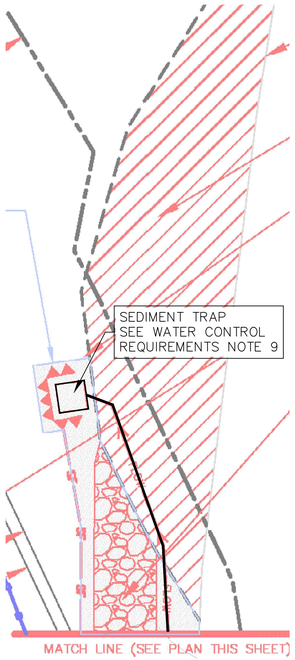
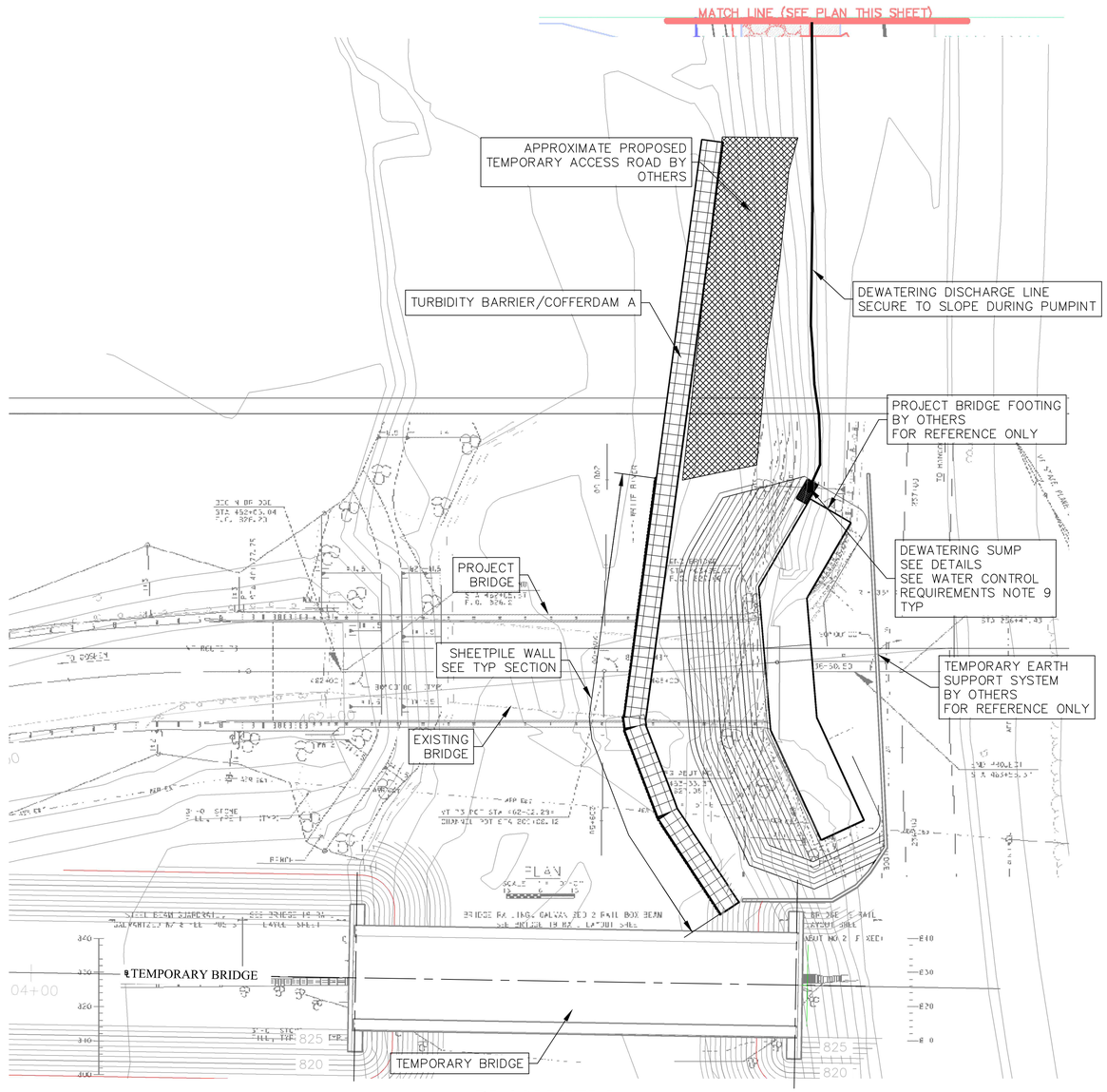
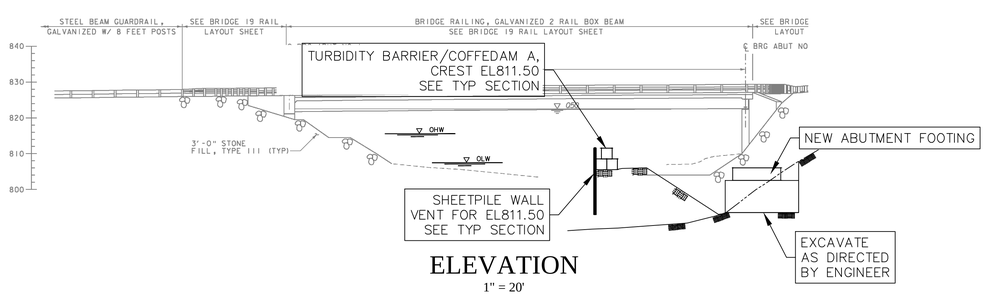




PLAN VIEW

1" = 20'



ELEVATION

1" = 20'

Water Control Requirements:

1. The water control system is to be coordinated with the EPSC work.
2. This work shall consist of the construction, material excavation within, dewatering, maintenance and removal of water control system in accordance with the specifications at locations designated in the Plans or in the Contract.
3. This work shall consist of providing a method for the purpose of constructing, in the dry, a specific foundation or other component of a structure in accordance with Contract requirements.
4. This involves construction, maintenance, and removal of a watertight structure or may involve alternate methods of de-watering and stabilizing the specific site.
5. The Contractor shall obtain any and all necessary permits or clearances for alternate methods.
6. The locations and elevations for excavation shall be as indicated on the Plans.
7. The Engineer may order removal of poor foundation material below the normal designated elevation and replacement with an approved material.
8. Dewatering system elements shown on the plan are approximate
9. Actual location and sizing of dewatering system elements are to be based on current field conditions
10. During the performance of all work under this contract, the Contractor shall adopt such precautions in the conduct of his operation as may be necessary to avoid contaminating ground or surface water.
11. All earthwork, grading, moving of equipment, water control and other operation likely to create silting, shall be so planned and conducted as to minimize pollution in any wetland resource area.
12. Water used for any purpose whatsoever by the Contractor, which has become contaminated with soil, bitumen, salt, concrete or other pollutants shall not be discharged into any wetland resource area.
13. Under no circumstances shall the Contractor discharge pollutants into a wetland resource area.
14. The Contractor shall not store fuel or permit any refueling of construction equipment while such equipment is within 100 feet of any resource area.
15. The contractor shall make all efforts to control the run-off of water and sediment from the project site during path construction.
16. All work to be done in the dry.
17. The Contractor shall use such equipment and shall perform his operations in such a manner that boiling or other disturbances of the soil in the construction area will be prevented.
18. He shall keep the area being excavated dry by such means that water will be prevented from entering from the adjacent soils.
19. All dewatering and related earthworks shall be conducted in such a manner as to prevent siltation or contamination of the brook.
20. The pumping discharge shall not be allowed to enter directly into the brook.
21. The water from the work areas shall be pumped to a sediment system in accordance with the EPSC Plan.
22. The Contractor shall provide and maintain ample pumps, pipes and other devices to promptly and continually remove and dispose of water from the excavation areas.
23. The size and configuration of pumps and pipes shall be selected by the contractor.
24. After having served its purpose, the water control system shall become the property of the Contractor and shall be removed by the Contractor from the site subject to the Engineer's approval.

Water Control Procedure:

1. The Water Control System is to control water intrusion into the work areas such that the work can be performed "in-the-dry"
2. Water control includes all dewatering necessary to accomplish existing bridge removal, new bridge base material placement, new bridge construction, and new stream bed construction "in-the-dry"
3. The need and extent of sedimentation systems and dewatering techniques and sedimentation controls needed to control water and sediment at the site are to be determined in the field based on current conditions and the EPSC Plan.
4. Provide the means of removing all sediment from water pumped from the excavation areas
5. Apply pumping operations, installation of sandbags, geotextile fabrics, and all other means to collect, settle, and discharge water back in to the waterway as required during construction
6. Stream diversions shall be conducted in such a manner as to minimize siltation and prevent contamination of the waterway
7. Ensure that water control operations neither cause the accumulation of siltation nor any adverse effect to the water or the environment
8. The effectiveness of the water control method used will vary based on the field conditions at the time at which the work is being performed
9. Weather monitoring will be required.
10. If a storm is forecast additional adequate measures are to be at the ready to handle anticipated flow increases.
11. Flow increases can be handled by addition of by-pass pumps in size and number to be determined in the field based on current conditions and anticipated flow increases.
12. If flows are beyond the capacity of all available measures, the water control system is to be remove, the excavation flooded and all obstacle preventing free flow of the stream removed.
13. The Water Control System is non-permanent and is to not harm the ecology of the waterway, land under water, and surrounding land

Water Control System:

1. Applicable EPSC and erosion control measures are to be put into place.
2. Install Access Road in conformance with Access Road Plan to limit of Water Control System
3. Place and anchor a length of membrane in the stream along the line of the Turbidity Barrier/Cofferdam A
4. Place Turbidity Barrier/Cofferdam A cubic yard sand bags into position onto the landside edge of the membrane working in a southerly direction
5. Place Stone Fill on the land side of the the Turbidity Barrier/Cofferdam A progressive as the installation proceeds in a southerly direction
6. Install Containment Wall Type B or C on the landside of the Stone Fill, if required, based on current field conditions if Stone Fill will encroach into abutment footing excavation
7. Install Roadbed stone on top of Stone Fill
8. Install Cell Wall as its location is reached
9. Repeat steps 3 through 8 until all Cells are installed
10. Install Dewatering Sediment Trap
11. Install Dewatering Sumps & Pumps as required based on current field conditions
12. Dewater work area discharging into Dewatering Sediment Trap
13. Perform contract work
14. Remove Water Control System using reverse of installation sequence

General Notes

General:

1. Existing conditions are taken from Contract Drawings.
2. All dimensions relative to existing elements are to be field checked prior to fabrication and installation of proposed elements.
3. Control datums are those from the Contract Documents.
4. Design is based on conditions shown in the Contract Documents. Should conditions encountered in the field vary from those indicated conditions, the design may be invalid and revisions should be investigated.

Sheetpile Wall Installation:

1. Drive sheets to a minimum embedment as indicated in the "REQUIRED PILE EMBEDMENT VS WALL HEIGHT" table
2. Top of Sheetpile Wall to be vented such that water levels on both sides of the wall will equalize when water surface elevation reaches EL811.50
3. Assure that the Turbidity Barrier/Cofferdam A sand bags are in full contact with the land side of the sheets up to elevation EL808.5

REVIEW SET
NOT FOR
CONSTRUCTION

-140529-

No.	Revision/Issue	Date
2	add sheetpile wall	pending
1	general revision	140618

Firm Name and Address
TAW Associates
Waterville Valley, NH
603-236-4247 www.TAWAssociates.net

Proposed Improvement Bridge Project Bridge No. 13, 15, 16 & 19 - Rochester, VT Vtrans ER BRF 0162(19), (16), (17) & (18)

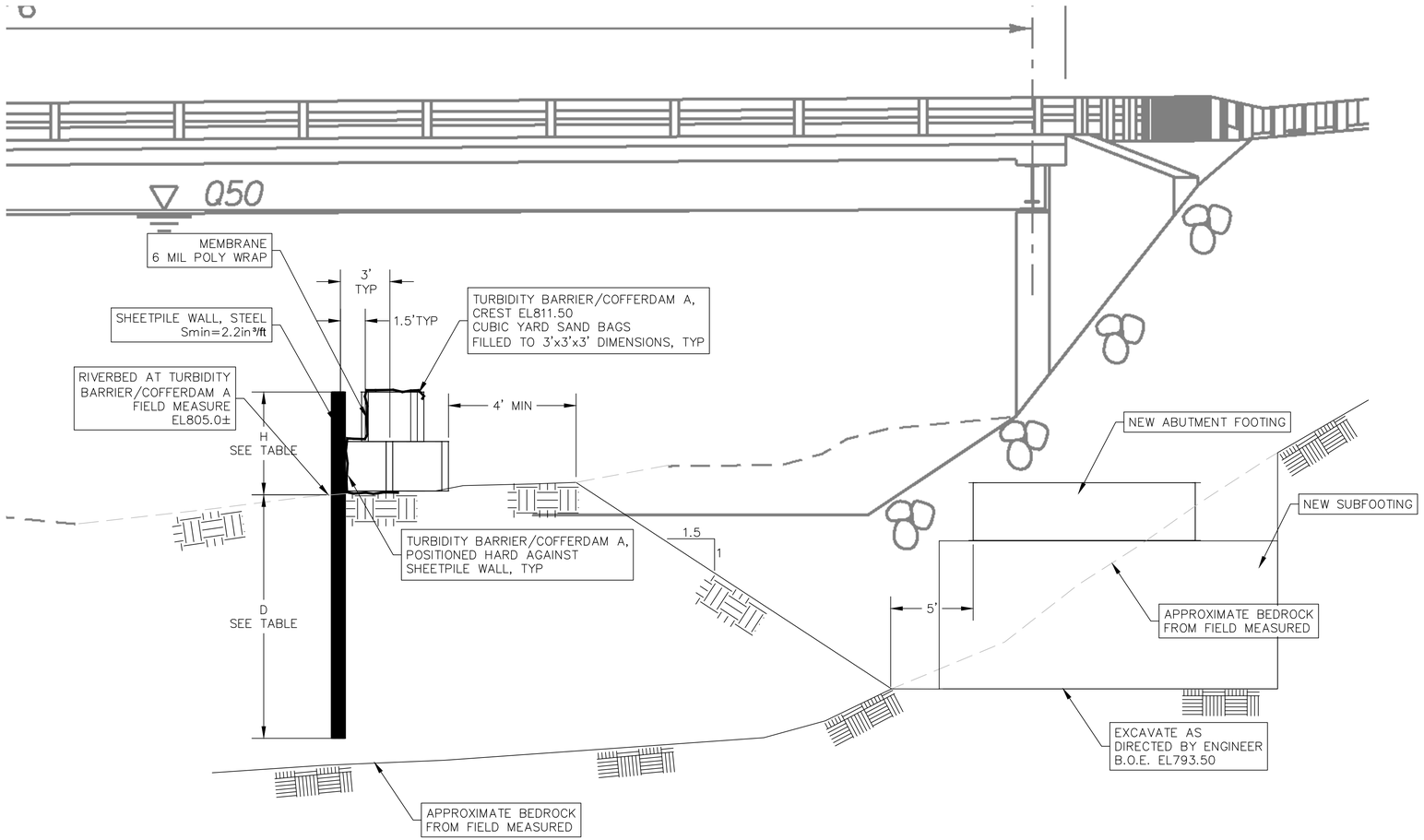
Project Name and Address

Water Control
Bridge 19

GENERAL PLAN

Project 1404030	Sheet WC01
Date May 29, 2014	
Scale noted	

SCHULTZ CONSTRUCTION, INC.



