

STRUCTURE GEOTECHNICAL REPORT

Proposed S.N. 081-1118

Existing S.N. N/A

IL Rte 5/John Deere Road
Over Drainage Ditch
0.6 Mile 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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Exhibits:

- 1) Location Map
- 2) Boring Locations
- 3) Subsurface Data Profile
- 4) Boring Logs
- 5) Slope Stability Output
- 6) Special Provisions
- 7) Mining Information

Project Description and Proposed Structure Information

This project consists of replacing an existing reinforced concrete pipe with a double barrel reinforced concrete box culvert under IL Rte. 5 at station 280+51.50 to accommodate proposed widening of the roadway. The structure will carry three lanes in each direction. This work will need to be completed using stage construction. The proposed culvert is a 6'x3' double barrel reinforced concrete box culvert, 166'-6" 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 pipe will be required for construction.

The stage construction requires soil retention for excavation during removal of existing pipe and construction of proposed structure. The maximum fill height is approximately 6'-5" above the proposed culvert. The structure will have $\pm 5'-6"$ long horizontal cantilever wingwalls at the south end of the culvert that will retain a 1:2 (V:H) embankment slope. The north end of the culvert will have a concrete drop box end section. On the USGS Coal Valley quadrangle map, the project area falls within Section 10 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 081-1120, 44th Avenue Culvert and Retaining Wall Location-1.

Existing Information

The existing 42" concrete pipe with flared end sections is $\pm 159'-6"$ long measured along its centerline and has no skew. The existing pipe has a maximum fill of $\pm 4'-0"$. Existing IL Rte. 5 was built on a horizontally curved alignment. The roadway currently provides two eastbound lanes of traffic and two westbound lanes widening into four lanes for an additional right and left turn lane at the intersection of IL Rte. 5 and 38th Street. 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. There are drainage ditches on each end of the existing pipe flowing from north to south. Existing underground water main and sanitary sewers are located outside the limits of the structure.

The boring data was provided by IDOT District 2 personnel. Two borings drilled in April of 2011 are associated with the proposed culvert location. Boring B-1 was drilled at station 280+44 approximately 52 ft right of the centerline of the roadway. Boring B-2 was drilled at station 280+63 approximately 49 ft left of the centerline. Both borings were terminated 19 ft below ground surface. Boring locations relative to the culvert location are shown in Exhibit 2.

At each location, a standard penetration test (SPT) was conducted every 2.5 ft according to AASHTO T 206 using a hollow stem auger drill. Borings B-1 and B-2 show a sandstone rock line depth of 17 ft below the surface with water being encountered at a depth of 12.5 ft. The borings encountered about 12 ft of moist to very moist clay loam with blow count values ranging from 4 to 11 blows per foot with an unconfined compressive strength ranging from 0.5 to 2.3 tsf. The borings encountered a sand layer about 5 ft thick between the clay and sandstone with blow counts ranging from 7 to 21 blows per foot. 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: The profile grade is proposed to be raised by ± 2.5 feet, which will substantially increase the soil loading at this location. The proposed culvert will be extending beyond the limits of existing concrete pipe. Due to weaker clay soil layers at the base of the proposed culvert, it is recommended the streambed soils beneath the proposed culvert be removed down to Elev. 559.75 and replaced with Rockfill-Foundation.

Slope Stability: Stability analyses were performed using a temporary excavation 1:1 slope model which rendered a factor of safety over 4. The resulting maximum excavation required for removal and replacement is 11 ft.

Seismic Considerations: According to AASHTO, the structure falls in the Seismic Performance Zone (SPZ) 1 and the Soil Site class is E. The Design Spectral Acceleration at 1.0 sec (S_{D1}) is 0.129g and at 0.2 sec (S_{DS}) is 0.204g. No problems affecting serviceability are anticipated following a seismic event.

Scour: The design scour elevations should correspond to the bottom of the toe wall elevation on the upstream and downstream ends as shown in the table below. 10-year velocity for the proposed culvert is 7.34 fps. The Hydraulic Report recommends an excelsior blanket for erosion protection at the downstream end.

Design Scour Elevation (ft.)	Upstream	Downstream
		560.25

Mining Activity: According to the Illinois State Geological Survey (ISGS) "Coal Mines in Illinois Viewer," the structure is located in a underground mine proximity region. Mine index 7372 is located 0.1 miles north of structure location. No data was found for this mine. Mine index 3246 is located 0.6 miles from the structure location. See Exhibit 7 for further detail for mine index 3246.

