STRUCTURE GEOTECHNICAL REPORT

Proposed S.N. 081-1120

Existing S.N. 081-1018

IL Rte 5/John Deere Road
Over Drainage Ditch
1.2 Miles East of I-74
FAP Route 595
Section (142-1, 142)R
Rock Island County

PTB 155 - Item 026
IDOT Job No. D-92-003-06
Contract No. 64B83

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Date Prepared: February, 2012

Date Revised: August, 2012

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Exhibits:
1) Location Map
2) Boring Locations
3) Subsurface Data Profile
4) Boring Logs
5) Slope Stability Output
6) Special Provisions

Project Description and Proposed Structure Information

This project consists of replacing an existing single barrel concrete box culvert with a double barrel reinforced concrete box culvert under IL Rte. 5 at station 310+60 to accommodate proposed widening of the roadway. The structure will be rotated clockwise to improve its alignment with the channel. The structure will carry three lanes of traffic in each direction. The proposed structure is an 11'x4' double barrel reinforced concrete box culvert, 174'-0" long out-to-out headwalls with no skew. The proposed structure design will follow the LRFD Design Specifications. The proposed culvert opening has been increased to satisfy hydraulic design requirements. Complete removal of the existing structure will be required for construction. This work will need to be completed using stage construction.

The stage construction requires soil retention for excavation during removal of existing structure and construction of the proposed structure. The maximum fill height is approximately 4'-0" above the proposed culvert. The structure will have ±7'-3" long horizontal cantilever wingwalls at the south end that will retain a 1:2 (V:H) embankment slope. The north end of the culvert will have L-type wingwalls placed at right angles to the structure. On the USGS Coal Valley quadrangle map, the project area falls within Section 15 of Township 17 N and Range 1 W of the 4th PM. A location map is presented in Exhibit 1.

The project also requires separate SGR's to be prepared for SN 081-1118, 44th Avenue Culvert and Retaining Wall Location-1.

Existing Information

The existing culvert is located at station 310+71.36. The 10'x4' single barrel culvert has a length of ±132'-0" measured along its centerline and has a ±5 degree right ahead skew. Existing IL Rte. 5 was built on a horizontally curved alignment. The existing structure has a maximum fill height of ±4'-0". The roadway currently provides 2 lanes of traffic in each direction. Stationing along the roadway increases from west to east.

Existing plans were not available for the structure.

Site Investigation, Subsurface Exploration and Generalized Subsurface Conditions

The site is located in an urban area approximately one mile north of the Rock River. The drainage ditch flows from north to south towards the existing structure and merges with another drainage ditch to the west. Existing underground water main and sanitary sewer are outside the limits of the structure.

The boring data was provided by IDOT District 2 personnel. Three borings drilled in July of 2011 are associated with the proposed culvert location. Boring B-1 was drilled at station 310+55 at the centerline of the roadway and was terminated at a depth of 23.5 ft. Boring B-2 was drilled at station 310+28 approximately 87 ft left of the centerline and was terminated at a depth of 21 ft below ground surface. Boring B-3 was drilled at station 310+60 approximately 81.5 ft right of the centerline of roadway and was

terminated 26 ft below the ground surface. Boring locations relative to the culvert location are shown in Exhibit 2. It should be noted there is an apparent error in elevations referenced in Boring B-1. It's estimated the boring is approximately 12 ft higher than indicated on the boring log.

At each boring location, a standard penetration test (SPT) was conducted every 2.5 ft according to AASHTO T 206 using a hollow stem auger drill. Boring B-1 was the only boring that encountered water, at the depth of 12 ft. All borings show a majority of the soil immediately below the surface consisting of silty clay loam with blow count values ranging from 4 to 7 blows per ft and unconfined compressive strengths ranging from 0.3 to 3.5 tsf. Borings B-1 and B-2 encountered a 2.5 ft thick sand layer approximately 9 ft below the ground surface. The sand present for borings B-1 and B-2 had blow counts of 4 blows per ft. The cohesive soil just above the rock layers had similar soil properties as the cohesive layers just below the surface with blow counts ranging from 2 to 5 blows per ft and unconfined compressive strengths ranging from 0.2 to 0.8 tsf. Shale rock layer was encountered between depths of 20 to 22 ft from ground surface. Further descriptions of the soil layers can be found in the boring logs attached in Exhibit 4 and Subsurface Data Profile in Exhibit 3.