REQUIRED PILE EMBEDMENT VS WALL HEIGHT

Wall Height H ft	Embedment Depth D ft
6.0	12.0
6.5	13.0
7.0	14.0
7.5	15.0

TYPICAL SECTION

NTS

General Notes

Sheetpile Wall Installation:

1. Drive sheets to a minimum embedment as indicated in the "REQUIRED PILE EMBEDMENT VS WALL HEIGHT" table
2. Top of Sheetpile Wall to be vented such that water levels on both sides of the wall will equalize when water surface elevation reaches EL811.50
3. Assure that the Turbidity Barrier/Cofferdam A sand bags are in full contact with the land side of the sheets up to elevation EL808.5

Sheetpile:

1. Material is to be ASTM A328 unless otherwise noted.
2. Sheetpile is to be provided with standard pulling holes.
3. Interlocks are to be free sliding and provide a free swing angle of not less than 5°.

Cofferdam

1. Design is based on soil taken from test borings as shown in the Contract Documents. Should actual conditions be found to differ from those indicated in the Contract Documents, this design may not be applicable and a new analysis should be performed.

REVIEW SET
NOT FOR
CONSTRUCTION

-140529-

No.	Revision/Issue	Date
2	add sheetpile wall	pending
1	general revision	140618

Firm Name and Address
TAW Associates
Waterville Valley, NH
603-236-4247 www.TAWAssociates.net

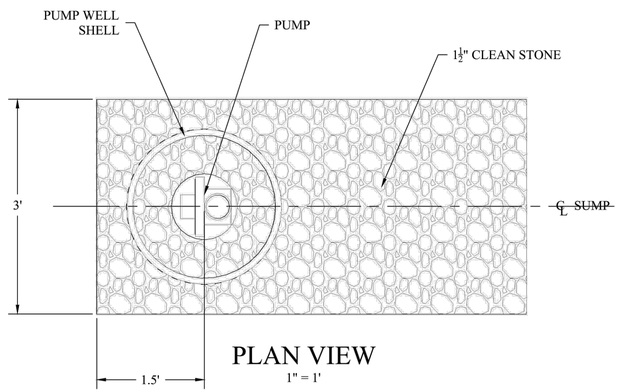
Proposed Improvement Bridge Project Bridge No. 13, 15, 16 & 19 - Rochester, VT Vtrans ER BRF 0162(19), (16), (17) & (18)

Project Name and Address
Water Control
Bridge 19

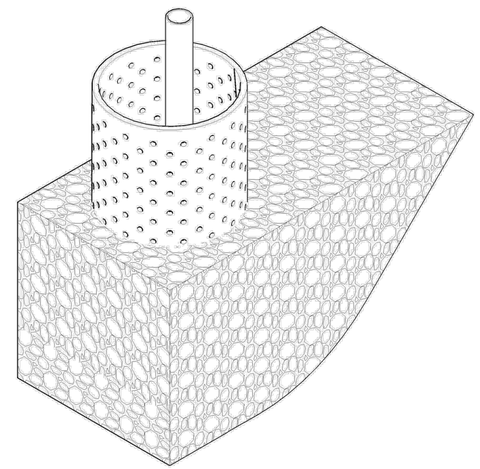
DETAILS

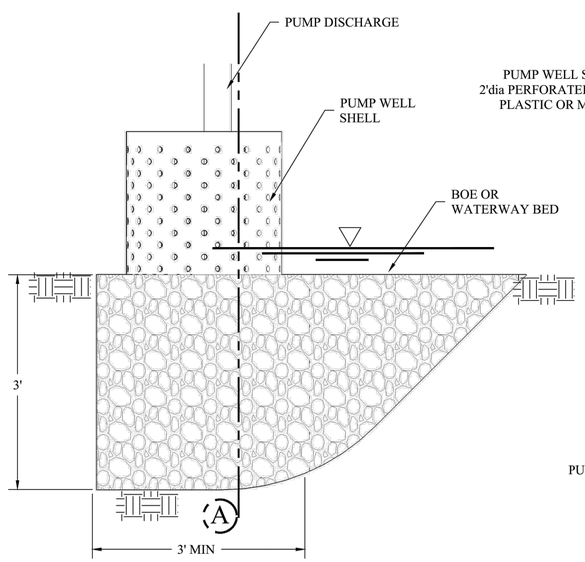
Project 1404030
Date May 29, 2014
Scale noted
Sheet WC02

SCHULTZ CONSTRUCTION, INC.

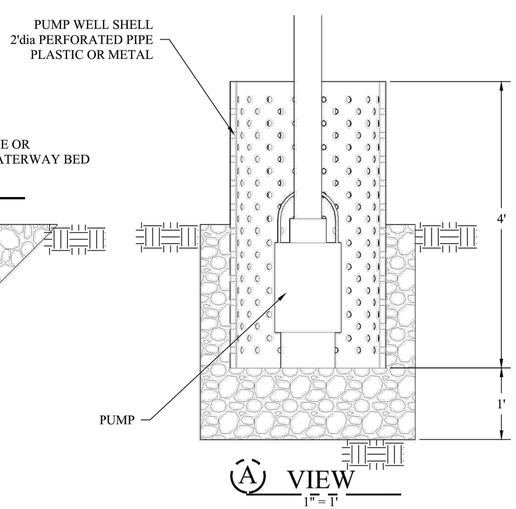


PLAN VIEW
1" = 1'





ELEVATION



VIEW
1" = 1'

SUMP DETAIL
NTS

General Notes

REVIEW SET
NOT FOR
CONSTRUCTION

-140529-

No.	Revision/Issue	Date
2	add sheetpile wall	pending
1	general revision	140618

Firm Name and Address
TAW Associates
Waterville Valley, NH
603-236-4247 www.TAWAssociates.net

Proposed Improvement Bridge Project Bridge No. 13, 15, 16 & 19 - Rochester, VT Vtrans ER BRF 0162(19), (16), (17) & (18)

Project Name and Address
Water Control
Bridge 19

DETAILS

Project 1404030
Date May 29, 2014
Scale noted
Sheet WC03

SCHULTZ CONSTRUCTION, INC.

DOCUMENT: 140403D REV02

REVIEW SET NOT FOR CONSTRUCTION

Engineering Computations

Water Control Plan
Bridge 19

-

For The Project:

Proposed Improvement Bridge Project Bridge No. 13, 15, 16 & 19 – Rochester, VT

Vtrans ER BRF 0162(19), (16), (17) & (18)

-

for

SCHULTZ CONSTRUCTION, INC.

by

TAW ASSOCIATES

pending

TABLE OF CONTENTS

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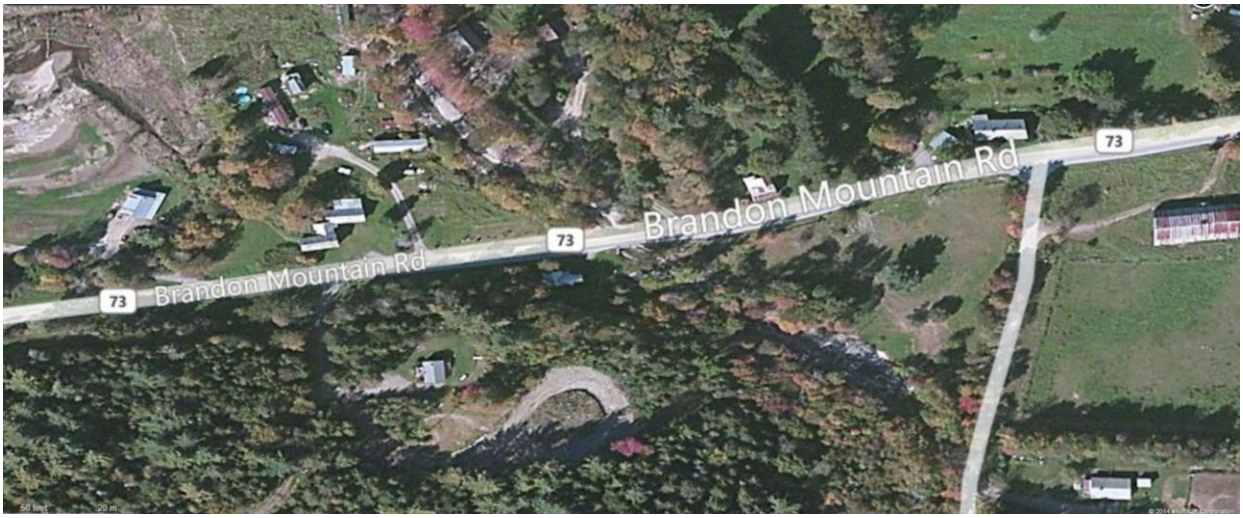
PHOTOS:

Brandon Mountain Rd
73
73
Bra


Brandon Mountain Rd
73
Brandon Mountain Rd
73
73
Brandon Mountain Rd
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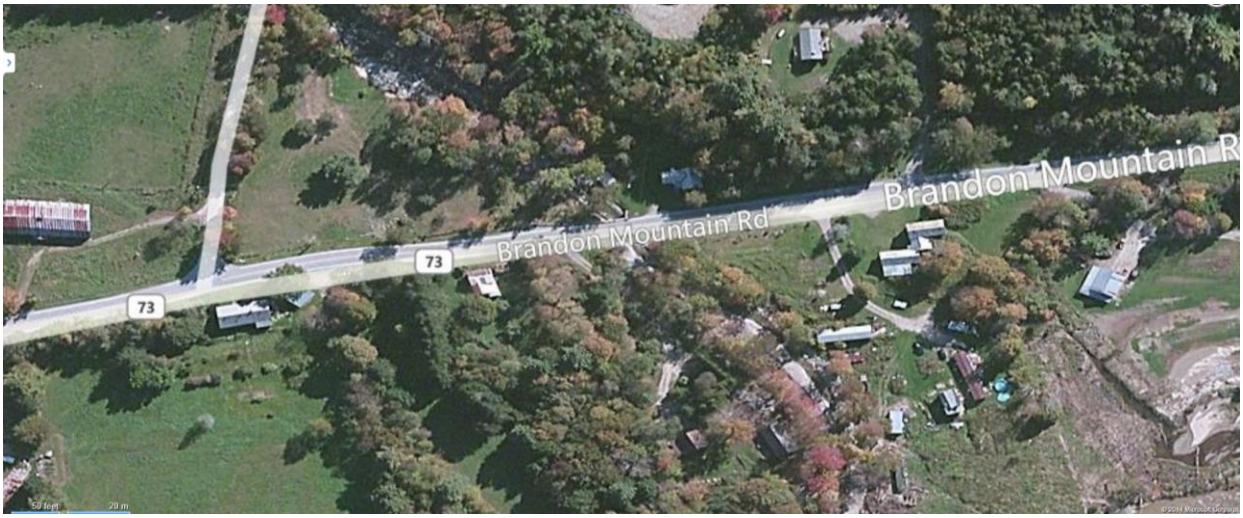
don Mountain Rd
73
Corporation Rd


Brandon Mountain R
Brandon Mountain Rd
73
73

73
Brandon M

HYDROLOGIC DATA

Date: 4/16/13

DRAINAGE AREA : 79.5 sq. mi.
CHARACTER OF TERRAIN : Mountainous Valley
STREAM CHARACTERISTICS : Sinuous, not braided
NATURE OF STREAMBED : Sand and gravel

PEAK FLOW DATA

Q 2.33 =	4560 cfs	Q 50 =	13175 cfs
Q 10 =	8100 cfs	Q 100 =	16220 cfs
Q 25 =	10840 cfs	Q 500 =	23000 cfs

DATE OF FLOOD OF RECORD : Unknown
ESTIMATED DISCHARGE: Unknown
WATER SURFACE ELEV.: Unknown
NATURAL STREAM VELOCITY : @ Q50 = 5.1 ft/s
ICE CONDITIONS : Moderate
DEBRIS: Moderate
DOES THE STREAM REACH MAXIMUM HIGHWATER ELEV. RAPIDLY? No
IS ORDINARY RISE RAPID? No
IS STAGE AFFECTED BY UPSTREAM OR DOWNSTREAM CONDITIONS? No
IF YES, DESCRIBE:

WATERSHED STORAGE: <1%

HEADWATERS:
UNIFORM: X
IMMEDIATELY ABOVE SITE:

EXISTING STRUCTURE INFORMATION

STRUCTURE TYPE:	Concrete Deck with Steel Beams
YEAR BUILT:	1974
CLEAR SPAN(NORMAL TO STREAM):	70'-0"
VERTICAL CLEARANCE ABOVE STREAMBED:	17'-0"
WATERWAY OF FULL OPENING:	1,098 sf
DISPOSITION OF STRUCTURE:	Damaged during Irene, Replaced with Temp. Br.
TYPE OF MATERIAL UNDER SUBSTRUCTURE:	See Borings

WATER SURFACE ELEVATIONS AT:

Q2.33 =	816.6 ft	VELOCITY =	4.4 ft/s
Q10 =	820.3 ft	"	5.5 ft/s
Q25 =	822.4 ft	"	6.6 ft/s
Q50 =	827.0 ft	"	7.3 ft/s
Q100 =	828.5 ft	"	8.0 ft/s

LONG TERM STREAMBED CHANGES: Lateral Movement

IS THE ROADWAY OVERTOPPED BELOW Q100:	Yes
FREQUENCY:	Q50
RELIEF ELEVATION:	824.80'
DISCHARGE OVER ROAD @Q100:	1269 cfs

PROPOSED STRUCTURE

STRUCTURE TYPE: Single Span Steel Plate Girder with Concrete Deck

CLEAR SPAN(NORMAL TO STREAM):	124'-6"
VERTICAL CLEARANCE ABOVE STREAMBED:	15'-6"
WATERWAY OF FULL OPENING:	1,837 sf

WATER SURFACE ELEVATIONS AT:

Q2.33 =	816.1 ft	VELOCITY=	4.7 ft/s
Q10 =	819.3 ft	"	5.5 ft/s
Q25 =	820.9 ft	"	6.6 ft/s
Q50 =	823.6 ft	"	7.4 ft/s
Q100 =	824.6 ft	"	8.2 ft/s

IS THE ROADWAY OVERTOPPED BELOW Q100: No
FREQUENCY: N/A
RELIEF ELEVATION: 825.06
DISCHARGE OVER ROAD @Q100: N/A

AVERAGE LOW ELEVATION OF SUPERSTRUCTURE: 821.7 ft
VERTICAL CLEARANCE: @ Q50 = -1.9 ft

SCOUR: Contraction Scour up to Q100 = 6.7 ft and up to Q500 = 9.4 ft

REQUIRED CHANNEL PROTECTION: Stone Fill, Type III

PERMIT INFORMATION

		DEPTH OR ELEVATION:
AVERAGE DAILY FLOW:	140 cfs	
ORDINARY LOW WATER:	40 cfs	1.5 ft
ORDINARY HIGH WATER:	2850 cfs	11.0 ft

GENERAL PROCEDURE:

The GC has proposed this general procedure regarding this Project:

Construct a sandbag turbidity barrier/cofferdam using Cubic Yard Sand Bags which will allow construction of the Project East Abutment of the new bridge in the dry and will be incorporated into a temporary access road over which equipment will travel for access to the work. The cofferdam is to be capable of withstanding conditions of Observed Water 140616 as observed in the field by the GC on June 13, 2014.

