CME Associates, Inc.
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(860) 290-4100 FAX (860) 290-4114

REPORT OF MEETING

SUBJECT: Lyman Viaduct – Culvert Rehabilitation Project
Town of Colchester

DATE: May 1, 2008

TIME: 2:00 -3:30 pm

LOCATION: CME Associates, East Hartford Office

ATTENDEES: Mark Decker – Colchester DPW
Eric Ott – CT DEP
Peter Spangenberg – CT DEP
Michael Culmo, Scott Young, Bryan Busch – CME Associates

Transactions and Determinations:
Upon completion of the emergency repairs to the embankments at the viaduct performed during the winter months of 2008, the Town of Colchester expressed concern about the integrity of the culvert below the embankment. There was concern that a sinkhole similar to the Rapallo Viaduct failure would occur. There were also concerns regarding the size of the outlet pool and any potential undermining of the culvert outlet and wingwalls.

There were monies left over from the embankment stabilization project that was funded by DEP and administered by the Town of Colchester. The Town requested and DEP granted permission to use these funds to further investigate the Lyman Viaduct Culvert. The project includes the field inspection of the culvert on outlet pool area, and the development of rehabilitation plans.

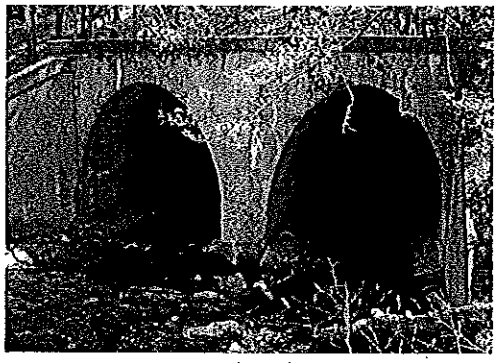
The existing structure is comprised of a twin barrel concrete arch culvert constructed in 1913. Each barrel has an approximate width of 15 feet, a rise of 17 feet, and a length of 410 feet. The structure is comprised of large aggregate concrete with construction joints spaced at 10 to 15 foot intervals. There was no evidence of steel reinforcing noted throughout the culvert or the wingwalls at the time of the inspection. The culvert runs perpendicular to the viaduct and is covered by approximately 120 feet of fill. There are large concrete gravity wingwalls at both the inlet and outlet of the culvert that retain the embankment fills.

The meeting was organized by CME Associates following the completion of the field inspection and survey. The purpose of the meeting was to convey the inspection findings to the meeting participants and determine the next course of action for the design process. The following paragraphs along with the enclosed plans and sketches provide a summary of the meeting discussions:

Culvert Inspection Results

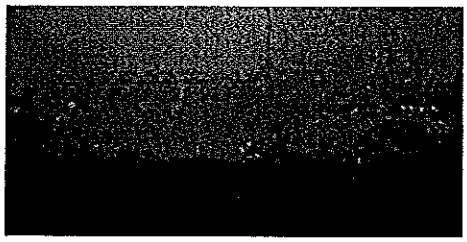
Inlet Headwall and Wingwalls

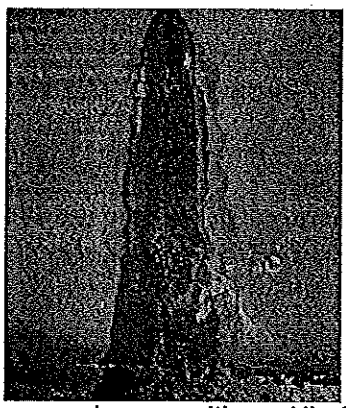
The entire concrete surface was hammer tapped to determine areas of deteriorated concrete. There are only minor areas of unsound concrete with the majority of the deterioration located near concrete construction joints at/or the near the waterline. All deterioration noted was delineated with survey marking paint to quantify future repair areas. There is no evidence of scouring in the stream channel at the inlet of the structure. There are no serious deficiencies at the culvert inlet that need immediate repair.



Arch Barrels

All concrete surfaces within the arch barrels were hammer tapped to determine areas of deteriorated concrete. The majority of the concrete surfaces within the arch barrels are in fair condition. The areas of deteriorated concrete exist at the longitudinal construction joint near the waterline.

