Addendum 1
File # 18-0116E (18-10AA)
Project: Dead Ship Two – Temporary Relocation of the William A. Irvin

This addendum serves to notify all bidders of the following changes to the solicitation documents:

Attached please find a list of additional information as well as the final tow plans dated 7.16.18.

Please acknowledge receipt of this Addendum by initialing and dating Addendum #1 at the bottom of the below the bid form.

Posted: 7.16.18
July 16, 2018

Re: William A. Irvin Dead Ship Tow Bid No. 18-0116E: Addendum #1
AMI Project # 181078

- The temporary guide wall structure may be left in place during the winter. The Contractor is responsible for coordinating navigational requirements with the USCG and reverifying the alignment of the guide structure prior to moving the Irvin back to MN Slip.

- The allowable deflection of the temporary guide wall will increase as the vessel moves further from the MN Slip Pedestrian Bridge. The maximum allowable deflection at the outer corner of the dock wall will be 6”. The maximum allowable deflection will linearly increase to 2'-0” at 200 lineal feet from the corner of the dock wall.

- Five of the six deck winches will be fully operational by the time the vessel needs to be removed from the slip. Benson Electric Company out of Superior, WI will inspect & test the carbon brushes, brush holders and commutators, winch controls & brakes. The forward deck winch will not be operational.

- Three of the five operational deck winches have 200 feet of steel cable. One of the midship deck winches has 300 feet of steel cable and one of the stern deck winches have 400 feet of cable. All the cables are less than one year old and have been certified. One of the cable certifications showing the results of the mill test & load tests has been included to this addendum. The Contractor is responsible for supplying additional steel cable if they determine it to be necessary.

- The decorative anchor on the stern and the third anchor attached to the bow anchor will need to be removed prior to moving the vessel. The anchors may be removed and left at the DECC. The Contractor will be responsible for removing the anchors, moving the anchors to the specified storage area at the DECC and reinstalling the anchors on the Irvin once it returns to MN Slip in the Spring of 2019.

- The vessel will be at Fraser Shipyards, Inc. (Fraser) from the Fall of 2018 to the Spring of 2019. The Contractor is responsible for towing the vessel to & from Fraser and properly securing the vessel at Fraser & MN Slip. Fraser personnel will be responsible for moving the vessel in & out of the dry dock. The exact location of the vessel at Fraser is undetermined and the Contractor is responsible for coordinating the vessels location prior to the tow.

- The docks & boats along the Canal Park (East) side of MN Slip will not be removed until October 1st, 2018. The Contractor is responsible for working around the docks and boats while there are in the marina. The City will notify that no boats shall enter or leave MN Slip while the Contractor is moving the vessel. The United States Coast Guard (USCG) will also provide a safety perimeter during the relocation of the vessel.

- All the doors on the vessel do lock but the forward doors are all constructed of wood.
The DECC will be responsible for securing any items in the vessel associated with the “Haunted Ship”, the gift shop, concessions and museum tours. The Contractor shall coordinate with the DECC on any items not properly secured by the time of the move.

The Contractor shall be responsible for securing the bridge crane above the engine room and the deck crane which is utilized to remove the hatch covers.

Additional water ballast can not be added to the vessel since the sea chests have been completely welded shut.

Since the steel bridge members of the MN Slip Pedestrian Bridge overhang the face of the concrete abutment on the canal park side (east side), the City of Duluth will issue a separate contract to pull the steel members past the face of the concrete abutment. The steel bridge members on the DECC side (west side) will not be altered. It is the responsibility of the Contractor to coordinate with the DECC, City of Duluth & the Contractor performing the required bridge work. The bridge Contractor will also be required to provide a redundant system to hold the bridge members in position during the relocation process.

The size of the tugs in the slip after the MN Slip cleanup project in the fall of 2018, will be restricted to “Tender Tugs” with a maximum draft depth of 7 feet. The maximum propeller horsepower of the tugs shall not exceed 400 HP. The size of the tug inside the slip prior to the cleanup project is not restricted but the Contractor shall review the existing bathymetry of the slip. The size of the tug outside of the slip is also not restricted.

Power to the vessel is currently provide by shore. The emergency generator onboard does currently generate power but the operation of it is unknown. The Contractor shall determine how to transfer power from the emergency generator to the vessel or will be responsible for providing temporary power to the Irvin during the relocation process if required.

