Tide Gate and Outlet Structure Investigation

Great Creek Outlet Structure

Silver Sands State Park
Milford, CT
April 2012

146 Hartford Road
Manchester, CT 06040

Project No. 2000445.A20

Table of Contents

Tide Gate and Outlet Structure Investigation
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1 Introduction 1

1.1 Project Understanding 1

1.2 Background and Description of Tide Gate and Outlet Structure 1

2 Tide Gate Structure Inspection 2

2.1 Structural Inspection 2

2.2 Mechanical/Operational Inspection 3

2.3 Electrical/Telemetering Inspection 3

3 Outlet Structure Inspection 4

3.1 Structural Inspection 4

3.2 Geotechnical Investigation 4

3.3 Topographic Survey 6

4 Conclusions and Recommendations 7

4.1 Tide Gate Structure 7

4.2 Outlet Structure 8

4.3 Next Steps 8

Figures

1 Site Location Map

2 Exploration Location Plan

Table of Contents

Tide Gate and Outlet Structure Investigation
Great Creek Outlet Structure
Silver Sands State Park
Milford, CT

Appendicies

A Original Design Drawings – Diversified Technologies Corporation
(Diversified Technologies Corporation, June 1987)
1 – Plan & Profile Index
13 – Gate Vault Structural, Mechanical, Electrical
14 – Structural Details

B Select Photographs

C Review and Recommendations Concerning the Self-Regulating Tide Gates
(Thomas J. Steinke, December 20, 2011)

D Letter from AECOM to DEEP dated December 20, 2011

E Emergency Construction Work on the Outlet Wall at Great Creek – As-Built
(CT DEEP, May 15, 2007)

F Boring Logs

G Laboratory Test Results

H Survey Maps
V-1.00 – 2001 Section Locations
V-2.00 through V-2.01 – 2012 Sections Location
V-2.02 – Inlet Structure Topography
V-2.03 through V-2.04 – 2012 Section Views

I Opinion of Probable Construction Cost

1 Introduction

1.1 Project Understanding

On behalf of the Connecticut Department of Energy and Environmental Protection (CT DEEP), Fuss & O'Neill Inc. completed an investigation of the Great Creek Tide Gate and Outlet Structure at the Silver Sands State Park in Milford, Connecticut (*Figure 1*). The tide gate structure was constructed in the mid 1980's and controls the water level of Great Creek. Fuss & O'Neill inspected the tide gate structure in April of 2007 and deficiencies in the concrete structure itself were observed. In addition, the condition of the tide gates' mechanical and operational elements suggested that they were not being regularly maintained. The purpose of the current inspection was to confirm the findings of the 2007 emergency investigation and to document specific deficiencies related to the tide gates and their associated concrete structural elements. The timber piles, walers, and sheet piles that form the training walls at the outlet structure were also inspected to assess their current condition. This report discusses:

- The background and description of the tide gate and outlet structure.
- An overview of the tide gate inspection.
- An overview of the outlet structure inspection.
- Recommendations for repairing and rehabilitating the tide gate and outlet structure.

Additionally, Woods Hole Group, as a subconsultant to Fuss & O'Neill, will be evaluating the need to modify the existing configuration of the outlet structure to better protect the adjacent beach from erosion. Woods Hole Group's findings will be summarized in a separate report that details recommendations to correct the identified deficiencies as well as an order of magnitude cost estimate for their implementation.

1.2 Background and Description of Tide Gate and Outlet Structure

The self-regulating tide gates were installed as part of the Great Creek flood relief project for drainage improvements at the Silver Sands Beach area in Milford in 1989. The initial objective of the Great Creek flood control project was to provide drainage relief to the residents occupying the low-lying homes northerly of East Broadway and southerly of the Great Creek salt marshes. A primary goal of the flood relief efforts was to accommodate for the discharge of floodwaters in the 12-hour tidal cycle following a storm event instead of over a week's time.

The initial drainage design included a concrete gate vault structure with two wall-mounted, manually-operated, and electrically-powered vertical sluice gates as the primary water control structures in the flood relief system. Subsequent coastal management priorities for fire control, mosquito control, and ecological restoration of the extensive salt marshes resulted in the addition of the two self-regulating tide gates located immediately landward the sluice gates. This design approach placed the two different gate design systems in direct conflict and resulted in the premature closure of the self-regulating tide gates. As a corrective measure, the two sluice gates are operated at different and opposite openings. This allows the self-regulating tide gates to function as originally intended.

A timber outlet structure was constructed in conjunction with the concrete gate vault structure. The training walls of the timber outlet structure extend into Long Island Sound. The purpose of the outlet structure was to provide a permanent solution to the ongoing beach erosion in the vicinity of Great Creek, which in the past had caused shoaling and blockage of the previous tide gate structure.

A plan view of both structures is depicted on Drawing 1 in *Appendix A* and in Photo 1 of *Appendix B*. Drawings 13 and 14 in *Appendix A* detail the structural components of both structures.

2 Tide Gate Structure Inspection

The inspection of the tide gate Structure, led by Fuss & O'Neill, included an underwater inspection of the structural concrete elements performed by Shoreline Diving Services and a visual inspection of the tide gate's mechanical and operational components performed by its original designer, Tom Steinke. Shoreline Diving Services also inspected the precast concrete culvert that leads to the timber training walls at the outlet. Both inspections took place during the morning low tide on December 1, 2011. In attendance were Jay Kane (Shoreline Diving), Ted Rybak (CT DEEP), Jason LeDoux and Craig Lapinski (Fuss & O'Neill), Tom Steinke, Jim Cooper (Milford WPCA), Mary Rose Palumbo (City of Milford), and Gary Wassmer (City of Milford). The electrical and telemetering systems associated with the operation of the tide gate structure were also discussed and evaluated. Photos of the inspection taken by Fuss & O'Neill are located in *Appendix B* and photos taken by Tom Steinke are located in *Appendix C*.

2.1 Structural Inspection

We began our inspection with the precast concrete culvert at the inlet of Great Creek. The precast concrete culvert has a clear width of 16 feet and a clear height of 5 feet. There are 4 butted box sections with a concrete headwall and wingwalls retaining grade at the inlet. The headwall and wingwalls are in good condition with isolated locations of minor map cracking. There is moderate erosion of embankment material adjacent to both wingwalls (Photo 2 of *Appendix B*) and deposits of sediment farther upstream of the culvert. The underside of the top slabs of the concrete culvert boxes have multiple locations of spalled concrete. Some of the spalls expose reinforcing steel that has begun to corrode. The walls of the concrete box sections are in good condition. Evidence of joint repair between the box sections was observed and appears to be in fair condition.

The inspection continued with the concrete structure containing the tide gates. The structure consists of a concrete containment bay adjacent to the inlet culvert, twin precast concrete boxes with the tide gates attached at their outlets, and a containment bay leading to the outlet culvert. The containment bay near the inlet culvert is in good condition with isolated locations of minor map cracking and light scaling (Photo 3 of *Appendix B*). The concrete surfaces at and below the water level are covered with marine bio-fouling growth. The two 10-foot long precast concrete box culvert sections, with the tide gates attached at their outlets, are in fair condition. The underside of the top slab of the southwest culvert has numerous spalls, most of which expose reinforcing steel that is moderately corroded. This condition is identified in Tom Steinke's report and is depicted in Photo 4147 of *Appendix C*. There are also spalls in the northeast culvert which are less severe. The exterior corners between the top slab and sidewalls of the northeast culvert contain multiple spalls near the tide gate; however, the spalls have not exposed

reinforcing steel (Photo 4 of *Appendix B*). The containment bay near the outlet culvert is in good condition with minor cracks and light scaling in multiple locations.

The precast concrete outlet culvert extends from the containment bay southeast to Long Island Sound. The culvert is approximately 250 feet long and has a clear width of 16 feet and a clear height of 5 feet. The interior portions of the culvert are in fair condition with minor spalls and cracks on many of the walls and the underside of the top slabs. The joints between the box culvert sections are in poor condition. Many are cracked, loose, or missing joint filler material. The tops of the boxes adjacent to the outlet are exposed and reveal spalls and separation at the joints between adjacent sections (Photo 5 of *Appendix B*).

2.2 Mechanical/Operational Inspection

The mechanical and operational components of the tide gate structure were inspected by Tom Steinke, its original designer. A detailed report that includes the history of the tide gate structure, observations of its current condition, and recommendations for repairs and improvements is included as *Appendix C*. A summary of Mr. Steinke's recommendations is included in Section 4.1 of this report.

2.3 Electrical/Telemetering Inspection

At the time of the inspection, Fuss & O'Neill observed the successful operation of the two motorized sluice gates located immediately downstream of the tide gates. Jim Cooper of the Milford WPCA informed us that he periodically exercises these sluice gates and greases the gate stems. A 480 volt, 3 phase electrical service from the East Broadway Pump Station was used to power the gates. However, since the date of the inspection, CT DEEP was informed that the East Broadway Pump Station has been demolished and the electrical service to the tide gate structure has been disconnected. The structure is still without power today because the United Illuminating (UI) Company is unwilling to supply 3 phase power to the tide gate structure and the Milford WPCA does not have the budget to replace the existing gate motors with new motors that will run on single phase power. This also affects the existing pole light located adjacent to the tide gate structure. Further detail can be found in a December 20, 2011 letter from AECOM to the CT DEEP, which is included as *Appendix D*.

In addition, there is an existing pole-mounted, solar-powered telemetering device located near the tide gate structure. According to Jim Cooper, this device is owned and operated by the Milford Fire Department and is used to monitor tide levels within the structure. Since this equipment is independently powered, its operation will not be affected by demolition of the East Broadway Pump Station. The existing electrical and telemetering equipment is shown in Photo 6 of *Appendix B*. The sluice gates and associated appurtenances are shown on Photos 4133 and 4135 of *Appendix C*.

3 Outlet Structure Inspection

The training walls at the outlet structure consist of 12" diameter pressure treated timber piles, 4"x8" and 8"x10" timber walers, and 4" thick timber sheet piles. The training walls extend southeast to the sound from the outlet of the box culvert. The training walls experienced a localized failure in 2007. Tie-backs were installed by the CT DEEP as an emergency action to repair and stabilize the training walls. A copy of the repair plan is included as *Appendix E*. Despite this emergency action, erosion has still occurred adjacent to the southwestern training wall near the outlet of the box culvert and partially exposed some of the tie-backs at the time of this inspection (Photo 7 of *Appendix B*). This condition, which is a result of sand migrating under the training walls, is threatening the integrity of the outlet structure.

3.1 Structural Inspection

We observed significant rot and deterioration to the interior portions of the timber piles and sheet piles (Photo 8 of *Appendix B*). The damage may be due to worm infestation of the timber at and below the typical low tide water elevation. The extent of the damage to the timber members has likely reduced their load-bearing capacities substantially. In their current condition, the timber training walls may fail. No additional deficiencies to the outlet structure were observed in the vicinity of the erosion that would indicate its cause.

3.2 Geotechnical Investigation

3.2.1 Field Investigation

Fuss & O'Neill subcontracted with Clarence Welti Associates, Inc. to drill three test borings near the existing timber retaining wall at the outlet structure on December 8, 2012. The borings were observed and logged by a Fuss & O'Neill engineer. Locations of the borings are included on *Figure 2*. Logs of the subsurface explorations are included in *Appendix E*.

Two borings were advanced to depths of 20 feet and one to 80 feet using a track-mounted drill rig and standard hollow stem auger techniques. Boring B-1 was located adjacent to the south side of the timber retaining wall at its approximate midpoint. Boring B-2 was located on the south side of the walls, and B-3 was located on the north side closer to the Sound. Soil samples were obtained and standard penetration tests (SPTs) were performed at 5-foot intervals in the test borings. The SPT consists of driving a 2-inch outside-diameter split spoon sampler 24 inches with a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler from 6 to 18 inches is the Standard Penetration Resistance, also known as the SPT N-value, which is a relative indicator of the in-place soil density or consistency.

Fuss & O'Neill selected two soil samples from the boring B-2 and submitted them to Clarence Welti Associates, Inc. for grain size testing in accordance with ASTM D 422. The test results were used to confirm our field classifications. The laboratory test results are included in *Appendix G*.

The material encountered in the borings generally consisted of approximately 2 to 8 feet of loose fine to medium sand overlying a very soft organic silt/peat layer. The variation of sand cover over the organic silt/peat layer is due to the difference in elevations of the ground surface around the existing retaining wall. On the north side the sand has been eroded, while on the south side sand has accumulated against the side of the timber retaining wall. The surface elevation of the organic silt/peat layer is approximately the same in all borings. The thickness of the organic silt/peat layer is approximately 4 feet. Below the organic silt/peat layer, the borings encountered medium dense to very dense silty sand (approximately 19 feet in boring B-2). In boring B-2, the 40-foot deep boring, silt with varying quantities of sand and a trace amount of clay was encountered to the bottom of the boring at 41.5 feet below ground surface. No refusal was encountered by the split spoon sampler or the augers in any of the borings. Groundwater levels closely mimicked the existing surface water elevation, and likely rise and fall with the tide.

3.2.2 Existing Retaining Wall Analysis

Fuss & O'Neill performed an analysis of the stability of the existing cantilevered (not anchored) soldier pile and lagging retaining wall that defines the southern side of the outlet channel. The original design for the wall called for 12-inch diameter wood piles to be driven to a total embedment depth of 24 feet, a spacing of 8 feet between piles, two levels of walers, and lagging embedded 6 feet into the ground. The design included a structural analysis of the piles, but no analysis of the soil reaction to the loading on the piles was included in the design report reviewed by Fuss & O'Neill (Timber Open Channel Structural Design by Diversified Technologies Corporation (DTC) of North Haven, CT dated 6/21/84). An important design assumption made then was that the pressure on the walls would be that of differential water pressure alone and that the water load would be on the exterior side of the channel with no water on the inside of the channel. No soil pressures were considered, and no justification of the differential water pressure was given. It should also be noted that DTC was not responsible for considering the accumulation of sand against the wall as part of their design.

In addition, it appears no independent construction observation was performed during pile driving to confirm design pile depths were achieved. This is an important observation since there is a dense sand and silt layer at approximately 15 feet deep that would make it very difficult and possibly impossible to drive a pile to the specified 24-foot depth without resorting to some alternate methodology such as jetting. Over time, the retaining wall on the south side began to fail as migrating sand piled up against the outside of the wall. In response, CT DEEP repaired the wall and installed dead men in the sand cabled to the piles approximately 40 feet from the wall. It appears this action has stabilized the southern wall, but damage to the walers is evident from the failure and subsequent repair. It also appears there is significant ongoing natural deterioration of the piles.

In accordance with our scope of services, we analyzed the stability of the pre-cable-anchored cantilevered south wall. Our analysis consisted of a cantilevered wall design accounting for the soil surrounding the wall and piles, but not an analysis of the structural members themselves. We also used the present condition with soil accumulated against the outside of the south wall. Since the tidal water within and outside the channel will rise and fall to approximately equal elevations, with a small lag time resulting in minor differential water levels, we neglected the net water forces on the wall. Instead, we assumed the most critical scenario for the wall would be when the tide is low, resulting in moist

unsaturated sand against the outside of the south wall and the water level inside the channel at the channel bottom surface.

To check the stability of this scenario, we performed a design analysis with the given soil information, existing soil elevations, pile size, and pile spacing to calculate an acceptable depth of pile embedment to allow use of a cantilevered wall. This result was then compared to the original design recommendation and to the possibility that the piles were driven only to the dense soil layer. The analysis was performed using the conventional method of analysis summarized by Braja M. Das in his text book titled "Principles of Foundation Engineering." One simplifying assumption was made for the analysis. The presence of the peat was neglected, and a correction was applied at the end of the analysis to account for this simplification. Peat has very low shear strength and submerged unit weight. Because of these characteristics of peat, it has very little effect on the wall, either in exerting a force on the wall (active pressure) or in ability to resist pressure (passive pressure). Its main contribution to wall instability in this case is that it makes the moment arm of the forces on the upper portions of the wall longer. Neglecting this longer moment arm results in under-estimating the force on the wall. To simplify the analysis, the peat thickness of 4 feet was ignored for the numerical analysis, but the thickness was added to the required pile embedment depth at the end of the analysis to compensate. While this is not strictly accurate, it is sufficiently accurate for the intended purpose.

The numerical results of the analysis indicate that if the wall were to be designed for the soil forces of the accumulated sand behind the wall (the original DTC design was not intended to evaluate this scenario), the depth of embedment of the 12-inch diameter timber piles should be 15.2 feet. Add to this the 4-foot thickness of peat described in the preceding paragraph, and the required depth becomes 19.2 feet. In addition, it is necessary to apply a reduction factor to the passive resistance of the soil to pile movement, since the full realization of this resistance would allow too much movement of the pile below the ground surface. Typically, the depth of embedment is increased by 20 to 30 percent to account for the reduction. If we apply a 25 percent increase, the minimum safe embedment depth would be 24 feet. This matches the recommendation given by DTC in their design report, although they provide no justification for this embedment depth.

As mentioned previously, this embedment depth would require the 12-inch piles to be driven 9 feet into a dense sand and silt layer to achieve the design embedment. A cantilevered wall built on piles driven to a depth of 15 feet would not be expected to be stable under the loads imposed by the accumulated sand. A typical solution to this problem would be to design an anchored wall with less embedment depth, similar to that installed as a repair by CT DEEP. Based on observations since the wall was repaired, it appears the alignment of the piles on both sides of the channel is satisfactory with no visual evidence of significant wall displacement, although the condition of the structural members of the wall is suspect, and may warrant replacement or removal of the wall.

3.3 Topographic Survey

A field topographic survey was performed to resurvey the same eight beach profile lines surveyed in 2011 and to survey an additional five profiles. In total, 13 beach profiles were completed. Seven profiles were west of the structure for a distance of approximately 800 feet and six profiles were east of the structure over a distance of approximately 6,000 feet. The survey also consisted of a detailed

location of the outlet structure, centerline of channel, timber training walls, and finish floor elevations of the first six cottages east of the outlet structure. A limited topographic survey to identify sediment accumulation at the inlet of the tide gate structure was also performed. The survey drawings that were prepared in association with this effort are included in *Appendix H*.

