FINAL REPORT
Adaptive Environmental Management for the Columbia River Channel Improvement Project:

Annual Report for 2010

prepared by

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List of Acronyms and Abbreviations

AEM	Adaptive Environmental Management
AFEP	Anadromous Fish Evaluation Program
AMP	adaptive management process
AMT	Adaptive Management Team
C	centigrade
CI	confidence intervals
CRCIP	Columbia River Channel Improvement Project
CRM	Columbia River Mile
cys	cubic yards
CZMA	Coastal Zone Management Act
DLCD	Department of Land and Conservation Development
DWS	Deep Water Site
E2	E2 Consulting Engineers, Inc.
ESU	Evolutionary Significant Unit
FTP	file transfer protocol
LCR	Lower Columbia River
LCREP	Lower Columbia River Estuary Program
LCSG	Lower Columbia Solution Group
m	meters
MA	Monitoring Action
MCR	mouth of the Columbia River
NMFS	National Marine Fishery Service
NOAA	National Oceanic and Atmospheric Administration
O&M	operations and maintenance
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
PAH	polycyclic aromatic hydrocarbon
PCBs	Polychlorinated biphenyl
PRG	Project Review Group
psu	practical salinity unit
SD	standard deviation
SEF	Sediment Evaluation Framework
SQER	Sediment Quality Evaluation Report
TOC	total organic carbon
UDB	Upper Dobelbower
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WAN	Wauna/Driscoll
WDOE	Washington Department of Ecology
WRDA	Water Resources Development Act
WST	Westport
YOY	year of the young

1 Introduction

This 2010 report continues the series of annual reports produced by of the Adaptive Environmental Management (AEM) Program for the Columbia River Channel Improvement Project (CRCIP). The first annual report was developed for the calendar year 2006, which was the first full year of Project construction and implementation of the CRCIP AEM Program. Subsequent annual reports were produced for calendar years 2007–2009. The 2010 annual report documents the activities and results of Project construction and ecosystem mitigation activities completed through January 31, 2010.

Each CRCIP AEM annual report is developed as a separate stand-alone document for the convenience of the reader. Therefore, the previously developed background materials that describe the adaptive management process (AMP) for the CRCIP AEM Program are presented in each annual report. There is considerable redundancy among the annual reports. Again, this is intentional to save the reader from having to consult each annual report for important background materials developed as part of the CRCIP AEM Program.

To provide a degree of continuity from year-to-year, the 2010 annual report also briefly reviews the major AEM results and decisions for calendar year 2009. The results for Monitoring Action (MA)-1 monitoring for 2009 are presented for convenient comparison with the 2010 results. In addition, each of the monitoring activities includes a continuous summary of decisions made during the course of the CRCIP AEM Program. However, the details of the 2009 AEM activities are described more fully in the 2009 CRCIP AEM Program annual report.

1-1 CRCIP Construction Progress

Phase 4 of the Project construction performed mainly during calendar year 2010 emphasized rock removal in several locations plus some additional dredging (red lines in Figure 1-1.1). Disposal of Phase 4 Project dredged materials in 2010 is addressed in detail in the report section for MA-2. Importantly, overall CRCIP construction dredging was completed in November 2010.

The Project will transition into the operations and maintenance (O&M) phase in 2011. As the Project moves to O&M, Jessica Stokke will become the United States Army Corps of Engineers (USACE) Project manager and replace Marci Johnson; who assisted Jessica during the transition Adaptive Management Team (AMT) meeting in October 2010. Marci Johnson will no longer be a member of the AMT. As a result of this transition, Steve Bartell [E2 Consulting Engineers, Inc. (E2)] will serve as the main facilitator during the AEM quarterly meetings. Steve Bartell will coordinate with Jessica Stokke in providing information and other communication to members of the AMT.

Transition of the channel improvement project from construction to O&M is also important in relation to the organization and continued operation of the CRCIP AEM Program. Transition of the AEM Program to the O&M phase will be discussed in a later section in this report and variously throughout the report as appropriate.

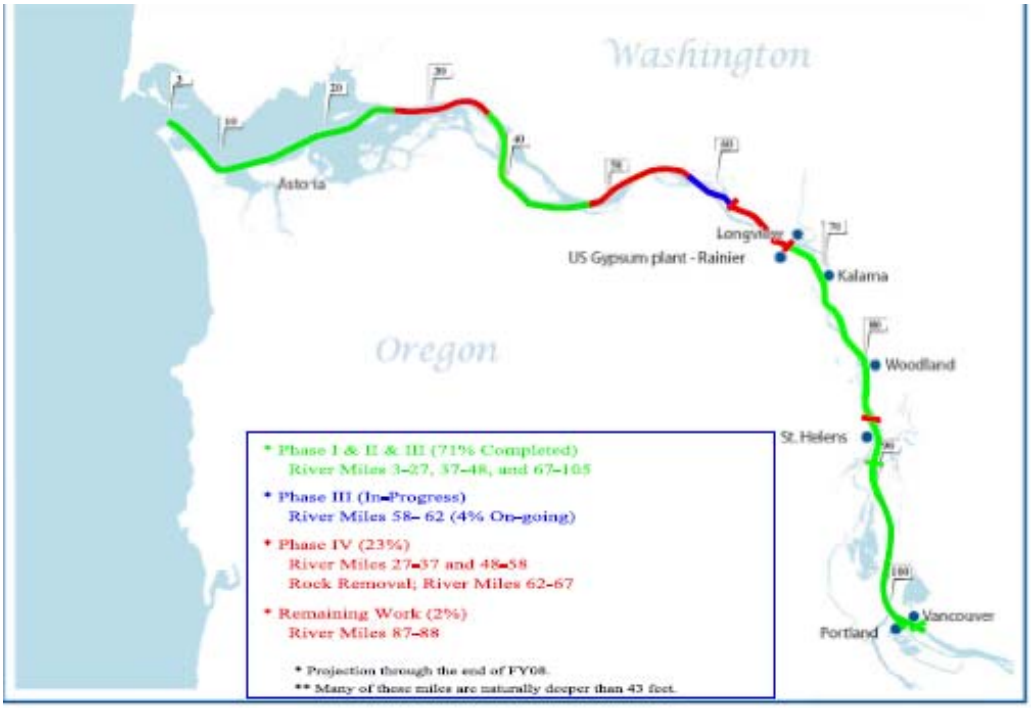


Figure 1-l.1. Construction Progress of the CRCIP.

1-2 CRCIP Rock Removal

As previously mentioned, construction activities during 2010 focused primarily on rock removal. Initial rock removal was in the vicinity of the St. Helens area. The members of the AMT visited this location and witnessed rock removal activities during the November 2009 AMT meeting. McAmis, Inc., completed its blasting in the St. Helens area on February 4, 2010, and completed its removal of the rock on February 8, 2010. Approximately 460,000 cubic yards (cys) of material (rock and sand) were removed from this area. No fish takes were observed beyond the two individual sturgeon observed in the very initial stages of blasting. Material was placed at an approved, Contractor-provided in-water site at Ross Island.

Additional rock removal was required for an area near Longview Bridge. Test digging performed during the Feasibility Study indicated rubble deposition in this area as a result of the St. Helen's eruption. Additional studies were performed to confirm whether the materials were amenable to dredging or if rock removal required blasting. Testing at Longview was completed before the blasting teams disbanded from the St. Helens area. No blasting was necessary at Longview.

Rock removal near the Longview Bridge began on January 27, 2010. J. E. McAmis, Inc., and their subcontractor Dutra Dredging performed this work. J. E. McAmis backhoe dredge "Megan Renee" worked downstream of the Longview bridge. Dutra clamshell dredge "Paula Lee" worked upstream of the Longview bridge. J. E. McAmis, Inc., completed its rock removal at Longview in August 2010. Dutra Dredging completed its work in November 2010. Materials dredged by J. E. McAmis, Inc., were offloaded to trucks and transferred to the Dibblee Point

upland placement site, which was Contractor-provided. Materials dredged by Dutra Dredging were placed at an approved, Contractor-provided in-water site at Ross Island.

In September and October 2010, J. E. McAmis, Inc., removed remaining hard spots at Astoria and Wauna Driscoll Bar and several locations near Vancouver. Placement areas included an approved, Contractor-provided upland site in Astoria and in-water sites.