Box Culvert Evaluations and Design Recommendations

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

According to IDOT culvert manual, precast option is not recommended when set on rock foundation. Furthermore, precast sections are discouraged with high flow velocities and scour concerns.

Based on existing site conditions and need for cast-in-place headwalls and drop inlet, a cast-in-place culvert appears to be the most appropriate option.

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. Since a drop box will be present at the north end of the culvert, wingwalls will only be required at the south end. 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 4'-2", the wingwall length chart shows a length of 5'-6" with an angle of 45°.

The horizontal cantilever wingwall is the most appropriate design choice according to the Culvert Manual. The IDOT Bridge Manual also states that horizontal cantilever shall be considered the most economical. The recommended active earth pressure as an equivalent fluid pressure on the wingwalls according to the proposed design is 65 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.

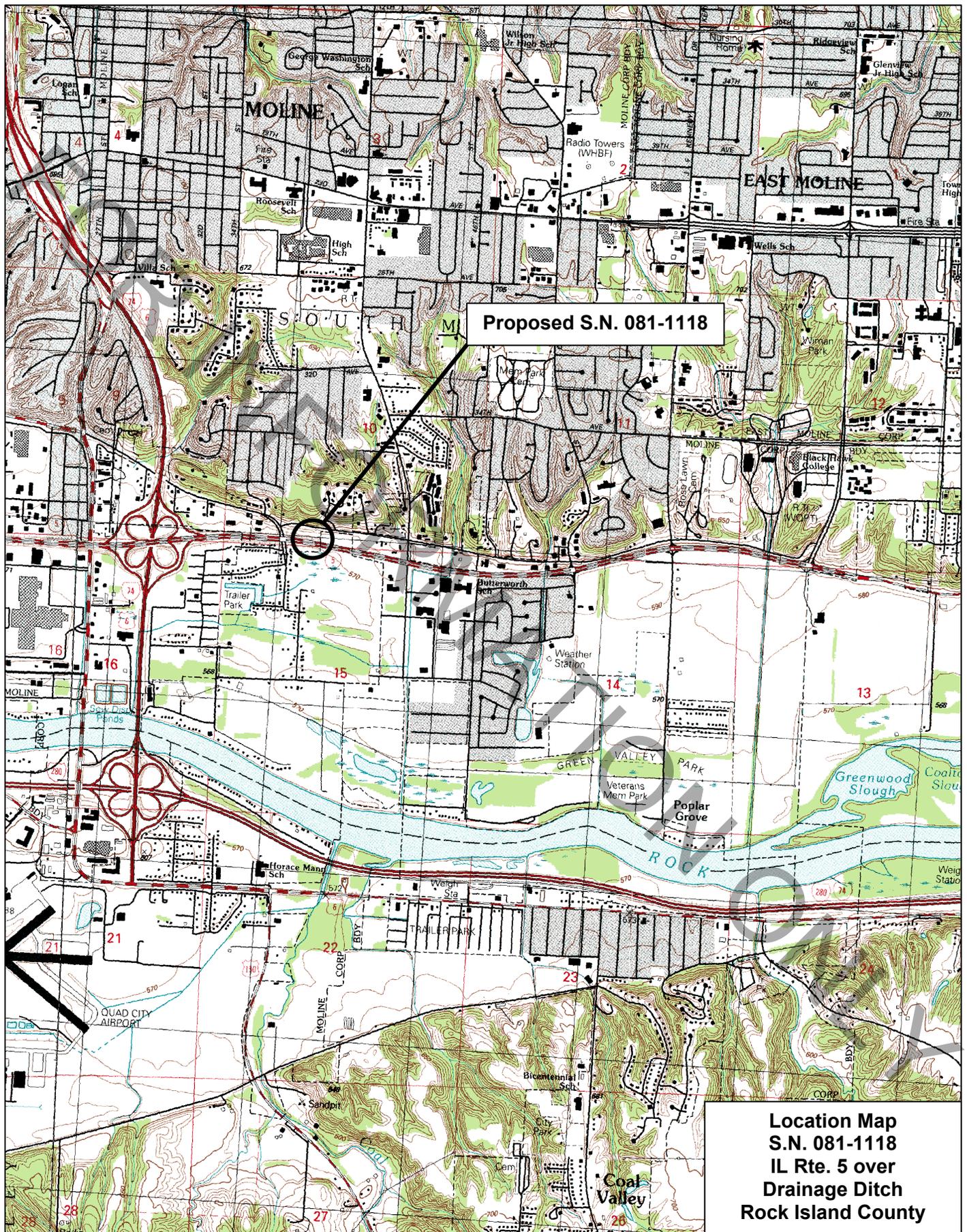
Stage Construction: In order to maintain traffic flow, stage construction shall be utilized. To retain fill at the edge of slab during stage construction, it is recommended that Temporary Geotextile walls be used per IDOT Bridge Manual Fig. 3.13.2-1.