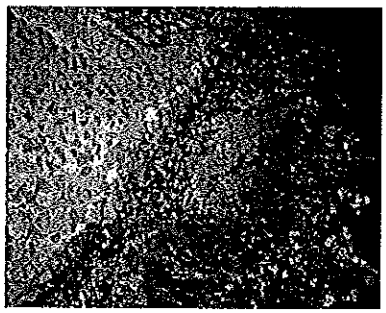




Additionally, many of the vertical construction joints exhibit areas with active leakage and spalling concrete. The spalling concrete measures up to 1 foot deep from the original face of the concrete surface at certain locations. The large thickness of the culvert wall structure is such that this does not represent a level of deterioration that requires immediate attention.

There are several longitudinal cracks located near the top of the culvert in a few sections of the culvert. These cracks are most likely due to normal stresses in the culvert caused by the weight of the soil overburden. This is a typical condition in arches of this age and composition. All of the cracks at these locations were hairline width only one or two of these locations showed evidence of leakage.

The invert of the culvert has exposed aggregate and is showing signs of deterioration that is common is a one hundred year old structure. The bed load or transfer of sediment over the years has eroded a measurable amount of concrete and left the surface irregular and uneven. While this level of deterioration is common throughout both barrels, it does not pose a significant problem requiring immediate attention.

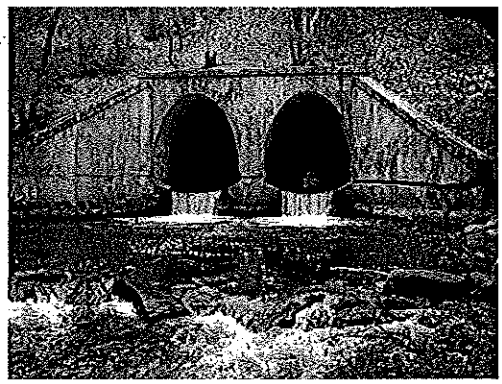


Outlet Headwall and Wingwalls

An attempt was made to hammer tap the entire surface area of the outlet headwall and wingwalls, but the depth of water, irregular surface of the bottom, and amount of water dropping out of the culvert (approximately 5 feet vertically) made certain areas inaccessible. Similar to the inlet walls the majority of the concrete surface was sound with areas of deterioration near construction joints at the waterline.

Outlet Pool Scour (Erosion)

The entire outlet of the structure and its adjacent wingwalls are undermined both vertically and horizontally. The vertical measurements shown on the enclosed sketches represent vertical scour dimensions from the bottom of the footing to the bottom of the stream channel. The vertical measurements vary from approximately 2 to 7 feet. The horizontal measurements represent the horizontal scour dimension measured from face of the wall to existing grade. At certain locations the dimensions cited are approximate due to accessibility but the measurements vary from 2 feet to 12 feet. Note that in the photo at right the bottom of footings is located above the waterline.



These dimensions indicate that the entire outlet structure is experiencing major erosion and scour. All footing toes are exposed and the undercutting is excessive in many locations.

The eastern outlet retaining wall (right side of photo above) is currently in a failed state. The lower portion of the wall below the horizontal construction joint has settled and rotated approximately 3½ inches. The upper portion of the wall has moved laterally approximately 8 inches.

At its deepest point the bottom of the outlet pool is approximately 17 feet below the flow line of the culvert. See the enclosed profile.

Overall Condition Assessment:

1. The inlet wingwalls, inlet headwalls, and the culvert interior walls are all in fair condition and do not require immediate repairs or attention. None of the spalls and deterioration are considered serious at this time. These structures should be rehabilitated in the next 5 to 10 years. Prolonging these repairs beyond this time frame could lead to accelerated deterioration and more serious problems in the future.
2. The outlet headwall and adjacent wingwalls are in critical condition. The southeast wingwall has already started to move, which constitutes a failed condition. The amount of undermining on all these walls combined with the movement of the southeast wingwall leads us to conclude that the structure could fail at any time. This area requires immediate rehabilitation. We would classify this condition as an emergency situation. If any of these walls were to fall into the river, the stability of the entire slope would be in question. Our previous analysis of the slope showed that the current factor of safety of the embankment is very close to 1.0 . It is possible that failure of one of these walls could result in a slope failure (landslide) and potential failure of the Colchester/East Hampton Sewer Line.

