FINAL REPORT

DULUTH CORROSION INVESTIGATION
DULUTH HARBOR

Prepared for: US Army Corps of Engineers
Detroit District
DACW35-01-D-0006
Delivery Order Number: 0044

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January 2007

Statement of Independent Technical Review (ITR)

COMPLETION OF INDEPENDENT TECHNICAL REVIEW

Altech has completed the Duluth Corrosion Investigation, Duluth, Minnesota. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing USACE policy.

Prepared by

_____ _____

(Signature) (Date)

Mariah Hope P.E.

Project Engineer

_____ _____

(Signature) (Date)

Mark E. Resch L.P.G

Independent Technical Review

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1.0 Introduction

The United States Army Corps of Engineers, Detroit District (USACE) retained Altech Environmental Services, Inc. (Altech) as an A/E Contractor to provide and oversee water quality and diving services at designated sampling locations in Duluth Harbor, Superior Bay, St. Louis Bay, Spirit Lake, and St. Louis River. Duluth Harbor is surrounded by Duluth, Minnesota to the west, and Superior, Wisconsin to the east.

Altech Environmental Services, Inc. (Altech) is pleased to present this Duluth Corrosion Investigation report for Duluth Harbor. The purpose of the project was to evaluate water quality at Duluth Harbor, Minnesota in areas of corrosion on steel structures. Work was performed for the USACE under Contract No. DACW35-01-D-0006, Delivery Order No. 0044.

1.1 Project Description

The purpose of the project was to characterize water quality and determine steel corrosion rates of hydraulic steel structures in the vicinity of areas identified by the USACE. This project collected and tested water quality samples and tested water columns at specified locations in and around Duluth Harbor. This project also documented the existing condition of steel structures with respect to pitting and corrosion at specified locations using non-destructive test methods.

1.2 Site Description

Duluth Harbor is a relatively large port located on the southwest shore of Lake Superior in Duluth, Minnesota and Superior, Wisconsin. This harbor serves a large number of both commercial ships and recreational boaters providing access to Lake Superior. The St. Louis River is the main tributary, which flows into the harbor. Refer to Plates 1 through 7 in Appendix A for a depiction of the 27 Federal corrosion monitoring locations. No plates were provided by the USACE for the 17 additional non-Federal corrosion monitoring locations. The furthest sample point located upstream from Duluth Harbor on the St. Louis River is the Oliver Bridge.

1.3 Limitations

The USACE provided the following changes to the testing and documentation locations prior to the commencement of fieldwork:

A. Delete the “web” (portion of the sheet piling between the inner and outer flanges) location from data collection location DE2.
B. Delete data collection locations EP1w, EP2w, CGA2o, and CGB.
C. Relocate data collection locations CGA1o.
D. Add alternate point 328 in place of CGB (identified as CGB in report).

Mr. John Larson of the US Army Corps, Duluth Office, agreed approved AMI's GPS coordinate acquisition process and accuracy of the unit. Mr. Larson felt no further calibration was necessary at that time.

Water quality samples were collected from a boat and not from the land. The elevation of the boat fluctuated both with the water datum at the time and the amount of wind generated waves. The waves during the sampling events were as high as 1.5-feet. This wave action means that all sample depths are approximate.

2.0 Scope of Work

Water quality testing and samples were collected from the 27 Federal and 17 non-Federal corrosion monitoring locations (44 total locations) within and in the vicinity of Duluth Harbor, Minnesota. Sample locations were provided by the USACE for the Federal Structures and are included in Appendix A –Sample Location Plates and on Table 1. Corrosion monitoring was only performed at the 27 Federal monitoring locations. Harbor sample locations and designations were recorded on the USACE provided data entry sheet. Sample locations were recorded with a Global Positioning System (GPS) unit and their proximity were permanently marked for the 27 Federal corrosion monitoring locations and temporarily marked with paint for the 17 non-Federal corrosion monitoring locations. Sampling location designations are depicted on Table 1.

Table 1: Sample Location Designations

Original Sample Locations			Addendum Locations	
Duluth Entry 1	Superior Entry 1	Erie Pier 1	DSPA Berth 1	Spirit Lake Marina
Duluth Entry 2	Superior Entry 2	Eire Pier 2	DSPA Berth 4	Oliver Bridge
Duluth Entry 3	Superior Entry 3	USACE Vessel Yard 1	DSPA Berth 6	Midwest Energy
Duluth Entry 4	Superior Entry 4	USACE Vessel Yard 2	CN/DMIR Two Harbors	Cenex/Harvest States
Duluth Entry 5	Superior Entry 5	Coast Guard Cell - CGA	William A. Irvin Slip	Cutler Magner
Duluth Entry 6	Superior Entry 6	Coast Guard Cell - CGB	DECC	Lakehead Boat Basin
Duluth Entry 7	Superior Entry 7	Coast Guard Cell - CGC	Cargill	Community Sailing Dock
Duluth Entry 8	Superior Entry 8		Hallett Dock 5	
Duluth Entry 9	Superior Entry 9		Hallett Dock 7	
Duluth Entry 10	Superior Entry 10		Bong Bridge Cell	

2.1 Water Quality Testing and Collection

Water quality samples were obtained at each of the USACE identified sample locations. A field log was maintained for all water quality sample locations that resulted in the recording of the following items of information while sampling:

A. Station identification number.
B. Sample collection date, time and the names of the sample team.
C. Depth at each sample location corrected to low water datum.
D. Type of sampling equipment used.
E. GPS coordinates.
F. Identification number of the USACE sample location.

Analyzed water quality parameters are listed in Table 2 noted below. Field parameters were recorded from various depth increments for field parameter analysis (depth increments indicated on USACE plate number 8 of 9 located in Appendix A). This data was collected using a Hydrolab Corporation Quanta water quality meter. The meter has a pressure sensor for determining sample depth and several sensors that recorded the above noted field parameter.

Laboratory analysis involved the use of a Geotech Environmental Equipment, Inc. peristaltic pump with the sampler lowered to an approximate depth of four feet below the International Great Lakes Datum (IGLD) of 1955. Water samples were directly discharged by the pump to laboratory supplied containers. Laboratory analysis was performed by Trace Analytical Laboratories, Inc. (Trace), a USACE certified lab.

Table 2: Water Quality Sample Parameters

Field Parameters	Laboratory Parameters
PH	Alkalinity
Dissolved oxygen	Chloride Ions
Conductivity	Sulfate Ions
Temperature	Total Suspended Solids (TSS)
	Hardness
	Total Iron

2.2 Steel Corrosion and Pitting

Corrosion measurements were made at the 27 Federal scope of work locations. Work was performed by Altech subcontractor AMI Consulting Engineers, PA, of Duluth Minnesota. The extent of steel sheet piling (SSP) and other steel plate corrosion were determined by the use of non-destructive test methods. Three columns of data were required at each test location. Each

column of data required testing at ten (10) different elevations, as applicable as shown on Plate 8 in Appendix A.

Each test location was composed of either a 6-inch by 6-inch square area or a 4-inch by 4-inch square area that were restricted by the flange width of SSP at any given column location. The perimeter of each square where data was measured was photographed and permanently marked or scribed for future data measurements.

Within each 4-inch or 6-inch square area of corrosion measurement there were a total of ten (10) data entries. Each square area was photographed and had the following data entries described as follows:

A Overall thickness of steel plate, which should be the original thickness of the steel plate installed.
B Measurement of the corrosion pit depth of four (4) representative pits within the steel plate area. The pit depth shall be as referenced from the plane of the original face of steel plate. Label each of the representative pits as 1, 2, 3, and 4 as shown on Plate 9 in Appendix A.
C Measure the representative pit diameter corresponding to the same representative corrosion pit depths noted above.
D Determine a qualitative indicator that rates each square as highly corroded (75-100% of square is pitted); moderately corroded (50-75% of square is pitted); low corrosion (less than 50% of square area is pitted). See Plate 9 in Appendix A for an example of labeling the pits and a representative rating.

3.0 Weather/Climatic Conditions

Corrosion investigation occurred from August 17, 2006 through September 1, 2006. Water quality sampling occurred from September 19, 2006 through September 24, 2006. Weather for the six days of water quality sampling is summarized in Table 3.

Table 3: Weather Conditions for Water Quality Sampling

Date	Temperature, °F	Wind Speed, mph	Wind Direction	Wind Gusts, mph	Condition
September 19	36-52	12	NW	31	Overcast
September 20	33-57	8	WNW	24	Overcast
September 21	36-59	9	SE	23	Overcast
September 22	50-53	18	E	43	Rain
September 23	44-55	11	NNE	28	Rain
September 24	37-62	9	WNW	24	Overcast

Water Datums were obtained from Station 9099064, Duluth, Lake Superior from the National Oceanic and Atmospheric Administration's (NOAA) website on a regular basis. Water levels during the sampling event ranged from 600.75 to 601.94 feet MSL.

4.0 Sample Collection

Sampling services were performed from Tuesday September 19, 2006, through Sunday September 24, 2006, with the assistance of AMI. The sampling crew consisted of Altech representatives Mark Resch and Mariah Hope, and AMI's boat captain. Altech provided project supervision, including direction of all sampling activities, sample handling, descriptive work, field documentation, photography, data logging, and health and safety issues.

Water quality samples were collected over the six-day period beginning on September 19, 2006, and concluding on September 24, 2006. No samples were collected on September 23, 2006 due to heavy rains and winds. Water quality samples (see Table 1 for sampling nomenclature and Attachment A for sample locations) were collected from Duluth Harbor in the immediate vicinity of the monitoring locations pre-selected by the USACE. Sample locations were located by GPS and permanently marked for future reference. Sample locations are listed in Table 4 below:

Table 4: GPS Coordinates for Sampling Locations

Investigation Site	Identifier	North	West	Mark Location height above IGLD
Duluth Entry	DE1	N46°46.854	W92°05.313	2 FT
	DE2	N46°46.852	W92°05.306	2 FT
	DE3	N46°46.810	W92°05.406	2 FT
	DE4	N46°46.777	W92°05.510	2 FT
	DE5	N46°46.766	W92°05.670	2 FT
	DE6	N46°46.682	W92°05.597	2 FT
	DE7	N46°46.737	W92°05.475	2 FT
	DE8	N46°46.779	W92°05.368	2 FT
	DE9	N46°46.791	W92°05.305	2 FT
	DE10	N46°46.804	W92°05.281	2 FT
ACOE Vessel Yard	VY1	N46°46.513	W92°05.540	2 FT
	VY2	N46°46.517	W92°05.524	2 FT
Erie Pier	EP1	N46°44.289	W92°08.666	2 FT
	EP2	N46°44.317	W92°08.717	2 FT
Coast Guard Cells	CGA1	N46°44.102	W92°08.681	2 FT
	CGC1	N46°43.200	W92°08.617	2 FT
	CGB	N46°42 25.63	W92°02 07.52	2 FT

Table 4: GPS Coordinates for Sample Locations Cont.

Investigation Site	Identifier	North	West	Mark Location height above IGLD
Superior Entry	SE1	N46°42.613	W92°00.380	2 FT
	SE2	N46°42.699	W92°00.465	2 FT
	SE3	N46°42.510	W92°00.867	2 FT
	SE4	N46°42.477	W92°00.900	2 FT
	SE5	N46°42.426	W92°01.014	2 FT
	SE6	N46°42.408	W92°01.191	2 FT
	SE7	N46°42.442	W92°00.760	2 FT
	SE8	N46°42.443	W92°00.784	2 FT
	SE9	N46°42.402	W92°00.883	2 FT
	SE10	N46°42.279	W92°01.007	2 FT
DSPA	Berth 1	N46°45.495	W92°06.151	3 FT
	Berth 4	N46°45.480	W92°05.776	3 FT
	Berth 7	N46°45.171	W92°05.702	3 FT
William A Irvin Slip		N46°47.018	W92°05.865	2 FT
DECC		N46°46.765	W92°05.906	2 FT
Cargill		N46°46.166	W92°06.312	4 FT
Hallett Dock 5		N46°44.734	W92°07.943	1'-6"
Bong Bridge Cell		N46°43.882	W92°08.668	3 FT
Hallett Dock 7		N46°43.173	W92°09.720	No mark
Spirit Lake Marina		N46°42.433	W92°12.172	2 FT
Oliver Bridge		N46°39.391	W92°12.165	top of sheet = 1FT
Midwest Energy		N46°44.571	W92°06.891	2 FT
Cenex/ Harvest States	CHS 1	N46°44.399	W92°05.965	2 FT
	CHS 2	N46°44.377	W92°06.155	2 FT
	CHS 3	N46°44.406	W92°06.151	2 FT
Cutler Magner		N46°43.990	W92°04.492	4 FT
Lakehead Boat Basin	1	N46°46.457	W92°05.563	2'-6"
	2	N46°46.454	W92°05.552	2 FT
Community Sailing Dock		N46°43.932	W92°03.408	2 FT
CN/ DMIR Two Harbors		N47°00.931	W91°40.258	2 FT

Water depth quality measurements (pH, dissolved oxygen, conductivity and temperature) were performed at the pre-selected target depths of surface, -2 feet, -4 feet, -6 feet, -8 feet, -10 feet, -15 feet, and -20 feet below low water datum. All data measurements were recorded on a field form. Results from the field sampling events can be found in Appendix B for the 27 Federal and Appendix C for the additional 17 non-Federal corrosion monitoring locations.

5.0 Laboratory Analysis

Water quality parameters that were sent to Trace included alkalinity, chloride, sulfate, total dissolved solids, hardness and total iron. Samples were collected –4 feet below low water datum at all sites except one. The Community Boat Basin had a depth of 3.7 feet below low water datum, resulting in the water quality sample being collected at –3 feet below low water datum to lessen any particulate matter from the bottom sediments.

Upon containerization of project samples, the containers were placed in rigid coolers, maintained under ice, and subject to appropriate chain-of-custody protocols until delivered to Trace in Muskegon, Michigan.

Results from the chemical analytical report can be found in Appendix D, and with results also presented on the USACE data entry sheets found in Appendices B and C.

6.0 AMI Corrosion Investigation Report Summary

AMI Consulting Engineers conducted the corrosion investigation from August 17, 2006 through September 1, 2006. A copy of their report including photographs and field logs are included in Appendix E. A general summary of the data from their report is provided in the following paragraphs.

The previously reported corrosion conditions, as discussed in the 2004 ACOE Document ERDC/CERL SR-05-3 on the Fresh Water Corrosion in the Duluth – Superior Harbor, indicate the majority of the structures within the harbor confines and throughout the Superior Entry, with notable physical changes in marine growth, pitting penetration and corrosion type, exist throughout the Duluth Entry.

Penetration of the pitting within the harbor structures 0 to -4 foot zone from the IGLD water levels was typically 1/4 of an inch to more than 3/8 of an inch on the older structures that were installed prior to the 1980's. Due to this degree of pitting on all the Coast Guard Cells inspected, perforations were found from -1 to -2 feet IGLD. The accelerated corrosion problem became very evident in looking at the new steel sheet piling installed this year on the Superior Entry, with orange nodules already covering over 50% of the sheet pile surfaces. The other sheet pile inspected at the Superior Entry was less than five years old and had a degree of overall and pitting relative to its age. The superior entry corrosion on the oldest steel near the Lake Superior side of the entry was consistent with the rest of the harbor steel inspected with a high concentration of deep pits on the ice plates.

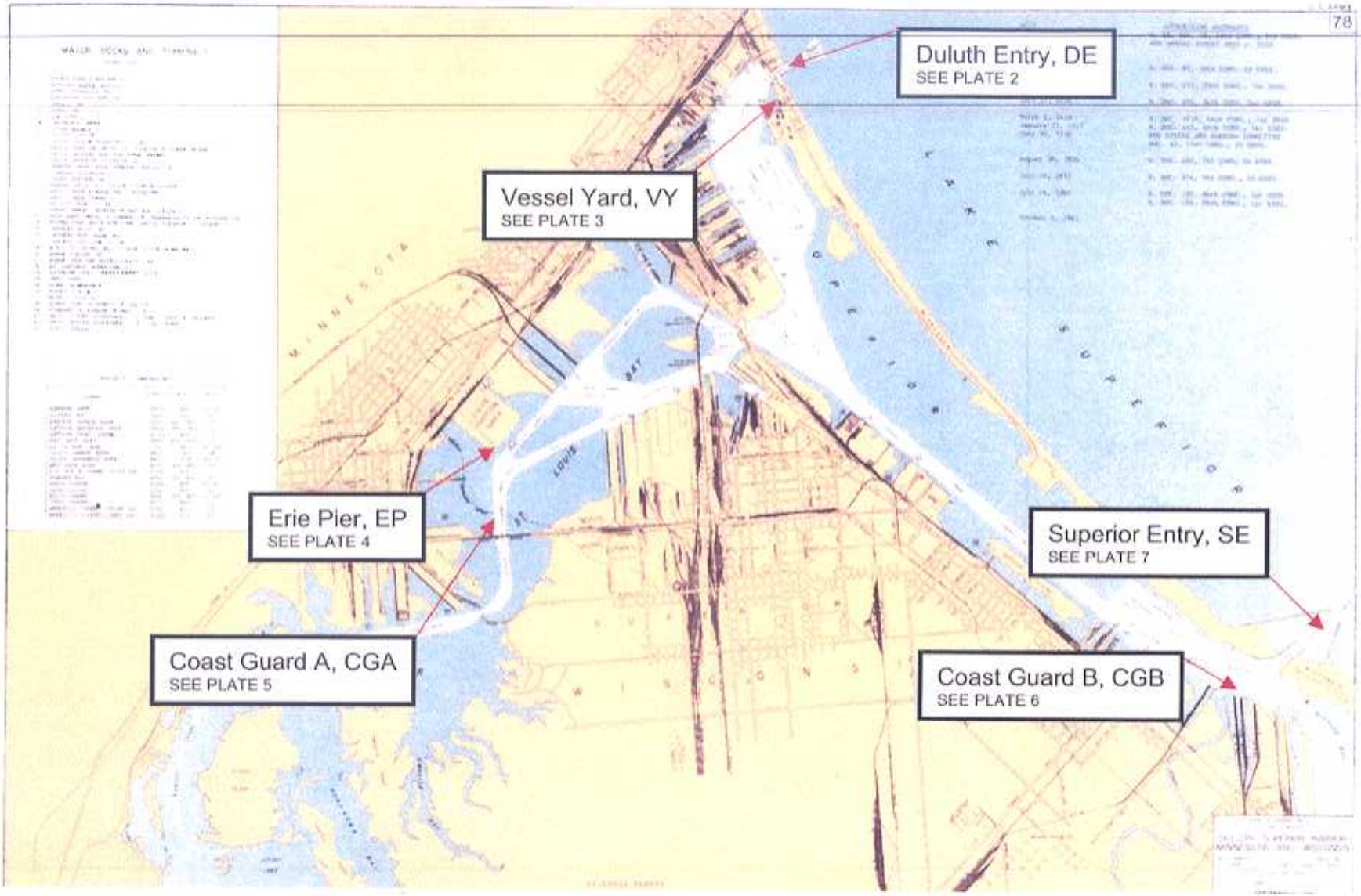
From the inspection data it appears that the overall level of corrosion and pitting drops from the main lower harbor area towards Lake Superior through the Duluth Entry. Physical

changes in corrosion occurred between the middle sample points at the Duluth Entry where the type of marine growth and the type of corrosion began its visible transition. Although pitting was present on all parts within the Duluth Entry, many of the pits measured from the DE3 and DE8 points within the entry to the Lake entrance did not have active orange nodules consistently present. Instead the pits and general steel surface were covered with a thin to heavy rust scale, with occasional orange nodules present. Outside the Entry the pit sizes were smaller in diameter and had less penetration as shown by the data.

At this time we believe the Duluth Entry data should be evaluated very carefully to take into account all the physical changes and differences from the typically seen harbor corrosion. We would recommend further investigation of this area to provide a more complete understanding of the transition in corrosion type, marine growth, currents and water quality changes. The data from the other areas investigated should be carefully evaluated based on all data submitted for the different areas inspected.

Appendix A. Sample Location Plates

U. S. Army Corps of Engineers



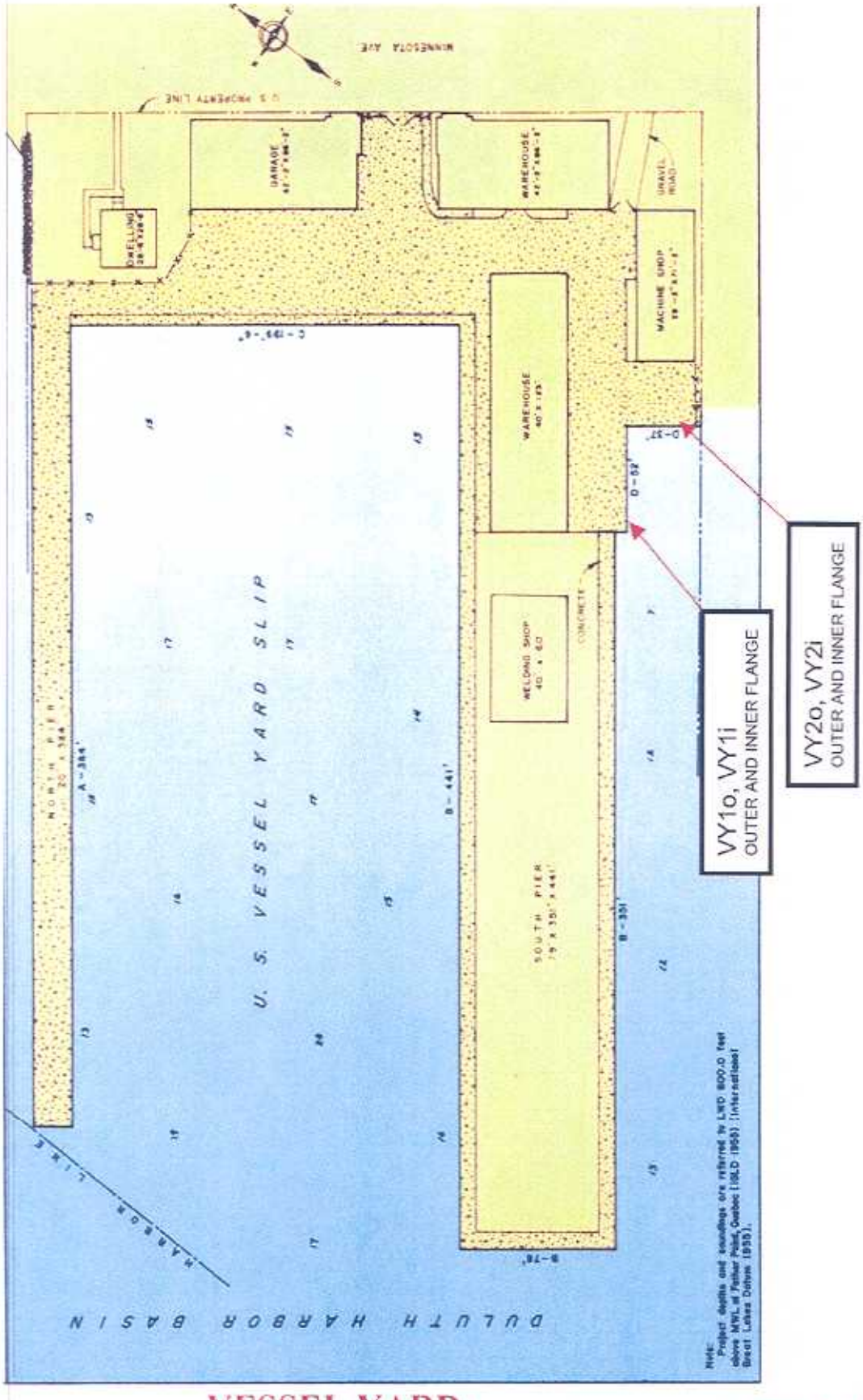
Structure Locations for Corrosion Study
Duluth-Superior Harbor, MN/WI

Plate 1 of 9
JUNE 2006

DULUTH ENTRY

DATA COLLECTION LOCATIONS FOR
DULUTH HARBOR CORROSION STUDY

Plate 2 of 9
JUNE 2006
Revised 13Jul06



VESSEL YARD

DATA COLLECTION LOCATIONS FOR
DULUTH HARBOR CORROSION STUDY

Plate 3 of 9
JUNE 2006

ERIE PIER

DATA COLLECTION LOCAITONS FOR DULUTH HARBOR CORROSION STUDY

Plate 4 of 9
December 2006

Image courtesy of the U.S. Geological Survey

m 50 100 150
yds 50 100 150

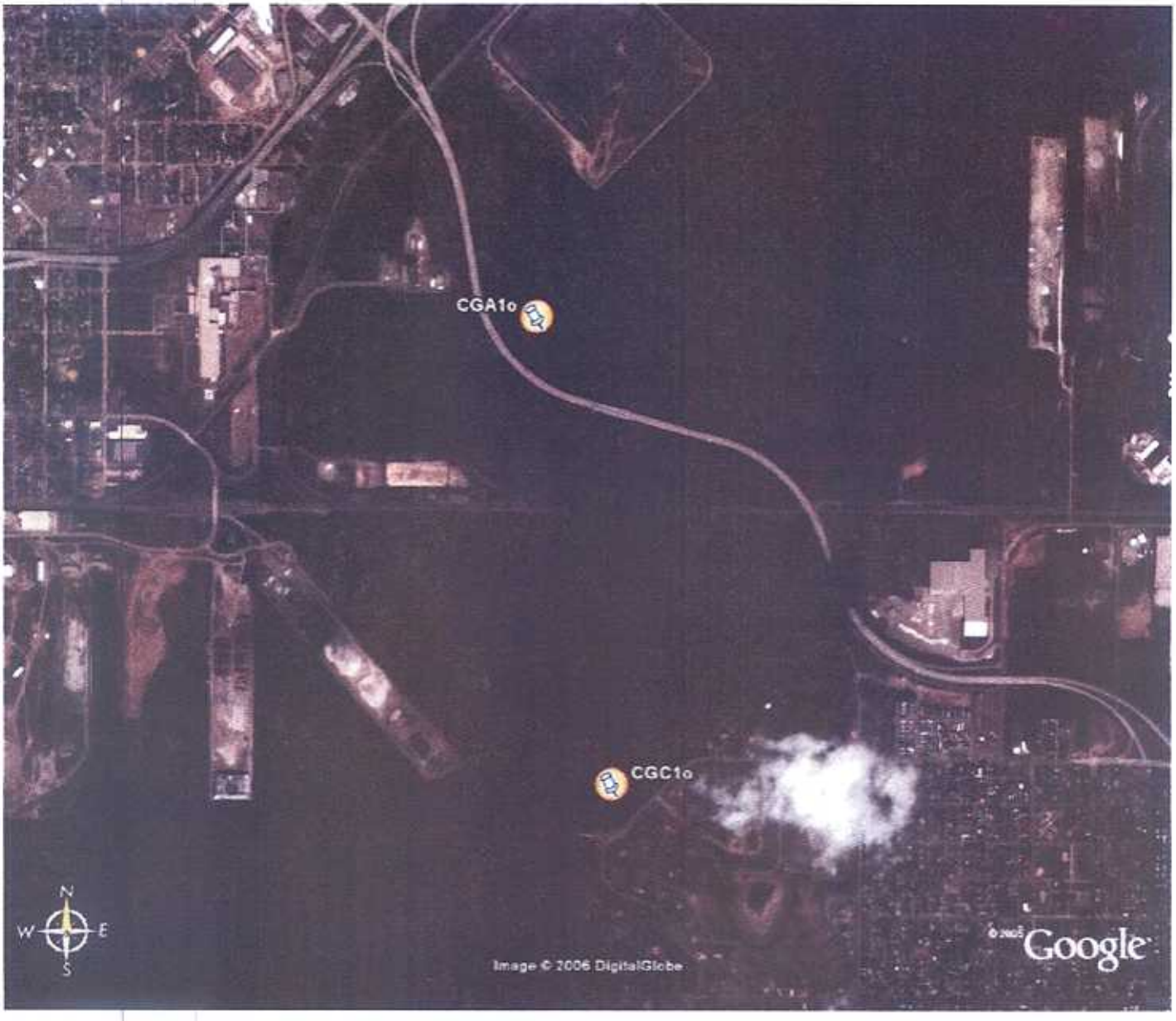
COAST GUARD 2 STRUCTURE

DATA COLLECTION LOCAITONS FOR
DULUTH HARBOR CORROSION STUDY

Plate 5 of 9
December 2006

Image courtesy of the U.S. Geological Survey

m 50 100 150
yds 50 100 150



COAST GUARD STRUCTURES

DATA COLLECTION LOCATION FOR DULUTH HARBOR CORROSION STUDY

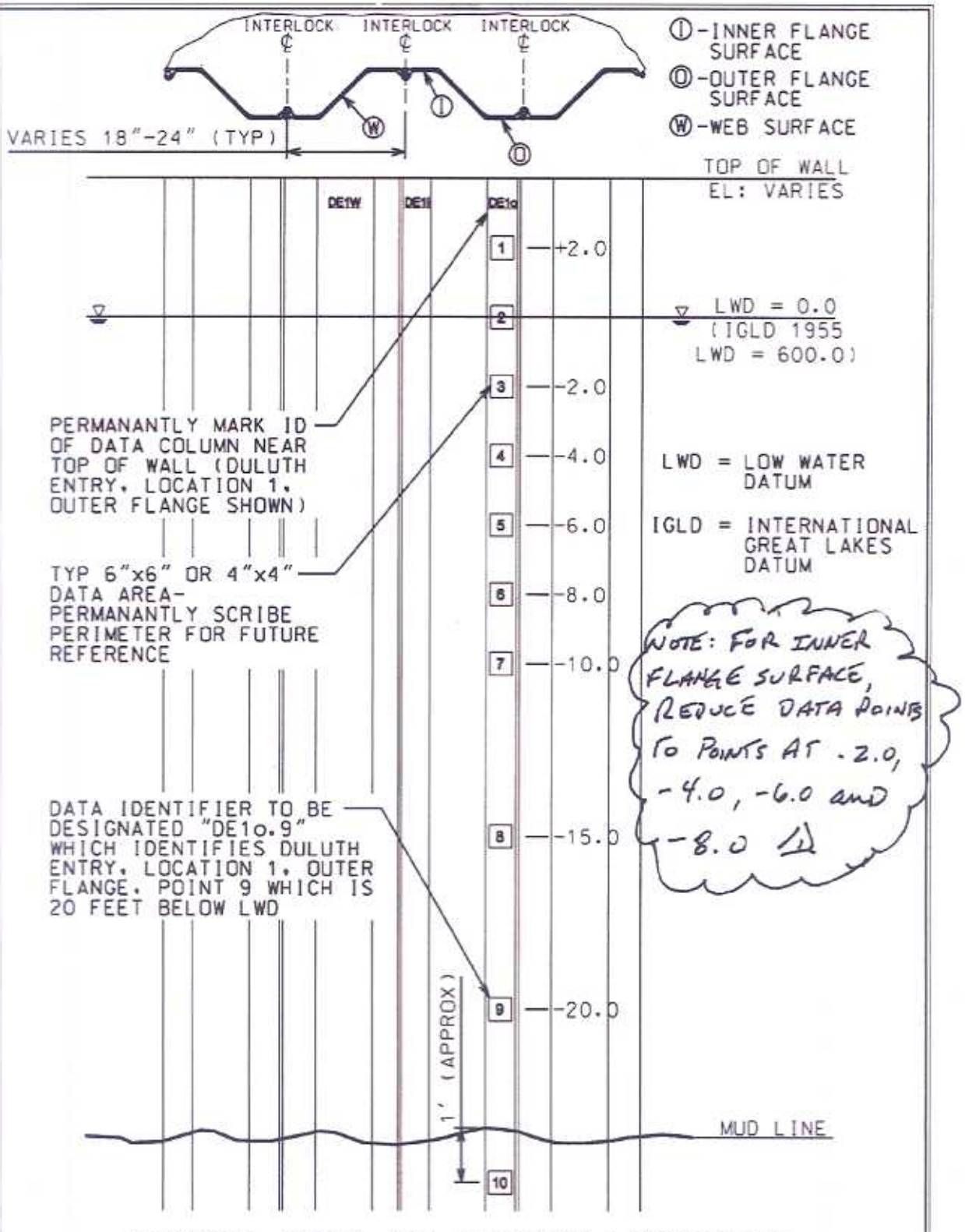
Plate 6 of 9

13 JUL 06

SUPERIOR ENTRY

DATA COLLECTION LOCATIONS FOR
DULUTH HARBOR CORROSION STUDY

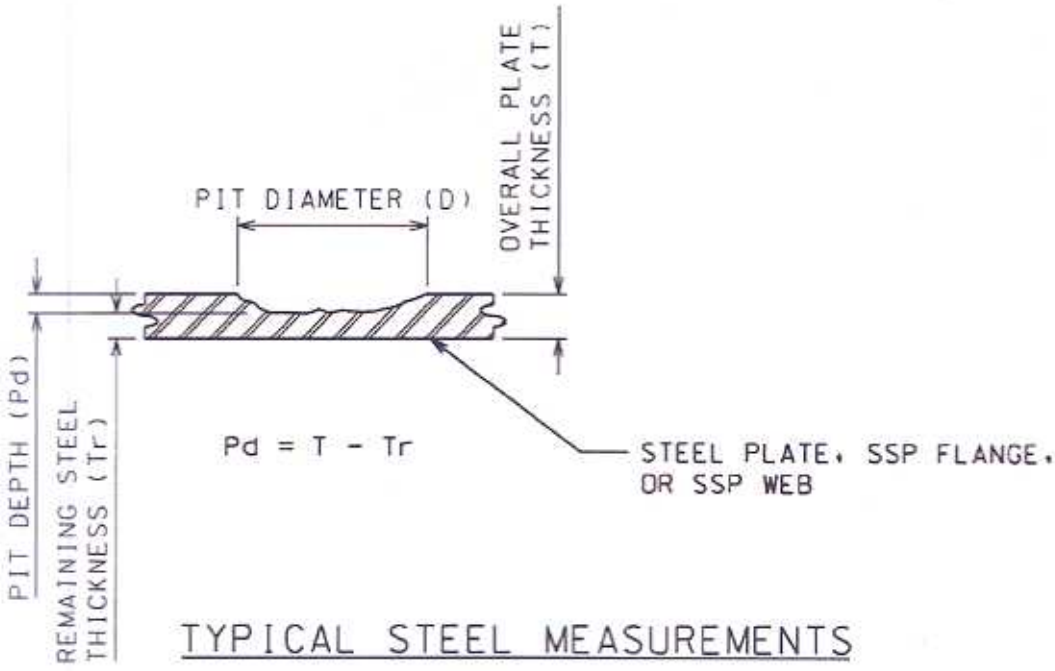
Plate 7 of 9
JUNE 2006



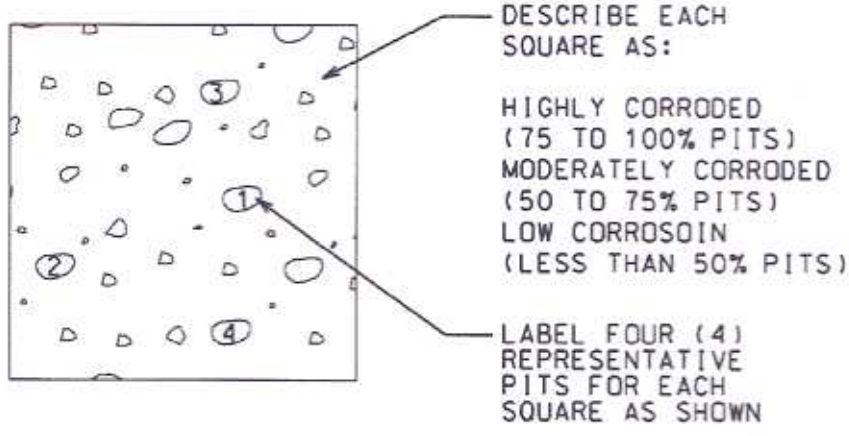
TYPICAL DATA COLLECTION LOCATIONS

NOT TO SCALE

PLATE NUMBER 8 OF: 9	DULUTH-SUPERIOR HARBOR CORROSION STUDY DULUTH, MN DATA COLLECTION LOCATIONS	U.S. ARMY CORPS OF ENGINEERS DETROIT DISTRICT	1 - 13 July 06	US Army Corps of Engineers Detroit District



TYPICAL STEEL MEASUREMENTS



TYPICAL PHOTOGRAPH REQ'D

(4"x4" MODERATELY CORRODED SQUARE SHOWN)

PLATE NUMBER 9 OF: 9	DULUTH-SUPERIOR HARBOR CORROSION STUDY DULUTH, MN DATA COLLECTION SCOPE OF WORK	U.S. ARMY CORPS OF ENGINEERS DETROIT DISTRICT		US Army Corps of Engineers Detroit District

Appendix B. Water Quality Field Data Federal Structures

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Coast Guard Range ell

Data Column ID: CGA1o

Data Collection Date: Corrosion 8/18/06 Water quality 9/20/06

Square Size of Steel Data: 6 inches **Surface Type** Flat SSP

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.375													
2 (0.0)	0.344	0.156	0.625	0.094	0.625	0.094	0.750	0.219	0.500	HIGH	7.72	7.77	0.261	61.6
3 (-2.0)	0.304	0.179	0.375	0.116	0.250	0.116	0.500	0.179	0.250	HIGH	7.99	7.36	0.261	61.6
4 (-4.0)	0.300	0.112	0.375	0.237	0.250	0.237	0.250	0.237	0.250	HIGH	8.04	7.30	0.261	61.6
5 (-6.0)	0.320	0.257	0.250	0.257	0.188	0.257	0.188	0.257	0.125	HIGH	8.09	7.27	0.260	61.6
6 (-8.0)	0.378	0.315	0.250	0.338	0.188	0.315	0.250	0.315	0.188	HIGH	8.09	7.50	0.260	61.5
7 (-10.0)	0.320	0.290	0.125	0.290	0.188	0.257	0.250	0.280	0.125	HIGH	8.08	7.41	0.257	61.4
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 14.5 ft.			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	19	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	90	mg/L
Total Iron:	0.37	mg/L
Sulfate Ions:	28	mg/L
Alkalinity:	86	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Coast Guard Range Cell

Data Column ID: CGB1o

Data Collection Date: Corrosion 8/31/06 Water Quality 9/20/06

Square Size of Steel Data: 6 inches **Surface Type** Flat SSP

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.375													
2 (0.0)	0.307	0.182	0.500	0.057	0.500	hole	0.625	hole	0.625	HIGH	8.11	8.44	0.192	61.0
3 (-2.0)	0.379	0.191	0.500	0.254	0.500	hole	0.375	hole	0.500	HIGH	8.20	8.40	0.192	61.0
4 (-4.0)	0.363	0.303	0.250	0.300	0.375	0.313	0.500	0.293	0.375	HIGH	8.15	8.41	0.192	60.9
5 (-6.0)	0.350	0.310	0.250	0.287	0.250	0.300	0.500	0.287	0.375	HIGH	8.15	8.45	0.193	60.9
6 (-8.0)														
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 7 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	13	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	66	mg/L
Total Iron:	0.25	mg/L
Sulfate Ions:	20	mg/L
Alkalinity:	66	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Coast Guard Range Cell

Data Column ID: CGC1o

Data Collection Date: Corrosion 8/18/06 Water quality 9/20/06

Square Size of Steel Data: 6 inches **Surface Type** Flat SSP

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.375													
2 (0.0)	0.346	0.158	0.500	0.089	0.500	0.208	0.500	0.096	0.500	HIGH	8.16	8.25	0.218	60.0
3 (-2.0)	0.278	0.122	0.375	0.153	0.750	0.153	0.500	0.065	0.625	HIGH	8.19	8.22	0.218	60.1
4 (-4.0)	0.337	0.274	0.250	0.297	0.250	0.274	0.375	0.287	0.125	HIGH	8.20	8.22	0.218	60.1
5 (-6.0)											8.18	8.14	0.217	60.0
6 (-8.0)											8.18	8.15	0.217	60.0
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 8.5 ft.			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	13	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	98	mg/L
Total Iron:	0.8	mg/L
Sulfate Ions:	15	mg/L
Alkalinity:	89	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE1i