The new dock wall, which is currently being constructed, will include eight new 65-ton staghorn bollards spaced at approximately 100-foot intervals. The plans have been updated to include the approximate location of the bollards.

AMI Consulting Engineers performed an underwater inspection of the hull. The final report titled “SS William A Irvin Underwater Hull Inspection” dated June 26th, 2018 has been provided for information purposes. This document is referred to as Appendix B in the project specifications.

The propeller and rubber of the vessel are not adequately locked out. This information was confirmed during the project walkthrough on June 27th, 2018 with potential Contractors.

The Contractor is responsible for confirming the number & size of hull penetrations and if covers will be necessary.
• The Contractor is responsible for determine if the existing seals around the propeller shaft need to be repacked prior to the movement of the Irvin. If necessary, the Contractor shall repack the seals as necessary.

• Contractor is responsible for verify the amount of potential pollutants on the vessel prior to the relocation of the vessel.

• The Contractor is responsible for determining the air draft of the vessel and determining if any overhead obstructions may impact the movement/tow of the vessel.

• The damaged steel plates documented at the bow of the vessel will be the responsibility of the DECC.

• The drawing set has been updated to include additional information of the current condition of the Irvin, the condition of the new seawall at the time of the vessel movement, and other miscellaneous information.

If you have any questions or comments, please contact AMI at (715) 718-2193 extension 17.

Respectfully Submitted,

Chase Dewhirst
Marine Engineering Manager
MILL TEST CERTIFICATE

Customer: Messrs SOUTHWEST WIRE ROPE INC
Supplier: Messrs MANHO ROPE & WIRE LTD.
L/C No.: D/A
Commodity: UNGALVANIZED STEEL WIRE ROPE
Construction: 6XWS36 IWRC
Specification: API 9A
Order Quantity: 5,000.00 Feet
Gross Weight: Net Weight 27,740.59 Lbs

TEST RESULT

Rope Dia 1 0/0 (Actual) 1.026 Inch Preforming GOOD
Kind of Lay R.H.R.L
Length of Lay 6.15 Inch
Specified Breaking Strength of Wire Rope 103,400.00 Lbs
Actual Breaking strength of Wire Rope 105,820.00 Lbs
Nominal Dia. of Wire 0.057 Inch
Tensile Strength of Wires Min 194 Max 196 Kg / mm²
Number of Torsion of Wires Min 32 Max 36 Times
Weight of Zinc Coating

CHEMICAL ANALYSIS OF WIRE ROD

<table>
<thead>
<tr>
<th>Heat No.</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF66057</td>
<td>0.7311</td>
<td>0.204</td>
<td>0.652</td>
<td>0.0116</td>
<td>0.0038</td>
</tr>
</tbody>
</table>

REMARKS TORSION TEST LENGTH: 1000D

Manho Rope & Wire Ltd.

MHS-B102-31

(203X280)
June 26, 2018

Erik Birkland  
City of Duluth  
1532 West Michigan Street  
Duluth, MN 55806

Re: SS William A Irvin Underwater Hull Inspection  
AMI Project # 171295

Mr. Birkland:

This letter is written in regards to the underwater visual inspection AMI Consulting Engineers, PA (AMI) performed on the steel hull of the Vessel SS William A. Irvin (Irvin). The Irvin is located in Minnesota Slip (MN Slip) adjacent to the Duluth Entertainment Convention Center (DECC) in Duluth, MN. The purpose of the inspection was to visually inspection the hull below the waterline for damage or deterioration and assess the corrosion of the hull.

**Background Information**

Based on the historical construction drawings, the Irvin was a Great Lakes bulk carrier originally constructed in 1937. The vessel was in the fleet until 1978 when it was retired. The Irvin sat dormant until it was purchased by the DECC in 1986. Based on American Bureau of Shipping (ABS) records, the vessel was last in dry-dock in 1981 when the hull was repainted and the sea chests were sealed shut with ⅜” thick plate. The vessel was then moved to MN Slip where it is currently located. The steel plating below the waterline consists of ½”, ⅝” & ¾” thick steel plating. The steel plating was primarily riveting together but some welding was documented on areas of the hull.

**Procedures for Inspection**

The AMI Engineering inspection team consisted of one professional engineer diver and two divers/tenders. Surface supplied diving techniques were utilized during all phases of the underwater inspection process to meet OSHA, US Coast Guard, and Association of Diving Contractors International (ADCI) standards to ensure proper safety at all times. The divers used an underwater helmet mounded video camera to document the existing condition of the dock wall for future review by the City, DECC & AMI personnel.

