We will discuss with the township about the need for updating safety features of roadway bridge and pedestrian bridges.
- Install the missing hazard marker at northwest corner.

A conceptual construction cost estimate and estimate of engineering cost is provided for the recommended work.

South Devon Avenue over Little Darby Creek Culvert Rehabilitation

Construction Item Estimate:

	Unit	Qty	Unit \$	Item Cost	
Bridge					
1	Bypass Pumping	LS	1	\$3,000	\$3,000
2	Removal of Existing N. Pedestrian Bridge (Superstructure and Substructures - Wings A & D)	LS	1	\$4,000	\$4,000
3	Class A Cement Concrete Abutments/Wings A & D	CY	15	\$1,000	\$15,000
4	Reinforcement Bars, Epoxy Coated	LB	3000	\$1.5	\$4,500
5	#2A or AASHTO #8	CY	16	\$100	\$1,600
6	Install Prefabricated New North Pedestrian Bridge (16' long x 5' wide)	LS	1	\$16,000	\$16,000
7	Update South Pedestrian Bridge Railings	LF	40	\$65	\$2,600
8	Repair/Repaint South Pedestrian Bridge	LS	1	\$4,375	\$4,375
9	Riprap at Outlet and Inlet	CY	20	\$85	\$1,700
10	Class 3 Excavation	CY	95	\$65	\$6,175
11	Structure Backfill	CY	60	\$55	\$3,300
12	Temporary Excavation Support and Protection System	LS	1	\$6,000	\$6,000
13	Repoint Masonry Abutment and Wingwalls	LF	180	\$15	\$2,700
14	Replace Drainage Pipes in Wings A & D	EA	2	\$1,000	\$2,000
15	Replace Segments of Removed sidewalk	EA	10	\$100	\$1,000
				Total Str. Cost:	\$73,950
Roadway					
1	Curb and approach roadway work	LS	1	\$9,400	\$9,400
2	Guide rail and end treatments	LS	1	\$9,250	\$9,250
				Total Roadway Cost:	\$18,650

Total Construction Cost: \$92,600

Total Construction Cost:	\$92,600
+ 5% Mobilization	
+ 20% Contingency	
Construction Total:	\$116,000
Engineering Fee:	\$84,300
Total Project Cost:	\$200,300