Geotechnical Evaluations

Settlement: No significant changes are proposed to the profile grade. The proposed culvert will be extending beyond the existing roadway limits on each end due to proposed widening and clear zone requirements. The soil within the existing roadway limits should be naturally compacted and no significant settlement is anticipated. However, soils outside these limits will have an increase in pressure due to weight of the culvert and new fill, which will cause the culvert to sustain differential settlements. One foot deep removal and replacement will be required along the length of the culvert to establish a working platform and this was taken into account with the settlement calculations. According to the structural planner, a tolerable settlement amount of ½" is recommended to address differential settlement concerns. To achieve the desired limit, removal and replacement of unsuitable soils with Rockfill-Foundation is suggested at the south end. The removal and replacement will only be required outside the limits of the existing embankment (approximately 25 feet from the south end). We recommend removal down to elevation 565.2 ft at the south end. Due to the large amount of excavation, braced excavation should be used during construction. Per IDOT Bridge Manual 2.3.11.4.1, an alternative is to utilize a settlement collar at the south end where the structure transitions into new embankment (approximately 25 feet from the end). Settlements near 0.98" at the south end are expected if this option is chosen. This section of the bridge manual also states that a precast box culvert should not be allowed under these conditions.

Slope Stability: Stability analyses were performed using a temporary excavation 1:1 slope model which rendered a factor of safety over 3. The resulting maximum excavation required for removal and replacement is 12 ft.

Scour: The design scour elevations should correspond to the bottom of the toe wall elevation on upstream and downstream ends as shown in the table below. 10-year velocity thru the proposed culvert is 7.10 fps. The Hydraulic Report recommends Class

A4 Riprap at the upstream end and an excelsior blanket at the downstream end for erosion protection.

Design Scour Elevation (ft.)	Upstream	Downstream
	572.90	572.60

Mining Activity: According to the Illinois State Geological Survey (ISGS) "Coal Mines in Illinois Viewer," there is an abandoned mine 0.3 miles northwest of the structure's location. However, as per ISGS, the project area is outside the underground mine proximity region.

Box Culvert Evaluations and Design Recommendations

Culvert Barrel. Based on hydraulic requirements and size limitations, a 3-sided structure is not a viable option.

Due to anticipated differential settlements at the ends of the culvert, the precast culvert option is not recommended.

With the large foundation area and proposed Rockfill-Foundation material at the culvert base, the bearing capacity at the base of the foundation was found to be more than adequate for resistance of estimated bearing pressures.

Wingwalls. There are several feasible options for selection of wingwalls. The wall type selection should be performed considering but not limited to soil conditions, length and economy.

Per IDOT Culvert Manual Figure 3.1.5-2, based on the 0˚ skew, 1:2 (V:H) slope behind the wingwall, and an estimated H_L of 5'-7", the wingwall length chart shows a length of 7'-3" with an angle of 45˚.

The horizontal cantilever wingwall is the most appropriate design choice according to the Culvert Manual. Horizontal cantilever walls will not be feasible at the north end of the culvert due to geometry restrictions. Based on the Culvert Manual 3.1.3, the appropriate wingwall is an L-type vertical cantilever. The recommended active earth pressure as an equivalent fluid pressure on the wingwalls according to the proposed design is 56 pcf.

Cantilever sheet pile wall with a concrete cap is a feasible option. Given cohesive soils at the base, driving piles appears to be possible. However, this wall type is not economical for short walls.

Soldier pile walls are not an ideal option considering fill situation for the project. Additionally, this wall will require drainage behind it and is not economical for shorter walls.

Gabion baskets appear to be feasible and can be constructed easily and quickly with traditional labor equipment. This wall can be labor intensive and expensive if a nearby stone source is not available.

Construction Considerations

Cofferdams: In order to maintain a dry construction area, dewatering techniques may be necessary. However, based on hydraulic conditions, a temporary cofferdam is not expected to be necessary. Stream diversion could be utilized in order to facilitate construction of the box culvert.