In addition to completing the rock removal, there were ~70 days of dredging work completed by the pipeline dredge Oregon at Pillar Rock and Stella-Fisher Bars. Material removed from Pillar Rock Bar was placed in-water. Material removed from Stella-Fisher Bar was placed in-water and upland in the Crims Island site.

The dredges removed approximately 95–98% of the material available to the maximum contract depth.

1-3 Ecosystem Restoration and Mitigation

Ecosystem restoration and mitigation actions remain as important components of the CRCIP. These components primarily serve as sources of additional information for overall evaluation of the Project by the AMT. However, restoration and mitigation activities associated with the Project do not enter directly into the decision-making aspects of the AEM Program. Formal decision criteria have not been developed to evaluate the restoration or mitigation activities within the framework of the CRCIP AEM Program.

Two restoration and mitigation actions were discussed during the 2010 quarterly meetings of the AMT. Mitigation activities were largely completed at Chumbley and Webb, and activities progressed at Cottonwood Island. The USACE had purchased a portion of Cottonwood Island for both disposal of Project construction materials and ecosystem restoration. The proposed mitigation actions include conversion of selected areas from pasture to riparian forested wetlands and the introduction of Columbia white-tailed deer to the island.

During 2010, mitigation work continued at Cottonwood Island (120 acre site). Physical excavations of swales and removal of overburden were completed to alter the hydrology of parts of Cottonwood Island. Changes in hydrology favor the germination of native plants and facilitate efforts to convert areas currently dominated by reed canary grass to riparian forested wetlands. USACE plans describing the proposed mitigation actions had been provided previously to the Washington Department of Ecology (WDOE) for review.

Wetland areas were prepared for planting riparian forest species in the spring of 2010. Mowing, tilling, and spraying will continue as part of the mitigation efforts underway on Cottonwood Island through the spring of 2011. Three iterations of these activities will occur before planting. Planting of native species of riparian vegetation is now planned for the spring of 2011.

In addition to restoration of riparian areas, Cottonwood Island white-tailed deer were transplanted to the island beginning in August of 2010. The Washington Department of Fish and Wildlife collaborates with the USACE to facilitate deer introduction to the island.

1-4 Annual Report Structure

As suggested previously, the CRCIP AEM annual reports are similar in structure. Following a brief description of the CRCIP AEM process, each MA of the adaptive management effort is addressed. Summaries of the monitoring results for 2010 are provided along with comparisons of the results with AEM decision criteria. Decisions concerning adaptive management for each of the MAs recorded by the AMT during the assessment year are also reported.

In addition, detailed accounts of the actions of the AMT, minutes of the quarterly AMT meetings and additional supporting information are documented in the CRCIP AEM workbook. The workbook is updated as additional monitoring data becomes available and serves as ongoing documentation of the AEM process. The workbook is reviewed by the AMT at each of the quarterly meetings. An electronic working version of the workbook is available to the AMT at the website (www.e2tm.com) hosted by E2.

1-5 CRCIP AEM Process

The AEM process developed for the CRCIP includes the following steps for adaptively managing the environmental resources of concern in relation to channel deepening (Bartell 2004):

1. Results of the ongoing monitoring programs are summarized and reported quarterly to the AMT.

2. The AMT evaluates monitoring results in relation to the consensus management decision criteria (see Appendix D in Bartell 2004).

3. If none of the decision criteria are exceeded, the AEM process can continue with the current monitoring programs until the next evaluation (i.e., Step 1).

4. If decision criteria are exceeded, the AMT can request the USACE to explain the variances or offer a mitigation plan.

5. Based on an evaluation of the USACE submission, the AMT may (a) determine that there is no justification for changing the current management practices, or (b) recommend changes to the current management practices and/or modifications to the decision criteria.

6. Following resolution of the proposed adaptive management actions and possible revisions to monitoring and criteria recommended by the AMT, the AEM process cycles back to analysis and review of new data and information at the next quarterly meeting.

The steps in the above described AEM process are schematically illustrated in the following AEM plan flowchart (Figure 1-5.1).

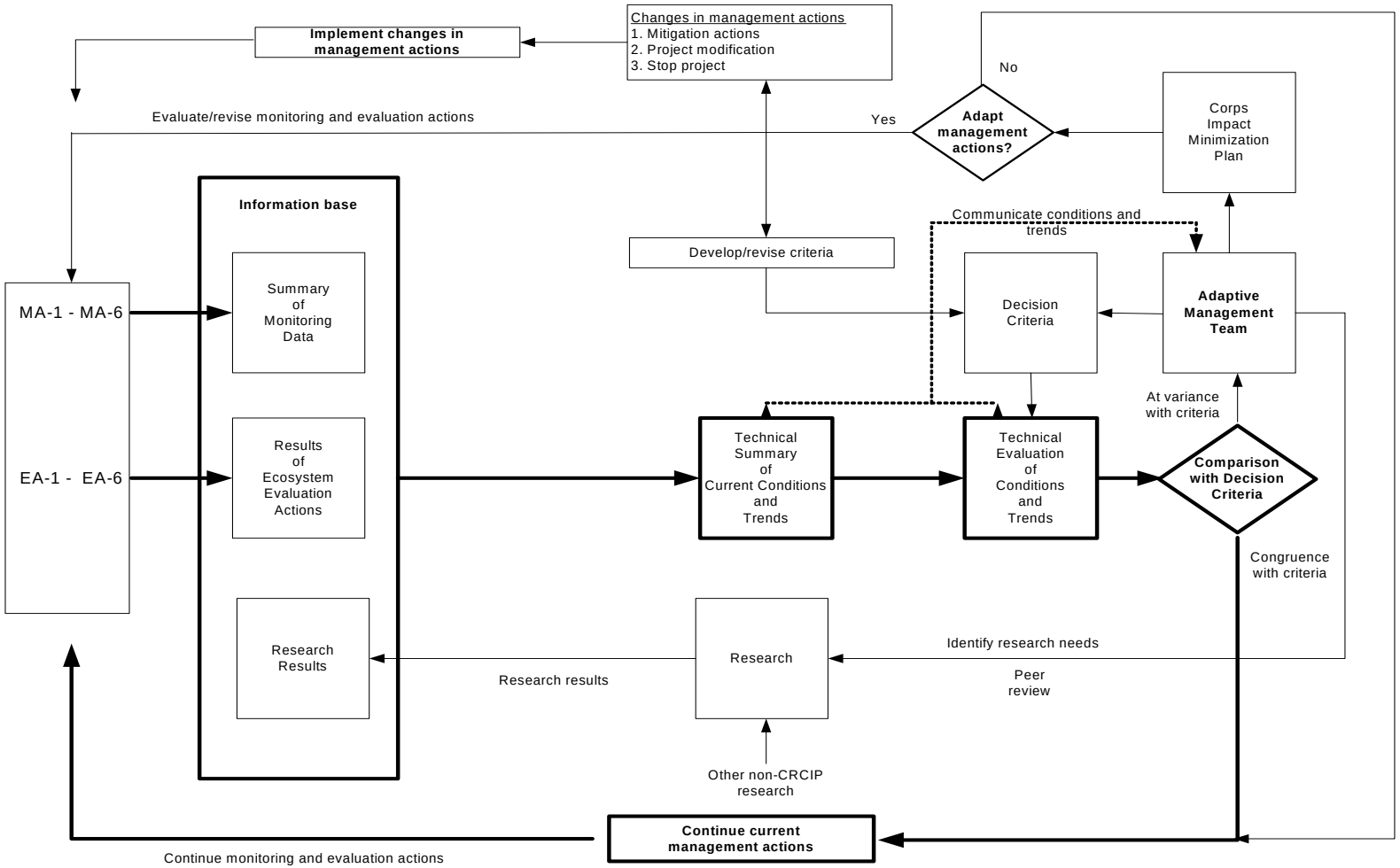


Figure 1-5.1. Flowchart describing the AEM process for the CRCIP.

1-6 Post-Construction Transition of the AEM Program

Upon completion of Project construction in 2010, the CRCIP will move from Project construction status to an O&M phase. The O&M Biological Assessment proposes to continue the CRCIP AEM for three years following completion of construction as stated in the 2005 CRCIP Biological Opinion. The AMT recognized that completion of construction and transition to O&M may require modifications to the continuing AEM program. This transition from construction to O&M provided an excellent opportunity for the AMT to review and revise, as necessary, the CRCIP AEM Program.