Weather monitoring will be required. If a storm is forecast additional adequate measures are to be at the ready to handle anticipated flow increases. Flow increases can be handled by addition of by-pass pumps in size and number to be determined in the field based on current conditions and anticipated flow increases.

Should a storm occur of flow rate greater than the capacity of the design by-pass system, the by-pass system will be allowed to overtop and the area below the existing bridge allowed to temporarily flood.

WATER CONTROL SYSTEM:

Water Control Requirements:

1. The water control system is to be coordinated with the EPSC work.
2. This work shall consist of the construction, material excavation within, dewatering, maintenance and removal of water control system in accordance with the specifications at locations designated in the Plans or in the Contract.
3. This work shall consist of providing a method for the purpose of constructing, in the dry, a specific foundation or other component of a structure in accordance with Contract requirements.
4. This involves construction, maintenance, and removal of a watertight structure or may involve alternate methods of de-watering and stabilizing the specific site.
5. The Contractor shall obtain any and all necessary permits or clearances for alternate methods.
6. The locations and elevations for excavation shall be as indicated on the Plans.
7. The Engineer may order removal of poor foundation material below the normal designated elevation and replacement with an approved material.
8. Dewatering system elements shown on the plan are approximate
9. Actual location and sizing of dewatering system elements are to be based on current field conditions
10. During the performance of all work under this contract, the Contractor shall adopt such precautions in the conduct of his operation as may be necessary to avoid contaminating ground or surface water.
11. All earthwork, grading, moving of equipment, water control and other operation likely to create silting, shall be so planned and conducted as to minimize pollution in any wetland resource area.

12. Water used for any purpose whatsoever by the Contractor, which has become contaminated with soil, bitumen, salt, concrete or other pollutants shall not be discharged into any wetland resource area.
13. Under no circumstances shall the Contractor discharge pollutants into a wetland resource area.
14. The Contractor shall not store fuel or permit any refueling of construction equipment while such equipment is within 100 feet of any resource area.
15. The contractor shall make all efforts to control the run-off of water and sediment from the project site during path construction.
16. All work to be done in the dry.
17. The Contractor shall use such equipment and shall perform his operations in such a manner that boiling or other disturbances of the soil in the construction area will be prevented.
18. He shall keep the area being excavated dry by such means that water will be prevented from entering from the adjacent soils.
19. All dewatering and related earthworks shall be conducted in such a manner as to prevent siltation or contamination of the brook.
20. The pumping discharge shall not be allowed to enter directly into the brook.
21. The water from the work areas shall be pumped to a sediment system in accordance with the EPSC Plan.
22. The Contractor shall provide and maintain ample pumps, pipes and other devices to promptly and continually remove and dispose of water from the excavation areas.
23. The size and configuration of pumps and pipes shall be selected by the contractor.
24. After having served its purpose, the water control system shall become the property of the Contractor and shall be removed by the Contractor from the site subject to the Engineer's approval.

Water Control Procedure:

1. The Water Control System is to control water intrusion into the work areas such that the work can be performed "in-the-dry"
2. Water control includes all dewatering necessary to accomplish existing bridge removal, new bridge base material placement, new bridge construction, and new stream bed construction "in-the-dry"
3. The need and extent of sedimentation systems and dewatering techniques and sedimentation controls needed to control water and sediment at the site are to be determined in the field based on current conditions and the EPSC Plan.
4. Provide the means of removing all sediment from water pumped from the excavation areas
5. Apply pumping operations, installation of sandbags, geotextile fabrics, and all other means to collect, settle, and discharge water back in to the waterway as required during construction
6. Stream diversions shall be conducted in such a manner as to minimize siltation and prevent contamination of the waterway
7. Ensure that water control operations neither cause the accumulation of siltation nor any adverse effect to the water or the environment
8. The effectiveness of the water control method used will vary based on the field conditions at the time at which the work is being performed
9. Weather monitoring will be required.

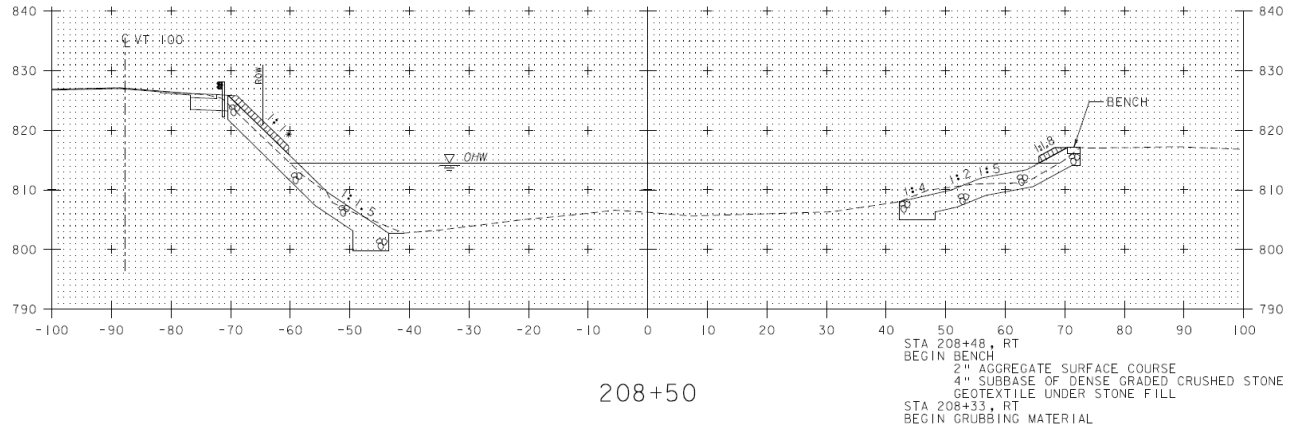
10. If a storm is forecast additional adequate measures are to be at the ready to handle anticipated flow increases.
11. Flow increases can be handled by addition of by-pass pumps in size and number to be determined in the field based on current conditions and anticipated flow increases.
12. If flows are beyond the capacity of all available measures, the water control system is to be remove, the excavation flooded and all obstacle preventing free flow of the stream removed.
13. The Water Control System is non-permanent and is to not harm the ecology of the waterway, land under water, and surrounding land

Water Control System:

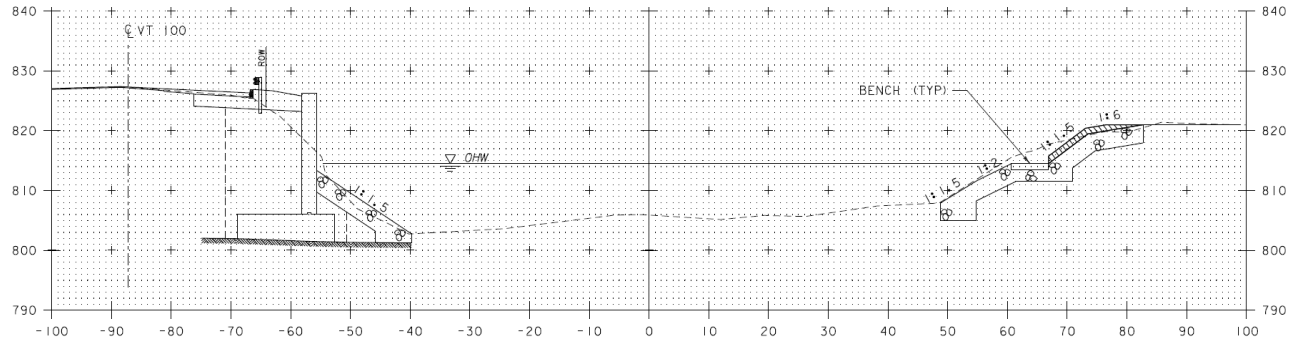
1. Applicable EPSC and erosion control measures are to be put into place.
2. Install Access Road in conformance with Access Road Plan to limit of Water Control System
3. Place and anchor a length of membrane in the stream along the line of the Turbidity Barrier/Cofferdam A
4. Place Turbidity Barrier/Cofferdam A cubic yard sand bags into position onto the landside edge of the membrane working in a southerly direction
5. Place Stone Fill on the land side of the the Turbidity Barrier/Cofferdam A progressive as the installation proceeds in a southerly direction
6. Install Containment Wall Type B or C on the landside of the Stone Fill, if required, based on current field conditions if Stone Fill will encroach into abutment footing excavation
7. Install Roadbed stone on top of Stone Fill
8. Install Cell Wall as its location is reached
9. Repeat steps 3 through 8 until all Cells are installed
10. Install Dewatering Sediment Trap
11. Install Dewatering Sumps & Pumps as required based on current field conditions
12. Dewater work area discharging into Dewatering Sediment Trap
13. Perform contract work
14. Remove Water Control System using reverse of installation sequence

SUPPORTING ANALYSIS:

Channel Flows:



208+50



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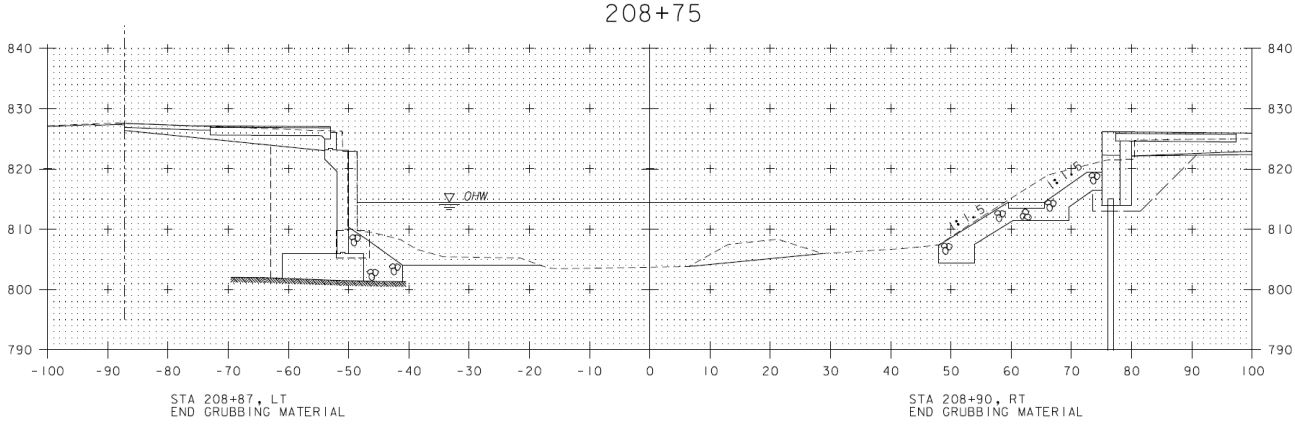