Data Collection Date: Corrosion 8/21/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.608													
2 (0.0)	0.593	0.588	0.063	0.583	0.063	0.588	0.063	0.588	0.063	LOW	Data is located on the DE1o file			
3 (-2.0)	0.578	0.453	0.375	0.515	0.375	0.538	0.375	0.538	0.188	MOD				
4 (-4.0)	0.608	0.545	0.500	0.518	0.500	0.518	0.375	0.558	0.250	MOD				
5 (-6.0)	0.613	0.513	0.750	0.550	0.375	0.550	0.500	0.563	0.375	MOD				
6 (-8.0)	0.628	0.588	0.375	0.608	0.188	0.608	0.250	0.588	0.188	MOD				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE1o

Data Collection Date: Corrosion 8/21/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.611													
2 (0.0)	0.596	0.591	0.063	0.591	0.063	0.556	0.125	0.591	0.063	LOW	7.86	8.82	0.096	61.5
3 (-2.0)	0.569	0.506	0.125	0.506	0.125	0.519	0.125	0.529	0.188	MOD	8.19	8.94	0.096	61.4
4 (-4.0)	0.593	0.53	0.188	0.53	0.375	0.543	0.188	0.543	0.188	MOD	8.21	8.94	0.096	61.4
5 (-6.0)	0.609	0.519	0.25	0.519	0.063	0.546	0.25	0.546	0.188	HIGH	8.21	9.01	0.096	61.4
6 (-8.0)	0.608	0.545	0.188	0.545	0.125	0.558	0.188	0.568	0.188	HIGH	8.21	9.06	0.096	61.4
7 (-10.0)	0.618	0.588	0.125	0.555	0.25	0.578	0.125	0.578	0.25	HIGH	8.19	9.10	0.096	61.4
8 (-15.0)	0.613	0.55	0.25	0.55	0.25	0.543	0.25	0.563	0.188	HIGH	8.20	9.17	0.096	60.9
9 (-21.0)	0.616	0.553	0.188	0.576	0.125	0.586	0.125	0.566	0.188	HIGH				
10 (*)											Bottom was measured at 18 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	48	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.1	mg/L
Alkalinity:	46	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE2i

Data Collection Date: Corrosion 8/21/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.602													
2 (0.0)	0.604	0.564	0.188	0.541	0.250	0.541	0.188	0.541	0.188	MOD	Data is located on the DE2o file			
3 (-2.0)	0.618	0.508	0.500	0.518	0.375	0.528	0.375	0.548	0.250	HIGH				
4 (-4.0)	0.606	0.506	0.500	0.496	0.500	0.543	0.250	0.506	0.500	HIGH				
5 (-6.0)	0.604	0.504	0.250	0.541	0.188	0.564	0.250	0.554	0.188	HIGH				
6 (-8.0)	0.612	0.562	0.188	0.572	0.188	0.562	0.188	0.572	0.250	HIGH				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE2o

Data Collection Date: Corrosion 8/21/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.613													
2 (0.0)	0.622	0.559	0.188	0.582	0.125	0.582	0.250	0.559	0.125	HIGH	8.11	8.72	0.096	61.6
3 (-2.0)	0.614	0.551	0.250	0.534	0.250	0.544	0.375	0.551	0.125	HIGH	8.24	8.74	0.096	61.6
4 (-4.0)	0.603	0.523	0.188	0.503	0.188	0.493	0.375	0.533	0.500	HIGH	8.21	8.87	0.096	61.6
5 (-6.0)	0.605	0.515	0.375	0.542	0.188	0.542	0.250	0.542	0.375	HIGH	8.19	8.99	0.096	61.6
6 (-8.0)	0.615	0.575	0.250	0.552	0.250	0.552	0.250	0.552	0.250	HIGH	8.19	9.09	0.096	61.7
7 (-10.0)	0.602	0.539	0.125	0.539	0.188	0.539	0.188	0.562	0.125	HIGH	8.19	9.16	0.096	61.5
8 (-15.0)	0.612	0.549	0.188	0.582	0.188	0.602	0.250	0.592	0.125	HIGH	8.19	9.20	0.096	61.6
9 (-20.0)	0.621	0.591	0.125	0.601	0.125	0.591	0.250	0.601	0.188	HIGH	8.19	9.22	0.096	61.7
10 (-31)	0.623	0.583	0.125	0.583	0.188	0.553	0.250	0.583	0.125	MOD	Bottom was measured at 25 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	45	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.1	mg/L
Alkalinity:	46	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE 3i

Data Collection Date: Corrosion 8/21/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.628													
2 (0.0)	0.619	0.579	0.250	0.569	0.250	0.539	0.250	0.549	0.188	HIGH	Data is located on the DE3o file			
3 (-2.0)	0.602	0.539	0.625	0.552	0.625	0.532	0.500	0.539	0.188	HIGH				
4 (-4.0)	0.604	0.541	0.188	0.554	0.188	0.541	0.250	0.541	0.125	HIGH				
5 (-6.0)	0.596	0.556	0.188	0.471	0.250	0.556	0.063	0.546	0.188	HIGH				
6 (-8.0)	0.619	0.539	0.063	0.556	0.125	0.556	0.250	0.556	0.125	HIGH				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE3o

Data Collection Date: Corrosion 8/21/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.607													
2 (0.0)	0.604	0.564	0.188	0.574	0.125	0.544	0.250	0.541	0.125	HIGH	8.10	8.72	0.096	61.5
3 (-2.0)	0.595	0.515	0.250	0.532	0.188	0.515	0.250	0.532	0.500	HIGH	8.18	8.77	0.097	61.5
4 (-4.0)	0.597	0.507	0.250	0.497	0.375	0.507	0.375	0.537	0.375	HIGH	8.22	8.88	0.096	61.5
5 (-6.0)	0.605	0.542	0.250	0.565	0.125	0.555	0.125	0.565	0.250	HIGH	8.20	9.00	0.096	61.5
6 (-8.0)	0.604	0.541	0.188	0.564	0.125	0.554	0.125	0.554	0.125	HIGH	8.20	9.00	0.096	61.5
7 (-10.0)	0.618	0.555	0.188	0.578	0.250	0.555	0.250	0.555	0.250	HIGH	8.19	9.03	0.096	61.5
8 (-15.0)	0.611	0.571	0.125	0.601	0.188	0.531	0.063	0.548	0.125	MOD	8.20	8.97	0.096	61.5
9 (-20.0)	0.612	0.572	0.188	0.592	0.125	0.572	0.125	0.562	0.250	LOW	8.19	8.90	0.096	61.5
10 (-30.0)	0.615	0.575	0.500	0.585	0.375	0.565	0.250	0.575	0.188	LOW	Bottom was measured at 29 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	46	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.2	mg/L
Alkalinity:	46	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE4i

Data Collection Date: Corrosion 8/21/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.606													
2 (0.0)	0.581	0.551	0.125	0.561	0.250	0.541	0.250	0.551	0.125	MOD	Data is located on the DE4o file			
3 (-2.0)	0.585	0.505	0.625	0.522	0.375	0.522	0.250	0.522	0.250	HIGH				
4 (-4.0)	0.592	0.542	0.250	0.542	0.125	0.562	0.188	0.572	0.125	HIGH				
5 (-6.0)	0.603	0.540	0.125	0.553	0.125	0.553	0.063	0.573	0.125	HIGH				
6 (-8.0)	0.615	0.585	0.188	0.595	0.125	0.585	0.125	0.595	0.125	HIGH				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE4o

Data Collection Date: Corrosion 8/21/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.600													
2 (0.0)	0.578	0.515	0.250	0.515	0.188	0.548	0.188	0.515	0.250	MOD	7.68	8.8	0.103	61.2
3 (-2.0)	0.587	0.497	0.500	0.524	0.375	0.524	0.375	0.497	0.188	HIGH	8.03	8.63	0.103	61.2
4 (-4.0)	0.626	0.563	0.125	0.563	0.250	0.563	0.125	0.546	0.625	HIGH	8.11	8.66	0.103	61.2
5 (-6.0)	0.623	0.560	0.125	0.583	0.500	0.583	0.375	0.593	0.188	HIGH	8.13	8.65	0.103	61.2
6 (-8.0)	0.606	0.543	0.125	0.566	0.250	0.586	0.063	0.566	0.125	HIGH	8.13	8.66	0.103	61.2
7 (-10.0)	0.635	0.605	0.250	0.615	0.125	0.585	0.250	0.595	0.188	HIGH	8.14	8.67	0.103	61.2
8 (-15.0)	0.581	0.561	0.250	0.566	0.375	0.561	0.375	0.556	0.375	HIGH	8.14	8.67	0.103	61.2
9 (-20.0)	0.626	0.596	0.125	0.616	0.250	0.611	0.250	0.606	0.250	HIGH	8.14	8.64	0.102	61.2
10 (29.5)	0.623	0.583	0.375	0.603	0.250	0.573	0.250	0.583	0.125	MOD	Bottom was measured at 24 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	46	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	5.2	mg/L
Alkalinity:	48	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE5i

Data Collection Date: Corrosion 8/23/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.596													
2 (0.0)	0.524	0.399	0.500	0.384	0.500	0.424	0.063	0.424	0.250	HIGH	Data is located on the DE5o file			
3 (-2.0)	0.606	0.476	0.250	0.486	0.500	0.543	0.063	0.543	0.125	HIGH				
4 (-4.0)	0.589	0.499	0.125	0.499	0.063	0.469	0.063	0.489	0.063	HIGH				
5 (-6.0)	0.613	0.483	1.000	0.550	0.125	0.513	0.500	0.513	0.500	HIGH				
6 (-8.0)	0.623	0.523	0.250	0.493	0.125	0.513	0.125	0.523	0.063	HIGH				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE5o

Data Collection Date: Corrosion 8/23/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.609													
2 (0.0)	0.593	0.468	0.250	0.503	0.500	0.473	0.250	0.533	0.125	Mod	7.90	8.63	0.105	61.3
3 (-2.0)	0.563	0.463	0.500	0.438	0.188	0.413	0.500	0.423	0.250	High	8.07	8.82	0.105	61.3
4 (-4.0)	0.608	0.433	1.000	0.448	0.750	0.488	0.250	0.508	0.750	High	8.19	9.05	0.105	61.3
5 (-6.0)	0.560	0.395	0.500	0.497	0.250	0.460	0.250	0.450	0.188	High	8.15	9.10	0.104	61.3
6 (-8.0)	0.618	0.555	0.063	0.518	0.500	0.538	0.500	0.513	0.625	High	8.17	9.20	0.105	61.4
7 (-10.0)	0.626	0.546	0.500	0.556	0.125	0.536	0.125	0.563	0.125	High	8.17	9.26	0.105	61.4
8 (-15.0)	0.616	0.491	0.250	0.516	0.063	0.426	0.063	0.516	0.063	High	8.17	9.30	0.106	61.3
9 (-20.0)	0.617	0.554	0.063	0.554	0.125	0.527	0.125	0.517	0.125	High	8.15	8.93	0.105	61.3
											Bottom was measured at 23 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	47	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	5.5	mg/L
Alkalinity:	48	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE6i

Data Collection Date: Corrosion 8/23/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.611													
2 (0.0)	0.614	0.551	0.063	0.544	0.250	0.551	0.063	0.564	0.125	MOD	Data is located on the DE6o file			
3 (-2.0)	0.623	0.498	0.500	0.503	0.063	0.498	0.500	0.473	0.500	HIGH				
4 (-4.0)	0.617	0.554	0.250	0.527	0.063	0.477	0.125	0.497	0.188	HIGH				
5 (-6.0)	0.609	0.449	0.125	0.549	0.063	0.519	0.125	0.546	0.250	HIGH				
6 (-8.0)	0.615	0.552	0.063	0.505	0.250	0.525	0.250	0.552	0.125	HIGH				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE 6o

Data Collection Date: Corrosion 8/23/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.611													
2 (0.0)	0.609	0.546	0.063	0.484	0.250	0.519	0.063	0.546	0.125	LOW	8.11	8.74	0.104	61.1
3 (-2.0)	0.612	0.487	0.500	0.462	0.500	0.462	0.250	0.487	0.313	MOD	8.20	8.94	0.103	61.1
4 (-4.0)	0.612	0.462	0.750	0.462	0.875	0.482	0.125	0.462	0.250	HIGH	8.15	8.99	0.103	61.1
5 (-6.0)	0.614	0.489	0.125	0.494	0.250	0.514	0.063	0.551	0.125	HIGH	8.12	9.04	0.103	61.1
6 (-8.0)	0.616	0.536	0.063	0.506	0.125	0.526	0.250	0.553	0.500	HIGH	8.12	9.16	0.103	61.1
7 (-10.0)	0.533	0.453	0.063	0.423	0.063	0.413	0.250	0.403	0.375	HIGH	8.13	9.22	0.102	61.1
8 (-15.0)	0.618	0.555	0.250	0.518	0.125	0.518	0.125	0.528	0.250	HIGH	8.15	9.32	0.101	61.1
9 (-20.0)	0.613	0.583	0.063	0.523	0.063	0.513	0.250	0.503	0.125	HIGH	8.14	9.32	0.102	61.1
10 (25)	0.601	0.538	0.250	0.538	0.063	0.511	0.125	0.526	0.063	HIGH	Bottom was measured at 23 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	48	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	5	mg/L
Alkalinity:	47	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE7i

Data Collection Date: Corrosion 9/1/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Inner Flange

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.063													
2 (0.0)	0.606	0.586	0.125	0.556	0.250	0.556	0.250	0.556	0.125	LOW	Data is located on the DE7o file			
3 (-2.0)	0.603	0.543	0.250	0.523	0.250	0.523	0.250	0.533	0.188	HIGH				
4 (-4.0)	0.625	0.585	0.250	0.605	0.250	0.575	0.188	0.575	0.188	HIGH				
5 (-6.0)	0.573	0.523	0.250	0.523	0.125	0.553	0.125	0.523	0.250	HIGH				
6 (-8.0)	0.612	0.572	0.250	0.602	0.250	0.592	0.375	0.582	0.125	HIGH				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE7o

Data Collection Date: Corrosion 9/1/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.591													
2 (0.0)	0.607	0.547	0.250	0.547	0.125	0.547	0.125	0.557	0.125	MOD	8.01	8.61	0.104	61.2
3 (-2.0)	0.607	0.507	0.500	0.497	0.375	0.497	0.375	0.527	0.625	HIGH	8.17	8.80	0.103	61.2
4 (-4.0)	0.594	0.524	0.125	0.504	0.188	0.544	0.375	0.531	0.250	HIGH	8.18	8.92	0.103	61.2
5 (-6.0)	0.611	0.541	0.188	0.511	0.375	0.548	0.125	0.561	0.250	HIGH	8.17	9.01	0.103	61.2
6 (-8.0)	0.567	0.517	0.188	0.547	0.250	0.537	0.188	0.547	0.125	HIGH	8.17	9.05	0.103	61.2
7 (-10.0)	0.617	0.587	0.250	0.577	0.125	0.577	0.250	0.577	0.125	HIGH	8.17	8.93	0.103	61.2
8 (-15.0)	0.627	0.577	0.250	0.587	0.375	0.587	0.375	0.617	0.250	HIGH	8.17	8.96	0.104	61.1
9 (-20.0)	0.622	0.582	0.250	0.602	0.188	0.562	0.250	0.592	0.188	HIGH	8.16	8.95	0.103	61.1
10 (-30.5)	0.619	0.559	0.375	0.579	0.375	0.494	0.625	0.569	0.500	LOW	Bottom was measured at 26 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	46	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.7	mg/L
Alkalinity:	47	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE 8i

Data Collection Date: Corrosion 9/1/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Inner Flange

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.596													
2 (0.0)	0.579	0.479	0.250	0.529	0.250	0.499	0.250	0.516	0.250	MOD	Data is located on the DE8o file			
3 (-2.0)	0.597	0.534	0.500	0.534	0.250	0.547	0.375	0.534	0.375	HIGH				
4 (-4.0)	0.623	0.583	0.375	0.573	0.250	0.583	0.250	0.573	0.250	HIGH				
5 (-6.0)	0.628	0.618	0.125	0.618	0.250	0.598	0.375	0.588	0.250	HIGH				
6 (-8.0)	0.609	0.569	0.125	0.589	0.375	0.589	0.250	0.569	0.125	HIGH				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE8o

Data Collection Date: Corrosion 8/23/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.618													
2 (0.0)	0.615	0.515	0.500	0.495	0.500	0.505	0.250	0.490	0.250	HIGH	8.05	8.54	0.103	61.1
3 (-2.0)	0.609	0.484	0.500	0.459	0.500	0.449	0.375	0.439	0.250	HIGH	8.22	8.78	0.104	61.1
4 (-4.0)	0.605	0.425	1.000	0.455	0.750	0.455	0.500	0.455	0.500	HIGH	8.19	8.88	0.103	61.1
5 (-6.0)	0.599	0.449	0.500	0.449	1.000	0.469	0.625	0.449	0.500	HIGH	8.18	8.92	0.103	61.1
6 (-8.0)	0.603	0.428	0.500	0.453	1.000	0.453	0.250	0.503	0.125	HIGH	8.17	8.99	0.103	61.1
7 (-10.0)	0.598	0.448	0.313	0.468	0.250	0.498	0.125	0.448	0.250	HIGH	8.17	9.02	0.103	61.1
8 (-15.0)	0.610	0.470	0.250	0.470	0.125	0.510	0.250	0.440	0.063	HIGH	8.18	9.12	0.103	61.1
9 (-20.0)	0.605	0.525	0.063	0.535	0.063	0.525	0.125	0.505	0.063	MOD	8.18	9.56	0.100	61.1
10 (-29.5)	0.628	0.598	0.250	0.608	0.125	0.588	0.125	0.578	0.188	LOW	Bottom was measured at 26 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	45	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.4	mg/L
Alkalinity:	47	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE 9i

Data Collection Date: Corrosion 8/22/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.618													
2 (0.0)	0.611	0.581	0.125	0.591	0.125	0.571	0.125	0.561	0.188	MOD	Data is located on the DE9o file			
3 (-2.0)	0.611	0.548	0.250	0.571	0.188	0.551	0.188	0.548	0.188	HIGH				
4 (-4.0)	0.617	0.554	0.250	0.567	0.188	0.567	0.188	0.567	0.188	HIGH				
5 (-6.0)	0.616	0.566	0.125	0.566	0.250	0.553	0.250	0.566	0.188	HIGH				
6 (-8.0)	0.623	0.583	0.125	0.593	0.125	0.593	0.188	0.583	0.125	HIGH				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE9o

Data Collection Date: Corrosion 8/22/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.616													
2 (0.0)	0.615	0.585	0.125	0.565	0.063	0.595	0.125	0.595	0.125	MOD	8.02	8.97	0.095	60.8
3 (-2.0)	0.598	0.548	0.188	0.498	0.250	0.538	0.125	0.558	0.188	High	8.20	9.00	0.096	60.8
4 (-4.0)	0.614	0.534	0.188	0.564	0.188	0.564	0.188	0.564	0.188	High	8.22	8.99	0.096	60.8
5 (-6.0)	0.612	0.549	0.250	0.549	0.125	0.549	0.125	0.542	0.250	High	8.23	8.99	0.096	60.8
6 (-8.0)	0.603	0.540	0.250	0.553	0.188	0.563	0.188	0.573	0.125	High	8.23	8.98	0.096	60.7
7 (-10.0)	0.626	0.586	0.125	0.596	0.125	0.586	0.188	0.596	0.125	High	8.25	8.95	0.096	60.8
8 (-15.0)											8.25	8.95	0.095	60.8
9 (-20.0)											Bottom was measured at 15.2 feet			
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	46	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.1	mg/L
Alkalinity:	46	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE10i

Data Collection Date: Corrosion 8/22/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.618													
2 (0.0)	0.613	0.550	0.063	0.513	0.250	0.550	0.063	0.550	0.063	LOW	Data is located on the DE10o file			
3 (-2.0)	0.598	0.473	0.250	0.423	0.500	0.473	0.500	0.403	0.500	HIGH				
4 (-4.0)	0.605	0.430	0.500	0.470	0.250	0.455	0.500	0.480	0.500	HIGH				
5 (-6.0)	0.617	0.554	0.250	0.554	0.125	0.517	0.063	0.492	0.750	MOD				
6 (-8.0)	0.609	0.489	0.250	0.546	0.125	0.546	0.250	0.509	0.063	MOD				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE10o

Data Collection Date: Corrosion 8/22/06 Water Quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.615													
2 (0.0)	0.618	0.493	0.500	0.468	0.500	0.493	0.750	0.468	0.250	HIGH	7.98	8.99	0.103	61.5
3 (-2.0)	0.617	0.492	0.500	0.517	0.500	0.507	0.750	0.492	0.250	HIGH	8.13	8.85	0.103	61.3
4 (-4.0)	0.613	0.488	1.250	0.493	0.500	0.488	0.750	0.483	0.875	HIGH	8.20	8.92	0.102	61.1
5 (-6.0)	0.614	0.514	0.250	0.494	0.063	0.426	0.750	0.489	0.500	HIGH	8.20	8.92	0.103	61.1
6 (-8.0)	0.621	0.496	0.500	0.521	0.250	0.521	0.125	0.521	0.500	HIGH	8.19	8.96	0.102	61.1
7 (-10.0)	0.605	0.542	0.063	0.542	0.250	0.525	0.063	0.542	0.250	LOW	8.20	8.78	0.101	61.1
8 (-15.0)	0.611	0.521	0.063	0.521	0.125	0.521	0.500	0.561	0.250	LOW	8.19	8.75	0.098	61.1
9 (-20.0)	0.613	0.513	0.250	0.543	0.063	0.533	0.250	0.553	0.063	MOD	8.20	8.76	0.099	61.1
10 (-30.5)	0.619	0.494	0.500	0.444	0.050	0.494	0.500	0.494	0.188	MOD	Bottom was measured at 28.7 feet			

* Indicate ..

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	45	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.3	mg/L
Alkalinity:	45	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Erie Pier

Data Column ID: EP1o

Data Collection Date: Corrosion 8/23/06 Water Quality 9/24/06

Square Size of Steel Data: 6 inches **Surface Type** Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.375													
2 (0.0)	0.382	0.352	0.125	0.342	0.250	0.352	0.063	0.292	0.250	LOW	8.08	8.44	0.243	58.6
3 (-2.0)	0.371	0.308	0.250	0.246	0.250	0.271	0.188	0.281	0.188	HIGH	8.09	8.43	0.243	58.5
4 (-4.0)	0.369	0.319	0.188	0.329	0.188	0.339	0.125	0.319	0.250	HIGH	8.09	8.45	0.242	58.0
5 (-6.0)	0.366	0.326	0.125	0.316	0.188	0.336	0.125	0.326	0.125	HIGH	8.08	8.42	0.242	57.4
6 (-8.0)	0.371	0.321	0.188	0.331	0.188	0.308	0.125	0.331	0.125	HIGH	8.08	8.40	0.242	57.2
7 (-10.0)	0.378	0.338	0.125	0.348	0.125	0.358	0.188	0.253	1.000	HIGH	8.08	8.33	0.243	57.0
8 (-15.0)	0.374	0.334	0.125	0.324	0.125	0.311	0.063	0.344	0.250	HIGH	8.01	7.75	0.242	56.8
9 (-20.0)														
10 (*)											Bottom was measured at 15 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	17	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	88	mg/L
Total Iron:	0.63	mg/L
Sulfate Ions:	22	mg/L
Alkalinity:	89	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Erie Pier

Data Column ID: EP2o

Data Collection Date: Corrosion 8/23/06 Water Quality 9/24/06

Square Size of Steel Data: 6 inches **Surface Type** Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.379													
2 (0.0)	0.377	0.252	0.500	0.314	0.375	0.252	0.500	0.314	0.250	HIGH	8.25	9.03	0.239	59.1
3 (-2.0)	0.371	0.281	0.188	0.291	0.188	0.271	0.125	0.291	0.188	HIGH	8.25	9.23	0.239	59.1
4 (-4.0)	0.369	0.306	0.188	0.329	0.125	0.279	0.188	0.319	0.125	HIGH	8.17	8.97	0.238	58.5
5 (-6.0)	0.358	0.295	0.125	0.318	0.125	0.298	0.063	0.318	0.125	HIGH	8.13	8.91	0.24	57.9
6 (-8.0)	0.371	0.327	0.188	0.308	0.125	0.271	0.250	0.308	0.188	HIGH	8.06	8.77	0.24	56.7
7 (-10.0)	0.369	0.306	0.250	0.306	0.125	0.329	0.125	0.329	0.125	HIGH	8.05	8.68	0.24	56.7
8 (-15.0)	0.372	0.332	0.125	0.332	0.125	0.282	0.500	0.309	0.250	HIGH				
9 (-20.0)														
10 (*)											Bottom was measured at 13.4 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	16	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	100	mg/L
Total Iron:	0.71	mg/L
Sulfate Ions:	21	mg/L
Alkalinity:	89	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE1o

Data Collection Date: Corrosion 8/17/06 Water Quality 9/20/06

Square Size of Steel Data: 6 inches **Surface Type** Plate

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	0.899	0.774	0.500	0.711	0.500	0.711	0.500	0.743	0.375	HIGH	8.20	8.97	0.111	61.1
3 (-2.0)	0.982	0.763	0.500	0.794	0.500	0.732	0.625	0.669	0.500	HIGH	8.27	8.96	0.100	61.2
4 (-4.0)	1.460	1.147	0.625	1.147	0.500	1.147	0.500	1.210	0.500	HIGH	8.24	8.97	0.105	61.2
5 (-6.0)	1.440	1.190	0.750	1.127	0.750	1.221	0.750	1.252	0.750	HIGH	8.22	8.88	0.115	61.1
6 (-8.0)	1.465	1.152	0.750	1.215	0.625	1.152	0.625	1.065	0.750	HIGH	8.21	8.95	0.103	61.2
7 (-10.0)											8.20	8.8	0.110	61.0
8 (-15.0)											8.11	8.49	0.162	60.6
9 (-20.0)											8.10	8.36	0.171	60.4
10 (*)											Bottom was measured at 33 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	48	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.8	mg/L
Alkalinity:	47	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE2o

Data Collection Date: Corrosion 8/17/06 Water Quality 9/20/06

Square Size of Steel Data: 6 inches **Surface Type** Plate

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	0.846	0.690	0.375	0.690	0.625	0.721	0.625	0.658	0.500	HIGH	8.21	8.78	0.114	61.5
3 (-2.0)	1.060	0.810	0.500	0.872	0.375	0.810	0.625	0.810	0.500	HIGH	8.13	8.77	0.116	61.5
4 (-4.0)	1.450	1.200	0.625	1.075	0.625	1.137	0.625	1.137	0.750	HIGH	8.15	8.78	0.118	61.4
5 (-6.0)	1.340	1.090	0.500	0.940	0.625	0.902	0.500	1.027	0.500	HIGH	8.13	8.75	0.123	61.3
6 (-8.0)	1.350	0.950	0.500	0.975	0.625	1.010	0.625	0.930	0.375	HIGH	8.13	8.79	0.120	61.4
7 (-10.0)											8.12	8.77	0.132	61.2
8 (-15.0)											8.11	8.72	0.131	61.1
9 (-20.0)											8.10	8.71	0.134	61.1
10 (*)											Bottom was measured at 31 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	53	mg/L
Total Iron:	0.21	mg/L
Sulfate Ions:	8.9	mg/L
Alkalinity:	53	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE3w

Data Collection Date: Water Quality 9/24/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No data collected - breakwall is made of wood										8.17	9.42	0.121	59.0
3 (-2.0)											8.11	9.04	0.125	58.9
4 (-4.0)											8.12	9.00	0.126	58.8
5 (-6.0)											8.11	9.03	0.125	58.8
6 (-8.0)											8.11	9.05	0.127	58.8
7 (-10.0)											8.12	9.07	0.125	58.9
8 (-15.0)											8.08	9.02	0.138	58.4
9 (-20.0)											8.06	8.93	0.140	58.3
10 (*)											Bottom was measured at 20 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	61	mg/L
Total Iron:	0.42	mg/L
Sulfate Ions:	6.8	mg/L
Alkalinity:	52	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE4w

Data Collection Date: Water Quality 9/21/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No data collected - breakwall is made of wood										8.26	8.90	0.108	61.3
3 (-2.0)											8.26	8.83	0.108	61.3
4 (-4.0)											8.18	8.84	0.107	61.3
5 (-6.0)											8.17	8.83	0.107	61.3
6 (-8.0)											8.17	8.89	0.107	61.3
7 (-10.0)											8.17	8.89	0.107	61.3
8 (-15.0)											8.17	8.90	0.107	61.3
9 (-20.0)											8.13	8.83	0.107	61.3
10 (*)											Bottom was measured at 20.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	47	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	5.6	mg/L
Alkalinity:	49	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE5w

Data Collection Date: Water Quality 9/21/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No data collected - breakwall is made of wood										8.21	8.86	0.109	61.3
3 (-2.0)											8.19	8.90	0.109	61.3
4 (-4.0)											8.18	8.87	0.108	61.2
5 (-6.0)											8.15	8.90	0.108	61.2
6 (-8.0)											8.15	8.90	0.108	61.2
7 (-10.0)											8.15	8.87	0.108	61.2
8 (-15.0)											8.14	8.89	0.108	61.2
9 (-20.0)											8.07	8.76	0.111	61.1
10 (*)											Bottom was measured at 20.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	48	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	6	mg/L
Alkalinity:	49	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE6w

Data Collection Date: Water Quality 9/21/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No data collected - breakwall is made of wood										7.83	8.97	0.124	60.8
3 (-2.0)											8.16	8.96	0.125	60.8
4 (-4.0)											8.11	8.88	0.126	60.6
5 (-6.0)											8.08	8.80	0.127	60.6
6 (-8.0)											8.08	8.75	0.128	60.5
7 (-10.0)											8.07	8.69	0.127	60.6
8 (-15.0)											8.06	8.69	0.129	60.5
9 (-20.0)											Bottom was measured at 18 feet			
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	53	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	9.5	mg/L
Alkalinity:	53	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry
Data Column ID: SE7i
Data Collection Date: Corrosion 8/17/06 Water Quality 9/20/06
Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.421													
2 (0.0)	0.420	0.357	0.250	0.357	0.250	0.357	0.188	0.357	0.250	HIGH	Data located on the SE7o file			
3 (-2.0)	0.413	0.350	0.188	0.350	0.250	0.350	0.500	0.350	0.250	HIGH				
4 (-4.0)	0.418	0.387	0.375	0.387	0.250	0.355	0.250	0.355	0.188	HIGH				
5 (-6.0)	0.413	0.382	0.375	0.382	0.188	0.382	0.125	0.382	0.188	MOD				
6 (-8.0)	0.421	0.358	0.250	0.411	0.188	0.401	0.250	0.411	0.375	MOD				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE7o

Data Collection Date: Corrosion 8/17/06 Water Quality 9/20/06

Square Size of Steel Data: 6 inches **Surface Type** Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.417													
2 (0.0)	0.416	0.385	0.125	0.396	0.063	0.353	0.125	0.385	0.188	HIGH	8.05	8.56	0.156	60.3
3 (-2.0)	0.403	0.340	0.125	0.340	0.188	0.340	0.188	0.340	0.125	HIGH	8.15	8.60	0.155	60.3
4 (-4.0)	0.428	0.334	0.250	0.365	0.188	0.365	0.188	0.365	0.375	HIGH	8.14	8.56	0.155	60.3
5 (-6.0)	0.422	0.359	0.188	0.359	0.375	0.359	0.250	0.359	0.375	HIGH	8.13	8.58	0.154	60.2
6 (-8.0)	0.416	0.385	0.250	0.353	0.250	0.353	0.250	0.385	0.188	HIGH	8.12	8.52	0.154	60.3
7 (-10.0)	0.415	0.405	0.500	0.395	0.250	0.405	0.125	0.395	0.375	LOW	8.12	8.55	0.153	60.3
8 (-15.0)											Bottmom measured at 12.5 feet			
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	59	mg/L
Total Iron:	0.22	mg/L
Sulfate Ions:	13	mg/L
Alkalinity:	60	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE8i

Data Collection Date: Corrosion 8/17/06 Water Quality 9/20/06

Square Size of Steel Data: 6 inches

Surface Type Inner Flange

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.409													
2 (0.0)	0.417	0.387	0.250	0.387	0.188	0.377	0.375	0.387	0.250	HIGH	Data located on the SE8o file			
3 (-2.0)	0.414	0.351	0.250	0.351	0.250	0.374	0.125	0.351	0.375	HIGH				
4 (-4.0)	0.421	0.381	0.125	0.401	0.250	0.401	0.125	0.381	0.188	HIGH				
5 (-6.0)	0.414	0.394	0.125	0.404	0.188	0.404	0.125	0.384	0.188	MOD				
6 (-8.0)	0.407	0.387	0.750	0.387	0.250	0.387	0.750	0.397	0.250	LOW				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE8o

Data Collection Date: Corrosion 8/17/06 Water quality 9/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.413													
2 (0.0)	0.410	0.379	0.125	0.379	0.188	0.379	0.125	0.347	0.188	LOW	8.26	8.90	0.108	61.3
3 (-2.0)	0.417	0.386	0.125	0.354	0.063	0.354	0.188	0.354	0.125	MOD	8.26	8.83	0.108	61.3
4 (-4.0)	0.409	0.346	0.250	0.346	0.250	0.346	0.250	0.346	0.188	HIGH	8.18	8.84	0.107	61.3
5 (-6.0)	0.409	0.346	0.250	0.346	0.188	0.346	0.375	0.346	0.250	HIGH	8.17	8.83	0.107	61.3
6 (-8.0)	0.418	0.398	0.250	0.398	0.125	0.398	0.250	0.398	0.250	LOW	8.17	8.89	0.107	61.3
7 (-10.0)	0.414	0.394	0.125	0.394	0.063	0.384	0.063	0.394	0.125	LOW	8.17	8.89	0.107	61.3
8 (-15.0)	0.411	0.391	0.375	0.391	0.375	0.381	0.500	0.371	0.188	LOW	8.17	8.90	0.107	61.3
9 (-20.0)	0.419	0.409	0.125	0.409	0.125	0.399	0.125	0.409	0.063	LOW	8.13	8.83	0.107	61.3
10 (*)											Bottom was measured at 20.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	47	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	5.6	mg/L
Alkalinity:	49	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE8o

Data Collection Date: Corrosion 8/17/06 Water quality 9/20/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.413													
2 (0.0)	0.410	0.379	0.125	0.379	0.188	0.379	0.125	0.347	0.188	LOW	8.06	8.47	0.167	60.2
3 (-2.0)	0.417	0.386	0.125	0.354	0.063	0.354	0.188	0.354	0.125	MOD	8.12	8.44	0.167	60.3
4 (-4.0)	0.409	0.346	0.250	0.346	0.250	0.346	0.250	0.346	0.188	HIGH	8.08	8.44	0.167	60.3
5 (-6.0)	0.409	0.346	0.250	0.346	0.188	0.346	0.375	0.346	0.250	HIGH	8.07	8.41	0.167	60.3
6 (-8.0)	0.418	0.398	0.250	0.398	0.125	0.398	0.250	0.398	0.250	LOW	8.07	8.37	0.168	60.3
7 (-10.0)	0.414	0.394	0.125	0.394	0.063	0.384	0.063	0.394	0.125	LOW	8.06	8.36	0.167	60.3
8 (-15.0)	0.411	0.391	0.375	0.391	0.375	0.381	0.500	0.371	0.188	LOW	8.07	8.25	0.167	60.3
9 (-20.0)	0.419	0.409	0.125	0.409	0.125	0.399	0.125	0.409	0.063	LOW	8.06	7.91	0.167	60.3
10 (*)											Bottom was measured at 20.6 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	62	mg/L
Total Iron:	0.29	mg/L
Sulfate Ions:	15	mg/L
Alkalinity:	63	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE9o

Data Collection Date: Corrosion 8/17/06 Water Quality 9/20/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.371													
2 (0.0)	0.367	0.357	0.063	0.360	0.063	0.360	0.125	0.360	0.125	LOW	8.13	8.29	0.167	60.4
3 (-2.0)	0.369	0.359	0.063	0.350	0.063	0.350	0.125	0.360	0.063	MOD	8.10	8.29	0.167	60.4
4 (-4.0)	0.377	0.357	0.063	0.370	0.063	0.370	0.063	0.360	0.063	HIGH	8.11	8.42	0.166	60.4
5 (-6.0)	0.386	0.346	0.063	0.370	0.063	0.370	0.063	0.380	0.063	HIGH	8.09	8.41	0.167	60.4
6 (-8.0)	0.376	0.366	0.063	0.350	0.063	0.360	0.063	0.360	0.063	HIGH	8.07	8.72	0.167	60.4
7 (-10.0)	0.370	0.350	0.063	0.350	0.063	0.360	0.125	0.350	0.063	MOD	8.08	8.43	0.165	60.4
8 (-15.0)	0.369	0.339	0.063	0.350	0.031	0.350	0.063	0.360	0.031	LOW	8.06	8.36	0.166	60.4
9 (-20.0)	0.370	0.350	0.063	0.360	0.063	0.360	0.063	0.360	0.063	LOW	8.04	8.31	0.169	60.3
10 (-25.0)	0.379	0.369	0.063	0.370	0.031	0.370	0.031	0.370	0.031	LOW	Bottom measured at 28 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	61	mg/L
Total Iron:	0.28	mg/L
Sulfate Ions:	16	mg/L
Alkalinity:	62	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE10i

Data Collection Date: Corrosion 8/18/06 Water Quality 9/20/06

Square Size of Steel Data: 6 inches **Surface Type** Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.378													
2 (0.0)	0.385	0.375	0.063	0.380	0.031	0.380	0.031	0.380	0.031	LOW	Data is located on the SE10o file			
3 (-2.0)	0.372	0.357	0.063	0.352	0.063	0.357	0.063	0.357	0.031	LOW				
4 (-4.0)	0.386	0.367	0.063	0.366	0.094	0.376	0.063	0.366	0.094	LOW				
5 (-6.0)	0.376	0.366	0.063	0.366	0.063	0.366	0.063	0.366	0.063	MOD				
6 (-8.0)	0.375	0.370	0.063	0.365	0.063	0.370	0.063	0.370	0.063	LOW				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE10o

Data Collection Date: Corrosion 8/18/06 Water Quality 9/20/06

Square Size of Steel Data: 6 inches **Surface Type** Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.374													
2 (0.0)	0.363	NR	NR	NR	NR	NR	NR	NR	NR	LOW	8.07	8.35	0.173	60.4
3 (-2.0)	0.372	0.362	0.063	0.367	0.063	0.357	0.063	0.357	0.063	LOW	8.07	8.41	0.170	60.3
4 (-4.0)	0.377	0.357	0.063	0.367	0.063	0.372	0.063	0.372	0.125	LOW	8.06	8.52	0.168	60.4
5 (-6.0)	0.363	0.353	0.094	0.353	0.063	0.353	0.063	0.353	0.063	LOW	8.06	8.54	0.171	60.3
6 (-8.0)	0.370	0.365	0.031	0.355	0.063	0.365	0.063	0.365	0.063	MOD	8.05	8.55	0.173	60.2
7 (-10.0)	0.371	0.366	0.063	0.366	0.063	0.361	0.063	0.366	0.063	MOD	8.04	8.56	0.174	60.2
8 (-15.0)	0.371	0.366	0.031	0.366	0.031	0.361	0.031	0.361	0.063	MOD	8.02	8.62	0.175	60.2
9(-18.0)	0.367	0.362	0.063	0.362	0.031	0.362	0.063	0.362	0.063	MOD	8.03	8.66	0.176	60.1
10 (*)											Bottom was measured at 21 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	11	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	63	mg/L
Total Iron:	0.33	mg/L
Sulfate Ions:	16	mg/L
Alkalinity:	64	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: USACE Vessel Yard

Data Column ID: VY1i

Data Collection Date: Corrosion 8/21/06 Water Quality 9/19/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.381													
2 (0.0)	0.374	0.186	0.750	0.218	0.500	0.214	0.375	0.280	0.500	HIGH	Data is located on the VY1o file			
3 (-2.0)	0.343	0.280	0.250	0.218	0.250	0.243	0.250	0.280	0.250	MOD				
4 (-4.0)	0.378	0.268	0.250	0.355	0.250	0.293	0.188	0.324	0.188	MOD				
5 (-6.0)	0.390	0.296	0.375	0.327	0.250	0.327	0.375	0.296	0.125	HIGH				
6 (-8.0)	0.393	0.330	0.250	0.330	0.250	0.373	0.250	0.299	0.250	MOD				
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: USACE Vessel Yard

Data Column ID: VY1o

Data Collection Date: Corrosion 8/21/06 Water Quality 9/19/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.376													
2 (0.0)	0.389	0.274	0.375	0.274	0.250	0.243	0.500	0.243	0.250	HIGH	8.10	8.71	0.113	61.9
3 (-2.0)	0.384	0.300	0.188	0.331	0.240	0.331	0.375	0.300	0.250	HIGH	8.11	8.72	0.113	61.9
4 (-4.0)	0.387	0.262	0.250	0.262	0.250	0.324	0.250	0.357	0.188	MOD	8.11	8.76	0.113	61.9
5 (-6.0)	0.387	0.272	0.188	0.272	0.250	0.303	0.250	0.357	0.250	MOD	8.12	8.79	0.113	61.9
6 (-8.0)	0.381	0.320	0.250	0.351	0.250	0.320	0.125	0.374	0.250	MOD	8.13	8.89	0.113	61.9
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 8.3 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	48	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	6.4	mg/L
Alkalinity:	49	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: USACE Vessel Yard

Data Column ID: VY2i

Data Collection Date: Corrosion 8/21/06 Water Quality 9/19/06

Square Size of Steel Data: 6 inches

Surface Type Inner Flange

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.381													
2 (0.0)	0.377	0.330	0.500	0.299	0.500	0.299	0.625	0.264	0.500	HIGH	Data is located on the VY2o file			
3 (-2.0)	0.339	0.276	0.125	0.276	0.094	0.276	0.250	0.269	0.250	HIGH				
4 (-4.0)	0.385	0.352	0.250	0.295	0.125	0.352	0.125	0.321	0.250	MOD				
5 (-6.0)	0.381	0.342	0.375	0.396	0.125	0.336	0.188	0.326	0.250	MOD				
6 (-8.0)														
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)														
6 feet	* Indicate elevation where data is required one (1) foot below the mud line.													

