TWO GATE FISH PROTECTION PLAN

Preliminary Construction Submittal (90%)

PREPARED FOR:		BY:	
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References

1. Moffatt & Nichol Drawing 6097-03, "Two Gate Fish Protection Plan," 100% Submittal.
2. Glosten Report, "Two Gate Fish Protection: Barge Survey and Suitability Report," 8 June 2009.
3. Code of Federal Regulations, Title 46.
4. Marine Safety Manual, Volume IV – Technical.
5. General Hydrostatics Software Suite, Creative Systems, Inc., v. 11.42.

Project Summary

The Two Gate Fish Protection Plan consists of two pairs of butterfly gates to be installed at the Old River and Connection Slough sites of the Sacramento River Delta near Bacon Island. The objective of the gates is to control salinity incursion in the river. The gates are to be mounted on barges that serve both as a foundation and a means of transporting, installing, and removing the gates at the prepared sites. This report and attachments form a preliminary design for the barge and gate foundations. It is anticipated that the next design phase will take place with a selected contractor, at which point the engineering can be refined and details developed.

A preliminary design of a barge and gate foundation was developed for each of the two sites using the specifications and drawings issued by Moffatt & Nichol, Reference 1. The resulting design satisfies the requirements and specifications given. Technical solutions have been found that include the use of existing barges as the supporting structure, with new spud piles and casings to facilitate the placement of the units at the prepared river gravel bed. Removal of the barge/gate structures will be by salvage methods and is not considered in detail in this report. This approach is considered to be the preferred solution given the project schedule and budget constraints. A list of engineering tasks to be included in the next phases of the design is included.

Design Criteria

The following section is a summary of the design basis and the required criteria imposed on the gate design.

Objective

Barge gates:

1. Form a system component for controlling salinity incursion.
2. Are intended to pass floodwaters during high water events.
3. Allow small boat traffic transit during normal conditions.

The expected life span of the barge performing these objectives is 5 years.

Site Restrictions / Geometric Constraints

1. Length is not restricted, within reason.
2. Breadth is nominally 50', but will be controlled by the barge floating stability, barge grounded stability, and gate foundation geometry.
3. Barge depth is not restricted, but per Reference 1, the barge deck for the Connection Slough location is fixed at EL -13.00' and EL -19.17 for the Old River location. The sill and seal bar will be higher as defined in Reference 1.

Loads

The gate structure reaction loads into the barge for both sites are taken from Reference 1.

Loads into the barge from the gate via the HDPE track are estimated to be 15 kips, as provided by Dr. Michel Benoit of Moffat & Nichol on May 27, 2009, via email.

The water levels, per References 1 will have a maximum water differential of 3.5 ft (EL +6.6' and EL 3.1') between the upstream and downstream sides of the structure.

The differential heads used in the calculations for sizing the internal structure will be based on the actual values found using hydrostatics modeling.

Allowables

Structure

Local barge structure will be evaluated using *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*, 2007.

Longitudinal strength will be compared to the ABS maximum combined hull stress of 11.33 LT/in^2, as taken from *ABS Rules for Building and Classing Steel Vessels*.

For first principle calculations, the Allowable Stress Design (AISC) method will be used with the design loads.

Stability

Transport stability will be evaluated using both righting energy and wind heel calculations, as per the following CFRs:

1. Righting Energy - 46 CFR 174.015, modified for inland vessels per Marine Safety Manual Vol IV 6.E.20.k.
2. Wind Heel - 46 CFR 170.170, Weather criteria for vessels operating on protected waters.

Submerging and raising stability will be evaluated for 3" of positive metacentric height (GM) over a range of 6 degrees of heel at each step.

Operations

The following discrete operations will be planned for and engineered to support:

- Transport.
- Installation – ballasting, positioning, driving pile, lowering on jacks and locking in position with clamps on spud piles. Required submerging and raising times have not been defined; however, there will be hang points identified in the operating procedure, at which ballasting can cease for an extended time.
- Flood (high water) – open and closing of gates (cycles per year and open/close times per M&N).
- Small Boat Transit – open and closing of gates (cycles per year and open/close times per M&N). Water depth and clear opening per References 1.

Design Overview

The Old River gate and Connection Slough gate barges are to be constructed by modifying existing barges *Ignacio* and *Denise* with spud piles held in casings at each corner of the barge. A report on the evaluation and selection of the barges is provided in Reference 2.

The spud piles serve several purposes, as they provide:

- Mechanical means of lowering the barge to the river bottom.
- Rigid mooring of the barge during placement.
- Additional restraint to resist overturning.

The gates and superstructure will be placed on top of the barge and will be tied into specially-designed gate foundations that will be built inside the barge hulls.

The gate barges will be installed on site by lowering them using strand jacks supported by spud piles. A concept design of the spud piles and jacking head was developed by Mike Huggins of PND engineers and can be found in Attachment C.

Once on the river bottom the barge will be anchored in place by installing locking collars against the deck around the spud piles. The complete details of the placement procedure, weight, and stability for the Old River gate and the Connection Slough gate are included in Attachment A1 and B1, respectively.

Drawings showing the details of the Old River gate design and barge modifications are provided in Attachment A2. Drawings showing the details of the Connection Slough gate design and barge modifications are provided in Attachment B2.

Required Engineering in the Next Phase

There are several items that should be addressed in future development of the gate and barge design. None of these future considerations, however, jeopardize the suitability and acceptability of the preliminary design.

The spud pile design results from PND need to be incorporated into the package. Late in the design the size of the spud piles was refined and decreased to 36” diameter X 1/2” wall X 140’ total length, ASTM Grade 252 (42 ksi yield), and a jacking head utilizing two strand jacks per spud pile was proposed. Other items related to the spud pile design are:

- Review the design of the jacking wells at each corner of the barge and resize.
- Padeyes at each of the jacking wells will need to be reduced from 4 per well to 2 per well and resized.
- Further development of the jacking head frame will be required based on the selected jacking system.
- The locking collar has not been designed.

Design changes for the gate locking mechanisms need to be finalized and incorporated into the package.

- Review the single hydraulically operated locking pin concept and incorporate details.
- Review the failure mode of locking mechanism to ensure proper gate function in the event of power failure.
- Review the hydraulic system to ensure proper sizing of HPU

Detail structural calculations, including Finite Element Analysis, are recommended for the foundations for the gate pivot post, side post, and end post.

Review the end wall height on the barges in light of excavated bed height tolerances. Our design uses the end wall heights shown in the Moffat & Nichol 100% package. It should be confirmed that the top of the end wall will be higher than the sheet pile wall at the grading tolerances deepest extent.

The interfaces between the gates and the barge were generally considered but were not fully detailed in the preliminary design. In the next phase, these details will need to be developed. Some of the details of interest are whether connections are watertight, the access into gate structure such as the pillars and pivots, and the bracket and weld design for structural connections.

The site preparation and gate installation sequence will be very important for the placement procedure. It is our recommendation and assumption that the barge gate will be installed before the sheet pile. If this is not the case, detailed consideration must be given to the placement procedure to ensure it can be accomplished safely and effectively without disturbing the prepared site.

Attachments

A. Old River Gate

A1. Glosten Report, "Placement Operation & Stability: Old River, Preliminary Construction Submittal (90%)." Rev P2

A2. Glosten Drawings

09041-01-02, Old River Gate (Barge *Ignacio*) General Arrangement, Rev. P2.

09041-02-02, Barge *Ignacio* Modifications, Rev. P2.

09041-03-02, End Wall Structure, Rev. P2.

09041-04-02, Old River Gate Foundation, Rev. P2.

09041-05-02, Below Deck Hydraulic and Electrical Conduit, Rev. P2.

B. Connection Slough Gate

B1. Glosten Report, “Placement Operation & Stability: Connection Slough Preliminary Construction Submittal (90%),” Rev. P2.

B2. Glosten Drawings

09041-01-01, Connection Slough Gate (Barge Ignacio) General Arrangement, Rev. P2.

09041-02-01, Barge Denise Modifications, Rev. P2.

09041-03-01, End Wall Structure, Rev. P2.

09041-04-01, Connection Slough Gate Foundation, Rev. P2.

09041-05-01, Below Deck Hydraulic and Electrical Conduit, Rev. P2.

C. Spud Pile and Jacking Head Concept

ATTACHMENT A1. Old River Gate Placement Procedure and Stability

TWO GATE FISH PROTECTION PLAN

Placement Operation & Stability: Old River Gate
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References

1. Glosten Drawing 09041-01-02, *Old River Gate (Barge Ignacio): General Arrangement*.
2. *Code of Federal Regulations*, Title 46.
3. *Marine Safety Manual*, Volume IV – Technical.
4. *General Hydrostatics Software Suite*, Creative Systems, Inc., v. 11.42.
5. *Two Gate Fish Protection Plan*, specification document.

Summary

This document describes the placement procedure of the Old River gate and summarizes the weight estimate, stability analysis, and longitudinal strength analysis of the barge during all phases of placement operations. Also evaluated are the spud pile vertical loading and overturning moments that the spud pile securing system will be required to withstand.

The stability was evaluated for both the transit condition and placement. The barge meets the stability requirements in all transit and placement operations.

The stresses developed in the hull during the placement procedure described below are below the allowable stress of 25.38 ksi.

Spud piles should be designed to overcome a maximum 500 kip downward force during placement, and a 120 kip upward force during gate operation.

Old River Gate Design

The Old River gate is comprised of the barge *Ignacio*, with a butterfly gate system mounted above deck as shown in Reference 1. The barge will be held in location using 4 spud piles driven into the river bottom. Lowering and raising of the barge will be accomplished using cable or chain jacks utilizing the spud piles as bases for the lifting system. Once the barge is on the bottom of the river, the barge/gate will be held in place and will resist uplift from overturning moments by locking collars attached to the spud piles.

The barge hull is divided into 14 tanks; 7 port and 7 starboard. The hull tanks are designated Tank 1P&S at the bow, through 7 P&S at the stern. See Figure 1, below.

No ballasting system will be installed on the barge. All ballasting and deballasting will be done using portable pumps through new salvage fittings and manholes on the main deck.

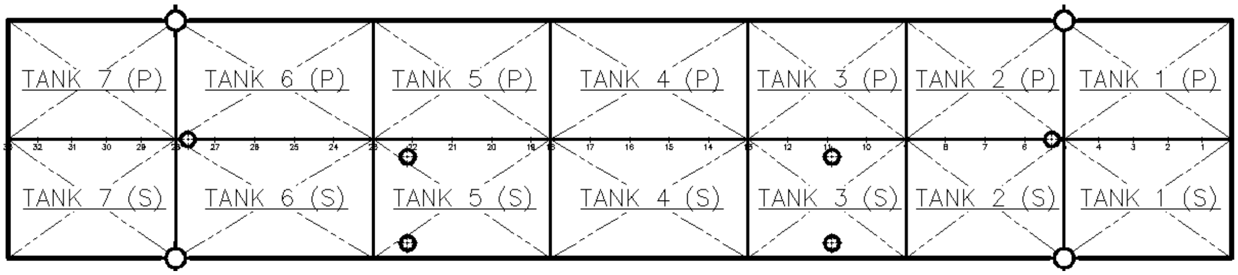


Figure 1. Tank arrangement plan

Placement Procedure

The assembled gate and barge will be towed to location in the Transit Condition, with all tanks dry and tight except Tanks 4 and 5 port that will be used to level the barge.

Lowering Procedure

1. With the barge onsite and temporarily secured in location, and with level trim and heel, the spuds will be lowered so they are resting on the river bottom.

2. With the spuds holding the barge in place, the spuds can be driven in plumb to the depth required. At this stage it is safe to suspend lowering operations for an extended period of time.

3. Once the spuds are driven in place, Tanks 2 and 6 port and starboard should be filled with ballast until all air is displaced from the tanks. Tanks 3, 4, and 5 port and starboard can simultaneously be filled to roughly 80% capacity. Tank loading can be adjusted slightly to maintain level submergence of barge. Once loaded to this stage, the barge should be floating roughly level with 6" of freeboard. All manholes should be secured with salvage fittings open.

4. The jacking system should be attached from the spud piles to the barge. Wire length should be adjusted such that, when taut, the barge deck edge will remain 1" above the water.

5. Tanks 1 and 7 port and starboard should be filled to roughly 80% capacity. During the filling of these tanks, the jacking system should start to take load and the barge should be hanging from the jacking system, with the deck roughly 1" above water by the end of this stage.

6. Tanks 2, 3, 4, and 5 port and starboard should be pressed until all air is displaced from the tanks. All tanks should then have salvage plugs sealed, except at the ends of the barge for Tanks 1 and 7 port and starboard.

7. The barge should be lowered so that the deck is 2' below the water.

8. Tanks 1 and 7 port and starboard should be pressed until all air is displaced from the tanks. Install the salvage plugs for Tanks 1 and 7 port and starboard. All tanks should be pressed full, with hatches and salvage plugs installed by the end of this stage.

9. The barge can now be lowered onto the river bottom.

10. Once the barge is firmly on the bottom and the jacking system is slack, a diver should install the locking mechanisms on all 4 of the spud piles, making sure to fit them snugly against the jacking well structure.

11. The barge/gate structure is now installed in the river, and locking fill can be applied around the barge.

Table 1. Condition summary

Stage	Hull Tank Loads (%)							Draft (ft)	Jacking pile Loads Fwd S (kip)	Fwd P (kip)	AFT S (kip)	Aft P (kip)
	1P/S	2P/S	3P/S	4P/S	5P/S	6P/S	7P/S					
1	0	0	0	var	var	0	0	4.2	-	-	-	-
3	0	100	80	var	100	100	0	12.2	-	-	-	-
5	80	100	80	var	100	100	80	12.7	228	278	228	278
6	80	100	100	100	100	100	80	12.7	475	455	417	397
7	80	100	100	100	100	100	80	15.0	410	351	388	330
8	100	100	100	100	100	100	100	15.0	482	425	474	416
9	100	100	100	100	100	100	100	20.0	454	404	441	390
9a	100	100	100	100	100	100	100	30.0	390	357	367	334
10	100	100	100	100	100	100	100	32.0	-	-	-	-

Refloating Procedure

The refloating procedure was not developed for this report. It is expected that the jacking system could be used to raise the barge/gate structure to the water surface, where portable pumps can be used to dewater the barge to its transit condition.

Weight Estimate

A weight for each of the components of the barge/gate structure was estimated, along with its LCG, TCG, and VCG. The table below summarizes the results of the calculations.

Table 2. Weight Summary

Item	Weight (With Margins)	LCG	TCG	VCG
	Kip	ft from Bow	ft +Stbd	ft ABL
Barge Hull	1157.02	124.00	0.00	7.65
Gates	478.30	124.00	2.39	27.52
Miscellaneous gate system	232.28	120.66	7.07	25.91
End Walls	50.16	128.75	0.00	18.85
Jacking Wells	42.95	128.75	0.00	6.36
Total	**1960.70**	**123.83**	**1.42**	**14.92**

Stability

The stability was evaluated for both the transit condition and the placement conditions. In the transit condition, the barge is shown to comply with the recommendations of the *Marine Safety*

Manual, Volume IV – Technical, 6.E.5.b. During the placement operations, the barge is shown to maintain a GM greater than 3 inches (0.25 feet) and maintain roll stability to at least 6 degrees.

Calculations

Stability calculations were performed using Creative Systems' General Hydrostatics program. The geometry model was created based on the vessel geometry per Reference 1. Weights were placed as distributed weights, according to their location per Reference 1.

Calculations are performed using fresh water with a specific gravity of 1.0. As the actual specific gravity of the river is unknown, between 1.0 and 1.025, the lighter density was chosen for conservatism.

Basic stability calculations, including an evaluation of GM and righting arms, were performed. True free surface effects of any slack tanks were included. The results of the calculations can be seen in Appendix A.

Required GM for the weather criterion was evaluated using the sail area of the gates when closed. Calculations can be found in Appendix C.

Transit Condition

In the transit condition, the barge is shown to comply with the recommendations of the *Marine Safety Manual, Volume IV – Technical, 6.E.5.b.*

Pertinent areas read as follows:

6.E.5.b. Intact And Damage Stability Criteria By Barge Type.

(1) All Barges: Weather Criterion And Righting Energy. The weather criterion in 46 CFR 170, Subpart E applies to barges, except as specified in 46 CFR 170.160. Inland tank barges inspected under Subchapter D do not have specific stability requirements but may be loaded beyond safe limits when they do not have centerline bulkheads in way of cargo. The OCMI should be so notified in such cases. Due to their large B/D ratio and high draft to depth ratio, most inland barges cannot be evaluated considering GM alone, in which case righting energy calculations are appropriate. As stated in 46 CFR 170.170(d), additional calculations must be submitted for barges. Except as provided in subparagraphs 6.E.5.b.(2), (3), and (4) below, the calculations normally required are those contained in 46 CFR 174.015. Suitable route alternatives to 46 CFR 174.015 include reducing the required 15 foot-degrees to 5 foot-degrees for service on protected waters and to l0 foot-degrees for service on those lakes, bays, and sounds which the OCMI considers to be partially-protected.

Pertinent areas of *46 CFR 170 Subpart E - Weather Criteria* read as follows:

§170.170 Calculations Required

(a) Each vessel must be shown by design calculations to have a metacentric height (GM) that is equal to or greater than the following in each condition of loading and operation:

$$GM \geq \frac{PAH}{W \tan(T)}$$

(b) *The criterion specified in this section is generally limited in application to flush deck, mechanically powered vessels of ordinary proportions and form that carry cargo below the main deck. On other types of vessels, the Commanding Officer, marine Safety Center requires calculations in addition to those in paragraph (a) of this section. On a mechanically powered vessel under 328 feet in length, other than a tugboat or a towboat, the requirements in §170.173 are applied.*

Pertinent areas of *46 CFR 174 Subpart B - Special Rules Pertaining to Deck Cargo Barges* read as follows:

§174.015 Intact Stability

(a) *Except as provided in §174.020, in each condition of loading and operation, each barge must be shown by design calculations to have an area under the righting arm curve up to the angle of maximum righting arm, the downflooding angle, or 40 degrees, whichever angle is smallest, equal to or greater than-*

(1) 15 foot-degrees (4.57 meter-degrees) for ocean and great lakes winter service; and

(2) 10 foot-degrees (3.05 meter-degrees) for lakes, bays, sounds, and great lakes summer service

(b) *For the purpose of this section, downflooding angle means the static angle from the intersection of the vessel's centerline and waterline in calm water to the first opening that does not close watertight automatically. The vessel is fitted with float-type check valves on the ballast tank vents and thus has no downflooding points applicable to this requirement.*

As indicated in the *Marine Safety Manual, Volume IV 6.E.5.b.*, the minimum required area under the righting curve for the calculations in *46 CFR §174.015* for protected water is taken to be 5 foot-degrees.

All tanks were considered dry and tight.

Results—Transit Condition

The barge in the transit condition has roll stability far in excess of the required minimums. The GM of 39.89 feet far exceeds the 1.08 feet requirement of the Weather Criterion. The righting arm is positive well beyond 40 degrees, and the righting energy at 40 degrees (165 ft-Deg) far exceeds the 5 ft-deg requirement of *46 CFR 174.015* as modified by the *Marine Safety Manual, Volume IV – Technical, 6.E.5.b.*

Results—Placement Conditions

Stability of the barge was evaluated at the stage of placement where the jacking system would be attached to the barge. At this stage, the barge is shown to comply with the minimum of 3 inches (0.25 feet) of GM and roll stability, to 6 degrees as required by the specification document (Reference 6).

Stability is not an issue once the jacking system has taken the load of the barge, and the barge is hanging from the wires and restrained by the spuds.

True free surface effects were included for all slack tanks.

Longitudinal Strength

The longitudinal strength of the barge was evaluated for each stage of placement. Stresses were calculated based on a hull girder section modulus of 3268.16 in^3. The calculated stresses were compared to an allowable stress of 11.33LT/in^2 (25.38 ksi).

The maximum expected stress is 9.97 ksi, corresponding to 39.3% of the allowable stress.

Spud Pile Calculations

The assumed spud pile for this report is a 42" diameter pile, with a 1" wall thickness and an overall length of 120'.

Once the jacking system has been attached to the barge, the spud piles will be required to support the barge/gate structures weight until the barge is lowered to the river bottom. A calculation of the estimated pile loading during barge placement is included in the stability calculations shown in Appendix A. The maximum expected vertical loading of any one spud pile is 482 kip, and a margin is added for a design load of 500 kip during barge/gate placement.

Once the barge is on the river bottom and the gates are closed, a differential water level will develop and impose translational forces and overturning moments on the barge/gate structure. The translational forces will be overcome by the gravel backfill around the barge and by the spuds. By inspection, this shearing force is not expected to be the driving factor in sizing the spud piles. The overturning moments will be resolved by the barge/gate structures' self weight, and two of the spud piles' weight and pullout resistance. Calculations for the estimated overturning force on the piles are shown in Appendix B. The maximum expected uplifting load is 103 kip, and a margin is added for a design uplifting load of 120 kip during gate operations.

Appendix A Stability Calculations

TRANSIT CONDITION WITH MINIMAL HEEL AND TRIM

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 4.161 @ 0.00, 4.166 @ 248.00a
Trim: 0.00/248.00, Heel: zero

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			1,157.02	124.00a	0.00	7.65	
EndWallF			25.08	17.50a	0.00	18.85	
EndWallA			25.08	230.50a	0.00	18.85	
GateF			239.15	81.00a	2.39s	27.52	
GateA			239.15	167.00a	2.39s	27.52	
Misc			232.28	120.66a	7.07s	25.91	
Fwd Wells			21.47	34.00a	0.00	6.36	
Aft Wells			21.47	214.00a	0.00	6.36	
Total Fixed -->			1,960.70	123.60a	1.42s	14.92	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK4.P	0.165	1.000	118.69	118.00a	11.49p	1.26	-2.27
TANK5.P	0.190	1.000	123.01	156.00a	11.56p	1.41	-2.58
Total Tanks -->			241.70	137.34a	11.53p	1.34	
Total Weight -->			2,202.40	125.11a	0.00	13.43	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	2,202.41	125.12a	0.00	2.27	-4.16
GATEF_FLOOD.S	Flooded	1.000	0.00				
GATEA_FLOOD.S	Flooded	1.000	0.00				
Total Displacement-->		1.000	2,202.41	125.12a	0.00	2.27	
Righting Arms:				0.00a	0.00		

Distances in FEET.

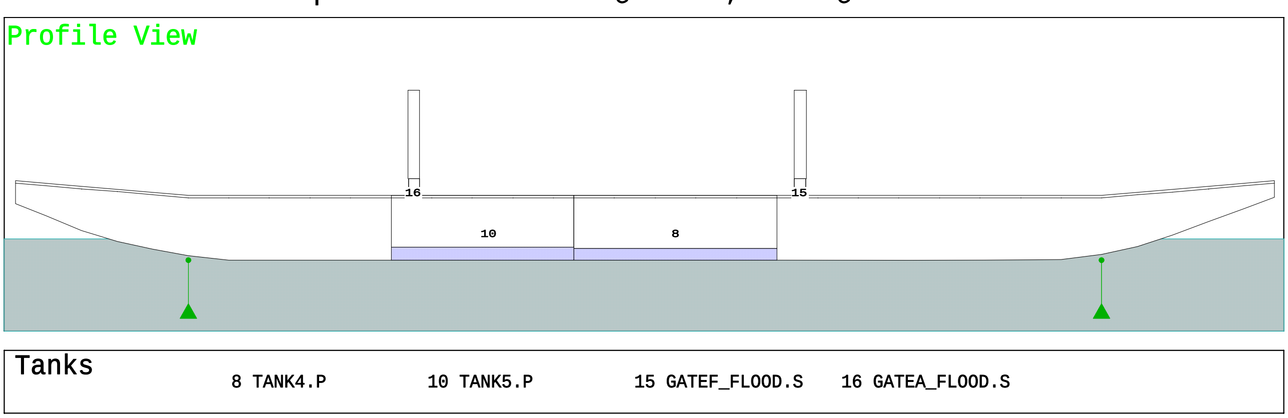
HYDROSTATIC PROPERTIES with FLOODING

Trim: 0.00/248.00, No Heel, VCG = 13.43

LCF Draft	Displacement Weight(KP)	Buoyancy-Ctr. LCB	VCB	Weight/ Inch	LCF	Moment/ In trim	GML	GMT
4.163	2,202.41	125.12a	2.27	51.45	125.52a	721.39	974.8	39.89

Distances in FEET. Specific Gravity = 1.000. Moment in Ft-KP.
Trim is per 248.00Ft
Draft is from Baseline. True Free Surface included.

Condition Graphic - Draft: 4.16 @ 0.00 , 4.17 @ 248.00a Heel: zero



LIM	STABILITY CRITERION		Min/Max	Attained
(1)	Area from 0 deg to MaxRA or 40	>	5.00 Ft-deg	165.18 P

Relative angles measured from 0.000

LONGITUDINAL STRENGTH with FLOODING

LOCATION Ft	WEIGHT KP/Ft	BUOYANCY KP/Ft	SHEAR KP	SECT.MOD SqIn-Ft	STRESS KP/SqIn
0.00	0.00		0.0	3,268.2	0.000
0.00	5.38		0.0	3,268.2	0.000
11.25a	5.38		-60.5	3,268.2	0.104
22.50a	5.38	0.00	-121.1	3,268.2	0.417
22.50a	5.38	0.00	-121.1	3,268.2	0.417
25.66a	5.38	2.51	-134.1	3,268.2	0.541
25.66a	6.60	2.51	-134.1	3,268.2	0.541
27.00a	6.60	3.57	-138.9	3,268.2	0.597
32.00a	6.60	6.98	-145.6	3,268.2	0.816
32.00a	11.97	6.98	-145.6	3,268.2	0.816
34.00a	11.97	8.34	-154.2	3,268.2	0.908
35.00a	11.97	8.72	-157.6	3,268.2	0.956
35.00a	11.26	8.72	-157.6	3,268.2	0.956
36.00a	11.26	9.11	-160.0	3,268.2	1.004
36.00a	5.89	9.11	-160.0	3,268.2	1.004
42.00a	5.89	11.40	-133.8	3,268.2	1.276
50.00a	5.89	11.71	-88.4	3,268.2	1.548
58.00a	5.89	11.71	-41.8	3,268.2	1.708
66.00a	5.89	11.71	4.8	3,268.2	1.753
74.00a	5.89	11.72	51.4	3,268.2	1.684
79.00a	5.89	11.72	80.6	3,268.2	1.583
79.00a	65.68	11.72	80.6	3,268.2	1.583
82.00a	65.68	11.72	-81.3	3,268.2	1.583
83.00a	65.68	11.72	-135.3	3,268.2	1.616
83.00a	5.89	11.72	-135.3	3,268.2	1.616
90.00a	5.89	11.72	-94.5	3,268.2	1.862
98.00a	5.89	11.72	-47.8	3,268.2	2.036
98.00a	8.85	11.72	-47.8	3,268.2	2.036
106.00a	8.85	11.72	-24.9	3,268.2	2.125
114.00a	8.86	11.72	-2.0	3,268.2	2.158
122.00a	8.86	11.72	20.9	3,268.2	2.135
130.00a	8.86	11.72	43.8	3,268.2	2.056
138.00a	8.86	11.72	66.7	3,268.2	1.920
138.00a	9.30	11.72	66.7	3,268.2	1.920
142.00a	9.30	11.72	76.4	3,268.2	1.833
150.00a	9.30	11.72	95.7	3,268.2	1.622
158.00a	9.30	11.72	115.0	3,268.2	1.364
165.00a	9.31	11.72	131.9	3,268.2	1.100
165.00a	69.09	11.72	131.9	3,268.2	1.100
166.00a	69.09	11.72	74.5	3,268.2	1.068
169.00a	69.09	11.72	-97.6	3,268.2	1.079
169.00a	9.31	11.72	-97.6	3,268.2	1.079
174.00a	9.31	11.72	-85.5	3,268.2	1.219
174.00a	5.89	11.72	-85.5	3,268.2	1.219
182.00a	5.89	11.72	-38.8	3,268.2	1.371

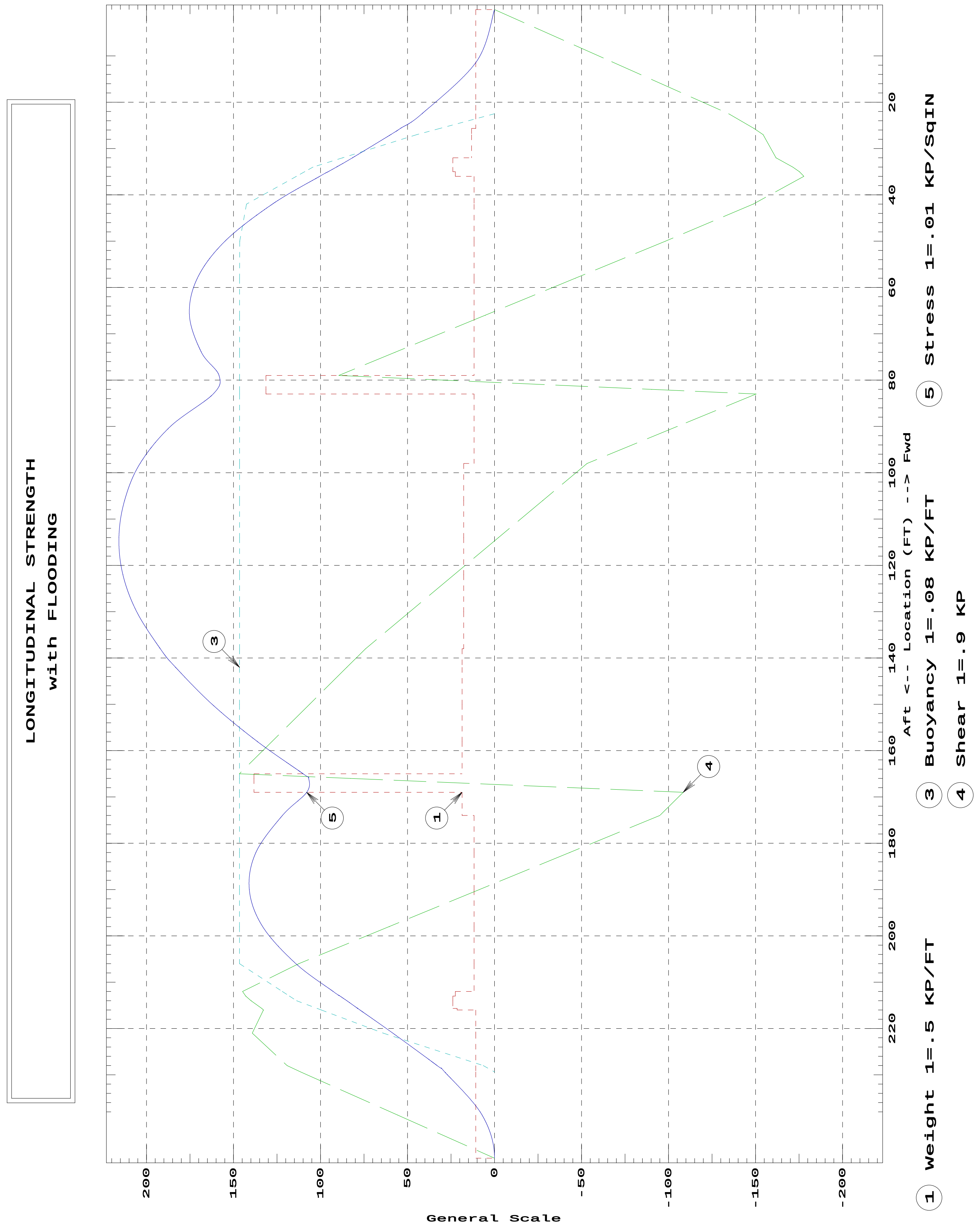
continued next page

LOCATION Ft	WEIGHT KP/Ft	BUOYANCY KP/Ft	SHEAR KP	SECT.MOD SqIn-Ft	STRESS KP/SqIn
190.00a	5.89	11.72	7.8	3,268.2	1.409
198.00a	5.89	11.72	54.5	3,268.2	1.332
206.00a	5.89	11.72	101.2	3,268.2	1.142
212.00a	5.89	9.76	130.3	3,268.2	0.927
212.00a	11.26	9.75	130.3	3,268.2	0.927
213.00a	11.26	9.43	128.6	3,268.2	0.888
213.00a	11.97	9.43	128.6	3,268.2	0.887
214.00a	11.97	9.10	125.9	3,268.2	0.849
215.66a	11.97	8.15	120.4	3,268.2	0.786
215.66a	10.75	8.15	120.4	3,268.2	0.786
216.00a	10.75	7.96	119.5	3,268.2	0.773
216.00a	5.38	7.96	119.5	3,268.2	0.773
221.00a	5.38	5.11	125.2	3,268.2	0.584
228.00a	5.38	0.52	107.3	3,268.2	0.330
229.36a	5.38	0.00	100.3	3,268.2	0.286
229.36a	5.38		100.3	3,268.2	0.286
238.68a	5.38		50.2	3,268.2	0.072
248.00a	5.38		0.0	3,268.2	-0.000
248.00a	0.00		0.0	3,268.2	

S U M M A R Y

Largest Shear: -160.0 KP at 36.00a
Largest Bending Moment: 7,053 KP-Ft at 114.00a (Hogging)
Largest Stress: 2.158 KP/SqIn at 114.00a (Tension)
(11.1% of 19.380 KP/SqIn limit)
Warning: Stress values may be inaccurate due to lack of correction for hull deflection.

2 GATE FISH PROTECTION -- OLD RIVER GATE



STAGE TO INSTALL JACKING WIRES

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 12.196 @ 0.00, 12.176 @ 248.00a

Trim: Fwd 0.02/248.00, Heel: Stbd 0.09 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			1,157.02	124.00a	0.00	7.65	
EndWallF			25.08	17.50a	0.00	18.85	
EndWallA			25.08	230.50a	0.00	18.85	
GateF			239.15	81.00a	2.39s	27.52	
GateA			239.15	167.00a	2.39s	27.52	
Misc			232.28	120.66a	7.07s	25.91	
Fwd Wells			21.47	34.00a	0.00	6.36	
Aft Wells			21.47	214.00a	0.00	6.36	
Total Fixed ------>			1,960.70	123.60a	1.42s	14.92	
TANK2.S	1.000	1.000	567.64	50.17a	11.83s	6.46	
TANK2.P	1.000	1.000	567.64	50.17a	11.83p	6.46	
TANK3.S	0.800	1.000	460.37	82.00a	11.90s	5.15	-10.04
TANK3.P	0.800	1.000	460.37	82.00a	11.89p	5.15	-10.08
TANK4.S	0.500	1.000	359.65	118.00a	11.85s	3.31	-6.37
TANK4.P	0.800	1.000	575.47	118.00a	11.89p	5.15	-10.08
TANK5.S	1.000	1.000	647.40	156.00a	11.83s	6.38	
TANK5.P	1.000	1.000	647.40	156.00a	11.83p	6.38	
TANK6.S	1.000	1.000	714.19	193.88a	11.83s	6.42	
TANK6.P	1.000	1.000	714.19	193.88a	11.83p	6.42	
Total Tanks ------>			5,714.30	126.30a	0.45p	5.89	
Total Weight ------>			7,675.00	125.61a	0.03s	8.20	
			Displ(KP)	LCB	TCB	VCB	
HULL		1.000	7,675.00	125.61a	0.03s	6.57	-12.20
GATEF_FLOOD.S	Flooded	1.000	0.00				
GATEA_FLOOD.S	Flooded	1.000	0.00				
Total Displacement-->		1.000	7,675.00	125.61a	0.03s	6.57	
Righting Arms:				0.00	0.00		

Distances in FEET.

HYDROSTATIC PROPERTIES with FLOODING

Trim: Fwd 0.02/248.00, Heel: Stbd 0.09 deg., VCG = 8.20

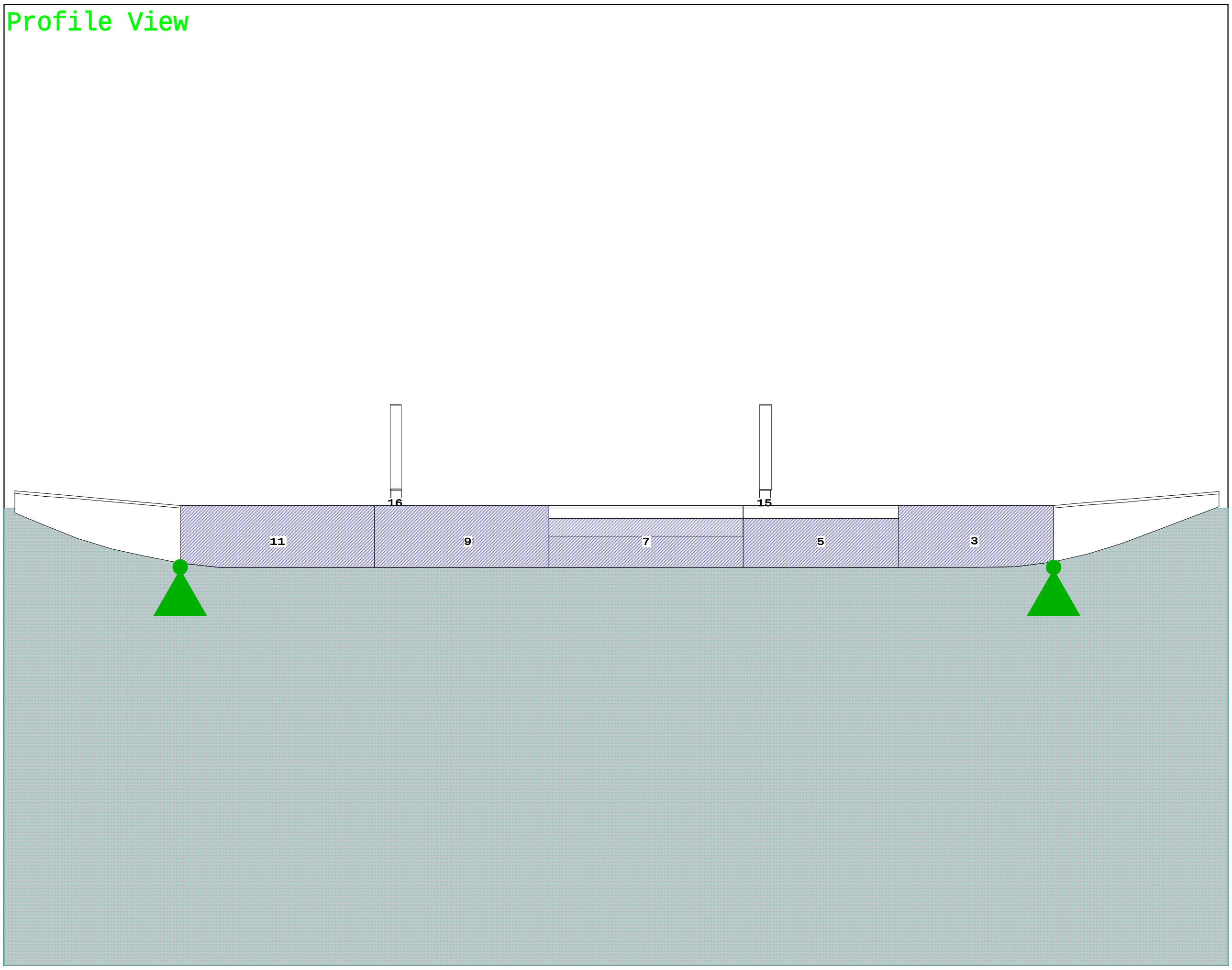
LCF Draft	Displacement Weight(KP)	Buoyancy-Ctr. LCB	VCB	Weight/ Inch	LCF	Moment/ In trim	GML	GMT
12.186	7,675.00	125.61a	6.57	61.78	124.30a	1258.48	488.0	15.60

Distances in FEET. Specific Gravity = 1.000. Moment in Ft-KP.

Trim is per 248.00Ft

Draft is from Baseline. True Free Surface included.

CG - Draft: 12.20 @ 0.00 , 12.18 @ 248.00a Heel: stbd 0.09 deg.



Tanks

	7 TANK4.S........50% FRESH WATER	12 TANK6.P.......100% FRESH WATER
3 TANK2.S.......100% FRESH WATER	8 TANK4.P........80% FRESH WATER	15 GATEF_FLOOD.S..Flooded
4 TANK2.P.......100% FRESH WATER	9 TANK5.S.......100% FRESH WATER	16 GATEA_FLOOD.S..Flooded
5 TANK3.S........80% FRESH WATER	10 TANK5.P.......100% FRESH WATER	
6 TANK3.P........80% FRESH WATER	11 TANK6.S.......100% FRESH WATER	

LIM	STABILITY CRITERION		Min/Max	Attained
(1)	Area from 0 deg to MaxRA or 40	>	5.00 Ft-deg	220.49 P

Relative angles measured from 0.095

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.09 deg.

Largest Shear:	-491.1 KP	at	214.00a	
Largest Bending Moment:	-21,289 KP-Ft	at	166.00a	(Sagging)
Largest Stress:	-6.514 KP/SqIn	at	166.00a	(Compression)
(33.6% of	19.380 KP/SqIn limit)			

GROUNDING points

Origin Depth: 12.196
Trim: Fwd 0.02/248.00 Heel: Stbd 0.09 deg.

	Depth to		Penetration		
Ground Point	Point	Ground	Present	Maximum	React(KP)
Fwd Stbd Jack	12.23	12.66	-0.43	0.10	0.00
Fwd Port Jack	12.15	12.66	-0.51	0.10	0.00
Aft Stbd Jack	12.22	12.66	-0.44	0.10	0.00
Aft Port Jack	12.14	12.66	-0.52	0.10	0.00
Total Ground Reaction -->					0.00

Distances in FEET.

FILLING TANKS 1P/S and 7P/S AND TENSIONING JACKING WIRES
BARGE SUPPORTED BY JACKING WIRES

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 12.671 @ 0.00, 12.675 @ 248.00a
Trim: 0.00/248.00, Heel: 0.00 deg.

Part			Weight(KP)	LCG	TCG	VCG	
Hull			1,157.02	124.00a	0.00	7.65	
EndWallF			25.08	17.50a	0.00	18.85	
EndWallA			25.08	230.50a	0.00	18.85	
GateF			239.15	81.00a	2.39s	27.52	
GateA			239.15	167.00a	2.39s	27.52	
Misc			232.28	120.66a	7.07s	25.91	
Fwd Wells			21.47	34.00a	0.00	6.36	
Aft Wells			21.47	214.00a	0.00	6.36	
Total Fixed-->			1,960.70	123.60a	1.42s	14.92	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK1.S	0.800	1.000	295.90	22.52a	11.79s	8.54	-12.46
TANK1.P	0.800	1.000	295.90	22.52a	11.79p	8.54	-12.46
TANK2.S	1.000	1.000	567.64	50.17a	11.83s	6.46	
TANK2.P	1.000	1.000	567.64	50.17a	11.83p	6.46	
TANK3.S	0.800	1.000	460.37	82.00a	11.90s	5.15	-10.05
TANK3.P	0.800	1.000	460.37	82.00a	11.90p	5.15	-10.05
TANK4.S	0.500	1.000	359.65	118.00a	11.83s	3.31	-6.37
TANK4.P	0.800	1.000	575.47	118.00a	11.90p	5.15	-10.05
TANK5.S	1.000	1.000	647.40	156.00a	11.83s	6.38	
TANK5.P	1.000	1.000	647.40	156.00a	11.83p	6.38	
TANK6.S	1.000	1.000	714.19	193.88a	11.83s	6.42	
TANK6.P	1.000	1.000	714.19	193.88a	11.83p	6.42	
TANK7.S	0.800	1.000	339.62	226.64a	11.82s	8.17	-12.26
TANK7.P	0.800	1.000	339.62	226.64a	11.82p	8.17	-12.26
Total Tanks-->			6,985.34	127.27a	0.37p	6.34	
Total Weight-->			8,946.04	126.46a	0.02s	8.22	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	7,934.41	125.64a	0.00	6.76	-12.67
GATEF_FLOOD.S	Flooded	1.000	0.00				
GATEA_FLOOD.S	Flooded	1.000	0.00				
Total Displacement-->		1.000	7,934.41	125.64a	0.00	6.76	
			React(KP)	**LCR**	**TCR**	**VCR**	
Fwd Stbd Jack			232.54	34.00a	24.00s	0.00	-12.67
Fwd Port Jack			222.97	34.00a	24.00p	0.00	-12.67
Aft Stbd Jack			282.83	214.00a	24.00s	0.00	-12.67
Aft Port Jack			273.26	214.00a	24.00p	0.00	-12.67
Total Reaction-->			1,011.60	132.95a	0.45s	0.00	
Total Buoyancy-->			8,946.01	126.46a	0.05s	6.00	
Righting Arms:				0.00	0.03s		

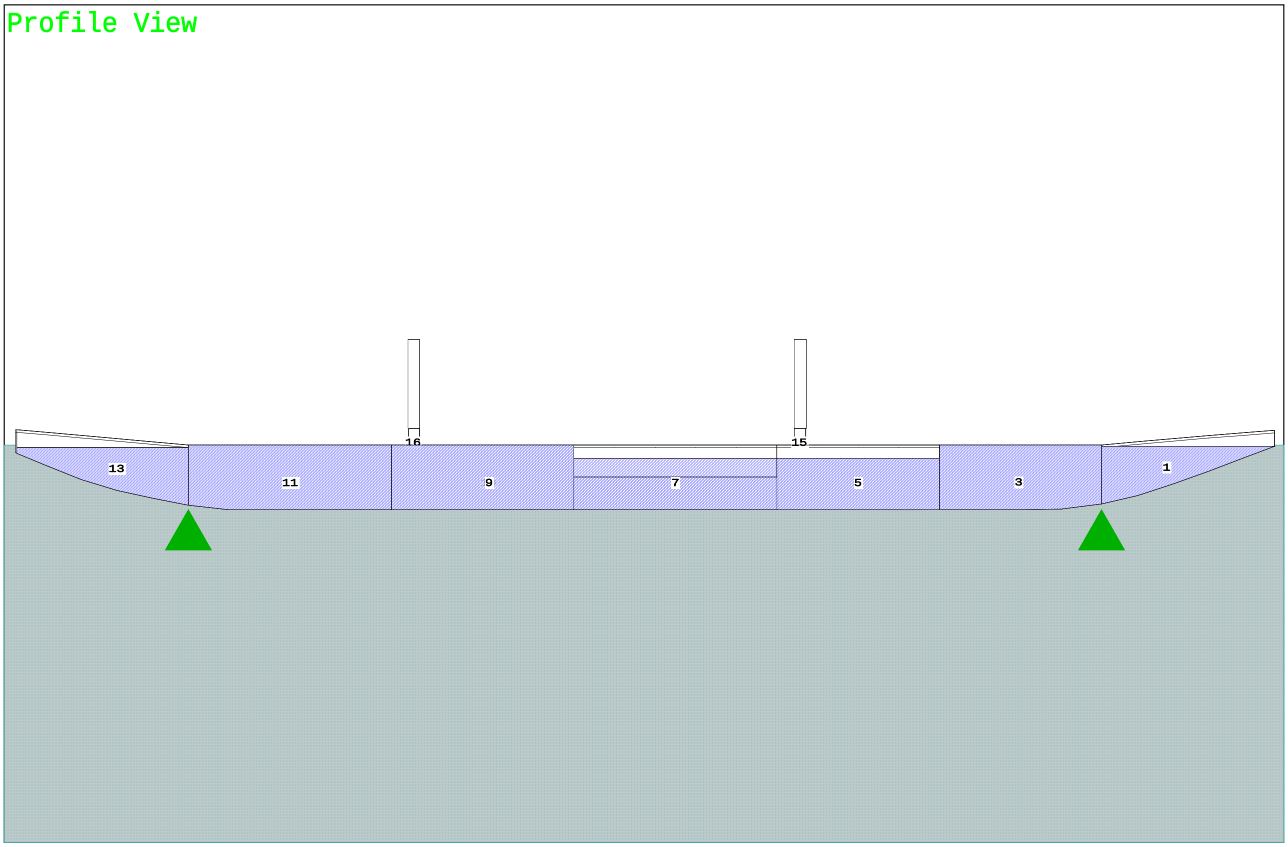
Distances in FEET.

HYDROSTATIC PROPERTIES with FLOODING
Trim: 0.00/248.00, Heel: 0.00 deg., VCG = 8.22

LCF Draft	Displacement Weight(KP)	Buoyancy-Ctr. LCB	VCB	Weight/ Inch	LCF	Moment/ In trim	GML	GMT
12.673	8,946.01	126.46a	6.00	6557.73	124.01a	214236	Large	Large

Distances in FEET. Specific Gravity = 1.000. Moment in Ft-KP.
Trim is per 248.00Ft
Draft is from Baseline. True Free Surface included.

Condition Graphic - Draft: 12.67 @ 0.00 , 12.67 @ 248.00a Heel: 0.00 deg.



Tanks

1 TANK1.S	3 TANK2.S	6 TANK3.P	9 TANK5.S	12 TANK6.P	15 GATEF_FLOOD.S
2 TANK1.P	4 TANK2.P	7 TANK4.S	10 TANK5.P	13 TANK7.S	16 GATEA_FLOOD.S
	5 TANK3.S	8 TANK4.P	11 TANK6.S	14 TANK7.P	

LIM	STABILITY CRITERION		Min/Max	Margin
(1)	Area from 0 deg to MaxRA or 40	>	5.00 Ft-deg	4594%

Relative angles measured from 0.001

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.01 deg.