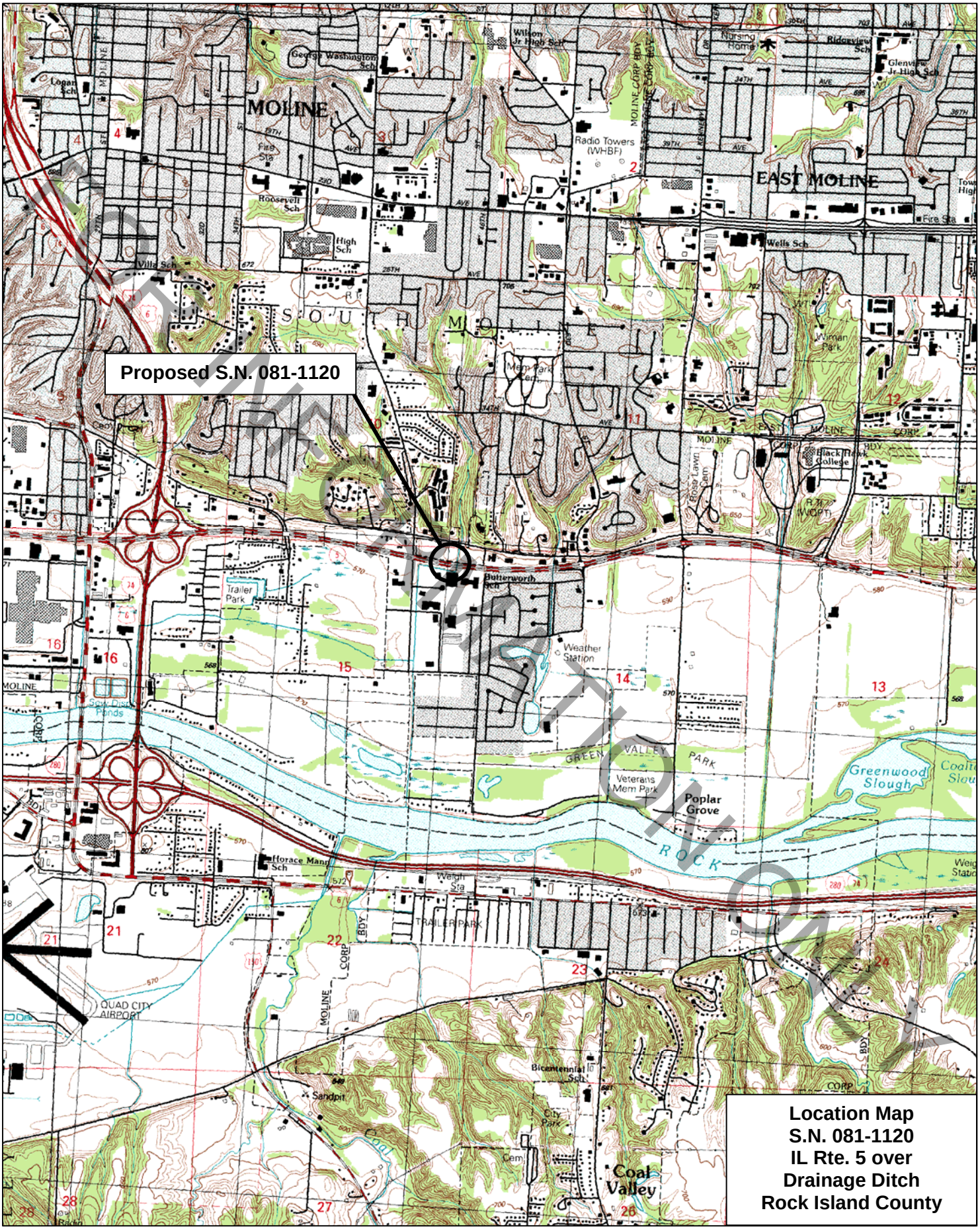
Stage Construction: In order to maintain traffic flow, stage construction shall be utilized. To retain fill at the edge of slab during stage construction, it is recommended that temporary timber blocking be used to retain the Stage I fill. If this method is not adequate, it may be necessary to provide a Temporary Geotextile Wall per IDOT Bridge Manual Fig. 3.13.2-1.

Temporary Soil Retention System: Due to the presence of a rock layer within the required embedment depth of temporary sheet piling, it is recommended that a Temporary Soil Retention System be included in design plans.

