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Cache Creek Settling Basin Trap Efficiency Study
Progress Report
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Prepared By

Kara Carr
Ali Ercan
Tongbi Tu
Hossein Bandeh
M. Levent Kavvas (Principal Investigator)

UC Davis J. A. Hydraulics Laboratory

Department of Civil and Environmental Engineering
University of California, Davis
One Shields Avenue
Davis, CA 95616

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TABLE OF CONTENTS

Table of Contents 2
List of Figures 3
List of Tables 5
1. Introduction 6
1.1. Background 7
1.2. Objective 8
2. Flow Sampling by UCDJAHL 8
2.1. Flow Inundation Observations 12
3. CCSB Flow and Sediment Transport Simulations 14
3.1. Sediment Inflow Boundary Condition 15
3.2. Trap Efficiency of Current Bathymetry 18
3.3. Modification Scenarios 19
3.3.1. Alternative A 19
3.3.2. Alternative B 20
3.3.3. Alternative C 20
3.3.4. Alternative D 20
4. Future Work 32
5. References 33

LIST OF FIGURES

Figure 2.1 ADCP velocity measurement transects taken December 18, 2014. Labeled with measurement start and end time. Relative location within CCSB shown in upper left. 9
Figure 2.2 ADCP velocity transect contours a) transect 1 b) transect 2 c) transect 3. .. 10
Figure 2.3 ADCP velocity transect contours a) transect 4 b) transect 5 c) transect 6. .. 11
Figure 2.4 ADCP velocity transect contours a) transect 7 b) transect 8. 12
Figure 2.5 Simulated water depth contour (left) representing simulated inundation and corresponding location of photographs showing view to the east (top right) and south (bottom right) from the northern levee. 13
Figure 2.6 Simulated water depth contour (left) representing simulated inundation and corresponding location of photographs showing view to the south (top right) and southeast (bottom right) from the northern levee. 13
Figure 2.7 Simulated water depth contour (left) representing simulated inundation and corresponding location of photographs showing view to the south (top right) and northwest (bottom right) from the northern levee. 14
Figure 3.1 Upstream flow boundary condition for all modeled sediment transport scenarios. 15
Figure 3.2 1986 USACE suspended sediment load regression, and 1997 USACE total sediment load regression. 17
Figure 3.3 Upstream sediment boundary condition for all modeled sediment transport scenarios. 18
Figure 3.4 Bed elevation contour map, Alternative A, current bathymetry..... 22
Figure 3.5 Bed elevation contour map, Alternative B, weir raised 6 feet. 22
Figure 3.6 Bed elevation contour map, Alternative C, 400 foot section removed from end of training channel. 23
Figure 3.7 Bed elevation contour map, Alternative D, weir raised 6 feet, and 400 foot section removed from end of training channel. 23
Figure 3.8 Bedload transport rate for time steps 1-5, Alternative A. Minimum transport rate (blue) is 0.0 kg/s, maximum transport rate (red) is 0.80 kg/s. 24
Figure 3.9 Suspended sediment concentration for time steps 1-5, Alternative A. Minimum concentration (blue) is 0.0 kg/m^3, maximum concentration (red) is 0.50 kg/m^3. 25
Figure 3.10 Bedload transport rate for time steps 1-5, Alternative B. Minimum transport rate (blue) is 0.0 kg/s, maximum transport rate (red) is 0.80 kg/s. 26
Figure 3.11 Suspended sediment concentration for time steps 1-5, Alternative B. Minimum concentration (blue) is 0.0 kg/m^3, maximum concentration (red) is 0.50 kg/m^3. 27
Figure 3.12 Bedload transport rate for time steps 1-5, Alternative C. Minimum transport rate (blue) is 0.0 kg/s, maximum transport rate (red) is 0.80 kg/s. 28
Figure 3.13 Suspended sediment concentration for time steps 1-5, Alternative C. Minimum concentration (blue) is 0.0 kg/m3, maximum concentration (red) is 0.50 kg/m^3. 29
Figure 3.14 Bedload transport rate for time steps 1-5, Alternative C. Minimum transport rate (blue) is 0.0 kg/s, maximum transport rate (red) is 0.80 kg/s. 30

Figure 3.15 Suspended sediment concentration for time steps 1-5, Alternative D. Minimum concentration (blue) is 0.0 kg/m3, maximum concentration (red) is 0.50 kg/m^3. 31

LIST OF TABLES

Table 2.1 Transect names, timing, and SNR..... 9
Table 3.1 NRMSE and Nash Coefficient for calibration and validation simulations..... 15
Table 3.2 Lustig and Busch (1967) Total sediment-discharge data from Cache Creek at the Yolo Sediment stations..... 16
Table 3.3 1997 USACE memorandum total sediment load rating curve data. 17
Table 3.4 Sediment trap efficiency under the current bathymetric condition for three scenarios of CCHE2D parameter definition..... 19
Table 3.5 Trap efficiency percentage of bathymetric modification scenarios. 21

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1. INTRODUCTION

This report describes the Cache Creek Settling Basin (CCSB) / Yolo Bypass Project progress during May 1, 2014, through June 15th, 2015. Objectives for this year of the study included:

Year II Objective 1. Field measurement sampling program was to be continued in Year II in the wet season to enable sampling of 2-dimensional velocity and discharge along transects as needed and decided by Objective 3 of Year I.

Samples were taken for a single discharge event, representing the first effort of field sampling in the CCSB. Due to the drought conditions in California, this event was one of the rare opportunities to take samples from the CCSB during the second year of the project. The velocity transects will be incorporated as validation data for the CCHE2D simulation of the corresponding flow event.

Year II Objective 2. Similar to Objective 2 of Year I, field measurements provided by USGS were to be catalogued and incorporated into the 2-D flow and sediment transport models for updated calibration and validation.

Available data were catalogued and stored in our data bank. Of particular importance is the December 11-12, 2014, storm event, which had a maximum measured discharge of 17,800 cubic feet per second (cfs) (provisional data via (http://nwis.waterdata.usgs.gov/ site 11452500). The USGS has not yet provided the associated water surface elevation, discharge, and sediment data for the Road 102 site 11452600 (Cache C Inflow to Settling Basin Nr Yolo Ca), or Site C within the CCSB (384041121402601). Provisional gage height, discharge and sediment concentration data are available for the Cache Creek at Yolo gauge (11452500). Provisional gage height, discharge and turbidity data are available for the overflow weir (11452800).

Year II Objective 3. 2-D flow and sediment transport models results were to be analyzed utilizing all the available flow and sediment data, and further data gaps would be noted.

The objective was met. Samples of coincident flow and sediment, taken periodically over the duration of a storm event are required to aid in calibration and

validation of the sediment transport model. Further sediment grain size distribution and sediment concentration at the inlet and outlet of the CCSB are also necessary to support the sediment transport model. Preliminary trap efficiency values are estimated based on the available sediment rating curve at Cache Creek at Yolo and under the default sediment transport model settings, which will be calibrated and validated when the CCSB survey, as planned in the summer of 2015, is available. The detailed survey of the basin is required for calibration of the sediment transport model parameters.

1.1. Background

CCSB, located two miles east of the City of Woodland, California, was originally built by the United States Army Corp of Engineers (USACE) in 1938. The primary function of the CCSB is to remove a significant portion of the sediment load from Cache Creek to avoid its deposition in the Yolo Bypass, thereby preserving the capacity of the bypass for conveying flood flows. The Yolo Bypass serves to protect Sacramento and surrounding areas from flooding with a design flow of 216,000 cfs. Cache Creek delivers sediment to the Settling Basin during each wet year, and per the Central Valley Regional Water Quality Control Board (CVRWQCB) is a source of mercury to the San Francisco Bay-Delta. In addition to preserving the flood flow capacity of the Yolo Bypass; entrapment of sediment in the Basin is instrumental in diminishing the mercury load to the San Francisco Bay-Delta, making the Basin fundamental in preserving water quality. The sediment entering the CCSB is a legacy of the California Gold Rush and mercury mining of the naturally occurring “economically recoverable deposits of mercury” in California's Coastal range (Domagalski et al. 2004). A number of abandoned, un-reclaimed and partially reclaimed mercury mines are situated in the Cache Creek watershed. Furthermore, aggregate mining of Cache Creek has increased channel incision and sediment loading in the creek (Thayer, 2009).

The CCSB has been modified by USACE many times since 1938 to redistribute sediment settling patterns and increase sediment storage capacity. From 1991 to 1993, the Basin was radically altered. Surrounding levees were raised 12 feet, the training channel was relocated, and a new outlet weir was built 5 feet higher than the previous weir, representing the current conditions. At the time of alteration USACE believed the Basin would retain 340 acre-feet of sediment per year, at a 55% trap efficiency, and that an additional 50 years of sediment storage was being provided. This postulated trap efficiency is based on an action plan outlined in the USACE 2007 Cache Creek Settling Basin DRAFT Operations and Maintenance Manual, in which the outlet weir is to be raised 6-feet at year 25 (2018) of the project, or when the trap-efficiency becomes 30%. Also beginning in year 25 of the project, 400-foot sections of the interior training levee will be removed every five years, starting with a section 1100 feet upstream from the current terminus of the training channel. Each subsequent 400-foot section will be removed 1100 feet upstream from the section that is removed previously.

To assess whether the trap-efficiency and sedimentation rate in the Basin are meeting design requirements set forth by USACE, the personnel at UC Davis J. Amorocho Hydraulics Laboratory (UCDJAHL) began evaluating the settling basin trap efficiency through application of the National Center for Computational Hydroscience and

Engineering's CCHE2D model of two-dimensional depth averaged flow and sediment transport. The evaluation was conducted with respect to the current Settling Basin design as defined by 2006 and 2008 surveys of the Basin, utilizing field measurements of suspended sediment and flow into, within, and out of the CCSB as provided by USGS, as well as by the physical sedimentation modeling performed at the UCDJAHL in 2009.

1.2. Objective

The major objectives of this study are:
i. to perform field measurements by UCDJAHL staff of 2-D velocities and flow within the Settling Basin to be incorporated in calibration and validation of 2-D flow and sediment transport models. Because of the 2-D nature of flow in the basin and the desire to capture the 2-D spread of sediment within the basin, it is critical to capture internal transects, as well as inflow and outflow sections. Additionally, field measurements performed by UCDJAHL staff will provide a dense sampling of flow and velocity during storm events, capturing multiple samples as a storm hydrograph passes through the Basin.

ii. to incorporate flow and suspended sediment measurements provided by USGS to calibrate and validate the 2-D flow and sediment transport models. Available flow and sediment measurements are insufficient to support the simulations' claim of loading due to the lack of concurrent (flow and sediment) data into and out of the basin. It is essential for calibration and validation of the models that these sediment measurements be concurrent with velocity/flow measurements. Additional data will ultimately result in a more reliable estimate of the settling basin trap efficiency with respect to current and future settling basin design. Additional concurrent data will also serve to characterize the sediment rating curve for flows over 12,000 cfs, a region that is currently under-defined.

Furthermore, UCDJAHL will provide DWR with a method of reevaluating sedimentation for any further augmentation proposals. Estimates of trap efficiency will be produced for a range of possible future climate conditions. The mean trap efficiency as well as the 95% confidence bands will be provided.

2. FLOW SAMPLING BY UCDJAHL

To increase accuracy of velocity representations in the 2-dimensional flow and sediment model of the CCSB, a flow measurement campaign was initiated by the UCDJAHL. Due to lack of storm events during this study period, only one visit was made to measure velocity in the CCSB. Dr. Ali Ercan, Dr. Kara Carr, and Mr. John Nosacka, visited the basin on Dec 18, 2014, to collect transects of ADCP flow velocity measurements. The eight transect locations, identified by their time stamps in Figure 2.1, were chosen based on accessibility and flow conditions. Location mapping was made possible by a Global Positioning System (GPS) mounted on the ADCP unit. Simulations of the corresponding flow event are ongoing, with preliminary inundation comparisons

presented in the next section. Velocity measurements may be utilized in subsequent modeling efforts, if necessary. .

For ease of reference, the ADCP measurement transects are named in order of their measurement, as shown in Table 2.1. Included in Table 2.1 is the signal to noise ratio (SNR) for the measured velocities. SNR, given as the mean of the measured values divided by their standard deviation, signifies whether the measured values are significantly different from zero. While the SNR values are all greater than one, they are fairly low as a result of small water velocities relative to boat velocities. The velocity contour plots of the 8 transects are depicted in Figures 2.2-2.4.

