

Structure Geotechnical Report

F.A.S. Route 1652 (U.S. Route 45)
Section (13BY)B-1
Effingham County

Contract No. 94698
PTB #148 / Item #27 – Work Order #2

Existing S.N. 025-0024
Proposed S.N. 025-2023

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Project Description and Proposed Structure Information

The following report presents geotechnical recommendations for the complete structure replacement of the structure carrying US Route 45 over East Branch Green Creek in Effingham County. This project consists of the removal and replacement of the existing widened reinforced concrete slab bridge with a triple 12' x 12' cast-in-place box culvert skewed 0°. This project will be constructed under staged construction.

Existing Structure and Site Information

The existing structure consists of an original 40'-0" single span concrete slab bridge on closed concrete abutments supported by spread footings. The structure has been widened on each side by a reinforced concrete slab superstructure with three 12'-0" spans, 40'-0" bk.-bk. of new abutments. The substructure was widened with closed abutment extensions and new T-type cantilevered wingwalls on spread footings. Stone riprap has been placed in the streambed to protect the existing foundation from scour.

Subsurface Exploration and Generalized Subsurface Conditions

The Illinois Department of Transportation conducted a total of two (2) soil borings, one near the SW corner and one near the NE corner of the existing structure. See the attached Soil Boring Logs and Subsurface Data Profile for geotechnical data.

The borings were conducted on September 5, 2008. The boring results show that upper soil layers above elevation of approximately 565 consist of soft to medium silty clay loams. These soils are underlain by very stiff to hard clay loam till with an average unconfined compressive strength of 5.2 tsf.

The surface water elevation of East Branch Green Creek is 564.9' at the existing structure. The boring results indicate ground water was discovered at 557.6' and upon completion at 546.1'. After 144 hours, the borings indicate the groundwater elevation was determined to be 556.2'. Groundwater is not expected to affect the foundation design or construction activities.

Seismic Considerations

The project site is located in Seismic Performance Category (SPC) A based on a horizontal bedrock acceleration coefficient (A) of 0.065. The Site Coefficient (S) is 1.0 using an AASHTO Soil Profile Type I. No serviceability problems are anticipated for a seismic event at this location.

Scour

In 2003, riprap was placed to mitigate the scour occurring along the abutment footings. The Hydraulic Report prepared in January 2007 indicated contraction scour for the proposed structure was calculated to be zero for the 100-year storm. The contraction scour for the existing structure and pier was calculated to be 4' for the 100-year storm. Design scour elevations are 557.7' downstream and 558' upstream. The proposed channel velocity is 5.9 ft/sec. Foundation elements of the proposed culvert should be protected with stone riprap.

Design Scour Table	Down Stream	Up Stream
	557.7	558.0

Wingwall Alternatives

The proposed wingwalls are 19'-0" long and have a design height of $\pm 17'-9"$ and fill height of $\pm 5'-0"$. Based on Culvert Manual policies, a standard horizontal cantilever design or an alternate L-type wingwall design are not appropriate for the proposed geometry. A T-type wingwall design was evaluated for use at this site. Foundation soils are adequate at this location for a proposed T-type wingwall on spread footings. Consideration of a special design horizontal cantilevered wingwall was not considered due to length and fill height.

The elevation for which the T-type cantilevered wingwalls will be founded is 557.7'. The unconfined compression strength at this elevation is 8.2 tsf with an allowable bearing pressure of 2.7 tsf. Based on Culvert Manual's vertical cantilever T-type wingwall design tables, the maximum bearing pressure at the toe of the footing is 1.6 tsf. The foundation soil is adequate to support the proposed T-type cantilever wingwall on spread footings.

Soldier pile wingwalls were also considered as an alternate to the T-type cantilever wingwalls. Since good foundation soils are present and since ground water is not anticipated to be a problem at this site, T-type wingwalls should be easy to construct at this location. The additional excavation required to construct the T-type wingwalls can easily be accomplished when excavating for placement of the barrel and while removing the existing structures. For these reasons T-type cantilever wingwalls are expected to be a better solution at this location.

Box Culvert Evaluation and Design Recommendations

Based on the results of the soil borings we recommend that the proposed culvert be constructed on the existing material in place at the culvert location. Settlement problems are not anticipated at the site. The proposed structure will not cause a large change in the overburden to foundation soils.

The District prefers a reinforced concrete box culvert alternative at this location. The precast box culvert alternative is not a good option for this structure due to the large size and multiple cells.

Due to the length of the proposed wingwalls and the presence of good foundation material, we recommend that the wingwall type be a T-type vertical cantilevered wing.

Riprap as an outlet protection is recommended due to high outlet velocities.

Construction Considerations

Stage Construction and Temporary Soil Retention System:

This project will be constructed under staged construction. A cantilevered temporary sheet pile wall is not feasible at this location due to lack of adequate embedment before encountering hard clay till. Guide Bridge Special Provision 44 "Temporary Soil Retention System" should be used. Embankment constructed above the barrel at the Stage Construction Line of the proposed box culvert is approximately 5' in depth. A temporary geotextile retaining wall will be used at the stage line to retain fill above the barrel during Stage 2 Construction.

The use of cofferdams or underwater structure excavation protection is unnecessary. The creek bed has minimal flow for a majority of the year, but during periods of high periodic flow, limited pumping and water diversion will allow for construction.