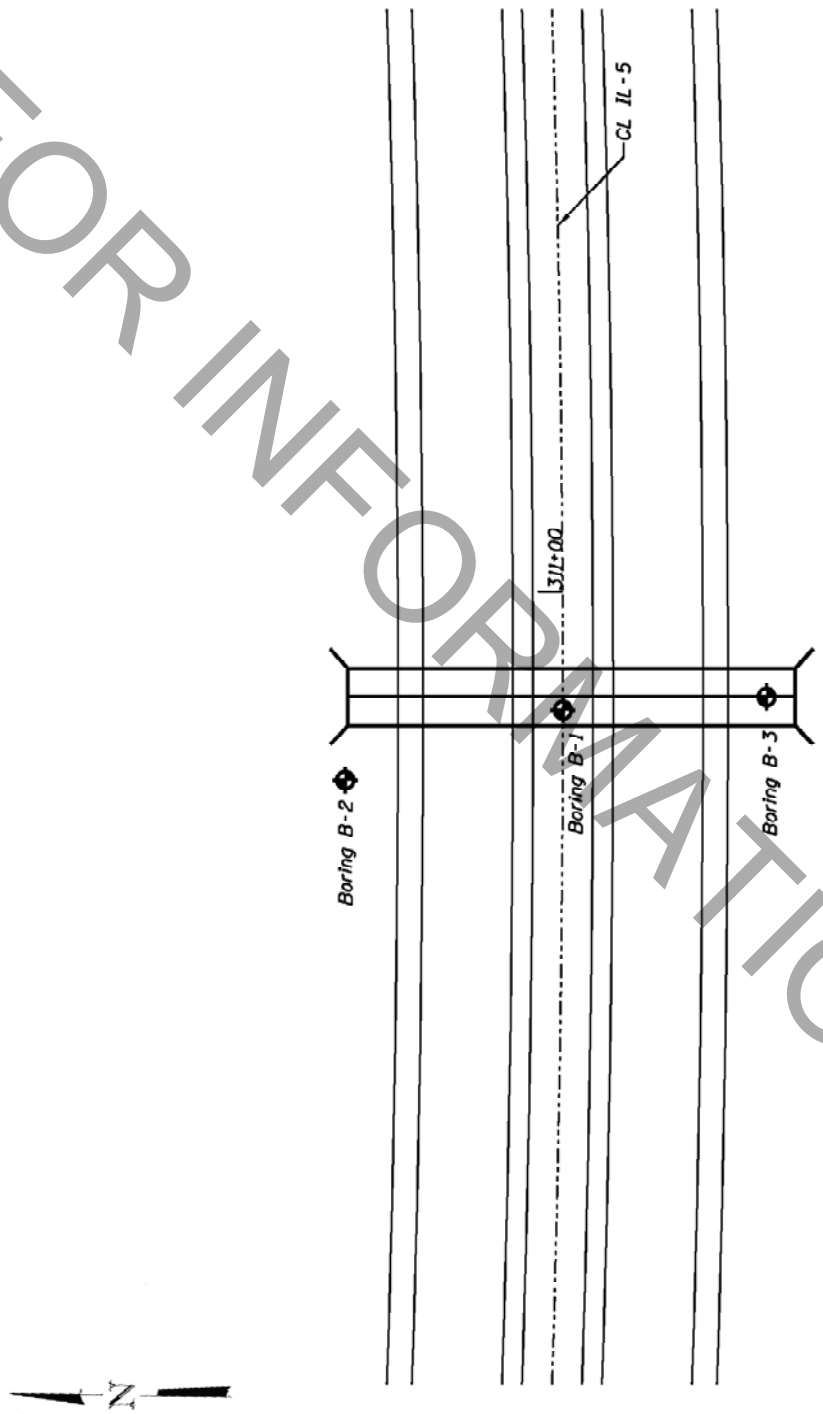
Excavation: A 1:1 temporary excavation slope for construction clearance has an adequate factor of safety. The factor of safety is limited to 1:1 slopes and any steeper slopes should not be used.