4 Conclusions and Recommendations

4.1 Tide Gate Structure

Based on the results of the tide gate structure inspections performed by Fuss & O'Neill Inc., Shoreline Diving Services, and Mr. Thomas J. Steinke, we recommend proceeding with the following repairs and improvements:

1. Repair the concrete spalls on the undersides of the top slabs of the inlet culvert and tide gate culverts. The structural integrity of the box culverts may be compromised if the corroded reinforcing steel exposed by the concrete spalls has experienced significant section loss.

2. Repair the exposed portions of the joints between adjacent box culvert sections near the outlet structure. The interior portions of the joints between adjacent outlet box sections do not require immediate attention; however, their condition should be monitored annually and repaired if water and/or debris are freely entering the culvert from the joints.

3. Remove the accumulated bio-fouling on the interior portions of the concrete containment chambers.

4. Clean or replace the clear plastic protective sleeves over the lift screws at the sluice gates.

5. Redesign and refit the Self-Regulating Tide Gates (SRT) including their sub-assemblies as recommended by Tom Steinke in his report located in *Appendix C*. This work includes:

    a) Re-bond gaskets to the stainless steel backing plate.
    b) Replace the upper floats with all new spheres.
    c) Replace all broken and missing bolts with 316 stainless steel bolts.
    d) Redesign the SRT hinge sub-assembly to optimize performance.
    e) Remove all accumulated bio-fouling from the SRT assemblies.
    f) Implement an annual cleaning procedure for the SRT's.

6. Update/develop an operation and maintenance manual as recommended by Tom Steinke in his report located in *Appendix C*.

We estimated the cost to construct the repairs and improvements listed above. A detailed breakdown of this estimated cost is included as *Appendix I*.

4.2 Outlet Structure

Based on our visual observations of the timber training walls and the geotechnical investigation, the outlet structure is in poor condition and will require significant repairs or replacement. The recommendations from the investigation performed by Woods Hole Group will likely affect the new configuration for the repair or replacement of the timber training walls.

4.3 Next Steps

As of the date of this report, Woods Hole Group has performed grain size sampling of the native sand material and taken current velocity measurements within the harbor just downstream of the outlet structure. These data, along with the survey mapping included in this report, will be used to determine how the outlet structure should be modified to remedy the existing beach erosion condition located just down drift of the structure itself. The results of this investigation, including short-term and long-term beach stabilization recommendations with associated cost estimates, will be included in a supplemental report.

Figures

File Path: J:\DWG\P2000\445\A20\Civil\Plan\2000445A20_LOC01.dwg Layout: FIG 1 Plotted: Thu, April 05, 2012 - 1:01 PM User: KEVIN MCGARRY
Plotter: DWG TO PDF.PC3 CTB File: FO COLOR.CTB
MS VIEW: LAYER STATE:

SCALE:	
HORZ.: 1" = 2000'	
VERT.:	
DATUM:	
HORZ.:	
VERT.:	

0 1000 2000
GRAPHIC SCALE

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www.fando.com

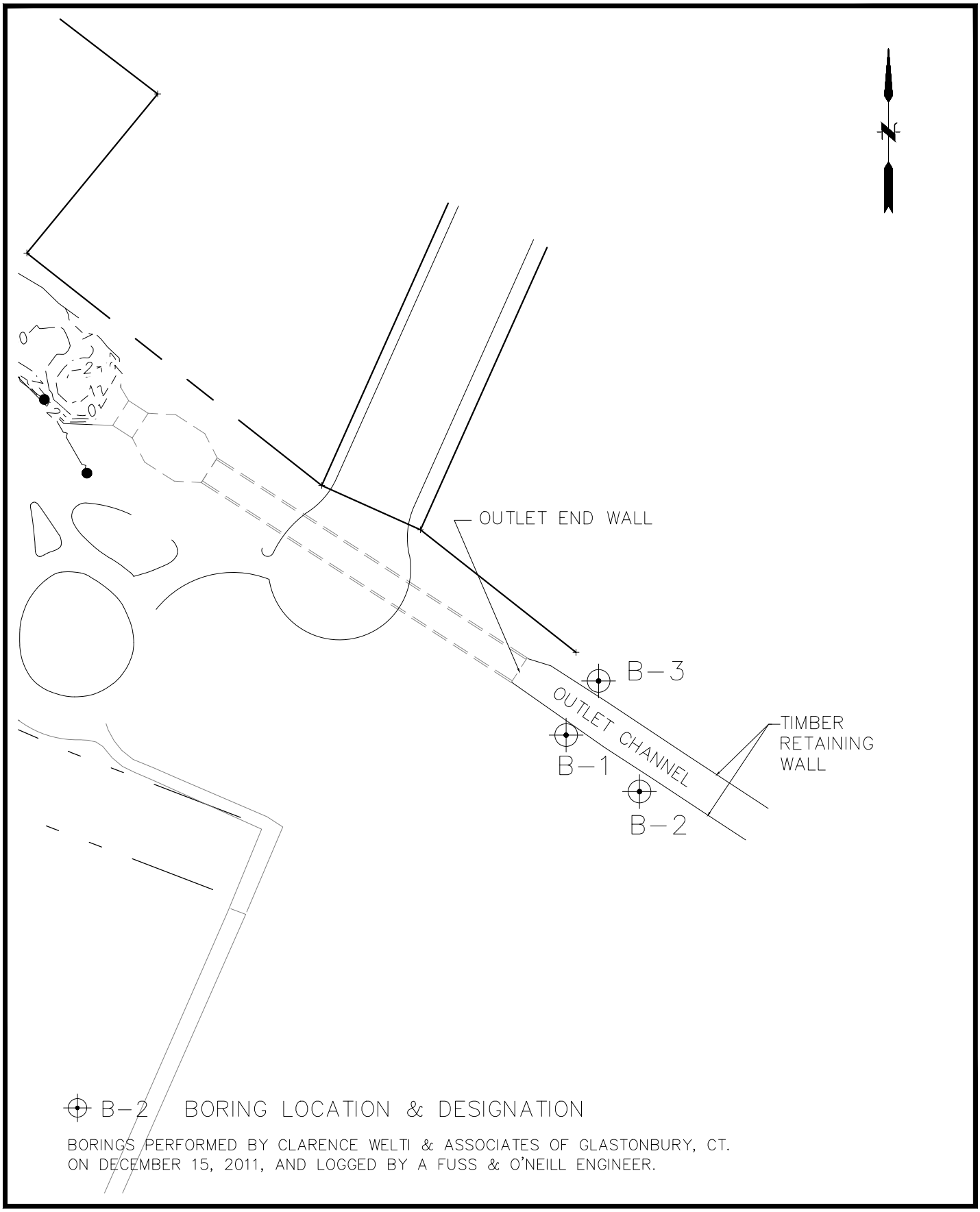
SITE LOCATION MAP

GREAT CREEK TIDE GATE & OUTLET STRUCTURE
SILVER SANDS STATE PARK

MILFORD CONNECTICUT

PROJ. No.: 2000 445.A20
DATE: APRIL 2012

FIGURE 1



BORINGS PERFORMED BY CLARENCE WELTI & ASSOCIATES OF GLASTONBURY, CT. ON DECEMBER 15, 2011, AND LOGGED BY A FUSS & O'NEILL ENGINEER.

File Path: J:\DWG\P2000\445\A20\Civil\Plan\Exploration Location Plan.dwg Layout: FIG 2 Plotted: Thu, April 05, 2012 - 1:08 PM User: KEVIN MCGARRY
Plotter: DWG TO PDF.PC3 CTB File: FO 2008 MONO (HALF).CTB

MS VIEW:
LAYER STATE:

SCALE:
HORZ.: NTS
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

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EXPLORATION LOCATION PLAN

GREAT CREEK TIDE GATE & OUTLET STRUCTURE
SILVER SAND STATE PAR

MILFORD CONNECTICUT

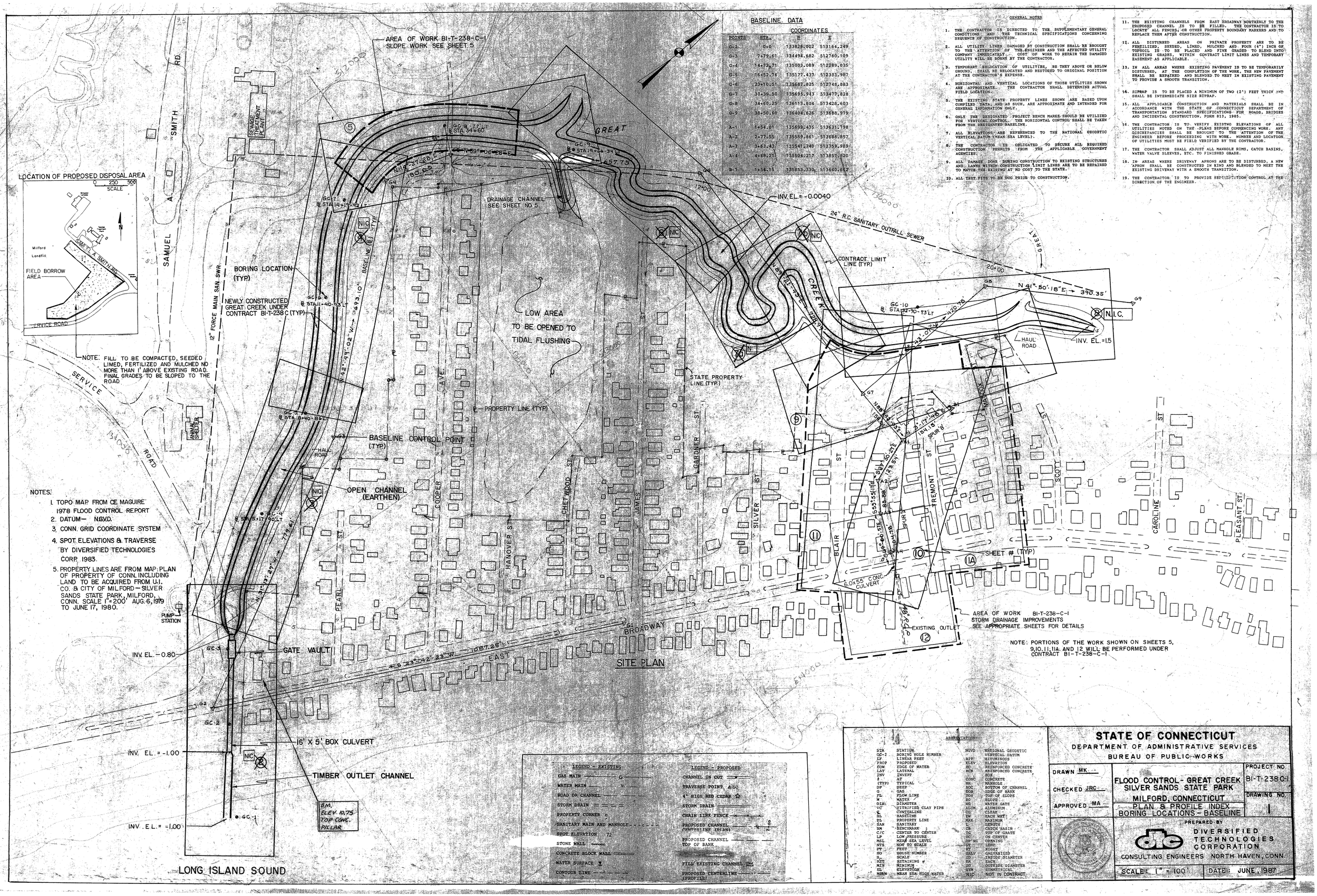
PROJ. No.: 2000 445.A20
DATE: APRIL 2012

FIGURE 2

Appendix A

Original Design Drawings
(Diversified Technologies Corporation, June 1987)

1 - Plan & Profile Index
13 - Gate Vault Structural, Mechanical, Electrical
14 - Structural Details



NOTES:

1. TOPO MAP FROM CE MAGUIRE 1978 FLOOD CONTROL REPORT
2. DATUM— N.G.V.D.
3. CONN. GRID COORDINATE SYSTEM
4. SPOT ELEVATIONS & TRAVERSE BY DIVERSIFIED TECHNOLOGIES CORP. 1983.
5. PROPERTY LINES ARE FROM MAP: PLAN OF PROPERTY OF CONN. INCLUDING LAND TO BE ACQUIRED FROM U.I. CO. & CITY OF MILFORD — SILVER SANDS STATE PARK, MILFORD, CONN. SCALE 1"=200' AUG. 6, 1979 TO JUNE 17, 1980.

BASELINE DATA

POINTS	STA.	COORDINATES N	E
G-2	0+0	133828.002	513164.249
G-3	7+79.61	134494.682	512760.109
G-4	14+72.71	135003.089	512289.035
G-5	16+52.76	135177.437	512333.987
G-6	23+10.51	135687.825	512748.883
G-7	30+39.50	135695.943	513477.828
G-8	34+60.25	136113.804	513428.603
G-9	38+50.60	136404.626	513688.979
A-1	1+54.01	135699.435	513631.798
A-2	2+77.55	135589.861	513688.857
A-3	3+63.43	135541.740	513759.989
A-4	4+68.21	135504.217	513857.820
B-1	1+54.15	135853.330	513640.682

GENERAL NOTES

1. THE CONTRACTOR IS DIRECTED TO THE SUPPLEMENTARY GENERAL CONDITIONS AND THE TECHNICAL SPECIFICATIONS CONCERNING SEQUENCE OF CONSTRUCTION.
2. ALL UTILITY LINES DAMAGED BY CONSTRUCTION SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND THE AFFECTED UTILITY COMPANY IMMEDIATELY. COST OF WORK TO REPAIR THE DAMAGED UTILITY WILL BE BORNE BY THE CONTRACTOR.
3. TEMPORARY RELOCATION OF UTILITIES, BE THEY ABOVE OR BELOW GROUND, SHALL BE RELOCATED AND RESTORED TO ORIGINAL POSITION AT THE CONTRACTOR'S EXPENSE.
4. HORIZONTAL AND VERTICAL LOCATIONS OF THOSE UTILITIES SHOWN ARE APPROXIMATE. THE CONTRACTOR SHALL DETERMINE ACTUAL FIELD LOCATION.
5. THE EXISTING STATE PROPERTY LINES SHOWN ARE BASED UPON COMPILED DATA, AND AS SUCH, ARE APPROXIMATE AND INTENDED FOR GENERAL INFORMATION ONLY.
6. ONLY THE DESIGNATED PROJECT BENCH MARKS SHOULD BE UTILIZED FOR VERTICAL CONTROL. THE HORIZONTAL CONTROL SHALL BE TAKEN FROM THE DESIGNATED BASELINE.
7. ALL ELEVATIONS ARE REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM (MEAN SEA LEVEL).
8. THE CONTRACTOR IS OBLIGATED TO SECURE ALL REQUIRED CONSTRUCTION PERMITS FROM THE APPLICABLE GOVERNMENT AGENCIES.
9. ALL DAMAGE DONE DURING CONSTRUCTION TO EXISTING STRUCTURES AND LAWNS WITHIN CONSTRUCTION LIMIT LINES ARE TO BE REPAIRED TO MATCH THE EXISTING AT NO COST TO THE STATE.
10. ALL TEST PITS TO BE DUG PRIOR TO CONSTRUCTION.
11. THE EXISTING CHANNELS FROM EAST BROADWAY NORTHERLY TO THE PROPOSED CHANNEL IS TO BE FILLED. THE CONTRACTOR IS TO LOCATE ALL FENCES, OR OTHER PROPERTY BOUNDARY MARKERS AND TO REPLACE THEM AFTER CONSTRUCTION.
12. ALL DISTURBED AREAS ON PRIVATE PROPERTY ARE TO BE FERTILIZED, SEEDED, LIMED, MULCHED AND FOUR (4") INCH OF TOPSOIL IS TO BE PLACED AND FINE GRADED TO BLEND INTO EXISTING GRADES, WITHIN CONTRACT LIMIT LINES AND TEMPORARY EASEMENT AS APPLICABLE.
13. IN ALL AREAS WHERE EXISTING PAVEMENT IS TO BE TEMPORARILY DISTURBED, AT THE COMPLETION OF THE WORK, THE NEW PAVEMENT SHALL BE REPAIRED AND BLENDED TO MEET IN EXISTING PAVEMENT TO PROVIDE A SMOOTH TRANSITION.
14. RIPRAP IS TO BE PLACED A MINIMUM OF TWO (2') FEET THICK AND SHALL BE INTERMEDIATE SIZE RIPRAP.
15. ALL APPLICABLE CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROADS, BRIDGES AND INCIDENTAL CONSTRUCTION, FORM 813, 1985.
16. THE CONTRACTOR IS TO VERIFY EXISTING ELEVATIONS OF ALL UTILITIES NOTED ON THE PLANS BEFORE COMMENCING WORK. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER BEFORE PROCEEDING WITH WORK. NUMBER AND LOCATION OF UTILITIES MUST BE FIELD VERIFIED BY THE CONTRACTOR.
17. THE CONTRACTOR SHALL ADJUST ALL MANHOLE RIMS, CATCH BASINS, WATER VALVE SLEEVES, ETC. TO FINISHED GRADE.
18. IN AREAS WHERE DRIVEWAY APRONS ARE TO BE DISTURBED, A NEW APRON SHALL BE CONSTRUCTED IN KIND AND BLENDED TO MEET THE EXISTING DRIVEWAY WITH A SMOOTH TRANSITION.
19. THE CONTRACTOR IS TO PROVIDE SEDIMENTATION CONTROL AT THE DIRECTION OF THE ENGINEER.