The divers performed a Level I underwater inspection of the steel hull below the waterline where access was available. A level I inspection consists of documenting any areas of damage, major deterioration, or irregularities that can be observed visually or tactilely below the waterline without removing any marine grown/ life. At three different locations, the steel hull was cleaned and a corrosion assessment was performed. This assessment was completed with an ultrasonic thickness (UT) gage and a pipe pit gage to determine the average remaining thickness of the hull plating. The UT gage requires a relatively flat surface to accurately measure the remaining steel thickness. When a flat surface was not present, pit measurements were performed with the pipe pit gage to measure the penetration of the pit into the hull. Corrosion documentation is important to determine effects of microbiologically induced corrosion (MIC) which is a known cause of accelerated steel loss in the Duluth – Superior Harbor.

To describe the marine growth on the hull, the divers used terminology standardized in the United States Navy (US Navy). The US Navy uses the term “Fouling Rating Scale” & “Fouling Percentages” to
describe the amount of unwanted material that has accumulated on the surface. Fouling Rate Scale (FR) is based on a rating number that increase from 0 to 100 on 10-point increments. Each FR designation represents different types of marine growth with the lowest severity of marine growth with a FR 0 to the highest severity of marine growth with FR 100. The standard table of the different FR is presented in Table 1 & picture examples of each FR is also provided in Attachment C.

<table>
<thead>
<tr>
<th>Type</th>
<th>Fouling Rating (FR)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft</td>
<td>0</td>
<td>A clean, foul-free surface; red and/or black AF paint or a bare metal surface.</td>
</tr>
<tr>
<td>Soft</td>
<td>10</td>
<td>Light shades of red and green (incipient slime). Bare metal and painted surfaces are visible beneath the fouling.</td>
</tr>
<tr>
<td>Soft</td>
<td>20</td>
<td>Slime as dark green patches with yellow or brown colored areas (advanced slime). Bare metal and painted surfaces may be obscured by the fouling.</td>
</tr>
<tr>
<td>Soft</td>
<td>30</td>
<td>Grass as filaments up to 3 inches (76 mm) in length, projections up to 1/4 inch (6.4 mm) in height; or a flat network of filaments, green, yellow, or brown in color; or soft non calcareous fouling such as sea cucumbers, sea grapes, or sea squirts projecting up to 1/4 inch (6.4 mm) in height. The fouling can not be easily wiped off by hand.</td>
</tr>
<tr>
<td>Hard</td>
<td>40</td>
<td>Calcareous fouling in the form of tubeworms less than ¼ inch in diameter or height.</td>
</tr>
<tr>
<td>Hard</td>
<td>50</td>
<td>Calcareous fouling in the form of barnacles less than ¼ inch in diameter or height.</td>
</tr>
<tr>
<td>Hard</td>
<td>60</td>
<td>Combination of tubeworms and barnacles, less than ¼ inch (6.4 mm) in diameter or height.</td>
</tr>
<tr>
<td>Hard</td>
<td>70</td>
<td>Combination of tubeworms and barnacles, greater than ¼ inch in diameter or height.</td>
</tr>
<tr>
<td>Hard</td>
<td>80</td>
<td>Tubeworms closely packed together and growing upright away from surface. Barnacles growing one on top of another, ¼ inch or less in height. Calcareous shells appear clean or white in color.</td>
</tr>
<tr>
<td>Hard</td>
<td>90</td>
<td>Dense growth of tubeworms with barnacles, ¼ inch or greater in height; Calcareous shells brown in color (oysters and mussels); or with slime or grass overlay.</td>
</tr>
<tr>
<td>Composite</td>
<td>100</td>
<td>All forms of fouling present, Soft and Hard, particularly soft sedentary animals without calcareous covering (tunicates) growing over various forms of hard growth.</td>
</tr>
</tbody>
</table>

**Existing Conditions**
AMI mobilized to the project site on June 3rd, 2018 to begin its underwater inspection of the hull. The divers stationed the entire length of vessel and utilized the diver’s umbilical to determine the location along the hull of the Irvin. The stern of the vessel was selected as STA 0+00. All defects documented during the inspection can be reviewed in Appendix A & B. The following is a summary of our inspection and should be used in conjunction with the appendices.