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: USACE Vessel Yard

Data Column ID: VY2o

Data Collection Date: Corrosion 8/21/06 Water Quality 9/19/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)	0.384													
2 (0.0)	0.381	0.293	0.500	0.355	0.750	0.355	0.500	0.293	0.500	HIGH	8.12	8.81	0.113	61.9
3 (-2.0)	0.379	0.307	0.375	0.338	0.375	0.369	0.250	0.338	0.250	HIGH	8.37	9.01	0.113	61.9
4 (-4.0)	0.379	0.356	0.250	0.294	0.375	0.339	0.250	0.356	0.188	MOD	8.32	9.10	0.113	61.9
5 (-6.0)														
6 (-8.0)														
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 4.7 feet			
6 feet	* Indicate elevation where data is required one (1) foot below the mud line.													

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	49	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	6.5	mg/L
Alkalinity:	49	mg/L

Appendix C. Water Quality Field Data Non-Federal Structures

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: BONG BRIDGE CELL

Data Column ID: BONG BRIDGE CELL

Data Collection Date: Water Quality 9/20/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.03	7.95	0.233	60.4
3 (-2.0)											8.05	7.94	0.232	60.4
4 (-4.0)											8.10	7.93	0.234	60.6
5 (-6.0)											8.10	7.89	0.232	60.5
6 (-8.0)											8.10	7.89	0.230	60.1
7 (-10.0)											8.10	7.88	0.229	60.1
8 (-15.0)											8.11	7.91	0.229	60.1
9 (-20.0)											8.09	7.90	0.229	60.1
10 (*)											Bottom measured at 23 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	15	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	93	mg/L
Total Iron:	0.62	mg/L
Sulfate Ions:	20	mg/L
Alkalinity:	86	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: CARGILL

Data Column ID: CARGILL

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										7.95	8.26	0.136	62.8
3 (-2.0)											8.16	8.31	0.139	62.9
4 (-4.0)											8.14	8.32	0.139	62.9
5 (-6.0)											8.12	8.30	0.141	63.0
6 (-8.0)											8.13	8.30	0.141	63.0
7 (-10.0)											8.14	8.26	0.148	63.0
8 (-15.0)											8.15	8.24	0.156	63.0
9 (-20.0)											8.14	8.28	0.148	63.0
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	53	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	12	mg/L
Alkalinity:	53	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: CENEX HARVEST STATES 1

Data Column ID: CHS1

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.13	8.10	0.266	62.7
3 (-2.0)											8.19	8.09	0.265	62.7
4 (-4.0)											8.16	8.01	0.266	62.7
5 (-6.0)											8.14	8.05	0.266	62.7
6 (-8.0)											8.15	8.09	0.266	62.7
7 (-10.0)											8.12	8.04	0.265	62.6
8 (-15.0)											8.05	7.75	0.265	62.2
9 (-20.0)											7.98	7.45	0.264	62.1
10 (*)											Bottom was measured at 20.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	21	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	82	mg/L
Total Iron:	0.29	mg/L
Sulfate Ions:	32	mg/L
Alkalinity:	86	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: CENEX HARVEST STATES 2

Data Column ID: CHS2

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.19	7.79	0.264	62.9
3 (-2.0)											8.10	7.74	0.265	62.8
4 (-4.0)											8.06	7.73	0.265	62.8
5 (-6.0)											8.05	7.76	0.265	62.8
6 (-8.0)											8.05	7.78	0.265	62.8
7 (-10.0)											8.05	7.81	0.265	62.8
8 (-15.0)											8.05	7.86	0.265	62.5
9 (-20.0)											7.99	7.49	0.264	62.1
10 (*)											Bottom was measured at 24.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids: No analysis performed at this location

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: CENEX HARVEST STATES 3

Data Column ID: CHS3

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										7.87	6.92	0.259	62.8
3 (-2.0)											7.88	6.90	0.258	62.9
4 (-4.0)											7.85	6.87	0.258	63.0
5 (-6.0)											7.84	6.85	0.258	62.9
6 (-8.0)											7.84	6.89	0.259	63.0
7 (-10.0)											7.83	6.89	0.259	63.0
8 (-15.0)											7.83	6.90	0.259	63.0
9 (-20.0)											7.83	6.92	0.258	62.9
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids: No analysis performed at this location

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: COMMUNITY SAILING DOCK

Data Column ID: COMMUNITY SAILING DOCK

Data Collection Date: Water Quality 9/20/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR):

H = High (75 -100% Pitted)

M = Moderate (50 -75% Pitted)

L = Low (0 - 50% Pitted)

T = Overall Plate Thickness

P1r = Thickness of steel at pit 1

P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.10	9.11	0.135	58.5
3 (-2.0)											8.24	9.02	0.135	58.5
4 (-4.0)														
5 (-6.0)														
6 (-8.0)														
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 3.7 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD*

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	59	mg/L
Total Iron:	0.21	mg/L
Sulfate Ions:	11	mg/L
Alkalinity:	54	mg/L

* Water sample was collected at -3.0 ft below LWD

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: CUTLER MAGNER

Data Column ID: CUTLER MAGNER

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.02	8.50	0.195	62.5
3 (-2.0)											8.20	8.13	0.195	62.7
4 (-4.0)											8.18	8.19	0.195	62.7
5 (-6.0)											8.14	8.05	0.195	62.8
6 (-8.0)											8.13	8.03	0.195	62.7
7 (-10.0)											8.12	8.02	0.195	62.7
8 (-15.0)											8.12	8.01	0.195	62.7
9 (-20.0)											8.11	8.00	0.196	62.7
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	14	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	68	mg/L
Total Iron:	0.21	mg/L
Sulfate Ions:	19	mg/L
Alkalinity:	66	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: DECC

Data Column ID: DECC

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.32	8.79	0.100	62.3
3 (-2.0)											8.40	8.97	0.100	62.3
4 (-4.0)											8.36	9.09	0.100	62.3
5 (-6.0)											8.34	9.07	0.100	62.3
6 (-8.0)											8.33	9.15	0.100	62.3
7 (-10.0)											8.32	9.07	0.100	62.3
8 (-15.0)											8.32	9.07	0.100	62.3
9 (-20.0)											8.31	9.07	0.099	62.3
10 (*)											Bottom was measured at 20.4 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	46	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	4.6	mg/L
Alkalinity:	46	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: DSPA BERTH 1

Data Column ID: DSPA BERTH 1

Data Collection Date: Water Quality 9/24/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.00	8.39	0.210	59.6
3 (-2.0)											7.97	8.44	0.210	59.6
4 (-4.0)											7.88	8.37	0.208	59.3
5 (-6.0)											7.86	8.36	0.208	59.3
6 (-8.0)											7.88	8.45	0.212	59.2
7 (-10.0)											7.80	8.41	0.233	59.1
8 (-15.0)											7.96	8.46	0.222	59.0
9 (-20.0)											8.02	8.48	0.225	58.9
10 (*)											Bottom was measured at 29.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	27	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	61	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	16	mg/L
Alkalinity:	60	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: DSPA BERTH 4

Data Column ID: DSPA BERTH 4

Data Collection Date: Water Quality 9/24/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.06	8.46	0.199	59.0
3 (-2.0)											8.08	8.51	0.199	59.0
4 (-4.0)											8.05	8.51	0.199	58.9
5 (-6.0)											8.04	8.46	0.201	58.8
6 (-8.0)											8.03	8.42	0.200	58.8
7 (-10.0)											8.05	8.48	0.200	58.8
8 (-15.0)											8.01	8.38	0.202	58.8
9 (-20.0)											8.02	8.34	0.210	58.6
10 (*)											Bottom was measured at 30.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	14	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	66	mg/L
Total Iron:	0.21	mg/L
Sulfate Ions:	21	mg/L
Alkalinity:	69	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: DSPA BERTH 6

Data Column ID: DSPA BERTH 6

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.00	7.58	0.268	63.5
3 (-2.0)											8.12	7.60	0.271	63.6
4 (-4.0)											8.11	7.61	0.274	63.6
5 (-6.0)											8.10	7.62	0.273	63.6
6 (-8.0)											8.10	7.61	0.274	63.6
7 (-10.0)											8.09	7.54	0.277	63.6
8 (-15.0)											8.08	7.46	0.294	63.4
9 (-20.0)											8.08	7.46	0.297	63.4
10 (*)														

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	21	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	81	mg/L
Total Iron:	0.25	mg/L
Sulfate Ions:	35	mg/L
Alkalinity:	82	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: HALLETT 5

Data Column ID: HALLETT 5

Data Collection Date: Water Quality 9/20/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										7.89	7.23	0.268	62.4
3 (-2.0)											8.05	7.15	0.268	62.3
4 (-4.0)											8.02	7.05	0.269	62.2
5 (-6.0)											8.01	7.07	0.269	62.2
6 (-8.0)											8.00	7.14	0.268	62.0
7 (-10.0)											8.04	7.29	0.269	61.9
8 (-15.0)											8.04	7.35	0.268	61.9
9 (-20.0)											8.05	7.44	0.262	61.3
10 (*)											Bottom was measured at 28.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	21	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	91	mg/L
Total Iron:	0.21	mg/L
Sulfate Ions:	30	mg/L
Alkalinity:	87	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: HALLETT 7

Data Column ID: HALLETT 7

Data Collection Date: Water Quality 9/22/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.00	8.26	0.218	58.9
3 (-2.0)											8.01	8.26	0.218	58.9
4 (-4.0)											8.03	8.29	0.218	58.9
5 (-6.0)											8.03	8.39	0.218	58.9
6 (-8.0)											8.04	8.38	0.218	58.9
7 (-10.0)											8.04	8.08	0.218	58.9
8 (-15.0)											8.05	7.82	0.218	58.8
9 (-20.0)											8.03	7.66	0.219	58.8
10 (*)											Bottom was measured at 20 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	12	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	94	mg/L
Total Iron:	0.65	mg/L
Sulfate Ions:	14	mg/L
Alkalinity:	92	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: LAKEHEAD BOAT BASIN 1

Data Column ID: LAKEHEAD BOAT BASIN 1

Data Collection Date: Water Quality 9/20/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.29	8.83	0.110	61.7
3 (-2.0)											8.26	8.80	0.110	61.5
4 (-4.0)											8.25	8.84	0.110	61.4
5 (-6.0)											8.24	8.90	0.110	61.4
6 (-8.0)											8.26	9.02	0.109	61.3
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 10 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	48	mg/L
Total Iron:	<0.20	mg/L
Sulfate Ions:	6.4	mg/L
Alkalinity:	48	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: LAKEHEAD BOAT BASIN 2

Data Column ID: LAKEHEAD BOAT BASIN 2

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR):
H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.17	8.77	0.115	61.4
3 (-2.0)											8.12	8.70	0.115	61.4
4 (-4.0)											8.08	8.77	0.115	61.4
5 (-6.0)														
6 (-8.0)														
7 (-10.0)														
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 4.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

No analysis performed at this location

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: MIDWEST ENERGY

Data Column ID: MIDWEST ENERGY

Data Collection Date: Water Quality 9/24/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.05	8.23	0.280	59.0
3 (-2.0)											8.01	8.21	0.280	58.9
4 (-4.0)											8.02	8.21	0.281	58.8
5 (-6.0)											8.03	8.17	0.281	58.9
6 (-8.0)											8.03	8.16	0.281	58.9
7 (-10.0)											8.03	8.14	0.281	58.9
8 (-15.0)											8.03	8.00	0.282	58.8
9 (-20.0)											8.02	8.05	0.283	58.7
10 (*)											Bottom was measured at 27.5 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	21	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	84	mg/L
Total Iron:	0.43	mg/L
Sulfate Ions:	32	mg/L
Alkalinity:	93	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: OLIVER BRIDGE

Data Column ID: OLIVER BRIDGE

Data Collection Date: Water Quality 9/21/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.44	9.26	0.236	60.7
3 (-2.0)											8.45	9.28	0.237	60.6
4 (-4.0)											8.43	9.25	0.237	60.3
5 (-6.0)											8.43	9.26	0.237	60.3
6 (-8.0)											8.40	9.21	0.237	60.1
7 (-10.0)											8.33	8.98	0.237	59.5
8 (-15.0)											8.28	8.78	0.237	59.3
9 (-20.0)											8.26	8.79	0.237	59.2
10 (*)											Bottom was measured at 21 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	11	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	110	mg/L
Total Iron:	0.23	mg/L
Sulfate Ions:	14	mg/L
Alkalinity:	110	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: SPIRIT LAKE MARINA

Data Column ID: SPIRIT LAKE MARINA

Data Collection Date: Water Quality 9/22/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.11	8.15	0.219	58.6
3 (-2.0)											8.11	8.31	0.219	58.6
4 (-4.0)											8.12	8.32	0.219	58.6
5 (-6.0)											8.12	8.33	0.218	58.6
6 (-8.0)											8.13	8.34	0.218	58.6
7 (-10.0)											8.12	8.30	0.218	58.6
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 13 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	11	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	100	mg/L
Total Iron:	0.36	mg/L
Sulfate Ions:	11	mg/L
Alkalinity:	99	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: TWO HARBORS

Data Column ID: TWO HARBORS

Data Collection Date: Water Quality 9/24/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										8.10	9.30	0.094	59.3
3 (-2.0)											8.14	8.98	0.094	59.4
4 (-4.0)											8.14	9.02	0.094	59.4
5 (-6.0)											8.14	9.07	0.094	59.4
6 (-8.0)											8.16	8.86	0.095	59.4
7 (-10.0)											8.16	8.90	0.094	59.4
8 (-15.0)											8.16	8.90	0.094	59.4
9 (-20.0)											8.16	8.92	0.094	59.4
10 (*)											Bottom was measured at 30 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	<10	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	81	mg/L
Total Iron:	0.37	mg/L
Sulfate Ions:	4.1	mg/L
Alkalinity:	47	mg/L

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: WILLIAM A IRVIN SLIP

Data Column ID: MN SLIP

Data Collection Date: Water Quality 9/19/06

Square Size of Steel Data: NA

Surface Type NA

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data			
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Temp
1 (+2.0)														
2 (0.0)	No corrosion data collected for this report.										7.73	7.98	0.149	63.4
3 (-2.0)											7.73	8.04	0.149	63.4
4 (-4.0)											7.68	8.13	0.148	63.3
5 (-6.0)											7.68	8.23	0.146	63.3
6 (-8.0)											7.67	8.30	0.146	63.3
7 (-10.0)											7.68	8.35	0.146	63.3
8 (-15.0)														
9 (-20.0)														
10 (*)											Bottom was measured at 13 feet			

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:	13	mg/L
Total Suspended Solids:	<10	mg/L
Hardness:	56	mg/L
Total Iron:	0.47	mg/L
Sulfate Ions:	6.9	mg/L
Alkalinity:	55	mg/L

Appendix D. Trace Chemical Analytical Report

DULUTLH CORROSION CHEMICAL ANALYSIS DATA SPREADSHEET

TRACE ID	SAMPLE ID	MATRIX	ANALYSIS METHOD	PARAMETER	DILUTION	RESULT	UNITS	RDL	QUALIFIER
GJ212-01	CUTLER MAGNER	W	SM18-2340 B	Hardness (as CaCO3)	11.1	68	mg/L	7.3	
GJ212-01	CUTLER MAGNER	W	SW846 6010B	Iron	10	0.21	mg/L	0.2	
GJ212-01	CUTLER MAGNER	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-01	CUTLER MAGNER	W	EPA 300.0	Chloride	2	14	mg/L	10	
GJ212-01	CUTLER MAGNER	W	EPA 300.0	Sulfate (as SO4)	2	19	mg/L	1	
GJ212-01	CUTLER MAGNER	W	EPA 310.1	Alkalinity, Total	1	66	mg/L	10	
GJ212-02	DSPA BERTH #6	W	SM18-2340 B	Hardness (as CaCO3)	11.1	81	mg/L	7.3	
GJ212-02	DSPA BERTH #6	W	SW846 6010B	Iron	10	0.25	mg/L	0.2	
GJ212-02	DSPA BERTH #6	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-02	DSPA BERTH #6	W	EPA 300.0	Chloride	2	21	mg/L	10	
GJ212-02	DSPA BERTH #6	W	EPA 300.0	Sulfate (as SO4)	2	35	mg/L	1	
GJ212-02	DSPA BERTH #6	W	EPA 310.1	Alkalinity, Total	1	82	mg/L	10	
GJ212-03	CARGILL	W	SM18-2340 B	Hardness (as CaCO3)	11.1	53	mg/L	7.3	
GJ212-03	CARGILL	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-03	CARGILL	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-03	CARGILL	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-03	CARGILL	W	EPA 300.0	Sulfate (as SO4)	2	12	mg/L	1	
GJ212-03	CARGILL	W	EPA 310.1	Alkalinity, Total	1	53	mg/L	10	
GJ212-04	DECC	W	SM18-2340 B	Hardness (as CaCO3)	11.1	46	mg/L	7.3	
GJ212-04	DECC	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-04	DECC	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-04	DECC	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-04	DECC	W	EPA 300.0	Sulfate (as SO4)	2	4.6	mg/L	1	
GJ212-04	DECC	W	EPA 310.1	Alkalinity, Total	1	46	mg/L	10	
GJ212-05	MN SLIP (WILLIAM A IRVIN SLIP)	W	SM18-2340 B	Hardness (as CaCO3)	11.1	56	mg/L	7.3	
GJ212-05	MN SLIP (WILLIAM A IRVIN SLIP)	W	SW846 6010B	Iron	10	0.47	mg/L	0.2	
GJ212-05	MN SLIP (WILLIAM A IRVIN SLIP)	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-05	MN SLIP (WILLIAM A IRVIN SLIP)	W	EPA 300.0	Chloride	2	13	mg/L	10	
GJ212-05	MN SLIP (WILLIAM A IRVIN SLIP)	W	EPA 300.0	Sulfate (as SO4)	2	6.9	mg/L	1	
GJ212-05	MN SLIP (WILLIAM A IRVIN SLIP)	W	EPA 310.1	Alkalinity, Total	1	55	mg/L	10	
GJ212-06	VY2	W	SM18-2340 B	Hardness (as CaCO3)	11.1	49	mg/L	7.3	
GJ212-06	VY2	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-06	VY2	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-06	VY2	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-06	VY2	W	EPA 300.0	Sulfate (as SO4)	2	6.5	mg/L	1	
GJ212-06	VY2	W	EPA 310.1	Alkalinity, Total	1	49	mg/L	10	
GJ212-07	VY1	W	SM18-2340 B	Hardness (as CaCO3)	11.1	48	mg/L	7.3	
GJ212-07	VY1	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-07	VY1	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-07	VY1	W	EPA 300.0	Chloride	2	<10	mg/L	10	

DULUTLH CORROSION CHEMICAL ANALYSIS DATA SPREADSHEET

TRACE ID	SAMPLE ID	MATRIX	ANALYSIS METHOD	PARAMETER	DILUTION	RESULT	UNITS	RDL	QUALIFIER
GJ212-07	VY1	W	EPA 300.0	Sulfate (as SO4)	2	6.4	mg/L	1	
GJ212-07	VY1	W	EPA 310.1	Alkalinity, Total	1	49	mg/L	10	
GJ212-09	CHS #1	W	SM18-2340 B	Hardness (as CaCO3)	11.1	82	mg/L	7.3	
GJ212-09	CHS #1	W	SW846 6010B	Iron	10	0.29	mg/L	0.2	
GJ212-09	CHS #1	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-09	CHS #1	W	EPA 300.0	Chloride	5	21	mg/L	10	
GJ212-09	CHS #1	W	EPA 300.0	Sulfate (as SO4)	5	32	mg/L	1	
GJ212-09	CHS #1	W	EPA 310.1	Alkalinity, Total	1	86	mg/L	10	
GJ212-12	SE 1	W	SM18-2340 B	Hardness (as CaCO3)	11.1	48	mg/L	7.3	
GJ212-12	SE 1	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-12	SE 1	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-12	SE 1	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-12	SE 1	W	EPA 300.0	Sulfate (as SO4)	2	4.8	mg/L	1	
GJ212-12	SE 1	W	EPA 310.1	Alkalinity, Total	1	47	mg/L	10	
GJ212-13	SE 7	W	SM18-2340 B	Hardness (as CaCO3)	11.1	59	mg/L	7.3	
GJ212-13	SE 7	W	SW846 6010B	Iron	10	0.22	mg/L	0.2	
GJ212-13	SE 7	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-13	SE 7	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-13	SE 7	W	EPA 300.0	Sulfate (as SO4)	2	13	mg/L	1	
GJ212-13	SE 7	W	EPA 310.1	Alkalinity, Total	1	60	mg/L	10	
GJ212-14	SE 4	W	SM18-2340 B	Hardness (as CaCO3)	11.1	62	mg/L	7.3	
GJ212-14	SE 4	W	SW846 6010B	Iron	10	0.29	mg/L	0.2	
GJ212-14	SE 4	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-14	SE 4	W	EPA 300.0	Chloride	2	10	mg/L	10	
GJ212-14	SE 4	W	EPA 300.0	Sulfate (as SO4)	2	15	mg/L	1	
GJ212-14	SE 4	W	EPA 310.1	Alkalinity, Total	1	63	mg/L	10	
GJ212-15	SE 9	W	SM18-2340 B	Hardness (as CaCO3)	11.1	61	mg/L	7.3	
GJ212-15	SE 9	W	SW846 6010B	Iron	10	0.28	mg/L	0.2	
GJ212-15	SE 9	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-15	SE 9	W	EPA 300.0	Chloride	2	10	mg/L	10	
GJ212-15	SE 9	W	EPA 300.0	Sulfate (as SO4)	2	16	mg/L	1	
GJ212-15	SE 9	W	EPA 310.1	Alkalinity, Total	1	62	mg/L	10	
GJ212-16	SE 10	W	SM18-2340 B	Hardness (as CaCO3)	11.1	63	mg/L	7.3	
GJ212-16	SE 10	W	SW846 6010B	Iron	10	0.33	mg/L	0.2	
GJ212-16	SE 10	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-16	SE 10	W	EPA 300.0	Chloride	2	11	mg/L	10	
GJ212-16	SE 10	W	EPA 300.0	Sulfate (as SO4)	2	16	mg/L	1	
GJ212-16	SE 10	W	EPA 310.1	Alkalinity, Total	1	64	mg/L	10	
GJ212-17	SE 2	W	SM18-2340 B	Hardness (as CaCO3)	11.1	53	mg/L	7.3	
GJ212-17	SE 2	W	SW846 6010B	Iron	10	0.21	mg/L	0.2	

TRACE ID	SAMPLE ID	MATRIX	ANALYSIS METHOD	PARAMETER	DILUTION	RESULT	UNITS	RDL	QUALIFIER
GJ212-17	SE 2	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-17	SE 2	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-17	SE 2	W	EPA 300.0	Sulfate (as SO4)	2	8.9	mg/L	1	
GJ212-17	SE 2	W	EPA 310.1	Alkalinity, Total	1	53	mg/L	10	
GJ212-18	CGB2 ALT (CELL)	W	SM18-2340 B	Hardness (as CaCO3)	11.1	66	mg/L	7.3	
GJ212-18	CGB2 ALT (CELL)	W	SW846 6010B	Iron	10	0.25	mg/L	0.2	
GJ212-18	CGB2 ALT (CELL)	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-18	CGB2 ALT (CELL)	W	EPA 300.0	Chloride	2	13	mg/L	10	
GJ212-18	CGB2 ALT (CELL)	W	EPA 300.0	Sulfate (as SO4)	2	20	mg/L	1	
GJ212-18	CGB2 ALT (CELL)	W	EPA 310.1	Alkalinity, Total	1	66	mg/L	10	
GJ212-19	COMMUNITY SAILING DOCK	W	SM18-2340 B	Hardness (as CaCO3)	11.1	59	mg/L	7.3	
GJ212-19	COMMUNITY SAILING DOCK	W	SW846 6010B	Iron	10	0.21	mg/L	0.2	
GJ212-19	COMMUNITY SAILING DOCK	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-19	COMMUNITY SAILING DOCK	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-19	COMMUNITY SAILING DOCK	W	EPA 300.0	Sulfate (as SO4)	2	11	mg/L	1	
GJ212-19	COMMUNITY SAILING DOCK	W	EPA 310.1	Alkalinity, Total	1	54	mg/L	10	
GJ212-20	CGA1 (CELL)	W	SM18-2340 B	Hardness (as CaCO3)	11.1	90	mg/L	7.3	
GJ212-20	CGA1 (CELL)	W	SW846 6010B	Iron	10	0.37	mg/L	0.2	
GJ212-20	CGA1 (CELL)	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-20	CGA1 (CELL)	W	EPA 300.0	Chloride	2	19	mg/L	10	
GJ212-20	CGA1 (CELL)	W	EPA 300.0	Sulfate (as SO4)	2	28	mg/L	1	
GJ212-20	CGA1 (CELL)	W	EPA 310.1	Alkalinity, Total	1	86	mg/L	10	
GJ212-21	BONG BRIDGE CELL	W	SM18-2340 B	Hardness (as CaCO3)	11.1	93	mg/L	7.3	
GJ212-21	BONG BRIDGE CELL	W	SW846 6010B	Iron	10	0.62	mg/L	0.2	
GJ212-21	BONG BRIDGE CELL	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-21	BONG BRIDGE CELL	W	EPA 300.0	Chloride	2	15	mg/L	10	
GJ212-21	BONG BRIDGE CELL	W	EPA 300.0	Sulfate (as SO4)	2	20	mg/L	1	
GJ212-21	BONG BRIDGE CELL	W	EPA 310.1	Alkalinity, Total	1	86	mg/L	10	
GJ212-22	CGCI (CELL)	W	SM18-2340 B	Hardness (as CaCO3)	11.1	98	mg/L	7.3	
GJ212-22	CGCI (CELL)	W	SW846 6010B	Iron	10	0.8	mg/L	0.2	
GJ212-22	CGCI (CELL)	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-22	CGCI (CELL)	W	EPA 300.0	Chloride	2	13	mg/L	10	
GJ212-22	CGCI (CELL)	W	EPA 300.0	Sulfate (as SO4)	2	15	mg/L	1	
GJ212-22	CGCI (CELL)	W	EPA 310.1	Alkalinity, Total	1	89	mg/L	10	
GJ212-23	HALLETT 5	W	SM18-2340 B	Hardness (as CaCO3)	11.1	91	mg/L	7.3	
GJ212-23	HALLETT 5	W	SW846 6010B	Iron	10	0.21	mg/L	0.2	
GJ212-23	HALLETT 5	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-23	HALLETT 5	W	EPA 300.0	Chloride	2	21	mg/L	10	
GJ212-23	HALLETT 5	W	EPA 300.0	Sulfate (as SO4)	2	30	mg/L	1	
GJ212-23	HALLETT 5	W	EPA 310.1	Alkalinity, Total	1	87	mg/L	10	

DULUTLH CORROSION CHEMICAL ANALYSIS DATA SPREADSHEET

TRACE ID	SAMPLE ID	MATRIX	ANALYSIS METHOD	PARAMETER	DILUTION	RESULT	UNITS	RDL	QUALIFIER
GJ212-24	LAKEHEAD BOAT BASIN # 1	W	SM18-2340 B	Hardness (as CaCO3)	11.1	48	mg/L	7.3	
GJ212-24	LAKEHEAD BOAT BASIN # 1	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-24	LAKEHEAD BOAT BASIN # 1	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-24	LAKEHEAD BOAT BASIN # 1	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-24	LAKEHEAD BOAT BASIN # 1	W	EPA 300.0	Sulfate (as SO4)	2	6.4	mg/L	1	
GJ212-24	LAKEHEAD BOAT BASIN # 1	W	EPA 310.1	Alkalinity, Total	1	48	mg/L	10	
GJ212-25	DE 9	W	SM18-2340 B	Hardness (as CaCO3)	11.1	46	mg/L	7.3	
GJ212-25	DE 9	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-25	DE 9	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-25	DE 9	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-25	DE 9	W	EPA 300.0	Sulfate (as SO4)	2	4.1	mg/L	1	
GJ212-25	DE 9	W	EPA 310.1	Alkalinity, Total	1	46	mg/L	10	
GJ212-26	DE 10	W	SM18-2340 B	Hardness (as CaCO3)	11.1	45	mg/L	7.3	
GJ212-26	DE 10	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-26	DE 10	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-26	DE 10	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-26	DE 10	W	EPA 300.0	Sulfate (as SO4)	2	4.3	mg/L	1	
GJ212-26	DE 10	W	EPA 310.1	Alkalinity, Total	1	45	mg/L	10	
GJ212-27	DE 8	W	SM18-2340 B	Hardness (as CaCO3)	11.1	45	mg/L	7.3	
GJ212-27	DE 8	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-27	DE 8	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-27	DE 8	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-27	DE 8	W	EPA 300.0	Sulfate (as SO4)	2	4.4	mg/L	1	
GJ212-27	DE 8	W	EPA 310.1	Alkalinity, Total	1	47	mg/L	10	
GJ212-28	DE 4	W	SM18-2340 B	Hardness (as CaCO3)	11.1	46	mg/L	7.3	
GJ212-28	DE 4	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-28	DE 4	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-28	DE 4	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-28	DE 4	W	EPA 300.0	Sulfate (as SO4)	2	5.2	mg/L	1	
GJ212-28	DE 4	W	EPA 310.1	Alkalinity, Total	1	48	mg/L	10	
GJ212-29	DE 7	W	SM18-2340 B	Hardness (as CaCO3)	11.1	46	mg/L	7.3	
GJ212-29	DE 7	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-29	DE 7	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-29	DE 7	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-29	DE 7	W	EPA 300.0	Sulfate (as SO4)	2	4.7	mg/L	1	
GJ212-29	DE 7	W	EPA 310.1	Alkalinity, Total	1	47	mg/L	10	
GJ212-30	DE 6	W	SM18-2340 B	Hardness (as CaCO3)	11.1	48	mg/L	7.3	
GJ212-30	DE 6	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-30	DE 6	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-30	DE 6	W	EPA 300.0	Chloride	5	<10	mg/L	10	

DULUTLH CORROSION CHEMICAL ANALYSIS DATA SPREADSHEET

TRACE ID	SAMPLE ID	MATRIX	ANALYSIS METHOD	PARAMETER	DILUTION	RESULT	UNITS	RDL	QUALIFIER
GJ212-30	DE 6	W	EPA 300.0	Sulfate (as SO4)	5	5	mg/L	1	
GJ212-30	DE 6	W	EPA 310.1	Alkalinity, Total	1	47	mg/L	10	
GJ212-31	DE 1	W	SM18-2340 B	Hardness (as CaCO3)	11.1	48	mg/L	7.3	
GJ212-31	DE 1	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-31	DE 1	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-31	DE 1	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-31	DE 1	W	EPA 300.0	Sulfate (as SO4)	2	4.1	mg/L	1	
GJ212-31	DE 1	W	EPA 310.1	Alkalinity, Total	1	46	mg/L	10	
GJ212-32	DE 2	W	SM18-2340 B	Hardness (as CaCO3)	11.1	45	mg/L	7.3	
GJ212-32	DE 2	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-32	DE 2	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-32	DE 2	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-32	DE 2	W	EPA 300.0	Sulfate (as SO4)	2	4.1	mg/L	1	
GJ212-32	DE 2	W	EPA 310.1	Alkalinity, Total	1	46	mg/L	10	
GJ212-33	DE 3	W	SM18-2340 B	Hardness (as CaCO3)	11.1	46	mg/L	7.3	
GJ212-33	DE 3	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-33	DE 3	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-33	DE 3	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-33	DE 3	W	EPA 300.0	Sulfate (as SO4)	2	4.2	mg/L	1	
GJ212-33	DE 3	W	EPA 310.1	Alkalinity, Total	1	46	mg/L	10	
GJ212-34	DE 5	W	SM18-2340 B	Hardness (as CaCO3)	11.1	47	mg/L	7.3	
GJ212-34	DE 5	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-34	DE 5	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-34	DE 5	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-34	DE 5	W	EPA 300.0	Sulfate (as SO4)	2	5.5	mg/L	1	
GJ212-34	DE 5	W	EPA 310.1	Alkalinity, Total	1	48	mg/L	10	
GJ212-35	SE 6	W	SM18-2340 B	Hardness (as CaCO3)	11.1	53	mg/L	7.3	
GJ212-35	SE 6	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-35	SE 6	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-35	SE 6	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-35	SE 6	W	EPA 300.0	Sulfate (as SO4)	2	9.5	mg/L	1	
GJ212-35	SE 6	W	EPA 310.1	Alkalinity, Total	1	53	mg/L	10	
GJ212-36	SE 5	W	SM18-2340 B	Hardness (as CaCO3)	11.1	48	mg/L	7.3	
GJ212-36	SE 5	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-36	SE 5	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-36	SE 5	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-36	SE 5	W	EPA 300.0	Sulfate (as SO4)	2	6	mg/L	1	
GJ212-36	SE 5	W	EPA 310.1	Alkalinity, Total	1	49	mg/L	10	
GJ212-37	SE 8	W	SM18-2340 B	Hardness (as CaCO3)	11.1	47	mg/L	7.3	
GJ212-37	SE 8	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	

TRACE ID	SAMPLE ID	MATRIX	ANALYSIS METHOD	PARAMETER	DILUTION	RESULT	UNITS	RDL	QUALIFIER
GJ212-37	SE 8	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-37	SE 8	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-37	SE 8	W	EPA 300.0	Sulfate (as SO4)	2	5.6	mg/L	1	
GJ212-37	SE 8	W	EPA 310.1	Alkalinity, Total	1	49	mg/L	10	
GJ212-38	OLIVER BRIDGE	W	SM18-2340 B	Hardness (as CaCO3)	11.1	110	mg/L	7.3	
GJ212-38	OLIVER BRIDGE	W	SW846 6010B	Iron	10	0.23	mg/L	0.2	
GJ212-38	OLIVER BRIDGE	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-38	OLIVER BRIDGE	W	EPA 300.0	Chloride	2	11	mg/L	10	
GJ212-38	OLIVER BRIDGE	W	EPA 300.0	Sulfate (as SO4)	2	14	mg/L	1	
GJ212-38	OLIVER BRIDGE	W	EPA 310.1	Alkalinity, Total	1	110	mg/L	10	
GJ212-39	HALLETT 7	W	SM18-2340 B	Hardness (as CaCO3)	11.1	94	mg/L	7.3	
GJ212-39	HALLETT 7	W	SW846 6010B	Iron	10	0.65	mg/L	0.2	
GJ212-39	HALLETT 7	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-39	HALLETT 7	W	EPA 300.0	Chloride	2	12	mg/L	10	
GJ212-39	HALLETT 7	W	EPA 300.0	Sulfate (as SO4)	2	14	mg/L	1	
GJ212-39	HALLETT 7	W	EPA 310.1	Alkalinity, Total	1	92	mg/L	10	
GJ212-40	SPIRIT LAKE MARINA	W	SM18-2340 B	Hardness (as CaCO3)	11.1	100	mg/L	7.3	
GJ212-40	SPIRIT LAKE MARINA	W	SW846 6010B	Iron	10	0.36	mg/L	0.2	
GJ212-40	SPIRIT LAKE MARINA	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-40	SPIRIT LAKE MARINA	W	EPA 300.0	Chloride	2	11	mg/L	10	
GJ212-40	SPIRIT LAKE MARINA	W	EPA 300.0	Sulfate (as SO4)	2	11	mg/L	1	
GJ212-40	SPIRIT LAKE MARINA	W	EPA 310.1	Alkalinity, Total	1	99	mg/L	10	
GJ212-41	TWO HARBORS	W	SM18-2340 B	Hardness (as CaCO3)	11.1	81	mg/L	7.3	
GJ212-41	TWO HARBORS	W	SW846 6010B	Iron	10	0.37	mg/L	0.2	
GJ212-41	TWO HARBORS	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-41	TWO HARBORS	W	EPA 300.0	Chloride	5	<10	mg/L	10	
GJ212-41	TWO HARBORS	W	EPA 300.0	Sulfate (as SO4)	5	4.1	mg/L	1	
GJ212-41	TWO HARBORS	W	EPA 310.1	Alkalinity, Total	1	47	mg/L	10	
GJ212-42	SE 3	W	SM18-2340 B	Hardness (as CaCO3)	11.1	61	mg/L	7.3	
GJ212-42	SE 3	W	SW846 6010B	Iron	10	0.42	mg/L	0.2	
GJ212-42	SE 3	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-42	SE 3	W	EPA 300.0	Chloride	2	<10	mg/L	10	
GJ212-42	SE 3	W	EPA 300.0	Sulfate (as SO4)	2	6.8	mg/L	1	
GJ212-42	SE 3	W	EPA 310.1	Alkalinity, Total	1	52	mg/L	10	
GJ212-43	DSPA BERTH 4	W	SM18-2340 B	Hardness (as CaCO3)	11.1	66	mg/L	7.3	
GJ212-43	DSPA BERTH 4	W	SW846 6010B	Iron	10	0.21	mg/L	0.2	
GJ212-43	DSPA BERTH 4	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-43	DSPA BERTH 4	W	EPA 300.0	Chloride	2	14	mg/L	10	
GJ212-43	DSPA BERTH 4	W	EPA 300.0	Sulfate (as SO4)	2	21	mg/L	1	
GJ212-43	DSPA BERTH 4	W	EPA 310.1	Alkalinity, Total	1	69	mg/L	10	

DULUTLH CORROSION CHEMICAL ANALYSIS DATA SPREADSHEET

TRACE ID	SAMPLE ID	MATRIX	ANALYSIS METHOD	PARAMETER	DILUTION	RESULT	UNITS	RDL	QUALIFIER
GJ212-44	DSPA BERTH 1	W	SM18-2340 B	Hardness (as CaCO3)	11.1	61	mg/L	7.3	
GJ212-44	DSPA BERTH 1	W	SW846 6010B	Iron	10	<0.20	mg/L	0.2	
GJ212-44	DSPA BERTH 1	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-44	DSPA BERTH 1	W	EPA 300.0	Chloride	5	27	mg/L	10	
GJ212-44	DSPA BERTH 1	W	EPA 300.0	Sulfate (as SO4)	2	16	mg/L	1	
GJ212-44	DSPA BERTH 1	W	EPA 310.1	Alkalinity, Total	1	60	mg/L	10	
GJ212-45	ERIE PIER 1	W	SM18-2340 B	Hardness (as CaCO3)	11.1	88	mg/L	7.3	
GJ212-45	ERIE PIER 1	W	SW846 6010B	Iron	10	0.63	mg/L	0.2	
GJ212-45	ERIE PIER 1	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-45	ERIE PIER 1	W	EPA 300.0	Chloride	2	17	mg/L	10	
GJ212-45	ERIE PIER 1	W	EPA 300.0	Sulfate (as SO4)	2	22	mg/L	1	
GJ212-45	ERIE PIER 1	W	EPA 310.1	Alkalinity, Total	1	89	mg/L	10	
GJ212-46	ERIE PIER 2	W	SM18-2340 B	Hardness (as CaCO3)	11.1	100	mg/L	7.3	
GJ212-46	ERIE PIER 2	W	SW846 6010B	Iron	10	0.71	mg/L	0.2	
GJ212-46	ERIE PIER 2	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-46	ERIE PIER 2	W	EPA 300.0	Chloride	2	16	mg/L	10	
GJ212-46	ERIE PIER 2	W	EPA 300.0	Sulfate (as SO4)	2	21	mg/L	1	
GJ212-46	ERIE PIER 2	W	EPA 310.1	Alkalinity, Total	1	89	mg/L	10	
GJ212-47	MIDWEST ENERGY	W	SM18-2340 B	Hardness (as CaCO3)	11.1	84	mg/L	7.3	
GJ212-47	MIDWEST ENERGY	W	SW846 6010B	Iron	10	0.43	mg/L	0.2	
GJ212-47	MIDWEST ENERGY	W	EPA 160.2	Total Suspended Solids	1	<10	mg/L	10	
GJ212-47	MIDWEST ENERGY	W	EPA 300.0	Chloride	5	21	mg/L	10	
GJ212-47	MIDWEST ENERGY	W	EPA 300.0	Sulfate (as SO4)	5	32	mg/L	1	
GJ212-47	MIDWEST ENERGY	W	EPA 310.1	Alkalinity, Total	1	93	mg/L	10	

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TRACE

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October 17, 2006

Mr. Mark Resch
Altech Environmental Services
17350 W. 10 Mile Road
Suite 200
Southfield, MI 48075

248-559-5500
FAX: 248-559-5540

RE: Trace Project GJ212
Client Project DULUTH CORROSION / 9201-044

Dear Mr. Resch:

Enclosed are your analytical results.