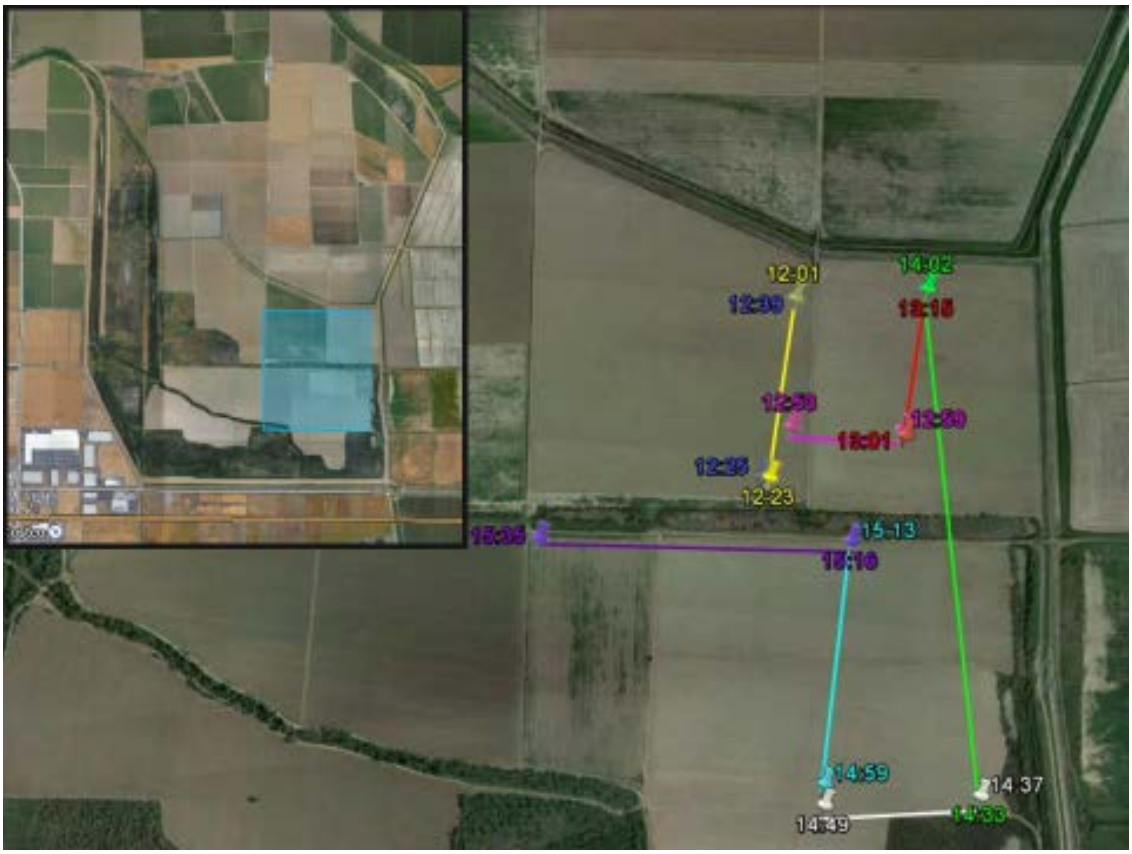

Figure 2.1 ADCP velocity measurement transects taken December 18, 2014. Labeled with measurement start and end time. Relative location within CCSB shown in upper left.

Table 2.1 Transect names, timing, and SNR

Transect Name	Start Time	End Time	SNR
1	12:01	12:23	1.84
2	12:25	12:39	1.58
3	12:53	12:59	1.76
4	13:01	13:15	1.88
5	14:02	14:33	1.65
6	14:37	14:49	1.81
7	14:59	15:13	1.85
8	15:16	15:35	1.70

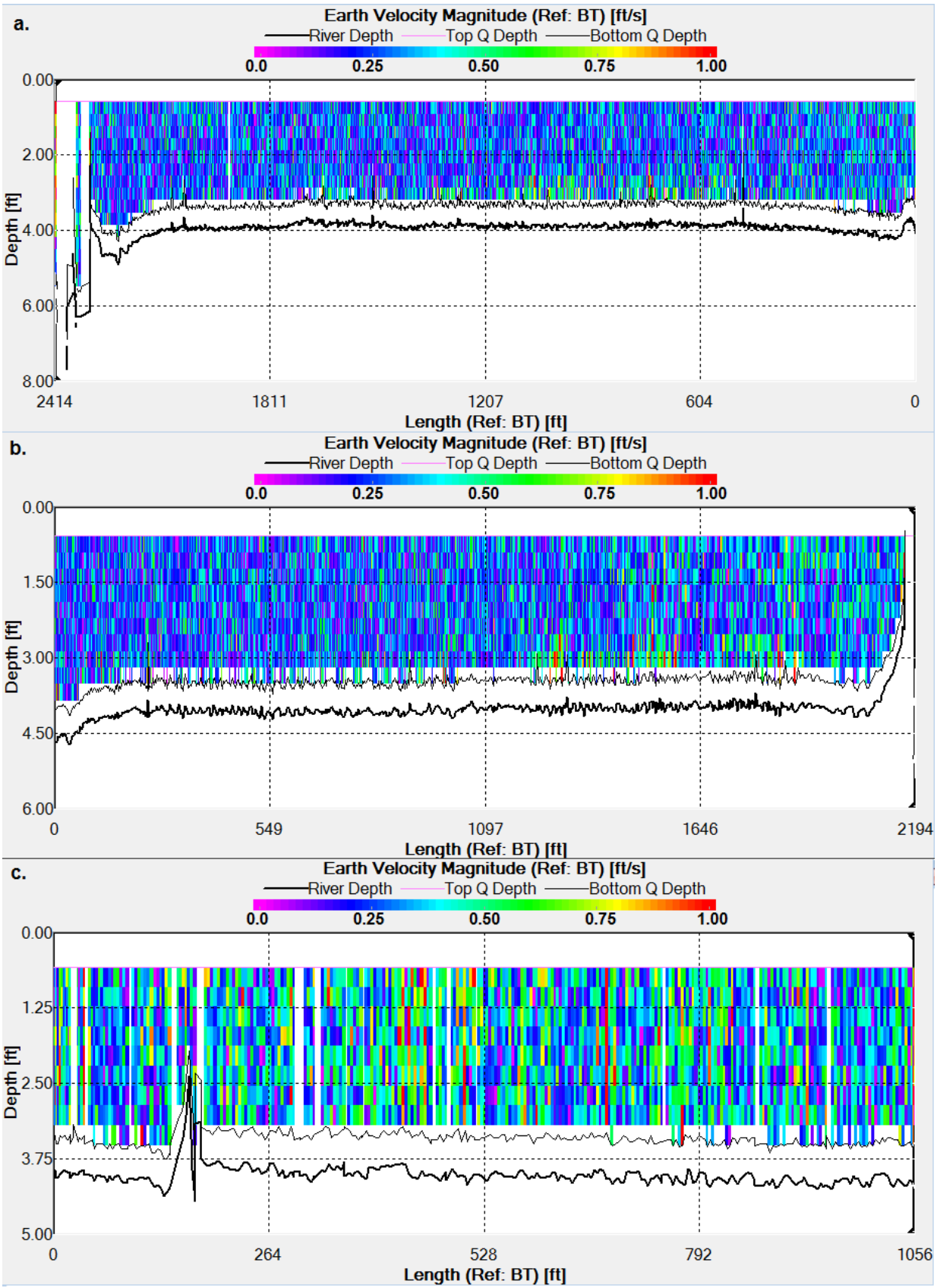

Figure 2.2 ADCP velocity transect contours a) transect 1 b) transect 2 c) transect 3.

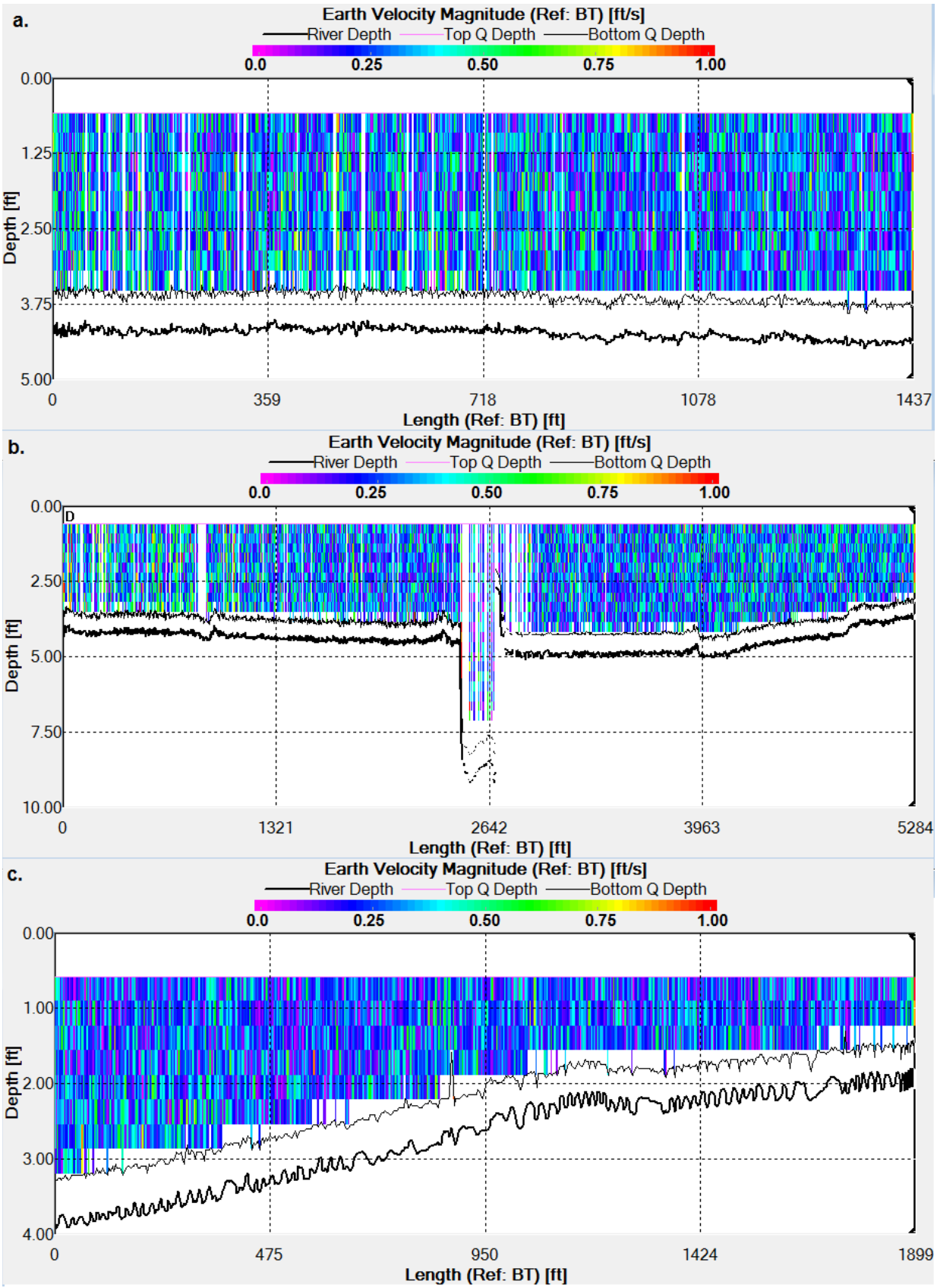

Figure 2.3 ADCP velocity transect contours a) transect 4 b) transect 5 c) transect 6.