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.

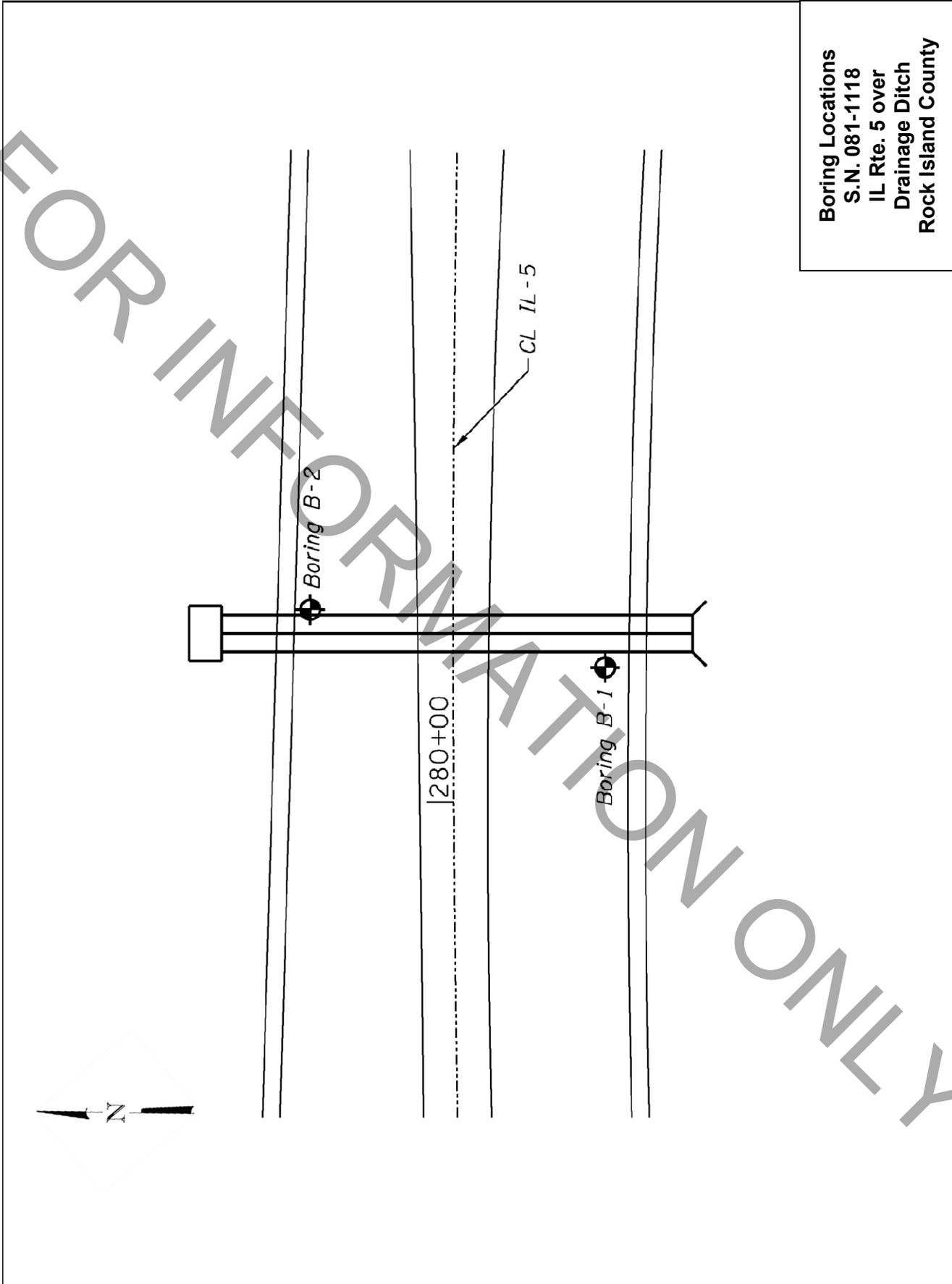
Excavation: A 1:1 temporary excavation slope for construction clearance has an adequate factor of safety. The factor of safety is limited to 1:1 slopes and any steeper slopes should not be used.