All reports were examined through Trace's validation process to ensure that all requirements for quality and completeness were satisfied. All reported analytical results were obtained in accordance with the methods referenced on the reports. Every practical effort was made to meet the reporting limit specifications for this work.

If you have questions concerning this report, please contact me at (231)773-5998, or by e-mail at jmink@trace-labs.com.

Sincerely,

Jon Mink
Project Manager

Enclosures

TRACE IS VALIDATED BY THE U.S. ARMY CORPS OF ENGINEERS

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AN EXPLANATION OF TERMS AND SYMBOLS WHICH MAY OCCUR IN THIS REPORT

QC DEFINITIONS

LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
RPD	Relative Percent Difference
DUP	Matrix Duplicate

QUALIFIER KEYS These descriptors will be associated with the individual results for a specific sample and a specific analyte and will help qualify the data

<, ND, or U	Indicates the compound was analyzed for but not detected
J	Indicates an estimated value
B	Indicates the analyte is found in the blank associated with the sample
E	Indicates the analyte exceeded the range of calibration
*	Indicates that a QC result was outside the acceptance criterion or that a sample result exceeded an MCL

OTHER DEFINITIONS

RDL	Reporting Detection Limit
MCL	Maximum Contamination Limit
TIC	Tentatively Identified Compound
TPC	Time-Proportional Composite
FPC	Flow-Proportional Composite

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SAMPLE SUMMARY

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID	Sample ID	Matrix	Collected By	Date Collected	Date Received
GJ212-01	CUTLER MAGNER	Water	Client	09/19/06 09:40	09/21/06 10:25
GJ212-02	DSPA BERTH #6	Water	Client	09/19/06 10:30	09/21/06 10:25
GJ212-03	CARGILL	Water	Client	09/19/06 11:35	09/21/06 10:25
GJ212-04	DECC	Water	Client	09/19/06 12:10	09/21/06 10:25
GJ212-05	MN SLIP (WILLIAM A IRVIN SLIP)	Water	Client	09/19/06 12:50	09/21/06 10:25
GJ212-06	VY2	Water	Client	09/19/06 14:20	09/21/06 10:25
GJ212-07	VY1	Water	Client	09/19/06 14:45	09/21/06 10:25
GJ212-09	CHS #1	Water	Client	09/19/06 15:45	09/21/06 10:25
GJ212-12	SE 1	Water	Client	09/20/06 09:00	09/21/06 10:25
GJ212-13	SE 7	Water	Client	09/20/06 09:35	09/21/06 10:25
GJ212-14	SE 4	Water	Client	09/20/06 10:05	09/21/06 10:25
GJ212-15	SE 9	Water	Client	09/20/06 10:45	09/21/06 10:25
GJ212-16	SE 10	Water	Client	09/20/06 11:10	09/21/06 10:25
GJ212-17	SE 2	Water	Client	09/20/06 12:20	09/21/06 10:25
GJ212-18	CGB2 ALT (CELL)	Water	Client	09/20/06 12:50	09/21/06 10:25
GJ212-19	COMMUNITY SAILING DOCK	Water	Client	09/20/06 13:20	09/21/06 10:25
GJ212-20	CGA1 (CELL)	Water	MR/Client	09/20/06 15:05	09/23/06 11:30
GJ212-21	BONG BRIDGE CELL	Water	MR/Client	09/20/06 15:35	09/23/06 11:30
GJ212-22	CGCI (CELL)	Water	MR/Client	09/20/06 16:05	09/23/06 11:30
GJ212-23	HALLETT 5	Water	MR/Client	09/20/06 16:45	09/23/06 11:30
GJ212-24	LAKEHEAD BOAT BASIN # 1	Water	MR/Client	09/20/06 17:20	09/23/06 11:30
GJ212-25	DE 9	Water	MR/Client	09/21/06 08:10	09/23/06 11:30
GJ212-26	DE 10	Water	MR/Client	09/21/06 08:40	09/23/06 11:30
GJ212-27	DE 8	Water	MR/Client	09/21/06 09:05	09/23/06 11:30
GJ212-28	DE 4	Water	MR/Client	09/21/06 09:40	09/23/06 11:30
GJ212-29	DE 7	Water	MR/Client	09/21/06 10:05	09/23/06 11:30
GJ212-30	DE 6	Water	MR/Client	09/21/06 10:35	09/23/06 11:30
GJ212-31	DE 1	Water	MR/Client	09/21/06 11:00	09/23/06 11:30
GJ212-32	DE 2	Water	MR/Client	09/21/06 11:20	09/23/06 11:30
GJ212-33	DE 3	Water	MR/Client	09/21/06 11:40	09/23/06 11:30
GJ212-34	DE 5	Water	MR/Client	09/21/06 12:05	09/23/06 11:30
GJ212-35	SE 6	Water	MR/Client	09/21/06 13:45	09/23/06 11:30
GJ212-36	SE 5	Water	MR/Client	09/21/06 14:10	09/23/06 11:30
GJ212-37	SE 8	Water	MR/Client	09/21/06 14:45	09/23/06 11:30
GJ212-38	OLIVER BRIDGE	Water	MR/Client	09/21/06 16:00	09/23/06 11:30
GJ212-39	HALLETT 7	Water	MR/Client	09/22/06 08:15	09/23/06 11:30
GJ212-40	SPIRIT LAKE MARINA	Water	MR/Client	09/22/06 08:45	09/23/06 11:30

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SAMPLE SUMMARY

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID	Sample ID	Matrix	Collected By	Date Collected	Date Received
GJ212-41	TWO HARBORS	Water	MR/Client	09/24/06 09:45	09/26/06 10:27
GJ212-42	SE 3	Water	MR/Client	09/24/06 11:50	09/26/06 10:27
GJ212-43	DSPA BERTH 4	Water	MR/Client	09/24/06 12:20	09/26/06 10:27
GJ212-44	DSPA BERTH 1	Water	MR/Client	09/24/06 12:50	09/26/06 10:27
GJ212-45	ERIE PIER 1	Water	MR/Client	09/24/06 13:25	09/26/06 10:27
GJ212-46	ERIE PIER 2	Water	MR/Client	09/24/06 13:45	09/26/06 10:27
GJ212-47	MIDWEST ENERGY	Water	MR/Client	09/24/06 14:20	09/26/06 10:27

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-01** Date Collected: 09/19/06 09:40 Matrix: Water
Sample ID: **CUTLER MAGNER** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**68**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.21**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**14**	**mg/L**	**10**	**2**			**09/25/06**	**at**		
Sulfate (as SO4)	**19**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**66**	**mg/L**	**10**	**1**			**09/26/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-02** Date Collected: 09/19/06 10:30 Matrix: Water
Sample ID: **DSPA BERTH #6** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**81**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.25**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**21**	**mg/L**	**10**	**2**			**09/25/06**	**at**		
Sulfate (as SO4)	**35**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**82**	**mg/L**	**10**	**1**			**09/26/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-03** Date Collected: 09/19/06 11:35 Matrix: Water
Sample ID: **CARGILL** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**53**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/21/06	da	09/29/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/25/06	at		
Sulfate (as SO4)	**12**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**53**	**mg/L**	**10**	**1**			**09/26/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-04** Date Collected: 09/19/06 12:10 Matrix: Water
Sample ID: **DECC** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**46**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/21/06	da	09/29/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/25/06	at		
Sulfate (as SO4)	**4.6**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**46**	**mg/L**	**10**	1			**09/26/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-05** Date Collected: 09/19/06 12:50 Matrix: Water
Sample ID: **MN SLIP (WILLIAM A IRVIN SLIP)** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**56**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.47**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**13**	**mg/L**	**10**	**2**			**09/25/06**	**at**		
Sulfate (as SO4)	**6.9**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**55**	**mg/L**	**10**	**1**			**09/26/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-06** Date Collected: 09/19/06 14:20 Matrix: Water
Sample ID: **VY2** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**49**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/21/06	da	09/29/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/25/06	at		
Sulfate (as SO4)	**6.5**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**49**	**mg/L**	**10**	**1**			**09/26/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-07** Date Collected: 09/19/06 14:45 Matrix: Water
Sample ID: **VY1** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**48**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/21/06	da	09/29/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/25/06	at		
Sulfate (as SO4)	**6.4**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**49**	**mg/L**	**10**	**1**			**09/26/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-09**
Sample ID: **CHS #1**

Date Collected: 09/19/06 15:45
Date Received: 09/21/06 10:25

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**82**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.29**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**21**	**mg/L**	**10**	**5**			**09/25/06**	**at**		
Sulfate (as SO4)	**32**	**mg/L**	**1.0**	**5**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**86**	**mg/L**	**10**	**1**			**10/03/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-12** Date Collected: 09/20/06 09:00 Matrix: Water
Sample ID: **SE 1** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**48**	**mg/L**	**7.3**	11.1			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/21/06	da	09/29/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/25/06	at		
Sulfate (as SO4)	**4.8**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**47**	**mg/L**	**10**	1			**10/03/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-13** Date Collected: 09/20/06 09:35 Matrix: Water
Sample ID: **SE 7** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**59**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.22**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/25/06	at		
Sulfate (as SO4)	**13**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**60**	**mg/L**	**10**	**1**			**10/03/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-14** Date Collected: 09/20/06 10:05 Matrix: Water
Sample ID: **SE 4** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**62**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.29**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**10**	**mg/L**	**10**	**2**			**09/25/06**	**at**		
Sulfate (as SO4)	**15**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**63**	**mg/L**	**10**	**1**			**10/03/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-15** Date Collected: 09/20/06 10:45 Matrix: Water
Sample ID: **SE 9** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**61**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.28**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**10**	**mg/L**	**10**	**2**			**09/25/06**	**at**		
Sulfate (as SO4)	**16**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**62**	**mg/L**	**10**	**1**			**10/03/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-16** Date Collected: 09/20/06 11:10 Matrix: Water
Sample ID: **SE 10** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**63**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.33**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**11**	**mg/L**	**10**	**2**			**09/25/06**	**at**		
Sulfate (as SO4)	**16**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**64**	**mg/L**	**10**	**1**			**10/03/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 920 -044

Trace ID: **GJ212-17**
Sample ID: **SE 2**

Date Collected: 09/20/06 12:20
Date Received: 09/21/06 10:25

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**53**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.21**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/25/06	at		
Sulfate (as SO4)	**8.9**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**53**	**mg/L**	**10**	**1**			**10/03/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-18** Date Collected: 09/20/06 12:50 Matrix: Water
Sample ID: **CGB2 ALT (CELL)** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**66**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.25**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**13**	**mg/L**	**10**	**2**			**09/25/06**	**at**		
Sulfate (as SO4)	**20**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**66**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-19** Date Collected: 09/20/06 13:20 Matrix: Water
Sample ID: **COMMUNITY SAILING DOCK** Date Received: 09/21/06 10:25

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**59**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.21**	**mg/L**	**0.20**	**10**	**09/21/06**	**da**	**09/29/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/22/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/25/06	at		
Sulfate (as SO4)	**11**	**mg/L**	**1.0**	**2**			**09/25/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**54**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-20** Date Collected: 09/20/06 15:05 Matrix: Water
Sample ID: **CGA1 (CELL)** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**90**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.37**	**mg/L**	**0.20**	**10**	**09/25/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**19**	**mg/L**	**10**	**2**			**09/26/06**	**at**		
Sulfate (as SO4)	**28**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**86**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-21** Date Collected: 09/20/06 15:35 Matrix: Water
Sample ID: **BONG BRIDGE CELL** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**93**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.62**	**mg/L**	**0.20**	**10**	**09/25/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**15**	**mg/L**	**10**	**2**			**09/26/06**	**at**		
Sulfate (as SO4)	**20**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**86**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-22**
Sample ID: **CGCI (CELL)**

Date Collected: 09/20/06 16:05
Date Received: 09/23/06 11:30

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**98**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.80**	**mg/L**	**0.20**	**10**	**09/25/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**13**	**mg/L**	**10**	**2**			**09/26/06**	**at**		
Sulfate (as SO4)	**15**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**89**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-23** Date Collected: 09/20/06 16:45 Matrix: Water
Sample ID: **HALLETT 5** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**91**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.21**	**mg/L**	**0.20**	**10**	**09/25/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**21**	**mg/L**	**10**	**2**			**09/26/06**	**at**		
Sulfate (as SO4)	**30**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**87**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-24**
Sample ID: **LAKEHEAD BOAT BASIN # 1**

Date Collected: 09/20/06 17:20
Date Received: 09/23/06 11:30

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**48**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**6.4**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**48**	**mg/L**	**10**	1			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-25**
Sample ID: **DE 9**

Date Collected: 09/21/06 08:10
Date Received: 09/23/06 11:30

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**46**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**4.1**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**46**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-26** Date Collected: 09/21/06 08:40 Matrix: Water
Sample ID: **DE 10** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**45**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**4.3**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**45**	**mg/L**	**10**	1			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-27** Date Collected: 09/21/06 09:05 Matrix: Water
Sample ID: **DE 8** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**45**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**4.4**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**47**	**mg/L**	**10**	1			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-28** Date Collected: 09/21/06 09:40 Matrix: Water
Sample ID: **DE 4** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**46**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**5.2**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**48**	**mg/L**	**10**	1			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-29** Date Collected: 09/21/06 10:05 Matrix: Water
Sample ID: **DE 7** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**46**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**4.7**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**47**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-30**
Sample ID: **DE 6**

Date Collected: 09/21/06 10:35
Date Received: 09/23/06 11:30

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**48**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	5			09/26/06	at		
Sulfate (as SO4)	**5.0**	**mg/L**	**1.0**	**5**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**47**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-31** Date Collected: 09/21/06 11:00 Matrix: Water
Sample ID: **DE 1** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**48**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**4.1**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**46**	**mg/L**	**10**	1			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-32**
Sample ID: **DE 2**

Date Collected: 09/21/06 11:20
Date Received: 09/23/06 11:30

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**45**	**mg/L**	**7.3**	11.1			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**4.1**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**46**	**mg/L**	**10**	1			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-33** Date Collected: 09/21/06 11:40 Matrix: Water
Sample ID: **DE 3** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**46**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**4.2**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**46**	**mg/L**	**10**	1			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-34** Date Collected: 09/21/06 12:05 Matrix: Water
Sample ID: **DE 5** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**47**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**5.5**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**48**	**mg/L**	**10**	**1**			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-35** Date Collected: 09/21/06 13:45 Matrix: Water
Sample ID: **SE 6** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**53**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	lc		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**9.5**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**53**	**mg/L**	**10**	1			**10/06/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-36** Date Collected: 09/21/06 14:10 Matrix: Water
Sample ID: **SE 5** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**48**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**6.0**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**49**	**mg/L**	**10**	1			**10/09/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-37** Date Collected: 09/21/06 14:45 Matrix: Water
Sample ID: **SE 8** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**47**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/25/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**5.6**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**49**	**mg/L**	**10**	1			**10/09/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-38**
Sample ID: **OLIVER BRIDGE**

Date Collected: 09/21/06 16:00
Date Received: 09/23/06 11:30

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**110**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.23**	**mg/L**	**0.20**	**10**	**09/25/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**11**	**mg/L**	**10**	**2**			**09/26/06**	**at**		
Sulfate (as SO4)	**14**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**110**	**mg/L**	**10**	**1**			**10/09/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-39** Date Collected: 09/22/06 08:15 Matrix: Water
Sample ID: **HALLETT 7** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**94**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.65**	**mg/L**	**0.20**	**10**	**09/25/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**12**	**mg/L**	**10**	**2**			**09/26/06**	**at**		
Sulfate (as SO4)	**14**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**92**	**mg/L**	**10**	**1**			**10/09/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-40** Date Collected: 09/22/06 08:45 Matrix: Water
Sample ID: **SPIRIT LAKE MARINA** Date Received: 09/23/06 11:30

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**100**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.36**	**mg/L**	**0.20**	**10**	**09/25/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**11**	**mg/L**	**10**	**2**			**09/26/06**	**at**		
Sulfate (as SO4)	**11**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**99**	**mg/L**	**10**	**1**			**10/09/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-41** Date Collected: 09/24/06 09:45 Matrix: Water
Sample ID: **TWO HARBORS** Date Received: 09/26/06 10:27

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**81**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.37**	**mg/L**	**0.20**	**10**	**09/26/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	5			09/26/06	at		
Sulfate (as SO4)	**4.1**	**mg/L**	**1.0**	**5**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**47**	**mg/L**	**10**	**1**			**10/09/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-42**
Sample ID: **SE 3**

Date Collected: 09/24/06 11:50
Date Received: 09/26/06 10:27

Matrix: Water

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**61**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.42**	**mg/L**	**0.20**	**10**	**09/26/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	<10	mg/L	10	2			09/26/06	at		
Sulfate (as SO4)	**6.8**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**52**	**mg/L**	**10**	1			**10/11/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-43** Date Collected: 09/24/06 12:20 Matrix: Water
Sample ID: **DSPA BERTH 4** Date Received: 09/26/06 10:27

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**66**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.21**	**mg/L**	**0.20**	**10**	**09/26/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**14**	**mg/L**	**10**	**2**			**09/26/06**	**at**		
Sulfate (as SO4)	**21**	**mg/L**	**1.0**	**2**			**09/26/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**69**	**mg/L**	**10**	**1**			**10/11/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-44** Date Collected: 09/24/06 12:50 Matrix: Water
Sample ID: **DSPA BERTH 1** Date Received: 09/26/06 10:27

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**61**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	<0.20	mg/L	0.20	10	09/26/06	da	09/28/06	pad		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**27**	**mg/L**	**10**	**5**			**09/27/06**	**at**		
Sulfate (as SO4)	**16**	**mg/L**	**1.0**	**2**			**09/27/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**60**	**mg/L**	**10**	**1**			**10/11/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-45** Date Collected: 09/24/06 13:25 Matrix: Water
Sample ID: **ERIE PIER 1** Date Received: 09/26/06 10:27

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**88**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.63**	**mg/L**	**0.20**	**10**	**09/26/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**17**	**mg/L**	**10**	**2**			**09/27/06**	**at**		
Sulfate (as SO4)	**22**	**mg/L**	**1.0**	**2**			**09/27/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**89**	**mg/L**	**10**	**1**			**10/11/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-46** Date Collected: 09/24/06 13:45 Matrix: Water
Sample ID: **ERIE PIER 2** Date Received: 09/26/06 10:27

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**100**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.71**	**mg/L**	**0.20**	**10**	**09/26/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**16**	**mg/L**	**10**	**2**			**09/27/06**	**at**		
Sulfate (as SO4)	**21**	**mg/L**	**1.0**	**2**			**09/27/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**89**	**mg/L**	**10**	**1**			**10/11/06**	**at**		

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ANALYTICAL RESULTS

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

Trace ID: **GJ212-47** Date Collected: 09/24/06 14:20 Matrix: Water
Sample ID: **MIDWEST ENERGY** Date Received: 09/26/06 10:27

PARAMETERS	RESULTS	UNITS	RDL	DILUTION	PREPARED	BY	ANALYZED	BY	QUAL	MCL
INORGANICS										
Analysis Desc: SM18-2340B, Hardness										
Hardness (as CaCO3)	**84**	**mg/L**	**7.3**	**11.1**			**09/28/06**	**pad**		
Analysis Desc: SW846 6010B Analysis, Total Waters										
Iron	**0.43**	**mg/L**	**0.20**	**10**	**09/26/06**	**da**	**09/28/06**	**pad**		
WET CHEMISTRY										
Analysis Desc: EPA 160.2, Total Suspended Solids										
Total Suspended Solids	<10	mg/L	10	1			09/26/06	pad		
Analysis Desc: EPA 300.0R2.1, Anions										
Chloride	**21**	**mg/L**	**10**	**5**			**09/27/06**	**at**		
Sulfate (as SO4)	**32**	**mg/L**	**1.0**	**5**			**09/27/06**	**at**		
Analysis Desc: EPA 310.1, Alkalinity, Total										
Alkalinity, Total	**93**	**mg/L**	**10**	**1**			**10/11/06**	**at**		

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: DIG/3892 Analysis Method: SW846 6010B

QC Batch Method: SW846 3015

Associated Lab Samples: GJ205-01, GJ212-01, GJ212-02, GJ212-03, GJ212-04, GJ212-05, GJ212-06, GJ212-07, GJ212-09, GJ212-12, GJ212-13, GJ212-14, GJ212-15, GJ212-16, GJ212-17, GJ212-18, GJ212-19

METHOD BLANK: 97669

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Iron	mg/L	<0.20	0.20	

LABORATORY CONTROL SAMPLE: 97670

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Iron	mg/L	8.9	9.0	102	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 97671 97672 Original: GJ212-09

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Iron	mg/L	0.29	8.9	9.1	9.1	99	99	75-125	0	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8264 Analysis Method: EPA 160.2

QC Batch Method: EPA 160.2

Associated Lab Samples: GJ212-01, GJ212-02, GJ212-03, GJ212-04, GJ212-05, GJ212-06, GJ212-07, GJ212-09, GJ212-12, GJ212-13, GJ212-14, GJ212-15, GJ212-16, GJ212-17, GJ212-18, GJ212-19

METHOD BLANK: 97741

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Total Suspended Solids	mg/L	<10	10	

LABORATORY CONTROL SAMPLE: 97742

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Suspended Solids	mg/L	50	48	96	85-115	

SAMPLE DUPLICATE: 97886 Original: GJ212-09

Parameter	Units	Original Result	DUP Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L		<10	0	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8272 Analysis Method: EPA 300.0

QC Batch Method: EPA 300.0

Associated Lab Samples: GJ212-01, GJ212-02, GJ212-03, GJ212-04, GJ212-05, GJ212-06, GJ212-07, GJ212-09, GJ212-12, GJ212-13, GJ212-14, GJ212-15, GJ212-16, GJ212-17, GJ212-18, GJ212-19

METHOD BLANK: 97840

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Chloride	mg/L	<10	10	
Sulfate (as SO4)	mg/L	<1.0	1.0	

LABORATORY CONTROL SAMPLE: 97841

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	1	<10	108	90-110	
Sulfate (as SO4)	mg/L	2.5	2.7	109	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 97994 97995 Original: GJ212-09

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Chloride	mg/L	21	15	39	38	117	111	80-120	5.3	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: DIG/3902 Analysis Method: SW846 6010B

QC Batch Method: SW846 3015

Associated Lab Samples: GJ212-20, GJ212-21, GJ212-22, GJ212-23, GJ212-24, GJ212-25, GJ212-26, GJ212-27, GJ212-28, GJ212-29, GJ212-30, GJ212-31, GJ212-32, GJ212-33, GJ212-34, GJ212-35, GJ212-36, GJ212-37, GJ212-38, GJ212-39

METHOD BLANK: 97935

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Iron	mg/L	<0.20	0.20	

LABORATORY CONTROL SAMPLE: 97936

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Iron	mg/L	8.9	9.1	103	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 97937 97938 Original: GJ212-30

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Iron	mg/L	0	8.9	9.0	9.1	102	103	75-125	0.98	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: DIG/3903 Analysis Method: SW846 6010B

QC Batch Method: SW846 3015

Associated Lab Samples: GJ212-40, GJ242-02, GJ242-04, GJ242-05, GJ242-06, GJ242-07, GJ242-08, GJ242-09, GJ242-10, GJ242-12, GJ242-13, GJ242-14, GJ242-15, GJ242-16, GJ242-17, GJ242-18, GJ242-19

METHOD BLANK: 97948

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Iron	mg/L	<0.20	0.20	

LABORATORY CONTROL SAMPLE: 97949

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Iron	mg/L	8.9	8.8	98	80-120	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8282 Analysis Method: EPA 160.2

QC Batch Method: EPA 160.2

Associated Lab Samples: GJ212-20, GJ212-21, GJ212-22, GJ212-23, GJ212-24, GJ212-25, GJ212-26, GJ212-27, GJ212-28, GJ212-29, GJ212-30, GJ212-31, GJ212-32, GJ212-33, GJ212-34, GJ212-35, GJ235-01, GJ237-01, GJ241-01, GJ250-01

METHOD BLANK: 97985

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Total Suspended Solids	mg/L	<10	10	

LABORATORY CONTROL SAMPLE: 97986

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Suspended Solids	mg/L	50	49	98	85-115	

SAMPLE DUPLICATE: 97987 Original: GJ250-01

Parameter	Units	Original Result	DUP Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L		1000	4.9	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8285 Analysis Method: EPA 310.1

QC Batch Method: EPA 310.1

Associated Lab Samples: GJ210-01, GJ210-02, GJ210-04, GJ210-06, GJ210-07, GJ210-08, GJ210-09, GJ210-10, GJ212-01, GJ212-02, GJ212-03, GJ212-04, GJ212-05, GJ212-06, GJ212-07, GJ229-07, GJ229-08, GJ229-09, GJ235-01, GJ237-01

METHOD BLANK: 98059

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Alkalinity, Total	mg/L	<10	10	

LABORATORY CONTROL SAMPLE: 98060

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total	mg/L	94	96	102	90-122	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98111 98112 Original: GJ212-01

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Alkalinity, Total	mg/L	66	94	160	160	98	99	78-130	1	24	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: DIG/3907 Analysis Method: SW846 6010B

QC Batch Method: SW846 3015

Associated Lab Samples: GJ212-41 GJ212-42 GJ212-43 GJ212-44 GJ212-45 GJ212-46 GJ212-47

METHOD BLANK: 98072

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Iron	mg/L	<0.20	0.20	

LABORATORY CONTROL SAMPLE: 98073

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Iron	mg/L	8.9	8.6	97	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98074 98075 Original: GJ212-41

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Iron	mg/L	0.37	8.9	9.1	9.2	98	99	75-125	1	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98076 98077 Original: GJ212-47

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Iron	mg/L	0.43	8.9	9.1	9.1	97	98	75-125	1	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8288 Analysis Method: EPA 300.0

QC Batch Method: EPA 300.0

Associated Lab Samples: GJ212-20, GJ212-21, GJ212-22, GJ212-23, GJ212-24, GJ212-25, GJ212-26, GJ212-27, GJ212-28, GJ212-29, GJ212-30, GJ212-31, GJ212-32, GJ212-33, GJ212-34, GJ212-35, GJ212-36, GJ252-01, GJ257-01, GJ258-01

METHOD BLANK: 98081

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Chloride	mg/L	<10	10	
Sulfate (as SO4)	mg/L	<1.0	1.0	

LABORATORY CONTROL SAMPLE: 98082

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	1	<10	92	90-110	
Sulfate (as SO4)	mg/L	2.5	2.3	93	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98288 98289 Original: GJ212-30

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Chloride	mg/L	2.6	15	20	20	115	117	80-120	1.7	20	
Sulfate (as SO4)	mg/L	5	30	35	36	101	103	80-120	2	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8289 Analysis Method: EPA 300.0

QC Batch Method: EPA 300.0

Associated Lab Samples: GJ212-37 GJ212-38 GJ212-39 GJ212-40 GJ212-41 GJ212-42 GJ212-43 GJ212-44 GJ212-45 GJ212-46 GJ212-47

METHOD BLANK: 98083

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Chloride	mg/L	<10	10	
Sulfate (as SO4)	mg/L	<1.0	1.0	

LABORATORY CONTROL SAMPLE: 98084

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	1	<10	110	90-110	
Sulfate (as SO4)	mg/L	2.5	2.6	103	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98293 98294 Original: GJ212-41

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Chloride	mg/L	1.5	15	20	19	120	115	80-120	4.3	20	
Sulfate (as SO4)	mg/L	4.1	30	35	34	103	100	80-120	3	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98295 98296 Original: GJ212-47

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Chloride	mg/L	21	15	40	38	124	116	80-120	6.7	20	1
Sulfate (as SO4)	mg/L	32	30	65	66	111	111	80-120	0	20	

QC Notes

[1] The MS recovery was out of control. Because the MSD recovery and the RPD between the MS and the MSD were in control, no data require qualification.

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8292 Analysis Method: EPA 160.2

QC Batch Method: EPA 160.2

Associated Lab Samples: GJ012-04, GJ212-36, GJ212-37, GJ212-38, GJ212-39, GJ212-40, GJ212-41, GJ212-42, GJ212-43, GJ212-44, GJ212-45, GJ212-46, GJ212-47, GJ249-01, GJ254RUSH-01

METHOD BLANK: 98091

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Total Suspended Solids	mg/L	<10	10	

LABORATORY CONTROL SAMPLE: 98092

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Suspended Solids	mg/L	50	50	100	85-115	

SAMPLE DUPLICATE: 98248 Original: GJ212-41

Parameter	Units	Original Result	DUP Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L		<10	0	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: META/8140 Analysis Method: SM18-2340 B

QC Batch Method: SM18-2340 B

Associated Lab Samples: GJ212-01, GJ212-02, GJ212-03, GJ212-04, GJ212-05, GJ212-06, GJ212-07, GJ212-09, GJ212-12, GJ212-13, GJ212-14, GJ212-15, GJ212-16, GJ212-17, GJ212-18, GJ212-19

METHOD BLANK: 98397

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Hardness (as CaCO3)	mg/L	<2.0	2.0	

LABORATORY CONTROL SAMPLE: 98398

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Hardness (as CaCO3)	mg/L	66	59	90	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98399 98400 Original: GJ212-09

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Hardness (as CaCO3)	mg/L	82	53	140	140	111	110	75-125	0.9	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: META/8141 Analysis Method: SM18-2340 B

QC Batch Method: SM18-2340 B

Associated Lab Samples: GJ212-20, GJ212-21, GJ212-22, GJ212-23, GJ212-24, GJ212-25, GJ212-26, GJ212-27, GJ212-28, GJ212-29, GJ212-30, GJ212-31, GJ212-32, GJ212-33, GJ212-34, GJ212-35, GJ212-36, GJ212-37, GJ212-38, GJ212-39

METHOD BLANK: 98417

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Hardness (as CaCO3)	mg/L	<2.0	2.0	

LABORATORY CONTROL SAMPLE: 98418

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Hardness (as CaCO3)	mg/L	66	62	94	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98419 98420 Original: GJ212-30

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Hardness (as CaCO3)	mg/L	48	53	110	110	113	116	75-125	2.6	20	

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toll-free 800.733.5998
fax 231.773.6537

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Muskegon, MI 49444-2673
info@trace-labs.com
www.trace-labs.com

QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: META/8142
Analysis Method: SM18-2340 B
QC Batch Method: SM18-2340 B
Associated Lab Samples: GJ212-40

METHOD BLANK: 98421

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Hardness (as CaCO3)	mg/L	<2.0	2.0	

LABORATORY CONTROL SAMPLE: 98422

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Hardness (as CaCO3)	mg/L	66	58	87	80-120	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: META/8143 Analysis Method: SM18-2340 B

QC Batch Method: SM18-2340 B

Associated Lab Samples: GJ212-41 GJ212-42 GJ212-43 GJ212-44 GJ212-45 GJ212-46 GJ212-47

METHOD BLANK: 98427

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Hardness (as CaCO3)	mg/L	<2.0	2.0	

LABORATORY CONTROL SAMPLE: 98428

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Hardness (as CaCO3)	mg/L	66	57	85	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98423 98424 Original: GJ212-41

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Hardness (as CaCO3)	mg/L	81	53	140	140	108	112	75-125	3.6	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98425 98426 Original: GJ212-47

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Hardness (as CaCO3)	mg/L	84	53	140	140	108	105	75-125	2.8	20	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8330 Analysis Method: EPA 310.1

QC Batch Method: EPA 310.1

Associated Lab Samples: GJ212-09, GJ212-12, GJ212-13, GJ212-14, GJ212-15, GJ212-16, GJ212-17, GJ281-01, GJ281-02, GJ281-03, GJ296-01, GJ296-02, GJ296-03, GJ296-04, GJ296-05, GJ296-06, GJ296-07, GJ296-08

METHOD BLANK: 98596

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Alkalinity, Total	mg/L	<10	10	

LABORATORY CONTROL SAMPLE: 98597

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total	mg/L	94	98	104	90-122	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 98721 98722 Original: GJ212-09

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Alkalinity, Total	mg/L	86	94	180	180	99	94	78-130	5.2	24	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8368 Analysis Method: EPA 310.1

QC Batch Method: EPA 310.1

Associated Lab Samples: GJ212-18, GJ212-19, GJ212-20, GJ212-21, GJ212-22, GJ212-23, GJ212-24, GJ212-25, GJ212-26, GJ212-27, GJ212-28, GJ212-29, GJ212-30, GJ212-31, GJ212-32, GJ212-33, GJ212-34, GJ212-35

METHOD BLANK: 99161

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Alkalinity, Total	mg/L	<10	10	

LABORATORY CONTROL SAMPLE: 99162

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total	mg/L	94	94	99	90-122	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 99222 99223 Original: GJ212-30

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Alkalinity, Total	mg/L	47	94	150	140	109	97	78-130	12	24	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8382 Analysis Method: EPA 310.1

QC Batch Method: EPA 310.1

Associated Lab Samples: GJ212-36 GJ212-37 GJ212-38 GJ212-39 GJ212-40 GJ212-41

METHOD BLANK: 99263

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Alkalinity, Total	mg/L	<10	10	

LABORATORY CONTROL SAMPLE: 99264

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total	mg/L	94	96	102	90-122	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 99278 99279 Original: GJ212-41

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Alkalinity, Total	mg/L	47	94	140	140	98	98	78-130	0	24	

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QUALITY CONTROL DATA

Trace Project ID: GJ212
Client Project ID: DULUTH CORROSION / 9201-044

QC Batch: WETC/8406 Analysis Method: EPA 310.1

QC Batch Method: EPA 310.1

Associated Lab Samples: GJ212-42 GJ212-43 GJ212-44 GJ212-45 GJ212-46 GJ212-47 GK098-01 GK100-01

METHOD BLANK: 99464

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Alkalinity, Total	mg/L	<10	10	

LABORATORY CONTROL SAMPLE: 99465

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total	mg/L	94	95	101	90-122	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 99466 99467 Original: GJ212-47

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Alkalinity, Total	mg/L	93	94	180	180	95	94	78-130	1.1	24	

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Appendix E. AMI Corrosion Investigation Report

USACE CORROSION INVESTIGATION REPORT

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USACE CORROSION INVESTIGATION REPORT

AMI #061036 DATE: AUG/SEPT, 2006

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Project

The Freshwater Corrosion in the Duluth / Superior Harbor project was initiated to further investigate the findings as published by a panel of experts in the ERDC/CERL SR-05-3 publication dated March 2005. The panel made recommendations on future testing necessary to narrow down the list of possible causes and to determine the full extent of the process around the entire harbor. The purpose of these underwater corrosion inspections was to investigate and document the corrosion on a wide variety of federal sheet pile structures throughout the harbor to determine the extent of the current corrosion on the existing sheet pile by the use of visual inspections and non destructive testing.

Scope of Work

The services required to complete the full investigation of the Duluth-Superior Harbor corrosion study for the federal structures included underwater visual engineering inspection, non destructive testing and complete documentation. All data was collected and reported in a manner consistent with the needs of the study being undertaken by the Army Corps of Engineers. From the plates provided in the scope of work, all of the USACE inspection points were located in the lower harbor region from the Bong Bridge to each harbor entry. The harbor entry work on both the Superior and Duluth side required very precise timing and coordination because of the significant boating activity in these areas and the abrupt change in weather affecting the sites.

AMI Consulting Engineers utilized our 22 foot Hewes Craft pilot house dive boat with a 200HP Honda motor and a surface supplied dive spread. The diver's surface supplied air was provided from a high pressure bank system to the diver's helmet. The primary helmet was a SL-27 with a band mask standby system. Bailout bottles were required for all dives. The diver's visuals inspections were documented utilizing an Outland color camera and light. This system was connected to a computer system capable of collecting and backing up all video data colleted. The non-destructive testing equipment utilized for the project was a Dakota Ultrasonics MX3 system with an underwater housing and transducer. The system was calibrated with a certified calibration step block, 4340 FE SN#06-1200, before every use to insure accuracy of the measurements. Our standard dive forms were utilized to collect the general data and then transferred to the USACE electronic forms as shown in the original scope of work.

AMI Consulting Engineers provided the following scope of services as directed by Altech Environmental Services and the local USACE representative, John Larson, during our pre-inspection meeting.

The basic scope of services finalized was as follows:

- Attend a meeting to organize investigation and set protocols with local USACE and other federal regulatory agencies.

- Prepare and submit dive plan policy and procedures, emergency action assessment and safety plan to USACE for formal approval before starting dive activities.