LEGEND - EXISTING

GAS MAIN — G —
WATER MAIN — W —
ROAD OR CHANNEL
STORM DRAIN
PROPERTY CORNER
SANITARY MAIN AND MANHOLE
SPOT ELEVATION .72
STONE WALL
CONCRETE BLOCK WALL
WATER SURFACE
CONTOUR LINE

LEGEND - PROPOSED

CHANNEL IN CUT
TRAVERSE POINT
4" HIGH RED CEDAR
STORM DRAIN
CHAIN LINK FENCE
PROPOSED CHANNEL (CENTERLINE PROFILE)
PROPOSED CHANNEL TOP OF BANK
FILL EXISTING CHANNEL
PROPOSED CENTERLINE (PROFILE)

ABBREVIATIONS

STA	STATION	NGVD	NATIONAL GEODETIC VERTICAL DATUM
GC-2	BORING HOLE NUMBER	BIT	BITUMINOUS
LF	LINEAR FEET	ELEV	ELEVATION
PROP	PROPOSED	RC	REINFORCED CONCRETE
EOW	EDGE OF WATER	RCB	REINFORCED CONCRETE BOX
LAT	LATERAL	CONC	CONCRETE
INV	INVERT	MH	MANHOLE
(TYP)	TYPICAL	BOC	BOTTOM OF CHANNEL
DP	DEEP	EOB	EDGE OF BANK
G	GAS	TOS	TOP OF SLOPE
FL	FLOW LINE	SO	SLOPE
W	WATER	WG	WATER GATE
DIA	DIAMETER	ALUM	ALUMINUM
VC	VITRIFIED CLAY PIPE	CL	CLEAR
℄	CENTERLINE	EW	EACH WAY
BL	BASELINE	MAX	MAXIMUM
PL	PROPERTY LINE	L	LENGTH
SAN	SANITARY	CB	CATCH BASIN
BM	BENCHMARK	TG	TOP OF GRATE
C/C	CENTER TO CENTER	OC	ON CENTER
LP	LOW PRESSURE	OPNG	OPENING
MSL	MEAN SEA LEVEL	LEFT	LEFT
NTS	NOT TO SCALE	RT	RIGHT
FT	FEET	GALV	GALVANIZED
HO	HOUSE NUMBER	ID	INSIDE DIAMETER
S	SCALE	EA	EACH
RTN	RETAINING	OD	OUTSIDE DIAMETER
MIN	MINIMUM	SYM	SYMMETRICAL
EL	ELEVATION	NIC	NOT IN CONTRACT
MHW	MEAN SEA HIGH WATER		

STATE OF CONNECTICUT
DEPARTMENT OF ADMINISTRATIVE SERVICES
BUREAU OF PUBLIC WORKS

DRAWN MK
CHECKED JRC
APPROVED MA

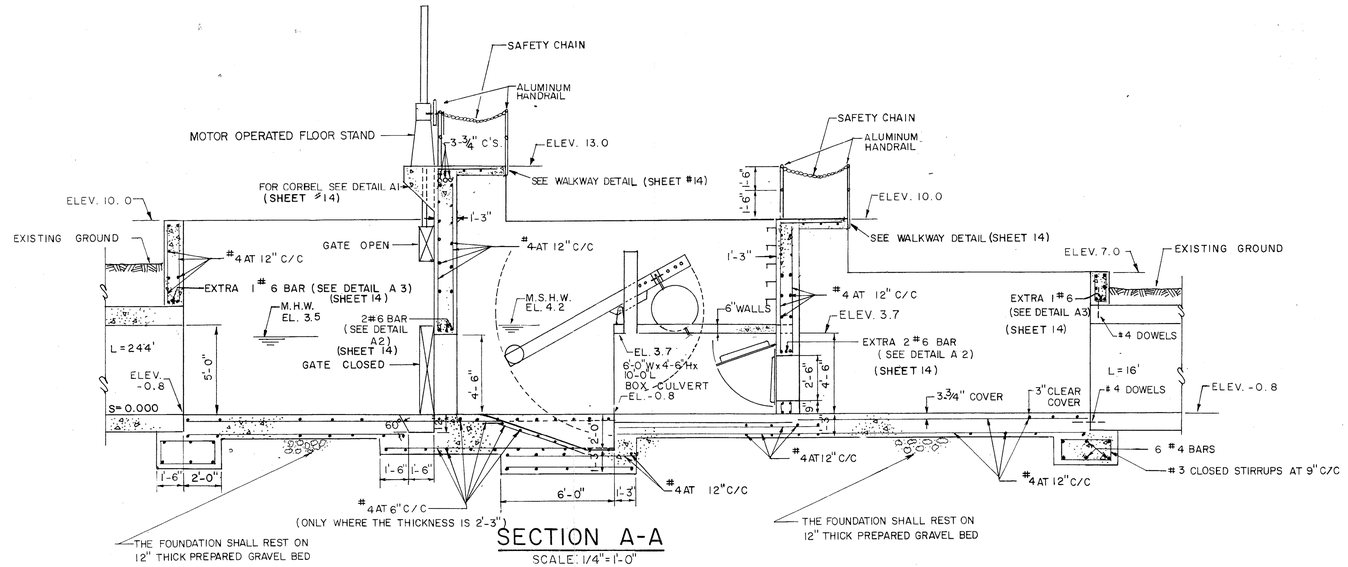
FLOOD CONTROL - GREAT CREEK
SILVER SANDS STATE PARK
MILFORD, CONNECTICUT
PLAN & PROFILE INDEX
BORING LOCATIONS - BASELINE

PROJECT NO. BI-T-238C-1
DRAWING NO. 1

PREPARED BY
DIVERSIFIED TECHNOLOGIES CORPORATION
CONSULTING ENGINEERS NORTH HAVEN, CONN.

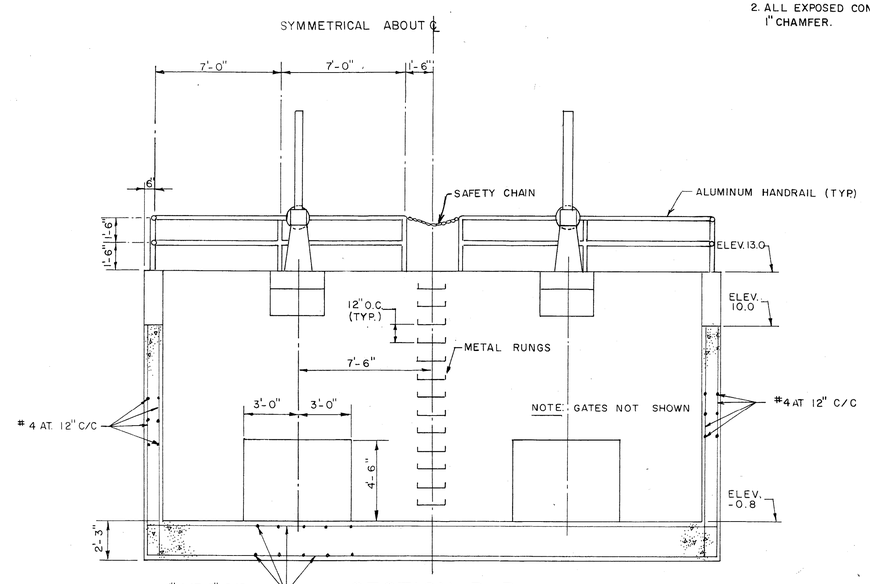
SCALE 1" = 100'
DATE JUNE, 1987

1. ALL ALUMINUM RAILINGS, STEPS, GRAB BARS, ETC., THAT COME IN CONTACT WITH CONCRETE SHALL RECEIVE, 1 COAT OF KOPPERS SUPER SERVICE BLACK OVER THE CONTACT AREA OF THE ALUMINUM.
2. ALL EXPOSED CONCRETE EDGER TO RECEIVE A 1" CHAMFER.



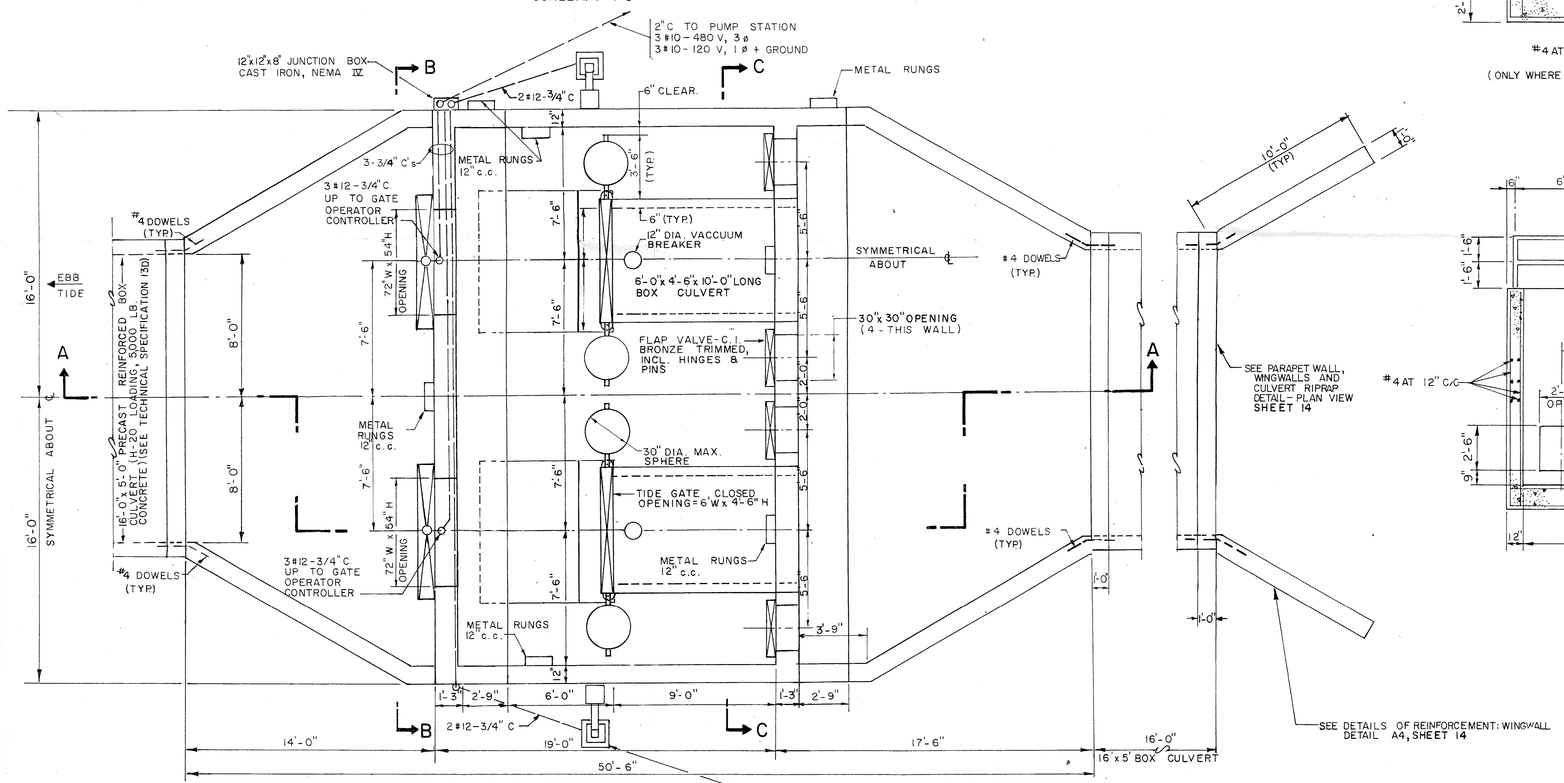
SECTION A-A

SCALE: 1/4" = 1'-0"



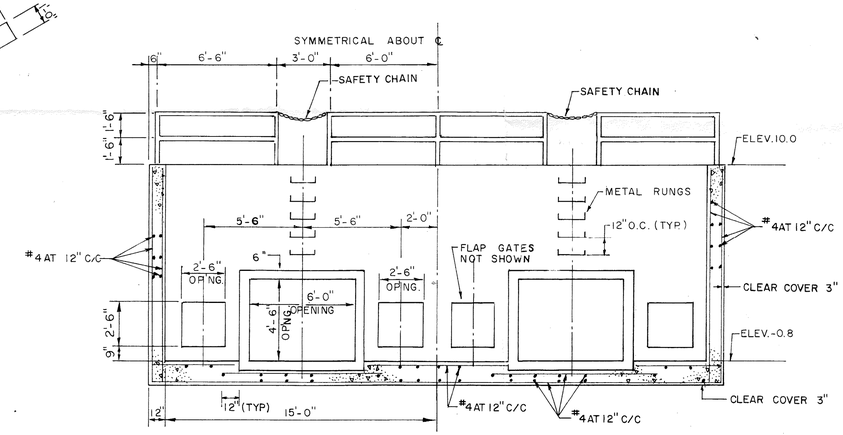
SECTION B-B

SCALE: 1/4" = 1'-0"



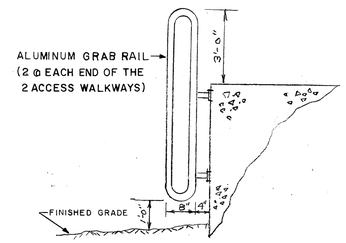
PLAN VIEW - GATE VAULT

SCALE: 1/4" = 1'-0"



SECTION C-C

SCALE: 1/4" = 1'-0"



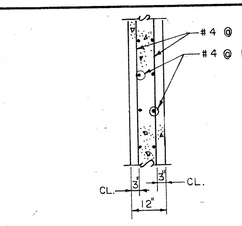
ELEVATION VIEW

GRAB RAILING (8 REQUIRED)

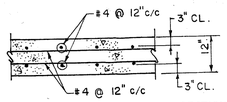
NTS

STATE OF CONNECTICUT DEPARTMENT OF ADMINISTRATIVE SERVICES BUREAU OF PUBLIC WORKS		
DRAWN GAB/SA CHECKED DTB/LL APPROVED MA	FLOOD CONTROL - GREAT CREEK SILVER SANDS STATE PARK MILFORD, CONNECTICUT GATE VAULT - STRUCTURAL - MECHANICAL - ELECTRICAL	PROJECT NO. BI-T-238 C DRAWING NO. 13
	PREPARED BY dtc CONSULTING ENGINEERS	DIVERSIFIED TECHNOLOGIES CORPORATION 55 Middletown Avenue North Haven, Conn. 06473 Tel: (203) 562-7560
	SCALE: AS NOTED	DATE: JUNE, 1985

GATE VAULT STRUCTURAL DETAILS

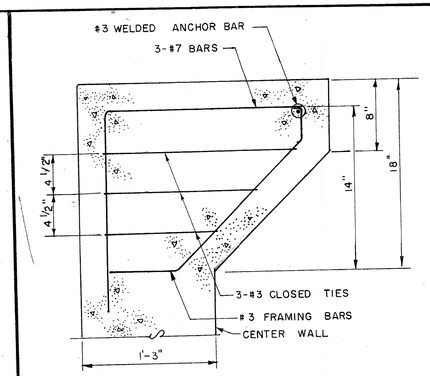


VERTICAL CROSS SECTION (TYP.)

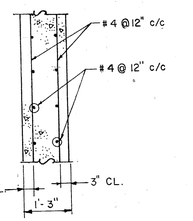


HORIZONTAL CROSS SECTION (TYP.)

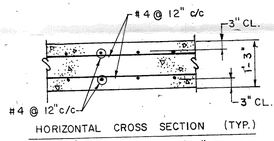
REINFORCEMENT FOR 12" THICK WALLS
N.T.S.



CORBEL DETAIL A1
N.T.S.

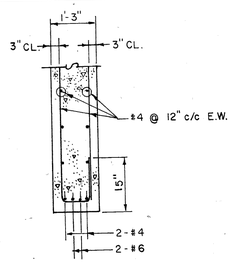


VERTICAL CROSS SECTION (TYP.)

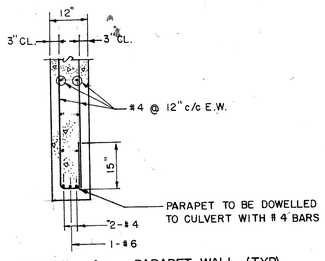


HORIZONTAL CROSS SECTION (TYP.)

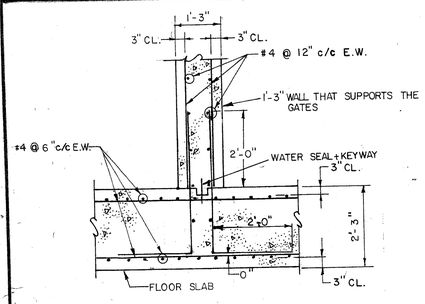
REINFORCEMENT FOR 1'-3" THICK WALLS
N.T.S.



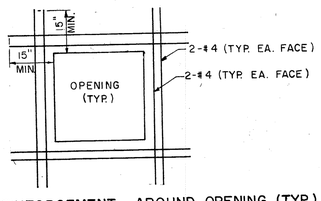
DETAIL A2
N.T.S.



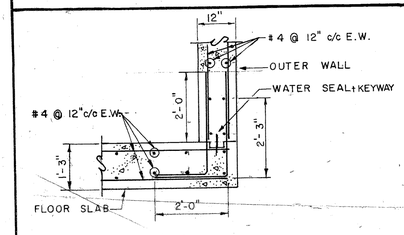
DETAIL A3 PARAPET WALL (TYP)
N.T.S.



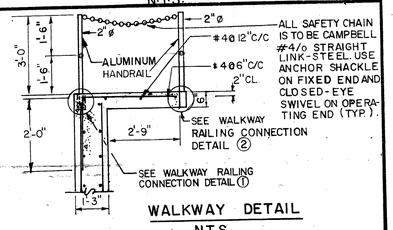
TYPICAL ⊥ JUNCTION TO THE FLOOR SLAB
N.T.S.



EXTRA REINFORCEMENT AROUND OPENING (TYP.)
N.T.S.

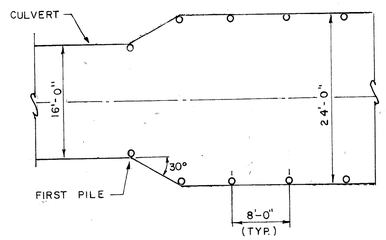


TYPICAL CORNER DETAIL
N.T.S.

