Hurricane Barrier Inspection Report
New London, CT

Prepared for

GEI Consultants

BY

December 13, 2011

455 Main Street Bldg 1 Ste A-B
Deep River, CT 06417
Tel: (860-526-2610)
Fax: (860-526-5018)
www.extechllc.com

Division Headquarters

455 Main St. Bldg. 1 Suite AB
Deep River, CT 06417
Tel: (860) 526-2610
Fax: (860) 526-5018

Mr. John McGrane, P.E.
GEI Consultants
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033

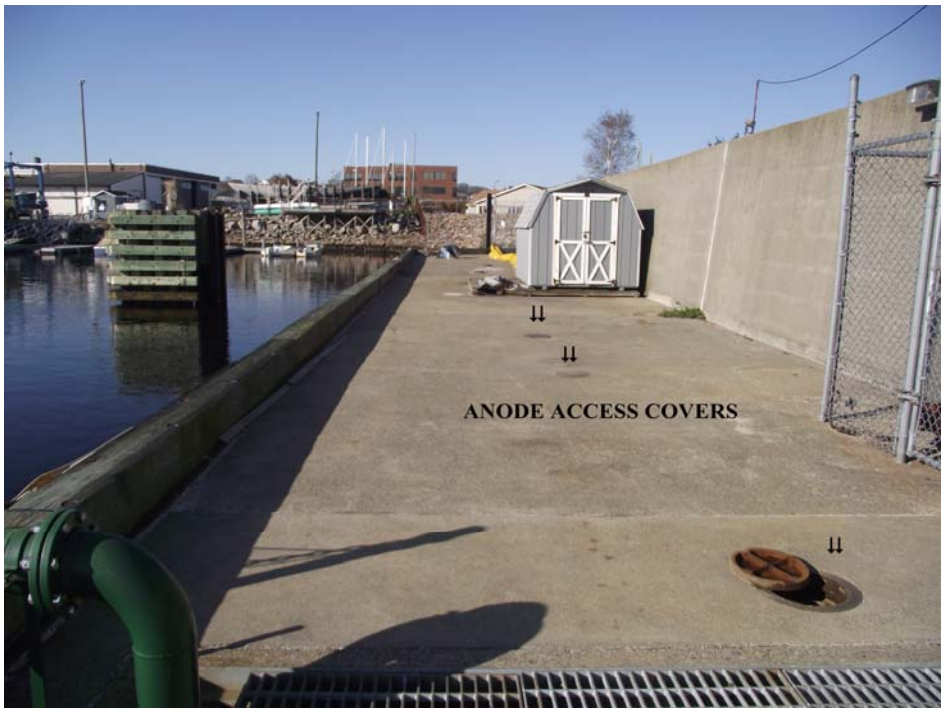
December 13, 2011

Re: New London Shaw Cove Hurricane Barrier Inspection
Job # DR31011

Dear John:

On November 2, 2011 we completed the inspection of the hurricane barrier sheeting and testing of the cathodic protection system on the Shaw Cover concrete dock in the City of New London. The inspection included visual inspection of the exposed steel sheeting, ultrasonic thickness testing of the sheet, inspection of the cathodic protection system, and electrical testing of the CP anodes.

The testing of the cathodic protection anodes was conducted by our subconsultant Corrtech whose report is attached.



Executive Summary

Discussion with DDLC Energy personnel and the Dock Master indicated that the structure is at least 30-years old and the cathodic protection was installed at the same time. They have replacement zinc anodes on the dock and recalled replacing some of the anodes over the years. Many of the anode pull ropes have broken and other pvc slotted tubes have filled with sand anchoring the anodes in place.

The steel sheeting exposed above the sediment line, in the tidal zone and above the tidal zone has extensive and severe metal loss. The metal loss on the exterior is most severe in the tidal zone and down to the sediment. Only a small portion of the sheeting was available for inspection in the deep water area. The combination of exterior corrosion on the water side and soil corrosion on the land side has thinned the steel by 75% in the tidal zone. The steel is not uniformly thinned by 75% the extreme corrosion is localized but there is also a high probability of localized perforation. The average metal loss is 30% based on the areas measured.

The sacrificial cathodic protection system is providing very marginal to no corrosion protection on the soil side and zero corrosion protection on the water side. The zinc anodes are nearly all consumed and many cannot be properly maintained due to clogging of the pvc tubes, broken pull ropes and broken bonding cables.

The steel sheeting needs to be repaired, recoated and cathodically protected for preserve the remaining structure. A structural analysis of the metal loss and stress of the structure is needed to define the extent of repairs required.