- Submit through formal channels a request for access to USCG structures and acquire written approval before proceeding with investigations.
- Prepare all pre/ post dive and field collection forms.
- Provide all dive equipment, cleaning equipment, digital video camera equipment, GPS and Non destructive testing equipment.
- Provide a four man dive team meeting all government and USACE regulations (EM385-1-1) and other local standards for commercial diving.
- Provide space and coordination for local USACE representative to monitor all activity.
- Properly mark above the waterline a permanent reference mark to IGLD with a grinder and record GPS location data in Latitude/Longitude format.
- Perform selected underwater inspections on all approved steel federal structure locations.
- Document conditions with digital video system and include marine growth notes, overall plate thickness measurements, 4 pit depth readings, 4 diameter readings and concentrations per elevation as shown on the USACE plates.

All schedules, modifications, collection methods and dive procedures were finalized with the local USACE representatives Mr. John Larson and Mr. Edward Parzych prior to starting the project. Mr. Edward Parzych was on site at all times monitoring our activity on behalf of the USACE. Local coordination with the USCG was done on a daily basis to provide notice to mariners and to insure the safety of the port structures.

Field Data Collection

The field collection of all data was conducted between the dates of August 17th 2006 and September 1, 2006. The project started with the inspections at the Superior Entry and ended at the Duluth Entry. To provide proper time management and minimize down times, the USCG beacons, Erie pier and the USACE vessel yard were inspected when inclement weather and shipping traffic did not allow us to work in the Duluth Entry.

Plate 2

The data collection locations for the Duluth Entry Structures DE1o, DE1i, DE2o, DE2i, SE3o, DE3i, DE4o, DE4i, DE5o, DE5i, DE6o, DE6i, DE7o, DE7i, DE8o, DE8i, DE9o, DE9i, DE10o and DE10i were collected as planned.

Many delays occurred due to shipping activity throughout the project. Although we used all possible means to make the boating community aware of our presence while working in the channel, we were often ignored by the local boating community. They had a lack of concern or understanding of our activity and the fact that the large wakes from their boats slam a moored vessel into the channel walls repetitively. Eventually the Coast Guard had to be notified to track down some gross offenders to educate them on what the dive flags, yellow strobes and notice to mariners actually mean. Eventually the normal daily traffic began to slow down and it made our activities much easier. At all

times, AMI was notified by the USACE and left the interior of the entry during the passing of all large cargo ships and research vessels. We attempted to work around the known schedule, but had to evacuate the channel seven times throughout the inspection process.

The last four sites along the South side of the Duluth entry provide some difficulty due to the change in the local weather pushing heavy rollers through the interior of the entry. Additionally, heavy weather wind days caused significant current to flow through the entry also providing difficult dive situations. These weather delays prevented us from performing inspections safely and caused a number of weather day delays to occur. We made every attempt to complete the project in a timely manner by working at the other sites as much as possible during the weather delays.

Plate 3

The data collection locations for the Vessel Yard Structure VY1o, VY1i, VY2o and VY2i were collected as planned with very little delay. On the day of collection, the local USACE allowed a local television network to come into the yard area and observe the corrosion inspection process for public interest reporting.

Plate 4

The data collection locations for the Erie Pier Structure EP1o and EP2o were collected as planned with very little delay.

Plate 5

The data collection locations for the Coast Guard 1 Structures CGA1o and CGC1o were collected as planned with very little delay. Some current was present on the CGA1o structure due to the high winds on the day of inspection, but did not cause any significant delays.

Plate 6

The data collection locations for the Coast Guard 2 Structure CGB10 and CGB2o were found to be in error during the first dive at the CGB1o location. It was found that this structure as shown on the plate was all wood timber construction. Edward Parzych researched the error and directed the team to another circular Coast Guard Structure to the East of the one shown on Plate 7. Edward Parzych made the decision to only take one measurement at this new location due to the type of structure and do we matched the same sampling requirements as set forth on the other circular USCG structure locations. The structure was inspected on the West side as directed.

Plate 7

The data collection locations for the Superior Entry structures SE1o, SE2o, SE7o, SE7i, SE8o, SE8, SE9o, Se10o and SE10i were collected as planned and with very little delay. No steel was present at the data collection locations specified to be at SE3o, SE3i, SE4o, SE5o, SE6o and SE6i. Subsequently no data was collected.

Some difficulty was encountered in collecting data on the ice plate surface at SE1o and SE2o due to the currents exiting the channel and the amount of crib extending out

beyond the edge of the upper concrete entry piers preventing the boat from being tight up against the pier during the inspections. Other delays due to one large vessel coming through the channel and numerous charter boats ignoring the dive flags and strobe lights led to us calling the USCG to slow the charter boats down when we were present in the channel.

Plate 8

Data was collected according to plate 8 as presented in the final revision with the exception of the scribing as shown on plate 8. To save cost it was agreed by the Detroit and Local USACE offices to only mark the reference location mark above the water line. It was also found that during the collection of the data, a four inch square frame would not fit on the in pan of the flanges on the structures. Instead the six inch by six inch data frame was utilized to frame out the area of inspection and then the diver used that area to collect the data for all structures. Space in the in pans was limited, but all data was collected and documented on the non federal form and transferred to the USACE standard form for final presentation.

General Assessment of Data

In general the data collected was consistent with the structures that had been previously inspected in the other areas of the harbor. It's important to note that previously measured corrosion in other investigations researched was always reported from the current waterline or from the top of dock, not IGLD, which is the zero depth and reference for this study. With the water levels being much lower than what has been seen over the past years, the excessive pitting noted in the past is closer to the surface. This is very evident when you look at the high water marks on the structures around the harbor. Additionally the muscle population was thriving and present up higher on the sheet pile structures this year due to the mild ice season during the past winter.

The general conditions seen at most sites within the harbor are as follows:

0 to 0.5 feet below IGLD	Generally full material thickness remains with a low level of pitting.
0.5 to 3 feet below IGLD	Overall material thickness loss. High concentration and very deep ice cream scoop type pitting present.
4 to 10 feet below IGLD	Overall material thickness loss. High concentration with a transition from deep to shallow pitting. Large pitted areas tend to have numerous small 1/16 to 1/8 inch diameter pits within the large pitted area.
10 to 32 feet below IGLD	Minor material thickness loss, high to Moderate concentration but tends to reflect more of an overall etched surface than actual pitting. In most areas the mill scale has been removed only and a very low concentration of actual deep pits existed.

It has been found in this federal study that the major differences in the degree of corrosion and type occurred as we inspected closer to the Duluth entry and through the channels towards the lake water.

Below is a summary of the notable items beyond the general conditions on the different structures:

Coast Guard Structures – The Coast Guard structures were constructed with a 3/8" thick flat sheet piling. The circular cells were not coated originally and have significant overall corrosion and deep pitting from the IGLD mark down to -4 feet IGLD. The cells are currently perforated completely at the -1 to -2 feet IGLD. The diver could easily peel and twist off sections of the remaining steel from the cell with his hands. The interior of the cell which was visible at the time of inspection was filled with concrete.

USACE Vessel Yard – The Vessel yard sheet piling was very typical in nature, but due to the shallow area, a lot more silt and algae was present due to the somewhat stagnant nature of the slip.

Duluth Entry – The Duluth entry had typical corrosion characteristics for the DE5 and DE6 locations, but the degree of corrosion (penetration) was much less than other locations around the harbor. Locations DE1 to DE4 and DE7 to DE10 had significantly less corrosion concentration and penetration of pitting. Although corrosion was still present through the typical heavy zone of corrosion, we found a heavier layer of rust scale over the surface that was very tough to remove. The typically seen orange nodules were present covering the surface but the degree of active coverage dropped off as we inspected towards the lake through the channel. The muscle population became almost non existent somewhere in the middle third of the channel. A few stray pieces were found out toward the lake end of the channel. Another phenomenon that was witnessed was the abrupt wall that forms in the water between the lake water and harbor water in the middle third of the channel on calm days. Within two feet, the water can go from murky to clear on days with very little flow through the channel. This may have some correlation with the muscle ending in the same area.

Superior Entry – The superior entry had typical corrosion characteristics throughout the entry. The outer most ice plates at SE1o and SE2o were heavily corroded with pitting penetrations in excess of .4 inches. The connections holding the plates in place were heavily deteriorated. Although the pitting penetration on SE7 to SE10 was not as significant as the ice plates, considering the short exposure of the new steel, it has seen a much accelerated level. Orange nodules coverage was over 50% of the sheet pile surfaces on the newly installed sheet pile.

Summary

Throughout the inspections, the typical conditions existed on the majority of the structures within the harbor confines. The major changes were noticed during the corrosion inspections of the Duluth channel entry. It appears from our inspections that the level of corrosion drops significantly as we head towards the lake through the channel. The superior entry corrosion was very consistent with the rest of the harbor even out near the lake end. Typical penetration of the pitting within the harbor in the 0 to 4 feet IGLD water level on all the USCG range cells was more than 3/8 of and inch and the structures were perforated. The accelerated corrosion problem became very evident in looking at the new steel just installed a few months ago on the superior entry, with orange nodules coverage over 50% of the sheet pile surfaces.

Photo Index-
Click on individual location to see photos.

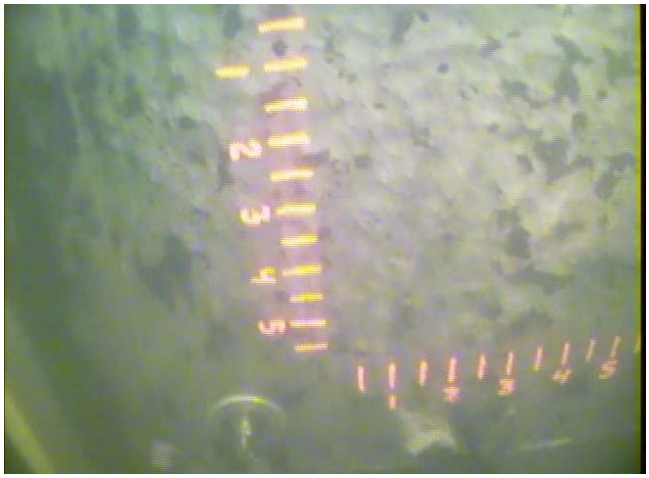
Duluth Entry
- DE1
- DE2
- DE3
- DE4
- DE5
- DE6
- DE7
- DE8
- DE9
- DE10

Army Corps Vessel Yard
- VY1
- VY2

Erie Pier
- EP1
- EP2

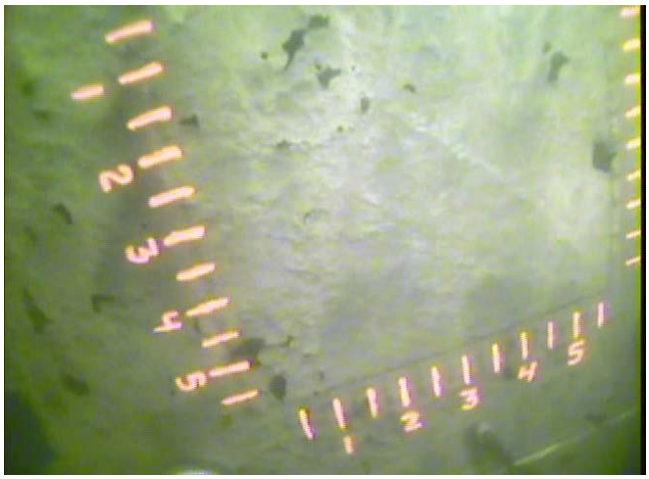
USCG Structures
- CGA1
- CGC1
- Alt Cell