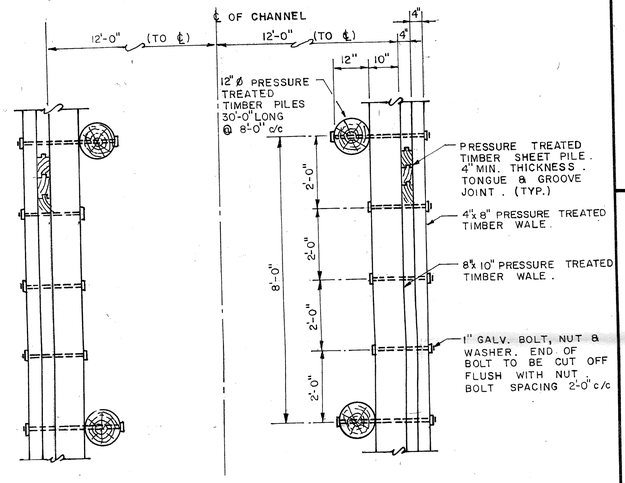


WALKWAY DETAIL
N.T.S.

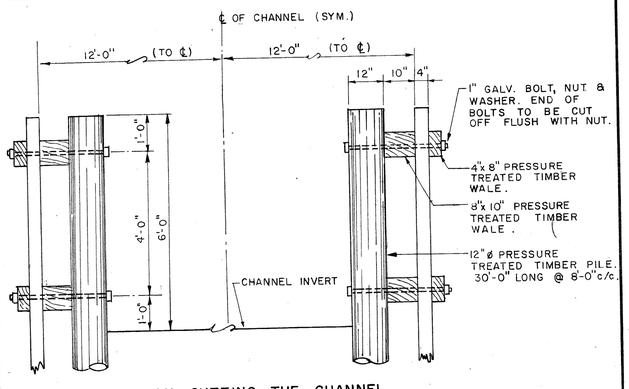
TIMBER OUTLET STRUCTURE DETAILS



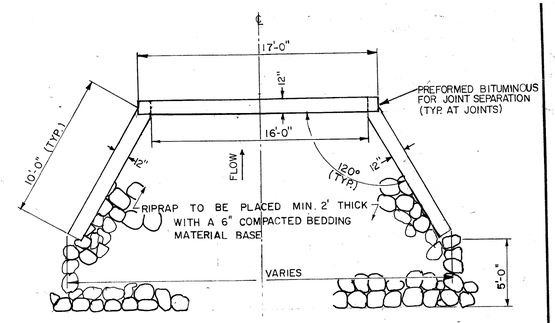
- OPEN CHANNEL
N.T.S.



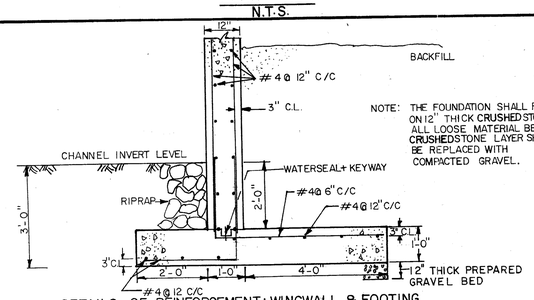
PLAN VIEW OF CHANNEL
N.T.S.



SECTION CUTTING THE CHANNEL
N.T.S.

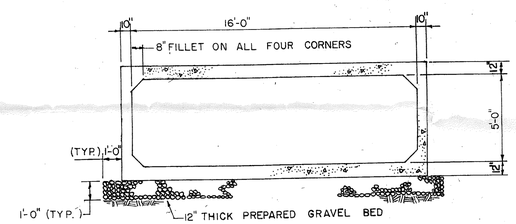


PARAPET WALL, WINGWALLS AND CULVERT RIPRAP DETAIL
PLAN VIEW
N.T.S.

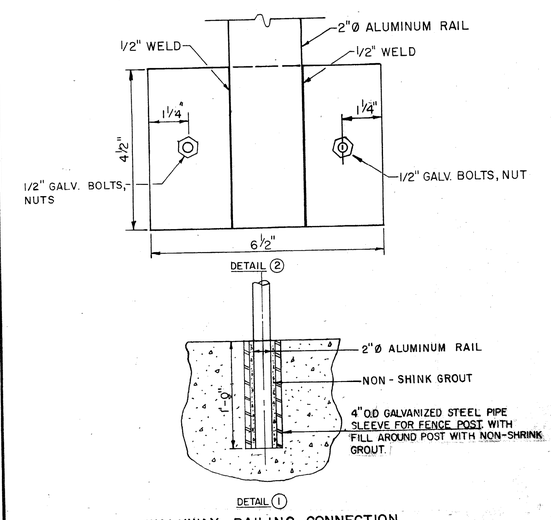


NOTE: THE FOUNDATION SHALL REST ON 12" THICK CRUSHED STONE. ALL LOOSE MATERIAL BELOW CRUSHED STONE LAYER SHALL BE REPLACED WITH COMPACTED GRAVEL.

DETAILS OF REINFORCEMENT: WINGWALL & FOOTING
N.T.S. DETAIL A4



PRECAST BOX CULVERT DETAIL
N.T.S.



WALKWAY RAILING CONNECTION
N.T.S.

DESIGN NOTES

GATE VAULT

1. 5000 PSI, MIN. 6% AIR ENTRAINED, SLUMP 4" TO 5" TRI CALCIUM ALUMINATE CONTENT LESS THAN OR EQUAL TO 8%. ASTM TYPE II OR TYPE V CEMENT SHALL BE USED.
2. STEEL BARS 60,000 PSI YIELD STRENGTH (GRADE 60) USE ONLY DEFORMED BARS. 3" CLEAR COVER SHALL BE MAINTAINED FOR ALL STEEL REINFORCEMENT.
3. FOUNDATION SHALL BE 12" GRAVEL BED.
4. WALL REINFORCING - A) 12" AND 15" THICK WALL PROVIDE #4 BARS AT 12" C/C ON BOTH SIDES AND IN VERTICAL AND HORIZONTAL DIRECTIONS. B) 27" THICK FLOOR SLAB PROVIDE #4 BARS AT 6" C/C ON TOP AND BOTTOM ALONG THE LENGTH AND WIDTH. ON REGIONS WHERE THE THICKNESS IS 15" INCREASE THE SPACING TO 12" C/C.
5. CORBELS SHALL BE 15" WIDE WITH STANDARD REINFORCEMENT.

OPEN CHANNELS

1. ROUND TIMBER PILING SHALL CONFORM TO ASTM D25-1973 AND PRESSURE TREATED TO SATISFY THE REQUIREMENTS OF AWPA C3 AND SHALL HAVE A MINIMUM BENDING STRESS OF 2400 PSI.
2. WALES SHALL BE 8" X 10" UPPER AND 4" X 8" LOWER PRESSURE TREATED TIMBER TO SATISFY THE REQUIREMENTS OF AWPA C3 AND SHALL HAVE A MINIMUM BENDING STRESS OF 1400 PSI.
3. SHEET PILING SHALL CONFORM TO ASTM D25-1973 AND PRESSURE TREATED TO SATISFY THE REQUIREMENTS OF AWPA C3 AND SHALL HAVE A MINIMUM BENDING STRESS OF 1400 PSI.
4. PILE SPACING SHALL BE 8' ON CENTER AND 12" IN DIAMETER. THEY SHALL BE 30' LONG AND DRIVEN INTO THE GROUND 24'.
5. SHEET PILES SHALL BE PRESSURE TREATED TIMBER SHEET PILE 4" MINIMUM THICKNESS AND A HEIGHT OF 12' AND SHALL BE DRIVER 6' INTO THE GROUND. THEY ARE TO BE TONGUE AND GROOVE JOINTED.
6. NUTS, BOLTS AND WASHERS ARE TO BE GALVANIZED. END OF BOLTS TO BE CUT OFF FLUSH WITH NUT.

PRECAST BOX CULVERT

1. TO BE DESIGNED FOR H-20 TRUCK LOADING.
2. DESIGN TO CONFORM TO ASTM C789, TABLE 1.
3. THE DESIGN SHALL BE MODIFIED TO RESIST EXTERNAL SATURATED SOIL PRESSURE WITH THE GROUND WATER AT FINISHED GRADES.
4. SEE SPECIAL CONSTRUCTION SECTION 13D OF THE CONTRACT SPECIFICATIONS, FOR FURTHER INFORMATION.

NOTE

SEE DIVISION 3 CONCRTETE SECTION 34, CONCRETE FOR STRUCTURES FOR CONCRETE REQUIREMENTS (SPECIFICATION)

STATE OF CONNECTICUT
DEPARTMENT OF ADMINISTRATIVE SERVICES
BUREAU OF PUBLIC WORKS

DRAWN DTB GAB/JW	FLOOD CONTROL - GREAT CREEK SILVER SANDS STATE PARK MILFORD, CONNECTICUT	PROJECT NO. BI-T-238 C
CHECKED DTB/LL		DRAWING NO.
APPROVED MA	STRUCTURAL DETAILS	14
	PREPARED BY dtc CONSULTING ENGINEERS	DIVERSIFIED TECHNOLOGIES CORPORATION 55 Middletown Avenue North Haven, Conn. 06473 Tel. (203) 562-7560
	SCALE: AS NOTED	DATE: JUNE, 1985

Appendix B

Select Photographs

Photo 1: Overall View of Tide Gate and Outlet Structures

Photo 2: Embankment Erosion at Inlet Culvert Wingwall

Photo 3: Map Cracking on Tide Gate Structure Wall

Photo 4: Spalls at Corners of Tide Gate Concrete Boxes

Photo 5: Spalls at Concrete Box Culvert Joints

Photo 6: Existing Electrical and Telemetry Services at the Tide Gate Structure

Photo 7: Exposed Tie-Backs at Outlet Structure

Photo 8: Deterioration of Timber Piles and Lagging

Appendix C

Review and Recommendations Concerning the Self-Regulating Tide Gates

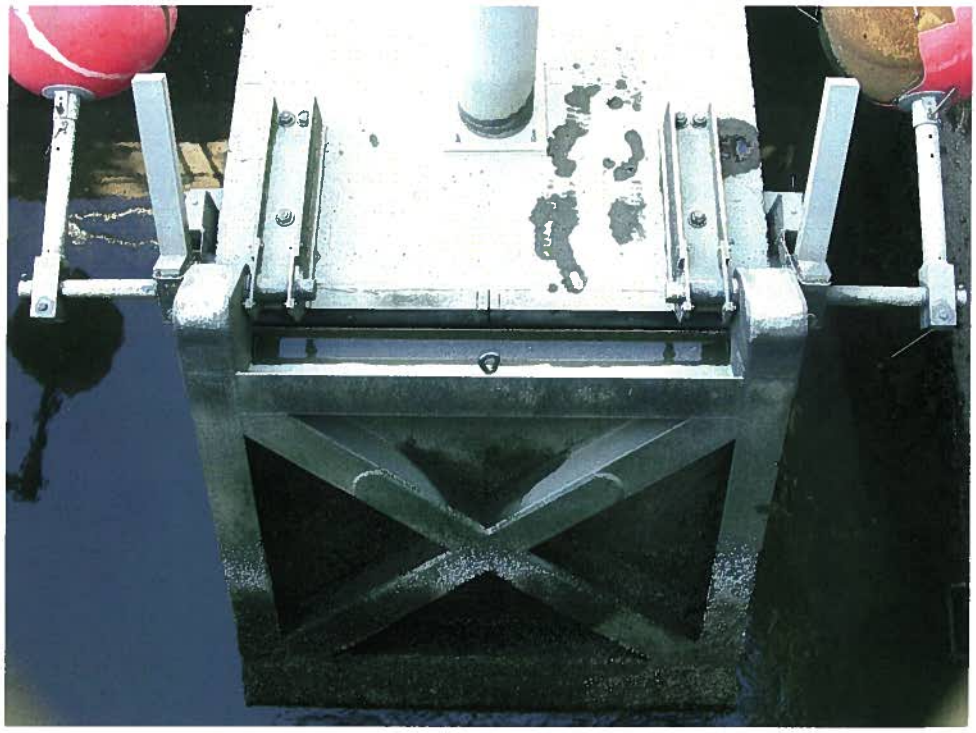
(Thomas J. Steinke, December 20, 2011)

Report
to
Fuss & O'Neil, Inc.
Concerning
the
Great Creek Outlet Structure Improvement Project
Milford Connecticut

Review and Recommendations Concerning the Self-Regulating Tidegates

Thomas J. Steinke

December 20, 2011



(Photo 4118. View of easterly Self-Regulating Tidegate Assembly)

Table of Contents

I. Introduction 3

A. Project Background 3

B. Design Conditions and Tidegate Adjustments 3

C. Operational Considerations 4

II. Findings and Recommendations 5

A. Chamber 5

1. Culverts 5

2. Sluice Gates 5

3. Ground Surface Outside of the Chamber 5

B. Self-Regulating Tidegates 5

1. Sub-assemblies 5

a. Gaskets 5

b. Upper Floats 6

c. Filler Plates 6

d. Hinge and Float Shafts 6

e. Vertical Floats 7

f. Bio-fouling 7

g. Corrosion 7

2. Operation and Maintenance Manual (O&M Manual) 8

III. Appendix (Numbered photographs referenced to report descriptions) 9

NOTE: The report text includes two sets of numbers that refer to item views in the 11/13/87 fabrication drawings of the Self-Regulating Tidegate by Spiegel and Zamecnik {item # }; and to annotated photographs in the appendix (photo #).

I. Introduction

The Great Creek flood relief project for drainage improvements at the Silver Sands Beach area of East Broadway Milford, was substantially completed and the two SRTs were installed in 1989. Since that time the tidegate chamber and sluice gates have been repaired, but the SRTs apparently have had little or no maintenance or repair after their initial installation – and they show it; yet they continue to operate satisfactorily – a testament to the good design engineering by Spiegel and Zamecnik, Inc. and fabrication by the Southington Metal Fabricating Company.

A. Project background

The initial objective of the Great Creek flood control project was to provide drainage relief to the residents occupying low-lying homes located northerly of East Broadway and southerly of the Great Creek salt marshes (photo 3906). These properties were often flooded for a period of days following a coastal storm event as a result of storm waves over-washing the East Broadway barrier beach and then flowing into the tidal wetland basin behind the beach. A relatively large upland watershed also drained to the marsh; and its runoff, combined with the beach over-wash coastal flood water, overtopped the creek banks and flooded the local streets and low-lying homes because the only drainage conduit was a 48" RCP under East Broadway – and this culvert was usually filled with sand and shell thereby significantly obstructing drainage. A primary goal of the flood relief efforts was the provision for discharge of floodwaters in the 12-hour tidal cycle following a storm event instead of over the next week.

The marsh flood water often required many days to drain down to normal water elevations through the obstructed culvert – which created another problem during the summer due to the mosquito breeding that followed the rains by creating excellent breeding habitat with no fish to prey on the larvae in isolated marsh pools.

Another consequence of inadequate drainage and flushing of the tidal wetland in the marsh basin was the loss of salt water and the elimination of the natural salt marsh plants and animals followed by their replacement with the low-salt tolerant phragmites plant (Phragmites australis or tall reed grass) that supported extensive annual marsh grass fires that threatened the houses bordering the marsh.

Of the flooding, fire, and mosquito problems, flooding was considered the most significant and the state and city sought plans and funding for providing relief.

B. Design Conditions and Tidegate Adjustments

The initial drainage design provided for two wall-mounted manually-operated, electrically-powered vertical sluice gates as the primary water control structures in the flood relief system. Subsequent coastal management priorities for fire and mosquito control, and for ecological restoration of the extensive salt marshes, resulted in the addition of two self-regulating tidegates located immediately behind the sluice gates. Unfortunately, this belt-and-suspenders design approach placed the two different gate design systems in direct conflict and resulted in the premature closure of the SRTs rendering them incapable of operating properly while both sluice gates were wide open. The reason for this conflict results from the fact that the SRT is designed for conditions where the in-coming tidal water transitions from laminar to turbulent flow in the short distance (approximately five feet) between the leading edge of the floating SRT gate door and the mouth of the SRT culvert. If a turbulent flow condition exists in front of this gate door transition zone, e. g., by locating the sluice gate opening

immediately in front of the SRT door as was done at Great Creek, the turbulent in-coming tidal currents will impinge on the leading edge of the SRT door where this turbulent water wave will ride-up over the door and the water current will push the gate closed at about one-third tide, thereby eliminating further water flow into the marsh.

As a corrective measure, the two sluice gates are operated at very different and opposite openings, with reciprocal settings of approximately 100% (primary gate) and 25% (secondary gate) of gate capacity, so as to cause a crossing water current to flow from the fully-opened primary sluice gate, past the rear SRT that closed prematurely, and then approach from the side of the fully opened adjacent SRT (thereby avoiding the turbulent flow impinging on the leading edge of the SRT). These settings allow the SRTs to open at any time that the head inside the SRT is greater than the water level outside the SRT. The sluice gate openings are adjusted manually: 100% for the primary gate opening and 25 – 30% for the secondary sluice gate opening. The sluice gate lift-stem settings are marked at reciprocal points with tapes of different colors on the guide housings and the sluice gate settings are periodically reversed to ensure equal wear and tear on all gate assemblies.

In hindsight, the SRTs may have been better installed where they would not have been affected by the disruptive flow of another water control structure. This could have been achieved by locating the SRT sufficiently behind the sluice gates at a point where there was no turbulent flow impinging on the SRT door; or, forward of the sluice gates, on the wall at the front of the chamber as the first water control structure facing the in-coming tide.