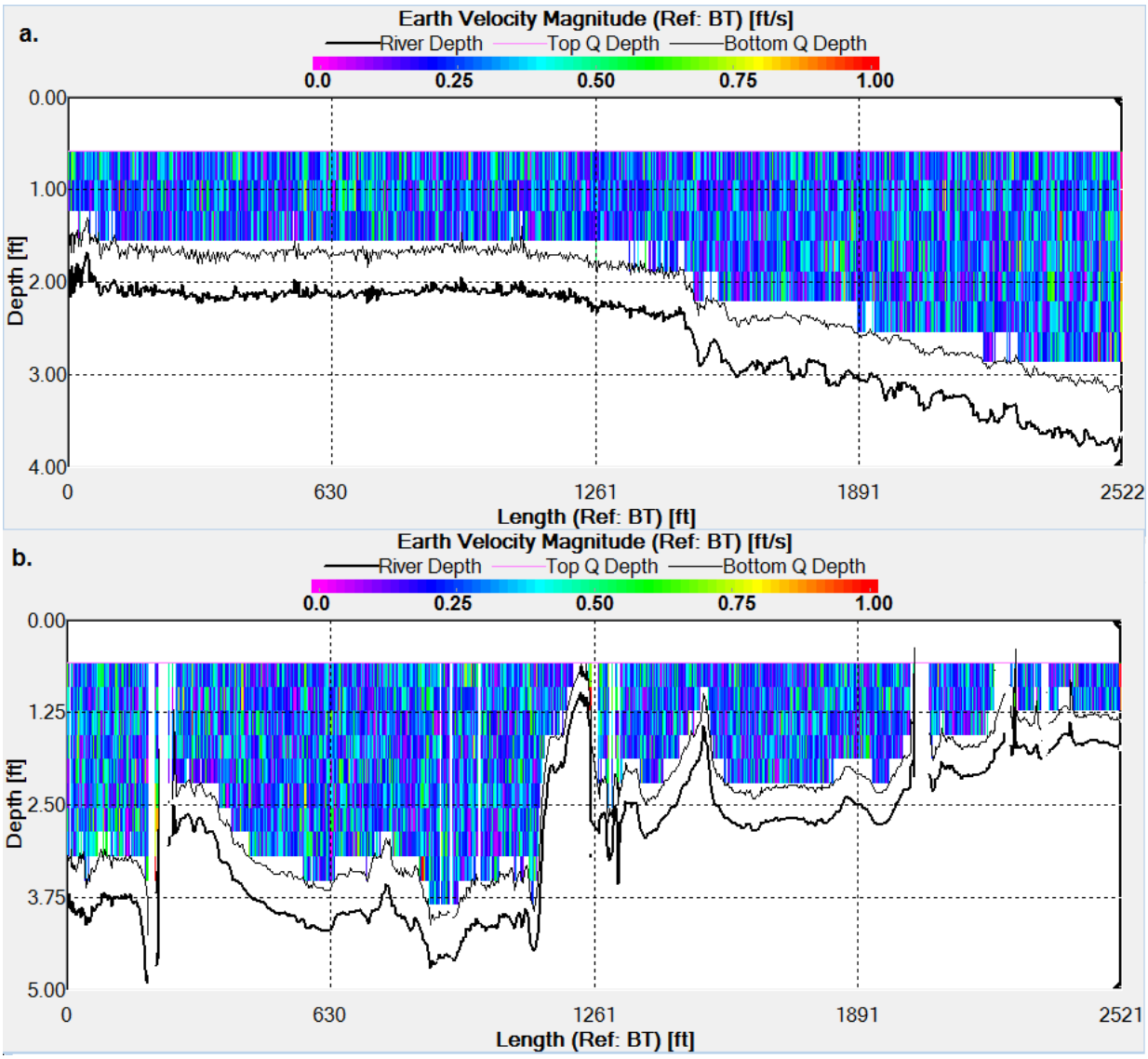

Figure 2.4 ADCP velocity transect contours a) transect 7 b) transect 8.

2.1. Flow Inundation Observations

Flow inundation observations were made during the December 18, 2014 site visit. A number of pictures were taken at three recorded geolocations to compare field inundation conditions in the northern section of the basin with simulated results. Water depth results from the numerical simulation which indicate inundation extent are displayed on Figures 2.5 – 2.7. Also in the figures are photographs from indicated areas, showing actual inundation of the northernmost section of the basin. Under visual inspection, simulation and field conditions corresponded well.

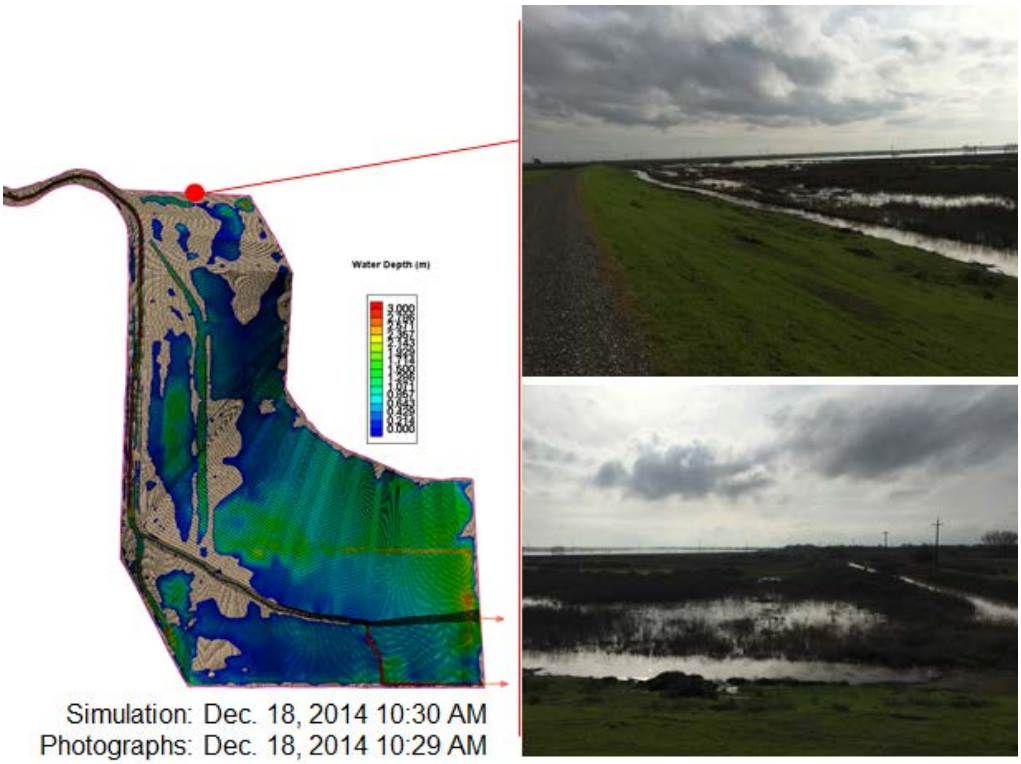

Figure 2.5 Simulated water depth contour (left) representing simulated inundation and corresponding location of photographs showing view to the east (top right) and south (bottom right) from the northern levee.

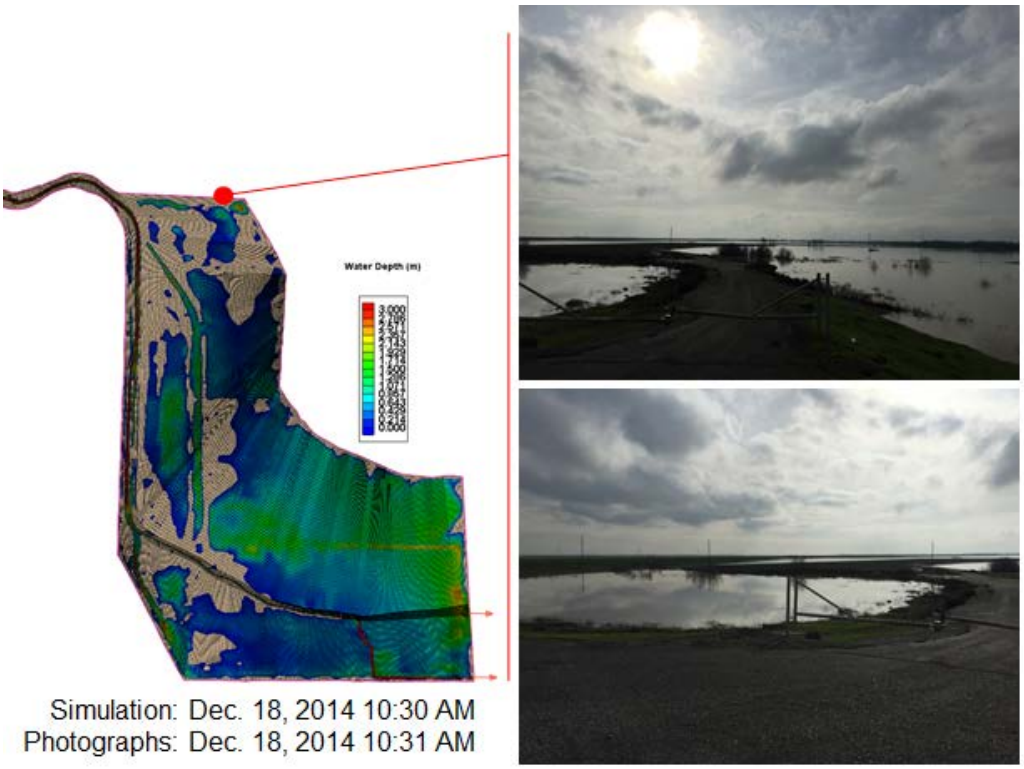

Figure 2.6 Simulated water depth contour (left) representing simulated inundation and corresponding location of photographs showing view to the south (top right) and southeast (bottom right) from the northern levee.

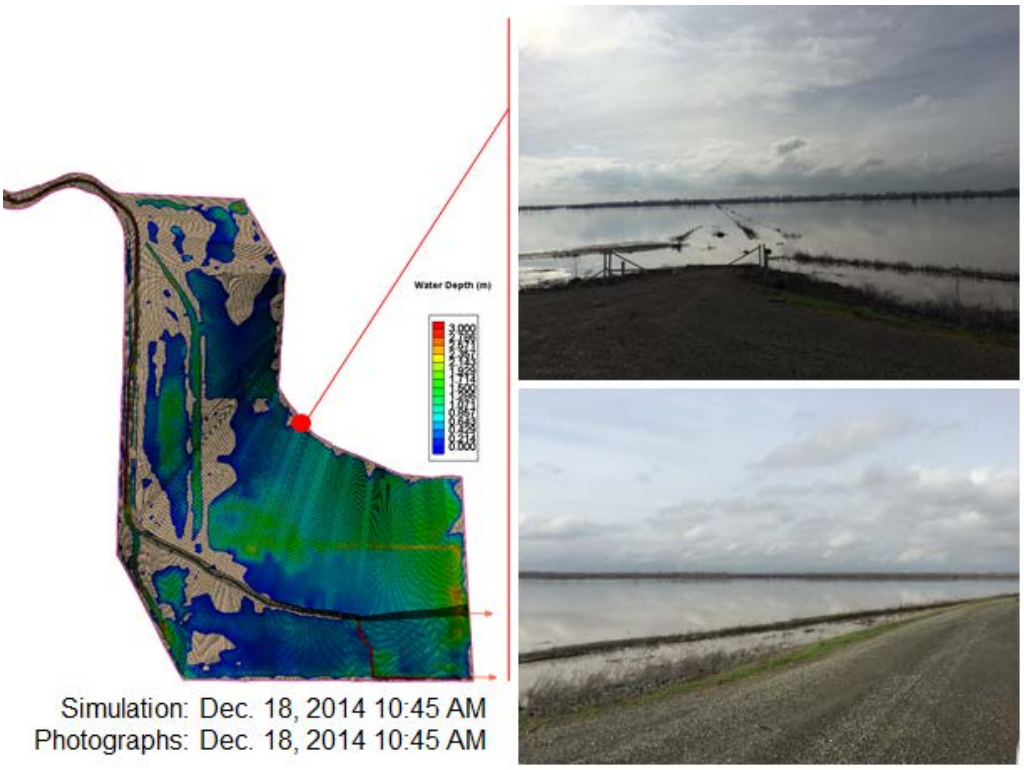

Figure 2.7 Simulated water depth contour (left) representing simulated inundation and corresponding location of photographs showing view to the south (top right) and northwest (bottom right) from the northern levee.

3. CCSB FLOW AND SEDIMENT TRANSPORT SIMULATIONS

The validated flow model, used in the numerical simulations presented herein, is described in detail in the CCSB Trap Efficiency Study Progress Report dated May 1, 2014 (Carr et al. 2014). Each numerical simulation presented herein was performed using the CCHE2D model, developed at the National Center for Computation Hydroscience and Engineering at the University of Mississippi. CCHE2D is a two-dimensional depth averaged unsteady flow and sediment transport model that simulates the movement of water, and both cohesive and non-cohesive sediment. Performance of the calibrated and validated model, with respect to flow, can be inferred from the normalized root mean square error, and Nash-Sutcliffe Model Efficiency coefficient (Nash Coefficient) contained in Table 3.1. Note that the calibration of the model was performed utilizing water surface elevations at the Rd 102 gauge only (USGS gauge 11452600), allowing for validation of model performance through comparison of water surface elevation results at two other gauging stations in the basin, Site C (USGS site 384041121402601) and the Overflow Weir (USGS gauge 11452800). The hydrodynamic model performed very well, with good correspondence in water depths distributed both spatially and temporally.