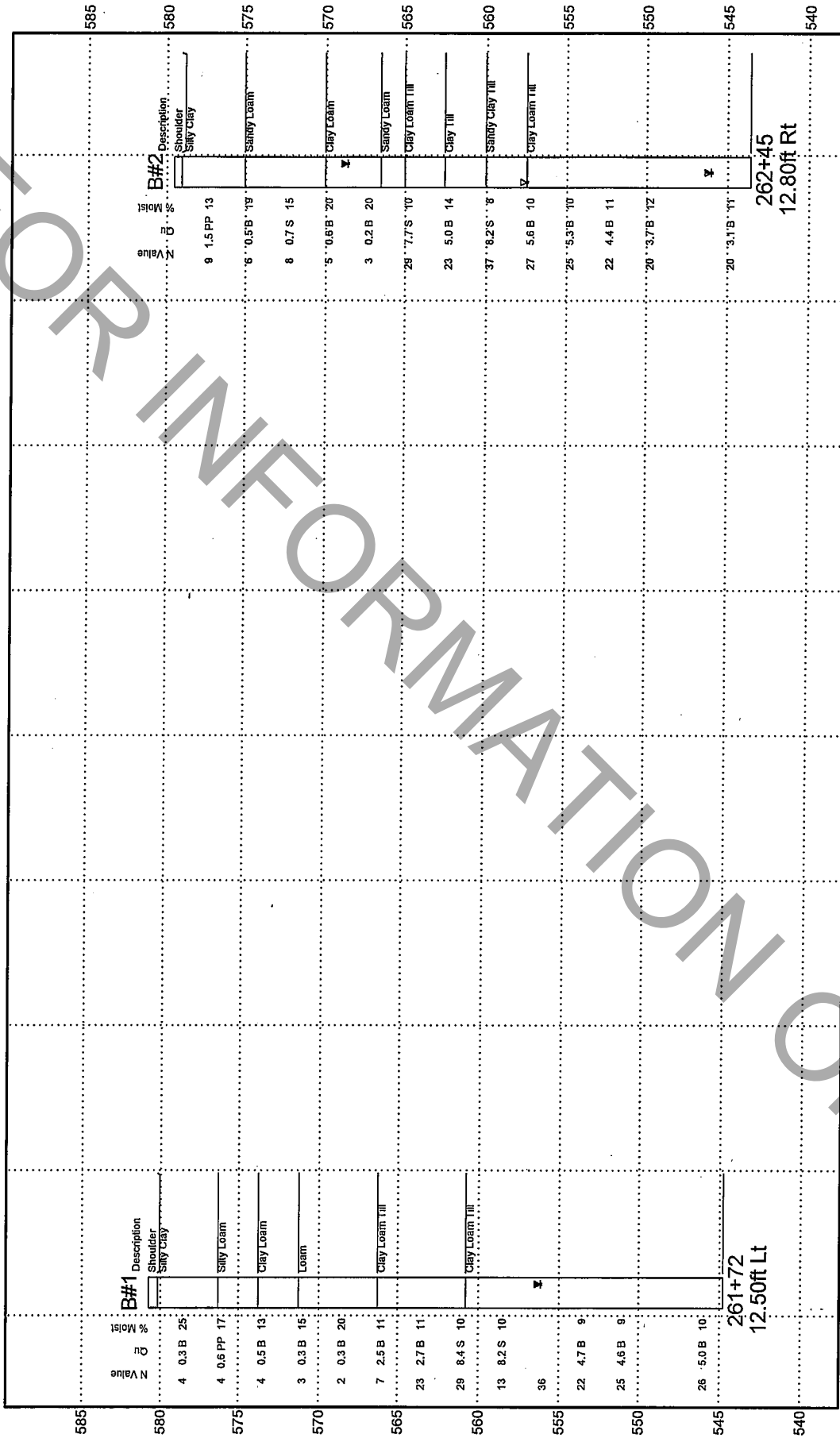
Excavation and Backfill:

Excavation behind the existing closed abutments will be required prior to existing superstructure removal. The existing slabs provide support for the existing bridge widening. The existing closed abutments will need to be excavated prior to removal of the existing concrete slab and widening. A 1½:1 cut slope behind the existing abutments during stage construction will be used. The proposed culvert will be backfilled with a granular backfill material.

Ground Improvement:

No ground improvements are required at this site.

Structure Number 025-0024 Green Creek
 Located in the NE 1/4 of Section 27, Township 9 N, Range 6 E of the 3 P.M.



SUBSURFACE DATA PROFILE 025-0024.GPJ D6TEMP.LT.GDT 08/09/15

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SUBSURFACE DATA PROFILE
 Route: FAS 1652 (US 45)
 Section: (13BY)B-1
 County: Effingham

NOT TO HORIZONTAL SCALE
VARIATIONS IN SUBSURFACE CONDITIONS MAY EXIST BETWEEN BORINGS

Illinois Department of Transportation
 Division of Highways
 Illinois Department of Transportation

Groundwater First Encounter Completion after (refer to log) hours
 WOH - Sampler Advanced by Weight of Hammer, WCP - Weight of Pipe
 B.S. - Before Sealing