Largest Shear:	-416.8	KP	at	214.00a	
Largest Bending Moment:	-11,076	KP-Ft	at	166.00a	(Sagging)
Largest Stress:	-3.389	KP/SqIn	at	166.00a	(Compression)
(17.5% of	19.380	KP/SqIn	limit)		

GROUNDING points

Origin Depth: 12.671
Trim: 0.00/248.00 Heel: Stbd 0.01 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	12.67	12.66	0.01	0.10	227.75
Fwd Port Jack	12.67	12.66	0.01	0.10	227.75
Aft Stbd Jack	12.67	12.66	0.01	0.10	278.07
Aft Port Jack	12.67	12.66	0.01	0.10	278.07
Total Ground Reaction >					1,011.65

Distances in FEET.

TANKS FULL EXCEPT ENDS WITH BARGE DECK 1" ABOVE WATER

WEIGHT and DISPLACEMENT STATUS

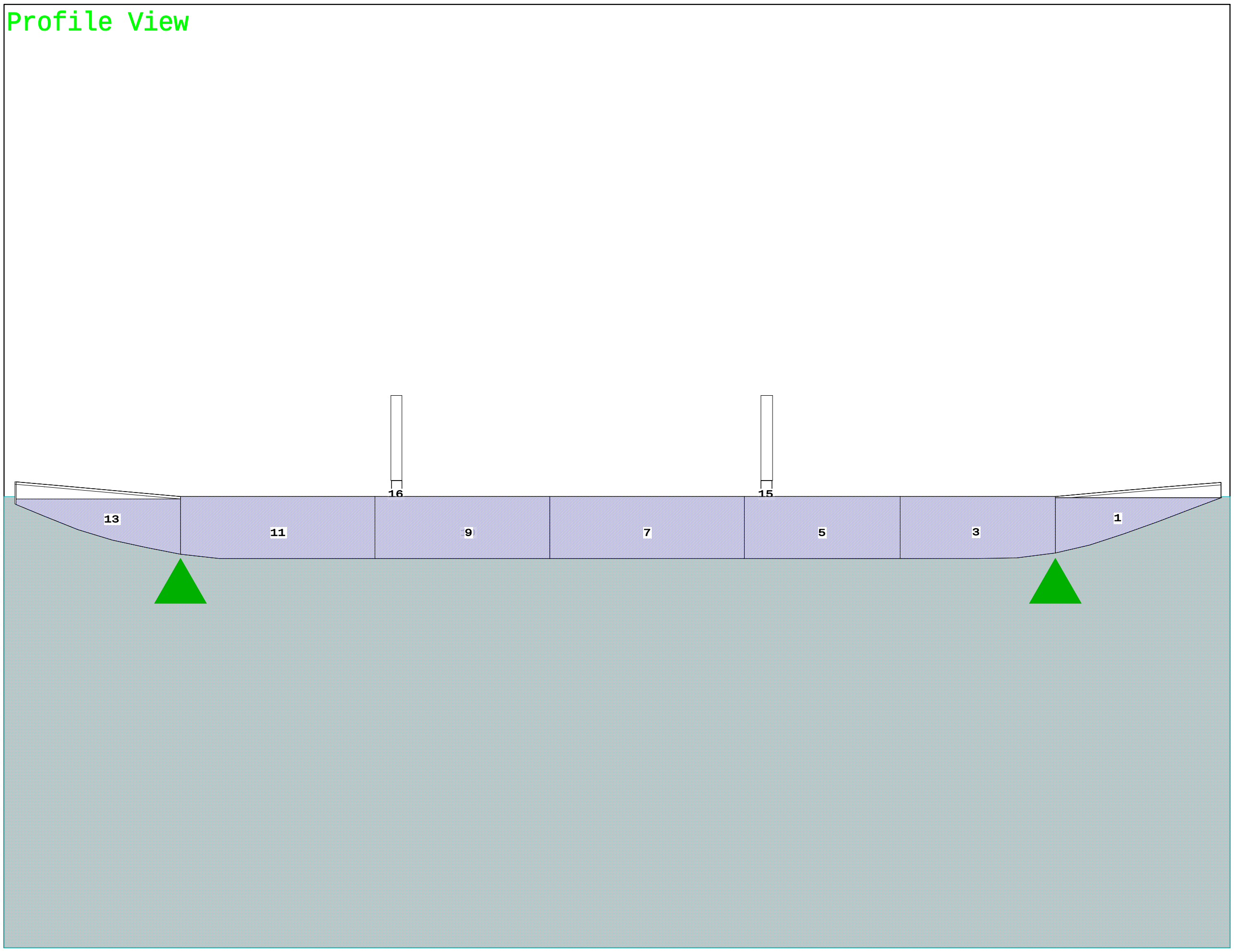
Baseline draft: 12.683 @ 0.00, 12.685 @ 248.00a

Trim: 0.00/248.00, Heel: 0.00 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			1,157.02	124.00a	0.00	7.65	
EndWallF			25.08	17.50a	0.00	18.85	
EndWallA			25.08	230.50a	0.00	18.85	
GateF			239.15	81.00a	2.39s	27.52	
GateA			239.15	167.00a	2.39s	27.52	
Misc			232.28	120.66a	7.07s	25.91	
Fwd Wells			21.47	34.00a	0.00	6.36	
Aft Wells			21.47	214.00a	0.00	6.36	
Total Fixed -->			1,960.70	123.60a	1.42s	14.92	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK1.S	0.800	1.000	295.90	22.52a	11.79s	8.54	-12.46
TANK1.P	0.800	1.000	295.90	22.52a	11.79p	8.54	-12.46
TANK2.S	1.000	1.000	567.64	50.17a	11.83s	6.46	
TANK2.P	1.000	1.000	567.64	50.17a	11.83p	6.46	
TANK3.S	1.000	1.000	575.47	82.00a	11.83s	6.38	
TANK3.P	1.000	1.000	575.47	82.00a	11.83p	6.38	
TANK4.S	1.000	1.000	719.33	118.00a	11.83s	6.38	
TANK4.P	1.000	1.000	719.33	118.00a	11.83p	6.38	
TANK5.S	1.000	1.000	647.40	156.00a	11.83s	6.38	
TANK5.P	1.000	1.000	647.40	156.00a	11.83p	6.38	
TANK6.S	1.000	1.000	714.19	193.88a	11.83s	6.42	
TANK6.P	1.000	1.000	714.19	193.88a	11.83p	6.42	
TANK7.S	0.800	1.000	339.62	226.64a	11.82s	8.17	-12.26
TANK7.P	0.800	1.000	339.62	226.64a	11.82p	8.17	-12.26
Total Tanks -->			7,719.08	125.31a	0.00	6.72	
Total Weight -->			9,679.78	124.97a	0.29s	8.38	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	7,937.28	125.63a	0.00	6.76	-12.68
GATEF_FLOOD.S	Flooded	1.000	0.00				
GATEA_FLOOD.S	Flooded	1.000	0.00				
Total Displacement-->		1.000	7,937.28	125.63a	0.00	6.76	
			React(KP)	**LCR**	**TCR**	**VCR**	
Fwd Stbd Jack			474.84	34.00a	24.00s	0.00	-12.68
Fwd Port Jack			416.82	34.00a	24.00p	0.00	-12.68
Aft Stbd Jack			454.70	214.00a	24.00s	0.00	-12.69
Aft Port Jack			396.67	214.00a	24.00p	0.00	-12.68
Total Reaction -->			1,743.04	121.92a	1.60s	0.00	
Total Buoyancy -->			9,680.32	124.97a	0.29s	5.55	
Righting Arms:				0.00	0.00		

Distances in FEET.

Condition Graphic - Draft: 12.68 @ 0.00 , 12.69 @ 248.00a Heel: 0.00 deg.



Tanks

	6 TANK3.P.......100% FRESH WATER	12 TANK6.P.......100% FRESH WATER
1 TANK1.S........80% FRESH WATER	7 TANK4.S.......100% FRESH WATER	13 TANK7.S........80% FRESH WATER
2 TANK1.P........80% FRESH WATER	8 TANK4.P.......100% FRESH WATER	14 TANK7.P........80% FRESH WATER
3 TANK2.S.......100% FRESH WATER	9 TANK5.S.......100% FRESH WATER	15 GATEF_FLOOD.S..Flooded
4 TANK2.P.......100% FRESH WATER	10 TANK5.P.......100% FRESH WATER	16 GATEA_FLOOD.S..Flooded
5 TANK3.S.......100% FRESH WATER	11 TANK6.S.......100% FRESH WATER	

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = 0.00 deg.

Largest Shear:	719.3 KP	at 34.00a	
Largest Bending Moment:	-29,756 KP-Ft	at 122.00a	(Sagging)
Largest Stress:	-9.105 KP/SqIn	at 122.00a	(Compression)
(47.0% of	19.380 KP/SqIn limit)		

GROUNDING points

Origin Depth: 12.683
Trim: 0.00/248.00 Heel: 0.00 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	12.68	12.66	0.02	0.10	474.84
Fwd Port Jack	12.68	12.66	0.02	0.10	416.82
Aft Stbd Jack	12.69	12.66	0.02	0.10	454.70
Aft Port Jack	12.68	12.66	0.02	0.10	396.67
Total Ground Reaction ——>					1,743.04

Distances in FEET.

ALL TANKS FULL EXCEPT ENDS WITH BARGE DECK 2' BELOW WATER

WEIGHT and DISPLACEMENT STATUS

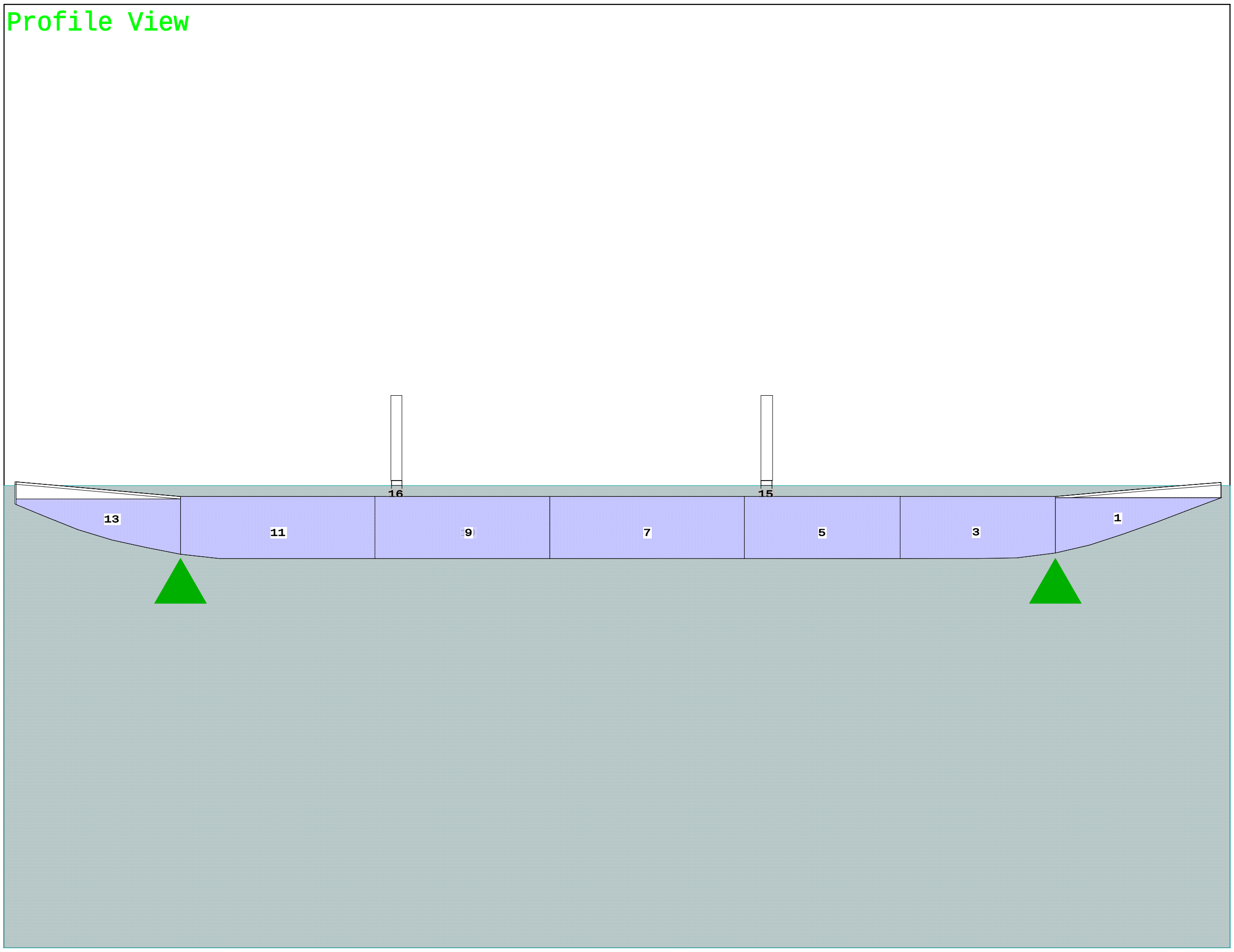
Baseline draft: 15.020 @ 0.00, 15.020 @ 248.00a

Trim: 0.00/248.00, Heel: Stbd 0.01 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			1,157.02	124.00a	0.00	7.65	
EndWallF			25.08	17.50a	0.00	18.85	
EndWallA			25.08	230.50a	0.00	18.85	
GateF			239.15	81.00a	2.39s	27.52	
GateA			239.15	167.00a	2.39s	27.52	
Misc			232.28	120.66a	7.07s	25.91	
Fwd Wells			21.47	34.00a	0.00	6.36	
Aft Wells			21.47	214.00a	0.00	6.36	
Total Fixed-->			1,960.70	123.60a	1.42s	14.92	
TANK1.S	0.800	1.000	295.90	22.52a	11.79s	8.54	-12.46
TANK1.P	0.800	1.000	295.90	22.52a	11.79p	8.54	-12.47
TANK2.S	1.000	1.000	567.64	50.17a	11.83s	6.46	
TANK2.P	1.000	1.000	567.64	50.17a	11.83p	6.46	
TANK3.S	1.000	1.000	575.47	82.00a	11.83s	6.38	
TANK3.P	1.000	1.000	575.47	82.00a	11.83p	6.38	
TANK4.S	1.000	1.000	719.33	118.00a	11.83s	6.38	
TANK4.P	1.000	1.000	719.33	118.00a	11.83p	6.38	
TANK5.S	1.000	1.000	647.40	156.00a	11.83s	6.38	
TANK5.P	1.000	1.000	647.40	156.00a	11.83p	6.38	
TANK6.S	1.000	1.000	714.19	193.88a	11.83s	6.42	
TANK6.P	1.000	1.000	714.19	193.88a	11.83p	6.42	
TANK7.S	0.800	1.000	339.62	226.64a	11.82s	8.17	-12.26
TANK7.P	0.800	1.000	339.62	226.64a	11.82p	8.17	-12.27
Total Tanks-->			7,719.08	125.31a	0.00	6.72	
Total Weight-->			9,679.78	124.97a	0.29s	8.38	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	8,250.21	125.65a	0.02s	7.02	-15.02
GATEF_FLOOD.S	Flooded	1.000	-25.40	93.45a	3.53s	13.89	-15.02
GATEA_FLOOD.S	Flooded	1.000	-24.65	169.50a	3.53s	13.89	-15.02
Total Displacement-->		1.000	8,200.17	125.62a	0.00	6.98	
			React(KP)	**LCR**	**TCR**	**VCR**	
Fwd Stbd Jack			410.80	34.00a	24.00s	0.00	-15.02
Fwd Port Jack			351.49	34.00a	24.00p	0.00	-15.02
Aft Stbd Jack			388.31	214.00a	24.00s	0.00	-15.02
Aft Port Jack			328.98	214.00a	24.00p	0.00	-15.02
Total Reaction-->			1,479.58	121.26a	1.92s	0.00	
Total Buoyancy-->			9,679.75	124.95a	0.30s	5.91	
Righting Arms:				0.01f	0.01s		

Distances in FEET.

CG - Draft: 15.02 @ 0.00 , 15.02 @ 248.00a Heel: stbd 0.01 deg.



Tanks

1 TANK1.S........80% FRESH WATER	6 TANK3.P.......100% FRESH WATER	12 TANK6.P.......100% FRESH WATER
2 TANK1.P........80% FRESH WATER	7 TANK4.S.......100% FRESH WATER	13 TANK7.S........80% FRESH WATER
3 TANK2.S.......100% FRESH WATER	8 TANK4.P.......100% FRESH WATER	14 TANK7.P........80% FRESH WATER
4 TANK2.P.......100% FRESH WATER	9 TANK5.S.......100% FRESH WATER	15 GATEF_FLOOD.S..Flooded
5 TANK3.S.......100% FRESH WATER	10 TANK5.P.......100% FRESH WATER	16 GATEA_FLOOD.S..Flooded
	11 TANK6.S.......100% FRESH WATER	

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.01 deg.

```
         Largest Shear:        716.9 KP       at   34.00a
 Largest Bending Moment:      -32,572 KP-Ft   at  122.00a (Sagging)
        Largest Stress:       -9.967 KP/SqIn  at  122.00a (Compression)
           (  51.4%  of       19.380 KP/SqIn  limit)
```

GROUNDING points

Origin Depth: 15.020
Trim: 0.00/248.00 Heel: Stbd 0.01 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	15.02	15.00	0.02	0.10	409.74
Fwd Port Jack	15.02	15.00	0.02	0.10	351.84
Aft Stbd Jack	15.02	15.00	0.02	0.10	387.96
Aft Port Jack	15.02	15.00	0.02	0.10	330.04
Total Ground Reaction ——>					1,479.58

Distances in FEET.

ALL TANKS FULL WITH BARGE DECK 2' BELOW WATER

WEIGHT and DISPLACEMENT STATUS

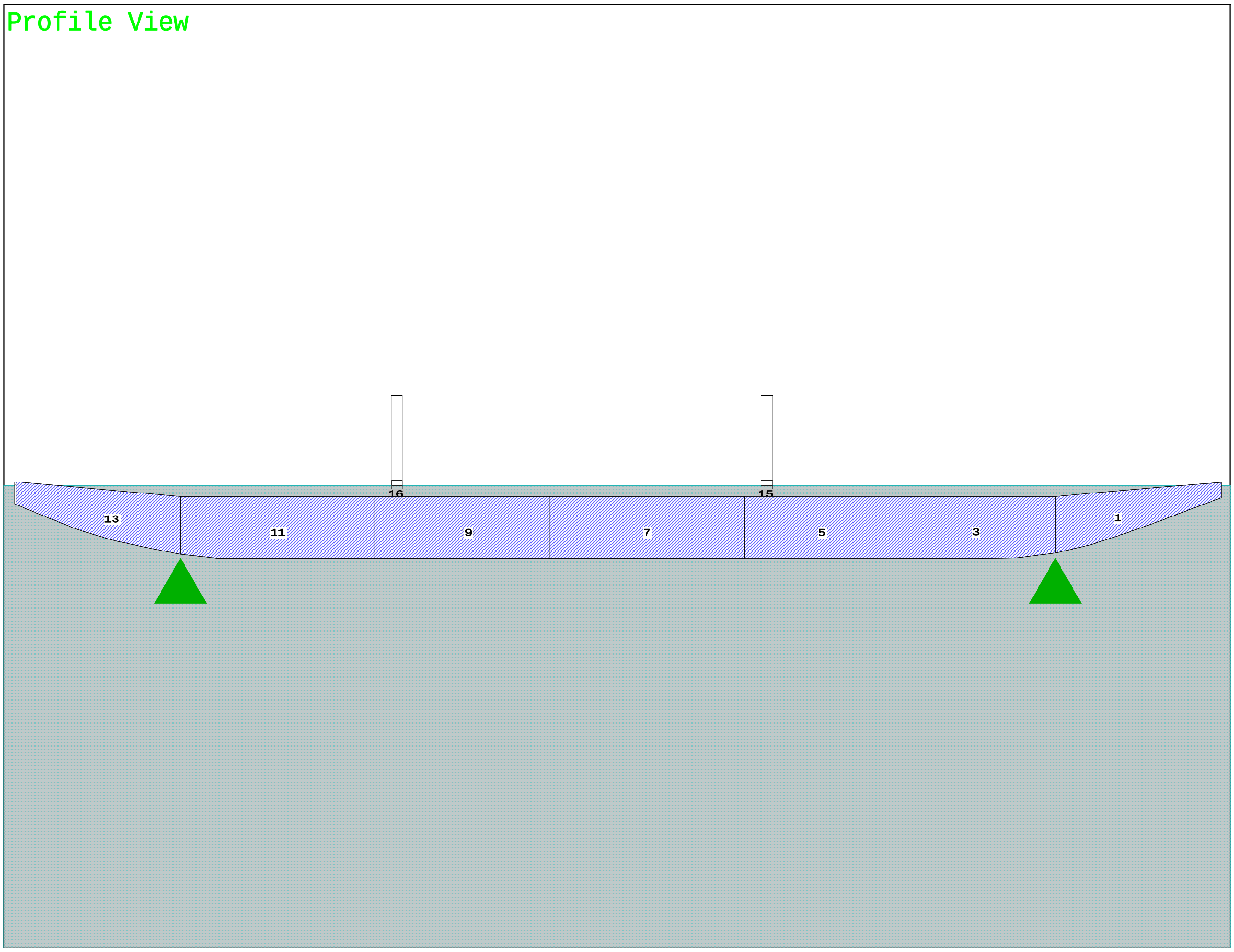
Baseline draft: 15.023

Trim: zero, Heel: Stbd 0.01 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			1,157.02	124.00a	0.00	7.65	
EndWallF			25.08	17.50a	0.00	18.85	
EndWallA			25.08	230.50a	0.00	18.85	
GateF			239.15	81.00a	2.39s	27.52	
GateA			239.15	167.00a	2.39s	27.52	
Misc			232.28	120.66a	7.07s	25.91	
Fwd Wells			21.47	34.00a	0.00	6.36	
Aft Wells			21.47	214.00a	0.00	6.36	
Total Fixed--->			1,960.70	123.60a	1.42s	14.92	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK1.S	1.000	1.000	369.89	20.35a	11.72s	9.53	
TANK1.P	1.000	1.000	369.89	20.35a	11.72p	9.53	
TANK2.S	1.000	1.000	567.64	50.17a	11.83s	6.46	
TANK2.P	1.000	1.000	567.64	50.17a	11.83p	6.46	
TANK3.S	1.000	1.000	575.47	82.00a	11.83s	6.38	
TANK3.P	1.000	1.000	575.47	82.00a	11.83p	6.38	
TANK4.S	1.000	1.000	719.33	118.00a	11.83s	6.38	
TANK4.P	1.000	1.000	719.33	118.00a	11.83p	6.38	
TANK5.S	1.000	1.000	647.40	156.00a	11.83s	6.38	
TANK5.P	1.000	1.000	647.40	156.00a	11.83p	6.38	
TANK6.S	1.000	1.000	714.19	193.88a	11.83s	6.42	
TANK6.P	1.000	1.000	714.19	193.88a	11.83p	6.42	
TANK7.S	1.000	1.000	424.45	228.46a	11.75s	9.21	
TANK7.P	1.000	1.000	424.45	228.46a	11.75p	9.21	
Total Tanks--->			8,036.71	125.55a	0.00	6.98	
Total Weight--->			9,997.41	125.17a	0.28s	8.54	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	8,250.38	125.65a	0.02s	7.02	-15.02
GATEF_FLOOD.S	Flooded	1.000	-25.44	93.45a	3.55s	13.89	-15.02
GATEA_FLOOD.S	Flooded	1.000	-24.69	169.50a	3.55s	13.89	-15.02
Total Displacement-->		1.000	8,200.25	125.62a	0.00	6.98	
			React(KP)	**LCR**	**TCR**	**VCR**	
Fwd Stbd Jack			482.05	34.00a	24.00s	0.00	-15.03
Fwd Port Jack			424.89	34.00a	24.00p	0.00	-15.02
Aft Stbd Jack			473.67	214.00a	24.00s	0.00	-15.03
Aft Port Jack			416.51	214.00a	24.00p	0.00	-15.02
Total Reaction--->			1,797.13	123.16a	1.53s	0.00	
Total Buoyancy--->			9,997.38	125.18a	0.28s	5.73	
Righting Arms:				0.01a	-0.00s		

Distances in FEET.

Condition Graphic - Draft: 15.023 Trim: zero Heel: stbd 0.01 deg.



Tanks

1 TANK1.S.......100% FRESH WATER	6 TANK3.P.......100% FRESH WATER	12 TANK6.P.......100% FRESH WATER
2 TANK1.P.......100% FRESH WATER	7 TANK4.S.......100% FRESH WATER	13 TANK7.S.......100% FRESH WATER
3 TANK2.S.......100% FRESH WATER	8 TANK4.P.......100% FRESH WATER	14 TANK7.P.......100% FRESH WATER
4 TANK2.P.......100% FRESH WATER	9 TANK5.S.......100% FRESH WATER	15 GATEF_FLOOD.S..Flooded
5 TANK3.S.......100% FRESH WATER	10 TANK5.P.......100% FRESH WATER	16 GATEA_FLOOD.S..Flooded
	11 TANK6.S.......100% FRESH WATER	

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.01 deg.

Largest Shear:	714.4	KP	at	34.00a	
Largest Bending Moment:	-29,081	KP-Ft	at	122.00a	(Sagging)
Largest Stress:	-8.898	KP/SqIn	at	122.00a	(Compression)
(45.9% of	19.380	KP/SqIn	limit)		

GROUNDING points

Origin Depth: 15.023
Trim: zero Heel: Stbd 0.01 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	15.03	15.00	0.02	0.10	482.05
Fwd Port Jack	15.02	15.00	0.02	0.10	424.89
Aft Stbd Jack	15.03	15.00	0.02	0.10	473.67
Aft Port Jack	15.02	15.00	0.02	0.10	416.51
Total Ground Reaction ——>					1,797.13

Distances in FEET.

LOWERING BARGE ON WIRES WITH GATES STARTING TO BECOME NEUTRALY BUOYANT

WEIGHT and DISPLACEMENT STATUS

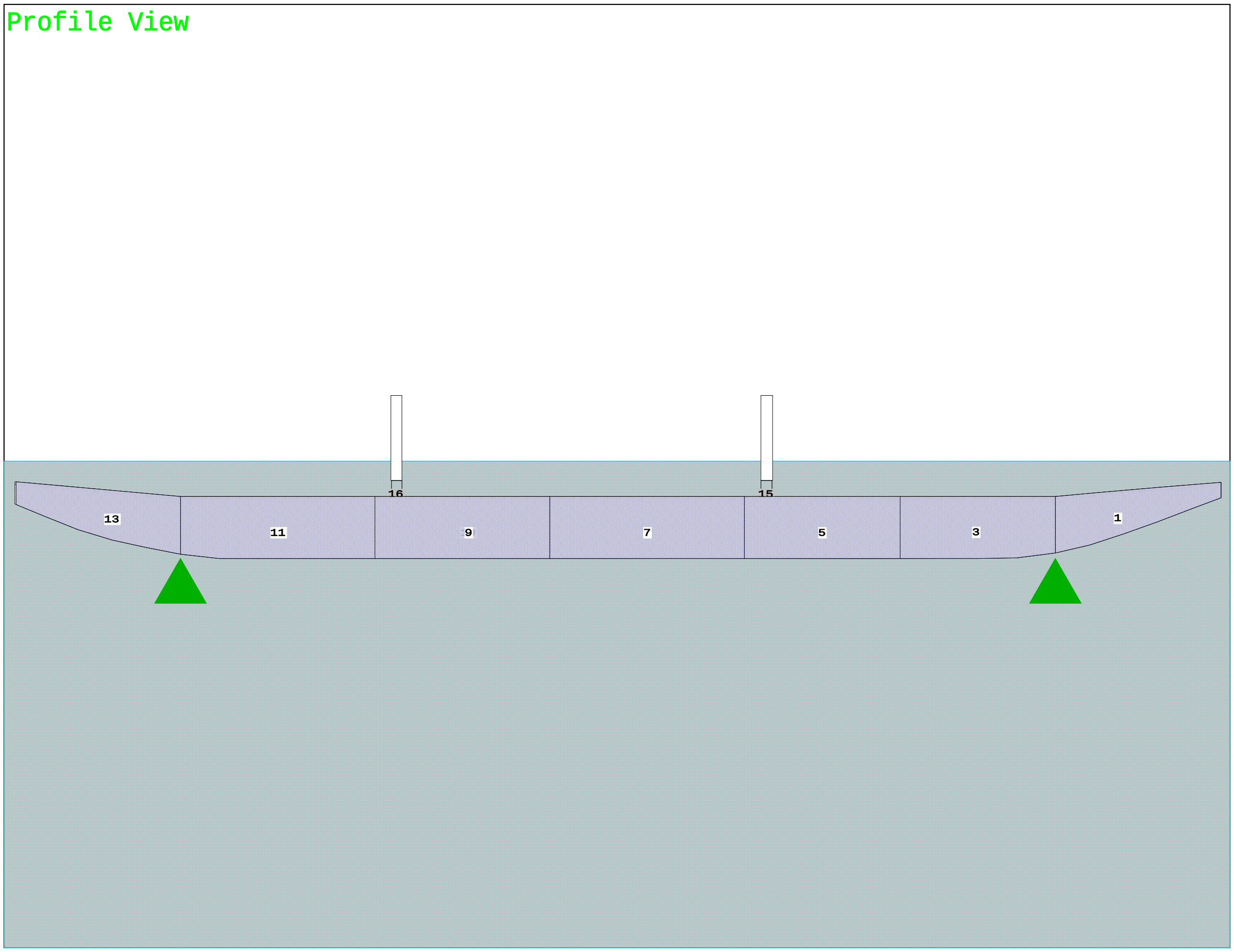
Baseline draft: 20.022 @ 0.00, 20.021 @ 248.00a

Trim: 0.00/248.00, Heel: Stbd 0.01 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			1,157.02	124.00a	0.00	7.65	
EndWallF			25.08	17.50a	0.00	18.85	
EndWallA			25.08	230.50a	0.00	18.85	
GateF			239.15	81.00a	2.39s	27.52	
GateA			239.15	167.00a	2.39s	27.52	
Misc			232.28	120.66a	7.07s	25.91	
Fwd Wells			21.47	34.00a	0.00	6.36	
Aft Wells			21.47	214.00a	0.00	6.36	
Total Fixed >			1,960.70	123.60a	1.42s	14.92	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK1.S	1.000	1.000	369.89	20.35a	11.72s	9.53	
TANK1.P	1.000	1.000	369.89	20.35a	11.72p	9.53	
TANK2.S	1.000	1.000	567.64	50.17a	11.83s	6.46	
TANK2.P	1.000	1.000	567.64	50.17a	11.83p	6.46	
TANK3.S	1.000	1.000	575.47	82.00a	11.83s	6.38	
TANK3.P	1.000	1.000	575.47	82.00a	11.83p	6.38	
TANK4.S	1.000	1.000	719.33	118.00a	11.83s	6.38	
TANK4.P	1.000	1.000	719.33	118.00a	11.83p	6.38	
TANK5.S	1.000	1.000	647.40	156.00a	11.83s	6.38	
TANK5.P	1.000	1.000	647.40	156.00a	11.83p	6.38	
TANK6.S	1.000	1.000	714.19	193.88a	11.83s	6.42	
TANK6.P	1.000	1.000	714.19	193.88a	11.83p	6.42	
TANK7.S	1.000	1.000	424.45	228.46a	11.75s	9.21	
TANK7.P	1.000	1.000	424.45	228.46a	11.75p	9.21	
Total Tanks >			8,036.71	125.55a	0.00	6.98	
Total Weight >			9,997.41	125.17a	0.28s	8.54	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	8,378.78	125.74a	0.07s	7.18	-20.02
GATEF_FLOOD.S	Flooded	1.000	-36.35	93.45a	3.50s	14.38	-20.02
GATEA_FLOOD.S	Flooded	1.000	-35.29	169.50a	3.50s	14.38	-20.02
Total Displacement-->		1.000	8,307.14	125.70a	0.04s	7.12	
			React(KP)	**LCR**	**TCR**	**VCR**	
Fwd Stbd Jack			454.73	34.00a	24.00s	0.00	-20.03
Fwd Port Jack			403.96	34.00a	24.00p	0.00	-20.02
Aft Stbd Jack			441.21	214.00a	24.00s	0.00	-20.03
Aft Port Jack			390.43	214.00a	24.00p	0.00	-20.02
Total Reaction >			1,690.33	122.56a	1.44s	0.00	
Total Buoyancy >			9,997.47	125.17a	0.28s	5.92	
Righting Arms:				0.00	0.00		

Distances in FEET.

CG - Draft: 20.02 @ 0.00 , 20.02 @ 248.00a Heel: stbd 0.01 deg.



Tanks

1 TANK1.S.......100% FRESH WATER	6 TANK3.P.......100% FRESH WATER	12 TANK6.P.......100% FRESH WATER
2 TANK1.P.......100% FRESH WATER	7 TANK4.S.......100% FRESH WATER	13 TANK7.S.......100% FRESH WATER
3 TANK2.S.......100% FRESH WATER	8 TANK4.P.......100% FRESH WATER	14 TANK7.P.......100% FRESH WATER
4 TANK2.P.......100% FRESH WATER	9 TANK5.S.......100% FRESH WATER	15 GATEF_FLOOD.S..Flooded
5 TANK3.S.......100% FRESH WATER	10 TANK5.P.......100% FRESH WATER	16 GATEA_FLOOD.S..Flooded
	11 TANK6.S.......100% FRESH WATER	

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.01 deg.

Largest Shear: 669.9 KP at 34.00a
Largest Bending Moment: -26,641 KP-Ft at 122.00a (Sagging)
Largest Stress: -8.152 KP/SqIn at 122.00a (Compression)
(42.1% of 19.380 KP/SqIn limit)

GROUNDING points

Origin Depth: 20.022
Trim: 0.00/248.00 Heel: Stbd 0.01 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	20.03	20.00	0.02	0.10	454.73
Fwd Port Jack	20.02	20.00	0.02	0.10	403.96
Aft Stbd Jack	20.03	20.00	0.02	0.10	441.21
Aft Port Jack	20.02	20.00	0.02	0.10	390.43
Total Ground Reaction ——>					1,690.33

Distances in FEET.

BARGE NEARING TOUCHDOWN ON BOTTOM GATES MOSTLY NEUTRALLY BUOYANT

WEIGHT and DISPLACEMENT STATUS

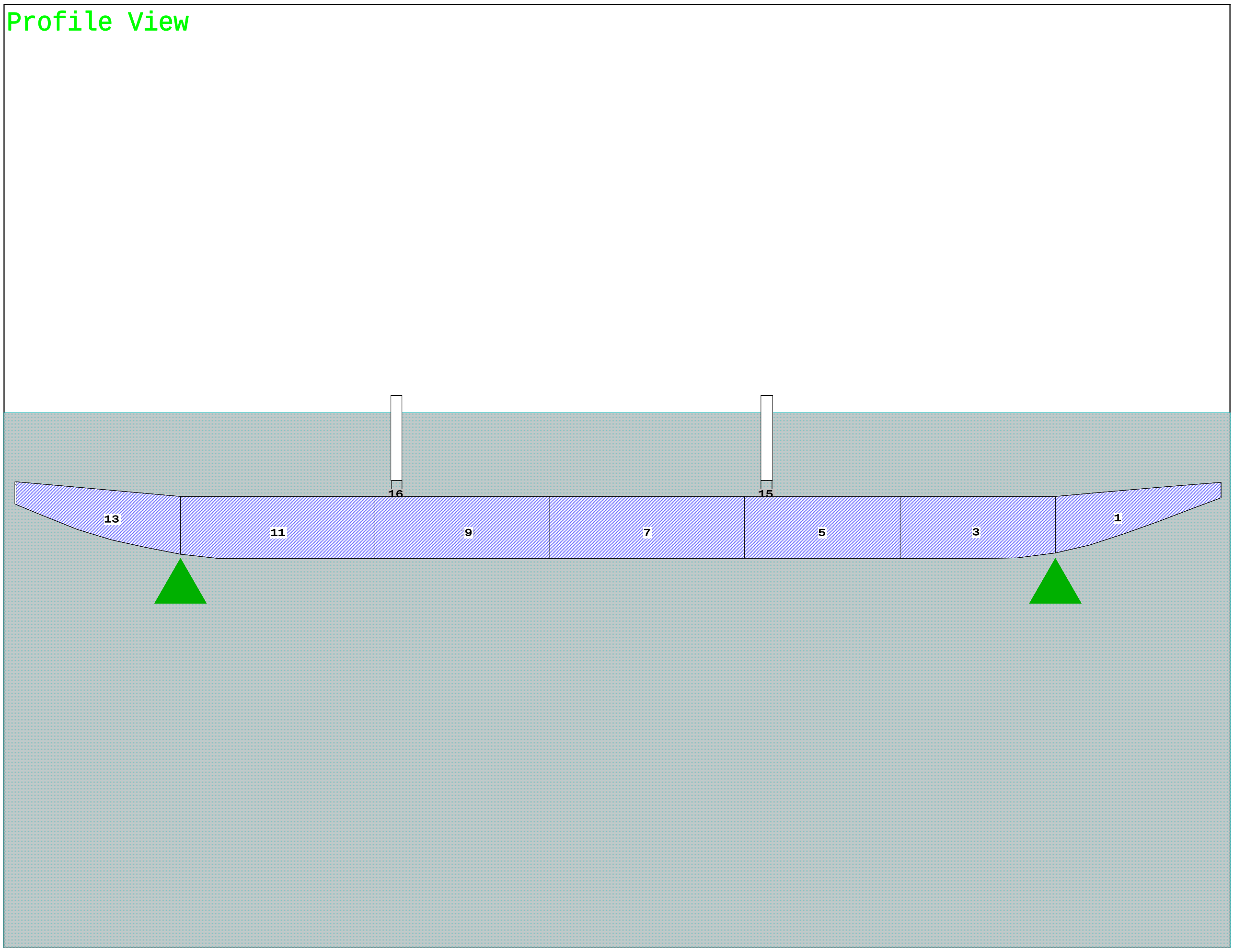
Baseline draft: 30.019 @ 0.00, 30.017 @ 248.00a

Trim: 0.00/248.00, Heel: Stbd 0.02 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			1,157.02	124.00a	0.00	7.65	
EndWallF			25.08	17.50a	0.00	18.85	
EndWallA			25.08	230.50a	0.00	18.85	
GateF			239.15	81.00a	2.39s	27.52	
GateA			239.15	167.00a	2.39s	27.52	
Misc			232.28	120.66a	7.07s	25.91	
Fwd Wells			21.47	34.00a	0.00	6.36	
Aft Wells			21.47	214.00a	0.00	6.36	
Total Fixed-->			1,960.70	123.60a	1.42s	14.92	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK1.S	1.000	1.000	369.89	20.35a	11.72s	9.53	
TANK1.P	1.000	1.000	369.89	20.35a	11.72p	9.53	
TANK2.S	1.000	1.000	567.64	50.17a	11.83s	6.46	
TANK2.P	1.000	1.000	567.64	50.17a	11.83p	6.46	
TANK3.S	1.000	1.000	575.47	82.00a	11.83s	6.38	
TANK3.P	1.000	1.000	575.47	82.00a	11.83p	6.38	
TANK4.S	1.000	1.000	719.33	118.00a	11.83s	6.38	
TANK4.P	1.000	1.000	719.33	118.00a	11.83p	6.38	
TANK5.S	1.000	1.000	647.40	156.00a	11.83s	6.38	
TANK5.P	1.000	1.000	647.40	156.00a	11.83p	6.38	
TANK6.S	1.000	1.000	714.19	193.88a	11.83s	6.42	
TANK6.P	1.000	1.000	714.19	193.88a	11.83p	6.42	
TANK7.S	1.000	1.000	424.45	228.46a	11.75s	9.21	
TANK7.P	1.000	1.000	424.45	228.46a	11.75p	9.21	
Total Tanks-->			8,036.71	125.55a	0.00	6.98	
Total Weight-->			9,997.41	125.17a	0.28s	8.54	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	8,621.25	125.90a	0.17s	7.68	-30.02
GATEF_FLOOD.S	Flooded	1.000	-36.35	93.45a	3.50s	14.37	-30.02
GATEA_FLOOD.S	Flooded	1.000	-35.29	169.50a	3.50s	14.37	-30.02
Total Displacement-->		1.000	8,549.61	125.86a	0.14s	7.63	
			React(KP)	**LCR**	**TCR**	**VCR**	
Fwd Stbd Jack			390.17	34.00a	24.00s	0.00	-30.03
Fwd Port Jack			357.16	34.00a	24.00p	0.00	-30.01
Aft Stbd Jack			366.72	214.00a	24.00s	0.00	-30.02
Aft Port Jack			333.74	214.00a	24.00p	0.00	-30.01
Total Reaction-->			1,447.80	121.09a	1.09s	0.00	
Total Buoyancy-->			9,997.40	125.17a	0.28s	6.52	
Righting Arms:				0.00	0.00		

Distances in FEET.

CG - Draft: 30.02 @ 0.00 , 30.02 @ 248.00a Heel: stbd 0.02 deg.



Tanks

1 TANK1.S.......100% FRESH WATER	6 TANK3.P.......100% FRESH WATER	12 TANK6.P.......100% FRESH WATER
2 TANK1.P.......100% FRESH WATER	7 TANK4.S.......100% FRESH WATER	13 TANK7.S.......100% FRESH WATER
3 TANK2.S.......100% FRESH WATER	8 TANK4.P.......100% FRESH WATER	14 TANK7.P.......100% FRESH WATER
4 TANK2.P.......100% FRESH WATER	9 TANK5.S.......100% FRESH WATER	15 GATEF_FLOOD.S..Flooded
5 TANK3.S.......100% FRESH WATER	10 TANK5.P.......100% FRESH WATER	16 GATEA_FLOOD.S..Flooded
	11 TANK6.S.......100% FRESH WATER	

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.02 deg.

Largest Shear:	558.5 KP	at 34.00a	
Largest Bending Moment:	-20,363 KP-Ft	at 130.00a	(Sagging)
Largest Stress:	-6.231 KP/SqIn	at 130.00a	(Compression)
(32.2% of	19.380 KP/SqIn limit)		

GROUNDING points

Origin Depth: 30.019
Trim: 0.00/248.00 Heel: Stbd 0.02 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	30.03	30.01	0.02	0.10	390.17
Fwd Port Jack	30.01	29.99	0.02	0.10	357.16
Aft Stbd Jack	30.02	30.00	0.02	0.10	366.72
Aft Port Jack	30.01	29.99	0.02	0.10	333.74
Total Ground Reaction --->					1,447.80

Distances in FEET.