Sediment transport simulations were performed utilizing upstream flow boundary data taken from instantaneous flow data at the Cache Creek at Yolo gauge (source: http://nwis.waterdata.usgs.gov, USGS 11452500) from March 18, 2011, through March

22, 2011. These data correspond to the flow validation simulation that has the highest flow magnitude fully simulated by the model at the time of this report. The simulated hydrograph is displayed in Figure 3.1. The simulations are not calibrated with respect to sediment transport, and therefore results presented herein are preliminary, and subject to change following sediment transport calibration and validation. Calibration will be performed upon receipt of the 2014/2015 survey data.

Table 3.1 NRMSE and Nash Coefficient for calibration and validation simulations.

Event	18-22 March 2011			23-27 March 2011		
Peak Flow at Cache Creek at Yolo	15,900 cfs			14,300 cfs		
Mode	Calibration	Validation		Validation		
Location	Rd 102	Site C	Weir	Rd 102	Site C	Weir
NRMSE	0.07	0.11	0.09	0.12	0.07	0.08
Nash Coefficient	0.93	0.83	0.90	0.69	0.90	0.87

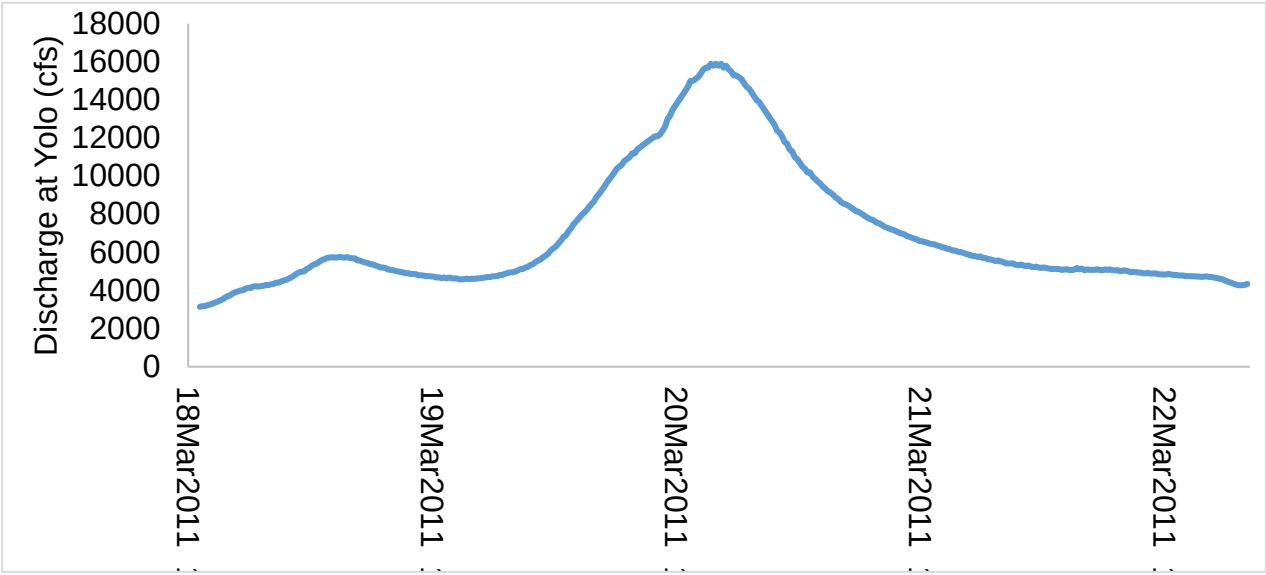

Figure 3.1 Upstream flow boundary condition for all modeled sediment transport scenarios.

3.1. Sediment Inflow Boundary Condition

Sediment loading conditions for the simulations were assigned using the total sediment load rating curve developed by USACE and described in the 1997 HEC-6 Analysis Technical Memorandum (USACE 1997). The memorandum states that the rating curve is a regression line based on a set of instantaneous suspended sediment samples collected by the USGS between 1943 and 1971 at the Cache Creek at Yolo station. Because the USACE curve provides a single sediment load per discharge magnitude, without reference to time of occurrence (rising or falling limb), some uncertainties are introduced. Typically sediment loads are higher on the rising limb of a hydrograph than

for sediment loads for an equivalent discharge on the falling limb. The averaging effect of disregarding the time-signature for data used in the curve introduces error, especially in simulations of Cache Creek where duration of the storm event is short, and the flow changes rapidly. Long term simulations, are less sensitive to this averaging effect.

More importantly, the 1997 USACE memorandum mentions dependence on the regression line defined in the 1986 USACE Cache Creek Settling Basin: Final General Design Memorandum. The data from which this regression was created are not included in the referenced work. Historical data on the USGS website contain only 121 sediment samples for the date ranges specified in the reference. Of those, 108 are for flows less than 10,000 cfs, 10 are for flows between 10,000 – 15,000 cfs, and only 3 are available for flows over 15,000 cfs. Therefore, there is inherent uncertainty in the rating curve regression for flows larger than 10,000 cfs. Additionally, the 1986 USACE regression represents suspended load only. However, the 1997 USACE memorandum expands the regression to include bedload, following the method outlined in Lustig and Busch (1967). Lustig and Busch (1967) determined the percentage of total load attributed to bedload, and related it to suspended load, using 7 instantaneous measurements of total and suspended load as shown in Table 3.2. The data, collected from 1959-1964, are limited to flow magnitudes under 13,000 cfs. The 1997 USACE memorandum applies the relation of bedload to suspended load to create a total load rating curve regression, the points defining the regression, as given in the memorandum, are listed in Table 3.3. Figure 3.2 includes the sediment rating curve regressions for the 1986 and 1997 USACE memorandums. The resulting sediment load hydrograph for the numerical simulations is provided in Figure 3.3.

Table 3.2 Lustig and Busch (1967) Total sediment-discharge data from Cache Creek at the Yolo Sediment stations.

Date	Instantaneous Water Discharge (cfs)	Mean Velocity (ft/sec)	Suspended Sediment Load (tons/day)	Bedload (tons/day)	Total Sediment Load (tons/day)[1]
15-Jan-1959	276	1.96	118	58	176
16-Feb-1959	12800	6.18	272700	6900	279600
17-Feb-1959	6000	5.07	65100	2130	67230
18-Mar-1959	109	1.65	4	18	22
3-Feb-1960	748	2.64	1293	257	1550
9-Feb-1960	7540	5.31	62700	5310	68010
28-Jan-1964	396	2.54	96	24	120

[1.] Total sediment load is related to instantaneous water discharge through application of the “modified Einstein method”. The method relates hydraulic geometry of the cross section, concentration of suspended sediment, and particle size distribution of suspended and bed material.

Table 3.3 1997 USACE memorandum total sediment load rating curve data.

Discharge (cfs)	Suspended Load (tons/day)	Bedload (tons/day)	Total Load (tons/day)
50	7	8	15
100	22	19	41
500	320	80	400
1000	1010	180	1190
5000	14450	920	15370
10000	45450	1890	47340
20000	143000	3700	146700
30000	279600	5700	285300
60000	879940	13400	893340

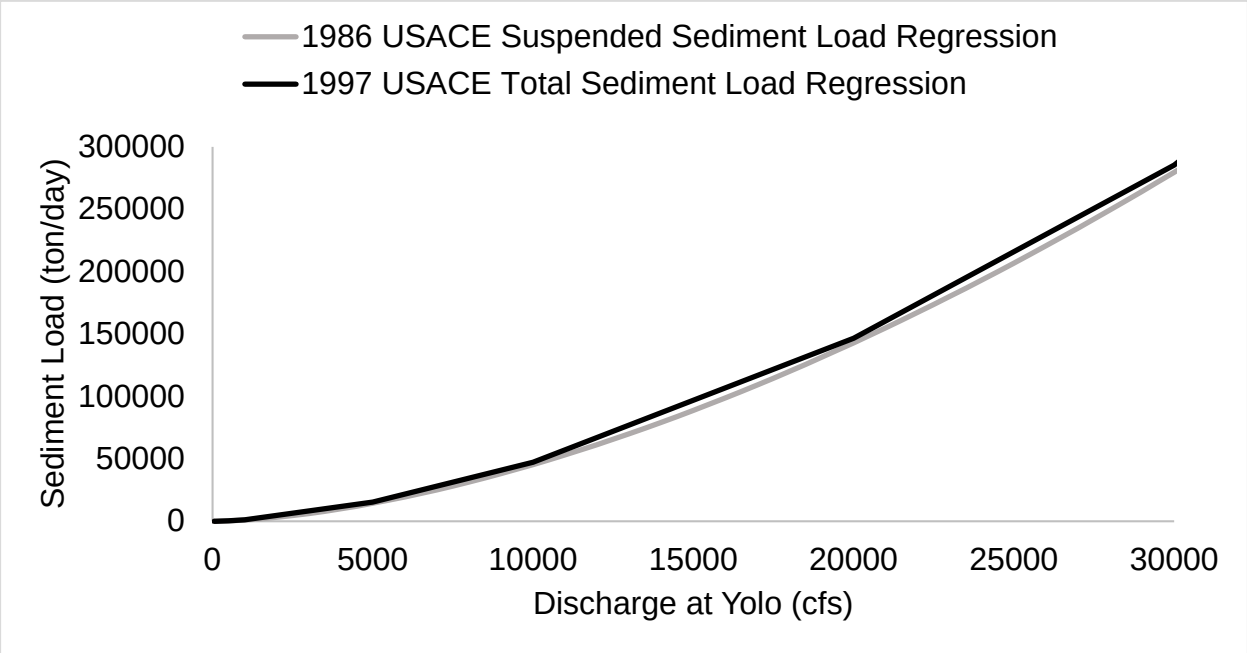

Figure 3.2 1986 USACE suspended sediment load regression, and 1997 USACE total sediment load regression.

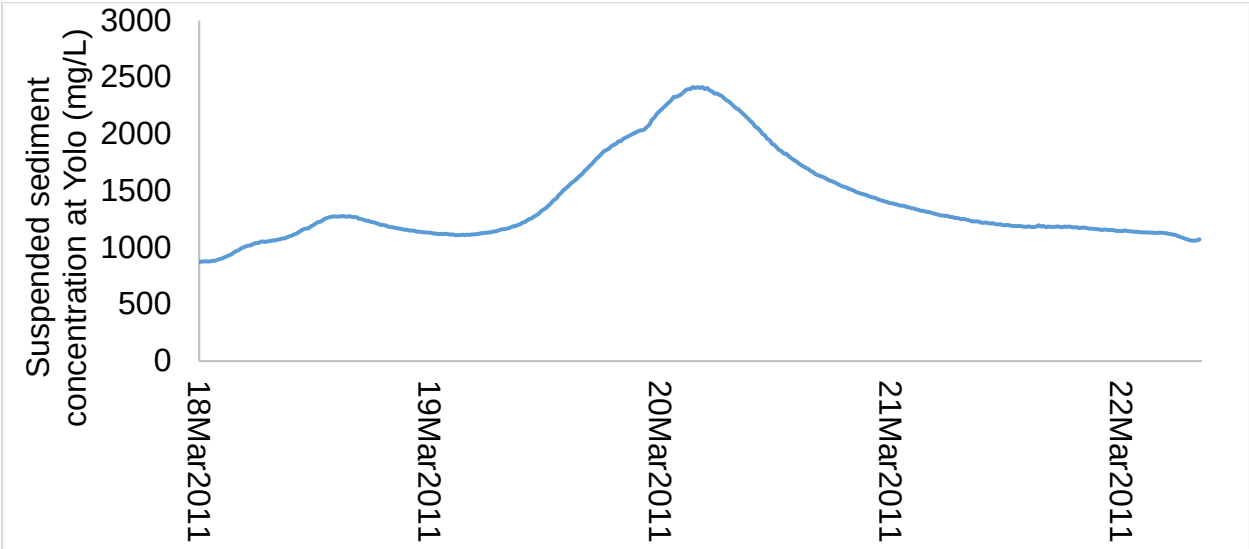

Figure 3.3 Upstream sediment boundary condition for all modeled sediment transport scenarios.

3.2. Trap Efficiency of Current Bathymetry

Utilizing the CCHE2D model under the upstream boundary conditions described in Sections 3 and 3.1, simulations were run for the "current" bathymetric conditions of Cache Creek from Cache Creek at Yolo through the CCSB for 18-22 March 2011 period. The current condition is defined by surveys taken in 2006 and 2008.