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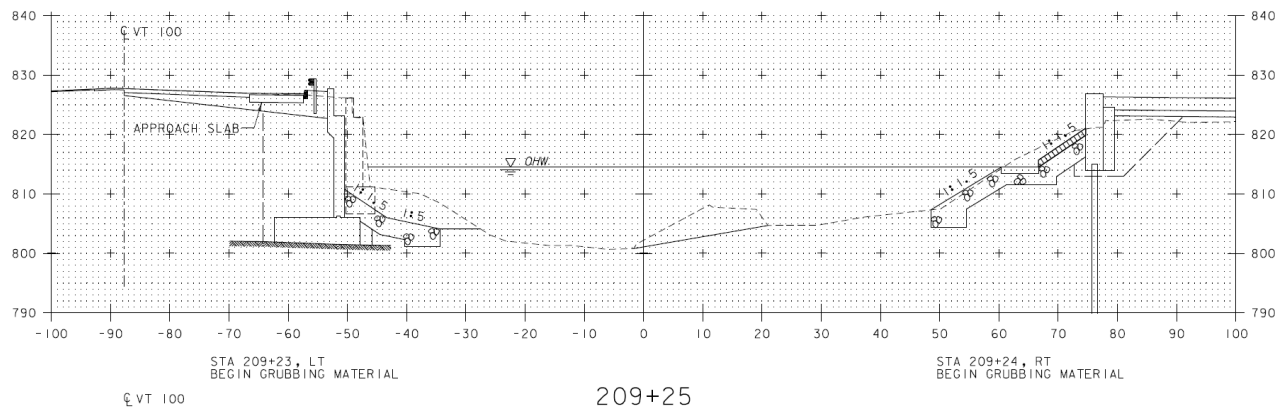
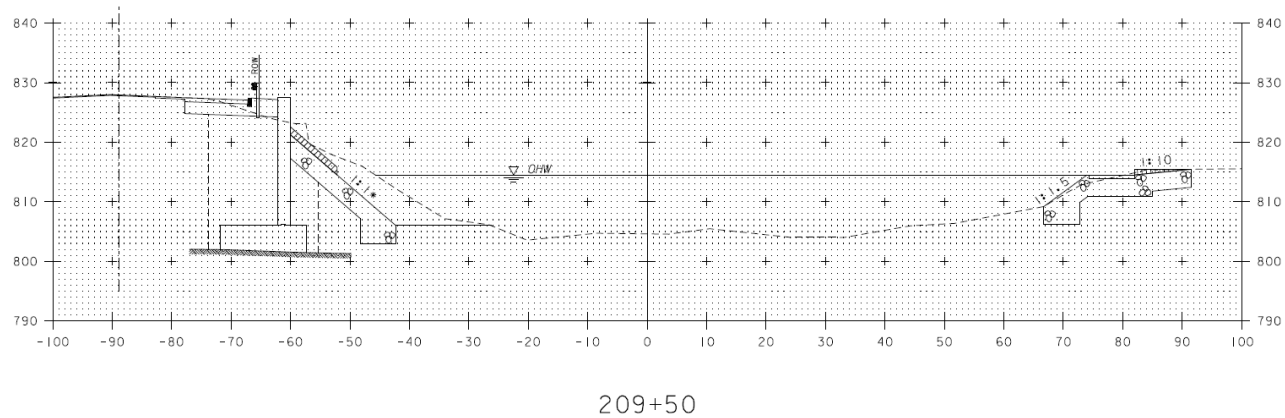
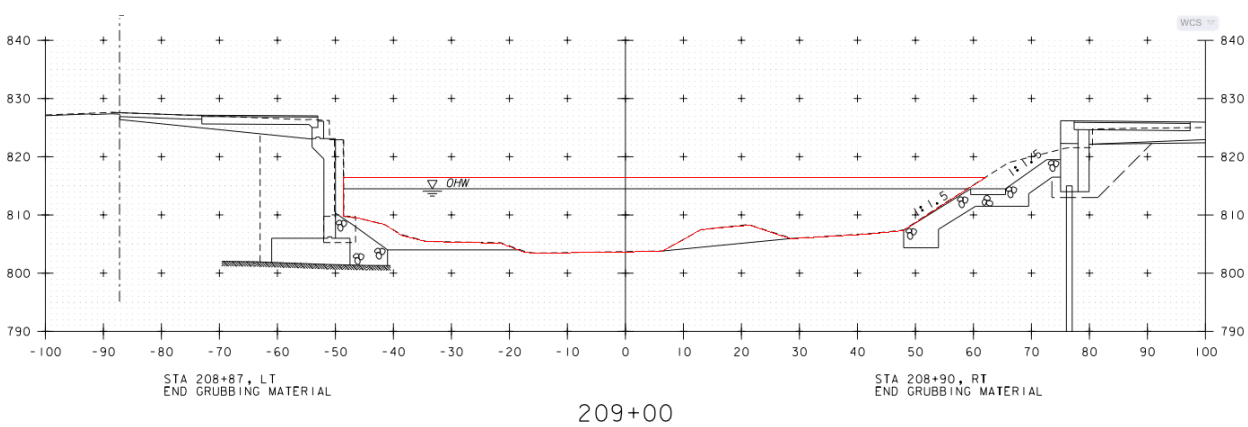




Determine characteristics of the existing channel through the existing bridge. From the Contract Documents for,

$EL_{Q2.33}$ = 816.6 ft
$V_{Q2.33}$ = 4.4 fps
$Q_{2.33}$ = 4560 cfs

Based on,



P = 122.7’

A = 1092.4sf

Natural Channels (minor streams, top width at flood state < 100 feet)	
Fairly regular section	0.030 to 0.070
Irregular section with pools	0.040 to 0.100

Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers and the Water Pollution Control Federation, 1969.

n = 0.095

Then,

S	ft/ft	0.00390
n		0.095
P	ft	122.700
A	ft^2	1092.400
R=A/P	ft	8.903
$Q = A (1.486/n) R^{2/3} S^{1/2}$	cfs	4584
V=Q/A	fps	4.20

The Q and V values correspond closely with the Contract Plan hydraulic data for $Q_{2.33}$.

Design Flow:

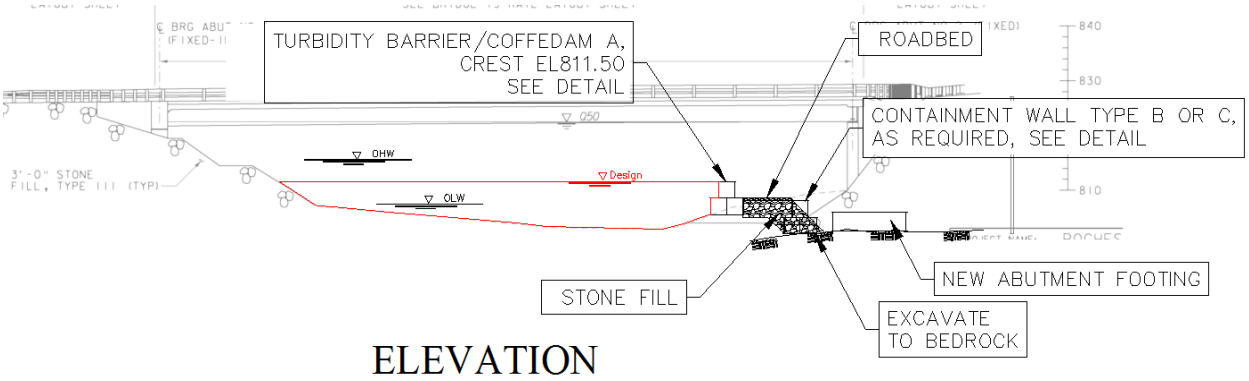
Field observation report:

From: Terry A. Waite [mailto:terry@tawassociates.net]
Sent: Monday, June 16, 2014 10:21 AM
To: Rob Hinman
Subject: Re: "observed" High Water
Hi Rob,
We will base the design on a design flow at EL811.50. Please confirm that you are in agreement.
Thanks,
Terry
From: Rob Hinman
Sent: Monday, June 16, 2014 10:14 AM
To: terry@tawassociates.net
Cc: Kevin Ture
Subject: "observed" High Water
Terry,
The elevation we took for the observed high water level is 811.30. Let me know if you have any questions as you get further into it.
Thanks.
Rob Hinman, Project Manager
SCHULTZ CONSTRUCTION, INC.

Turbidity/Cofferdam A Crest = EL811.50

Using these assumptions which conform will with the specified $Q_{2.33}$, determine Q_{design}.

S = 0.00390
EL $_{Qdesign}$ = 811.30 ft



ELEVATION

S	ft/ft	0.00390
n		0.095
P	ft	88.714
A	ft^2	527.800
R=A/P	ft	5.949
$Q = A\ (1.486/n)\ R^{2/3}\ S^{1/2}$	cfs	1693
V=Q/A	fps	3.21

Therefore,

Q_{design} = 1693 cfs

Turbidity Barrier/Cofferdam A:

The Turbidity Barrier/Cofferdam A (TBCA), located along the EPSC approved limit of disturbed area, will be constructed of sandbags to divert stream flow around the work area. The crest of the TBCA will be at EL811.50. The land side of the TBCA will be backfilled Stone Fill to Roadbed EL808.50.

The TBCA will be constructed of Cubic Yard sand bags 3'x3'x3' in nominal dimension. Large and Small sandbags may be used in construction of the barrier to accommodate varying streambed elevations and to facilitate sealing.

The TBCA will be subjected to loads and will be investigated for two load conditions. Unless otherwise noted the assumptions used as a basis for the design as applicable are as follows:

- weight of water, γ_w = 62.4pcf
- weight of sand, γ_s' = 125pcf

AASHTO 5.2.2.3 calls for design of overall stability of retaining walls to have a minimum Factor of Safety of 1.3 for static loads and 1.5 for installations with a low tolerance for failure.

Condition 1:

a) water on one side to top

Wall Section	Location STA± from	to	Depth from T.O.Wall ft	Wall/Ftg Width ft
1	0+00	0+01	0.00	3.00
			1.00	3.00
			2.00	3.00
			3.00	3.00
			4.00	6.00
			5.00	6.00
			6.00	6.00

W_{stem} = width of stem =	4.29	ft	average
H_{stem} = height of stem =	6.00	ft	
γ_{stem} = density of stem material =	0.125	kcf	
HRE = height toe of ftg to top of retained earth =	6.00	ft	
HBF = height of backfill on front face from BOF =	0.00	ft	
γ'_{soil} = density of stonefill, wet =	0.140	kcf	
ϕ = friction angle of stonefill =	45	°	
δ = friction angle of soil on wall =	22	°	
β = slope angle from horizontal of retained earth =	0	°	
K_a = active soil coefficient =	0.16	where	$\mathbf{K_a} = \cos^2\phi / \{\cos\delta[1+(\sin(\phi+\delta)\sin(\phi-\beta)/(\cos\delta\cos\beta))^{1/2}]^2\}$
K_p = passive soil coefficient =	20.51	where	$\mathbf{K_p} = \cos^2\phi / \{\cos\delta[1-(\sin(\phi+\delta)\sin(\phi+\beta)/(\cos\delta\cos\beta))^{1/2}]^2\}$
c = coefficient of friction sandbag/soil =	0.50		

DRIVING FORCES:

ACTIVE EARTH Horizontal Load:	0.000	k	0.000	ft-k
WATER Horizontal Load:	1.123	k	2.278	ft-k

Depth from T.O. Wall:

				F_D		MA		M_D	
0	water	0.000	k	0.000	k	0.00	ft	0.000	ft-k
1	water	0.062	k	0.031	k	5.50	ft	0.172	ft-k
2	water	0.125	k	0.094	k	4.50	ft	0.421	ft-k

3	water	0.187	k	0.156	k	3.50	ft	0.546	ft-k
4	water	0.250	k	0.218	k	2.50	ft	0.546	ft-k
5	water	0.312	k	0.281	k	1.50	ft	0.421	ft-k
6	water	0.374	k	0.343	k	0.50	ft	0.172	ft-k

SURCHARGE Horizontal Load: 0.000 k 0.000 ft-k

STREAM FLOW PRESSURE: 0.095 k 0.348 ft-k

P_{max} = maximum stream pressure = $2P_{avg}$ / 1000 = 0.04 ksf [AASHTO 3.18.1.1

where:

$P_{avg} = KV_{avg}^2$ = 22.4 psf

K = constant for barrier shape = 1.4 for flat face

V_{avg} = average velocity of water = Q/A = 4 fps

q = angle of attack = 45 °

$P = P_{max}\sin\theta$ = 0.03 ksf

Depth from T.O. Wall:

	ID			F_D		MA		M_D	
0			k	0.000	k	0.00	ft	0.000	ft-k
1	stream pressure	0.03	k	0.032	k	5.00	ft	0.158	ft-k
2	stream pressure	0.03	k	0.025	k	4.00	ft	0.101	ft-k
3	stream pressure	0.02	k	0.019	k	3.00	ft	0.057	ft-k
4	stream pressure	0.01	k	0.013	k	2.00	ft	0.025	ft-k
5	stream pressure	0.01	k	0.006	k	1.00	ft	0.006	ft-k
6	stream pressure	0.00	k	0.000	k	0.00	ft	0.000	ft-k

$F_{sliding} = \Sigma F_D$ = **1.218** **k**

$M_{overturning} = \Sigma M_D$ = **2.626** **ft-k**

RESISTING FORCES:

SELF-WEIGHT & VERTICAL LOADS: 3.375 k 10.125 ft-k

Depth from B.O. Excavation:

	ID			F_V		MA		M_R	
0	Wall	0.000	k	0.000	k	3.00	ft	0.000	ft-k
1	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k
2	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k
3	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k
4	Wall	0.750	k	0.750	k	3.00	ft	2.250	ft-k
5	Wall	0.750	k	0.750	k	3.00	ft	2.250	ft-k
6	Wall	0.750	k	0.750	k	3.00	ft	2.250	ft-k

$F_{resisting} = c\Sigma F_V + \Sigma F_R$ = **1.688** **k** >= 1.218 k FS = 1.39

$M_{resisting} = \Sigma M_R$ = **10.125** **ft-k** >= 2.626 ft-k FS = 3.86

Condition 2:

a) stone fill on one side to 3’ below top
b) equipment surcharge

Surcharge Loading:

Surcharge
Equipment

Height of Wall = 3
Depth of Wall = 0
Load Factor of Surcharge Loading = 1

Wall Condition:
Flexible Wall Condition -- Small Movement or deflection are allowed.

**********Loading**********

STRIP LOADING:

Xarea	Width	Length	Qarea
0.0	10.0	30.0	0.4

**********Total Pressure Distribution**********

Max. Pressure =0.195 at depth =0.15

Depth	Pressure
0.00	0.000
0.15	0.195
0.30	0.191
0.45	0.187
0.60	0.183
0.75	0.180
0.90	0.176
1.05	0.172
1.20	0.168
1.35	0.165
1.50	0.161
1.65	0.158
1.80	0.154
1.95	0.150
2.10	0.147
2.25	0.143
2.40	0.140
2.55	0.137
2.70	0.133
2.85	0.130
3.00	0.127
3.30	0.121

3.60	0.115
3.90	0.109
4.20	0.103
4.50	0.098
4.80	0.093
5.10	0.088
5.40	0.083
5.70	0.079
6.00	0.074
6.60	0.067
7.20	0.060
7.80	0.054
8.40	0.048
9.00	0.043
9.60	0.039
10.20	0.035
10.80	0.031
11.40	0.028
12.00	0.000

Depth Is Measured From Top of the Wall
LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Wall Section	Location STA± from	to	ft	Depth from T.O.Wall ft	Wall/Ftg Width
1	0+00	0+01	0.00	3.00	
			1.00	3.00	
			2.00	3.00	
			3.00	3.00	
			4.00	6.00	
			5.00	6.00	
			6.00	6.00	

Wftg = width of footing =	0.00	ft	
tftg = thickness of footing =	0.00	ft	
gftg = density of ftg material =		0.135	kcf
Wstem = width of stem =	4.29	ft	average
Hstem = height of stem =	6.00	ft	
gstem = density of stem material =		0.125	kcf

HRE = height toe of ftg to top of retained earth = 3.00 ft

HBF = height of backfill on front face from BOF = 0.00 ft

g'soil = density of stonefill, wet =	0.140	kcf
f = friction angle of stonefill =	45	°
d = friction angle of soil on wall =	22	°

b = slope angle from horizontal of retained earth = 0 °

Ka = active soil coefficient = 0.16 where Ka = cos2f / {cosd[1+(sin(f+d)sin(f-b)/(cosdcosb))1/2]2}
Kp = passive soil coefficient = 20.51 where Kp = cos2f / {cosd[1-(sin(f+d)sin(f+b)/(cosdcosb))1/2]2}

c = coefficient of friction sandbag/soil = 0.50

DRIVING FORCES:

ACTIVE EARTH Horizontal Load: 0.101 k 0.106 ft-k
Depth from T.O. Wall:

	ID		FD		MA		MD		
0	cofferdam	0.000	k	0.000	k	3.00	ft	0.000	ft-k
1	cofferdam	0.022	k	0.011	k	2.50	ft	0.028	ft-k
2	cofferdam	0.045	k	0.034	k	1.50	ft	0.050	ft-k
3	cofferdam	0.067	k	0.056	k	0.50	ft	0.028	ft-k

SURCHARGE Horizontal Load: 0.470 k 0.738 ft-k
Depth from T.O. Wall:

Depth	Pressure		FD		MA		MD	
0.00	0.000	ksf	0.000	k	3.00	ft	0.000	ft-k
0.15	0.195	ksf	0.015	k	2.93	ft	0.043	ft-k
0.30	0.191	ksf	0.029	k	2.78	ft	0.080	ft-k
0.45	0.187	ksf	0.028	k	2.63	ft	0.074	ft-k
0.60	0.183	ksf	0.028	k	2.48	ft	0.069	ft-k
0.75	0.180	ksf	0.027	k	2.33	ft	0.063	ft-k
0.90	0.176	ksf	0.027	k	2.18	ft	0.058	ft-k
1.05	0.172	ksf	0.026	k	2.03	ft	0.053	ft-k
1.20	0.168	ksf	0.026	k	1.88	ft	0.048	ft-k
1.35	0.165	ksf	0.025	k	1.73	ft	0.043	ft-k
1.50	0.161	ksf	0.024	k	1.58	ft	0.039	ft-k
1.65	0.158	ksf	0.024	k	1.43	ft	0.034	ft-k
1.80	0.154	ksf	0.023	k	1.28	ft	0.030	ft-k
1.95	0.150	ksf	0.023	k	1.13	ft	0.026	ft-k
2.10	0.147	ksf	0.022	k	0.98	ft	0.022	ft-k
2.25	0.143	ksf	0.022	k	0.83	ft	0.018	ft-k
2.40	0.140	ksf	0.021	k	0.68	ft	0.014	ft-k
2.55	0.137	ksf	0.021	k	0.53	ft	0.011	ft-k
2.70	0.133	ksf	0.020	k	0.38	ft	0.008	ft-k

2.85	0.130	ksf	0.020	k	0.23	ft	0.004	ft-k
3.00	0.127	ksf	0.019	k	0.08	ft	0.001	ft-k

Fsliding = SFD = 0.571 k
Moverturning = SMD = 0.844 ft-k

RESISTING FORCES:

SELF-WEIGHT & VERTICAL LOADS: 3.375 k
10.125 ft-k
Depth from B.O. Excavation:

	ID			FV		MA		MR	
0	Wall	0.000	k	0.000	k	3.00	ft	0.000	ft-k
1	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k
2	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k
3	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k

Fresisting = cSFV + SFR = 1.688 k >= 0.571 k FS = 2.96
Mresisting = SMR = 10.125 ft-k >= 0.844 ft-k FS = 12.00

Containment Wall Type B:

The Containment Wall Type B will be constructed on the opposite side of the access road from the TBCA, at about 3' off the face of the new Abutment 2 footing. It will be founded on bedrock and extend up to EL808.00 and constructed of cubic yard sandbags with a double row first level and a single row second level.

The Containment Wall Type B will be investigated for one load condition. Unless otherwise noted the assumptions used as a basis for the design as applicable are as follows:

- weight of water, γ_w = 62.4pcf
- weight of sand, γ_s' = 125pcf

AASHTO 5.2.2.3 calls for design of overall stability of retaining walls to have a minimum Factor of Safety of 1.3 for static loads and 1.5 for installations with a low tolerance for failure.

Condition 1:
a) stone fill on one side to top
b) equipment surcharge

Equipment Travelling Surcharge:

East Side Equipment.lp8

Surcharge
Equipment

Height of Wall = 8
Depth of Wall = 0
Load Factor of Surcharge Loading = 1

Wall Condition:
Flexible Wall Condition -- Small Movement or deflection are allowed.

**********Loading**********

STRIP LOADING:

Xarea	Width	Length	Qarea
0.0	10.0	30.0	0.4

**********Total Pressure Distribution**********

Max. Pressure =0.188 at depth =0.40

Depth	Pressure
0.00	0.000

0.40	0.188
0.80	0.178
1.20	0.168
1.60	0.159
2.00	0.149
2.40	0.140
2.80	0.131
3.20	0.123
3.60	0.115
4.00	0.107
4.40	0.100
4.80	0.093
5.20	0.086
5.60	0.080
6.00	0.074
6.40	0.069
6.80	0.064
7.20	0.060
7.60	0.056
8.00	0.052
8.80	0.045
9.60	0.039
10.40	0.034
11.20	0.029
12.00	0.026
12.80	0.023
13.60	0.020
14.40	0.018
15.20	0.016
16.00	0.014
17.60	0.011
19.20	0.009
20.80	0.007
22.40	0.006
24.00	0.005
25.60	0.004
27.20	0.004
28.80	0.003
30.40	0.003
32.00	0.000

Depth Is Measured From Top of the Wall
LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Wall Section	Location from	STA± to	ft	Depth from T.O.Wall ft	Wall/Ftg Width
1	0+00	0+01	0.00	3.00	
			1.00	3.00	
			2.00	3.00	
			3.00	3.00	
			4.00	6.00	

5.00	6.00
6.00	6.00

Wstem = width of stem = 4.29 ft average
Hstem = height of stem = 6.00 ft
gstem = density of stem material = 0.125 kcf

HRE = height toe of ftg to top of retained earth = 6.00 ft

HBF = height of backfill on front face from BOF = 0.00 ft

g'soil = density of stonefill, wet = 0.140 kcf
f = friction angle of stonefill = 45 °
d = friction angle of soil on wall = 22 °
b = slope angle from horizontal of retained earth = 0 °

Ka = active soil coefficient = 0.16 where Ka = cos2f / {cosd[1+(sin(f+d)sin(f-b)/(cosdcosb))1/2]2}
Kp = passive soil coefficient = 20.51 where Kp = cos2f / {cosd[1-(sin(f+d)sin(f+b)/(cosdcosb))1/2]2}

c = coefficient of friction sandbag/soil = 0.50

DRIVING FORCES:

ACTIVE EARTH Horizontal Load: 0.402 k 0.816 ft-k
Depth from T.O. Wall:

	ID		FD		MA		MD		
0	cofferdam	0.000	k	0.000	k	6.00	ft	0.000	ft-k
1	cofferdam	0.022	k	0.011	k	5.50	ft	0.061	ft-k
2	cofferdam	0.045	k	0.034	k	4.50	ft	0.151	ft-k
3	cofferdam	0.067	k	0.056	k	3.50	ft	0.196	ft-k
4	cofferdam	0.089	k	0.078	k	2.50	ft	0.196	ft-k
5	cofferdam	0.112	k	0.101	k	1.50	ft	0.151	ft-k
6	cofferdam	0.134	k	0.123	k	0.50	ft	0.061	ft-k

SURCHARGE Horizontal Load: 0.742 k 2.487 ft-k
Depth from T.O. Wall:

Depth	Pressure		FD		MA		MD	
0.00	0.000	ksf	0.000	k	6.00	ft	0.000	ft-k
0.40	0.188	ksf	0.038	k	5.80	ft	0.218	ft-k
0.80	0.178	ksf	0.073	k	5.40	ft	0.395	ft-k

1.20	0.168	ksf	0.069	k	5.00	ft	0.346	ft-k
1.60	0.159	ksf	0.065	k	4.60	ft	0.301	ft-k
2.00	0.149	ksf	0.062	k	4.20	ft	0.259	ft-k
2.40	0.140	ksf	0.058	k	3.80	ft	0.220	ft-k
2.80	0.131	ksf	0.054	k	3.40	ft	0.184	ft-k
3.20	0.123	ksf	0.051	k	3.00	ft	0.152	ft-k
3.60	0.115	ksf	0.048	k	2.60	ft	0.124	ft-k
4.00	0.107	ksf	0.044	k	2.20	ft	0.098	ft-k
4.40	0.100	ksf	0.041	k	1.80	ft	0.075	ft-k
4.80	0.093	ksf	0.039	k	1.40	ft	0.054	ft-k
5.20	0.086	ksf	0.036	k	1.00	ft	0.036	ft-k
5.60	0.080	ksf	0.033	k	0.60	ft	0.020	ft-k
6.00	0.074	ksf	0.031	k	0.20	ft	0.006	ft-k

Fsliding = SFD = 1.144 k
Moverturning = SMD = 3.303 ft-k

RESISTING FORCES:

SELF-WEIGHT & VERTICAL LOADS: 3.375 k
10.125 ft-k
Depth from B.O. Excavation:

	ID			FV		MA		MR	
0	Wall	0.000	k	0.000	k	3.00	ft	0.000	ft-k
1	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k
2	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k
3	Wall	0.375	k	0.375	k	3.00	ft	1.125	ft-k
4	Wall	0.750	k	0.750	k	3.00	ft	2.250	ft-k
5	Wall	0.750	k	0.750	k	3.00	ft	2.250	ft-k
6	Wall	0.750	k	0.750	k	3.00	ft	2.250	ft-k

Fresisting = cSFV + SFR = 1.688 k >= 1.144 k FS = 1.48
Mresisting = SMR = 10.125 ft-k >= 3.303 ft-k FS = 3.07

Containment Wall Type C:

The Containment Wall Type C will be constructed on the opposite side of the access road from the TBCA, at about 3' off the face of the new Abutment 2 footing. It will be founded on bedrock and extend up to EL810.00± and constructed of 6' wide trench boxes filled with select subbase material.

The Containment Wall Type C will be investigated for one load condition. Unless otherwise noted the assumptions used as a basis for the design as applicable are as follows:

- weight of water, γ_w = 62.4pcf
- weight of sand, γ_s' = 125pcf

AASHTO 5.2.2.3 calls for design of overall stability of retaining walls to have a minimum Factor of Safety of 1.3 for static loads and 1.5 for installations with a low tolerance for failure.

Condition 1:
a) water on one side to top of cofferdam

Wall Section	Location from	STA± to	ft	Depth from T.O.Wall ft	Wall/Ftg Width
1	0+00	0+01	0.00	6.00	
			1.00	6.00	
			2.00	6.00	
			3.00	6.00	
			4.00	6.00	
			5.00	6.00	
			6.00	6.00	

Wstem = width of stem = 6.00 ft average
Hstem = height of stem = 6.00 ft
gstem = density of stem material = 0.135 kcf

HRE = height toe of ftg to top of retained earth = 6.00 ft

HBF = height of backfill on front face from BOF = 0.00 ft

g'soil = density of selectfill, wet = 0.135 kcf
f = friction angle of selectfill = 34 °
d = friction angle of soil on wall = 14 °
b = slope angle from horizontal of retained earth = 0 °

Ka = active soil coefficient = 0.26 where Ka = cos2f / {cosd[1+(sin(f+d)sin(f-b)/(cosdcosb))1/2]2}

Kp = passive soil coefficient = 5.93 where Kp = cos2f / {cosd[1-(sin(f+d)sin(f+b)/(cosdcosb))1/2]2}

c = coefficient of friction sandbag/soil = 0.50

DRIVING FORCES:

ACTIVE EARTH Horizontal Load: 0.629 k 1.275 ft-k
Depth from T.O. Wall:

	ID		FD		MA		MD		
0	cofferdam	0.000	k	0.000	k	6.00	ft	0.000	ft-k
1	cofferdam	0.035	k	0.017	k	5.50	ft	0.096	ft-k
2	cofferdam	0.070	k	0.052	k	4.50	ft	0.236	ft-k
3	cofferdam	0.105	k	0.087	k	3.50	ft	0.306	ft-k
4	cofferdam	0.140	k	0.122	k	2.50	ft	0.306	ft-k
5	cofferdam	0.175	k	0.157	k	1.50	ft	0.236	ft-k
6	cofferdam	0.210	k	0.192	k	0.50	ft	0.096	ft-k

SURCHARGE Horizontal Load: 0.742 k 2.487 ft-k
Depth from T.O. Wall:

Depth	Pressure		FD		MA		MD	
0.00	0.000	ksf	0.000	k	6.00	ft	0.000	ft-k
0.40	0.188	ksf	0.038	k	5.80	ft	0.218	ft-k
0.80	0.178	ksf	0.073	k	5.40	ft	0.395	ft-k
1.20	0.168	ksf	0.069	k	5.00	ft	0.346	ft-k
1.60	0.159	ksf	0.065	k	4.60	ft	0.301	ft-k
2.00	0.149	ksf	0.062	k	4.20	ft	0.259	ft-k
2.40	0.140	ksf	0.058	k	3.80	ft	0.220	ft-k
2.80	0.131	ksf	0.054	k	3.40	ft	0.184	ft-k
3.20	0.123	ksf	0.051	k	3.00	ft	0.152	ft-k
3.60	0.115	ksf	0.048	k	2.60	ft	0.124	ft-k
4.00	0.107	ksf	0.044	k	2.20	ft	0.098	ft-k
4.40	0.100	ksf	0.041	k	1.80	ft	0.075	ft-k
4.80	0.093	ksf	0.039	k	1.40	ft	0.054	ft-k
5.20	0.086	ksf	0.036	k	1.00	ft	0.036	ft-k
5.60	0.080	ksf	0.033	k	0.60	ft	0.020	ft-k
6.00	0.074	ksf	0.031	k	0.20	ft	0.006	ft-k

Fsliding = SFD = 1.370 k
Moverturning = SMD = 3.762 ft-k

RESISTING FORCES:

SELF-WEIGHT & VERTICAL LOADS: 4.860 k
14.580 ft-k
Depth from B.O. Excavation:

	ID			FV		MA		MR	
0	Wall	0.000	k	0.000	k	3.00	ft	0.000	ft-k
1	Wall	0.810	k	0.810	k	3.00	ft	2.430	ft-k
2	Wall	0.810	k	0.810	k	3.00	ft	2.430	ft-k
3	Wall	0.810	k	0.810	k	3.00	ft	2.430	ft-k
4	Wall	0.810	k	0.810	k	3.00	ft	2.430	ft-k
5	Wall	0.810	k	0.810	k	3.00	ft	2.430	ft-k
6	Wall	0.810	k	0.810	k	3.00	ft	2.430	ft-k

Fresisting = cSFV + SFR = 2.430 k >= 1.370 k FS = 1.77
Mresisting = SMR = 14.580 ft-k >= 3.762 ft-k FS = 3.88

ADDENDUM 1: Address Review Comments dated June 3, 2014, & Revised Concept.