The marine growth and corrosion documented on the hull of the vessel was typical of other facilities around the Duluth-Superior Harbor. A light marine growth or algae was documented over the entire surface area of the hull which would be described as a FR 10 to 30 with 100% coverage. Below the light layer of algae, rust tubercles were documented from the waterline to 6'-0" below the waterline. The rust tubercles have a harder surface with a FR rating of 60 with 70% to 80% coverage from the waterline to 4'-0" below the waterline. The concentration of the rust tubercles significantly dropped off at 4'-0" to 6'-0" below the water and no rust tubercles were documented below 8'-0". The bottom of the vessel is approximately 10'-0" below the waterline and only the light marine growth or algae was documented.

Below the rust tubercles, steel corrosion of the hull was documented in the form of overlapping pits. The highest concentration of pitting was documented from the waterline to 4'-0" below the waterline with a coverage of 70% to 80%. The concentration of the pits dropped off below 4'-0" and no pits were documented below the 8'-0" as described with the rust tubercles above.

The penetration of the pits documented between the waterline and 4'-0" below the waterline ranged from approximately 3/16" to 9/32". The size or diameter of the pits also ranged from 5/16" to 1” along the
same water depth range. The corrosion transitioned to a light etching below 4’-0” and no corrosion was documented below 8’-0”. The average pit penetration of all the corrosion assessments was approximately 0.222”. A typical condition of the corrosion on the hull can be seen in Picture 1.

![Picture 1: Typical Condition of the Corrosion](image)

During the inspection, AMI also documented the condition of the coating that was applied in 1981. However, due to the low visibility of the water at the time of the inspection, AMI was unable to verify the condition of the coating and document any deterioration. But due to the amount of pitting documented, it is likely that the coating near the waterline is severely deteriorated and is no longer protecting the steel hull from corrosion.

**Conclusions**

Based on other scientific studies that AMI has been involved with over the past twelve years, the average corrosion rate in the Duluth-Superior Harbor is approximately 0.0107 inches per year on standard uncoated ASTM A36 steel.

The highest concentration of the corrosion was documented between the waterline and 4’-0” below the waterline with an average pit depth of 0.222”. Base on the historical construction drawings of the Irvin, the hull plating near the waterline was constructed of ¾” or ⅝” thick steel plates. However, at the overlaps or seams in the hull, the hull plating tapers down to approximately ½”. The sea chests were also sealed up with approximately ⅜” thick steel plate. The effects of the corrosion and the different estimated times to perforations in steel plating are summarized in Table 1 for the different steel thicknesses below the waterline.

<table>
<thead>
<tr>
<th>Nominal Thickness</th>
<th>Actual Thickness [in]</th>
<th>Min Steel Thickness at Base of Pit [in]</th>
<th>% Steel Loss</th>
<th>Estimated Time to Perforations</th>
</tr>
</thead>
<tbody>
<tr>
<td>⅜”</td>
<td>0.375</td>
<td>0.153</td>
<td>59%</td>
<td>15 to 20 Years</td>
</tr>
<tr>
<td>½”</td>
<td>0.465</td>
<td>0.243</td>
<td>48%</td>
<td>20 to 25 Years</td>
</tr>
<tr>
<td>⅝”</td>
<td>0.637</td>
<td>0.415</td>
<td>35%</td>
<td>40 to 45 Years</td>
</tr>
<tr>
<td>¾”</td>
<td>0.759</td>
<td>0.537</td>
<td>29%</td>
<td>50 to 55 Years</td>
</tr>
</tbody>
</table>

Table 2: Results of Corrosion Assessment & Estimated Time to Perforations

Perforations of the ⅜” steel plates are likely to occur in 15 to 20 years. But the locations of the ⅜” steel plates are isolated to the sea chests, so the condition of these plates will have little impact on the overall structural integrity of the hull. Perforations of the hull at the overlaps where ½” steel is located, are likely to occur in 20 to 25 years. The amount of corrosion documented resulted in an approximate steel loss of
48% in these areas. Based on this information, the overlaps in the steel plating are the most susceptible to damage if the hull is not protected from further corrosion.