A sensitivity analysis was run on the uncalibrated model to assess the reaction of CCHE2D to sediment transport parameters. The trap efficiency was calculated under three different scenarios. Scenario A uses the default sediment transport parameters of CCHE2D. The model defaults the suspended transport capacity coefficient to 1.0, and the sediment transport capacity equation to that described by the Wu, Wang, Jia method (Wu, 2001). Scenario B sets the sediment transport capacity coefficient to 0.9, and as Scenario A, uses the Wu, Wang, Jia method. Scenario B therefore has a suspended sediment transport capacity that is 90% of that for Scenario A. Scenario C was run with the suspended transport capacity coefficient set to 1.0, and the SEDTRA sediment transport capacity module was assigned. The SEDTRA module (Garbrecht et al. 1995) uses three transport relations for different size classes. The Laursen (1958) formula is used for size classes 0.010 mm to 0.25 mm, the Yang (1973) formula for size classes from 0.25 mm to 2.0 mm, and the Meyer-Peter and Mueller's (1948) formula for size classes from 2.0 mm to 50.0 mm. For each simulation, the sediment bed grain size, and roughness solution method were set as outlined in the description of flow calibration in the CCSB Trap Efficiency Study Progress Report dated May 1, 2014. Trap efficiencies for the three different simulated scenarios of sediment transport under the current condition are provided in Table 3.4.

The trap efficiencies were calculated by determining the difference in the sediment inflow volume entering the CCSB at Rd 102 and that exiting the basin, over the entire simulation duration. When the suspended transport capacity coefficient was altered

from the default of 1.0 to 0.9, the trap efficiency changed, increasing by 15.6%. When the SEDTRA sediment transport equation was utilized instead of the default equation, the trap efficiency increased by 18.8%. The sensitivity analysis of the selection of the suspended transport capacity coefficient or the sediment transport equation demonstrate the significance of the calibration and validation of the sediment transport modeling. The uncertainty and variability of the sediment trap efficiency estimates can be limited by calibration and validation of the sediment transport module of the CCHE2D model.

Table 3.4 Sediment trap efficiency under the current bathymetric condition for three scenarios of CCHE2D parameter definition.

Scenario	Suspended Transport Capacity Coefficient	Sediment Transport Equation	Sediment Trap Efficiency
A	1.0	Wu, Wang, Jia method	47.0%
B	0.9	Wu, Wang, Jia method	62.6%
C	1.0	SEDTRA	65.8%

3.3. Modification Scenarios

Simulations were run for the current condition, and three additional bathymetric conditions within the basin. The current bathymetry, as defined by 2006 and 2008 surveys of the CCSB, is denoted Alternative A. Alternative B raises the weir 6 feet, from its current elevation of 32.5 feet, to 38.5 feet, but does not otherwise change the bathymetry of the basin. Alternative C removes a 400 foot section from the terminus of the training levee, but does not otherwise change the bathymetry of the basin. Alternative D is the combination of Alternatives B and C, such that the weir is raised 6 feet, and the 400 foot section of training levee is removed. Each alteration scenario was run with the default parameters of the model: suspended transport capacity coefficient of 1.0, sediment transport capacity equation of Wu, Wang, Jia method (Wu, 2001) such that they may be compared relative to each other. Bed elevation contour maps are shown in Figures 3.4 through 3.7 for Alternatives A, B, C, and D respectively. The resulting trap efficiency for each of the simulated alternatives is tabulated in Table 3.5.

3.3.1. Alternative A

As previously noted, the simulated trap efficiency of the CCSB, for Alternative A, was most conservatively found to be 47%. Shown in Figures 3.8 and 3.9, respectively, are the bedload transport rate, and suspended sediment concentration contour plots of the simulation results. Each figure contains the 5 time steps identified on the hydrograph to show the evolution of these parameters with time and flow magnitude. It should be noted that the volume of sediment in the water as flow recedes below the weir elevation should be largely deposited in the basin.

3.3.2. Alternative B

Simulated trap efficiency of Alternative B, in which the overflow weir is raised 6 feet is 72.8%. The relative increase in trap efficiency, for this event, compared to the current condition is nearly 26%. Shown in Figures 3.10 and 3.11 are the bedload transport rate, and suspended sediment concentration contour plots of the simulation results for the 5 identified time steps on the hydrograph. Compared to the bed load of Alternative A, Figure 3.10 displays a clear band of higher bed load transport across the southern portion of the basin. According to Figure 3.11, the suspended sediment concentration is low in the northern portion of the basin for the duration of the flow event. The simulation suggests that relative to the current bathymetry, raising the weir will enhance sediment trap efficiency, but less sediment will be transported to the northern portion of the basin.

3.3.3. Alternative C

Simulated trap efficiency of Alternative C, in which 400 feet of training levee is removed from the downstream end is 48.6%. The 1.6% increase from the current condition suggests that removal of just this initial section of training levee will not significantly alter sediment dynamics and sediment retention. The bedload transport rate, and suspended sediment concentration contour plots of the simulation results are shown on Figures 3.13 and 3.1.3. Both the bedload and suspended sediment concentration are altered when compared to the current condition. The slight increase in bedload transport rate in the northern portion of the basin is more obvious than that in the southern portion, however there is a slight increase in bedload transport over the entire simulation domain. The same pattern of increase is seen in Figure 3.13 for suspended sediment concentration.

3.3.4. Alternative D

Simulated trap efficiency of Alternative D, in which 400 feet of training levee are removed from the downstream end and the weir is raised 6 feet, is 75.3%. Again the alteration of the weir elevation has a significant effect on sediment retention. The bedload transport rate, and suspended sediment concentration contour plots of the simulation results are illustrated in Figures 3.1.4 and 3.1.5. Comparison of Alternative D and Alternative B (raised weir alone) shows that there is a 2.5% increase in sediment retention when the terminus of the training levee is removed in addition to the weir being raised. Comparing Alternative D to the current condition shows a 28.3% increase in trap efficiency. As with Alternative B, there is a clear band of bed load transport across the southern portion of the basin, whereas the suspended sediment concentration is more uniformly distributed.

Table 3.5 Trap efficiency percentage of bathymetric modification scenarios, under default parameters of the model: suspended transport capacity coefficient of 1.0, sediment transport capacity equation of Wu, Wang, Jia method (Wu, 2001).

Trap Efficiency Percentage			
Alternative A[1]	Alternative B[2]	Alternative C[3]	Alternative D[4]
47.0%[5]	72.8%	48.6%	75.3%

[1]The current bathymetry, as defined by 2006 and 2008 surveys of the CCSB, is denoted Alternative A.
[2]Alternative B raises the weir 6 feet, from its current elevation of 32.5 feet, to 38.5 feet, but does not otherwise change the bathymetry of the basin.
[3]Alternative C removes a 400 foot section from the terminus of the training levee, but does not otherwise change the bathymetry of the basin.
[4]Alternative D is the combination of Alternatives B and C, such that the weir is raised 6 feet, and the 400 foot section of training levee is removed.
[5] When the sediment model parameters are changed, the trap efficiency of Alternative A ranges from 47 to 65.8%. Please see Table 3.4.

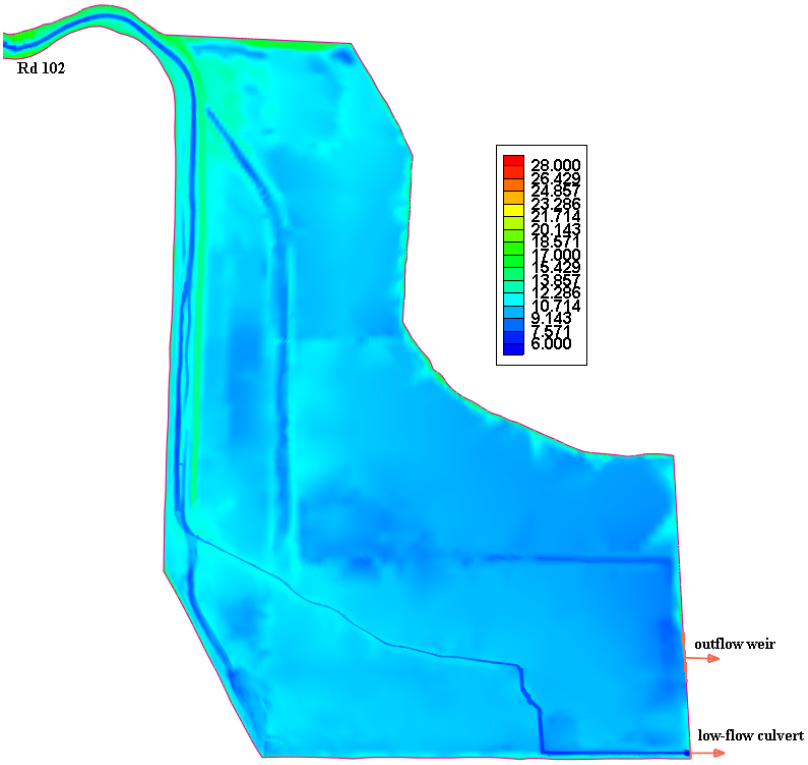

Figure 3.4 Bed elevation contour map, Alternative A, current bathymetry.

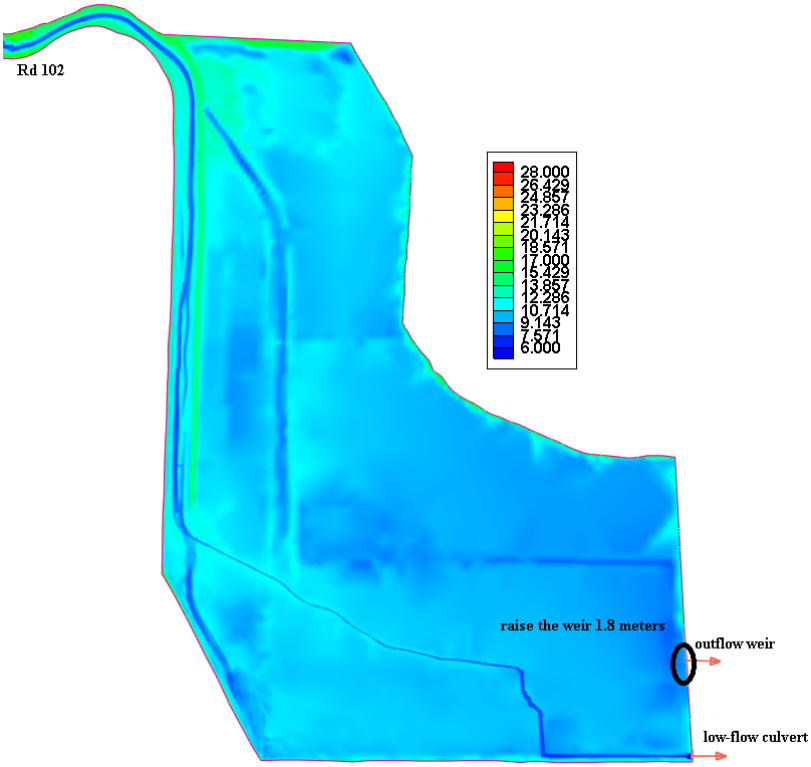

Figure 3.5 Bed elevation contour map, Alternative B, weir raised 6 feet.

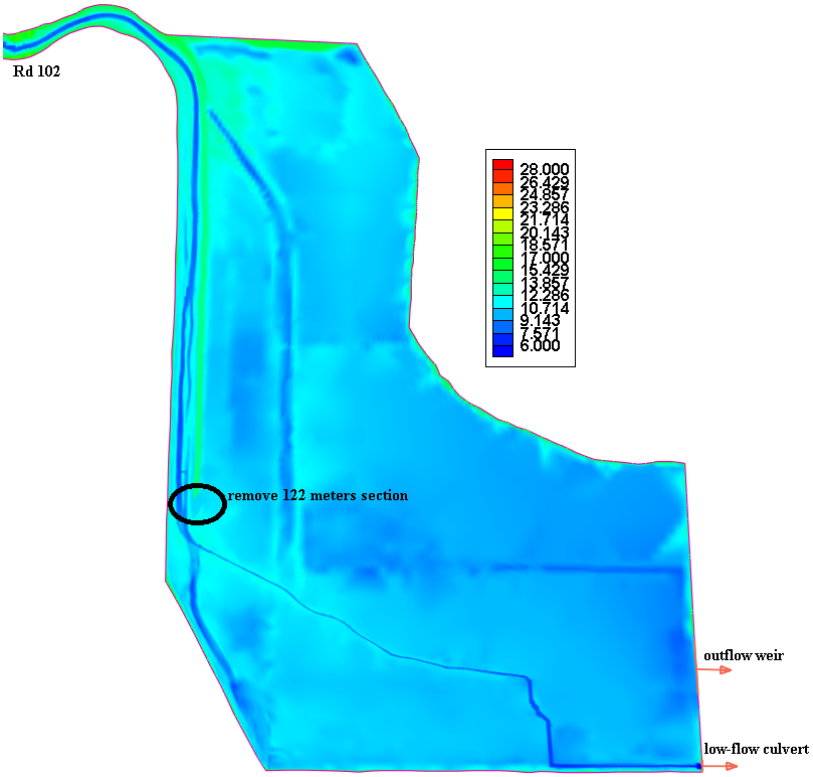

Figure 3.6 Bed elevation contour map, Alternative C, 400 foot section removed from end of training channel.