This addendum addresses review comments dated June 3, 2014 in addition to revising the design concept to accommodate GC experience in installing the initial portions of the related Access Road.

COMMENT:
1. An elevation view needs to be provided showing each wall dimensioned and its location shown relative to each other in the final condition.

RESPONSE:
The elevation view is on sht WC01 of the DWG. Dimensions are shown in the section details of the various options on sht WC02 of the DWG.

COMMENT:
2. More detail needs to be provided as to the sequence of construction, specifically when will the trench box be removed after placing the flowable fill, how will each section of the retaining wall be connected and sealed.

RESPONSE:
The Construction Sequence notes have been eliminated. The Water Control System notes have been expanded to provide more detail. Flowable fill is not used in the revised concept.

COMMENT:
3. What testing and QC will take place to ensure that the material properties of the flowable fill represent the design assumptions? In our use of flowable fill we have found its properties to be highly variable.

RESPONSE:
Testing of the flowable fill is no longer relavent as the flowable fill has been eliminated in the revised concept.

COMMENT:
4. The calculations for the retaining wall indicate that it is an 8' wall. It appears that the wall will need to withstand the earth pressure of a 14' wall because a six foot sandbag wall will be placed on top of the retaining wall.

RESPONSE:
The Retaining Wall has been eliminated in the revised concept and replaced by the Containment Wall Types B and C. The design height of retained fill has been reduced to 6'. Design Flow has been revised to reflect a water surface elevation as observed in the field by the GC on June 16, 2014. Calculations have been revised to reflect these changes.

COMMENT:
5. No detail was provided for the 6' sandbag wall on top of the retaining wall. Is this wall going to be two - 1 CY sandbags stacked on top of each other? Is this a stable configuration?

RESPONSE:
The 6' sandbag wall on top of the Retaining Wall has been eliminated with the revised concept.

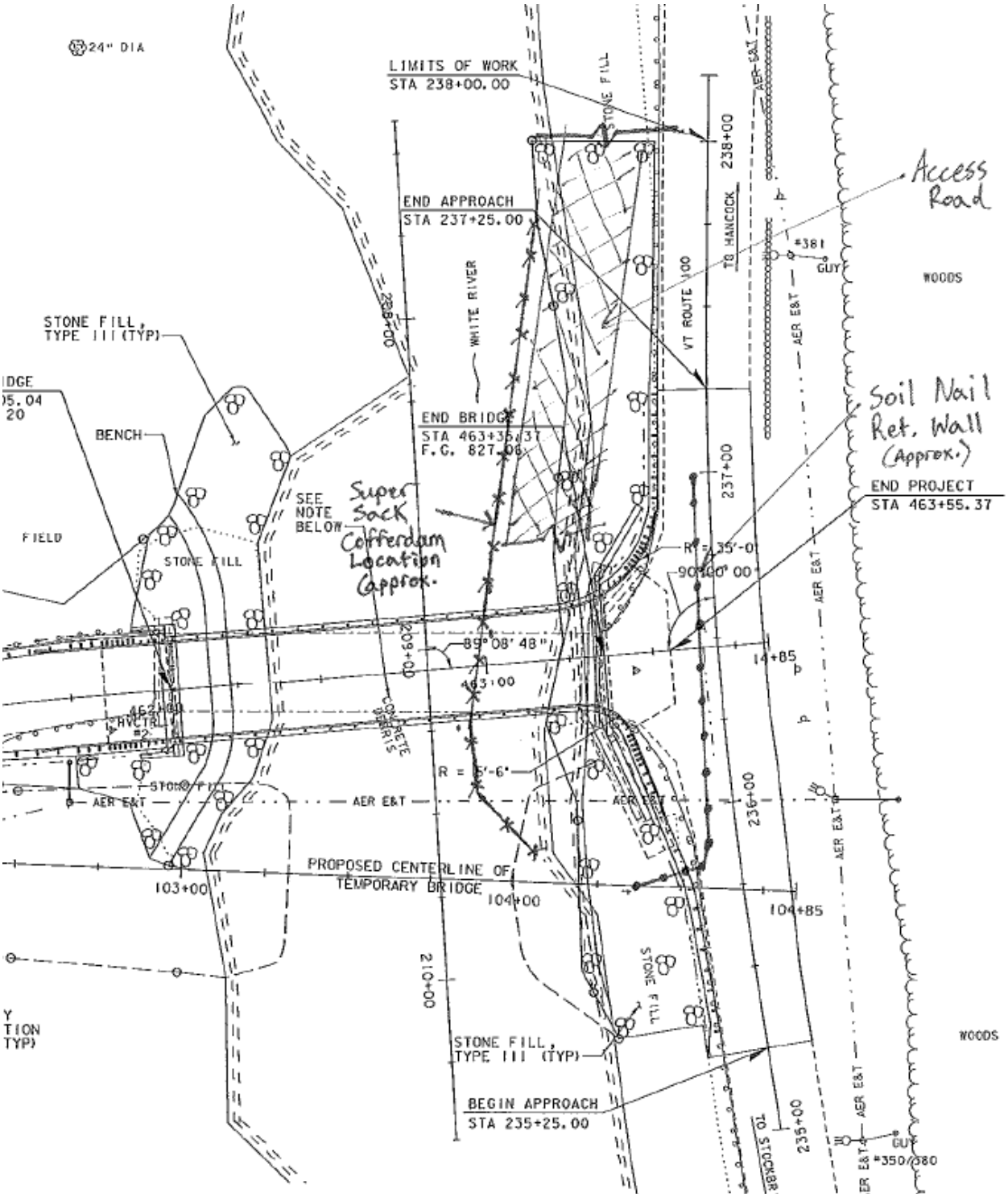
ADDENDUM 2: Revised Cofferdam Cross Section w/ Sheetpile

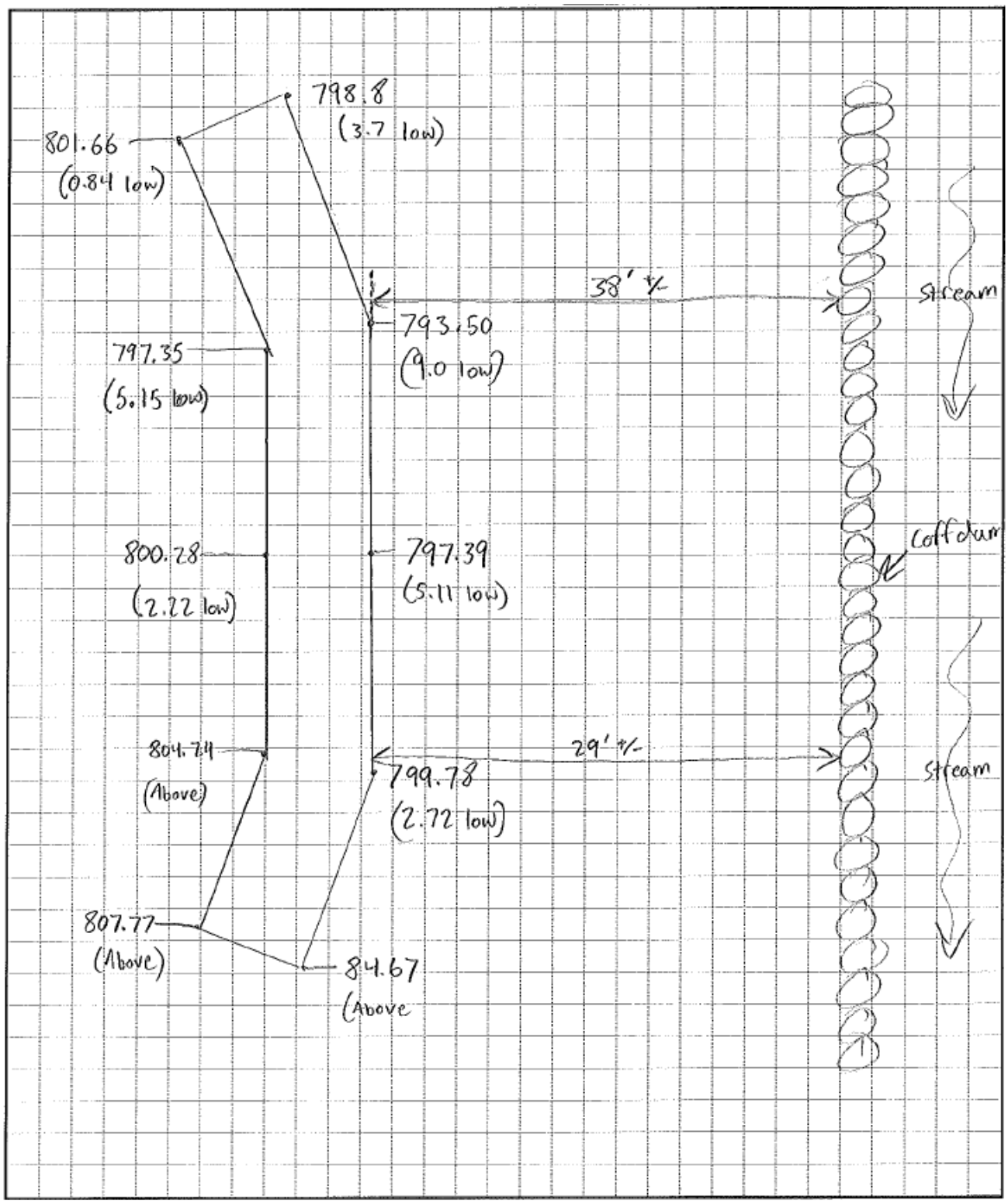
Ledge was discovered in the field to be deeper than indicated in the Contract Documents. This requires that excavation for the Abutment 2 footing be carried to a greater depth relative to the riverbed to a degree where the original cofferdam design cross sections are precluded.

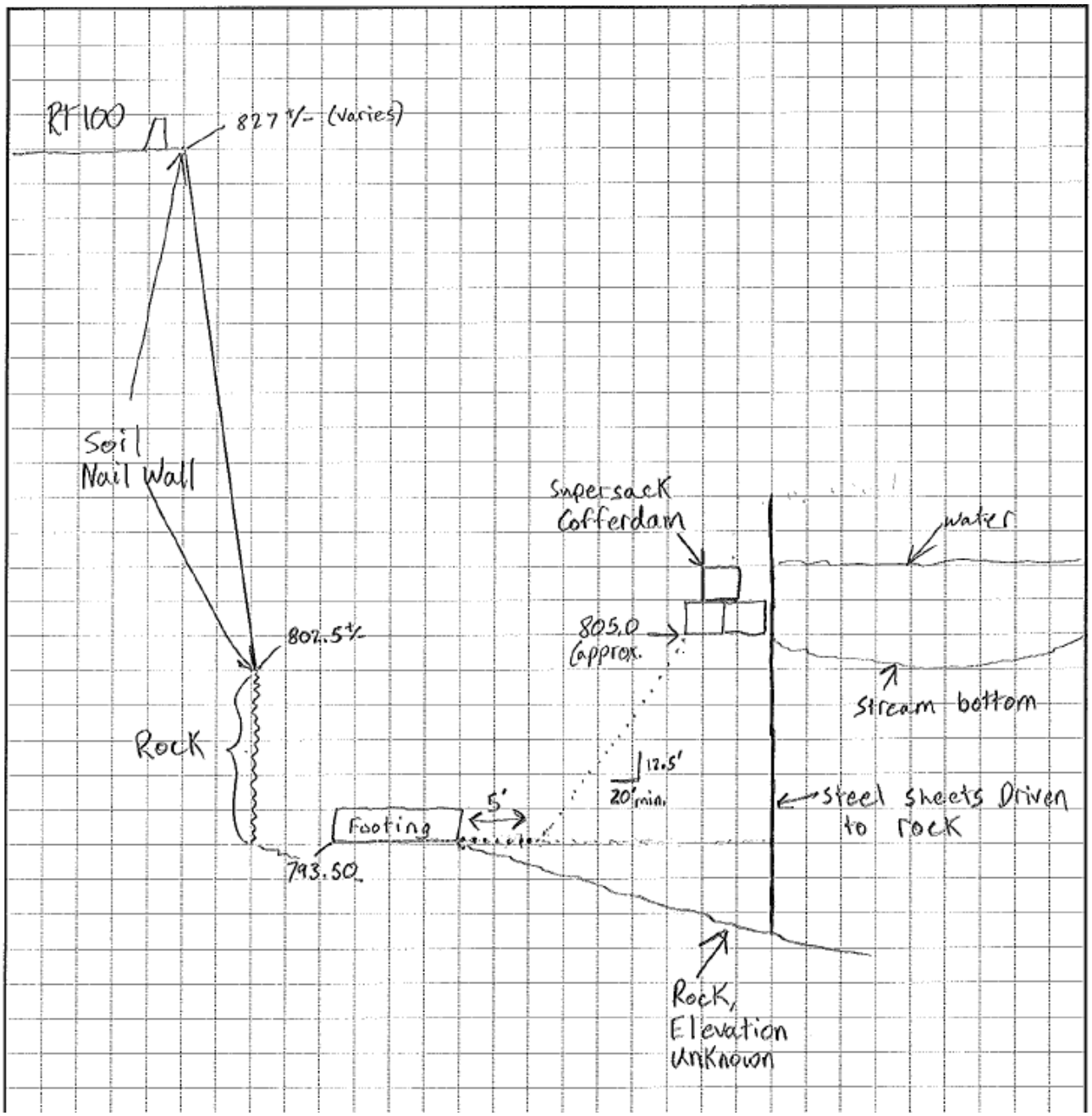
The GC is proposing use of steel sheet piles drived to refusal in combination with the Turbidity Barrier/Cofferdam A components of the original design sections to serve as a cofferdam for the revised field conditions.

FIELD MEASUREMENTS:

The following measurements were taken in the field by the GC,




798.8
(3.7 low)
801.66
(0.84 low)
38' +/-
Stream
793.50
(9.0 low)
797.35
(5.15 low)
800.28
(2.22 low)
797.39
(5.11 low)
Cofferdam
804.74
(Above)
29' +/-
799.78
(2.72 low)
Stream
807.77
(Above)
84.67
(Above


RT 100
827 +/- (varies)
Soil
Nail Wall
Supersack
Cofferdam
water
805.0
(approx.
802.5 +/-
Rock
Stream bottom
12.5'
20' min.
5'
Footing
steel sheets Driven
to rock
793.50
Rock,
Elevation
Unknown

SHEETPILE WALL:

To meet the requirements of the actual current field conditions, provide steel sheeting along the outer face of the Turbidity Barrier/Cofferdam A.