Lower corrosion rates have been documented closer to the Duluth Entry, so the corrosion rate is likely not as severe as 0.0107 inches per year. On previous projects, a corrosion rate could be estimated from the data collected and the known historical information. But there are several variables in particular to this project that make it difficult to determine a corrosion rate. One difficulty is determining when the corrosion on the hull started. Based on scientific studies, it is believed that the type of corrosion in the Duluth-Superior Harbor (MIC) did not occur until approximately 1972 when the Clean Water Act was enacted. The hull of the vessel was also coated in 1981 and would prevent any future corrosion until the coating became deteriorated. It is also likely that some corrosion did occur on the steel hull prior to being coated in 1981, but the extent of that deterioration is unknown. Due to these unknowns, AMI utilized the known corrosion rate of 0.0107 inches per year.

Recommendations
After reviewing all of the data and assessing the existing site conditions, AMI Consulting Engineers, makes the following recommendations. Due to the condition of the hull and AMI’s knowledge of the Duluth-Superior Harbor, AMI’s recommends that the hull of the vessel be coated with a corrosion resistant epoxy coating. AMI based its recommendation of the following items:

- The vessel is required to be moved from its current location in MN Slip due to the remediation of the contaminated sediments in MN Slip. The vessel will already be relocated to Fraser Shipyards where the hull could be recoated and other repairs could be performed.
- While the vessel is in dry-dock, the hull could be inspected more thoroughly to document and potentially remediate any deteriorated sections of the hull.
- The vessel will be at greater risk of major structural damage if the vessel is moved out of MN Slip in the future. The corrosion will continue to deteriorate the steel hull causing steel members to become thinner. The risk of severe structural damage will increase as the steel members become thinner.
- The cost to remove the vessel from MN Slip will only become more expensive in the future.
- Coating the vessel in the wet could be completed but the longevity of the coating once applied is much less than when it is applied in a dry controlled environment.
- Mobile cofferdams have also been utilized to coat & repair vessels below the waterline but the cost of equipment, labor & difficult access to the vessel would make this option not viable.

If you have any questions or comments, please contact AMI at (715) 718-2193 extension 17.

Respectfully Submitted,

Chase Dewhirst, PE
Marine Engineering Manager

Reviewed by,
Chad W. Scott, PE
Principal

Enclosed:
- Appendix A - Underwater Inspection Notes
- Appendix B - Corrosion Assessment Results
- Appendix C - Picture Examples of Typical Fouling Ratings (Provided by Nordic Group “Underwater Ship Husbandry Manual” Revision 1, Dated July 28th, 2017)
- Appendix D - Historical William A. Irvin Construction Drawings “Midship Section”
APPENDIX A – UNDERWATER INSPECTION NOTES
<table>
<thead>
<tr>
<th>Station</th>
<th>Video Time/ Ref.</th>
<th>Depth (ft)</th>
<th>Corrosion</th>
<th>Degree</th>
<th>Cracking</th>
<th>Hole</th>
<th>Marine Growth</th>
<th>Protective Coat'g Present</th>
<th>Impact Damage</th>
<th>Protective Coat'g NDT</th>
<th>Protective Coat'g NDT Gauge Value (in.)</th>
<th>Debris</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+00</td>
<td>-16:00:00</td>
<td>-</td>
<td>X</td>
<td>Pitting</td>
<td>60</td>
<td>100%</td>
<td>70 - 80</td>
<td>100%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Pit = 1/2&quot; Long x 3/16&quot; Pen with Zebra Mussels</td>
</tr>
<tr>
<td>0+50</td>
<td>9:12:00</td>
<td>0</td>
<td>X</td>
<td>Pitting</td>
<td>60</td>
<td>100%</td>
<td>50-70</td>
<td>65% to 100%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-0:12:00</td>
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</tr>
<tr>
<td>1+20</td>
<td>0.28:00</td>
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<td>1+90</td>
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<td>X</td>
<td>Pitting</td>
<td>-</td>
<td>-</td>
<td>20-30</td>
<td>100%</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Comments**

- Some light marine growth over heavy pitting (Marine Growth: FR = 20-30)
- Unable to determine if coating is intact due to trapped air & poor visibility. No
- Pitting or major corrosion documented
- Pitting stops at 6'-0" below the WL and no pits were documented on the bottom
- Pitting appears to be less on port Side than starboard side
- Debris is approximately 1'-6" from bottom of hull (Approx 6'-6" from ML to Hull) //
- Approx. located in line with the south corner of the fourth recreation dock on East side of MN Slip.
- Unable to determine if coating is intact due to trapped air & poor visibility.
APPENDIX B – CORROSION ASSESSMENT RESULTS
Corrosion Inspection

