April 25, 2017

Response to SCDHEC Request for Additional Information Regarding Cofferdam Options

There have been many engineering studies and reports completed in support of the removal via the cofferdam approach for the Congaree River Project over the last several years. These engineering studies included (but were not limited to) the following:

- February 6, 2012 – Cofferdam Conceptual Design ["Full-scale area"]
- May 1, 2012 – Revised Cofferdam Conceptual Design [Incorporated new river data and 2 additional berm height alternatives]; ["Full-scale area", 3- Phases, see Attachment 1]
  - 10 – Options for isolating the project area were evaluated.
  - Cofferdam height evaluation, how high, or what top elevation of any type of any option.
  - Evaluated over-topping events, design elevation vs. historical river data.
  - Developed Conceptual Design for 3 alternatives, with preliminary estimated costs.
  - Rizzo recommendation to proceed with the rock-filled cofferdam approach.
- May 23, 2012 – Internal SCANA decision document to select top elevation of 123.5 (least likely to be overtopped, most conservative)
- September 20, 2012 – Final Drawings Cofferdam Design ["Full-scale area", 3 – Phases; 8.33 acres
- March 20, 2013 – Leakage calculation – an estimate of water seepage rate thru cofferdam
- October 11, 2013 – Draft Hydraulic Backwater Analysis (HEC-RAS modeling, FEMA mapping, 100- Year Flood No-Rise Certification)
- June 20, 2014 – Cofferdam Stability Analysis
- June 23, 2014 Updated Cofferdam drawings (Switched from 3-phases to 2-Phases to reduce "flooding" impact (rise) on western shoreline
- August 14, 2014 - Lower Flow Sensitivity Study (Water Elevations of 123.0, 120.0 & 116.3) [Phase 1 rise = 1.2 feet; Phase 2 rise = 6.4 feet] = **Unacceptable**

In a continued effort to still complete a removal action, but address the western shore rise (flooding) issue at lower flow elevations, SCE&G proposed a smaller, targeted removal area:

- January 30, 2015 - Design Criteria & Cofferdam Options [**smaller scale removal area** to negate adverse effects of larger scale cofferdam] see Attachment 2,
  - 5 – Design Criteria; and
  - 15 – Cofferdam Options
- February 11, 2015 - Cofferdam Options Evaluation (smaller scale removal area) 3 Potential options were identified;
- March 9, 2015 – Draft Conceptual Design of Cofferdam Options (smaller scale removal area);
- April 30, 2015 - Modified Removal Area (MRA) proposed to USACE, advocated the use of a temporary berm be installed parallel to the shoreline, with cross berms installed. 2.33 acres.
- June 12, 2015 – Draft Cofferdam Berm Height Evaluation – "None of the berm elevations analyzed were able to meet the no-rise criteria for all low flow conditions"
- July 1, 2015 - Cofferdam Berm Height Evaluation -; main berm height=123.5', cross berm heights = 123 yields a minimal rise (0.1') at low flow conditions = **Unacceptable**

Based on the SCDHEC's request, we have attached two of the option evaluations as highlighted above.

ATTACHMENT 1

ENGINEERS / CONSULTANTS / CM
Paul C. Rizzo Associates, Inc.
500 Penn Center Boulevard • Penn Center East, Building 5, Suite 100 • Pittsburgh, PA 15235
Phone (412) 856-9700 • Fax (412) 856-9749
www.rizzoassoc.com

May 1, 2012
Project No. 11-4708

Mr. William Zeli
Management and Technical Resources, Inc.
1600 Commerce Circle
Trafford, PA 15085

REVISED LETTER REPORT
COFFERDAM CONCEPTUAL DESIGN
CONGAREE RIVER REMEDIATION
COLUMBIA, SOUTH CAROLINA

Dear Mr. Zeli:

This Letter Report presents the results of Paul C. Rizzo Associates, Inc.'s (RIZZO) engineering evaluation and conceptual design of cofferdam options for the Congaree River Remediation Project. Our services for this Project were performed in accordance with our November 17, 2011 revised proposal submitted to Management and Technical Resources, Inc. (MTR).

This Letter Report has been revised to incorporate new stream gage data and provide two additional berm height alternatives for the rockfill berm option.

1.0 PROJECT UNDERSTANDING

MTR is currently working with South Carolina Electric & Gas (SCE&G) on a sediment remediation project in Columbia, South Carolina. The area to be remediated is located on the East bank of the Congaree River, immediately downstream of the Gervais Street Bridge. MTR is currently delineating the extent of down-river impacts and is beginning to formulate an approach to remediation. The current approach for remediation consists of installing a cofferdam in phases around the area that requires remediation to allow access to the area and removal of material.

Challenges with the Project include an uneven river bottom with boulders and rock outcrops, variable water levels, and swift currents in the Project area. MTR anticipates that the Project will be completed in phases over multiple construction seasons, so the cofferdam will need to be removed and replaced.

If any of the Project information described in this Letter Report is incorrect or has changed, please contact RIZZO immediately so that we can revise or amend the recommendations provided in this Letter Report, if appropriate.

2.0 EVALUATION OF OPTIONS

A total of ten options were considered for the cofferdam, each option considered is listed in ***Table 1***, below. The options were ranked based on the key factors listed in ***Table 1***. The most important factors in the ranking were whether the cofferdam could be designed to be overtopped and whether it was practical to found the cofferdam on the rock stream bottom. Other factors considered include cost, if the cofferdam could be removed easily, and the estimated leakage through the cofferdam.