Typical tidal zone metal loss

Discussion

The steel sheeting has widespread failure of the asphaltic coating on the water side. The steel has extensive, deep layer corrosion in the sheeting seams and on the corners. Thick layer corrosion has developed and has resulted in 20-50% metal loss on the water side.

Ultrasonic thickness measurements of the sheeting show the original thickness to be approximately .500 inch. The maximum thickness value recorded generally represents the original thickness.

Eight (8) locations were scraped, hammered and power tool cleaned to remove the corrosion scale and coating. A 5Mhz transducer was used to scan the prepared areas to record the maximum and minimum values. The eight locations are shown on the attached dock diagram. In the thinnest areas a hammer test clearly showed the remaining plate to be a fraction of the original thickness, evident by the flex in the plate.

UT Test Data (inches)

Location	Max	Min
UT1	.500	.380
UT2	.500	.385
UT3	.380	.135
UT4	.440	.170
UT5	.375	.125
UT6	.380	.245
UT7	.450	.120
UT8	.480	.135

The following water side and land side cathodic protection test covers were opened, tests were conducted and one anode was pulled as indicated below; See the attached Corrtech report.

Typical CP Station

Test Station (as shown on dwg)	Comment
4	potential test
5	potential test
6	potential test
11	potential test
14	detached for current potential
16	detached for current potential
25	pulled and photographed
26	potential test
27	detached for current potential
28	potential test
B	potential test
C	potential test
E	potential test
G	potential test
H	potential test
J	potential test
L	potential test

CP#25

Recommendations

The steel sheeting needs to be repaired, recoated and cathodically protected for preserve the remaining structure. A structural analysis of the metal loss and stress of the structure is needed to define the extent of repairs required.

The water side land side anodes need to be replaced. Replacement may require cleaning out the existing pvc tubes or installing new tubes through the concrete deck. The land side anodes should be magnesium and the water side anodes should be aluminum. The anodes should be inspected every year for deterioration.

The exposed sheeting should be abrasive blasted and hammered to remove the surface corrosion and layered steel. The thin areas should be reinforced with ½-inch plate welded on the exterior. All of the sheeting above the low tide level should be coated with a splash zone quick cure catalyzed coating.

If there are any questions regarding the inspection methods, data or observations please contact me directly.

Respectfully

Ted Lund, Division Manager

Attachment:

- Dock Drawing with Field Notes
- Digital Photographs
- Corrtech Cathodic Protection Report

GEI- New London Hurricane Barrier

DP#1

West end of dock and sheet pile

DP#2

Unused zinc anodes for replacement

DP#3

Typical soil side anode installation

DP#4

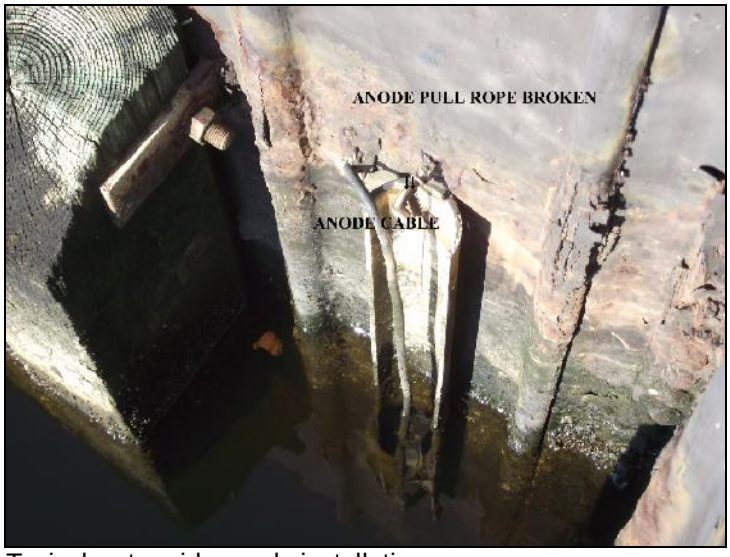
Zinc anode pulled from station 25

GEI- New London Hurricane Barrier

DP#5

Close-up of anode, shows deterioration of zinc

DP#6



Typical water side anode installation

DP#7

Typical sheet pile condition at top

DP#8

East end of sheeting, tidal zone corrosion is apparent

GEI- New London Hurricane Barrier

DP#9

Typical severe corrosion and layering in tidal zone

DP#10

Deep layer corrosion and splitting on corner bend of sheet

November 14, 2011

Mr. Ted Lund
Division Manager
Acuren Inspection, Inc.
455 Main Street
Building No.1 Suite A-B
Deep River, CT 06417