Access Road

There is an access road to the site that starts at lower Bull Hill Road through a gate owned and maintained by the CT DEP, and ends at the culvert outlet. The entire access road and culvert is located on a land owned by the State of Connecticut. There are two wetland crossings along the access road. One of the crossings has an existing corrugated metal pipe, while the other appears to be an intermittent drainage swale that conveys runoff from Bull Hill Road. The access roadway width varies along its length, but is primarily a minimum of 10 feet wide. In most areas, the access road parallels the contours of the land; therefore it is not very steep. There are cobbles and boulders protruding from the surface along its entire length; however most of the road is traversable by truck. It is the intent of the Town to use this road for access to the culvert outlet for construction equipment. The roadway will need minor improvements to allow equipment and materials to access the site safely. One or two pull-offs and a turn around will also be required.

Project Moving Forward

The remainder of the discussion of the meeting focused on the approach for the overall project. The following conclusions were agreed upon:

1. It was agreed that the rehabilitation of the culvert inlet and interior could be put off for several years unless sufficient funds could be appropriated in the near term.
2. There may be sufficient funds available in the current project budget to make the necessary repairs to the access road. This work will most likely exhaust the remaining funds left over from the embankment repair project.
3. The repairs to the undermining of the outlet headwall and wingwalls is critical; however there are not sufficient funds currently available to move this forward.

The meeting continued with discussion on water handling, permitting, and estimated cost for the necessary improvements to the outlet structures. The attached draft copy of the water handling scheme was presented and discussed at length. The goal of the project proceeding forward is to determine a cost effective repair to the outlet walls, while working to minimize environmental impacts.

Based on historical photographs, it is believed that the original stream channel was approximately level with the culvert outlet (similar to the inlet). This means that the existing stream channel has eroded approximately 17 feet in the last 95 years. The depth of the headwall and wingwall footing are consistent with this assumption. A survey of the area by CME confirmed that the slope of the downstream channel leads directly to the outlet flow line of the culvert. Based on this, the project team proposes to fill in the entire outlet pool to its original elevation in order to restore the creek to its original 1913 condition. The finished product will resemble a set of stone rapids. No pool is proposed for the area, since apparently none existing in 1913. The repairs will consist of the following items:

1. Underpin the existing headwall and wingwall footings to stabilize the structures. This will be done by placing cast-in-place concrete under the footings down to the bottom of the existing scour holes.
2. Fill the scour hole up to an elevation of approximately 3 feet below the proposed stream channel grade (approximately 14 feet at the deepest). The fill will either be large diameter stone or a combination of stone and flowable fill. Flowable fill is a mixture of sand water and a small amount of cement. When installed, it has the consistency of hard sand. The intent of the filling operation is not to use compacted gravel or soil.

There will be potential for flash flooding of the work area during a storm event. The materials chosen needs to remain stable in the event of a storm surge that overtops the water handling system.

3. In order to prevent a future scour hole, a reinforced concrete apron slab is proposed under the stream channel. This slab will span the entire width of the outlet pool and be tied into the existing headwall and wingwall footings. The approximate dimensions of this slab are 60' by 60'. This slab will not be visible in the completed structure.
4. Large diameter stones will be placed on top of the concrete slab and anchored to it. It is the intent to have these stones protruding from the water surface during normal flows. The large stones will assist with the dissipation of energy as the water exits the culvert.
5. Smaller diameter stones will then be placed between the large stones to create a natural stream channel.
6. Once the outlet pool is filled, a chain link fence will be install on top of the headwall and wingwalls to prevent swimmers from attempting to jump into the creek.

In order to provide a reasonable work zone, it was proposed to dewater the entire outlet pool area. This will allow for placement of stone and concrete in the dry. A preliminary water handling scheme was developed by CME. It includes the installation of temporary water handling pipes that can transfer the water from the culvert interior over the outlet pool. The pipes would start approximately 15 feet inside the culvert and span approximately 80 feet to the downstream channel. Preliminary calculations indicate that two 36 inch diameter pipes can convey twice the normal low flow of the creek. In the event of a storm, the system will be designed to be overtopped. In this scenario, the contractor will be ordered to abandon the work site prior to the storm and prepare it for water flow.

In order to span the outlet pool area, temporary shoring tower may be required to support the water handling pipes. The tower will remain in place during the filling of the outlet area. The lower portion of the tower will be sacrificial since it will be buried within the concrete pour for the apron.

Construction Estimate and Funding Issues:
The design is currently in a schematic form; however it is possible to develop a budget estimate for the repairs outlined above. Attached is a spreadsheet which includes the budget estimate for the work required to stabilize the outlet of the culvert and the wingwalls. The costs for the access roadway improvements have not been included, since this will most likely be covered by the funds that are currently in place.