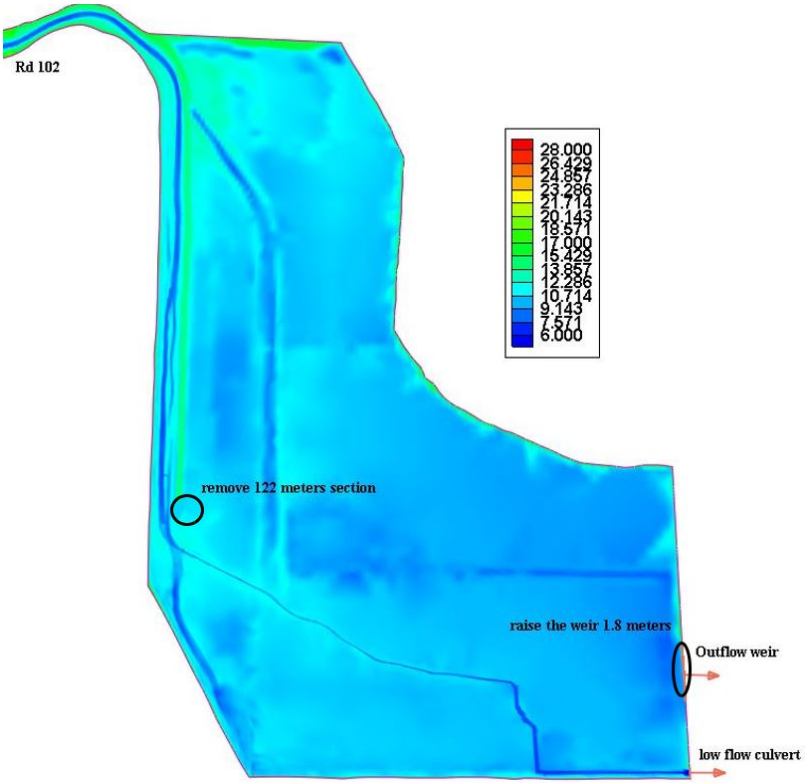

Figure 3.7 Bed elevation contour map, Alternative D, weir raised 6 feet, and 400 foot section removed from end of training channel.

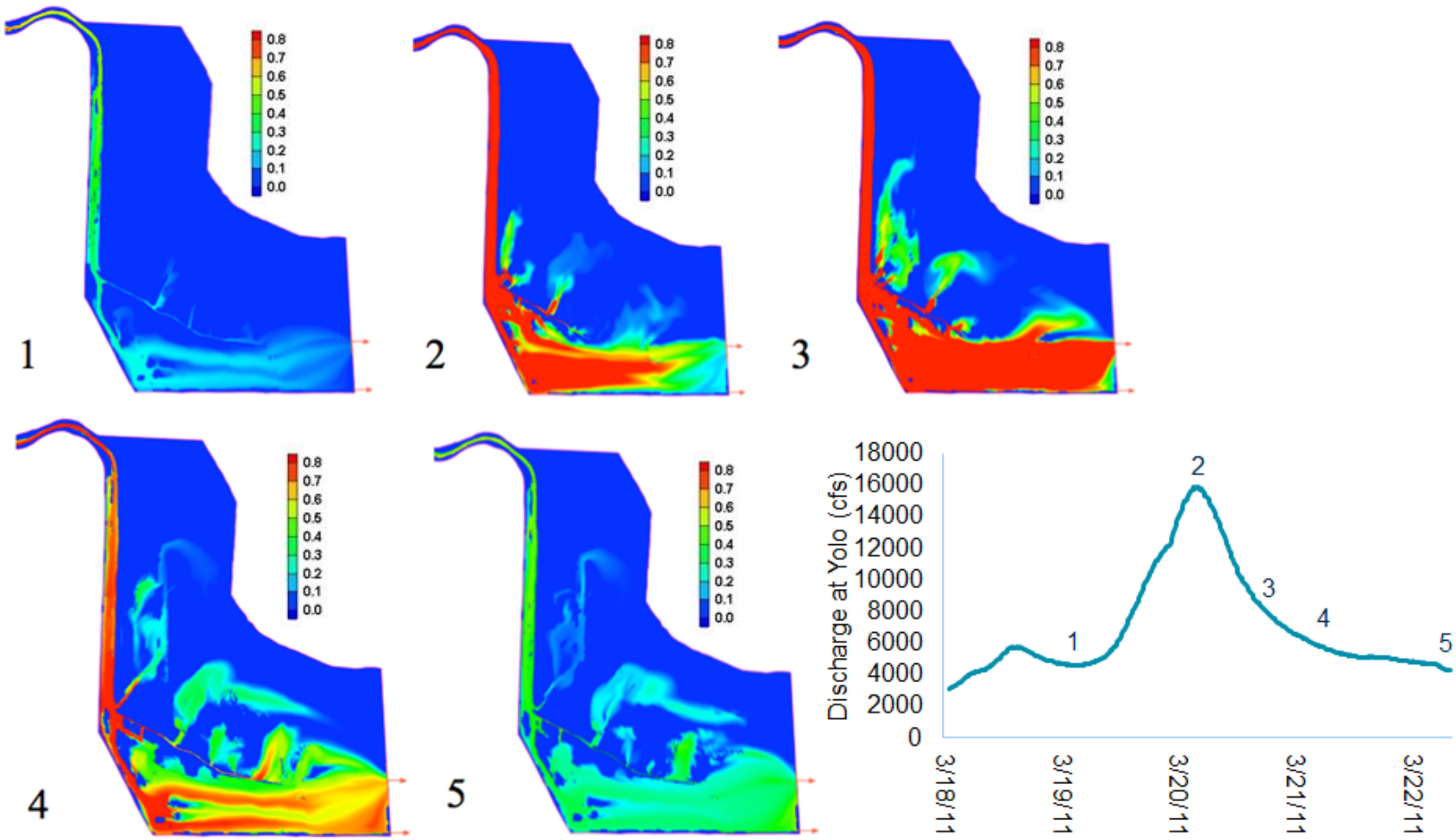

Figure 3.8 Bedload transport rate for time steps 1-5, Alternative A. Minimum transport rate (blue) is 0.0 kg/s, maximum transport rate (red) is 0.80 kg/s.

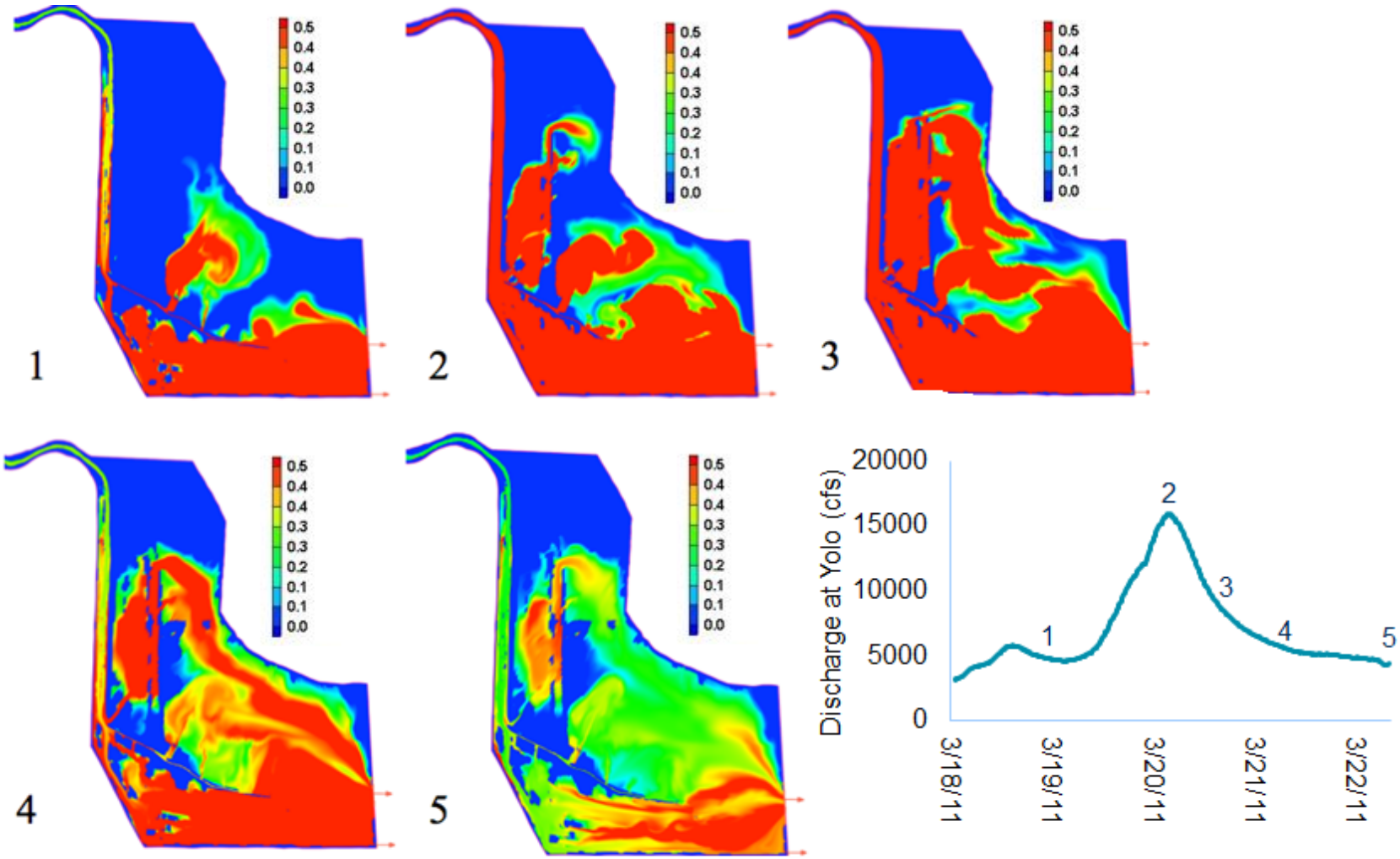

Figure 3.9 Suspended sediment concentration for time steps 1-5, Alternative A. Minimum concentration (blue) is 0.0 kg/m^3, maximum concentration (red) is 0.50 kg/m^3.