The Top of Sheets elevation [or ventingelevation] will be maintained at

Top Of Sheetpile = EL811.50

Sheetpile Wall Installation:
1. Drive sheets to a minimum embedment as indicated in the "REQUIRED PILE EMBEDMENT VS WALL HEIGHT" table
2. Top of Sheetpile Wall to be vented such that water levels on both sides of the wall will equalize when water surface elevation reaches EL811.50
3. Assure that the Turbidity Barrier/Cofferdam A sand bags are in full contact with the land side of the sheets up to elevation EL808.5

Sheetpile:
1. Material is to be ASTM A328 unless otherwise noted.
2. Sheetpile is to be provided with standard pulling holes.
3. Interlocks are to be free sliding and provide a free swing angle of not less than 5°.

Three conditions are analyzed.
1. Wall Height of 6.5' backed up on the passive side by the 3'x6' bottom row of Cofferdam A
2. Wall Height of 7.5' backed up on the passive side by the 3'x6' bottom row of Cofferdam A
3. Wall Height of 7.5' backed up on the passive side by the 3'x6' bottom row of Cofferdam A and with an extended shelf of 3' width on the passive side

Wall heights are entered in the analysis 3' less than the design height to account for the 3' high sandbags of Cofferdam A on the passive side, resulting in the actual design height on the active side.

The extended shelf is entered as 3', however, the sandbags are entered as 6' wide at the top and 7' wide at the bottom which results in an actual extended shelf width of 4'. The 4' shelf width is called out in the drawing.

Wall Height of 6.5' backed up on the passive side by the 3'x6' bottom row of Cofferdam A

The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in
---
Date: 7/31/2014 File: C:\Users\Terry\Desktop\PENDING\140403D Sheetpile in Cofferdam 6.5ft.sh8

Title: Turbidity Barrier / Cofferdam w/ Sheetpile Wall 6.5'
Subtitle: Water @ 811.50

**********INPUT DATA**********
Wall Type: 1. Sheet Pile
Wall Height: 3.50
Pile Diameter: 1.00
Pile Spacing: 1.00
Factor of Safety (F.S.): 1.50
Lateral Support Type (Braces): 1. No
Top Brace Increase (Multi-Bracing): Add 15%*
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Allowable Fb/Fy: 0.66
Steel Strength, Fy: 50 ksi = 345 MPa
Elastic Module, E: 29000.00
Moment of Inertia, I: 882.00
User Input Pile: W14X82

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		

2	0.000	0.000	3.500	0.000	0.000000
3	*	Below	Base		
4	3.500	0.000	6.500	0.000	0.000000
5	6.500	0.000	17.500	0.207	0.018785
6	*	Water	Pres.		
7	0.000	0.000	13.000	0.811	0.062400

---

* PASSIVE PRESSURE *
Passive Pressures below will be divided by a Factor of Safety =1.5

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	3.50	0.40	13.00	1.41	0.1064
2	13.00	1.41	17.50	1.53	0.0259

The pressures above will be divided by a Factor of Safety =1.5

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	3.50	1.00

---

* PASSIVE SPACE *

No.	Z depth	Spacing
1	3.50	1.00

---

*For Tieback: Input1 = Diameter; Input2 = Bond Stength
*For Plate: Input1 = Diameter; Input2 = Allowable Pressure
*For Deaman: Input1 = Horz. Width; Input2 = Allowable Pressure; Angle = 0

**********CALCULATION**********

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

```
|     D1=0.00
|
|
```

```
  |
==|==    D2=3.50
  |
  |
  |     D3=17.16
```

D1 - TOP DEPTH
D2 - EXCAVATION BASE
D3 - PILE TIP (20% increased, see EMBEDMENT Notes below)

MOMENT BALANCE: M=0.00 AT DEPTH=14.89 WITH EMBEDMENT OF 11.39
FORCE BALANCE: F=0.00 AT DEPTH=17.16 WITH EMBEDMENT OF 13.66

The program calculates an embedment for moment equilibrium, then increase the embedment by 20% to reach force equilibrium.
A Balance Force=1.60 is developed from depth=14.89 to depth=17.16
Total Passive Pressure = Total Active Pressure, OK!

**********RESULTS**********

* EMBEDMENT Notes *
Based on USS Design Manual, fist calculate embedment for moment equilibrium, then increased by 20 to 40 % to reach force equilibrium.
The embedment for moment equilibrium is 11.39
The 20% increased embedment for force equilibrium is 13.66 (Used by Program)
The 30% increased embedment for force equilibrium is 14.80
The 40% increased embedment for force equilibrium is 15.94

Based on AASHTO Standard Specifications, fist calculate embedment for moment equilibrium, then add safety factor of 30% for temporary shoring; add safety factor of 50% for permanent shoring.
The embedment for moment equilibrium is 11.39
Add 30% embedment for temporary shoring is 14.80
Add 50% embedment for permanent shoring is 17.08

PROGRAM CALCULATED MINIMUM EMBEDMENT = 13.66
TOTAL MINIMUM PILE LENGTH = 17.16

* MOMENT IN PILE (per pile spacing)*
Overall Maximum Moment = 1.67 at 10.19
Maximum Shear = 1.59
Moment and Shear are per pile spacing: 1.0 foot or meter

* VERTICAL LOADING *

Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00

**********SHEET PILE SELECTION**********

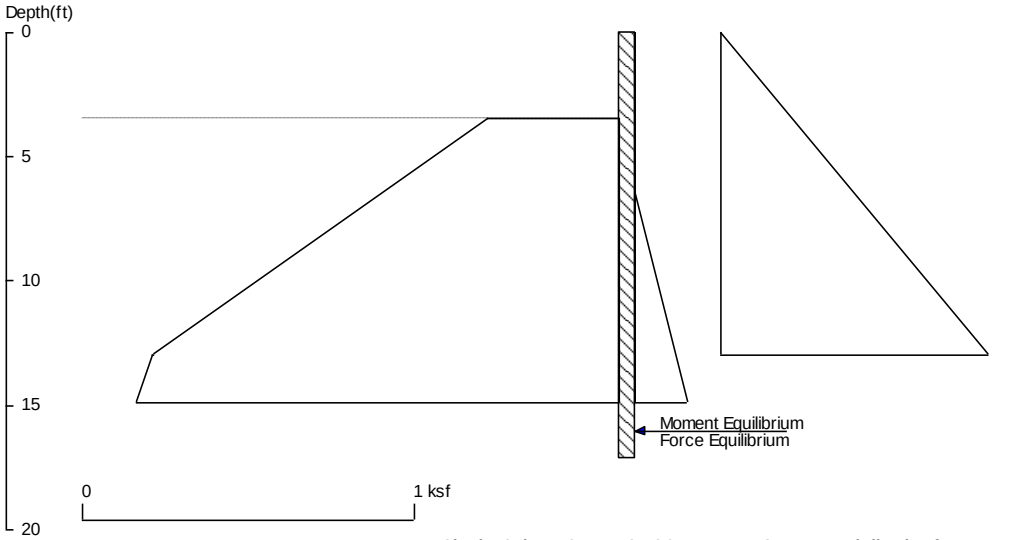
Request Min. Section Modulus = 0.6 in3/ft, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
The pile selection is based on the magnitude of the moment only. Axial force is neglected.
Sx(in3) and Ix(in4) are per one foot of horizontal width of the pile

* Note: The sheet pile properties are in English Units and based on one foot width (even in Metric unit).

AS59-5 Sx= 1.4 in3/ft Ix= 2.5 in4/ft Weight= 26.22 lb/ft
Top deflection = 56.989(in)
AS511-0 Sx= 1.83 in3/ft Ix= 2.74 in4/ft Weight= 28.88 lb/ft
Top deflection = 51.997(in)
AS512-0 Sx= 1.89 in3/ft Ix= 2.86 in4/ft Weight= 30.52 lb/ft
Top deflection = 49.816(in)
AS512-5 Sx= 1.89 in3/ft Ix= 2.93 in4/ft Weight= 31.34 lb/ft
Top deflection = 48.626(in)
PS28 Sx= 1.9 in3/ft Ix= 2.8 in4/ft Weight= 28 lb/ft
Top deflection = 50.883(in)
PS32 Sx= 1.9 in3/ft Ix= 2.9 in4/ft Weight= 32 lb/ft
Top deflection = 49.129(in)
AS512-7 Sx= 1.95 in3/ft Ix= 2.99 in4/ft Weight= 31.54 lb/ft
Top deflection = 47.650(in)
PSA23 Sx= 2.4 in3/ft Ix= 4.1 in4/ft Weight= 23 lb/ft
Top deflection = 34.750(in)
PSX32 Sx= 2.4 in3/ft Ix= 3.7 in4/ft Weight= 32 lb/ft
Top deflection = 38.506(in)
PSA28 Sx= 2.5 in3/ft Ix= 4.5 in4/ft Weight= 28 lb/ft
Top deflection = 31.661(in)
CL42 Sx= 2.55 in3/ft Ix= 4.5 in4/ft Weight= 8.6 lb/ft
Top deflection = 31.661(in)
CL47 Sx= 2.88 in3/ft Ix= 5.09 in4/ft Weight= 9.63 lb/ft
Top deflection = 27.991(in)
CL57 Sx= 3.53 in3/ft Ix= 6.22 in4/ft Weight= 11.67 lb/ft
Top deflection = 22.906(in)
LZ8 Sx= 3.63 in3/ft Ix= 8.11 in4/ft Weight= 16.88 lb/ft
Top deflection = 17.568(in)

Cofferdam A w/ Sheetpile Wall 6.5' Wall

Water @ 811.50



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Licensed to 4324324234 3424343 Date: 7/31/2014
File: C:\Users\Terry\Desktop\PENDING\140403D Sheetpile in Cofferdam 6.5ft.sh8

Wall Height=3.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=13.66 Min. Pile Length=17.16
MOMENT IN PILE: Max. Moment=1.67 per Pile Spacing=1.0 at Depth=10.18

PILE SELECTION:
Request Min. Section Modulus = 0.6 in3/ft, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)
AS59-5 (57.15) AS511-0 (52.14) AS512-0 (49.95) AS512-5 (48.76) PS28 (51.02)
PS32 (49.26) AS512-7 (47.78) PSA23 (34.85) PSX32 (38.61) PSA28 (31.75)
CL42 (31.75) CL47 (28.07) CL57 (22.97) LZ8 (17.62)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	3.500	0.000	0.000000
*	Below	Base		
3.500	0.000	6.500	0.000	0.000000
6.500	0.000	17.500	0.207	0.018785
*	Water	Pres.		
0.000	0.000	13.000	0.811	0.062400

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
3.5	0.40	13.0	1.41	0.106
13.0	1.41	17.5	1.53	0.026

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	3.50	1.00

Wall Height of 7.5' backed up on the passive side by the 3'x6' bottom row of Cofferdam A

The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in
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Date: 7/31/2014 File: C:\Users\Terry\Desktop\PENDING\140403D Sheetpile in Cofferdam 6.5ft.sh8

Title: Turbidity Barrier / Cofferdam w/ Sheetpile Wall 7.5'
Subtitle: Water @ 811.50

**********INPUT DATA**********
Wall Type: 1. Sheet Pile
Wall Height: 4.50
Pile Diameter: 1.00
Pile Spacing: 1.00
Factor of Safety (F.S.): 1.50
Lateral Support Type (Braces): 1. No
Top Brace Increase (Multi-Bracing): Add 15%*
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Allowable Fb/Fy: 0.66
Steel Strength, Fy: 50 ksi = 345 MPa
Elastic Module, E: 29000.00
Moment of Inertia, I: 882.00
User Input Pile: W14X82

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		

2	0.000	0.000	4.500	0.000	0.000000
3	*	Below	Base		
4	4.500	0.000	7.500	0.000	0.000000
5	7.500	0.000	22.500	0.282	0.018785
6	*	Water	Pres.		
7	0.000	0.000	13.000	0.811	0.062400

---

* PASSIVE PRESSURE *
Passive Pressures below will be divided by a Factor of Safety =1.5

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	4.50	0.40	13.00	1.12	0.0849
2	13.00	1.12	22.50	3.38	0.2375

The pressures above will be divided by a Factor of Safety =1.5

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	4.50	1.00

---

* PASSIVE SPACE *

No.	Z depth	Spacing
1	4.50	1.00

---

*For Tieback: Input1 = Diameter; Input2 = Bond Stength
*For Plate: Input1 = Diameter; Input2 = Allowable Pressure
*For Deaman: Input1 = Horz. Width; Input2 = Allowable Pressure; Angle = 0

**********CALCULATION**********

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

```
|     D1=0.00
|
|
```

```
  |
==|==    D2=4.50
  |
  |
  |     D3=21.62
```

D1 - TOP DEPTH
D2 - EXCAVATION BASE
D3 - PILE TIP (20% increased, see EMBEDMENT Notes below)

MOMENT BALANCE: M=0.00 AT DEPTH=18.77 WITH EMBEDMENT OF 14.27
FORCE BALANCE: F=0.00 AT DEPTH=21.62 WITH EMBEDMENT OF 17.12

The program calculates an embedment for moment equilibrium, then increase the embedment by 20% to reach force equilibrium.
A Balance Force=4.80 is developed from depth=18.77 to depth=21.62
Total Passive Pressure = Total Active Pressure, OK!