In anticipation of the transition, the AMT initiated discussions during the 2010 quarterly meetings to develop consensus concerning modifications to the channel improvement adaptive management program in relation to the change in project status. The transition will require careful thought and actions as the current CRCIP AEM Program and its AMT continue because several of the Project post-construction MAs and follow-up studies are scheduled for three years after Project completion (~2013).

The AMT discussed the continued participation of the Oregon Department of Land and Conservation Development (DLCD) in relation to the transition of the CRCIP from construction into O&M. Mr. Charland (DLCD) stated that he would no longer be with the DLCD and that Juna Hickner would be replacing him. When asked if a new Coastal Zone Management (CZMA) determination was going to be required for O&M, Mr. Charland stated that he was unsure, but believed that the completion of the channel deepening constituted a significant change to the Project. He would need to consult with Oregon Department of Environmental Quality (ODEQ) and Oregon Department of Fish and Wildlife (ODFW) to work through the technical issues pertaining to the CZMA. Mr. Charland stated that he would ensure that Juna Hickner would attend the October 2010 meeting to provide DLCD guidance regarding any changes to the CZMA status for channel improvement.

Similarly, the AMT asked Marci Johnson (USACE) to contact the WDOE regarding its position concerning the CZMA questions raised in relation to the discussion with the DLCD and to learn if WDOE would require the USACE to initiate a new CZMA determination. The AMT also expressed its interest in the continued participation of the WDOE in the AMT during the O&M phase of channel improvement.

At a more general level, the AMT discussed the current CRCIP AEM Plan in relation to the pending transition to O&M. The AMT decided that changes to the plan were not necessary at this time and that the Plan would simply carry over into the O&M. An AEM Plan for O&M would simply incorporate the AEM Plan as originally developed for the CRCIP.

The frequency of AMT meetings was raised during the discussion of the CZMA. The AMT reaffirmed its preference for regularly scheduled quarterly meetings.

The following consensus conclusions regarding the remainder of the CRCIP adaptive management program resulted from discussions initiated at the January 2010 quarterly meeting and continued throughout 2010:

- MA-1: continue for three years post Project construction.
- MA-2: transition into O&M monitoring and reporting.
- MA-3: continue for three years post Project construction.
- MA-4: to be discussed further at the April 2011 quarterly meeting.
- MA-5: transition to O&M for compliance with Sediment Evaluation Framework (SEF).
- MA-6: complete the post-construction follow-up experiments; March 2012–2013.
- Bank to Bank Survey: complete post construction survey two years after construction WDOE and for National Marine Fishery Service (NMFS), five years after the State of Washington's required survey.
- Sediment Management: will transition to the USACE regional sediment management program (Mike Ott, USACE).
- Sturgeon: a green sturgeon study program has begun as part of the CRCIP O&M phase.
- Crab: the CRCIP completed this requirement under Oregon and Washington's 401 requirements and DLCD's Coastal Zone Consistency Determination.
- Smelt: the assessment of potential CRCIP impacts on smelt has been completed in relation to Project construction. However, smelt was listed as a threatened species on March 16, 2010. The effective date of listing was May 17, 2010. The new O&M Biological Opinion expected June 2011 will include consultation for smelt.

The AMT recognizes that changes to the current consensus decisions might result from continued discussions and revisions to the CRCIP AEM Program during 2011.

CZMA Discussion

In 2010, the WDOE reviewed the entire CRCIP, including proposed O&M activities. On the basis of this review, WDOE granted consistency and concluded that no new application concerning the CZMA would be required. Given limited resources, WDOE plans for minimal participation in the AMT regarding O&M activities. However, WDOE requests to retain its membership and listing in the AMT Charter. The consensus among AMT members was to honor this request.

DLCD perspectives concerning the CZMA were similar to those of WDOE. No new application was required as the CRCIP transitions into its O&M phase. However, DLCD does require the continuation of project reporting as specified in the original Oregon CZMA document. Of particular concern to DLCD are (1) the collection of bank-to-bank bathymetry data in 2012 and 2017, (2) revisiting the dredged material disposal plan in five years, and (3) continued evaluations of future disposal at the Deep Water Site (DWS).

2 Monitoring Action 1—Physical, Chemical Data

The following figures and tables summarize the MA-1 results of monitoring depth, temperature, and salinity values in relation to channel improvements for calendar 2010. The results are based on analyses of verified data downloaded from the CORIE public website. The monitoring data are obtained from three sampling stations located in the lower river and estuary: tansy, grays, and cbnc3 (Figure 2-1). The tansy station replaced the red26 station (used in previous years of the AEM Program), which was physically lost from the CORIE network during 2008.

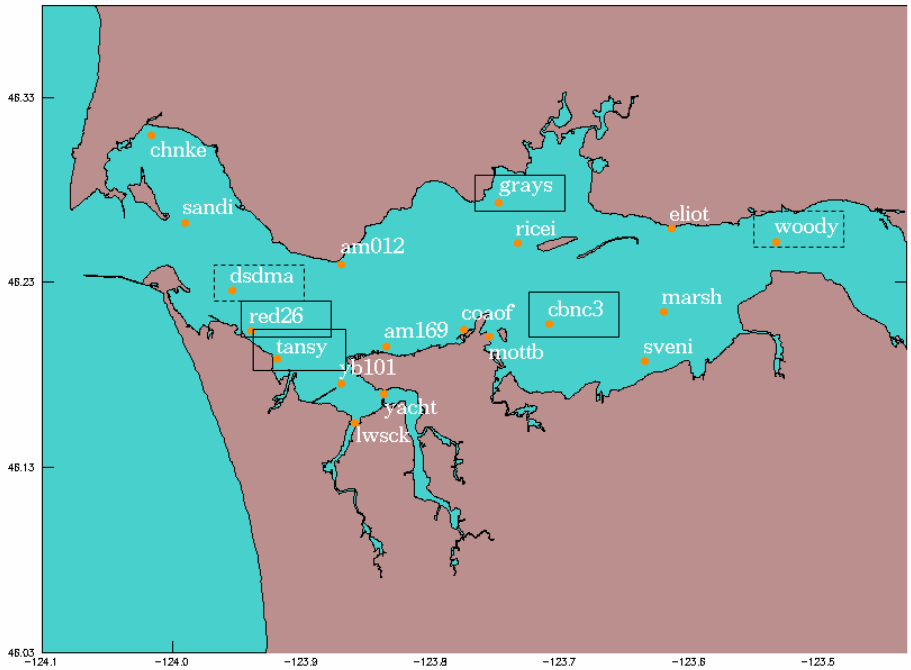


Figure 2-1. Location of CORIE monitoring stations in the Lower Columbia River (LCR) and estuary. The three stations (tansy, grays, and cbnc3) indicated by the solid rectangles provide data for MA-1. The two stations indicated by the dashed rectangle provide salinity (dsdma) and temperature (woody) data used in normalization of the data collected at the three MA-1 stations.

CORIE monitoring data collected from 1996–2004 provided the pre-Project (baseline) physical chemical data. Decision criteria were defined for depth, temperature, and salinity through analyses of these data. Two sets of criteria were defined during the development of the AEM plan in calendar years 2004–2005: (1) the upper and lower 90th percentile criteria were defined by the 5th and 95th percentile values computed for each month, and (2) the upper and lower 60th percentile criteria were defined by the 20th and 80th percentile computed monthly values. These values were approved as AEM decision criteria by the CRCIP AMT.

2-1 Depth

As in previous years (2006–2008), depth data were only available for the grays sampling station in 2010 (Figure 2-1.1).