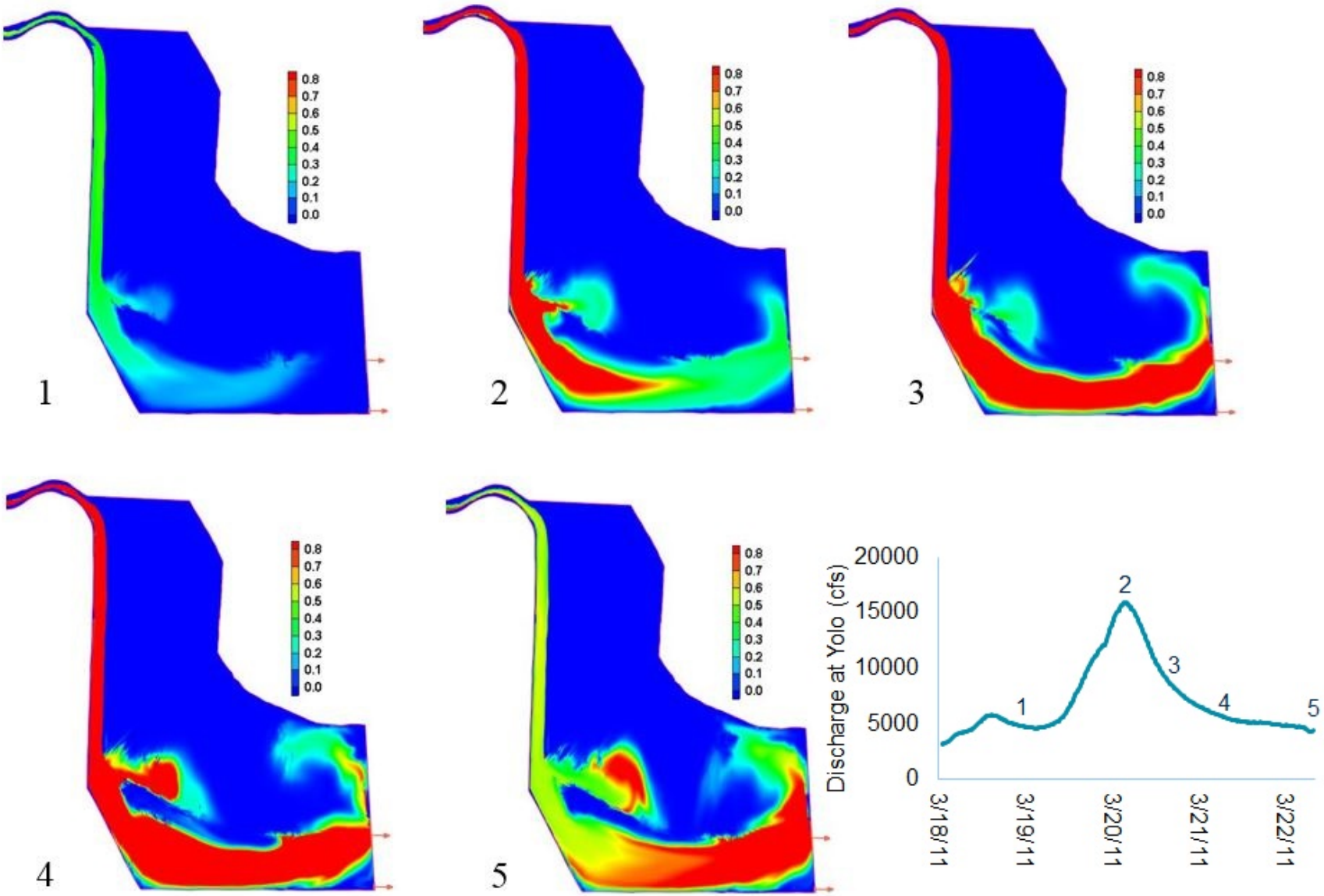

Figure 3.10 Bedload transport rate for time steps 1-5, Alternative B. Minimum transport rate (blue) is 0.0 kg/s, maximum transport rate (red) is 0.80 kg/s.

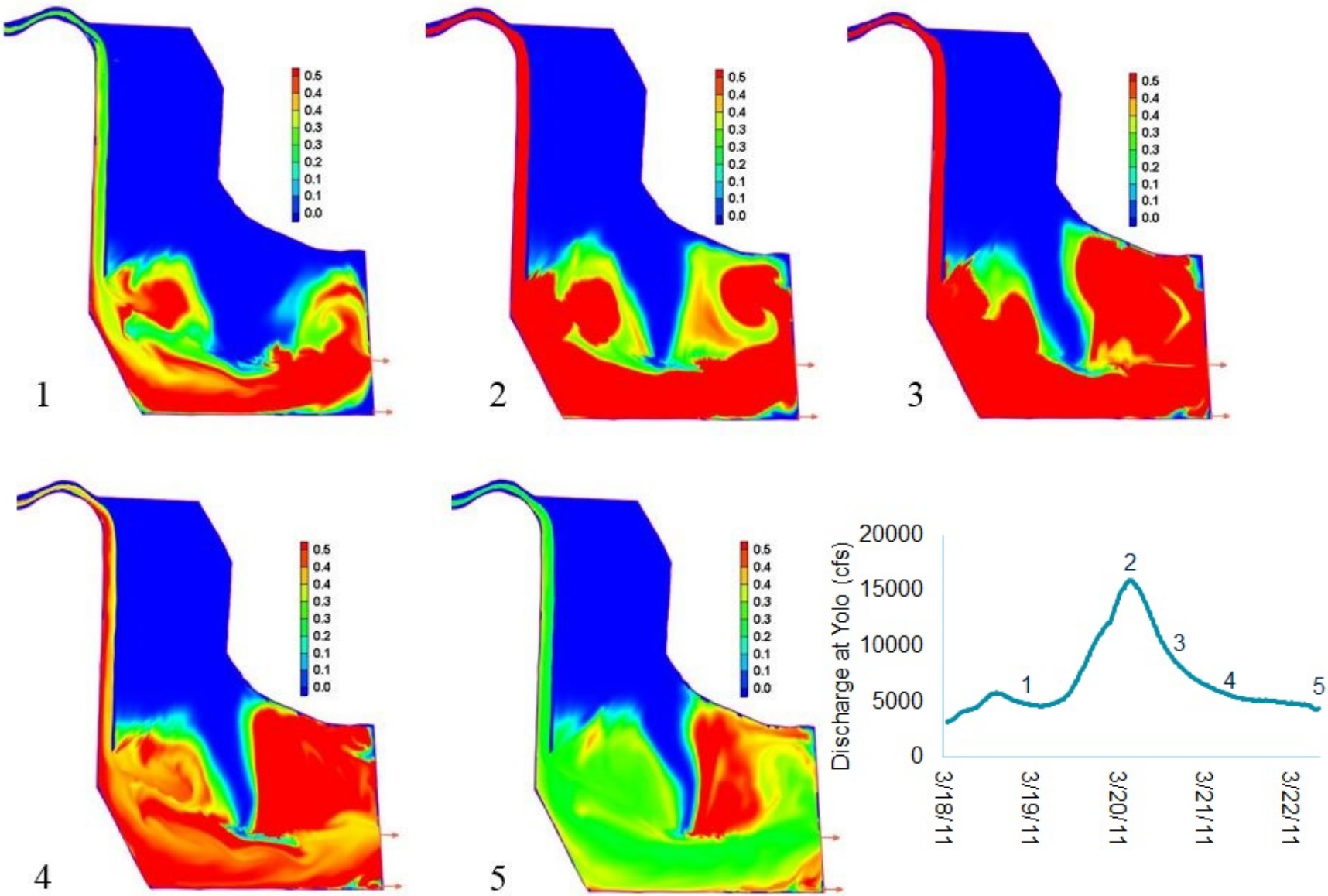

Figure 3.11 Suspended sediment concentration for time steps 1-5, Alternative B. Minimum concentration (blue) is 0.0 kg/m^3, maximum concentration (red) is 0.50 kg/m^3.

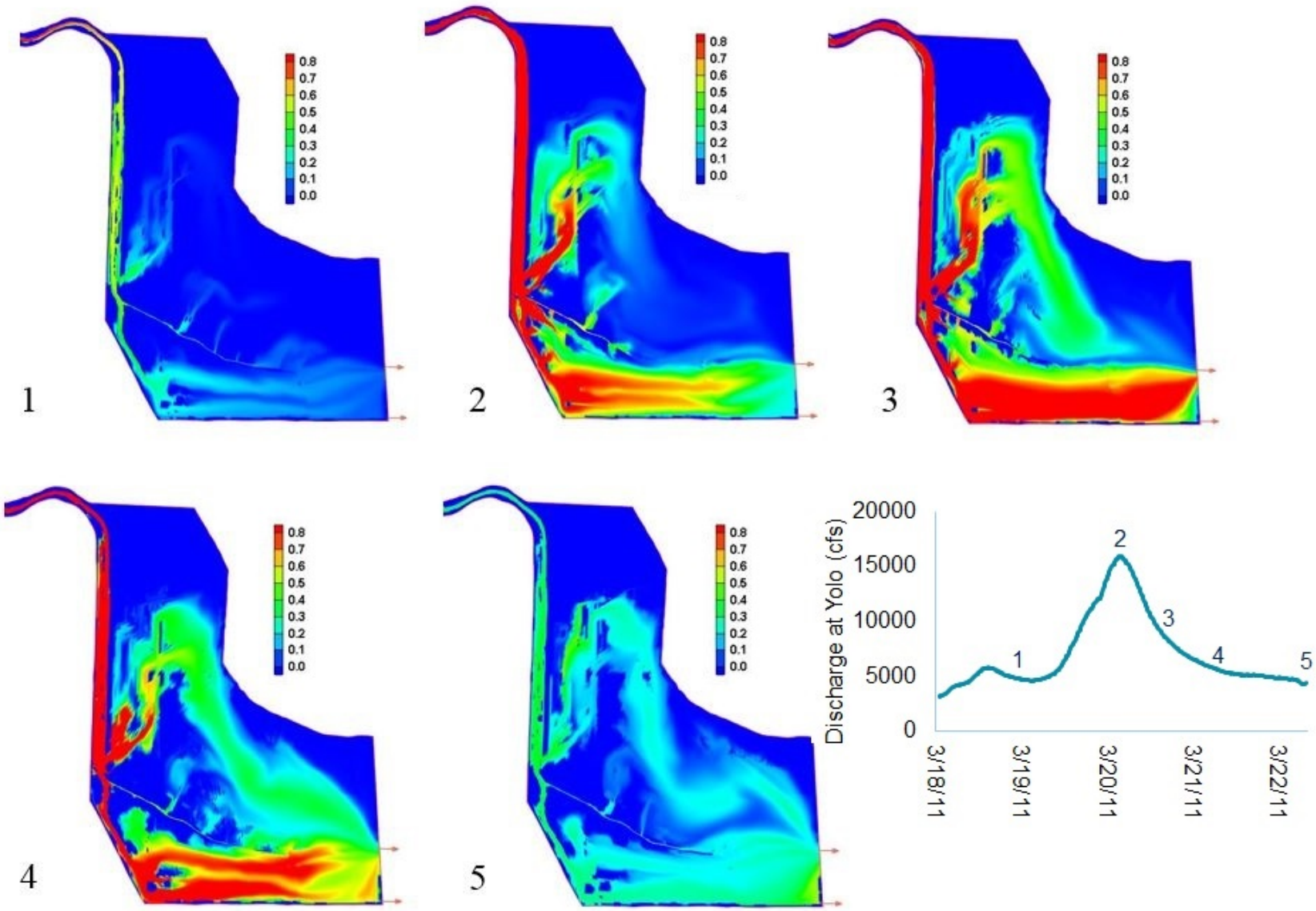

Figure 3.12 Bedload transport rate for time steps 1-5, Alternative C. Minimum transport rate (blue) is 0.0 kg/s, maximum transport rate (red) is 0.80 kg/s.