Superior Entry
- SE1
- SE2
- SE7
- SE8
- SE9
- SE10

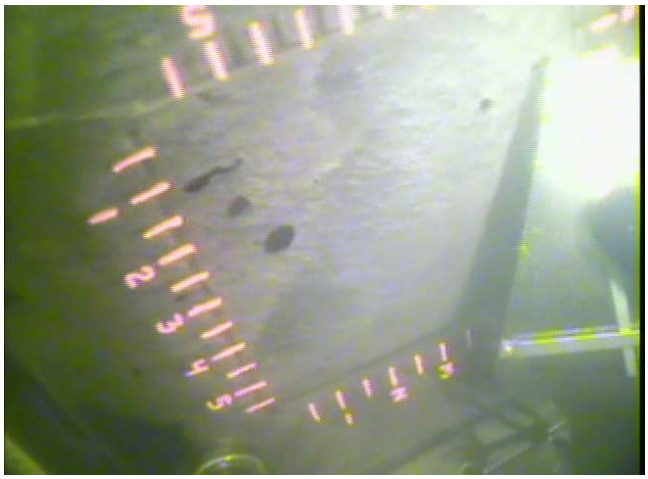


CGA1(0ft).jpg

CGA1(2ft).jpg



CGA1(4ft).jpg



CGA1(6ft).jpg

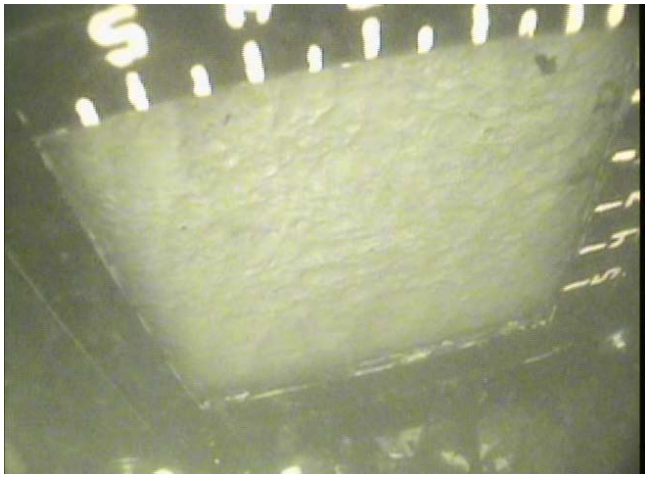
CGA1(8ft).jpg

CGalt(0ft).jpg

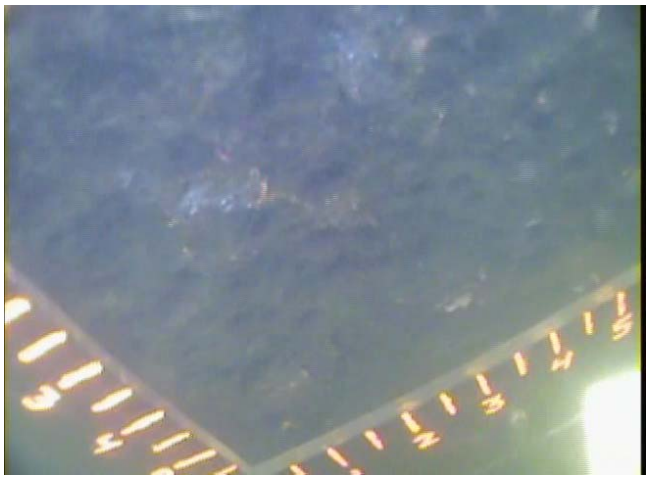
CGalt(0ftcu).jpg

CGalt(2ft).jpg

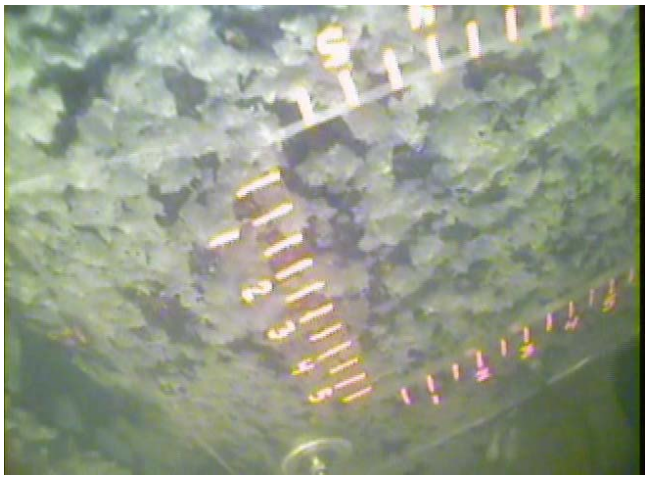
CGalt(4ft).jpg



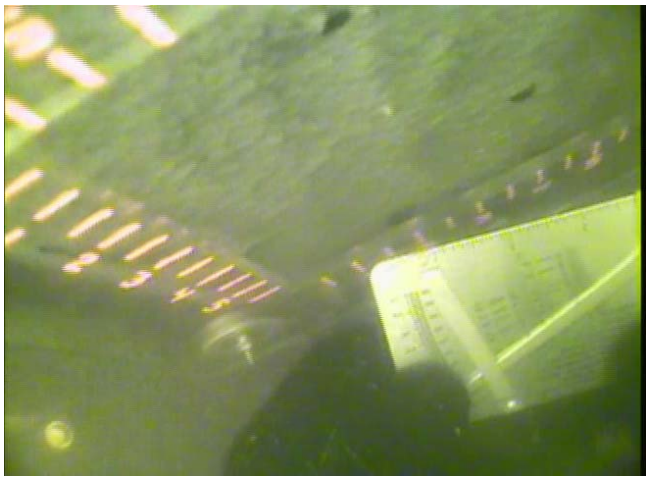
CGalt(6ft).jpg



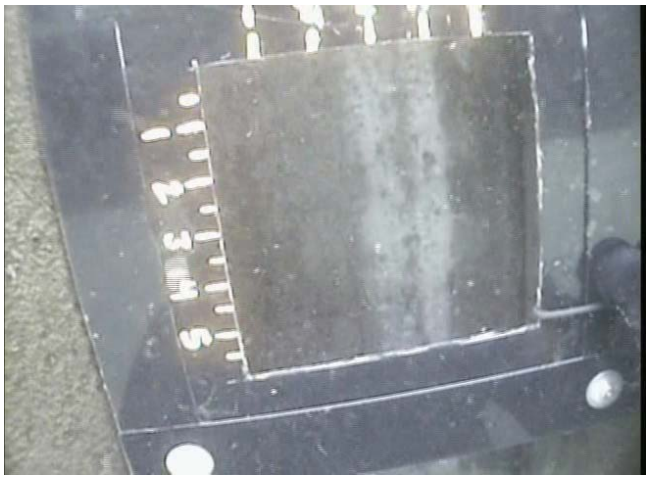
CGC1(0ft).jpg



CGC1(2ft).jpg



CGC1(4ft).jpg



DE1i(0ft).jpg

DE1i(2ft).jpg

DE1i(4ft).jpg

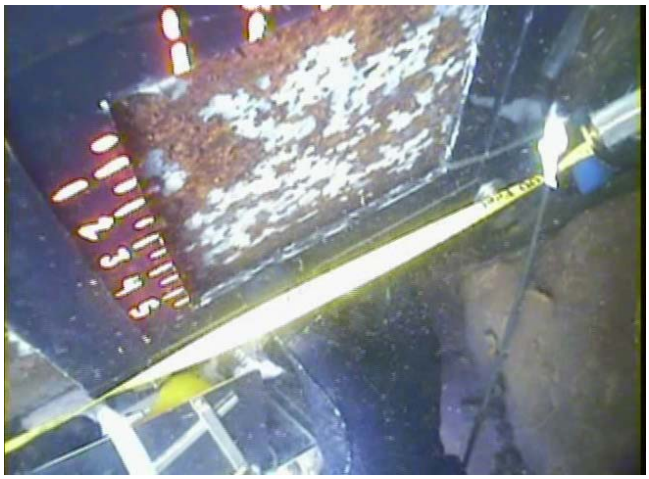
DE1i(6ft).jpg

DE1i(8ft).jpg

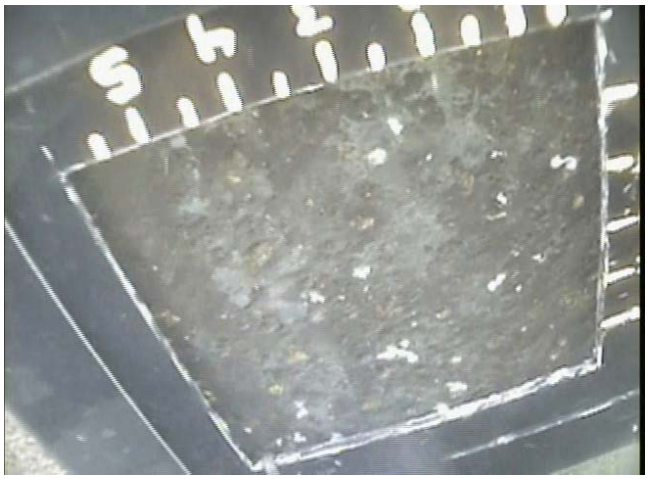
DE1o(0ft).jpg

DE1o(10ft).jpg

DE1o(15ft).jpg



DE1o(20ft).jpg

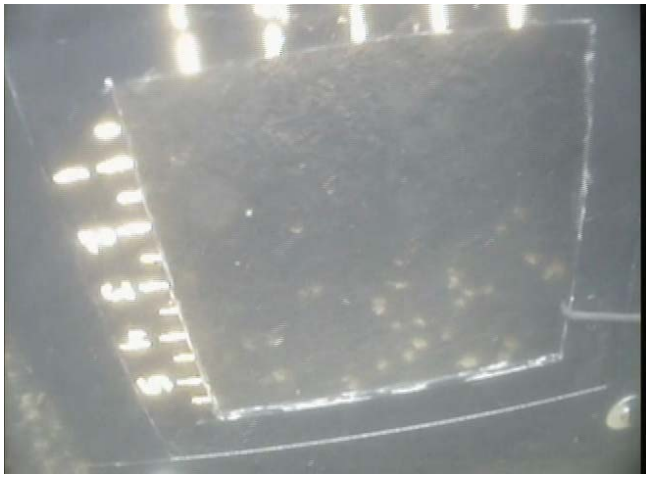


DE1o(2ft).jpg

DE1o(4ft).jpg

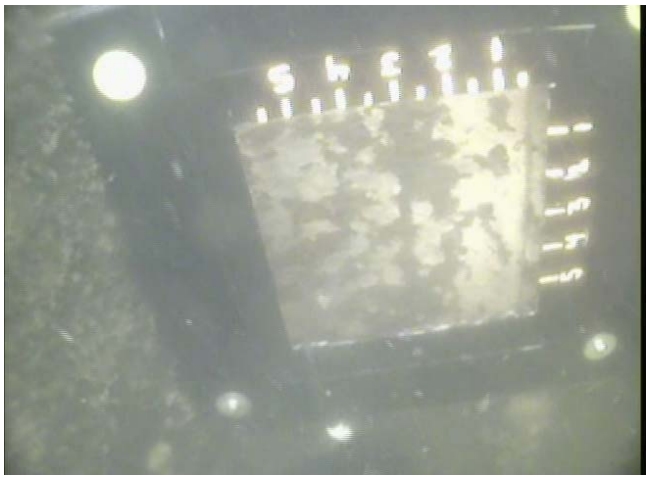
DE1o(6ft).jpg

DE1o(8ft).jpg



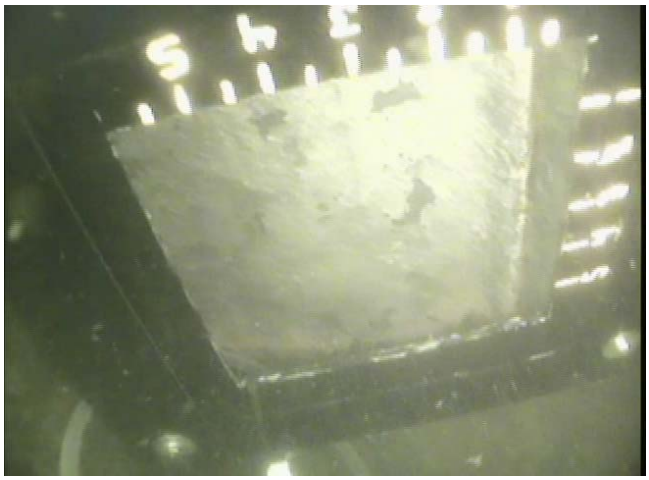
DE2i(0ft).jpg

DE2i(2ft).jpg

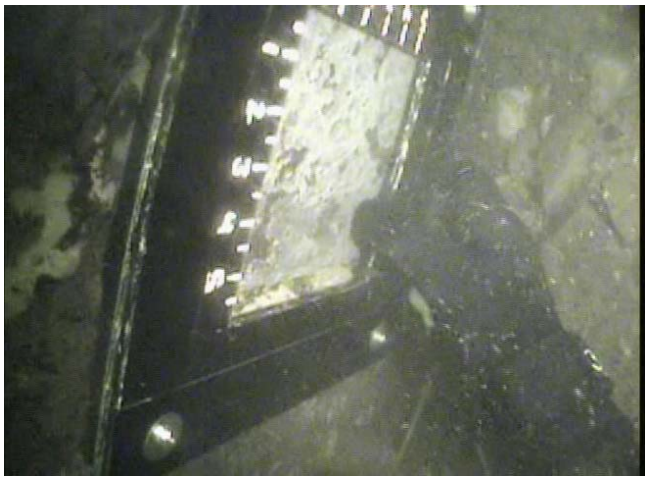


DE2i(4ft).jpg

DE2i(6ft).jpg

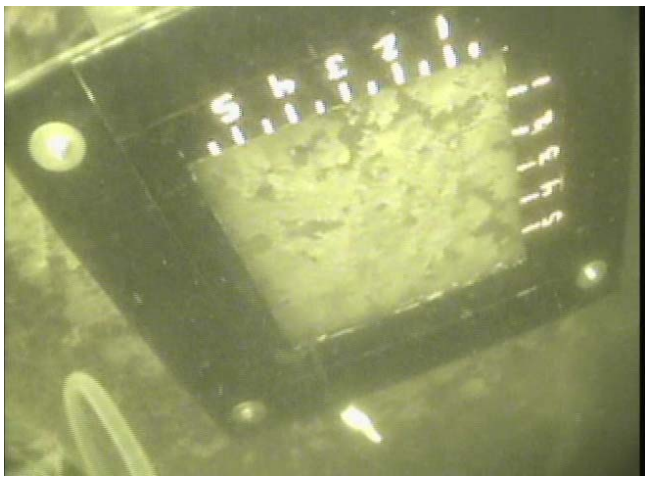


DE2i(8ft).jpg



DE2o(ml).jpg

DE2o(0ft).jpg



DE2o(10ft).jpg

DE2o(15ft).jpg

DE2o(20ft).jpg

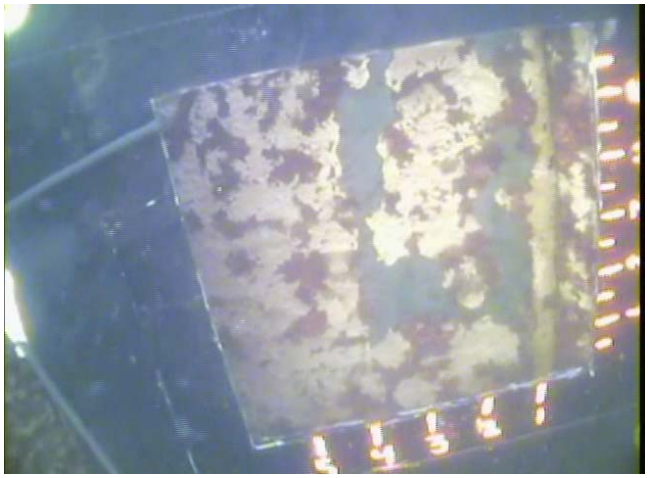
DE2o(2ft).jpg

DE2o(4ft).jpg

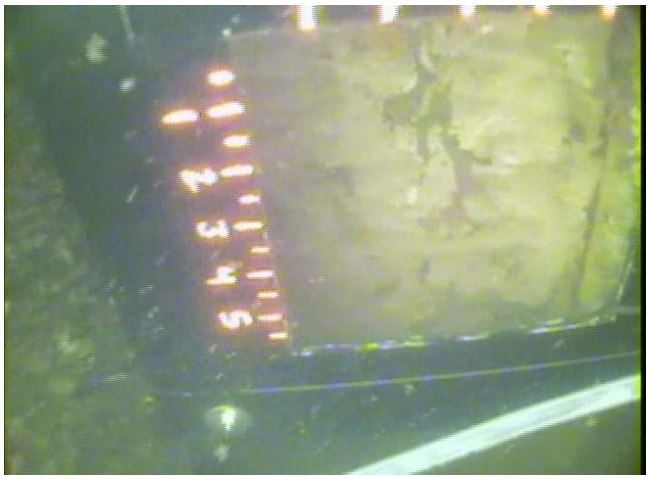
DE2o(6ft).jpg

DE2o(8ft).jpg

DE3i(0ft).jpg

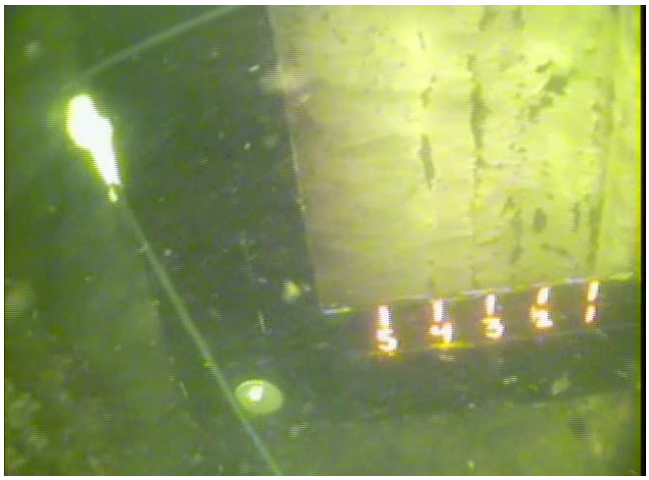


DE3i(2ft).jpg



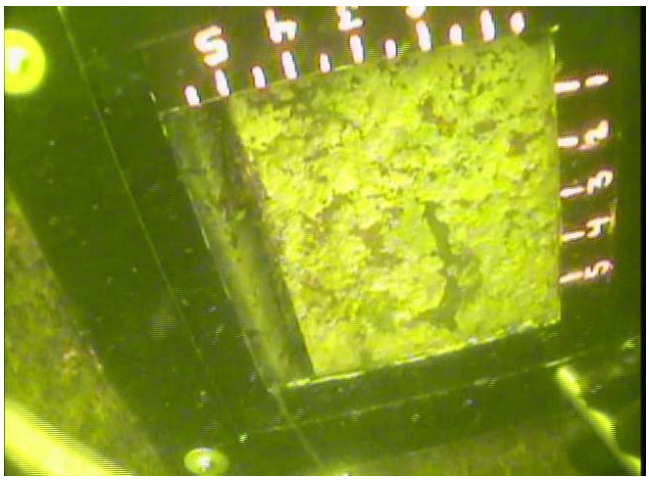
DE3i(4ft).jpg

DE3i(6ft).jpg

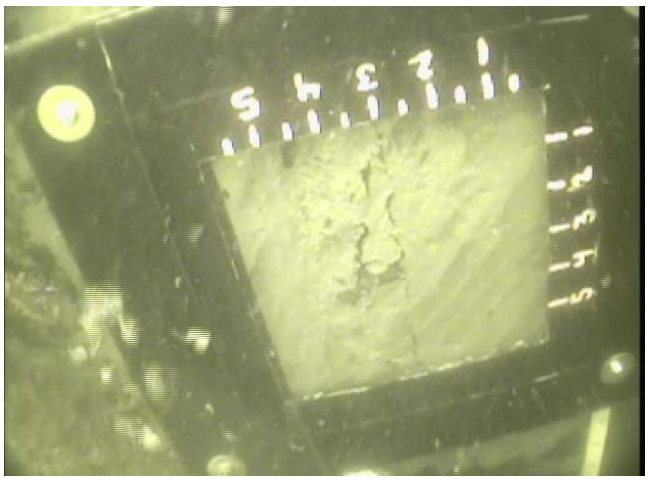


DE3i(8ft).jpg

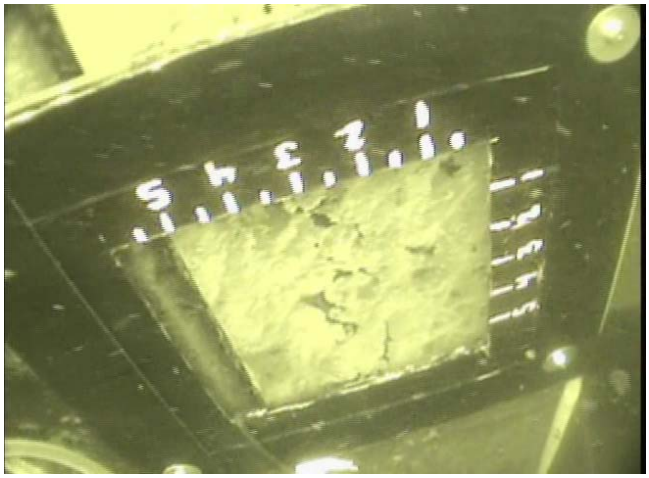
DE3o(0ft).jpg



DE3o(10ft).jpg



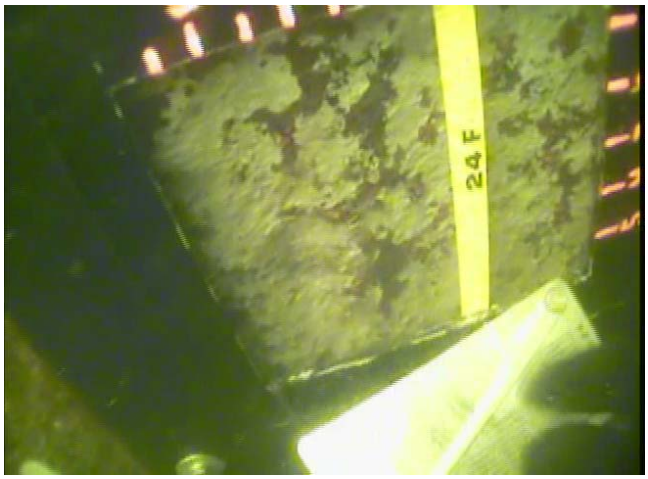
DE3o(15ft).jpg



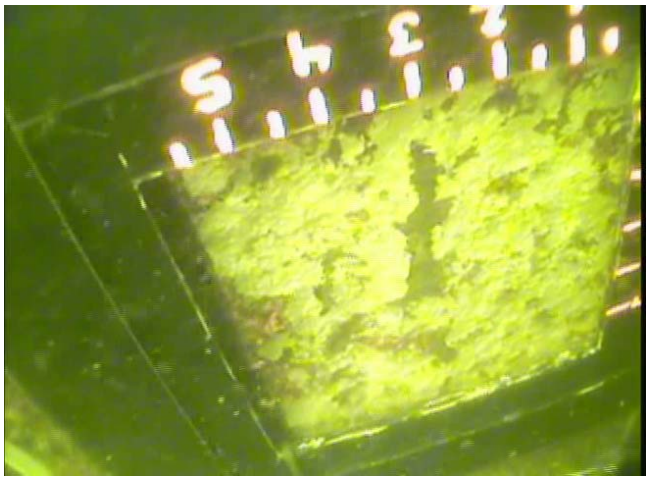
DE3o(20ft).jpg

DE3o(2ft).jpg

DE3o(4ft).jpg



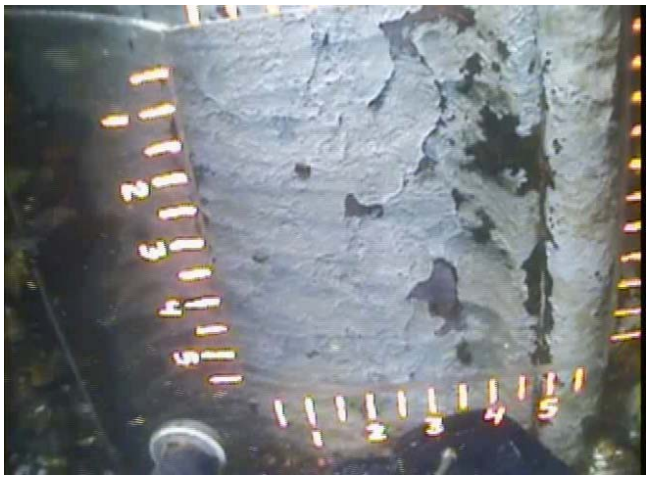
DE3o(6ft).jpg



DE3o(8ft).jpg

DE4i(0ft).jpg

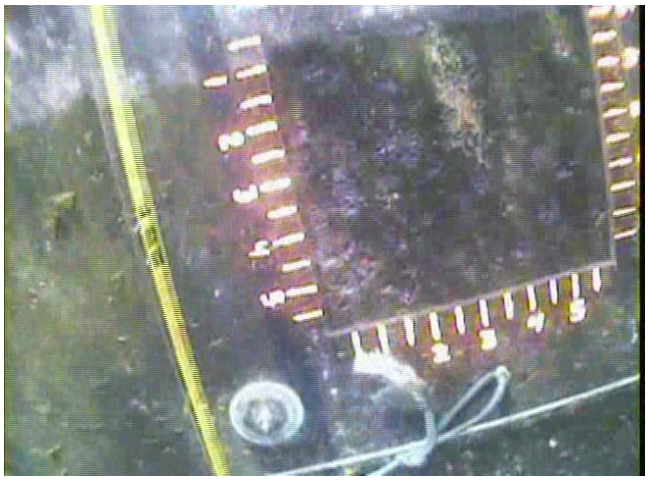
DE4i(2ft).jpg



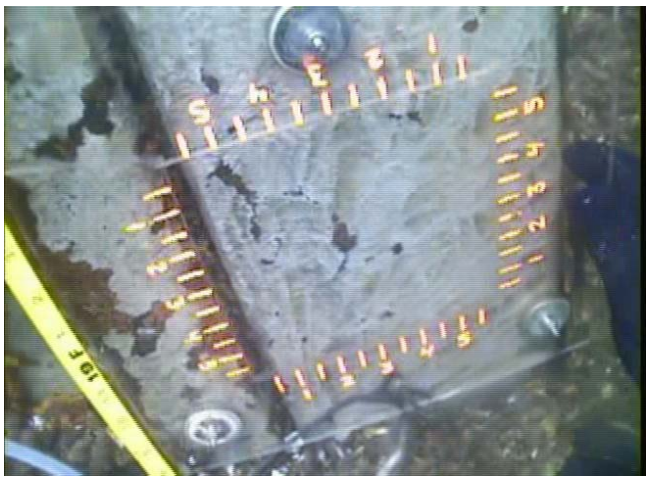
DE4i(4ft).jpg

DE4i(6ft).jpg

DE4i(8ft).jpg



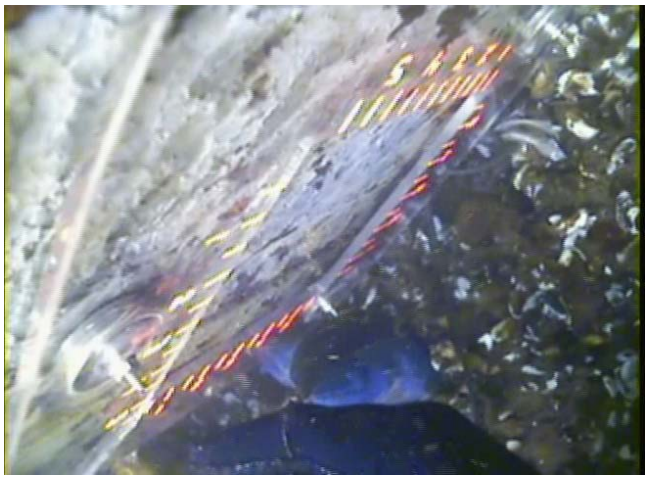
DE4o(0ft).jpg



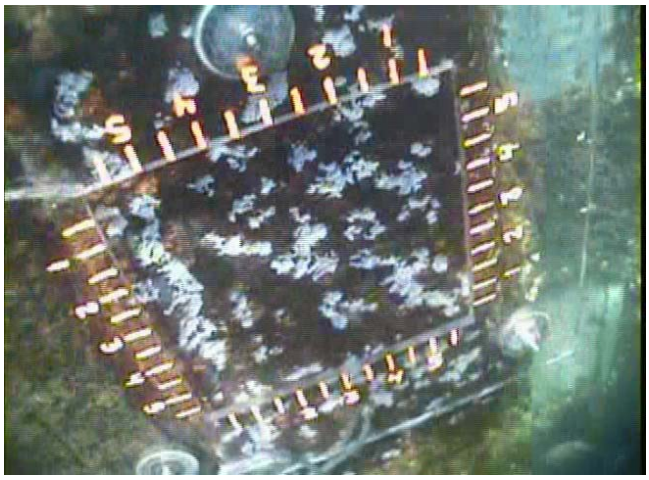
DE4o(10ft).jpg

DE4o(15ft).jpg

DE4o(20ft).jpg

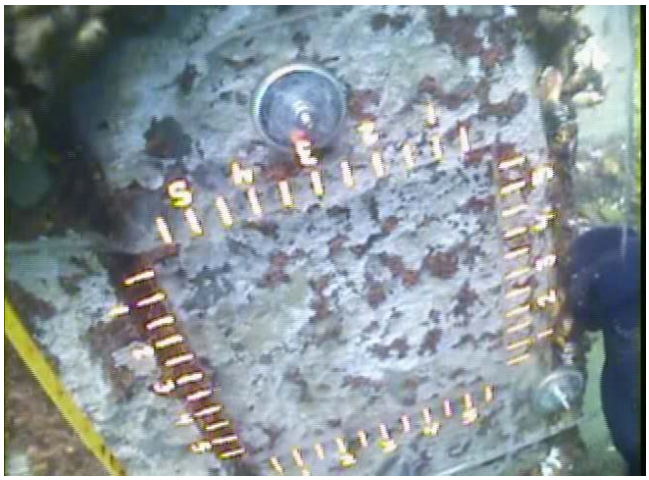


DE4o(29ft ml).jpg



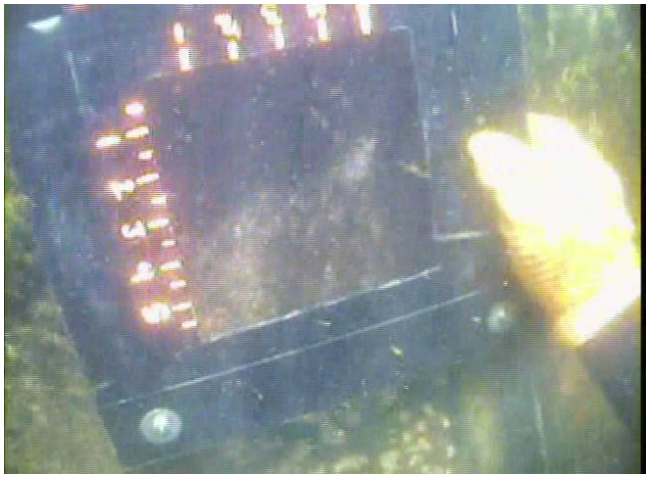
DE4o(2ft).jpg

DE4o(4ft).jpg



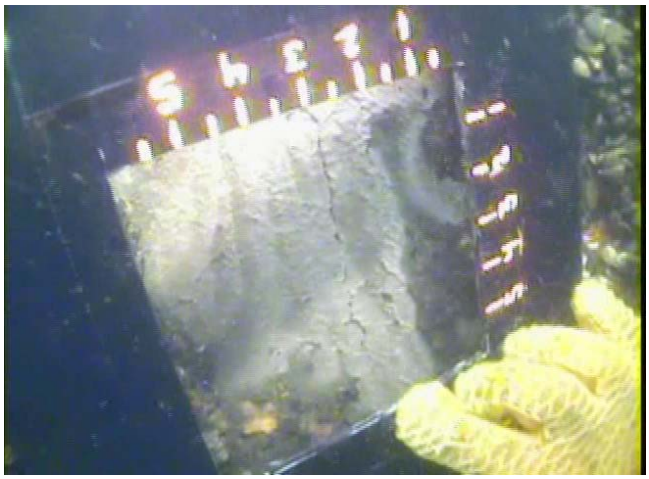
DE4o(6ft).jpg

DE4o(8ft).jpg

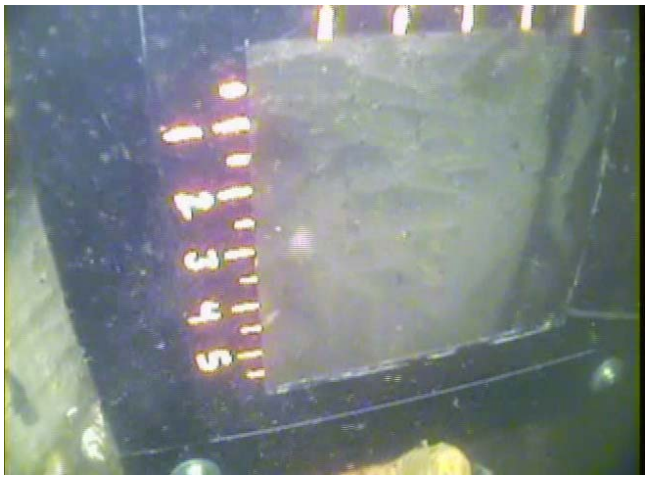


DE5i(0ft).jpg

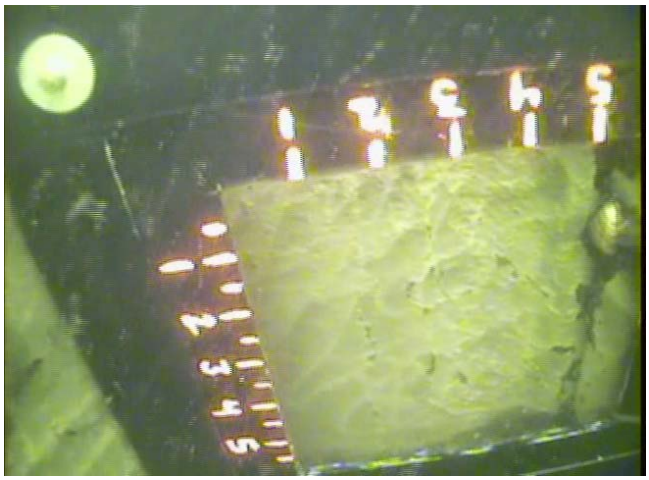
DE5i(2ft).jpg



DE5i(4ft).jpg



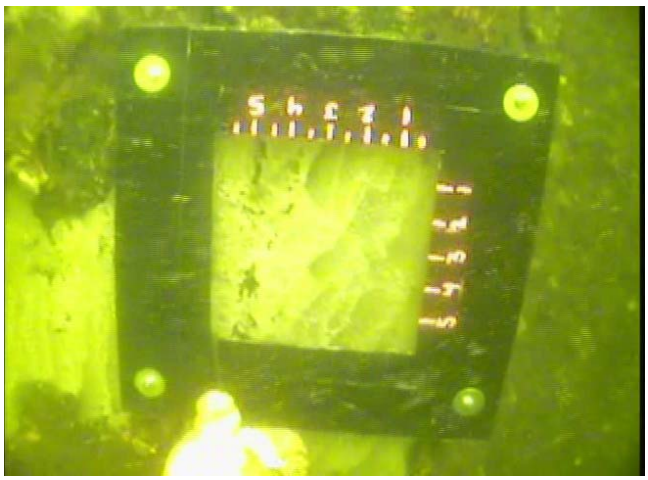
DE5i(6ft).jpg



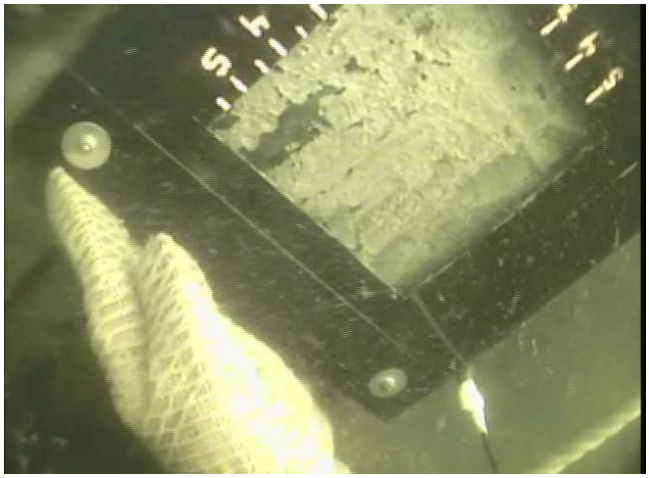
DE5i(8ft).jpg

DE5o(0ft).jpg

DE5o(10ft).jpg



DE5o(15ft).jpg

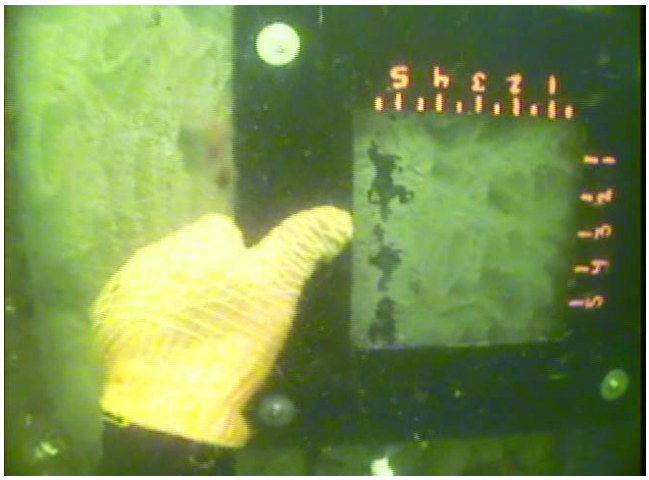


DE5o(20ft ml).jpg

DE5o(2ft).jpg

DE5o(4ft).jpg

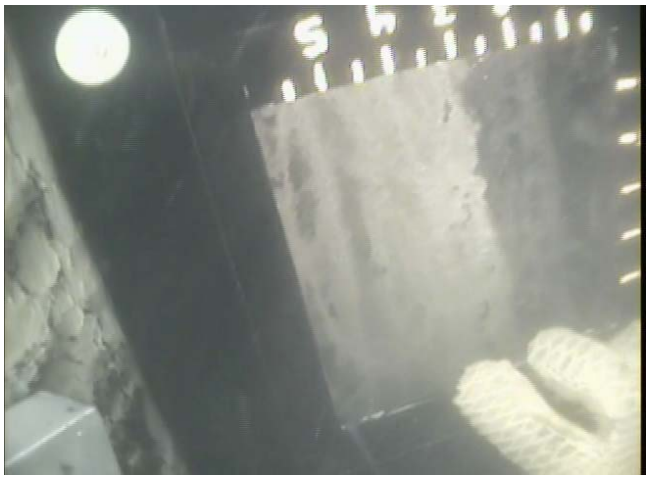
DE5o(6ft).jpg



DE5o(8ft).jpg

DE6i(2ft).jpg

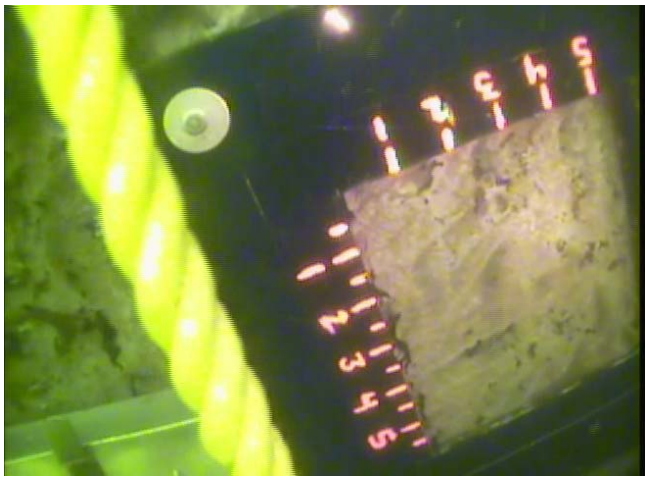
DE6i(4ft).jpg



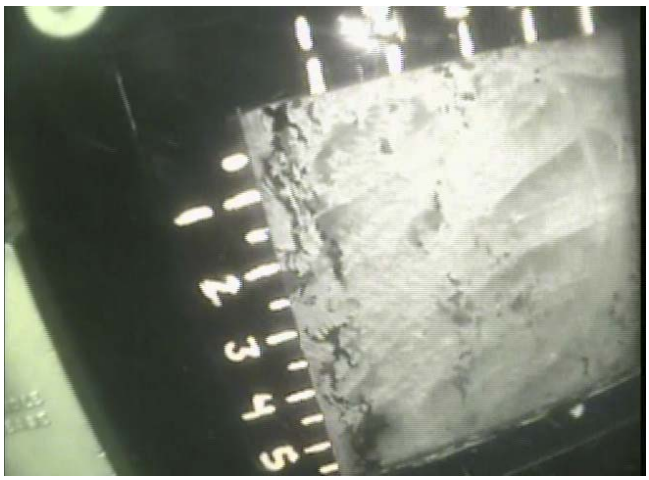
DE6i(6ft).jpg

DE6i(8ft).jpg

DE6o(0ft).jpg



DE6o(10ft).jpg



DE6o(15ft).jpg

DE6o(20ft).jpg

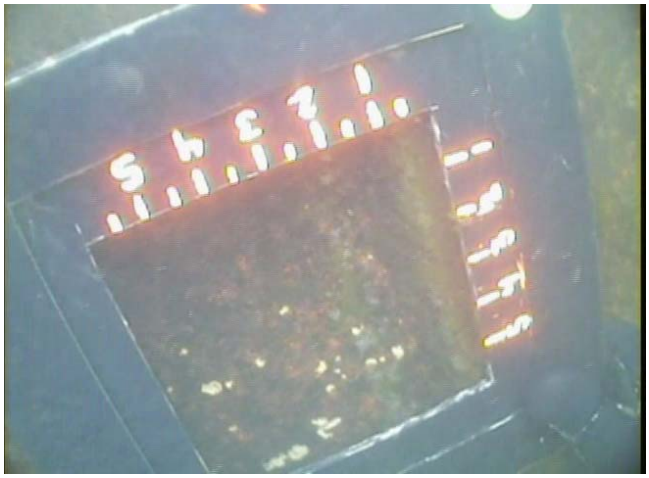
DE6o(2ft).jpg

DE6o(4ft).jpg

DE6o(6ft).jpg

DE6o(8ft).jpg

DE6o(ml).jpg



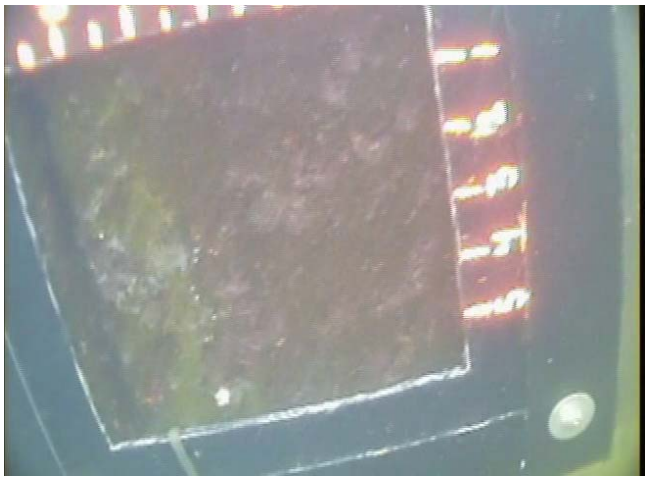
DE7i(0ft).jpg

DE7i(2ft).jpg

DE7i(4ft).jpg

DE7i(6ft).jpg

DE7i(8ft).jpg



DE7o(0ft).jpg

DE7o(10ft).jpg

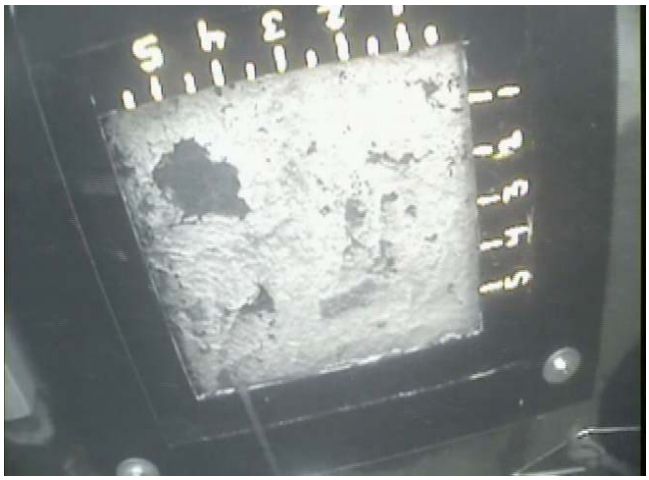
DE7o(15ft).jpg

DE7o(20ft).jpg

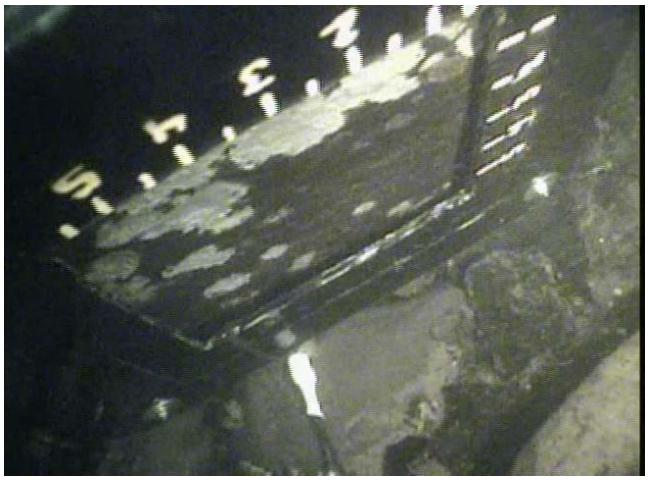
DE7o(2ft).jpg

DE7o(4ft).jpg

DE7o(6ft).jpg



DE7o(8ft).jpg



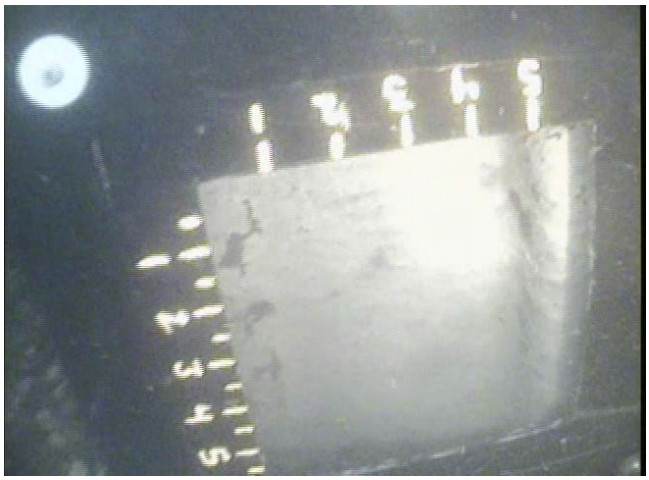
DE7o(ml).jpg

DE8i(0ft).jpg

DE8i(2ft).jpg

DE8i(4ft).jpg

DE8i(6ft).jpg



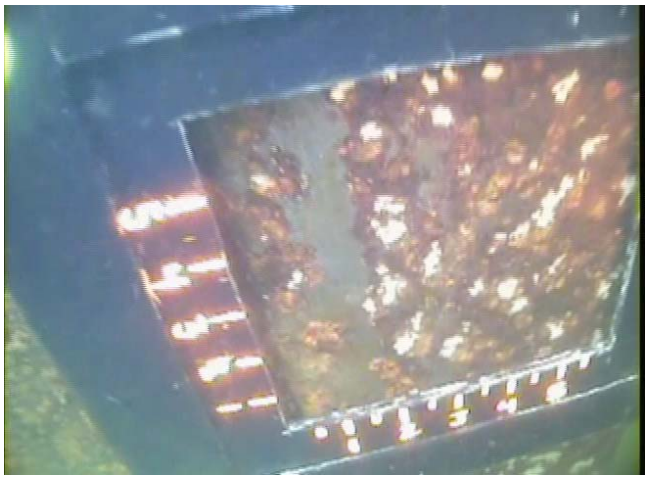
DE8i(8ft).jpg

DE8o(0ft).jpg

DE8o(10ft).jpg

DE8o(15ft).jpg

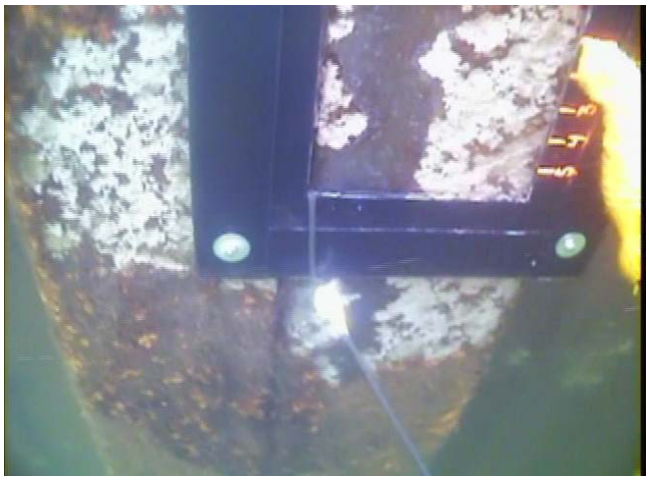
DE8o(20ft).jpg



DE8o(2ft).jpg

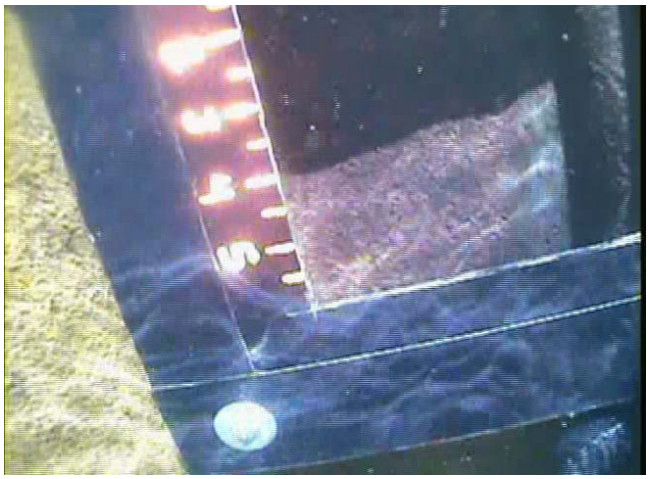
DE8o(4ft).jpg

DE8o(6ft).jpg



DE8o(8ft).jpg

DE8o(ml).jpg



DE9i(0ft).jpg

DE9i(2ft).jpg

DE9i(4ft).jpg

DE9i(6ft).jpg

DE9i(8ft).jpg

DE9o(0ft).jpg

DE9o(10ft).jpg

DE9o(2ft).jpg

DE9o(4ft).jpg

DE9o(6ft).jpg

DE9o(8ft).jpg

DE10i(2ft).jpg

DE10i(4ft).jpg

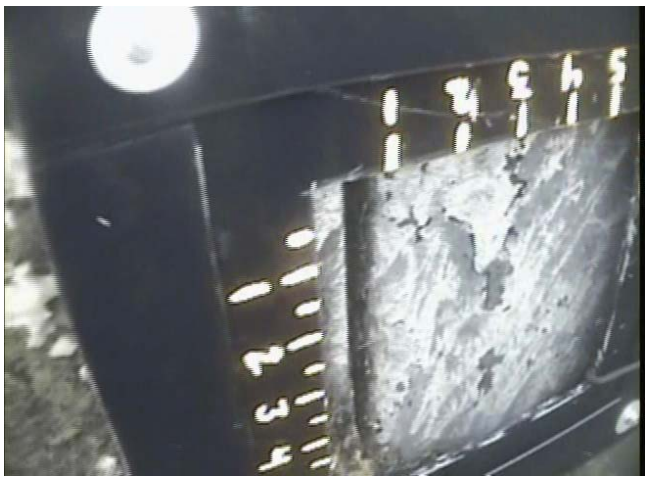
DE10i(6ft).jpg

DE10i(8ft).jpg