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 to an elevation of 559.75 and replaced with Rockfill-Foundation. The pay limits shall extend 2 feet outside the limits of the barrel.



Boring Locations
S.N. 081-1118
IL Rte. 5 over
Drainage Ditch
Rock Island County



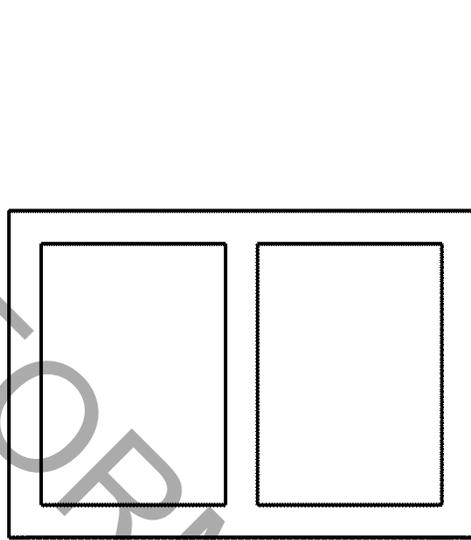
Boring B-1

Station 280+44
Offset 52.00ft Rt CL

Boring B-2

Station 280+63
Offset 49.00ft Lt CL

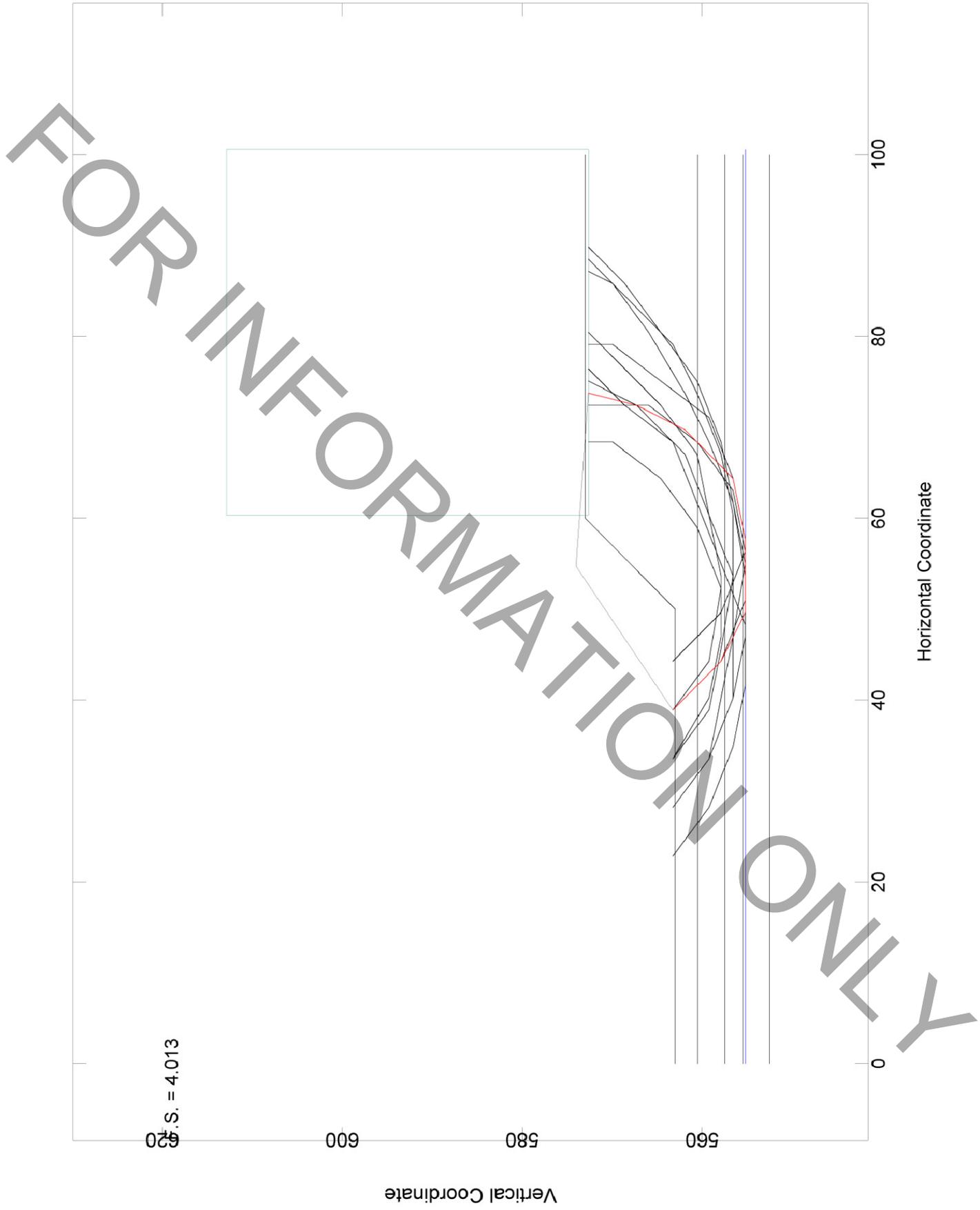
Elevation	Soil Description	N	Qu	W
569.50				
569.00				
568.50	SILTY CLAY LOAM	1.1	P	18.0 %
568.00				
567.50				
567.00				
566.50	SILTY CLAY LOAM	11	2.3	P 20.0 %
566.00				
565.50				
565.00				
564.50	SILTY CLAY LOAM	6	0.5	B 47.0 %
564.00				
563.50				
563.00				
562.50	SILTY CLAY LOAM			
562.00				
561.50				
561.00				
560.50	SILTY CLAY LOAM	4	0.5	B 47.0 %
560.00				
559.50				
559.00				
558.50	SILTY CLAY LOAM	5	0.5	B 45.0 %
558.00				
557.50				
557.00				
556.50	SAND			
556.00				
555.50		13		
555.00				
554.50	SAND			
554.00				
553.50				
553.00		21		
552.50	SANDSTONE			
552.00				
551.50		100/5"		
551.00				
550.50				