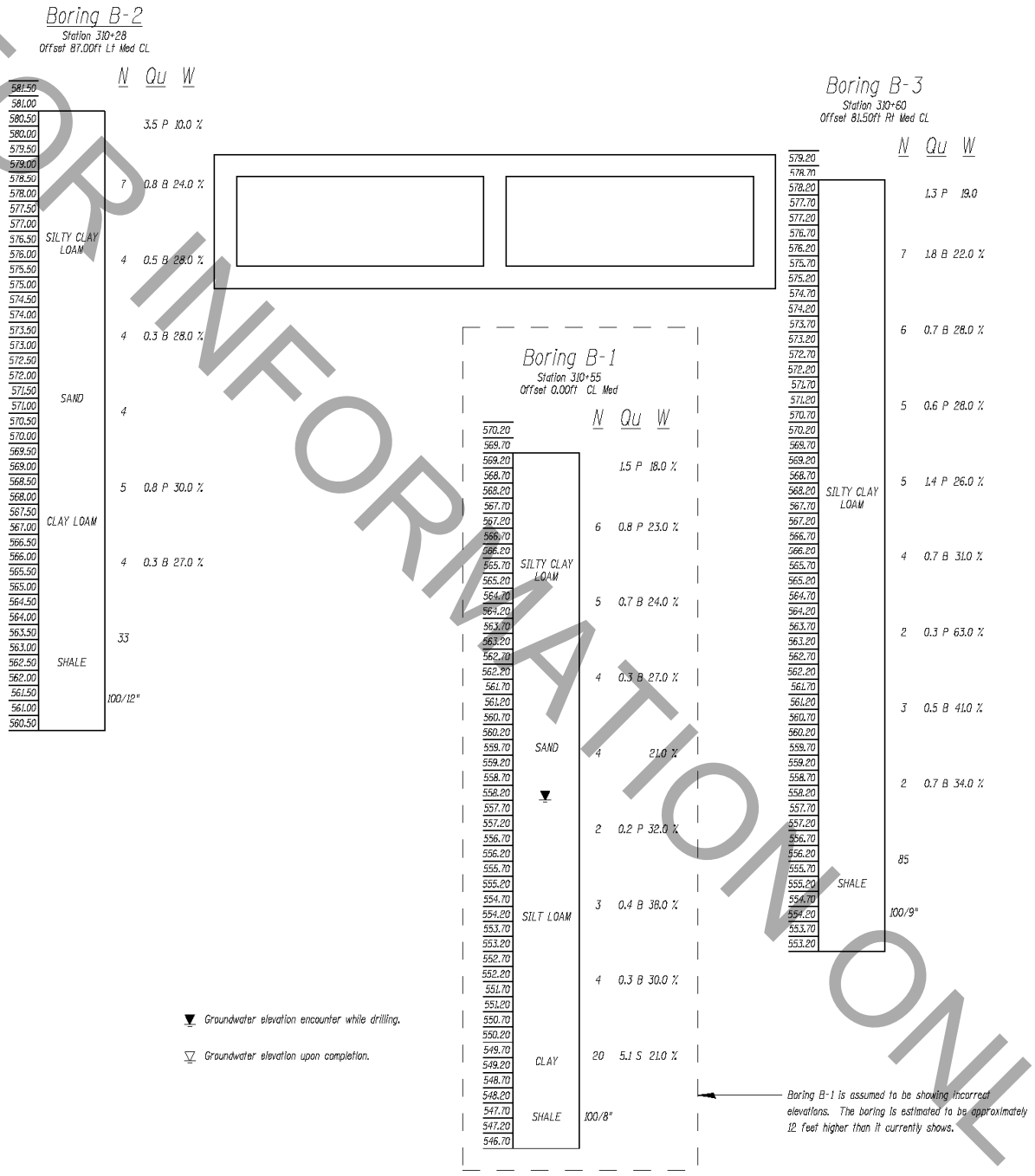
Backfill: Backfill within the limits of the paved surface to the top of culvert elevation should be performed according to the special provision for Granular Culvert Backfill which is shown in Exhibit 6. The pay limits of Granular Culvert Backfill include a vertical line projected at the outside edge of shoulder. All other backfill may be composed of soil materials excavated from the project site placed and compacted according to the Standard Specifications.