DE10o(0ft).jpg

DE10o(10ft).jpg

DE10o(15ft).jpg



DE10o(20ft).jpg

DE10o(2ft).jpg

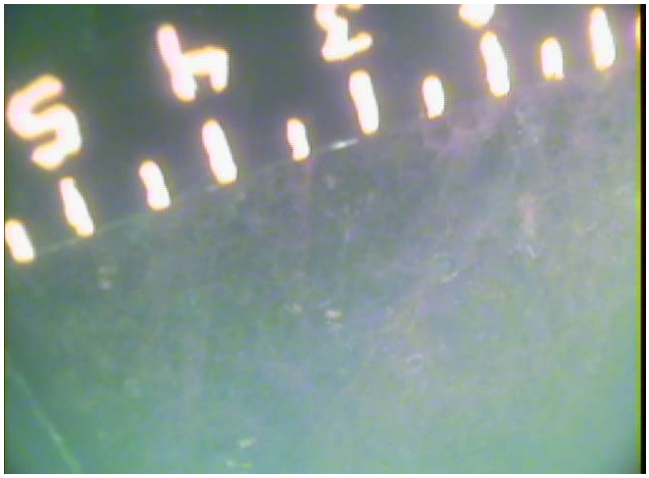
DE10o(2ft)b.jpg

DE10o(4ft).jpg

DE10o(6ft).jpg

DE10o(8ft).jpg

DE10o(ml).jpg

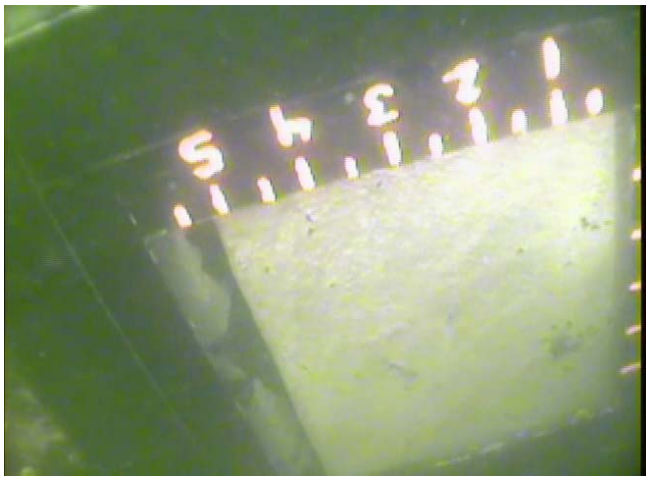


EP1(0ft).jpg

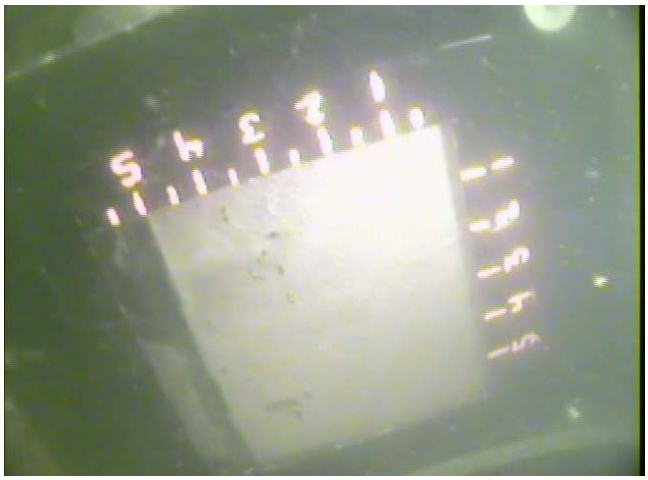
EP1(10ft).jpg

EP1(13ft ml).jpg

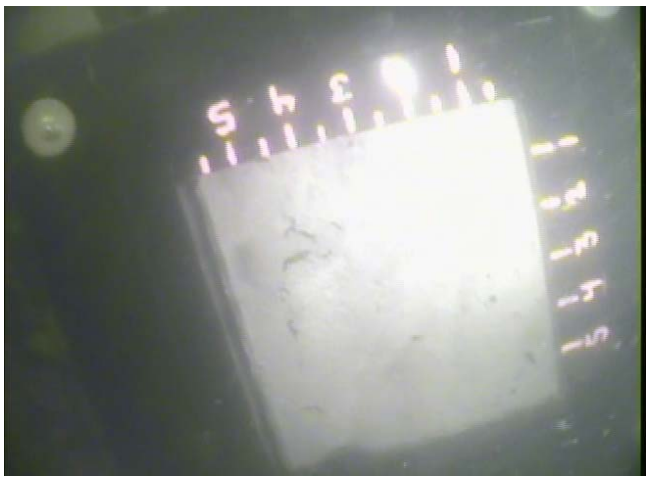
EP1(2ft).jpg



EP1(4ft).jpg

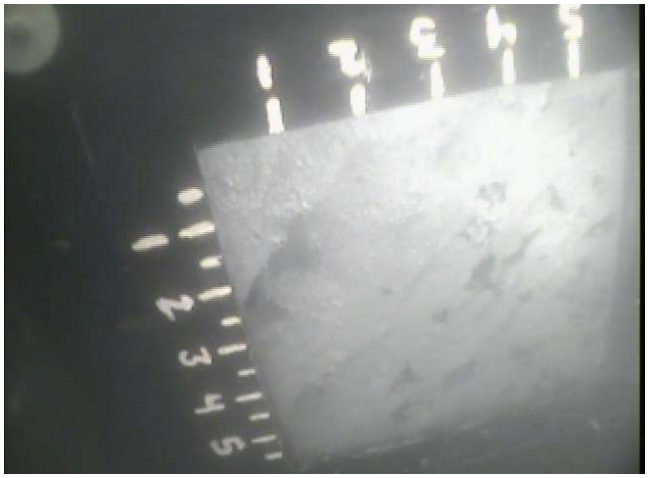


EP1(6ft).jpg

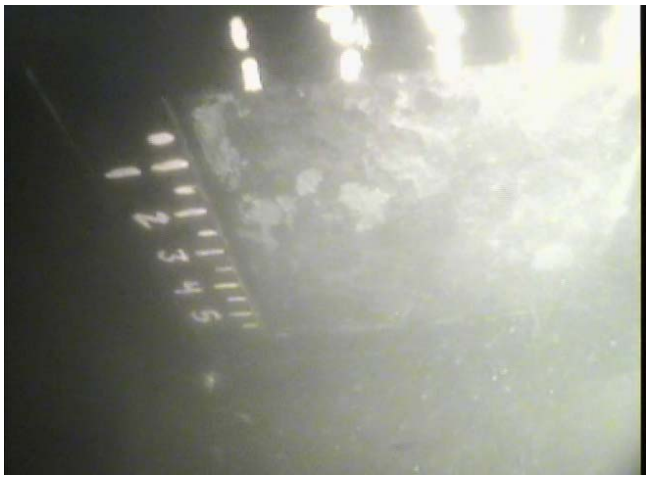


EP1(8ft).jpg

EP2(0ft).jpg

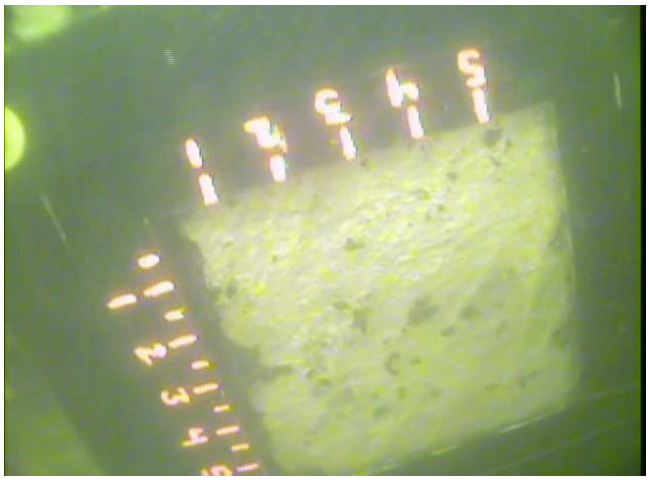


EP2(10ft).jpg

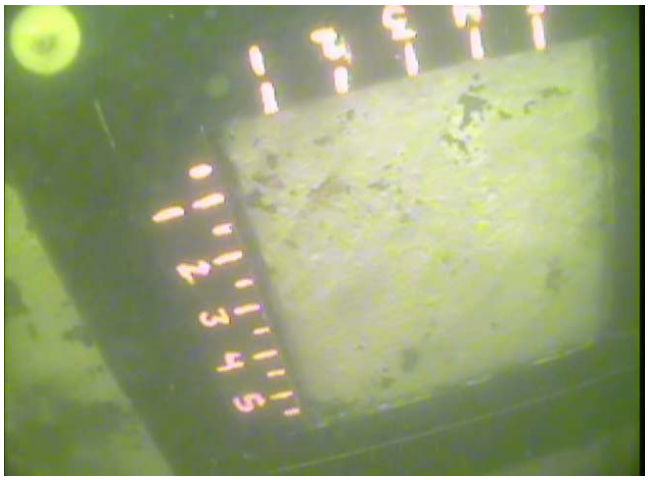


EP2(15ft ml).jpg

EP2(2ft).jpg



EP2(4ft).jpg

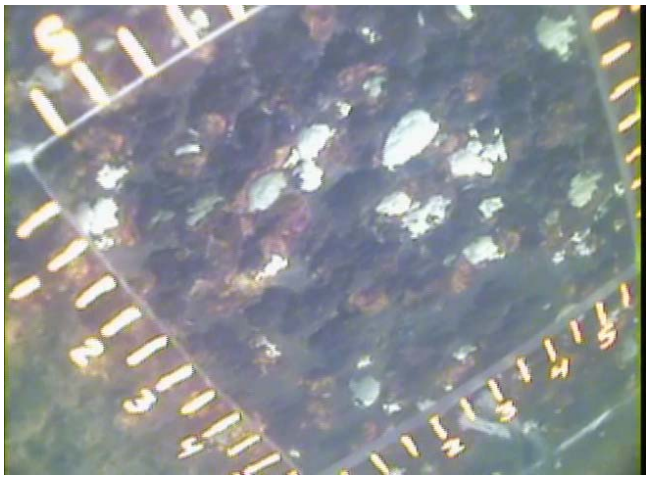


EP2(6ft).jpg

EP2(8ft).jpg

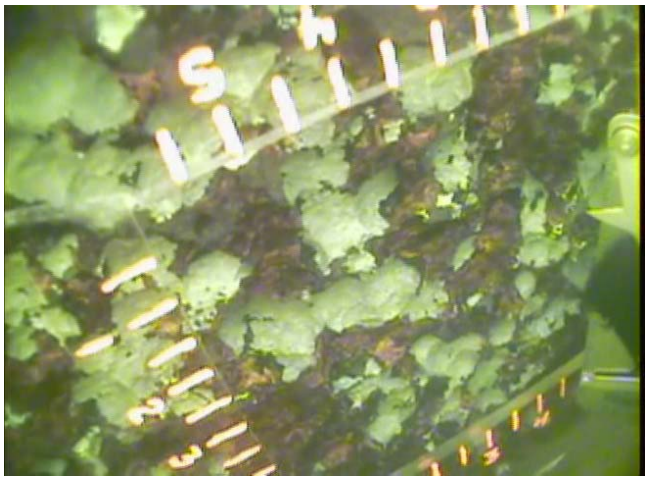

SE1o(0ft).jpg

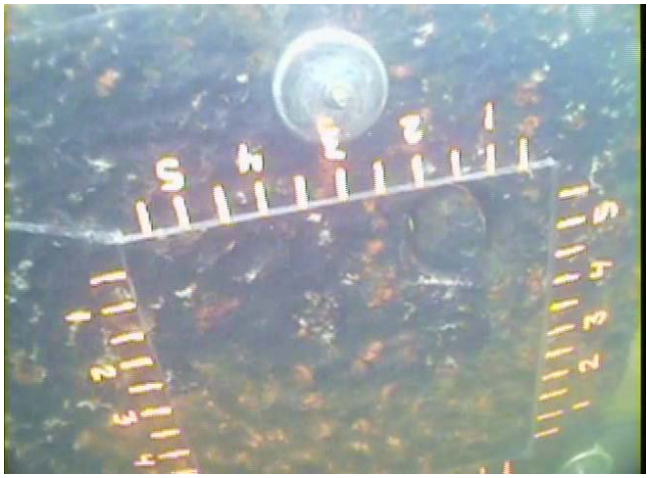

SE1o(2ft).jpg


SE1o(4ft).jpg


SE1o(6ft).jpg

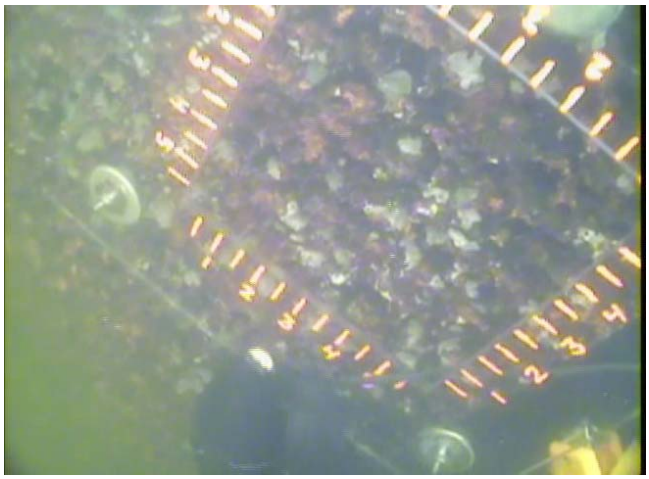

SE1o(8ft).jpg


SE1o(8ft)b.jpg

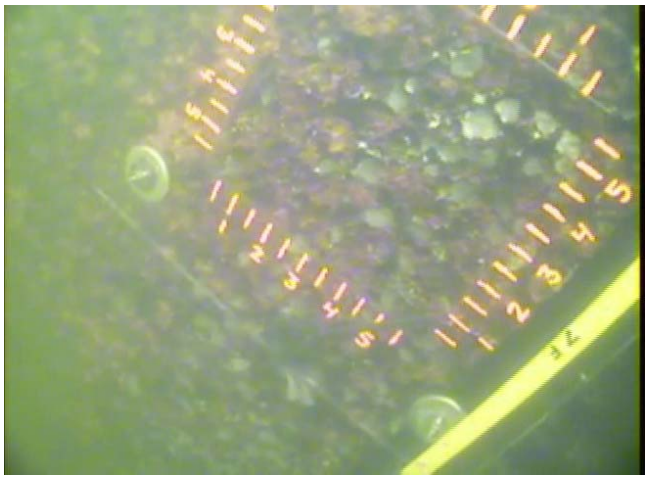


SE2(0ft).jpg

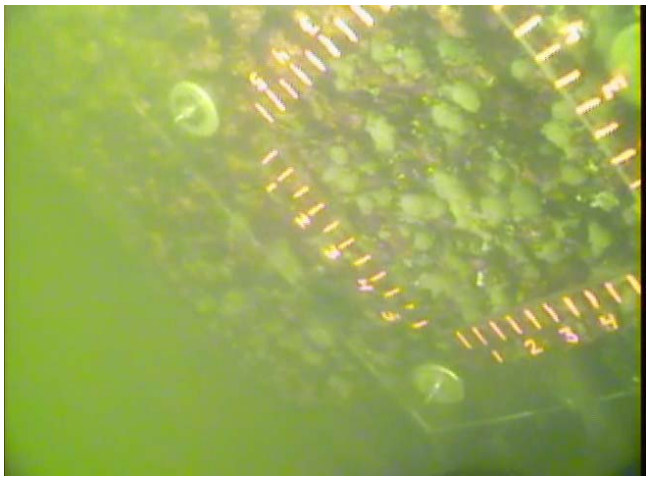
SE2(2ft).jpg



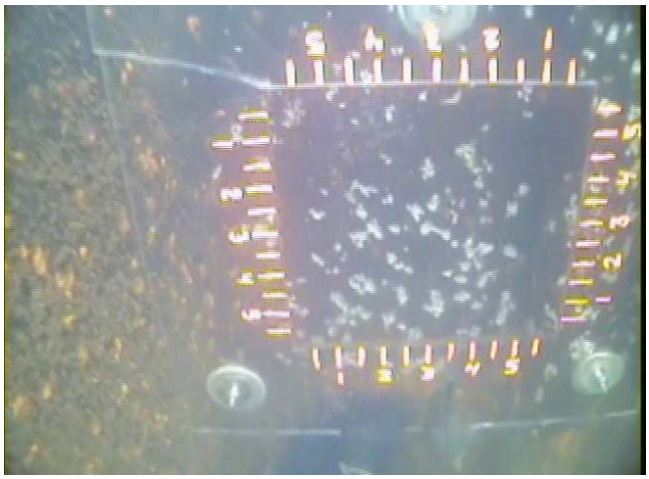
SE2(4ft).jpg



SE2(6ft).jpg

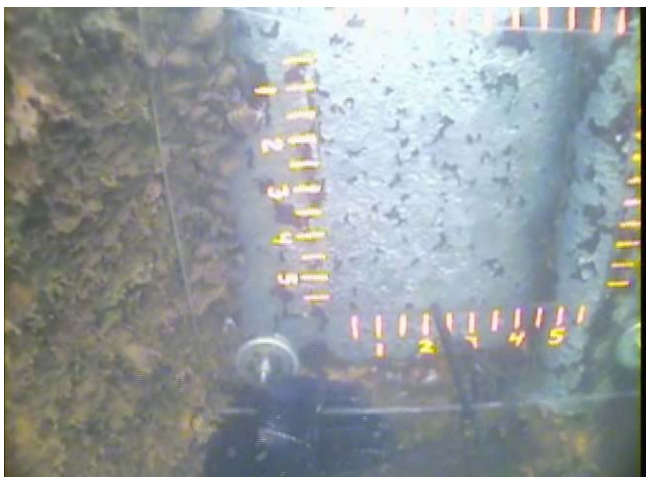


SE2(8ft).jpg



SE7i(0ft).jpg

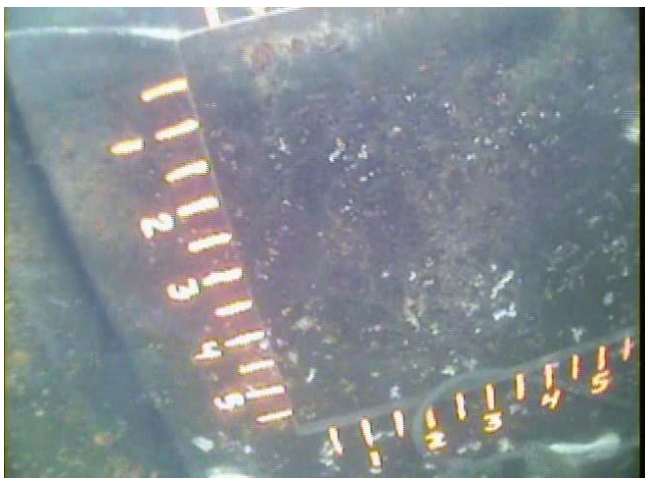
SE7i(2ft).jpg



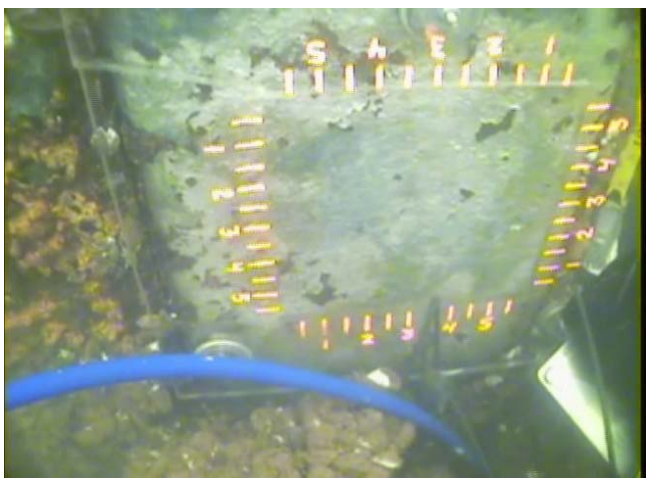
SE7i(4ft).jpg

SE7i(6ft).jpg

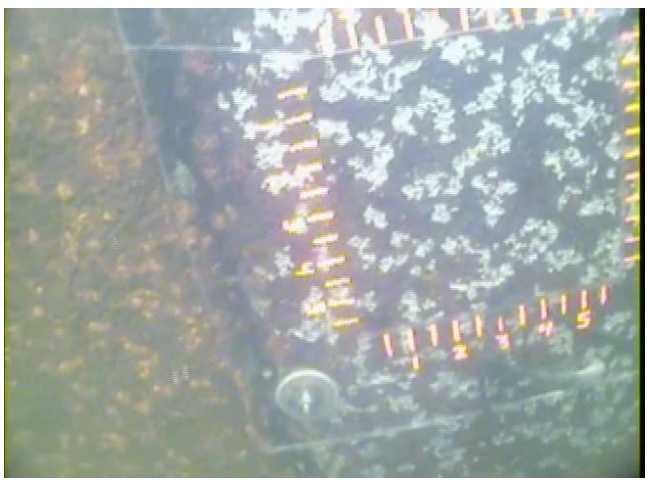
SE7i(8ft).jpg



SE7o(0ft).jpg

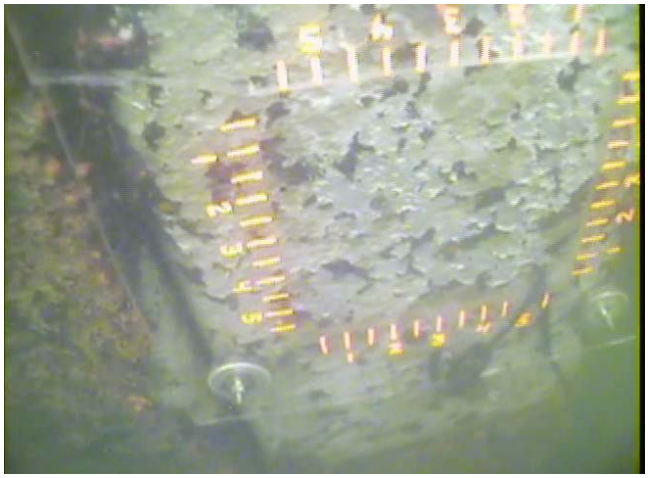


SE7o(10ft).jpg

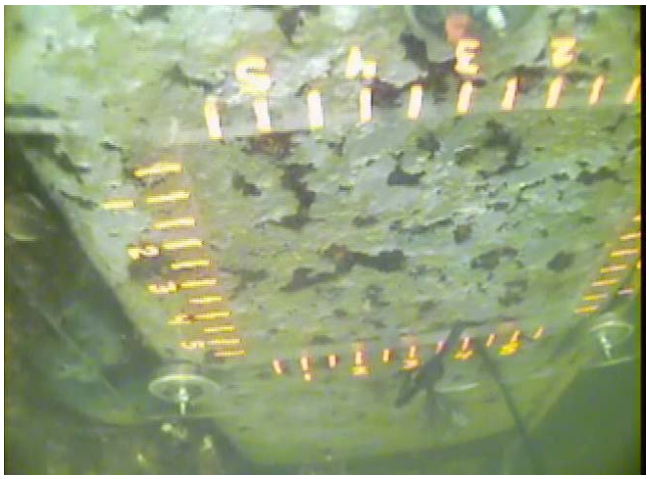


SE7o(2ft).jpg

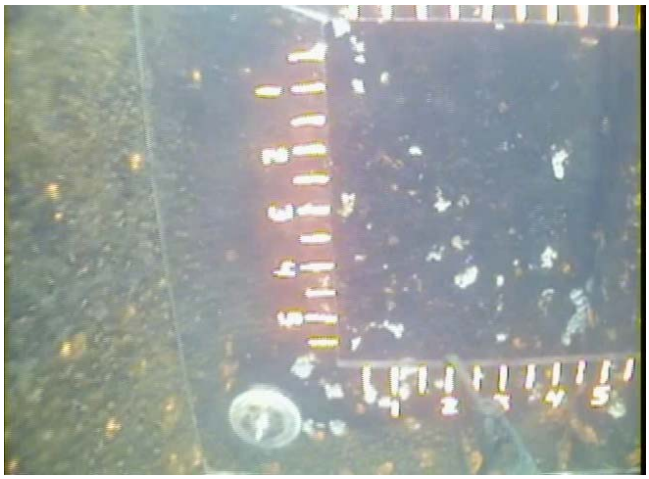
SE7o(4ft).jpg



SE7o(6ft).jpg



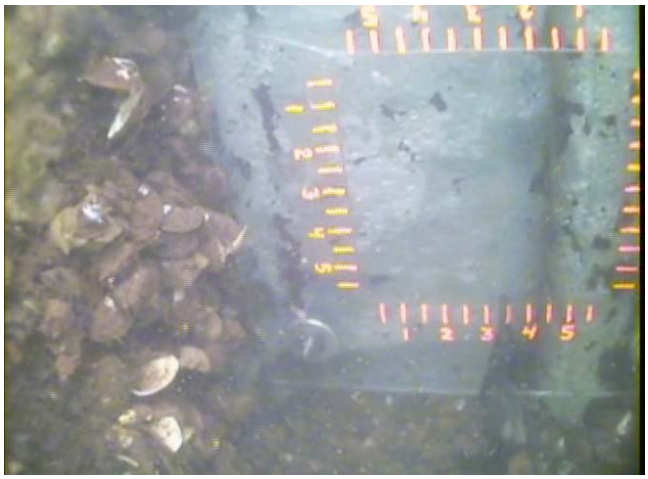
SE7o(8ft).jpg



SE8i(0ft).jpg

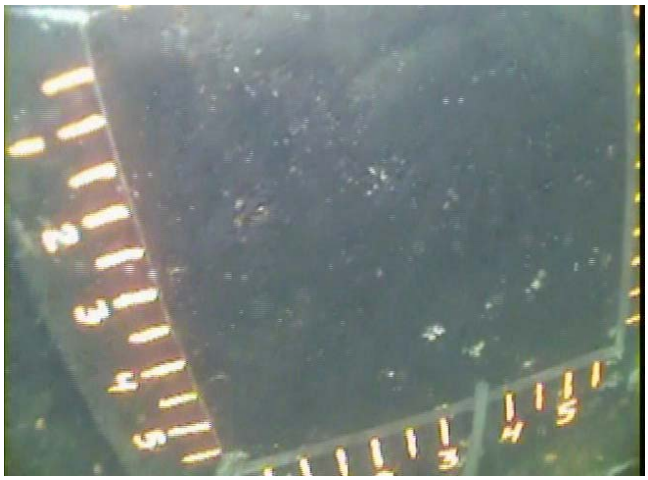
SE8i(2ft).jpg

SE8i(4ft).jpg

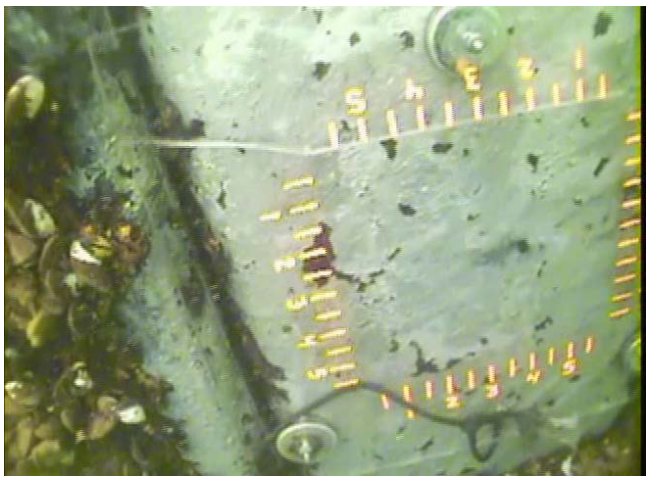


SE8i(6ft).jpg

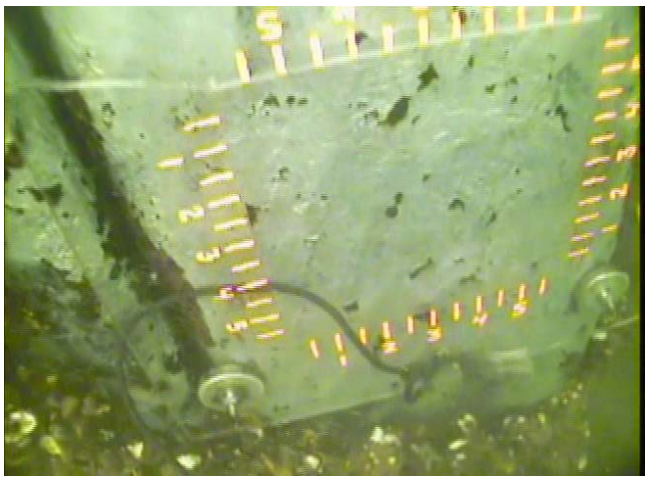
SE8i(8ft).jpg



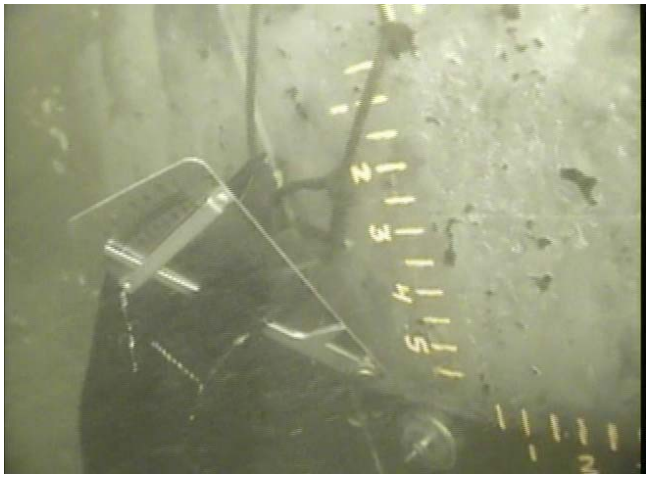
SE8o(0ft).jpg



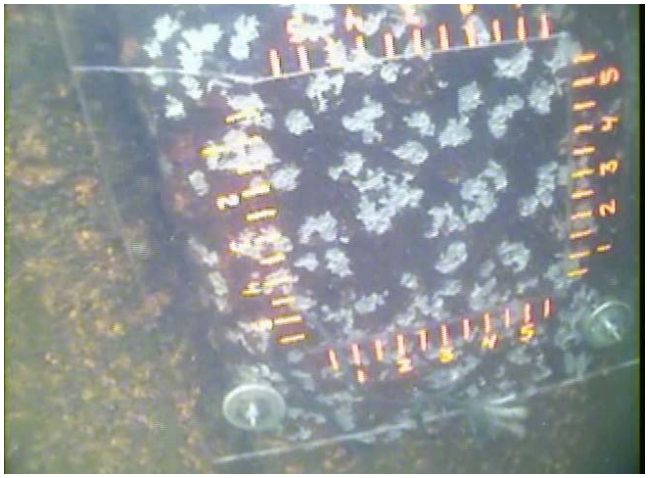
SE8o(10FT).jpg



SE8o(15ft).jpg

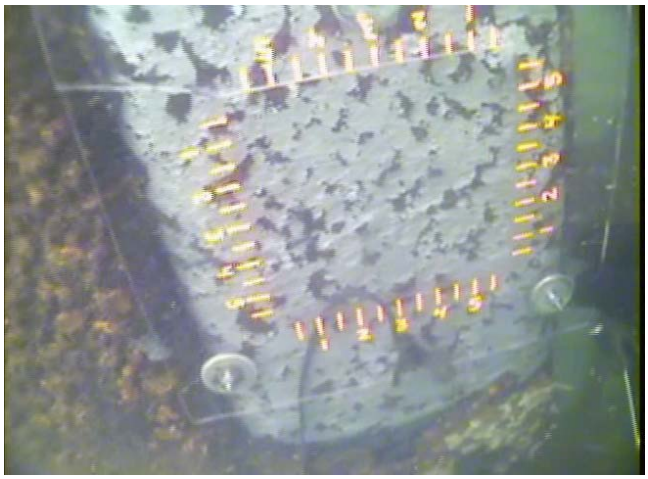


SE8o(20ft).jpg



SE8o(2ft).jpg

SE8o(4ft).jpg



SE8o(6ft).jpg

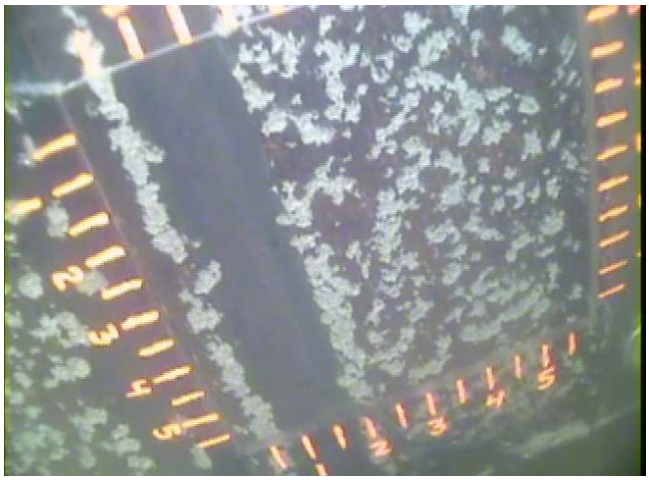
SE8o(8ft).jpg

SE9(0ft).jpg

SE9(10ft).jpg

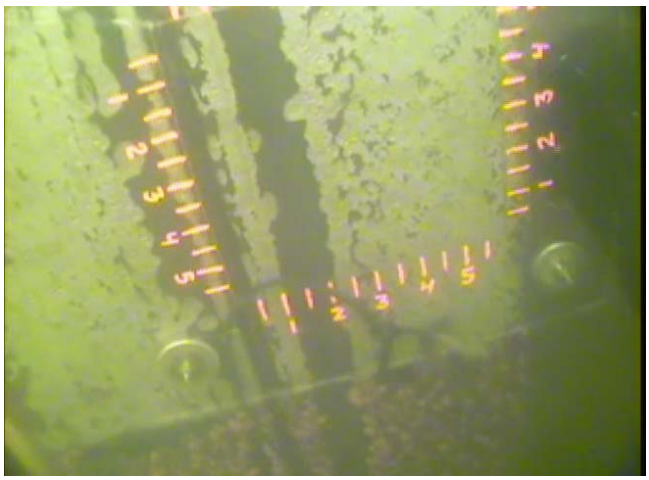
SE9(15ft).jpg

SE9(20ft).jpg



SE9(2ft).jpg

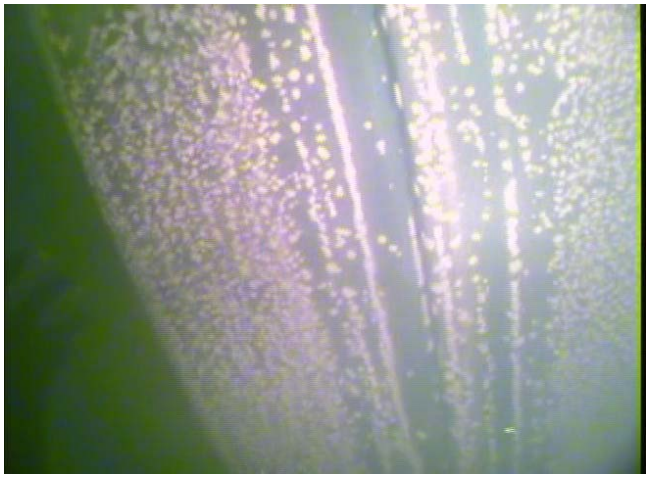
SE9(4ft).jpg



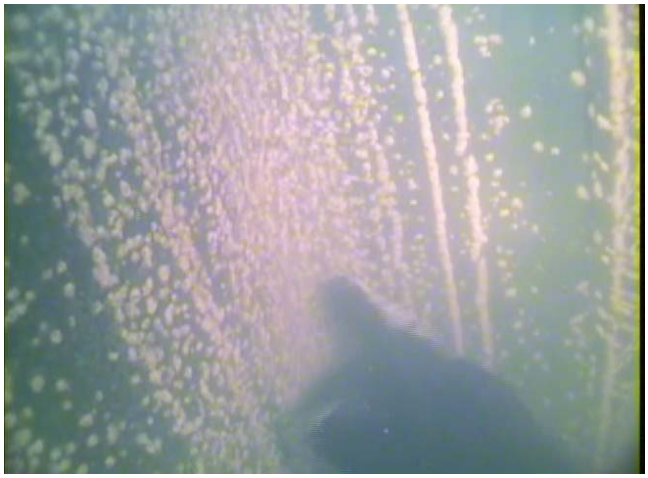
SE9(6ft).jpg

SE9(8ft).jpg

SE9(ml).jpg

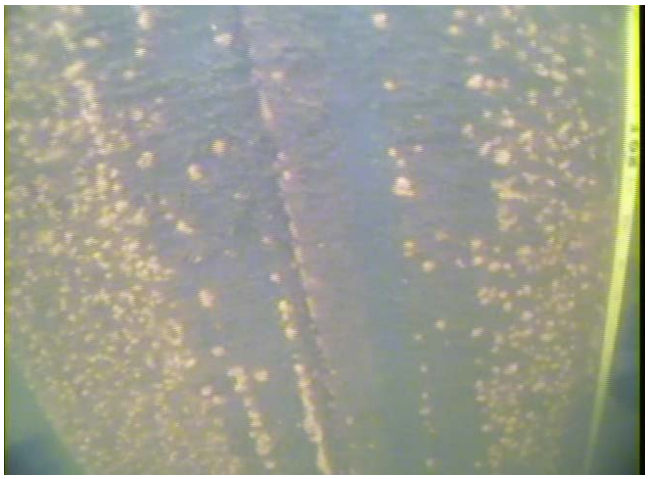


SE10(10FT).jpg



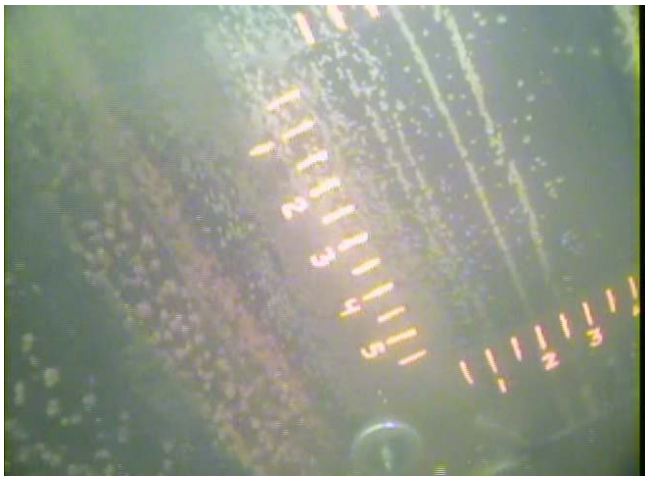
SE10(2ft-ip).jpg

SE10(4ft).jpg

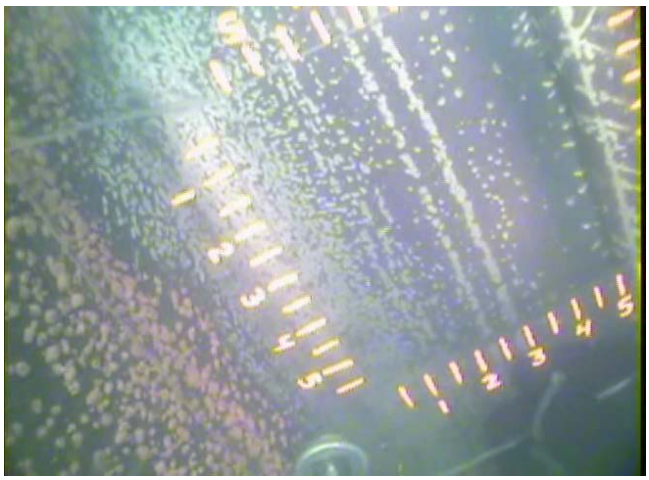


SE10(4ft)b.jpg

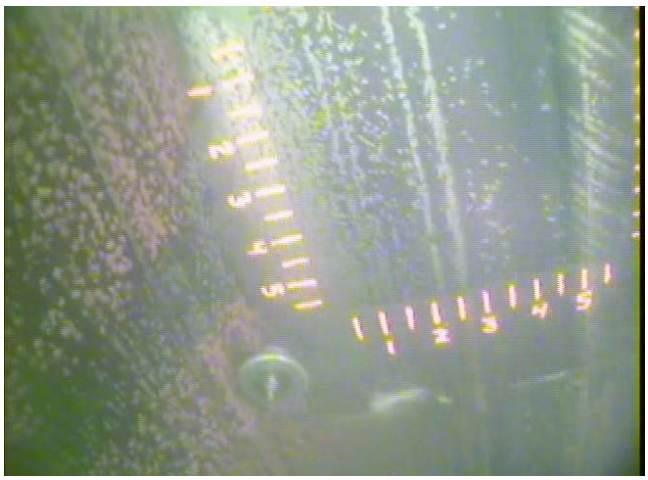
SE10i(0ft).jpg



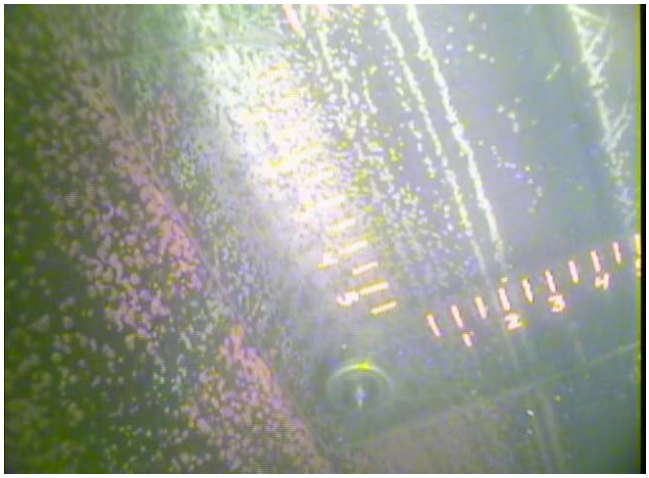
SE10i(2ft).jpg



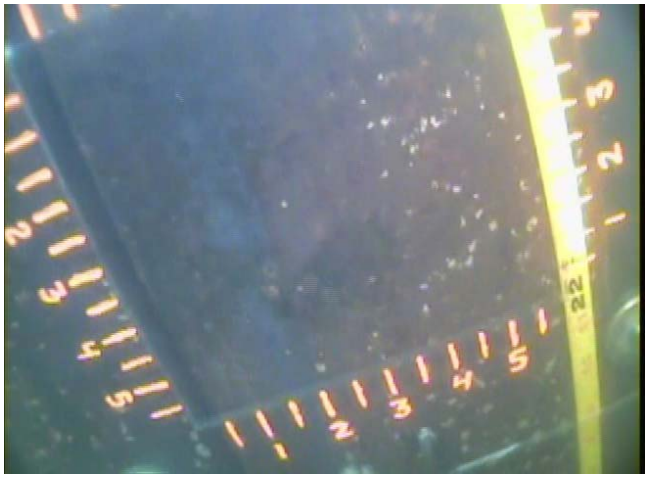
SE10i(4ft).jpg



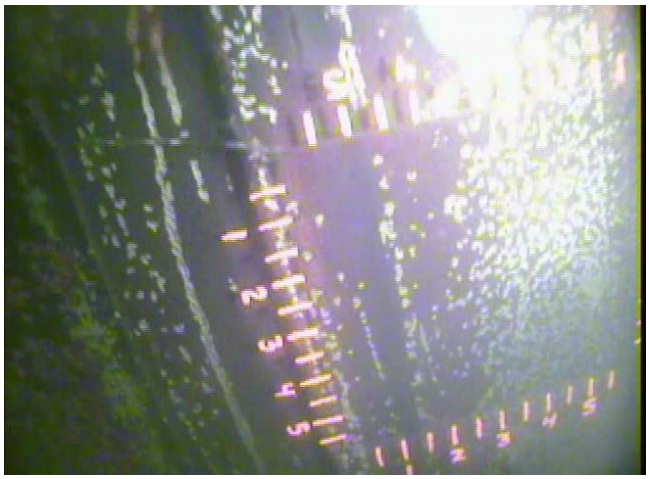
SE10i(6ft).jpg



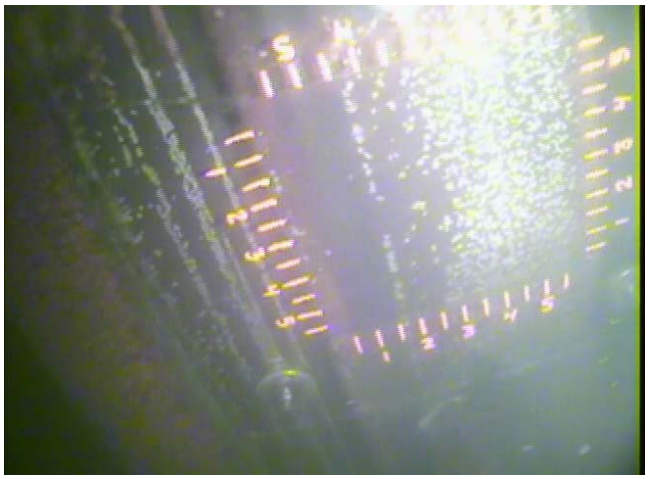
SE10i(8ft).jpg



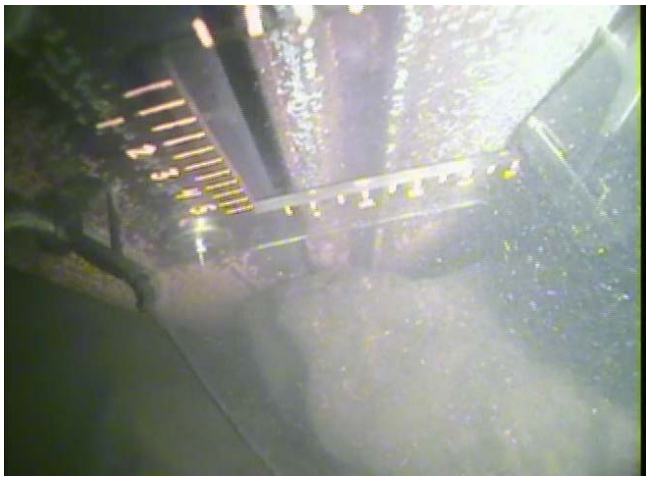
SE10o(0ft).jpg



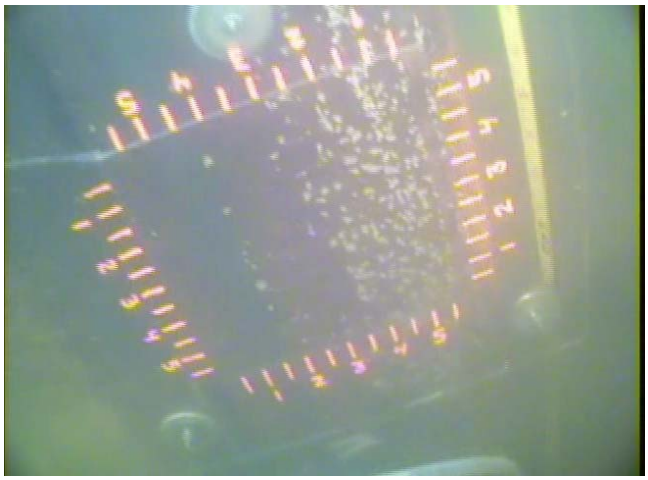
SE10o(10ft).jpg



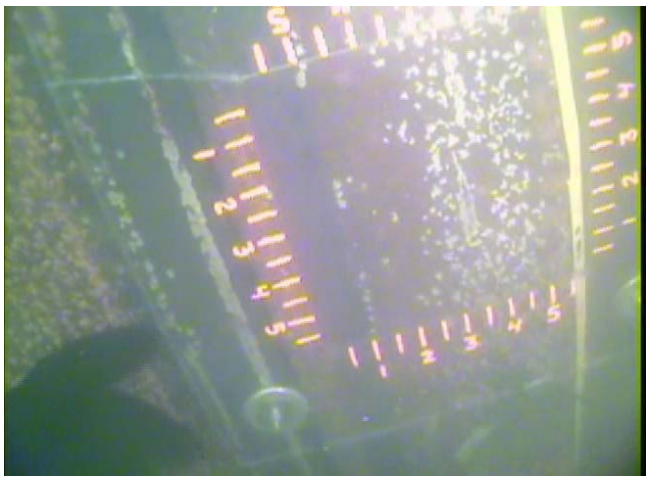
SE10o(15ft).jpg



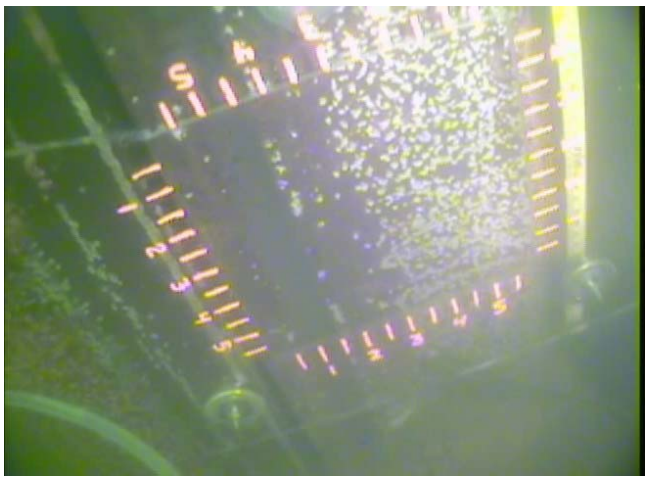
SE10o(18ft-ml).jpg



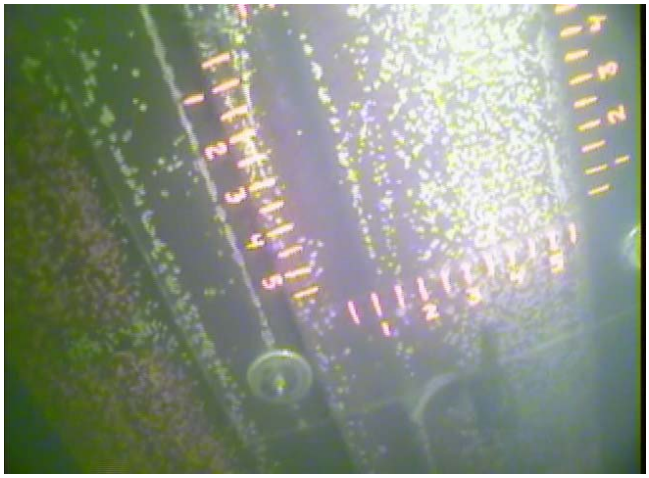
SE10o(2ft).jpg



SE10o(4ft).jpg

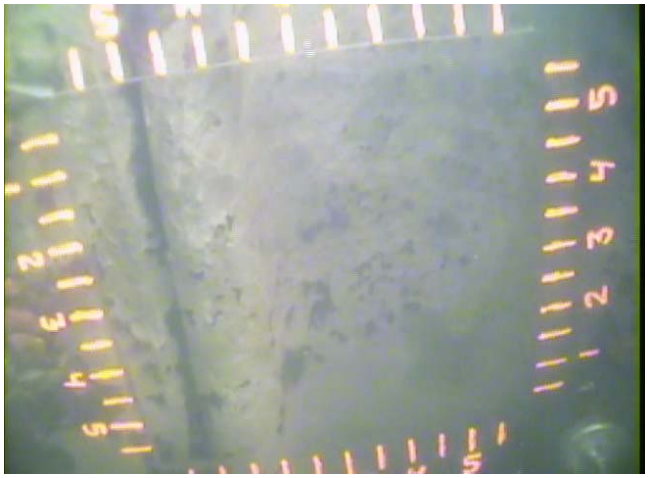


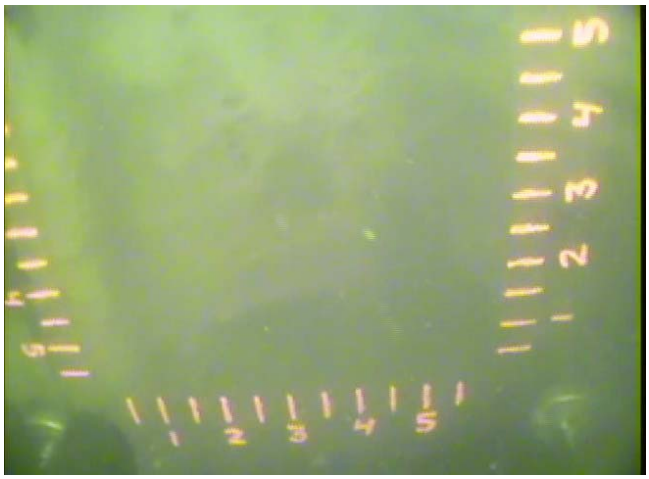
SE10o(6ft).jpg

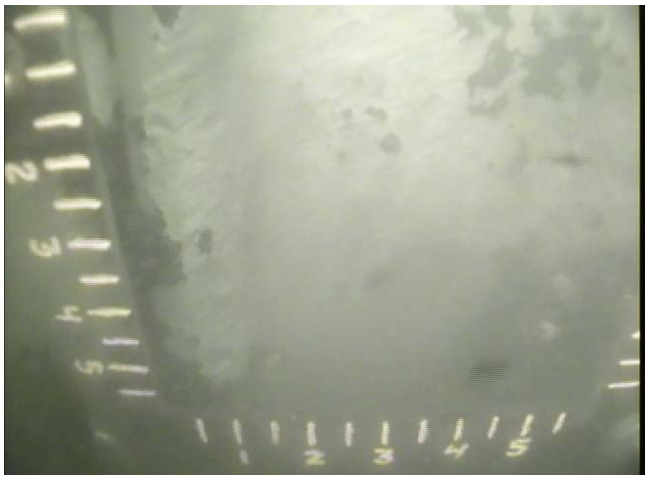


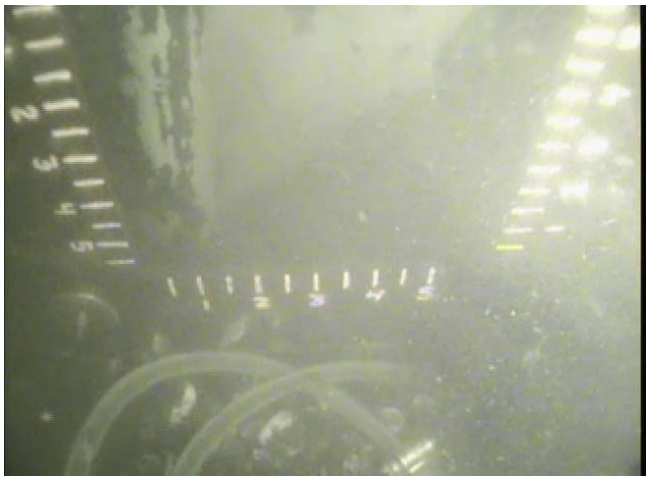
SE10o(8ft).jpg

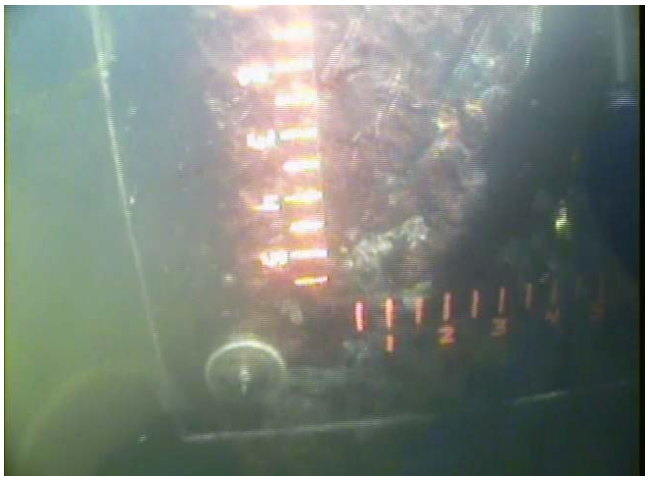

VY1i(0ft).jpg

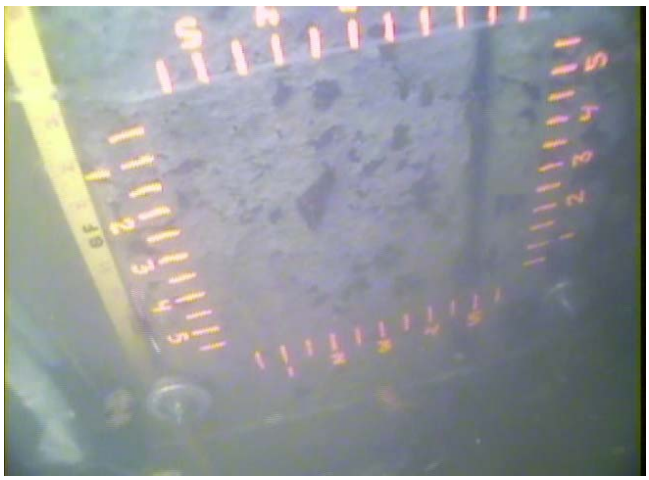

VY1i(2ft).jpg

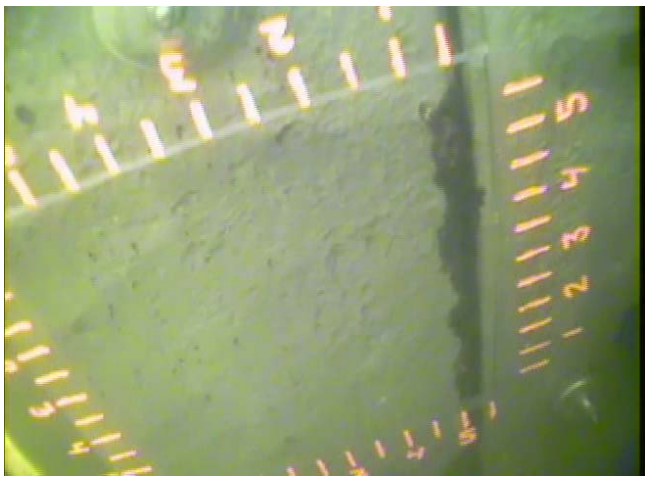

VY1i(4ft).jpg

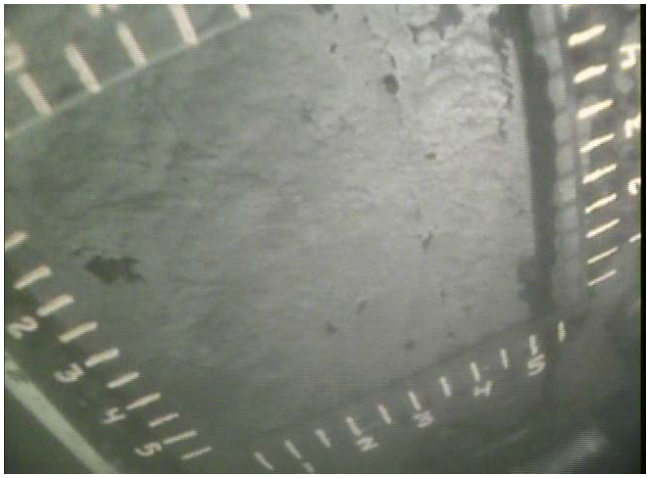

VY1i(6ft).jpg


VY1i(8ft).jpg


VY1o(0ft).jpg


VY1o(2ft).jpg


VY1o(4ft).jpg



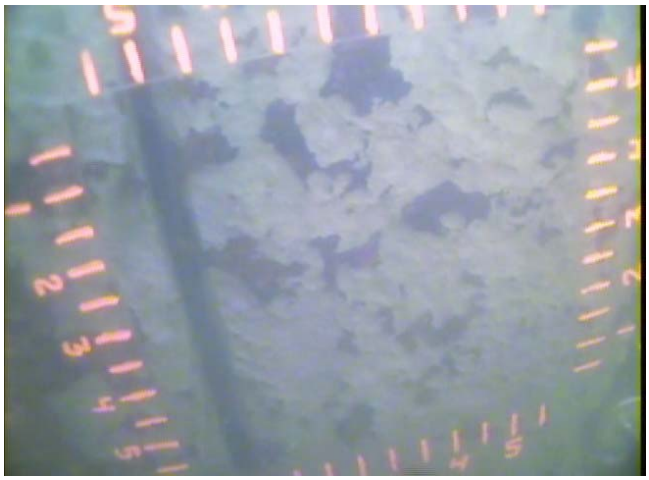
VY1o(6ft).jpg

VY1o(8ft).jpg

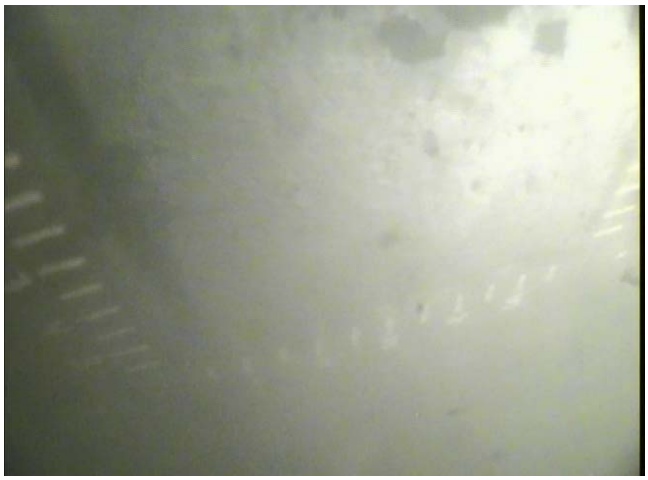
VY2i(0ft).jpg

VY2i(2ft).jpg

VY2o(0ft).jpg



VY2o(2ft).jpg



VY2o(4ft).jpg

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Coast Guard Cell

Data Column ID: CGA1o

Data Collection Date: 8/18/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Flat SSP