C. Operational Considerations

An inspection of the SRTs will show that one of its sub-assemblies has been deactivated, i.e., the vertical floats located on each side of the SRT. The SRTs have a vacuum-break or Air Purge {25} (photo 4074) which is designed for operational conditions on long culverts that allow for the development of dynamic opening forces on the rear (interior) face of the SRT following its closure. These forces are the result of closure of the SRT on an in-coming tide with the submerged culvert flowing full behind it; and developing a velocity head that, upon gate closure, caused the water to evacuate the culvert and then rush back into the culvert and run-up against the interior face of the door with its velocity head differential exceeding the tidal forces acting on the exterior face of the gate and thereby causing the gate door to reopen. This hydraulic flow reversal could be repeated several times in a harmonic sequence to the detriment of the gate assembly. To prevent this repetition or cycling, two buoyant vertical float assemblies are poised for deployment from just below and behind the gate hinge shaft {14} spring arms {8} and they float up behind the spring float arms when the gate door rotates closed. They remain deployed until they drop out of position with the receding tide water. These vertical float sub-assemblies are unnecessary at the Great Creek chamber installation with the present upper float settings for SRT closure because the chamber SRT culverts are in an essentially open system that does not become submerged and produce vacuum forces, nor does it confine discharge water in a long culvert behind it and therefore do not form the cycling forces that tend to reopen the SRT – the SRTs stay closed after closing due to the greater force of the tide water on the outside or exterior face of the SRT door. If the vertical floats deploy under these circumstances, they have no effective role in SRT operation and only serve to temporarily and slightly retard water flow when discharging from the marsh through the SRT and the four adjacent flapper tidegates. To prevent even that temporary and minor flow reduction, the vertical floats have been weighted and/or tied down to prevent their deployment (photo 4174).

II. Findings and Recommendations

A. Chamber

The concrete chamber structure has several issues needing attention:

1. Culverts

The easterly upper wall of the easterly SRT box culvert on the marsh end has a open hole into the rebar and aggregate that is flowing at high tide (photo 4142).

The concrete ceilings of both SRT box culverts are spalled and scaling with exposed rebar (photos 4144, 4147).

Recommendation: The chamber floor around the SRTs and the SRT door sumps below the gates contain accumulations of mud, shells, bottles and debris that should be removed with a shovel (photo 4171).

2. Sluice Gates

I recall that the sluice gates were operated before the limit switches were installed resulting in breaking/repair of the concrete in the bottom sumps beneath the sluice gates, stressing the assemblies and tracks, and subsequently shuddering and chattering in operation.

Recommendation: The clear plastic protective sleeves over the lift screws should be cleaned or replaced and permanent reciprocal sluice-gate opening reference points clearly marked on the sleeves for systematic adjustment of the sluice-gates; and indirect adjustment of the SRTs.

3. Ground Surface Outside of the Chamber

A hole was observed in the ground surface near the northeasterly corner of the chamber installation with sediment patterns in the grass indicating that the hole may have been flowing during the recent Tropical Storm Irene (photo 3877).

Recommendation: Investigate the hole and secure as necessary.

B. Self-Regulating Tidegates

The SRTs are in relatively good shape considering the time period and marine environment in which they have operated. However, several sub-assemblies are in need of attention and consideration should be given to sending the SRTs out for redesign, refit and repair on a rotating basis to maintain operation of at least one SRT in the chamber at all times.

Recommendation: I recommend that Spiegel and Zamecnik and Southington Metal Fabricating Company be considered for the redesign/refit project as their work product is of the highest quality.

1. Sub-assemblies

a. Gaskets

The Neoprene rubber Gasket {Plan Sheet 2, part no. 27/28} and Gasket Backing Plate {29/30} have separated at the adhesive joint on the easterly SRT along the invert's easterly side of the opening of the box culvert where it leaks at high tide (photo 3834, 4226). The stainless steel gasket backing plate is still bolted to the studs in the concrete, while the 3.5-ft. long gasket was recovered on the floor of the chamber at its transition to the creek channel upstream. The two horizontal neoprene

gasket sections, at the crown and invert of the SRT culvert, were originally designed as a single unit 7-ft. long, but the gaskets on the SRT invert and crown are composed of two separate pieces, each 3.5-ft. long, and secured with three studs in the face of the box culvert (photo 4083, 4122). The two-piece gasket is at variance with the SRT plans and I could not find any explanation for this anomalous condition. It is possible that the fabricator (SMF) could not obtain gaskets of the initial 7-ft. design and so provided an alternate that Spiegel and Zamecnik (S&Z) covered in revised shop drawings or the "as-built" provided to the state (S&Z's representative supervised the installation of all SRTs during construction.)
Recommendation: Rebond the gasket to the stainless steel backing plate and install on the studs.

b. Upper Floats
The upper floats, i.e., the two large orange spheres {9} on each SRT, are foam-injected rotationally-molded PVC shells, retro-fitted with internal PVC sleeves, that continue to function properly despite the fact that the PVC shells are cracked and broken (photos 4081, 4088). These are among the most important SRT components as they serve to close the gates and secure the protected area from flooding after the desired high tide elevation is achieved.
Recommendation: Replace the upper floats with all new spheres (foam-injected with internal PVC sleeve tubing as per original design plans).

c. Filler Plates
Each SRT gate has four triangular filler plates {sheet 1, items 22 and 23} secured to the downstream face of the inner flanges of the cross-beams by 3/8-inch bolts along their perimeter (photos 4157, 4205). Several of these bolts, or their bolt heads, are missing. It appears that the bolts may be stressed by the constant small shock and vibration of floating debris and ice impacting on the upstream (inland), face of the filler plates at various stages of the out-going tide, eventually breaking off the bolt head or backing out the bolt.
Recommendation: Drill out and replace all broken and missing bolts and replace with 316 stainless steel bolts and "Loctite".

d. Hinge and Float Shafts
The SRT Hinge and Float Shafts {14} and Hinge Side Plates {33} are wearing due to scoring and flattening of their bearing surfaces (photos 4103, 4077). The hinge shaft is designed to roll (not rotate) back and forth within the elongated hinge hole or slot created by the upper Hinge Cover Plate {32} and the lower Hinge Side Plate {33} as the gate door rises and falls with the tide. However, the combined buoyancy of the large bottom door float and the two large back floats serve to lift the door assembly approximately 1/4th inch within the hinge hole just prior to closing, at which point water currents due to turbulence may push the gate assembly with hinge shaft forward to the front of the hinge slot where the hinge shaft then rotates in a stationary position as the door rotates approximately 90-degrees to closure. This rotary motion serves to deform the bearing surfaces by scoring a groove (about 3/16^{ths} inch deep) in the shafts and a similar amount of cutting and mushrooming in the lower Hinge Side Plate (photo 4077).
Recommendation: Redesign the SRT hinge sub-assembly so that the hinge shaft has a full bearing

surface between the lower Hinge Side Plates to support the shaft without deformation. This may be achieved by adding a front extension bearing plate (to support the full width of the hinge shaft) to the Hinge Web Plate {37} between the Hinge Side Plates; or by rebuilding the profile of the scored shaft and fitting a sacrificial sleeve over the hinge shaft to be replaced as needed.

e. Vertical Floats

As noted above, the vertical floats have been deactivated, initially with stone weights placed on the Top Plates {53} of the tank sub-assemblies and subsequently with ropes, to prevent their deployment when the SRT closes (photos 4155, 4168, 4171).

Recommendation: Allow these units to remain in their deactivated condition under the existing upper float settings; and be prepared to reactivate them if subsequent upper float adjustments warrant it in the future.

f. Bio-fouling:

The SRT Tide Gate Door Assemblies each support approximately 50 to 100 lbs. of marine fouling organisms composed primarily of acorn barnacles, mud snails, oysters, blue and ribbed mussels, seaweeds, and sediment (photos 4157, 4158). As an environmental variable, this fouling community contributes to the weights and balances equation used in determining the settings of the Upper Float Assembly. However, the practical effect of the weight of the fouling community is negligible on gate operation and opening – closing in the context of the greater buoyancy of the bottom door float tube {20} and the two upper float spheres {9}. Marine fouling is of greater importance with respect to corrosion as noted below.

Recommendation: I recommend that the SRT assemblies be scraped (with a putty knife or paint scraper) or power washed on an annual basis for the purposes of removing the marine fouling community, but more importantly for inspecting and monitoring the SRT assembly in its operating environment. The knowledge of SRT operation, wear points, deterioration, and maintenance needs of all sub-assemblies is of the utmost value to proper gate operation, maintenance and repair in the long term.

g. Corrosion

The SRTs are fabricated primarily from an aluminum alloy (alloy 6061-T6) that is corrosion resistant in the marine environment. A quick inspection of the sub-assemblies will reveal little corrosion on the SRTs. However, an inspection below the marine fouling community will reveal scattered shallow corrosion blisters and pits where conditions promote oxidation of the surface and base metal (photos 4158, 4160, 4162, 4164). If the metal surfaces can be maintained substantially free of fouling organisms, the metal surfaces will quickly form a protective oxide over the aluminum wherever the surface is abraded or scratched leading to an extended service life.

Recommendation: The Chamber walls, floor and the SRT gate sumps and sluice gate sumps should all be cleaned following the cleaning of the SRTs.

Recommendation: As noted above, implement an annual cleaning procedure for the SRTs and include it in the O&M manual.

2. Operation and Maintenance Manual (O&M Manual)

The O&M Manual for the Tide Gate Chamber water control systems should include a description of the Sluice gates and the SRTs, with all of their sub-assemblies described with respect to their purpose and adjustment, and how the success of the flood relief and marsh restoration goals are dependent on the operational settings of the gate systems. Also, describe all inspection protocols and cleaning procedures and the annual schedules for the same. Further, include a description and location of several permanent benchmark elevations and a tide gage staff, clearly marked and maintained in and around the Chamber, for the purpose of monitoring gate closing and opening water levels when adjusting SRT upper float and Sluice gate openings.

In addition to operational aspects, the O&M manual should include copies of all plans and drawings; sources of gate parts and service; installation and service history; and providing for addenda sheets, standard forms, and photographs for documenting all damage, repair, inspection, cleaning, and adjustment events associated with the Chamber installation and its water control structures.

+++

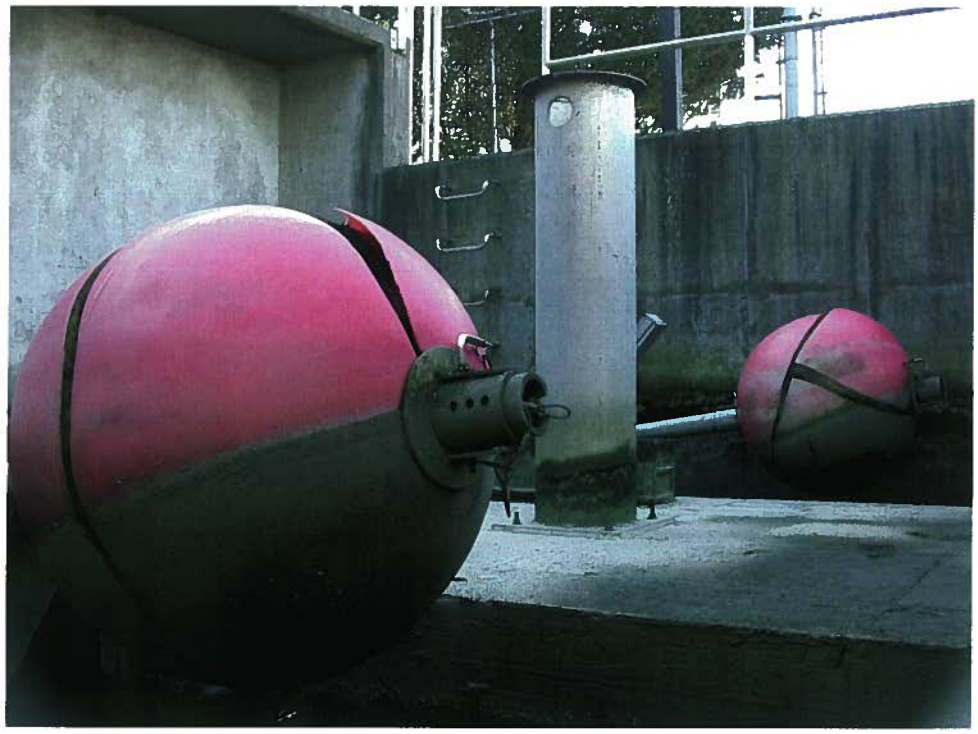
Appendix

(All photographs taken in November and December 2011.)

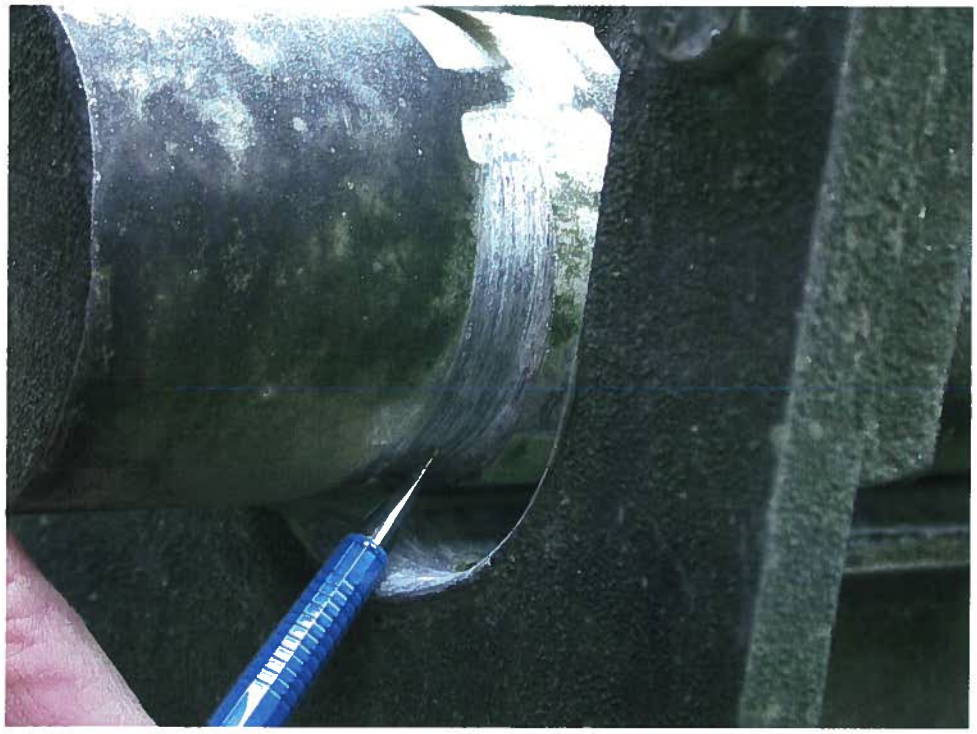
3834. View of easterly culvert invert gasket leak at high tide with the SRT closed.

3877. View of hole in the soil located outside of the northeasterly corner of the concrete chamber with indications of flowage from recent Tropical Storm Irene.

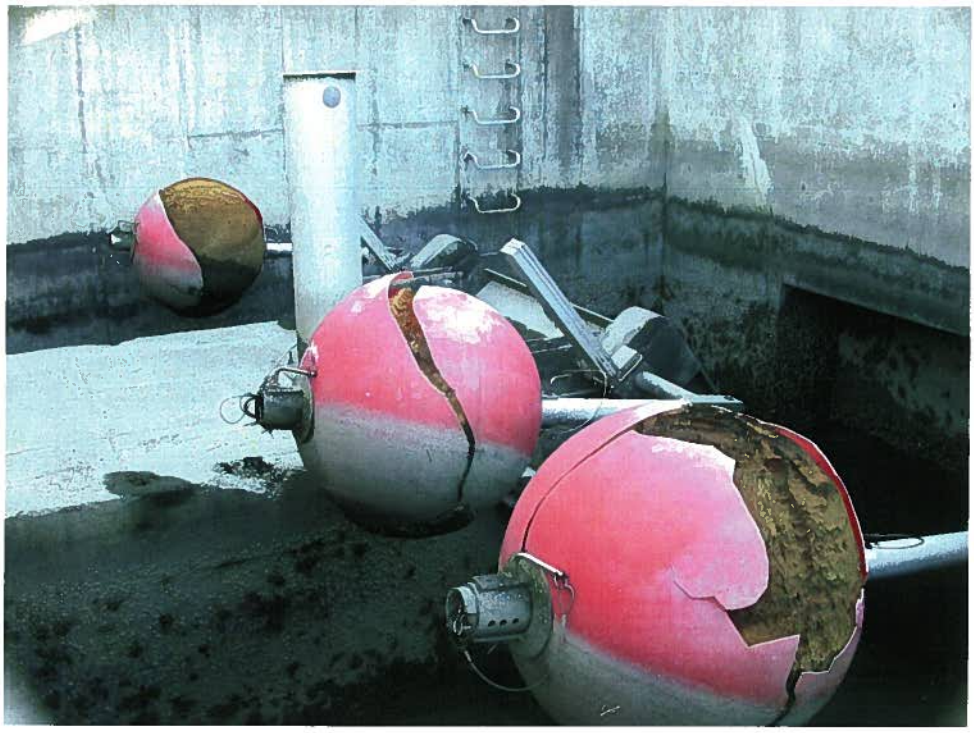
3906. View of low-lying homes bordering the restored salt marsh north of E. Broadway.