TABLE 1
COFFERDAM OPTIONS EVALUATION

COFFERDAM OPTION	DESIGNED TO OVERTOP?	PRACTICAL TO FOUND ON ROCK STREAM BOTTOM?	COST	EASILY REMOVABLE	ESTIMATED LEAKAGE	RANK
Rockfill Berm with Liner	**yes**	**yes**	**low**	**yes**	**medium**	**1**
Portadam System	**yes**	**yes**	**medium to high**	**yes**	**medium**	**2**
Cellular Sheetpile	**yes**	**possibly**	**medium to high**	**no**	**medium**	**3**
Soldier Pile and Lagging	yes	yes	medium to high	no	medium	-
Pre-cast Concrete Sections	yes	no	high	yes	low	-
Sheet Piles	yes	no	low	no	medium	-
Timber Piles	yes	no	low	no	medium	-
Water-Inflated Dam	yes	no	medium	yes	low	-
Sand Bags	no	yes	low	yes	high	-

TABLE 1
COFFERDAM OPTIONS EVALUATION
(CONTINUED)

COFFERDAM OPTION	DESIGNED TO OVERTOP?	PRACTICAL TO FOUND ON ROCK STREAM BOTTOM?	COST	EASILY REMOVABLE	ESTIMATED LEAKAGE	RANK
Earthen Dike	no	yes	low	no	high	-

Based on the initial evaluation described in ***Table 1***, we have developed conceptual designs for the rockfill berm, Portadam, and cellular sheetpile options shown in bold.

3.0 HYDROLOGIC ANALYSIS

To estimate an appropriate top elevation for the cofferdam, RIZZO reviewed discharge and gage height data for US Geological Survey (USGS) Gage No. 02169500 located near the Site and just downstream of the Gervais Street Bridge. Data from MTR for maximum daily gage height at the gage were reviewed. Data from May 1 to October 31 for the previous ten years (2002 – 2011) were reviewed.

The average maximum stream elevation during the May – October period, excluding the maximum data from 2003, 2004, and 2005, is elevation (EL) 121.4. Data from 2003, 2004, and 2005 were excluded from the average stream elevation calculation because the maximum stream elevation during these years were far above other years and exceeded the height that would be reasonable for design of a temporary cofferdam. Based on the review of hydrologic data, for the comparison of options for the cofferdam we have selected a top elevation of EL 119.5.

The maximum height of the cofferdam would then be approximately 13.5 feet (ft) because the minimum streambed elevation near the cofferdam is approximately EL 106. All elevations presented in this Letter Report use National Geodetic Vertical Datum 1929 (NGVD 29).

The maximum stream elevations for the May – October period over the past ten years and the number of events when the stream level exceeded EL 119.5, 121.5, and 123.5 in each year, is summarized in ***Table 2***.

TABLE 2
SUMMARY OF HYDROLOGIC DATA (MAY 1 – OCTOBER 31)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Max Gage Height (ft) NGVD 29	7.33	23.15	23.88	16.74	7.98	7.01	10.47	9.36	10.42	6.37
Max Stream Elevation (ft) NGVD 29	120.35	136.17	136.90	129.76	121.00	120.03	123.49	122.38	123.44	119.39
No. of Events Exceeding EL 119.5	2	9	5	8	4	2	1	3	4	0
No. of Events Exceeding EL 121.5	0	9	6	5	0	0	1	2	1	0
No. of Events Exceeding EL 123.5	0	7	3	5	0	0	0	0	0	0

Note:

Overtopping events may encompass more than one day of overtopping per event. For overtopping of EL 119.5, a number of the events lasted several weeks at a time.

Although a cofferdam with a top elevation of EL 119.5 or 121.5 would have been overtopped several times during the previous ten years, the size of the cofferdam needs to be balanced with the number of times it is likely to be overtopped. During wet periods in 2003, 2004, and 2005, the maximum stream elevation exceeded EL 119.5 by 10 to 17 ft during several events, so cofferdams taller than EL 123.5 would also have been overtopped.

4.0 CONCEPTUAL DESIGNS

For conceptual design and budgetary level pricing purposes, we have assumed the cofferdam will be constructed in three phases. A conceptual layout for each phase is shown on ***Figure 1*** in ***Attachment A***.

4.1 ROCKFILL BERM WITH LINER

Figure 2 shows the conceptual design for this option. This option consists of a rockfill or shotrock berm with heavy plastic sheeting (i.e., 10 thousandths of an inch [mil] thick visqueen) as a seepage barrier. The cofferdam will be approximately 10 ft wide at the top to allow construction with a small excavator. Heavy riprap will be used on the outboard side of the cofferdam to prevent erosion, and a geotextile can be placed on the streambed prior to placing the berm to make it easier to remove the cofferdam. It is anticipated that the outboard and inboard slopes will be approximately 1.5H:1.0V. We estimate that it would take approximately three weeks to install each phase of this option, and approximately two weeks to remove each phase. There would likely be a medium amount of pumping associated with this option when work is occurring inside the cofferdam, with a small trench constructed at the inboard toe to collect leakage.

The rockfill berm option has been revised to look at two alternative berm heights at EL 121.5 and 123.5, based on the frequency of overtopping for the 119.5 crest. A 10-foot wide berm crest width is maintained. We estimate that the time required to construct the options would be approximately four weeks for the 121.5 alternative and five weeks for the 123.5 alternative. Berm removal time will also increase for each alternative.

4.2 PORTADAM SYSTEM

Figure 3 shows the conceptual design for the Portadam system. This option consists of steel frames placed on the streambed with an impervious fabric sealing membrane placed over the steel frames and the streambed. The maximum height of the frames is 10 ft, so large or deep holes in the streambed would need to be filled in with shotrock or rockfill. We estimate that it would take approximately five weeks to

install each phase of this option, and approximately two weeks to remove each phase. There would likely be a medium amount of pumping associated with this option when work is occurring inside the cofferdam, with a small trench constructed inside the cofferdam to collect leakage.

