# Technical Memo

WEST Consultants, Inc.
2601 25th St. SE
Suite 450
Salem, OR  97302-1286
(503) 485 5490
(503) 485-5491 Fax
www.westconsultants.com

REGISTERED PROFESSIONAL ENGINEER
77018PE
OREGON
JANUARY 9, 2007
HANS RAYMOND HADLEY
EXPIRES: 6/30/17

**To:** Denise Kai
Assistant Parks and Recreation Director

**Company:** City of Oregon City

**Date:** May 5, 2016

**Cc:** Jeff Smith, P.E., Oregon State Marine Board
Raymond Lanham, P.E., Oregon State Marine Board
Curt Vanderzanden, P.E., KPFF

**From:** Hans R. Hadley, P.E., CFM
Senior Hydraulic Engineer

**Subject:** Clackamette Park Replacement Boat Ramp - Hydraulic Design and Impact Assessment

---

## Introduction

This memo is intended to document the hydraulic design for the replacement of the Clackamette Park boat ramp. For additional background information, please review the technical memo for the repair of the existing ramp provided on December 18, 2015 and the concept level replacement ramp alternatives evaluation memo provided on December 3, 2015. Additional background information regarding the preferred location of the replacement ramp is also available in the memo provided on February 24, 2016, (also provided in **Appendix B**). Preliminary (30% level) design drawings for the project are shown in **Appendix C**.

## 1-Dimensional Hydraulic Modeling

The purpose of the hydraulic modeling is to understand the potential impacts to the base flood and floodway elevations as a result of the proposed replacement ramp. The proposed replacement ramp will be located downstream of the most downstream FEMA cross section (cross section A). The hydraulic modeling extends from the Clackamas River confluence with the Willamette to FEMA cross section B. A map showing the FEMA flood hazard zones and cross section locations is provided in **Figure 1** (all figures are provided in **Appendix A**).

HEC-RAS version 4.1 software (USACE, 2010) was used to develop an existing conditions steady state hydraulic model for the Clackamas River in the vicinity of the project site. The upstream boundary of the model is located approximately 2,800 feet upstream of the confluence with the Willamette River. The downstream boundary of the model is located approximately 560 feet upstream of the confluence with the Willamette River. As seen in **Figure 2**, a total of 23 cross sections were used in HEC-RAS to represent the geometry of the channel and floodplain. The downstream boundary condition was set to a normal depth slope of 0.000535. The selected normal depth slope results in a water surface elevation of 44.5 feet at FEMA cross section A, which is the same as the published "without floodway" base flood elevation for this cross section.

**No-Rise Hydraulic Analysis**

A proposed conditions model was developed to evaluate the hydraulic conditions for the project reach as a result of the proposed project and for comparison with the existing conditions model. Cross section geometry in the existing conditions model was updated to reflect the 30-percent level grading plan provided by KPFF. As seen in **Table 1**, the proposed project will not result in an increase in the floodway elevations for the Clackamas River. Although the proposed ramp causes a slight increase in the water surface elevation for the without floodway condition, the regulatory base flood elevation is not affected by the proposed ramp. This is because the regulatory base flood elevation for this portion of the Clackamas River is based on the backwater conditions from the Willamette River which has an elevation of 47.8 ft. HEC-RAS hydraulic model results are presented in **Appendix D**. A comparison of cross section geometry for the existing and proposed conditions is provided in **Appendix E**. It should be noted that the available effective FEMA hydraulic model for the Clackamas River did not extend downstream of Section A. Also, the effective model obtained from FEMA included only the output information and no input geometry. Therefore, a duplicate effective model could not be developed.

**Table 1. Comparison of output for Existing and Proposed Conditions.**

| FEMA XS | HEC-RAS River Station | Floodway Elevation Existing (ft) | Floodway Elevation Proposed (ft) | Difference (ft) |
|---|---|---|---|---|
| 1/ | 559 | 44.06 | 44.06 | 0.00 |
| 1/ | 587 | 44.11 | 44.11 | 0.00 |
| 1/ | 615 | 44.25 | 44.25 | 0.00 |
| 1/ | 641 | 44.21 | 44.21 | 0.00 |
| 1/ | 662 | 44.21 | 44.19 | -0.02 |
| 1/ | 682 | 44.21 | 44.17 | -0.04 |
| 1/ | 703 | 43.99 | 43.99 | 0.00 |
| 1/ | 723 | 44.36 | 44.35 | -0.01 |
| 1/ | 786 | 44.31 | 44.30 | -0.01 |
| 1/ | 980 | 44.58 | 44.57 | -0.01 |
| 1/ | 993 | 44.57 | 44.55 | -0.02 |
| 1/ | 1010 | 44.56 | 44.55 | -0.01 |
| 1/ | 1017 | 44.58 | 44.57 | -0.01 |

| FEMA XS | HEC-RAS River Station | Floodway Elevation Existing (ft) | Floodway Elevation Proposed (ft) | Difference (ft) |
|---|---|---|---|---|
| 1/ | 1033 | 44.59 | 44.58 | -0.01 |
| 1/ | 1052 | 44.60 | 44.58 | -0.02 |
| 1/ | 1061 | 44.60 | 44.59 | -0.01 |
| 1/ | 1084 | 44.67 | 44.66 | -0.01 |
| 1/ | 1391 | 44.75 | 44.74 | -0.01 |
| A | 1490 BR | | | |
| 1/ | 1625 | 45.39 | 45.38 | -0.01 |
| 1/ | 1861 | 45.20 | 45.19 | -0.01 |
| 1/ | 2050 | 45.52 | 45.51 | -0.01 |
| 1/ | 2430 | 45.65 | 45.64 | -0.01 |
| B2/ | 2801 | 45.89 | 45.89 | 0.00 |

1/ Additional cross section not included in effective FEMA model

2/ FEMA cross section geometry updated to represent current conditions

## Scour Analysis

Scour depths were estimated for the 2-, and 1-percent annual chance floods using the procedure provided in *EM 1110-2-1601: Hydraulic Design of Flood Control Channels* (USACE, 1994). **Figure 3** shows the relationship of the meander bend geometry and maximum flow depth in the bend due to scour. Scour estimates were developed using the one-dimensional model results for River Station 615 (RS 615), which is located along the downstream edge of the replacement boat ramp. The meander bend along the project reach has a radius of approximately 3,740 ft and a channel top width of approximately 392 ft. The mean flow depth in the approach channel (RS 2801) is 27.1 ft, and 30.2 ft for the 2- and 1-percent annual chance floods, respectively. Parameters and results of the scour estimates are summarized in **Table 2**. As seen in the table, the maximum predicted scour depth for the 2- and 1-percent annual chance floods is 10.6 ft and 13.1 ft, respectively.

**Table 2 – Summary of Scour Estimates at Proposed Ramp**

| Annual Chance | River Station | Bend Radius/ Channel Width (ft/ft) | Scour Flow Depth/Mean Approach Depth[1] (ft/ft) | Max Flow Depth with Scour (ft) | Water Surface Elevation (ft, NAVD88) | Scour Elevation (ft, NAVD88) | Scour Depth (ft) |
|---|---|---|---|---|---|---|---|
| 2% | 615 | 9.5 | 1.8 | 48.8 | 40.5 | -8.3 | 10.6 |
| 1% | 615 | 9.5 | 1.8 | 54.3 | 43.5 | -10.8 | 13.1 |

[1]Note: Value from EM 1110-2-1601: Plate-42, Scour Depth in Bends - Gravel Bed Channels diagram.

## Riprap Design

A riprap evaluation using U.S. Army Corps of Engineers (USACE, 1994) criteria was conducted for the 2- and 1-percent annual chance flood events. Riprap size was computed using the following equation:

$$D_{30} = S_f C_s C_v C_t d_{ss} \left( \left( \frac{\gamma_w}{\gamma_s - \gamma_w} \right)^{0.5} \frac{V_{ss}}{\sqrt{K_1 g d}} \right)^{2.5}$$

where $D_{30}$ is the stone size for which 30 percent of the riprap size distribution is finer, $S_f$ is the safety factor, 1.5; $C_s$ is the stability coefficient for incipient failure, 0.30 for angular rock; $C_v$ is the vertical velocity distribution coefficient, 1.12 for the velocity profile along the outside of the bend; $C_t$ is the thickness coefficient, 1.0; $d_{ss}$ is the product of the local depth and the side slope correction factor of 0.8 and is shown in **Table 3**; $\gamma_s$ is unit weight of stone, assumed to be 165 lbs/ft$^3$; $\gamma_w$ is unit weight of water, 62.4 lb/ft$^3$; $V_{ss}$ is the product of the local depth-averaged velocity and the side slope correction factor of 1.58 and is shown in **Table 3**; g is gravitational constant, 32.2 ft/s$^2$; and $K_1$ is side slope correction factor, 0.88, (from **Figure 4**) using the proposed riprap side slope of 2H:1V.

It is recommended that ODOT Class 2000 riprap be used to protect the proposed ramp. Class 2000 riprap has a $D_{30}$ size of 1.7 feet. Parameters and results of the calculations are summarized in **Table 3**.

**Table 3 – Summary of Riprap Sizing for 2% and 1% Annual Chance Events**

| Annual Chance | River Station | d (ft) | $d_{ss}$ (ft) | V (ft/s) | $V_{ss}$ (ft/s) | $D_{30}$ (ft) |
|---|---|---|---|---|---|---|
| 2% | 682 | 38.0 | 30.4 | 8.7 | 13.7 | 1.2 |
| 1% | 615 | 41.0 | 32.8 | 9.0 | 14.2 | 1.3 |

Riprap size and gradation requirements for ODOT Class 2000 riprap are shown in **Table 4**. The minimum recommended blanket thickness (T) is 4 feet. **Figure 5** shows typical riprap blanket section that can be used for Class 2,000 riprap. The modified blanket section used for the design is shown in the design plans provided in **Appendix C**.

**Table 4 – Class 2,000 Riprap Gradation**

| Percent by Weight | Stone Size (ft)[1] | Stone Weight (lb) |
|---|---|---|
| 20 | 2.9 – 2.5 | 2,000 – 1,400 |
| 30 | 2.5 – 2.0 | 1,400 – 700 |
| 40 | 2.0 – 0.8 | 700 – 40 |
| 10 - 0 | 0.8 – 0.0 | 40 – 0 |

1. Assumes a stone density of 165 lbs/ft$^3$

It is recommended that the toe of the revetment along the base of the ramp be set at or below the scour elevations for the 1-percent annual chance event presented in **Table 2** or a toe trench should be provided that can accommodate the estimated scour. Details for the riprap protection are shown in the design plans provided in **Appendix C**. The toe trench shown in the design plans is expected to accommodate scour depths of 10.9 feet, which is slightly greater than the scour depth for the 2-percent annual chance flood. As shown in the design plans, the riprap will extend to the edge of the ramp and will include a 16-inch wide section which has its voids filled with Class 50 riprap. This is intended to help provide additional lateral support for the ramp's aggregate base material.

A riprap geotextile filter fabric should be used at the interface between the riprap and native bank material. The filter prevents migration of fine soil particles through the voids in the riprap. The riprap filter should meet ODOT's specifications for at Type 2 riprap geotextile.

**Two-Dimensional Modeling**

A 2-dimensional hydraulic model was developed to better understand the hydraulic conditions at the proposed ramp and to understand how the upstream bridge, adjacent gravel bar, and confluence with the Willamette River influence to hydraulic and sediment transport conditions at the replacement ramp location.

The two-dimensional hydrodynamic software modeling program Sedimentation and River Hydraulics – Two-Dimensional (SRH-2D) Beta Version 3.0 (dated May 2014), developed by the US Bureau of Reclamation (USBR), was used to simulate the hydraulic conditions surrounding the project site. Because the hydraulic characteristics near the project site can be impacted by both Willamette River and Clackamas River flows, the 2-dimensional model encompassed the entire extents of the 1-dimensional HEC-RAS model plus the extents of the Willamette River that were surveyed for this project (i.e., approximately 2,100 upstream and 2,300 feet downstream of the Clackamas River confluence). Additional details regarding the 2-dimensional hydraulic modeling can be found in the December 18, 2015 memo. Table 5 lists the hydrology used for the 2-dimensional modeling conducted for the replacement ramp. Although only two discharge scenarios were evaluated; for consistency, the scenario numbers were kept the same as was used in previous modeling efforts.

**Table 7 – Flow scenarios evaluated with the 2-D model**

| Scenario No. | Clackamas Discharge (cfs) | Clackamas Recurrence Interval (yrs) | Willamette Discharge (cfs) | Willamette Recurrence Interval (yrs) |
|---|---|---|---|---|
| 1 | 10,000 | ~1 | 50,000 | ~1 |
| 5 | 110,000 | 100 | 220,000 | ~10 |

**2-Dimensional Modeling Results**

Flow velocities for a typical annual winter high flow event (Scenario No. 1) are shown in **Figures 6-9**. **Figures 6 and 7** show the flow velocity magnitudes and vectors, respectively in the vicinity of the boat ramp; indicating that for this flow condition the highest velocities occur upstream of highway 99E and near the existing boat ramp compared to the location of the replacement ramp. **Figures 8 and 9** shows the velocity magnitudes and vectors, respectively for the replacement ramp and immediate surrounding areas. The figures indicate that velocities near the proposed boat ramp are fairly uniform and that the ramp causes an eddy current within the portion of the ramp that is inset into the bank. The eddy current may induce minor deposition of suspended sediment on the upper portion of the ramp surface, likely consisting of sand-sized or finer material. The flow along the toe of the ramp appears to be uniformly directed downstream with no significant disruption in the flow patterns.

Flow velocities for the 100-year flood (Scenario No. 5) are shown in **Figures 10-13**. As seen in the figures, the velocities are generally highest between the Highway 99E bridge and the existing boat ramp. The contraction of flow through the Highway 99E bridge opening causes the flow to accelerate though the bridge creating a zone of higher velocities. As the flow exits the bridge opening, it expands and velocities are gradually reduced. As seen in the figures, the proposed ramp is located downstream of the high velocity zone created by the bridge and the ramp does not appear cause any significant disruption in the natural flow patterns.

**Summary and Conclusions**

Existing and proposed conditions 1-dimensional and 2-dimensional hydraulic models were developed for the proposed Clackamette Boat Ramp replacement project. Output from the 1-dimensional modeling indicates that the proposed project will not cause a rise in the 1-percent annual chance floodplain or floodway. A no-rise certification is provided in **Figure 14**.

The maximum predicted scour depth for the 2- and 1-percent annual chance flood events is 10.6 ft and 13.1 ft, respectively. The riprap calculations for the 2- and 1-percent annual chance flood results in riprap with a $D_{30}$ size of 1.2 and 1.3 feet, respectively. It is recommended that ODOT Class 2000 riprap be used to protect the replacement ramp. If placed per the design, the riprap protection should accommodate scour of 10.9 feet, which is slightly greater than the scour depth for the 2-percent annual chance flood.

The 2-dimensional model indicates that a high velocity zone is created by the Highway 99E bridge. The zone does not extend far enough downstream to impact the proposed replacement boat ramp. During typical winter high flow conditions, minor sedimentation consisting of sand-sized material may occur along the upper ramp surface. During major flooding, the ramp is not expected to have any significant impact on the flow patterns in the Clackamas River.

If you have any questions, please do not hesitate to contact me at 503-485-5490.

# APPENDIX A
# FIGURES

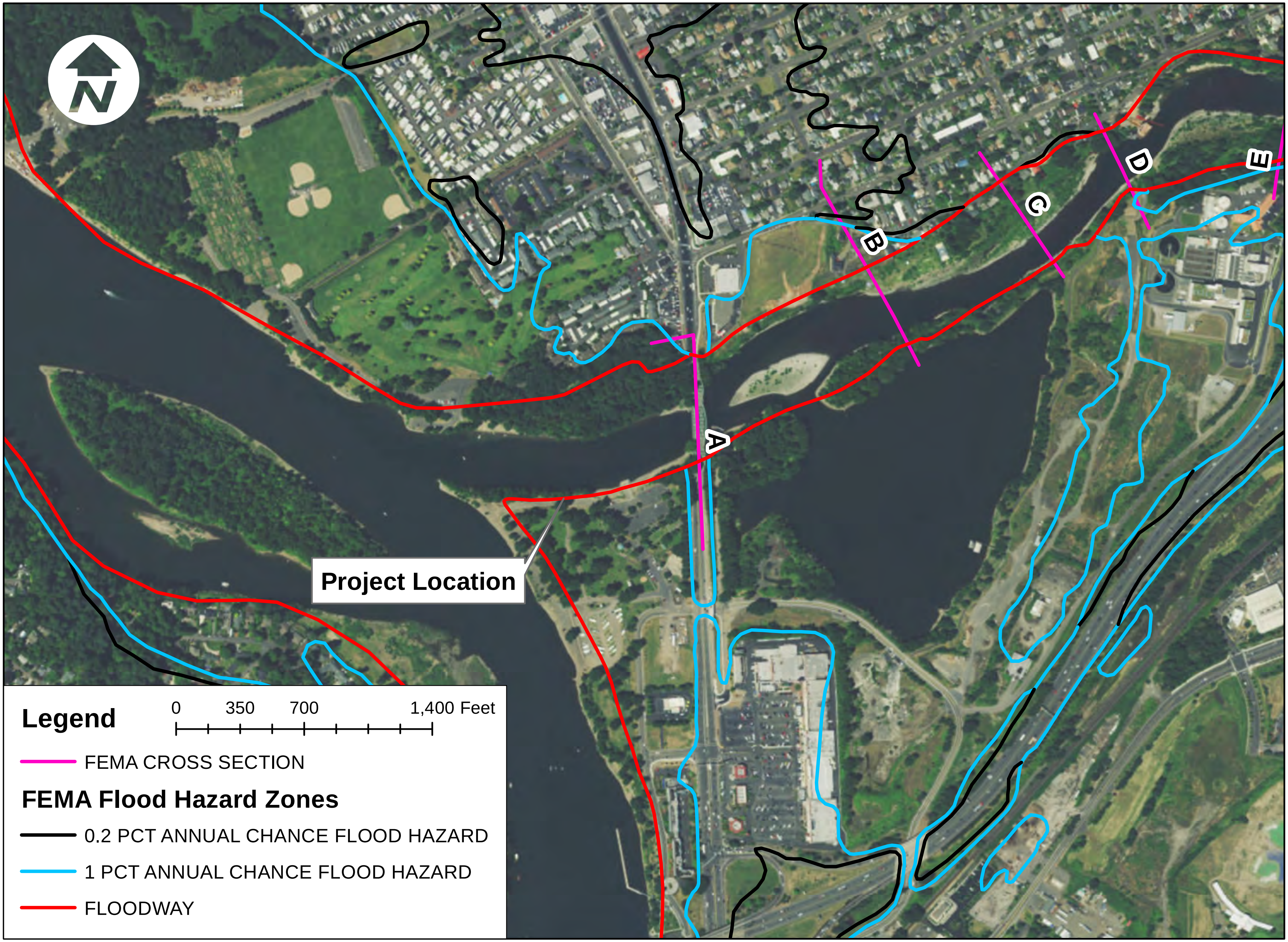



Figure 1 - FEMA flood hazard zones and cross section locations

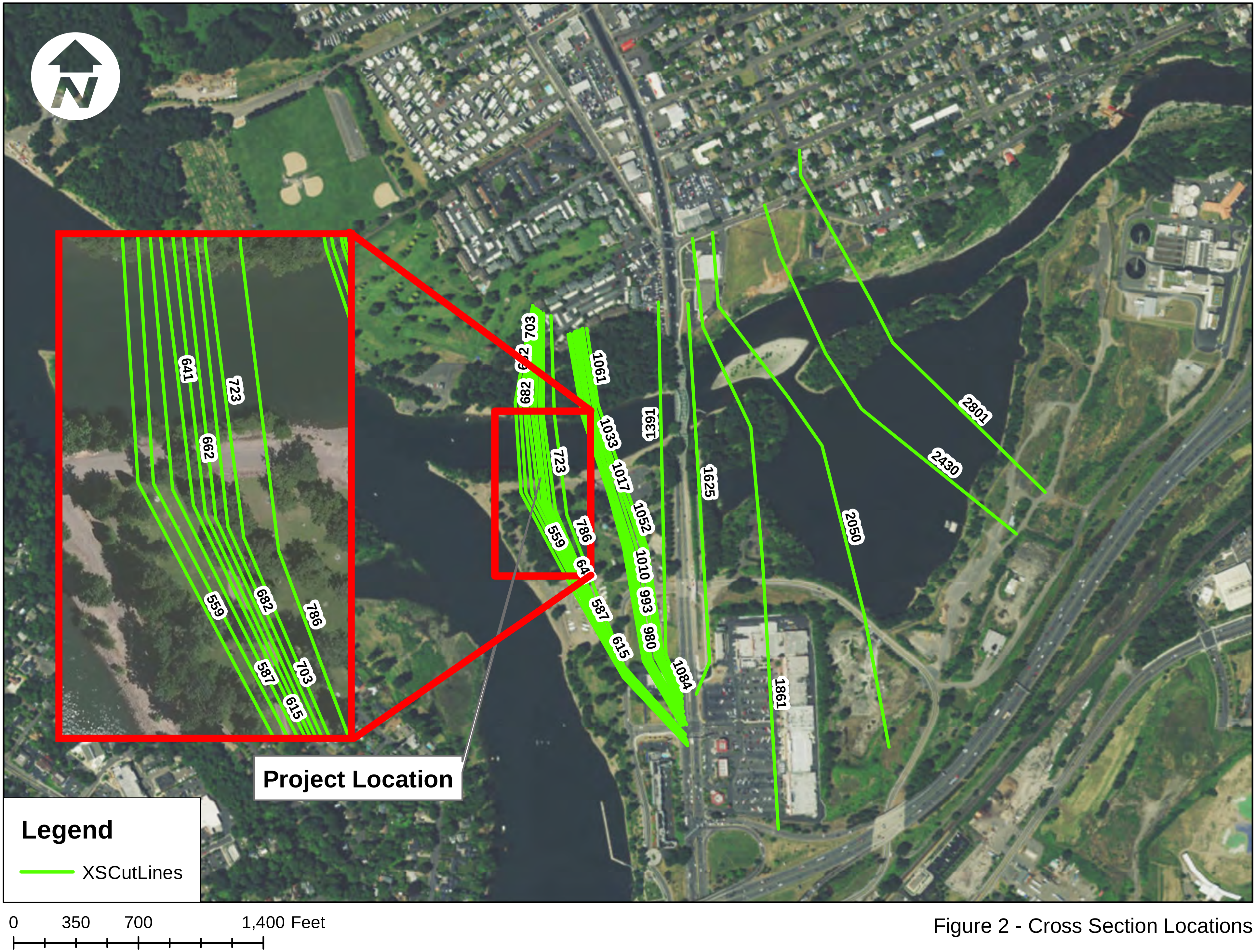



Figure 2 - Cross Section Locations

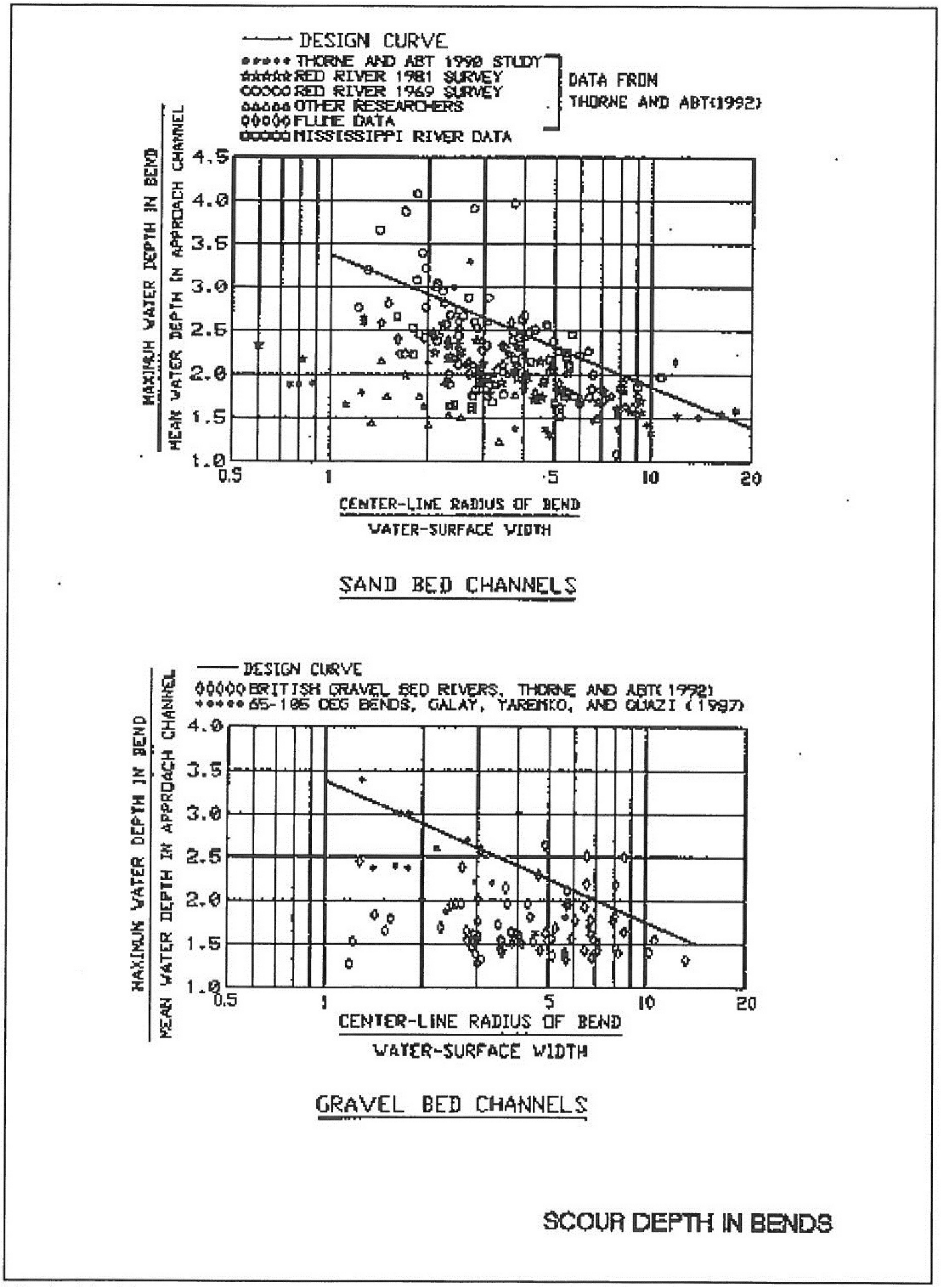



**Figure 3 – Scour Depth in Bends**

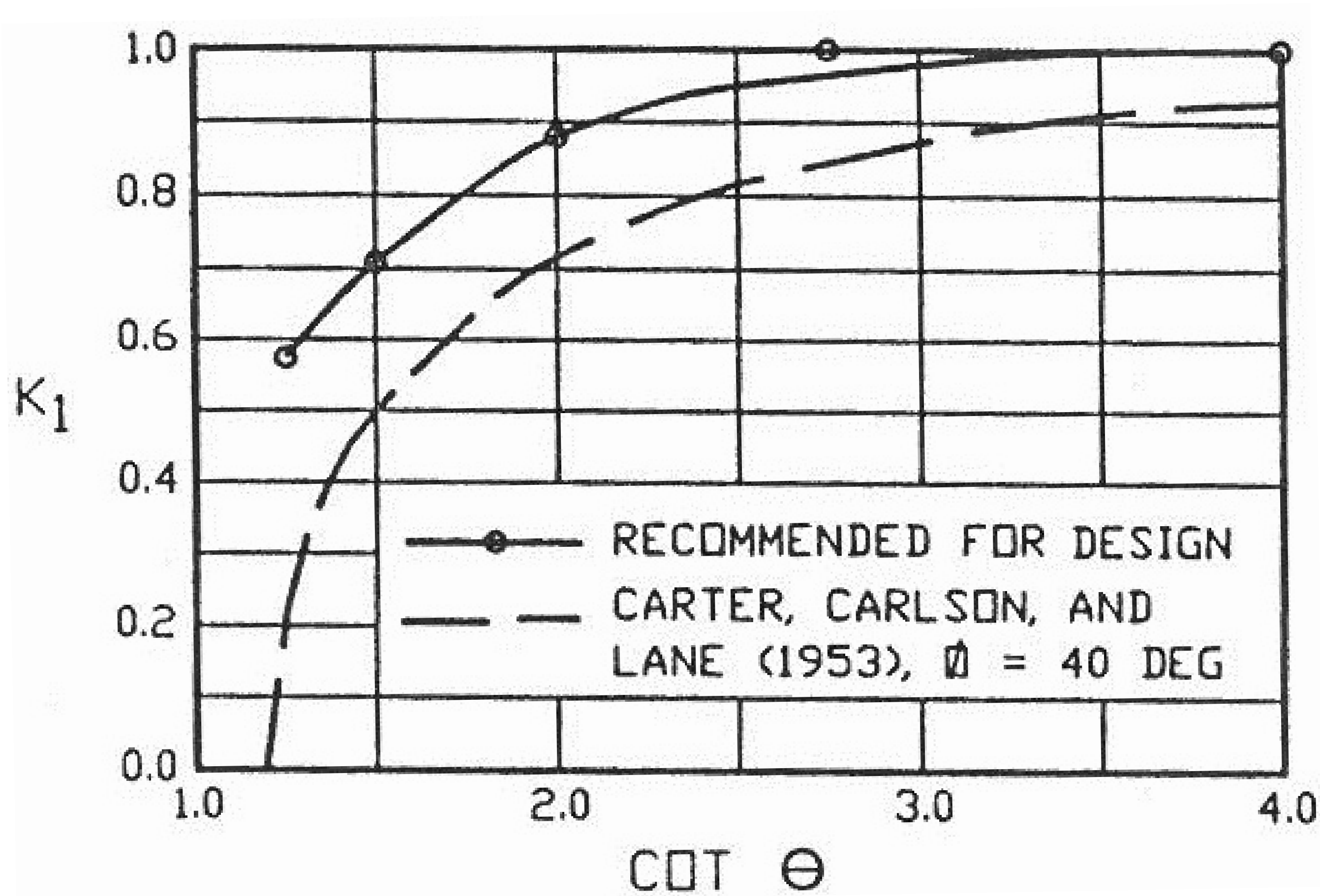



**Figure 4 – Riprap Side Slope Correction Factor**

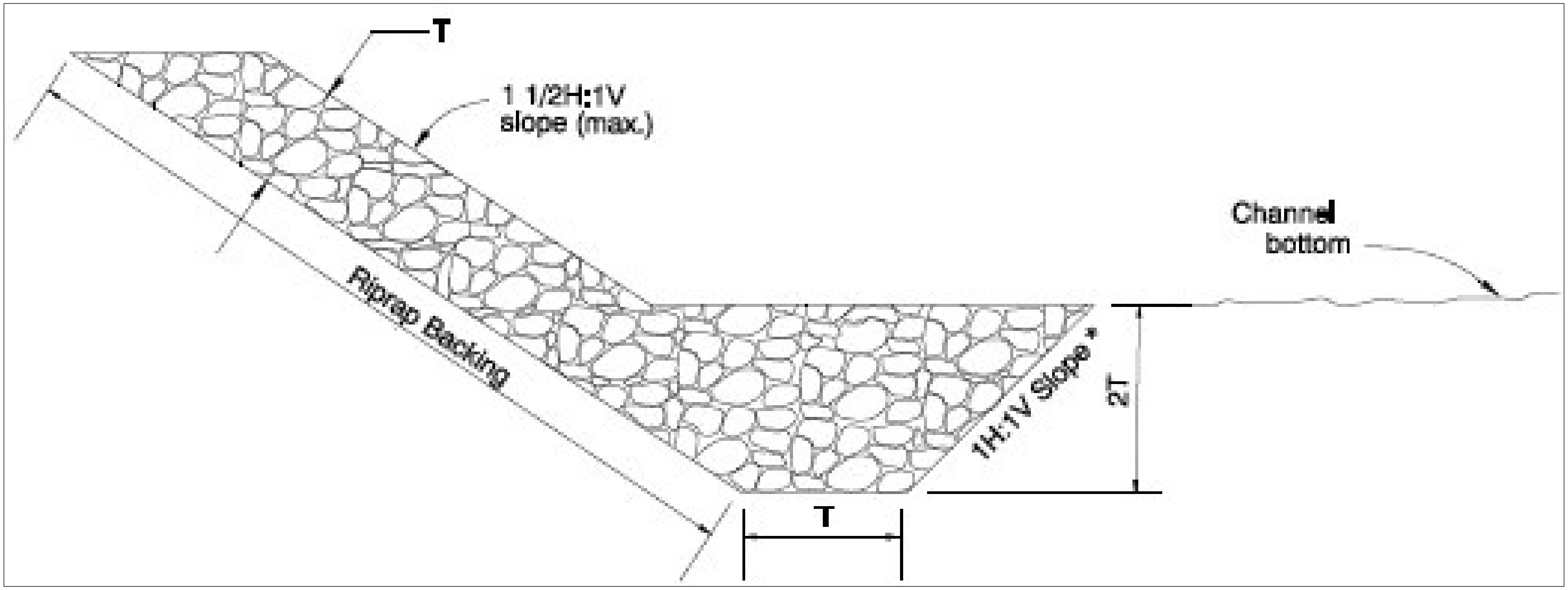



**Figure 5 – ODOT Standard Riprap Section**

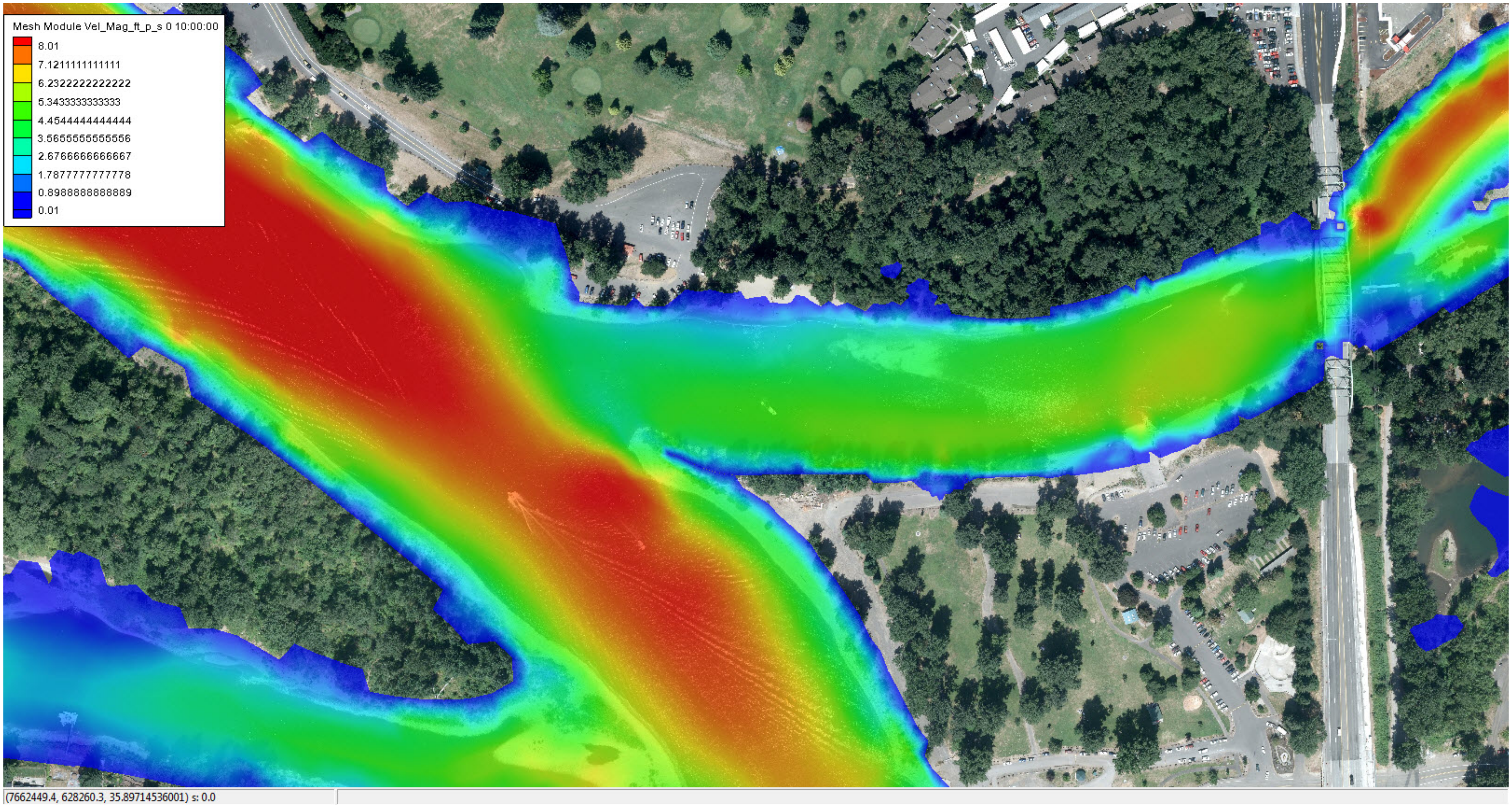



**Figure 6 - Flow velocity magnitudes near project site for typical annual winter high flow**

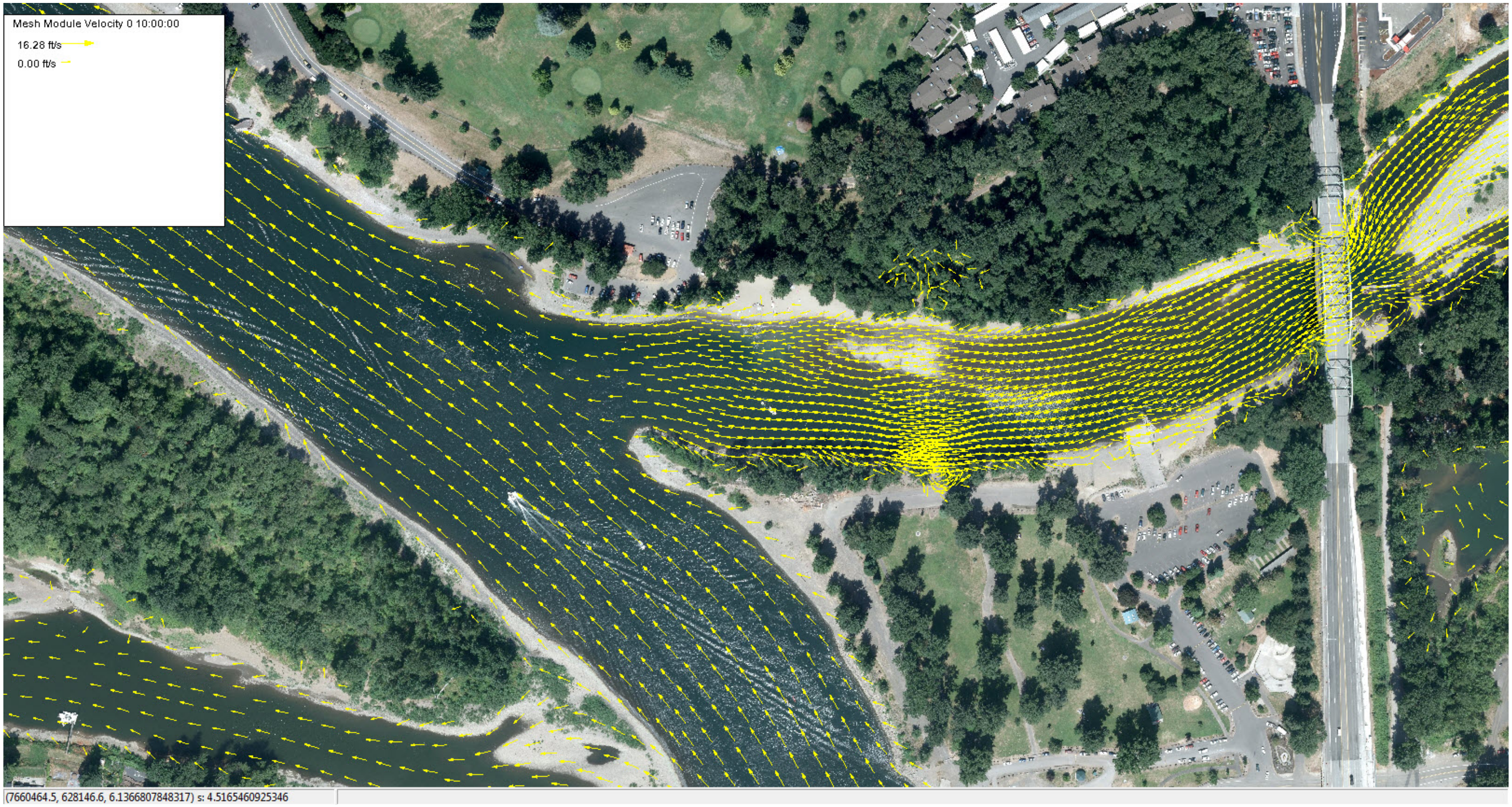



**Figure 7 - Flow velocity vectors near project site for typical annual winter high flow**

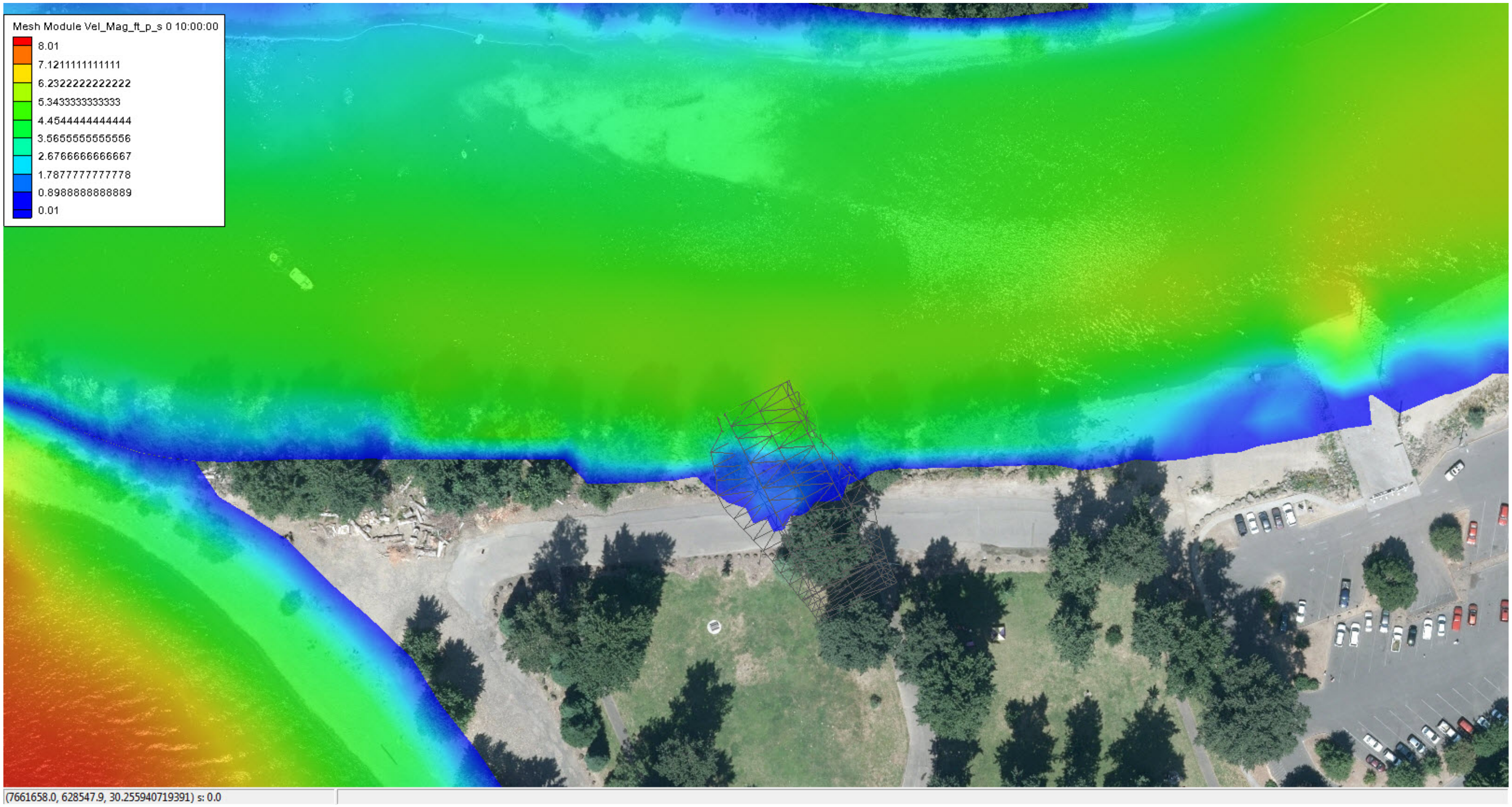



**Figure 8 - Flow velocity magnitudes at project site for typical annual winter high flow**

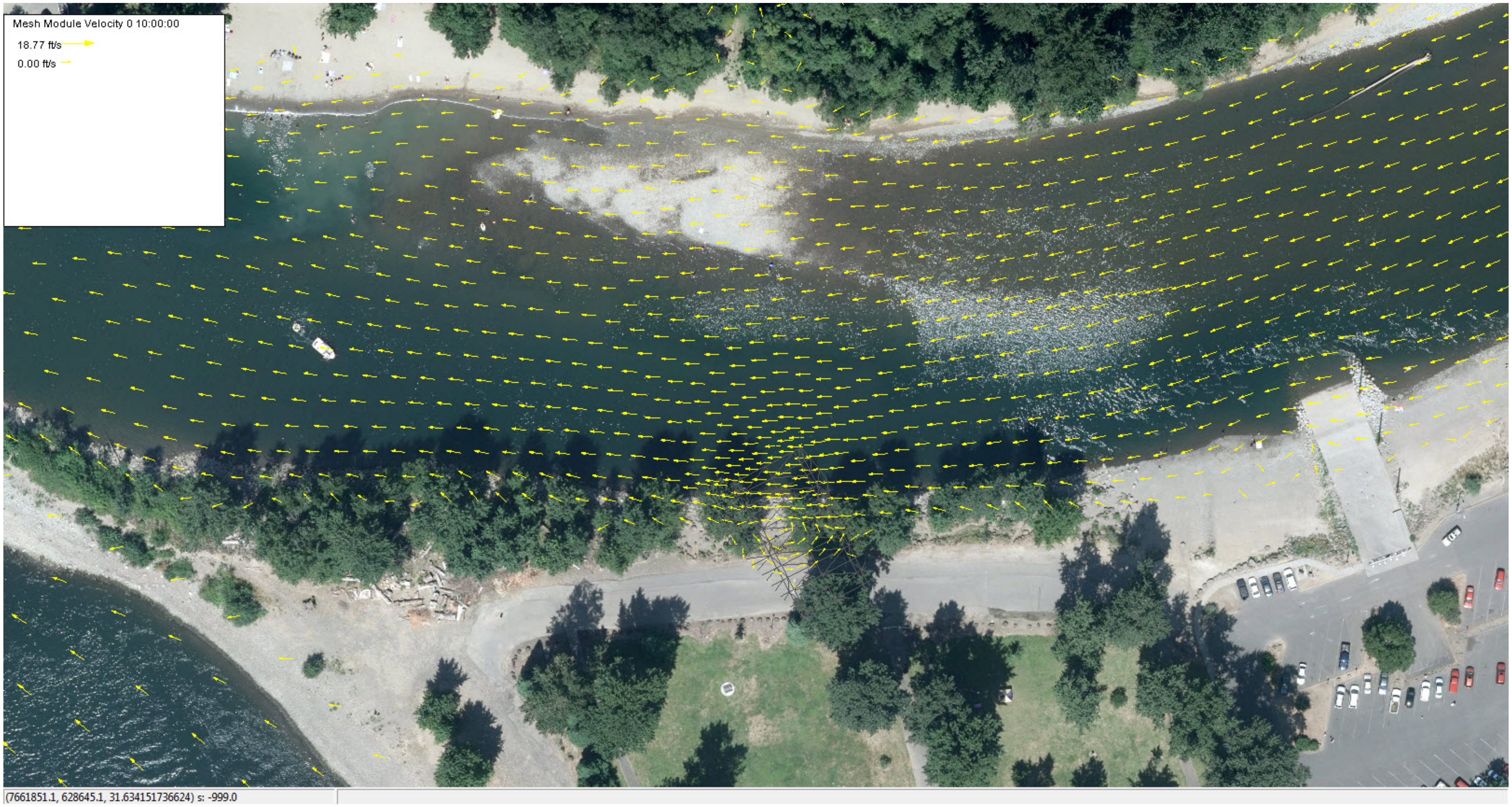



**Figure 9 - Flow velocity vectors at project site for typical annual winter high flow**

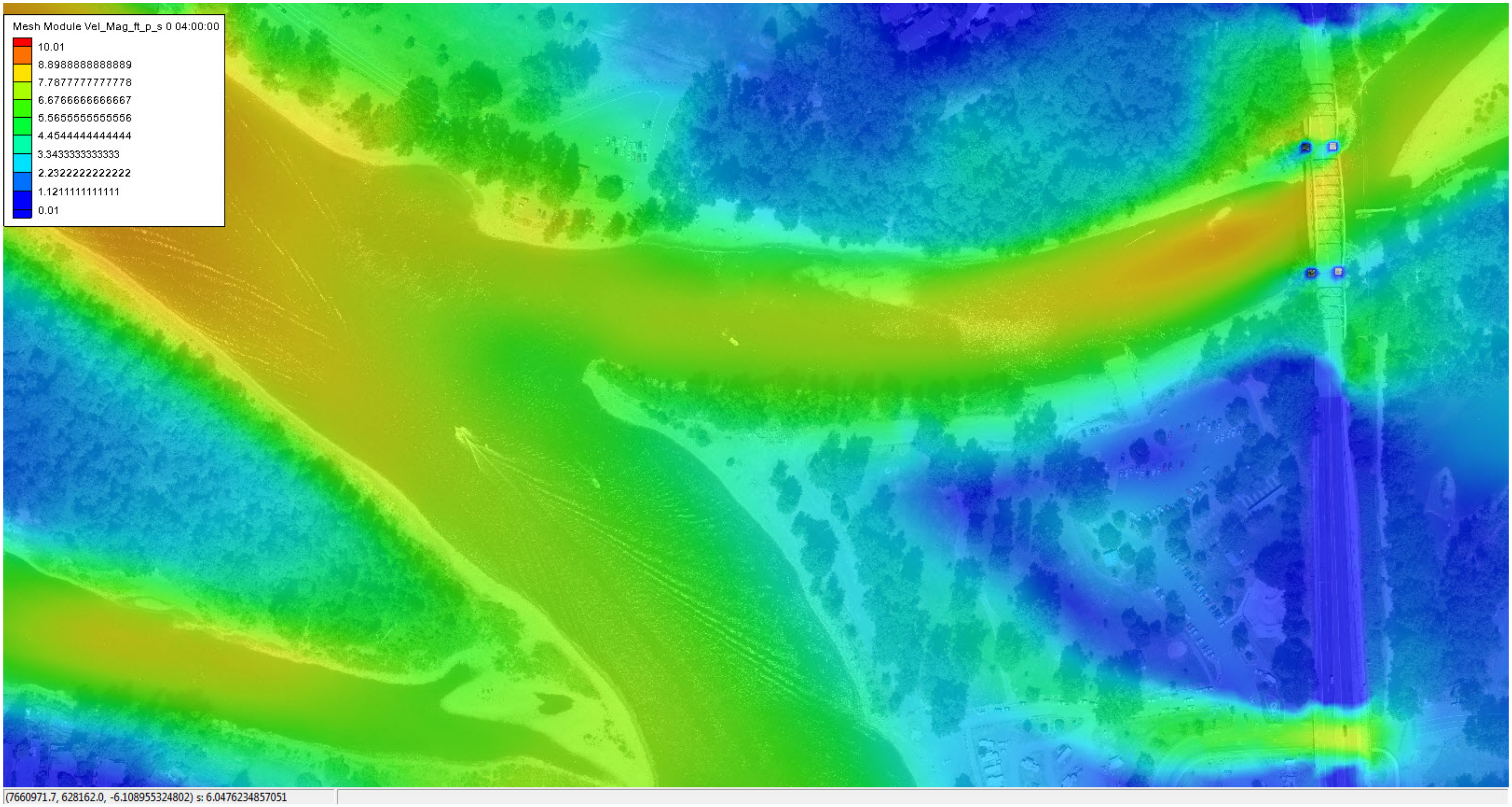



**Figure 10 - Flow velocity magnitudes near project site for Clackamas River 1-percent annual chance (100-yr) Flood**

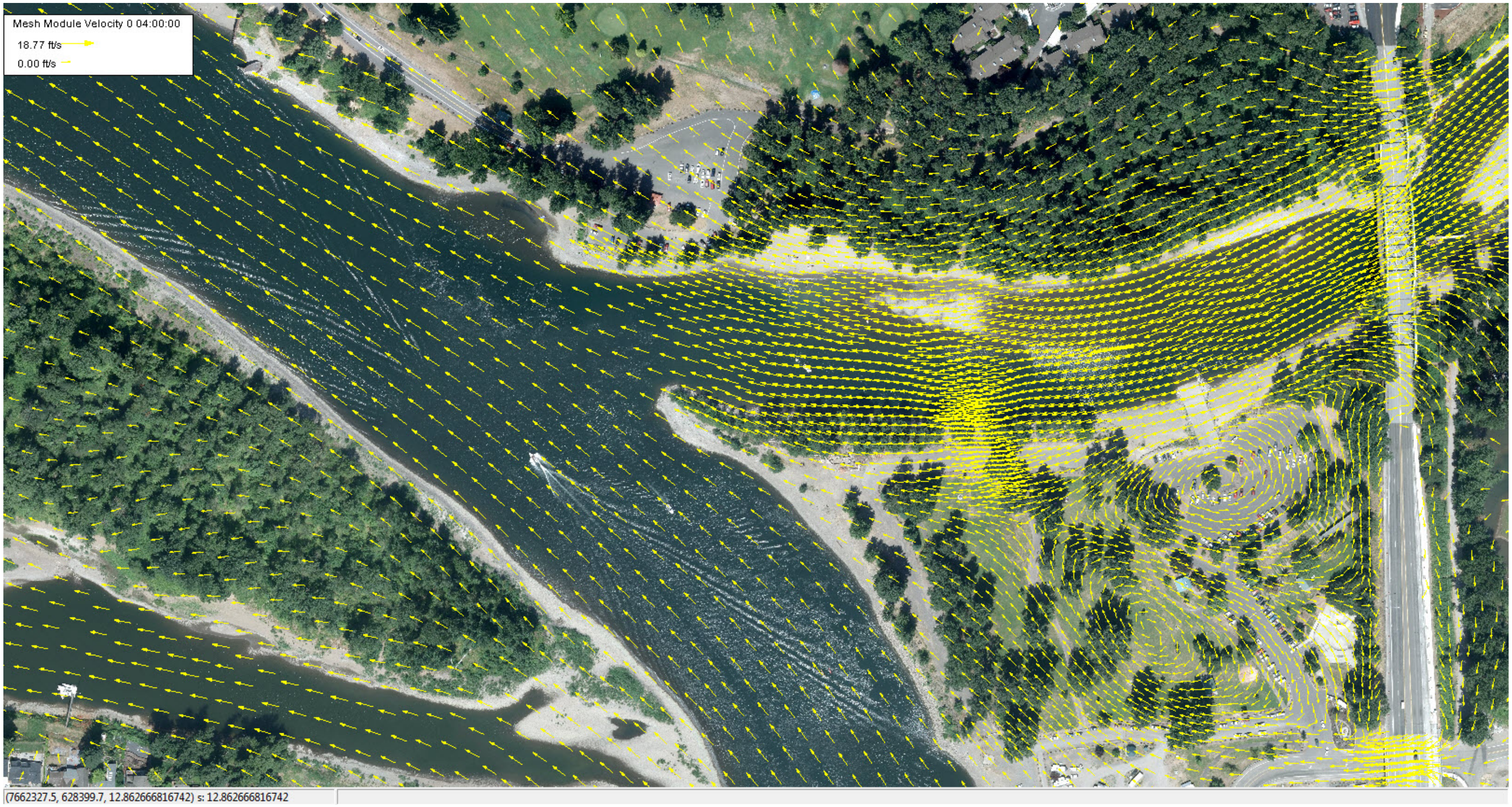



**Figure 11 - Flow velocity vectors near project site for Clackamas River 1-percent annual chance (100-yr) Flood**

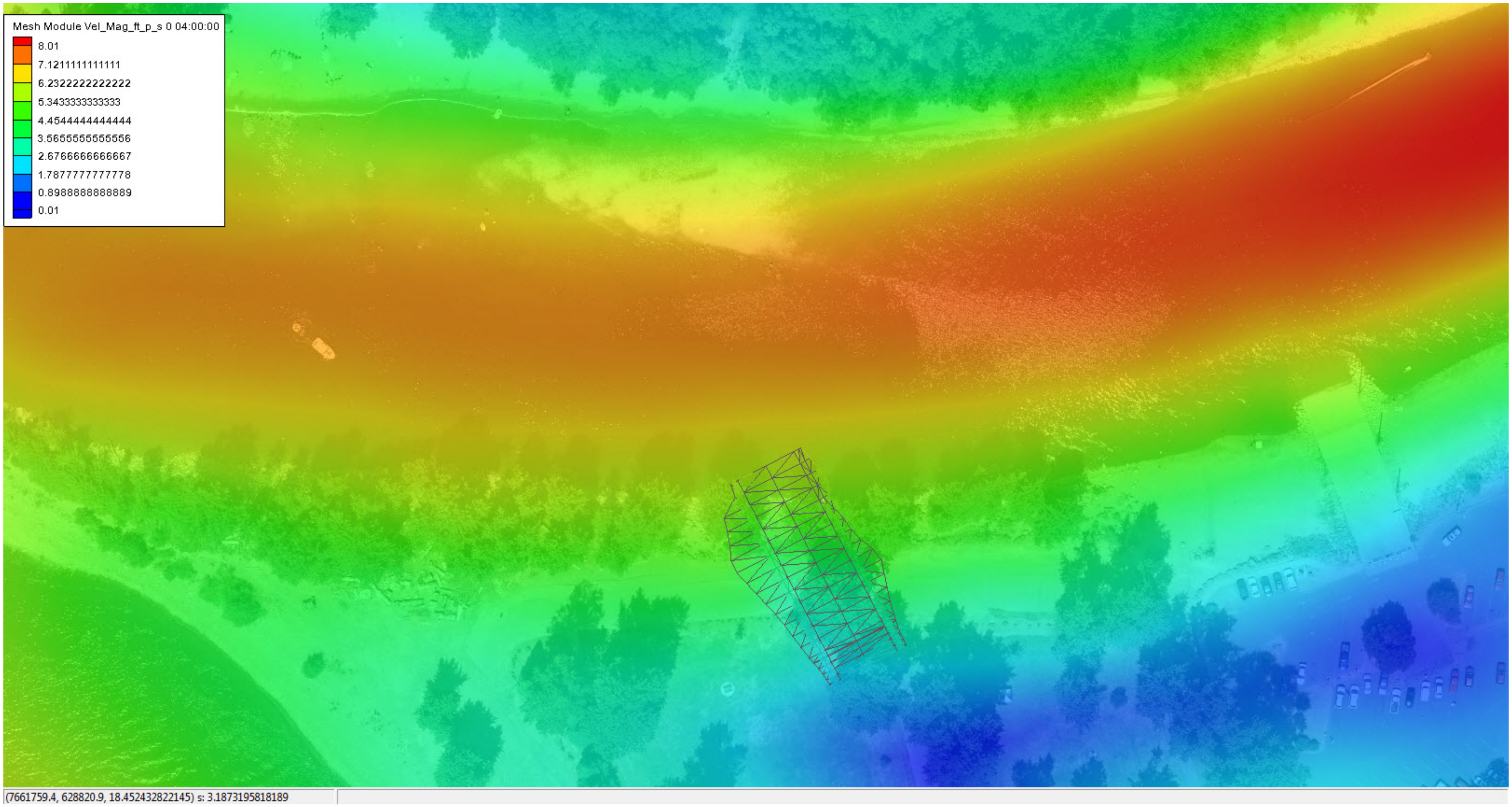



**Figure 12 - Flow velocity magnitudes at project site for Clackamas River 1-percent annual chance (100-yr) Flood**

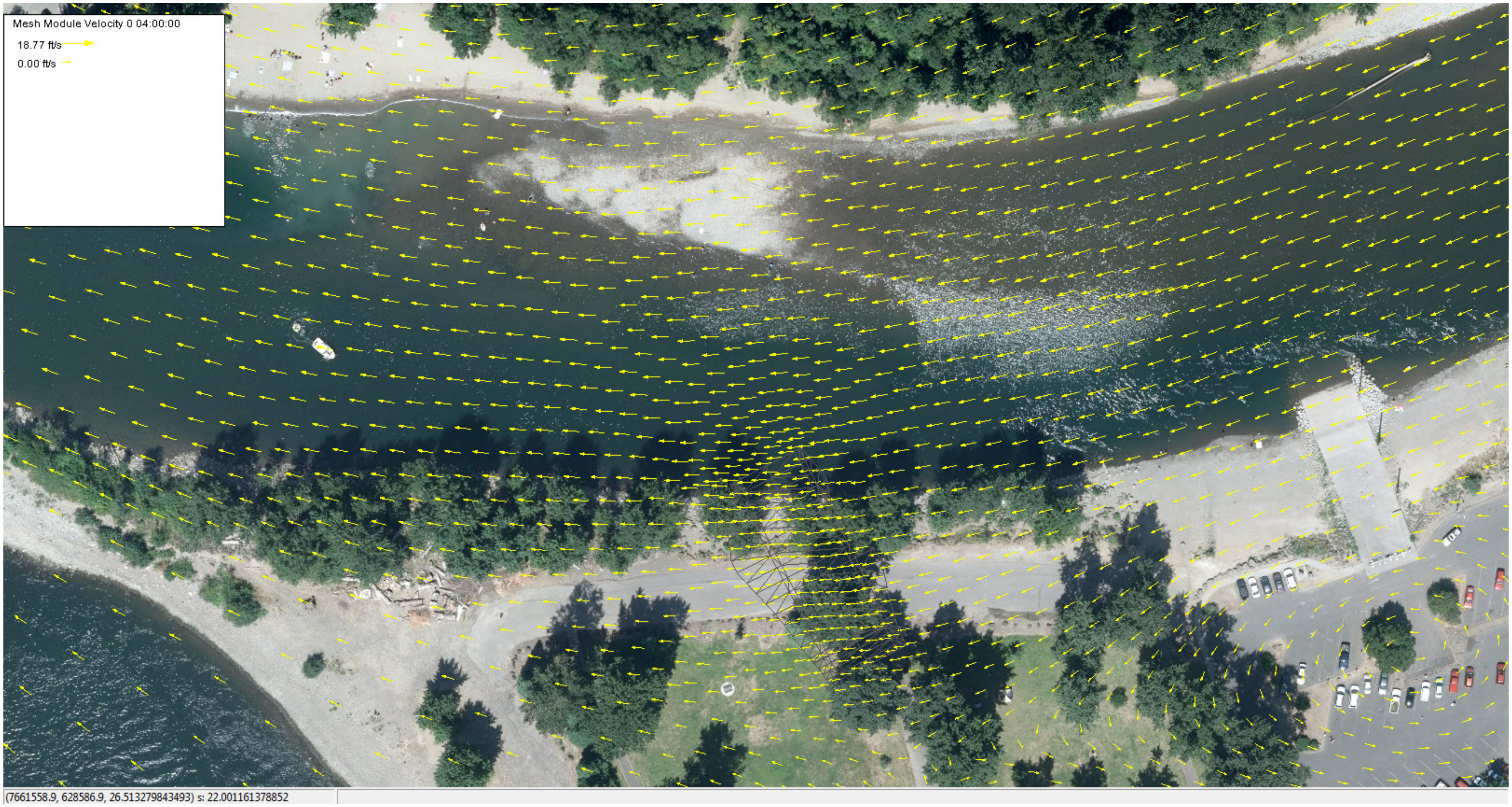



**Figure 13 - Flow velocity vectors at project site for Clackamas River 1-percent annual chance (100-yr) Flood**

**FIGURE 14**

## ENGINEERING "NO-RISE" CERTIFICATION

This is to certify that I am a duly qualified engineer licensed to practice in the State of Oregon. It is to further certify that the attached technical data supports the fact that the Clackamette Park boat ramp located in the city of Oregon City in Clackamas County, will not impact the 100-year flood elevations, floodway elevations and floodway widths for the Clackamas River at published cross sections in the Flood Insurance Study for Clackamas County, Oregon and Incorporated Areas, dated June 17, 2008 and will not impact the 100-year flood elevations, floodway elevations, and floodway widths at unpublished cross-sections in the vicinity of the proposed repair.

Attached are the following documents that support my findings:

1. Clackamette Park Replacement Boat Ramp – Hydraulic Design and Impact Assessment (this document)

2. HEC-RAS Input and Output Files (Existing and Proposed Conditions)

Hans R. Hadley, P.E., Project Manager/Senior Hydraulic Engineer
Licensed Engineer

May 5, 2016
(Date)

WEST Consultants, Inc.
2601 25th Street SE, Ste 450
Salem, OR 97302

(Seal)

# APPENDIX B
# PREFERRED RAMP LOCATION MEMO

# Technical Memo

WEST Consultants, Inc.
2601 25th St. SE
Suite 450
Salem, OR  97302-1286
(503) 485 5490
(503) 485-5491 Fax
www.westconsultants.com

**To:** Scott Archer
Community Services Director

**Company:** City of Oregon City

**Date:** February 24, 2016

**Cc:** Denise Kai, City of Oregon City
Jeff Smith, P.E., Oregon State Marine Board
Raymond Lanham, P.E., Oregon State Marine Board

**From:** Hans R. Hadley, P.E., CFM
Senior Hydraulic Engineer

**Subject:** Opinion Regarding Relocation of Clackamette Park Boat Ramp to the Willamette River

---

During the February 9, 2016 Clackamette Park Boat Ramp Repair/Replacement presentation to the City Planning Commission, one of the commissioners asked if it would make sense to locate the permanent replacement boat ramp along the Willamette River frontage of Clackamette Park. The following are opinions offered by members of the Oregon State Marine Board and myself in opposition to relocating the Clackamette Park Boat Ramp to the Willamette River.

- The ramp would be further away from existing infrastructure (parking lot and restroom). New parking and restroom facilities would likely be needed.
- The top of the ramp would be located at a lower elevation as the topography within this portion of the park slopes down toward the Willamette River. The ramp would be out of service more often and stay closed longer during high flow events.
- The Willamette River frontage is on the outside of a bend in the river, exposing the ramp to higher river velocities, greater debris accumulation, and greater erosion potential. It would also

leave boaters more exposed to larger magnitude river currents during launch and retrieval of their boats. These are all the things that we are trying to avoid by moving the ramp from its current location. If moved to the Willamette River, we would expect that the severity of these issues would even greater.

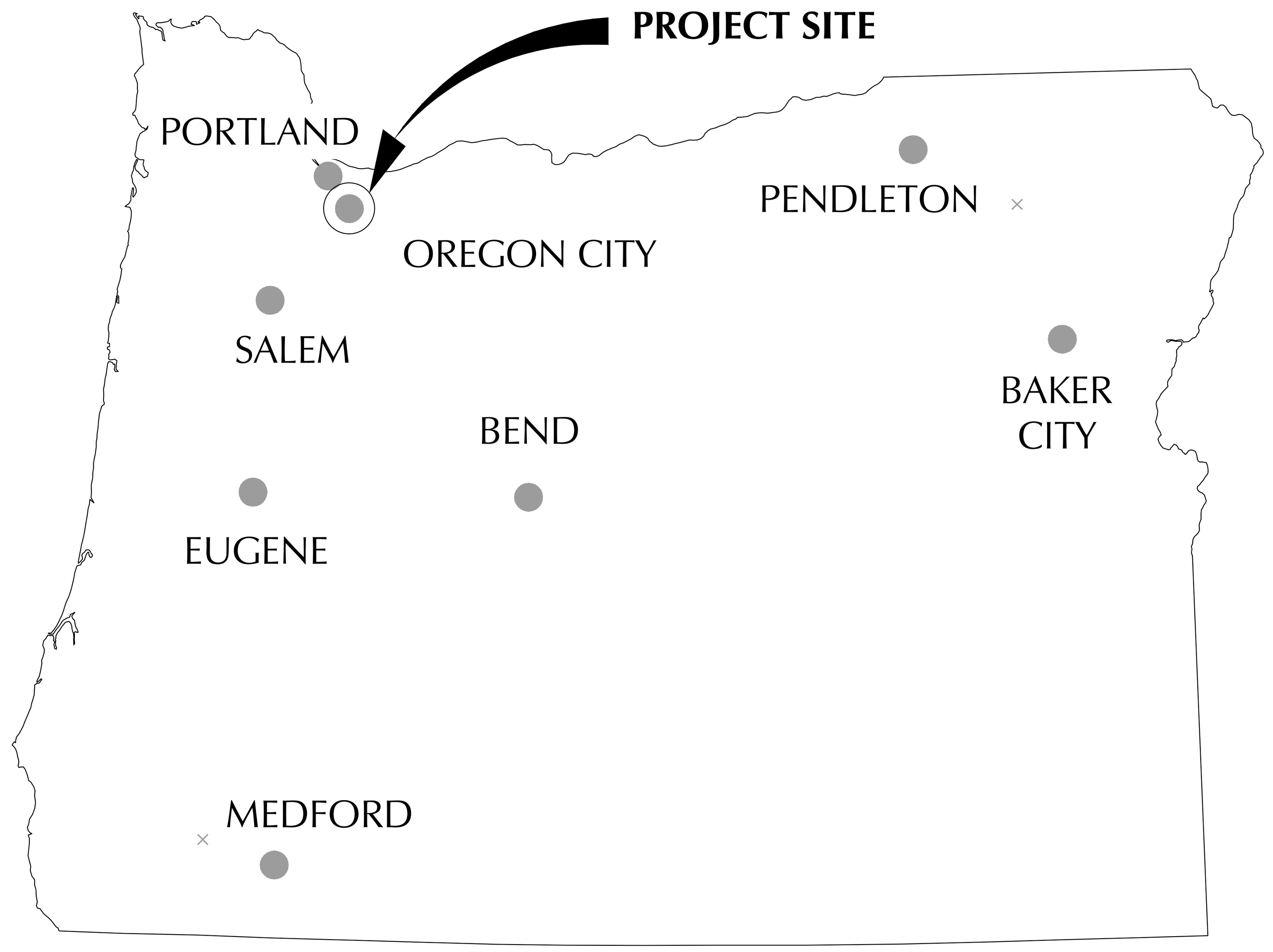
- Although there is some bank protection along the Willamette River frontage of Clackamette Park, there are large gaps in the protection that are subject to bank erosion. If any of the non-protected locations were to be considered for the replacement ramp, significant bank protection would be required. This would be difficult to get permitted and would add significantly to the project cost.

- Recently collected bathymetric data indicates that a large scour hole exists in the channel along the Willamette River frontage of Clackamette Park. The bottom elevation of the scour hole is approximately -12 ft (NAVD88). This would complicate the scour protection design for the ramp. In contrast, the channel bed elevation along the Clackamas River at the preferred ramp location is +2 ft.

- Considering the amount of debris accumulation along the right (East) bank of the Willamette River at its confluence point with the Clackamas River, we believe a facility located along this reach of the Willamette River would require significantly more cleanup/maintenance/repair following seasonal high water events.

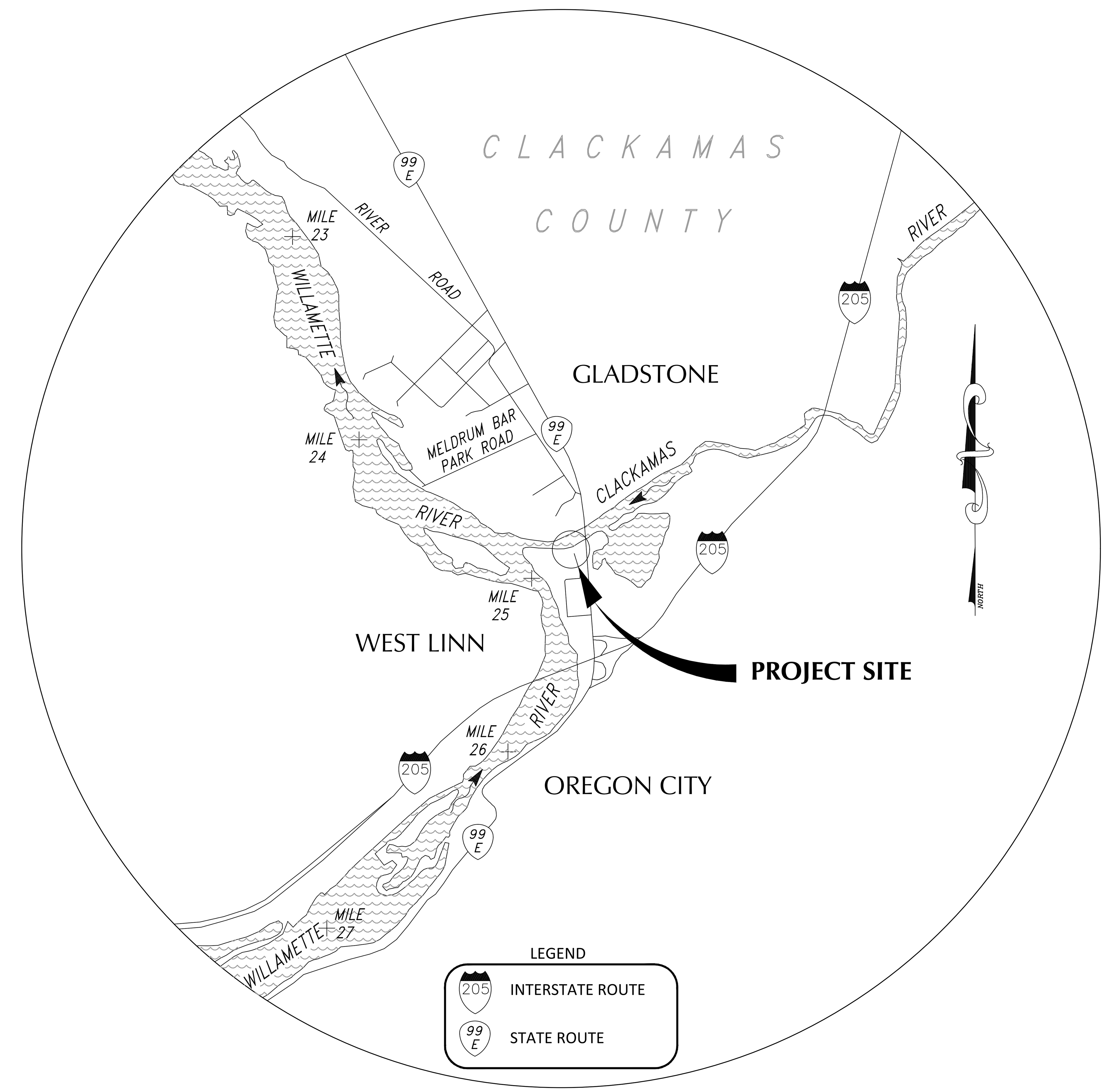
If you have any questions, please do not hesitate to contact me at 503-485-5490.

# APPENDIX C
# PRELIMINARY DESIGN PLANS




## LOCATION MAP

SCALE NONE




## VICINITY MAP

SCALE — SCALE IN MILES 0 1

### DRAWING INDEX

| | |
|---|---|
| 1 | COVER SHEET |
| 2 | EXISTING CONDITIONS |
| 3 | CONCEPTUAL SITE PLAN – OPTION 1 |
| 4 | CONCEPTUAL SITE PLAN – OPTION 2 |
| 5 | RAMP PLAN & PROFILE |
| 6 | SECTIONS |
| 7 | DETAILS |
| 8 | DETAILS |
| 9 | DETAILS |
| 10 | DETAILS |

NOTE: OREGON MARINE BOARD AND SITE SPECIFIC DETAILS TO BE ADDED AT LATER DATE.

# BOAT LAUNCH RAMP PROJECT

## AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2

## FOR THE CITY OF OREGON CITY

kpff

111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

File: N:\c\p\2015\31571-Clackamette-Park-Boat-Ramp\CAD\PLOT\5171-01-COVER.dwg TAB:1
Plotted: 4/13/16 at 7:25am By: TKetchum

| REVISIONS | DATE | BY |
|---|---|---|
| | | |

FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY: CV
DESIGNED BY: RM
DRAWN BY: TK
DATE: 12/02/2015

30% DESIGN NOT FOR CONSTRUCTION
ENGINEER

OREGON CITY

COVER SHEET
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

SHEET 1 OF 10

0302 - 1514 - 1
DRAWING NO.


## SHEET NOTES

1. ADDITIONAL TOPOGRAPHIC SURVEY WILL BE REQUIRED TO FACILITATE FINAL DESIGN.
2. VERTICAL DATUM IS NAVD 88 (GEOID 12A).
3. HORIZONTAL DATUM IS THE OREGON SATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83 (2011).

N

SCALE 1 INCH = 30 FEET

30 0 30 60


kpff

111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com


| DATE | REVISIONS | BY |
|---|---|---|
| | | |
| | | |
| | | |

FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER

FINAL CHECK BY CV

DESIGNED BY RM

DRAWN BY TK

DATE 12/02/2015

30% DESIGN NOT FOR CONSTRUCTION

ENGINEER

OREGON CITY

# EXISTING CONDITIONS
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

SHEET 2 OF 10

DRAWING NO. 0302 - 1514 - 2


File: N:\c\p\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\5171-02-EX.dwg TAB:2
Plotted: 4/27/16 at 2:50pm By: TKetchum


## SHEET LEGEND

- REMOVALS
- STANDARD ASPHALT PAVEMENT
- CONCRETE
- CONCRETE RAMP ABUTMENT
- SAWCUT

## SHEET NOTES

1. SELECTION OF A PREFERRED ACCESS CONFIGURATION ALTERNATIVE TO BE DETERMINED.

SCALE 1 INCH = 30 FEET
30 0 30 60

kpff

111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

| DATE | REVISIONS | BY |
|---|---|---|

FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY CV
DESIGNED BY RM
DRAWN BY TK
DATE 12/02/2015

30% DESIGN NOT FOR CONSTRUCTION
ENGINEER

OREGON CITY

CONCEPTUAL SITE PLAN - OPTION 1
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

SHEET 3 OF 10
DRAWING NO. 0302 - 1514 - 3


## SHEET LEGEND

| | | | |
|---|---|---|---|
| | REMOVALS | | CONCRETE RAMP ABUTMENT |
| | STANDARD ASPHALT PAVEMENT | | SAWCUT |
| | CONCRETE | | |

## SHEET NOTES

1. SELECTION OF A PREFERRED ACCESS CONFIGURATION ALTERNATIVE TO BE DETERMINED.

SCALE 1 INCH = 30 FEET
30 0 30 60

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

REVISIONS | DATE | BY
FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY CV
DESIGNED BY RM
DRAWN BY TK
DATE 12/02/2015

30% DESIGN NOT FOR CONSTRUCTION
ENGINEER

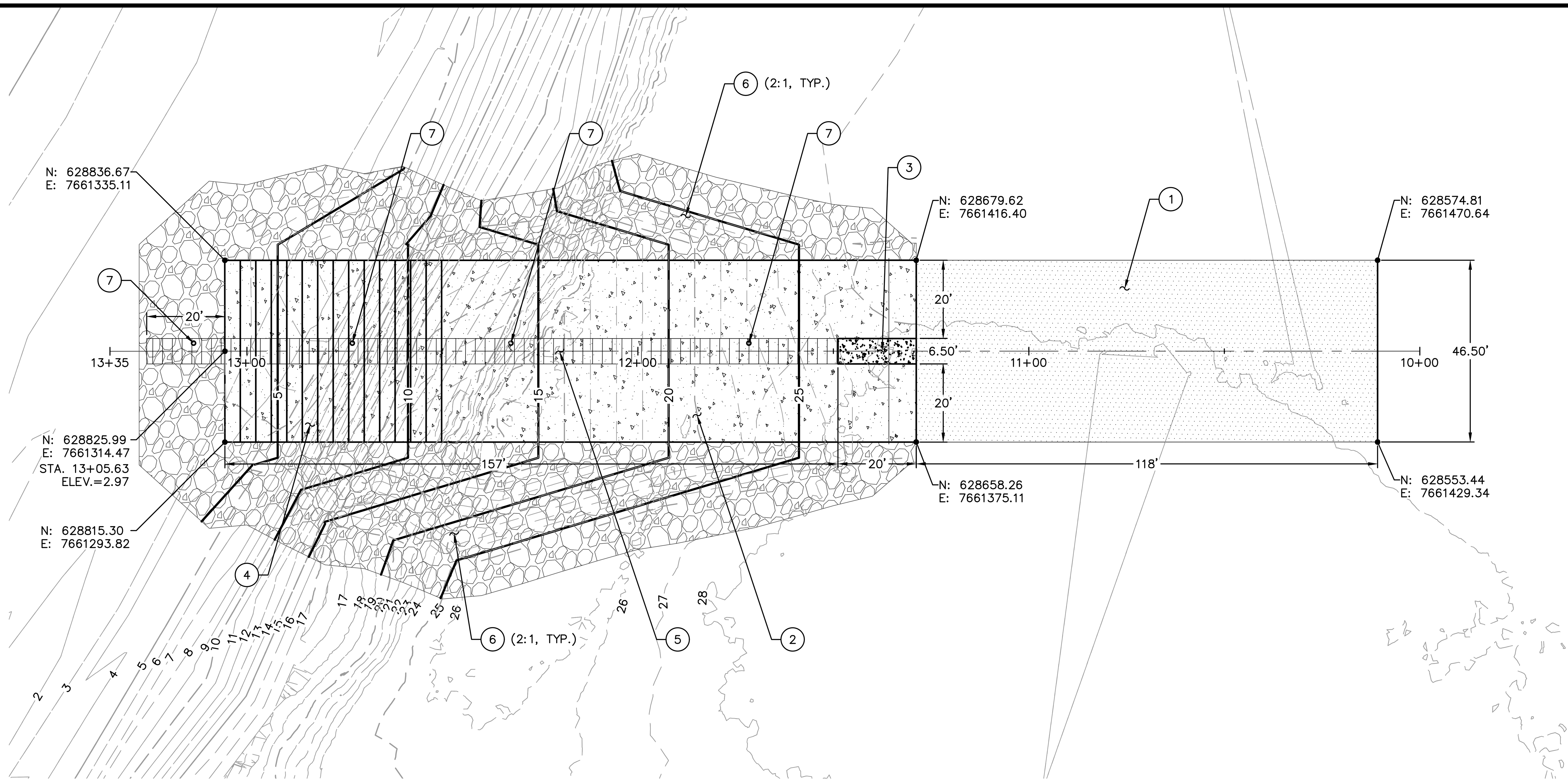
OREGON CITY

CONCEPTUAL SITE PLAN - OPTION 2
AT CLACKAMETTE PARK, CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

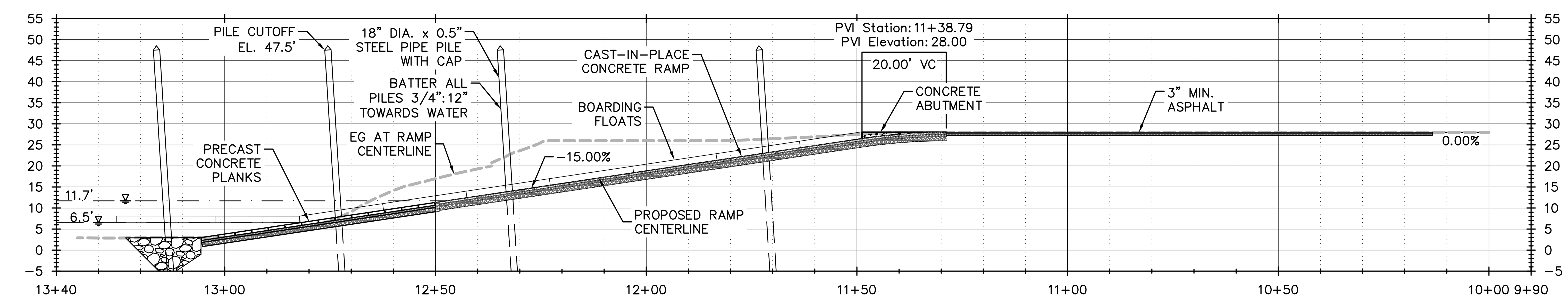
CITY OF OREGON CITY

SHEET 4 OF 10
0302 - 1514 - 4
DRAWING NO.

File: N:\c\p\2015\31571-Clackamette-Park-Boat-Ramp\CAD\PLOT\5171-03-SP.dwg TAB:4
Plotted: 4/28/16 at 9:33am By: TKetchum




## PLAN
SCALE: 1" = 20'




## PROFILE
SCALE: HORZ: 1" = 20'
VERT: 1" = 20'

## (X) KEY NOTES

1. CONSTRUCT ASPHALT CONCRETE PER DETAIL 4 ON SHEET 8.
2. CONSTRUCT CAST–IN–PLACE CONCRETE PER DETAIL 8 ON SHEET 8.
3. CONSTRUCT CONCRETE ABUTMENT.
4. INSTALL PRE–CAST CONCRETE PLANKS PER DETAIL 1 AND 2 ON SHEET 7.
5. CONSTRUCT BOARDING FLOATS PER DETAILS ON SHEET 9 AND SHEET 10
6. INSTALL CLASS 2000 RIP RAP.
7. INSTALL STEEL PILE.

SCALE 1 INCH = 20 FEET
20 0 20 40

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

BY | REVISIONS | DATE
FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY CV
DESIGNED BY RM
DRAWN BY TK
DATE 12/02/2015

30% DESIGN NOT FOR CONSTRUCTION
ENGINEER

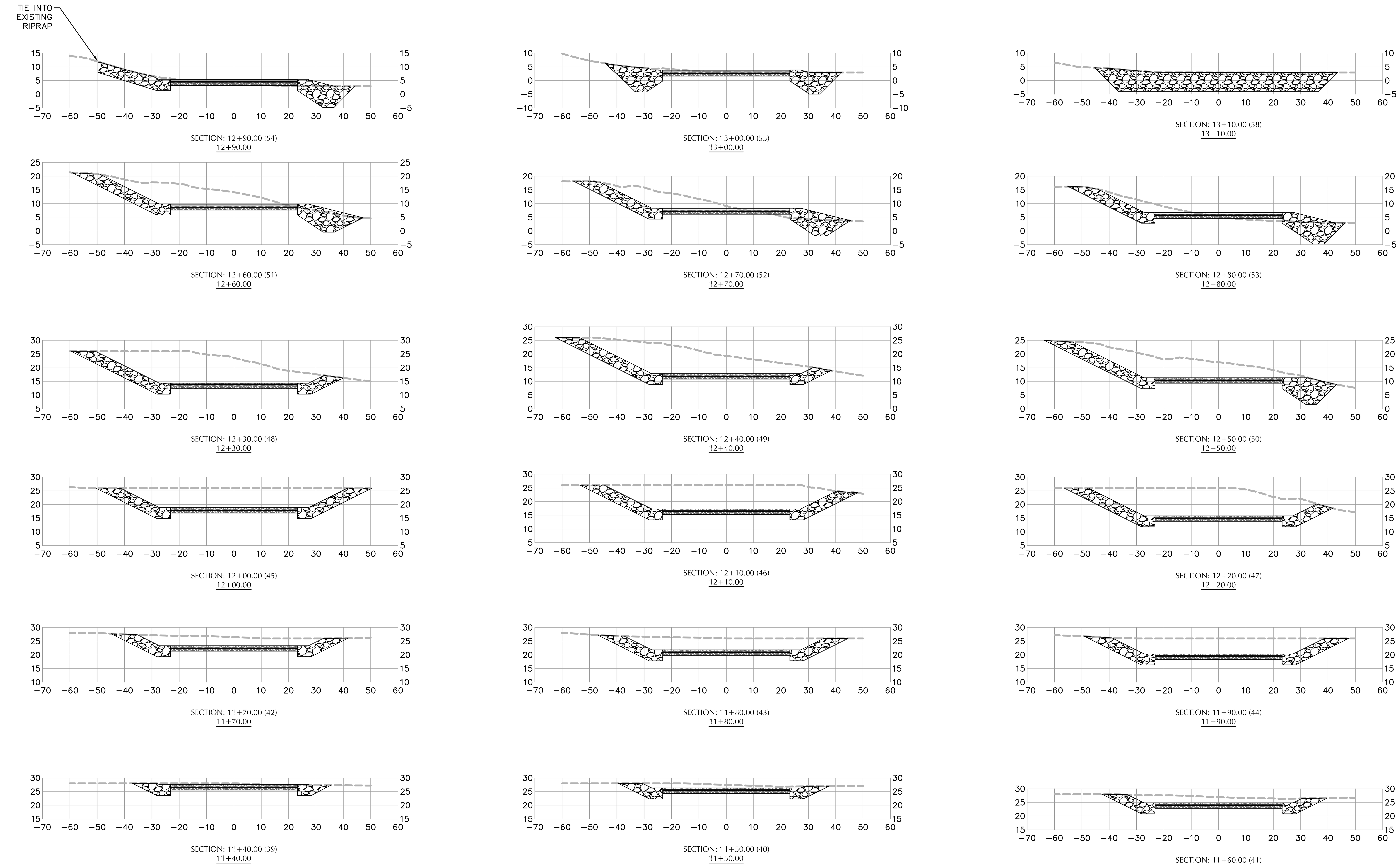
OREGON CITY

# RAMP PLAN & PROFILE
AT CLACKAMETTE PARK CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

SHEET 5 OF 10

DRAWING NO. 0302 - 1514 - 5




## RAMP SECTIONS

SCALE: HORZ: 1" = 20'
VERT: 1" = 20'

kpff

111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

| BY | REVISIONS | DATE |
|---|---|---|
| | | |

FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER CV
FINAL CHECK BY RM
DESIGNED BY TK
DRAWN BY
DATE 12/02/2015

30% DESIGN NOT FOR CONSTRUCTION

ENGINEER

OREGON CITY

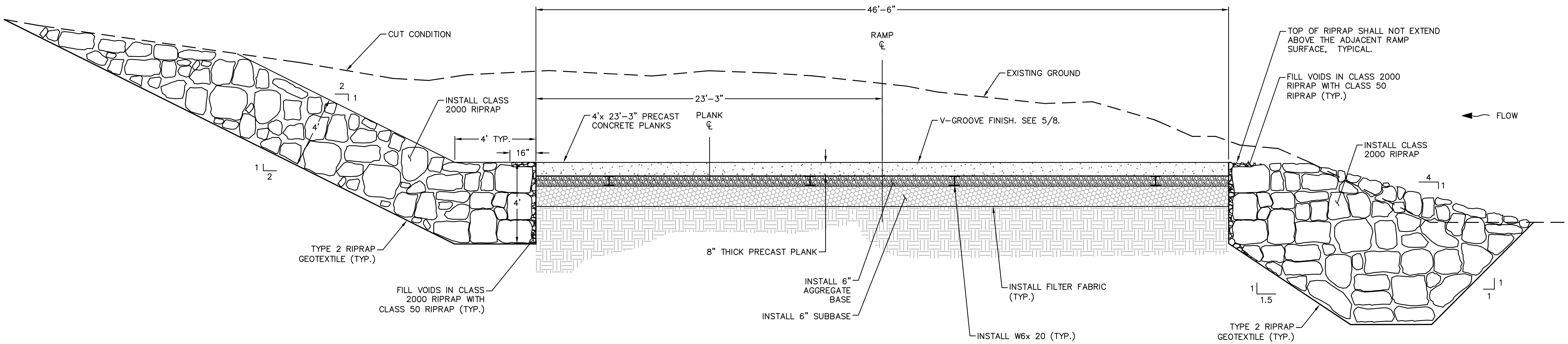
# SECTIONS

AT CLACKAMETTE PARK CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

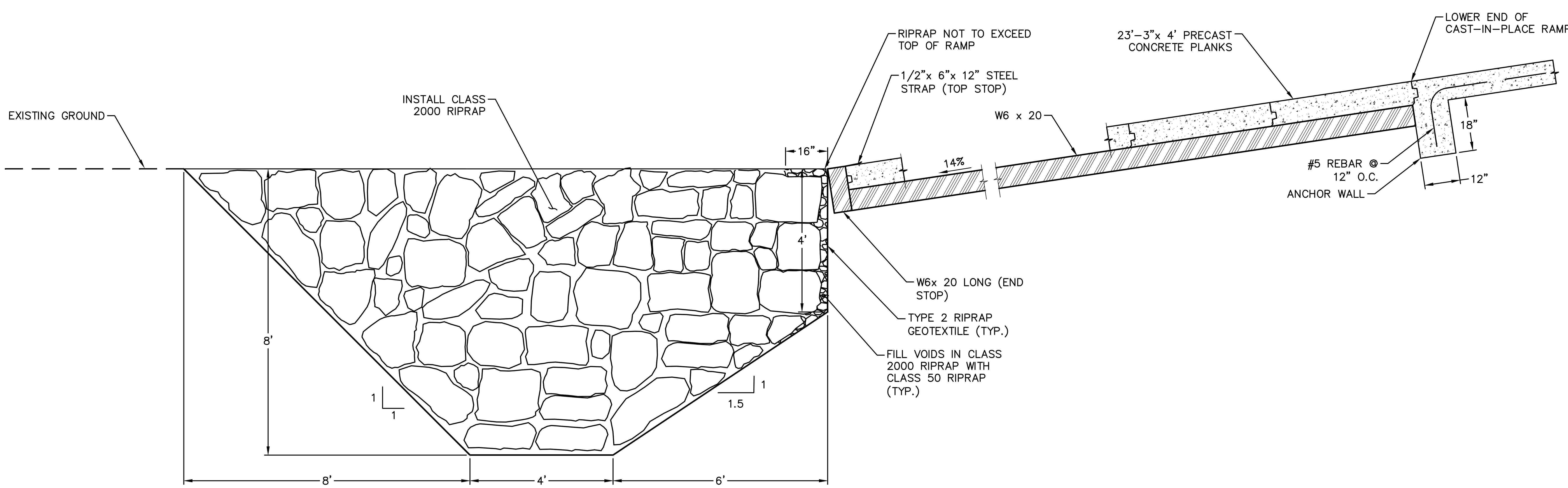
CITY OF OREGON CITY

SHEET 6 OF 10

0302 - 1514 - 6
DRAWING NO.




1 PRE-CAST PLANK SECTION
SCALE: NTS




2 PRECAST PLANK/BEAM PROFILE
SCALE: NTS

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

REVISIONS | DATE | BY

FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER
CV
FINAL CHECK BY
RM
DESIGNED BY
TK
DRAWN BY
12/02/2015
DATE

30% DESIGN
NOT FOR CONSTRUCTION
ENGINEER

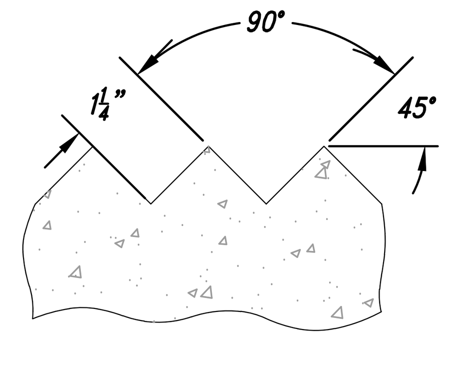
OREGON CITY

DETAILS
AT CLACKAMETTE PARK CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

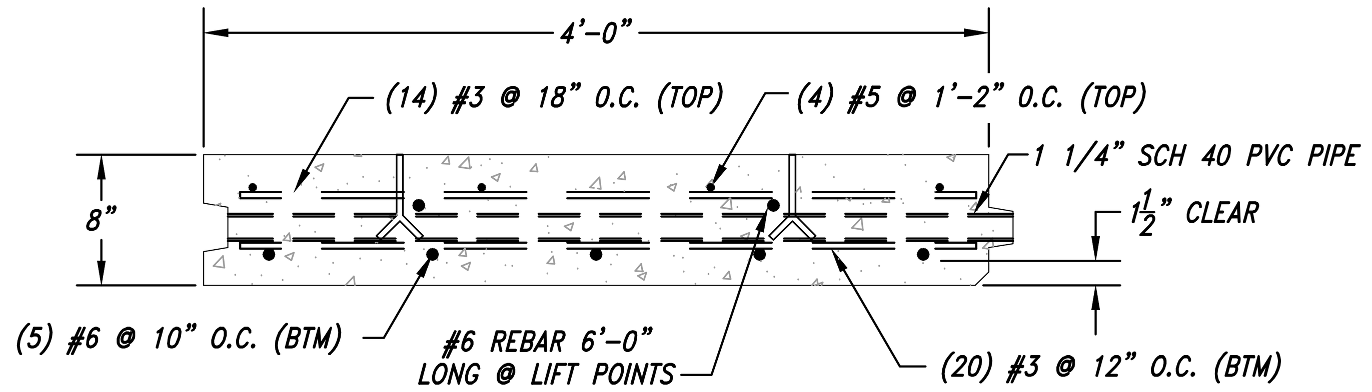
CITY OF OREGON CITY

7 SHEET 10 OF
0302 - 1514 - 7
DRAWING NO.

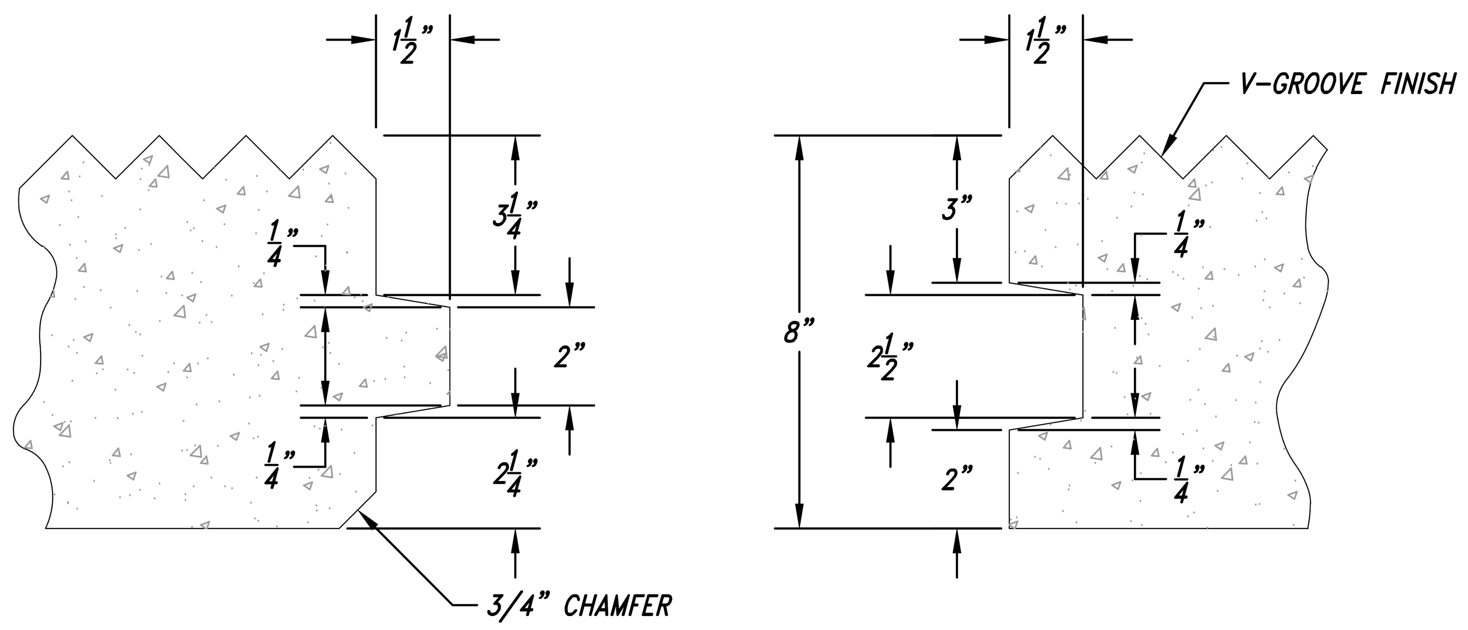
File: N:\c\p\2015\31517-Clackamette-Park-Boat-Ramp\CAD\PLOT\5171-07-DT.dwg TAB: 7
Plotted: 4/15/16 at 7:51am By: TKetchum




5 V-GROOVE DETAIL
SCALE: NTS

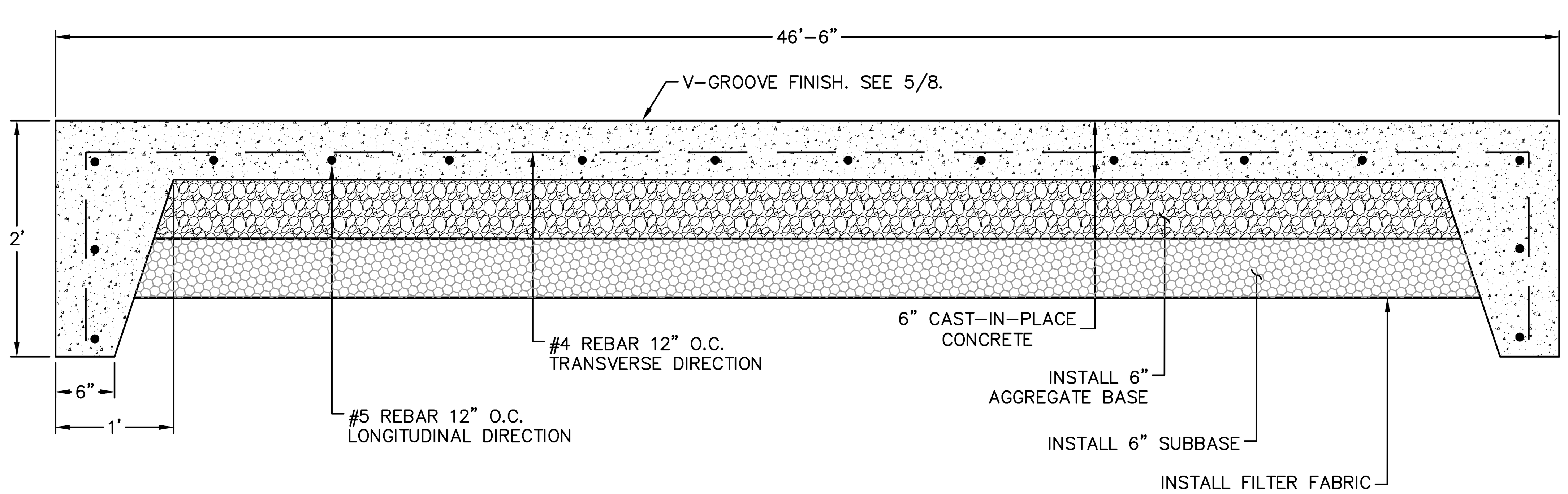



6 SECTION
SCALE: NTS

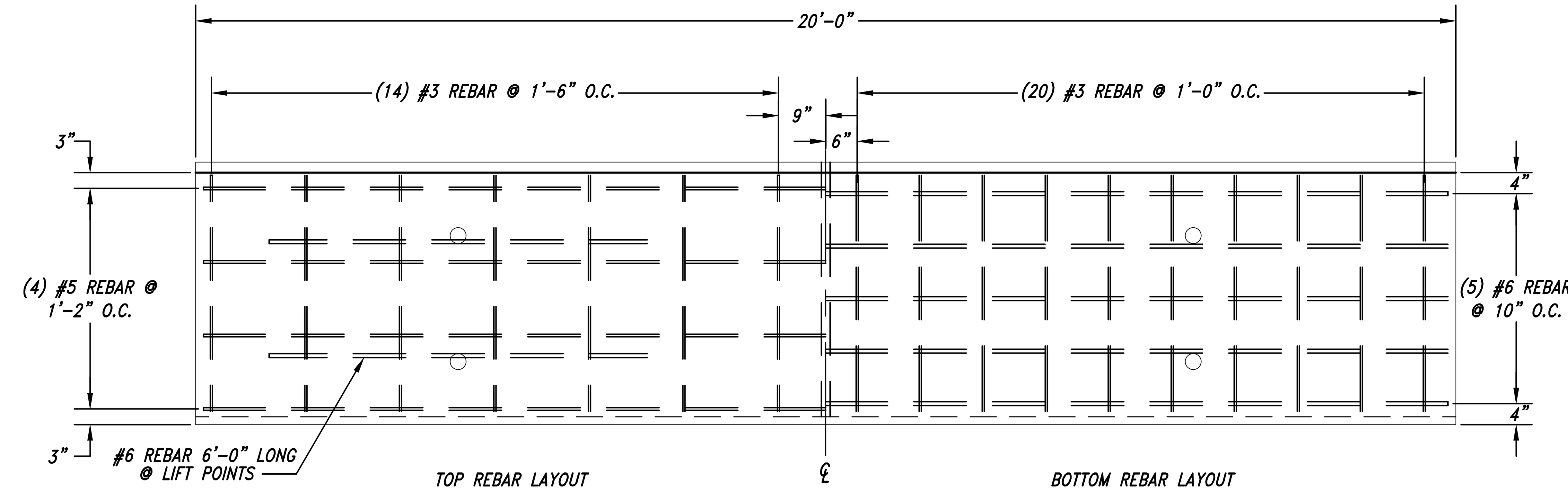



7 TONGUE & GROOVE DETAIL
SCALE: NTS

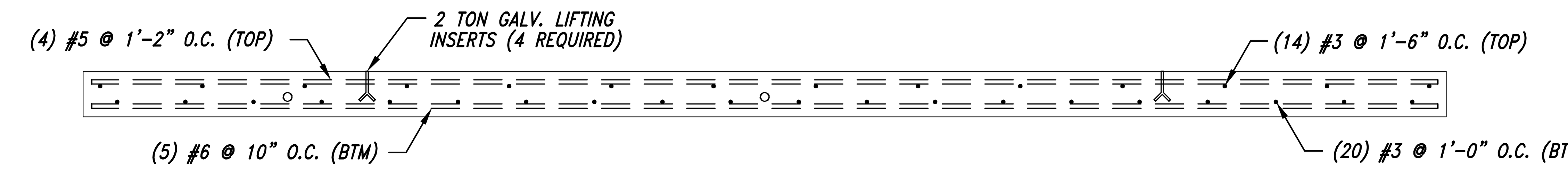
NOTE: PLANKS SHALL BE MANUFACTURED IN A PURPOSE-BUILT FORM WITH THE V-GROOVES CAST DURING PRODUCTION. HAND FINISHING IS NOT ALLOWED.



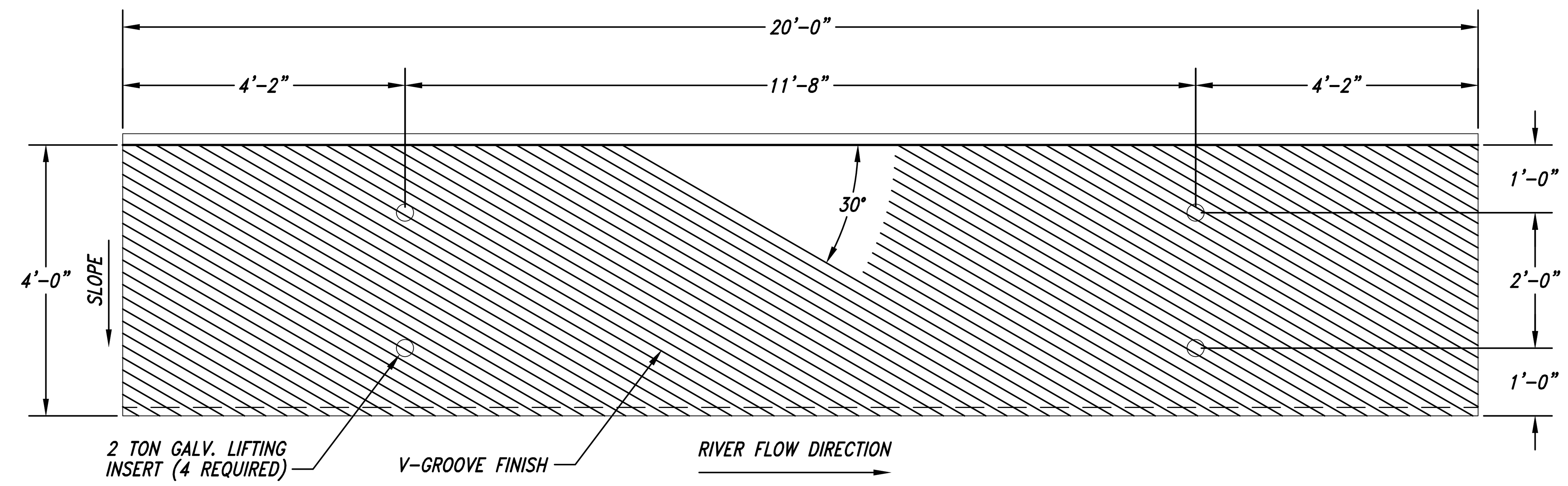

8 CAST-IN-PLACE SECTION
SCALE: NTS



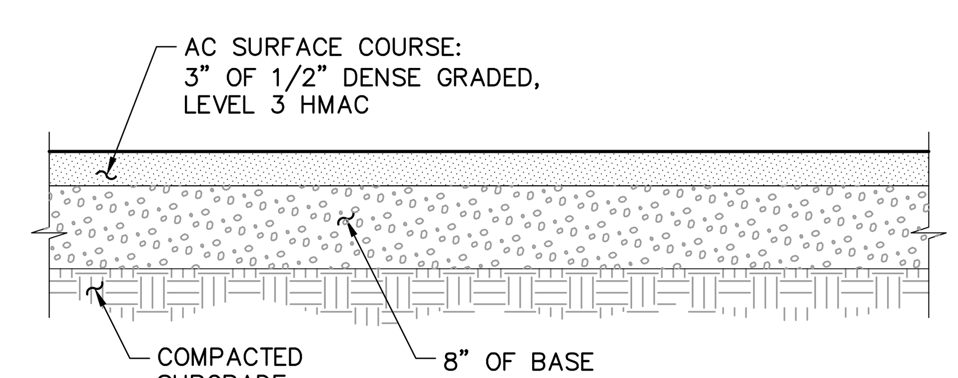

1 REBAR SCHEDULE - PLAN
SCALE: NTS




2 REBAR SCHEDULE - PROFILE
SCALE: NTS




3 LIFTING INSERT LOCATION
SCALE: NTS




4 ASPHALT PAVEMENT SECTION
SCALE: NTS

kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com

| REVISIONS | DATE | BY |
|---|---|---|
| | | |

FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER
CV
FINAL CHECK BY
RM
DESIGNED BY
TK
DRAWN BY
12/02/2015
DATE

30% DESIGN
NOT FOR
CONSTRUCTION
ENGINEER

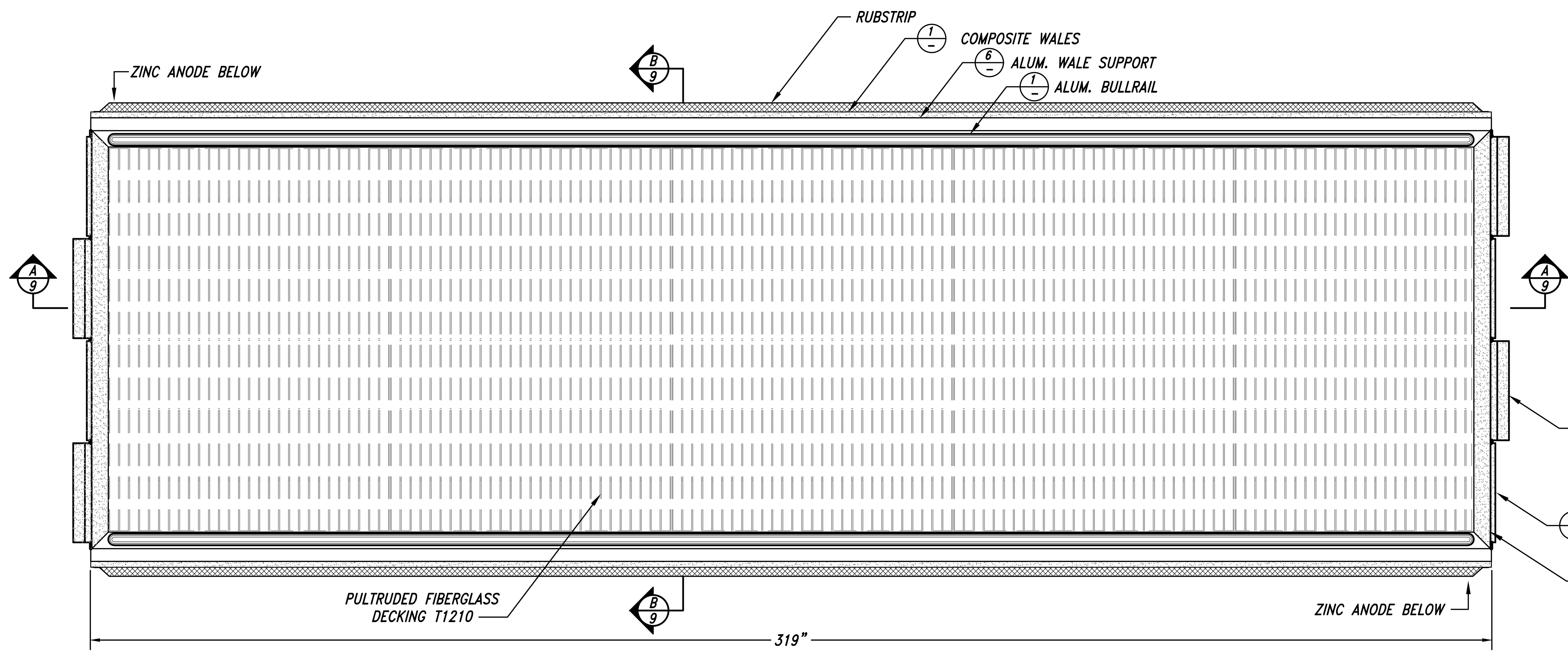
OREGON CITY

DETAILS
AT CLACKAMETTE PARK CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

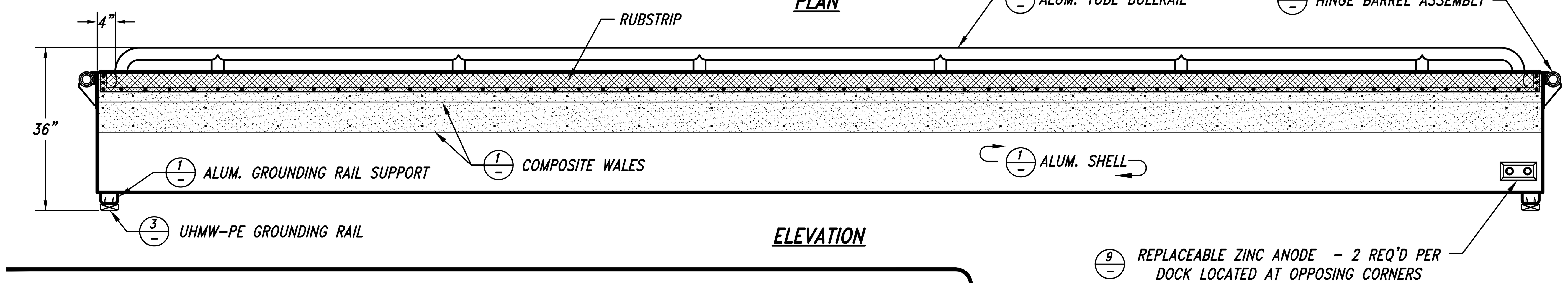
CITY OF OREGON CITY

8 SHEET 10 OF
0302 - 1514 - 8
DRAWING NO.

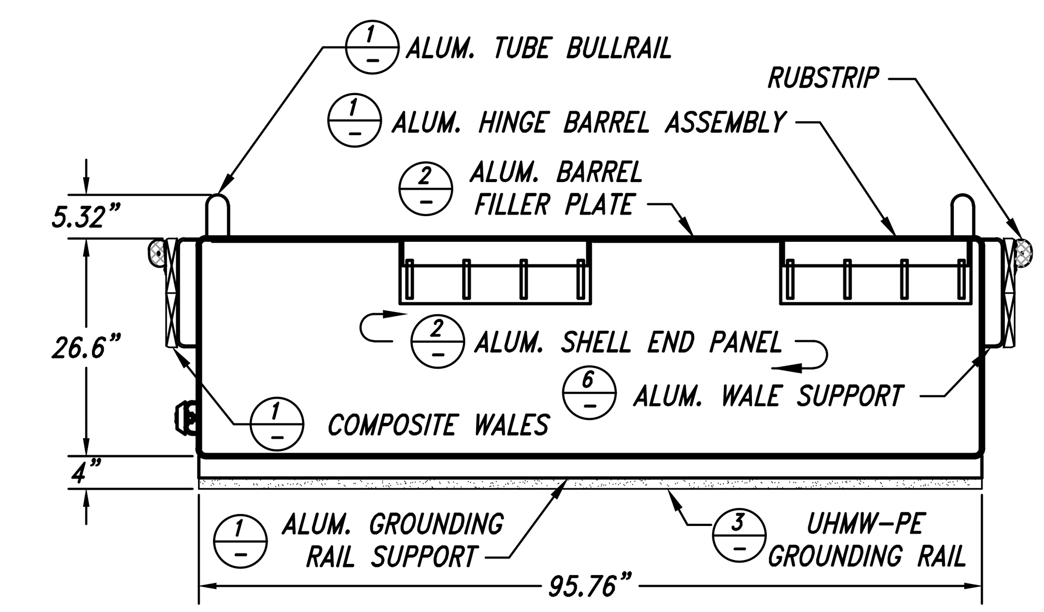
File: N:\c\p\2015\31571-Clackamette-Park-Boat-Ramp\CAD\PLOT\5171-07-DT.dwg TAB:8
Plotted: 4/15/16 at 7:51am By: TKetchum




**PLAN**



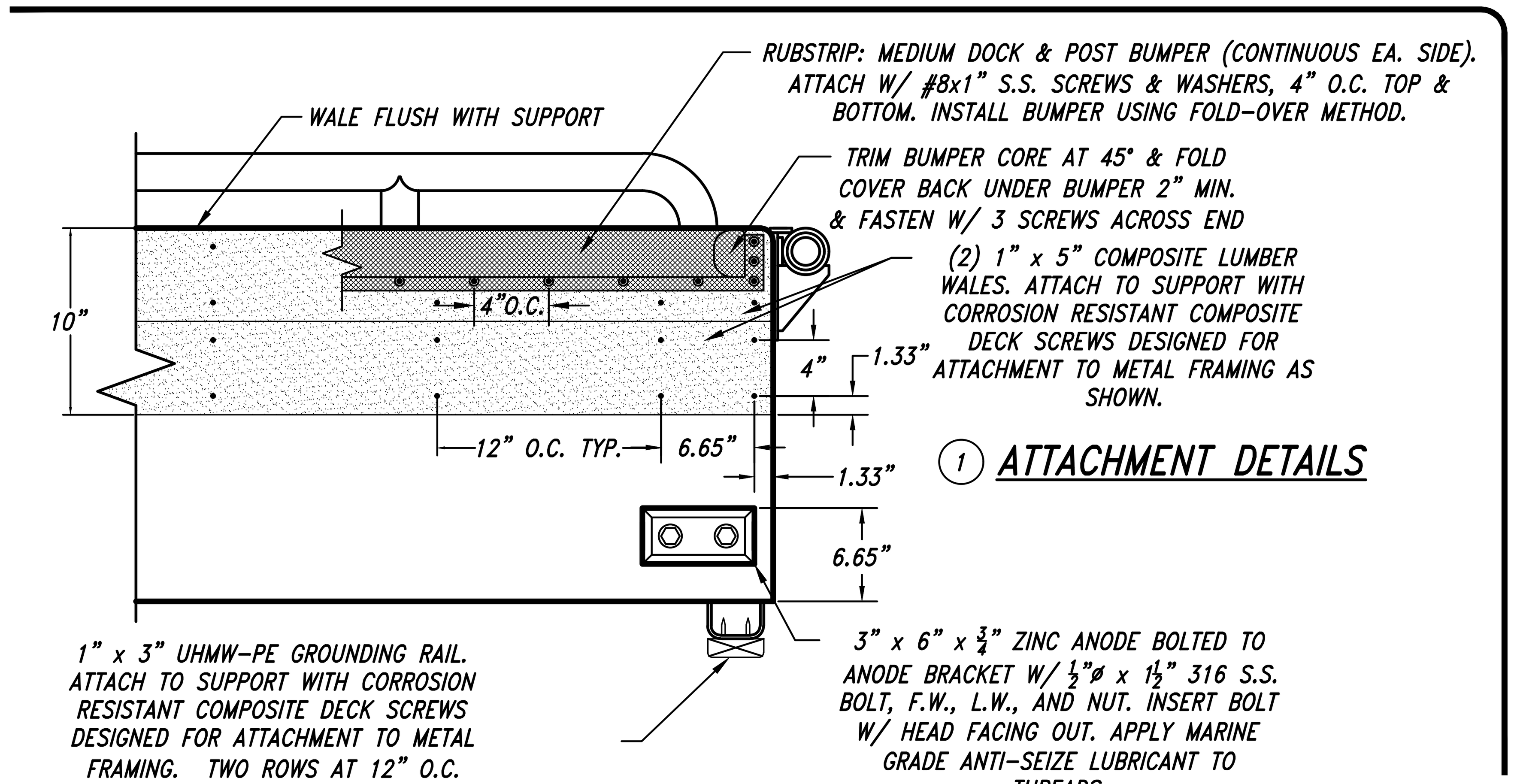

**ELEVATION**




**END**

**QUANTITIES: (X TOTAL)**
QTY (X) REQUIRED AS SHOWN
QTY (X) REQUIRED WITH EXTERNAL PILE HOOP ASSEMBLY
ONE (1) REQUIRED WITH NO HINGE BARREL ASSEMBLY ON ONE END
ONE (1) REQUIRED WITH TRANSITION PLATE HINGE ASSEMBLY ON ONE END

**NOTES:**
1. ALL PLATE, FLAT BAR, AND FORMED SHAPES SHALL BE 5086 ALUMINUM ALLOY PER SPECIFICATIONS.
2. ALL ROUND TUBE SHALL BE 6061 ALUMINUM ALLOY PER SPECIFICATIONS.




1 ATTACHMENT DETAILS

**ANTICIPATED ASSEMBLY SEQUENCE:**

1. FABRICATE SHELL
2. INSTALL SHELL END PANELS
3. INSTALL GROUNDING RAIL SUPPORTS & GROUNDING RAILS
4. INSTALL BULKHEADS
5. INSTALL BOTTOM STIFFENERS
6. INSTALL END STIFFENERS
7. INSTALL BULLRAIL GUSSETS
8. INSTALL WALE SUPPORTS & ANODE BRACKETS
9. INSTALL HINGE BARREL ASSEMBLIES & FILLER PLATES
10. INSTALL BULLRAILS
11. SANDBLAST HINGE BARRELS AND ADJACENT SHELL FLANGE
12. APPLY BARRIER COATING PRIOR TO PLACING CONCRETE
13. INSTALL CONCRETE BALLAST
14. INSTALL FOAM FLOATATION
15. INSTALL & SECURE TOP COVERS
16. INSTALL & SECURE TOP COVER SPACERS
17. INSTALL DECK SUPPORTS
18. INSTALL DECKING
19. INSTALL WALES
20. INSTALL RUBSTRIPS
21. INSTALL ZINC ANODES

1 ALUMINUM BOARDING DOCK (TYPE "A" DOCK)
SCALE: NTS

kpff

111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com



File: N:\c\p\2015\315171-Clackamette-Park-Boat-Ramp\CAD\PLOT\5171-07-DT.dwg TAB:9
Plotted: 4/13/16 at 9:29am By: TKetchum

DATE | REVISIONS | BY
FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER CV
FINAL CHECK BY RM
DESIGNED BY TK
DRAWN BY
DATE 12/02/2015

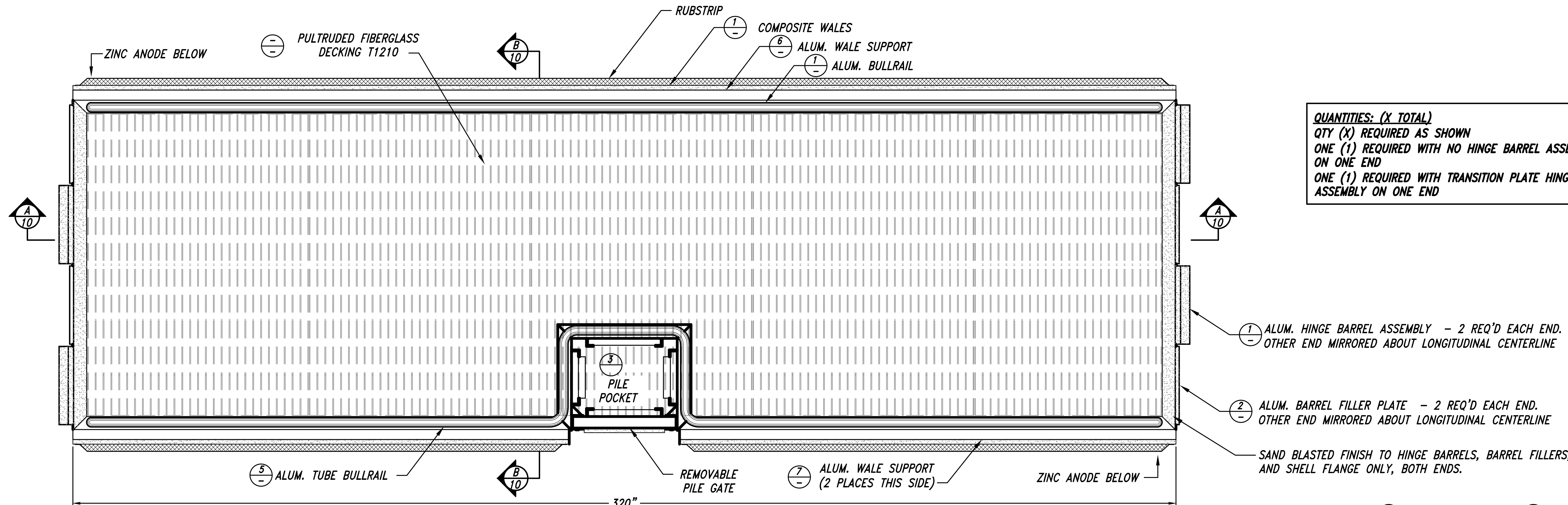
30% DESIGN NOT FOR CONSTRUCTION
ENGINEER

OREGON CITY

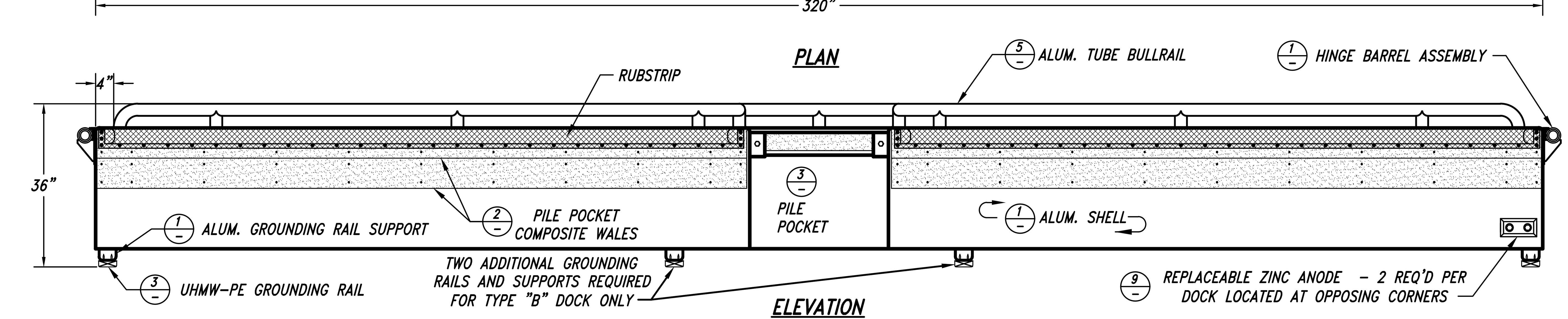
DETAILS
AT CLACKAMETTE PARK CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

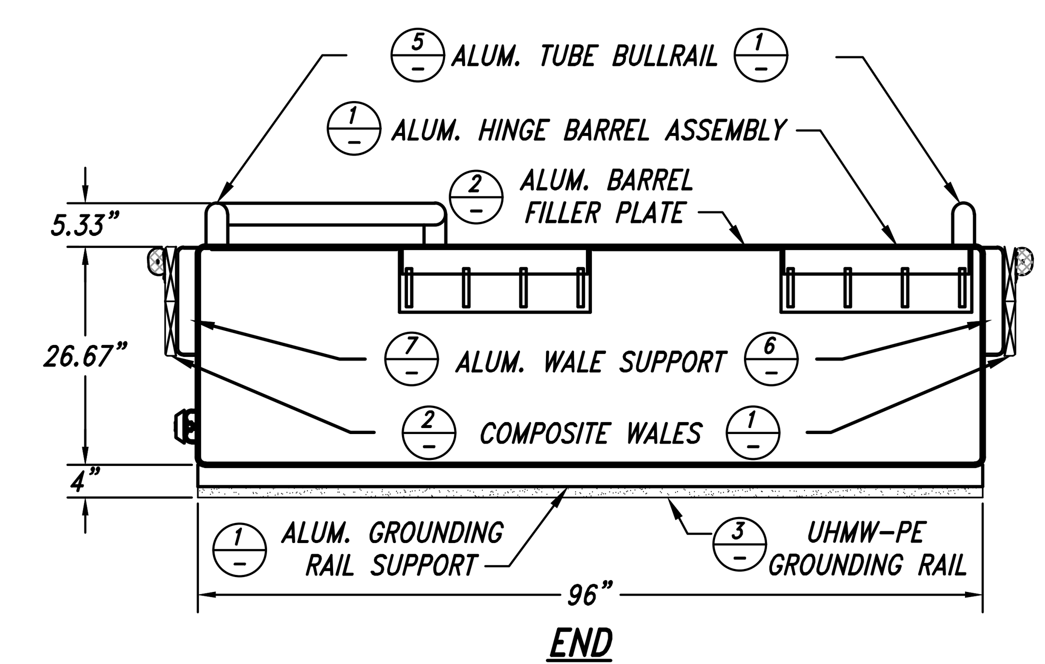
CITY OF OREGON CITY

SHEET 9 OF 10
DRAWING NO. 0302 - 1514 - 9

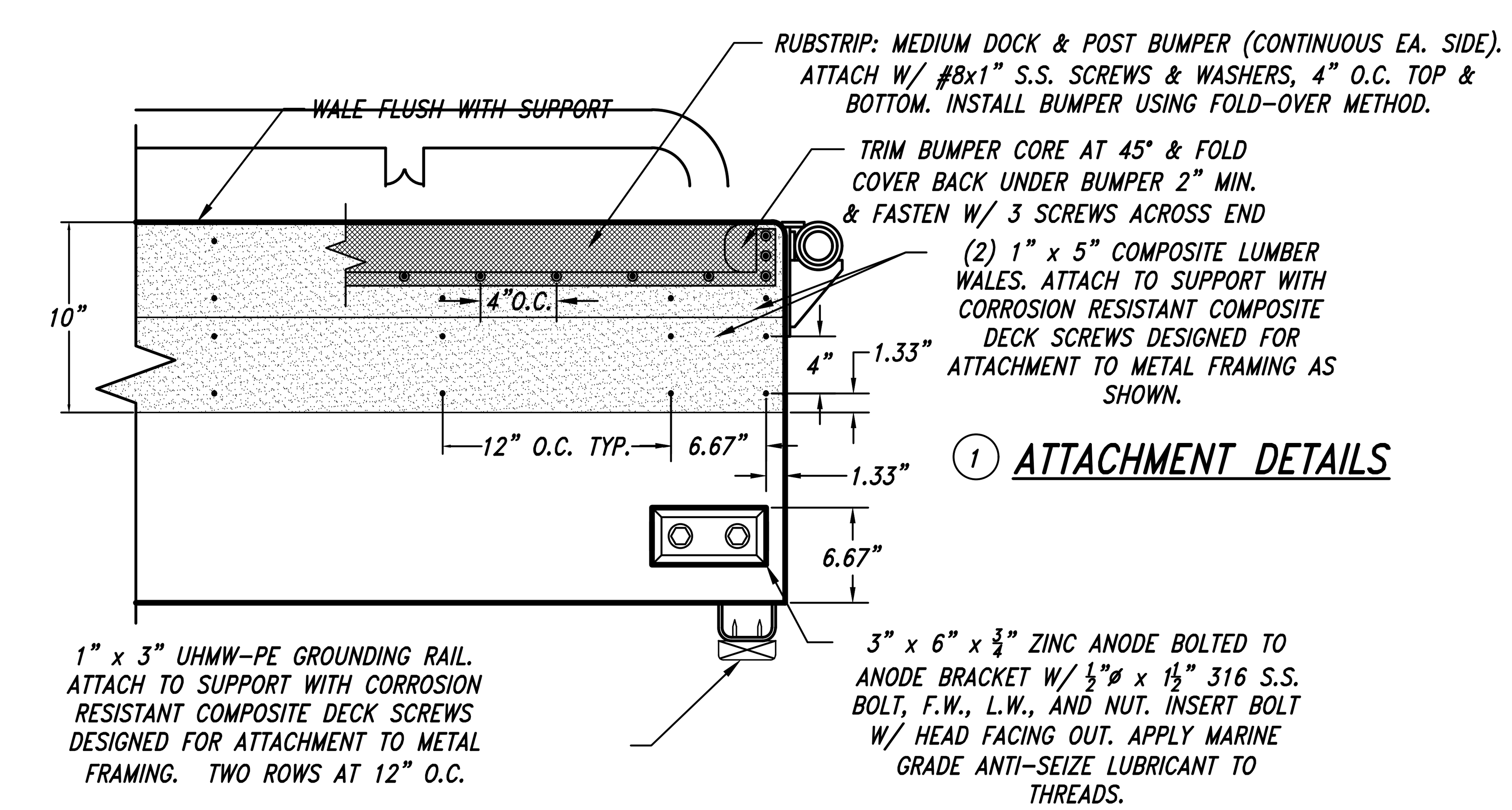



**QUANTITIES: (X TOTAL)**
QTY (X) REQUIRED AS SHOWN
ONE (1) REQUIRED WITH NO HINGE BARREL ASSEMBLY ON ONE END
ONE (1) REQUIRED WITH TRANSITION PLATE HINGE ASSEMBLY ON ONE END




**NOTES:**
1. ALL PLATE, FLAT BAR, AND FORMED SHAPES SHALL BE 5086 ALUMINUM ALLOY PER SPECIFICATIONS.
2. ALL ROUND TUBE SHALL BE 6061 ALUMINUM ALLOY PER SPECIFICATIONS.




① ATTACHMENT DETAILS

**ANTICIPATED ASSEMBLY SEQUENCE:**

1. FABRICATE SHELL
2. INSTALL SHELL END PANELS
3. INSTALL GROUNDING RAIL SUPPORTS & GROUNDING RAILS
4. INSTALL BULKHEADS
5. INSTALL BOTTOM STIFFENERS
6. INSTALL END STIFFENERS
7. INSTALL BULLRAIL GUSSETS
8. INSTALL WALE SUPPORTS & ANODE BRACKETS
9. INSTALL HINGE BARREL ASSEMBLIES & FILLER PLATES
10. INSTALL BULLRAILS
11. SANDBLAST HINGE BARRELS AND ADJACENT SHELL FLANGE
12. APPLY BARRIER COATING PRIOR TO PLACING CONCRETE
13. INSTALL CONCRETE BALLAST
14. INSTALL FOAM FLOATATION
15. INSTALL & SECURE TOP COVERS
16. INSTALL & SECURE TOP COVER SPACERS
17. INSTALL DECK SUPPORTS
18. INSTALL DECKING
19. INSTALL WALES
20. INSTALL RUBSTRIPS
21. INSTALL ZINC ANODES

① ALUMINUM BOARDING DOCK (TYPE "B" DOCK)
SCALE: NTS


kpff
111 SW Fifth Ave., Suite 2500
Portland, OR 97204
O: 503.227.3251
F: 503.274.4681
www.kpff.com


| REVISIONS | DATE | BY |
|---|---|---|
| | | |

FILE PATH
FILE NAME

APPROVED: BOATING FACILITIES MANAGER
FINAL CHECK BY: CV
DESIGNED BY: RM
DRAWN BY: TK
DATE: 12/02/2015

30% DESIGN
NOT FOR CONSTRUCTION
ENGINEER

OREGON CITY

# DETAILS
AT CLACKAMETTE PARK CLACKAMAS RIVER MILE 0.2
FOR THE CITY OF OREGON CITY

CITY OF OREGON CITY

SHEET 10 OF 10
DRAWING NO. 0302 - 1514 -10

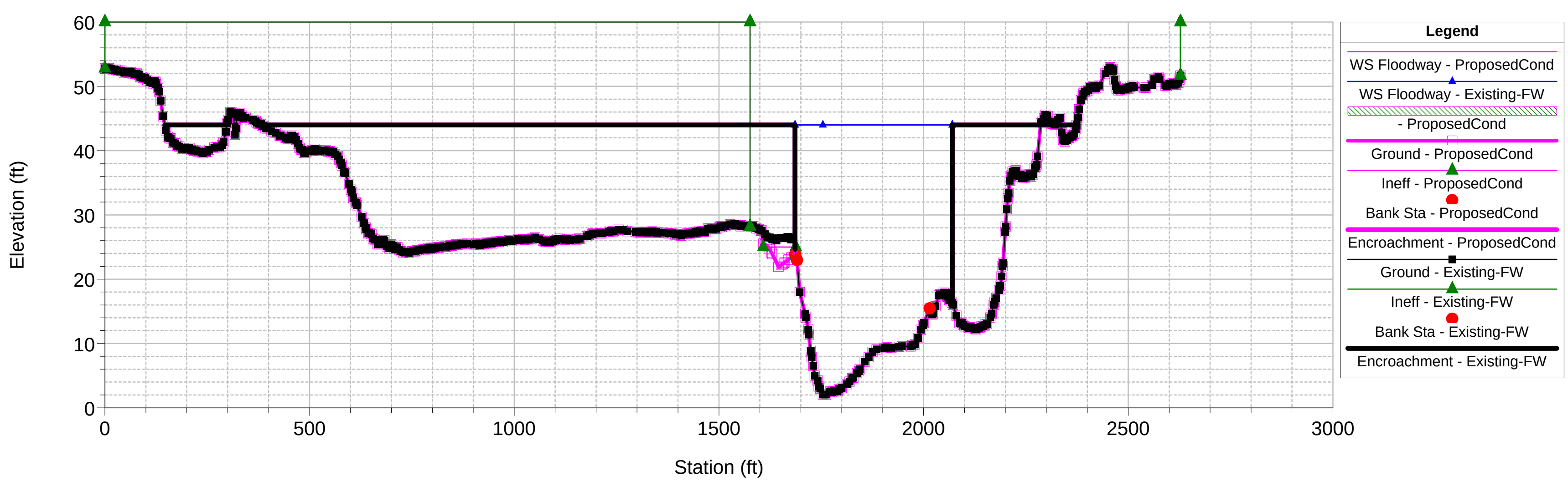

File: N:\c\p\2015\31571-Clackamette-Park-Boat-Ramp\CAD\PLOT\5171-07-DT.dwg TAB:10
Plotted: 4/13/16 at 9:28am By: TKetchum

# APPENDIX D
# HEC-RAS MODEL RESULTS

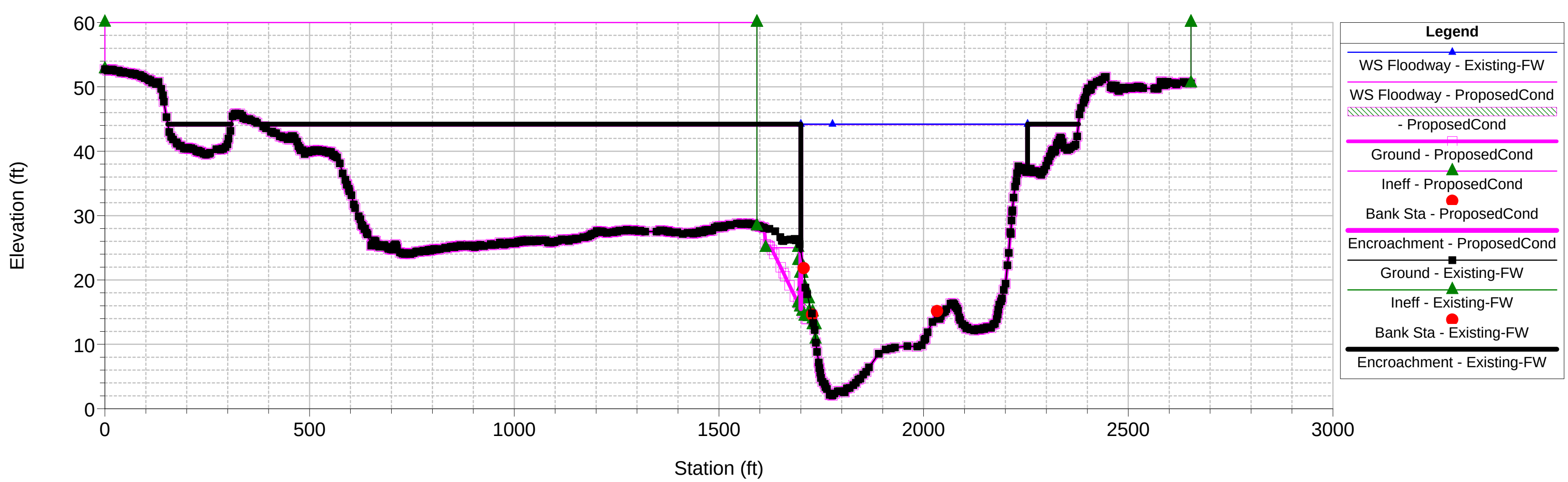
| Reach | River Sta | Profile | Plan | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ClackamasRiver | 559 | Floodway | Existing-FW | 110000 | 1.81 | 44.06 | 23.12 | 45.02 | 0.000535 | 8.4 | 17285.86 | 550 | 0.24 |
| ClackamasRiver | 559 | Floodway | ProposedCond | 110000 | 1.81 | 44.06 | 23.12 | 45.02 | 0.000535 | 8.4 | 17285.86 | 550 | 0.24 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 587 | Floodway | Existing-FW | 110000 | 2.08 | 44.11 | 22.97 | 45.04 | 0.000525 | 8.29 | 17655.37 | 551 | 0.24 |
| ClackamasRiver | 587 | Floodway | ProposedCond | 110000 | 2.08 | 44.11 | 22.97 | 45.04 | 0.000525 | 8.29 | 17655.37 | 551 | 0.24 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 615 | Floodway | Existing-FW | 110000 | 2.3 | 44.25 | 22.46 | 45.07 | 0.000457 | 7.59 | 17837.41 | 552 | 0.22 |
| ClackamasRiver | 615 | Floodway | ProposedCond | 110000 | 2.3 | 44.25 | 22.23 | 45.07 | 0.000457 | 7.65 | 18067.21 | 552 | 0.23 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 641 | Floodway | Existing-FW | 110000 | 2.16 | 44.21 | 22.67 | 45.11 | 0.000509 | 8.11 | 17801.85 | 554 | 0.24 |
| ClackamasRiver | 641 | Floodway | ProposedCond | 110000 | 2.16 | 44.21 | 22.44 | 45.1 | 0.000391 | 7.97 | 17991.43 | 554 | 0.23 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 662 | Floodway | Existing-FW | 110000 | 2.08 | 44.21 | 22.76 | 45.12 | 0.000518 | 8.14 | 17648.39 | 554 | 0.24 |
| ClackamasRiver | 662 | Floodway | ProposedCond | 110000 | 2.08 | 44.19 | 22.85 | 45.12 | 0.000413 | 8.14 | 17674.77 | 554 | 0.24 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 682 | Floodway | Existing-FW | 110000 | 2.07 | 44.21 | 22.76 | 45.13 | 0.000524 | 8.19 | 17585.16 | 554 | 0.24 |
| ClackamasRiver | 682 | Floodway | ProposedCond | 110000 | 2.07 | 44.17 | 22.86 | 45.14 | 0.000521 | 8.46 | 17602.87 | 554 | 0.25 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 703 | Floodway | Existing-FW | 110000 | 2.05 | 43.99 | 23.36 | 45.25 | 0.000663 | 9.15 | 13240.93 | 384 | 0.27 |
| ClackamasRiver | 703 | Floodway | ProposedCond | 110000 | 2.05 | 43.99 | 23.4 | 45.24 | 0.000631 | 9.1 | 13241.49 | 384 | 0.27 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 723 | Floodway | Existing-FW | 110000 | 1.98 | 44.36 | 23.19 | 45.29 | 0.000529 | 8.25 | 17602.31 | 560 | 0.24 |
| ClackamasRiver | 723 | Floodway | ProposedCond | 110000 | 1.98 | 44.35 | 23.19 | 45.28 | 0.00053 | 8.25 | 17596.25 | 560 | 0.24 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 786 | Floodway | Existing-FW | 110000 | 2.14 | 44.31 | 23.83 | 45.36 | 0.000582 | 8.75 | 16903.57 | 570 | 0.25 |
| ClackamasRiver | 786 | Floodway | ProposedCond | 110000 | 2.14 | 44.3 | 23.83 | 45.35 | 0.000582 | 8.75 | 16897.38 | 570 | 0.25 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 980 | Floodway | Existing-FW | 110000 | 0.9 | 44.58 | 23.8 | 45.48 | 0.000505 | 8.18 | 18631.08 | 610 | 0.24 |
| ClackamasRiver | 980 | Floodway | ProposedCond | 110000 | 0.9 | 44.57 | 23.8 | 45.47 | 0.000506 | 8.18 | 18624.61 | 610 | 0.24 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 993 | Floodway | Existing-FW | 110000 | -1.17 | 44.57 | 23.75 | 45.5 | 0.000519 | 8.34 | 18710.04 | 612 | 0.24 |
| ClackamasRiver | 993 | Floodway | ProposedCond | 110000 | -1.17 | 44.55 | 23.75 | 45.49 | 0.00052 | 8.35 | 18703.53 | 612 | 0.24 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1010 | Floodway | Existing-FW | 110000 | 0.78 | 44.56 | 24.73 | 45.51 | 0.00056 | 8.45 | 18417.58 | 615 | 0.25 |
| ClackamasRiver | 1010 | Floodway | ProposedCond | 110000 | 0.78 | 44.55 | 24.73 | 45.5 | 0.00056 | 8.46 | 18411.04 | 615 | 0.25 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1017 | Floodway | Existing-FW | 110000 | 0.56 | 44.58 | 24.67 | 45.52 | 0.000545 | 8.33 | 18420.66 | 617 | 0.24 |
| ClackamasRiver | 1017 | Floodway | ProposedCond | 110000 | 0.56 | 44.57 | 24.67 | 45.51 | 0.000546 | 8.33 | 18414.1 | 617 | 0.24 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1033 | Floodway | Existing-FW | 110000 | 1.24 | 44.59 | 25.02 | 45.53 | 0.000551 | 8.36 | 18528.17 | 620 | 0.25 |
| ClackamasRiver | 1033 | Floodway | ProposedCond | 110000 | 1.24 | 44.58 | 25.02 | 45.52 | 0.000552 | 8.36 | 18521.59 | 620 | 0.25 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1052 | Floodway | Existing-FW | 110000 | 2.57 | 44.6 | 24.58 | 45.54 | 0.000563 | 8.46 | 18622.76 | 624 | 0.25 |
| ClackamasRiver | 1052 | Floodway | ProposedCond | 110000 | 2.57 | 44.58 | 24.58 | 45.53 | 0.000564 | 8.46 | 18616.14 | 624 | 0.25 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1061 | Floodway | Existing-FW | 110000 | 2.66 | 44.6 | 25.46 | 45.55 | 0.000603 | 8.56 | 18689.41 | 627 | 0.25 |
| ClackamasRiver | 1061 | Floodway | ProposedCond | 110000 | 2.66 | 44.59 | 25.46 | 45.54 | 0.000604 | 8.56 | 18682.75 | 627 | 0.25 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1084 | Floodway | Existing-FW | 110000 | 3.99 | 44.67 | 24.29 | 45.56 | 0.000525 | 8.24 | 19164.9 | 632 | 0.24 |
| ClackamasRiver | 1084 | Floodway | ProposedCond | 110000 | 3.99 | 44.66 | 24.29 | 45.55 | 0.000526 | 8.24 | 19158.24 | 632 | 0.24 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1391 | Floodway | Existing-FW | 110000 | -0.31 | 44.75 | 22.54 | 45.82 | 0.000556 | 8.78 | 16810.54 | 585 | 0.25 |
| ClackamasRiver | 1391 | Floodway | ProposedCond | 110000 | -0.31 | 44.74 | 22.54 | 45.82 | 0.000557 | 8.78 | 16804.44 | 585 | 0.25 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1490 "A" | | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1625 | Floodway | Existing-FW | 110000 | -4.09 | 45.39 | 18.88 | 46.09 | 0.000331 | 6.88 | 17313.29 | 513.56 | 0.19 |
| ClackamasRiver | 1625 | Floodway | ProposedCond | 110000 | -4.09 | 45.38 | 18.88 | 46.08 | 0.000332 | 6.88 | 17308.21 | 513.55 | 0.19 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 1861 | Floodway | Existing-FW | 110000 | 4.87 | 45.2 | 25.64 | 46.33 | 0.000675 | 8.52 | 13098.8 | 421.57 | 0.26 |
| ClackamasRiver | 1861 | Floodway | ProposedCond | 110000 | 4.87 | 45.19 | 25.64 | 46.32 | 0.000675 | 8.52 | 13094.58 | 421.55 | 0.26 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 2050 | Floodway | Existing-FW | 110000 | 6.09 | 45.52 | 26.37 | 46.46 | 0.000583 | 7.84 | 14420.58 | 497.8 | 0.25 |
| ClackamasRiver | 2050 | Floodway | ProposedCond | 110000 | 6.09 | 45.51 | 26.37 | 46.45 | 0.000583 | 7.84 | 14415.71 | 497.77 | 0.25 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 2430 | Floodway | Existing-FW | 110000 | 6.47 | 45.65 | 26.31 | 46.75 | 0.000672 | 8.5 | 13858.45 | 544 | 0.26 |
| ClackamasRiver | 2430 | Floodway | ProposedCond | 110000 | 6.47 | 45.64 | 26.31 | 46.74 | 0.000672 | 8.5 | 13853.22 | 544 | 0.26 |
| | | | | | | | | | | | | | |
| ClackamasRiver | 2801 "B" | Floodway | Existing-FW | 110000 | 7.8 | 45.89 | 27.77 | 47.01 | 0.000726 | 8.53 | 13322.8 | 477 | 0.27 |
| ClackamasRiver | 2801 "B" | Floodway | ProposedCond | 110000 | 7.8 | 45.89 | 27.77 | 47 | 0.000727 | 8.53 | 13318.34 | 477 | 0.27 |

# APPENDIX E
# EXISTING AND PROPOSED HEC-RAS MODEL CROSS SECTIONS

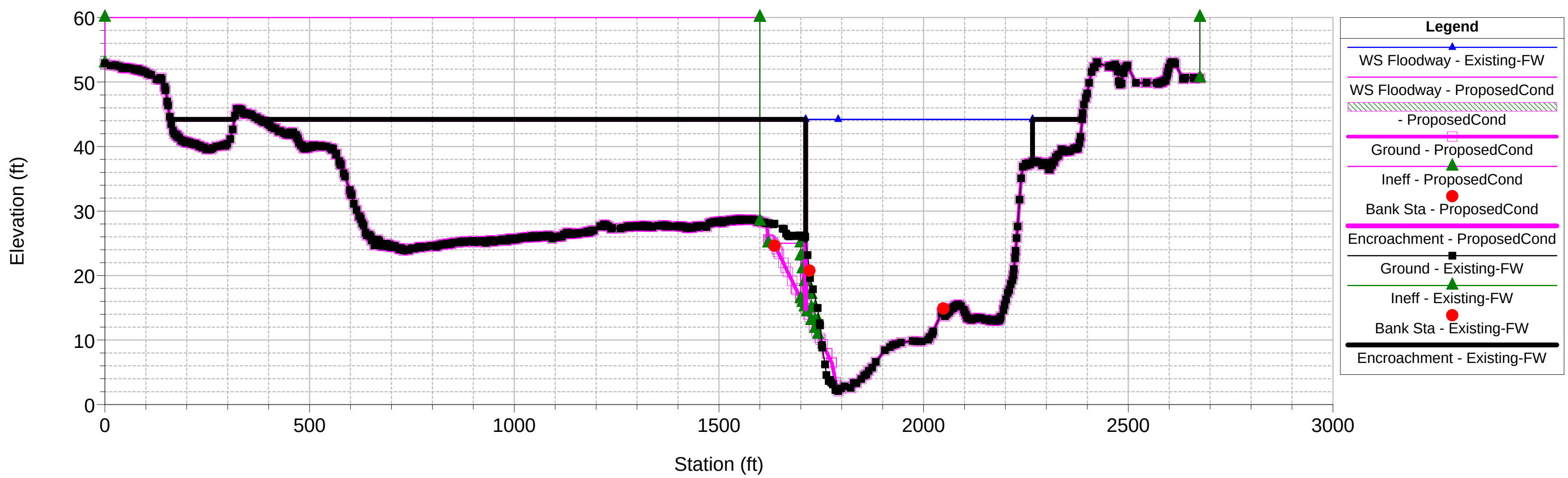
AngledBoatRamp Plan: 1) Existing-FW 2) ProposedCond
River = ClackamasRiver Reach = ClackamasRiver RS = 703



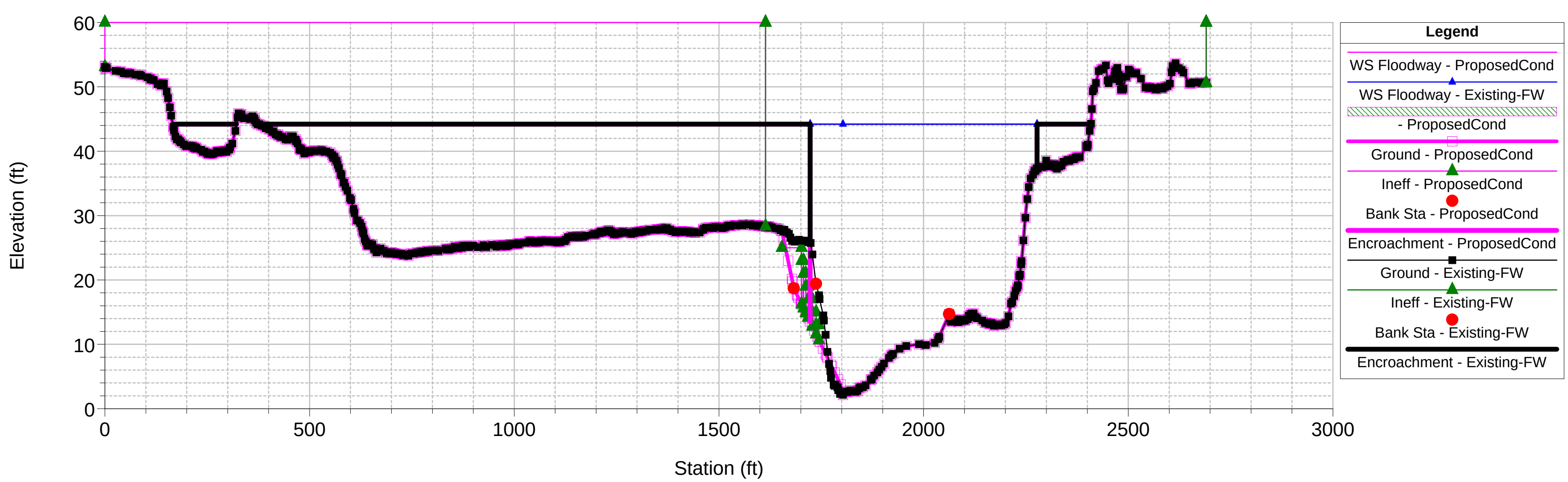

AngledBoatRamp Plan: 1) Existing-FW 2) ProposedCond
River = ClackamasRiver Reach = ClackamasRiver RS = 682

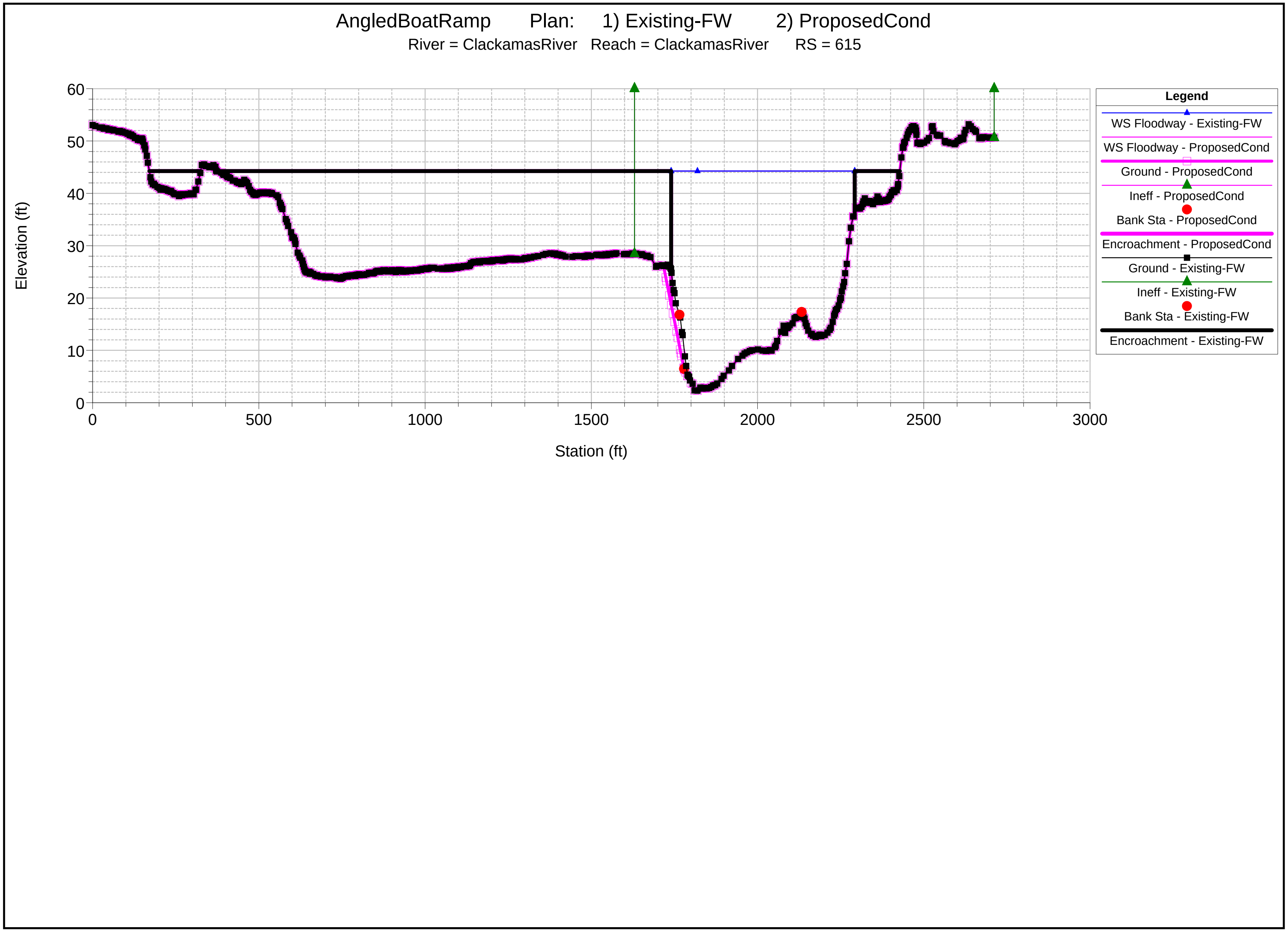


AngledBoatRamp Plan: 1) Existing-FW 2) ProposedCond
River = ClackamasRiver Reach = ClackamasRiver RS = 662




AngledBoatRamp Plan: 1) Existing-FW 2) ProposedCond
River = ClackamasRiver Reach = ClackamasRiver RS = 641




AngledBoatRamp Plan: 1) Existing-FW 2) ProposedCond
River = ClackamasRiver Reach = ClackamasRiver RS = 615
Elevation (ft)
Station (ft)
0
10
20
30
40
50
60
0
500
1000
1500
2000
2500
3000
Legend
WS Floodway - Existing-FW
WS Floodway - ProposedCond
Ground - ProposedCond
Ineff - ProposedCond
Bank Sta - ProposedCond
Encroachment - ProposedCond
Ground - Existing-FW
Ineff - Existing-FW
Bank Sta - Existing-FW
Encroachment - Existing-FW