Appendix B Overturning Condition

TWO GATE FISH PROTECTION
Old River Gate Structure
By: JKM/JTB
Date: 9/8/2009

Overturning Condition

Weights

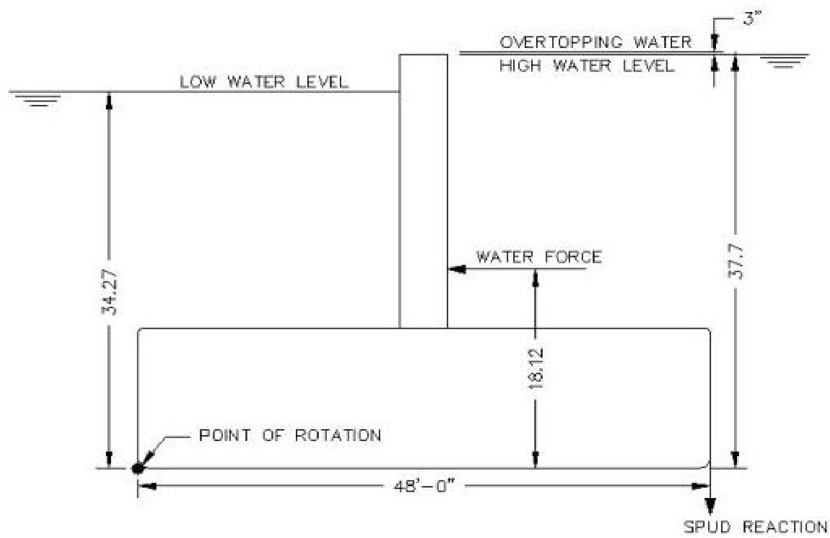
Item	Weight in Air	Weight in Water	TCG	Notes
	(Kip)	(Kip)	ft OCL +Stb	change from +10% to -10% margin
Barge Hull	946.65	823.59	0.00	Weight in water 87% of weight in air,
Gates (2)	391.34	0.00	2.39	Gate are assumed to be neutrally Bouyant
Miscellaneous sys	190.05	165.34	7.07	Weight in water 87% of weight in air
End Walls	50.16	43.64	0.00	Weight in water 87% of weight in air
Solid Ballast				
Super Charged Ballast				
Trapped Air	0	-87.40	0.00	Assumed 2" of trapped air
Total Weights	1578.19	945.17	1.24	

Static Head

	ft	psf	Notes
Height of High Side Water	37.77		Water assumed overtopping sheet pile
Height of Low Side Water	34.27		
Height of Topping Water	0.25		Assume standing water overtopping sheet pile
Differential Head	3.75		
Average Pressure Head	3.59	229.67	Assume worst case water density 64 lbs/cu.ft

Moment Balance

	Area	Force	Moment Arm	Moment	Notes
	Sq. Ft	kip	ft	kip-ft	
Water Pressure	9366.96	-2151.35	18.12	-38984.91	Area = 248'x37.7'
Weight		945.17	22.76254801	21514.39	
Net Moment				-17470.51	+ excess restoring moment
Margin				-44.8%	
Pile moment arm			48	-17470.51	CL pile to opposite bilge
Pile load, two piles		-363.97			
Pile load, one pile		-181.98			
Pile weight, kip/ft =	0.656				42" X 1" wall
Pile length (ft)	120				
Pile weight total (kip)	78.72				
Pile pull out (kip)		-103.26			Load minus pile weight



Appendix C Weather Criterion

Two Gate Fish Protection: Old River Weather Criterion

Weather Criterion
46 CFR 170 Subpart E

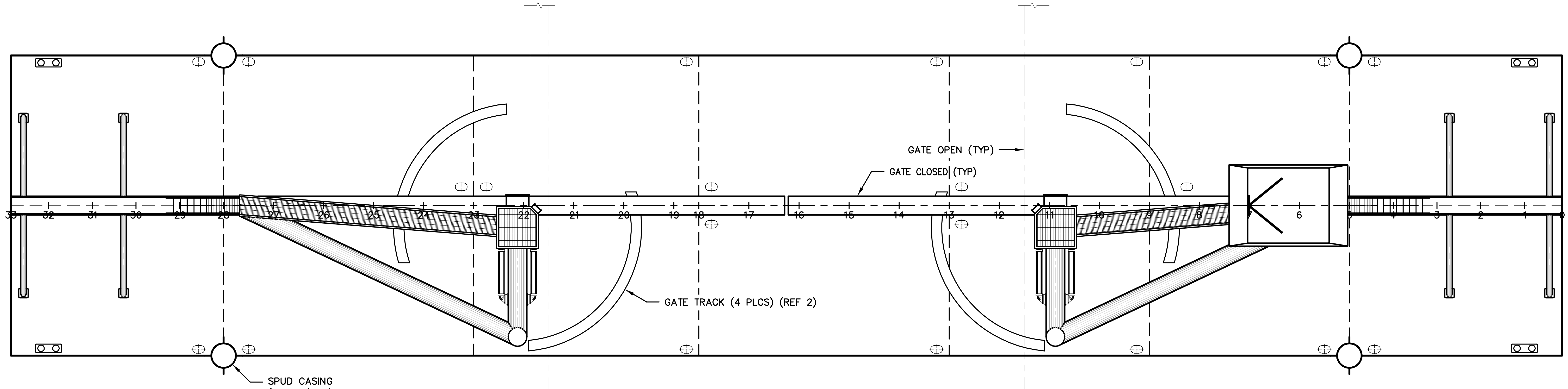
GM >= PAH / W tan T

Depth =	12.75 ft		
LBP =	215 ft		
Beam =	48 ft		
P =	0.002729 LT/ft^2	= 0.0025 + (LBP/14200)^2	. . . for service on protected water
A =	(see below) ft^2	= projected lateral area of portion of vessel and cargo above waterli	
H =	(see below) ft	= vertical distance from the center of A to the center of underwater lateral area (~ 1/2 draft)	
W =	(see below) LT	= Displacement	
T =	(see below) deg	= MIN (14º, Angle at which 1/2 freeboard to deck is immersed [call it heel])	

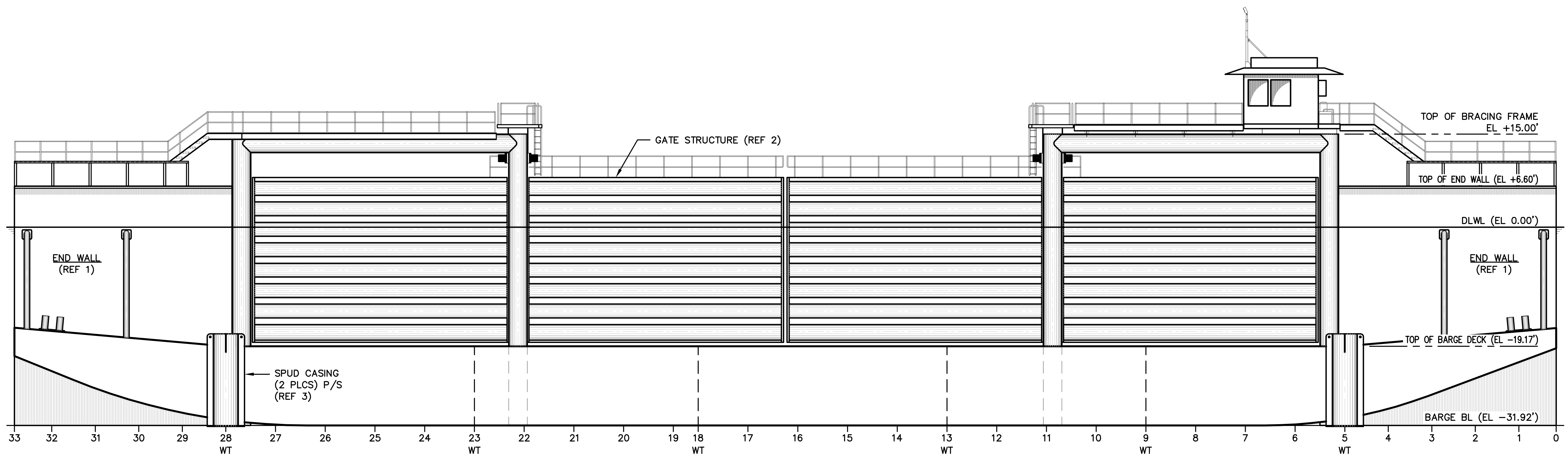
1/2 B tan (HEEL) = distance hull is immersed due to HEEL

Draft	Displacement = W	Freeboard	max VCG	A	H	tan (heel)	heel	min(14º, heel) = T	PAH / W tan T
ft ABL	LT	ft	ft Abv mn dk	ft^2	ft		deg	deg	ft
3.61	2,214.70	9.13	9.37	8,085.29	20.64	0.19	10.77	10.77	1.08

ATTACHMENT A2. Old River Gate Drawings



GENERAL ARRANGEMENT



OUTBOARD PROFILE

90% SUBMITTAL

GENERAL NOTES

1. DIMENSIONS GIVEN ARE FOR REFERENCE ONLY.

REFERENCES

1. GLOSTEN DWG 09041-03-02 BARGE IGNACIO END WALL STRUCTURE
2. MOFFATT & NICHOL DWG 6097-03 TWO GATE FISH PROTECTION PLAN
3. GLOSTEN DWG 09041-02-02 BARGE IGNACIO MODIFICATIONS

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD

PRELIMINARY — JON K. MARKESTAD, STATE OF WASHINGTON, 41178, REGISTERED PROFESSIONAL ENGINEER

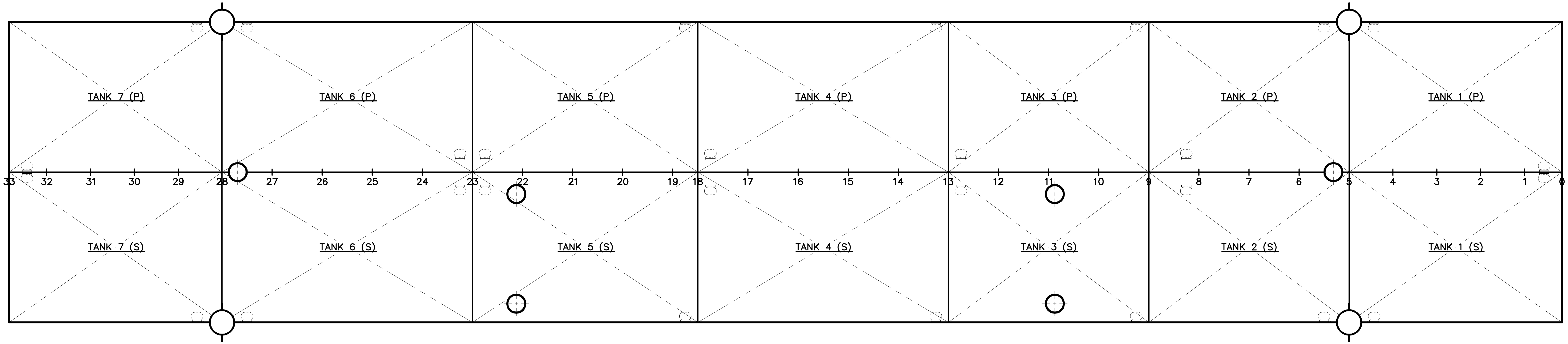
MOFFATT & NICHOL, INC.
WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
OLD RIVER GATE (BARGE IGNACIO)
GENERAL ARRANGEMENT

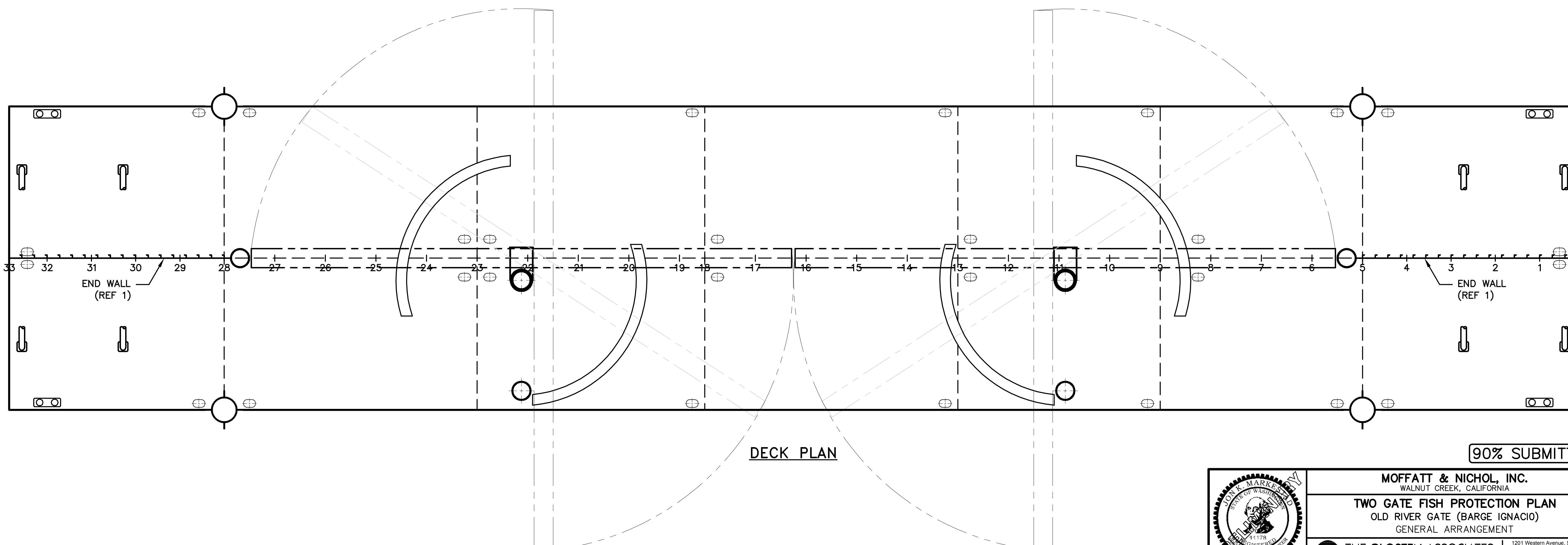
THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community
1201 Western Avenue, Suite 200
Seattle, Washington 98101-2921
TEL 206.624.7850
WEB www.glosten.com

Drawn	Checked	Approved	Date
CWK	JKM	WLH	7/9/2009

Scale	Drawing Number	Sheet	of	Revision
1/16"=1'-0"	09041-01-02	1	2	P2



HOLD PLAN



DECK PLAN

90% SUBMITTAL

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STATE OF WASHINGTON
11178
REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

MOFFATT & NICHOL, INC.
WALNUT CREEK, CALIFORNIA

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GENERAL ARRANGEMENT

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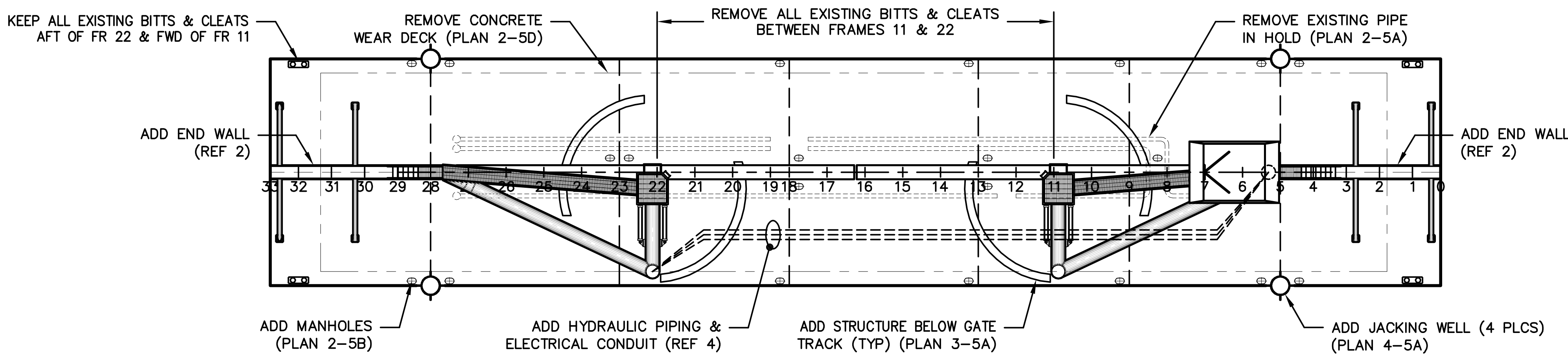
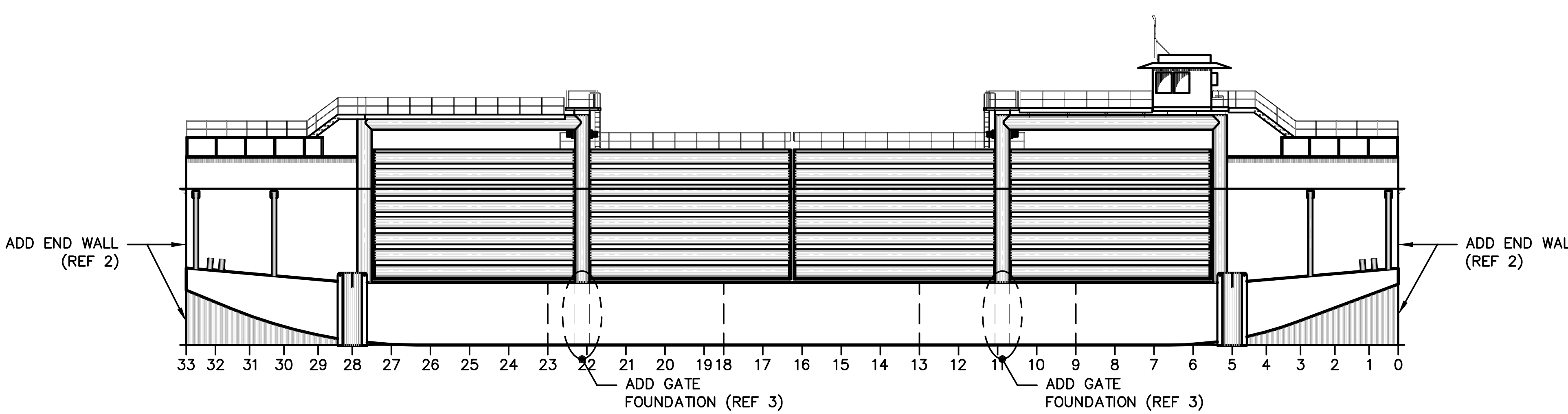
CWK	JKM	NAME	7/9/2009

Scale	Drawing Number	Sheet	of	Revision
1/16"=1'-0"	09041-01-02	2	2	P2



PLAN VIEW



OUTBOARD PROFILE

90% SUBMITTAL

GENERAL NOTES

REFERENCES

1. GLOSTEN DWG 09041–01–02 BARGE IGNACIO GENERAL ARRGT
2. GLOSTEN DWG 09041–03–02 BARGE IGNACIO END WALL STRUCTURE
3. GLOSTEN DWG 09041–04–02 BARGE IGNACIO GATE FOUNDATIONS
4. GLOSTEN DWG 09041–05–02 HYDRAULIC PIPING & ELEC CONDUIT
5. MOFFATT & NICHOL DWG 6097–03 TWO GATE FISH PROTECTION PLAN

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD

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STATE OF WASHINGTON
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REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

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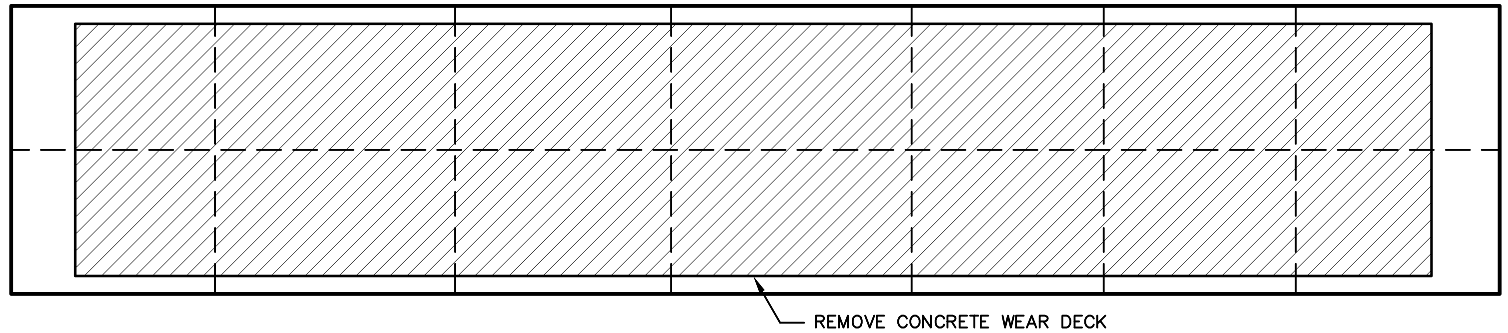
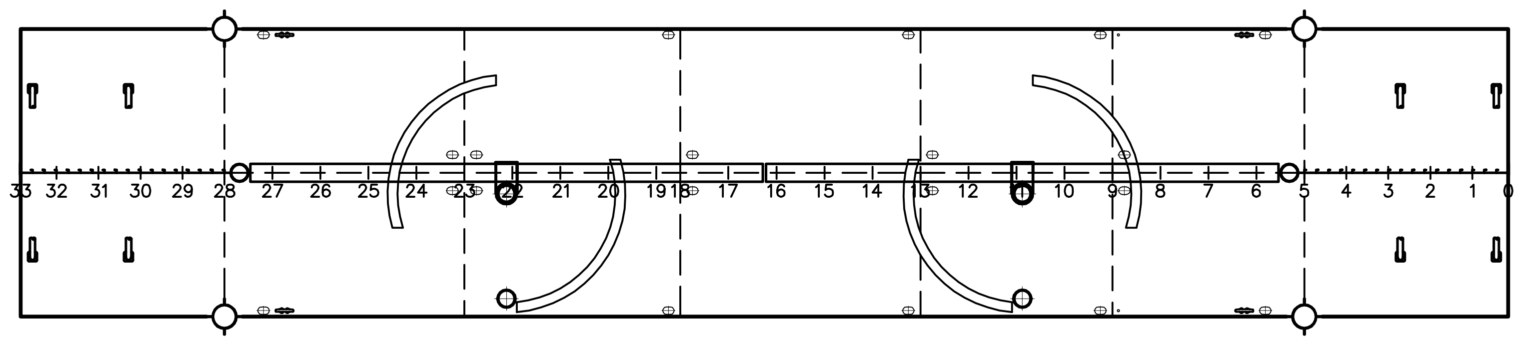
AS NOTED	09041–02–02	1	4	P2

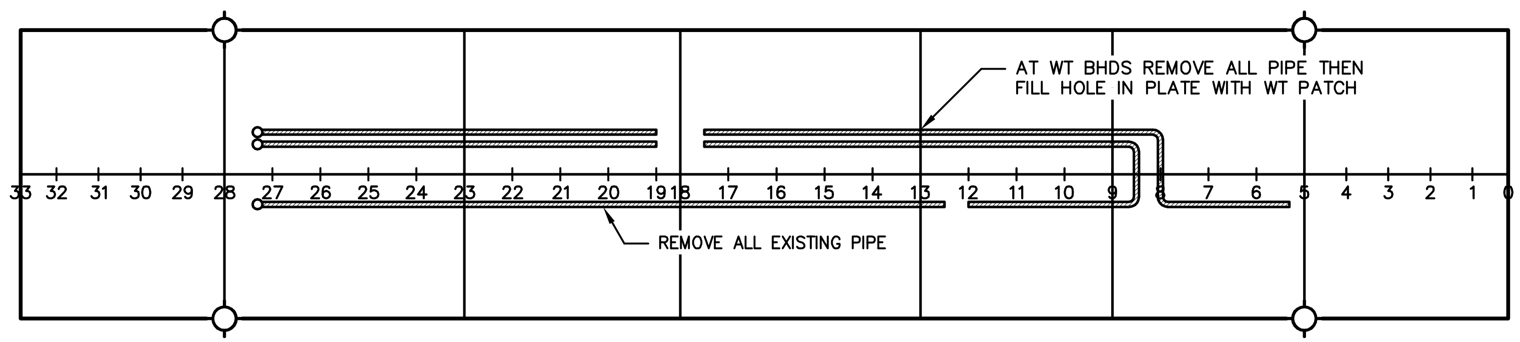


PLAN 2–5D
WEAR DECK REMOVAL
1/32"=1'–0"

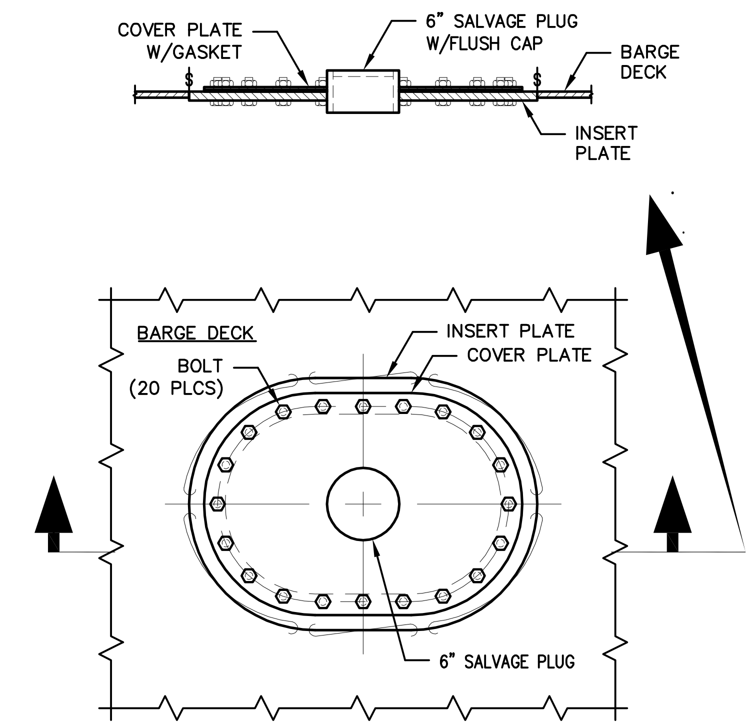


1. REMOVE AND PLUG EXISTING MANHOLES (14 PLCS)
2. ADD 15"x 23" FLUSH WT MANHOLES WITH 6" SALVAGE PLUGS (28 PLCS) SEE DETAIL 2–2B
3. TO ALLOW CLEARANCE FOR GATE SWING, NO PART OF NEW MANHOLES SHALL PROTRUDE MORE THAN 2" ABOVE THE DECK.

PLAN 2–5B
ADD MANHOLES
1/32"=1'–0"



PLAN 2–5A
PIPE REMOVAL
1/32"=1'–0"



DETAIL 2–2B
TYPICAL MANHOLE DETAIL
(NABRICO DF–503 OR EQUAL W/SALVAGE PLUG ADDED)
3/4"=1'–0"

90% SUBMITTAL

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TWO GATE FISH PROTECTION PLAN
OLD RIVER GATE (BARGE IGNACIO)
BARGE MODIFICATIONS

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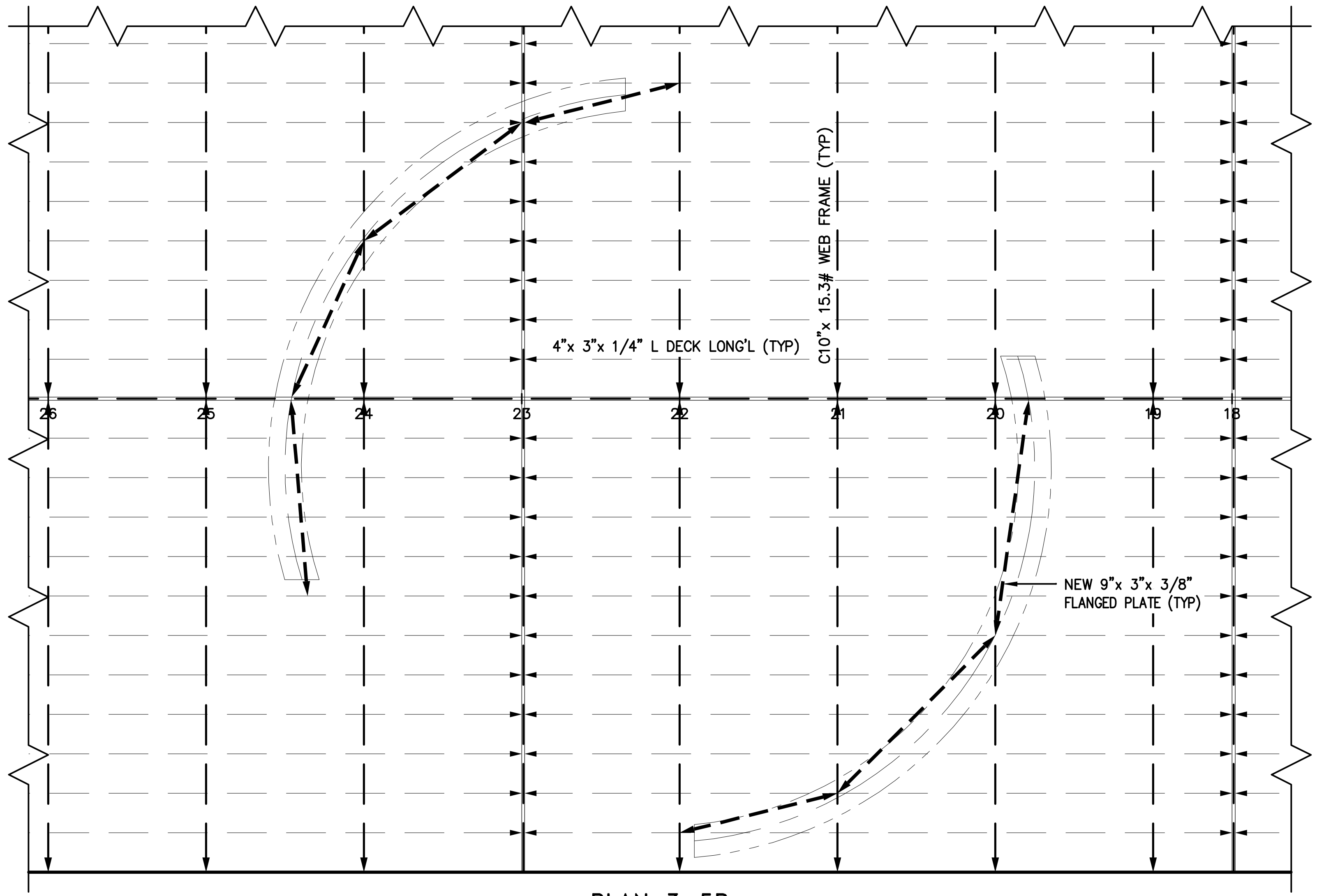
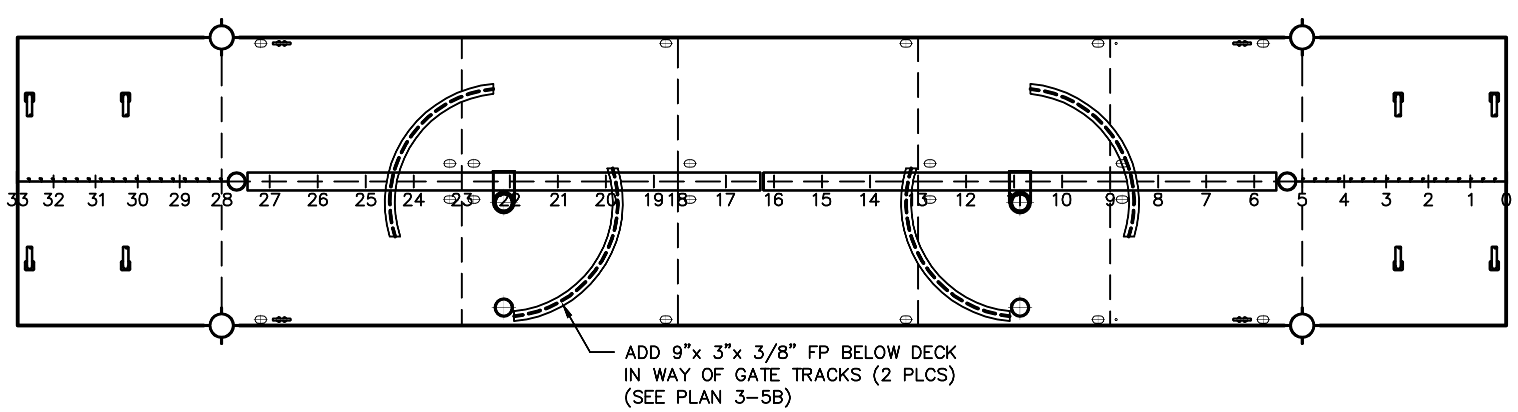


PLAN 3-5B

TYPICAL ADDED STRUCTURE BELOW GATE TRACKS

1/8"=1'-0"



PLAN 3-5A

ADD STRUCTURE BELOW GATE TRACKS

1/32"=1'-0"

90% SUBMITTAL

PRELIMINARY

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TWO GATE FISH PROTECTION PLAN
OLD RIVER GATE (BARGE IGNACIO)
BARGE MODIFICATIONS

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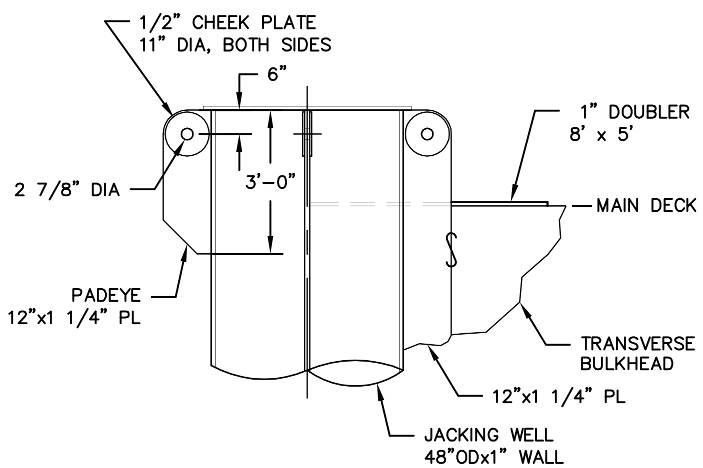
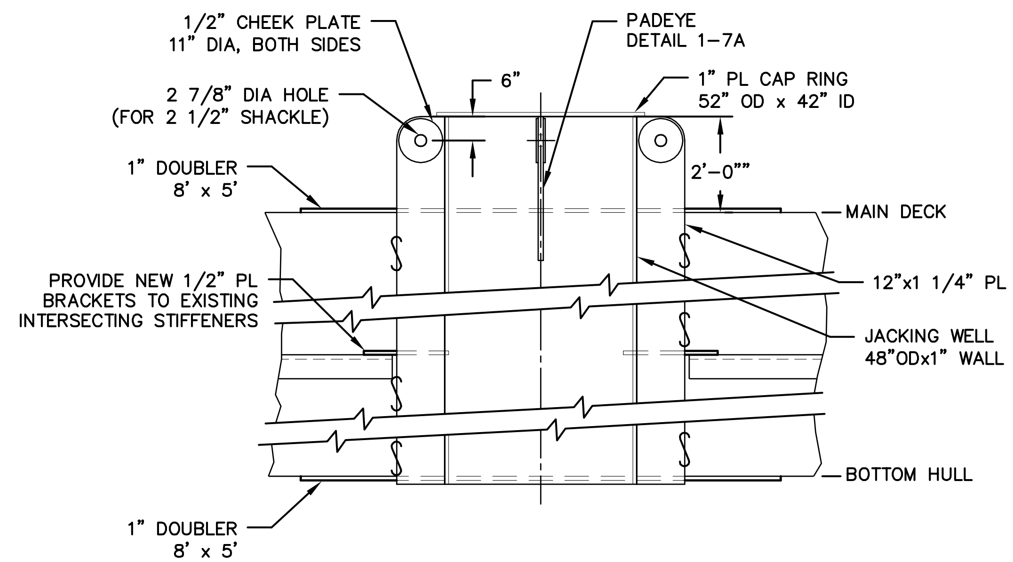


DETAIL 4-7D

TYPICAL PADEYE

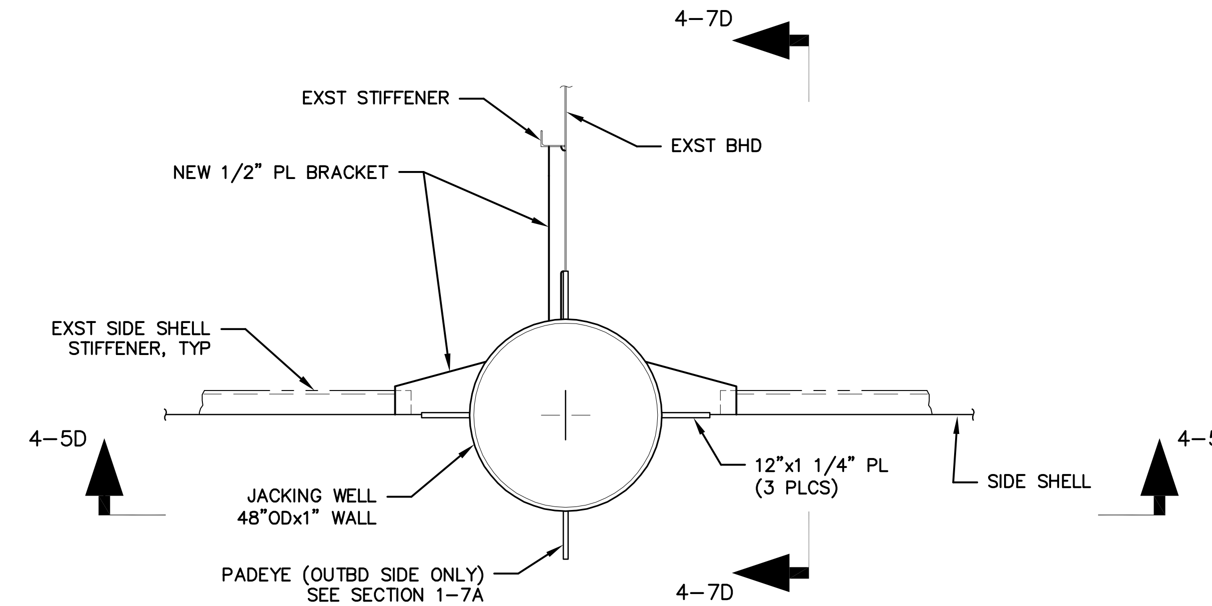
1/4"=1'-0"



ELEVATION 4-5D

LOOKING INBOARD

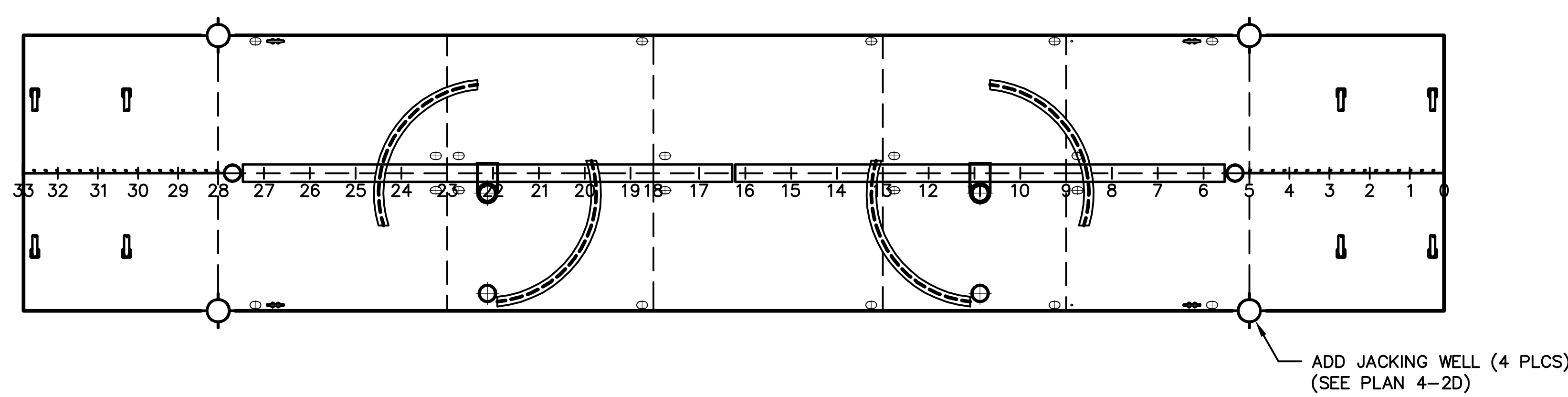
1/4"=1'-0"



PLAN 4-2D

TYPICAL JACKING WELL

1/4"=1'-0"



PLAN 4-5A

ADD JACKING WELLS

1/32"=1'-0"

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TWO GATE FISH PROTECTION PLAN OLD RIVER GATE (BARGE IGNACIO) BARGE MODIFICATIONS	
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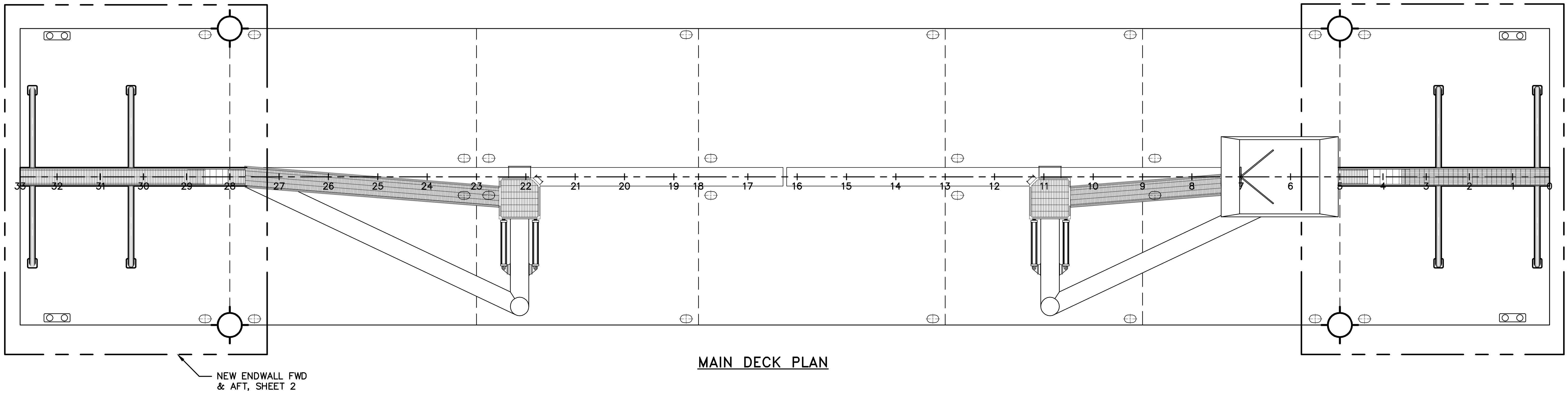
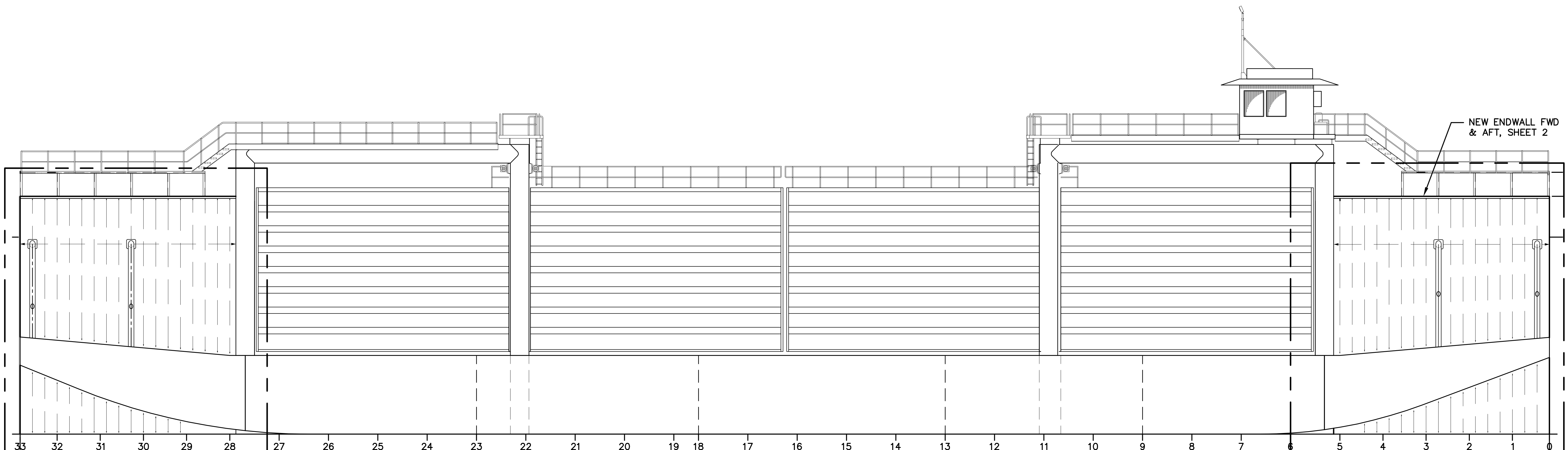
Drawn: CWK	Checked: JKM
Approved: WLH	Date: 7/9/2009
Scale: AS NOTED	Drawing Number: 09041-02-02
Sheet: 4 of 4	Revision: P2



MAIN DECK PLAN



OUTBOARD PROFILE

90% SUBMITTAL

GENERAL NOTES

REFERENCES

1. GLOSTEN DWG 09041-01-02 — BARGE IGNATIO GENERAL ARRANGEMENT
2. MOFFATT & NICHOL DWG 6097-03 — TWO GATE FISH PROTECTION PLAN
3. GLOSTEN DWG 09041-02-02 — BARGE IGNATIO MODIFICATIONS

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD

WILLIAM L. HURLEY JR. — STATE OF WASHINGTON — 19803 — REGISTERED PROFESSIONAL ENGINEER — PRELIMINARY

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WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
OLD RIVER GATE (BARGE IGNACIO)
END WALL STRUCTURE

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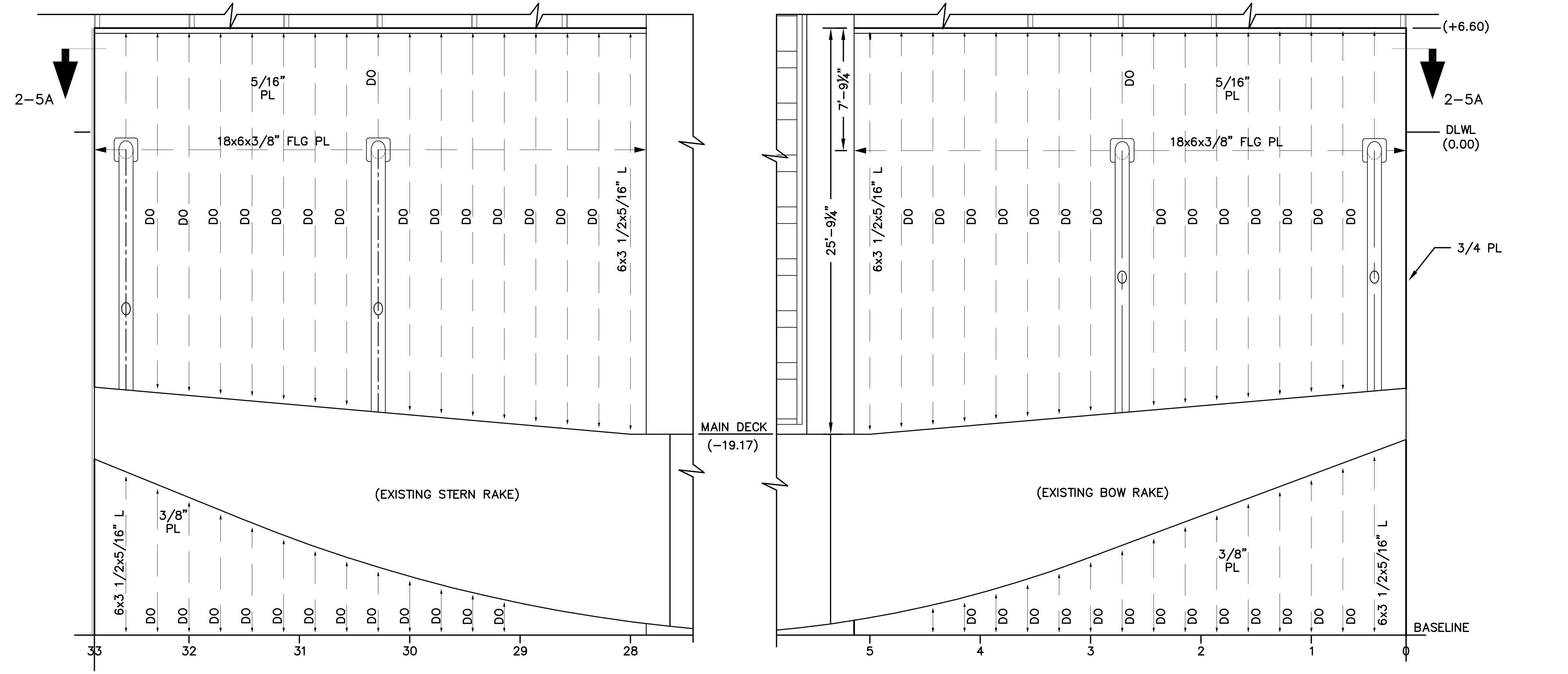
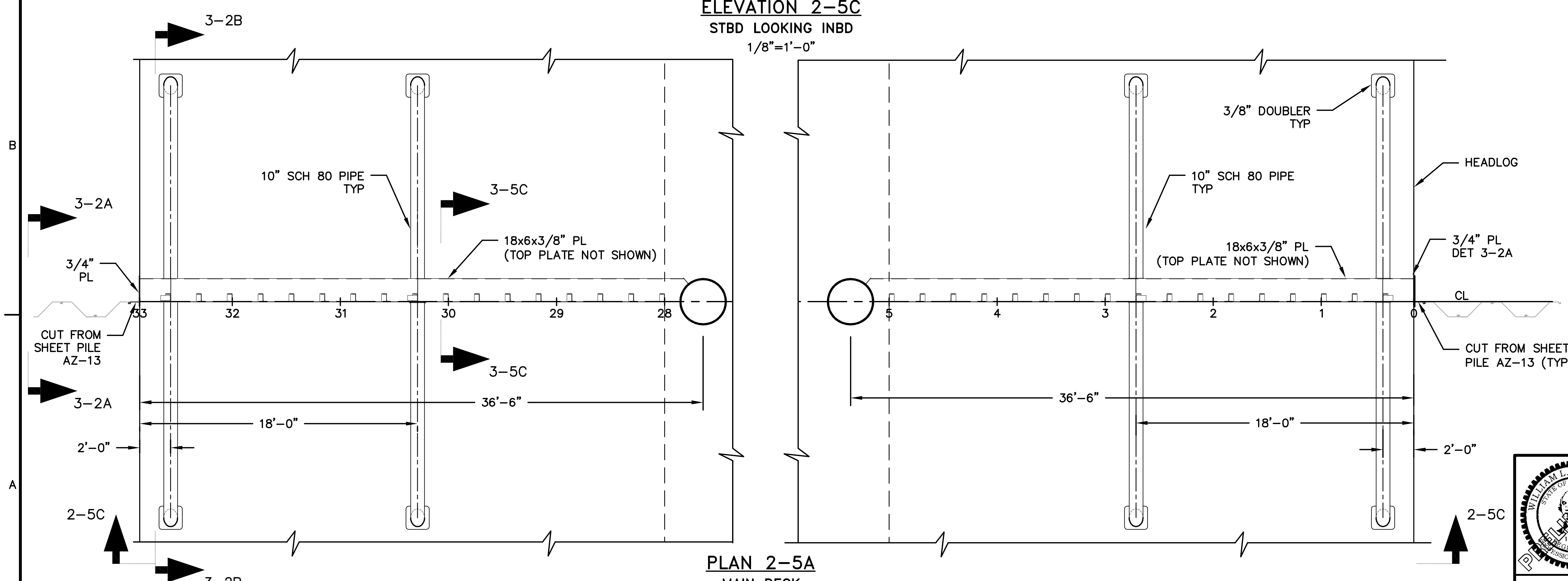
JL	WLH	WLH	9/2/09

Scale	Drawing Number	Sheet of	Revision
1/16"=1'-0"	09041-03-02	1 of 3	P2



ELEVATION 2-5C
STBD LOOKING INBD
1/8"=1'-0"



PLAN 2-5A
MAIN DECK
1/8"=1'-0"

90% SUBMITTAL

PRELIMINARY

MOFFATT & NICHOL, INC.
WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
OLD RIVER GATE (BARGE IGNACIO)
END WALL STRUCTURE

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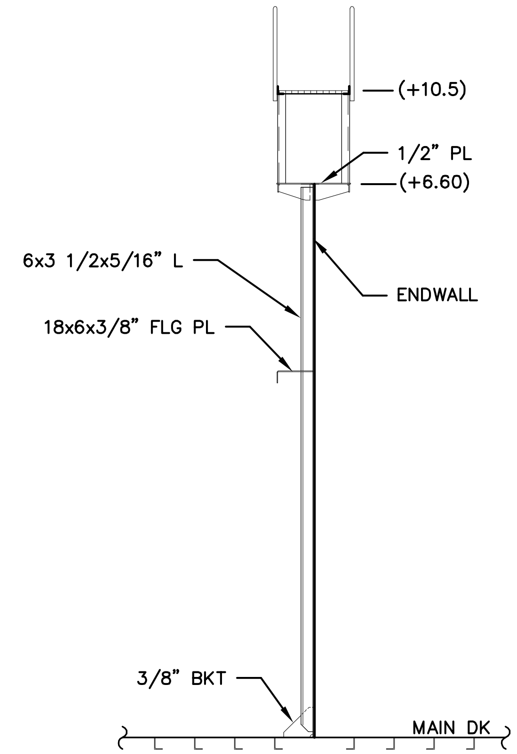
JL	WLH	WLH	9/2/09

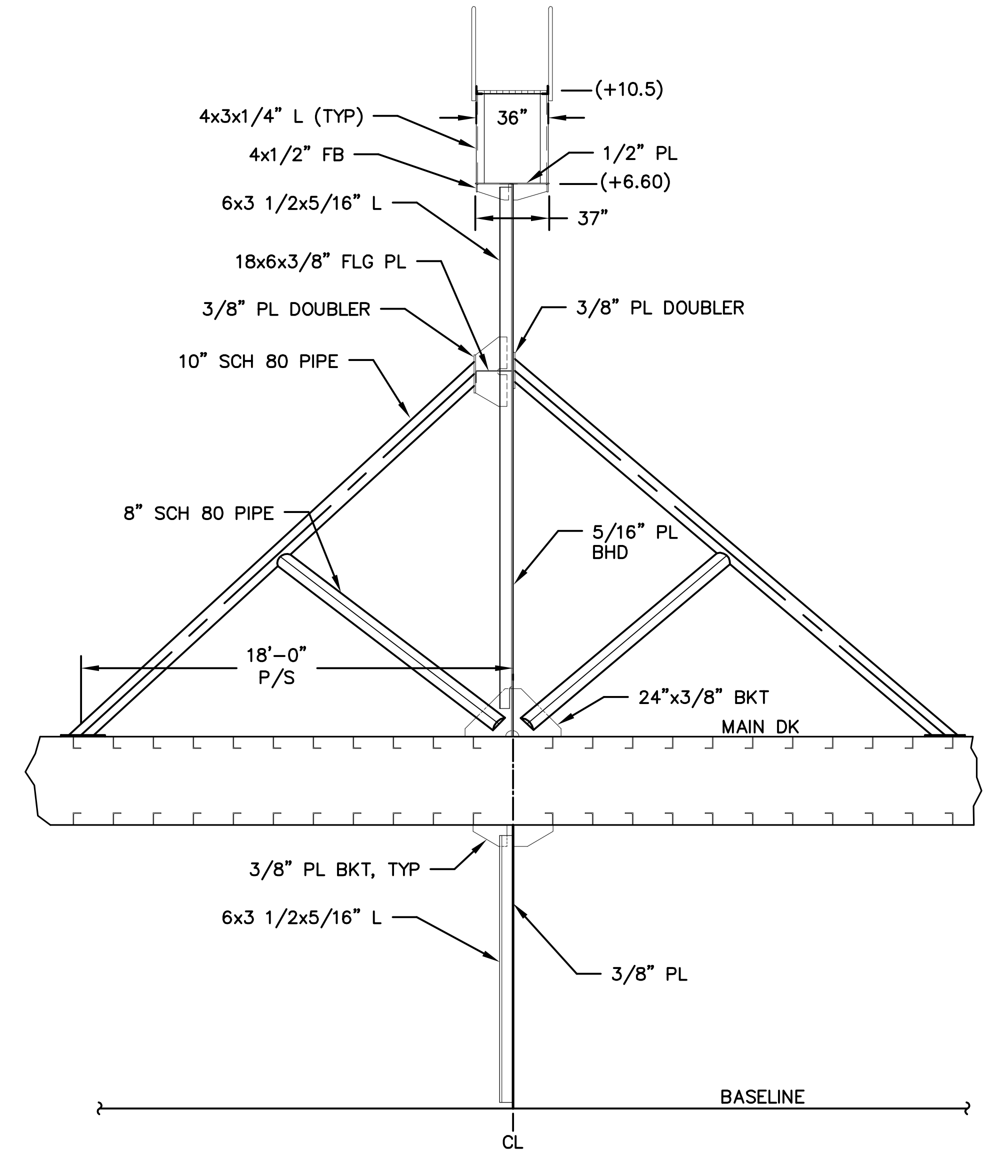
Scale	Drawing Number	Sheet	of	Revision
AS SHOWN	09041-03-02	2	3	P2



SECTION 3-5C

LOOKING FWD

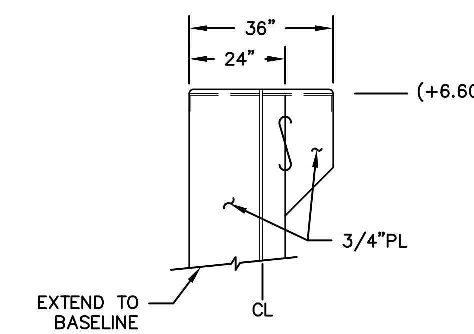
1/8"=1'-0"



SECTION 3-2B

LOOKING FWD

1/8"=1'-0"



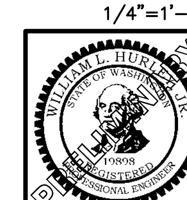
SECTION 3-2A

TOP OF END WALL

@ HEADLOG & STERNLOG

1/4"=1'-0"

90% SUBMITTAL



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TWO GATE FISH PROTECTION PLAN
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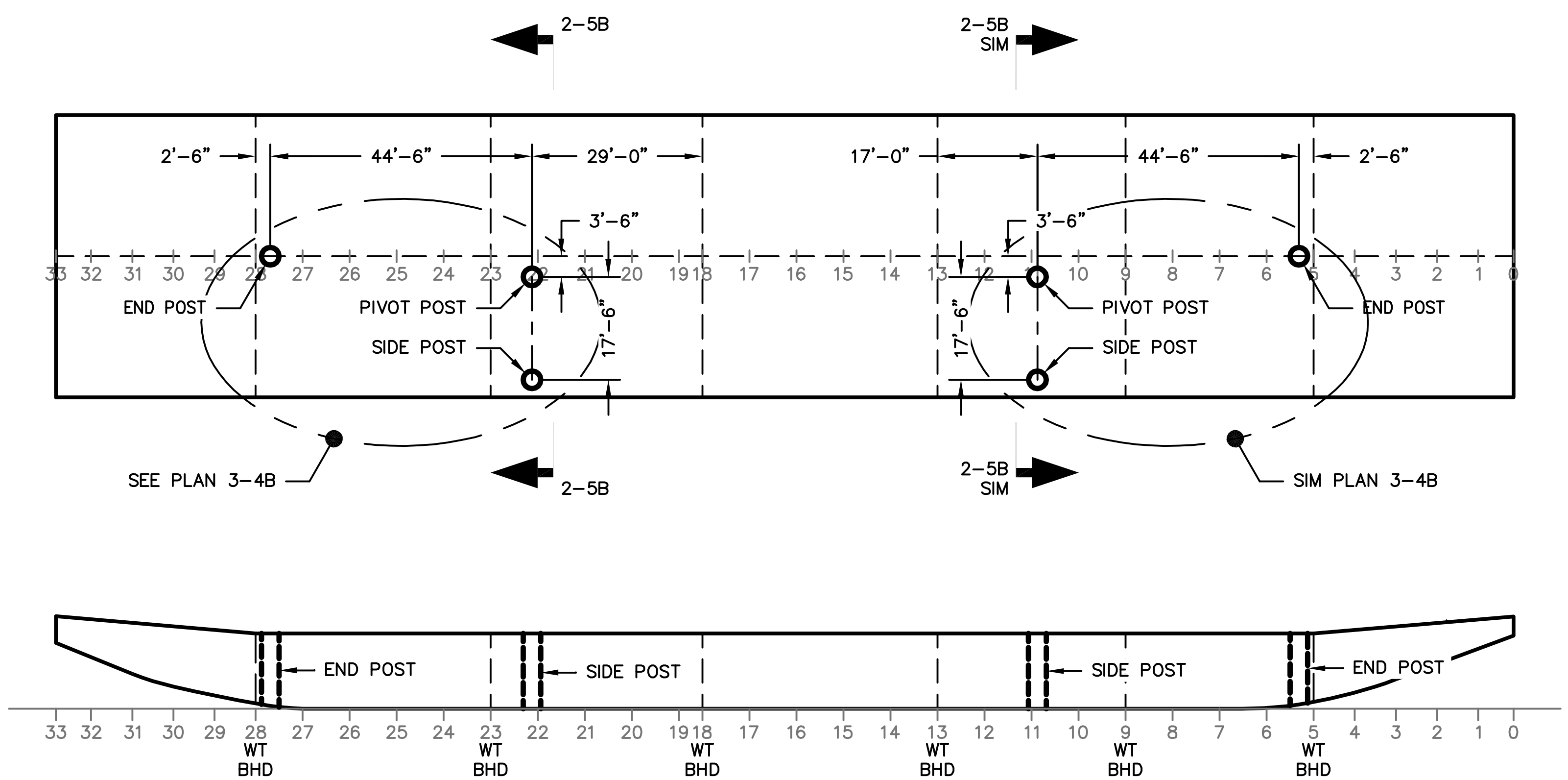
AS SHOWN	09041-03-02	3	3	P2



GATE FOUNDATION KEY PLAN

NO SCALE

GENERAL NOTES

1. BARGE SHOWN IN THIS DRAWING CORRESPONDS TO THE "IGNACIO" 248'x48'x12'-9".
2. ALL PLATES AND STIFFENERS TO BE ASTM A36 STEEL OR EQUIVALENT.
3. 3:1 TAPER TO BE USED IN BUTT JOINTS OF PLATES OF MORE THAN 1/8" UNEQUAL THICKNESS.
4. ALL WELDING TO BE DOUBLE CONTINUOUS UNLESS NOTED OTHERWISE.