4.3 CELLULAR SHEETPILE

The conceptual design for this option is shown on ***Figure 4***. A series of cells, each with a diameter of approximately 12 ft, would be constructed to build the cofferdam. Each cell would be constructed by creating a cylinder from sheetpile and then filling the cell with free-draining coarse grained fill. A block of concrete may be required on the outboard side to reduce seepage under and through the cells. Additional temporary forms might also be required to construct the cells since the sheetpile cannot be driven into the rock streambed. We estimate that it would take approximately six weeks to install each phase of this option, and approximately one month to remove each phase. There would likely be a medium amount of pumping associated with this option when work is occurring inside the cofferdam, with a small trench constructed at the inboard toe to collect leakage.

5.0 QUANTITY AND BUDGETARY LEVEL COST ESTIMATES

Material quantity estimates and cost estimates were developed for each option discussed in ***Section 3.0***; these estimates are included in ***Attachment B***. ***Table 3*** presents a summary of the costs for each option.

TABLE 3
SUMMARY OF COST ESTIMATES

COFFERDAM OPTION	TOTAL ESTIMATED BUDGETARY COST
Rockfill Berm with Liner (Crest EL 119.5)	$2.07M
Rockfill Berm with Liner (Crest EL 121.5)	$2.61M
Rockfill Berm with Liner (Crest EL 123.5)	$3.42M
Portadam System (Crest EL 119.5)	$2.20M
Cellular Sheetpile (Crest EL 119.5)	$3.83M

6.0 EVALUATION AND RECOMMENDATIONS

The rockfill berm, Portadam, and cellular sheetpile cofferdams could all be constructed at the Site. The rockfill berm would be the easiest to construct and remove and is also the most cost effective. The Portadam system would require some fill and leveling of the streambed prior to installation. Construction of the cellular sheetpile cofferdam would likely require additional measures such as temporary forms to

construct the cells since the sheets could not be driven into the streambed, and the sheets would not seal well with the irregular streambed.

We recommend that the design for the rockfill berm cofferdam is developed in additional detail. The recommended top elevation for the rockfill berm cofferdam is EL 121.5.

7.0 SUMMARY

An evaluation of cofferdam options for the Congaree River Remediation was conducted, including selection of a conceptual top elevation, and three preferred options were identified. Conceptual designs including an engineering sketch, material quantity estimates, and budgetary level cost estimates were prepared for the rockfill berm, Portadam, and cellular sheetpile options. RIZZO recommends that the design for the rockfill berm cofferdam be developed in additional detail. This option can be constructed easily at the Site, is easily removable, and has the lowest cost of the considered options.

If you have any questions or require any additional information, please contact John Osterle at (412) 825-2008 or john.osterle@rizzoassoc.com or Jared Deible at (412) 825-2014 or jared.deible@rizzoassoc.com.

Sincerely yours,
Paul C. Rizzo Associates, Inc.

Jared Deible, P.E.
Project Supervisor

John P. Osterle, P.E.
Vice President, Dams & Water Resources Projects

Attachments

JDD/JPO/KRC/pj

ATTACHMENT A

FIGURES

K1	
TOTAL BTEX	0.005 U
TOTAL PAH	0.39 U

I1	
TOTAL BTEX	0.005 U
TOTAL PAH	0.41 U

M1	
TOTAL BTEX	0.005 U
TOTAL PAH	0.41 U

O2	
TOTAL BTEX	0.0046 U
TOTAL PAH	0.37 U

L3	
TOTAL BTEX	0.0048 U
TOTAL PAH	5.6

P5	
TOTAL BTEX	0.0054 U
TOTAL PAH	0.36 U

SED-1	
TOTAL BTEX	245
TOTAL PAH	9,250

SED-2	
TOTAL BTEX	15.07
TOTAL PAH	3,307

SED-3	
TOTAL BTEX	117
TOTAL PAH	7,634

O8	
TOTAL BTEX	0.0049 U
TOTAL PAH	0.35 U

O11	
TOTAL BTEX	0.0052 U
TOTAL PAH	0.36 U

O14	
TOTAL BTEX	0.0112
TOTAL PAH	0.35 U

O17	
TOTAL BTEX	0.0055 U
TOTAL PAH	0.37 U

K19	
TOTAL BTEX	0.0052 U
TOTAL PAH	27.5

L19	
TOTAL BTEX	0.0051 U
TOTAL PAH	2.1

I17	
TOTAL BTEX	0.0058
TOTAL PAH	630.1

J19	
TOTAL BTEX	2.4
TOTAL PAH	647.6

UNNAMED TRIBUTARY #1

UNNAMED TRIBUTARY #2

GERVAIS STREET BRIDGE

GIST STREET

SENATE STREET

ASPHALT BOAT RAMP

BOULDER FIELD

CONGAREE RIVER

Phase 1 Soil Remediation

Phase 1 & 2 Overlap

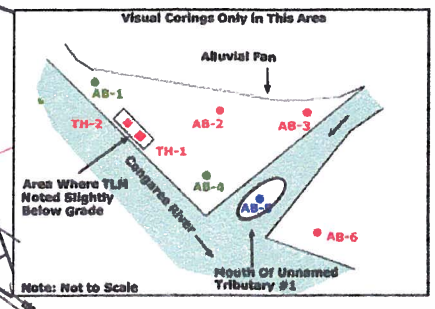
Phase 2 Soil Remediation

Phase 2 & 3 Overlap

Phase 3 Soil Remediation

N

Visual Corings Only in This Area



LEGEND

- TLM NOT OBSERVED
- TLM OBSERVED
- INACCESSIABLE OR OBSTRUCTED
- TLM ODOR AND/OR POTENTIAL VISUAL TLM
- OTHER WEATHERED MATERIAL (OWM)
- S-1 SCDHEC SEDIMENT SAMPLING LOCATION
- TH-1 SCANA RECONNAISSANCE LOCATION
- A A' TRANSECT LINE
- APPROXIMATE EDGE OF RIVER
- APPROXIMATE ISLAND LOCATION
- APPROXIMATE EXTENT OF TLM
- APPROXIMATE EXTENT OF TRANSITION ZONE
- ASSUMED EASTERN TLM BOUNDARY

NOTES:

1) SAMPLE POINTS K2 AND L2 ARE APPROXIMATE.