There was discussion regarding sources for this funding. Currently, the DEP does not have sufficient funds in their operating budget to fund this project. It is also beyond the means of the Town of Colchester. One possible source of funds is the State bonding commission; however the current legislative session and budget process is essentially over.

At the conclusion of the meeting the following tasks were assigned to individuals on the project team:

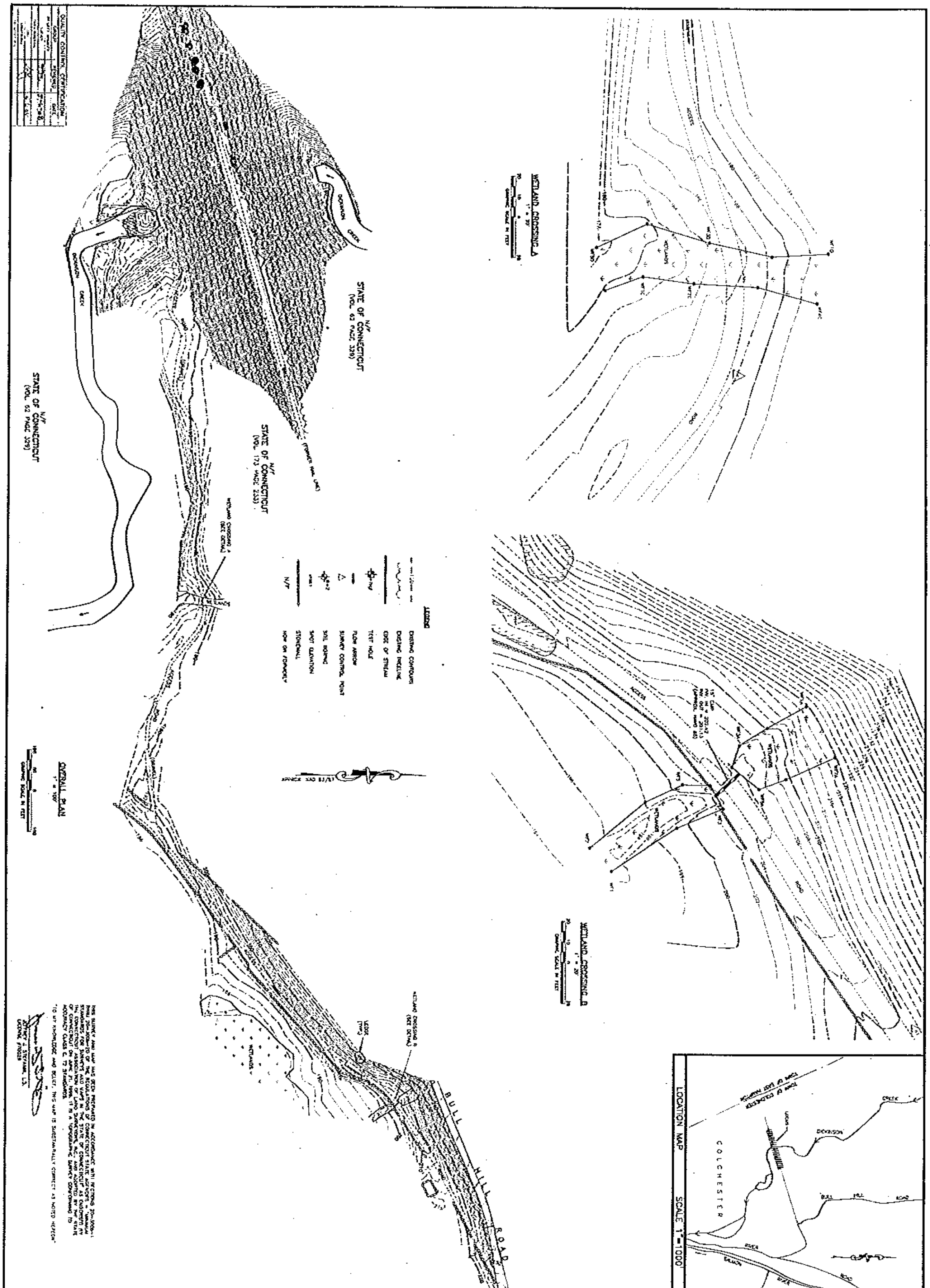
1. CME Associates will provide a written statement of our findings and outline the areas requiring repair (this report). Additionally, copies of the sketches used during the discussions would be provide to all attendees of the meeting (see attached).
2. Pete Spangenberg and Eric Ott would discuss the environmental permitting required for the proposed activities within the appropriate DEP units.