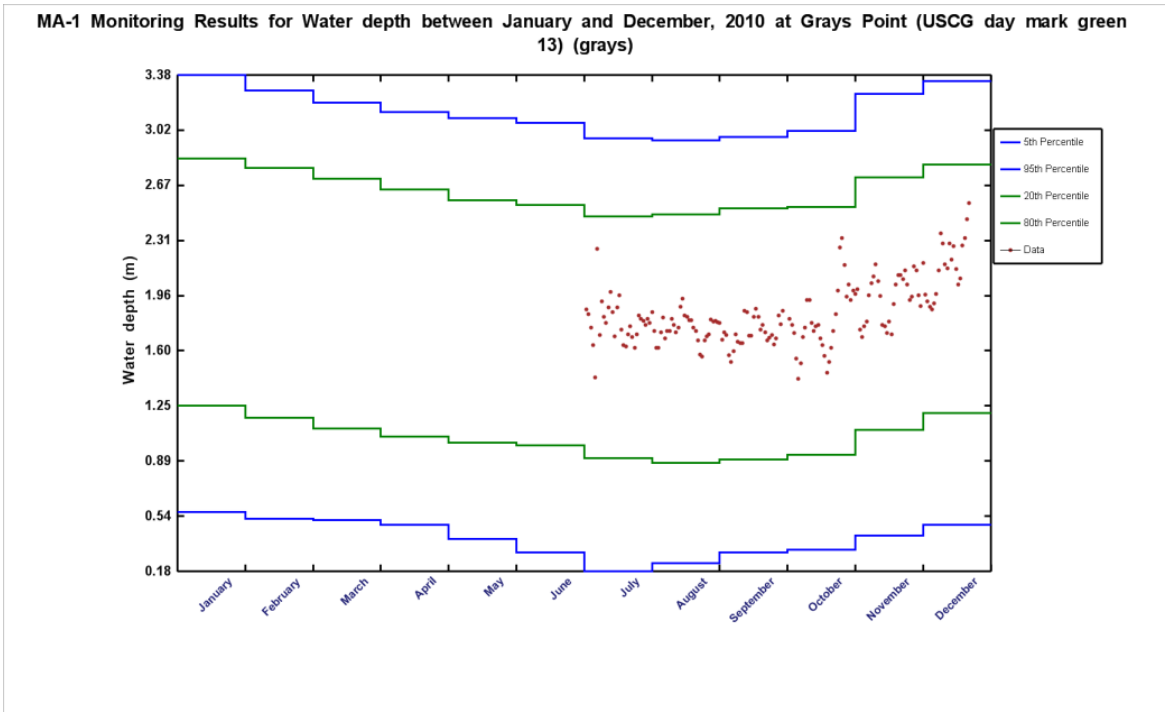


Figure 2-1.1. Daily median values of depth for the grays sampling location for 2010 plotted in relation to the CRCIP AEM decision criteria.

Depth data were available for the grays station only between July and September 2010. The daily values are nearly centered within the 20th–80th percentile decision criteria during this period.

Table 2-1.1 lists the monthly median depth values calculated using the 2010 data from the grays station. All reported 2010 monthly values were within the 20th–80th percentile range of the decision criteria derived from the 1996–2004 pre-Project data.

Table 2.1.1. Summary of 2010 monthly median depth values (bold numbers) for grays station in relation to AEM percentile decision criteria.

	Monthly Median Depth Meters (m)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	0.6	0.5	0.5	0.5	0.4	0.3	0.2	0.2	0.3	0.3	0.4	0.5
20	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.9	0.9	1.1	1.2
	No data	**No data**	**No data**	**No data**	**No data**	**No data**	**1.7**	**1.7**	**1.7**	**1.8**	**1.9**	**2.2**
80	2.8	2.8	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.7	2.8
95	3.4	3.3	3.2	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.3	3.3

2-2 Temperature

Figure 2-2.1(a,b,c) shows the daily median temperature values calculated for 2010 for the three CORIE stations: tansy, grays, and cbnc3. The daily values are plotted in relation to the percentile decision criteria established prior to the Project construction by the AMT. These decision criteria were estimated using CORIE data from 1996–2004 (i.e., pre-Project).

Water temperature data were variously available throughout 2010 for tansy (Figure 2-2.1a), grays (Figure 2-2.1b), and cbnc3 (Figure 2-2.1c). Temperature data for the tansy station were available for all months except December 2010 (Figure 2-2.1a). Daily median values for the early part of April were in the range of lower values reported for the pre-Project period. However, most of 2010 showed daily temperatures that were more consistent with higher values determined for pre-Project conditions. Except for several days at the end of March, beginning of October, and beginning of November, all of the calculated daily median values were within the decision criteria (Figure 2-2.1a).

Data were not available for the grays station from January through mid-March (Figure 2-2.1b). Data for the remainder of 2010 demonstrate that daily median values were primarily within the decision criteria developed from the pre-Project data for the grays station. Daily median values exceeded the high temperature criteria for several days at the end of March, beginning of October, and beginning of November. Daily median temperature was slightly lower than the monthly low temperature criteria for several days in early April and late November (Figure 2-2.1b).

Daily median temperature data for the cbnc3 station suggested slightly warmer than average temperatures during January through March 2010 and somewhat cooler than average values in June and July 2010 (Figure 2-2.1c). Daily median temperatures exceeded the monthly decision criteria for several days at the end of March (higher temperature), nearly half of June (lower temperatures), and several days in early July (lower temperatures). One daily value in early August was lower than the monthly decision value (Figure 2-2.1c). Temperature data were not available for the second half of September through the remainder of 2010.

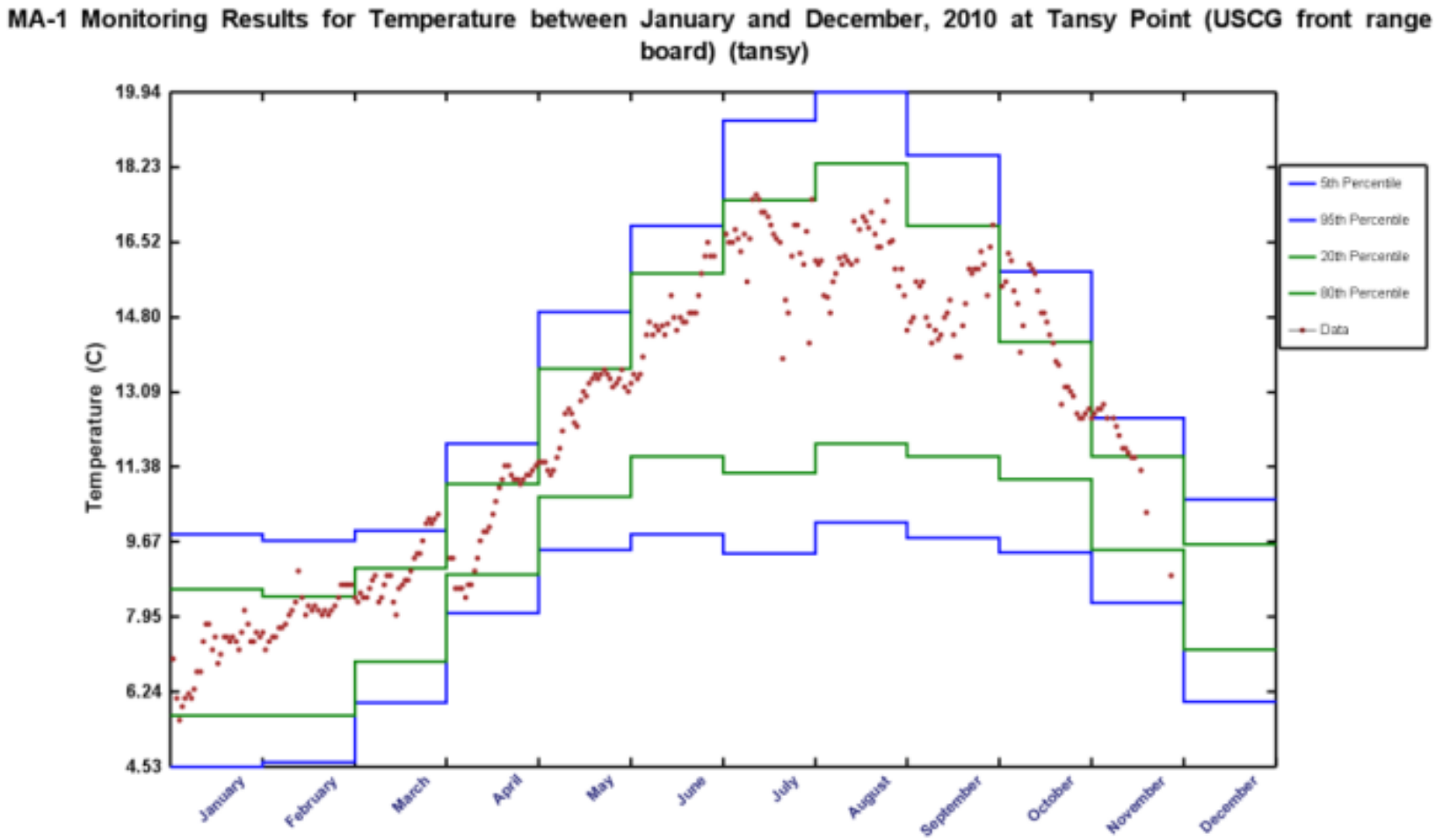
Tables 2-2.1–2-2.3 list the calculated monthly median values for 2010 and the corresponding temperature decision criteria derived from analysis of the pre-Project data (1996–2004). Despite the above mentioned variances in the daily temperature data, the spreadsheet summaries of monthly average temperatures used in the AEM decision-making process were nearly all within the decision criteria for all three stations for the months with available data. However, the June value of 14.8°C calculated for the cbnc3 station is 0.1°C less than the decision criterion of 14.9°C. The AMT did not consider this discrepancy to be of any significance in relation to the Project. The spreadsheet summaries of monthly average temperatures used in the decision-making process were predominantly within the 20th–80th percentile decision criteria for all three stations based on the available 2010 data. The February value for cbnc3, the March values for grays and tansy, and the October and November values for tansy were within the 80th–95th percentile decision criteria. The June value for grays was within the 5th and 20th percentile decision criteria (Tables 2-2.1–2-2.3).