2) TRANSECT LINES A-A' AND B-B' WERE INVESTEGATED IN OCTOBER 2010 VIA WADING AND USING A SHOVEL.

3) ALL RESULTS IN mg/Kg.

4) INVESTIGATION POINTS IN UNNAMED TRIBUTARY #1 ARE APPROXIMATE.

0 70 140 210

SCALE IN FEET

FIGURE 1
SOUTH CAROLINA ELECTRIC & GAS COMPANY

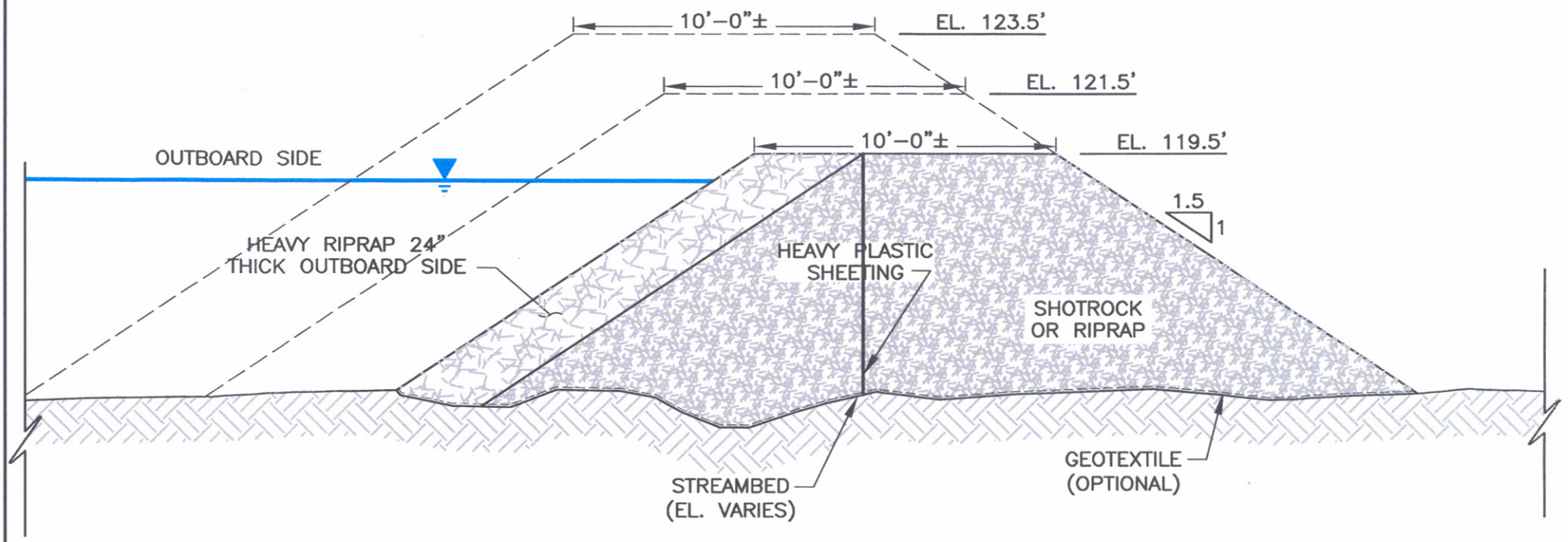
PHASE I AND PHASE II DELINEATION FINDINGS

COLUMBIA, SOUTH CAROLINA

DATE: 3-3-11 FILE NAME: PHASE I-PHASE 2 REV

MANAGEMENT AND TECHNICAL RESOURCES, INC.

PLOT		DRAWN	JLB	CHECKED BY	KFC	4-12-12	CAD FILE	114708A1(M)
1=1		BY	4-11-12	APPROVED BY	JDD	4/12/12	NUMBER	



NOTES:

1. ALTERNATIVE CREST ELEVATION OF 121.5' = 75SF OF ADDITIONAL HEAVY RIPRAP/SHOTROCK OR RIPRAP PER FT OF SECTION.
2. ALTERNATIVE CREST ELEVATION OF 123.5' = 162SF OF ADDITIONAL HEAVY RIPRAP/SHOTROCK OR RIPRAP PER FT OF SECTION.