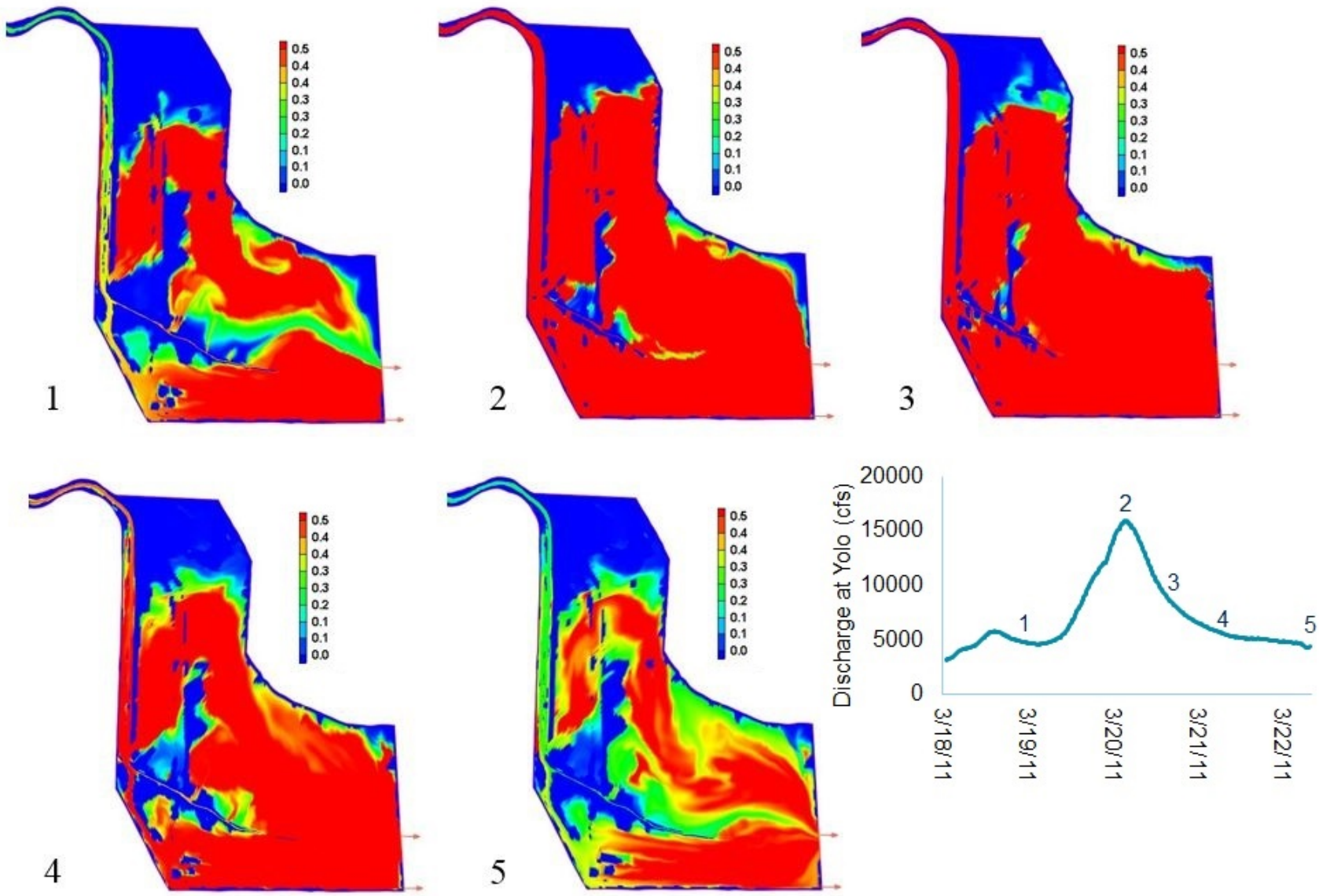

Figure 3.13 Suspended sediment concentration for time steps 1-5, Alternative C. Minimum concentration (blue) is 0.0 kg/m3, maximum concentration (red) is 0.50 kg/m^3.

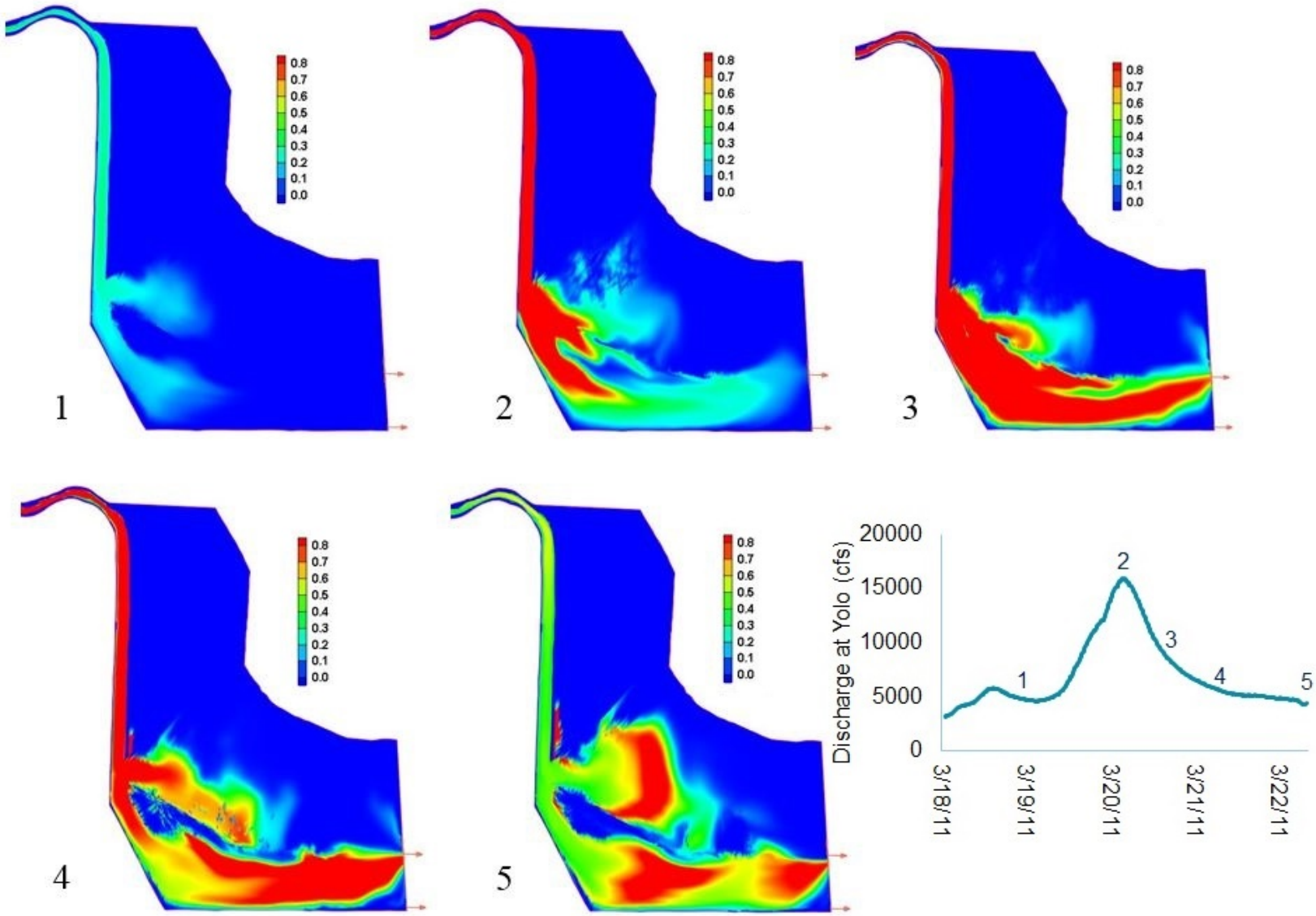

Figure 3.14 Bedload transport rate for time steps 1-5, Alternative C. Minimum transport rate (blue) is 0.0 kg/s, maximum transport rate (red) is 0.80 kg/s.

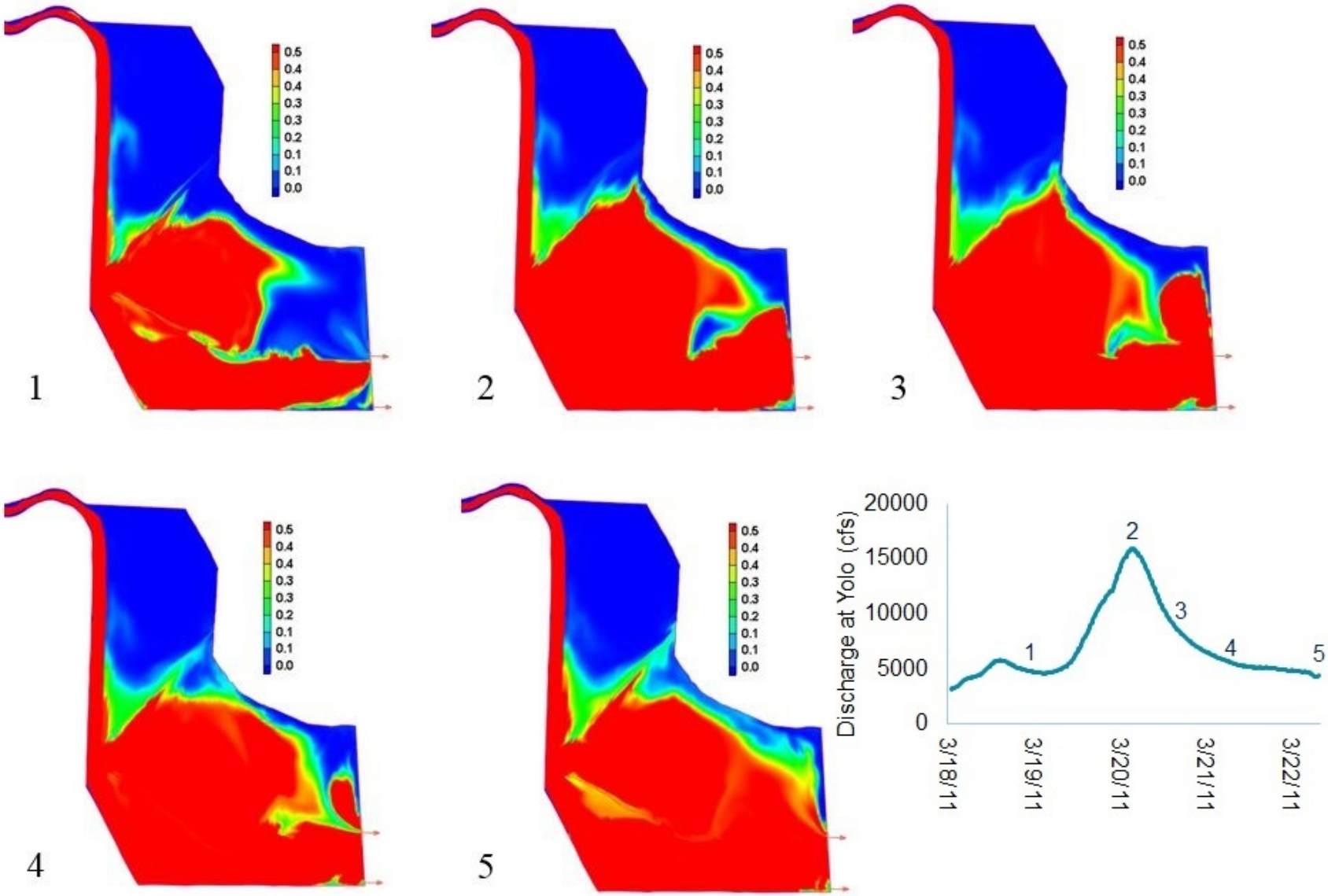

Figure 3.15 Suspended sediment concentration for time steps 1-5, Alternative D. Minimum concentration (blue) is 0.0 kg/m3, maximum concentration (red) is 0.50 kg/m^3.

4. CONCLUDING REMARKS AND FUTURE WORK

Trap efficiency estimates were provided for the current bathymetry of the CCSB using three parameter setting scenarios of the CCHE2D model. Under the three scenarios, trap efficiency ranged from 47 to 65.8%. A more realistic trap efficiency value will be provided following calibration of the sediment transport model. Calibration is reliant on survey data and volume differential from the 2006/2008 and 2014/2015 surveys of the CCSB.

Trap efficiency estimates were also supplied for three modification scenarios with bathymetric configurations that differed from the current condition. Each configuration was simulated using the default parameters of the sediment transport model to allow comparison of modification scenario performance. Reliability of such modification scenario trap efficiency estimates will be improved by calibration of the sediment transport model.

Flow sampling will continue in the subsequent year of the CCSB Trap Efficiency Study, with the goal of measuring velocities under conditions not seen in the study thus far. Such measurements will provide further verification of flow dynamics in the CCSB.

Data provided by the USGS Sacramento field office, and the California Water Science Center will be incorporated into the modeling to aid in calibration and validation of sediment transport in the CCHE2D model. Particularly, measurements of coincident suspended sediment concentration and discharge at Yolo, Rd 102, and the overflow weir will be used to increase model accuracy. Sediment cores obtained by the USGS from the CCSB may provide valuable information on the historical sediment deposition rates in the Settling Basin. Sediment cores may be especially helpful if they can provide information on the sediment deposition rates after 1993, when major bathymetric changes were made to the training channel of the CCSB. The information on the sediment deposition rates by the sediment cores will be analyzed and utilized in the calibration/validation process of the sediment model if possible.

Following completion of the planned 2015 basin survey, flow and sediment transport will be simulated for the period between the two most recent surveys. The numerical model will be calibrated to match the trap efficiency based on the depositional difference between the two survey sets, as calculated and reported by DWR. The surveys will allow calculation of depositional volume from 2006 to 2015.

Reconstructed flows produced by the Cache Creek Watershed Hydrology Study (UCDJAHL, 2014) will be simulated with the calibrated model, utilizing the sediment rating curve described in 1997 HEC-6 Analysis Technical Memorandum. The Cache Creek Watershed study provides an extensive period of hourly flow, from October 1950 through September 2010 at Cache Creek at Yolo, the upstream boundary of our CCHE2D simulation. Trap efficiency of the CCSB, under the current bathymetric conditions, can then be computed utilizing the reconstructed hourly historical flows and

the corresponding sediment conditions, obtained from the available sediment rating curve.

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