3. Pete Spangenberg will attempt to determine a source of funding within the DEP for the emergency project. Mark Decker will contact local legislators to see if additional funds can be appropriated.
4. Mark Decker and Scott Young will walk the access road in order to determine the level of rehabilitation required. They will also determine the necessary equipment and materials needed for the rehabilitation of the road. This work will most likely be completed using the current DAS contract in place. This sitewalk in anticipated to occur during the week of May 5th.
5. CME staff will remain available to the Town and DEP for assistance with any of these tasks.

Submitted By: _____ & _____

Michael P. Culmo, P.E.
Vice President of Trans. & Structures
CME Associates, Inc.

Bryan Busch, P.E.
Director of Structural Eng.
CME Associates, Inc.

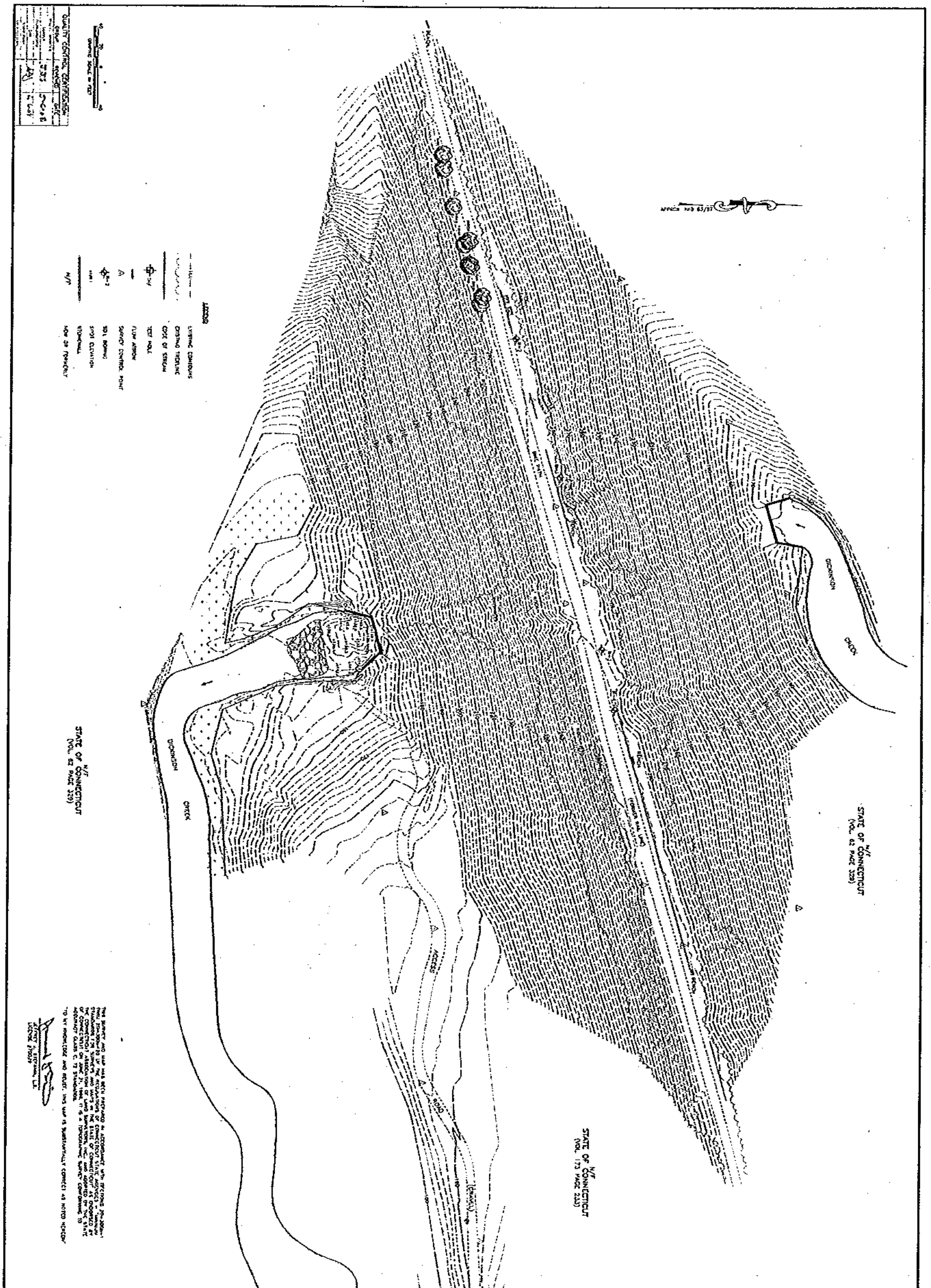


JOB DATA	REVISIONS
DATE: 05/01/2006	
SCALE: AS SHOWN	
PROJECT # 2006280.5	
SHEET 1	

LYMAN VIADUCT REHABILITATION
PREPARED FOR
TOWN OF COLCHESTER
AIR LINE TRAIL
COLCHESTER, CONNECTICUT

TOPOGRAPHIC SURVEY

CME Associates, Inc.