RE: Final Report for Cathodic Protection Compliance Testing, Inspection and Evaluation of Approximately 250 Linear Feet of Steel Sheet Pile Wall In New London, CT.
Acuren P.O. No.: Verbal Authorization as per Mr. Ted Lund
CorrTech, Inc. Job No. 6654

Dear Mr. Lund:

On November 2, 2011, CorrTech, Inc. engineering personnel met with you at the above referenced site and completed a random testing of the existing cathodic protection systems. There are twenty (20) land-side test stations. Most test stations contain two (2) 60-pound zinc anodes. There are twelve (12) water-side anodes. It is not known if there are one (1) or two (2) water-side anodes per location. Testing was performed in accordance with NACE International Standard Recommended Practices SP 0169, SP 0285 and Specification Section IX and Drawing No.'s NL-3 & Nl-5 as previously provided. All testing was performed with a portable silver/silver chloride reference electrode. The result of our testing and evaluation forms the basis of this report.

CONCLUSIONS

1. Land-side test station testing included No.'s 4, 5, 6, 11, 14, 16, 25, 26, 27 & 28. This is representative of a 50% random sampling. Please refer to the drawing produced in the field for test locations. Drawing produced by Acuren personnel.

2. The following test data was obtained:

Test Locations	"On" Potential	"Off" Potential	Current Output
4	1.070 v		
5	1.067 v		
6	0.873 v		
11	1.001 v		
14	1.047 v	0.540 v	2.500 mA
16	0.996 v	0626 v	40.00 mA
25	0.703 v		
26	1.006 v		
27	1.031 v	0.651 v	14.00 mA
28	1.059 v		

3. Anode No. 25 was pulled for inspection. The anode is depleted and will no longer function.

4. Analysis of the data obtained for the land-side cathodic protection indicates that the anodes tested are marginally effective, with the exception of anode No.25. It is not known the length of time the anodes have been operating. It is not known if any of the anodes have been replaced.

5. Water-side test station testing was limited to "on" potentials only as the connections are thermite welded to the sheet pile wall. Water side test stations were designated "A" through "L" for clarity. "On" potential readings were measured and found to be:

Location	"On" Potential
B	0.640 v
C	0.616 v
E	0.642 v
G	0.638 v
H	0.649 v
J	0.627 v
L	0.651 v

6. Analysis of the data obtained for the water-side cathodic protection indicates that the anodes are not effective. It is not known the length of time the anodes have been operating. It is not known if any of the anodes have been replaced. The testing performed is representative of a 58% random sampling.

RECOMMENDATIONS

1. Consideration should be given for the replacement of the land-side zinc anodes. Magnesium rod anodes are recommended.

2. Consideration should be given for the replacement of the water-side zinc anodes. Aluminum hull anodes are recommended.

3. Upon notice to proceed, CorrTech, Inc. would present design calculations and installation recommendations for the above referenced sacrificial cathodic protection systems.

DISCUSSION

Without past historical test results for comparison and date of installation and/or replacement records, it is concluded that the land-side zinc anodes are marginally functional at this time. Anode No. 25 was pulled for inspection and clearly indicated that the zinc anode was depleted as over 75% of its original weight has been lost. This anode is obviously non-functional and should be replaced. Several of the land-side anode locations could not be pulled for inspection as they are stuck in silt and debris. It is additionally considered that all land-side zinc anodes should be replaced with high potential magnesium rod anodes. This may present a problem with installation as a majority of the perforated PVC tubes that house the anodes have become filled with sediment and debris. This may necessitate the re-auguring and/or vacuuming of the PVC tube to allow for the installation of new anode material. Many of the hand-hole mechanical connections are badly corroded and would require replacement as well.

The water-side zinc anodes appear to be non-functional. Because of the location and direct attachment to the wall, these anodes were not pulled for inspection. A potential profile was performed and shows that the “protected on” values measured ranged from 0.616 volts to 0.649 volts. These values are indicative of un-protected, static base potentials of coated steel in a salt water environment. It should be noted at this time that the use of zinc anode material in a salt water environment is not recommended. The typical anode of design in this environment is aluminum. It also appears that the amount of zinc installed was underestimated.