REFERENCES

1. GLOSTEN DWG 09041-03-02 — BARGE IGNACIO END WALL STRUCTURE
2. GLOSTEN DWG 09041-02-02 — BARGE IGNACIO MODIFICATIONS
3. MOFFATT & NICHOL DWG C17 — GATE FRAMING LAYOUT
4. MOFFATT & NICHOL DWG C61-62 — GATE MECHANICAL DETAILS

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD

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WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
OLD RIVER GATE (BARGE IGNACIO)
GATE FOUNDATION

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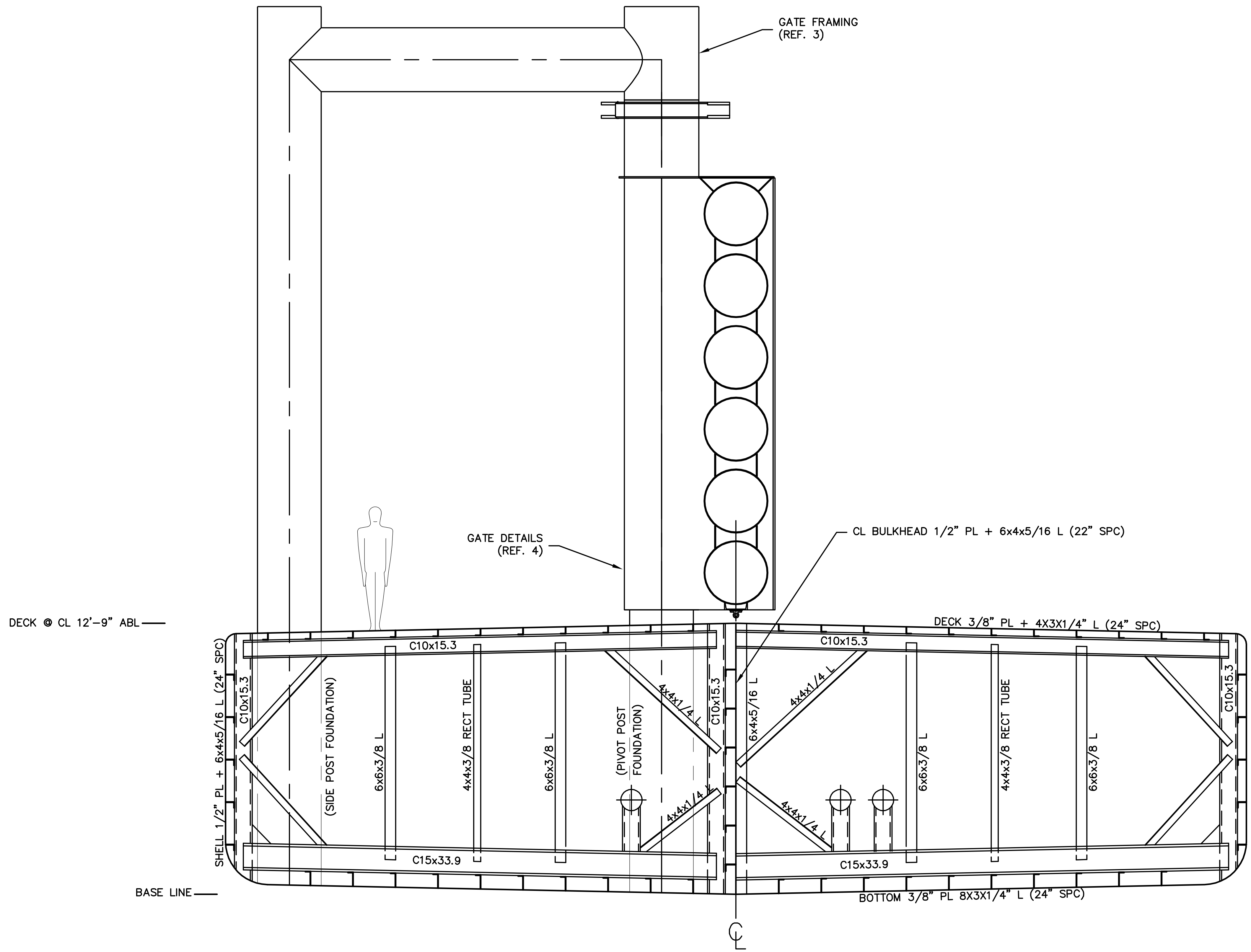

SECTION 2-5B

INSTALLATION OVERVIEW
SHOWN FRAME 22 LKG AFT
(FR 11 SIM)
3/16"=1'-0"

90% SUBMITTAL

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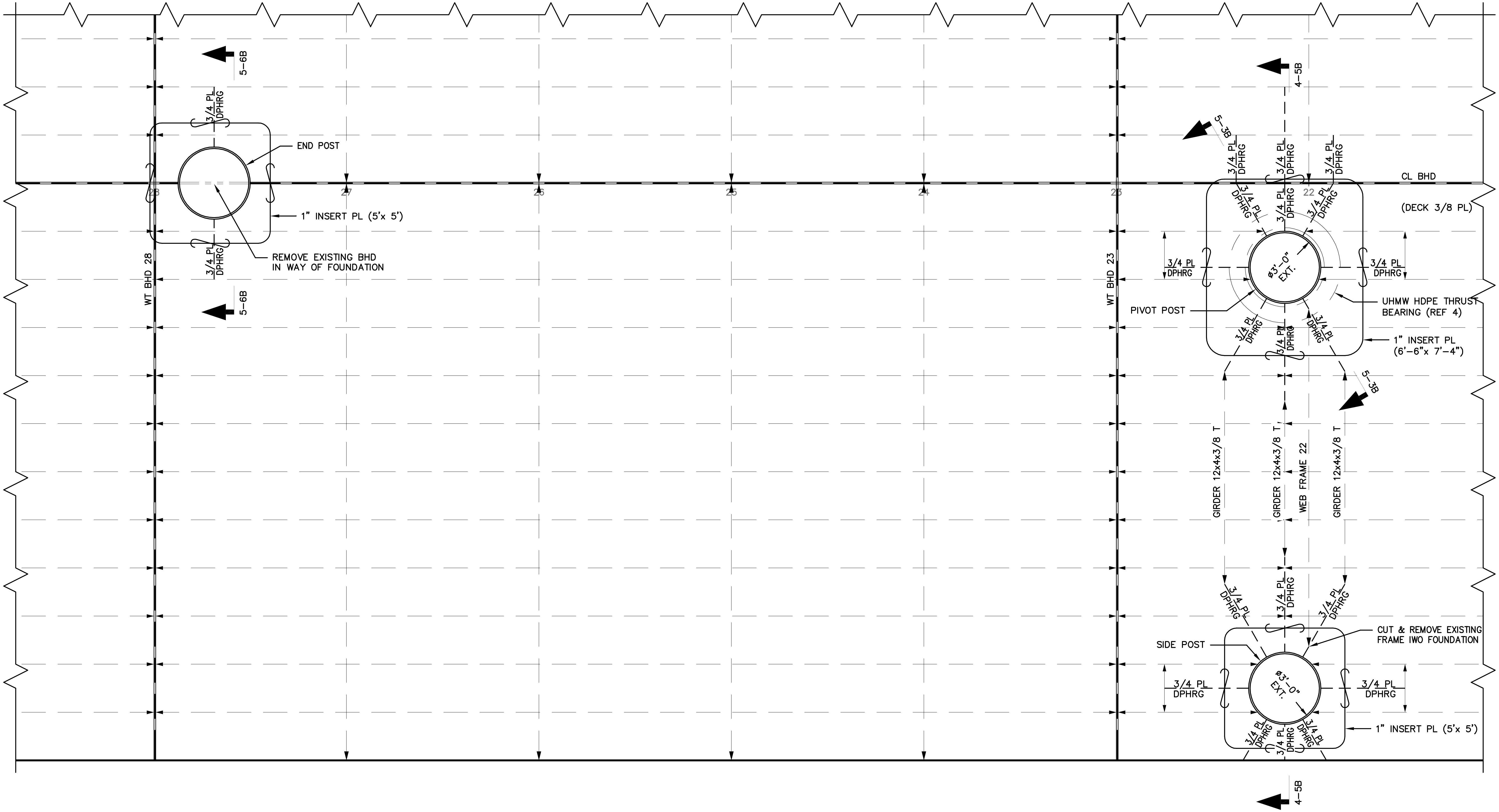

PLAN 3-4B

POST FOUNDATIONS AT BARGE DECK
(AFT SHOWN, FWD FOUNDATIONS SIMILAR)
1/4"=1'-0"

90% SUBMITTAL

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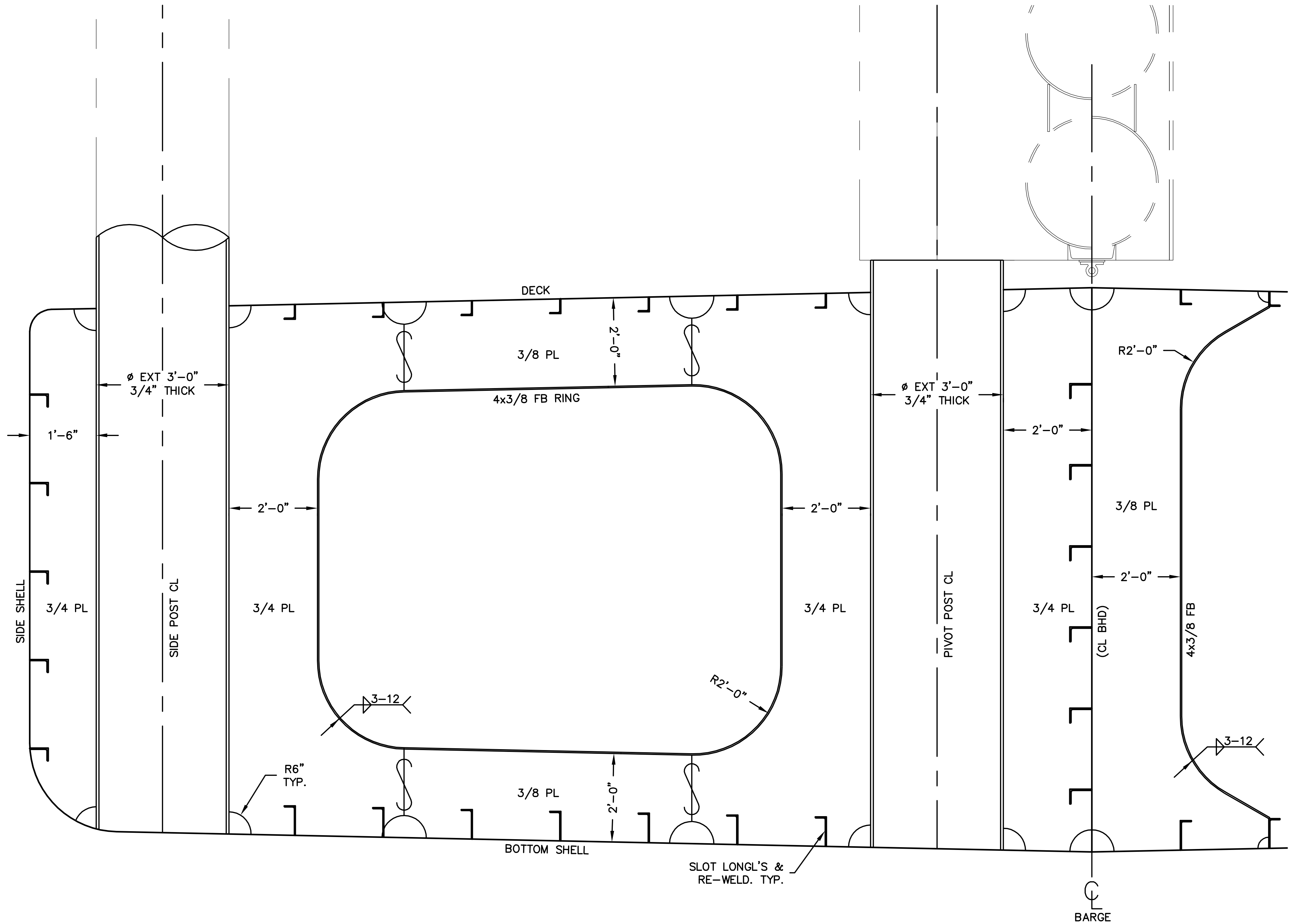

ELEVATION 4-5B

SIDE POST & PIVOT POST
FOUNDATIONS / LKG AFT
3/8"=1'-0"

90% SUBMITTAL

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STATE OF WASHINGTON
19898
REGISTERED
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PRELIMINARY

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WALNUT CREEK, CALIFORNIA

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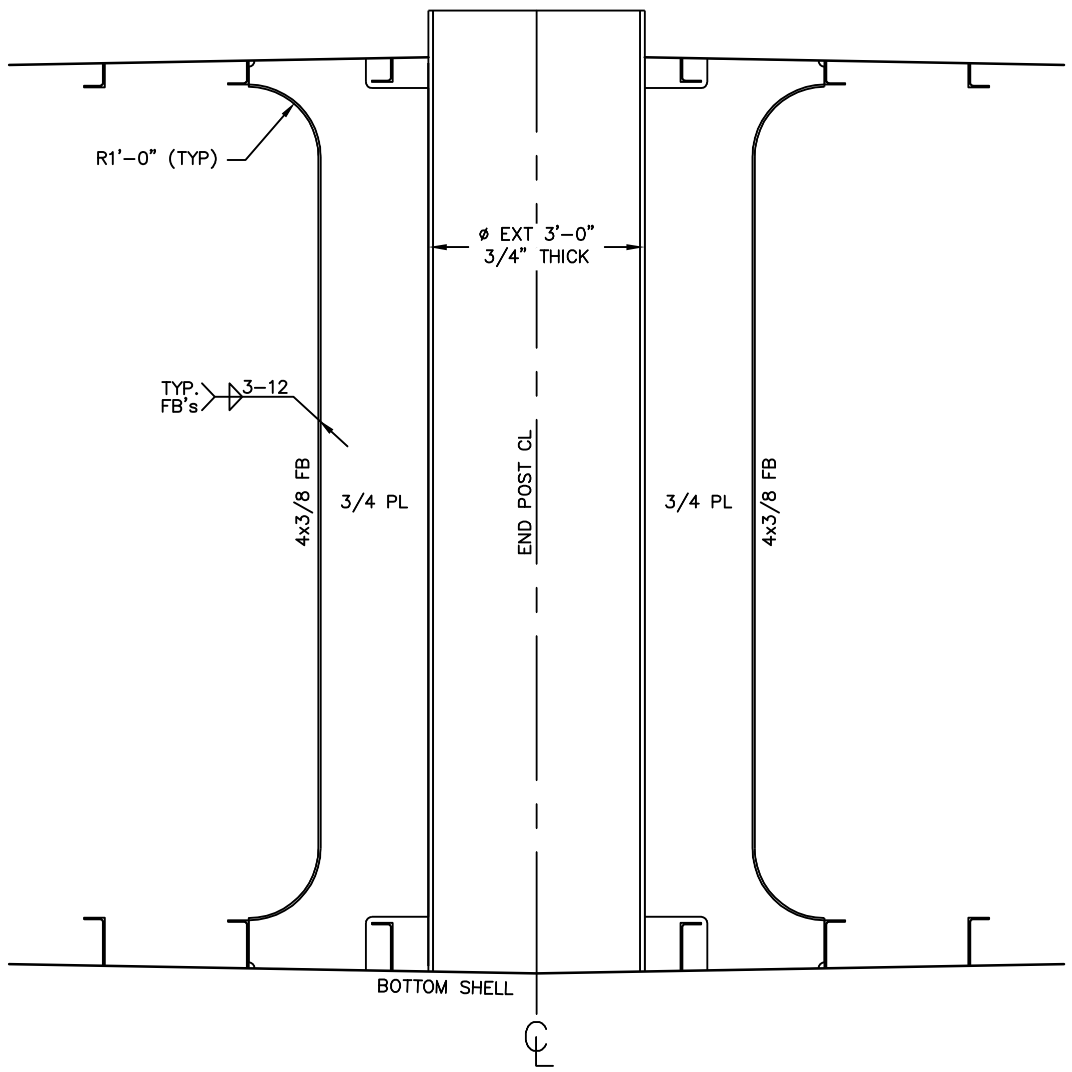
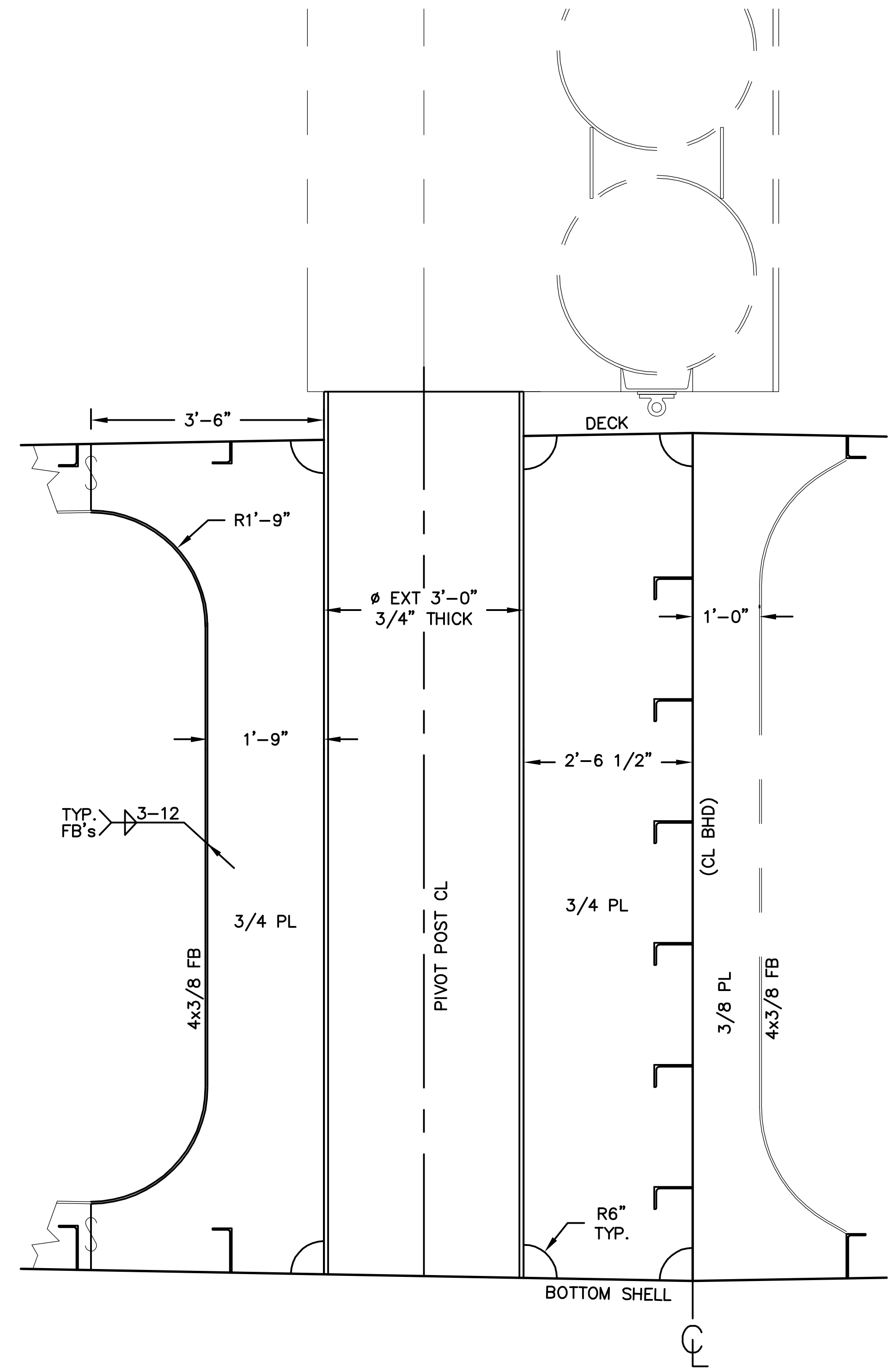


SECTION 5-6B

END POST FOUNDATION / LKG AFT
3/8"=1'-0"



ELEVATION 5-3B

30 DEG PIVOT POST DIAPH / LKG
AFT & OUTBD
3/8"=1'-0"

90% SUBMITTAL

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Drawn	Checked	Approved	Date
ADA	BGL	WLH	DATE

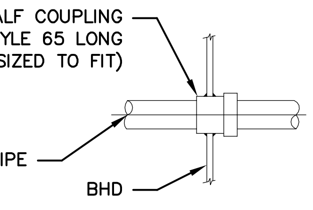
Scale	Drawing Number	Sheet of	Revision
AS NOTED	09041-04-02	5 of 5	P2

MATERIAL SCHEDULE

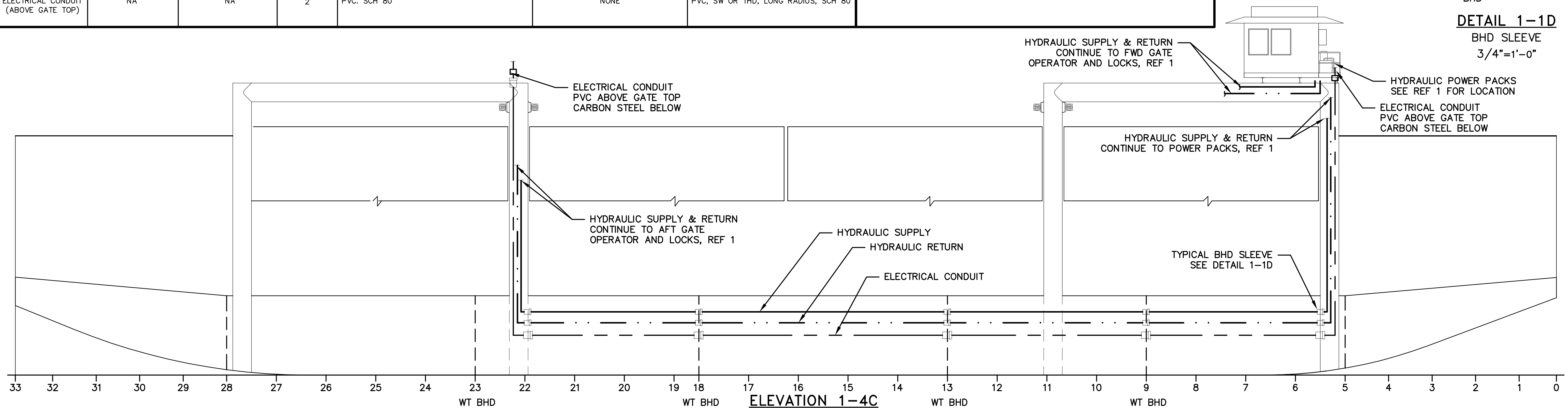
SYSTEM	MAXIMUM WORKING PRESSURE	TEST PRESSURE	PIPE SIZE	PIPE MATERIAL	TAKEDOWN JOINTS MATERIAL	FITTINGS TYPE & MATERIAL
HYDRAULICS	3000 PSI	4500 PSI	1"	STAINLESS STEEL TUBING, ASTM A269 OR A249, TYPE 304 OR 316, SEAMLESS OR WELDED & REDRAWN, FULLY ANNEALED	NONE	37° FLARE (JIC) FITTINGS, SAE J514
ELECTRICAL CONDUIT (BELOW GATE TOP)	NA	NA	2"	CARBON STEEL, ASTM A53 OR ASTM A106, GR B, SCH 40, ANSI B36.10	NONE	STEEL, SW, LONG RADIUS, ASTM A105 OR A234, GR WPB, ANSI B16.11, CLASS 3000, SEE GENERAL NOTE 2
ELECTRICAL CONDUIT (ABOVE GATE TOP)	NA	NA	2"	PVC. SCH 80	NONE	PVC, SW OR THD, LONG RADIUS, SCH 80

GENERAL NOTES (CONT'D)

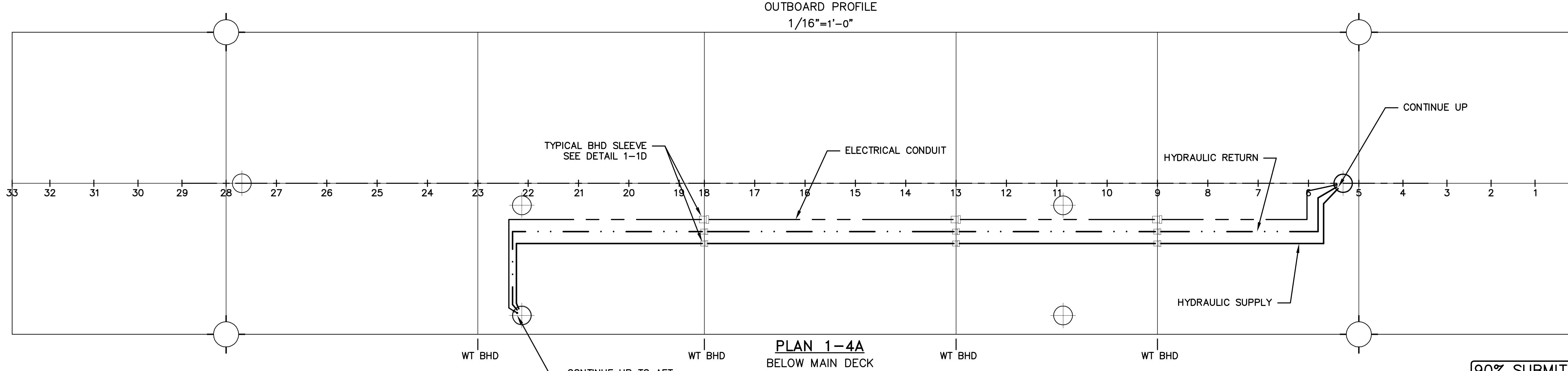
5. ALL PIPING RUNS SHALL BE FLUSHED BY AN APPROVED METHOD USING AND INDEPENDENT FLUSHING UNIT TO REMOVE LOOSE OR FOREIGN MATERIAL BEFORE SYSTEMS ARE OPERATED. USE BLANKING PLATES AND HOSE JUMPERS TO BYPASS ALL COMPONENTS(PUMPS, VALVES, ETC.). FLUSH TO CLEANLINESS LEVEL PER J1165.



DETAIL 1-1D
BHD SLEEVE
3/4"=1'-0"



ELEVATION 1-4C
OUTBOARD PROFILE
1/16"=1'-0"



PLAN 1-4A
BELOW MAIN DECK
1/16"=1'-0"

90% SUBMITTAL

GENERAL NOTES

1. ELECTRICAL CONDUIT SHOWN ONLY FOR BELOW WATERLINE. ABOVE WATERLINE, REFER TO REFERENCE 1.
2. BEND STEEL CONDUIT WHERE POSSIBLE.
3. RIGID PIPE HANGERS SHALL BE IN ACCORDANCE WITH ASTM F708.
4. COMPLETE ALL HYDRO PRESSURE TESTING PRIOR TO FLUSHING.

(CONTINUE ZONE 1-3D)

REFERENCES

1. MOFFATT & NICHOL DWG 6097-03 TWO GATE FISH PROTECTION PLAN

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD

PRELIMINARY

MOFFATT & NICHOL, INC.
WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
OLD RIVER GATE (BARGE IGNACIO)
BELOW DECK HYDRAULIC PIPING & ELECTRICAL CONDUIT

THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community
1201 Western Avenue, Suite 200 Seattle, Washington 98101-2921 TEL 206.624.7850 WEB www.glosten.com

DOUBLE SIZE PRINT

Drawn	Checked	Approved	Date
JL	JKM	WLH	9/4/09

Scale	Drawing Number	Sheet	of	Revision
AS NOTED	09041-05-02	1	1	P2

ATTACHMENT B1. Connection Slough Gate Placement Procedure and Stability

TWO GATE FISH PROTECTION PLAN

Placement Operation & Stability: Connection Slough Gate
Preliminary Construction Submittal (90%)

PREPARED FOR:	BY:
Moffatt & Nichol Walnut Creek, CA	Jon K. Markestad, PE PROJECT ENGINEER
THE GLOSTEN ASSOCIATES 1201 Western Avenue, Suite 200, Seattle, Washington 98101-2921 TEL 206.624.7850 FAX 206.682.9117 www.glosten.com	CHECKED: William L. Hurley, PE PRINCIPAL-IN-CHARGE APPROVED: William L. Hurley, PE PRINCIPAL-IN-CHARGE

DOC:	REV: P2	FILE: 09041.02	DATE: 11 September 2009

References

1. Glosten Drawing 09041-01-01, *Connection Slough Gate (Barge Denise): General Arrangement*.
2. *Code of Federal Regulations*, Title 46.
3. *Marine Safety Manual*, Volume IV – Technical.
4. *General Hydrostatics Software Suite*, Creative Systems, Inc., v. 11.42.
5. *Two Gate Fish Protection Plan*, specification document.

Summary

This document describes the placement procedure of the Connection Slough gate and summarizes the weight estimate, stability analysis, and longitudinal strength analysis of the barge during all phases of placement operations. Also evaluated are the spud pile vertical loading and overturning moments that the spud pile securing system will be required to withstand.

The stability was evaluated for both the transit condition and placement. The barge meets the stability requirements in all transit and placement operations.

The stresses developed in the hull during the placement procedure described below are below the allowable stress of 25.38 ksi.

Spud piles should be designed to overcome a maximum 500 kip downward force during placement, and a 20 kip upward force during gate operation.

Connection Slough Gate Design

The Connection Slough gate is comprised of the barge *Denise*, with a butterfly gate system mounted above deck as shown in Reference 1. The barge will be held in location using 4 spud piles driven into the river bottom. Lowering and raising of the barge will be accomplished using cable or chain jacks utilizing the spud piles as bases for the lifting system. Once the barge is on the bottom of the river, the barge/gate will be held in place and will resist uplift from overturning moments by locking collars attached to the spud piles.

The barge hull is divided into 10 tanks; 5 port and 5 starboard. The hull tanks are designated Tank 1P&S at the bow, through 5 P&S at the stern. See Figure 1, below.

No ballasting system will be installed on the barge. All ballasting and deballasting will be done using portable pumps through new salvage fittings and manholes on the main deck.

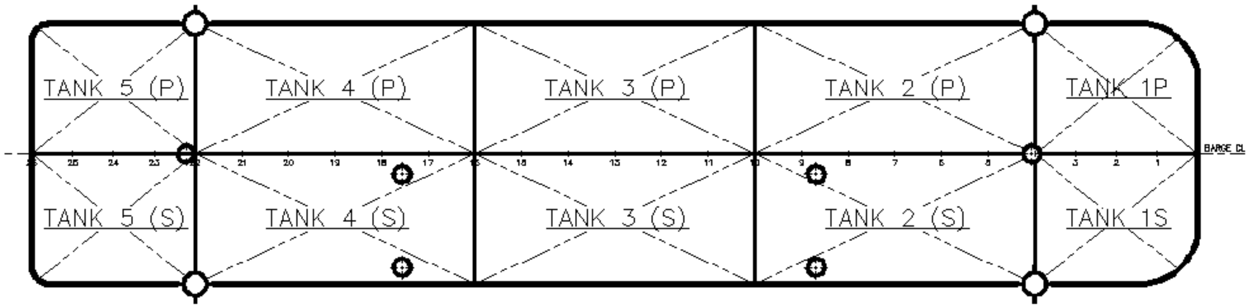


Figure 1. Tank arrangement plan

Placement Procedure

The assembled gate and barge will be towed to location in the Transit Condition, with all tanks dry and tight except Tank 3 port that will be used to level the barge.

Lowering Procedure

1. With the barge onsite and temporarily secured in location, and with level trim and heel, the spuds will be lowered so they are resting on the river bottom.

2. With the spuds holding the barge in place, the spuds can be driven in plumb to the depth required. At this stage it is safe to suspend lowering operations for an extended period of time.

3. Once the spuds are driven in place, Tanks 1, 3, and 5 port and starboard should be filled with ballast until all air is displaced from the tanks. Tanks 2 and 4 starboard should be filled with ballast to roughly 38% capacity, and Tanks 2 and 4 port should be filled to roughly 50% capacity. Tank loading can be adjusted slightly to maintain level submergence of barge. Once loaded to this stage, the barge should be floating roughly level with 6" of freeboard. All manholes should be secured with salvage fittings open.

4. The jacking system should be attached from the spud piles to the barge. Wire length should be adjusted such that, when taut, the barge deck edge will remain 1" above the water.

5. Tanks 2 and 4 port and starboard should be filled with ballast until all air is displaced from the tanks. During the filling of these tanks the jacking system should start to take load and the barge should be hanging from the jacking system with the deck roughly 1" above water by the end of this stage. All tanks should be pressed full, with hatches and salvage plugs installed by the end of this stage.

6. The barge can now be lowered onto the river bottom.

7. Once the barge is firmly on the bottom and the jacking system is slack, a diver should install the locking mechanisms on all 4 of the spud piles, making sure to fit them snugly against the jacking well structure.

8. The barge/gate structure is now installed in the river, and locking fill can be applied around the barge.

Table 1. Condition summary

Stage	Hull Tank Loads (%) 1P/S	2P/S	3P/S	4P/S	5P/S	Draft (ft)	Jacking pile Loads Fwd S (kip)	Fwd P (kip)	AFT S (kip)	Aft P (kip)
1	0	0	var	0	0	3.6	-	-	-	-
3	100	var	100	var	100	11.7	-	-	-	-
5	100	100	100	100	100	12.2	478	355	412	350
6a	100	100	100	100	100	15.0	364	305	362	303
6b	100	100	100	100	100	20.0	337	286	335	283
6c	100	100	100	100	100	30.0	280	244	277	241
7	100	100	100	100	100	Bottom	-	-	-	-

Refloating Procedure

The refloating procedure was not developed for this report. It is expected that the jacking system could be used to raise the barge/gate structure to the water surface, where portable pumps can be used to dewater the barge to its transit condition.

Weight Estimate

A weight for each of the components of the barge/gate structure was estimated, along with its LCG, TCG, and VCG. The table below summarizes the results of the calculations.

Table 2. Weight Summary

Category	Weight (With Margins)	LCG	TCG	VCG
	Kip	ft from bow	ft +Stbd	ft ABL
Barge Hull	859.56	100.00	0.00	7.35
Gates	319.49	101.00	2.49	24.74
Misscellaneous	214.07	97.06	6.57	23.15
End Walls	28.82	101.00	0.00	15.58
Jacking Wells	41.73	101.00	0.00	6.28
Total	**1463.67**	**99.84**	**1.50**	**13.59**

Stability

The stability was evaluated for both the transit condition and the placement conditions. In the transit condition, the barge is shown to comply with the recommendations of the *Marine Safety Manual, Volume IV – Technical, 6.E.5.b.* During the placement operations, the barge is shown to maintain a GM greater than 3 inches (0.25 feet) and maintain roll stability to at least 6 degrees.

Calculations

Stability calculations were performed using Creative Systems' General Hydrostatics program. The geometry model was created based on the vessel geometry per Reference 1. Weights were placed as distributed weights, according to their location per Reference 1.

Calculations are performed using fresh water with a specific gravity of 1.0. As the actual specific gravity of the river is unknown, between 1.0 and 1.025, the lighter density was chosen for conservatism.

Basic stability calculations, including an evaluation of GM and righting arms, were performed. True free surface effects of any slack tanks were included. The results of the calculations can be seen in Appendix A.

Required GM for the weather criterion was evaluated using the sail area of the gates when closed. Calculations can be found in Appendix C.

Transit Condition

In the transit condition, the barge is shown to comply with the recommendations of the *Marine Safety Manual, Volume IV – Technical, 6.E.5.b.*

Pertinent areas read as follows:

6.E.5.b. Intact And Damage Stability Criteria By Barge Type.

(1) All Barges: Weather Criterion And Righting Energy. The weather criterion in 46 CFR 170, Subpart E applies to barges, except as specified in 46 CFR 170.160. Inland tank barges inspected under Subchapter D do not have specific stability requirements but may be loaded beyond safe limits when they do not have centerline bulkheads in way of cargo. The OCMI should be so notified in such cases. Due to their large B/D ratio and high draft to depth ratio, most inland barges cannot be evaluated considering GM alone, in which case righting energy calculations are appropriate. As stated in 46 CFR 170.170(d), additional calculations must be submitted for barges. Except as provided in subparagraphs 6.E.5.b.(2), (3), and (4) below, the calculations normally required are those contained in 46 CFR 174.015. Suitable route alternatives to 46 CFR 174.015 include reducing the required 15 foot-degrees to 5 foot-degrees for service on protected waters and to l0 foot-degrees for service on those lakes, bays, and sounds which the OCMI considers to be partially-protected.

Pertinent areas of *46 CFR 170 Subpart E - Weather Criteria* read as follows:

§170.170 Calculations Required

(a) Each vessel must be shown by design calculations to have a metacentric height (GM) that is equal to or greater than the following in each condition of loading and operation:

$$GM \geq \frac{PAH}{W \tan(T)}$$

(b) The criterion specified in this section is generally limited in application to flush deck, mechanically powered vessels of ordinary proportions and form that carry cargo below the main deck. On other types of vessels, the Commanding Officer, marine Safety Center requires calculations in addition to those in paragraph (a) of this section. On a mechanically powered vessel under 328 feet in length, other than a tugboat or a towboat, the requirements in §170.173 are applied.

Pertinent areas of *46 CFR 174 Subpart B - Special Rules Pertaining to Deck Cargo Barges* read as follows:

§174.015 Intact Stability

(a) Except as provided in §174.020, in each condition of loading and operation, each barge must be shown by design calculations to have an area under the righting arm curve up to the angle of maximum righting arm, the downflooding angle, or 40 degrees, whichever angle is smallest, equal to or greater than-

(1) 15 foot-degrees (4.57 meter-degrees) for ocean and great lakes winter service; and

(2) 10 foot-degrees (3.05 meter-degrees) for lakes, bays, sounds, and great lakes summer service

(b) For the purpose of this section, downflooding angle means the static angle from the intersection of the vessel's centerline and waterline in calm water to the first opening that does not close watertight automatically. The vessel is fitted with float-type check valves on the ballast tank vents and thus has no downflooding points applicable to this requirement.

As indicated in the *Marine Safety Manual, Volume IV 6.E.5.b.*, the minimum required area under the righting curve for the calculations in *46 CFR §174.015* for protected water is taken to be 5 foot-degrees.

All tanks were considered dry and tight.

Results—Transit Condition

The barge in the transit condition has roll stability far in excess of the required minimums. The GM of 36.9 feet far exceeds the 1.08 feet requirement of the Weather Criterion. The righting arm is positive well beyond 40 degrees, and the righting energy at 40 degrees (157 ft-Deg) far exceeds the 5 ft-deg requirement of *46 CFR 174.015* as modified by the *Marine Safety Manual, Volume IV – Technical, 6.E.5.b.*

Results—Placement Conditions

Stability of the barge was evaluated at the stage of placement where the jacking system would be attached to the barge. At this stage the barge is shown to comply with the minimum of 3 inches (0.25 feet) of GM and roll stability, to 6 degrees as required by the specification document (Reference 6).

Stability is not an issue once the jacking system has taken the load of the barge, and the barge is hanging from the wires and restrained by the spuds.

True free surface effects were included for all slack tanks.

Longitudinal Strength

The longitudinal strength of the barge was evaluated for each stage of placement. Stresses were calculated based on a hull girder section modulus of 4725 in^3. The calculated stresses were compared to an allowable stress of 11.33LT/in^2 (25.38 ksi).

The maximum expected stress is 3.41 ksi, corresponding to 13.4% of the allowable stress.

Spud Pile Calculations

The assumed spud pile for this report is a 42" diameter pile with 1" wall thickness and an overall length of 120'.

Once the jacking system has been attached to the barge, the spud piles will be required to support the barge/gate structures weight until the barge is lowered to the river bottom. A calculation of the estimated pile loading during barge placement is included in the stability calculations shown in Appendix A. The maximum expected vertical loading of any one spud pile is 478 kip, and a margin is added for a design load of 500 kip during barge/gate placement.

Once the barge is on the river bottom and the gates are closed, a differential water level will develop and impose translational forces and overturning moments on the barge/gate structure. The translational forces will be overcome by the gravel backfill around the barge and by the spuds. By inspection, this shearing force is not expected to be the driving factor in sizing the spud piles. The overturning moments will be resolved by the barge/gate structures' self weight, and two of the spud piles' weight and pullout resistance. Calculations for the estimated overturning force on the piles are shown in Appendix B. The maximum expected uplifting load is -1 kip, and a margin is added for a design uplifting load of 20 kip during gate operations.

Appendix A Stability Calculations

TRANSIT CONDITION WITH MINIMAL HEEL

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 3.703 @ 0.00, 3.527 @ 200.00a

Trim: Fwd 0.18/200.00, Heel: Port 0.04 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			859.56	100.00a	0.00	7.35	
EndWallF			14.41	13.50a	0.00	15.58	
EndWallA			14.41	188.50a	0.00	15.58	
GateF			159.74	65.50a	2.49s	24.74	
GateA			159.74	136.50a	2.49s	24.74	
Misc			214.10	97.06a	6.57s	23.15	
Fwd Wells			20.86	28.00a	0.00	6.28	
Aft Wells			20.86	172.00a	0.00	6.28	
Total Fixed >			1,463.70	99.81a	1.50s	13.59	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK3.P	0.250	1.000	201.23	99.94a	11.20p	1.53	-3.14
Total Weight >			1,664.93	99.82a	0.03p	12.13	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	1,664.46	99.82a	0.04p	1.85	-3.70
GATEF_FLOOD.S	Flooded	1.000	0.00				
GATEA_FLOOD.S	Flooded	1.000	0.00				
Total Displacement-->		1.000	1,664.46	99.82a	0.04p	1.85	
Righting Arms:				0.00	0.00		

Distances in FEET.

HYDROSTATIC PROPERTIES with FLOODING

Trim: Fwd 0.18/200.00, Heel: Port 0.04 deg., VCG = 12.13

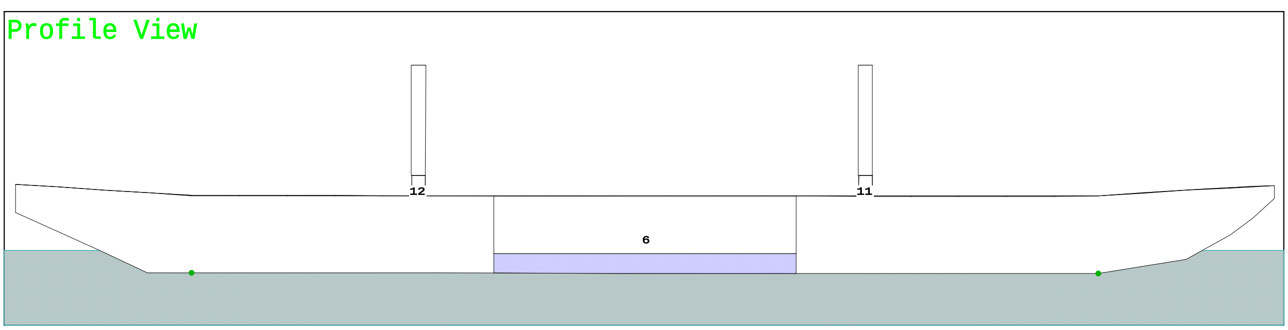
LCF Draft	Displacement Weight(KP)	Buoyancy-Ctr. LCB	VCB	Weight/ Inch	LCF	Moment/ In trim	GML	GMT
3.615	1,664.46	99.82a	1.85	40.70	99.30a	505.90	729.5	36.90

Distances in FEET. Specific Gravity = 1.000. Moment in Ft-KP.

Trim is per 200.00Ft

Draft is from Baseline. True Free Surface included.

CG - Draft: 3.70 @ 0.00 , 3.53 @ 200.00a Heel: port 0.04 deg.



Tanks
6 TANK3.P 11 GATEF_FLOOD.S 12 GATEA_FLOOD.S

RIGHTING ARMS vs HEEL ANGLE with FLOODING

Fixed CG: LCG = 99.81a TCG = 1.50s VCG = 13.59

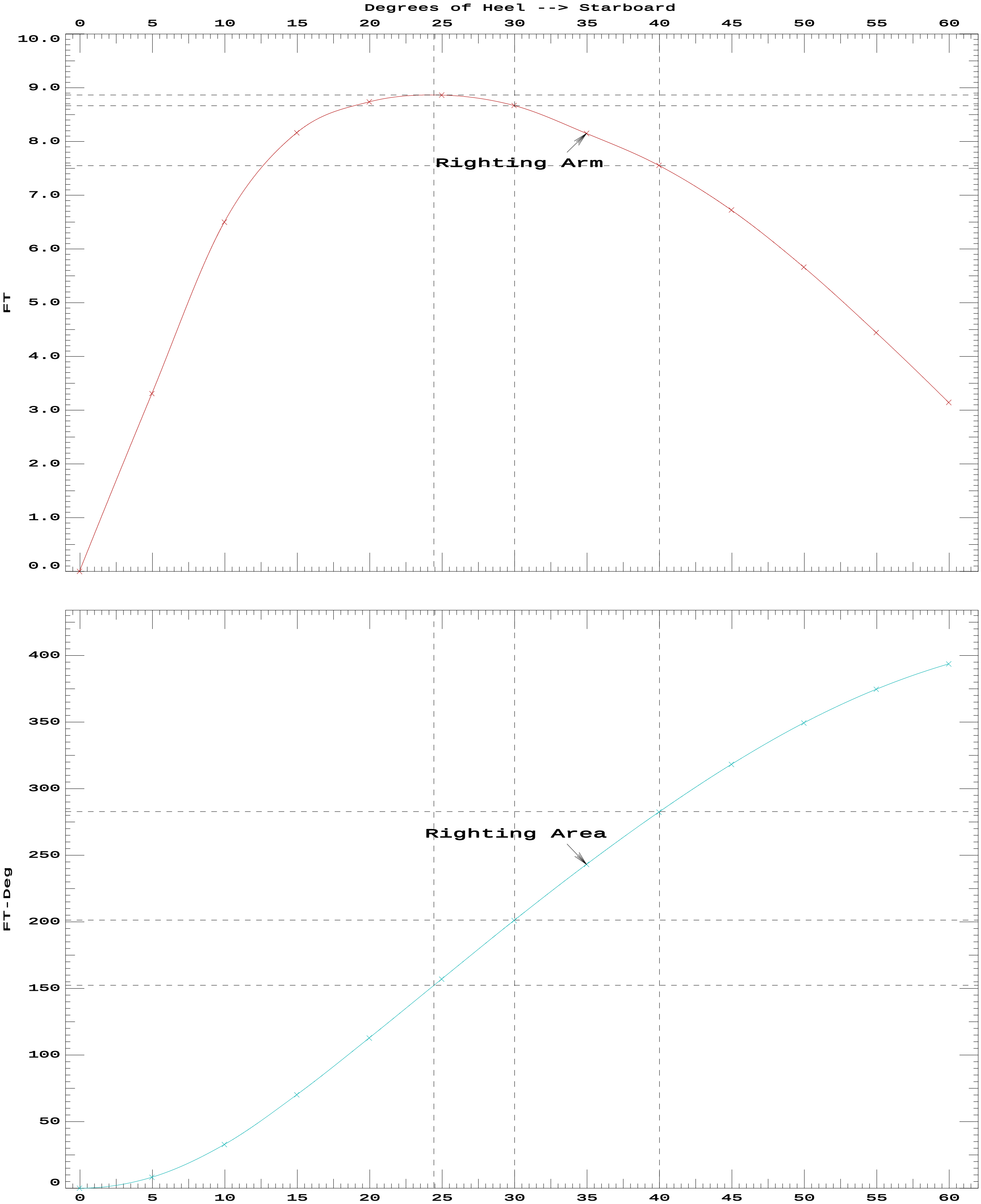
Origin Depth	Degrees of Trim	Heel	Displacement Weight(KP)	Righting Arms in Trim	in Heel	> Area
3.703	0.05f	0.04p	1,664.92	0.00	0.000	0.00
3.659	0.05f	4.96s	1,664.94	0.00	3.309	8.27
3.552	0.05f	9.96s	1,664.92	0.00	6.499	32.84
3.119	0.05f	14.96s	1,665.53	0.00	8.163	70.13
2.386	0.05f	19.96s	1,664.93	0.00	8.737	112.84
1.429	0.05f	24.96s	1,665.24	0.00	8.864	157.03
1.162	0.05f	26.21s	1,664.74	0.00	8.849	168.10
0.334	0.06f	29.96s	1,664.93	0.00	8.669	201.00
-0.797	0.06f	34.96s	1,664.94	0.00	8.149	243.18
-2.323	0.00	39.96s	1,664.93	0.03a	7.555	282.48
-3.769	0.00	44.96s	1,664.94	0.38f	6.723	318.27
-5.096	0.00	49.96s	1,664.92	0.00	5.662	349.33
-6.291	0.00	54.96s	1,664.92	0.39f	4.444	374.66
-7.348	0.00	59.96s	1,664.93	0.00	3.144	393.67

Distances in FEET. Specific Gravity = 1.000. Area in Ft-Deg.

Note: The Center of Gravity shown above is for the Fixed Weight of 1463.70 KP. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

LIM	STABILITY CRITERION		Min/Max	Attained
(1)	Area from 0 deg to MaxRA or 40	>	5.00 Ft-deg	157.03 P

Relative angles measured from 0.039


Degrees of Heel --> Starboard
0
5
10
15
20
25
30
35
40
45
50
55
60
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
FT
Righting Arm
400
350
300
250
200
150
100
50
0
FT-Deg
Righting Area

LONGITUDINAL STRENGTH with FLOODING at Heel = Port 0.04 deg.

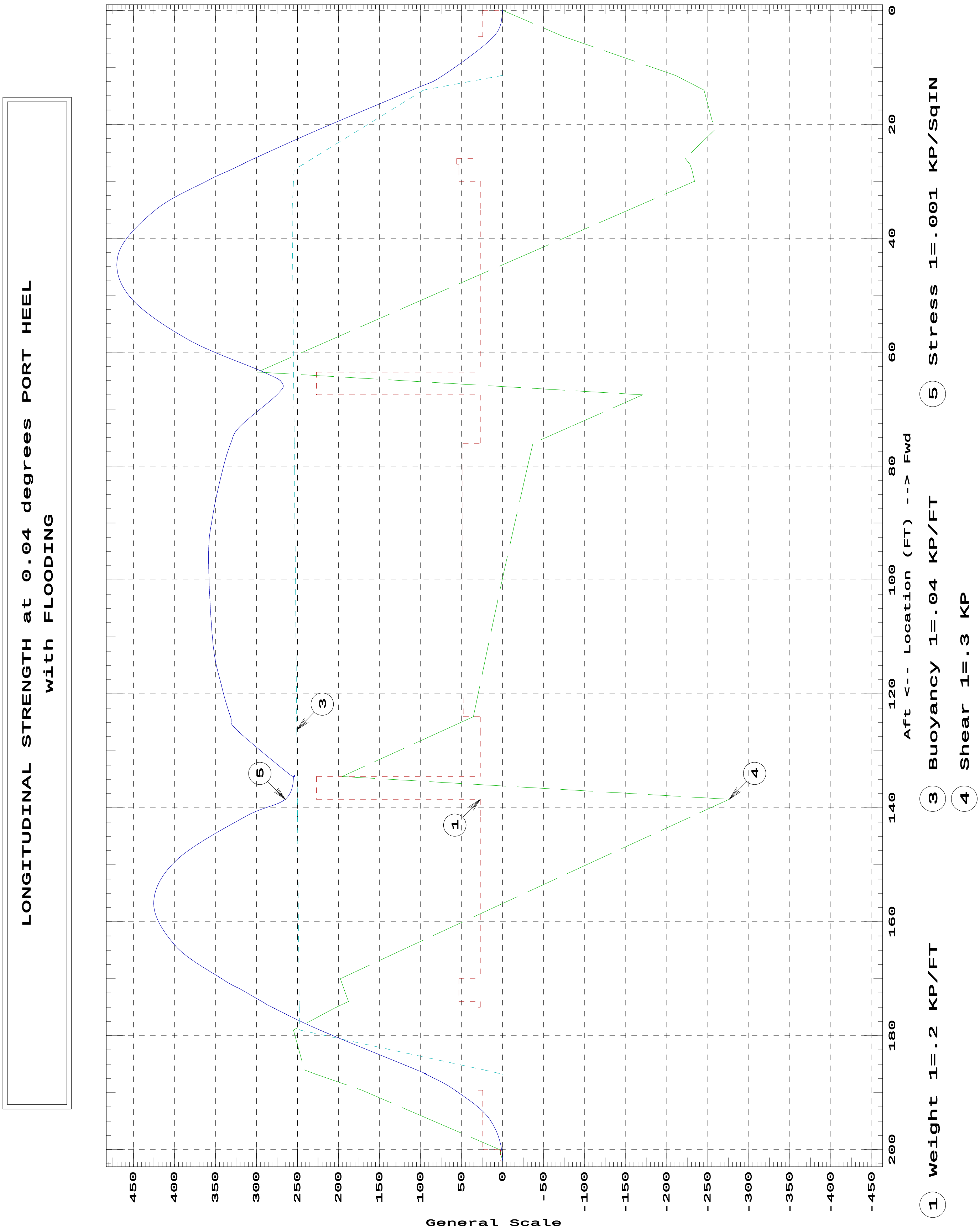
LOCATION Ft	WEIGHT KP/Ft	BUOYANCY KP/Ft	SHEAR KP	SECT.MOD SqIn-Ft	STRESS KP/SqIn
0.00	0.00		0.0	4,725.0	0.000
0.00	4.83		0.0	4,725.0	0.000
4.56a	4.83		-22.0	4,725.0	0.011
4.56a	5.99		-22.0	4,725.0	0.011
11.43a	5.99	0.00	-63.1	4,725.0	0.073
11.43a	5.99	0.00	-63.1	4,725.0	0.073
14.00a	5.99	3.86	-73.6	4,725.0	0.110
21.00a	5.99	7.01	-77.5	4,725.0	0.225
26.00a	5.99	9.26	-66.7	4,725.0	0.303
26.00a	11.21	9.26	-66.7	4,725.0	0.303
27.00a	11.21	9.72	-68.4	4,725.0	0.317
27.00a	10.67	9.72	-68.4	4,725.0	0.317
28.00a	10.67	10.17	-69.2	4,725.0	0.331
30.00a	10.67	10.19	-70.2	4,725.0	0.361
30.00a	5.46	10.19	-70.2	4,725.0	0.361
35.00a	5.46	10.26	-46.3	4,725.0	0.423
42.61a	5.46	10.24	-9.8	4,725.0	0.468
50.22a	5.46	10.22	26.6	4,725.0	0.455
57.83a	5.46	10.20	62.8	4,725.0	0.383
63.50a	5.46	10.19	89.7	4,725.0	0.291
63.50a	45.39	10.19	89.7	4,725.0	0.291
65.44a	45.39	10.19	21.2	4,725.0	0.269
67.50a	45.39	10.18	-51.2	4,725.0	0.275
67.50a	5.46	10.18	-51.2	4,725.0	0.275
73.06a	5.46	10.17	-24.9	4,725.0	0.320
76.00a	5.46	10.16	-11.1	4,725.0	0.331
76.00a	9.68	10.16	-11.1	4,725.0	0.331
80.67a	9.67	10.15	-8.8	4,725.0	0.341
88.28a	9.66	10.13	-5.2	4,725.0	0.353
95.89a	9.65	10.11	-1.7	4,725.0	0.358
103.50a	9.64	10.09	1.7	4,725.0	0.359
111.11a	9.63	10.07	5.1	4,725.0	0.353
118.72a	9.62	10.05	8.4	4,725.0	0.342
124.00a	9.62	10.04	10.7	4,725.0	0.332
124.00a	5.46	10.04	10.7	4,725.0	0.332
126.33a	5.46	10.04	21.4	4,725.0	0.324
133.94a	5.46	10.02	56.2	4,725.0	0.261
134.50a	5.46	10.02	58.7	4,725.0	0.255
134.50a	45.39	10.02	58.7	4,725.0	0.255
138.50a	45.39	10.01	-82.8	4,725.0	0.265
138.50a	5.46	10.01	-82.8	4,725.0	0.265
141.56a	5.46	10.00	-68.9	4,725.0	0.314
149.17a	5.46	9.98	-34.4	4,725.0	0.397
156.78a	5.46	9.96	-0.0	4,725.0	0.425
164.39a	5.46	9.94	34.2	4,725.0	0.398
170.00a	5.46	9.93	59.3	4,725.0	0.342
170.00a	10.67	9.93	59.3	4,725.0	0.342
172.00a	10.67	9.92	57.9	4,725.0	0.318
174.00a	10.67	9.92	56.4	4,725.0	0.293

continued next page

LOCATION Ft	WEIGHT KP/Ft	BUOYANCY KP/Ft	SHEAR KP	SECT.MOD SqIn-Ft	STRESS KP/SqIn
174.00a	5.46	9.92	56.4	4,725.0	0.293
175.00a	5.46	9.92	60.8	4,725.0	0.281
175.00a	5.99	9.92	60.8	4,725.0	0.281
179.00a	5.99	9.91	76.5	4,725.0	0.223
186.00a	5.99	0.92	72.5	4,725.0	0.105
186.75a	5.99	0.00	68.3	4,725.0	0.094
186.75a	5.99		68.3	4,725.0	0.094
189.56a	5.99		51.5	4,725.0	0.058
189.56a	4.83		51.5	4,725.0	0.058
194.78a	4.83		26.3	4,725.0	0.015
200.00a	4.83		1.1	4,725.0	0.000
200.00a	0.53		1.1	4,725.0	0.000
202.00a	0.53		-0.0	4,725.0	0.000
202.00a	0.00		-0.0	4,725.0	

S U M M A R Y

Largest Shear: 89.7 KP at 63.50a
Largest Bending Moment: 2,211 KP-Ft at 42.61a (Hogging)
Largest Stress: 0.468 KP/SqIn at 42.61a (Tension)
(2.3% of 20.400 KP/SqIn limit)
Warning: Stress values may be inaccurate due to
lack of correction for hull deflection.


LONGITUDINAL STRENGTH at 0.04 degrees PORT HEEL
with FLOODING
Aft <-- Location (FT) --> Fwd
General Scale
1 Weight 1=.2 KP/FT
3 Buoyancy 1=.04 KP/FT
4 Shear 1=.3 KP
5 Stress 1=.001 KP/SqIN

STAGE TO INSTALL JACKING WIRES

WEIGHT and DISPLACEMENT STATUS

Baseline draft: 11.717 @ 0.00, 11.625 @ 200.00a

Trim: Fwd 0.09/200.00, Heel: Stbd 0.01 deg.

Part			Weight(KP)	LCG	TCG	VCG	
Hull			859.56	100.00a	0.00	7.35	
EndWallF			14.41	13.50a	0.00	15.58	
EndWallA			14.41	188.50a	0.00	15.58	
GateF			159.74	65.50a	2.49s	24.74	
GateA			159.74	136.50a	2.49s	24.74	
Misc			214.10	97.06a	6.57s	23.15	
Fwd Wells			20.86	28.00a	0.00	6.28	
Aft Wells			20.86	172.00a	0.00	6.28	
Total Fixed --->			1,463.70	99.81a	1.50s	13.59	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK1.S	1.000	1.000	357.74	16.34a	11.19s	7.94	
TANK1.P	1.000	1.000	357.74	16.34a	11.19p	7.94	
TANK2.S	0.380	1.000	305.96	51.99a	11.19s	2.33	-4.68
TANK2.P	0.500	1.000	402.63	52.00a	11.19p	3.07	-6.16
TANK3.S	1.000	1.000	804.91	100.00a	11.19s	6.13	
TANK3.P	1.000	1.000	804.91	100.00a	11.19p	6.13	
TANK4.S	0.380	1.000	305.86	147.98a	11.19s	2.33	-4.72
TANK4.P	0.500	1.000	402.45	147.99a	11.19p	3.06	-6.19
TANK5.S	1.000	1.000	365.18	183.79a	11.19s	7.85	
TANK5.P	1.000	1.000	365.18	183.79a	11.19p	7.85	
Total Tanks --->			4,472.56	100.29a	0.48p	5.63	
Total Weight --->			5,936.26	100.17a	0.01s	7.59	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	5,936.29	100.17a	0.01s	6.08	-11.72
GATEF_FLOOD.S	Flooded	1.000	0.00				
GATEA_FLOOD.S	Flooded	1.000	0.00				
Total Displacement-->		1.000	5,936.29	100.17a	0.01s	6.08	
Righting Arms:				0.00	0.00		

Distances in FEET.

HYDROSTATIC PROPERTIES with FLOODING

Trim: Fwd 0.09/200.00, Heel: Stbd 0.01 deg., VCG = 7.59

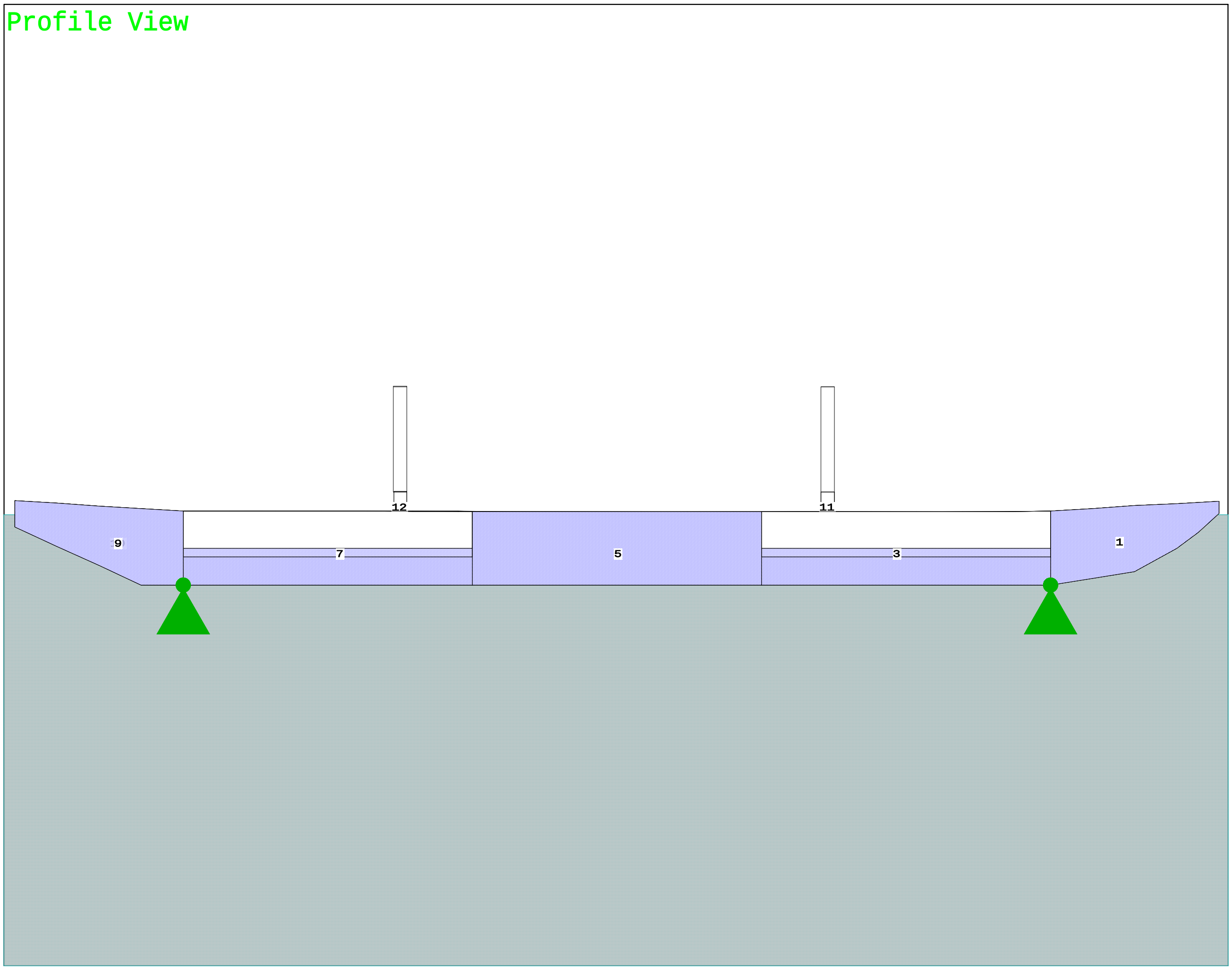
LCF Draft	Displacement Weight(KP)	Buoyancy-Ctr. LCB	VCB	Weight/ Inch	LCF	Moment/ In trim	GML	GMT
11.671	5,936.29	100.17a	6.08	46.15	100.88a	731.03	295.6	12.23

Distances in FEET. Specific Gravity = 1.000. Moment in Ft-KP.

Trim is per 200.00Ft

Draft is from Baseline. True Free Surface included.

CG - Draft: 11.72 @ 0.00 , 11.63 @ 200.00a Heel: stbd 0.01 deg.



Tanks

1 TANK1.S.......100% FRESH WATER
2 TANK1.P.......100% FRESH WATER
3 TANK2.S........38% FRESH WATER
4 TANK2.P........50% FRESH WATER
5 TANK3.S.......100% FRESH WATER
6 TANK3.P.......100% FRESH WATER
7 TANK4.S........38% FRESH WATER
8 TANK4.P........50% FRESH WATER
9 TANK5.S.......100% FRESH WATER
10 TANK5.P.......100% FRESH WATER
11 GATEF_FLOOD.S..Flooded
12 GATEA_FLOOD.S..Flooded

LIM	STABILITY CRITERION		Min/Max	Margin
(1)	Area from 0 deg to MaxRA or 40	>	5.00 Ft-deg	3778%

Relative angles measured from 0.007

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.01 deg.

Largest Shear:	-274.4	KP	at	28.00a
Largest Bending Moment:	7,233	KP-Ft	at	50.22a (Hogging)
Largest Stress:	1.531	KP/SqIn	at	50.22a (Tension)
(7.5% of	20.400	KP/SqIn	limit)	

GROUNDING points

Origin Depth: 11.717
Trim: Fwd 0.09/200.00 Heel: Stbd 0.01 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	11.71	12.12	-0.42	0.10	0.00
Fwd Port Jack	11.70	12.12	-0.42	0.10	0.00
Aft Stbd Jack	11.64	12.12	-0.48	0.10	0.00
Aft Port Jack	11.64	12.12	-0.49	0.10	0.00
Total Ground Reaction --->					0.00

Distances in FEET.

ALL TANKS FULL
BARGE SUPPORTED BY JACKING WIRES
WEIGHT and DISPLACEMENT STATUS

Baseline draft: 12.151 @ 0.00, 12.152 @ 200.00a
Trim: 0.00/200.00, Heel: Stbd 0.00 deg.

Part			Weight(KP)	LCG	TCG	VCG	
Hull			859.56	100.00a	0.00	7.35	
EndWallF			14.41	13.50a	0.00	15.58	
EndWallA			14.41	188.50a	0.00	15.58	
GateF			159.74	65.50a	2.49s	24.74	
GateA			159.74	136.50a	2.49s	24.74	
Misc			214.10	97.06a	6.57s	23.15	
Fwd Wells			20.86	28.00a	0.00	6.28	
Aft Wells			20.86	172.00a	0.00	6.28	
Total Fixed-->			1,463.70	99.81a	1.50s	13.59	
	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
TANK1.S	1.000	1.000	357.74	16.34a	11.19s	7.94	
TANK1.P	1.000	1.000	357.74	16.34a	11.19p	7.94	
TANK2.S	1.000	1.000	805.15	51.99a	11.19s	6.13	
TANK2.P	1.000	1.000	805.15	51.99a	11.19p	6.13	
TANK3.S	1.000	1.000	804.91	100.00a	11.19s	6.13	
TANK3.P	1.000	1.000	804.91	100.00a	11.19p	6.13	
TANK4.S	1.000	1.000	804.91	148.00a	11.19s	6.12	
TANK4.P	1.000	1.000	804.91	148.00a	11.19p	6.12	
TANK5.S	1.000	1.000	365.18	183.79a	11.19s	7.85	
TANK5.P	1.000	1.000	365.18	183.79a	11.19p	7.85	
Total Tanks-->			6,275.76	100.21a	0.00	6.53	
Total Weight-->			7,739.46	100.13a	0.28s	7.87	
			Displ(KP)	LCB	TCB	VCB	
HULL		1.000	6,204.50	100.31a	0.00	6.34	-12.15
GATEF_FLOOD.S	Flooded	1.000	0.00				
GATEA_FLOOD.S	Flooded	1.000	0.00				
Total Displacement-->		1.000	6,204.50	100.31a	0.00	6.34	
			React(KP)	LCR	TCR	VCR	
Fwd Stbd Jack			377.99	28.00a	22.50s	0.00	-12.15
Fwd Port Jack			377.99	28.00a	22.50p	0.00	-12.15
Aft Stbd Jack			389.48	172.00a	22.50s	0.00	-12.15
Aft Port Jack			389.48	172.00a	22.50p	0.00	-12.15
Total Reaction-->			1,534.95	101.08a	0.00	0.00	
Total Buoyancy-->			7,739.45	100.46a	0.00	5.08	
Righting Arms:				0.33a	-0.28s		

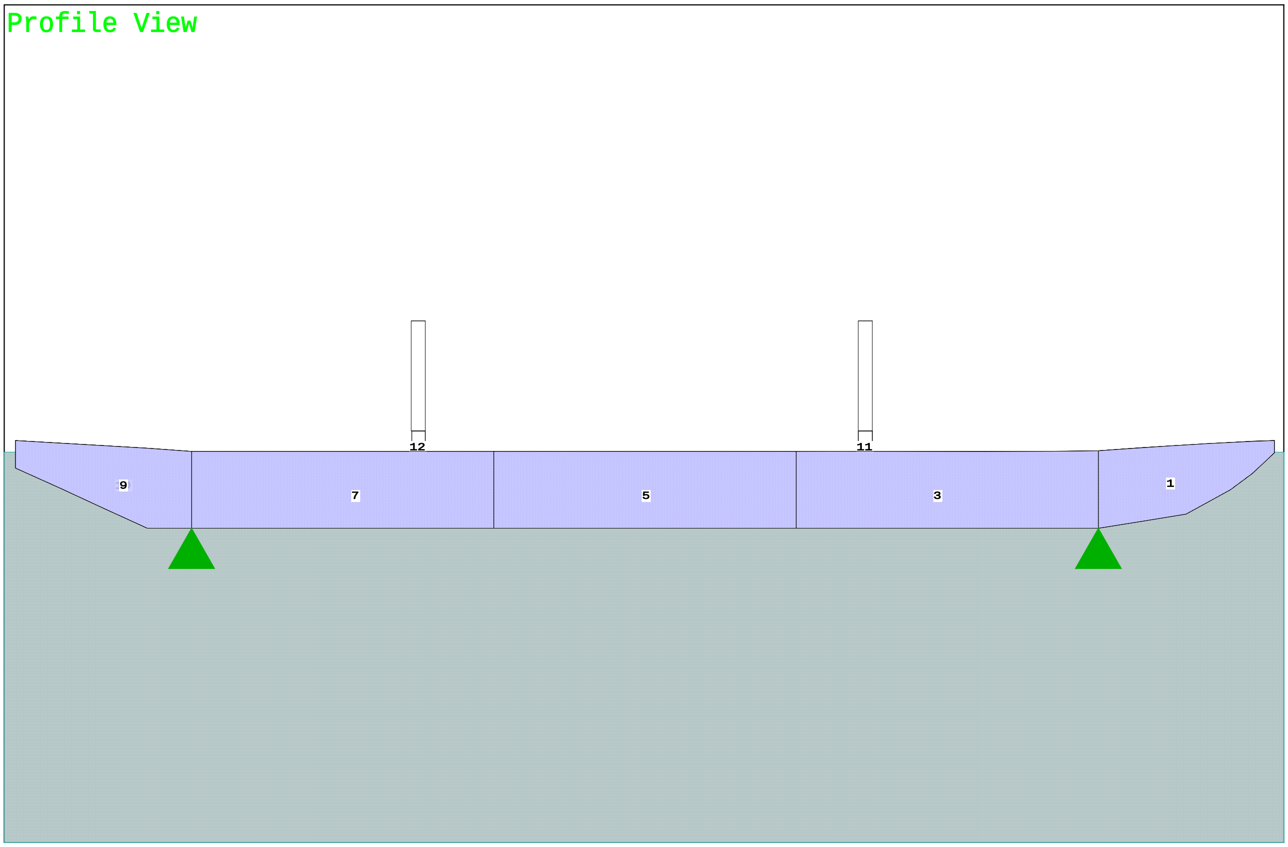
Distances in FEET.

HYDROSTATIC PROPERTIES with FLOODING
Trim: 0.00/200.00, Heel: Stbd 0.00 deg., VCG = 7.87

LCF Draft	Displacement Weight(KP)	Buoyancy-Ctr. LCB	VCB	Weight/ Inch	LCF	Moment/ In trim	GML	GMT
12.151	7,739.45	100.46a	5.08	4925.56	100.00a	127231	Large	Large

Distances in FEET. Specific Gravity = 1.000. Moment in Ft-KP.
Trim is per 200.00Ft
Draft is from Baseline.

Condition Graphic - Draft: 12.15 @ 0.00 , 12.15 @ 200.00a Heel: 0.00 deg.



Tanks

1 TANK1.S
2 TANK1.P
3 TANK2.S
4 TANK2.P
5 TANK3.S
6 TANK3.P
7 TANK4.S
8 TANK4.P
9 TANK5.S
10 TANK5.P
11 GATEF_FLOOD.S
12 GATEA_FLOOD.S

LIM	STABILITY CRITERION		Min/Max	Margin
(1)	Area from 0 deg to MaxRA or 40	>	5.00 Ft-deg	4657%

Relative angles measured from 0.005

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = 0.00 deg.

Largest Shear:	-552.0	KP	at	172.00a	
Largest Bending Moment:	-15,476	KP-Ft	at	95.89a	(Sagging)
Largest Stress:	-3.275	KP/SqIn	at	95.89a	(Compression)
(16.1% of	20.400	KP/SqIn	limit)		

GROUNDING points

Origin Depth: 12.151
Trim: 0.00/200.00 Heel: 0.00 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	12.15	12.12	0.03	0.10	402.40
Fwd Port Jack	12.15	12.12	0.02	0.10	353.59
Aft Stbd Jack	12.15	12.12	0.03	0.10	413.88
Aft Port Jack	12.15	12.12	0.02	0.10	365.07
Total Ground Reaction ——>					1,534.94

Distances in FEET.

LOWERING BARGE ON WIRES WITH DECK 2' UNDERWATER

WEIGHT and DISPLACEMENT STATUS

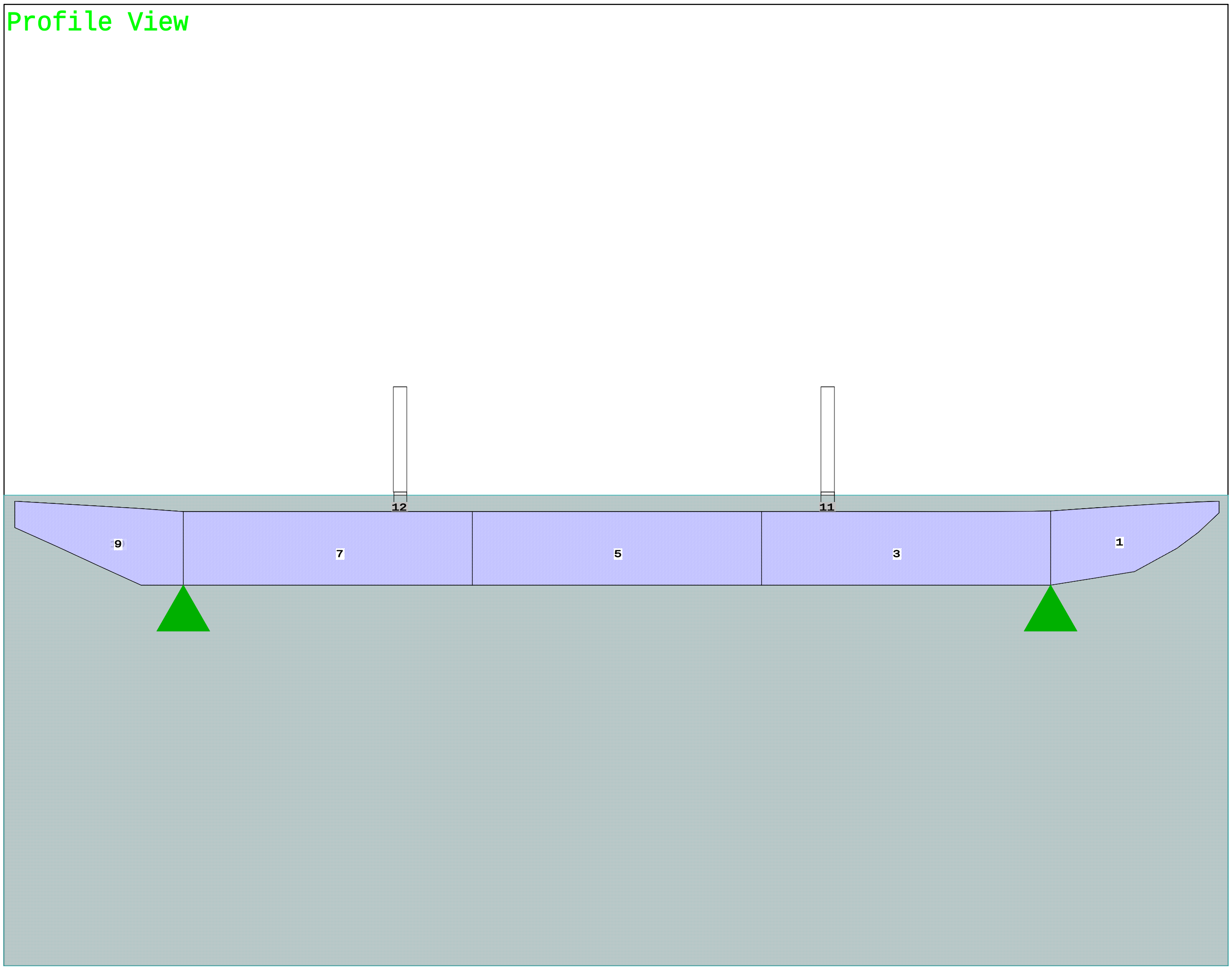
Baseline draft: 15.022 @ 0.00, 15.025 @ 200.00a

Trim: 0.00/200.00, Heel: Stbd 0.01 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			859.56	100.00a	0.00	7.35	
EndWallF			14.41	13.50a	0.00	15.58	
EndWallA			14.41	188.50a	0.00	15.58	
GateF			159.74	65.50a	2.49s	24.74	
GateA			159.74	136.50a	2.49s	24.74	
Misc			214.10	97.06a	6.57s	23.15	
Fwd Wells			20.86	28.00a	0.00	6.28	
Aft Wells			20.86	172.00a	0.00	6.28	
Total Fixed -->			1,463.70	99.81a	1.50s	13.59	
	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
TANK1.S	1.000	1.000	357.74	16.34a	11.19s	7.94	
TANK1.P	1.000	1.000	357.74	16.34a	11.19p	7.94	
TANK2.S	1.000	1.000	805.15	51.99a	11.19s	6.13	
TANK2.P	1.000	1.000	805.15	51.99a	11.19p	6.13	
TANK3.S	1.000	1.000	804.91	100.00a	11.19s	6.13	
TANK3.P	1.000	1.000	804.91	100.00a	11.19p	6.13	
TANK4.S	1.000	1.000	804.91	148.00a	11.19s	6.12	
TANK4.P	1.000	1.000	804.91	148.00a	11.19p	6.13	
TANK5.S	1.000	1.000	365.18	183.79a	11.19s	7.85	
TANK5.P	1.000	1.000	365.18	183.79a	11.19p	7.85	
Total Tanks -->			6,275.76	100.21a	0.00	6.53	
Total Weight -->			7,739.46	100.13a	0.28s	7.87	
			Displ(KP)	LCB	TCB	VCB	
HULL		1.000	6,456.39	100.21a	0.03s	6.59	-15.02
GATEF_FLOOD.S	Flooded	1.000	-24.96	65.00a	3.52s	13.64	-15.02
GATEA_FLOOD.S	Flooded	1.000	-24.97	136.00a	3.52s	13.64	-15.02
Total Displacement-->		1.000	6,406.46	100.21a	0.00	6.54	
			React(KP)	LCR	TCR	VCR	
Fwd Stbd Jack			349.48	28.00a	22.50s	0.00	-15.03
Fwd Port Jack			300.80	28.00a	22.50p	0.00	-15.02
Aft Stbd Jack			365.70	172.00a	22.50s	0.00	-15.03
Aft Port Jack			317.03	172.00a	22.50p	0.00	-15.02
Total Reaction -->			1,333.01	101.75a	1.64s	0.00	
Total Buoyancy -->			7,739.47	100.47a	0.28s	5.41	
Righting Arms:				0.34a	-0.00s		

Distances in FEET.

CG - Draft: 15.02 @ 0.00 , 15.02 @ 200.00a Heel: stbd 0.01 deg.



Tanks

1 TANK1.S.......100% FRESH WATER
2 TANK1.P.......100% FRESH WATER
3 TANK2.S.......100% FRESH WATER
4 TANK2.P.......100% FRESH WATER
5 TANK3.S.......100% FRESH WATER
6 TANK3.P.......100% FRESH WATER
7 TANK4.S.......100% FRESH WATER
8 TANK4.P.......100% FRESH WATER
9 TANK5.S.......100% FRESH WATER
10 TANK5.P.......100% FRESH WATER
11 GATEF_FLOOD.S..Flooded
12 GATEA_FLOOD.S..Flooded

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.01 deg.

```
        Largest Shear:       -513.8 KP       at  172.00a
Largest Bending Moment:     -16,131 KP-Ft    at  103.50a (Sagging)
       Largest Stress:       -3.414 KP/SqIn  at  103.50a (Compression)
          (  16.7%  of       20.400 KP/SqIn  limit)
```

GROUNDING points

Origin Depth: 15.023
Trim: 0.00/200.00 Heel: Stbd 0.01 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	15.03	15.00	0.02	0.10	358.66
Fwd Port Jack	15.02	15.00	0.02	0.10	309.99
Aft Stbd Jack	15.03	15.00	0.02	0.10	356.52
Aft Port Jack	15.02	15.00	0.02	0.10	307.84
Total Ground Reaction ——>					1,333.01

Distances in FEET.

LOWERING BARGE ON WIRES WITH GATES STARTING TO BECOME NEUTRALY BUOYANT

WEIGHT and DISPLACEMENT STATUS

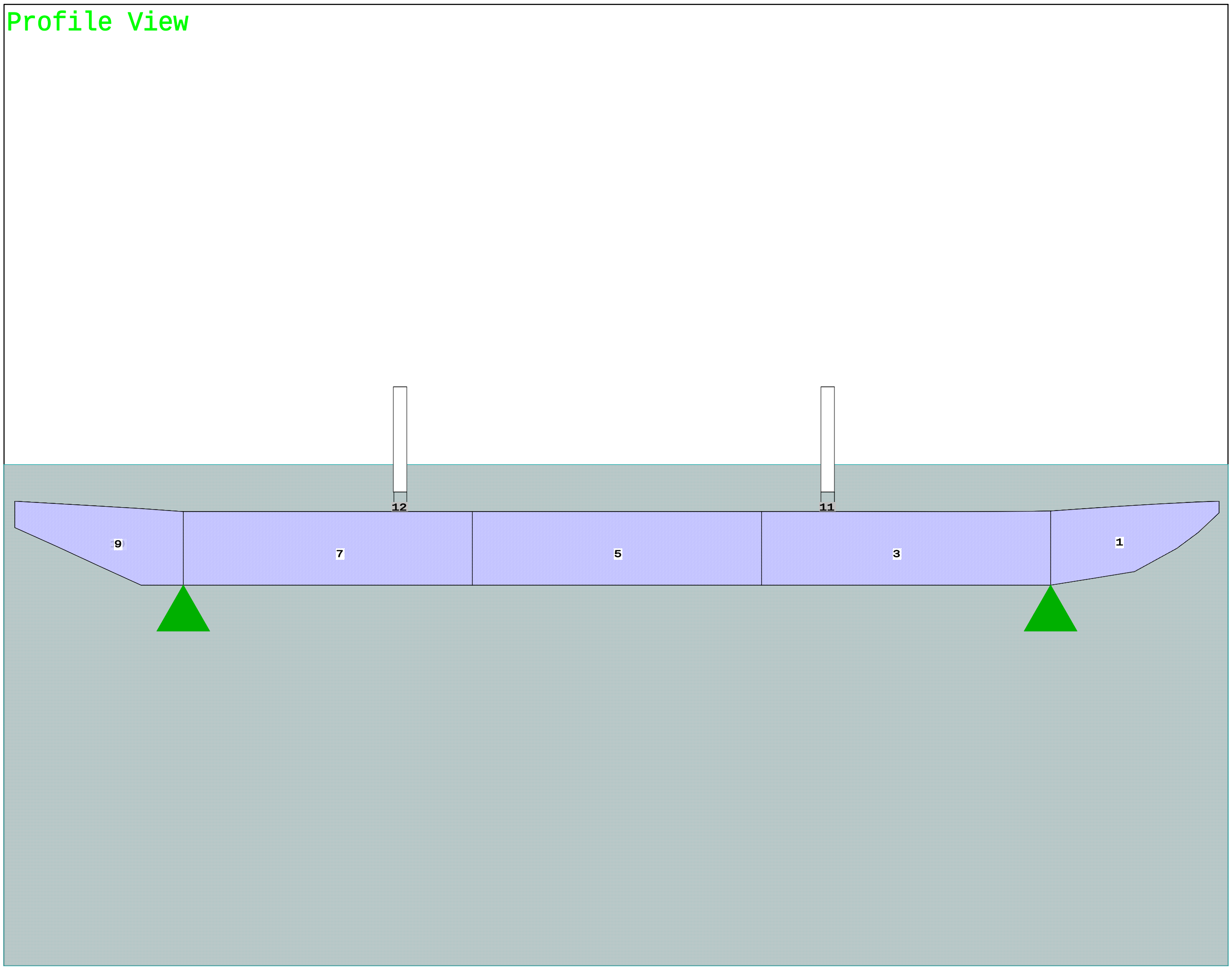
Baseline draft: 20.020 @ 0.00, 20.023 @ 200.00a

Trim: 0.00/200.00, Heel: Stbd 0.01 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			859.56	100.00a	0.00	7.35	
EndWallF			14.41	13.50a	0.00	15.58	
EndWallA			14.41	188.50a	0.00	15.58	
GateF			159.74	65.50a	2.49s	24.74	
GateA			159.74	136.50a	2.49s	24.74	
Misc			214.10	97.06a	6.57s	23.15	
Fwd Wells			20.86	28.00a	0.00	6.28	
Aft Wells			20.86	172.00a	0.00	6.28	
Total Fixed --->			1,463.70	99.81a	1.50s	13.59	
	Load	**SpGr**	**Weight(KP)**	**LCG**	**TCG**	**VCG**	**RefHt**
TANK1.S	1.000	1.000	357.74	16.34a	11.19s	7.94	
TANK1.P	1.000	1.000	357.74	16.34a	11.19p	7.94	
TANK2.S	1.000	1.000	805.15	51.99a	11.19s	6.13	
TANK2.P	1.000	1.000	805.15	51.99a	11.19p	6.13	
TANK3.S	1.000	1.000	804.91	100.00a	11.19s	6.12	
TANK3.P	1.000	1.000	804.91	100.00a	11.19p	6.12	
TANK4.S	1.000	1.000	804.91	148.00a	11.19s	6.13	
TANK4.P	1.000	1.000	804.91	148.00a	11.19p	6.12	
TANK5.S	1.000	1.000	365.18	183.79a	11.19s	7.85	
TANK5.P	1.000	1.000	365.18	183.79a	11.19p	7.85	
Total Tanks --->			6,275.76	100.21a	0.00	6.53	
Total Weight --->			7,739.46	100.13a	0.28s	7.87	
			Displ(KP)	**LCB**	**TCB**	**VCB**	
HULL		1.000	6,556.30	100.21a	0.08s	6.76	-20.02
GATEF_FLOOD.S	Flooded	1.000	-29.25	65.00a	3.50s	13.88	-20.02
GATEA_FLOOD.S	Flooded	1.000	-29.25	136.00a	3.50s	13.88	-20.02
Total Displacement-->		1.000	6,497.79	100.21a	0.05s	6.69	
			React(KP)	**LCR**	**TCR**	**VCR**	
Fwd Stbd Jack			323.28	28.00a	22.50s	0.00	-20.03
Fwd Port Jack			281.64	28.00a	22.50p	0.00	-20.02
Aft Stbd Jack			339.19	172.00a	22.50s	0.00	-20.03
Aft Port Jack			297.54	172.00a	22.50p	0.00	-20.02
Total Reaction --->			1,241.65	101.84a	1.51s	0.00	
Total Buoyancy --->			7,739.44	100.47a	0.28s	5.62	
Righting Arms:				0.34a	0.00		

Distances in FEET.

CG - Draft: 20.02 @ 0.00 , 20.02 @ 200.00a Heel: stbd 0.01 deg.



Tanks

1 TANK1.S.......100% FRESH WATER	5 TANK3.S.......100% FRESH WATER	10 TANK5.P.......100% FRESH WATER
2 TANK1.P.......100% FRESH WATER	6 TANK3.P.......100% FRESH WATER	11 GATEF_FLOOD.S..Flooded
3 TANK2.S.......100% FRESH WATER	7 TANK4.S.......100% FRESH WATER	12 GATEA_FLOOD.S..Flooded
4 TANK2.P.......100% FRESH WATER	8 TANK4.P.......100% FRESH WATER	
	9 TANK5.S.......100% FRESH WATER	

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.01 deg.

Largest Shear:	-486.1	KP	at	172.00a	
Largest Bending Moment:	-14,471	KP-Ft	at	95.89a	(Sagging)
Largest Stress:	-3.063	KP/SqIn	at	95.89a	(Compression)
(15.0% of	20.400	KP/SqIn	limit)		

GROUNDING points

Origin Depth: 20.020
Trim: 0.00/200.00 Heel: Stbd 0.01 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	20.03	20.00	0.02	0.10	320.94
Fwd Port Jack	20.02	20.00	0.02	0.10	283.98
Aft Stbd Jack	20.03	20.00	0.02	0.10	336.85
Aft Port Jack	20.02	20.00	0.02	0.10	299.89
Total Ground Reaction ——>					1,241.65

Distances in FEET.

BARGE NEARING TOUCHDOWN ON BOTTOM GATES MOSTLY NEUTRALLY BUOYANT

WEIGHT and DISPLACEMENT STATUS

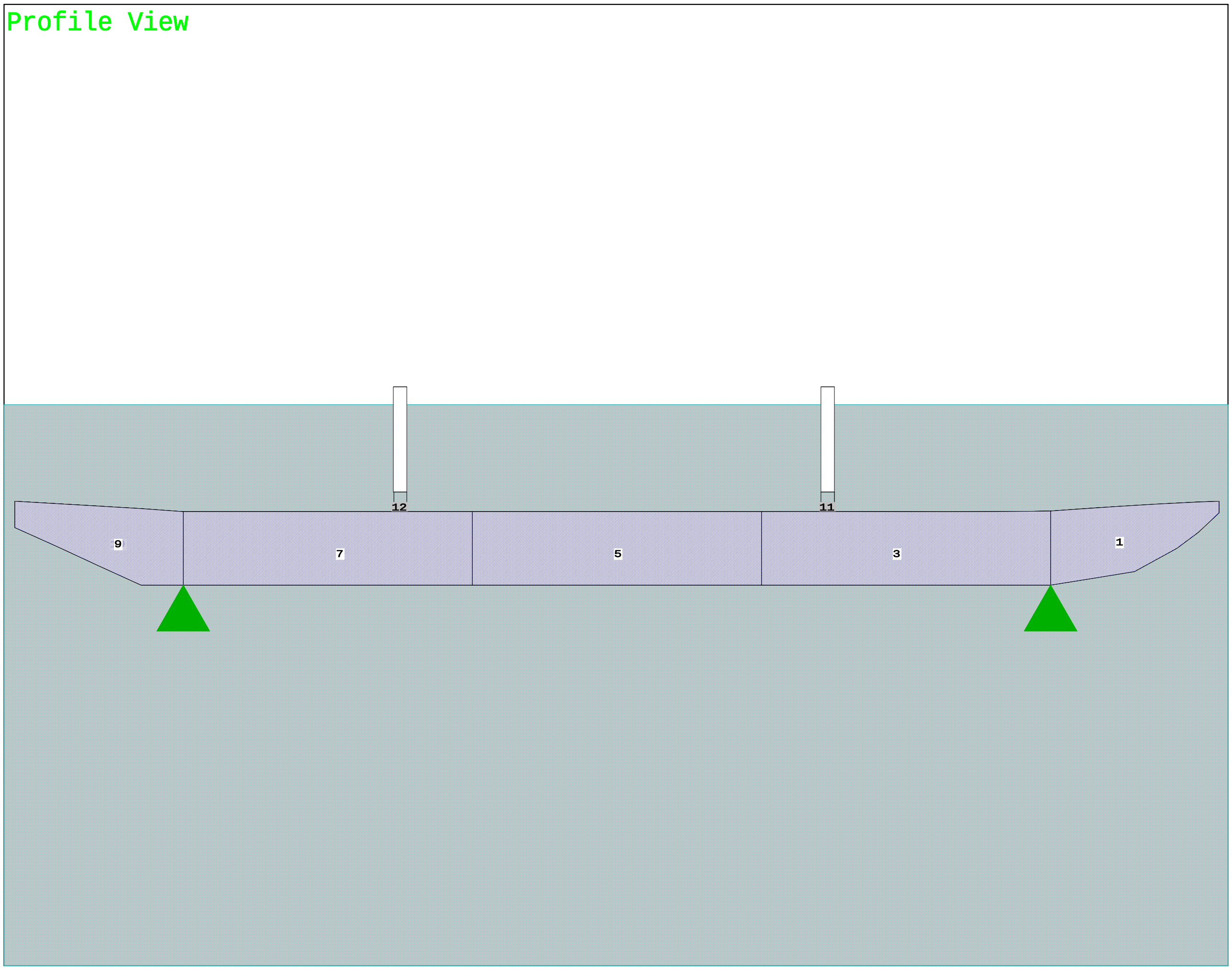
Baseline draft: 30.019 @ 0.00, 30.019 @ 200.00a

Trim: 0.00/200.00, Heel: Stbd 0.01 deg.

Part	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
Hull			859.56	100.00a	0.00	7.35	
EndWallF			14.41	13.50a	0.00	15.58	
EndWallA			14.41	188.50a	0.00	15.58	
GateF			159.74	65.50a	2.49s	24.74	
GateA			159.74	136.50a	2.49s	24.74	
Misc			214.10	97.06a	6.57s	23.15	
Fwd Wells			20.86	28.00a	0.00	6.28	
Aft Wells			20.86	172.00a	0.00	6.28	
Total Fixed -->			1,463.70	99.81a	1.50s	13.59	
	Load	SpGr	Weight(KP)	LCG	TCG	VCG	RefHt
TANK1.S	1.000	1.000	357.74	16.34a	11.19s	7.94	
TANK1.P	1.000	1.000	357.74	16.34a	11.19p	7.94	
TANK2.S	1.000	1.000	805.15	51.99a	11.19s	6.13	
TANK2.P	1.000	1.000	805.15	51.99a	11.19p	6.13	
TANK3.S	1.000	1.000	804.91	100.00a	11.19s	6.13	
TANK3.P	1.000	1.000	804.91	100.00a	11.19p	6.12	
TANK4.S	1.000	1.000	804.91	148.00a	11.19s	6.13	
TANK4.P	1.000	1.000	804.91	148.00a	11.19p	6.12	
TANK5.S	1.000	1.000	365.18	183.79a	11.19s	7.85	
TANK5.P	1.000	1.000	365.18	183.79a	11.19p	7.85	
Total Tanks -->			6,275.76	100.21a	0.00	6.53	
Total Weight -->			7,739.46	100.13a	0.28s	7.87	
			Displ(KP)	LCB	TCB	VCB	
HULL		1.000	6,757.23	100.22a	0.18s	7.30	-30.02
GATEF_FLOOD.S	Flooded	1.000	-29.25	65.00a	3.50s	13.88	-30.02
GATEA_FLOOD.S	Flooded	1.000	-29.25	136.00a	3.50s	13.87	-30.02
Total Displacement-->		1.000	6,698.72	100.22a	0.15s	7.24	
			React(KP)	LCR	TCR	VCR	
Fwd Stbd Jack			283.99	28.00a	22.50s	0.00	-30.02
Fwd Port Jack			257.95	28.00a	22.50p	0.00	-30.01
Aft Stbd Jack			262.44	172.00a	22.50s	0.00	-30.02
Aft Port Jack			236.41	172.00a	22.50p	0.00	-30.01
Total Reaction -->			1,040.79	97.02a	1.13s	0.00	
Total Buoyancy -->			7,739.51	99.79a	0.28s	6.27	
Righting Arms:				0.34f	0.00		

Distances in FEET.

CG - Draft: 30.02 @ 0.00 , 30.02 @ 200.00a Heel: stbd 0.01 deg.



Tanks

1 TANK1.S.......100% FRESH WATER
2 TANK1.P.......100% FRESH WATER
3 TANK2.S.......100% FRESH WATER
4 TANK2.P.......100% FRESH WATER
5 TANK3.S.......100% FRESH WATER
6 TANK3.P.......100% FRESH WATER
7 TANK4.S.......100% FRESH WATER
8 TANK4.P.......100% FRESH WATER
9 TANK5.S.......100% FRESH WATER
10 TANK5.P.......100% FRESH WATER
11 GATEF_FLOOD.S..Flooded
12 GATEA_FLOOD.S..Flooded

LONGITUDINAL STRENGTH with FLOODING -- SUMMARY at Heel = Stbd 0.01 deg.

Largest Shear:	-366.6	KP	at	172.00a
Largest Bending Moment:	-10,800	KP-Ft	at	103.50a (Sagging)
Largest Stress:	-2.286	KP/SqIn	at	103.50a (Compression)
(11.2% of	20.400	KP/SqIn	limit)	

GROUNDING points

Origin Depth: 30.018
Trim: 0.00/200.00 Heel: Stbd 0.01 deg.

Ground Point	Depth to Point	Depth to Ground	Penetration Present	Penetration Maximum	React(KP)
Fwd Stbd Jack	30.02	30.00	0.02	0.10	274.68
Fwd Port Jack	30.01	30.00	0.02	0.10	248.84
Aft Stbd Jack	30.03	30.01	0.02	0.10	271.51
Aft Port Jack	30.01	30.00	0.02	0.10	245.67
Total Ground Reaction ——>					1,040.70

Distances in FEET.

Appendix B Overturning Condition

TWO GATE FISH PROTECTION
Connection Slough Gate Structure
By: JKM/JTB
Date: 9/5/2009

Overturning Condition

Weights

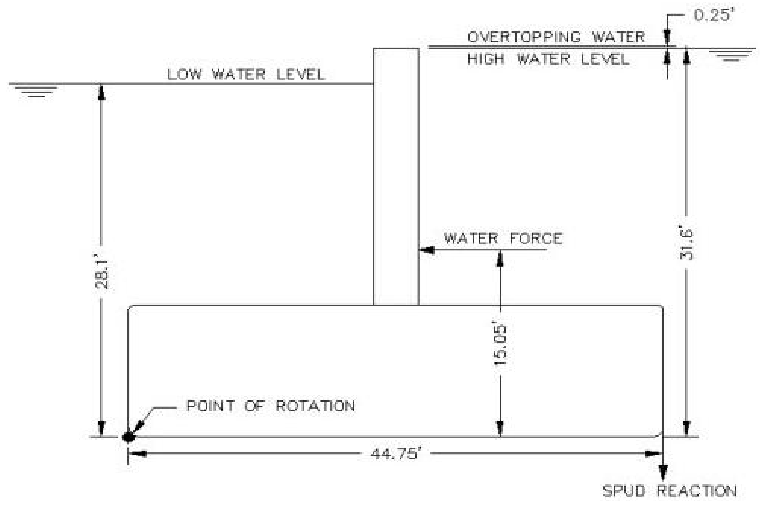
Item	Weight in Air	Weight in Water	TCG	Notes
	(Kip)	(Kip)	ft OCL +Stb	ghts change from +10% to -10% margin
Barge Hull	703.27	611.85	0.00	Weight in water 87% of weight in air,
Gates	261.40	0.00	2.49	Gate are assumed to be neutrally Bouyant
Misscellaneous	175.15	152.38	6.57	Weight in water 87% of weight in air
End Walls	28.82	25.08	0.00	Weight in water 87% of weight in air
Solid Ballast				
Super Charged Ballast				
Trapped Air	0.00	-87.40	0.00	Assumed 2" of trapped air
				(conservative for overturning calc)
Total Weights	1168.65	701.90	1.43	

Static Head

	ft	psf	Notes
Height of High Side Water	31.6		Top of sheet pile
Height of Low Side Water	28.1		
Height of Topping Water	0.25		Assume standing water overtopping sheet pile
Differential Head	3.75		
Average Pressure Head	3.56	227.66	Assume worst case water density 64 lbs/cu.ft

Moment Balance about Barge Corner

	Area	Force	Moment Arm	Moment	Notes
	Sq. Ft	kip	ft	kip-ft	
Water Pressure	6320	-1438.80	15.05	-21648.39	Area = 200'x31.6'
Weight		701.90	20.95	14703.76	
Net Moment				-6944.63	+ excess restoring moment
Margin				-32.1%	
Pile moment arm			44.75	-6944.63	CL pile to opposite bilge
Pile load, two piles		-155.19			
Pile load, one pile		-77.59			
Pile weight, kip/ft =	0.656				42" X 1" wall
Pile length (ft)	120				
Pile weight total (kip)	78.72				
Pile pull out		**1.13**			Load minus pile weight



Appendix C Weather Criterion

Two Gate Fish Protection: Connection Slough Weather Criterion

Weather Criterion
46 CFR 170 Subpart E

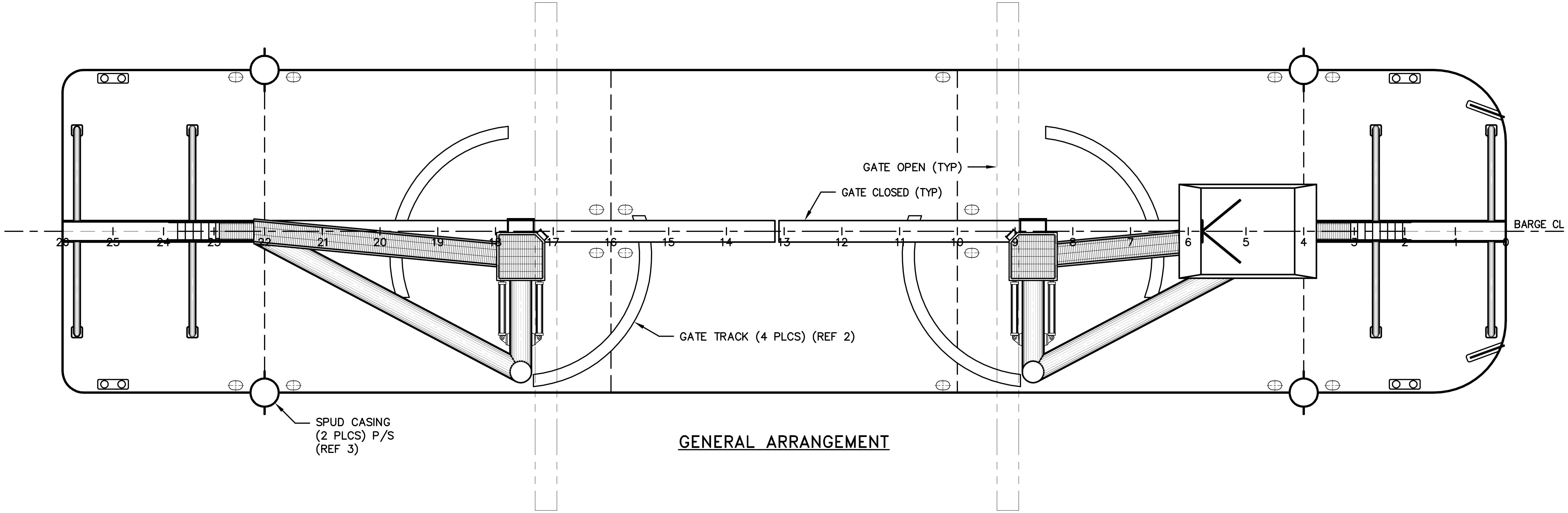
GM >= PAH / W tan T

Depth =	12.25 ft		
LBP =	185 ft		
Beam =	44.75 ft		
P =	0.002670 LT/ft^2	= 0.0025 + (LBP/14200)^2	. . . for service on protected water
A =	(see below) ft^2	= projected lateral area of portion of vessel and cargo above waterli	
H =	(see below) ft	= vertical distance from the center of A to the center of underwater lateral area (~ 1/2 draft)	
W =	(see below) LT	= Displacement	
T =	(see below) deg	= MIN (14º, Angle at which 1/2 freeboard to deck is immersed [call it heel])	

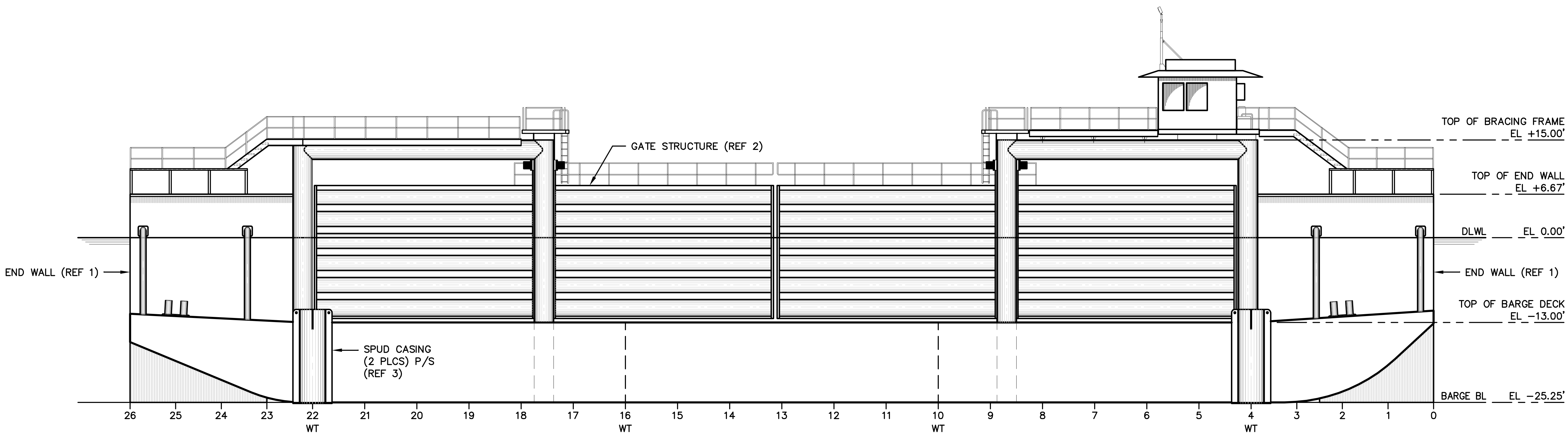
1/2 B tan (HEEL) = distance hull is immersed due to HEEL

Draft	Displacement = W	Freeboard	max VCG	A	H	tan (heel)	heel	min(14º, heel) = T	PAH / W tan T
ft ABL	LT	ft	ft Abv mn dk	ft^2	ft		deg	deg	ft
3.54	1,902.77	8.71	9.37	7,584.00	22.00	0.19	11.01	11.01	1.20

ATTACHMENT B2. Connection Slough Gate Drawings



GENERAL ARRANGEMENT



OUTBOARD PROFILE

90% SUBMITTAL

GENERAL NOTES

1. DIMENSIONS GIVEN ARE FOR REFERENCE ONLY.

REFERENCES

1.	GLOSTEN DWG 09041-03-01	BARGE DENISE END WALL STRUCTURE
2.	MOFFATT & NICHOL DWG 6097-03	TWO GATE FISH PROTECTION PLAN
3.	GLOSTEN DWG 09041-02-01	BARGE DENISE MODIFICATIONS

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD

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MOFFATT & NICHOL, INC.
WALNUT CREEK, CALIFORNIA

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CONNECTION SLOUGH GATE (BARGE DENISE)
GENERAL ARRANGEMENT

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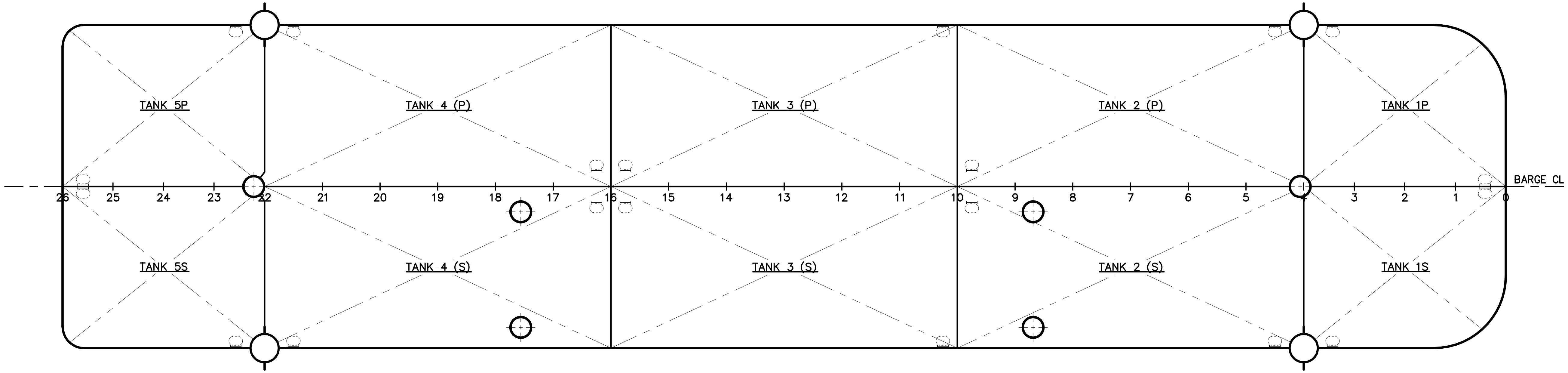
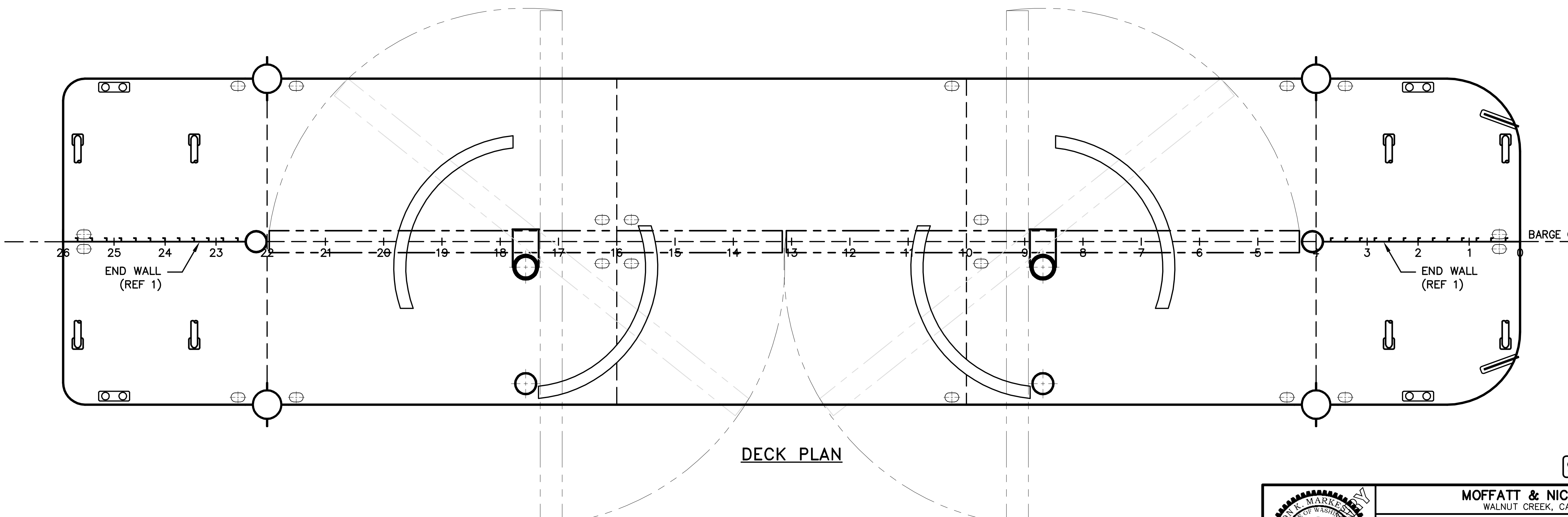
Drawn	Checked	Approved	Date
CWK	JKM	WLH	7/9/2009

Scale	Drawing Number	Sheet	of	Revision
1/16"=1'-0"	09041-01-01	1	2	P2



HOLD PLAN



DECK PLAN

90% SUBMITTAL

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1/16"=1'-0"	09041-01-01	2 2	P2

GENERAL NOTES

REFERENCES

1.	GLOSTEN DWG 09041-01-01	BARGE DENISE GENERAL ARRGT
2.	GLOSTEN DWG 09041-03-01	BARGE DENISE END WALL STRUCTURE
3.	GLOSTEN DWG 09041-04-01	BARGE DENISE GATE FOUNDATIONS
4.	GLOSTEN DWG 09041-05-01	HYDRAULIC PIPING & ELEC CONDUIT
5.	MOFFATT & NICHOL DWG 6097-03	TWO GATE FISH PROTECTION PLAN

REVISIONS

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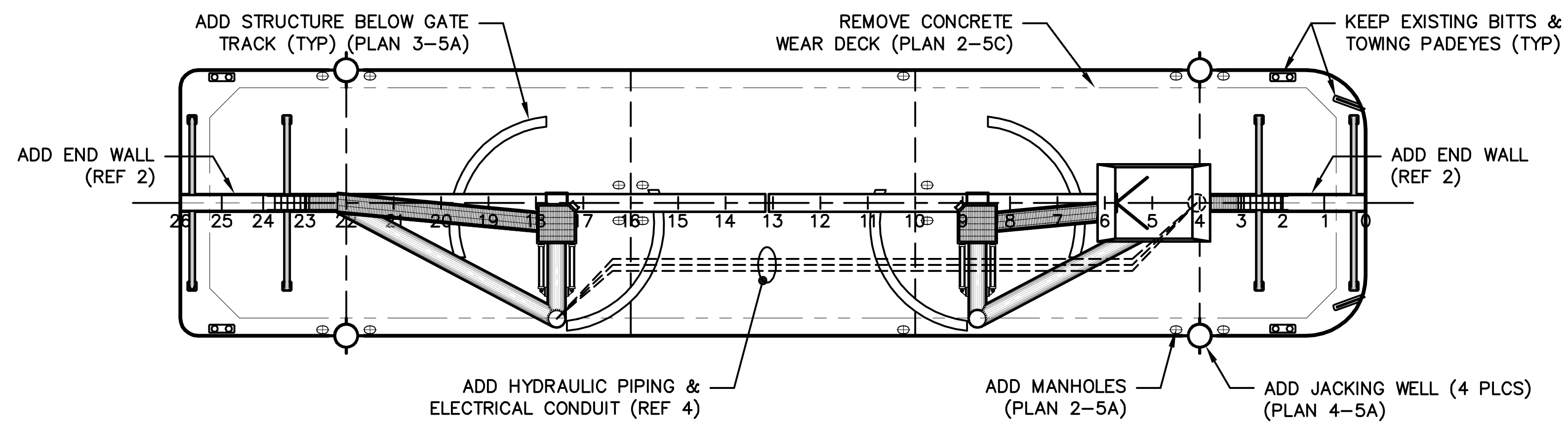
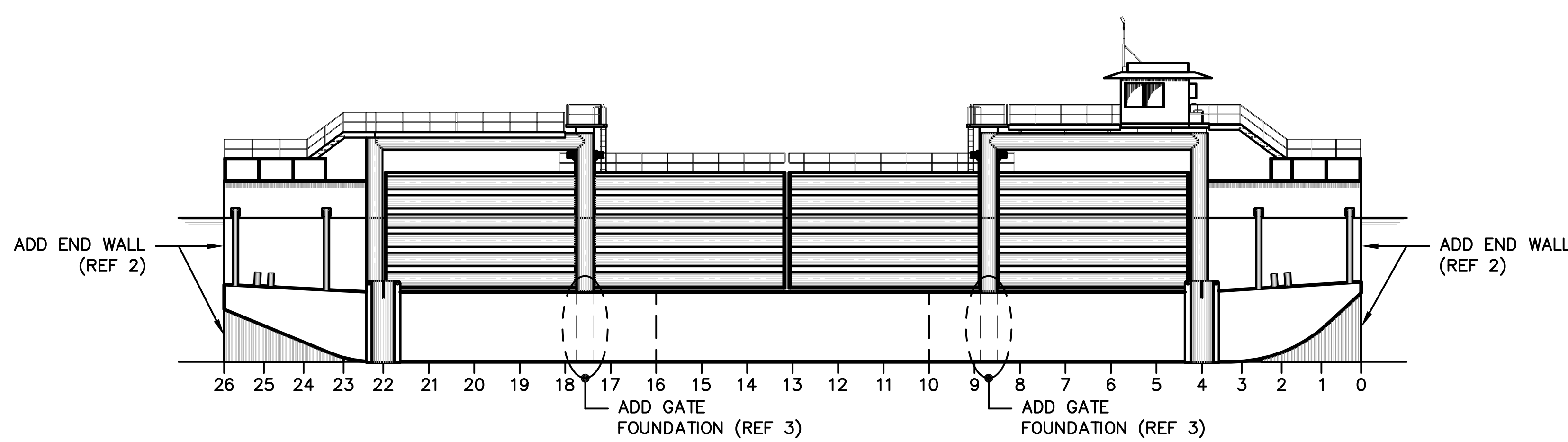


PLAN VIEW



OUTBOARD PROFILE

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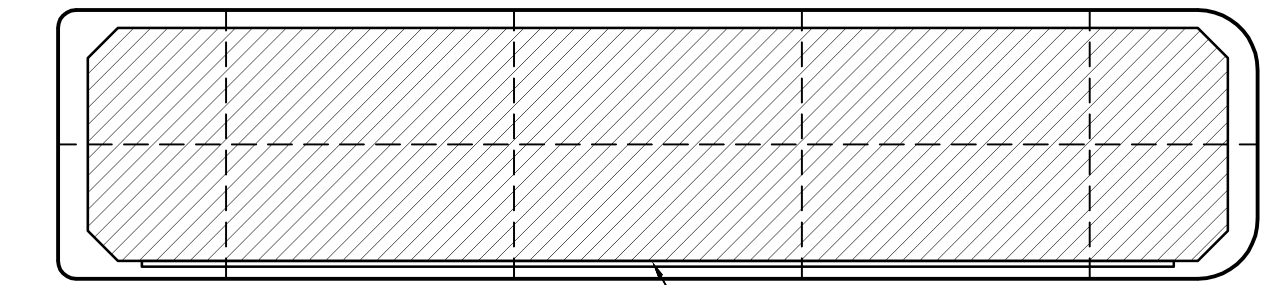
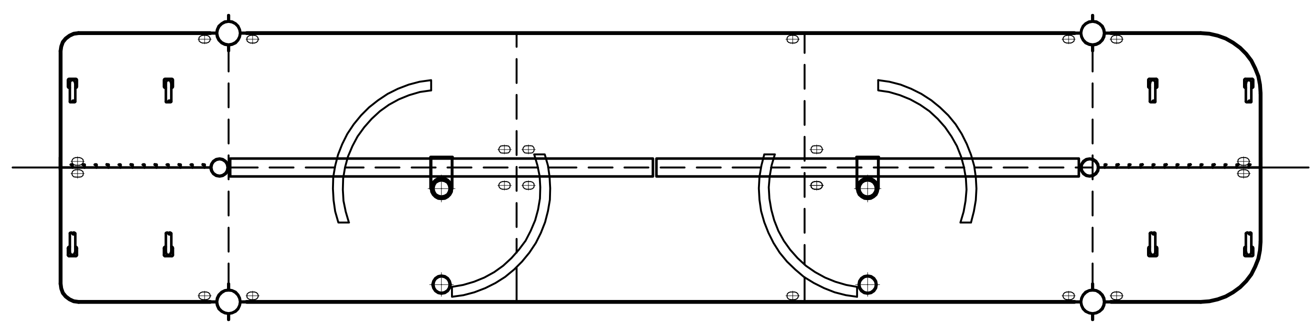


PLAN 2-5C

WEAR DECK REMOVAL

1/32"=1'-0"

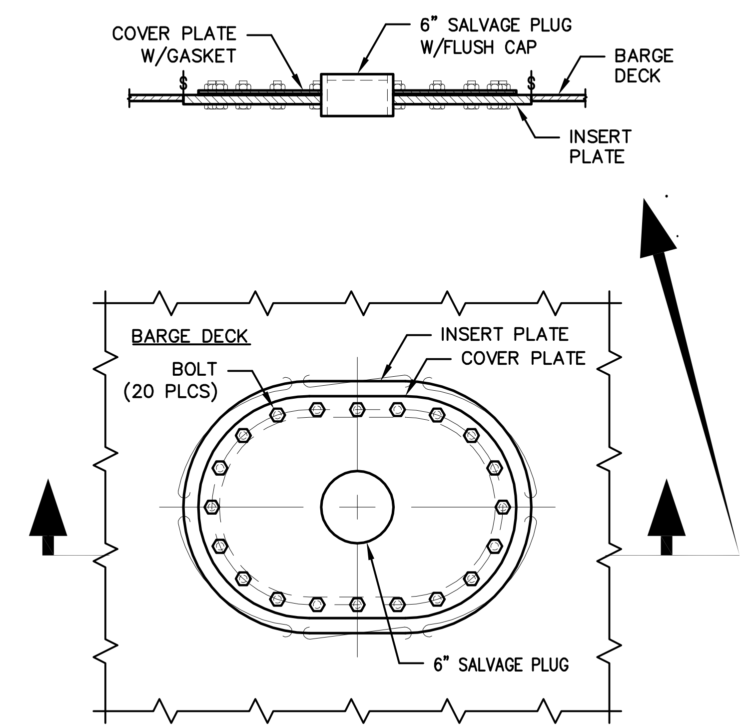


1. REMOVE AND PLUG EXISTING MANHOLES (10 PLCS)
2. ADD 15"x 23" FLUSH WT MANHOLES WITH 6" SALVAGE PLUGS (20 PLCS). SEE DETAIL 2-2A.
3. TO ALLOW CLEARANCE FOR GATE SWING, NO PART OF NEW MANHOLES SHALL PROTRUDE MORE THAN 2" ABOVE THE DECK.

PLAN 2-5A

ADD MANHOLES

1/32"=1'-0"



DETAIL 2-2A

TYPICAL MANHOLE DETAIL

(NABRICO DF-503 OR EQUAL W/SALVAGE PLUG ADDED)

3/4"=1'-0"

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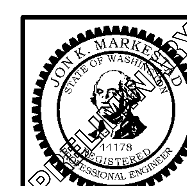

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TWO GATE FISH PROTECTION PLAN CONNECTION SLOUGH GATE (BARGE DENISE) BARGE MODIFICATIONS	
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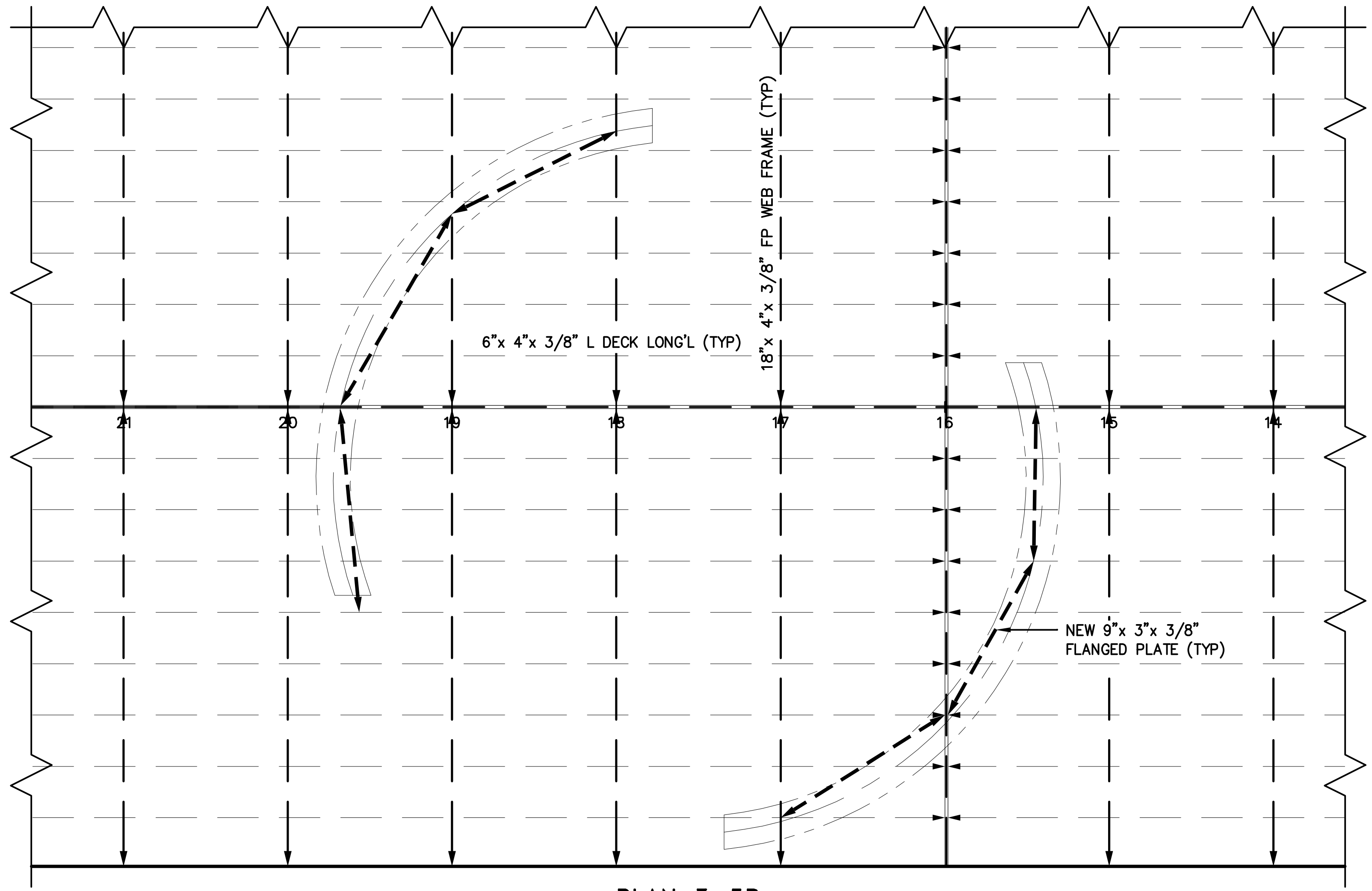
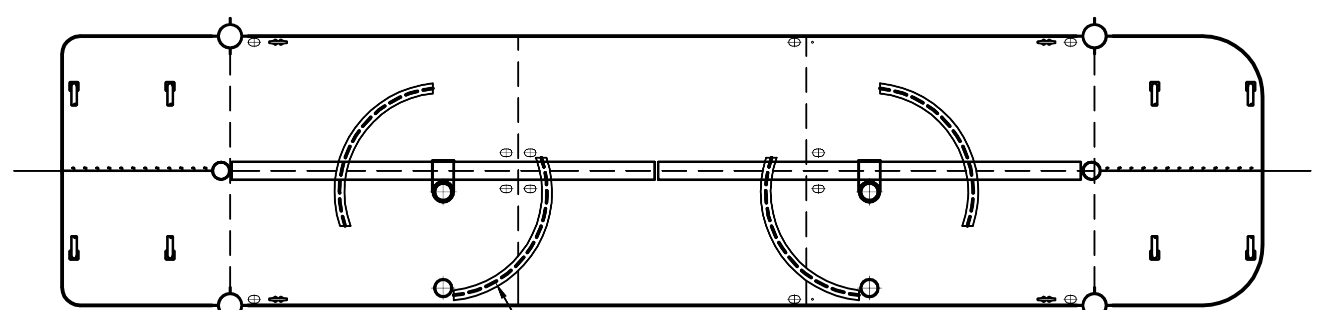
AS NOTED	09041-02-01	2	4	P2



PLAN 3–5B

TYPICAL ADDED STRUCTURE BELOW GATE TRACKS

1/8"=1'–0"



PLAN 3–5A

ADD STRUCTURE BELOW GATE TRACKS

1/32"=1'–0"

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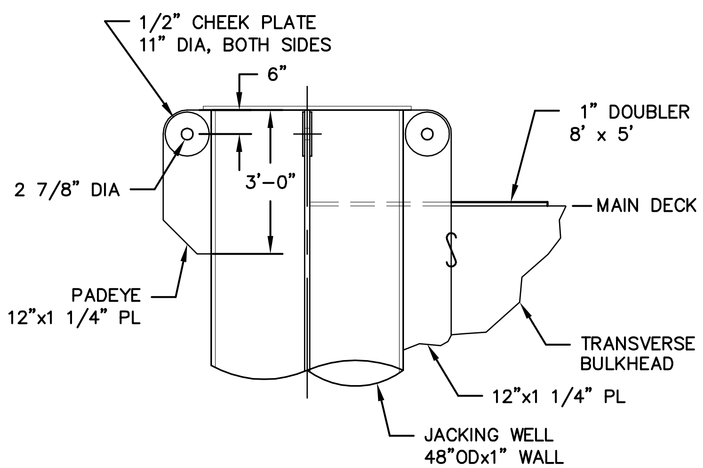
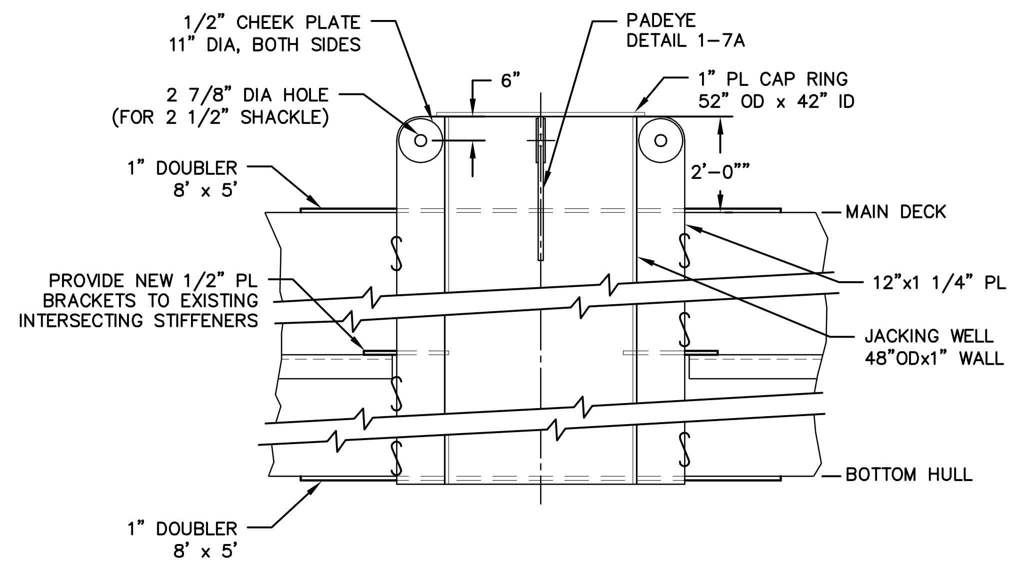
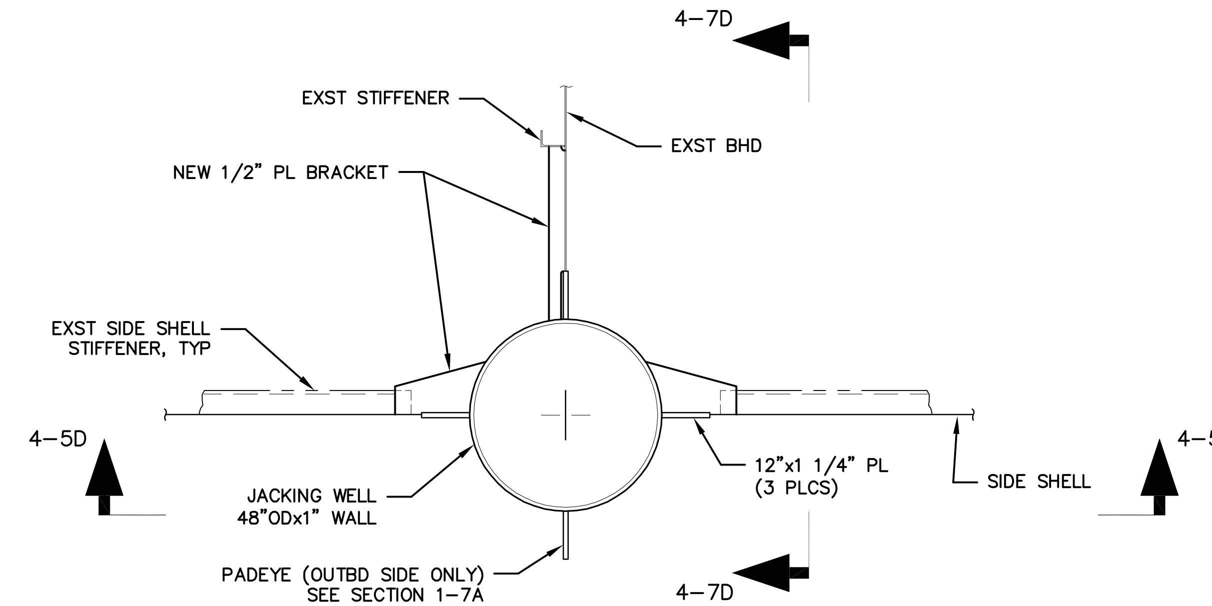
Scale	Drawing Number	Sheet	of	Revision
AS NOTED	09041–02–01	3	4	P2



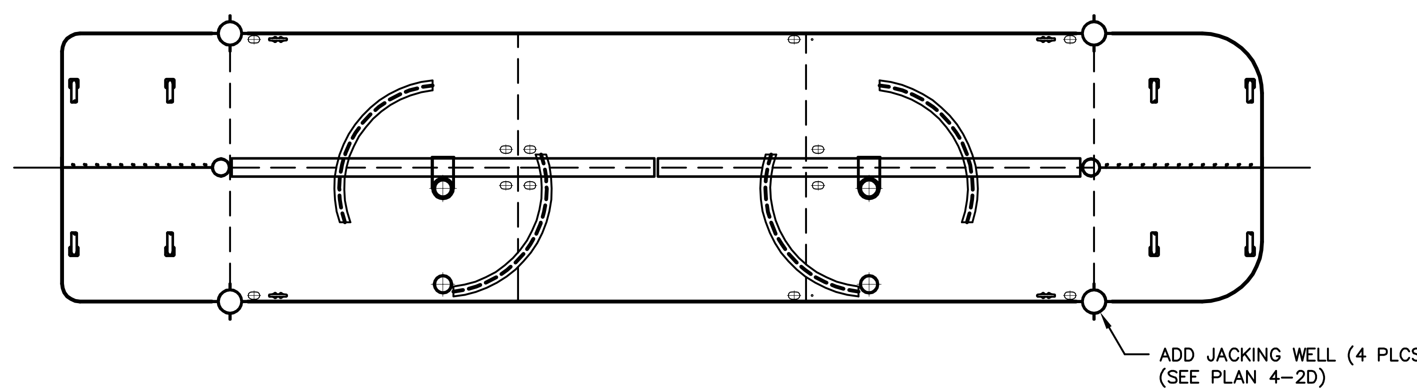
DETAIL 4-7D
TYPICAL PADEYE
1/4"=1'-0"



ELEVATION 4-5D
LOOKING INBOARD
1/4"=1'-0"



PLAN 4-2D
TYPICAL JACKING WELL
1/4"=1'-0"



PLAN 4-5A
ADD JACKING WELLS
1/32"=1'-0"

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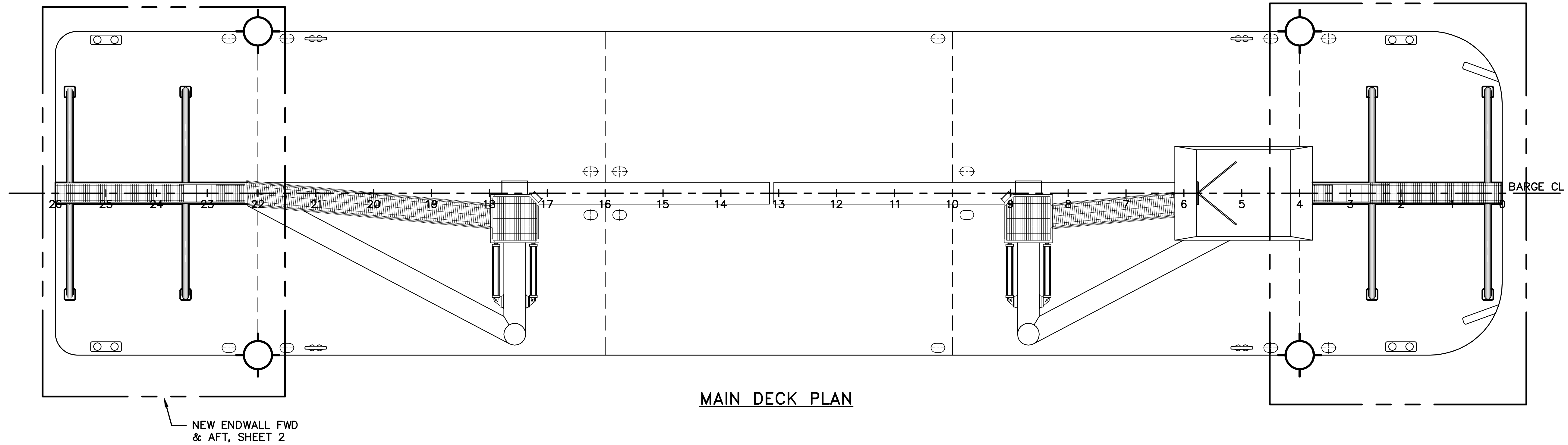
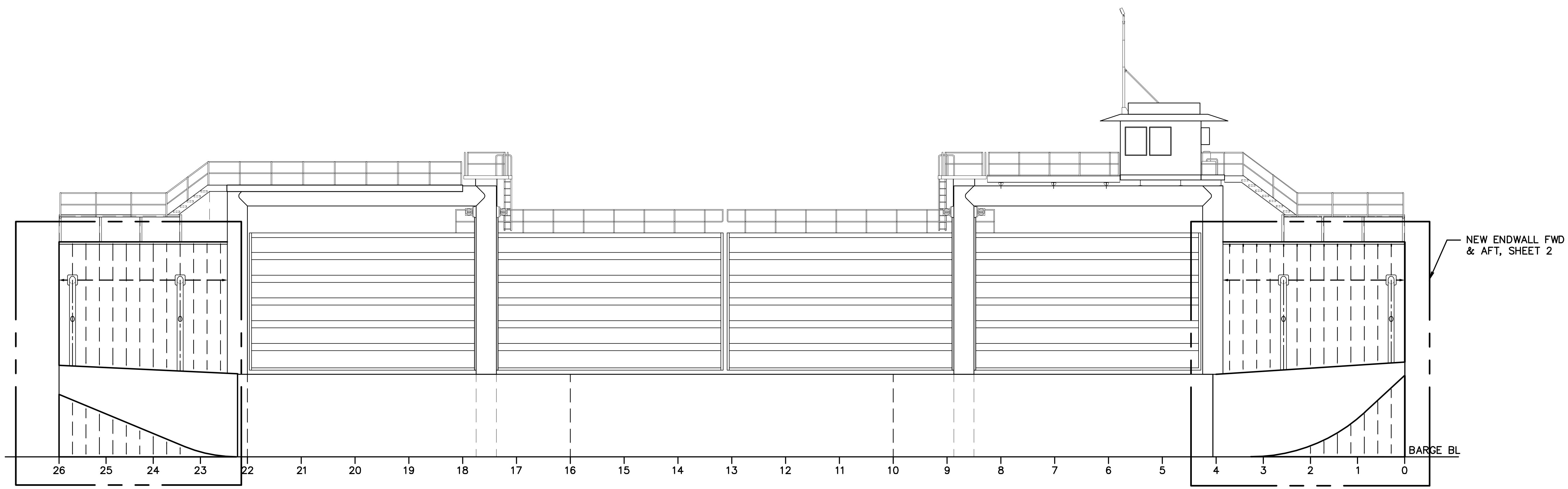
AS NOTED	09041-02-01	4	4	P2



MAIN DECK PLAN



OUTBOARD PROFILE

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GENERAL NOTES

REFERENCES

1. GLOSTEN DWG 09041-01-01 — BARGE DENISE GENERAL ARRANGEMENT
2. MOFFATT & NICHOL DWG 6097-03 — TWO GATE FISH PROTECTION PLAN
3. GLOSTEN DWG 09041-02-01 — BARGE DENISE MODIFICATIONS

REVISIONS

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END WALL STRUCTURE

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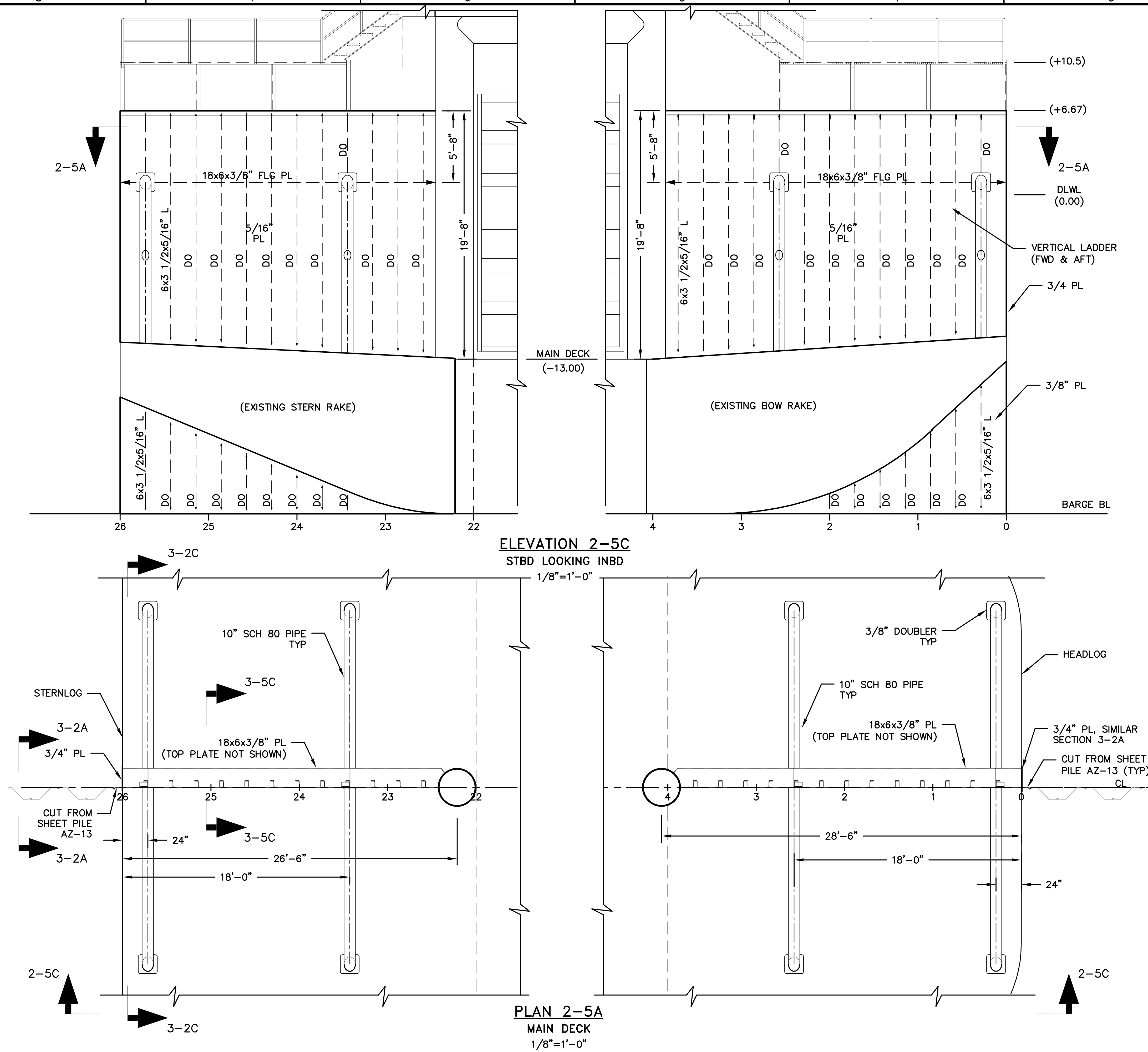
Scale	Drawing Number	Sheet	of	Revision
1/16"=1'-0"	09041-03-01	1	3	P2



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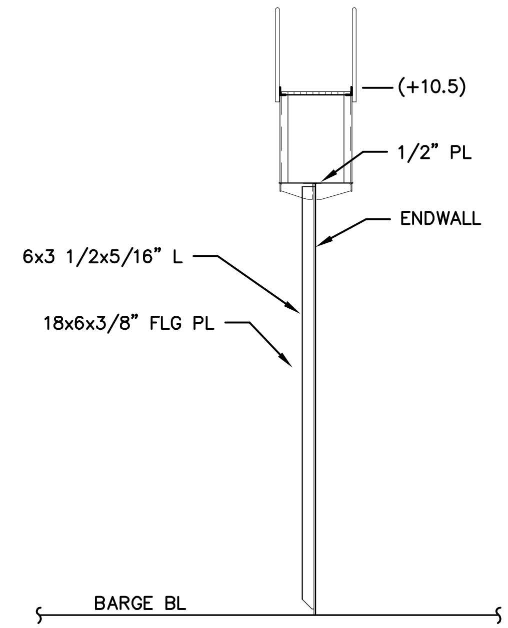
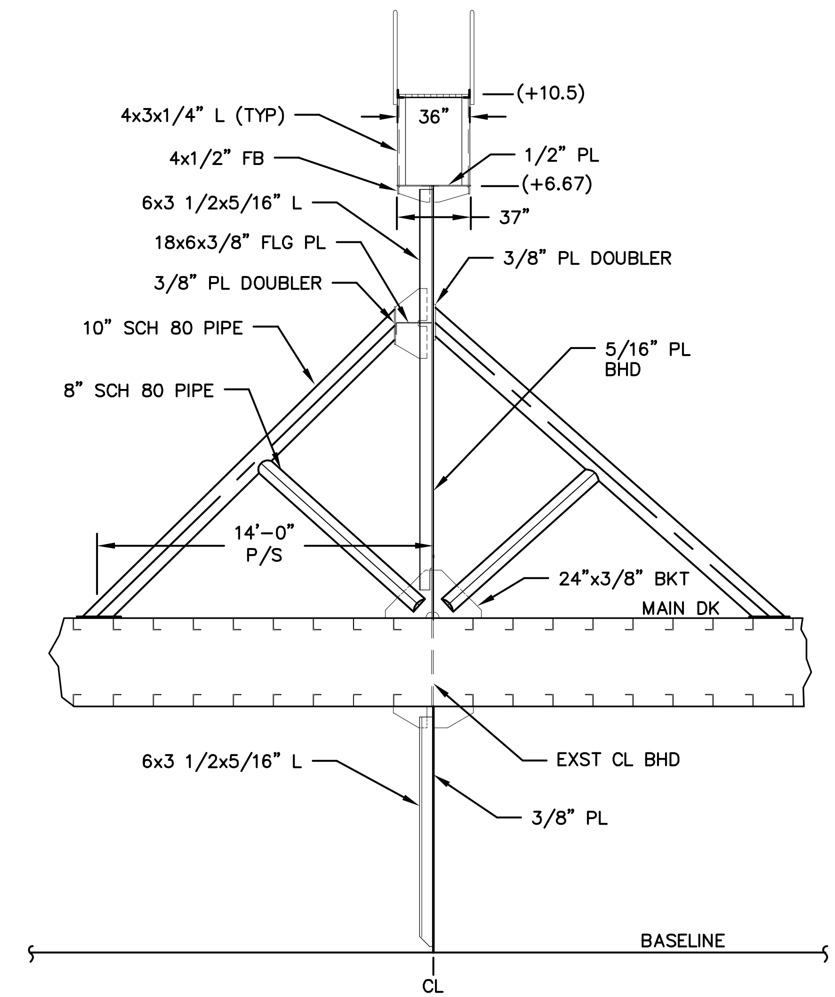
Drawn	Checked	Approved	Date
JL	WLH	WLH	9/2/09

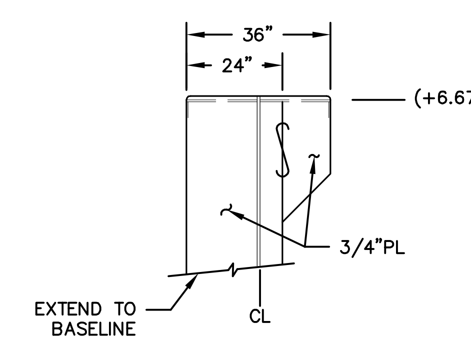
Scale	Drawing Number	Sheet	of	Revision
AS SHOWN	09041-03-01	2	3	P2



SECTION 3-5C
LOOKING FWD
1/8"=1'-0"



SECTION 3-2B
LOOKING FWD
1/8"=1'-0"



SECTION 3-2A
TOP OF END WALL
@ HEADLOG & STERNLOG
1/4"=1'-0"

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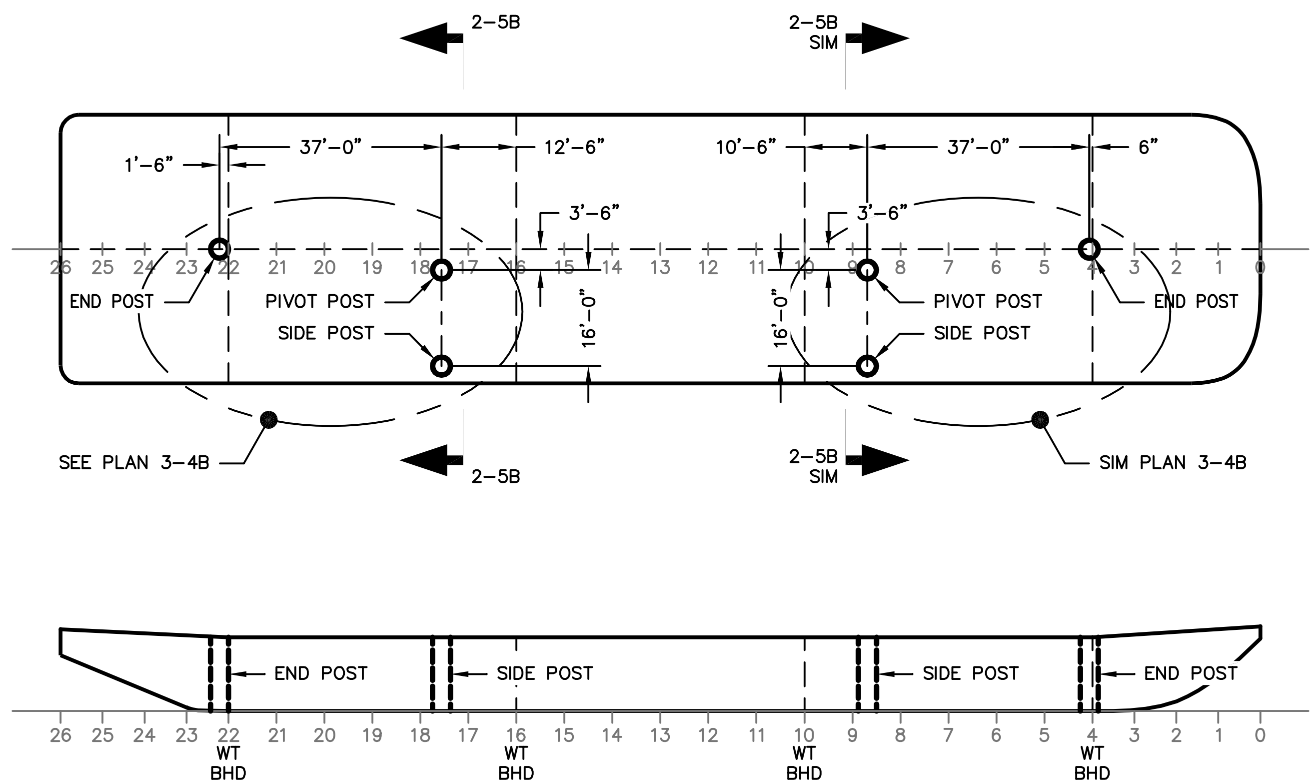
JL	WLH	WLH	9/2/09

Scale	Drawing Number	Sheet of	Revision
AS SHOWN	09041-03-01	3 of 3	P2



GATE FOUNDATION KEY PLAN

NO SCALE

GENERAL NOTES

1. BARGE SHOWN IN THIS DRAWING CORRESPONDS TO THE "DENISE" 200'x44'-9"x12'-3".
2. ALL PLATES AND STIFFENERS TO BE ASTM A36 STEEL OR EQUIVALENT.
3. 3:1 TAPER TO BE USED IN BUTT JOINTS OF PLATES OF MORE THAN 1/8" UNEQUAL THICKNESS.
4. ALL WELDING TO BE DOUBLE CONTINUOUS UNLESS NOTED OTHERWISE.

REFERENCES

1.	GLOSTEN DWG 09041-03-01	BARGE DENISE END WALL STRUCTURE
2.	GLOSTEN DWG 09041-02-01	BARGE DENISE MODIFICATIONS
3.	MOFFATT & NICHOL DWG C45	GATE FRAMING LAYOUT
4.	MOFFATT & NICHOL DWG C61-62	GATE MECHANICAL DETAILS

REVISIONS

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Scale	Drawing Number	Sheet	of	Revision
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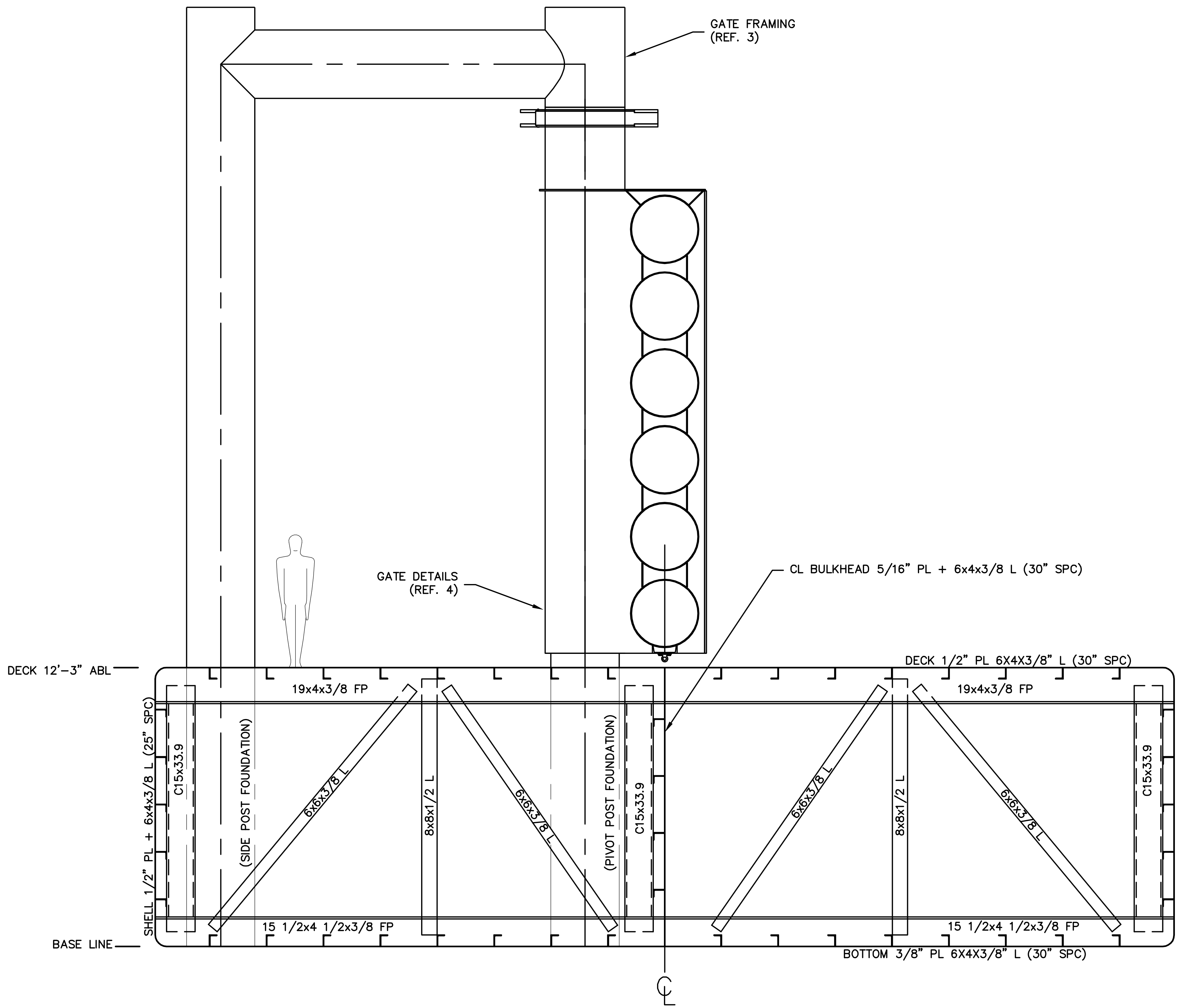

SECTION 2–5B

INSTALLATION OVERVIEW
SHOWN FRAME 18 LKG AFT
(FR 9 SIM)
3/16"=1'-0"

90% SUBMITTAL

PRELIMINARY

MOFFATT & NICHOL, INC.
WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
CONNECTION SLOUGH GATE (BARGE DENISE)
GATE FOUNDATION

THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community
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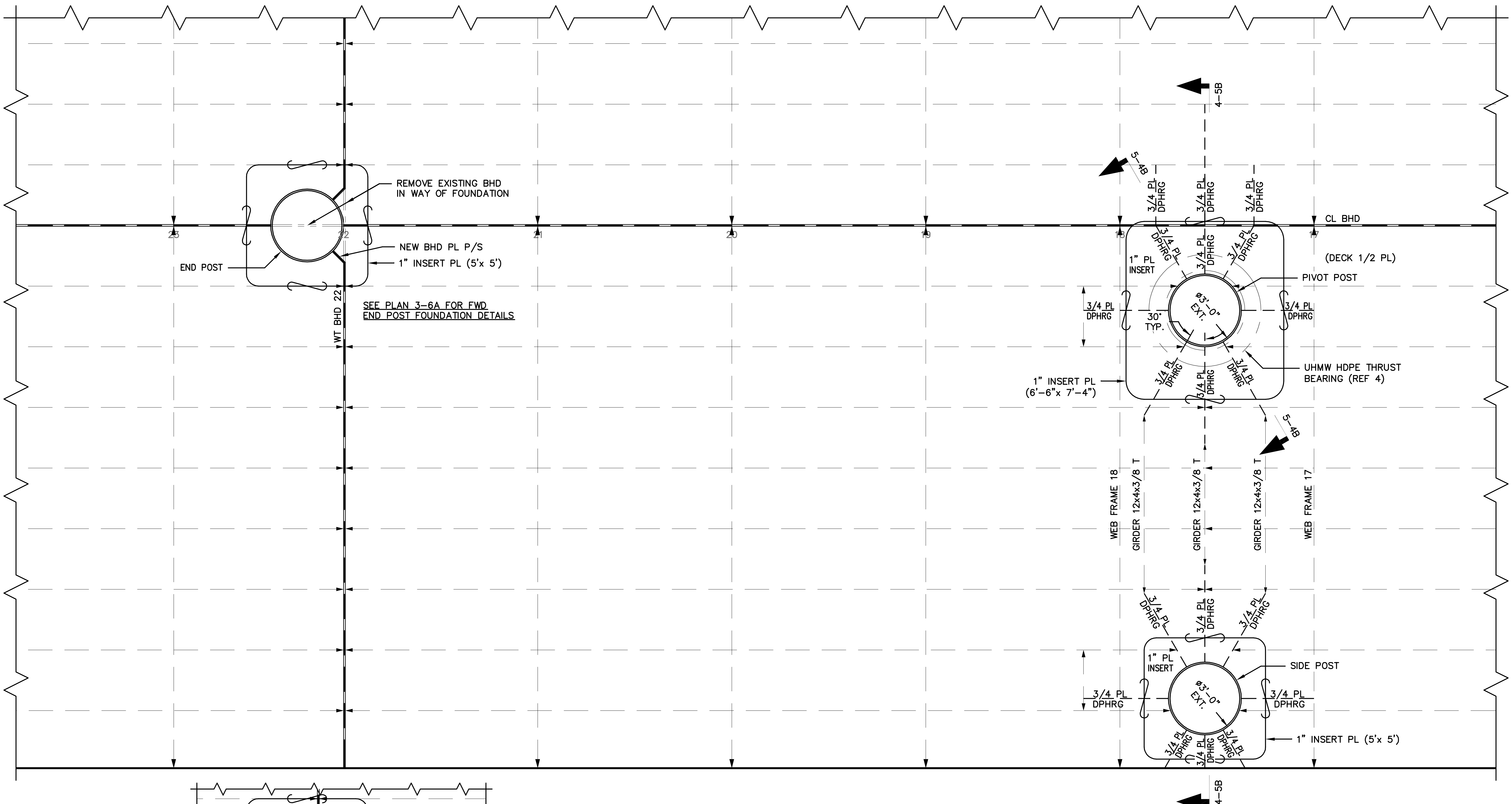
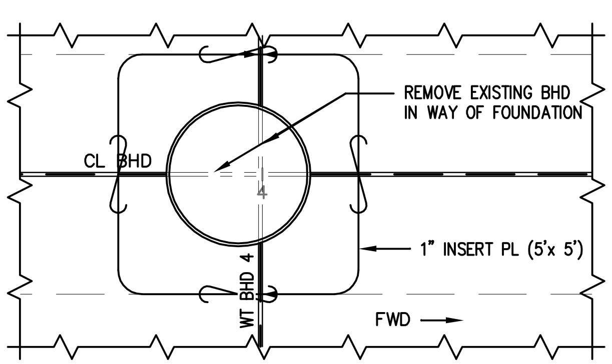


PLAN 3-4B

POST FOUNDATIONS AT BARGE DECK
(AFT SHOWN, FWD FOUNDATIONS SIMILAR EXCEPT AS NOTED)
1/4"=1'-0"



PLAN 3-6A

FWD END POST FOUNDATION AT BARGE DECK
1/4"=1'-0"

90% SUBMITTAL

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TWO GATE FISH PROTECTION PLAN
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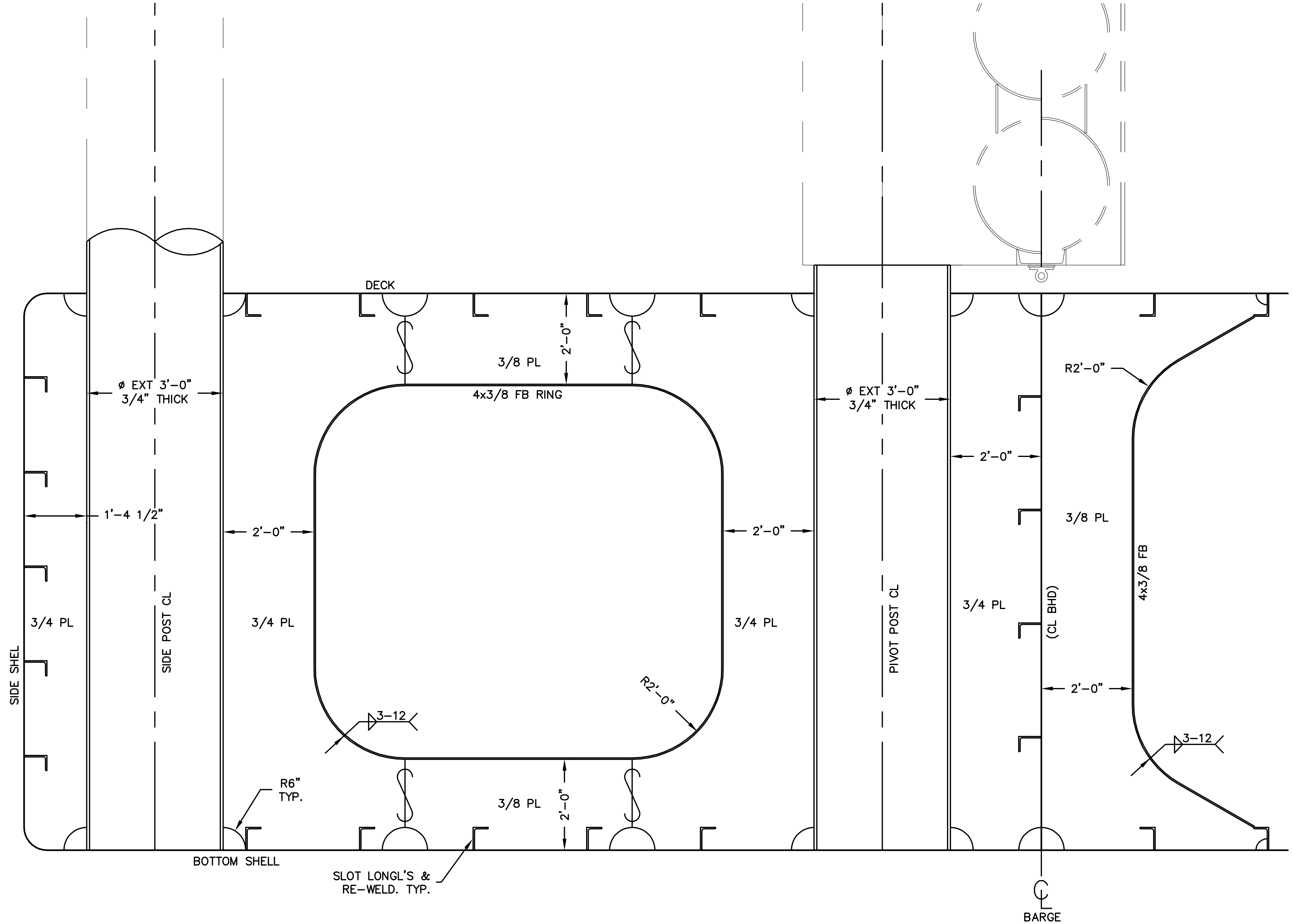

ELEVATION 4-5B

SIDE POST & PIVOT POST
FOUNDATIONS / LKG AFT
3/8"=1'-0"

90% SUBMITTAL

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WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
CONNECTION SLOUGH GATE (BARGE DENISE)
GATE FOUNDATION

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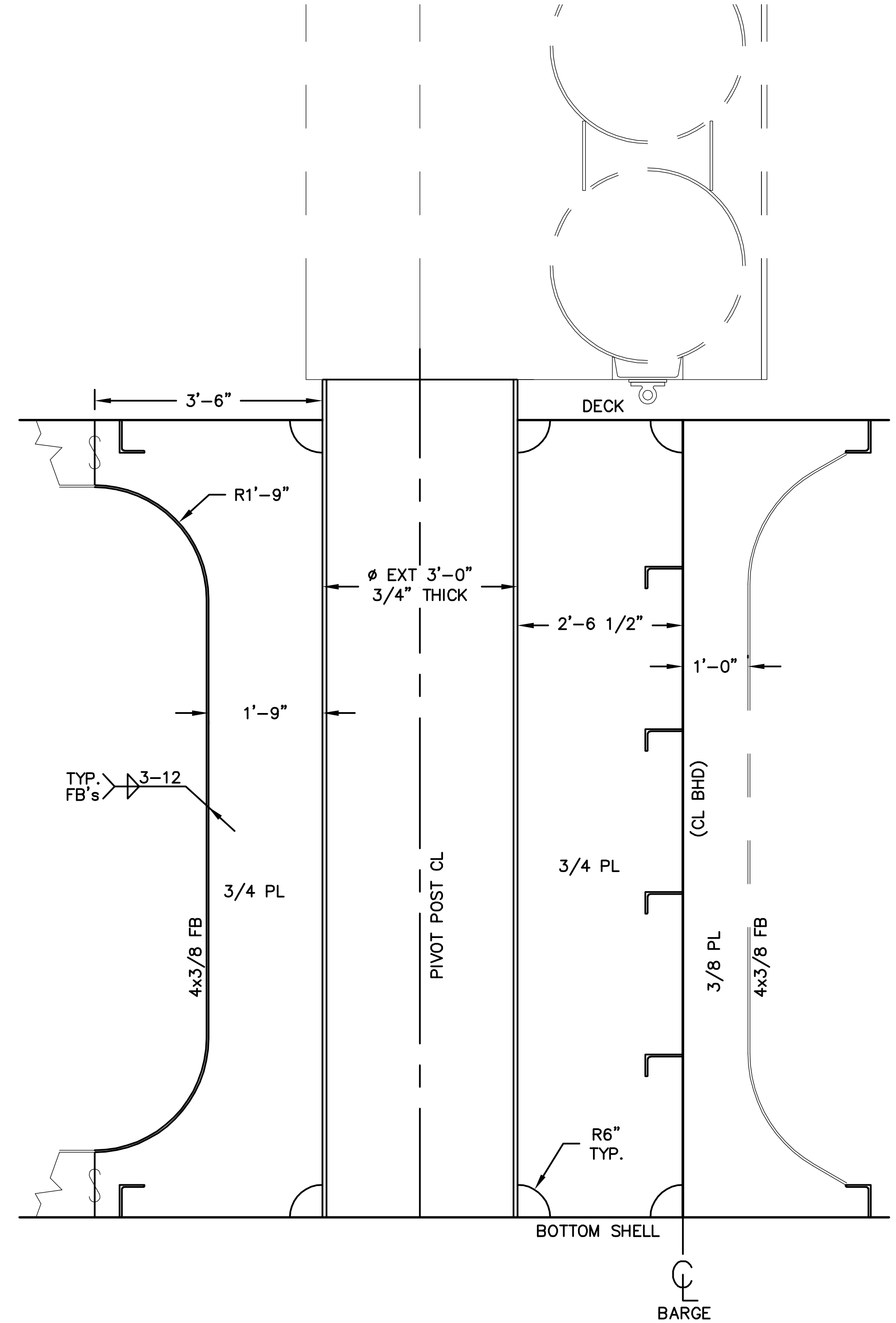

ELEVATION 5-4B

30 DEG PIVOT POST DIAPH / LKG
AFT & OUTBD
3/8"=1'-0"

90% SUBMITTAL

PRELIMINARY

WILLIAM L. HURLEY JR. — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER — 19808

MOFFATT & NICHOL, INC.
WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
CONNECTION SLOUGH GATE (BARGE DENISE)
GATE FOUNDATION

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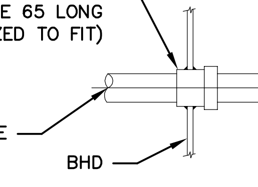
MATERIAL SCHEDULE

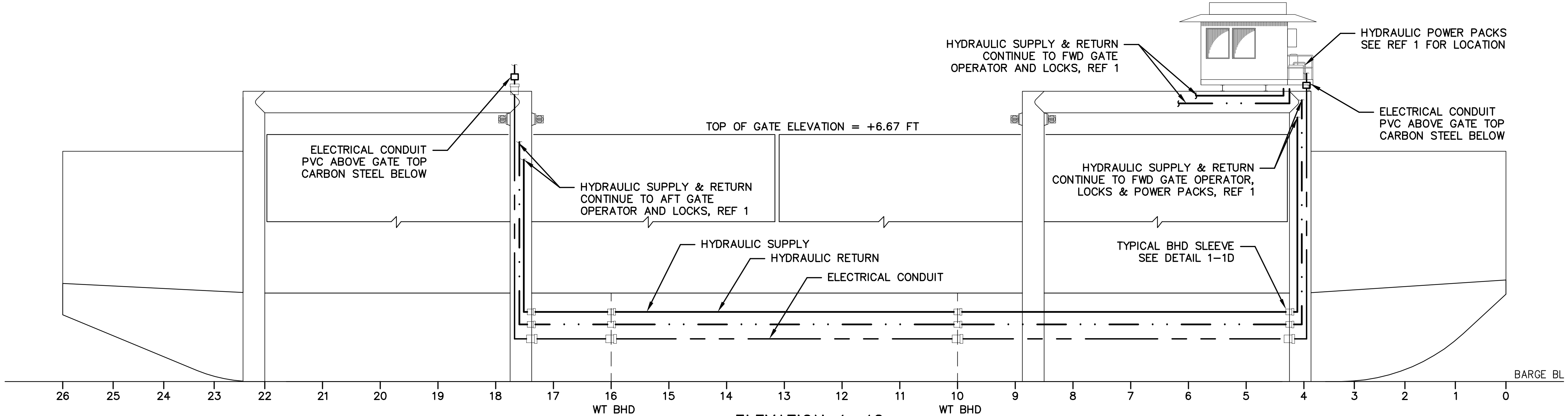
SYSTEM	MAXIMUM WORKING PRESSURE	TEST PRESSURE	PIPE SIZE	PIPE MATERIAL	TAKEDOWN JOINTS MATERIAL	FITTINGS TYPE & MATERIAL
HYDRAULICS	3000 PSI	4500 PSI	1"	STAINLESS STEEL TUBING, ASTM A269 OR A249, TYPE 304 OR 316, SEAMLESS OR WELDED & REDRAWN, FULLY ANNEALED	NONE	37° FLARE (JIC) FITTINGS, SAE J514
ELECTRICAL CONDUIT (BELOW GATE TOP)	NA	NA	2"	CARBON STEEL, ASTM A53 OR ASTM A106, GR B, SCH 40, ANSI B36.10	NONE	STEEL, SW, LONG RADIUS, ASTM A105 OR A234, GR WPB, ANSI B16.11, CLASS 3000, SEE GENERAL NOTE 2
ELECTRICAL CONDUIT (ABOVE GATE TOP)	NA	NA	2"	PVC. SCH 80	NONE	PVC, SW OR THD, LONG RADIUS, SCH 80

GENERAL NOTES (CONT'D)

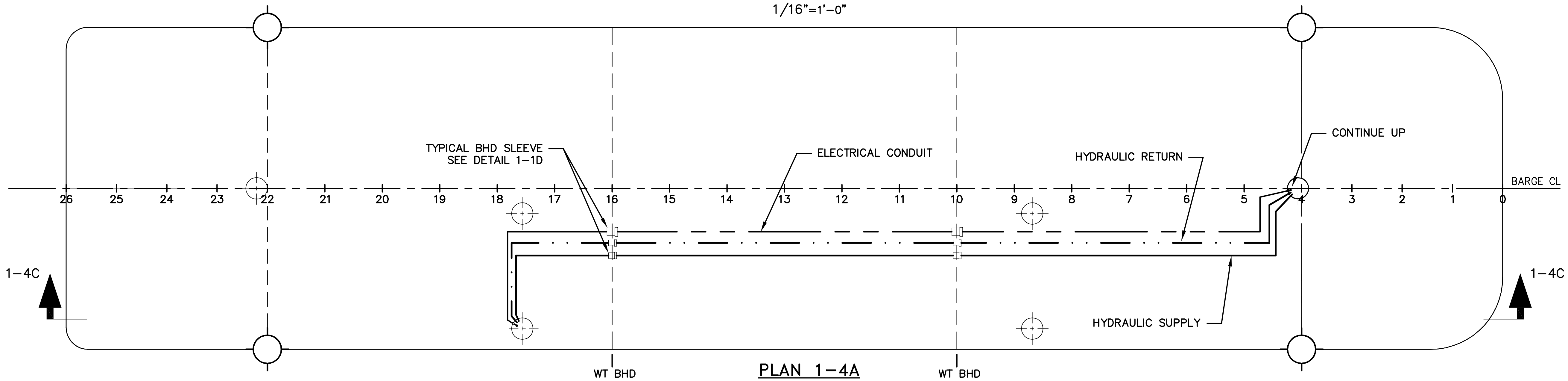
5. ALL PIPING RUNS SHALL BE FLUSHED BY AN APPROVED METHOD USING AND INDEPENDENT FLUSHING UNIT TO REMOVE LOOSE OR FOREIGN MATERIAL BEFORE SYSTEMS ARE OPERATED. USE BLANKING PLATES AND HOSE JUMPERS TO BYPASS ALL COMPONENTS(PUMPS, VALVES, ETC.). FLUSH TO CLEANLINESS LEVEL PER J1165.



DETAIL 1-1D
BHD SLEEVE
3/4"=1'-0"



ELEVATION 1-4C
OUTBOARD PROFILE
1/16"=1'-0"



PLAN 1-4A
BELOW MAIN DECK
1/16"=1'-0"

90% SUBMITTAL

GENERAL NOTES

1. ELECTRICAL CONDUIT SHOWN ONLY FOR BELOW WATERLINE. ABOVE WATERLINE, REFER TO REFERENCE 1.
2. BEND STEEL CONDUIT WHERE POSSIBLE.
3. RIGID PIPE HANGERS SHALL BE IN ACCORDANCE WITH ASTM F708.
4. COMPLETE ALL HYDRO PRESSURE TESTING PRIOR TO FLUSHING.

(CONTINUE ZONE 1-3D)

REFERENCES

1. MOFFATT & NICHOL DWG 6097-03 TWO GATE FISH PROTECTION PLAN

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD

PRELIMINARY — JON K. MARKESTAD, STATE OF WASHINGTON, 11178, REGISTERED PROFESSIONAL ENGINEER

DOUBLE SIZE PRINT

MOFFATT & NICHOL, INC.
WALNUT CREEK, CALIFORNIA

TWO GATE FISH PROTECTION PLAN
CONNECTION SLOUGH GATE (BARGE DENISE)
BELOW DECK HYDRAULIC PIPING & ELECTRICAL CONDUIT

THE GLOSTEN ASSOCIATES
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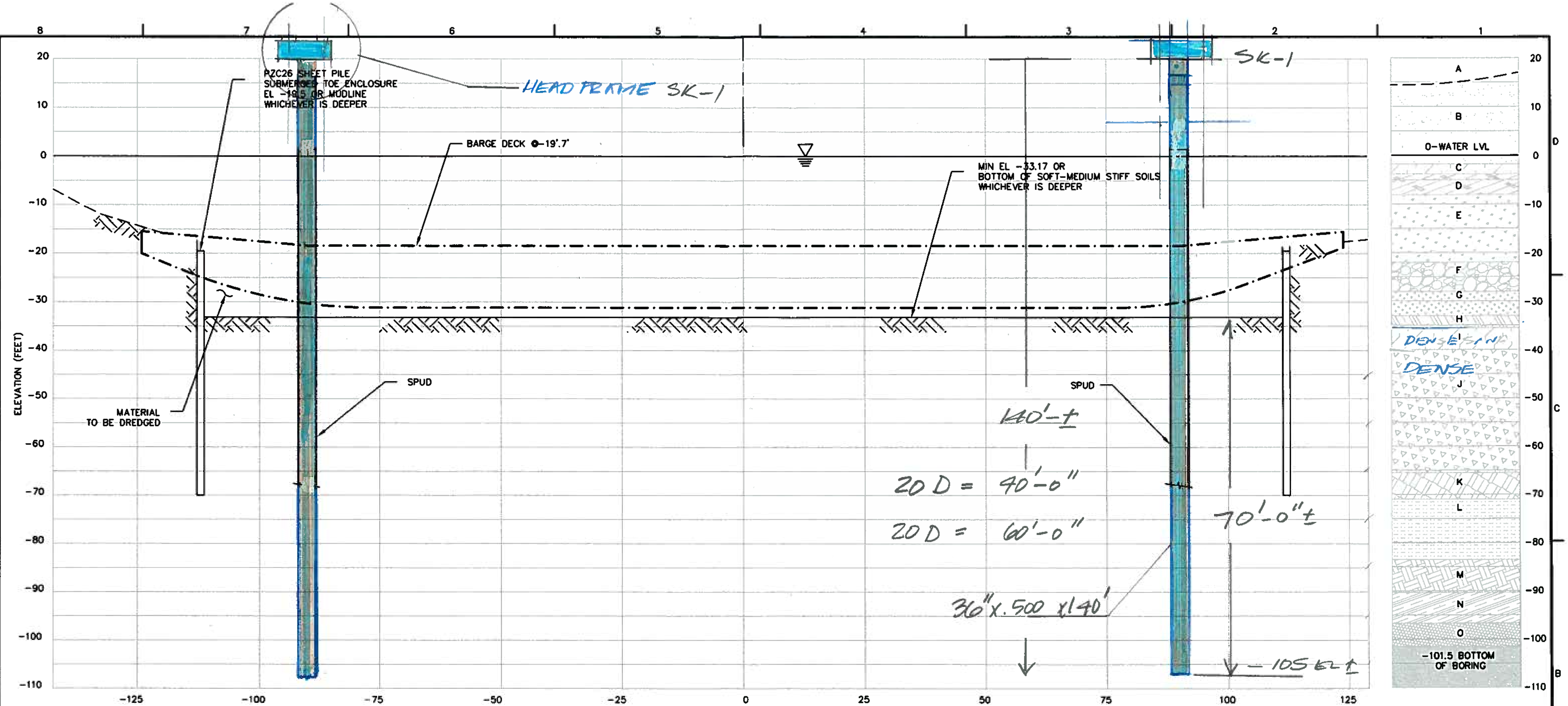
ATTACHMENT C. Spud Pile Concept and Jacking Frame



ELEVATION 2-4B

OLD RIVER – SOIL COMPOSITION

SCALE: 1"=20'-0"

P_c = 470 kips AXIAL FORCE:

P_u ~ 900 kips ULTIMATE

KEY

LETTER	ELEVATION	SOIL DESCRIPTION
A	N/A	N/A
B	0 FT	GRAY WELL GRADED GRAVEL (GW), DENSE, DRY (FILL)
C	-1.8 FT	DARK BROWN POORLY-GRADED SAND (SP) AND PEAT (PT), LOOSE TO MEDIUM DENSE, DRY TO MOIST (FILL)
D	-3.8 FT	BROWN LEAN CLAY (CL), SOFT TO MEDIUM STIFF, DRY, RED-BROWN MOTTLING, FINE SAND (FILL)
E	-8.1 FT	BLACK PEAT (PT), MEDIUM STIFF, SATURATED
F	-22 FT	DARK GRAY SILTY SAND (SM), LOOSE, SATURATED
G	-28 FT	GRAY POORLY-GRADED SAND (SP-SM) WITH SILT, MEDIUM DENSE, SATURATED
H	-33 FT	GRAY SILT (ML), STIFF, SATURATED
I	-35.5 FT	GRAY SILTY SAND (SM), MEDIUM DENSE, SATURATED
J	-40 FT	GRAY SILTY SAND (SM), DENSE TO VERY DENSE, MOIST
K	-65.5 FT	GRAY FAT CLAY (CH), VERY STIFF, DRY TO MOIST, OCCASIONAL ORGANICS
L	-70 FT	GRAY-BROWN POORLY-GRADED SAND (SP), VERY DENSE, SATURATED, FINE GRAINED
M	-83.5 FT	LIGHT BROWN FAT CLAY (CH), STIFF TO VERY STIFF, SATURATED, OCCASIONAL SAND, OCCASOPNAL BROWN ORGANICS
N	-90.3 FT	GRAY POORLY-GRADED SAND (SP), DENSE, SATURATED, FINE GRAINED (BECOMES DARK GRAY AT -94 FT)
O	-96.7 FT	DARK GRAY SANDY LEAN CLAY (CL), VERY STIFF, SATURATED

PRELIMINARY

TWO GATE FISH PROTECTION PLAN

SEDIMENT PROFILE

OLD RIVER – B22

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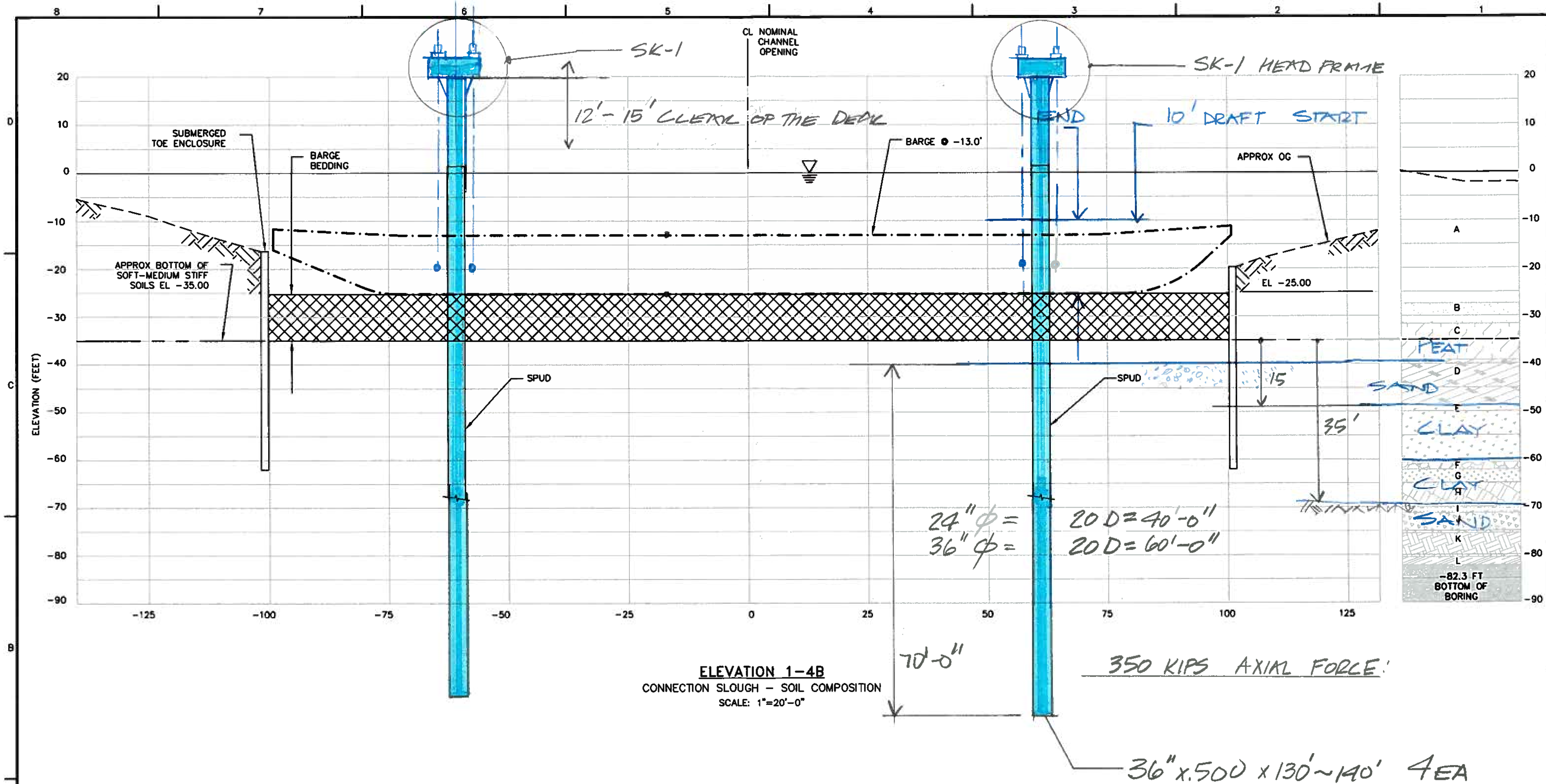

ELEVATION 1-4B

CONNECTION SLOUGH - SOIL COMPOSITION

SCALE: 1"=20'-0"

KEY

TOP OF LAYER

LETTER	ELEVATION	SOIL DESCRIPTION
A	N/A	N/A
B	-27.4 FT	MUDLINE
C	-33 FT	DARK GRAY PEAT (PT), SOFT, SATURATED
D	-39.2 FT	GRAY SILTY SAND (SM), MEDIUM DENSE, SATURATED
E	-48 FT	BLUE-GRAY LEAN CLAY (CL), VERY STIFF, SATURATED
F	-60.5 FT	GRAY-BLUE SILTY SAND (SM), MEDIUM DENSE TO DENSE, SATURATED
G	-61 FT	BLUE-GRAY FAT CLAY (CH), STIFF, SATURATED, WITH REDDISH MOTTLING
H	-65 FT	LIGHT BROWN CLAY, VERY STIFF, WITH BLACK SPECS OF ORGANIC MOTTLING
I	-69.3 FT	RED-BROWN SANDY SILT (ML), VERY STIFF, SATURATED
J	-72.4 FT	BLUE-GRAY WELL-GRADED SAND (SW) WITH SILT, DENSE, SATURATED
K	-75.8 FT	BLUE-GRAY SANDY SILT (ML), VERY STIFF SATURATED
L	-80.8 FT	GRAY-BLUE POORL-GRADED SAND WITH SILT(SP-SM), MEDIUM DENSE, SATURATED

PRELIMINARY

TWO GATE FISH PROTECTION PLAN
SEDIMENT PROFILE
CONNECTION SLOUGH - B7

THE GLOSTEN ASSOCIATES
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Scale AS NOTED | Drawing Number 09041-SKETCH | Sheet 1 of 2 | Revision

PND
811 First Avenue, Suite 570
Seattle, Washington 98104
phone 206.624.1387
fax 206.624.1388

Project: 094065
Sheet Number:
Of:
Calculated by: MNH
Date: 9/15/09
Checked by:
Date:

BILL OF MATERIAL

ASSEMBLY: JACK SYSTEM
(ALL LOCATIONS) AT CONNECTION SLOUGH
AT OLD RIVER

PC	QTY	DESCRIPTION	WT	MAT'L	
SK-1	4	JACKING HEAD	2400 lbs	SEE SKETCH	
b	4	1 3/4" ϕ 150 KSI WILLIAMS RODS		A 788	
c	4	36" x .500 x 140'	52K EA 210K TOTAL	A252 42 KSI	
d	4	RENTAL JACKING SYSTEM	TBD (AT SK-1 FRAME)		

P | N | D

811 First Avenue, Suite 570
Seattle, Washington 98104
phone 206.624.1387
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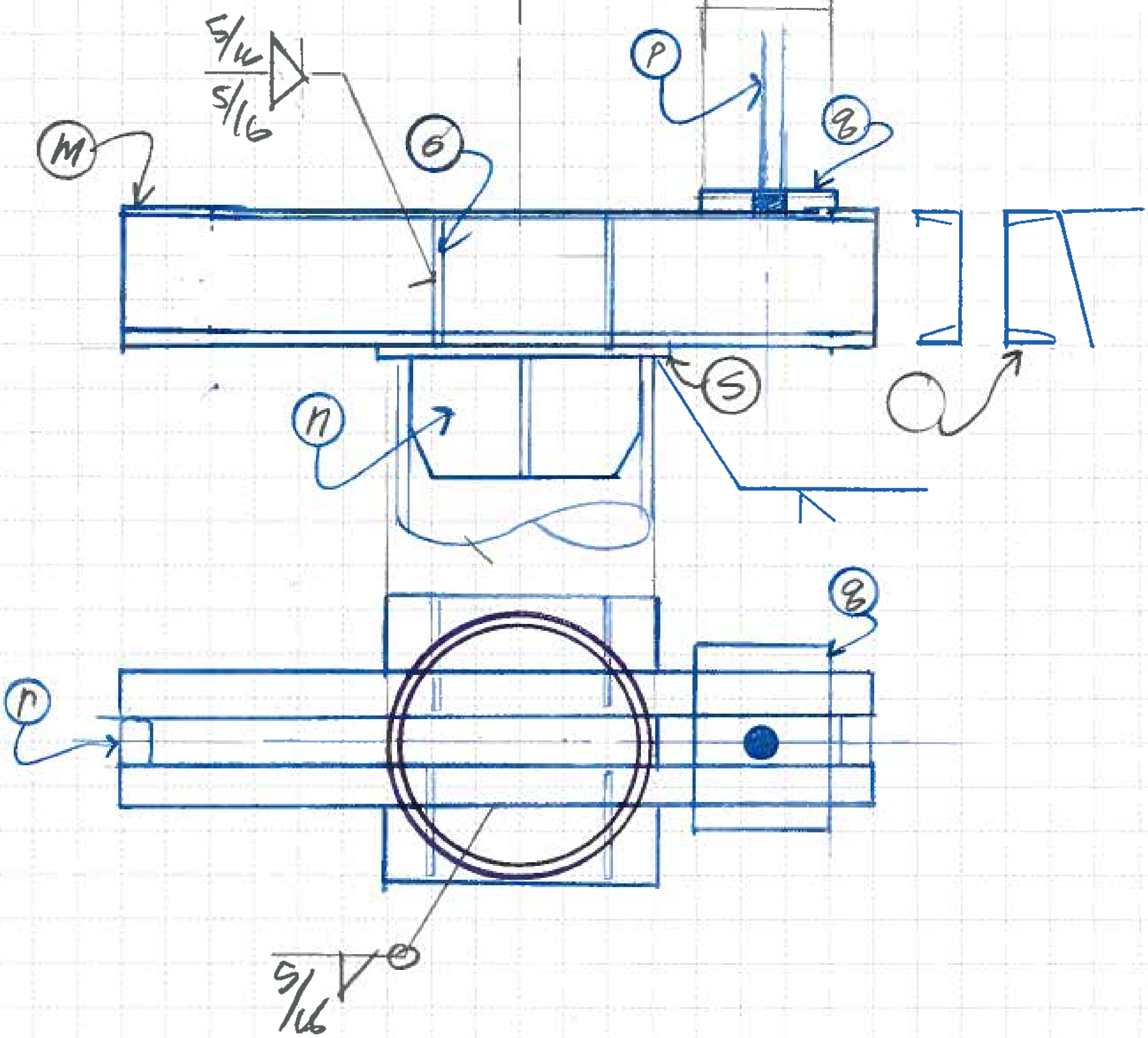

JACKING FRAME SK-1

1/2" = 1'-0"

MN HUGGINS

P N D
811 First Avenue, Suite 570
Seattle, Washington 98104
phone 206.624.1387
fax 206.624.1388

Project:
Sheet Number: Of:
Calculated by: MNH Date:
Checked by: Date:

BILL OF MATERIAL

ASSEMBLY: PER SK-1 HEAD FRAME
(2400 lbs EACH

PC	QTY	DESCRIPTION	WT	MAT'L	
[illegible]	2	PL 1"x34"x18"	340		
m	2	MC 18x58 x 8'-0"	1000	A36	
o	4	PL 1"x18" x6"	120		
p	2	WILLIAMS 150 ksi ROD 1 3/4" φ x 60'	—		
q	2	PL 2" x 18x18 PEDESTAL	360		
n	4	HSS 2x 3x 1/4"	~60		
S	1	PL 1 1/4x 38x38"	501		
		— lbs	2380		

REFFERENCE 2. Barge Survey and Suitability Report

2 GATE FISH PROTECTION

Barge Survey and Suitability Report

PREPARED FOR: Moffatt & Nichol, Inc Walnut Creek, CA			BY: Robert T. Madsen PROJECT ENGINEER	SIGNED COPY ON FILE
			CHECKED: Jon K. Markestad, PE PROJECT ENGINEER	
THE GLOSTEN ASSOCIATES 1201 Western Avenue, Suite 200, Seattle, Washington 98101-2921 TEL 206.624.7850 FAX 206.682.9117 www.glosten.com			APPROVED: William L. Hurley, PE PRINCIPAL-IN-CHARGE	
DOC:	REV: —	FILE: 09041.01	DATE: 8 June 2009	

Summary

On the 13th and 14th of May 2009, six candidate barges were surveyed at The Dutra Group's facility in Rio Vista, CA to determine their condition and suitability for the 2 Gate Fish Protection project. The barges surveyed were the *Ignacio, Denise, 202, RE Staite, Aimi,* and *Nash Bridges*.

Following the survey, the data gathered on the barges were used to rank them in order of their suitability for application at both the Old River and the Connection Slough sites using an Analytical Hierarchy Process (AHP). Principal factors of consideration in the ranking were:

- Overall structural condition, including corrosion and damage.
- Longitudinal strength.
- Deck strength.
- Ease of conversion.
- Transverse stability.

There are too many unknowns for explicit costing to be considered as a factor in this study, however the resulting technical rankings can be used with cost and schedule considerations when the barges are selected for actual purchase. Three of the five technical factors have an indirect impact on cost; good Overall Structural Condition implies fewer repairs are needed, Deck Strength implies smaller wing walls can be used, and Ease of Conversion implies lower overall fabrication costs. A thorough cost analysis would need to apply the barge procurement costs and consider the cost impacts due to schedule differences, both procurement and conversion, associated with the different barges. We would assume that a higher procurement cost for a more capable barge in better condition will result in an overall lower total cost due to lower conversion and fabrication time and effort. However, this assumption depends on the relative levels of the actual barge procurement costs.

After consideration of all the barges, the results of the AHP are consistent with our engineering judgment. It is our recommendation to use the *Ignacio* for the Old River site, and the *Denise* for the Connection Slough site.

Overview

The 2 Gate Fish Protection project will utilize existing barges as gate foundations in order to provide a removable platform. The barges will be modified to contain foundations for the gates, as well as ballast facilities for sinking and raising the gates. The ballast facilities will be created by removing the ends of the barges and replacing them with wing walls. The wing walls will be flooded with ballast to sink the barge in a controlled manner and emptied to refloat the barge. During sinking, first the barge hull will be flooded causing it to sink to a predetermined depth below the surface. Next, the wing walls will be flooded to lower the barge onto the riverbed. Figure 1 depicts the modified barge and gate concept.

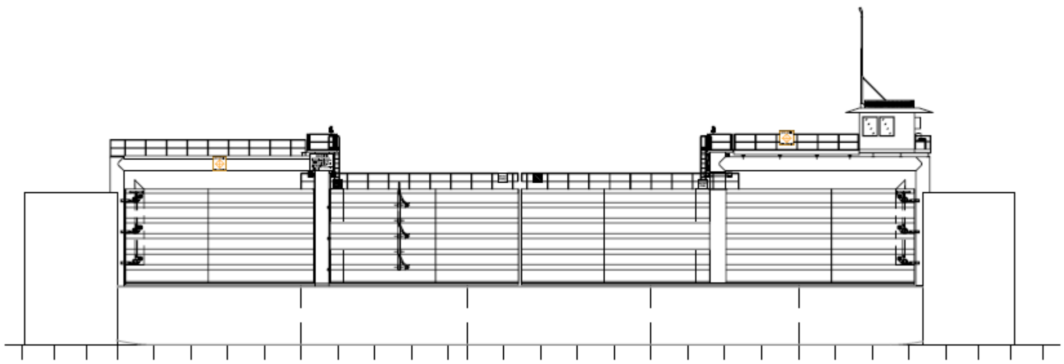

Figure 1. Barge and Gate Concept

Barge Survey

On the 13th of May 2009, the *Ignacio*, *Denise*, and *202* were surveyed while moored in the Sacramento River. On the 14th of May 2009, the *Aimi*, *RE Staite*, and *Nash Bridges* were surveyed while moored in the False River. A summary of the barges and their principal characteristics is shown in Table 1.

Table 1. Barge Principal Characteristics

	Length	Beam	Depth
202	200'	54'-0"	13'-0"
Aimi	200'	44'-9"	12'-3"
Denise	200'	44'-9"	12'-3"
Ignacio	249'	48'-0"	12'-9"
Nash Bridges	178'	50'-0"	12'-0"
RE Staite	178'	50'-0"	12'-0"

Ignacio—Survey

The *Ignacio* had been surveyed previously, and was considered a strong candidate for use. As such, a second survey was conducted that included a determination of the principal characteristics, a detailed determination of the scantlings, a survey of the condition in each tank, a deadweight survey, and the measurement of freeboards.

Principal Characteristics

Length .... 249'-0"

Beam .... 48'-0"

Depth...................... 12'-9"

The deck has sheer at both ends and has camber over the entire length.

Condition

Overall, the *Ignacio* is in fairly good condition. Most of the steel has only mild to moderate corrosion, and most structure appears to be effective. In the #3 starboard tank, there is one frame that is substantially wasted near the turn of the bilge. The deck stiffeners and deck frames have moderate sagging. One frame in #2 Starboard tank is tripped. Some bulkhead and side shell stiffeners have mild distortions. Overall, the barge appears to be sound and serviceable.

Removals

There are several items that need to be removed for conversion. There is a concrete wear deck over most of the barge. There is a retaining wall of Jersey Barriers on the starboard edge of the wear deck. There is 11" piping throughout the barge that will likely need to be removed in way of the gate pivots and associated structure.

Several of the tanks had a tar like residue assumed to be from products that had previously been carried. It is assumed that this residue will be removed prior to purchase of the barge and it is therefore not considered in the condition of the barge.

Required Repairs

Some repairs will need to be completed to make the barge serviceable. All access hatch covers will need to be replaced with effective watertight covers. All ineffective frames, stanchions, and diagonals will need to be replaced (complete list TBD).

Figure 2. Deck

Figure 3. Typical Deck Frames & Stiffeners

Denise—Survey

The survey of the *Denise* included a determination of the principal characteristics, a determination of the scantlings, a survey of the condition in each tank, a deadweight survey, and the measurement of freeboards. The *Denise* is a sister ship to the *Aimi*.

Principal Characteristics

Length ....200'-0"

Beam ....44'-9"

Depth......................12'-3"

There is sheer in the deck at both ends of the barge.

Condition

The *Denise* is in very good condition, and in the best condition of all the barges surveyed. The majority of the steel still has coatings on it, and corrosion was light. There was moderate corrosion in the aft end of the forward rake, the forward end of the aft rake, and near several of the hatches. The structure is in good condition and appears to be effective. There is mild sagging of the deck stiffeners and beams. Overall, the barge appears to be quite sound and serviceable.

Removals

There are a couple items that will need to be removed for conversion. There is a concrete wear deck that covers most of the deck. There is a steel retaining wall at the starboard edge of the wear deck.

Required Repairs

Some repairs will need to be completed to make the barge serviceable. All access hatch covers will need to be replaced with effective watertight covers. All ineffective frames, stanchions, and diagonals will need to be replaced (complete list TBD). The puncture in the deck plate at the side and the hole cut in the forward watertight bulkhead will require patching.

Figure 4. Deck

Figure 5. Typical Structure

202—Survey

The survey of the *202* included a determination of the principal characteristics, a determination of the scantlings, and a survey of the conditions in most tanks. The bow compartment was not surveyed due to a damaged ladder. The freeboards could not be measured due to high winds and rough water.

Principal Characteristics

Length ....200'-0"

Beam ....54'-0"

Depth......................13'-0"

The deck on the *202* is flat. There is a small breakwater at the forward end of the deck.

Condition

The *202* is in fairly good condition. Most of the steel has mild to moderate corrosion. Most of the structure appears to be effective. There are a few bowed stanchions and diagonals, and a few distorted deck, bulkhead, and side stiffeners. The wear deck is approximately half gone, there is substantial distortion and dishing of the deck, and there is sagging of deck stiffeners and frames. Overall, the barge appeared to be sound and serviceable.

Removals

There are a few items that will need to be removed for conversion. There are remnants of a concrete wear deck on portions of the deck. There is a steel retaining wall at the starboard edge of the wear deck, and a steel breakwater at the bow.

Required Repairs

Some repairs will need to be completed to make the barge serviceable. All access hatch covers will need to be replaced with effective watertight covers. All ineffective frames, stanchions, and diagonals will need to be replaced (complete list TBD).

Figure 6. Deck

Figure 7. Typical Structure

RE Staite—Survey

The survey of the *RE Staite* included a determination of the principal characteristics, a determination of the scantlings, a survey of the condition in the port tanks, a deadweight survey, and the measurement of freeboards. The *RE State* is a sister ship to the *Nash Bridges*.

Principal Characteristics

Length..................178'-0"

Beam......................50'-0"

Depth......................12'-0"

The barge deck has sheer in the bow.

Condition

The *RE Staite* is in poor condition. Most of the steel has moderate corrosion with some area of heavy corrosion. There is substantial structural damage to the barge. Many of the stanchions and diagonals are buckled, broken, or missing. Many of the deck frames have substantial deformation, and several are cracked or broken. Several bottom frames are cracked. The centerline bulkhead is badly buckled at about 3 feet above the bottom, over a length spanning several tanks. The bottom of the bulkhead is patched with plate, but substantial damaged portions are remaining. The deck is badly damaged, with many holes and tears. The deck stiffeners are badly dished or distorted in many places, and the deck frames are sagging. Overall the *RE Staite* is in poor condition, and would require substantial repair to be made serviceable.

Figure 8. Buckled Stanchions

Figure 9. Buckled Bulkhead

Figure 10. Deck Damage

Removals

There is a steel retaining wall at the starboard side of the barge that will require removal for conversion.

Required Repairs

Major repairs will need to be completed to make the barge serviceable. All access hatch covers will need to be replaced with effective watertight covers. All ineffective stiffeners, frames, stanchions, and diagonals will need to be replaced (complete list TBD would be extensive). Deck plate would require substantial repair. Centerline bulkhead would require major repair.

Aimi—Survey

The survey of the *Aimi* included a determination of the principal characteristics, a determination of the scantlings, a survey of the condition in each tank, a deadweight survey, and the measurement of freeboards. The *Aimi* is a sister ship to the *Denise*.

Principal Characteristics

Length .... 200'-0"

Beam .... 44'-9"

Depth...................... 12'-3"

There is sheer in the deck at both ends of the barge.

Condition

The *Aimi* is in good condition. Much of the steel still has coatings on it, and most of the corrosion was light to moderate. The corrosion on the bottom stiffeners and frames was moderate to heavy in some places. There was some severe corrosion in the immediate vicinity of several of the hatches. There was limited structural damage, including a couple of deck frames with moderate deformation, and a few cracked bottom frames. Several transverse bulkheads had small holes near the hatches, and the transverse bulkheads in the forward and aft rakes had 15" holes cut in them in the upper port corner. Overall, the *Aimi* was in good condition and may require limited repairs to be made serviceable.

Removals

There are a couple items that will need to be removed for conversion. There is a concrete wear deck that covers most of the deck. There is a steel retaining wall at the starboard edge of the wear deck.

Figure 11. Deck

Figure 12. Severe Corrosion near Hatches

Required Repairs

Some repairs will need to be completed to make the barge serviceable. All access hatch covers will need to be replaced with effective watertight covers. All ineffective frames, stanchions, and diagonals will need to be replaced (complete list TBD).

Nash Bridges—Survey

The survey of the *Nash Bridges* included a determination of the principal characteristics, a determination of the scantlings, and a survey of the condition in the port tanks. The barge was heavily loaded with rock, which made a deadweight survey impractical. The *Nash Bridges* is a sister ship to the *RE State*.

Principal Characteristics

Length .... 178'-0"

Beam .... 50'-0"

Depth...................... 12'-0"

The barge deck has sheer in the bow.

Condition

The *Nash Bridges* is in poor condition. The upper half of the barge has moderate corrosion, but the lower half has severe corrosion. The typical bottom frames and stiffeners, as well as the lower side stiffeners and lower portions of stanchions and vertical bulkhead stiffeners, are reduced to as little as 1/2 to 1/3 of their apparent original thickness. Structural members are corroded through in many places. The bottom plating is also severely corroded, and contains many patched holes. The #3 starboard tank has a patch plate welded to the top of the stiffeners that covers approximately the inboard half of tank. The deck stiffeners and frames have some sagging and distortion. Although there is not substantial structural deformation, the corrosion has rendered much of the structure ineffective. Overall, the *Nash Bridges* is in poor condition and would require substantial repair to be made serviceable.

Figure 13. Severe Corrosion

Figure 14. Bottom Patch Plate

Removals

There is a concrete wear deck covering most of the deck, and a steel retaining wall at the starboard side of the barge.

Required Repairs

Some repairs will need to be completed to make the barge serviceable. All access hatch covers will need to be replaced with effective watertight covers. All ineffective stiffeners, frames, stanchions, and diagonals will need to be replaced (complete list TBD would be extensive). It is likely that bottom and lower side shell plate would need partial replacement.

Suitability for Gate Application

The suitability of each barge for application in both the Old River and the Connection Slough sites was considered. Primary concerns included the structural condition of the barge, the longitudinal strength, the deck strength, the ease of conversion, and the transverse stability.

Condition

The overall structural condition of the barge was evaluated during the surveys. Of primary interest was the effectiveness of the structure, which accounted for both corrosion and physical damage such as tripped, buckled, or cracked structures. The watertight integrity of the compartments was also considered, including holes and tears in bulkheads and decks. Barge condition is a measure of potential structural repairs that would be required.

Table 2. Barge Condition

Barge	Overall Condition
202	Fair to Good
Aimi	Good
Denise	Very Good
Ignacio	Fair to Good
Nash Bridges	Poor
RE Staite	Poor

Longitudinal Strength

The longitudinal strength is important, because the hull girder needs to withstand the bending moment applied to the structure by the wing walls during the sinking and raising of the barge. The longitudinal strength was evaluated by determining the section modulus of each hull when new, based on the scantlings determined during the survey. The section moduli were then adjusted by a corrosion factor to account for weakened structure. The section modulus calculations assume that any ineffective structure has been replaced. A notional bending moment was developed using a preliminary concept of the Old River Gate installed on the modified *Ignacio* barge with 20' x 50' x 32' wing walls at each end. Because the concept for the Old River Gate is longer than the Connection Slough Gate, it represents an upper bound for the expected bending moment that will be experienced during the sinking or raising of the barges. Using the notional bending moment, and a maximum stress of 60% yield stress, the minimum section modulus required is 23.6 $x10^3$ in^3. Table 3 is a summary of the section moduli of the barges. As can be seen in the table, all the barges have satisfactory longitudinal strength; however, a higher section modulus is desirable, because the barge will have greater stiffness.

Table 3. Barge Section Modulus

Barge	SM as New (10^3 in^3)	Corrosion Factor	Adjusted SM (10^3 in^3)
202	70.1	15%	59.6
Aimi	56.7	5%	53.8
Denise	56.7	0%	56.7
Ignacio	41.5	5%	38.7
Nash Bridges	44.4	35%	28.8
RE Staite	44.4	20%	35.5

Deck Strength

The deck strength is important, because the deck is required to support a hydrostatic head during the sinking and raising of the barge. The greater the deck strength, the deeper the hull can be prior to flooding the wing walls. Higher deck strengths allow for a reduction in the size of the wing walls.

The deck strength was evaluated by calculating the maximum uniform hydrostatic head that can be applied to the deck, while limiting the resulting stress to 60% of yield stress. A corrosion factor was used to reduce the strength of the structure. The concept design we are using requires 4' of static head capacity. Additional static head capacity indicates deck strength margin. Table 4 is a summary of the deck strength of the barges.

Table 4. Barge Deck Strength

Barge	Corrosion Factor	Deck Head with Corrosion Factor (ft)
202	15%	8.8
Aimi	5%	8.5
Denise	0%	8.9
Ignacio	5%	5.4
Nash Bridges	35%	4.5
RE Staite	20%	5.5

Transverse Stability

The transverse stability of the barge is important for maintaining stability of the gate during transport and sinking. The transverse stability was evaluated by calculating the unit inertia of the water plane of each barge (ft^4 per foot of length). The unit value was used because the barges would all be cut to the same length for each gate, making the original length of the barge unimportant. The preliminary stability of the modified barge with the Old River Gate was evaluated using the *Ignacio,* and the modified barge with the Connection Slough Gate was evaluated using the *Denise*. Both of these evaluations used a preliminary concept with 20' x 50' x 32' wing walls at each end of the modified barges. From these preliminary evaluations, it appears that all of the barges will have adequate transverse stability for the transport and sinking/raising operations. Additional stability simply adds margin.

Table 5. Barge Transverse Stability

Barge	Unit Inertia of Waterplane (ft^4/ft)
202	13,122
Aimi	7,468
Denise	7,468
Ignacio	9,216
Nash Bridges	10,417
RE Staite	10,417

Ease of Conversion

The ease of conversion was a subjective measure of effort and cost required to convert the barge to a gate. Factors that weighed into this were how well the gate fit on the deck and the required modifications to the ends of the barge, including removal of sheer (sloped rake ends) or replacement of end sections.

202—Conversion

Converting the *202* to the Old River Gate would require removal of roughly half of the forward and aft rakes. A substantial amount of rake would remain that would either need to be closed off or reshaped to mate with the wing walls. Additionally, because of the 54' beam of the *202,* the wing walls would need to have a 56' breadth to account for a 1' fit-up allowance on both sides to aid in construction. This 1' allowance was considered to be an optimal minimum and was applied for all the barges. Because the *202* has a flat deck, no modification to the deck would be necessary.

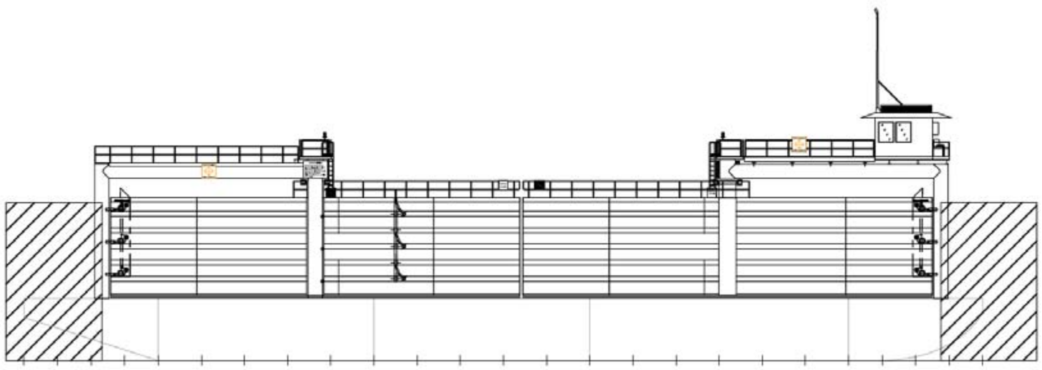

Figure 15. *202* with Old River Gate

Converting the *202* to the Connection Slough Gate would require removal of the stern of the barge just forward of the aft rake bulkhead, and removal of the bow just forward of the forward rake bulkhead. No significant modification to the aft end and a slight modification to the forward end may be required to mate it with the wing wall. Again, because of the 54' beam, a minimum 56' breadth wing wall would be required.

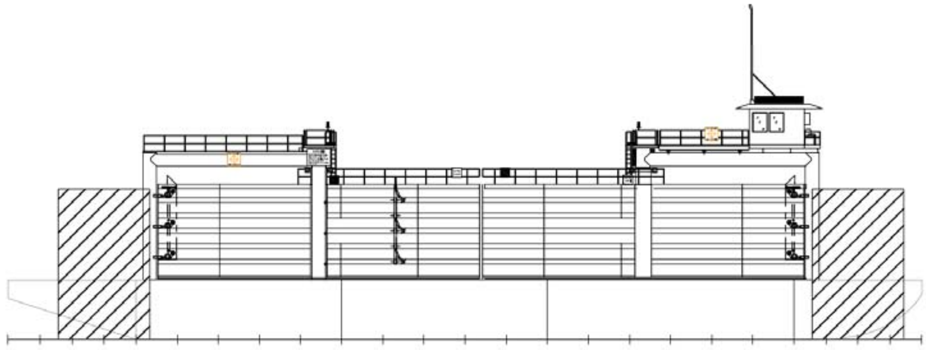

Figure 16. *202* with Connection Slough Gate

Aimi and Denise—Conversion

Converting the *Aimi* or *Denise* to the Old River Gate would require removal of roughly one third of the forward rake and half of the aft rake. A substantial amount of rake would remain that would either need to be closed off or reshaped to mate with the wing walls. To prevent interference with the gates, the deck on both the forward and aft ends would need to be reshaped to remove a moderate amount of deck sheer. Wing walls with a 50' breadth could be used for this conversion.

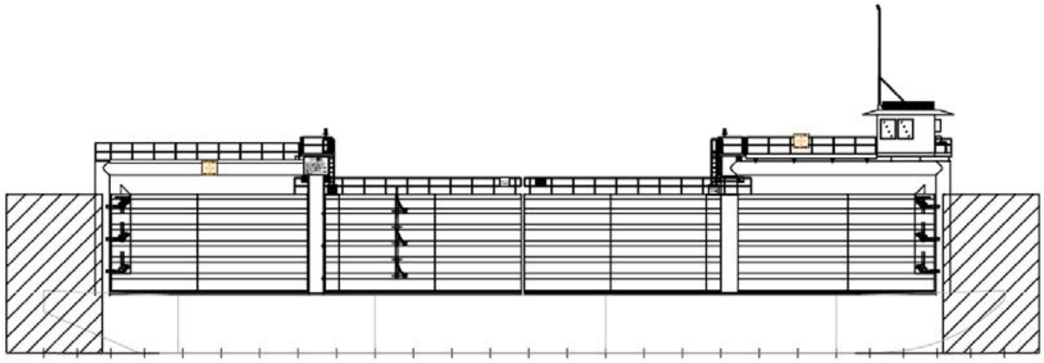

Figure 17. *Aimi* or *Denise* with Old River Gate

Converting the *Aimi* or *Denise* to the Connection Slough Gate would require removal of the stern of the barge just aft of the aft rake bulkhead and removal of the bow just forward of the forward rake bulkhead. To prevent interference with the gates, minimal reshaping of the deck at the forward and aft end would be required to remove remaining deck sheer. Again, wing walls with a 50' breadth could be used for this conversion.

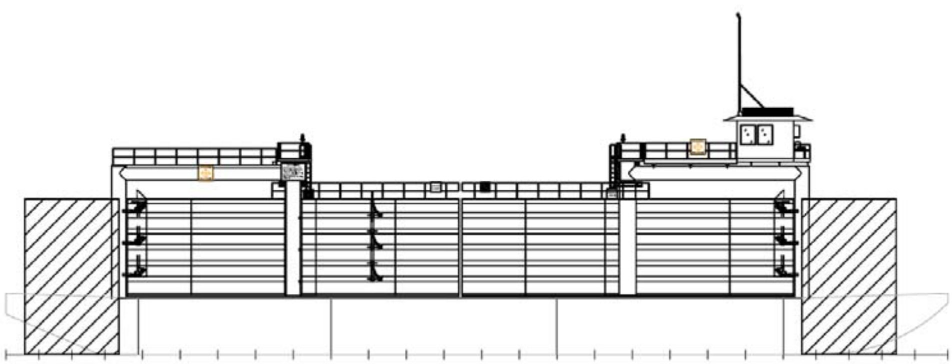

Figure 18. *Aimi* or *Denise* with Connection Slough Gate

Ignacio—Conversion

Converting the *Ignacio* to the Old River Gate would require removal of the bow just aft of the forward most bulkhead and removal of the stern at the aft most bulkhead. A small amount of rake would remain at both ends; however, the remaining rake is small enough that it would not need to be filled or reshaped. No reshaping of the deck at the ends would be required. Wing walls with a 50' breadth could be used for this conversion.

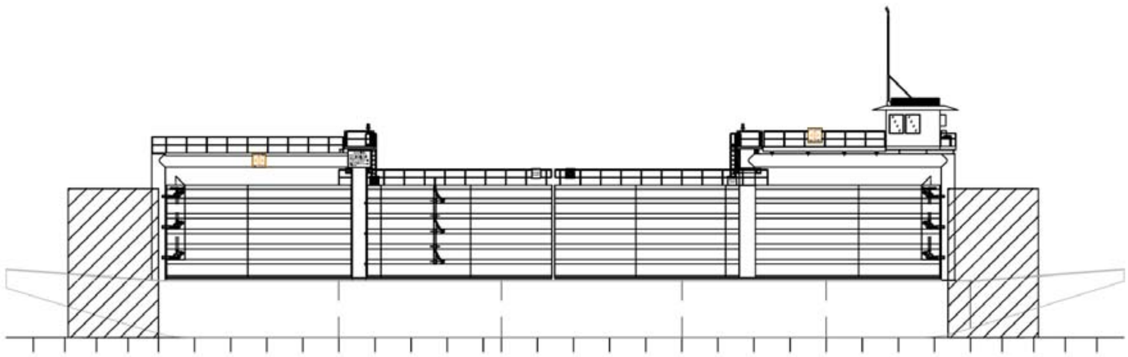

Figure 19. *Ignacio* with Old River Gate

Converting the *Ignacio* to the Connection Slough Gate would require removal of the bow approximately two frames aft of the forward most bulkhead and removal of the stern approximately two frames forward of the aft most bulkhead. No rake would remain, and no reshaping of the deck at the ends would be required. Wing walls with a 50' breadth could be used for this conversion.

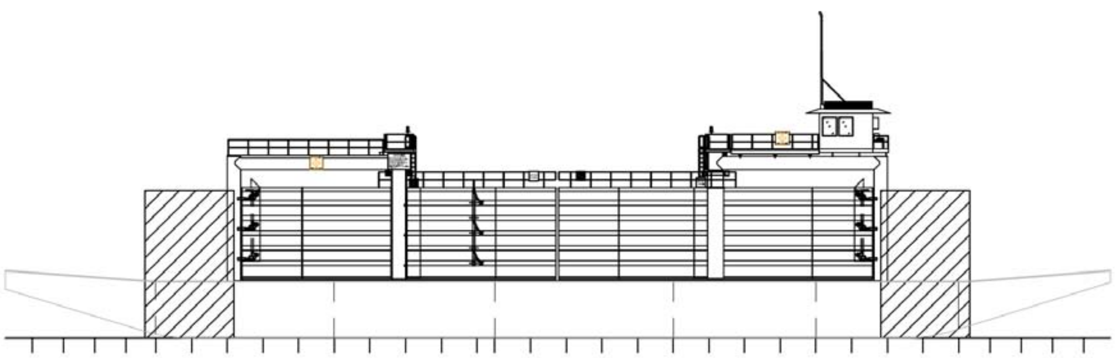

Figure 20. *Ignacio* with Connection Slough Gate

Nash Bridges and RE Staite—Conversion

Converting the *Nash Bridges* or *RE Staite* to the Old River Gate would require removal of the bow and stern sections at the start of their respective rakes. An L-shaped wing wall would need to be built to replace the removed sections. Wing walls with a 50' breadth could be used for this conversion.

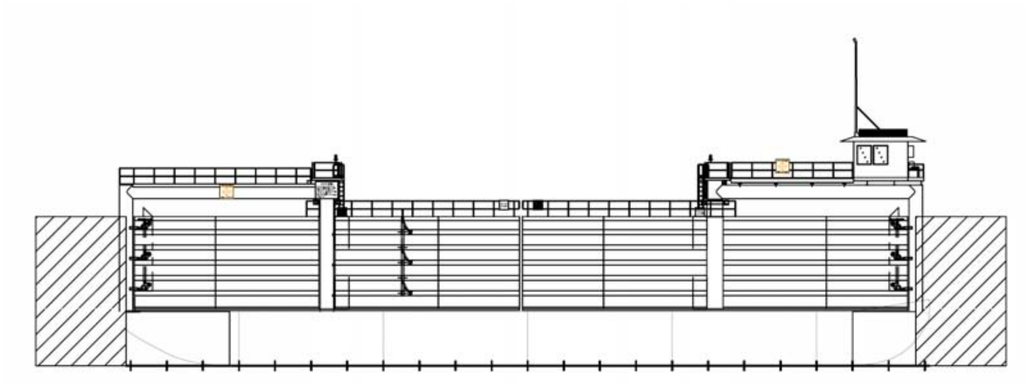

Figure 21. *Nash Bridges* or *RE Staite* with Old River Gate

Converting the *Nash Bridges* or *RE Staite* to the Connection Slough Gate would require removing approximately two thirds of the forward and aft rakes. Only a slight amount of rake would be remaining, and it would not need to be filled. To prevent interference with the gates, minimal reshaping of the deck at the forward and aft end would be required to remove remaining deck sheer. Again, wing walls with a 50' breadth could be used for this conversion.

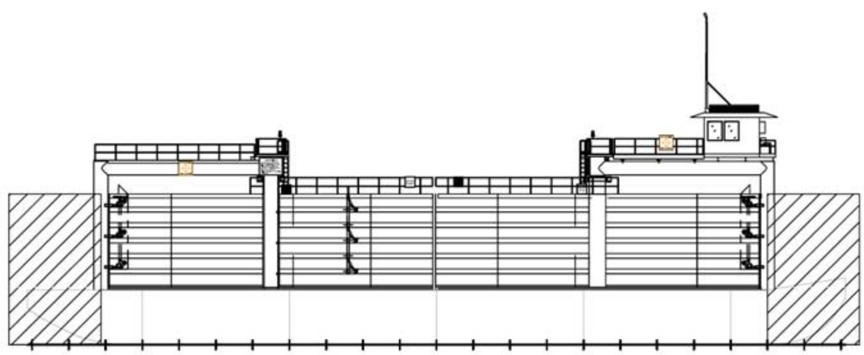

Figure 22. *Nash Bridges* or *RE Staite* with Connection Slough Gate

Selection of Barges

The selection of the barges for recommendation for each of the sites was conducted using the Analytical Hierarchy Process (AHP). This is a process that evaluates the ranking of the barges based on several evaluation criteria through a pair wise comparison of each barge to the other barges. Each evaluation criterion carries an assigned weight that is used to determine the final ranking of the barges. This process was performed using all six barges for both sites.

The criteria that were used for evaluation were the overall condition, longitudinal strength, deck strength, ease of conversion, and transverse stability. The condition criterion was a subjective measure of the overall condition of the barges. The longitudinal strength was an objective measure of the section modulus of the hull. The deck strength was an objective measure of the uniform pressure head that the deck could support. The ease of conversion was a subjective measure of the difficulty of conversion to the gates, including both the expected work content and the steel required. The transverse stability was an objective measure of the unit inertia of the water plane. The importance of these criteria was weighted according to Table 6.

Table 6. AHP Criteria Weights

Condition	25%
Longitudinal Strength	10%
Deck Strength	15%
Ease of Conversion	25%
Transverse Stability	25%

In the AHP, the comparisons are relative between the barges; i.e., how much is the *Ignacio* preferred to the *Denise* for ease of conversion to the Old River Gate? This allows for easy incorporation of both subjective and objective measures into the selection process. For objective measures, a ratio of the measured values is used for the comparison (e.g., section modulus). For subjective measure, the two barges are compared with scale of no preference, weak preference, moderate preference, strong preference, or absolute preference.

The resulting ranking of the barges from the AHP are given in Table 7.

Table 7. Barge Rankings

Barge	Old River	Connection Slough
202	17%	16%
Aimi	17%	20%
Denise	23%	**26%**
Ignacio	**25%**	17%
Nash Bridges	9%	10%
RE Staite	9%	11%

***Bold denotes selected barge**

Conclusion and Recommendation

In the resulting rankings, the *Ignacio* is slightly better than the *Denise* for the Old River Gate, and either would be a suitable choice. However for the Connection Slough Gate, the *Denise* is substantially better than the next best barge, the *Aimi*. It is, therefore, our recommendation to use the *Denise* for the Connection Slough Gate, and the *Ignacio* for the Old River Gate. As an added benefit, the use of the *Ignacio* and the *Denise* would allow for the use of identical wing walls for both applications. This would result in construction cost savings due to the standardization of fabrication.

As the barges were floating at the time of the survey the underwater condition of the hulls were not surveyed. It is recommended that the two selected barges be put into drydock so a below waterline survey can be conducted.

Appendix A Barge Selection using Analytical Hierarchy Process

Old River Gate

Barge Selection using Analytical Hierarchy Process (AHP)

Job #	9041.01
Date	5/26/2009
Created By	RTM

Procedure

1 Choose Selection Criteria Weights

2 Make a pairwise comparison between barges for each cell in each criteria matrix
The barge in grey is the one compared to the barge in blue
If there is a numerical value associated with the criterion (i.e. Section modulus), use it to calculated comparison
If the comparrison is subjective, use the following ranking

Comparison	Value
No Preference between A and B	1
A is weakly Prefered over B	3
A is moderately Prefered over B	5
A is strongly Prefered over B	7
A is absolutely prefered over B	9

i.e. In the 3rd row, 1st colum of the Condition criteria matrix, Denise is Moderately Prefered over 202

3 Caclulate the Priority Vectors. This is the normalized eigen vector associated with the largest eigen value for each critieria matrix

4 Calculate Normalized Selection Vector
This is done by caclulating the weighted sum of the criteria of each barge to make the selection vector and then normalizing it

5 The normalized selection vector is the overall preference for each barge.

Selection Criteria	**Weight**
Condition	0.25
Long. Strength	0.1
Deck Strength	0.15
Ease of Conversion	0.25
Stability	0.25

Condition

	202	***Aimi***	***Denise***	***Ignacio***	***Nash Bridges***	***RE State***	*Eigen Vector*	***Priority Vector***
202	1	1/3	1/5	1	7	7	0.23	**0.13**
Aimi	3	1	1/3	3	7	7	0.43	**0.24**
Denise	5	3	1	5	9	9	0.83	**0.46**
Ignacio	1	1/3	1/5	1	7	7	0.23	**0.13**
Nash Bridges	1/7	1/7	1/9	1/7	1	1	0.05	**0.03**
RE State	1/7	1/7	1/9	1/7	1	1	0.05	**0.03**

Longitudinal Strength

Barge	SM
202	59.6
Aimi	53.8
Denise	56.7
Ignacio	38.7
Nash Bridges	28.86
RE State	35.52

	202	***Aimi***	***Denise***	***Ignacio***	***Nash Bridges***	***RE State***	*Eigen Vector*	***Priority Vector***
202	1.00	1.11	1.05	1.54	2.07	1.68	0.52	**0.22**
Aimi	0.90	1.00	0.95	1.39	1.86	1.51	0.47	**0.20**
Denise	0.95	1.05	1.00	1.47	1.96	1.60	0.49	**0.21**
Ignacio	0.65	0.72	0.68	1.00	1.34	1.09	0.34	**0.14**
Nash Bridges	0.48	0.54	0.51	0.75	1.00	0.81	0.25	**0.11**
RE State	0.60	0.66	0.63	0.92	1.23	1.00	0.31	**0.13**

Deck Strength

Barge	Head
202	8.8
Aimi	8.5
Denise	8.9
Ignacio	5.4
Nash Bridges	4.5
RE State	5.5

	202	***Aimi***	***Denise***	***Ignacio***	***Nash Bridges***	***RE State***	*Eigen Vector*	***Priority Vector***
202	1.00	1.04	0.99	1.63	1.96	1.60	0.5	**0.21**
Aimi	0.97	1.00	0.96	1.57	1.89	1.55	0.48	**0.21**
Denise	1.01	1.05	1.00	1.65	1.98	1.62	0.5	**0.21**
Ignacio	0.61	0.64	0.61	1.00	1.20	0.98	0.3	**0.13**
Nash Bridges	0.51	0.53	0.51	0.83	1.00	0.82	0.25	**0.11**
RE State	0.63	0.65	0.62	1.02	1.22	1.00	0.31	**0.13**

Ease of Conversion

	202	*Aimi*	*Denise*	*Ignacio*	*Nash Bridges*	*RE State*	*Eigen Vector*	*Priority Vector*
202	1	1	1	1/7	5	5	0.19	**0.12**
Aimi	1	1	1	1/7	5	5	0.19	**0.12**
Denise	1	1	1	1/7	5	5	0.19	**0.12**
Ignacio	7	7	7	1	9	9	0.94	**0.58**
Nash Bridges	1/5	1/5	1/5	1/9	1	1	0.05	**0.03**
RE State	1/5	1/5	1/5	1/9	1	1	0.05	**0.03**

Barge	Unit Waterplane Inertia
202	13122
Aimi	7468
Denise	7468
Ignacio	9216
Nash Bridges	10417
RE State	10417

Transverse Stability

	202	*Aimi*	*Denise*	*Ignacio*	*Nash Bridges*	*RE State*	*Eigen Vector*	*Priority Vector*
202	1.00	1.76	1.76	1.42	1.26	1.26	0.54	**0.23**
Aimi	0.57	1.00	1.00	0.81	0.72	0.72	0.31	**0.13**
Denise	0.57	1.00	1.00	0.81	0.72	0.72	0.31	**0.13**
Ignacio	0.70	1.23	1.23	1.00	0.88	0.88	0.38	**0.16**
Nash Bridges	0.79	1.39	1.39	1.13	1.00	1.00	0.43	**0.18**
RE State	0.79	1.39	1.39	1.13	1.00	1.00	0.43	**0.18**

Caclulation of Results

	Cond.	**Long.**	**Deck**	**Conv.**	**Stability**	Selection Vector	Normalized Selection Vector
202	0.13	0.22	0.21	0.12	0.23	0.17	17%
Aimi	0.24	0.20	0.21	0.12	0.13	0.17	17%
Denise	0.46	0.21	0.21	0.12	0.13	0.23	23%
Ignacio	0.13	0.14	0.13	0.58	0.16	0.25	25%
Nash Bridges	0.03	0.11	0.11	0.03	0.18	0.09	9%
RE State	0.03	0.13	0.13	0.03	0.18	0.09	9%
						1.00	

Barge Ranking	
202	17%
Aimi	17%
Denise	23%
Ignacio	**25%**
Nash Bridges	9%
RE State	9%

Connection Slough Gate

Barge Selection using Analytical Hierarchy Process (AHP)

Job # 9041.01
Date 5/26/2009
Created By RTM

Procedure

1 Choose Selection Criteria Weights

2 Make a pairwise comparison between barges for each cell in each criteria matrix
The barge in grey is the one compared to the barge in blue
If there is a numerical value associated with the criterion (i.e. Section modulus), use it to calculated comparison
If the comparrison is subjective, use the following ranking

Comparison	Value
No Preference between A and B	1
A is weakly Prefered over B	3
A is moderately Prefered over B	5
A is strongly Prefered over B	7
A is absolutely prefered over B	9

i.e. In the 3rd row, 1st colum of the Condition criteria matrix, Denise is Moderately Prefered over 202

3 Caclulate the Priority Vectors. This is the normalized eigen vector associated with the largest eigen value for each critieria matrix

4 Calculate Normalized Selection Vector
This is done by caclulating the weighted sum of the criteria of each barge to make the selection vector and then normalizing it

5 The normalized selection vector is the overall preference for each barge.

Selection Criteria	Weight
Condition	0.25
Long. Strength	0.1
Deck Strength	0.15
Ease of Conversion	0.25
Stability	0.25

Condition

	202	*Aimi*	*Denise*	*Ignacio*	*Nash Bridges*	*RE State*	*Weights*	*Priority Vector*
202	1	1/3	1/5	1	7	7	**0.23**	**0.13**
Aimi	3	1	1/3	3	7	7	**0.43**	**0.24**
Denise	5	3	1	5	9	9	**0.83**	**0.46**
Ignacio	1	1/3	1/5	1	7	7	**0.23**	**0.13**
Nash Bridges	1/7	1/7	1/9	1/7	1	1	**0.05**	**0.03**
RE State	1/7	1/7	1/9	1/7	1	1	**0.05**	**0.03**

Longitudinal Strength

Barge	SM
202	59.6
Aimi	53.8
Denise	56.7
Ignacio	38.7
Nash Bridges	28.86
RE State	35.52

	202	*Aimi*	*Denise*	*Ignacio*	*Nash Bridges*	*RE State*	*Weights*	*Priority Vector*
202	1.00	1.11	1.05	1.54	2.07	1.68	**0.52**	**0.22**
Aimi	0.90	1.00	0.95	1.39	1.86	1.51	**0.47**	**0.20**
Denise	0.95	1.05	1.00	1.47	1.96	1.60	**0.49**	**0.21**
Ignacio	0.65	0.72	0.68	1.00	1.34	1.09	**0.34**	**0.14**
Nash Bridges	0.48	0.54	0.51	0.75	1.00	0.81	**0.25**	**0.11**
RE State	0.60	0.66	0.63	0.92	1.23	1.00	**0.31**	**0.13**

Deck Strength

Barge	Head
202	8.8
Aimi	8.5
Denise	8.9
Ignacio	5.4
Nash Bridges	4.5
RE State	5.5

	202	*Aimi*	*Denise*	*Ignacio*	*Nash Bridges*	*RE State*	*Weights*	*Priority Vector*
202	1.00	1.04	0.99	1.63	1.96	1.60	**0.5**	**0.21**
Aimi	0.97	1.00	0.96	1.57	1.89	1.55	**0.48**	**0.21**
Denise	1.01	1.05	1.00	1.65	1.98	1.62	**0.5**	**0.21**
Ignacio	0.61	0.64	0.61	1.00	1.20	0.98	**0.3**	**0.13**
Nash Bridges	0.51	0.53	0.51	0.83	1.00	0.82	**0.25**	**0.11**
RE State	0.63	0.65	0.62	1.02	1.22	1.00	**0.31**	**0.13**

Ease of Conversion

	202	***Aimi***	***Denise***	***Ignacio***	***Nash Bridges***	***RE State***	***Weights***	***Priority Vector***
202	1	1/3	1/3	1/3	1	1	**0.18**	**0.08**
Aimi	3	1	1	1	3	3	**0.55**	**0.25**
Denise	3	1	1	1	3	3	**0.55**	**0.25**
Ignacio	3	1	1	1	3	3	**0.55**	**0.25**
Nash Bridges	1	1/3	1/3	1/3	1	1	**0.18**	**0.08**
RE State	1	1/3	1/3	1/3	1	1	**0.18**	**0.08**

Barge	Unit Waterplane Inertia
202	13122
Aimi	7468
Denise	7468
Ignacio	9216
Nash Bridges	10417
RE State	10417

Tramsverse Stability

	202	***Aimi***	***Denise***	***Ignacio***	***Nash Bridges***	***RE State***	*Eigen Vector*	***Priority Vector***
202	1.00	1.76	1.76	1.42	1.26	1.26	0.54	**0.23**
Aimi	0.57	1.00	1.00	0.81	0.72	0.72	0.31	**0.13**
Denise	0.57	1.00	1.00	0.81	0.72	0.72	0.31	**0.13**
Ignacio	0.70	1.23	1.23	1.00	0.88	0.88	0.38	**0.16**
Nash Bridges	0.79	1.39	1.39	1.13	1.00	1.00	0.43	**0.18**
RE State	0.79	1.39	1.39	1.13	1.00	1.00	0.43	**0.18**

Caclulation of Results

	Cond.	**Long.**	**Deck**	**Conv.**		Selection Vector	Normalized Selection Vector
202	0.13	0.22	0.21	0.08	0.23	0.16	16%
Aimi	0.24	0.20	0.21	0.25	0.13	0.20	20%
Denise	0.46	0.21	0.21	0.25	0.13	0.26	26%
Ignacio	0.13	0.14	0.13	0.25	0.16	0.17	17%
Nash Bridges	0.03	0.11	0.11	0.08	0.18	0.10	10%
RE State	0.03	0.13	0.13	0.08	0.18	0.11	11%
					Vector Sun	1.00	

Barge Ranking	
202	16%
Aimi	20%
Denise	**26%**
Ignacio	17%
Nash Bridges	10%
RE State	11%