4074. View of vacuum-break or air purge pipe on crown of box culvert between the upper floats of the westerly SRT.



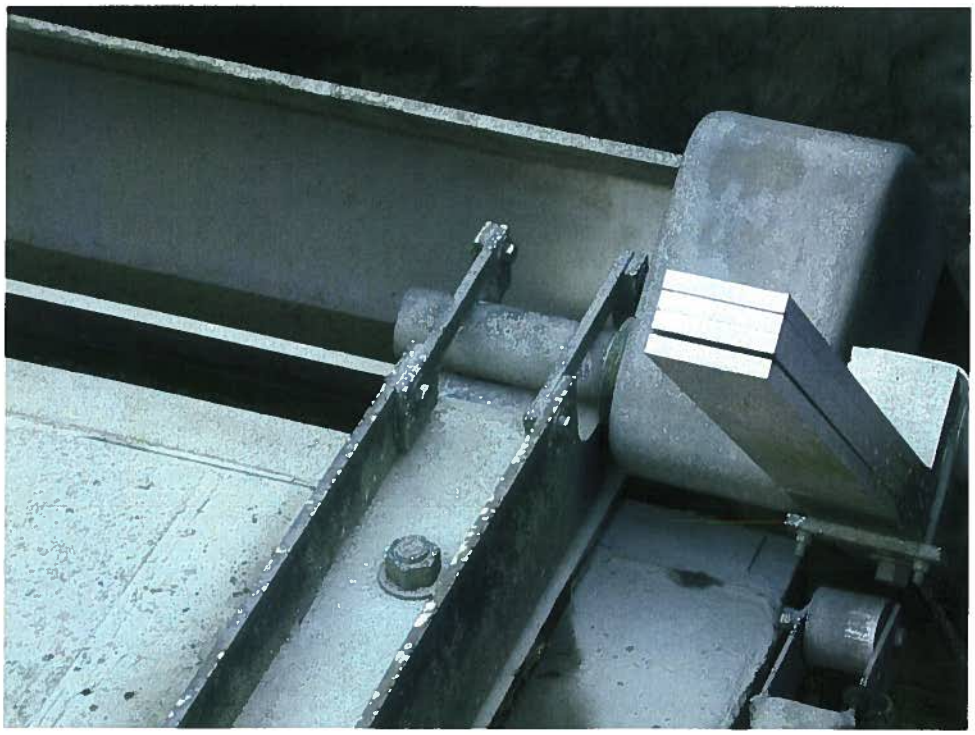
4077. View of scoring of shaft and mushrooming and down-cutting of hinge side plate due to hinge shaft rotating in place, instead of rolling forward, when gate door closes.



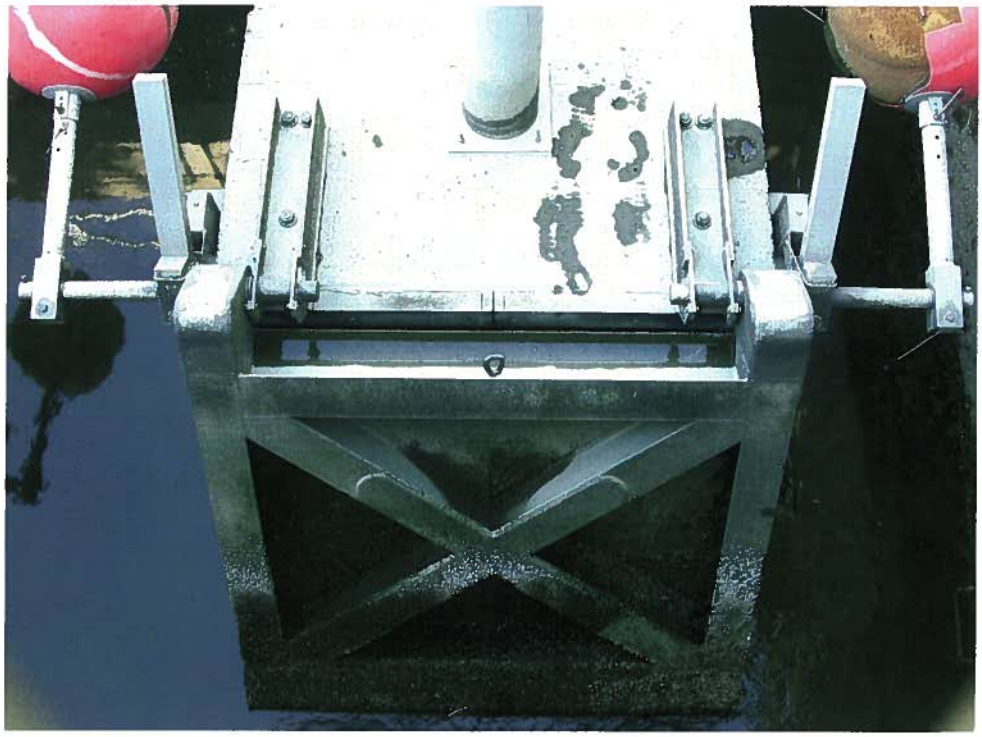
4081. View of deteriorated, but serviceable, foam-injected PVC shell upper floats and the pin-and-plate apparatus for adjusting position of float ball on the float ball arm and sleeve.

4083. View of intact two-piece (left- and right-side) gasket assembly on crown of easterly SRT for comparison with missing right-hand half gasket at invert immediately below. Vacuum-break hole in ceiling to right.

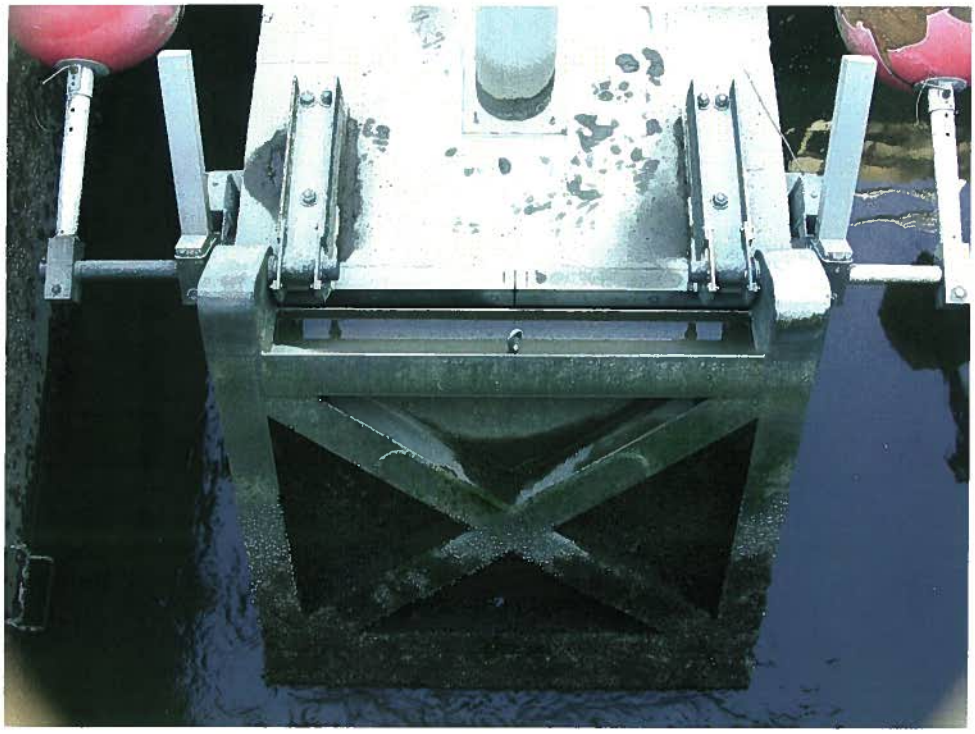
4088. Alternate view of foam-injected molded PVC shell upper floats that are still safe and functional in spite of their cosmetically-deteriorated appearance.



4103. View of SRT hinge shaft in hinge box, with gate door above, and leaf-spring arm, and top of vertical float in lower right. Deformation of hinge shaft and side plate is due to rotation instead of rolling in the slot.



4118 View of easterly SRT assembly with gate door and bottom float, hinge boxes and hinge shafts supporting leaf-springs (with vertical floats below and behind) and upper float arms and PVC floats.



4122. View of westerly SRT at crown of culvert noting the two-piece gasket with center joint which is identical to the gasket at the invert with its right-hand half-section having separated from the mounting plate and studs.

4133. View of Sluice Gate assemblies and the protective plastic sleeves with marker tapes indicating the relative positions of the sluice gate valve stems for proper operation of the SRTs.

4135. View of the westerly Sluice Gate valve leaf adjusted to the wide-open position (reciprocal position of easterly Sluice Gate is three-quarters closed) for proper operation of the SRTs located immediately behind.

4142. View of upper easterly wall of easterly box culvert noting a hole that flows freely with water at high tide after the SRTs are closed. Steel rebar is visible in the hole.

4144. View of ceiling of box culvert with rust staining the surface where the reinforcing steel is exposed through the concrete.

4155. View of SRT complete vertical float assembly secured with a rope in its low tide position.

4147. View of ceiling of westerly box culvert with spalling of concrete and rust staining of surface from an earlier repair due to exposure of reinforcing rods to seawater. The hole for the vacuum-break is to lower right.

4157. View of westerly SRT gate door filler plates and cross-beams with the marine-fouling community adhering to the gate surface.

4158. View of westerly SRT gate door and bottom float with bio-fouling primarily composed of acorn barnacles and blue mussels.

4160. View of SRT gate door cross-beam where the marine-fouling community has been scrapped away disclosing the pit corrosion beneath (center and lower left).

4162. View of SRT gate door triangular filler plate where bio-fouling has been removed exposing pit corrosion and exfoliation of thin aluminum blisters.

4164. View of SRT gate door filler plate where the marine-fouling community has been scrapped away exposing the scattered blisters and pit corrosion beneath.

4168. Low tide view of upper portion of vertical float assembly having been deactivated with rope and stone weights because the floats are not needed at the particular upper float settings now used to close the SRTs.

4171. Low tide view of lower portion of easterly SRT vertical float assembly (on left) noting accumulations of debris and oyster bed on wall and floor of chamber.

4174. View of lateral float and roller assembly depicting rope used to restrain the float from deploying when the gate closes as the float is not needed at the present upper float settings for gate closure.

4180. View of flood-tide sandbar on the inland side of the chamber deposited from water currents carrying in beach sand and scouring of the channel bottom. Its removal could incrementally enhance water flow.

Appendix D

Letter from AECOM to DEEP

(December 12, 2011)

AECOM

AECOM
500 Enterprise Drive
Suite 1A
Rocky Hill, CT 06067
www.aecom.com

860 263 5800 tel
860 263 5777 fax

Date: December 20, 2011

Sent by e-mail

Jennifer Perry
Department of Energy and Environmental Protection
79 Elm Street
Hartford, Connecticut 06106-5127

Re: **City of Milford Wastewater Program**
Replacement of the East Broadway Pump Station

Dear Ms. Perry
As discussed with you by telephone, we are the Engineers for the City of Milford for the project to replace the East Broadway Pump Station located in Silver Sands State Park We understand that DEEP owns the tide gates but that they are operated by the City of Milford.

There are two motorized slide gates which are a part of the tide gate structure. These gates were powered by a 480 volt, 3 phase circuit from a panel in the East Broadway Pump Station, which has recently been demolished. We were unaware of this when our project was under design. We have had several conversations with the UI Co. concerning providing power to these gates. They are unwilling to provide a 480 volt, 3 phase service at this location since there is no longer sufficient demand. Although the motors at the gates are small, it would be necessary to replace both gate operators in their entirety to power them from 110 volt single phase power. The City does not have the funds in this project to replace the gate operators and/or provide a new service panel for these gates.

The other concern is that while the gates were powered from the East Broadway Pump Station they were also provided with backup power from the emergency generator. Even if utility power was provided for the gates, they would not be served by emergency power. During a storm, when the gates are most likely needed to be operated, there is a good chance that they would have no power.

We wanted to bring this situation to your attention.

Very truly yours,

AECOM

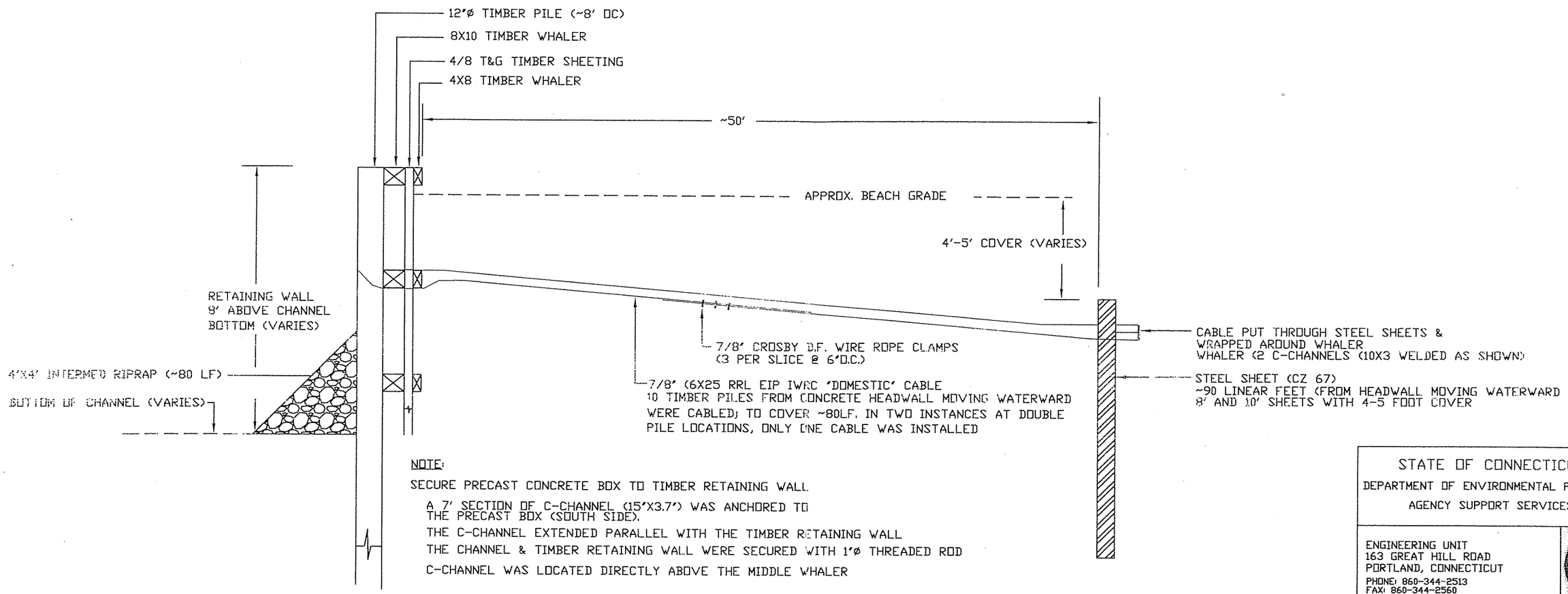
Kenneth A. Bradstreet, P.E.
Senior Project Manager

Cc: Joe Maler
Ray Macaluso
Charlie Smith
Sewer Commission

Appendix E

Emergency Construction Work on the Outlet Wall at Great Creek – As-Built

(CT DEEP, May 15, 2007)



NOTE:

SECURE PRECAST CONCRETE BOX TO TIMBER RETAINING WALL.

A 7' SECTION OF C-CHANNEL (15"X3.7") WAS ANCHORED TO THE PRECAST BOX (SOUTH SIDE).

THE C-CHANNEL EXTENDED PARALLEL WITH THE TIMBER RETAINING WALL

THE CHANNEL & TIMBER RETAINING WALL WERE SECURED WITH 1"ø THREADED ROD

C-CHANNEL WAS LOCATED DIRECTLY ABOVE THE MIDDLE WHALER

REPAIR ON THE RETAINING WALL WAS CONDUCTED JANUARY 2007

THE REPAIR DESIGN OR PLAN WAS A JOINT EFFORT BETWEEN DEP AGENCY SUPPORT, DEP-INLAND WATER RESOURCES DIVISION & MOHAWK NORTHEAST, INC.

STATE OF CONNECTICUT

DEPARTMENT OF ENVIRONMENTAL PROTECTION

AGENCY SUPPORT SERVICES

ENGINEERING UNIT
163 GREAT HILL ROAD
PORTLAND, CONNECTICUT
PHONE: 860-344-2513
FAX: 860-344-2560

PROJECT NAME & NUMBER:

EMERGENCY CONSTRUCTION WORK ON THE OUTLET WALL AT GREAT CREEK

SILVER SANDS STATE PARK
MILFORD, CONNECTICUT

PROJECT #2000-83

SHEET TITLE:

AS-BUILT

REVISIONS

DATE	DESCRIPTION	INITIALS

DATE: 5-15-07	DESIGNED:	SHEET #:
SCALE: NOT TO SCALE	DRAWN: DC	1/1
CAD FILE: DWG\MISC\SILVERSANDSSP\011207.DWG		

Appendix F

Boring Logs

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** Project: Silver Sands Location: Milford, CT	Boring ID: B-1 Sheet 1 of 2 Project No.: 2000445.A20

Contractor: Clarence Welti Assoc. Inc.
Operator: L. Lindenberger
F&O Rep.: Chris Cullen
Drilling Method: HSA
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 12/8/12 Date Finish: 12/8/12

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Time & Date of Completion:

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
0						Sand		
1								
2								
3								
4								
5	S-1	5-6.5		2-3-3	Loose brown fine to medium SAND trace Silt		SP	
6								
7								
8								
9						Organic Silt		
10	S-2	10-11.5		1-1-1	Very soft black organic SILT and PEAT		ML-OL	
11								
12								
13	S-3	12-14		2-2-6-7	Loose brown fine to medium SAND some Silt	Silty Sand	SM	
14								
15								
16	S-4	15-16.5		10-15-24	Dense gray-brown fine SAND, some Silt		SM	

MINOR CONSTITUENT PROPORTIONS:
Trace 0 to 10% Some 20 to 35%
Little 10 to 20% And 35 to 50%

REMARKS:

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** Project: Silver Sands Location: Milford, CT	Boring ID: B-1 Sheet 2 of 2 Project No.: 2000445.A20

Contractor: Clarence Welti Assoc. Inc.
Operator: L. Lindenberger
F&O Rep.: Chris Cullen
Drilling Method: HSA
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 12/8/12 Date Finish: 12/8/12

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Time & Date of Completion:

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
17						Silty Sand		
18								
19								
20	S-5	20-21.5		16-14-16	Dense brown fine SAND, some Silt		SM	
21								
					Bottom of boring at 21.5 feet			
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								

MINOR CONSTITUENT PROPORTIONS:

Trace	**0 to 10%**	**Some 20 to 35%**
Little	**10 to 20%**	**And 35 to 50%**

REMARKS:

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** Project: Silver Sands Location: Milford, CT	Boring ID: B-2 Sheet 1 of 3 Project No.: 2000445.A20

Contractor: Clarence Welti Assoc. Inc.
Operator: L. Lindenberger
F&O Rep.: Chris Cullen
Drilling Method: HSA
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 12/8/12 Date Finish: 12/8/12