SCALE

5 0 5 FEET

FIGURE 2

ROCKFILL BERM WITH LINER

CONGAREE RIVER REMEDIATION
COFFERDAM CONCEPTUAL DESIGNS

PREPARED FOR

MTR, INC.
TRAFFORD, PA

Paul C. Rizzo Associates, Inc.
ENGINEERS & CONSULTANTS

PLOT		DRAWN	KRC	CHECKED BY			CAD FILE	114708A1(M)
1=1		BY	1-11-12	APPROVED BY			NUMBER	

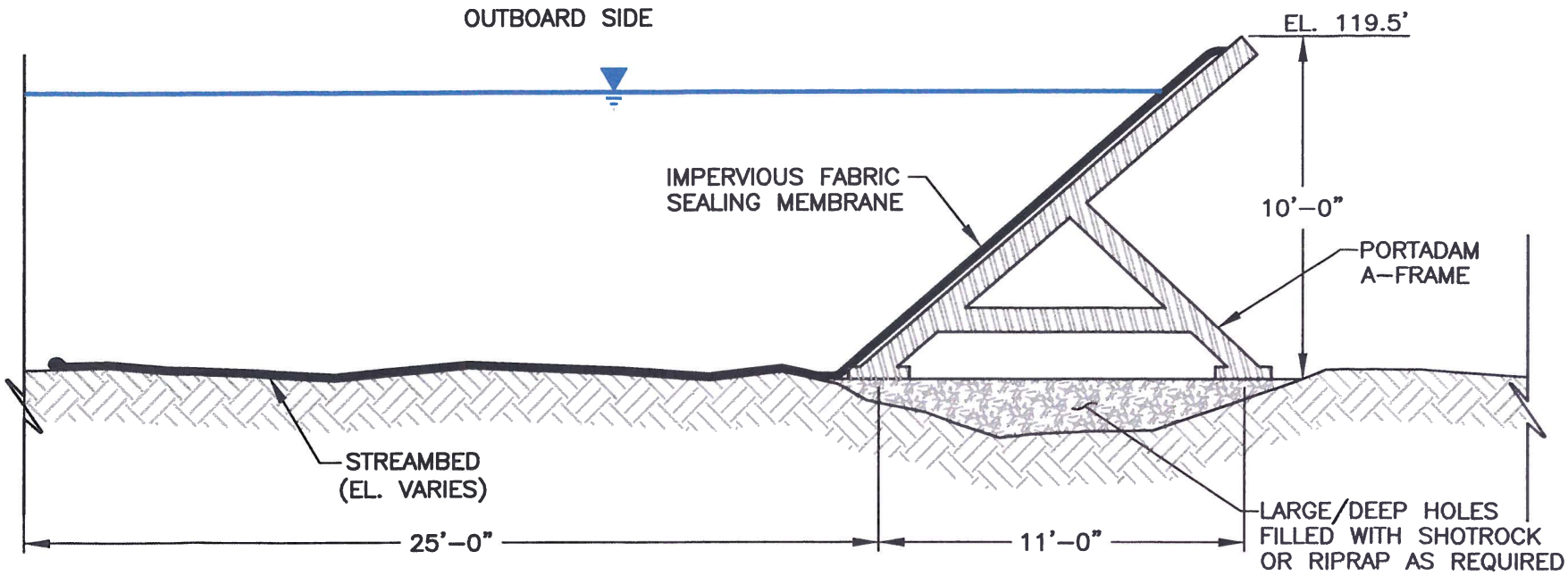


FIGURE 3

PORTA-DAM SYSTEM
CONGAREE RIVER REMEDIATION
COFFERDAM CONCEPTUAL DESIGNS

PREPARED FOR

MTR, INC.
TRAFFORD, PA

SCALE
5 0 5 FEET

Paul C. Rizzo Associates, Inc.
ENGINEERS & CONSULTANTS

PLOT		DRAWN	KRC	CHECKED BY	JDD	2/6/12	CAD FILE	114708A1(M)
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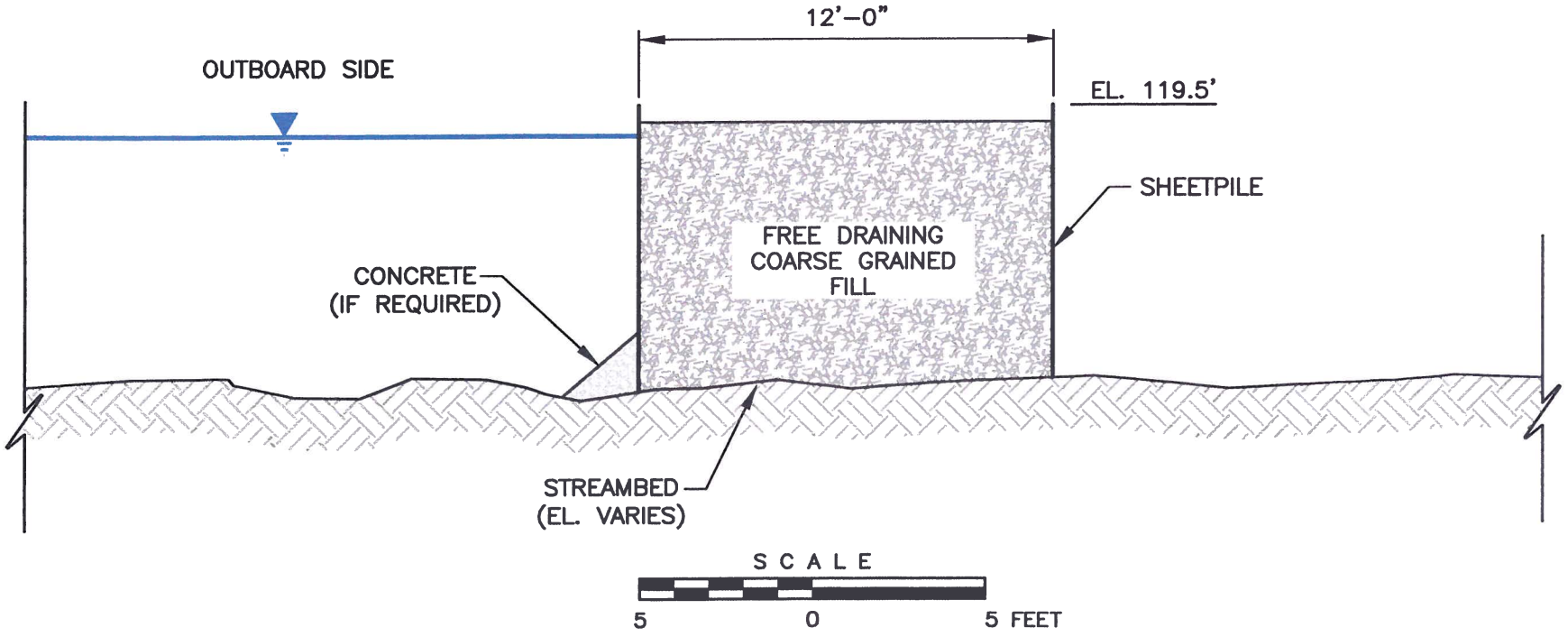