Ground Improvement: Existing soil shall be excavated down 1 ft to provide a working platform. If settlement collars are not chosen, removal of soil down to elevation 565.2 ft at the south end is recommended to satisfy the planner's recommendation. The pay limits for removal and replacement shall extend 2 feet outside the limits of the barrel.


Proposed S.N. 081-1120
MOLINE
EAST MOLINE
SOUTH MOLINE
Location Map
S.N. 081-1120
IL Rte. 5 over
Drainage Ditch
Rock Island County

Boring Locations
S.N. 081-1120
IL Rte. 5 over
Drainage Ditch
Rock Island County





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SOIL BORING LOG

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081-1120 D92-003-06 John Deere Road
proposed culvert, double 7' x 4' box, .16 m. E. of 41st Street

Date 7/7/11

ROUTE FAP 595 DESCRIPTION LOGGED BY W. Garza

SECTION 142-R LOCATION S. Moline Twp. – 15NE, SEC. , TWP. 17N, RNG. 1W

COUNTY Rock Island DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO. 081-1120
Station 310+60

BORING NO. B-1
Station 310+55
Offset 0.00ft CL Med
Ground Surface Elev. 582.10 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 570.1 ft
Upon Completion Dry ft
After Hrs. ft

DEPTH (ft)	BLOWS (6")	UCS Qu (tsf)	MOIST (%)
STIFF brown SILTY CLAY LOAM			
		1.5 P	18.0
580.10			
MEDIUM brown SILTY CLAY LOAM	3		
	2 4	0.8 P	23.0
578.60			
MEDIUM tan SILTY CLAY LOAM	1		
	2 3	0.7 B	24.0
576.10			
VERY SOFT tan SILTY LOAM	2		
	1 3	0.3 B	27.0
573.10			
VERY LOOSE tan dirty SAND with medium moist GRAVEL	2		
	1 3		21.0
570.60			
VERY SOFT gray SILT	0		
	0 2	0.2 P	32.0
568.60			
SOFT gray SILT LOAM with ORGANICS	0		
	1 2	0.4 B	38.0
566.10			
VERY SOFT gray SILT	0		
	0 4	0.3 B	30.0
563.60			
	2		

DEPTH (ft)	BLOWS (6")	UCS Qu (tsf)	MOIST (%)
HARD graytan CLAY with COAL fragments (continued)	8 12	5.1 S	21.0
560.60			
VERY DENSE gray SHALE with COAL lens	37 100/8"		
558.60			
End of Boring			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation/D-2

SOIL BORING LOG

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081-1120 D92-003-06 John Deere Road proposed culvert, double 7' x 4' box, .16 m. E. of 41st Street

Date 7/7/11

ROUTE FAP 595 DESCRIPTION LOGGED BY W. Garza

SECTION 142-R LOCATION S. Moline Twp. - 15NE, SEC., TWP. 17N, RNG. 1W

COUNTY Rock Island DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO. 081-1120
Station 310+60

BORING NO. B-2
Station 310+28
Offset 87.00ft Lt Med CL
Ground Surface Elev. 581.50 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter None ft
Upon Completion Dry ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Soil Description
		3.5 P	10.0	VERY STIFF brown SILTY CLAY LOAM
579.50				
	2			MEDIUM light brown SILTY CLAY LOAM
	3	0.8 B	24.0	
578.00	4			
-5	2			SOFT light brown/gray SILTY CLAY LOAM
	1	0.5 B	28.0	
575.50	3			
	0			SOFT tan SILTY LOAM
	2	0.3 B	28.0	
572.50	2			
-10	0			LOOSE tan dirty SAND with medium moist GRAVEL
	1			
570.00	3			
	1			MEDIUM gray/red CLAY LOAM
	2	0.8 P	30.0	
568.00	3			
-15	1			SOFT redish brown CLAY LOAM
	2	0.3 B	27.0	
565.00	2			
	10			DENSE gray SHALE
	12			
563.00	21			
-20	29			VERY DENSE gray SHALE

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Soil Description
	100/12"			VERY DENSE gray SHALE *(continued)*
560.50				End of Boring
-25				
-30				
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
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BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation/D-2

SOIL BORING LOG

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Date 7/8/11

ROUTE FAP 595 DESCRIPTION 081-1120 D92-003-06 John Deere Road proposed culvert, double 7' x 4' box, .16 m. E. of 41st Street LOGGED BY W. Garza