To further evaluate the potential impacts of channel modification on water temperatures, the daily median values for 2010 were plotted against corresponding baseline values (1996–2004) for the upriver "woody" (Woody Island) sampling location (Figure 2-2.2). Water temperatures at woody are primarily determined by river flows. Explicit decision criteria were not formulated by the AMT to evaluate the nature of the MA-1 temperature values relative to the woody baseline data. Temperature data were not available for the January–March 2010 time period for the woody station. Therefore, it was not possible to perform the normalized calculations or produce the plots that are routinely developed as part of MA-1 activities for the January–March time period. Temperature data were available for the woody station during the 2nd quarter of 2010 and the normalized temperature plots were produced for tansy, grays, and cbnc3. The plotted daily values of temperature for the three stations (tansy, grays, and cbnc3) were within the corresponding clusters of normalized temperature points defined by the pre-Project data (Figure 2-2.2). Temperature data were available for the woody station during the 3rd quarter (July–September) and the normalized temperature plots were produced for tansy, grays, and cbnc3. The plotted daily values of temperature for the three stations (tansy, grays, and cbnc3) were within the corresponding clusters of normalized temperature points defined by the pre-Project data (Figure 2-2.2a,b,c).

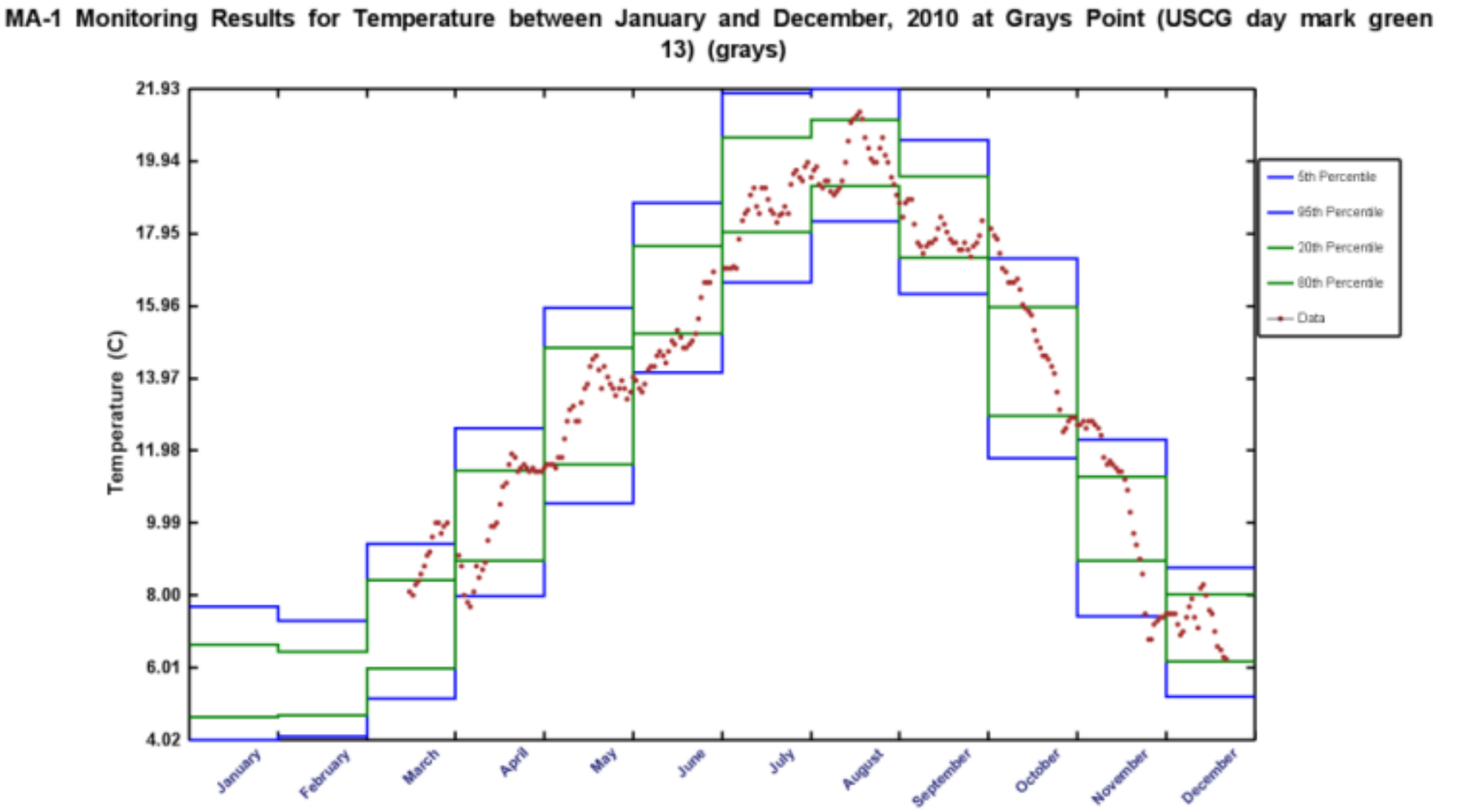
The plots of daily median temperature values of all three stations versus the temperatures recorded for the woody station demonstrated that the data available through December 2010 were consistent with the relationships established using the 1996–2004 pre-Project construction data.

The overall conclusion from the MA-1 analysis of water temperatures was that no discernible impacts of Project construction were evident based on the CORIE monitoring data available for 2010.

(a)


MA-1 Monitoring Results for Temperature between January and December, 2010 at Tansy Point (USCG front range board) (tansy)
Temperature (C)
19.94
18.23
16.52
14.80
13.09
11.38
9.67
7.95
6.24
4.53
January
February
March
April
May
June
July
August
September
October
November
December
5th Percentile
95th Percentile
20th Percentile
80th Percentile
Data

(b)


MA-1 Monitoring Results for Temperature between January and December, 2010 at Grays Point (USCG day mark green 13) (grays)
Temperature (C)
21.93
19.94
17.95
15.96
13.97
11.98
9.99
8.00
6.01
4.02
January
February
March
April
May
June
July
August
September
October
November
December
5th Percentile
95th Percentile
20th Percentile
80th Percentile
Data

(c)