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Time & Date of Completion:

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
0						Sand		
1								
2								
3								
4						Organic Silt		
5								
6	S-1	5-7		1-1-1-1	Very soft black organic SILT and PEAT		ML-OL	
7								
8						Silty Sand		
9								
10	S-2	10-11.5		9-13-19	Dense gray fine SAND, some Silt		SM	
11								
12								
13								
14								
15								
16	S-3	15-16.5		10-15-15	Dense gray fine SAND and SILT		SP-ML	

MINOR CONSTITUENT PROPORTIONS:
Trace 0 to 10% Some 20 to 35%
Little 10 to 20% And 35 to 50%

REMARKS:

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** Project: Silver Sands Location: Milford, CT	Boring ID: B-2 Sheet 2 of 3 Project No.: 2000445.A20

Contractor: Clarence Welti Assoc. Inc.
Operator: L. Lindenberger
F&O Rep.: Chris Cullen
Drilling Method: HSA
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 12/8/12 Date Finish: 12/8/12

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Time & Date of Completion:

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
17						Silty Sand'		
18								
19								
20	S-4	20-21.5		11-11-18	Medium dense gray fine SAND and SILT		SP-ML	
21								
22								
23								
24								
25	S-5	25-26.5		10-11-16	Medium dense gray fine SAND and SILT		SP-ML	
26								
27						Silt		
28								
29								
30	S-6	30-31.5		9-10-12	Medium dense gray SILT, little fine Sand		ML	
31								
32								
33								

MINOR CONSTITUENT PROPORTIONS:

Trace	**0 to 10%**	**Some 20 to 35%**
Little	**10 to 20%**	**And 35 to 50%**

REMARKS:

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** Project: Silver Sands Location: Milford, CT	Boring ID: B-2 Sheet 3 of 3 Project No.: 2000445.A20

Contractor: Clarence Welti Assoc. Inc.
Operator: L. Lindenberger
F&O Rep.: Chris Cullen
Drilling Method: HSA
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 12/8/12 Date Finish: 12/8/12

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Time & Date of Completion:

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
34						Silt		
35	S-7	35-36.5		6-7-8	Medium dense gray-red SILT, trace Clay		ML	
36								
37								
38								
39								
40	S-8	40-41.5		5-6-10	Medium dense gray-red SILT, trace Clay		ML	
41					Bottom of boring at 41.5 feet			
42								
43								
44								
45								
46								
47								
48								
49								
50								

MINOR CONSTITUENT PROPORTIONS:

Trace	**0 to 10%**	**Some 20 to 35%**
Little	**10 to 20%**	**And 35 to 50%**

REMARKS:

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** Project: Silver Sands Location: Milford, CT	Boring ID: B-3 Sheet 1 of 2 Project No.: 2000445.A20

Contractor: Clarence Welti Assoc. Inc.
Operator: L. Lindenberger
F&O Rep.: Chris Cullen
Drilling Method: HSA
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 12/8/12 Date Finish: 12/8/12

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Time & Date of Completion:

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
0						Sand		
1								
2						Organic Silt		
3								
4								
5	S-1	5-6.5		1-1-7	Very soft black organic SILT and PEAT		ML-OL	
6						Silty Sand		
7								
8								
9								
10	S-2	10-11.5		8-10-13	Medium dense gray fine SAND, some Silt		SM	
11								
12								
13								
14								
15								
16	S-3	15-16.5		13-16-18	Dense gray fine SAND, some Silt		SM	

MINOR CONSTITUENT PROPORTIONS:
Trace 0 to 10% Some 20 to 35%
Little 10 to 20% And 35 to 50%

REMARKS:

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** Project: Silver Sands Location: Milford, CT	Boring ID: B-3 Sheet 2 of 2 Project No.: 2000445.A20

Contractor: Clarence Welti Assoc. Inc.
Operator: L. Lindenberger
F&O Rep.: Chris Cullen
Drilling Method: HSA
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 12/8/12 Date Finish: 12/8/12

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Time & Date of Completion:

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
17						Silty Sand		
18								
19								
20	S-4	20-21.5		13-25-27	Very dense gray fine SAND, little Silt		SM	
21					Bottom of boring at 21.5 feet			
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								

MINOR CONSTITUENT PROPORTIONS:

Trace	**0 to 10%**	**Some 20 to 35%**
Little	**10 to 20%**	**And 35 to 50%**

REMARKS:

Appendix G

Laboratory Test Results

GRAIN SIZE DISTRIBUTION TEST DATA

12/17/2011

Client: FUSS & O'NEILL
Project: SILVER SANDS STATE PARK
Location: B-2
Depth: 15.0 **Sample Number:** 3
Testing Remarks: WATER CONTENT = 28.3%

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 50.80
Tare Wt. = 0.00
Minus #200 from wash = 32%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
74.60	0.00	#10	0.00	0.00	100
		#20	0.10	0.00	100
		#40	0.50	0.00	99
		#100	15.00	0.00	79
		#200	27.50	0.00	42

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	1	57	58			42

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0855	0.1018	0.1534	0.1763	0.2101	0.2704

Fineness Modulus
0.25

GRAIN SIZE DISTRIBUTION TEST DATA

12/17/2011

Client: FUSS & O'NEILL
Project: SILVER SANDS STATE PARK
Location: B-2
Depth: 30.0 **Sample Number:** 6
Testing Remarks: WATER CONTENT = 33.1%

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 13.60
Tare Wt. = 0.00
Minus #200 from wash = 83%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
80.40	0.00	#10	0.00	0.00	100
		#20	0.10	0.00	100
		#40	0.30	0.00	100
		#100	3.20	0.00	96
		#200	6.50	0.00	87

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	0	13	13			87

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
								0.0913	0.1416

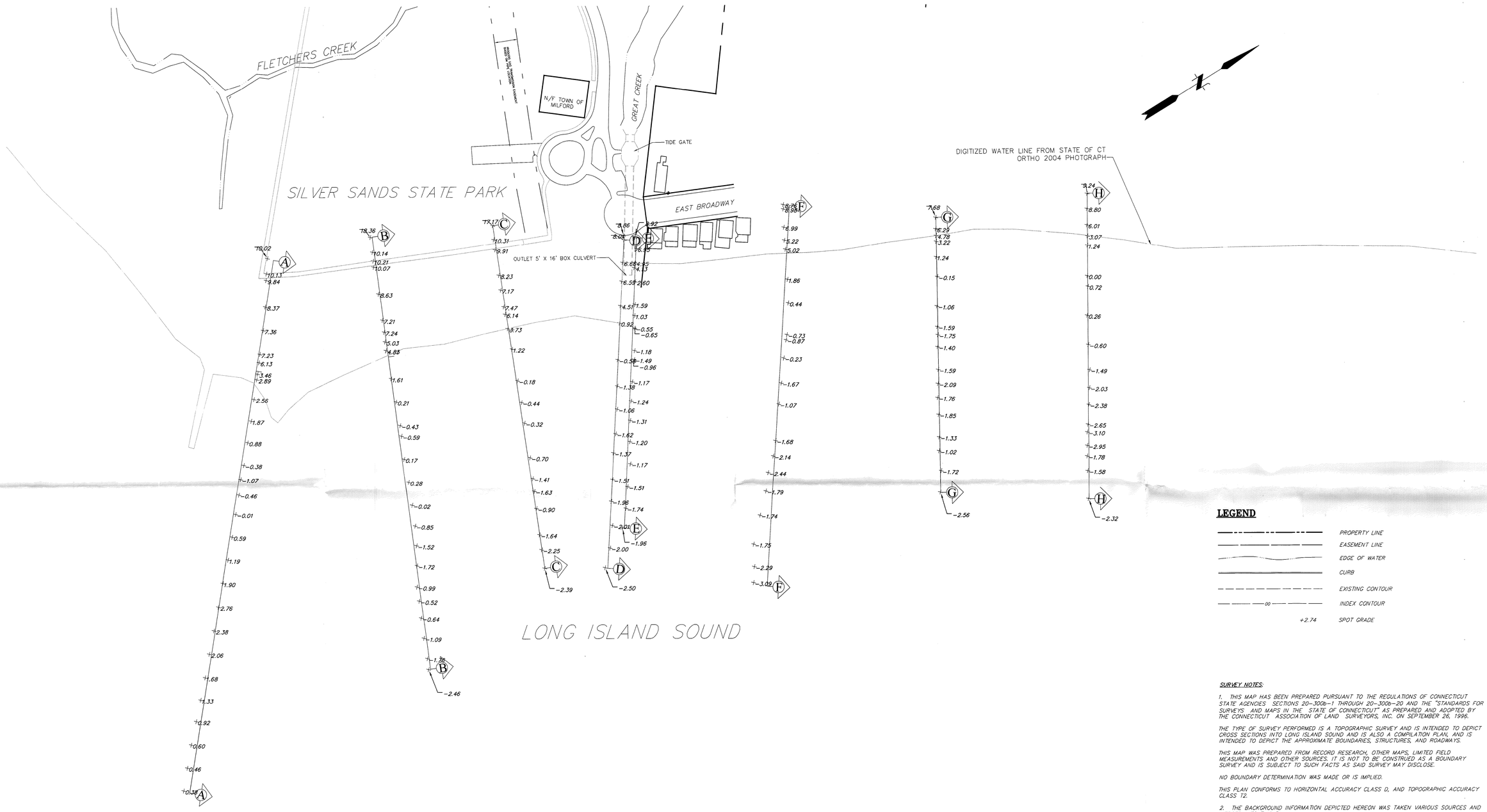
Fineness Modulus
0.06

FUSS & O'NEILL

Appendix H

Survey Maps

V-1.00 – 2001 - Section Locations
V-2.00 through V-2.01 – 2012 -Sections Location
V-2.02 – 2112 - Inlet Structure Topography
V-2.03 through V-2.04 – 2012 - Section Views



LEGEND

	PROPERTY LINE
	EASEMENT LINE
	EDGE OF WATER
	CURB
	EXISTING CONTOUR
00	INDEX CONTOUR
+2.74	SPOT GRADE

SURVEY NOTES:

1. THIS MAP HAS BEEN PREPARED PURSUANT TO THE REGULATIONS OF CONNECTICUT STATE AGENCIES SECTIONS 20-300b-1 THROUGH 20-300b-20 AND THE "STANDARDS FOR SURVEYS AND MAPS IN THE STATE OF CONNECTICUT" AS PREPARED AND ADOPTED BY THE CONNECTICUT ASSOCIATION OF LAND SURVEYORS, INC. ON SEPTEMBER 26, 1996.

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No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.			XX/XX	XX

SEAL

SEAL

TO MY KNOWLEDGE AND BELIEF, THIS MAP IS SUBSTANTIALLY CORRECT AS NOTED HEREON.

DAVID A. CARICCHIO L.S. #70036

SCALE:
HORZ.: 1" = 100
VERT.:
DATUM:
HORZ.: NAD 27
VERT.: NGVD 29
100 50 0 100
GRAPHIC SCALE

FUSS & O'NEILL
146 HARTFORD ROAD
MANCHESTER, CONNECTICUT 06040
860.646.2469
www.fando.com

STATE OF CONNECTICUT
DEPARTMENT OF ENERGY & ENVIRONMANTAL PROTECTION
SILVER SAND STATE PARK
GREAT CREEK OUTLET STRUCTURE
2001 SECTION LOCATIONS
MILFORD CONNECTICUT

PROJ. No.: 2000455A10
DATE: 01/30/2012

V-1.00

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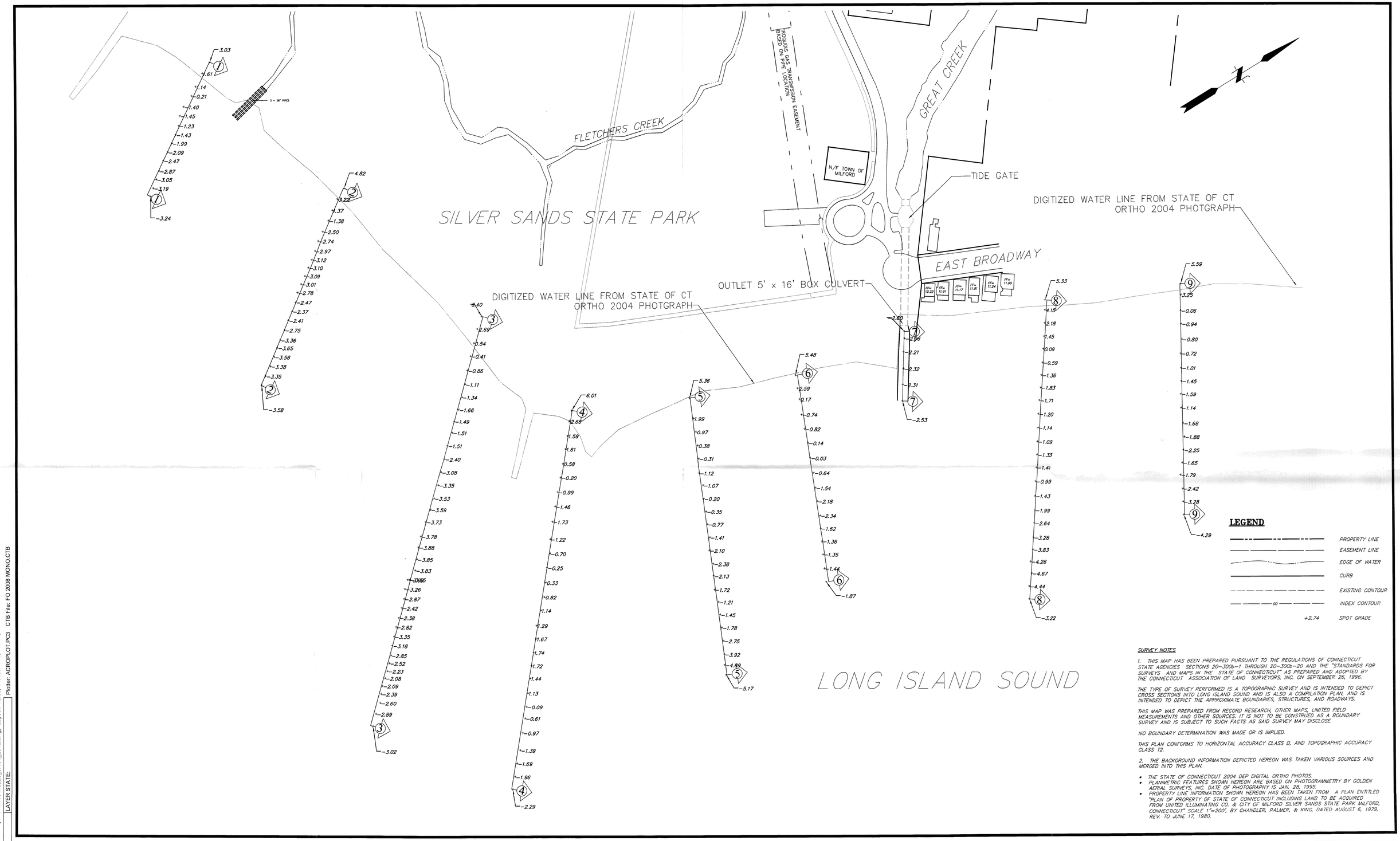

SURVEY NOTES

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No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.			XX/XX	XX

SEAL

SEAL

SCALE:
HORZ.: 1" = 100
VERT.:
DATUM:
HORZ.: NAD 27
VERT.: NGVD 29
100 50 0 100
GRAPHIC SCALE

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MANCHESTER, CONNECTICUT 06040
860.646.2469
www.fando.com

STATE OF CONNECTICUT
DEPAREMENT OF ENERGY & ENVIRONMENTAL PROTECTION
SILVER SANDS STATE PARK
GREAT CREEK OUTLET STRUCTURE
2012 SECTIONS LOCATIONS
MILFORD CONNECTICUT

PROJ. No.: 2000445S20
DATE: 01/30/2012
V-2.00

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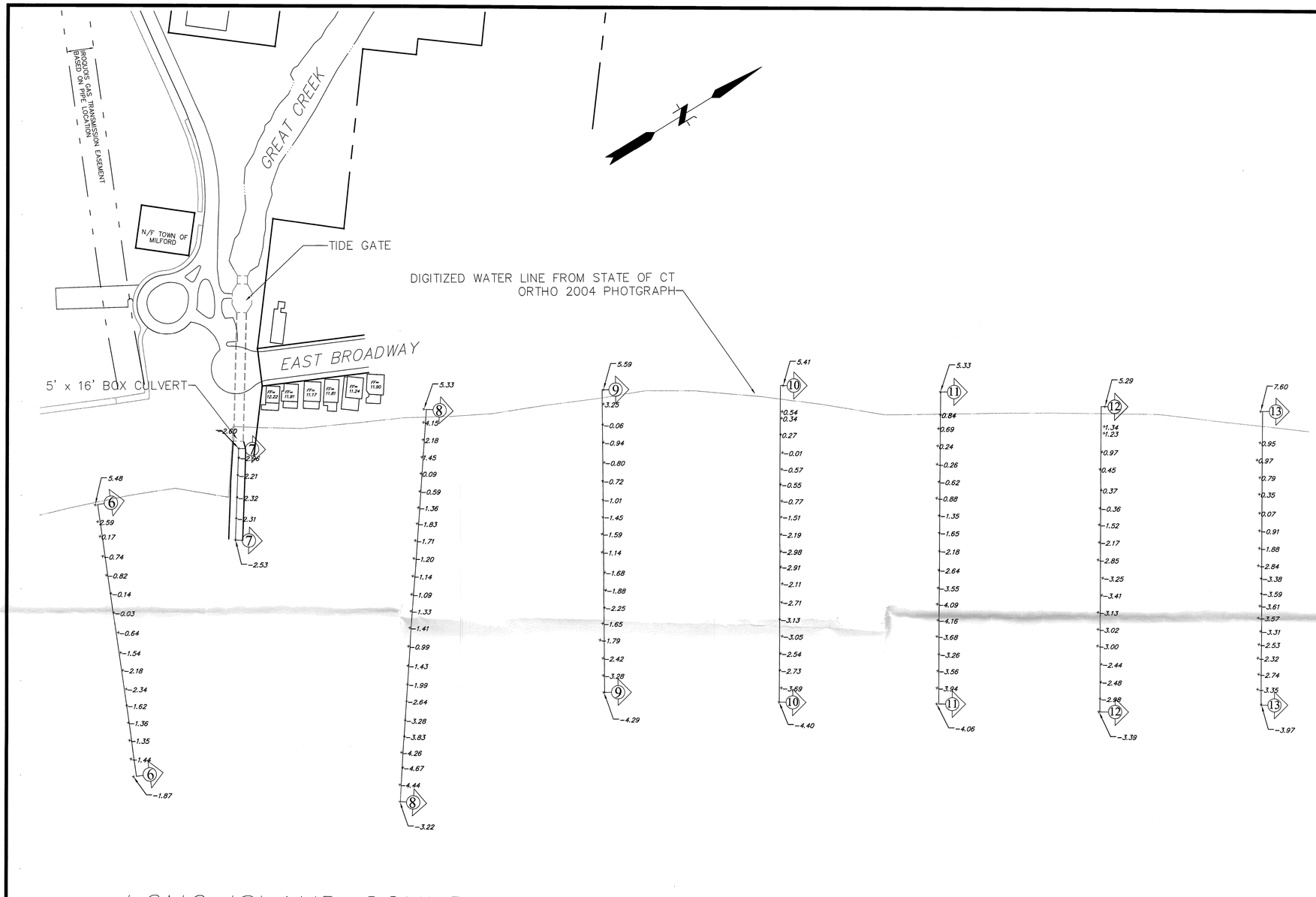