Station: 1+90  
Inspection Date: 6/3/2018

Total Water Depth: 16 Feet  
Vessel Side: Starboard

<table>
<thead>
<tr>
<th>Depth Below WL</th>
<th>Item / Location</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Average</th>
<th>% Coverage/ Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>WL (0')</td>
<td>Pit Penetration</td>
<td>0.25</td>
<td>0.1875</td>
<td>0.219</td>
<td>0.219</td>
<td>70 to 80%</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>0.5</td>
<td>1</td>
<td>0.75</td>
<td>0.750</td>
<td></td>
</tr>
<tr>
<td>2'</td>
<td>Pit Penetration</td>
<td>0.2188</td>
<td>0.21875</td>
<td>0.188</td>
<td>0.208</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>0.5</td>
<td>0.75</td>
<td>1.25</td>
<td>0.833</td>
<td></td>
</tr>
<tr>
<td>4'</td>
<td>Pit Penetration</td>
<td>0.1875</td>
<td>0.28125</td>
<td>0.219</td>
<td>0.229</td>
<td>80 to 90%</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>0.3125</td>
<td>0.5</td>
<td>0.75</td>
<td>0.521</td>
<td></td>
</tr>
<tr>
<td>6'</td>
<td>Pit Penetration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20% Uniform Etching (Beginning of Curve Plate)</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>8'</td>
<td>Pit Penetration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>15% Uniform Etching (FR = 60) // 100% Marine Growth (FR = 10) // Bottom of Curve Plate</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>10'</td>
<td>Pit Penetration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100% Coverage of Marine Growth (FR = 10) // Bottom of Vessel</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Note: Pit Measurements are in inches

Ultrasonic Thickness Inspection

<table>
<thead>
<tr>
<th>Depth Below WL</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Avg</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>WL (0')</td>
<td>0.750</td>
<td>-</td>
<td>-</td>
<td>0.750</td>
<td>-</td>
</tr>
<tr>
<td>7'</td>
<td>0.725</td>
<td>0.725</td>
<td>0.720</td>
<td>0.723</td>
<td>Start of Curve Plate</td>
</tr>
<tr>
<td>9'/10'</td>
<td>0.760</td>
<td>0.765</td>
<td>0.765</td>
<td>0.763</td>
<td>Bottom of Curve Plate</td>
</tr>
</tbody>
</table>

Note: UT Measurements are in inches
## Corrosion Inspection

Station: 3+96  
Inspection Date: 6/3/2018

Total Water Depth: - Feet  
Vessel Side: Starboard

### Pitting Inspection

<table>
<thead>
<tr>
<th>Depth Below WL</th>
<th>Item / Location</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Average</th>
<th>% Coverage/ Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0' to 2'</td>
<td>Pit Penetration</td>
<td>0.21875</td>
<td>0.1875</td>
<td>0.25</td>
<td>0.219</td>
<td>Pitting = 70% Coverage // Maring Growth = 100% Coverage (FR = 20)</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>0.75</td>
<td>0.5</td>
<td>0.5</td>
<td>0.583</td>
<td></td>
</tr>
<tr>
<td>2' to 4'</td>
<td>Pit Penetration</td>
<td>0.1875</td>
<td>0.21875</td>
<td>0.188</td>
<td>0.198</td>
<td>Pitting = 15% Coverage @ 4'-0&quot; // Maring Growth = 100% Coverage (FR = 20)</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>0.5</td>
<td>0.75</td>
<td>0.5</td>
<td>0.583</td>
<td></td>
</tr>
<tr>
<td>4' to Bottom of Hull</td>
<td>Pit Penetration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>No Pitting // Marine Growth = 100% (FR = 20)</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Note: Pit Measurements are in inches

### Ultrasonic Thickness Inspection

<table>
<thead>
<tr>
<th>Depth</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Avg</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>WL (0')</td>
<td>0.745</td>
<td>0.745</td>
<td>0.750</td>
<td>0.747</td>
<td>-</td>
</tr>
<tr>
<td>2'</td>
<td>0.745</td>
<td>0.755</td>
<td>0.750</td>
<td>0.750</td>
<td>-</td>
</tr>
<tr>
<td>4'</td>
<td>0.695</td>
<td>0.745</td>
<td>0.720</td>
<td>0.720</td>
<td>Above Curve Plate</td>
</tr>
<tr>
<td>6'</td>
<td>0.720</td>
<td>0.715</td>
<td>0.700</td>
<td>0.712</td>
<td>Below Curve Plate</td>
</tr>
</tbody>
</table>