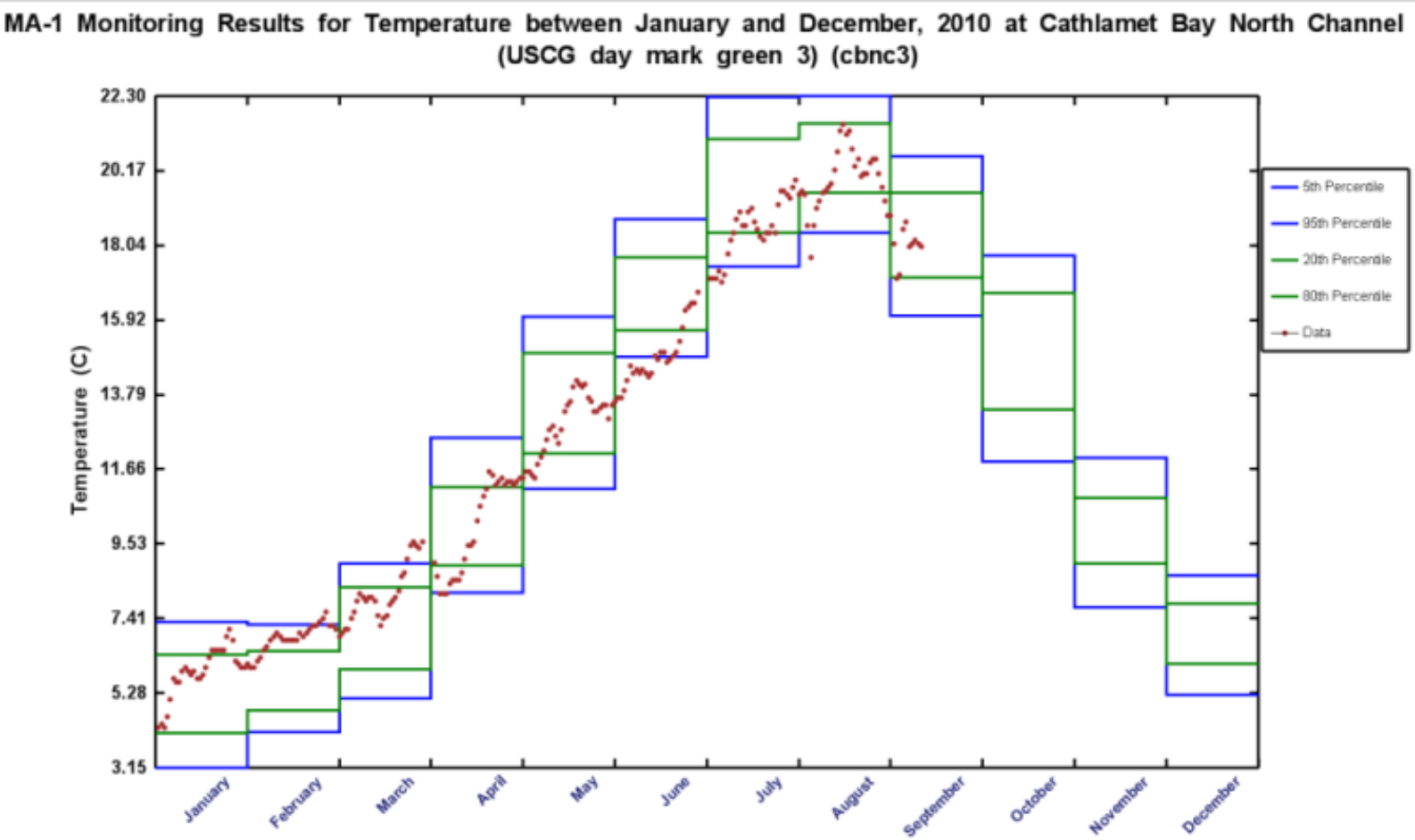


Figure 2-2.1. Daily median values of water temperature for (a) tansy, (b) grays, and (c) cbnc3 sampling stations for 2010 plotted in relation to the CRCIP AEM decision criteria.

Table 2-2.1. Summary of 2010 Monthly Median Temperature Values (bold numbers) for tansy Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Temperature Centigrade (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	4.5	4.6	6.0	7.0	9.5	9.8	9.4	10.1	9.8	9.4	8.3	6.0
20	5.7	5.7	8.9	8.9	10.7	11.6	11.2	11.9	11.6	11.1	9.5	7.2
	7.3	**8.2**		**10.5**	**12.8**	**14.7**	**16.6**	**16.3**	**15.3**			**No data**
80	8.9	8.4	9.1	11.0	13.6	15.8	17.5	18.3	16.9	14.2	11.6	9.6
			9.1							**14.5**	**12.4**	
95	9.8	9.7	9.9	11.9	14.5	16.9	19.3	19.9	18.5	15.8	12.5	10.6

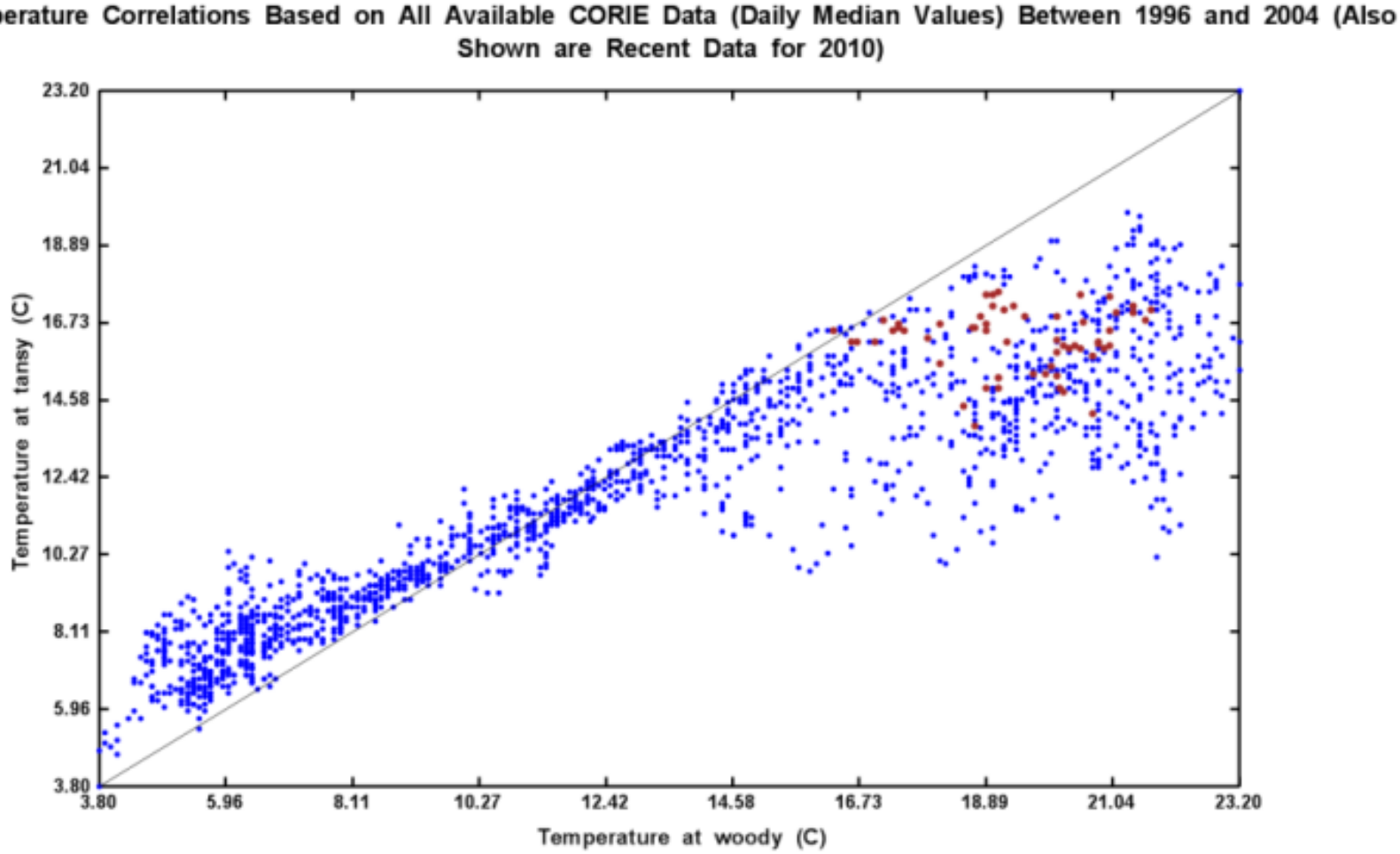
Table 2-2.2. Summary of 2010 Monthly Median Temperature Values (bold numbers) for grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	4.0	4.1	5.2	8.0	10.5	14.1	16.6	18.3	16.3	11.8	7.4	5.2
						14.8						
20	4.7	4.7	6.0	9.0	11.6	15.2	18.0	19.3	17.3	12.9	9.0	6.2
	No data	**No data**		**10.7**	**13.5**		**18.7**	**19.8**	**17.8**	**15.3**	**11.3**	**7.4**
80	6.6	6.5	8.4	11.4	14.8	17.6	20.6	21.1	19.5	15.9	11.3	8.0
			9.3									
95	7.7	7.3	9.4	12.6	15.9	18.8	21.8	21.9	20.5	17.3	12.3	8.8