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.375														
2 (0.0)	0.344	0.156	0.625	0.094	0.625	0.094	0.750	0.219	0.500	HIGH					
3 (-2.0)	0.304	0.179	0.375	0.116	0.250	0.116	0.500	0.179	0.250	HIGH					
4 (-4.0)	0.300	0.112	0.375	0.237	0.250	0.237	0.250	0.237	0.250	HIGH					
5 (-6.0)	0.320	0.257	0.250	0.257	0.188	0.257	0.188	0.257	0.125	HIGH					
6 (-8.0)	0.378	0.315	0.250	0.338	0.188	0.315	0.250	0.315	0.188	HIGH					
7 (-10.0)	0.320	0.290	0.125	0.290	0.188	0.257	0.250	0.280	0.125	HIGH					
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Coast Guard Range Cell **Corrosion Rating (CR):** H = High (75 -100% Pitted) T = Overall Plate Thickness

Data Column ID: CGB1o M = Moderate (50 -75% Pitted) P1r = Thickness of steel at pit 1

Data Collection Date: 8/31/06 L = Low (0 - 50% Pitted) P1dia = Pit 1 diameter

Square Size of Steel Data: 6 inches **Surface Type** Flat SSP

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.375														
2 (0.0)	0.307	0.182	0.500	0.057	0.500	hole	0.625	hole	0.625	HIGH					
3 (-2.0)	0.379	0.191	0.500	0.254	0.500	hole	0.375	hole	0.500	HIGH					
4 (-4.0)	0.363	0.303	0.250	0.300	0.375	0.313	0.500	0.293	0.375	HIGH					
5 (-6.0)	0.350	0.310	0.250	0.287	0.250	0.300	0.500	0.287	0.375	HIGH					
6 (-8.0)															
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Coast Guard Range Cell **Corrosion Rating (CR):** H = High (75 -100% Pitted) T = Overall Plate Thickness

Data Column ID: CGC1o M = Moderate (50 -75% Pitted) P1r = Thickness of steel at pit 1

Data Collection Date: 8/18/06 L = Low (0 - 50% Pitted) P1dia = Pit 1 diameter

Square Size of Steel Data: 6 inches **Surface Type** Flat SSP

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.375														
2 (0.0)	0.346	0.158	0.500	0.089	0.500	0.208	0.500	0.096	0.500	HIGH					
3 (-2.0)	0.278	0.122	0.375	0.153	0.750	0.153	0.500	0.065	0.625	HIGH					
4 (-4.0)	0.337	0.274	0.250	0.297	0.250	0.274	0.375	0.287	0.125	HIGH					
5 (-6.0)															
6 (-8.0)															
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE1i

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Inner Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.608														
2 (0.0)	0.593	0.588	0.063	0.583	0.063	0.588	0.063	0.588	0.063	LOW					
3 (-2.0)	0.578	0.453	0.375	0.515	0.375	0.538	0.375	0.538	0.188	MOD					
4 (-4.0)	0.608	0.545	0.500	0.518	0.500	0.518	0.375	0.558	0.250	MOD					
5 (-6.0)	0.613	0.513	0.750	0.550	0.375	0.550	0.500	0.563	0.375	MOD					
6 (-8.0)	0.628	0.588	0.375	0.608	0.188	0.608	0.250	0.588	0.188	MOD					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE1o

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.611														
2 (0.0)	0.596	0.591	0.063	0.591	0.063	0.556	0.125	0.591	0.063	LOW					
3 (-2.0)	0.569	0.506	0.125	0.506	0.125	0.519	0.125	0.529	0.188	MOD					
4 (-4.0)	0.593	0.53	0.188	0.53	0.375	0.543	0.188	0.543	0.188	MOD					
5 (-6.0)	0.609	0.519	0.25	0.519	0.063	0.546	0.25	0.546	0.188	HIGH					
6 (-8.0)	0.608	0.545	0.188	0.545	0.125	0.558	0.188	0.568	0.188	HIGH					
7 (-10.0)	0.618	0.588	0.125	0.555	0.25	0.578	0.125	0.578	0.25	HIGH					
8 (-15.0)	0.613	0.55	0.25	0.55	0.25	0.543	0.25	0.563	0.188	HIGH					
9 (-21.0)	0.616	0.553	0.188	0.576	0.125	0.586	0.125	0.566	0.188	HIGH					
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE2i

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Inner Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.602														
2 (0.0)	0.604	0.564	0.188	0.541	0.250	0.541	0.188	0.541	0.188	MOD					
3 (-2.0)	0.618	0.508	0.500	0.518	0.375	0.528	0.375	0.548	0.250	HIGH					
4 (-4.0)	0.606	0.506	0.500	0.496	0.500	0.543	0.250	0.506	0.500	HIGH					
5 (-6.0)	0.604	0.504	0.250	0.541	0.188	0.564	0.250	0.554	0.188	HIGH					
6 (-8.0)	0.612	0.562	0.188	0.572	0.188	0.562	0.188	0.572	0.250	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE2o

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.613														
2 (0.0)	0.622	0.559	0.188	0.582	0.125	0.582	0.250	0.559	0.125	HIGH					
3 (-2.0)	0.614	0.551	0.250	0.534	0.250	0.544	0.375	0.551	0.125	HIGH					
4 (-4.0)	0.603	0.523	0.188	0.503	0.188	0.493	0.375	0.533	0.500	HIGH					
5 (-6.0)	0.605	0.515	0.375	0.542	0.188	0.542	0.250	0.542	0.375	HIGH					
6 (-8.0)	0.615	0.575	0.250	0.552	0.250	0.552	0.250	0.552	0.250	HIGH					
7 (-10.0)	0.602	0.539	0.125	0.539	0.188	0.539	0.188	0.562	0.125	HIGH					
8 (-15.0)	0.612	0.549	0.188	0.582	0.188	0.602	0.250	0.592	0.125	HIGH					
9 (-20.0)	0.621	0.591	0.125	0.601	0.125	0.591	0.250	0.601	0.188	HIGH					
10 (-31)	0.623	0.583	0.125	0.583	0.188	0.553	0.250	0.583	0.125	MOD					

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE 3i

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Inner Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.628														
2 (0.0)	0.619	0.579	0.250	0.569	0.250	0.539	0.250	0.549	0.188	HIGH					
3 (-2.0)	0.602	0.539	0.625	0.552	0.625	0.532	0.500	0.539	0.188	HIGH					
4 (-4.0)	0.604	0.541	0.188	0.554	0.188	0.541	0.250	0.541	0.125	HIGH					
5 (-6.0)	0.596	0.556	0.188	0.471	0.250	0.556	0.063	0.546	0.188	HIGH					
6 (-8.0)	0.619	0.539	0.063	0.556	0.125	0.556	0.250	0.556	0.125	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE3o

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.607														
2 (0.0)	0.604	0.564	0.188	0.574	0.125	0.544	0.250	0.541	0.125	HIGH					
3 (-2.0)	0.595	0.515	0.250	0.532	0.188	0.515	0.250	0.532	0.500	HIGH					
4 (-4.0)	0.597	0.507	0.250	0.497	0.375	0.507	0.375	0.537	0.375	HIGH					
5 (-6.0)	0.605	0.542	0.250	0.565	0.125	0.555	0.125	0.565	0.250	HIGH					
6 (-8.0)	0.604	0.541	0.188	0.564	0.125	0.554	0.125	0.554	0.125	HIGH					
7 (-10.0)	0.618	0.555	0.188	0.578	0.250	0.555	0.250	0.555	0.250	HIGH					
8 (-15.0)	0.611	0.571	0.125	0.601	0.188	0.531	0.063	0.548	0.125	MOD					
9 (-20.0)	0.612	0.572	0.188	0.592	0.125	0.572	0.125	0.562	0.250	LOW					
10 (-30.0)	0.615	0.575	0.500	0.585	0.375	0.565	0.250	0.575	0.188	LOW					

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE4i

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

Surface Type Inner Flange

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.606														
2 (0.0)	0.581	0.551	0.125	0.561	0.250	0.541	0.250	0.551	0.125	MOD					
3 (-2.0)	0.585	0.505	0.625	0.522	0.375	0.522	0.250	0.522	0.250	HIGH					
4 (-4.0)	0.592	0.542	0.250	0.542	0.125	0.562	0.188	0.572	0.125	HIGH					
5 (-6.0)	0.603	0.540	0.125	0.553	0.125	0.553	0.063	0.573	0.125	HIGH					
6 (-8.0)	0.615	0.585	0.188	0.595	0.125	0.585	0.125	0.595	0.125	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE4o

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.600														
2 (0.0)	0.578	0.515	0.250	0.515	0.188	0.548	0.188	0.515	0.250	MOD					
3 (-2.0)	0.587	0.497	0.500	0.524	0.375	0.524	0.375	0.497	0.188	HIGH					
4 (-4.0)	0.626	0.563	0.125	0.563	0.250	0.563	0.125	0.546	0.625	HIGH					
5 (-6.0)	0.623	0.560	0.125	0.583	0.500	0.583	0.375	0.593	0.188	HIGH					
6 (-8.0)	0.606	0.543	0.125	0.566	0.250	0.586	0.063	0.566	0.125	HIGH					
7 (-10.0)	0.635	0.605	0.250	0.615	0.125	0.585	0.250	0.595	0.188	HIGH					
8 (-15.0)	0.581	0.561	0.250	0.566	0.375	0.561	0.375	0.556	0.375	HIGH					
9 (-20.0)	0.626	0.596	0.125	0.616	0.250	0.611	0.250	0.606	0.250	HIGH					
10 (29.5)	0.623	0.583	0.375	0.603	0.250	0.573	0.250	0.583	0.125	MOD					

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE5i

Data Collection Date: 8/23/06

Square Size of Steel Data: 6"

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Inner Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.596														
2 (0.0)	0.524	0.399	0.500	0.384	0.500	0.424	0.063	0.424	0.250	HIGH					
3 (-2.0)	0.606	0.476	0.250	0.486	0.500	0.543	0.063	0.543	0.125	HIGH					
4 (-4.0)	0.589	0.499	0.125	0.499	0.063	0.469	0.063	0.489	0.063	HIGH					
5 (-6.0)	0.613	0.483	1.000	0.550	0.125	0.513	0.500	0.513	0.500	HIGH					
6 (-8.0)	0.623	0.523	0.250	0.493	0.125	0.513	0.125	0.523	0.063	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE5o

Data Collection Date: 8/23/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.609														
2 (0.0)	0.593	0.468	0.250	0.503	0.500	0.473	0.250	0.533	0.125	Mod					
3 (-2.0)	0.563	0.463	0.500	0.438	0.188	0.413	0.500	0.423	0.250	High					
4 (-4.0)	0.608	0.433	1.000	0.448	0.750	0.488	0.250	0.508	0.750	High					
5 (-6.0)	0.560	0.395	0.500	0.497	0.250	0.460	0.250	0.450	0.188	High					
6 (-8.0)	0.618	0.555	0.063	0.518	0.500	0.538	0.500	0.513	0.625	High					
7 (-10.0)	0.626	0.546	0.500	0.556	0.125	0.536	0.125	0.563	0.125	High					
8 (-15.0)	0.616	0.491	0.250	0.516	0.063	0.426	0.063	0.516	0.063	High					
9 (-20.0)	0.617	0.554	0.063	0.554	0.125	0.527	0.125	0.517	0.125	High					

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: ACOE Duluth Entry

Data Column ID: DE6i

Data Collection Date: 8/23/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Inner Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.611														
2 (0.0)	0.614	0.551	0.063	0.544	0.250	0.551	0.063	0.564	0.125	MOD					
3 (-2.0)	0.623	0.498	0.500	0.503	0.063	0.498	0.500	0.473	0.500	HIGH					
4 (-4.0)	0.617	0.554	0.250	0.527	0.063	0.477	0.125	0.497	0.188	HIGH					
5 (-6.0)	0.609	0.449	0.125	0.549	0.063	0.519	0.125	0.546	0.250	HIGH					
6 (-8.0)	0.615	0.552	0.063	0.505	0.250	0.525	0.250	0.552	0.125	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE 6o

Data Collection Date: 8/23/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.611														
2 (0.0)	0.609	0.546	0.063	0.484	0.250	0.519	0.063	0.546	0.125	LOW					
3 (-2.0)	0.612	0.487	0.500	0.462	0.500	0.462	0.250	0.487	0.313	MOD					
4 (-4.0)	0.612	0.462	0.750	0.462	0.875	0.482	0.125	0.462	0.250	HIGH					
5 (-6.0)	0.614	0.489	0.125	0.494	0.250	0.514	0.063	0.551	0.125	HIGH					
6 (-8.0)	0.616	0.536	0.063	0.506	0.125	0.526	0.250	0.553	0.500	HIGH					
7 (-10.0)	0.533	0.453	0.063	0.423	0.063	0.413	0.250	0.403	0.375	HIGH					
8 (-15.0)	0.618	0.555	0.250	0.518	0.125	0.518	0.125	0.528	0.250	HIGH					
9 (-20.0)	0.613	0.583	0.063	0.523	0.063	0.513	0.250	0.503	0.125	HIGH					
10 (25)	0.601	0.538	0.250	0.538	0.063	0.511	0.125	0.526	0.063	HIGH					

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE7i

Data Collection Date: 9/1/06

Square Size of Steel Data: 6 inches

Surface Type Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.063														
2 (0.0)	0.606	0.586	0.125	0.556	0.250	0.556	0.250	0.556	0.125	LOW					
3 (-2.0)	0.603	0.543	0.250	0.523	0.250	0.523	0.250	0.533	0.188	HIGH					
4 (-4.0)	0.625	0.585	0.250	0.605	0.250	0.575	0.188	0.575	0.188	HIGH					
5 (-6.0)	0.573	0.523	0.250	0.523	0.125	0.553	0.125	0.523	0.250	HIGH					
6 (-8.0)	0.612	0.572	0.250	0.602	0.250	0.592	0.375	0.582	0.125	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE7o

Data Collection Date: 9/1/2006

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.591														
2 (0.0)	0.607	0.547	0.250	0.547	0.125	0.547	0.125	0.557	0.125	MOD					
3 (-2.0)	0.607	0.507	0.500	0.497	0.375	0.497	0.375	0.527	0.625	HIGH					
4 (-4.0)	0.594	0.524	0.125	0.504	0.188	0.544	0.375	0.531	0.250	HIGH					
5 (-6.0)	0.611	0.541	0.188	0.511	0.375	0.548	0.125	0.561	0.250	HIGH					
6 (-8.0)	0.567	0.517	0.188	0.547	0.250	0.537	0.188	0.547	0.125	HIGH					
7 (-10.0)	0.617	0.587	0.250	0.577	0.125	0.577	0.250	0.577	0.125	HIGH					
8 (-15.0)	0.627	0.577	0.250	0.587	0.375	0.587	0.375	0.617	0.250	HIGH					
9 (-20.0)	0.622	0.582	0.250	0.602	0.188	0.562	0.250	0.592	0.188	HIGH					
10 (-30.5)	0.619	0.559	0.375	0.579	0.375	0.494	0.625	0.569	0.500	LOW					

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry (south wall)
Data Column ID: DE 8i
Data Collection Date: 9/1/06
Square Size of Steel Data: 6 inches
Surface Type Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.596														
2 (0.0)	0.579	0.479	0.250	0.529	0.250	0.499	0.250	0.516	0.250	MOD					
3 (-2.0)	0.597	0.534	0.500	0.534	0.250	0.547	0.375	0.534	0.375	HIGH					
4 (-4.0)	0.623	0.583	0.375	0.573	0.250	0.583	0.250	0.573	0.250	HIGH					
5 (-6.0)	0.628	0.618	0.125	0.618	0.250	0.598	0.375	0.588	0.250	HIGH					
6 (-8.0)	0.609	0.569	0.125	0.589	0.375	0.589	0.250	0.569	0.125	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Acoe Duluth Entry

Data Column ID: DE8o

Data Collection Date: 8/23/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.618														
2 (0.0)	0.615	0.515	0.500	0.495	0.500	0.505	0.250	0.490	0.250	HIGH					
3 (-2.0)	0.609	0.484	0.500	0.459	0.500	0.449	0.375	0.439	0.250	HIGH					
4 (-4.0)	0.605	0.425	1.000	0.455	0.750	0.455	0.500	0.455	0.500	HIGH					
5 (-6.0)	0.599	0.449	0.500	0.449	1.000	0.469	0.625	0.449	0.500	HIGH					
6 (-8.0)	0.603	0.428	0.500	0.453	1.000	0.453	0.250	0.503	0.125	HIGH					
7 (-10.0)	0.598	0.448	0.313	0.468	0.250	0.498	0.125	0.448	0.250	HIGH					
8 (-15.0)	0.610	0.470	0.250	0.470	0.125	0.510	0.250	0.440	0.063	HIGH					
9 (-20.0)	0.605	0.525	0.063	0.535	0.063	0.525	0.125	0.505	0.063	MOD					
10 (-29.5)	0.628	0.598	0.250	0.608	0.125	0.588	0.125	0.578	0.188	LOW					

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE 9i

Data Collection Date: 8/22/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Inner Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.618														
2 (0.0)	0.611	0.581	0.125	0.591	0.125	0.571	0.125	0.561	0.188	MOD					
3 (-2.0)	0.611	0.548	0.250	0.571	0.188	0.551	0.188	0.548	0.188	HIGH					
4 (-4.0)	0.617	0.554	0.250	0.567	0.188	0.567	0.188	0.567	0.188	HIGH					
5 (-6.0)	0.616	0.566	0.125	0.566	0.250	0.553	0.250	0.566	0.188	HIGH					
6 (-8.0)	0.623	0.583	0.125	0.593	0.125	0.593	0.188	0.583	0.125	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE9o

Data Collection Date: 8/22/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.616														
2 (0.0)	0.615	0.585	0.125	0.565	0.063	0.595	0.125	0.595	0.125	MOD					
3 (-2.0)	0.598	0.548	0.188	0.498	0.250	0.538	0.125	0.558	0.188	High					
4 (-4.0)	0.614	0.534	0.188	0.564	0.188	0.564	0.188	0.564	0.188	High					
5 (-6.0)	0.612	0.549	0.250	0.549	0.125	0.549	0.125	0.542	0.250	High					
6 (-8.0)	0.603	0.540	0.250	0.553	0.188	0.563	0.188	0.573	0.125	High					
7 (-10.0)	0.626	0.586	0.125	0.596	0.125	0.586	0.188	0.596	0.125	High					
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE10i

Data Collection Date: 8/22/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Inner Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.618														
2 (0.0)	0.613	0.550	0.063	0.513	0.250	0.550	0.063	0.550	0.063	LOW					
3 (-2.0)	0.598	0.473	0.250	0.423	0.500	0.473	0.500	0.403	0.500	HIGH					
4 (-4.0)	0.605	0.430	0.500	0.470	0.250	0.455	0.500	0.480	0.500	HIGH					
5 (-6.0)	0.617	0.554	0.250	0.554	0.125	0.517	0.063	0.492	0.750	MOD					
6 (-8.0)	0.609	0.489	0.250	0.546	0.125	0.546	0.250	0.509	0.063	MOD					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Duluth Entry

Data Column ID: DE10o

Data Collection Date: 8/22/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

Surface Type Outer Flange

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.615														
2 (0.0)	0.618	0.493	0.500	0.468	0.500	0.493	0.750	0.468	0.250	HIGH					
3 (-2.0)	0.617	0.492	0.500	0.517	0.500	0.507	0.750	0.492	0.250	HIGH					
4 (-4.0)	0.613	0.488	1.250	0.493	0.500	0.488	0.750	0.483	0.875	HIGH					
5 (-6.0)	0.614	0.514	0.250	0.494	0.063	0.426	0.750	0.489	0.500	HIGH					
6 (-8.0)	0.621	0.496	0.500	0.521	0.250	0.521	0.125	0.521	0.500	HIGH					
7 (-10.0)	0.605	0.542	0.063	0.542	0.250	0.525	0.063	0.542	0.250	LOW					
8 (-15.0)	0.611	0.521	0.063	0.521	0.125	0.521	0.500	0.561	0.250	LOW					
9 (-20.0)	0.613	0.513	0.250	0.543	0.063	0.533	0.250	0.553	0.063	MOD					
10 (-30.5)	0.619	0.494	0.500	0.444	0.050	0.494	0.500	0.494	0.188	MOD					

* Indicate ..

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Erie Pier

Data Column ID: EP1o

Data Collection Date: 8/23/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

Surface Type Outer Flange

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.375														
2 (0.0)	0.382	0.352	0.125	0.342	0.250	0.352	0.063	0.292	0.250	LOW					
3 (-2.0)	0.371	0.308	0.250	0.246	0.250	0.271	0.188	0.281	0.188	HIGH					
4 (-4.0)	0.369	0.319	0.188	0.329	0.188	0.339	0.125	0.319	0.250	HIGH					
5 (-6.0)	0.366	0.326	0.125	0.316	0.188	0.336	0.125	0.326	0.125	HIGH					
6 (-8.0)	0.371	0.321	0.188	0.331	0.188	0.308	0.125	0.331	0.125	HIGH					
7 (-10.0)	0.378	0.338	0.125	0.348	0.125	0.358	0.188	0.253	1.000	HIGH					
8 (-15.0)	0.374	0.334	0.125	0.324	0.125	0.311	0.063	0.344	0.250	HIGH					
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Erie Pier

Data Column ID: EP2o

Data Collection Date: 8/23/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

Surface Type Outer Flange

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.379														
2 (0.0)	0.377	0.252	0.500	0.314	0.375	0.252	0.500	0.314	0.250	HIGH					
3 (-2.0)	0.371	0.281	0.188	0.291	0.188	0.271	0.125	0.291	0.188	HIGH					
4 (-4.0)	0.369	0.306	0.188	0.329	0.125	0.279	0.188	0.319	0.125	HIGH					
5 (-6.0)	0.358	0.295	0.125	0.318	0.125	0.298	0.063	0.318	0.125	HIGH					
6 (-8.0)	0.371	0.327	0.188	0.308	0.125	0.271	0.250	0.308	0.188	HIGH					
7 (-10.0)	0.369	0.306	0.250	0.306	0.125	0.329	0.125	0.329	0.125	HIGH					
8 (-15.0)	0.372	0.332	0.125	0.332	0.125	0.282	0.500	0.309	0.250	HIGH					
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry
Data Column ID: SE1o
Data Collection Date: 8/17/06
Square Size of Steel Data: 6 inches
Surface Type Plate

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)															
2 (0.0)	0.899	0.774	0.500	0.711	0.500	0.711	0.500	0.743	0.375	HIGH					
3 (-2.0)	0.982	0.763	0.500	0.794	0.500	0.732	0.625	0.669	0.500	HIGH					
4 (-4.0)	1.460	1.147	0.625	1.147	0.500	1.147	0.500	1.210	0.500	HIGH					
5 (-6.0)	1.440	1.190	0.750	1.127	0.750	1.221	0.750	1.252	0.750	HIGH					
6 (-8.0)	1.465	1.152	0.750	1.215	0.625	1.152	0.625	1.065	0.750	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry
Data Column ID: SE2o
Data Collection Date: 8/17/06
Square Size of Steel Data: 6 inches
Surface Type Plate

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)															
2 (0.0)	0.846	0.690	0.375	0.690	0.625	0.721	0.625	0.658	0.500	HIGH					
3 (-2.0)	1.060	0.810	0.500	0.872	0.375	0.810	0.625	0.810	0.500	HIGH					
4 (-4.0)	1.450	1.200	0.625	1.075	0.625	1.137	0.625	1.137	0.750	HIGH					
5 (-6.0)	1.340	1.090	0.500	0.940	0.625	0.902	0.500	1.027	0.500	HIGH					
6 (-8.0)	1.350	0.950	0.500	0.975	0.625	1.010	0.625	0.930	0.375	HIGH					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry
Data Column ID: SE7i
Data Collection Date: 8/17/06
Square Size of Steel Data: 6 inches
Surface Type Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.421														
2 (0.0)	0.420	0.357	0.250	0.357	0.250	0.357	0.188	0.357	0.250	HIGH					
3 (-2.0)	0.413	0.350	0.188	0.350	0.250	0.350	0.500	0.350	0.250	HIGH					
4 (-4.0)	0.418	0.387	0.375	0.387	0.250	0.355	0.250	0.355	0.188	HIGH					
5 (-6.0)	0.413	0.382	0.375	0.382	0.188	0.382	0.125	0.382	0.188	MOD					
6 (-8.0)	0.421	0.358	0.250	0.411	0.188	0.401	0.250	0.411	0.375	MOD					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE7o

Data Collection Date: 8/17/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.417														
2 (0.0)	0.416	0.385	0.125	0.396	0.063	0.353	0.125	0.385	0.188	HIGH					
3 (-2.0)	0.403	0.340	0.125	0.340	0.188	0.340	0.188	0.340	0.125	HIGH					
4 (-4.0)	0.428	0.334	0.250	0.365	0.188	0.365	0.188	0.365	0.375	HIGH					
5 (-6.0)	0.422	0.359	0.188	0.359	0.375	0.359	0.250	0.359	0.375	HIGH					
6 (-8.0)	0.416	0.385	0.250	0.353	0.250	0.353	0.250	0.385	0.188	HIGH					
7 (-10.0)	0.415	0.405	0.500	0.395	0.250	0.405	0.125	0.395	0.375	LOW					
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry
Data Column ID: SE8i
Data Collection Date: 8/17/06
Square Size of Steel Data: 6 inches
Surface Type Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.409														
2 (0.0)	0.417	0.387	0.250	0.387	0.188	0.377	0.375	0.387	0.250	HIGH					
3 (-2.0)	0.414	0.351	0.250	0.351	0.250	0.374	0.125	0.351	0.375	HIGH					
4 (-4.0)	0.421	0.381	0.125	0.401	0.250	0.401	0.125	0.381	0.188	HIGH					
5 (-6.0)	0.414	0.394	0.125	0.404	0.188	0.404	0.125	0.384	0.188	MOD					
6 (-8.0)	0.407	0.387	0.750	0.387	0.250	0.387	0.750	0.397	0.250	LOW					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE8o

Data Collection Date: 8/17/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.413														
2 (0.0)	0.410	0.379	0.125	0.379	0.188	0.379	0.125	0.347	0.188	LOW					
3 (-2.0)	0.417	0.386	0.125	0.354	0.063	0.354	0.188	0.354	0.125	MOD					
4 (-4.0)	0.409	0.346	0.250	0.346	0.250	0.346	0.250	0.346	0.188	HIGH					
5 (-6.0)	0.409	0.346	0.250	0.346	0.188	0.346	0.375	0.346	0.250	HIGH					
6 (-8.0)	0.418	0.398	0.250	0.398	0.125	0.398	0.250	0.398	0.250	LOW					
7 (-10.0)	0.414	0.394	0.125	0.394	0.063	0.384	0.063	0.394	0.125	LOW					
8 (-15.0)	0.411	0.391	0.375	0.391	0.375	0.381	0.500	0.371	0.188	LOW					
9 (-20.0)	0.419	0.409	0.125	0.409	0.125	0.399	0.125	0.409	0.063	LOW					
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry
Data Column ID: SE9o
Data Collection Date: 8/17/06
Square Size of Steel Data: 6 inches
Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.371														
2 (0.0)	0.367	0.357	0.063	0.360	0.063	0.360	0.125	0.360	0.125	LOW					
3 (-2.0)	0.369	0.359	0.063	0.350	0.063	0.350	0.125	0.360	0.063	MOD					
4 (-4.0)	0.377	0.357	0.063	0.370	0.063	0.370	0.063	0.360	0.063	HIGH					
5 (-6.0)	0.386	0.346	0.063	0.370	0.063	0.370	0.063	0.380	0.063	HIGH					
6 (-8.0)	0.376	0.366	0.063	0.350	0.063	0.360	0.063	0.360	0.063	HIGH					
7 (-10.0)	0.370	0.350	0.063	0.350	0.063	0.360	0.125	0.350	0.063	MOD					
8 (-15.0)	0.369	0.339	0.063	0.350	0.031	0.350	0.063	0.360	0.031	LOW					
9 (-20.0)	0.370	0.350	0.063	0.360	0.063	0.360	0.063	0.360	0.063	LOW					
10 (-25.0)	0.379	0.369	0.063	0.370	0.031	0.370	0.031	0.370	0.031	LOW					

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry
Data Column ID: SE10i
Data Collection Date: 8/18/06
Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Inner Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.378														
2 (0.0)	0.385	0.375	0.063	0.380	0.031	0.380	0.031	0.380	0.031	LOW					
3 (-2.0)	0.372	0.357	0.063	0.352	0.063	0.357	0.063	0.357	0.031	LOW					
4 (-4.0)	0.386	0.367	0.063	0.366	0.094	0.376	0.063	0.366	0.094	LOW					
5 (-6.0)	0.376	0.366	0.063	0.366	0.063	0.366	0.063	0.366	0.063	MOD					
6 (-8.0)	0.375	0.370	0.063	0.365	0.063	0.370	0.063	0.370	0.063	LOW					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: Superior Entry

Data Column ID: SE10o

Data Collection Date: 8/8/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

Surface Type Outer Flange

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.374														
2 (0.0)	0.363	NR	NR	NR	NR	NR	NR	NR	NR	LOW					
3 (-2.0)	0.372	0.362	0.063	0.367	0.063	0.357	0.063	0.357	0.063	LOW					
4 (-4.0)	0.377	0.357	0.063	0.367	0.063	0.372	0.063	0.372	0.125	LOW					
5 (-6.0)	0.363	0.353	0.094	0.353	0.063	0.353	0.063	0.353	0.063	LOW					
6 (-8.0)	0.370	0.365	0.031	0.355	0.063	0.365	0.063	0.365	0.063	MOD					
7 (-10.0)	0.371	0.366	0.063	0.366	0.063	0.361	0.063	0.366	0.063	MOD					
8 (-15.0)	0.371	0.366	0.031	0.366	0.031	0.361	0.031	0.361	0.063	MOD					
9(-18.0)	0.367	0.362	0.063	0.362	0.031	0.362	0.063	0.362	0.063	MOD					
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: USACE Vessel Yard

Data Column ID: VY1i

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

Surface Type Outer Flange

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.381														
2 (0.0)	0.374	0.186	0.750	0.218	0.500	0.214	0.375	0.280	0.500	HIGH					
3 (-2.0)	0.343	0.280	0.250	0.218	0.250	0.243	0.250	0.280	0.250	MOD					
4 (-4.0)	0.378	0.268	0.250	0.355	0.250	0.293	0.188	0.324	0.188	MOD					
5 (-6.0)	0.390	0.296	0.375	0.327	0.250	0.327	0.375	0.296	0.125	HIGH					
6 (-8.0)	0.393	0.330	0.250	0.330	0.250	0.373	0.250	0.299	0.250	MOD					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: USACE Vessel Yard

Data Column ID: VY1o

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Surface Type Outer Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.376														
2 (0.0)	0.389	0.274	0.375	0.274	0.250	0.243	0.500	0.243	0.250	HIGH					
3 (-2.0)	0.384	0.300	0.188	0.331	0.240	0.331	0.375	0.300	0.250	HIGH					
4 (-4.0)	0.387	0.262	0.250	0.262	0.250	0.324	0.250	0.357	0.188	MOD					
5 (-6.0)	0.387	0.272	0.188	0.272	0.250	0.303	0.250	0.357	0.250	MOD					
6 (-8.0)	0.381	0.320	0.250	0.351	0.250	0.320	0.125	0.374	0.250	MOD					
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: USACE Vessel Yard
Data Column ID: VY2o
Data Collection Date: 8/21/06
Square Size of Steel Data: 6 inches
Surface Type Inner Flange

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.381														
2 (0.0)	0.377	0.330	0.500	0.299	0.500	0.299	0.625	0.264	0.500	HIGH					
3 (-2.0)	0.339	0.276	0.125	0.276	0.094	0.276	0.250	0.269	0.250	HIGH					
4 (-4.0)	0.385	0.352	0.250	0.295	0.125	0.352	0.125	0.321	0.250	MOD					
5 (-6.0)	0.381	0.342	0.375	0.396	0.125	0.336	0.188	0.326	0.250	MOD					
6 (-8.0)															
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															
6 feet	* Indicate elevation where data is required one (1) foot below the mud line.														

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:
Total Suspended Solids:
Hardness:
Total Iron:
Sulfate Ions:
Alkalinity:

Duluth Corrosion Study

Data Entry Sheet

US Army Corps of Engineers

Structure Location: USACE Vessel Yard

Data Column ID: VY2o

Data Collection Date: 8/21/06

Square Size of Steel Data: 6 inches

Corrosion Rating (CR): H = High (75 -100% Pitted)
M = Moderate (50 -75% Pitted)
L = Low (0 - 50% Pitted)

T = Overall Plate Thickness
P1r = Thickness of steel at pit 1
P1dia = Pit 1 diameter

Surface Type Outer Flange

	Steel Corrosion Data										Water Quality Data				
Elevation	T	P1r	P1dia	P2r	P2dia	P3r	P3dia	P4r	P4dia	CR	pH	Diss. Oxygen	Conduct-ivity	Turbidity	Temp
1 (+2.0)	0.384														
2 (0.0)	0.381	0.293	0.500	0.355	0.750	0.355	0.500	0.293	0.500	HIGH					
3 (-2.0)	0.379	0.307	0.375	0.338	0.375	0.369	0.250	0.338	0.250	HIGH					
4 (-4.0)	0.379	0.356	0.250	0.294	0.375	0.339	0.250	0.356	0.188	MOD					
5 (-6.0)															
6 (-8.0)															
7 (-10.0)															
8 (-15.0)															
9 (-20.0)															
10 (*)															
6 feet															

* Indicate elevation where data is required one (1) foot below the mud line.

Water quality data at this entry to be taken at the mud line or bottom.

Notes: 1. See Plates 1 through 9 for locations of data.

2. All steel measurements are in inches to the nearest thousandth of an inch.

3. All elevations are referenced from Low Water Datum = IGLD 1955

Water Sample Data at -4.0 Below LWD

Chloride Ions:

Total Suspended Solids:

Hardness:

Total Iron:

Sulfate Ions:

Alkalinity: