Meeting of the Central Valley Flood Protection Board
March 22, 2013

Staff Report – Encroachment Permit

Reclamation District 2035
Woodland/Davis/RD-2035 Sacramento River Joint Intake Project, Yolo County

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1.0 – ITEM

Consider approval of Permit No. 18763 (Attachment B)

2.0 – APPLICANT

Reclamation District 2035

3.0 – LOCATION

The project is located on right (west) bank of the Sacramento River at River Mile 70.8 in Yolo County. (Sacramento River, Yolo County, See Attachment A)

4.0 – DESCRIPTION

To remove the existing RD 2035 pump station facility and construct a new pump station facility with fish screen intake and appurtenant structures.

5.0 – PROJECT ANALYSIS

In 2009, the Woodland-Davis Clean Water Agency (WDCWA) was formed to construct, operate, and maintain the Davis Woodland Water Supply Project (DWWSP). The DWWSP includes a Sacramento River intake structure, transmission pipelines and a new water treatment plant to provide a new surface water supply the cities of Woodland and Davis, and the University of California, Davis.

The proposed project includes the demolition of the existing Reclamation District 2035 (RD 2035) intake structure which is approximately 100-feet upstream of the proposed Sacramento River Joint Intake pumping facility that will be constructed by RD 2035 and the WDCWA. The existing intake and pumping station was constructed in 1919, before the adoption of the flood control project.

The facilities to be demolished for the project will include the existing intake facility, the caretaker house and appurtenances, and the existing electrical substation. To maintain continuous delivery service, the existing intake will be demolished after the new intake is fully operational. The existing intake is an in-river concrete structure and will be completely removed from the channel. All associated piles will be removed or cut off 3 feet below grade. The levee will be excavated to remove the existing concrete conduit and outlet structure then backfilled with suitable material. An existing PG&E electrical substation will be demolished after the existing pump station is fully operational.

The proposed Sacramento River Joint Intake facility will include a 400 cfs capacity screened intake and integrally constructed pump station. The new intake will be a concrete structure, founded on driven steel piles, with 10 stainless steel wedge-wire or profile wire fish screen panels. A submersible pump and piping system will be provided to re-suspend sediment to prevent its accumulation.

The pump station building will be a split-face concrete masonry unit (CMU) with a flat roof and 42-inch parapet walls. The pump station will house five 80 cfs capacity vertical pumps for RD 2035’s agricultural uses and four 20.6 cfs capacity vertical pumps for WDCWA’s municipal uses. The combined outflow of the facility will not exceed its 400 cfs design capacity. A 1.25 megawatt (MW) emergency generator will be included to provide backup power for the facility.

Space on the landside of the levee adjacent to the discharge pipelines has been reserved for a chemical feed building. It is anticipated that permanganate or other oxidant may be fed to the municipal pipelines from this location to provide manganese control. The building could also be used to provide chemical storage and feed facilities for invasive mussel or clam control, if required.

Five 42-inch-diameter steel discharge pipelines will exit the pump station above grade and be encased in reinforced concrete to pass under County Road 117. The pipelines will pass under the road, with the underside of their encasement at the Sacramento River levee 100-year flood elevation (Flow = 107,000 cfs), and continue sloping downward to the outlet structure at the RD-2035 Main Canal. Two 36-inch-diameter discharge pipelines will follow the same alignment as the five 42 inch diameter lines, however after passing over the levee and under the road, these two 36-inch diameter pipelines will be routed southwest under and across the adjacent Sierra Northern Railroad right of way where they will be capped. These pipelines will eventually tie in to the proposed WDCWA raw water pipelines that will feed the proposed WDCWA water treatment plant near Woodland.

The proposed Sacramento River Joint Intake will conform to all California Code of Regulations, Title 23 Standards.

5.1 – Hydraulic Analysis

West Yost Associates conducted a two dimensional hydraulic analysis for the proposed project that resulted in a technical memorandum dated March 19, 2012 and an addendum to the technical memorandum dated December 21, 2012. The addendum was written to address comments and recommendations received at a meeting between the applicant, Central Valley Flood Protection Board (CVFPB) Staff, and United States Army Corps of Engineers (USACE) staff. The purpose of this hydraulic analysis was to evaluate the potential impacts from the proposed facility on river flows and water surface elevations.

RiverFLO-2D software was used to develop a two-dimensional hydrodynamic model of the Sacramento River from 1000 feet downstream of the Interstate 5 Bridge to 1.6 miles upstream of the proposed intake. When developing the model, West Yost utilized previously obtained topographic and bathymetric mapping of the river prepared by the USACE for this area. Nine cross sections were obtained during a recent survey in 2010 and these closely matched the USACE mapping. The topographic and bathymetric mapping provided data for the entire river bed and subsequently was used for developing the 2-dimesnsional model.

The calibration of the hydraulic model involved adjusting the Manning's n values of the main channel and overbank areas, and adjusting the downstream water surface elevation (WSEL) boundary condition. The model was calibrated for the design flow of 107,000 cfs and the observed flow of 15,800 cfs that occurred on September 25, 2010 to achieve WSEL's consistent with the surveyed WSEL's and the USACE design profile.

The model was evaluated at the design flow of 107,000 cfs for the following conditions:

- No-Intake Condition – existing intake removed from the model
- Existing Condition – current conditions with the existing intake
- Construction Condition – existing intake, sheet pile wall around the construction site, and riprap along the face of the sheet pile wall
- Joint Intake Condition – with-project condition

The “No-Intake” condition was used as a baseline condition to analyze the hydraulic impacts of the existing intake and the proposed intake independently. Compared to the baseline, the existing intake resulted in a maximum WSE increase of 0.37-feet. The with-project condition resulted in a maximum WSE increase of 0.19-feet. Utilizing the baseline condition approach, the proposed project will lower the maximum WSE by approximately 0.18-feet from existing conditions. All hydraulic impacts are localized and considered to be insignificant.

5.2 – Geotechnical Analysis

A geotechnical investigation of the subsurface materials and conditions was completed by Taber Consultants. The purpose of this study was to provide geotechnical data for use in planning and design of the proposed project. Information on the nature and distribution of subsurface materials and conditions was obtained for this project by means of six logged and sampled angered/rotary drilled test borings, three electronic cone penetrometer tests, one flat-plate dilatometer tests and four impact driven probes.

The study concluded that the site is adequately stable with soil support available for the proposed structures.

6.0 – AGENCY COMMENTS AND ENDORSEMENTS

The comments and endorsements associated with this project from all pertinent agencies are shown below:

- The applicant is the local maintaining agency for the project area.

- The U.S. Army Corps of Engineers comment letter has been received for this application. The District Engineer has no objection to the project, subject to conditions. This letter has been incorporated into the permit as Exhibit A.

7.0 – CEQA ANALYSIS

Board staff has prepared the following California Environmental Quality Act (CEQA) determination:

The Board, as a responsible agency under CEQA, has reviewed Initial Study/Mitigated

Negative Declaration (IS/MND) (SCH Number: 2003102095, August 2012) and Mitigation Measures for the RD 2035/Woodland Davis Clean Water Agency Joint Intake and Fish Screen Project prepared by the lead agency, Reclamation District 2035. These documents, including project design, may be viewed or downloaded from the Central Valley Flood Protection Board website at http://www.cvfpb.ca.gov/meetings/2013/3-22-2013.cfm under a link for this agenda item. These documents are also available for review in hard copy at the Board and the RD 2035 offices.

RD 2035 determined that the project would not have a significant effect on the environment on August 28, 2012 with Resolution 2012-003 and filed a Notice of Determination on August 31, 2012 with the State Clearinghouse. Board staff finds that although the proposed project could have a potentially significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. The project proponent has incorporated mandatory mitigation measures into the project plans to avoid identified impacts or to mitigate such impacts to a point where no significant impacts will occur. These mitigation measures are included in the project proponent's IS/MND and address impacts to aesthetics, air quality, biological resources, cultural resources, hazards and hazardous materials, hydrology and water quality, geology and soil resources, and noise. The description of the mitigation measures are further described in the adopted IS/MND.

8.0 – SECTION 8610.5 CONSIDERATIONS

1. Evidence that the Board admits into its record from any party, State or local public agency, or nongovernmental organization with expertise in flood or flood plain management:

   The Board will make its decision based on the evidence in the permit application and attachments, this staff report, and any other evidence presented by any individual or group.

2. The best available science that related to the scientific issues presented by the executive officer, legal counsel, the Department or other parties that raise credible scientific issues.

   In making its findings the Board has used the best available science relating to the scientific and technical issues presented by all parties. The accepted industry standards for the work proposed under this permit as regulated by California Code of Regulations Title 23 have been applied to the review of this application.

3. Effects of the decision on the entire State Plan of Flood Control:

   The proposed project will include the removal of an outdated intake facility from the system and replace it with a new intake facility. The Sacramento River Joint Intake will be an improvement from the existing condition. The hydraulic and hydrologic impacts to the State Plan of Flood Control are considered to be insignificant and the project is consistent with the Central Valley Flood Protection Plan.

4. Effects of reasonable projected future events, including, but not limited to, changes in hydrology, climate, and development within the applicable watershed:

   There will be no effects to the proposed project from reasonable projected future events.

9.0 – STAFF RECOMMENDATION

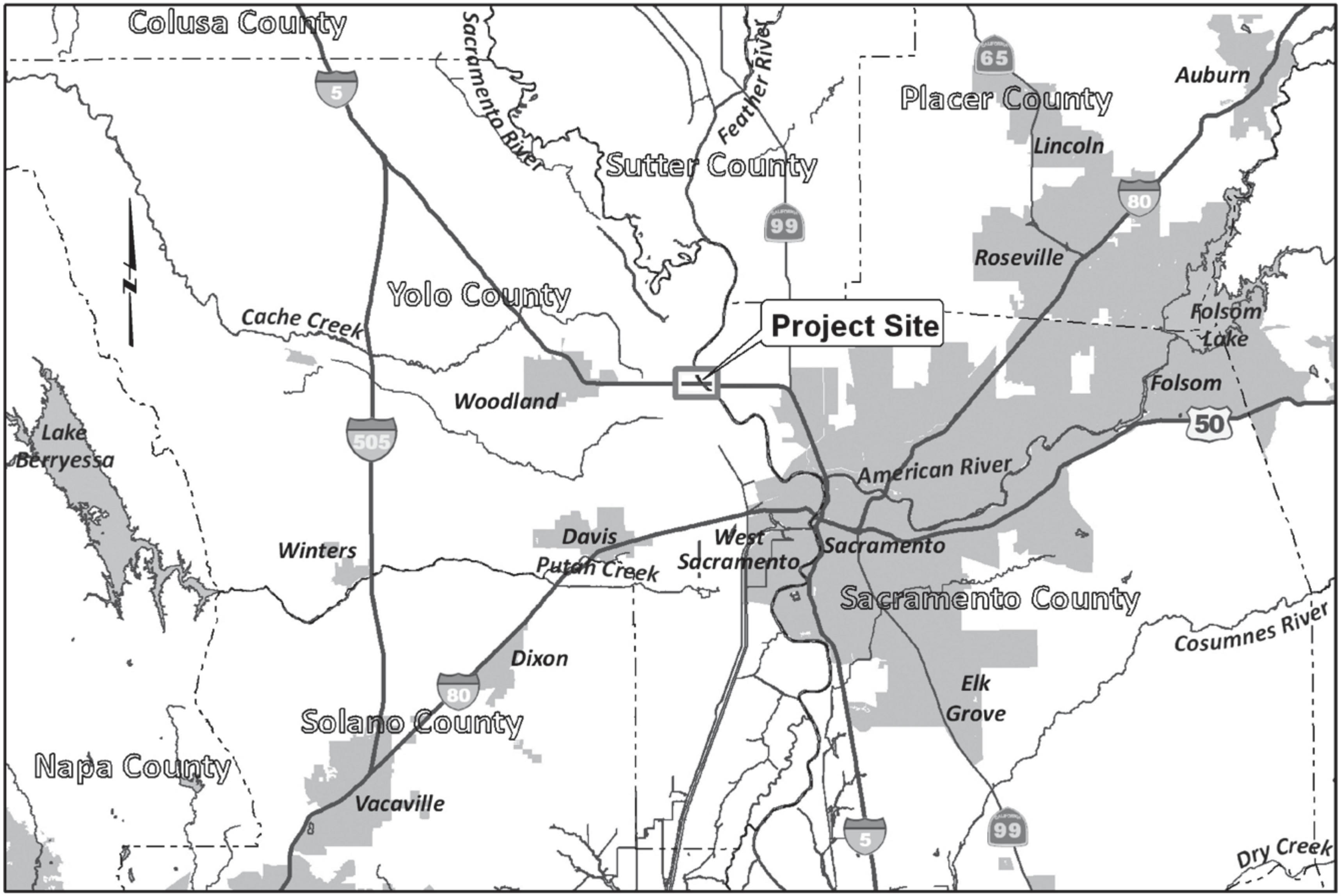
Staff recommends that the Board adopt the CEQA findings, approve the permit, and direct staff to file a Notice of Determination with the State Clearinghouse.

10.0 – LIST OF ATTACHMENTS

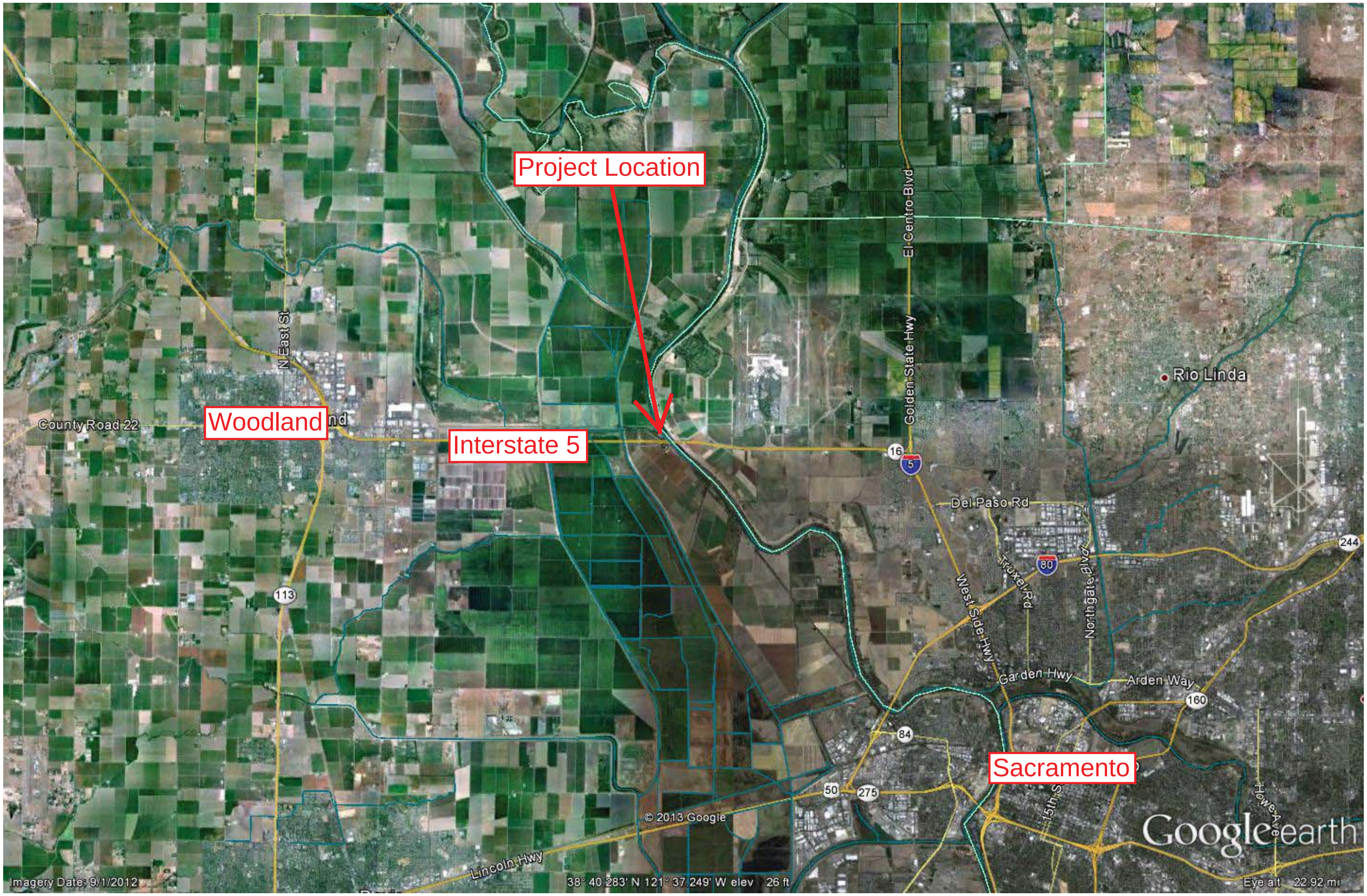
A. Location Maps and Photos
B. Draft Permit No. 18804
C. Project Plans
D. Hydraulic Technical Memorandum
E. Addendum to Hydraulic Technical Memorandum

Design Review:	Ashley Cousin
Environmental Review:	James Herota, Andrea Mauro
Document Review:	Gary Lemon P.E., Mitra Emami P.E., Len Marino P.E.

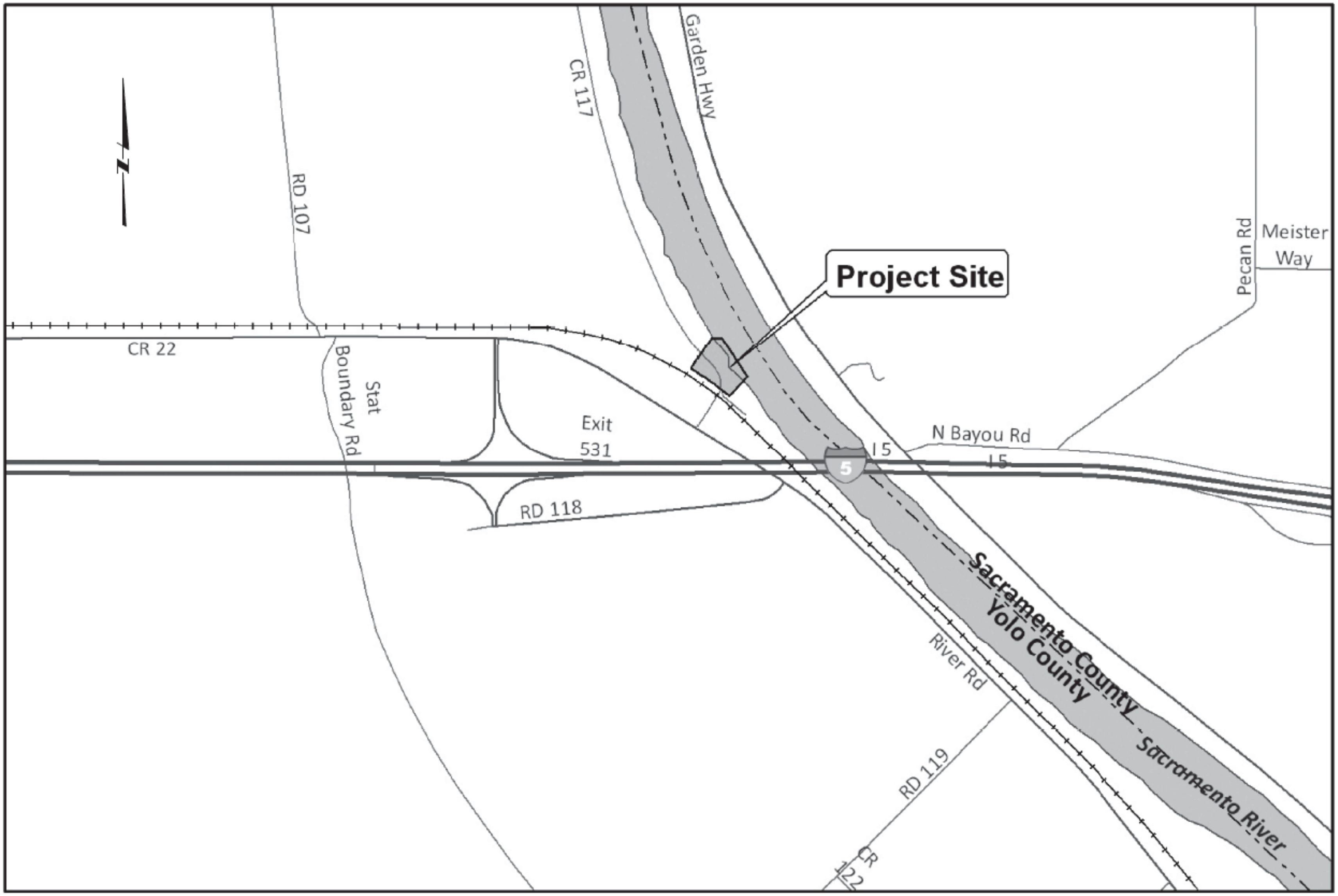
Project Vicinity Map



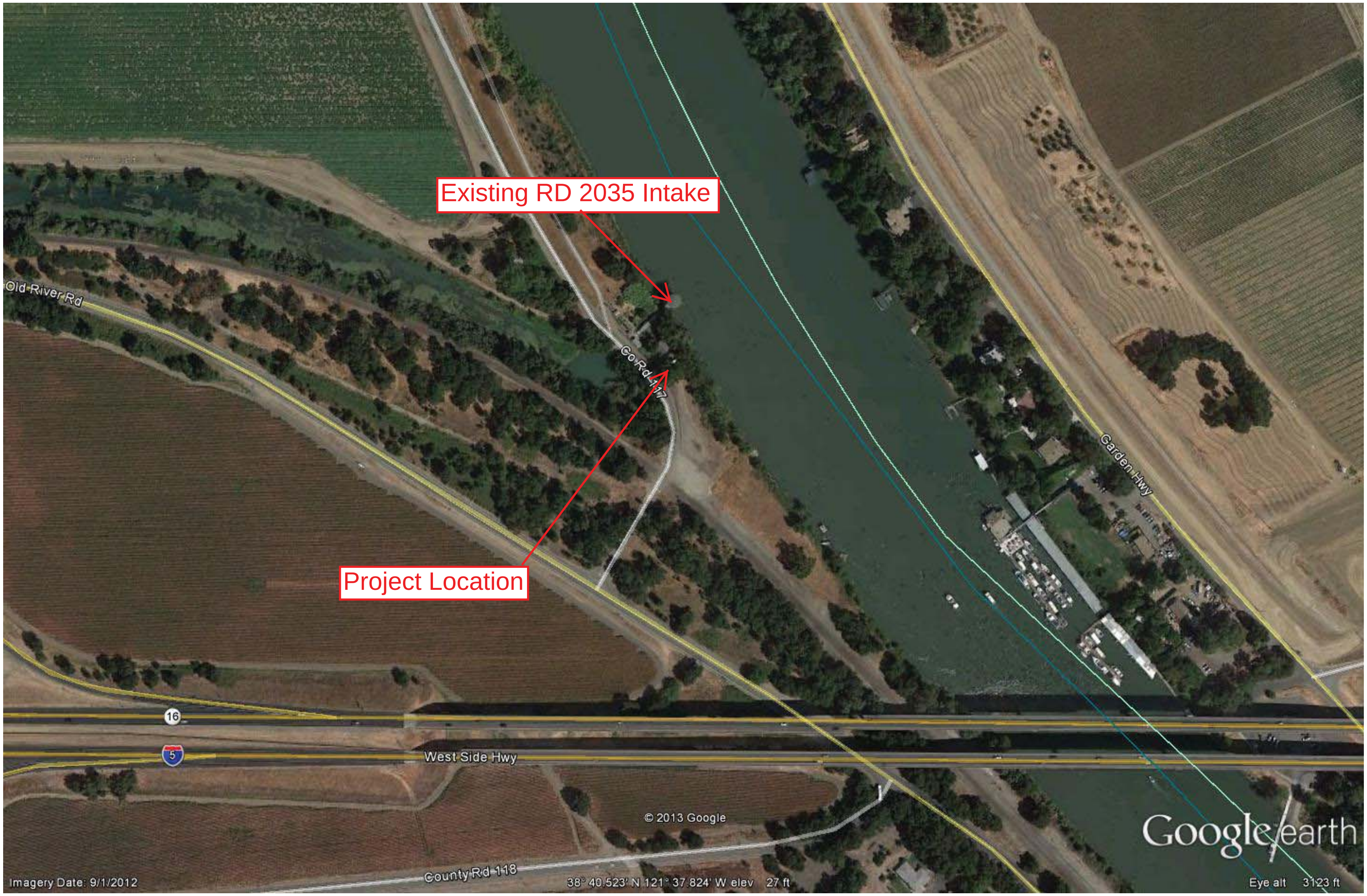
Project Vicinity Map



Project Location Map



Project Location Map



RD2035 & WOODLAND DAVIS CLEAN WATER AGENCY
SACRAMENTO RIVER JOINT INTAKE PROJECT –
CVFPB ENCROACHMENT PERMIT APPLICATION
PHOTO ATTACHMENTS

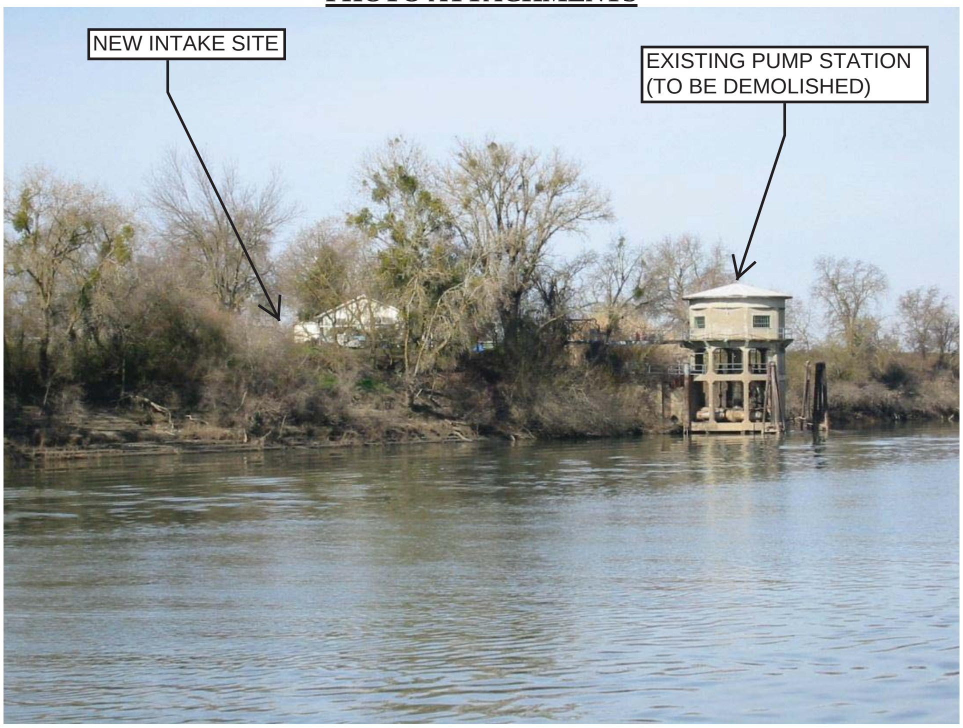


PHOTO 1 – EXISTING RD2035 PUMP STATION (TO BE DEMOLISHED) AND NEW INTAKE SITE. LOOKING WEST.

PHOTO 2 – EXISTING PUMP STATION (TO BE DEMOLISHED). VIEW FROM LEVEE CROWN. LOOKING NORTHEAST.

PHOTO 3 – EXISTING RD2035 PUMP STATION (TO BE DEMOLISHED). LOOKING EAST TOWARDS SACRAMENTO RIVER

PHOTO 4 –COUNTY ROAD 117 ON LEVEE, LOOKING NORHTWEST. APPROXIMATE AREA OF NEW PIPELINE CROSSING

PHOTO 5 – NEW INTAKE SITE. LOOKING DOWNSTREAM AT I-5 BRIDGE, SOUTHEAST.

PHOTO 6 – NEW INTAKE SITE. LOOKING EAST TOWARDS SACRAMENTO RIVER.

PHOTO 7 – TOP OF BANK AT NEW INTAKE SITE. LOOKING EAST TOWARDS SACRAMENTO RIVER

STATE OF CALIFORNIA
THE RESOURCES AGENCY

THE CENTRAL VALLEY FLOOD PROTECTION BOARD

PERMIT NO. 18763 BD

This Permit is issued to:

Reclamation District 2035
45332 County Road 25
Woodland, California 95776

To remove the existing RD 2035 pump station facility and construct a new pump station facility with fish screen intake and appurtenant structures. The project is located on right (west) bank of the Sacramento River at River Mile 70.8 in Yolo County. (Section 35, T10N, R3E, MDB&M, Reclamation District 1600, Sacramento River, Yolo County).

NOTE: Special Conditions have been incorporated herein which may place limitations on and/or require modification of your proposed project as described above.

(SEAL)

Dated: ______________________ ______________________________
Executive Officer

GENERAL CONDITIONS:

ONE: This permit is issued under the provisions of Sections 8700 – 8723 of the Water Code.

TWO: Only work described in the subject application is authorized hereby.

THREE: This permit does not grant a right to use or construct works on land owned by the Sacramento and San Joaquin Drainage District or on any other land.

FOUR: The approved work shall be accomplished under the direction and supervision of the State Department of Water Resources, and the permittee shall conform to all requirements of the Department and The Central Valley Flood Protection Board.

FIVE: Unless the work herein contemplated shall have been commenced within one year after issuance of this permit, the Board reserves the right to change any conditions in this permit as may be consistent with current flood control standards and policies of The Central Valley Flood Protection Board.

SIX: This permit shall remain in effect until revoked. In the event any conditions in this permit are not complied with, it may be revoked on 15 days' notice.

SEVEN: It is understood and agreed to by the permittee that the start of any work under this permit shall constitute an acceptance of the conditions in this permit and an agreement to perform work in accordance therewith.

EIGHT: This permit does not establish any precedent with respect to any other application received by The Central Valley Flood Protection Board.

NINE: The permittee shall, when required by law, secure the written order or consent from all other public agencies having jurisdiction.

TEN: The permittee is responsible for all personal liability and property damage which may arise out of failure on the permittee's part to perform the obligations under this permit. If any claim of liability is made against the State of California, or any departments thereof, the United States of America, a local district or other maintaining agencies and the officers, agents or employees thereof, the permittee shall defend and shall hold each of them harmless from each claim.

ELEVEN: The permittee shall exercise reasonable care to operate and maintain any work authorized herein to preclude injury to or damage to any works necessary to any plan of flood control adopted by the Board or the Legislature, or interfere with the successful execution, functioning or operation of any plan of flood control adopted by the Board or the Legislature.

TWELVE: Should any of the work not conform to the conditions of this permit, the permittee, upon order of The Central Valley Flood Protection Board, shall in the manner prescribed by the Board be responsible for the cost and expense to remove, alter, relocate, or reconstruct all or any part of the work herein approved.

SPECIAL CONDITIONS FOR PERMIT NO. 18763 BD

THIRTEEN: All work approved by this permit shall be in accordance with the submitted drawings and specifications except as modified by special permit conditions herein. No further work, other than that approved by this permit, shall be done in the area without prior approval of the Central Valley Flood Protection Board.

FOURTEEN: The permittee is responsible for all liability associated with construction, operation, and maintenance of the permitted facilities and shall defend, indemnify, and hold the Central Valley Flood Protection Board and the State of California; including its agencies, departments, boards, commissions, and their respective officers, agents, employees, successors and assigns (collectively, the "State"), safe and harmless, of and from all claims and damages arising from the project undertaken pursuant to this permit, all to the extent allowed by law. The State expressly reserves the right to supplement or take over its defense, in its sole discretion.

FIFTEEN: The permittee shall defend, indemnify, and hold the Central Valley Flood Protection Board and the State of California, including its agencies, departments, boards, commissions, and their respective officers, agents, employees, successors and assigns (collectively, the "State"), safe and harmless, of and from all claims and damages related to the Central Valley Flood Protection Board's approval of this permit, including but not limited to claims filed pursuant to the California Environmental Quality Act. The State expressly reserves the right to supplement or take over its defense, in its sole discretion.

SIXTEEN: The Central Valley Flood Protection Board, Department of Water Resources, and Reclamation District 1600 shall not be held liable for any damages to the permitted encroachment(s) resulting from flood fight, operation, maintenance, inspection, or emergency repair.

SEVENTEEN: No construction work of any kind shall be done during the flood season from November 1 to April 15 without prior approval of the Central Valley Flood Protection Board.

EIGHTEEN: Upon receipt of a signed copy of the issued (not approved only) permit the permittee shall contact the Department of Water Resources by telephone, (916) 574-0609, and submit the enclosed postcard to schedule a preconstruction conference. Failure to do so at least 10 working days prior to start of work may result in delay of the project.

NINETEEN: The permittee shall maintain the permitted encroachment(s) and the project works within the utilized area in the manner required and as requested by the authorized representative of the Department of Water Resources or any other agency responsible for maintenance.

TWENTY: The permitted encroachment(s) shall not interfere with operation and maintenance of the flood control project. If the permitted encroachment(s) are determined by any agency responsible for operation or maintenance of the flood control project to interfere, the permittee shall be required, at permittee's cost and expense, to modify or remove the permitted encroachment(s) under direction of the Central Valley Flood Protection Board or Department of Water Resources. If the permittee does not comply, the Central Valley Flood Protection Board may modify or remove the encroachment(s) at the permittee's expense.

TWENTY-ONE: The permittee may be required, at permittee's cost and expense, to remove, alter, relocate, or reconstruct all or any part of the permitted encroachment(s) if removal, alteration, relocation, or reconstruction is necessary as part of or in conjunction with any present or future flood control plan or project or if damaged by any cause. If the permittee does not comply, the Central Valley Flood Protection Board may remove the encroachment(s) at the permittee's expense.

TWENTY-TWO: If the project, or any portion thereof, is to be abandoned in the future, the permittee or successor shall abandon the project under direction of the Central Valley Flood Protection Board and Department of Water Resources, at the permittee's or successor's cost and expense.

TWENTY-THREE: The permittee shall be responsible for repair of any damages to the project levee and other flood control facilities due to construction, operation, or maintenance of the proposed project.

TWENTY-FOUR: The permittee shall provide supervision and inspection services acceptable to the Central Valley Flood Protection Board. A professional engineer registered in the State of California shall certify that all work was inspected and performed in accordance with submitted drawings, specifications, and permit conditions.

TWENTY-FIVE: A temporary bench mark, set to a known datum, shall be placed at the project site during construction.

TWENTY-SIX: Prior to construction the permittee shall install an X, Y, Z axis based coordinate monitoring system to monitor the levee before, during and after all pile driving activities.

TWENTY-SEVEN: All components of the existing water intake to be abandoned shall be completely removed and disposed of outside the limits of the levee section and floodway.

TWENTY-EIGHT: Piers, bents, and abutments being dismantled shall be removed to at least 1 foot below the natural ground line and at least 3 feet below the bottom of the low-water channel.

TWENTY-NINE: During demolition of the existing water intake and or construction of the new water intake, any and all anticipated or unanticipated conditions encountered which may impact levee integrity or flood control shall be brought to the attention of the Flood Project Inspector immediately and prior to continuation. Any encountered abandoned encroachments shall be completely removed or properly abandoned under the direction of the Flood Project Integrity and Inspection Branch Inspector.

THIRTY: Any excavations made in the levee section or within 10 feet of the levee toes shall be backfilled in 4- to 6-inch layers with impervious material with 20 percent or more passing the No. 200 sieve, a plasticity index of 8 or more, and a liquid limit of less than 50 and free of lumps or stones exceeding 3 inches in greatest dimension, vegetative matter, or other unsatisfactory material. Backfill material shall be compacted in 4- to 6-inch layers to a minimum of 90 percent relative compaction as measured by ASTM Method D1557-91.

THIRTY-ONE: Compaction tests by a certified soils laboratory will be required to verify compaction of backfill within the levee section or within 10 feet of the levee toe.

THIRTY-TWO: Excavations below the design flood plane and within the levee section or within 10 feet of the projected waterward and landward levee slopes shall have side slopes no steeper than 1 horizontal to 1 vertical. Flatter slopes may be required to ensure stability of the excavation.

THIRTY-THREE: No excavation shall be made or remain in the levee section during the flood season from November 1 to April 15 without prior approval of the Central Valley Flood Protection Board.

THIRTY-FOUR: The stability of the levee shall be maintained at all times during construction.

THIRTY-FIVE: No material stockpiles, temporary buildings, or equipment shall remain in the floodway during the flood season from November 1 to April 15.

THIRTY-SIX: Revetment shall be uniformly placed and properly transitioned into the bank, levee slope, or adjacent revetment and in a manner which avoids segregation.

THIRTY-SEVEN: Revetment shall be quarry stone and shall meet the following grading:

Quarry Stone

Stone Size	Percent Passing
15 inches;	100
8 inches;	80-95
6 inches;	45-80
4 inches;	15-45
2 inches;	0-15

THIRTY-EIGHT: The recommended minimum thickness of revetment, measured perpendicular to the bank or levee slope, is 18 inches below the usual water surface and 12 inches above the usual water surface.

THIRTY-NINE: In the event existing rock revetment on the levee or channel slope is disturbed or displaced during construction, it shall be restored to its preconstruction condition.

FORTY: A positive-closure device that is readily accessible during periods of high water shall be installed on the waterward side of the levee.

FORTY-ONE: The pipeline shall be tested and confirmed free of leaks by X-ray, pressure tests, or other approved methods during construction or anytime after construction upon request by the Central Valley Flood Protection Board.

FORTY-TWO: Pipe installed in the levee section and within 10 feet of the levee toes shall be new steel and at least 3 gauge. Steel pipe shall be corrosion-proofed externally with a coating of coal-tar enamel; asphalt-saturated felt wrap; cement mortar; or PVC or polyethylene tape wrapped to a thickness of 30 mils. Steel pipe shall be corrosion-proofed internally with a continuous lining of cement mortar or asphalt.

FORTY-THREE: All pipe joints within the levee section shall be butt welded or threaded.

FORTY-FOUR: The pipe shall be buried at least 12 inches below the levee slopes and 24 inches below the levee crown.

FORTY-FIVE: Pipes and joints shall be designed to withstand all anticipated loading conditions.

FORTY-SIX: Right-of-way marker sign/s shall be located off the levee section so as not to interfere with levee maintenance.

FORTY-SEVEN: The pipelines shall be installed through the levee section at a right angle to the centerline of the levee.

FORTY-EIGHT: The permittee shall ensure that all pipe joints are watertight.

FORTY-NINE: The invert of the pipeline through the levee section shall be above the design flood plane elevation of 35.8 feet, NGV Datum.

FIFTY: Debris that may accumulate on the permitted encroachment(s) and related facilities shall be cleared off and disposed of outside the floodway after each period of high water.

FIFTY-ONE: If erosion occurs adjacent to the permitted encroachment(s), the permittee shall repair the eroded areas and place adequate revetment on the affected areas to prevent further erosion.

FIFTY-TWO: Any damage to the levee crown roadway or access ramps shall be promptly repaired to the condition that existed prior to utilization.

FIFTY-THREE: The project site shall be restored to at least the condition that existed prior to commencement of work.

FIFTY-FOUR: If the permitted encroachment(s) result in any adverse hydraulic impact or if the flows being conveyed in an overland release result in scouring the permittee shall provide appropriate mitigation acceptable to the Central Valley Flood Protection Board.

FIFTY-FIVE: The permittee shall replant or reseed the levee slopes to restore sod, grass, or other non-woody ground covers if damaged during project work.

FIFTY-SIX: Cleared trees and brush shall be completely burned or removed from the floodway, and downed trees or brush shall not remain in the floodway during the flood season from November 1 to April 15.

FIFTY-SEVEN: All temporary fencing, gates and signs shall be removed upon completion of the project.

FIFTY-EIGHT: All debris generated by this project shall be disposed of outside the project works.

FIFTY-NINE: Landscaping, appurtenances, and maintenance practices shall conform to standards contained in Section 131 of the Central Valley Flood Protection Board's Regulations, unless a variance thereto is specifically granted by the Central Valley Flood Protection Board.

SIXTY: The mitigation measures approved by the CEQA lead agency and the permittee are found in its Mitigation and Monitoring Reporting Program (MMRP) adopted by the CEQA lead agency. The permittee shall implement all such mitigation measures.

SIXTY-ONE: The permittee shall comply with all conditions set forth in the letter from the Department of the Army (U.S. Army Corps of Engineers, Sacramento District) dated February 20. 2013, which is attached to this permit as Exhibit A and is incorporated by reference.

SIXTY-TWO: Upon completion of the project, the permittee shall submit As-Built Drawings to: Department of Water Resources, Flood Project Inspection Section, 3310 El Camino Avenue, Suite 256, Sacramento, California 95821.

Exhibit A

DEPARTMENT OF THE ARMY
U.S. Army Engineer District, Sacramento
Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

REPLY TO
ATTENTION OF

Flood Protection and Navigation Section (18763)

FEB 20 2013

Mr. Jay Punia, Executive Officer
Central Valley Flood Protection Board
3310 El Camino Avenue, Room 151
Sacramento, California 95821

Dear Mr. Punia:

We have reviewed an application for a permit by Woodland Davis Clean Water Agency/Reclamation District 2035 (application number 18763). These plans include removing the existing RD 2035 intake and appurtenant structures; and constructing a fish screen intake, pump station facility and appurtenant structures on the Sacramento River. The project is located at river mile 70.8, at 38.675833°N 121.630417°W NAD83, Yolo County, California.

The District Engineer has no objection to approval of this application by your Board from a flood control standpoint, subject to the following conditions:

a. That the work shall not be performed or remain during the flood season of November 1 to April 15, unless otherwise approved in writing by your Board.

b. That in the event trees and brush are cleared, they shall be properly disposed of either by complete burning or complete removal outside the limits of the project right-of-way. All cleared vegetation shall be properly grubbed and levee embankment returned to the existing lines and grade.

c. That the existing RD 2035 pumping facility shall be completely removed from the project right of way.

d. That any debris that accumulates around the proposed intake shall be completely removed prior to the flood season and immediately after major accumulations.

e. That the proposed bank protection work shall be placed uniformly and properly transitioned into the natural bank at both ends.

f. That the pipes shall be equipped with a positive shut-off valve placed at the waterside edge of the levee crest.

g. That in the event bank erosion injurious to the flood risk reduction project occurs at or adjacent to the site of the the proposed pumping facility, the eroded areas shall be repaired in a timely manner and adequate bank protection shall be placed to prevent further erosion.

h. That the levee fill shall be free of organic material, have the maximum particle diameter of 2 inches, a minimum fine content of 30%, a Liquid Limit (LL) of no more than 45, and a Plasticity Index (PI) between 8 and 40.

i. That the material shall be compacted to at least 95% of the maximum density as obtained by the Standard Proctor Test conforming to ASTM D 698, at a moisture content between -2 and +3% of the optimum moisture content. Modified Proctor ASTM D 1557 is acceptable with a minimum compaction of 90% of the maximum density and a moisture content between 0 and +4% of the optimum moisture content.

j. That the proposed work shall not interfere with the integrity or hydraulic capacity of the flood risk reduction project; easement access; or maintenance, inspection, and flood fighting procedures.

k. That the proposed work shall not reduce the channel flow capacity or change the channel flow in such a way that may cause damage to the existing levee embankment.

l. That the condition of the pipes through the levee shall be verified using video or sonar equipment at least once every 5 years or annual pressure readings showing no significant loss in pressure. The results shall be submitted through the Central Valley Flood Protection Board to the Department of Water Resources, Flood Project Integrity and Inspection Branch and this office.

A Section 10 and/or Section 404 permit application (201001034 and 201001141) is in process for this work.

A copy of this letter is being furnished to Mr. Don Rasmussen, Chief, Flood Project Integrity and Inspection Branch, 3310 El Camino Avenue, Suite LL30, Sacramento, CA, 95821.

Sincerely,

for Rick L. Poeppelman, P.E.
Chief, Engineering Division

Attachment C

PROJECT AREA PLAN

REV	DATE	BY	DESCRIPTION
			Rdes4

SCALE: 1" =300'

WARNING: 0 ½ 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED L. EDWARDS
DRAWN L. EDWARDS
CHECKED

60% DESIGN DRAWINGS - MARCH 2012

NOT FOR CONSTRUCTION
This document is an interim document and not suitable for construction. As an interim document, it may contain data that is potentially inaccurate or incomplete and is not to be relied upon without the express written consent of the preparer.

MWH

RECLAMATION DISTRICT 2035

WOODLAND-DAVIS Clean Water Agency
A partnership for a sustainable future.

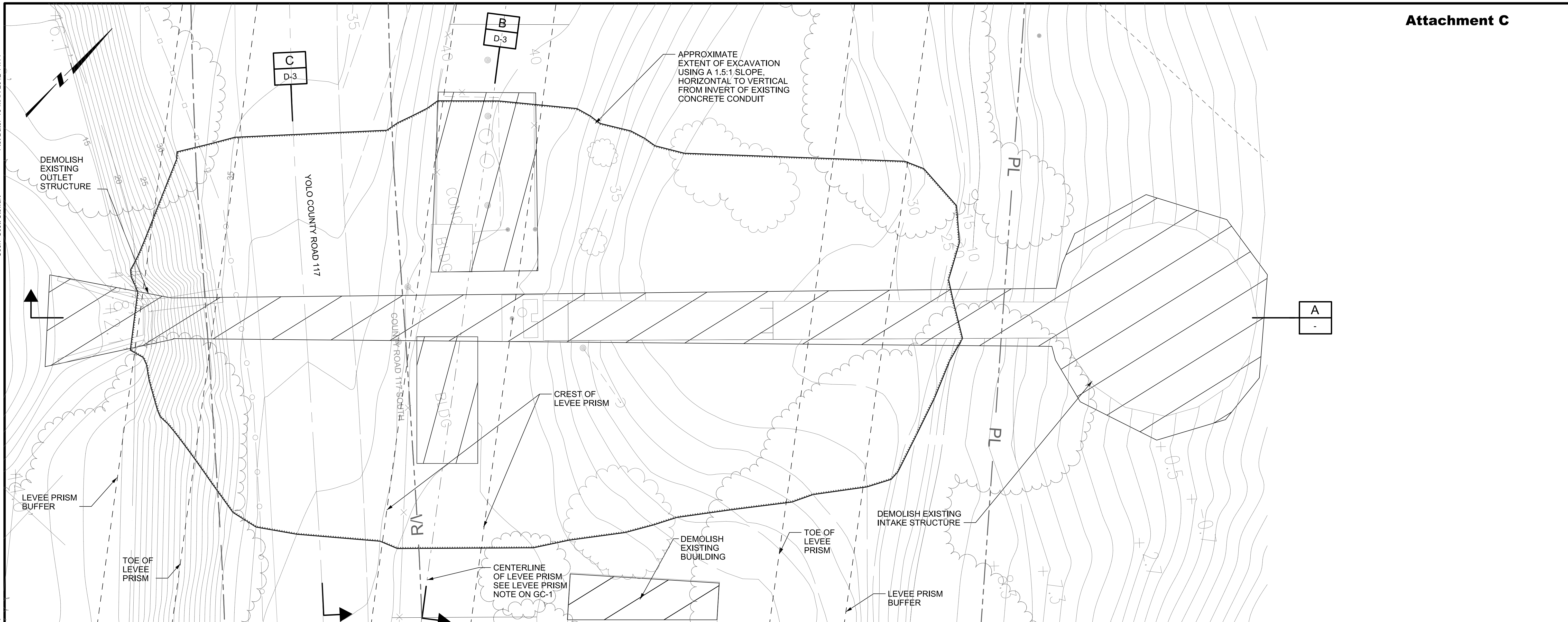
SACRAMENTO RIVER JOINT INTAKE

CIVIL
PROJECT AREA PLAN AND STOCKPILING AREA

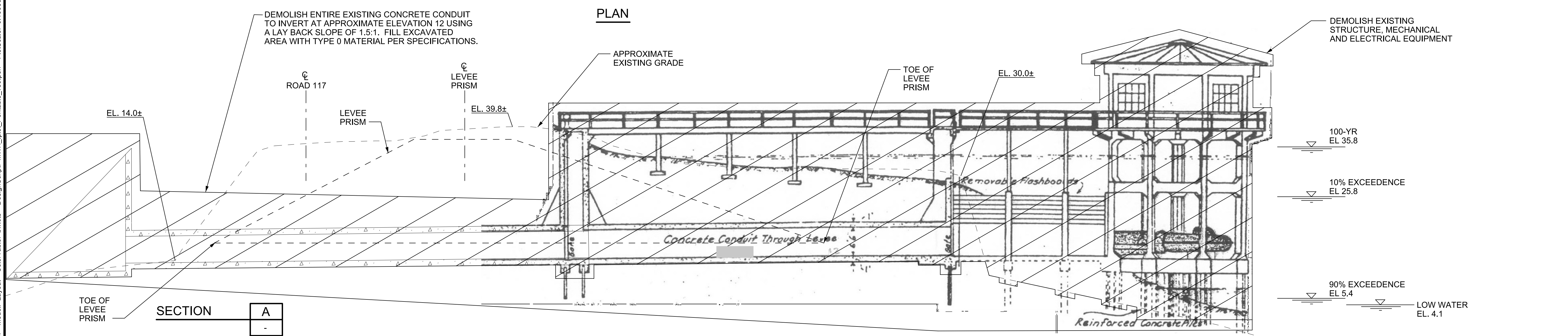
SHEET C-1

1011124

Attachment C



PLAN



SECTION A -

REV	DATE	BY	DESCRIPTION

SCALE: 1" = 10'

WARNING: 0 ½ 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED L. EDWARDS
DRAWN L. BRADY
CHECKED

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MWH

RECLAMATION DISTRICT 2035

WOODLAND-DAVIS Clean Water Agency
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SACRAMENTO RIVER JOINT INTAKE

DEMOLITION
EXISTING INTAKE DEMOLITION PLAN AND SECTION

SHEET D-2

1011124

Plot Date: 13-MAR-2012 14:14
User: Scott Stewart
PlotScale: 0.166667:1
DesignScript: MWH_Iplot_Pentable_v89.pen
ColorTable: bw.ctb
Model: Layout
File: RDRE_D02.dgn

Attachment C

SURVEY CONTROL POINT

THE HORIZONTAL DATUM FOR THIS SURVEY IS THE CALIFORNIA COORDINATE SYSTEM, ZONE 2, NAD 83, BASED UPON NGS STATION "FERRY" (CP-"FERRY" IN CURRENT DRAWINGS) AS SHOWN ON THE 2002 SURVEY PREPARED BY WEST YOST & ASSOCIATES HAVING THE FOLLOWING VALUES:

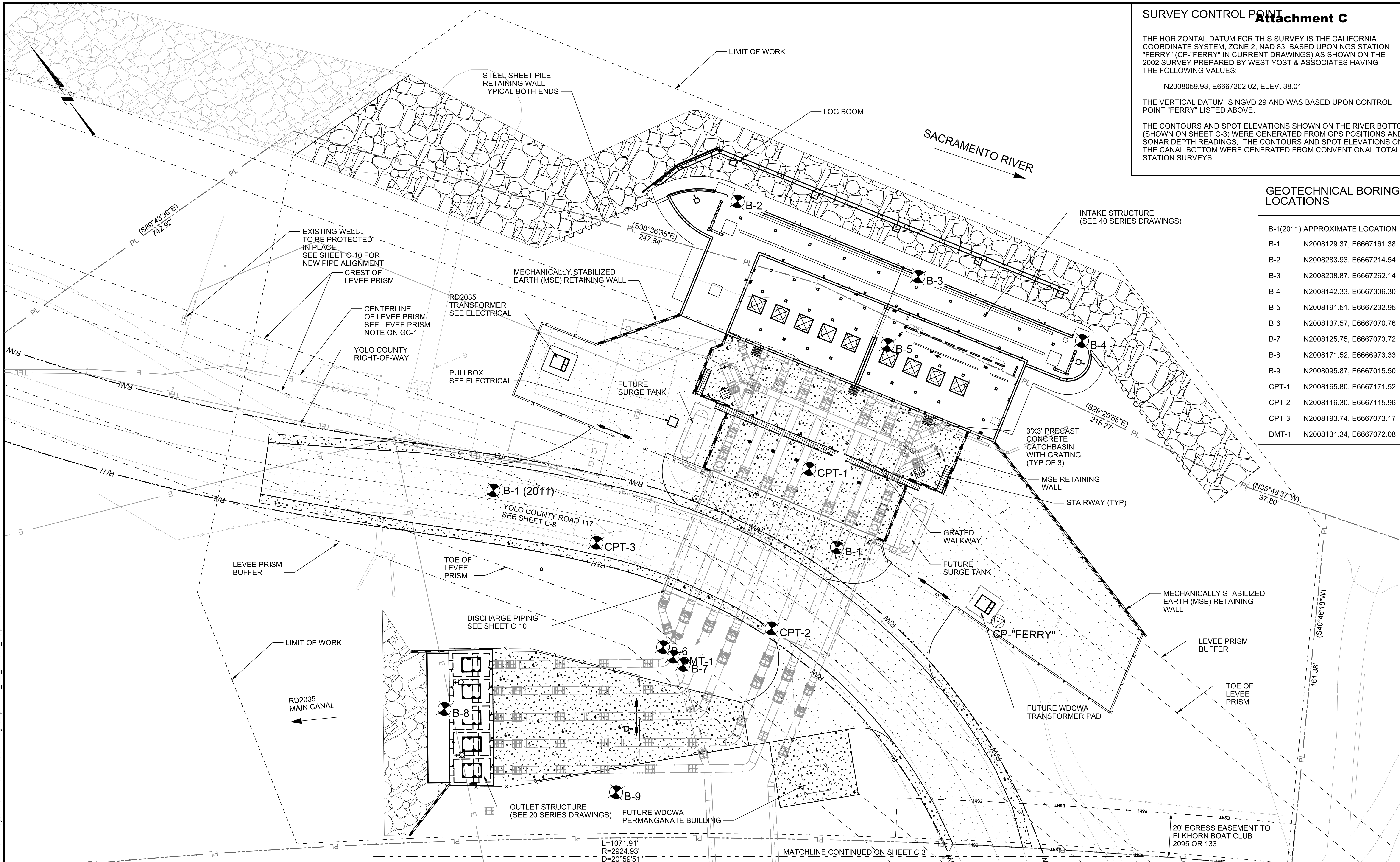
N2008059.93, E6667202.02, ELEV. 38.01

THE VERTICAL DATUM IS NGVD 29 AND WAS BASED UPON CONTROL POINT "FERRY" LISTED ABOVE.

THE CONTOURS AND SPOT ELEVATIONS SHOWN ON THE RIVER BOTTOM (SHOWN ON SHEET C-3) WERE GENERATED FROM GPS POSITIONS AND SONAR DEPTH READINGS. THE CONTOURS AND SPOT ELEVATIONS ON THE CANAL BOTTOM WERE GENERATED FROM CONVENTIONAL TOTAL STATION SURVEYS.

GEOTECHNICAL BORING LOCATIONS

B-1(2011) APPROXIMATE LOCATION	
B-1	N2008129.37, E6667161.38
B-2	N2008283.93, E6667214.54
B-3	N2008208.87, E6667262.14
B-4	N2008142.33, E6667306.30
B-5	N2008191.51, E6667232.95
B-6	N2008137.57, E6667070.76
B-7	N2008125.75, E6667073.72
B-8	N2008171.52, E6666973.33
B-9	N2008095.87, E6667015.50
CPT-1	N2008165.80, E6667171.52
CPT-2	N2008116.30, E6667115.96
CPT-3	N2008193.74, E6667073.17
DMT-1	N2008131.34, E6667072.08



File: RDRE_C02.dgn Model: Layout ColorTable: bw.ctb DesignScript: MWH_Iplot_Pentable_v89.pen PlotScale: 0.166667:1 User: Scott Stewart Plot Date: 07-MAR-2012 14:02

REV	DATE	BY	DESCRIPTION

SCALE 1" = 20'

WARNING 0 ½ 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED P SALZMAN
DRAWN M SKINNER
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SACRAMENTO RIVER JOINT INTAKE

CIVIL
SITE PLAN, SURVEY CONTROL POINT AND GEOTECHNICAL BORING LOCATIONS - 1

SHEET C-2

1011124

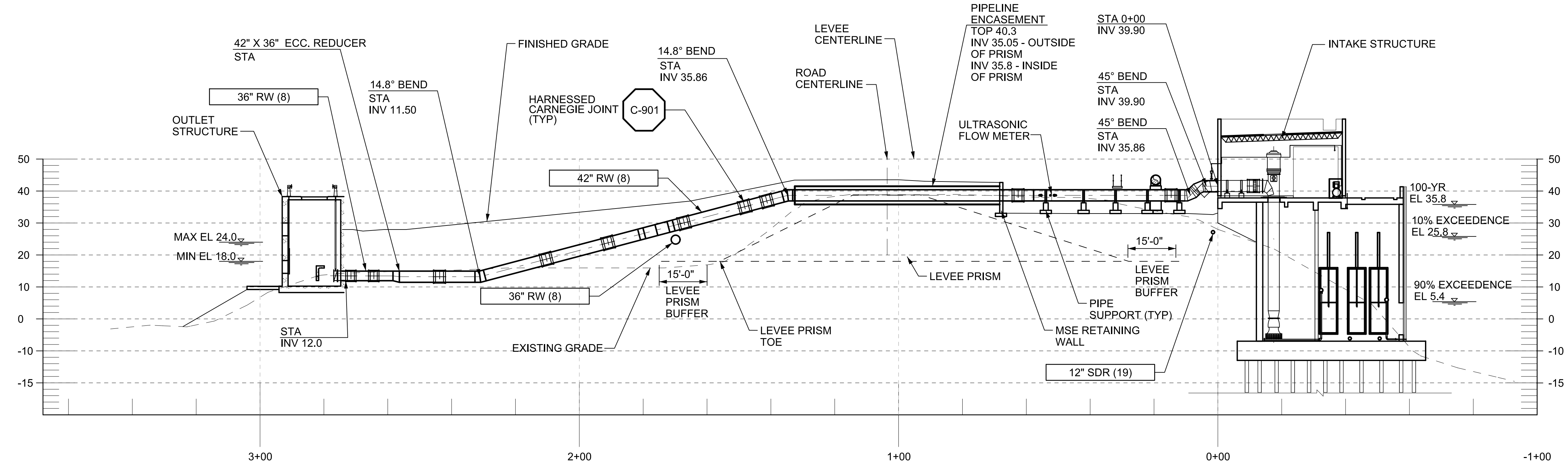
Attachment C

GENERAL SHEET NOTES

1. TEXT FOR NOTE 1
2. TEXT FOR NOTE 2
3. TEXT FOR NOTE 3
4. TEXT FOR NOTE 4

SHEET KEYNOTES

A. TEXT FOR KEYNOTE A
B. TEXT FOR KEYNOTE B
C. TEXT FOR KEYNOTE C
D. TEXT FOR KEYNOTE D



SITE SECTION K
SCALE: 1" = 20'
C-10

REV	DATE	BY	DESCRIPTION

SCALE 1" = 20'

WARNING: 0 ½ 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED L EDWARDS
DRAWN L EDWARDS
CHECKED CHECKED

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SACRAMENTO RIVER JOINT INTAKE

CIVIL
YARD PIPING PROFILES - 1

SHEET C-12
1011124

Attachment D

WEST YOST ASSOCIATES

REGISTERED PROFESSIONAL ENGINEER · DOUGLAS T. MOORE · 3-19-12 · No. 58122 · Expires 6-30-12 · CIVIL · STATE OF CALIFORNIA

TECHNICAL MEMORANDUM

DATE: March 19, 2012 Project No.: 376-00-11-06.030

TO: Gary Reents, Joint Intake Project Manager

CC: Dennis Diemer, General Manager, WDCWA

FROM: Douglas T. Moore, R.C.E. #C58122

REVIEWED BY: Jim Yost, R.C.E. #24137

SUBJECT: Sacramento River Joint Intake 2-Dimensional Model Evaluation

INTRODUCTION

Reclamation District 2035 (RD 2035) and the Woodland Davis Clean Water Agency (WDCWA) are designing a new intake on the Sacramento River (Joint Intake, JI) to divert water for agriculture and municipal use. This JI will replace an existing intake owned and operated by RD 2035 for agricultural use only. The JI will be located about 1,300 feet upstream of the Interstate 5 Bridge, as shown on Figure 1. The purpose of this Technical Memorandum (TM) is to develop and present information requested by the Central Valley Flood Protection Board (CVFPB) regarding the impacts of this facility on the river flow and stage conditions. The CVFPB will submit this TM to the US Army Corps of Engineers (USACE) for review and comment.

The JI will include a 400 cfs capacity fish screened intake and integrally constructed pump station. The JI will be a concrete structure, founded on driven steel piles, with 10 stainless steel wedge wire or profile wire fish screen panels. The screens will be cleaned with an automated traveling brush screen system. For RD 2035, there will be five 42-inch discharge pipelines flowing to a new outlet structure. The municipal system will include two 36-inch discharge pipelines flowing to a surface water treatment plant. The existing RD 2035 intake and its discharge line will be demolished.

The project schedule includes:

- Completion of design in May 2012
- Bid Period closes on October 31, 2012
- Construction begins on January 3, 2013
- Construction is completed on December 29, 2015

Information presented in this TM includes:

2020 Research Park Drive, Suite 100 Davis, CA 95618 Phone 530 756-5905 Fax 530 756-5991 westyost.com

- Sacramento River Survey – A 2010 survey of the river channel (channel banks and bathymetric survey) is compared with the 1997 topographic mapping prepared by the USACE.
- Two Dimensional Model Development – The development and calibration of the RiverFLO-2D hydraulic model is presented.
- Existing Conditions (EC) Evaluation – The EC are shown on Figure 2. EC includes the existing RD 2035 intake. The EC evaluation includes a flow velocity field figure, a water depth figure, and a water surface profile.
- Construction Period (CP) Evaluation – The CP conditions are shown on Figure 3. The CP conditions includes the existing RD 2035 pump station, a sheet pile wall around the construction site of the JI, and riprap along the face of sheet pile wall. The CP evaluation includes a flow velocity field figure, a water depth figure, and a water surface profile. Also presented are figures showing the changes in water surface elevation (WSEL) and water velocities from EC to CP.
- Joint Intake Conditions (JIC) Evaluation – The JIC are shown on Figure 4. The JIC evaluation includes the proposed JI only. In the JIC, the existing RD 2035 pump station has been removed. The JI evaluation includes a flow velocity field figure, a water depth figure, and a water surface profile. Also presented are figures showing the changes in WSEL and water velocities from EC to the JIC.
- Conclusions – The conclusion are summarized.

This work has been prepared using a RiverFLO-2D model from a previous evaluation of another river intake that was also considered by the WDCWA. The other intake was located upstream of the JI. The previous evaluation and the RiverFLO-2D model were developed using the NGVD29 datum. For this evaluation, WSEL profiles are presented in both the NGVD29 and NAVD88 datums.

SACRAMENTO RIVER SURVEY

West Yost Associates (West Yost) surveyed the nine cross sections through the Sacramento River shown on Figure 5. The survey was conducted on September 20 and 25, 2010. The horizontal datum is the North American Datum of 1983, California State Plane, Zone 2 (NAD 83 CASP Zone 2), Grid Coordinates (feet) and the vertical datum is North American Vertical Datum of 1988 (NAVD88).

West Yost had previously obtained topographic and bathymetric mapping of the Sacramento River prepared by the USACE for this area. The vertical datum of the USACE mapping is the National Geodetic Vertical Datum of 1929 (NGVD29). Cross sections were developed from the USACE mapping for the same nine locations as the cross sections surveyed by West Yost.

The cross sections surveyed by West Yost have been converted to the NGVD29 vertical datum by subtracting 2.49 feet (from the NOAA VERTCON website). The West Yost cross sections are compared with the similar sections from the USACE mapping in Figures 6 through 14 (from upstream to downstream). As shown, the current cross sections agree reasonably well with the USACE data, indicating that the river bed has not changed significantly since the USACE data were prepared in 1997. The USACE topographic and bathymetric mapping provides data for the entire river bed. The West Yost data includes nine cross sections and some spot elevations between the sections, but the West Yost survey is not as thorough as the USACE mapping. Consequently, the USACE mapping was used for developing the 2-dimensional model of the river and the JI.

TWO DIMENSIONAL MODEL DEVELOPMENT

The RiverFLO-2D software was used to develop a two-dimensional hydrodynamic model of the Sacramento River from about 1,000 feet downstream of the Interstate 5 Bridge to about 1.6 miles upstream of the JI (the modeled river reach). Development of a computer model involves several steps, including entry of the data representing the modeled system, calibrating the model, and then using the model to evaluate the different conditions.

The CVFPB requested that JI be evaluated with a 2-dminesional hydraulic model to identify changes in the river flow and stage conditions at a flow rate of 107,000 cfs. The RiverFLO-2D modeling software provides water velocity fields and WSEL data. USACE staff confirmed that the RiverFLO-2D model would be acceptable for this evaluation.

Model Data

The data used to develop the model include a representation of the river bed and banks (from the USACE bathymetric and topographic survey), representation of the roughness of the river bed and banks (Manning’s n values), and establishment of a flow boundary condition at the upstream end of the model and a WSEL boundary condition at the downstream end of the model.

Model Calibration and Downstream Stage Boundary Condition

Ideally, model calibration includes adjusting the model input variables to match real measured WSELs for gaged flow rates. Gaged flow data were available at the Verona Gage which should very closely match flow at the JI site. However, there is very little measured WSEL data available at the JI site. The only data that are available were collected by West Yost on September 25, 2010 when river cross sections were surveyed for this project.

For the RiverFLO-2D model, the calibration included adjusting the Manning’s n values of the river’s main channel and the overbank areas, and adjusting the downstream WSEL boundary condition (discussed more below) until the required WSEL at various locations was duplicated.

The Manning’s n values were originally set to 0.033 for the main channel and 0.047 for the overbank areas. These values were taken from the Sacramento River UNET hydraulic model that was originally developed by the USACE for the Sacramento and San Joaquin River Basins Comprehensive Study and subsequently modified by MBK Engineers. However, these values were adjusted downward in the RiverFLO-2D model during the calibration to 0.028 for the main channel and 0.032 for the overbank areas to achieve WSELs consistent with the surveyed WSELs and a USACE river profile.

On September 25, 2010, the river water surface was surveyed at seven locations, five of which were within the reach of the river being modeled. At several of these locations there were multiple surveys of the WSEL, and they generally varied by less than 0.1 foot. The surveyed WSEL near the downstream boundary condition (8.84 feet NGVD29) was about 0.1 foot higher than at the next upstream location (8.75 feet NGVD29). Continuing upstream, the surveyed results continued to increase as expected. Consequently, this (8.84 feet NGVD29) downstream surveyed WSEL value was disregarded for the model calibration. These surveyed WSELs are shown on Figure 15A (including the disregarded downstream WSEL). On September 25, 2010, the river flow was about 15,800 cubic feet per second (cfs) at the Verona Gage. The RiverFLO-2D model was run several times with a flow of 15,800 cfs. The downstream boundary condition WSEL and the Manning's n values were adjusted until the model results agreed well with surveyed data. The calibrated profile is also shown on Figure 15A. The calibration resulted in a downstream WSEL boundary condition of 8.00 feet NGVD29 and a main channel Manning's n value of 0.028.

At a flow rate of 15,800 cfs, the water did not flow in the overbank areas, and consequently this run provided no calibration of the Manning's n values of the overbank areas. To calibrate the Manning's n value for the overbank areas, model runs with a flow of 107,000 cfs were performed.

Presented in Attachment A is the 1957 Levee and Channel Profile obtained from the USACE for the Sacramento River. This profile provides the river channel bottom, the left and right levee tops, and the WSEL for a flow of 107,000 cfs. This water surface from the USACE 1957 profile is also shown on Figures 15A and 15B. The USACE water surface profile is linear through the modeled river reach. The USACE profile does not show any increased head loss at the I-80 Bridge. This profile is based on a Manning's n value of 0.030 (as used in Kutter's formula) for the entire river cross section.

Also shown on Figure 15A is the river channel bottom from the 1957 profile and the left and right levee tops. The river bed from the 1957 profile is significantly different than the river bed from the 1997 bathymetric mapping. The levee tops from the 1957 profile and the 1997 topographic mapping agree to within about one foot.

The RiverFLO-2D model was further calibrated to duplicate the USACE profile for a flow of 107,000 cfs. The model was run several times until the water surface profile from the model matched the USACE profile at the JI, as shown in Figures 15A and 15B. This resulted in a WSEL at the downstream boundary condition of 33.9 feet NGVD (converted from the USACE datum) and a Manning's n value for the overbank areas of the river of 0.032.

The USACE profile elevations are referred to the USACE datum of mean lower low water in the Suisun Bay, which is equal to 3.0 feet below mean sea level. USACE staff indicted that for the 1957 profile, mean sea level is usually assumed to be equivalent to the NGVD29 datum, but that this assumption is generally only accurate to about plus or minus 0.5 feet. Consequently, the absolute WSELs given in this TM should be considered accurate to less than plus or minus 0.5 feet. However, the focus of this TM is on changes in the water velocities and WSELS. The changes in the WSELs presented in this evaluation are accurate to a few hundredths of a foot. The changes in WSEL would be essentially the same even if the absolute WSEL profile was slightly higher or lower than the USACE WSEL from the 1957 profile.

EXISTING CONDITIONS EVALUATION

The calibrated model was used to evaluate EC at the location of the JI. The EC WSEL profile along the center of the river is shown in Figures 15A and 15B. Figure 15B is similar to Figure 15A, except the vertical scale is further exaggerated and centered on the WSEL profiles.

As shown in Figures 15A and 15B, the RiverFLO-2D results agree very closely with the USACE profile at the JI site. The USACE profile does not include the increased head loss at the Interstate 5 Bridge shown by the RiverFLO-2D profile. Upstream of river station 379,000 the RiverFLO-2D profiles rise more steeply than downstream of this point. This is probably because the river bottom is higher and the river is shallower, causing higher velocities and greater head loss.

The water velocity field for a flow of 107,000 cfs and for EC is presented in Figure 16. As shown, in the center of the River the velocities are in the range of 6 to 7 feet per second. Moving to the west, the velocities decrease to under 0.5 feet per second at the river bank. The flow vectors diverge around the existing river intake. In the area where the JI will be constructed (shown on the figure for reference, but not included in the modeling), the water velocities are about 0.5 to about 4.0 feet per second.

The water depth for a flow of 107,000 cfs and for EC is presented in Figure 17. In the area where the JI will be constructed (shown on the figure for reference, but not included in the EC modeling), the water depths range from 0 to 45 feet. There is a deep pool just beyond the face of the proposed JI, with a depth of about 50 feet.

JOINT INTAKE CONSTRUCTION PERIOD EVALUATION

The CP conditions include a sheet pile wall around the JI site, as described by Mr. Phil Salzman of MWH, who is preparing the design of the JI. The existing RD 2035 intake is included in the CP evaluation because it will not be demolished until the JI has been constructed and is operational.

The exact height of the future sheet pile wall is unknown at this time. To be conservative in the modeling of the CP conditions, the sheet pile wall was extended to above the modeled WSEL. It is likely that the construction contractor will actually use a lower wall, and that the wall would be overtopped at a flow of 107,000 cfs. Consequently, the evaluation presented below represents the maximum likely changes that would occur during the CP. The actual changes in the flow velocities and WSELs would be smaller than shown below.

A WSEL profile along the center of the river for the construction period is shown on Figures 15A and 15B. As shown in Figures 15A and 15B, just downstream of the JI site, the WSEL is as much as 0.05 feet lower during the construction period than for EC. This is because the sheet pile wall forces the water velocity to increase through the constricted portion of the river.

As shown in the WESL profile, adjacent to the sheet pile wall, the CP WSEL profile is about 0.03 feet higher than the water surface profile for EC. Moving upstream from the sheet pile wall, the CP WSEL is about 0.02 to 0.03 feet higher than the EC WSEL profile.

As a model simulation runs, it performs millions of hydraulic calculation. For this model, there are about 30,000 nodes. The time step was 0.1 seconds, and the total simulation time was 4 hours, for a total of 144,000 time steps. For each node and each times step, hydraulic calculations are performed and each calculation can introduce a very small error into the simulation. The model continuity evaluation is an evaluation of the cumulative error in the total flow.

An evaluation of the continuity of the flow between the CP and EC model results indicates that the CP simulation had flows of about 25 to 150 cfs higher than in the EC model run throughout most of the modeled river reach. This difference in continuity is likely the cause of the increased WSEL extending upstream of the sheet pile wall. The actual increase in the WSEL would not extend significantly upstream of the project site. A flow change of 150 cfs is only 0.14 percent of the input flow of 107,000 cfs, and is considered to represent a very good continuity balance between the model runs.

The water velocity field for a flow of 107,000 cfs and for the CP is presented in Figure 18. As shown, in the center of the river the velocities are in the range of 6 to 7 feet per second. Moving to the west, the velocities decrease to 1 to 2 feet per second at the riprap along the face of the sheet pile wall. At the river bank, the velocities are mostly under 0.5 feet per second. The flow diverges around the existing river intake, and then turns out around the sheet pile wall. At the downstream side of the sheet pile wall, an eddy is established, but the velocity in the eddy is less than 0.5 feet per second.

The water depth for a flow of 107,000 cfs and for the CP is presented in Figure 19. There is no water inside the sheet pile wall.

The change in water velocity from EC to CP is presented in Figure 20. As shown, there is a small area between the existing intake and the sheet pile wall where the velocity increases by up to 2 feet per second. This occurs because in the EC the water in this area is slowed down by the existing intake (see Figure 16). With the sheet pile wall, the water flows more rapidly through this area as it flows around the sheet pile wall (see Figure 18). Along the sheet pile wall, the water slows down by about 0.05 to 2.0 feet per second. This decrease in water velocity extends about 450 feet downstream of the sheet pile wall.

The change in WSEL from EC to CP is presented in Figure 21A. As shown, the WSEL increases just upstream of the sheet pile wall by up to 0.2 feet. There are also small localized areas of increased and decreased WSEL centered around the existing intake resulting from the minor changes in the turbulence around the existing intake. Around the downstream end of the sheet pile wall, the water level decreases by 0.05 to 0.2 feet.

As shown in Figure 15B, at one model cell, just upstream of the Interstate 5 Bridge, the model results indicate an increase in the water level of 0.18 feet. This occurs because the bridge columns set up shallow standing waves upstream of the columns. The small changes in the flow pattern caused by the sheet pile wall cause small changes in the standing wave pattern. For example, where there was a dip in the standing wave pattern, there may now be a crest, causing an increase in WSEL (as shown on Figure 15B). Conversely, where there was a crest, there may now be a dip, causing a decrease in the WSEL. As shown on Figure 21B, the changes in the standing wave pattern is limited to about 100 feet upstream of the bridge columns. Overall, in the 100 foot reach upstream of the bridge columns the small increase and decreases in the standing wave patterns balance out and there is no significant change in the WSEL. For most of the modeled river reach downstream of the sheet pile wall, the CP and EC WSEL profiles agree to within 0.01 feet.

In the area where the WSEL increases, the CP WSEL is 34.9 feet. The levee top in this area is at ranges from least 39.9 to 40.3 feet. This results in a minimum of 5.0 feet of freeboard.

JOINT INTAKE CONDITIONS EVALUATION

The JIC model includes the JI only, the existing RD 2035 intake was removed from the model. The modeled JIC is based on AutoCAD drawings provided by MWH of the design of the JI as of February 17, 2012. The JIC includes the new intake structure, the retaining walls, and changed grading around the intake structure.

A WSEL profile along the center of the river for the JIC is shown on Figures 15A and 15B. As shown in Figures 15A and 15B, just downstream of the JI site, the WSEL is about 0.01 to 0.02 feet lower for JIC than for EC. This is because the JI forces the water velocity to slightly increase through the constricted portion of the river.

Along the center of the river adjacent to the JI and just upstream, the JIC WSEL profile is about 0.03 to 0.04 feet higher than the water surface profile for EC. Moving farther upstream the JIC WSEL is about 0.01 foot lower than the EC WSEL. An evaluation of the model flow continuity between the JIC and EC model indicates that the JIC simulation had flows of about 4 cfs less than the EC simulation to 40 cfs greater than the EC run. These very small changes in the flow likely account for the very small changes in the WSEL upstream of the JI.

The water velocity field for a flow of 107,000 cfs and for the JIC is presented in Figure 22. As shown, in the center of the river the velocities are in the range of 6 to 7 feet per second. Moving to the west, the velocities decrease to 1 foot per second to just over 2 feet per second at the riprap along the face of the intake. At the river bank, the velocities are mostly under 0.5 feet per second. A small eddy is established just upstream of the JI. A larger eddy is established just downstream of the JI. The water velocity at both of these eddies is under 0.5 feet per second.

The water depth for a flow of 107,000 cfs and for the JIC is presented in Figure 23. There is no water inside the JI.

The change in water velocity from EC to JIC is presented in Figure 24. As shown, there is an area downstream of existing intake where the velocity increases by about 2 feet per second. This occurs because in EC the water in this area is slowed down by the existing intake (see Figure 16). In the JIC, the existing intake has been removed and the water in this area is no longer slowed down (see Figure 22). This increase in water velocity extends about 400 feet downstream of the location of existing intake.

Upstream and downstream of the JI, the water velocity decreases by about 2.0 feet per second. This decrease in water velocity extends about 250 feet downstream of the JI. Right along the face of the JI, the water velocity is essentially unchanged because the decrease in water velocity caused by the new JI is balanced by the increase in water velocity caused by the removal of the existing intake.

The change in WSEL from EC to JIC is presented in Figure 25A. As shown, just upstream of the JI the WSEL increases by about 0.2 feet. Downstream of the JI, the WSEL decreases by about 0.1 foot. Upstream of the existing intake location the WSEL decreases by about 0.2 feet when the existing intake is removed. The removal of the existing intake also contributes to the increased WSEL just upstream of the new JI.

As shown in Figure 15B, at one cell, just upstream of the Interstate 5 Bridge, the model results indicate an increase in the water level of 0.16 feet. This occurs because the bridge columns set up shallow standing waves upstream of the columns. The small changes in the flow pattern caused by the JI cause small changes in the standing wave pattern. For example, where there was a dip in the standing wave pattern, there may now be a crest, causing an increase in WSEL (as shown on Figure 15B). Conversely, where there was a crest, there may now be a dip, causing a decrease in the WSEL. As shown on Figure 25B, the changes in the standing wave pattern is limited to about 100 feet upstream of the bridge columns. Overall, in the 100 foot reach upstream of the bridge columns the small increase and decreases in the standing wave patterns balance out and there is no significant change in the WSEL. For most of the modeled river reach downstream of the sheet pile wall, the JIC and EC WSEL profiles agree to within 0.01 feet.

In the area where the WSEL increases, the CP WSEL is 34.9 feet. The levee top in this area ranges from least 39.9 to 40.3 feet. This results in a minimum of 5.0 feet of freeboard.

NAVD88 PROFILES

All of the elevation information provided above was presented in the NGVD29 vertical datum. At the JI location, the conversion from NGVD29 to the NAVD88 vertical datum adds 2.49 feet. For example, at the JI site, the right levee top is at elevation 39.9 feet NGVD. This levee top is at elevation 42.39 feet NAVD88, although it would be rounded to 42.4 feet NAVD88.

Presented in Figures 26A and 26B are WSEL profiles using the NAVD88 datum. These figures were developed by adding 2.49 feet to the profiles in Figures 15A and 15B.

The figures presenting water velocity fields, water depth, changes in water velocity, and changes in WSEL are not different regardless of which datum is used, and no conversion to NAVD88 is needed for these figures.

CONCLUSIONS

Conclusions are provided below:

- During the CP, the water velocities would only change near the sheet pile wall. In this area, the velocities mostly decrease by as much as 2 feet per second. There is a small area just downstream of the existing intake where the velocities would increase by about 2 feet per second; however, this area of increased velocity is very localized. These changes are considered insignificant.
- During the CP, the WSEL would increase by up to 0.2 feet just upstream of the sheet pile wall. However, there would still be 5.0 feet of freeboard. The area of increased WSEL is very localized, and this increase is considered insignificant.

- With the JI, the water velocities would change only in the area of the JI and the existing intake. Downstream of the existing intake the water velocity increases by as much as 2 feet per second when the existing intake is removed. Upstream and downstream of the JI the water velocity would decrease. Along the face of the JI the water velocity would be essentially be unchanged. These changes are considered insignificant.
- With the JI, the WSEL would increase by about 0.2 feet just upstream of the JI. However, there would still be 5.0 feet of freeboard. The area of increased WSEL is very localized, and this increase is considered insignificant.

Please contact Jim Yost or Doug Moore at 530-756-5905 if you have questions or comments on this TM.

Attachment D

LEGEND
- Existing Intake
- Joint Intake

N

0 0.25 0.5

Miles

FIGURE 1

Woodland-Davis Clean Water Agency
Sacramento River
Joint Intake Evaluation

Joint Intake Location

WEST YOST ASSOCIATES
Consulting Engineers

WOODLAND-DAVIS Clean Water Agency
A Partnership for a Sustainable Future

N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 02 Existing Conditions.mxd 3/9/2012

FIGURE 2

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Existing Conditions

N

0 37.5 75

Scale in Feet

LEGEND

- Existing Intake
- Joint Intake
- Riprap

WEST YOST ASSOCIATES Consulting Engineers

WOODLAND-DAVIS Clean Water Agency
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Attachment D

N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure3 Construction Period.mxd 3/9/2012

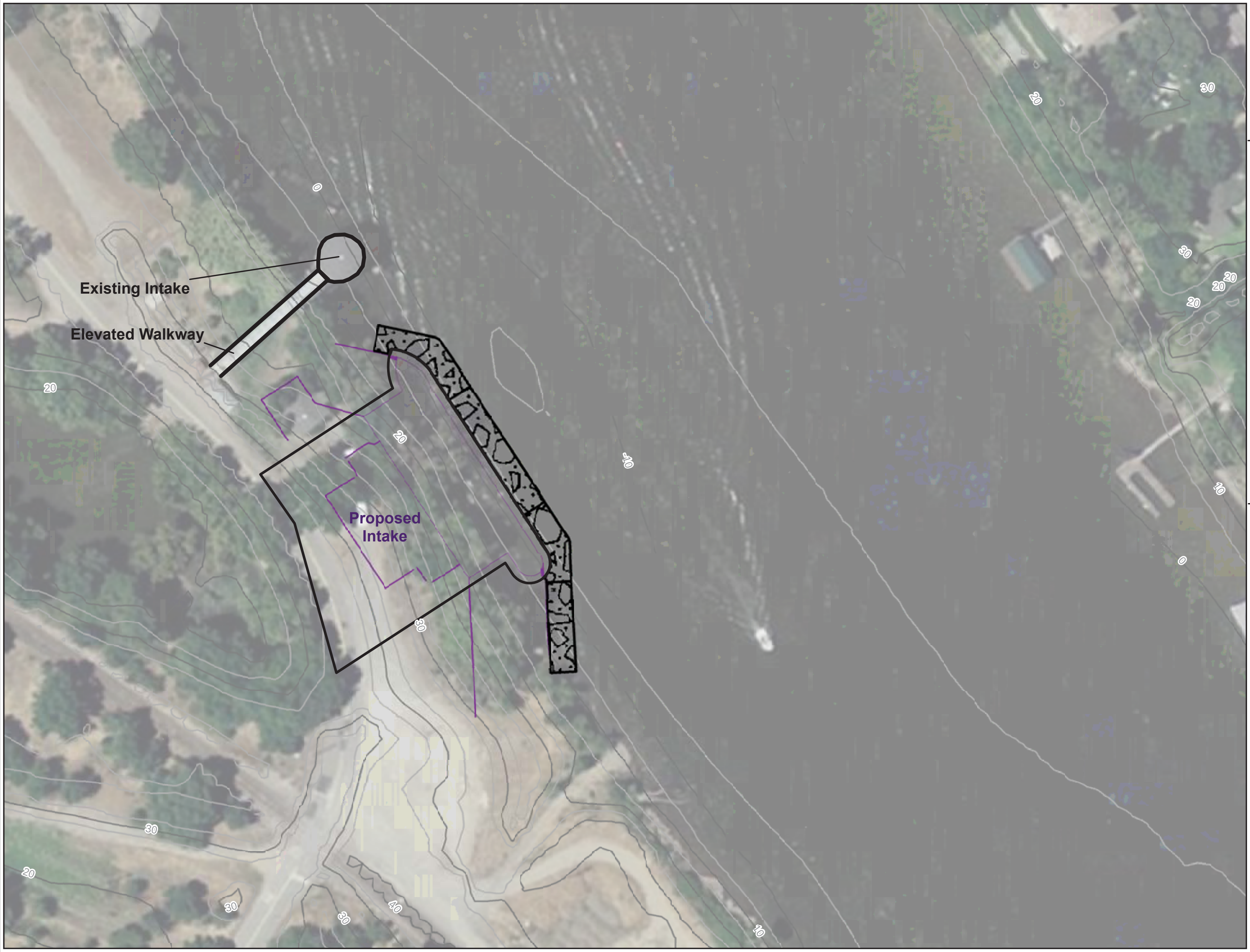

FIGURE 3

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Construction Period

N

0 37.5 75

Scale in Feet

LEGEND

- Existing Intake
- Riprap
- Joint Intake

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N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 04 Joint Intake.mxd 3/9/2012

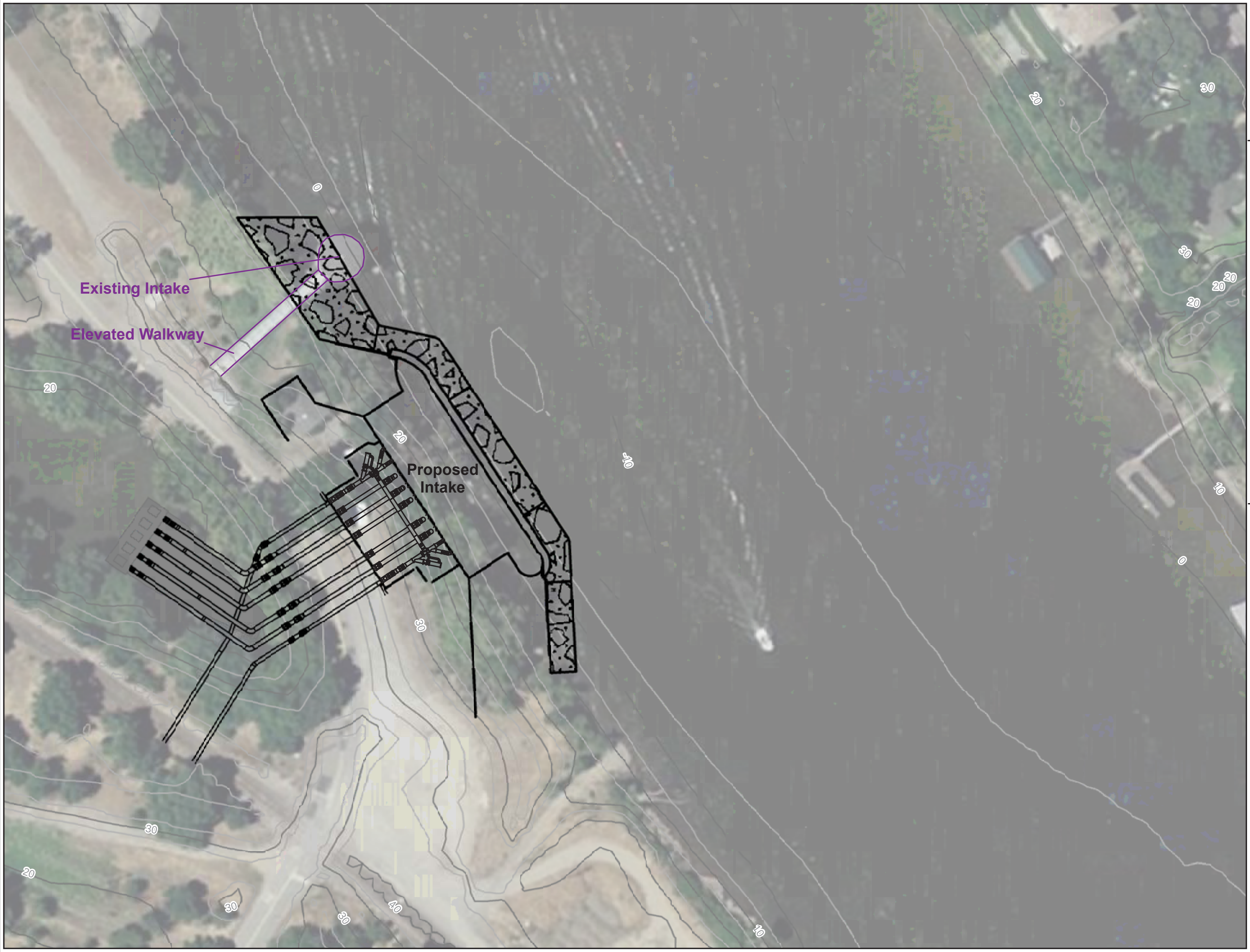

FIGURE 4

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Joint Intake

N

0 37.5 75

Scale in Feet

LEGEND

- Existing Intake
- Riprap
- Joint Intake

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N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 5 Cross Section Locations.mxd 3/9/2012

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LEGEND

- Surveyed Cross Sections
- Existing Intake
- Joint Intake

N

0 0.125 0.25

Miles

FIGURE 5

Woodland-Davis Clean Water Agency
Sacramento River
Joint Intake Evaluation

Surveyed Cross Section Locations

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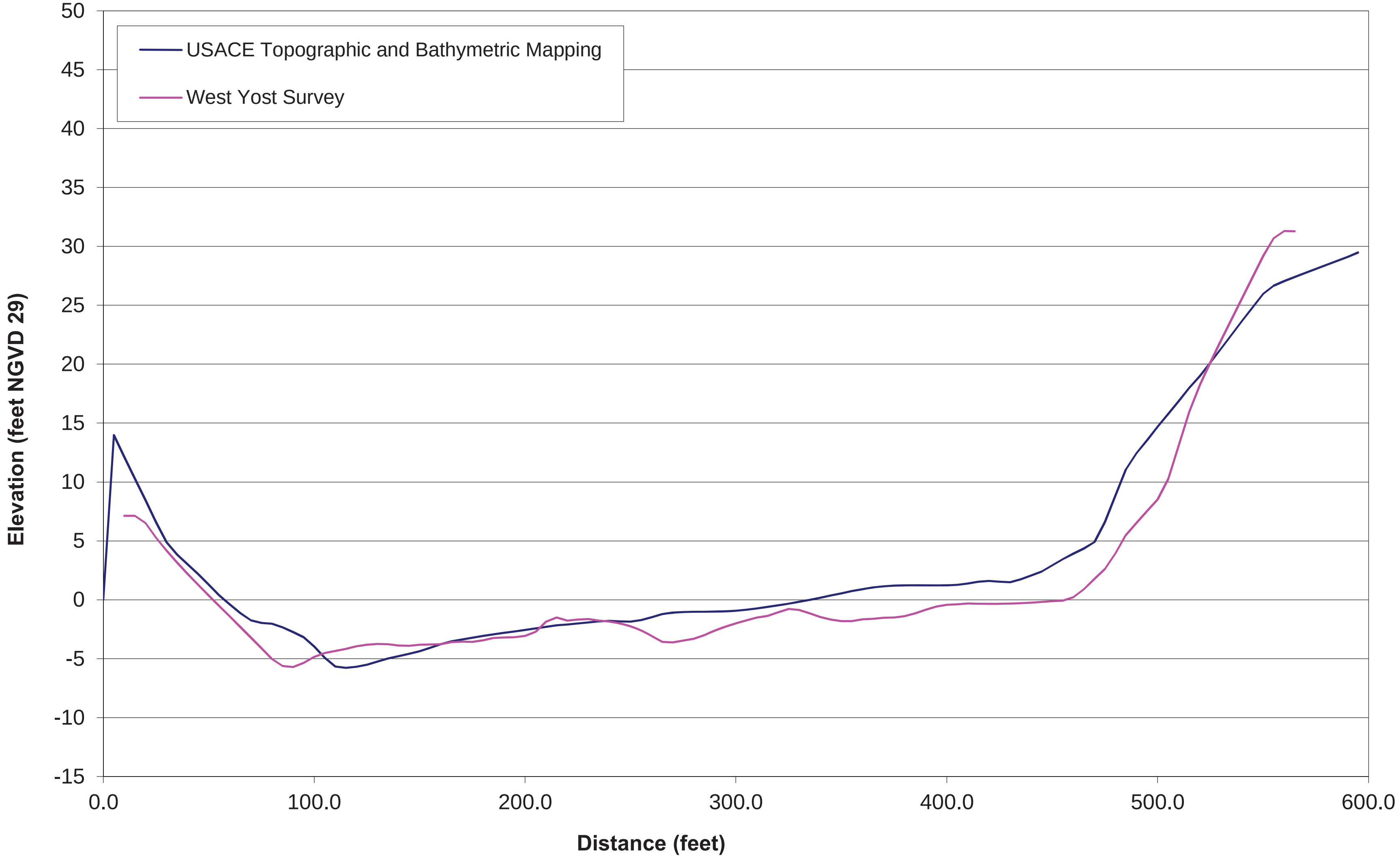
Figure 6. Comparison of West Yost Survey and USACE Data for Cross Section A



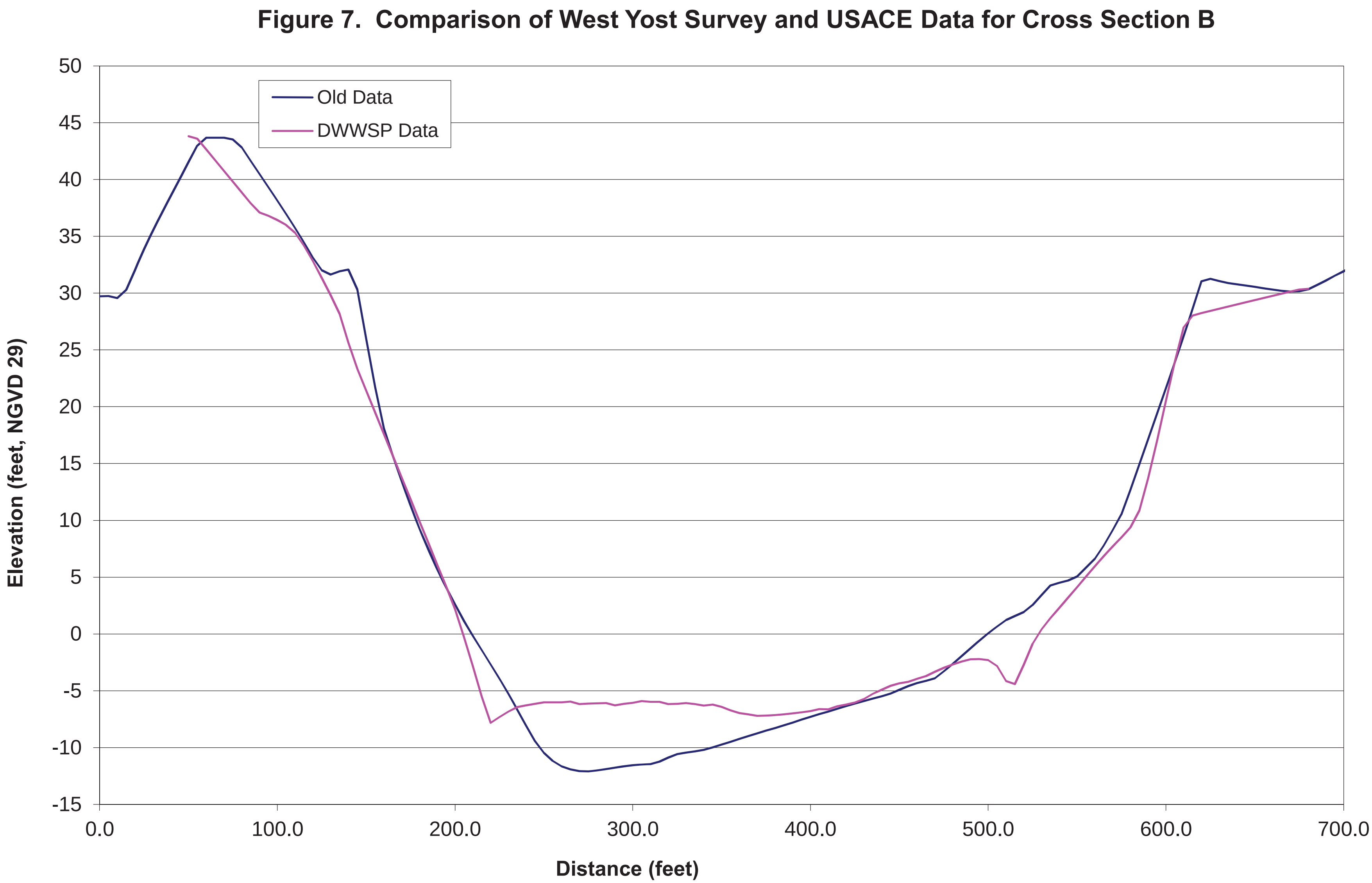


Figure 7. Comparison of West Yost Survey and USACE Data for Cross Section B
Old Data
DWWSP Data
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
Elevation (feet, NGVD 29)
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
Distance (feet)

Figure 8. Comparison of West Yost Survey and USACE Data for Cross Section C

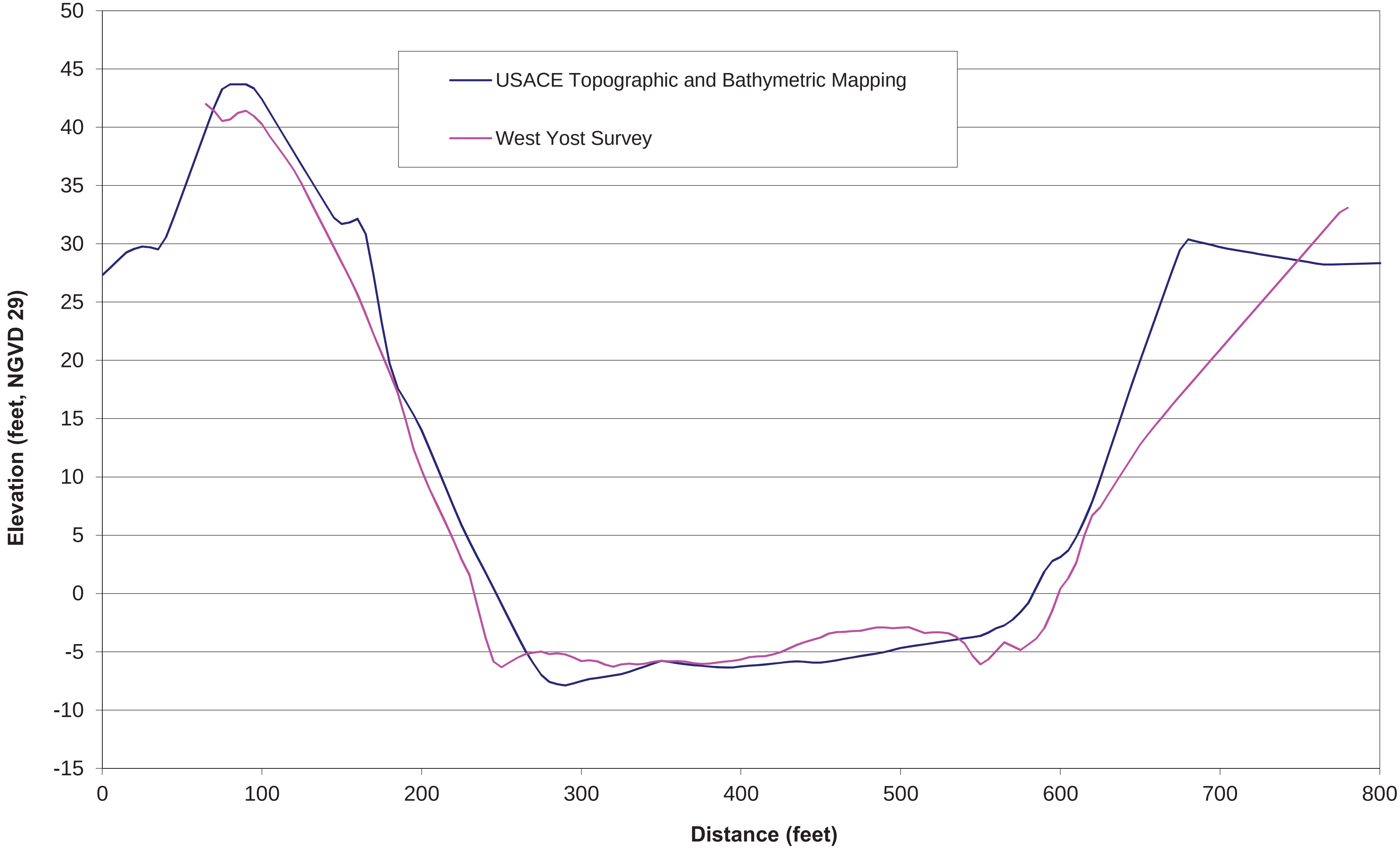


Figure 9. Comparison of West Yost Survey and USACE Data for Cross Section D

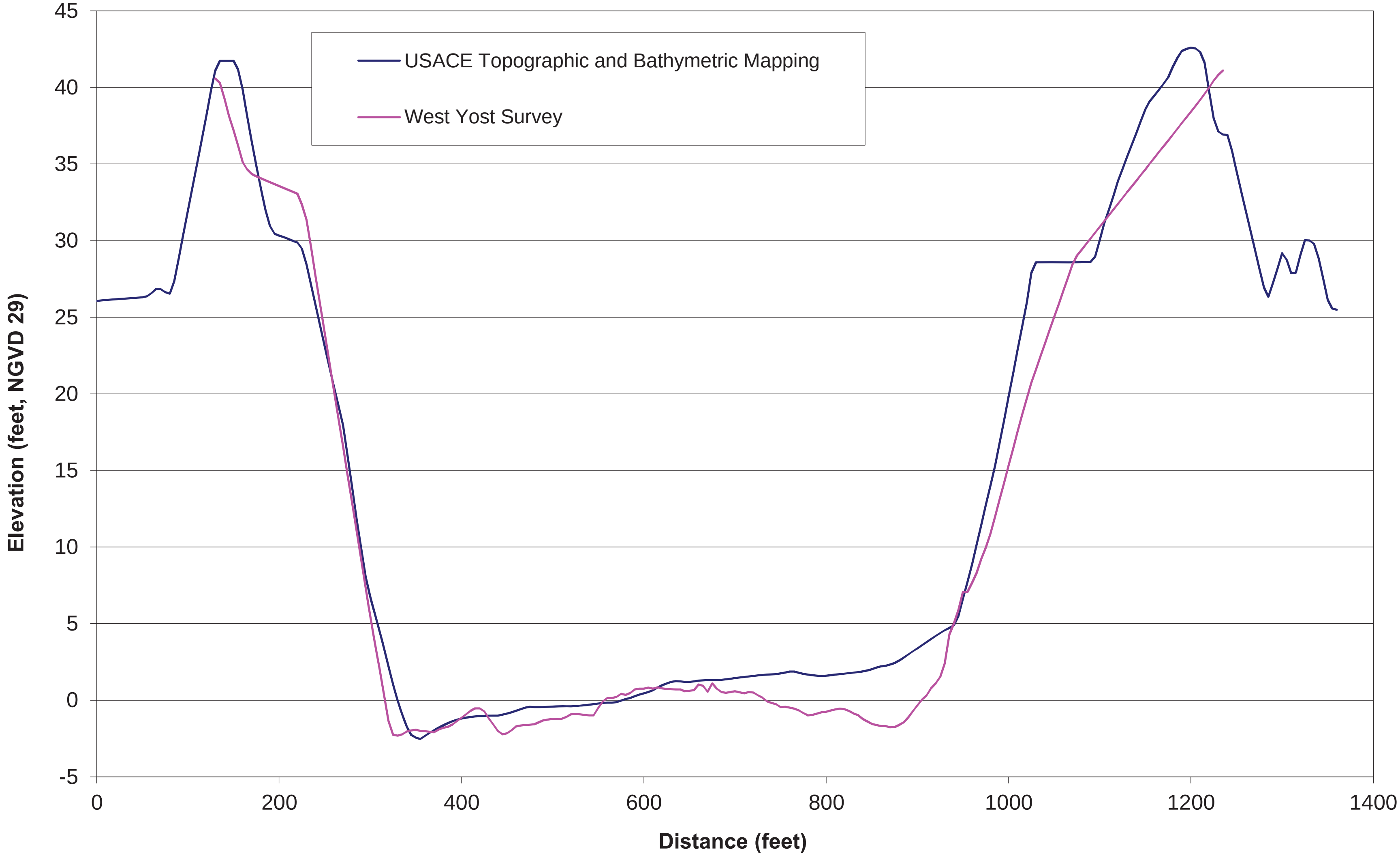


Figure 10. Comparison of West Yost Survey and USACE Data for Cross Section E

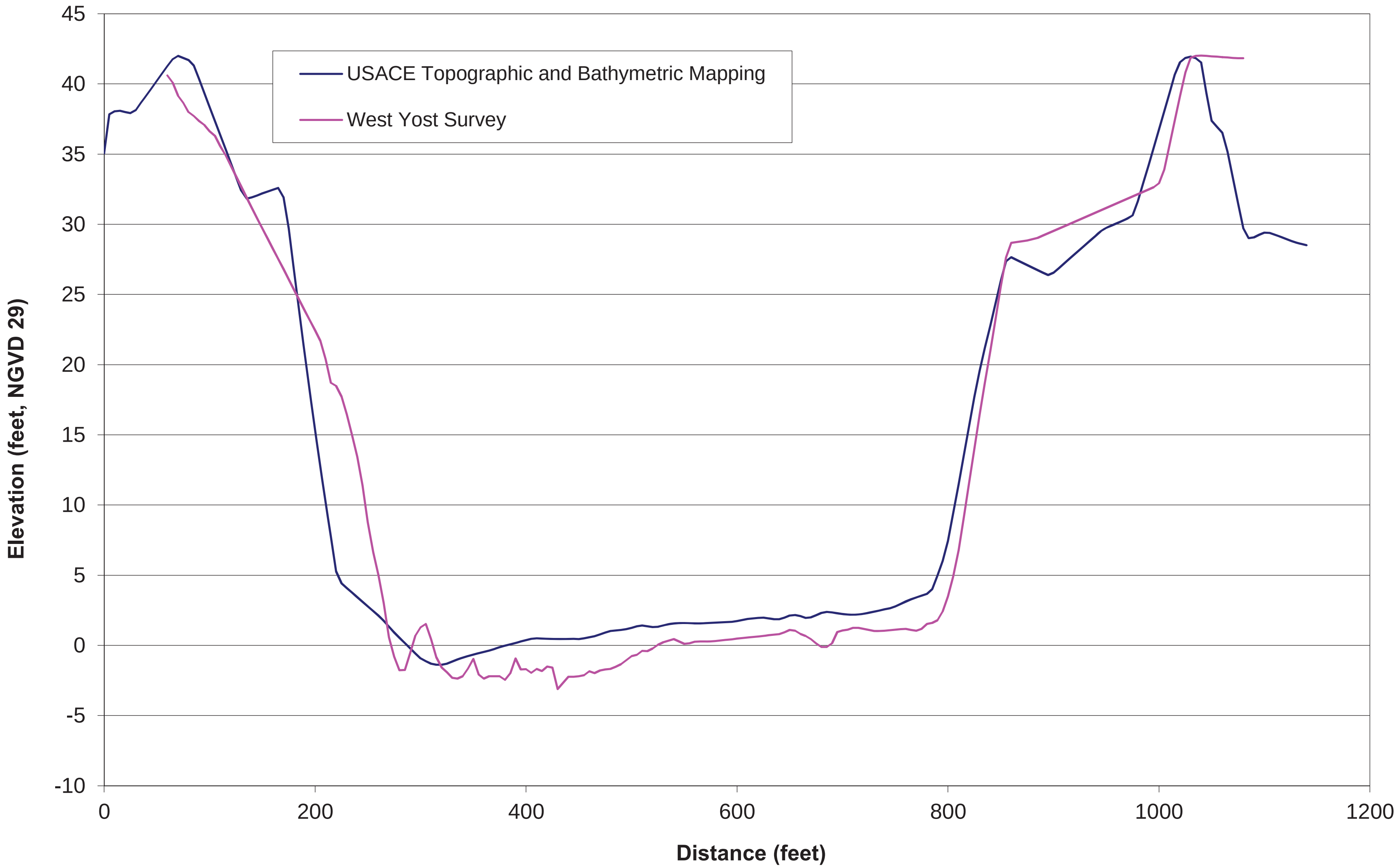


Figure 11. Comparison of West Yost Survey and USACE Data for Cross Section F

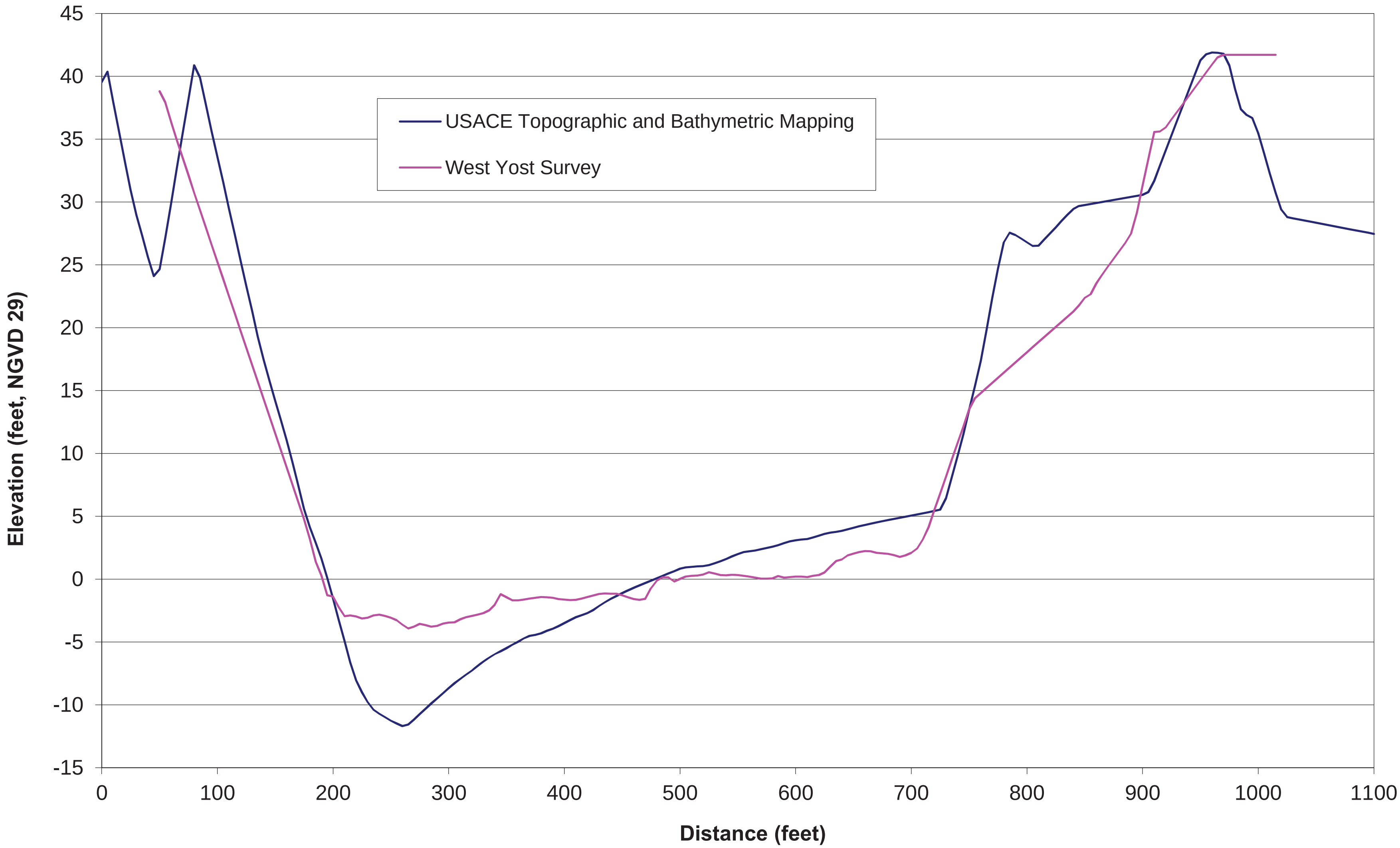


Figure 12. Comparison of West Yost Survey and USACE Data for Cross Section G

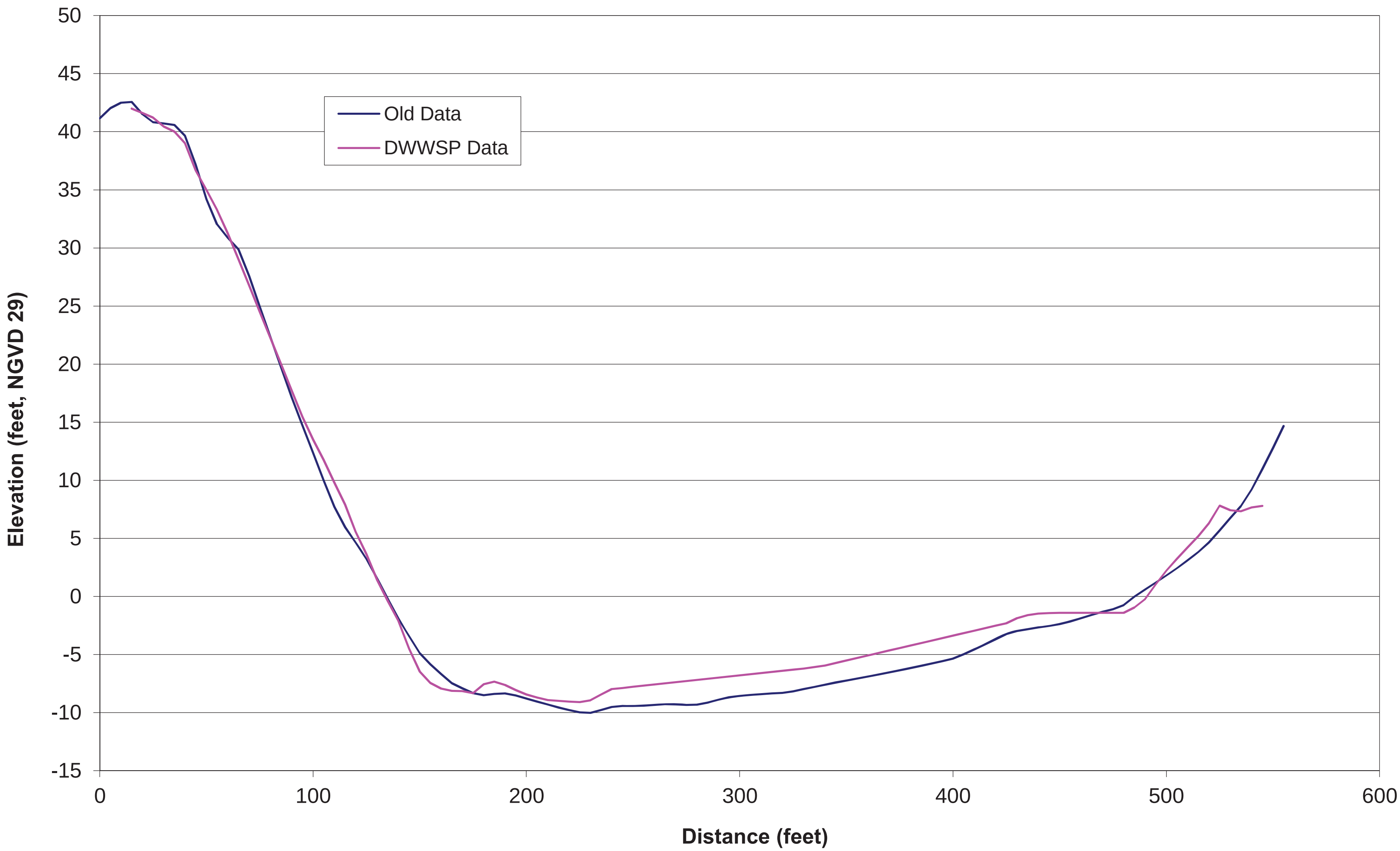


Figure 13. Comparison of West Yost Survey and USACE Data for Cross Section H

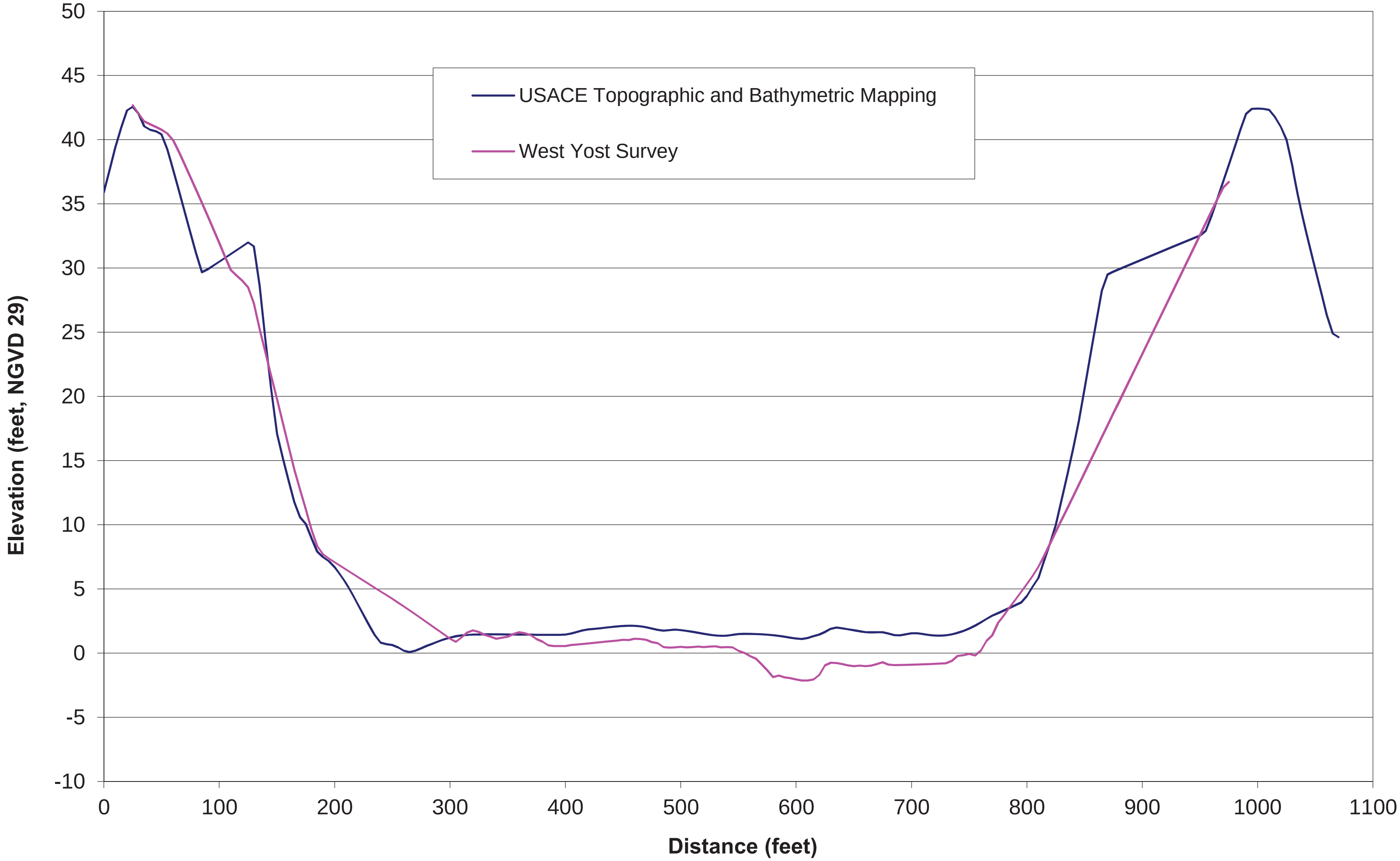
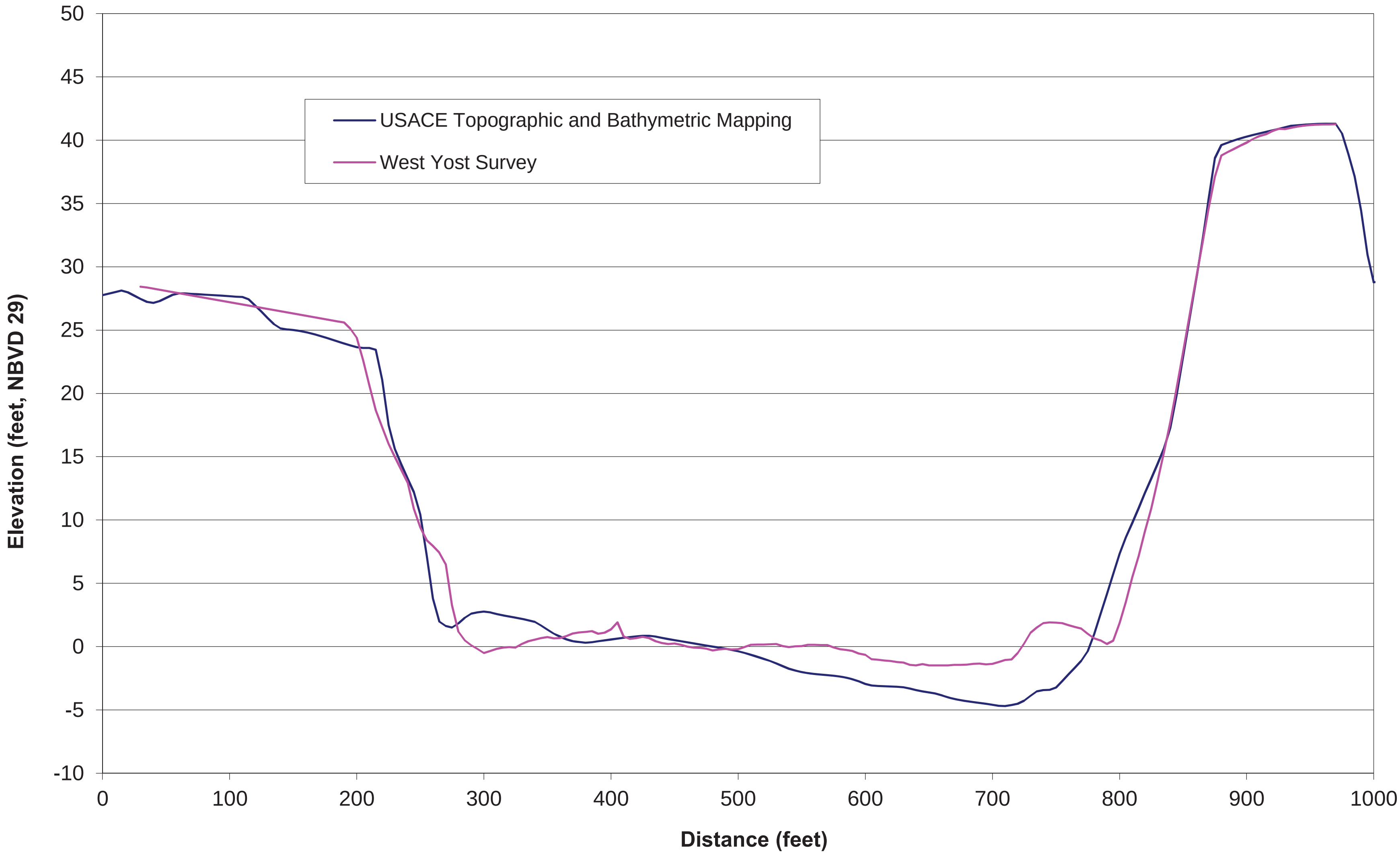


Figure 14. Comparison of West Yost Survey and USACE Data for Cross Section I



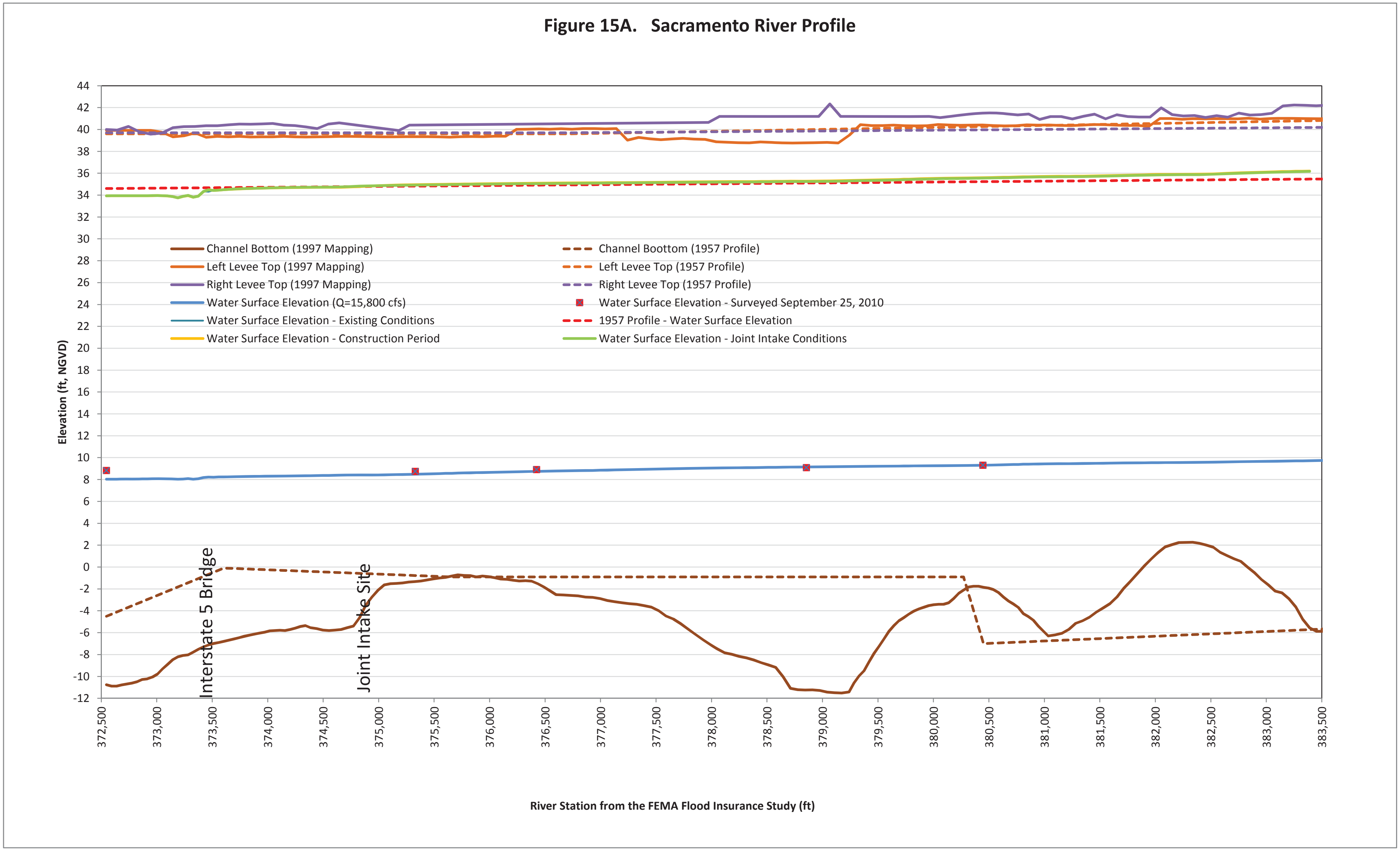


Figure 15A. Sacramento River Profile
Elevation (ft, NGVD)
River Station from the FEMA Flood Insurance Study (ft)
Channel Bottom (1997 Mapping)
Left Levee Top (1997 Mapping)
Right Levee Top (1997 Mapping)
Water Surface Elevation (Q=15,800 cfs)
Water Surface Elevation - Existing Conditions
Water Surface Elevation - Construction Period
Channel Boottom (1957 Profile)
Left Levee Top (1957 Profile)
Right Levee Top (1957 Profile)
Water Surface Elevation - Surveyed September 25, 2010
1957 Profile - Water Surface Elevation
Water Surface Elevation - Joint Intake Conditions
Interstate 5 Bridge
Joint Intake Site
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
372,500
373,000
373,500
374,000
374,500
375,000
375,500
376,000
376,500
377,000
377,500
378,000
378,500
379,000
379,500
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380,500
381,000
381,500
382,000
382,500
383,000
383,500

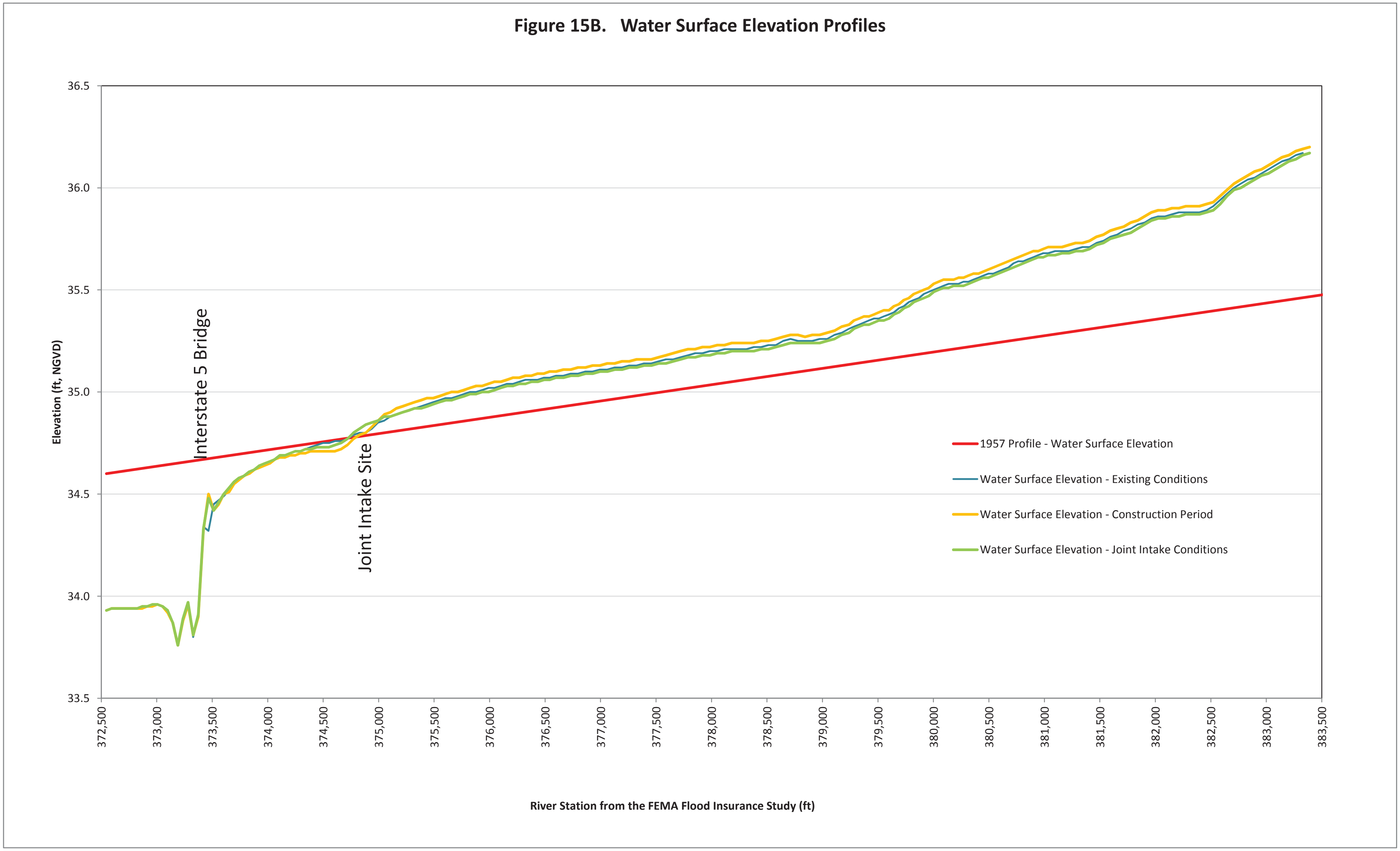
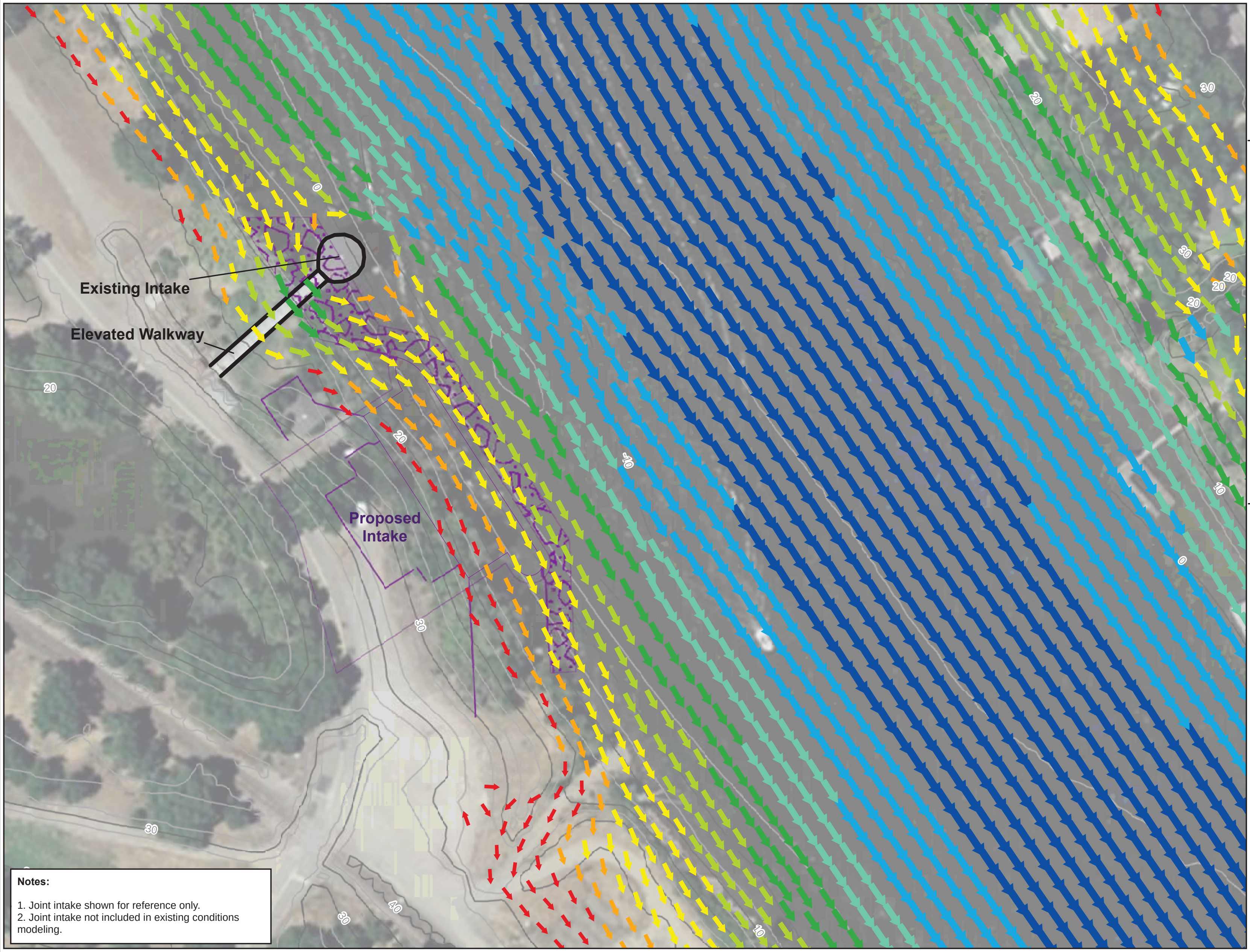


Figure 15B. Water Surface Elevation Profiles
Elevation (ft, NGVD)
36.5
36.0
35.5
35.0
34.5
34.0
33.5
Interstate 5 Bridge
Joint Intake Site
1957 Profile - Water Surface Elevation
Water Surface Elevation - Existing Conditions
Water Surface Elevation - Construction Period
Water Surface Elevation - Joint Intake Conditions
372,500
373,000
373,500
374,000
374,500
375,000
375,500
376,000
376,500
377,000
377,500
378,000
378,500
379,000
379,500
380,000
380,500
381,000
381,500
382,000
382,500
383,000
383,500
River Station from the FEMA Flood Insurance Study (ft)

Attachment D

N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure16 Velocity field mapEC.mxd 3/9/2012



Notes:

1. Joint intake shown for reference only.
2. Joint intake not included in existing conditions modeling.

FIGURE 16

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Existing Conditions Water Velocity Field for a Flow of 107,000 cfs

LEGEND

- Existing Intake
- Joint Intake
- Riprap

Velocity (feet/second)

- 0.01 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- 3.01 - 4.00
- 4.01 - 5.00
- 5.01 - 6.00
- 6.01 - 7.00

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N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Fig17 Water Depth map.mxd 3/9/2012

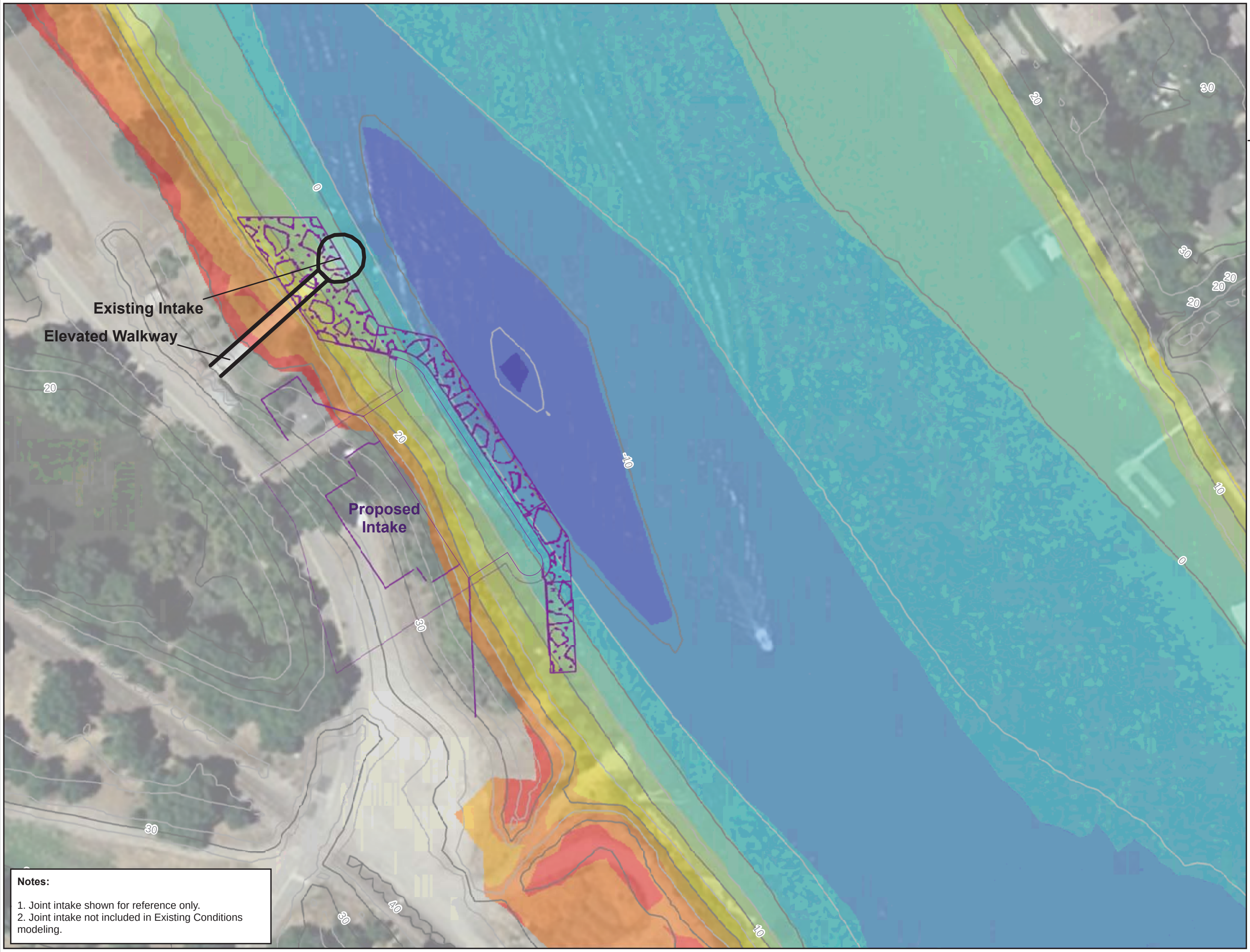

FIGURE 17

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Existing Conditions Water Depth

N

0 37.5 75

Scale in Feet

LEGEND

- Existing Intake
- Joint Intake
- Riprap

Water Depth (feet)

- 0.0 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 20
- 20.1 - 25
- 25.1 - 30
- 30.1 - 35
- 35.1 - 40
- 40.1 - 45
- 45.1 - 50
- 50.1 - 55

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N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 18 Velocity field mapCP.mxd 3/9/2012

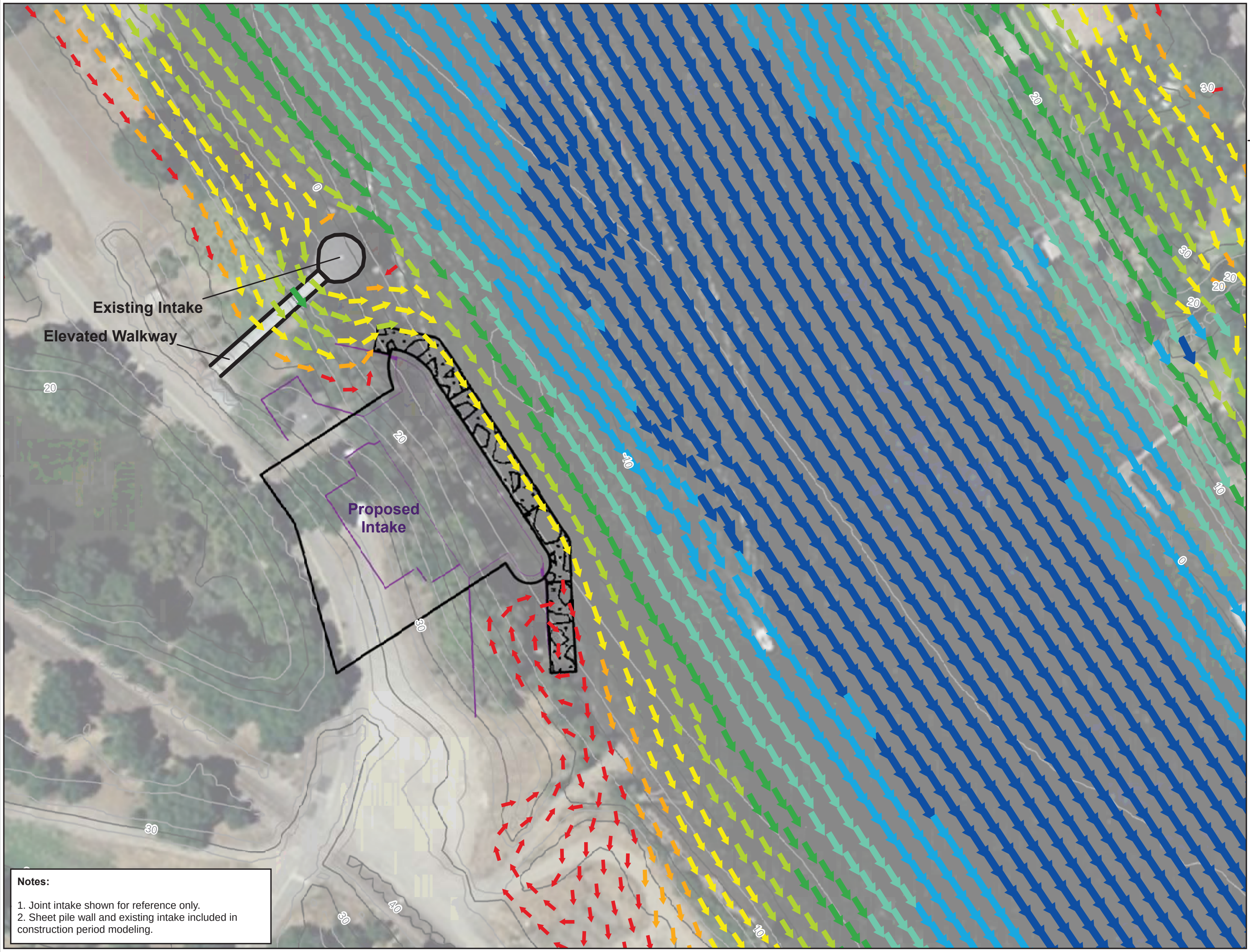

FIGURE 18

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Construction Period Water Velocity Field for a Flow of 107,000 cfs

0 37.5 75
Scale in Feet

LEGEND
- Joint Intake
- Existing Intake
- Riprap
- Sheet Pile Wall

Velocity (feet/second)
- 0.01 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- 3.01 - 4.00
- 4.01 - 5.00
- 5.01 - 6.00
- 6.01 - 7.00

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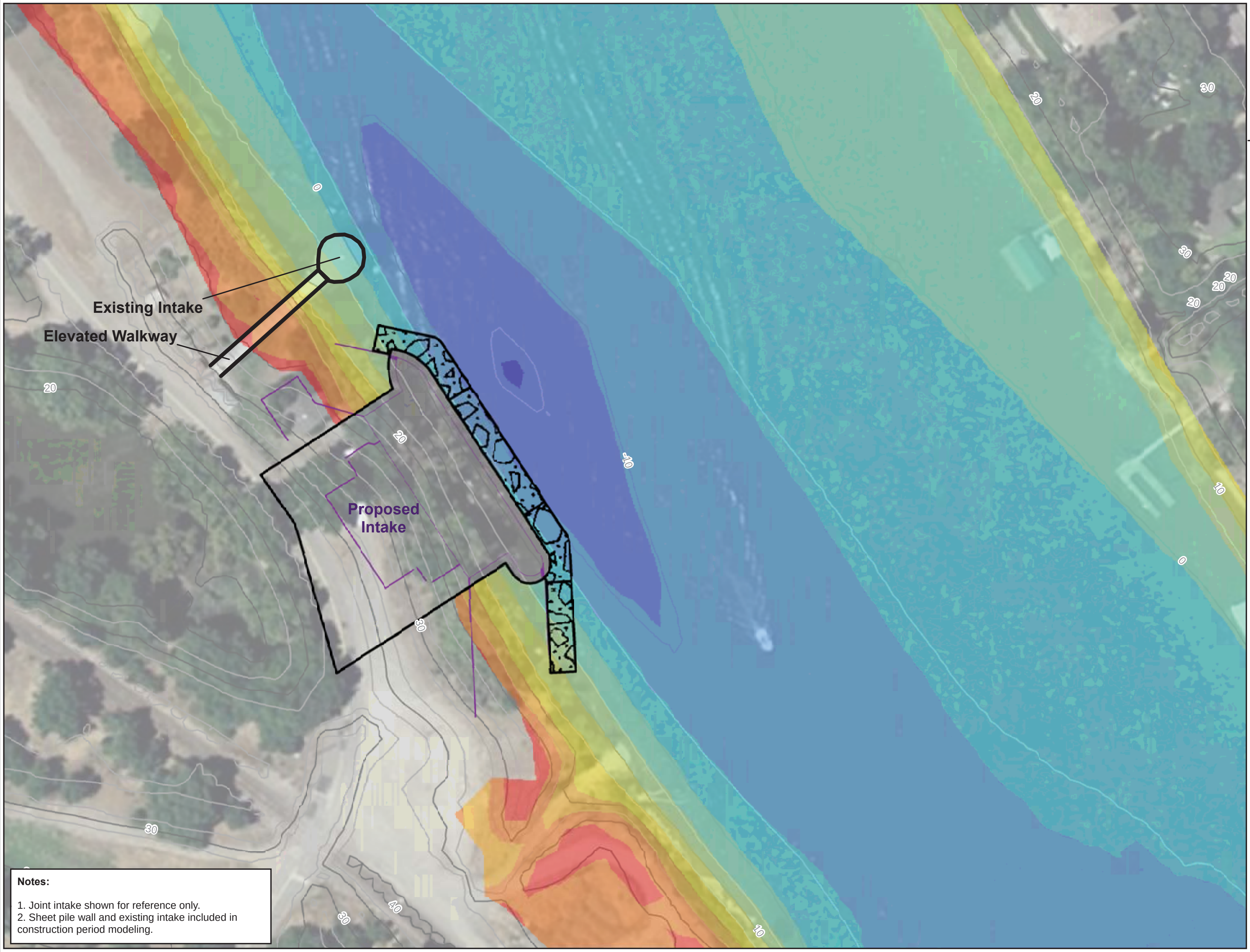
N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 19 Water Depth mapCP.mxd 3/9/2012

FIGURE 19

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Construction Period Water Depth



0 37.5 75
Scale in Feet

LEGEND

- Joint Intake
- Existing Intake
- Riprap
- Sheet Pile Wall

Water Depth (feet)

- 0.5 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 20
- 20.1 - 25
- 25.1 - 30
- 30.1 - 35
- 35.1 - 40
- 40.1 - 45
- 45.1 - 50
- 50.1 - 55

Notes:

1. Joint intake shown for reference only.
2. Sheet pile wall and existing intake included in construction period modeling.

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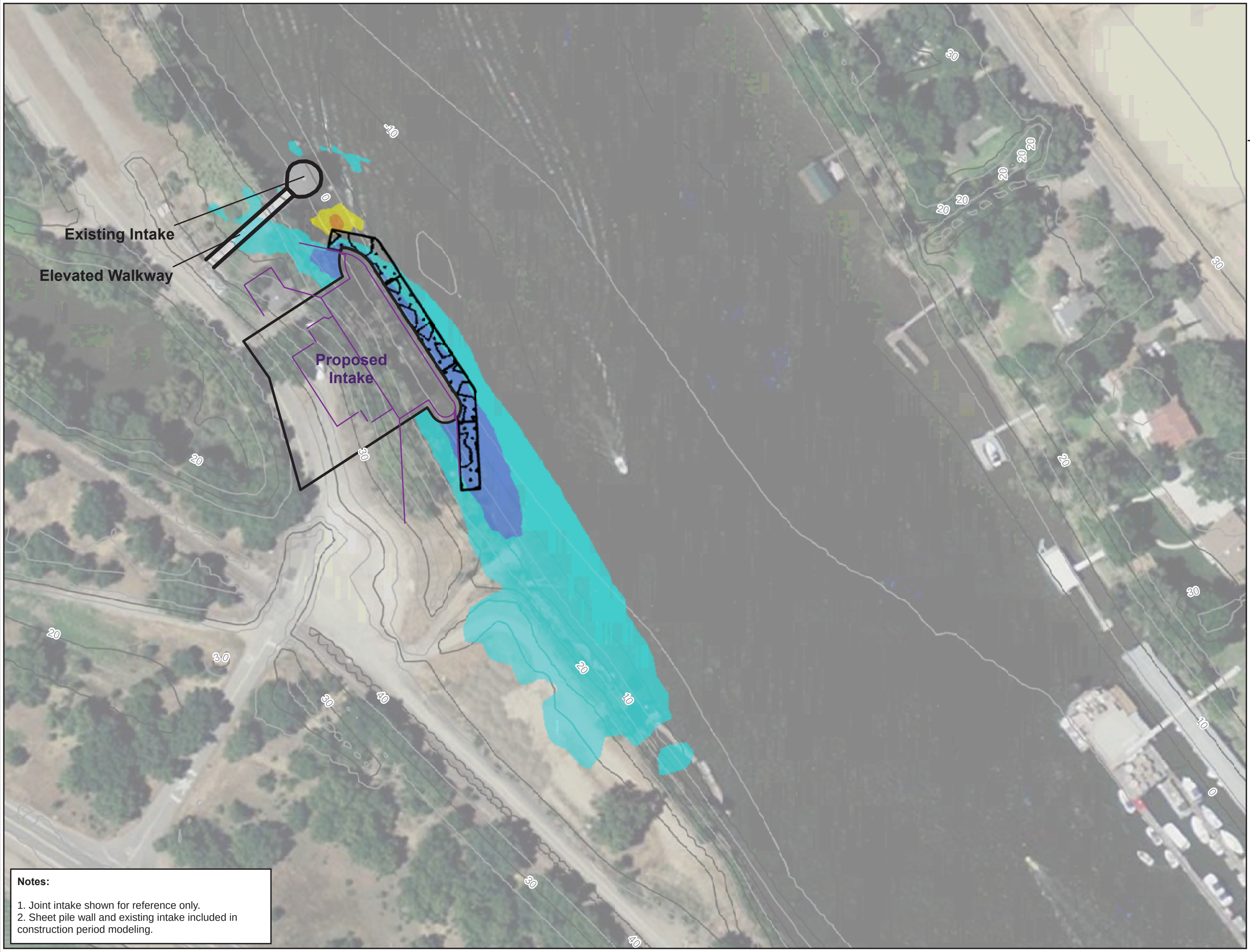
N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 20 change Velocity field mapCP.mxd 3/9/2012



Notes:

1. Joint intake shown for reference only.
2. Sheet pile wall and existing intake included in construction period modeling.

FIGURE 20

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Construction Period Change in Water Velocity Field for a Flow of 107,000 cfs

N

0 50 100

Scale in Feet

LEGEND

- Joint Intake
- Existing Intake
- Riprap
- Sheet Pile Wall

Change in Velocity (feet/second)

- < -2.00
- -2.00 - -1.00
- -1.00 - -0.50
- -0.50 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

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N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 21A changeWaterSurfElevCP.mxd 3/19/2012

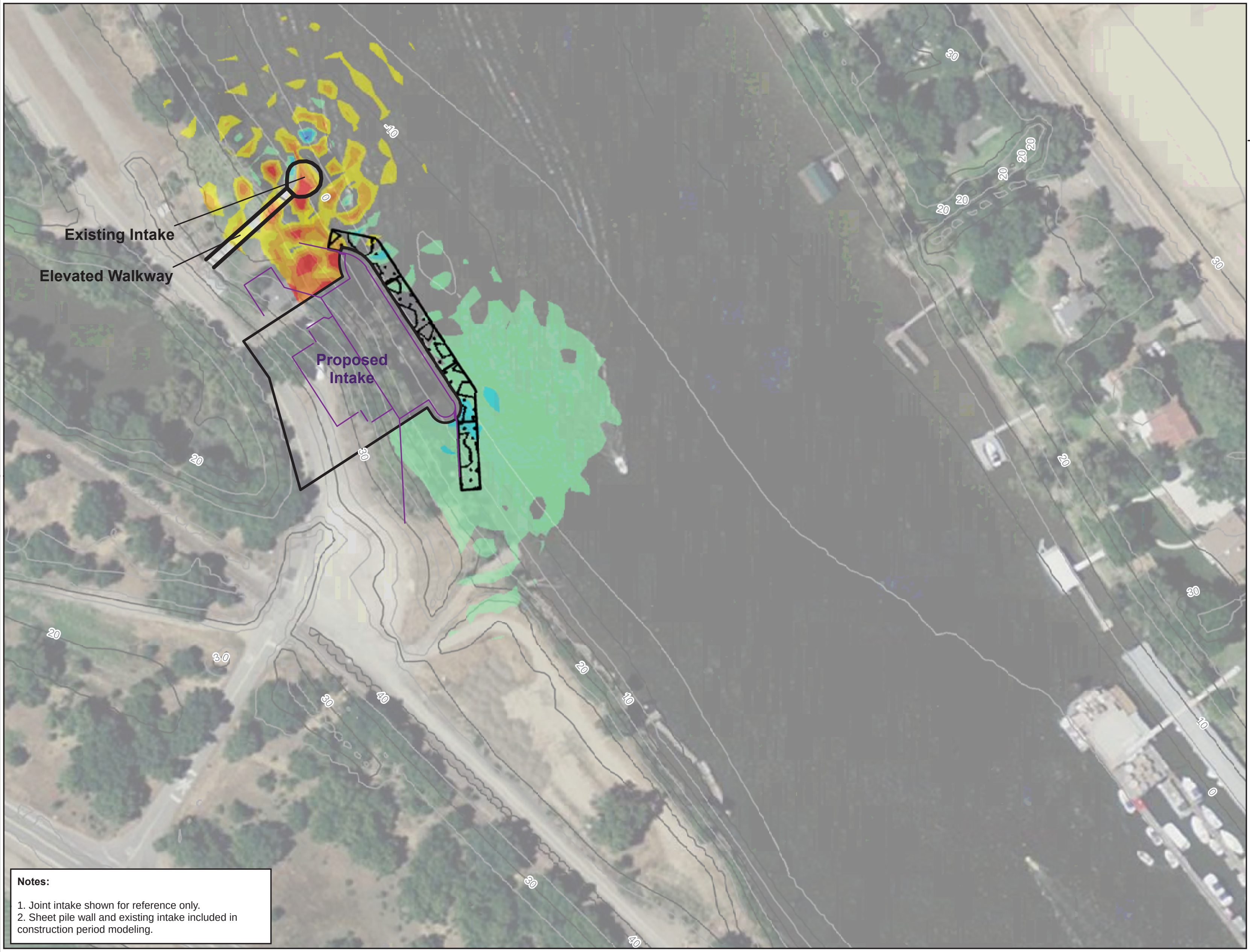

FIGURE 21A

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Construction Period Change in Water Surface Elevation for a Flow of 107,000 cfs

0 50 100
Scale in Feet

LEGEND
- Joint Intake
- Existing Intake
- Riprap
- Sheet Pile Wall

Change in Surface Elevation (feet)
- < -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- 0.15 - 0.20
- > 0.20

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Notes:

1. Joint intake shown for reference only.
2. Sheet pile wall and existing intake included in construction period modeling.

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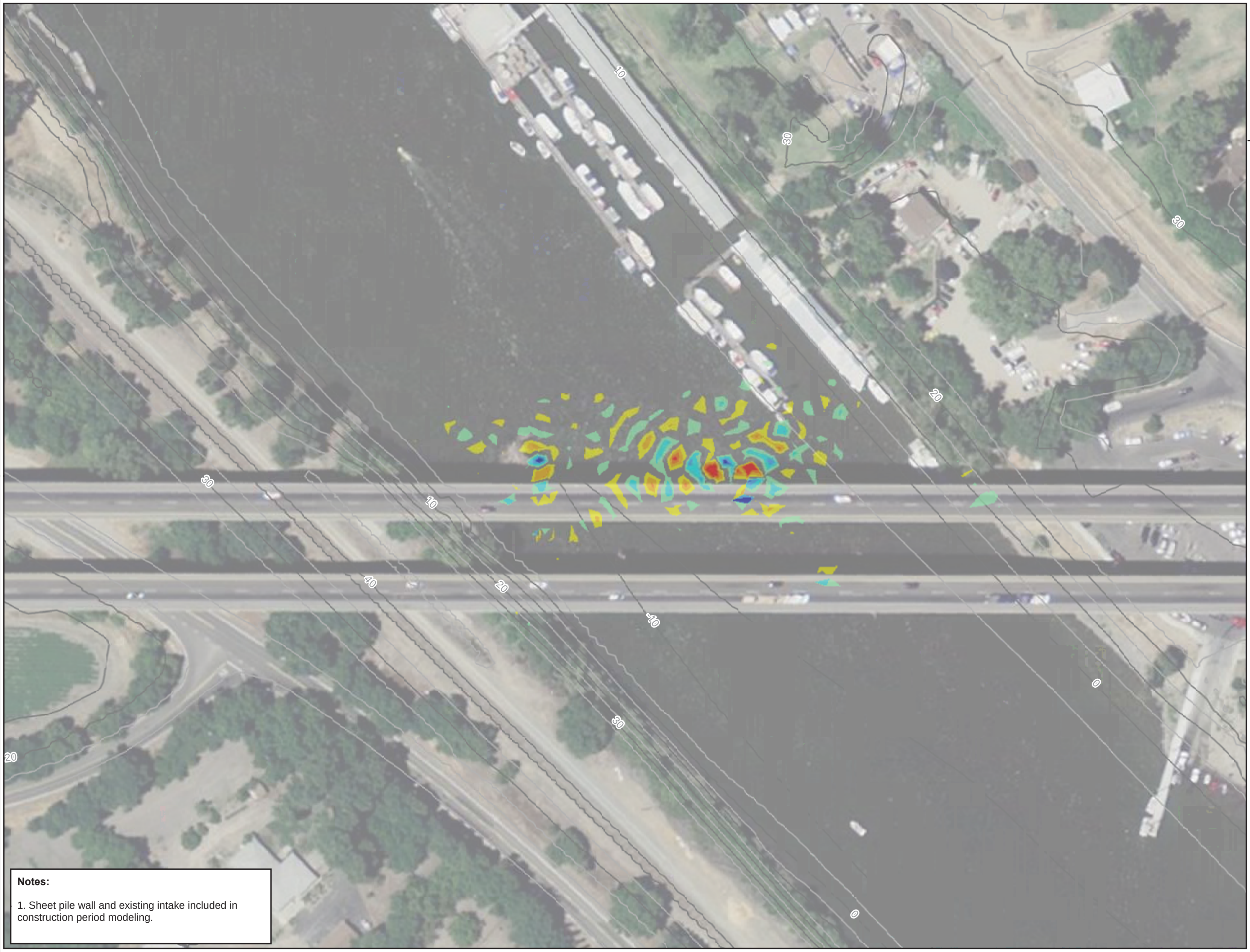
N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 21B changeWaterSurfElevCP.mxd 3/19/2012



Notes:

1. Sheet pile wall and existing intake included in construction period modeling.

FIGURE 21B

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Construction Period Change in Water Surface Elevation for a Flow of 107,000 cfs

N

0 50 100

Scale in Feet

LEGEND

Change in Surface Elevation (feet)

- < -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- 0.15 - 0.20
- > 0.20

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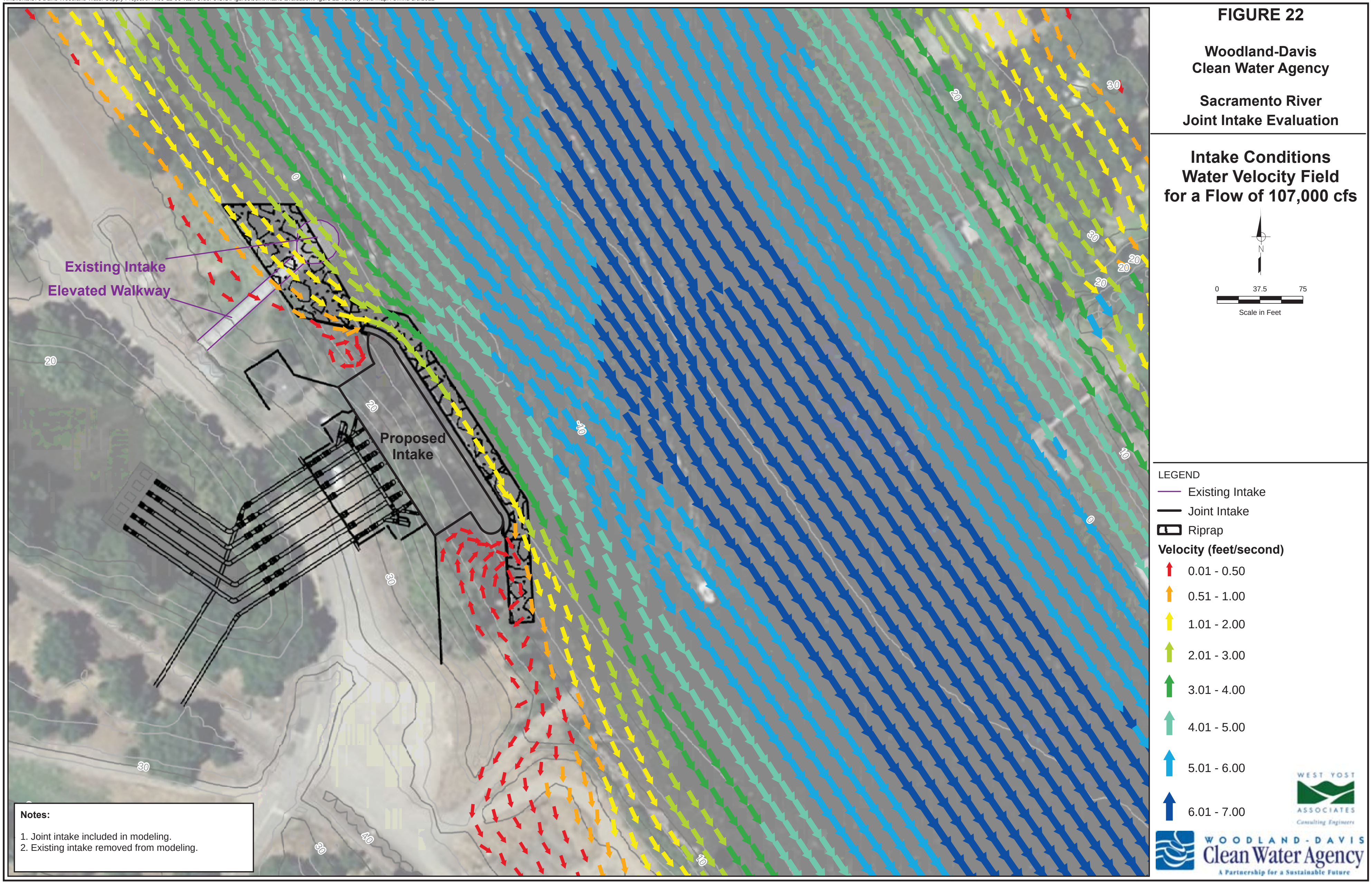
N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 22 Velocity field mapITC.mxd 3/9/2012



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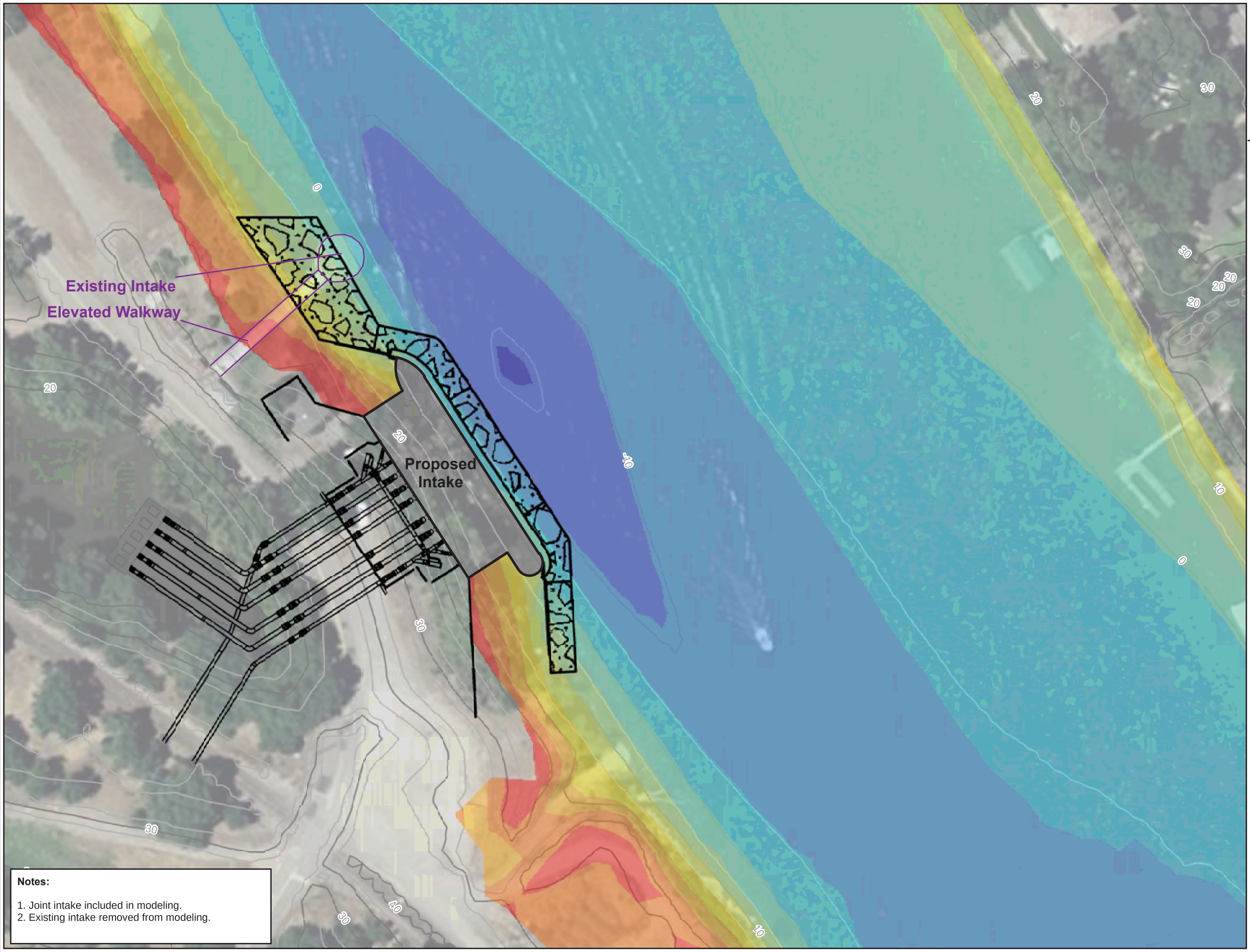

Notes:

1. Joint intake included in modeling.
2. Existing intake removed from modeling.

FIGURE 23

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Intake Conditions Water Depth

N

0 37.5 75

Scale in Feet

LEGEND

- Existing Intake
- Joint Intake
- Riprap

Water Depth (feet)

- 0.5 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 20
- 20.1 - 25
- 25.1 - 30
- 30.1 - 35
- 35.1 - 40
- 40.1 - 45
- 45.1 - 50
- 50.1 - 55

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N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 24 change Velocity field mapITC.mxd 3/9/2012

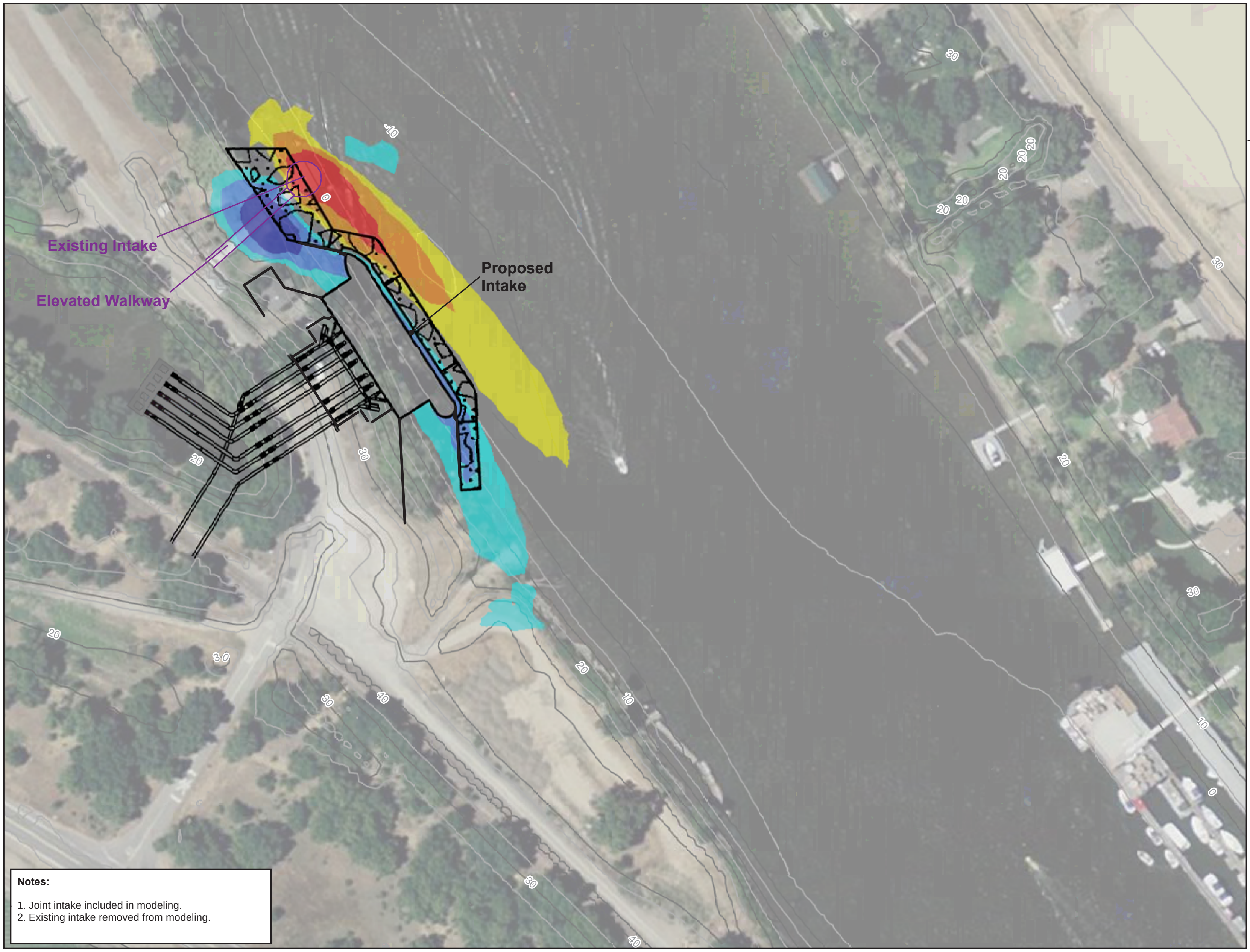

FIGURE 24

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Intake Conditions Change in Water Velocity Field for a Flow of 107,000 cfs

N

0 50 100
Scale in Feet

LEGEND
- Existing Intake
- Joint Intake
- Riprap

Change in Velocity (feet/second)
- < -2.00
- -2.00 - -1.00
- -1.00 - -0.50
- -0.50 - 0.50
- 0.50 - 1.00
- 1.00 - 200
- > 2.00

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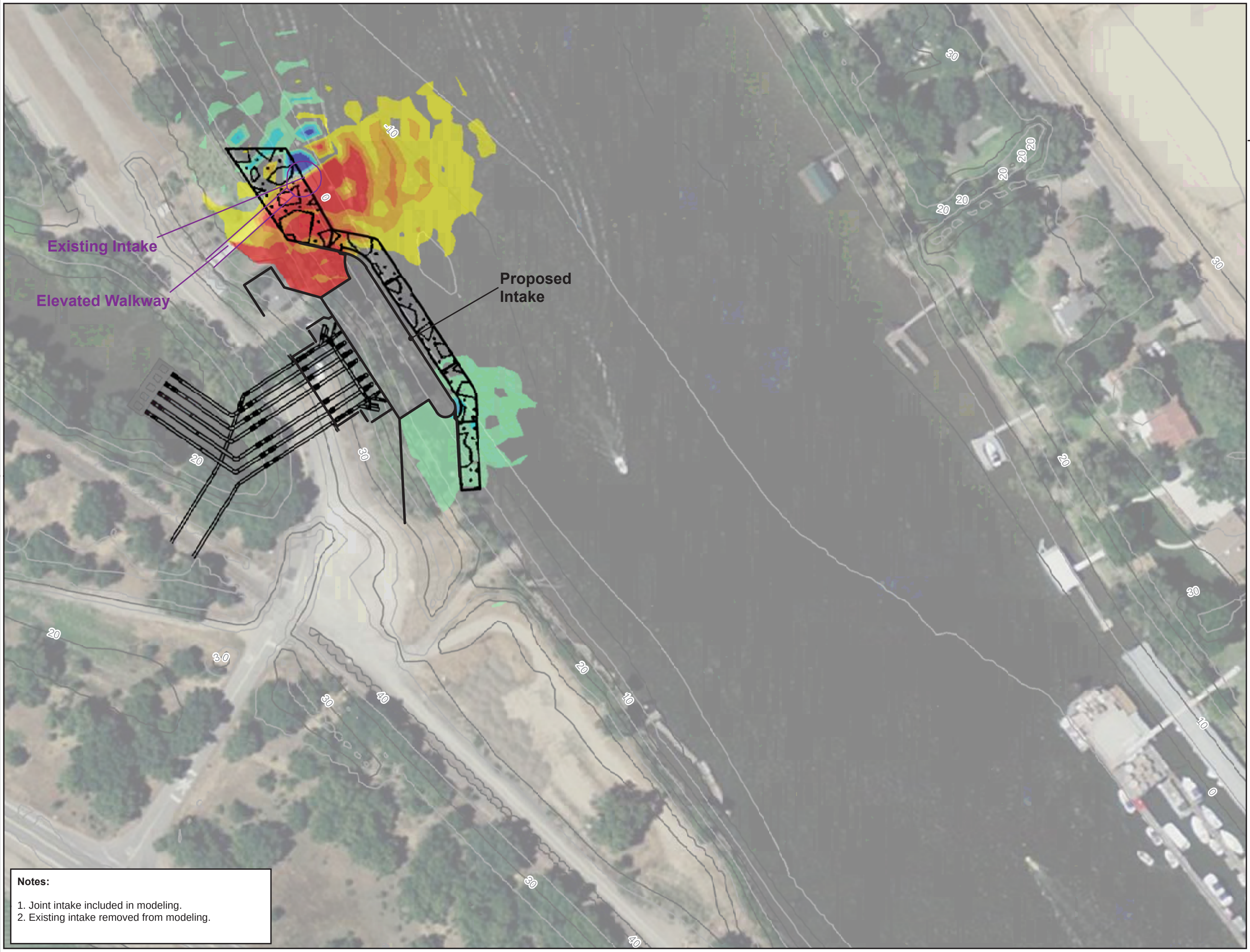
N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 25A changeWaterSurfElevITC.mxd 3/19/2012



Notes:

1. Joint intake included in modeling.
2. Existing intake removed from modeling.

FIGURE 25A

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Intake Conditions Change in Water Surface Elevation for a Flow of 107,000 cfs

N

0 50 100

Scale in Feet

LEGEND

- Existing Intake
- Joint Intake
- Riprap

Change in Surface Elevation (feet)

- < -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- 0.15 - 0.20
- > 0.20

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N:\Clients\376 Davis Woodland Water Supply Project JPA\00-11-06 Task Order 5\GIS\Figures\Joint Intake Evaluation\Figure 25B changeWaterSurfElevITC.mxd 3/19/2012

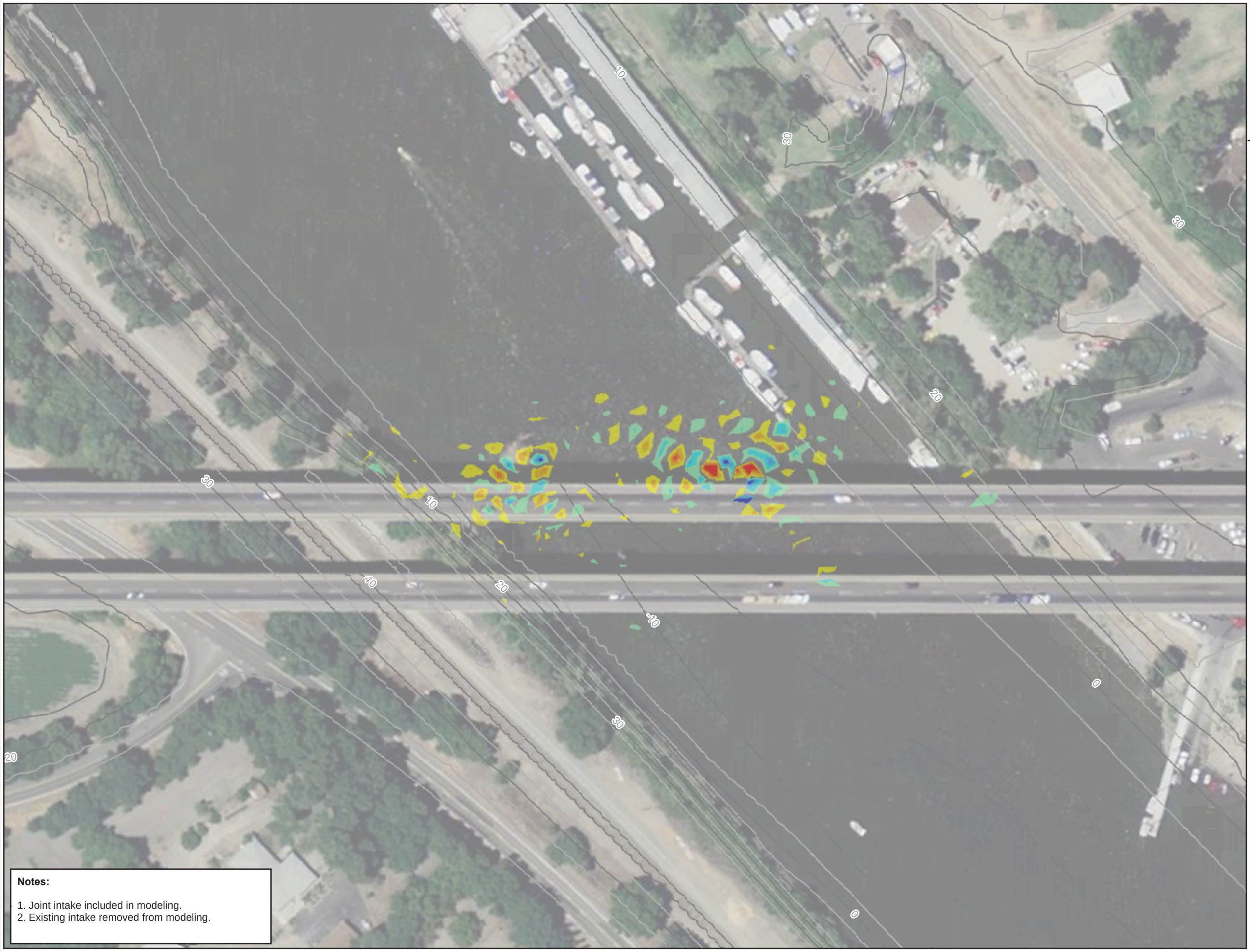

FIGURE 25B

Woodland-Davis Clean Water Agency

Sacramento River Joint Intake Evaluation

Intake Conditions Change in Water Surface Elevation for a Flow of 107,000 cfs

N

0 50 100

Scale in Feet

LEGEND

Change in Surface Elevation (feet)

- < -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- 0.15 - 0.20
- > 0.20

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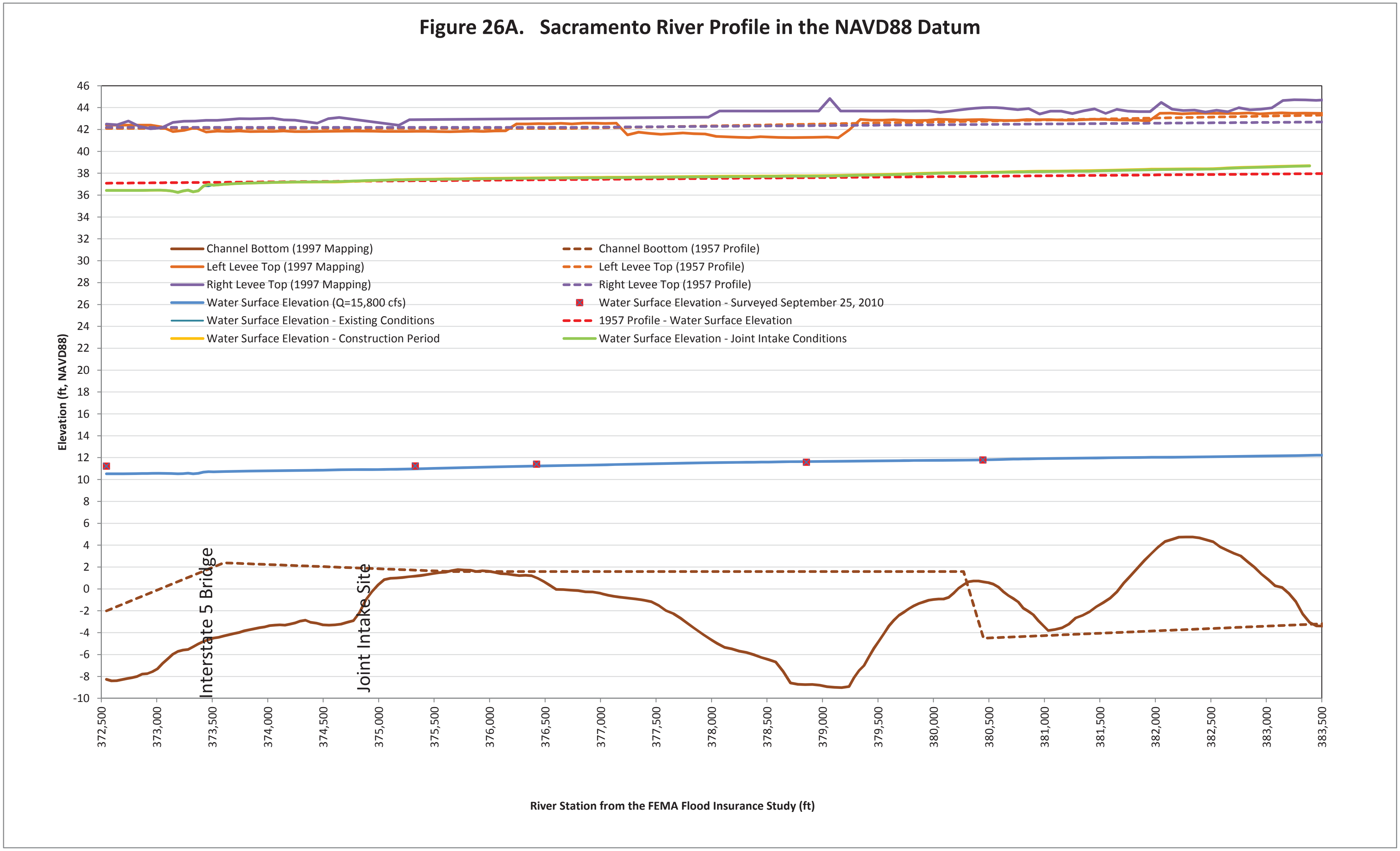

Figure 26A. Sacramento River Profile in the NAVD88 Datum
Elevation (ft, NAVD88)
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
Channel Bottom (1997 Mapping)
Channel Boottom (1957 Profile)
Left Levee Top (1997 Mapping)
Left Levee Top (1957 Profile)
Right Levee Top (1997 Mapping)
Right Levee Top (1957 Profile)
Water Surface Elevation (Q=15,800 cfs)
Water Surface Elevation - Surveyed September 25, 2010
Water Surface Elevation - Existing Conditions
1957 Profile - Water Surface Elevation
Water Surface Elevation - Construction Period
Water Surface Elevation - Joint Intake Conditions
Interstate 5 Bridge
Joint Intake Site
372,500
373,000
373,500
374,000
374,500
375,000
375,500
376,000
376,500
377,000
377,500
378,000
378,500
379,000
379,500
380,000
380,500
381,000
381,500
382,000
382,500
383,000
383,500
River Station from the FEMA Flood Insurance Study (ft)

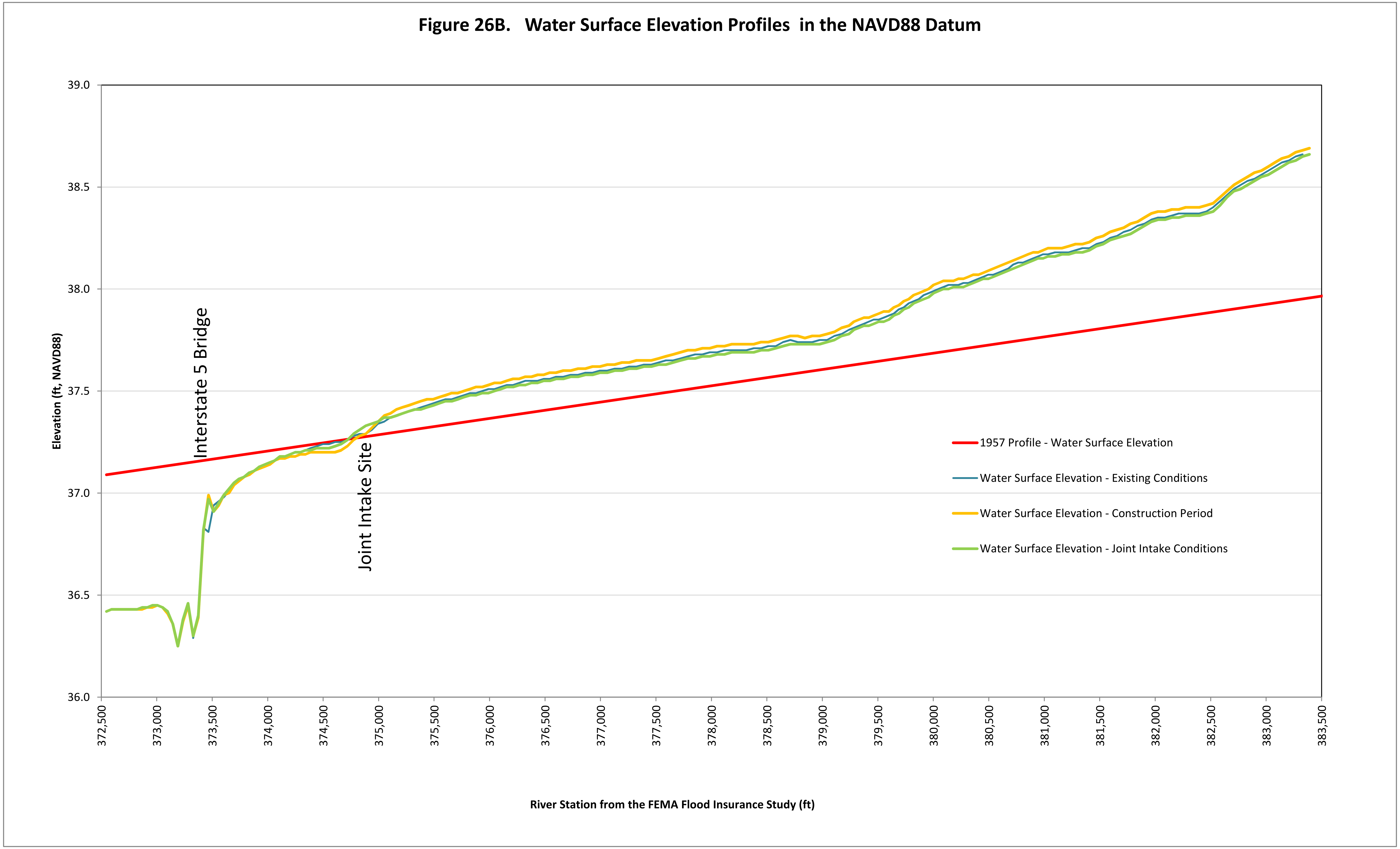

Figure 26B. Water Surface Elevation Profiles in the NAVD88 Datum
Elevation (ft, NAVD88)
39.0
38.5
38.0
37.5
37.0
36.5
36.0
Interstate 5 Bridge
Joint Intake Site
1957 Profile - Water Surface Elevation
Water Surface Elevation - Existing Conditions
Water Surface Elevation - Construction Period
Water Surface Elevation - Joint Intake Conditions
372,500
373,000
373,500
374,000
374,500
375,000
375,500
376,000
376,500
377,000
377,500
378,000
378,500
379,000
379,500
380,000
380,500
381,000
381,500
382,000
382,500
383,000
383,500
River Station from the FEMA Flood Insurance Study (ft)

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Consulting Engineers

REGISTERED PROFESSIONAL ENGINEER
DOUGLAS T. MOORE
No. 58122
Expires 6-30-14
CIVIL
STATE OF CALIFORNIA

12-21-12

ADDENDUM

DATE: December 21, 2012 Project No.: 376-00-11-06.030

TO: Gary Reents, Joint Intake Project Manager

CC: Dennis Diemer, General Manager, WDCWA

FROM: Douglas T. Moore, R.C.E. #C58122 DTM

REVIEWED BY: Jim Yost, R.C.E. #24137

SUBJECT: Addendum to the Sacramento River Joint Intake 2-Dimensional Model Evaluation (dated March 19, 2012)

INTRODUCTION

This document is an addendum to the Technical Memorandum Sacramento River Joint Intake 2-Dimensional Model Evaluation (dated March 19, 2012).

In the Technical Memorandum Sacramento River Joint Intake 2-Dimensional Model Evaluation the changes in the water flow patterns and velocities and the changes in the water surface elevation resulting from the proposed removal of the existing intake combined with the construction of the Woodland-Davis Clean Water Agency's proposed intake on the Sacramento River were evaluated. The evaluation was prepared using the RiverFLO-2D model. In that evaluation the water surfaces were found to increase by as much as 0.25 feet, which exceed the US Army Corps of Engineers (USACE) criterion of a maximum increase of 0.10 feet. The proposed project included both the removal of the existing intake and the construction of the proposed intake.

At a meeting with USACE staff on September 27, 2012, we discussed the proposed intake, and how much of the increase in water level occurs from the removal of the existing intake and questioned how much occurs from the construction of the proposed intake. Using the RiverFLO-2D model we have separately evaluated the change in water levels from removing the existing intake and the change from constructing the proposed intake. This revised modeling and the model results are presented below. Most of the increase in water level occurs from removal of the existing intake and only a small fraction of the increase results from the construction of the proposed intake. Conclusions and recommendations are also presented below.

The proposed project includes two separate but related actions, including removal of the existing intake and construction of the proposed intake. However, the existing intake cannot be removed until the proposed intake is operational. Because these are separate actions, the effects on the river water level should be modeled and evaluated separately.

Removal of the existing intake results in a large area where the water level increases by over 0.20 feet. In terms of river surface elevation and levee stability, this increase provides no real threat. The increase results from removal of the intake and the low water level downstream of this structure, and its replacement with a higher water level that matches the surrounding river level. It is clearly preferable to remove the existing intake when it is no longer needed than to leave it in place permanently. Therefore, the effect of removing the existing intake has been evaluated separately from the effect of constructing the proposed intake, and the starting conditions for evaluating the effects of constructing the proposed intake are based on the existing intake no longer being in place.

This Addendum, consequently, presents an evaluation of the effects of removal of the existing intake on Figure A1. Figure A1 shows the water level for the Existing Condition (EC) minus the water level for a No Existing Intake (NEI) condition. Figure A2 presents the change in water level from the NEI condition going to the Construction Period (CP), and Figure A3 presents the change in water level going from the NEI condition to the Proposed Intake Condition (PIC, after construction is completed).

REVISED MODELING

The modeling was revised to evaluate the change in water level from removal of the existing intake separately from the construction of the proposed intake. Additionally, the following revisions to the model were also made:

- Two changes were made in the topographic mapping (originally prepared by the USACE, in 1997) on which the model is based. One of the changes was the elimination of a 15 foot deep channel in the top of the levee at the site of the existing and proposed intakes. The second change was the elimination of a ridge of high ground projecting from the levee to the location of the main river channel across the river from the proposed intake. Site visits were performed to each location to confirm that the original topographic mapping was incorrect and to confirm the accuracy of these changes. The channel was eliminated from the top of the levee by revising the topographic mapping to maintain the levee top level. The ridge was eliminated by interpolation between the ground just upstream and downstream of the ridge.
- The model’s finite element mesh size was reduced from 20 feet to 8 feet in several areas where there are structures in the river that affect the flow pattern of the water. Specifically, this finer mesh was used in the area near the existing and proposed intakes, at the Interstate 80 bridge, and at two raised building pads on the left bank of the river across from the proposed intake. The use of the finer mesh improves the level of detail and resulting accuracy of the model results.

All of these changes were made for all model runs to ensure that the changes in water levels between model runs really occur from the changes in the existing and proposed intakes and not from different modeling conditions between different model runs.

As requested by USACE staff at the September 27, 2012 meeting, the existing intake was modeled as a solid cylinder in this revised modeling, which is consistent with the original modeling of the existing intake in the March 19, 2012, Technical Memorandum.

MODEL RESULTS FOR THE REMOVAL OF THE EXISTING INTAKE

The change in water level from the removal of the existing intake is presented on Figure A1. This figure shows the difference in water level resulting from the EC model run (with the existing intake in place) and the NEI model run (with no existing intake). The proposed intake is shown on Figure A1 in light gray only to illustrate its location relative to the existing intake and the changes in water levels from removing the existing intake. The proposed intake was not included in either the EC or NEI model runs.

As shown on Figure A1, removal of the existing intake causes a decrease in the water level just upstream of the intake and causes an increase in the water level adjacent to and downstream of the intake. The increase in water level extends downstream into the area where the proposed intake will be constructed. The maximum increase in water level exceeds 0.20 feet in some locations. This increase in the water level occurs because modeling the existing intake as a solid cylinder (EC model run) causes the water to accelerate around the intake, which in turn causes a depressed water level adjacent to and downstream of the existing intake. When the existing intake is removed (NEI model run), this depressed water level is eliminated, resulting in the water level increase shown in Figure A1.

As discussed above, it is essential to separate the effect on the river water level from removing the existing intake from the effects of constructing the proposed intake. Consequently presented in the next sections are the evaluations of the changes in water level from constructing the proposed intake (CP and PIC model runs) in comparison to the condition without the existing intake (NEI model run).

MODEL RESULTS FOR THE PROPOSED INTAKE CONSTRUCTION PERIOD (CP)

The change in water level from the construction of the proposed intake is presented on Figure A2. This figure shows the difference in water level between the CP model run and the NEI model run. This figure shows the changes in water level that occur from the construction of the proposed intake separately from the changes in the water level from removal of the existing intake. The CP model run includes a sheet pile wall around the footing of the proposed intake. The existing intake is shown on Figure A2 in light gray only to illustrate its location relative to the proposed intake and the changes in water levels from constructing the proposed intake. The existing intake was not included in either the CP or NEI model runs.

As shown on Figure A2, construction of the proposed intake would cause an increase in the water level that is mostly 0.10 feet or less. However, there are a few very small areas where the water level increases by more than 0.10 feet near the upstream end of the proposed intake. These areas are smaller than about 25 square feet and are located at least 60 feet from where the water surface would intersect the levee prism. These small areas with an increase exceeding 0.10 feet are even outside the levee prism buffer. Additionally there is a small area located at the downstream end of the proposed intake, which is also less than 25 square feet in size and is about 76 feet from the levee prism buffer. Consequently, these small areas that exceed 0.10 feet of increase do not pose a threat to the levee.

MODEL RESULTS FOR THE PROPOSED INTAKE CONDITION (PIC)

The change in water level from the construction of the proposed intake is presented on Figure A3. This figure shows the difference in water level between the proposed intake condition after it is fully constructed and the NEI model run. This figure shows the changes in water level that occur from the construction of the proposed intake separately from the changes in the water level from removal of the existing intake. The PIC model run includes the proposed intake but does not include the sheet pile wall around the footing of the proposed intake. The existing intake is shown on Figure A3 in light gray only to illustrate its location relative to the proposed intake and the changes in water levels from constructing the proposed intake. The existing intake was not included in either the PIC or NEI model runs.

As shown on Figure A3, the proposed intake would result in a water level increase of mostly 0.10 feet or less. There are a few very small areas where the water level increases by more than 0.10 feet near the upstream end of the proposed intake. However, these areas are smaller than about 25 square feet and are located over 70 feet from where the water surface would intersect the levee prism. These small areas with an increase exceeding 0.10 feet also are outside the levee prism buffer. Additionally there are two small areas located at the downstream end of the proposed intake, which are also less than 25 square feet in size and are at least 85 feet from the levee prism buffer. Consequently, these small areas that exceed 0.10 feet of increase do not pose a threat to the levee.

CONCLUSIONS

Relevant conclusions are presented below.

- The changes in water levels resulting from removal of the existing intake were evaluated separately from the changes in water levels from construction of the proposed intake.
- The removal of the existing intake causes an increase in the water level adjacent to and downstream of the existing intake that exceeds 0.10 feet. Even though removal of the existing intake causes an increase in the water level greater than 0.10 feet, the existing intake should be removed to eliminate an unnecessary structure from the river. This water level rise presents no threat to levee

stability in the area, and removal of the structure will actually result in more stable flow through the area.

- The construction of the proposed intake causes a few very small areas of water level increase greater than 0.10 feet. However, because these areas are very small (smaller than 5 feet by 5 feet), are outside the levee prism buffer, and are at least 60 feet from where the water surface meets the levee prism. They do not pose a risk to the levee.
- Because the very small areas where the water level increase exceeds 0.10 feet do not pose a risk to the levee, the proposed intake can be safely approved, permitted, and constructed.

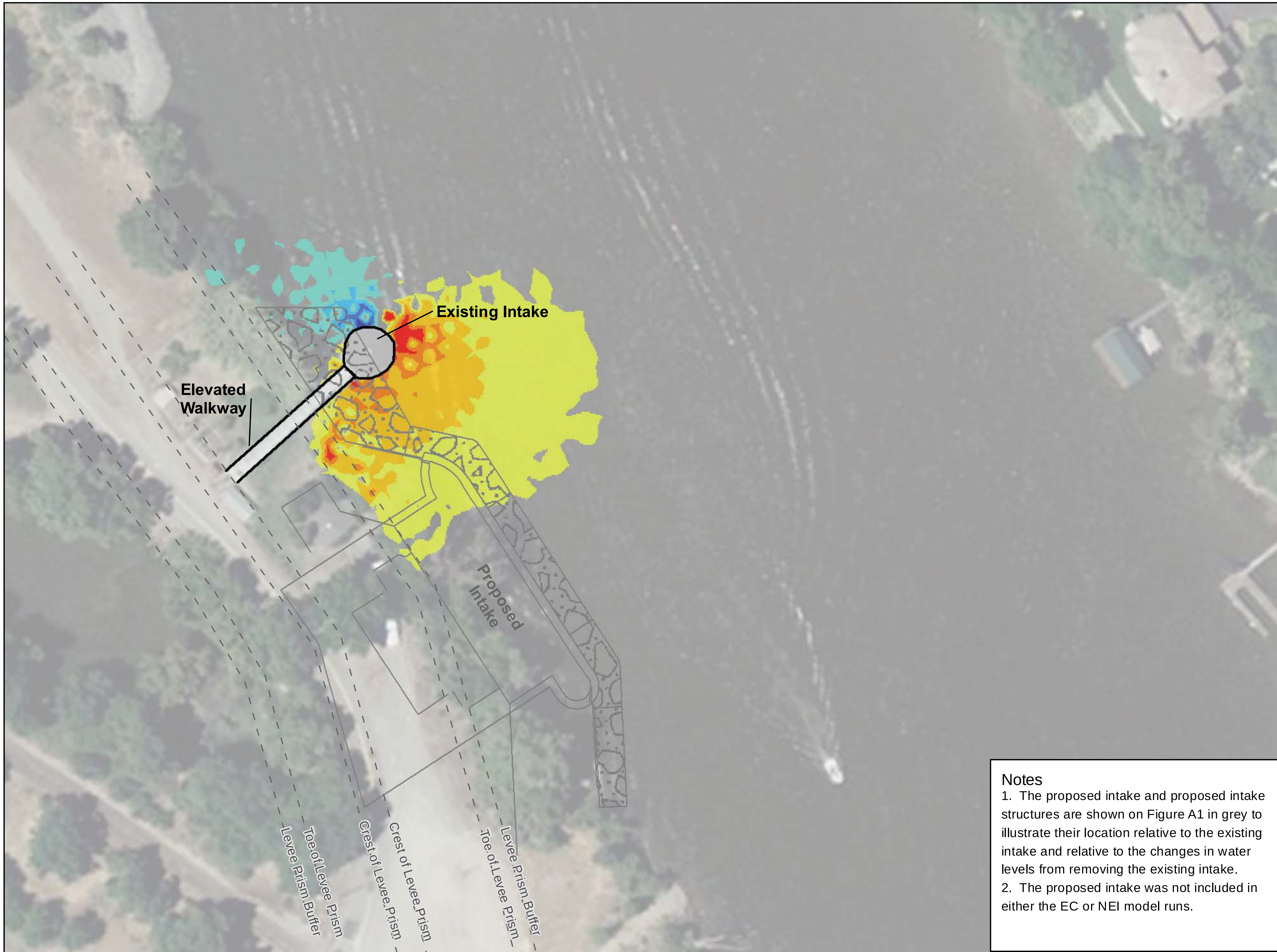
Please contact Jim Yost or Doug Moore at 530-756-5905 if you have questions or comments on this addendum.

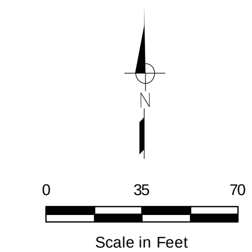
Attachment E

FIGURE A1

Woodland-Davis Clean Water Agency Sacramento River Joint Intake Evaluation

Change in Water Level from Existing Condition (EC) to the No Existing Intake (NEI) Condition





LEGEND

- Existing Intake
- Proposed Intake
- Proposed Riprap
- Proposed Sheet Pile

Change in Water Level (Feet)

- < -0.21
- -0.21 - -0.16
- -0.15 - -0.11
- -0.10 - -0.06
- -0.05 - 0.05
- 0.06 - 0.10
- 0.11 - 0.15
- 0.16 - 0.20
- > 0.20

Notes

1. The proposed intake and proposed intake structures are shown on Figure A1 in grey to illustrate their location relative to the existing intake and relative to the changes in water levels from removing the existing intake.
2. The proposed intake was not included in either the EC or NEI model runs.

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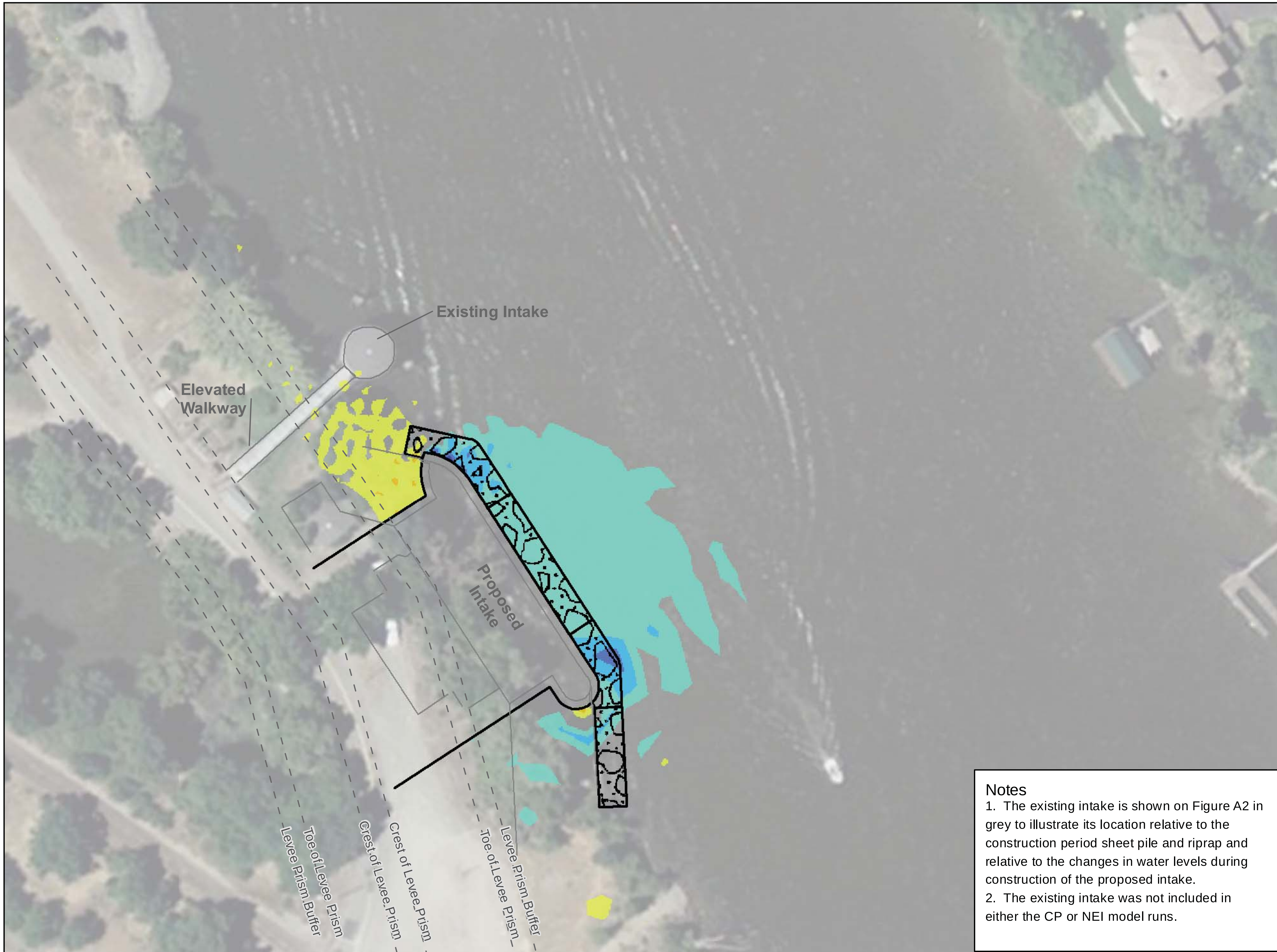

Attachment E

FIGURE A2

Woodland-Davis Clean Water Agency Sacramento River Joint Intake Evaluation

Change in Water Level from No Existing Intake (NEI) Condition to the Construction Period (CP)

N

0 35 70
Scale in Feet

LEGEND

- Existing Intake
- Proposed Intake
- Proposed Sheet Pile
- Proposed Riprap

Change in Water Level (Feet)

- < -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- 0.15 - 0.20
- > 0.20

Notes

1. The existing intake is shown on Figure A2 in grey to illustrate its location relative to the construction period sheet pile and riprap and relative to the changes in water levels during construction of the proposed intake.
2. The existing intake was not included in either the CP or NEI model runs.

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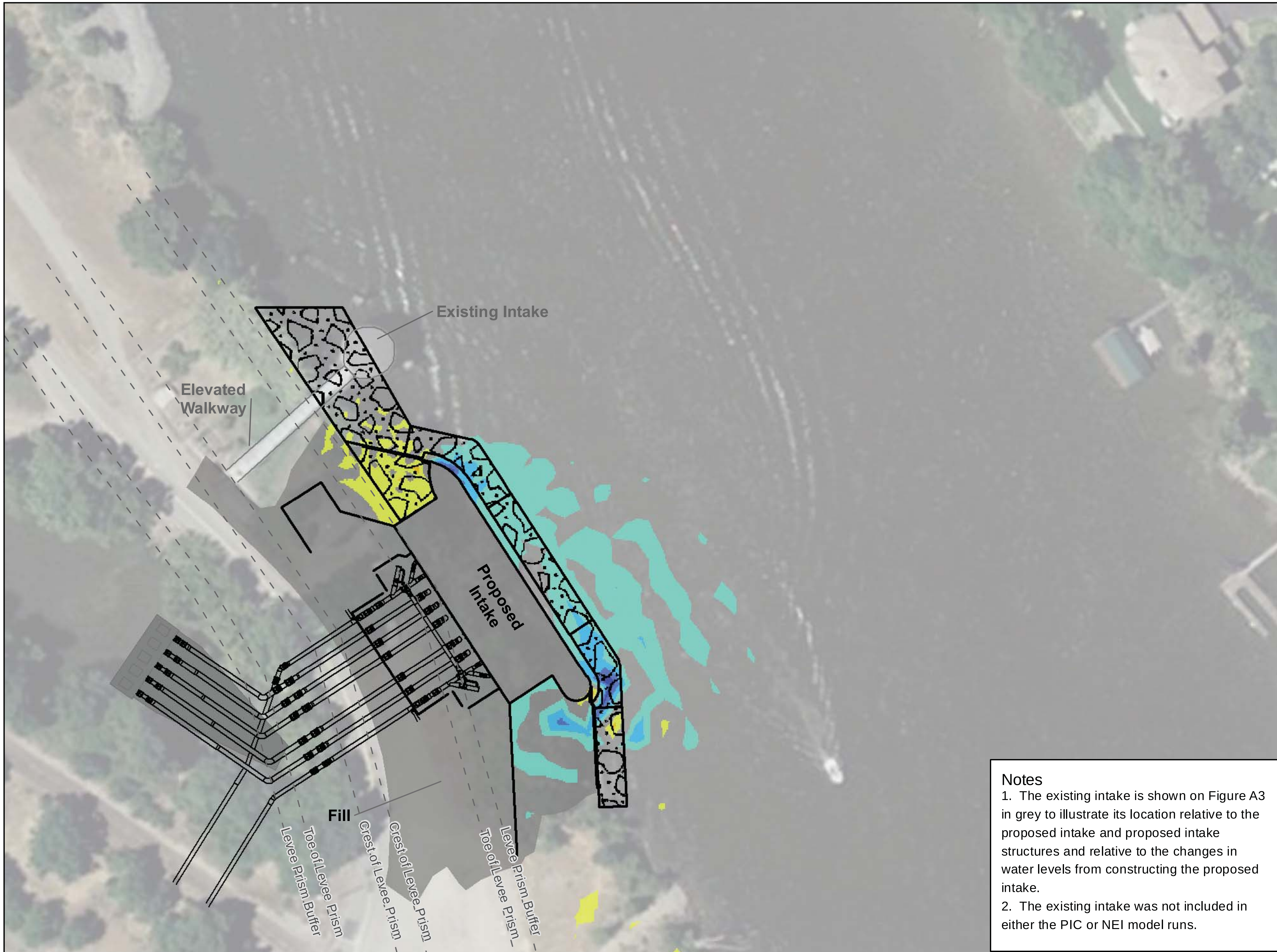
Attachment E

FIGURE A3

Woodland-Davis Clean Water Agency Sacramento River Joint Intake Evaluation

Change in Water Level from No Existing Intake (NEI) Condition to the Proposed Intake Conditions (PIC)



LEGEND

- Existing Intake
- Proposed Pumps and Pipelines
- Proposed Intake
- Proposed Riprap
- Proposed Ramp
- Proposed Fill

Change in Water Level (Feet)

- < -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- 0.15 - 0.20
- > 0.20

Notes

1. The existing intake is shown on Figure A3 in grey to illustrate its location relative to the proposed intake and proposed intake structures and relative to the changes in water levels from constructing the proposed intake.
2. The existing intake was not included in either the PIC or NEI model runs.

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