**********RESULTS**********

* EMBEDMENT Notes *
Based on USS Design Manual, fist calculate embedment for moment equilibrium, then increased by 20 to 40 % to reach force equilibrium.
The embedment for moment equilibrium is 14.27
The 20% increased embedment for force equilibrium is 17.12 (Used by Program)
The 30% increased embedment for force equilibrium is 18.55
The 40% increased embedment for force equilibrium is 19.98

Based on AASHTO Standard Specifications, fist calculate embedment for moment equilibrium, then add safety factor of 30% for temporary shoring; add safety factor of 50% for permanent shoring.
The embedment for moment equilibrium is 14.27
Add 30% embedment for temporary shoring is 18.55
Add 50% embedment for permanent shoring is 21.40

PROGRAM CALCULATED MINIMUM EMBEDMENT = 17.12
TOTAL MINIMUM PILE LENGTH = 21.62

* MOMENT IN PILE (per pile spacing)*
Overall Maximum Moment = 9.05 at 14.66
Maximum Shear = 4.75
Moment and Shear are per pile spacing: 1.0 foot or meter

* VERTICAL LOADING *

Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00

**********SHEET PILE SELECTION**********

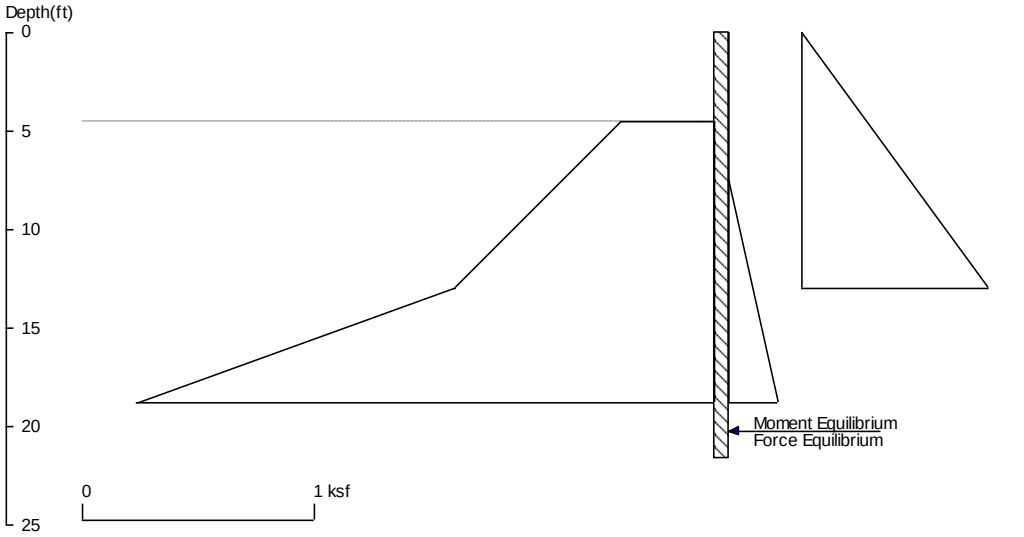
Request Min. Section Modulus = 3.3 in3/ft, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
The pile selection is based on the magnitude of the moment only. Axial force is neglected.
Sx(in3) and Ix(in4) are per one foot of horizontal width of the pile

* Note: The sheet pile properties are in English Units and based on one foot width (even in Metric unit).

CL57 Sx= 3.53 in3/ft Ix= 6.22 in4/ft Weight= 11.67 lb/ft
Top deflection = 21.616(in)
LZ8 Sx= 3.63 in3/ft Ix= 8.11 in4/ft Weight= 16.88 lb/ft
Top deflection = 16.579(in)
LZ7 Sx= 3.95 in3/ft Ix= 8.85 in4/ft Weight= 18.41 lb/ft
Top deflection = 15.192(in)
LZ5 Sx= 4.58 in3/ft Ix= 10.35 in4/ft Weight= 21.41 lb/ft
Top deflection = 12.991(in)
LZ3 Sx= 5.21 in3/ft Ix= 11.85 in4/ft Weight= 24.92 lb/ft
Top deflection = 11.346(in)
PMA22 Sx= 5.4 in3/ft Ix= 13.7 in4/ft Weight= 36 lb/ft
Top deflection = 9.814(in)
LZ250 Sx= 5.44 in3/ft Ix= 12.4 in4/ft Weight= 25.52 lb/ft
Top deflection = 10.843(in)
CS55 Sx= 6.34 in3/ft Ix= 18.67 in4/ft Weight= 11.26 lb/ft
Top deflection = 7.201(in)
CS60 Sx= 6.98 in3/ft Ix= 20.48 in4/ft Weight= 12.29 lb/ft
Top deflection = 6.565(in)
NSZ10 Sx= 7.27 in3/ft Ix= 27.39 in4/ft Weight= 16.88 lb/ft
Top deflection = 4.909(in)
NSZ11 Sx= 7.9 in3/ft Ix= 29.79 in4/ft Weight= 18.41 lb/ft
Top deflection = 4.513(in)
CS69 Sx= 8.05 in3/ft Ix= 23.78 in4/ft Weight= 14.19 lb/ft
Top deflection = 5.654(in)
SZ12 Sx= 8.6 in3/ft Ix= 36.4 in4/ft Weight= 13.1 lb/ft
Top deflection = 3.694(in)
CS76 Sx= 8.89 in3/ft Ix= 26.25 in4/ft Weight= 15.57 lb/ft
Top deflection = 5.122(in)

Cofferdam A w/ Sheetpile Wall 7.5' Wall

Water @ 811.50



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File: C:\Users\Terry\Desktop\PENDING\140403D Sheetpile in Cofferdam 7.5ft.sh8

Wall Height=4.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=17.12 Min. Pile Length=21.62
MOMENT IN PILE: Max. Moment=9.05 per Pile Spacing=1.0 at Depth=14.66

PILE SELECTION:
Request Min. Section Modulus = 3.3 in3/ft, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)
CL57 (21.62) LZ8 (16.58) LZ7 (15.19) LZ5 (12.99) LZ3 (11.35)
PMA22 (9.81) LZ250 (10.84) CS55 (7.20) CS60 (6.57) NSZ10 (4.91)
NSZ11 (4.51) CS69 (5.65) SZ12 (3.69) CS76 (5.12)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	4.500	0.000	0.000000
*	Below	Base		
4.500	0.000	7.500	0.000	0.000000
7.500	0.000	22.500	0.282	0.018785
*	Water	Pres.		
0.000	0.000	13.000	0.811	0.062400

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
4.5	0.40	13.0	1.12	0.085
13.0	1.12	22.5	3.38	0.237

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	4.50	1.00

Wall Height of 7.5' backed up on the passive side by the 3'x6' bottom row of Cofferdam A and with an extended shelf of 3' width on the passive side

The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in
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Date: 7/31/2014 File: C:\Users\Terry\Desktop\PENDING\140403D Sheetpile in Cofferdam 7.5ft with Shelf.sh8

Title: Turbidity Barrier / Cofferdam w/ Sheetpile Wall 7.5' w/ 3' Shelf
Subtitle: Water @ 811.50

**********INPUT DATA**********
Wall Type: 1. Sheet Pile
Wall Height: 4.50
Pile Diameter: 1.00
Pile Spacing: 1.00
Factor of Safety (F.S.): 1.50
Lateral Support Type (Braces): 1. No
Top Brace Increase (Multi-Bracing): Add 15%*
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Allowable Fb/Fy: 0.66
Steel Strength, Fy: 50 ksi = 345 MPa
Elastic Module, E: 29000.00
Moment of Inertia, I: 882.00
User Input Pile: W14X82

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope

1	*	Above	Base		
2	0.000	0.000	4.500	0.000	0.000000
3	*	Below	Base		
4	4.500	0.000	7.500	0.000	0.000000
5	7.500	0.000	22.500	0.282	0.018785
6	*	Water	Pres.		
7	0.000	0.000	13.000	0.811	0.062400

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* PASSIVE PRESSURE *
Passive Pressures below will be divided by a Factor of Safety =1.5

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	4.50	0.38	13.00	1.42	0.1222
2	13.00	1.42	22.50	3.55	0.2245

The pressures above will be divided by a Factor of Safety =1.5

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	4.50	1.00

---

* PASSIVE SPACE *

No.	Z depth	Spacing
1	4.50	1.00

---

*For Tieback: Input1 = Diameter; Input2 = Bond Stength
*For Plate: Input1 = Diameter; Input2 = Allowable Pressure
*For Deaman: Input1 = Horz. Width; Input2 = Allowable Pressure; Angle = 0

**********CALCULATION**********

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

| D1=0.00
|

```
    |
    |
  ==|==    D2=4.50
    |
    |
    |     D3=19.36
```

D1 - TOP DEPTH
D2 - EXCAVATION BASE
D3 - PILE TIP (20% increased, see EMBEDMENT Notes below)

MOMENT BALANCE: M=0.00 AT DEPTH=16.88 WITH EMBEDMENT OF 12.38
FORCE BALANCE: F=0.00 AT DEPTH=19.36 WITH EMBEDMENT OF 14.86

The program calculates an embedment for moment equilibrium, then increase the embedment by 20% to reach force equilibrium.
A Balance Force=3.82 is developed from depth=16.88 to depth=19.36
Total Passive Pressure = Total Active Pressure, OK!

**********RESULTS**********

* EMBEDMENT Notes *
Based on USS Design Manual, fist calculate embedment for moment equilibrium, then increased by 20 to 40 % to reach force equilibrium.
The embedment for moment equilibrium is 12.38
The 20% increased embedment for force equilibrium is 14.86 (Used by Program)
The 30% increased embedment for force equilibrium is 16.09
The 40% increased embedment for force equilibrium is 17.33

Based on AASHTO Standard Specifications, fist calculate embedment for moment equilibrium, then add safety factor of 30% for temporary shoring; add safety factor of 50% for permanent shoring.
The embedment for moment equilibrium is 12.38
Add 30% embedment for temporary shoring is 16.09
Add 50% embedment for permanent shoring is 18.57

PROGRAM CALCULATED MINIMUM EMBEDMENT = 14.86
TOTAL MINIMUM PILE LENGTH = 19.36

* MOMENT IN PILE (per pile spacing)*
Overall Maximum Moment = 5.97 at 13.52
Maximum Shear = 3.78
Moment and Shear are per pile spacing: 1.0 foot or meter

* VERTICAL LOADING *
Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00

**********SHEET PILE SELECTION**********

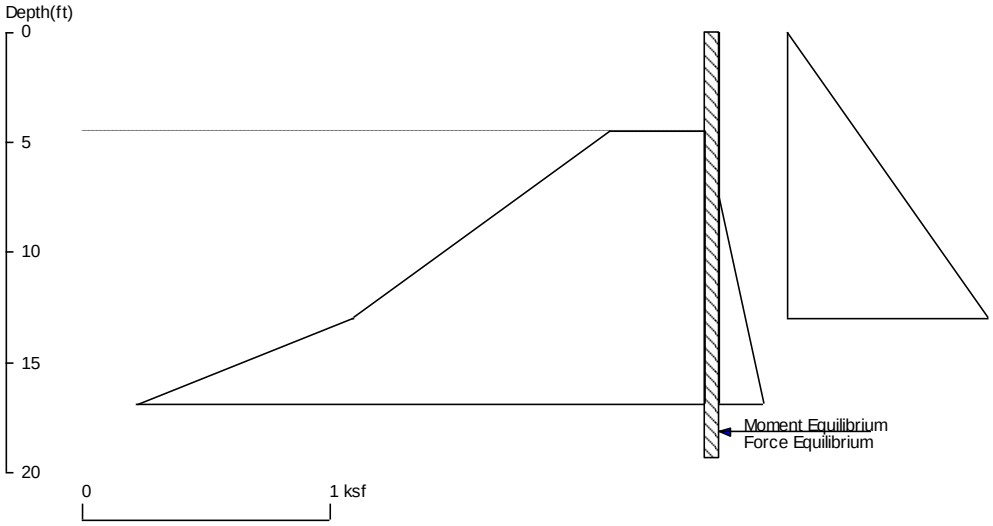
Request Min. Section Modulus = 2.2 in3/ft, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
The pile selection is based on the magnitude of the moment only. Axial force is neglected.
Sx(in3) and Ix(in4) are per one foot of horizontal width of the pile

* Note: The sheet pile properties are in English Units and based on one foot width (even in Metric unit).

PSA23 Sx= 2.4 in3/ft Ix= 4.1 in4/ft Weight= 23 lb/ft
Top deflection = 24.731(in)
PSX32 Sx= 2.4 in3/ft Ix= 3.7 in4/ft Weight= 32 lb/ft
Top deflection = 27.405(in)
PSA28 Sx= 2.5 in3/ft Ix= 4.5 in4/ft Weight= 28 lb/ft
Top deflection = 22.533(in)
CL42 Sx= 2.55 in3/ft Ix= 4.5 in4/ft Weight= 8.6 lb/ft
Top deflection = 22.533(in)
CL47 Sx= 2.88 in3/ft Ix= 5.09 in4/ft Weight= 9.63 lb/ft
Top deflection = 19.921(in)
CL57 Sx= 3.53 in3/ft Ix= 6.22 in4/ft Weight= 11.67 lb/ft
Top deflection = 16.302(in)
LZ8 Sx= 3.63 in3/ft Ix= 8.11 in4/ft Weight= 16.88 lb/ft
Top deflection = 12.503(in)
LZ7 Sx= 3.95 in3/ft Ix= 8.85 in4/ft Weight= 18.41 lb/ft
Top deflection = 11.458(in)
LZ5 Sx= 4.58 in3/ft Ix= 10.35 in4/ft Weight= 21.41 lb/ft
Top deflection = 9.797(in)
LZ3 Sx= 5.21 in3/ft Ix= 11.85 in4/ft Weight= 24.92 lb/ft
Top deflection = 8.557(in)
PMA22 Sx= 5.4 in3/ft Ix= 13.7 in4/ft Weight= 36 lb/ft
Top deflection = 7.401(in)
LZ250 Sx= 5.44 in3/ft Ix= 12.4 in4/ft Weight= 25.52 lb/ft
Top deflection = 8.177(in)
CS55 Sx= 6.34 in3/ft Ix= 18.67 in4/ft Weight= 11.26 lb/ft
Top deflection = 5.431(in)
CS60 Sx= 6.98 in3/ft Ix= 20.48 in4/ft Weight= 12.29 lb/ft
Top deflection = 4.951(in)

Cofferdam A w/ Sheetpile Wall 7.5' w/ 3' Shelf

Water @ 811.50



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Wall Height=4.5 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=14.86 Min. Pile Length=19.36
MOMENT IN PILE: Max. Moment=5.97 per Pile Spacing=1.0 at Depth=13.52

PILE SELECTION:
Request Min. Section Modulus = 2.2 in3/ft, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)
PSA23 (24.73) PSX32 (27.41) PSA28 (22.53) CL42 (22.53) CL47 (19.92)
CL57 (16.30) LZ8 (12.50) LZ7 (11.46) LZ5 (9.80) LZ3 (8.56)
PMA22 (7.40) LZ250 (8.18) CS55 (5.43) CS60 (4.95)

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	4.500	0.000	0.000000
*	Below	Base		
4.500	0.000	7.500	0.000	0.000000
7.500	0.000	22.500	0.282	0.018785
*	Water	Pres.		
0.000	0.000	13.000	0.811	0.062400

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
4.5	0.38	13.0	1.42	0.122
13.0	1.42	22.5	3.55	0.225

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	4.50	1.00

Sheetpile Criteria:

It is anticipated that the riverbed may vary in elevation along the length of the wall. If a constant vent elevation is kept along its length as well, the height of the wall may vary which would require varying lengths of embedment. Based on the above analyses and establishing at minimum shelf width of 4', the following spectrum is developed,

REQUIRED PILE EMBEDMENT VS WALL HEIGHT

Wall Height H ft	Embedment Depth D ft
6.0	12.0
6.5	13.0
7.0	14.0
7.5	15.0

The minimum required section modulus of the sheetpile is,

S_{min} 2.2 in^3/ft