JOB DATA		REVISIONS			
		NO	DATE	DESCRIPTION	BY

DATE: 09/01/2008
SCALE: 1" = 40'
PROJECT # 2006280.5
SHEET 2

LYMAN VIADUCT REHABILITATION
PREPARED FOR
TOWN OF COLCHESTER
AIR LINE TRAIL
COLCHESTER, CONNECTICUT

TOPOGRAPHIC SURVEY

CME Associates, Inc.
32 Crabtree Lane, Woodstock, CT 06281
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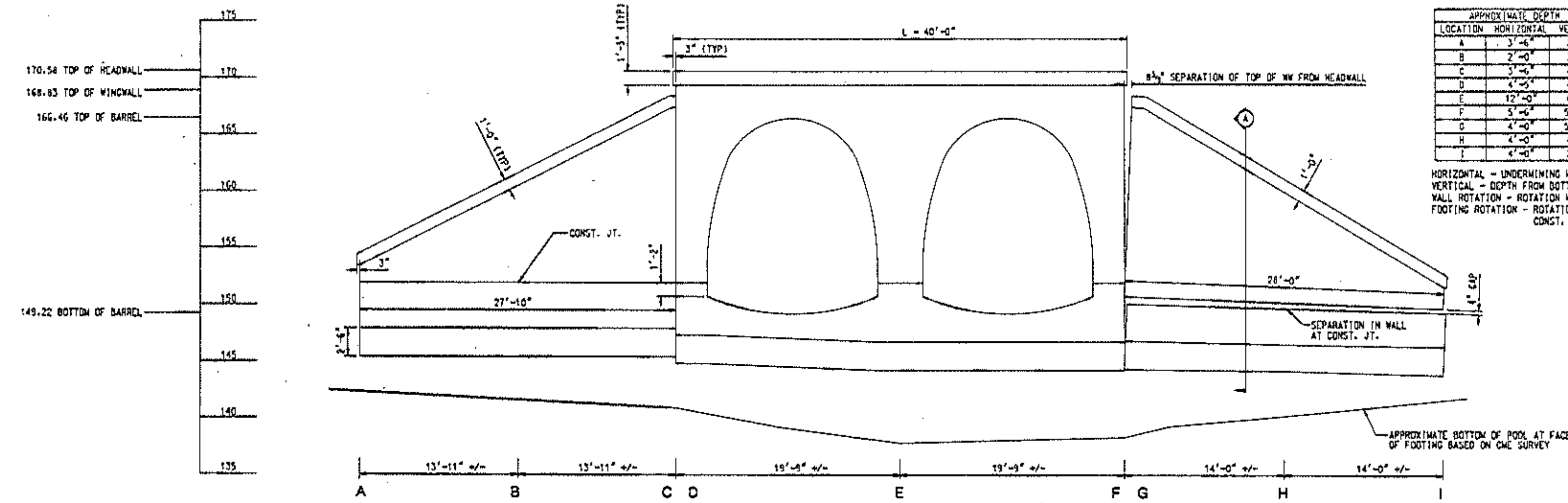
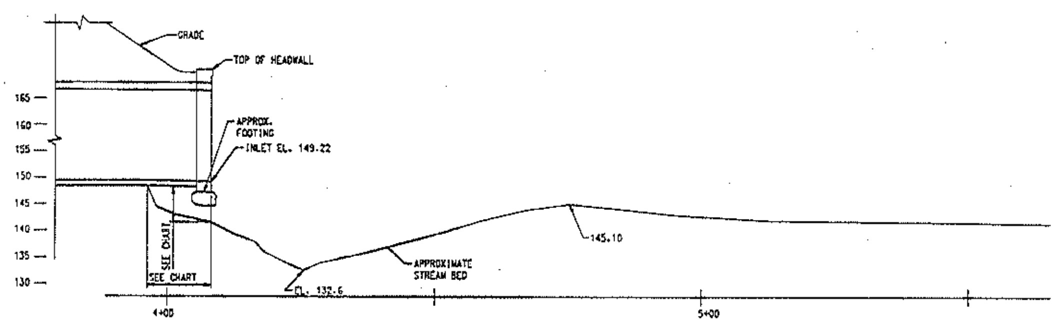


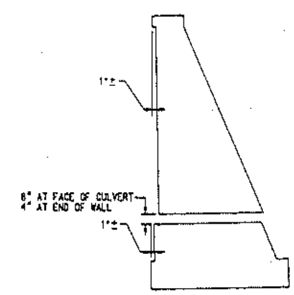
OUTLET (SOUTH FACE)
SCALE: 1:5

APPROXIMATE DEPTH			WALL	FOOTING
LOCATION	HORIZONTAL	VERTICAL	ROTATION	ROTATION
A	3'-6"	3'-0"	PLUMB	PLUMB
B	2'-0"	3'-9"	PLUMB	PLUMB
C	3'-6"	4'-6"	PLUMB	PLUMB
D	4'-5"	4'-6"	PLUMB	PLUMB
E	12'-0"	6'-6"	PLUMB	PLUMB
F	5'-6"	5'-11"	PLUMB	PLUMB
G	4'-0"	5'-11"	3.75"	3.5"
H	4'-0"	4'-0"	3½"	3.5"
I	4'-0"	2'-3"	0"	3.5"

HORIZONTAL - UNDERMINING MEASURED FROM FACE OF FOOTING
VERTICAL - DEPTH FROM BOTTOM OF FOOTING TO GRADE
WALL ROTATION - ROTATION MEASURED FROM CONST. JT. TO TOP OF WALL
FOOTING ROTATION - ROTATION MEASURED FROM TOP OF FOOTING TO CONST. JOINT



PROFILE - EAST BARREL
SCALE: 3/32" = 1'-0"



SECTION A
SCALE: 1:5

PRELIMINARY - NOT RELEASED FOR CONSTRUCTION

QUALITY CONTROL CERTIFICATION		
GROUP	REVIEWED	DATE
PROJECT MANAGER		
SURVEY		
ENVIRONMENTAL		
CIVIL		
STRUCTURAL		
ARCHITECTURAL		

CME Associates, Inc.

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REPAIRS TO THE LYMAN VIADUCT
PREPARED FOR
TOWN OF COLCHESTER
AIR LINE TRAIL COLCHESTER, CT

OUTLET EXISTING CONDITIONS

REVISIONS		
No.	DATE	DESCRIPTION

JOB DATA	
PROJECT	2006280.5
BOOK No.	
DESIGNED	KPS
DRAWN	JAR
CHECKED	BLB
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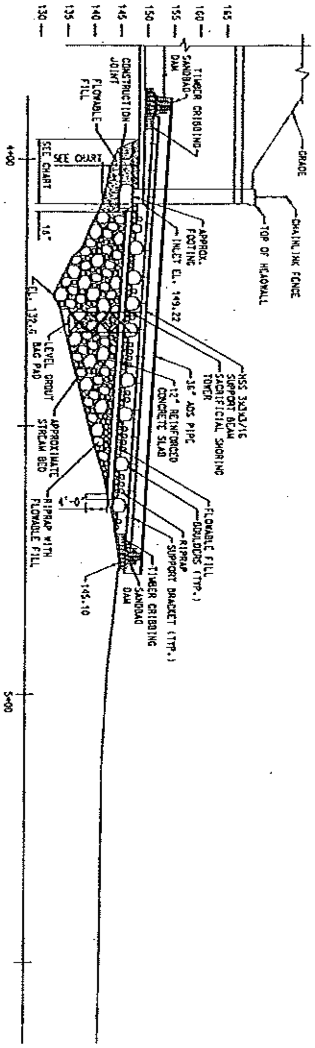
FILE	