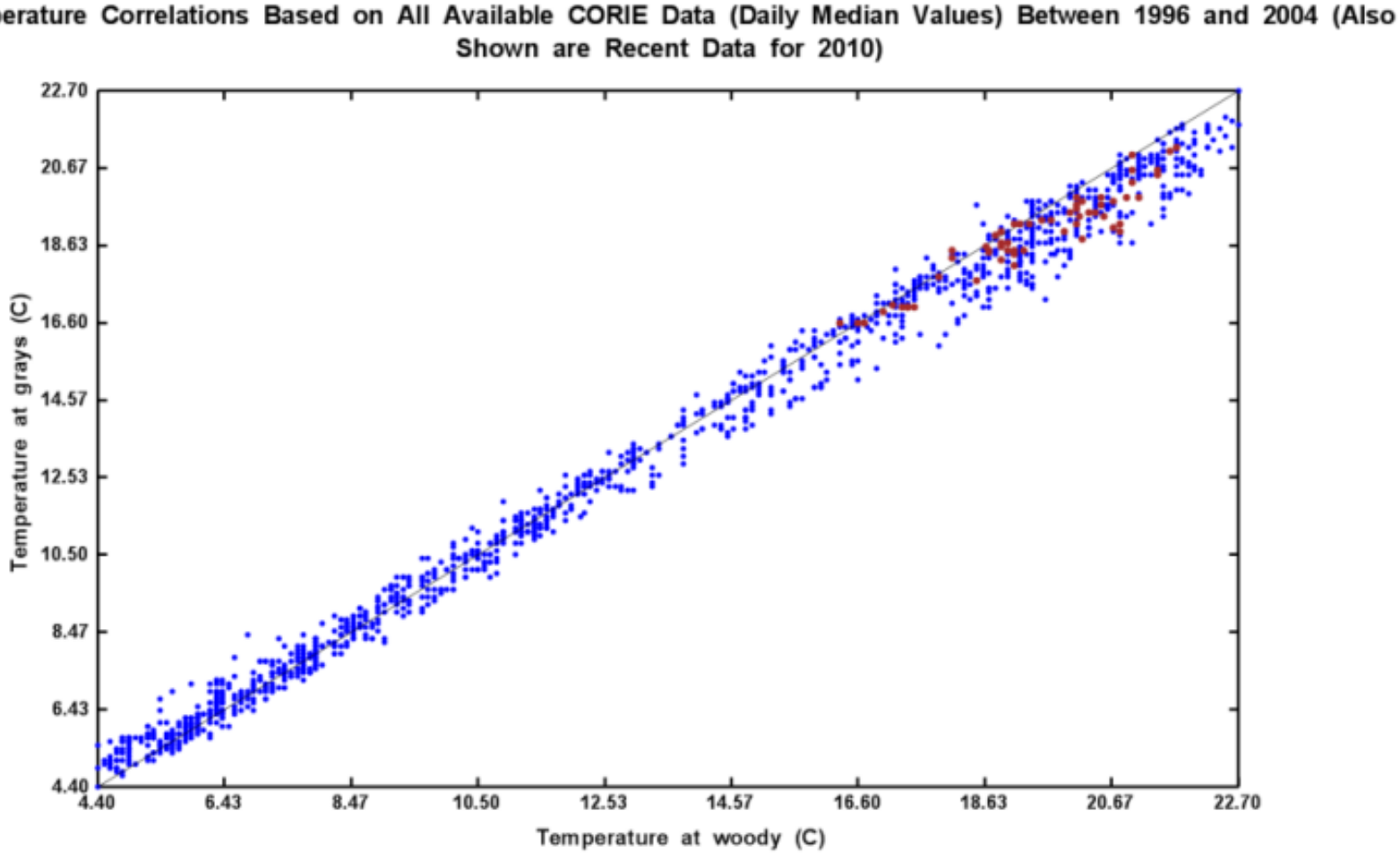
Table 2-2.3. Summary of 2010 Monthly Median Temperature Values (bold numbers) for cnbc3 Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
						14.8						**5.2**
5	3.2	4.2	5.1	8.1	11.1	14.9	17.4	18.4	16.0	11.9	7.7	5.2
20	4.1	4.8	6.0	8.9	12.1	15.6	18.4	19.5	17.1	13.4	9.0	6.1
	6.0		**8.0**	**10.4**	**13.3**		**18.6**	**20.0**	**18.1**	**No data**	**No data**	**No data**
80	6.4	6.5	8.3	11.2	15.0	17.7	21.1	21.5	19.5	16.7	10.9	7.6
		6.9										
95	7.3	7.2	9.0	12.6	16.0	18.8	22.3	22.3	20.6	17.8	12.0	8.6

(a)


Temperature Correlations Based on All Available CORIE Data (Daily Median Values) Between 1996 and 2004 (Also Shown are Recent Data for 2010)
Temperature at tansy (C)
Temperature at woody (C)
23.20
21.04
18.89
16.73
14.58
12.42
10.27
8.11
5.96
3.80
3.80
5.96
8.11
10.27
12.42
14.58
16.73
18.89
21.04
23.20

(b)


Temperature Correlations Based on All Available CORIE Data (Daily Median Values) Between 1996 and 2004 (Also Shown are Recent Data for 2010)
Temperature at grays (C)
Temperature at woody (C)
22.70
20.67
18.63
16.60
14.57
12.53
10.50
8.47
6.43
4.40
4.40
6.43
8.47
10.50
12.53
14.57
16.60
18.63
20.67
22.70

(c)

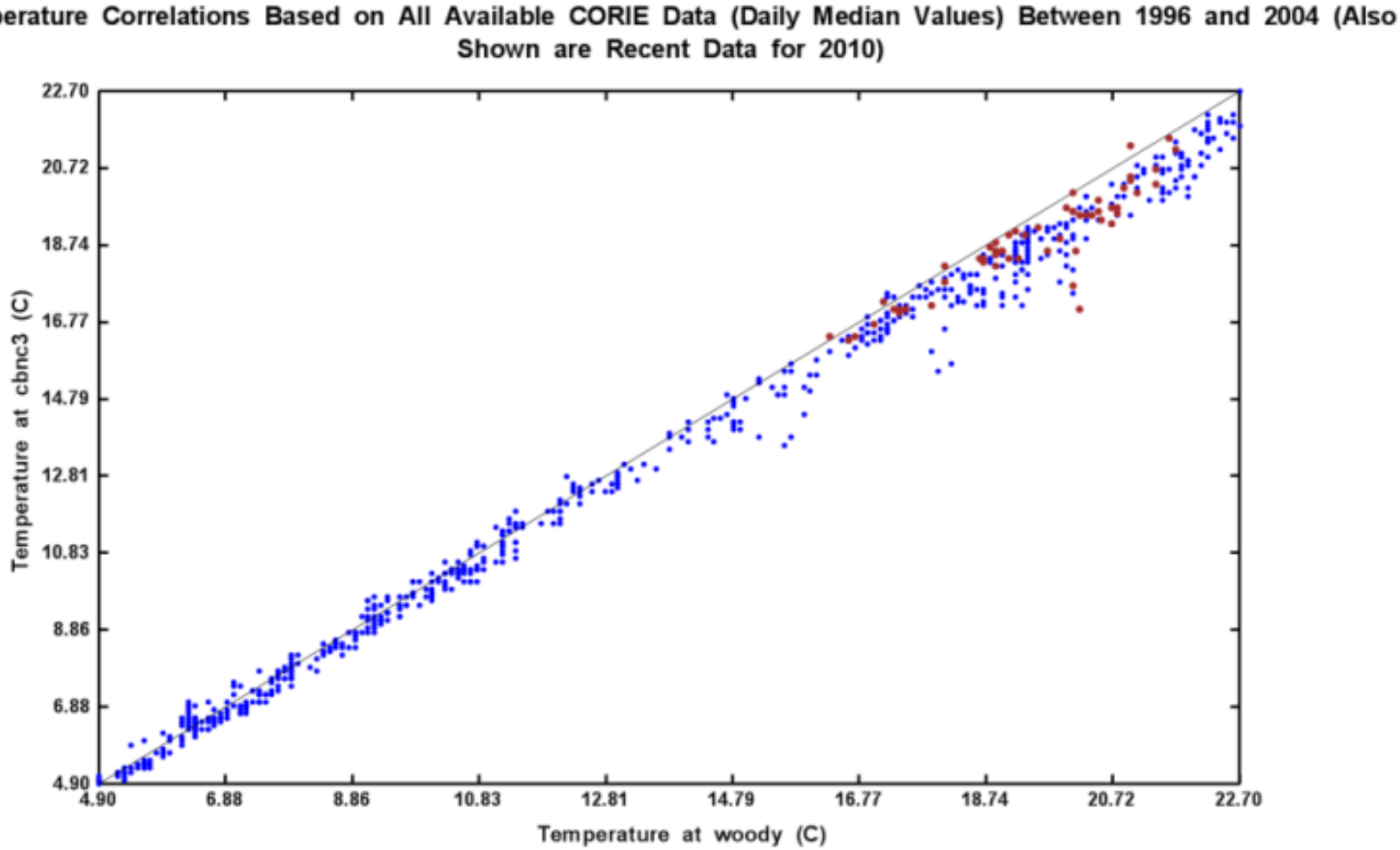


Figure 2-2.2. Median daily water temperatures for (a) tansy, (b) grays, and (c) cbnc3 stations plotted for 2010 against median daily water temperatures for the "woody" station.