Elevation	Soil Description	N	Qu	W
569.80				
569.30				
568.80	SILTY CLAY LOAM			
568.30				
567.80				
567.30				
566.80	SILTY CLAY LOAM	10	0.9	P 24.0 %
566.30				
565.80				
565.30				
564.80	SILTY CLAY LOAM	7	0.8	B 36.0 %
564.30				
563.80				
563.30				
562.80	SILTY CLAY LOAM			
562.30				
561.80				
561.30				
560.80	SILTY CLAY LOAM	8	1.2	B 30.0 %
560.30				
559.80				
559.30				
558.80	SILTY CLAY LOAM	7	0.5	B 45.0 %
558.30				
557.80				
557.30				
556.80	SAND			
556.30				
555.80		14		
555.30				
554.80	SAND			
554.30				
553.80				
553.30		7		
552.80	SANDSTONE			
552.30				
551.80		100/9"		
551.30				
550.80				

▼ Groundwater elevation encounter while drilling.

▽ Groundwater elevation upon completion.



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.

Mine Index 3246**M. W. Posten & Son, Posten Mine**

Type: Underground Total mined-out acreage shown: None; production indicates approximately 2 acres were mined.

SHAFT, SLOPE, DRIFT or TIPPLE LOCATIONS

Type	County	Township-Range	Section	Quarters-Footage
Main shaft	Rock Island	17N 1W	10	SE SW NW

GEOLOGY

Seam(s) Mined	Depth (ft)	Thickness (ft)			Mining Method
		Min	Max	Avg	
Rock Island	80			3.0-4.0	RP

Geologic Problems Reported:

PRODUCTION HISTORY

Company	Mine Name	Years	Production (tons)
Zeigler Brothers	Zeigler	1904-1906	2,872
Fred Zeigler	Zeigler	1906-1907	940
M. W. Posten & Son	Posten	1907-1909	<u>2,330</u> 6,142

Last reported production: 1909

SOURCES OF DATA

Source Map	Date	Original Scale	Digitized Scale	Map Type
Mine notes	Undated	(text only)	1:24000 *	Secondary source

* The mine location was plotted on a 1:24000 USGS topographic map from the mine location description and digitized.

Annotated Bibliography (data source, brief description of information)

Coal Reports - Production, ownership, years of operation, mine type, seam, depth, thickness, mining method.
Directory of Illinois Coal Mines (Rock Island County) - Mine names, mine index, ownership, years of operation.
Mine notes (Rock Island County) - Mine location.