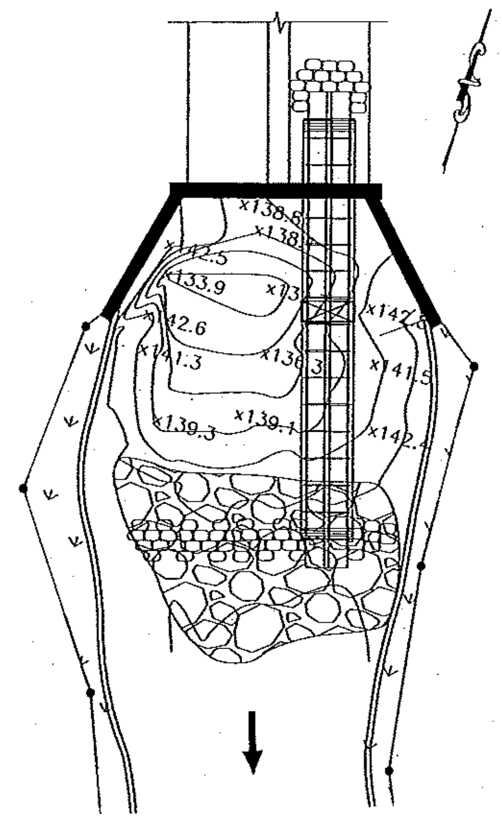
DATE: 05/05/2008
SCALE: AS NOTED
PROJECT No. 2006280.5

SHEET
1



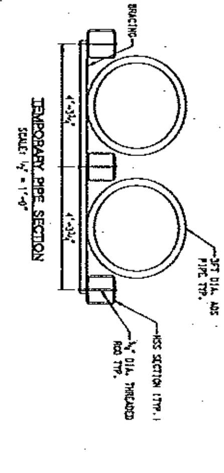
PROFILE - EAST BARREL

SCALE: 1/8" = 1'-0"



PROFILE - EAST BARREL

SCALE: 1/8" = 1'-0"



TEMPORARY PIPE SECTION

SCALE: 1/2" = 1'-0"

PRELIMINARY - NOT RELEASED FOR CONSTRUCTION

JOB DATA		REVISIONS		
PROJECT		No.	DATE	DESCRIPTION
BOOK No.				
DESIGNED				
DRAWN				
CHECKED				
CADD FILE				
FILE				

DATE: 05/05/2008

SCALE: AS NOTED

PROJECT No. 2008280.5

SHEET 2

REPAIRS TO THE LYMAN VIADUCT

PREPARED FOR

TOWN OF COLCHESTER

AIR LINE TRAIL COLCHESTER, CT

PROPOSED WATERHANDLING

CME Associates, Inc.

CME Project No. : 2006280.5

Date : 5/5/2008

CONTRACT ESTIMATE
THE STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 ELM STREET, HARTFORD, CONNECTICUT

LYMAN VIADUCT WALL STABILIZATION
Item Nos. Cooresponds to Form 816

Item No.	Qty.	Unit	Item Name/Description	Unit Price	Amount
Stabilize Walls					
0611002	20	C.Y.	Pressure Grouting	$ 1,000.00	$ 20,000.00
0601001	270	C.Y.	Class "A" Concrete - Concrete for underpinning	$ 600.00	$ 162,000.00
Outlet Pool					
0216011	50	C.Y.	Flowable Fill	$ 250.00	$ 12,500.00
728009	60	C.Y.	2" Crushed Stone -	$ 40.00	$ 2,400.00
0602002	18000	LB	Deformed steel bars - slab	$ 1.80	$ 32,400.00
0601001	120	C.Y.	Class "A" Concrete - Concrete for slab	$ 600.00	$ 72,000.00
703010	230	C.Y.	Standard Riprap	$ 175.00	$ 40,250.00
0703012	300	C.Y.	Modified Riprap	$ 200.00	$ 60,000.00
0204151	1	L.S.	Handling Water	$ 45,700.00	$ 45,700.00
				Sub-total :	$ 447,250.00
			15% Misc Items		$ 67,087.50
0975002	1	L.S.	3% Mobilization	$ 13,417.50	$ 14,000.00
			15% Contingencies	$ 67,087.50	$ 68,000.00
				Total :	$ 596,337.50
				Say :	**$ 600,000**

BREAKDOWN OF ITEM No. 0204151 - Handling Water

Item No.	Qty.	Unit	Item Description	Unit Price	Amount
	1	LS	Shoring Tower Erected	$ 15,000.00	$ 15,000.00
	80	LF	36" High Density Polyethylene Pipe incl. fittings	$ 25.00	$ 2,000.00
	1	LS	Sandbags	$ 2,500.00	$ 2,500.00
	1	LS	Timber Cribbing	$ 1,000.00	$ 1,000.00
	21000	LB	Structural Steel	$ 1.20	$ 25,200.00
				Total	$ 45,700.00
Prepared by:	JAR				
Checked by:	BLB				