LEGEND

- PROPERTY LINE
- EASEMENT LINE
- EDGE OF WATER
- CURB
- EXISTING CONTOUR
- INDEX CONTOUR
- +2.74 SPOT GRADE

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SEAL

SEAL

SCALE:
HORZ.: 1" = 100
VERT.:
DATUM:
HORZ.: NAD 27
VERT.: NGVD 29
100 50 0 100
GRAPHIC SCALE

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860.646.2469
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STATE OF CONNECTICUT
DEPAREMENT OF ENERGY & ENVIRONMENTAL PROTECTION
SILVER SANDS STATE PARK
GREAT CREEK OUTLET STRUCTURE
2012 SECTIONS LOCATIONS
MILFORD CONNECTICUT

PROJ. No.: 2000445S20
DATE: 01/30/2012

V-2.01

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LEGEND

	PROPERTY LINE
	EASEMENT LINE
	EDGE OF WATER
	CURB
	EXISTING CONTOUR
00	INDEX CONTOUR
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1.			XX/XX	XX

SEAL

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DAVID A. CARICCHIO L.S. #70036

SCALE:
HORZ.: 1" = 20'
VERT.:
DATUM:
HORZ.: NAD 27
VERT.: NGVD 29
20 10 0 20
GRAPHIC SCALE

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MANCHESTER, CONNECTICUT 06040
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STATE OF CONNECTICUT
DEPAREMENT OF ENERGY & ENVIRONMENTAL PROTECTION
SILVER SANDS STATE PARK
GREAT CREEK OUTLET STRUCTURE
INLET STRUCTURE TOPOGRAPHY
MILFORD CONNECTICUT

PROJ. No.: 2000445S20
DATE: 01/30/2012

V-2.02

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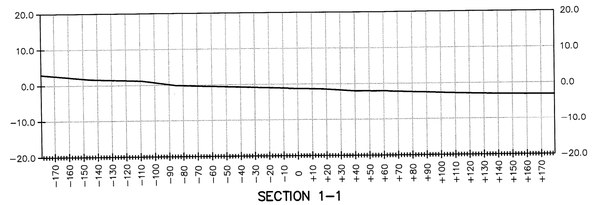

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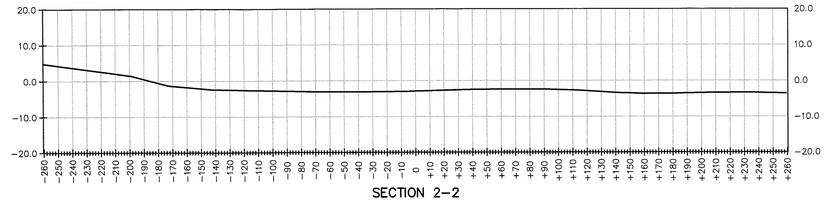

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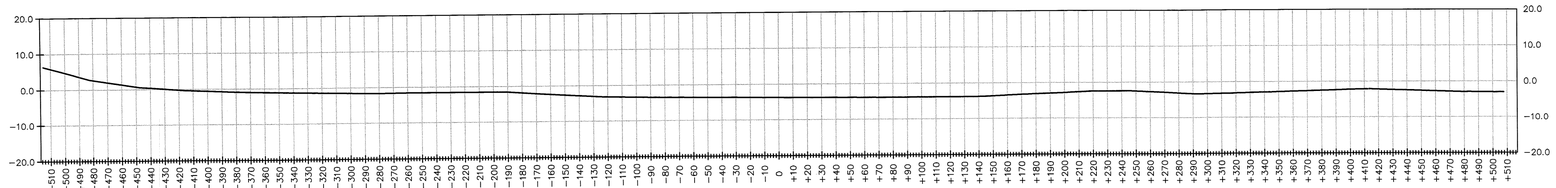

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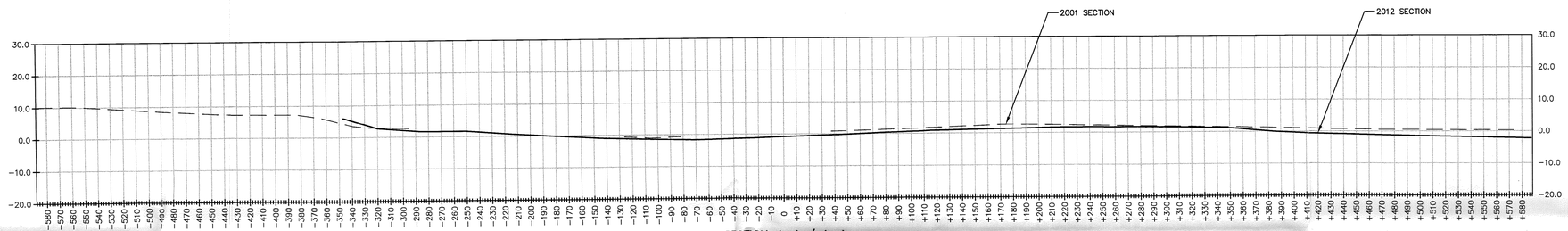

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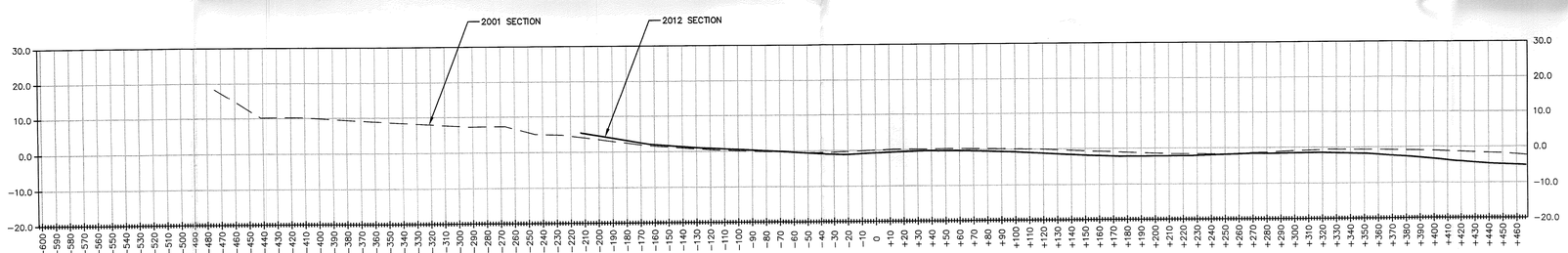

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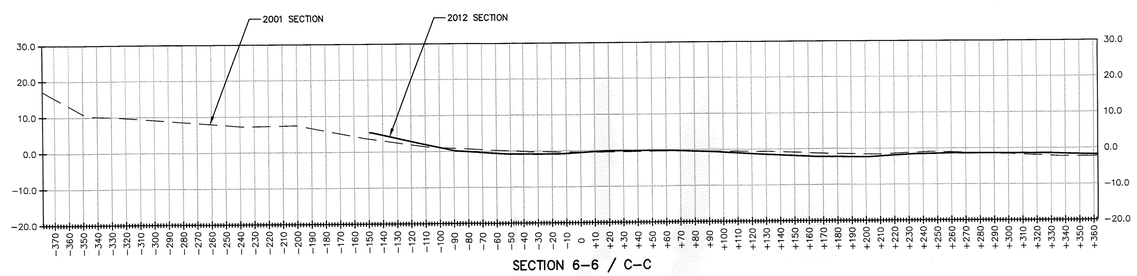

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SEAL

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GRAPHIC SCALE

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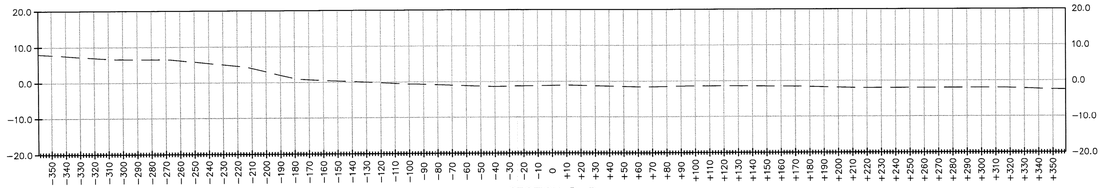
STATE OF CONNECTICUT
DEPAREMENT OF ENERGY & ENVIRONMENTAL PROTECTION
SILVER SANDS STATE PARK
GREAT CREEK OUTLET STRUCTURE
2012 SECTION VIEWS
MILFORD CONNECTICUT

PROJ. No.: 2004445A10
DATE: 01/30/2012

V-2.03



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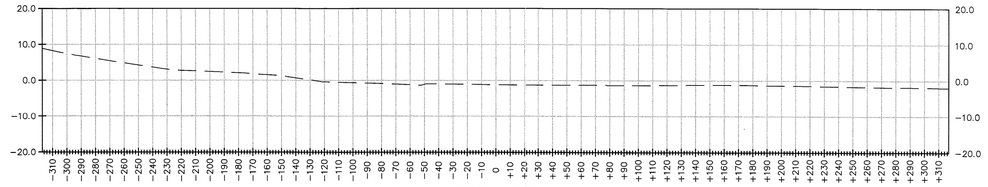

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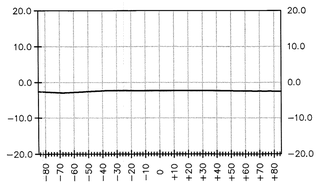

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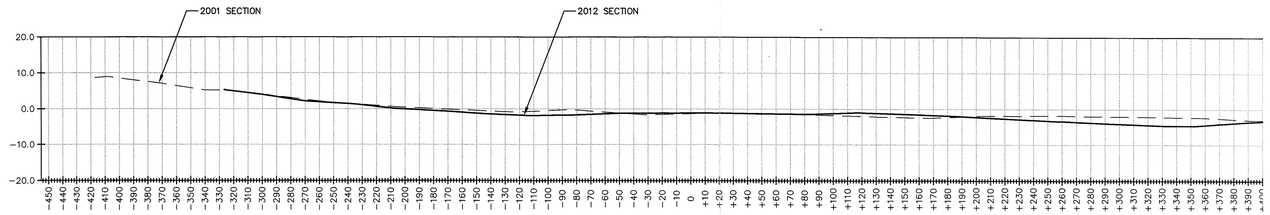

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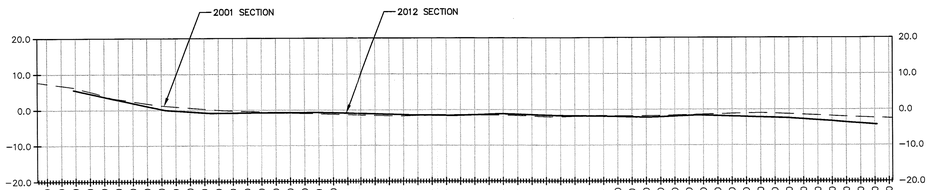

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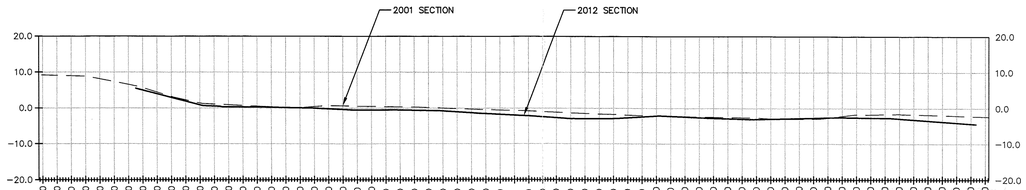
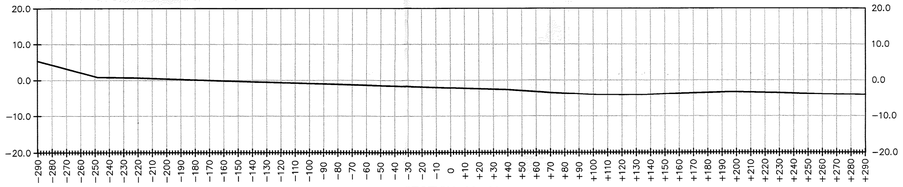


SECTION 10–10 / H–H



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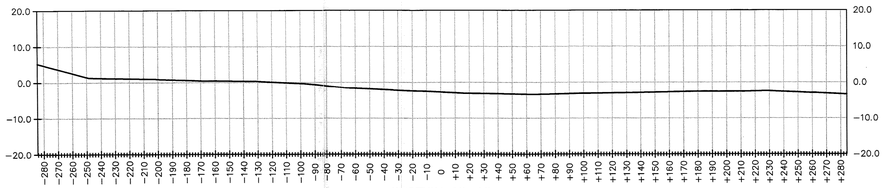

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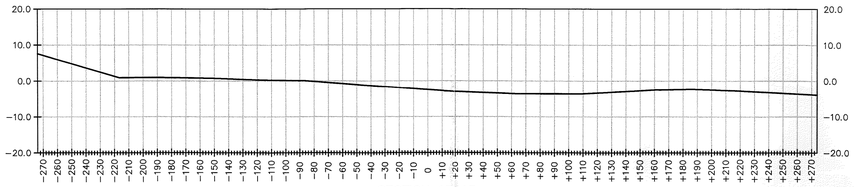

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LAYER STATE:

MS VIEW:

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

SEAL

SEAL

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HORZ.: 1" = 20'
VERT.:
DATUM:
HORZ.: NAD 27
VERT.: NGVD 29
20 10 0 20
GRAPHIC SCALE

FUSS & O'NEILL
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SILVER SANDS STATE PARK
GREAT CREEK OUTLET STRUCTURE
2012 SECTION VIEWS

MILFORD CONNECTICUT

PROJ. No.: 20044445A10
DATE: 01/30/2012

V-2.04

Appendix I

Opinion of Probable Construction Cost

Order of Magnitude Opinion of Probable Construction Cost [1]

Tide Gate and Outlet Structure Investigation Report
Great Creek Outlet Structure
Silver Sands State Park - Milford, Connecticut

Item No.	Description	Unit of Measure	Quantity	Unit Cost	Extended Cost
	Construction Costs				
1	Mobilization, Demobilization, Insurance and Bonds	LS	1	$5,000	$5,000
2	Remove Sediment from Inlet [2]	LS	1	$7,500	$7,500
3	Repair Concrete Spalls within the Tide Gate Structure	SF	150	$65	$9,750
4	Repair Precast Concrete Box Joints	LF	60	$25	$1,500
5	Repair Self-Regulating Tide Gates [3,4]	LS	1	$10,000	$10,000
6	Remove and Dispose Bio-Fouling	LS	1	$1,500	$1,500
7	Upgrade Motors and Gearing for Single Phase Power [5]	LS	1	$25,000	$25,000
8	Provide Single Phase Power to Tide Gate Structure [6]	LS	1	$20,000	$20,000
9	Contingency (25%)	LS	1	$20,000	$20,000
	Subtotal				*$100,250*
	Engineering				
10	Design & Permitting	LS	1	$30,000	$30,000
11	Construction Administration	LS	1	$10,000	$10,000
12	Construction Summary Report	LS	1	$5,000	$5,000
	Subtotal				*$45,000*
	Total (Rounded)				**$145,000**

This Order of Magnitude Opinion of cost estimate is expected to be within -30 to +50 percent of the actual project cost. Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions. Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

Date: April 9, 2012	Prepared By: JJL	Checked By: CML, TJG

Notes:

1. This Opinion of Cost is for repairs to the inlet, the self-regulating tide gates, the tide gate structure itself, and the concrete box culvert. This estimate does NOT included costs to repair and/or replace the timber training walls. This estimate will be included in a separate report prepared by Woods Hole Group.

2. Cost assumes excavator with operator ($1,500/day); tri-axle with driver ($800/day); laborer ($400/day); and water handling ($500/day). Assume two days plus $1,000 for materials. $3,200/day x 2 days +1,000 = $7,400; SAY $7,500 lump sum.

3. Work includes the items listed in Review and Recommendations Concerning the Self-Regulating Tide Gates, by: Tom Steinke, December 20, 2011.

4. Cost assumes crane with operator ($2,500/day); equipment truck with driver ($500/day); foreman ($500/day); laborer ($400/day); and water handling ($500/day). Assume two days plus $2,000 for materials. $4,400/day x 2 days +2,000 = $9,800; SAY $10,000 lump sum.

5. It is assumed that there is an off-the-shelf single phase sluice gate valve operator in existance that can be used for this application.

6. As part of final design, the local utility company (United Illuminating) should be contacted to verify the cost for installing single phase power.