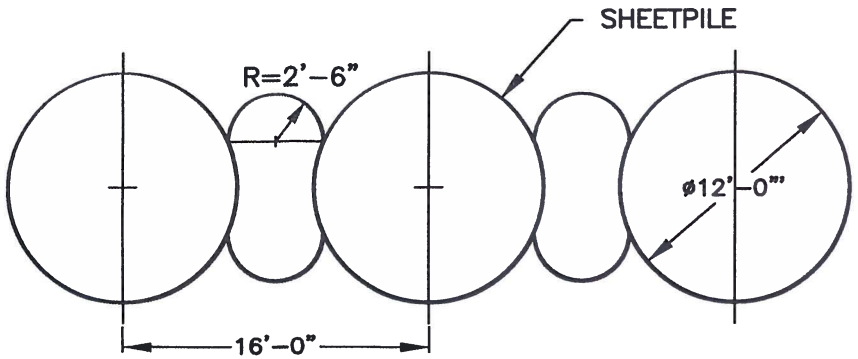

PLAN VIEW

N.T.S.

FIGURE 4

CELLULAR SHEETPILE COFFERDAM

CONGAREE RIVER REMEDIATION
COFFERDAM CONCEPTUAL DESIGNS

PREPARED FOR

MTR, INC.
TRAFFORD, PA

Paul C. Rizzo Associates, Inc.
ENGINEERS & CONSULTANTS

ATTACHMENT B

COST ESTIMATES

ENGINEERS & CONSULTANTS

Congaree River Remediation
Conceptual Cost Estimate
Rock Fill Berm with Liner (Crest El. 119.5)

Item	Description	Estimated Quantity	Unit of Measure	Unit Cost	Total Estimated Cost
1.0	**Mobilization/Demobilization**				
1.1	Mobilization/Demobilization (10% of cost)	1	Lump Sum	$170,000.00	$170,000
	Sub Total 1.0				**$170,000**
2.0	**Phase 1 Berm Construction**				
2.1	Geotextile	4,190	SQ-YD	$3.00	$12,571
2.2	10ft Plastic Liner	1,127	Lin-FT	$3.00	$3,381
2.3	Shotrock or Riprap Placement	8,930	CY	$40.00	$357,200
2.4	Heavy Riprap Placement	1,505	CY	$55.00	$82,775
2.5	Dewatering	7	Month	$8,000.00	$56,000
2.6	Berm Removal	10,435	CY	$20.00	$208,700
	Sub Total 2.0				**$720,627**
3.0	**Phase 2 Berm Construction**				
3.1	Geotextile	4,168	SQ-YD	$3.00	$12,504
3.2	10ft Plastic Liner	1,121	Lin-FT	$3.00	$3,363
3.3	Shotrock or Riprap Placement	8,883	CY	$20.00	$177,660
3.4	Heavy Riprap Placement	1,497	CY	$20.00	$29,940
3.5	Dewatering	7	Month	$8,000.00	$56,000
3.6	Berm Removal	10,380	CY	$20.00	$207,600
	Sub Total 3.0				$487,067
4.0	**Phase 3 Berm Construction**				
4.1	Geotextile	4,279	SQ-YD	$3.00	$12,838
4.2	10ft Plastic Liner	1,151	Lin-FT	$3.00	$3,453
4.3	Shotrock or Riprap Placement	9,120	CY	$20.00	$182,400
4.4	Heavy Riprap Placement	1,537	CY	$20.00	$30,740
4.5	Dewatering	7	Month	$8,000.00	$56,000
4.6	Berm Removal	10,657	CY	$5.00	$53,285
	Sub Total 4.0				$338,716
				Sub Total	**$1,716,410**
				Contingency (20%)	**$343,282**
				Total	**$2,059,692**

ENGINEERS & CONSULTANTS

Congaree River Remediation
Conceptual Cost Estimate
Rock Fill Berm with Liner (Crest El. 121.5)

Item	Description	Estimated Quantity	Unit of Measure	Unit Cost	Total Estimated Cost
1.0	**Mobilization/Demobilization**				
1.1	Mobilization/Demobilization (10% of cost)	1	Lump Sum	$170,000.00	$170,000
	Sub Total 1.0				**$170,000**
2.0	**Phase 1 Berm Construction**				
2.1	Geotextile	4,819	SQ-YD	$3.00	$14,456
2.2	12ft Plastic Liner	1,127	Lin-FT	$3.60	$4,057
2.3	Shotrock or Riprap Placement	12,219	CY	$40.00	$488,760
2.4	Heavy Riprap Placement	1,806	CY	$55.00	$99,330
2.5	Dewatering	7	Month	$8,000.00	$56,000
2.6	Berm Removal	14,025	CY	$20.00	$280,500
	Sub Total 2.0				**$943,103**
3.0	**Phase 2 Berm Construction**				
3.1	Geotextile	4,793	SQ-YD	$3.00	$14,379
3.2	12ft Plastic Liner	1,121	Lin-FT	$3.60	$4,036
3.3	Shotrock or Riprap Placement	12,154	CY	$20.00	$243,080
3.4	Heavy Riprap Placement	1,796	CY	$20.00	$35,920
3.5	Dewatering	7	Month	$8,000.00	$56,000
3.6	Berm Removal	13,950	CY	$20.00	$279,000
	Sub Total 3.0				$632,415
4.0	**Phase 3 Berm Construction**				
4.1	Geotextile	4,921	SQ-YD	$3.00	$14,764
4.2	12ft Plastic Liner	1,151	Lin-FT	$3.60	$4,144
4.3	Shotrock or Riprap Placement	12,479	CY	$20.00	$249,580
4.4	Heavy Riprap Placement	1,844	CY	$20.00	$36,880
4.5	Dewatering	7	Month	$8,000.00	$56,000
4.6	Berm Removal	14,323	CY	$5.00	$71,615
	Sub Total 4.0				$432,983
				Sub Total	**$2,178,501**
				Contingency (20%)	**$435,700**
				Total	**$2,614,201**