SECTION 142-R LOCATION S. Moline Twp. - 15NE, SEC., TWP. 17N, RNG. 1W

COUNTY Rock Island DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO. 081-1120
Station 310+60

BORING NO. B-3
Station 310+60
Offset 81.50ft Rt Med CL
Ground Surface Elev. 579.20 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

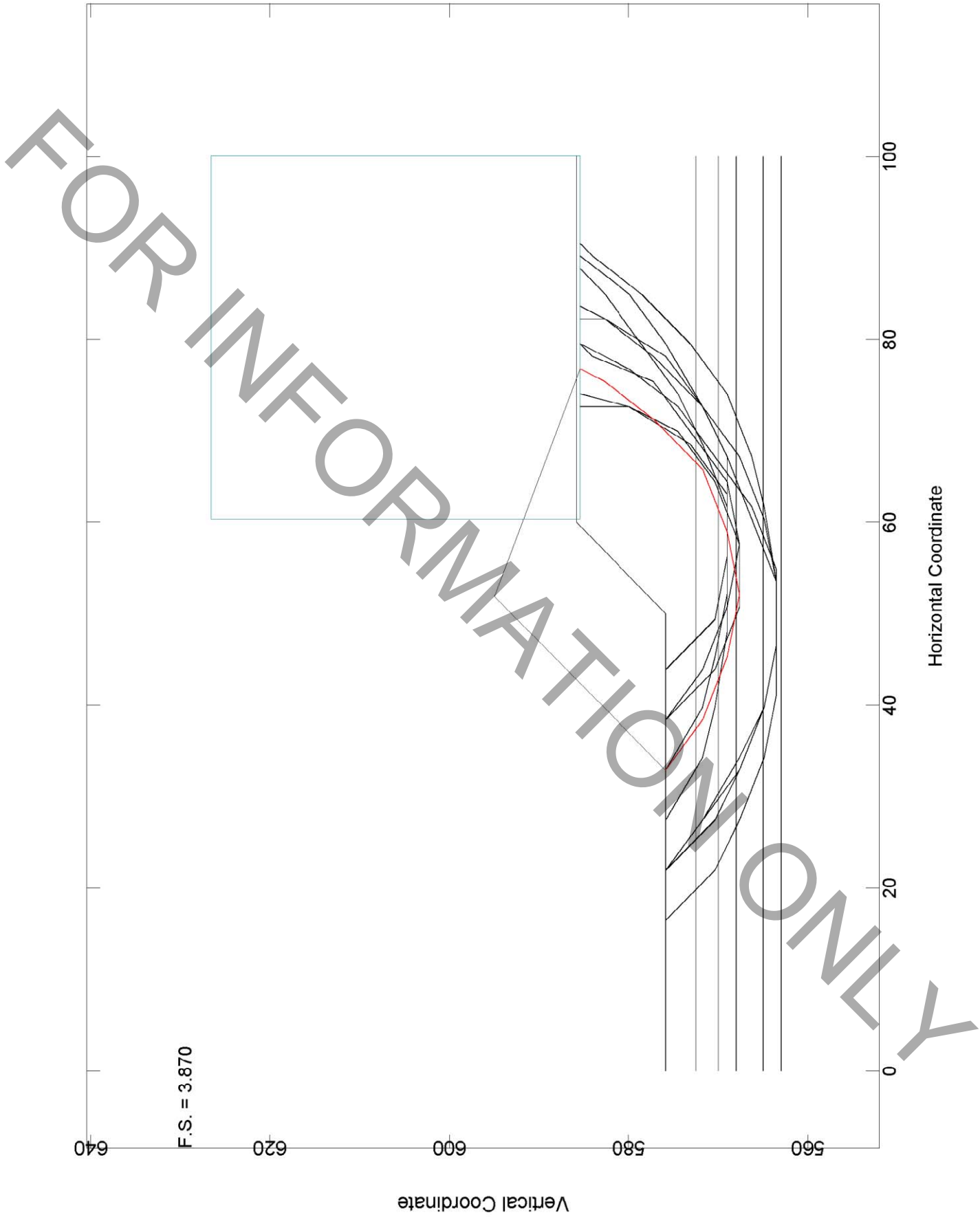
Groundwater Elev.:
First Encounter None ft
Upon Completion Dry ft
After ____ Hrs. ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
STIFF brown SILTY CLAY LOAM				
			1.3 P	19.0
	577.20			
STIFF brown SILTY CLAY LOAM		2		
		3 4	1.8 B	22.0
	575.70			
MEDIUM tan SILTY CLAY LOAM	-5	2		
		2 4	0.7 B	28.0
	573.20			
MEDIUM tan SILTY LOAM		2		
		2 3	0.6 P	28.0
	570.70			
STIFF gray SILTY LOAM with SAND lens	-10	0		
		1 4	1.4 P	26.0
	568.20			
MEDIUM gray SILTY LOAM with SAND lens		0		
		2 2	0.7 B	31.0
	565.70			
SOFT gray SILTY CLAY with 12% ORGANICS	-15	0		
		0 2	0.3 P	63.0
	563.20			
MEDIUM gray SILTY CLAY with 10% ORGANICS		0		
		1 2	0.5 B	41.0
	560.70			
MEDIUM gray SILTY CLAY	-20	0		