Note: UT Measurements are in inches
# Corrosion Inspection

Station: 5+61  
Inspection Date: 6/3/2018

Total Water Depth: - Feet  
Vessel Side: Starboard

## Pitting Inspection

<table>
<thead>
<tr>
<th>Depth Below WL</th>
<th>Item / Location</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Average</th>
<th>% Coverage/ Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0' to 2'</td>
<td>Pit Penetration</td>
<td>0.21875</td>
<td>0.21875</td>
<td>0.25</td>
<td>0.229</td>
<td>Pitting = 80% Coverage // Maring Growth = 100% Coverage (FR = 10)</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>0.5</td>
<td>0.625</td>
<td>0.75</td>
<td>0.625</td>
<td></td>
</tr>
<tr>
<td>2' to 4'</td>
<td>Pit Penetration</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.250</td>
<td>Pitting = 30% Coverage @ 4'-0&quot; // Maring Growth = 100% Coverage (FR = 20)</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>1</td>
<td>0.75</td>
<td>1</td>
<td>0.917</td>
<td></td>
</tr>
<tr>
<td>4' to Bottom of Hull</td>
<td>Pit Penetration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Minor Etching &amp; decreases further from WL // Marine Growth = 100% (FR = 20)</td>
</tr>
<tr>
<td></td>
<td>Pit Diameter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Note: Pit Measurements are in inches

## Ultrasonic Thickness Inspection

<table>
<thead>
<tr>
<th>Depth</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Avg</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0' to 2'</td>
<td>0.675</td>
<td>0.680</td>
<td>0.660</td>
<td>0.672</td>
<td></td>
</tr>
<tr>
<td>2' to 4'</td>
<td>0.670</td>
<td>0.675</td>
<td>0.665</td>
<td>0.670</td>
<td></td>
</tr>
<tr>
<td>4' to 6'</td>
<td>0.570</td>
<td>0.585</td>
<td>0.575</td>
<td>0.577</td>
<td></td>
</tr>
</tbody>
</table>

Note: UT Measurements are in inches
APPENDIX C – PICTURES OF TYPICAL FOULING RATINGS

Provided by Nordic Group “Underwater Ship Husbandry Manual” Revision 1, Dated July 28th, 2017
Figure 081–1–1. Typical Fouling Ratings (FR) in Order of Increasing Severity (22 Photos)

Figure 081-1-1 (SH1) FR-10, Over 30 Percent Of Area (Sheet 1 of 22).

Figure 081-1-1 (SH2) FR-10, Over 100 Percent Of Area (Sheet 2 of 22).
Figure 081-1-1 (SH3) FR-20, Over 80 Percent Of Area (Sheet 3 of 22).

Figure 081-1-1 (SH4) FR-30, Over 40 Percent Of Area (Sheet 4 of 22).
Figure 081-1-1 (SH5) FR-40, Over 20 Percent Of Area (Sheet 5 of 22).

Figure 081-1-1 (SH6) FR-40, Over 30 Percent Of Area (Sheet 6 of 22).
Figure 081-1-1 (SH7) FR-40, Over 90 Percent Of Area (Sheet 7 of 22).

Figure 081-1-1 (SH8) FR-50, Over 20 Percent Of Area (Sheet 8 of 22).
Figure 081-1-1 (SH9) FR-50, Over 40 Percent Of Area (Sheet 9 of 22).

Figure 081-1-1 (SH10) FR-50, Over 100 Percent Of Area (Sheet 10 of 22).
Figure 081-1-1 (SH11) FR-60, Over 15 Percent Of Area (Sheet 11 of 22).

Figure 081-1-1 (SH12) FR-60, Over 20 Percent Of Area (Sheet 12 of 22).
Figure 081-1-1 (SH13) FR-60, Over 90 Percent Of Area (Sheet 13 of 22).

Figure 081-1-1 (SH14) FR-70, Over 20 Percent Of Area (Sheet 14 of 22).
Figure 081-1-1 (SH15) FR-70, Over 80 Percent Of Area (Sheet 15 of 22).

Figure 081-1-1 (SH16) FR-80, Over 60 Percent Of Area (Sheet 16 of 22).
Figure 081-1-1. (SH17) FR-80, Over 80 Percent Of Area (Sheet 17 of 22).

Figure 081-1-1 (SH18) FR-80, Over 90 Percent Of Area (Sheet 18 of 22).
Figure 081-1-1 (SH19) FR-90, Over 90 Percent Of Area (Sheet 19 of 22).