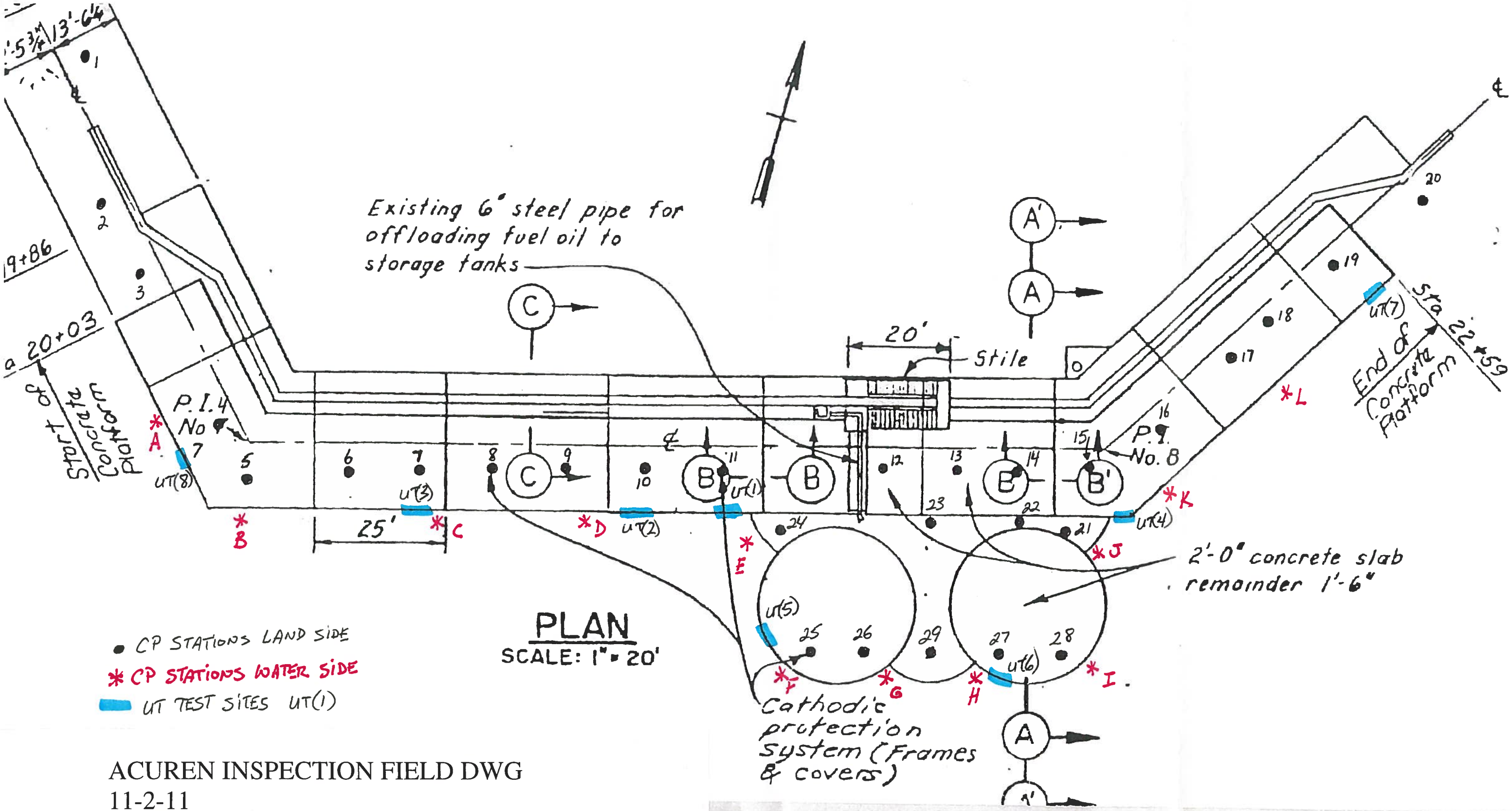
It is concluded at this time that the water-side zinc anodes should be replaced with aluminum hull anodes. A preliminary "estimate" is thirty (30) 96-pound anodes would be required. These anodes are manufactured with a steel core that is off-set. Under water welding would be required.

If you have any questions or desire further discussion, please call our office at your convenience.

Respectfully submitted,

Craig Scott Lower
Corrosion Engineer/Project Manager
NACE Certified Corrosion Specialist No. 4386

CT\Acuren\New London 6654



• CP STATIONS LAND SIDE

* CP STATIONS WATER SIDE

▬ UT TEST SITES UT(1)

PLAN

SCALE: 1" = 20'

ACUREN INSPECTION FIELD DWG
11-2-11
NEW LONDON HURRICANE BARRIER STUDY
SHAW COVE, NEW LONDON

Prepared for:
GEI CONSULTANTS