ENGINEERS & CONSULTANTS

Congaree River Remediation
Conceptual Cost Estimate
Rock Fill Berm with Liner (Crest El. 123.5)

Item	Description	Estimated Quantity	Unit of Measure	Unit Cost	Total Estimated Cost
1.0	**Mobilization/Demobilization**				
1.1	Mobilization/Demobilization (10% of cost)	1	Lump Sum	$170,000.00	$170,000
	Sub Total 1.0				**$170,000**
2.0	**Phase 1 Berm Construction**				
2.1	Geotextile	5,447	SQ-YD	$3.00	$16,342
2.2	14ft Plastic Liner	1,127	Lin-FT	$4.20	$4,733
2.3	Shotrock or Riprap Placement	16,009	CY	$40.00	$640,360
2.4	Heavy Riprap Placement	2,107	CY	$55.00	$115,885
2.5	Dewatering	7	Month	$8,000.00	$56,000
2.6	Berm Removal	18,116	CY	$20.00	$362,320
	Sub Total 2.0				**$1,195,640**
3.0	**Phase 2 Berm Construction**				
3.1	Geotextile	5,418	SQ-YD	$3.00	$16,255
3.2	14ft Plastic Liner	1,121	Lin-FT	$4.20	$4,708
3.3	Shotrock or Riprap Placement	15,923	CY	$20.00	$318,460
3.4	Heavy Riprap Placement	2,096	CY	$20.00	$41,920
3.5	Dewatering	7	Month	$8,000.00	$56,000
3.6	Berm Removal	18,019	CY	$20.00	$360,380
	Sub Total 3.0				$797,723
4.0	**Phase 3 Berm Construction**				
4.1	Geotextile	54,381	SQ-YD	$3.00	$163,143
4.2	14ft Plastic Liner	1,151	Lin-FT	$4.20	$4,834
4.3	Shotrock or Riprap Placement	16,349	CY	$20.00	$326,980
4.4	Heavy Riprap Placement	2,152	CY	$20.00	$43,040
4.5	Dewatering	7	Month	$8,000.00	$56,000
4.6	Berm Removal	18,501	CY	$5.00	$92,505
	Sub Total 4.0				$686,502
				Sub Total	**$2,849,865**
				Contingency (20%)	**$569,973**
				Total	**$3,419,838**

ENGINEERS & CONSULTANTS

Congaree River Remediation
Conceptual Cost Estimate
Porta-Dam System

Item	Description	Estimated Quantity	Unit of Measure	Unit Cost	Total Estimated Cost
1.0	**Mobilization/Demobilization**				
1.1	Mobilization/Demobilization (10% of cost)	1	Lump Sum	$180,000.00	$180,000
	Sub Total 1.0				**$180,000**
2.0	**Phase 1 Porta-Dam**				
2.1	Porta-Dam Crew Cost	1	Lump Sum	$80,000.00	$80,000
2.2	6 Month Rental of Porta-Dam	1	Lump Sum	$380,000.00	$380,000
2.3	Sandbags	2,254	EACH	$5.00	$11,270
2.4	Place Leveling Shotrock or Riprap	142	CY	$40.00	$5,680
2.5	Dewatering	7	Month	$8,000.00	$56,000
2.6	Remove Leveling Shotrock or Riprap	142	CY	$20.00	$2,840
	Sub Total 2.0				**$535,790**
3.0	**Phase 2 Porta-Dam**				
3.1	Porta-Dam Crew Cost	1	Lump Sum	$80,000.00	$80,000
3.2	6 Month Rental of Porta-Dam	1	Lump Sum	$380,000.00	$380,000
3.3	Sandbags	2,242	EACH	$5.00	$11,210
3.4	Place Leveling Shotrock or Riprap	670	CY	$40.00	$26,800
3.5	Dewatering	7	Month	$8,000.00	$56,000
3.6	Remove Leveling Shotrock or Riprap	671	CY	$20.00	$13,420
	Sub Total 3.0				**$567,430**
4.0	**Phase 3 Porta-Dam**				
4.1	Porta-Dam Crew Cost	1	Lump Sum	$80,000.00	$80,000
4.2	6 Month Rental of Porta-Dam	1	Lump Sum	$390,000.00	$390,000
4.3	Sandbags	2,302	EACH	$5.00	$11,510
4.4	Place Leveling Shotrock or Riprap	268	CY	$40.00	$10,720
4.5	Dewatering	7	Month	$8,000.00	$56,000
4.6	Remove Leveling Shotrock or Riprap	268	CY	$20.00	$5,360
	Sub Total 4.0				$553,590
				Sub Total	**$1,836,810**
				Contingency (20%)	**$367,362**
				Total	**$2,204,172**