Figure 081-1-1 (SH20) FR-90, Over 90 Percent Of Area (Sheet 20 of 22).
Figure 081-1-1 (SH21) FR-100, Over 50 Percent Of Area (Sheet 21 of 22).

Figure 081-1-1 (SH22) FR-100, Over 100 Percent Of Area (Sheet 22 of 22).
APPENDIX D – HISTORICAL WILLIAM A. IRVIN CONSTRUCTION DRAWINGS “MIDSHIP SECTION”
CITY OF DULUTH, MINNESOTA
IRVIN RELOCATION DESIGN
ST. LOUIS COUNTY
DULUTH, MINNESOTA

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218.529.8200

PERMITTING
JULIE A. KLOSS MOLINA
JKLOSSMOLINA@BARR.COM

Know what's below.
Call before you dig.

TOW ROUTE
FRASER SHIPYARDS

MINNESOTA SLIP
DULUTH / SUPERIOR HARBOR

SHEET INDEX
COV Cover Sheet
S1.0 Plans & Sections
S2.0 Irvin Section 1+53
S3.0 Irvin Section 2+65
S4.0 Irvin Section 3+86
S5.0 Irvin Section 4+82
S6.0 MN Slp Ped. Bridge Survey
S7.0 Dock Wall Details
S8.0 Irvin Plan - Anchor & Mooring
S8.1 Irvin Anchors & Mooring Photos

Governing Specifications

Go to www.barr.com for more information about the services we offer and how we can help you meet your goals.

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715.718.2193

www.amiengineers.com

E-mail: info@amiengineers.com

About this document

This document is intended to be a guide and may contain inaccuracies.

It is important to verify all information before proceeding.

Please contact your local authorities for the most current information.

Call before you dig.
MAX VELOCITY OF VESSEL DURING MOVEMENT =
MAX SUSTAINED WIND SPEED =
MAX WIND GUST SPEED =
MAX WAVE HEIGHT =
MAX CURRENT =

MINNESOTA SLIP - PLAN

SS. WILLIAM A. IRVIN - PLAN

OPTION 1 - WOOD PILES

OPTION 2 - SPUD BARGES

MAX VELOCITY OF VESSEL DURING MOVEMENT = 1 FT PER EVERY 4 SECONDS
MAX SUSTAINED WIND SPEED = 5 MPH
MAX WIND GUST SPEED = 10 MPH
MAX WAVE HEIGHT = 6 INCHES
MAX CURRENT = 0.5 FT / SEC
ARVIN SECTION AT STA V: 1 + 53

2. ALL MEASUREMENTS HAVE AN ACCURACY OF ±1.
Irvin Section at Sta. V: 2 + 65

1. Stationing begins at the stern of the Irvin at the extreme measurement of Top of Pl by 1. SEE 2/1.1.0.
2. All measurements have an accuracy of ±1.
1. Stationing begins at the stern of the Irvin at the extreme measurement of top of plate 1. See S1.0.
2. All measurements have an accuracy of 1".
IRVIN SECTION AT STA: V. 4 + 85

1. STATIONING BEGINS AT THE STERN OF THE IRVIN AT THE EXTREME MEASUREMENT OF TOP OF PLATE 1. SEE 2/S1.0.
2. ALL MEASUREMENTS HAVE AN ACCURACY OF ±1.
MINNESOTA SLIP PEDESTRIAN BRIDGE

NOTES:

1. Dimensions are in feet and inches. Tolerances shall be in accordance with the Contract Documents.

2. This drawing is subject to the requirements of the Contract Documents. It is intended for use as a guide for fabrication and construction.

3. Consult the Contract Documents for complete specifications.

4. Submit all questions regarding this drawing to the Project Manager.
S7.0 DETAILS

Irvin Relocation Design
City of Duluth
350 Harbor Drive
Duluth, Minnesota

Dock Wall Details

S7.0

181078
07.10.18
SAJ

CAD

Typical Dock Wall - STA 0 + 00 TO 6 + 65

Typical Dock Wall - STA 6 + 65 TO 7 + 91

Typical Dock Wall - STA 7 + 91 TO 9 + 00 & 9 + 25 TO 9 + 72

Typical Dock Wall Plan - STA 0 + 00 TO 6 + 65

Typical Dock Wall Plan - STA 6 + 65 TO 7 + 91