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM gray SILTY CLAY *(continued)*		0 2	0.7 B	34.0
	557.70			
VERY DENSE gray SHALE		4		
		30 55		
	555.70			
VERY DENSE gray SHALE	-25	100/9"		
	553.20			
End of Boring				
	-30			
	-35			
	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)



GRANULAR CULVERT BACKFILL 4/10/06

This work consists of backfilling box culverts or three-sided structures with granular materials. This work shall be performed at locations shown on the plans or as directed by the Engineer.

Backfilling shall be performed according to Article 502.10. The backfill material shall meet the requirements of Article 1004.06, except the gradation shall be CA-06 or CA-10.

Granular Culvert Backfill will be measured for payment in cubic yards compacted in place. Additional material required to backfill excavation outside the limits shown on the plans will not be measured for payment. This work shall be paid for at the contract unit price per cubic yard for GRANULAR CULVERT BACKFILL.

ROCKFILL - FOUNDATION 4/22/05

This work consists of constructing a layer of rockfill below culverts or spread footings having unstable or unsuitable soil conditions. When shown on the plans, the rockfill limits and thickness shall be confirmed by the Engineer prior to excavating below the theoretical top of rockfill line.

Materials shall meet the requirements of the following Articles of the Standard Specifications:

CA-6 and CA-7	.....	1004.04
Rockfill	.....	1005.01

All rockfill shall be well graded. The gradation of rockfill shall be selected based on layer thickness as shown below:

Less than or equal to 1 ft	.....	Gradations with a max size of 4 inches[b]
Greater than 1 ft	.....	Primary Crusher Run
Greater than 3 ft	.....	Primary Crusher Run or Shot Rock (18" max size)

[b] Gradations with a maximum size of 2 inches or smaller shall have less than 6% passing the No. 200 sieve.

Excavation shall be performed according to Section 202 of the Standard Specifications. Excavated material may be placed in fills according to Article 202.03 with the approval of the Engineer.

The method of rockfill placement shall be approved by the Engineer. Rockfill shall be capped according to application as shown below:

Spread Footing	.....	4 to 6 inches CA-6
Cast-In-Place Box Culverts	.....	4 to 6 inches CA-7
Pre-Cast Box Culverts	.....	Porous Granular Bedding Material (Article 540.06)
Pre-Cast Pipe Culverts	.....	4 to 6 inches Fine Aggregate (Article 542.04(c))

In spread footing applications, the CA-6 cap shall be compacted to the satisfaction of the Engineer. No compaction of rockfill is required for culvert applications.

This work will be measured and paid for at the contract unit price per ton for ROCKFILL - FOUNDATION. The contract price for ROCKFILL-FOUNDATION shall include excavation, aggregate materials, aggregate material placement, and placement of excavated materials within right-of-way or disposal off right-of-way. *Excavation will not be measured or paid for separately or as part of EARTH EXCAVATION.* For precast concrete box culverts, porous granular bedding material and the excavation required for bedding will be paid for according to Article 540.08. For pipe culverts, the fine aggregate and the excavation required for fine aggregate shall be included in the cost per foot for PIPE CULVERTS of the class and type specified.