ENGINEERS & CONSULTANTS

Congaree River Remediation
Conceptual Cost Estimate
Cellular Sheetpile Cofferdam

Item	Description	Estimated Quantity	Unit of Measure	Unit Cost	Total Estimated Cost
1.0	**Mobilization/Demobilization**				
1.1	Mobilization/Demobilization (10% of cost)	1	Lump Sum	$320,000.00	$320,000
	Sub Total 1.0				**$320,000**
2.0	**Phase 1 Cofferdam**				
2.1	Sheetpile (10ft high)	3,670	Lin-FT	$200.00	$734,000
2.2	Coarse Grained Fill	3,970	CY	$30.00	$119,100
2.3	Concrete	106	CY	$400.00	$42,400
2.4	Dewatering	7	Month	$8,000.00	$56,000
	Sub Total 2.0				**$951,500**
3.0	**Phase 2 Cofferdam**				
3.1	Sheetpile (10ft high)	3,650	Lin-FT	$200.00	$730,000
3.2	Coarse Grained Fill	3,950	CY	$30.00	$118,500
3.3	Concrete	106	CY	$400.00	$42,400
3.4	Dewatering	7	Month	$8,000.00	$56,000
	Sub Total 3.0				$946,900
4.0	**Phase 3 Cofferdam**				
4.1	Sheetpile (10ft high)	3,745	Lin-FT	$200.00	$749,000
4.2	Coarse Grained Fill	4,055	CY	$30.00	$121,650
4.3	Concrete	109	CY	$400.00	$43,600
4.4	Dewatering	7	Month	$8,000.00	$56,000
	Sub Total 4.0				$970,250
				Sub Total	**$3,188,650**
				Contingency (20%)	**$637,730**
				Total	**$3,826,380**

ATTACHMENT 2

RIZZO ASSOCIATES

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January 30, 2015
Project No. 11-4708

Mr. William Zeli
Apex Companies, LLC
1600 Commerce Circle
Trafford, PA 15085

DESIGN CRITERIA AND COFFERDAM OPTIONS
CONGAREE RIVER REMEDIATION
COLUMBIA, SOUTH CAROLINA

Dear Mr. Zeli:

This Letter presents the results of RIZZO Associates (RIZZO) development of the design criteria and evaluation of potential cofferdam options for the Congaree River Remediation Project. Our services for this Project were performed in accordance with our January 23, 2015 proposal submitted to Apex Companies, LLC (Apex).

1.0 DESIGN CRITERIA

Based on our meeting with Apex on January 20th, 2015, the Federal Emergency Management Agency (FEMA) requirements, and US Army Corp of Engineers (USACE) comments, RIZZO has identified the following design criteria for cofferdam options that will be considered for the site.

1. No rise for the 100 year flood: FEMA requirements dictate that proposed conditions show no rise in the base flood elevation (100 year flood) when compared to existing conditions. No rise is defined as less than 0.05 ft of rise (one significant figure considered).
2. No significant increase in the water surface level along the west bank: In addition to meeting the no rise requirement for the 100 year flood, the proposed cofferdam should not cause a significant rise in the water level for lower flows.
3. No catastrophic failure: The majority of the cofferdam should be removed or remain in place during the 100 year flood. The cofferdam should not be significantly eroded or washed away during flood events.
4. Non-Permanent: The cofferdam should be designed so that no components remain in the river for more than 6 months at a time.

5. Allow Removal of sediment "in the dry": Cofferdam alternatives should allow for removal of the contaminated sediment in the area identified by Apex in dry conditions.

2.0 COFFERDAM DESIGN OPTIONS

A total of 15 options have been developed for the cofferdam, each option developed is listed in ***Table 1*** below. The matrix includes options that could be fully removed during a flood and options where a portion of the cofferdam may remain in place during floods. In the case where a portion of the cofferdam would remain in place during floods, the portion that remains in place would need to meet design criteria 1 through 4 listed above. These options will be further evaluated by RIZZO during the next phase of work to determine three best options for further evaluation.

TABLE 1
COFFERDAM OPTIONS EVALUATION

COFFERDAM OPTION	PRACTICAL TO FOUND ON ROCK STREAM BOTTOM?	COST	EASILY REMOVABLE PORTION DURING FLOODS?	ESTIMATED LEAKAGE
Rockfill Berm with Integral Liner	yes	low to medium	no	medium
Combination Rockfill Berm with Removable Sandbags	yes	low	yes	medium to high
Combination Rockfill Berm with Removable Portadam	yes	low to medium	yes	medium
Combination Rockfill Berm with Removable Water-Inflated Dam	yes	medium	yes	medium to high
Combination Rockfill Berm with Removable precast concrete elements	yes	medium to high	yes	medium
Portadam System	no	medium to high	yes	medium
Cellular Sheetpile	no	medium to high	no	medium

TABLE 1
COFFERDAM OPTIONS EVALUATION
(CONTINUED)

COFFERDAM OPTION	PRACTICAL TO FOUND ON ROCK STREAM BOTTOM?	COST	EASILY REMOVABLE PORTION DURING FLOODS?	ESTIMATED LEAKAGE
Soldier Pile and Lagging	yes	medium to high	yes (lagging portion)	medium
Cast-In Place Concrete Sections	no	high	no	low
Sheet Piles	no	low	no	medium
Water-Inflated Dam	no	medium	yes	low
Sand Bags	yes	low	yes	high
Earthen Dike	no	high	no	high
Jersey Barriers/Precast concrete elements	no	low	yes	medium
Gabions	no	low	yes	medium

If you have any questions or require any additional information, please contact me at 412-825-2014 or email me at jared.deible@rizzoassoc.com.

Respectfully submitted,
RIZZO Associates

Jared Deible, P.E.
Managing Principal

KRC/JDD/kam