2-3 Salinity

MA-1 importantly includes an analysis of potential Project construction impacts on salinity values in the LCR and estuary. The analyses are based on the CORIE data and performed and presented in a manner analogous to those previously presented for water temperatures. The issue of concern for salinity is that channel modifications might increase the likelihood of salt water intrusions and elevate salinity values, which can impact habitat quality for juvenile salmon. Figure 2-3.1 (a,b,c) presents the daily median values of salinity measured in 2010 at the three MA-1 sampling locations: (tansy, grays and cbnc3). The corresponding decision criteria developed from pre-Project salinity data (i.e., 1996–2004) by the AMT are also plotted for convenient comparison with the monitoring results. Importantly, the plotted results also identify periods when data were not available from the monitoring stations.

Similar to previous years of monitoring, the greatest variations in daily median salinity values were observed for tansy in 2010 (Figure 2-3.1a). Daily values ranged from near 0.7 to ~26 practical salinity units (psu) during the 2010. This station is strongly influenced by tidal flows (Figure 2-3.1a). The greatest ranges of within-month values occurred in January–March and October in 2010. Data were not available for December. Despite these daily variations, the monthly mean salinity values reported for tansy did not exceed the 5th–95th percentile decision criteria during 2010. All but one (June) of the monthly average median values were within the 20th–80th percentile decision criteria.

Daily median salinity values reported in 2010 for the grays station are illustrated in Figure 2-3.1b. Data were not available for January and February. Daily median salinity values ranged from ~0 to 6 psu during 2010. Daily values exceeded the 95th percentile decision criteria for two days in March. The daily median values were within the decision criteria for the remainder of 2010 (Figure 2-3.1b).

The 2010 daily median salinity values for the cbnc3 station exceeded the 95th percentile decision criteria for several days during January through April, as well as one day in July (Figure 2-3.1c). The daily median values were mainly near zero for most of the year. Higher values were determined during July through September. Salinity data were not available for cbnc3 for October–December 2010.

Data for dsdma, the salinity reference station, were not available for the same days that salinity values were reported for the grays station and the corresponding normalized salinity plots could not be generated for the January–March 2010 reporting period. Corresponding sample dates occurred for the dsdma (reference station) and tansy and cbnc3 for the April–June 2010 reporting period. Normalized salinity plots were developed for these stations. However, concurrent sample dates for salinity were not available for grays and dsdma during the April–June reporting period. However, normalized salinity plots were developed for all three stations using the July–September 2010 data. Consistent with the results of previous years MA-1 monitoring (e.g., 2005–2009), the values of salinity associated with these three stations do not appear to deviate in any compelling way from the clusters of points defined by the pre-Project data. The normalized plots for tansy (Figure 2-3.2a), grays (Figure 2-3.2b), and cbnc3 (Figure 2-3.2c) based on available data in 2010 indicated that the values were within the pre-Project cluster of data points.

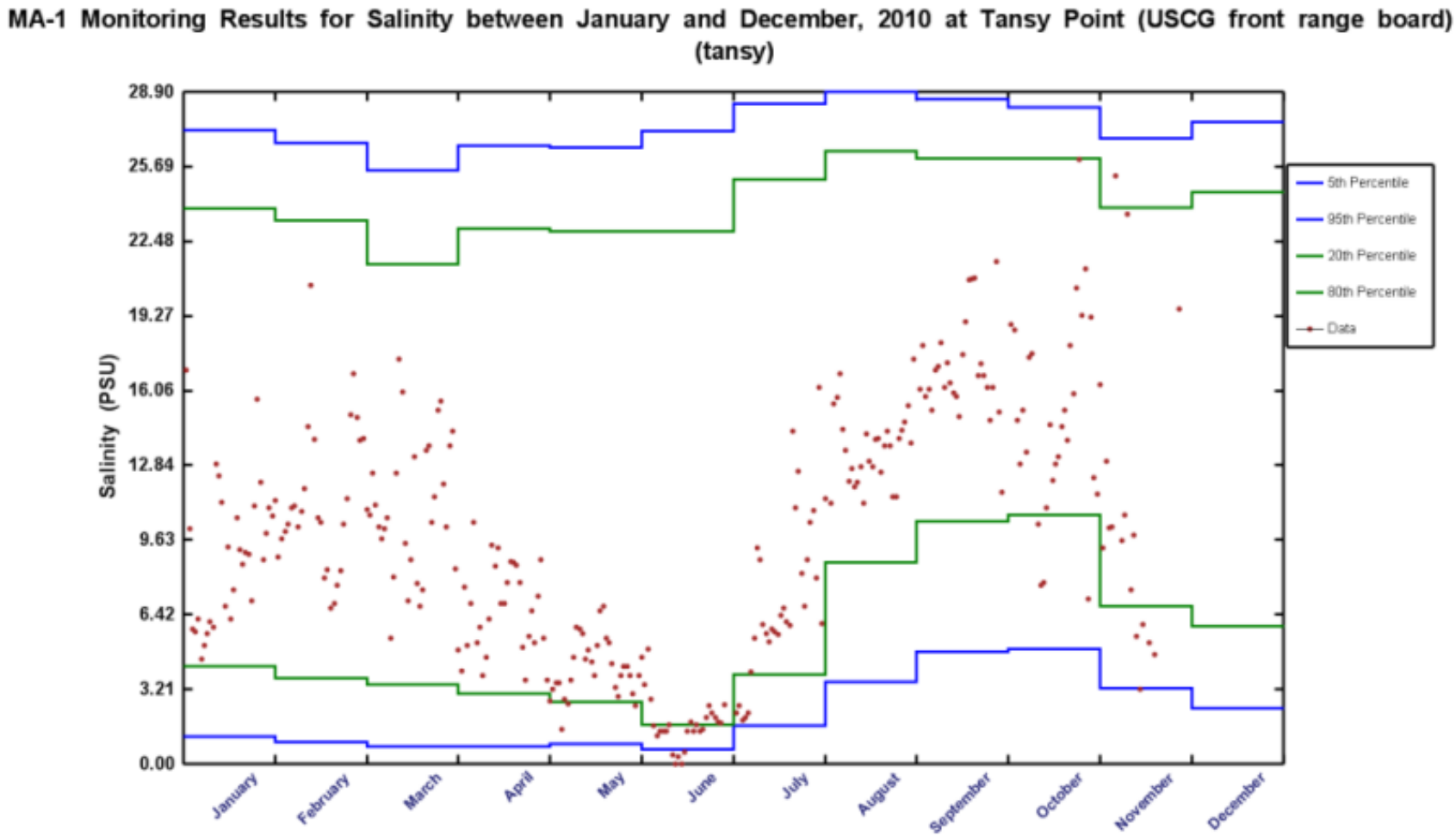
Tables 2-3.1–2-3.3 list the monthly median salinity values calculated for 2010 and the decision criteria developed by the AMT for MA-1. Despite the variations in the daily median values, the 2010 monthly average salinity values for tansy were within the 20th–80th percentile decision criteria, except for June (Table 2-3.1). The June value was 0.1 psu lower than the decision value and was well within the 5th–20th percentile criterion.

The average monthly values for the grays station did not suggest any issues concerning saltwater intrusion in relation to Project construction (Table 2-3.2). Monthly values were within the 20th–80th percentile criteria for five of the 10 months for which data were available in 2010. The remaining monthly values were ~zero or within the lower salinity criteria (i.e., 5th–20th percentile values).

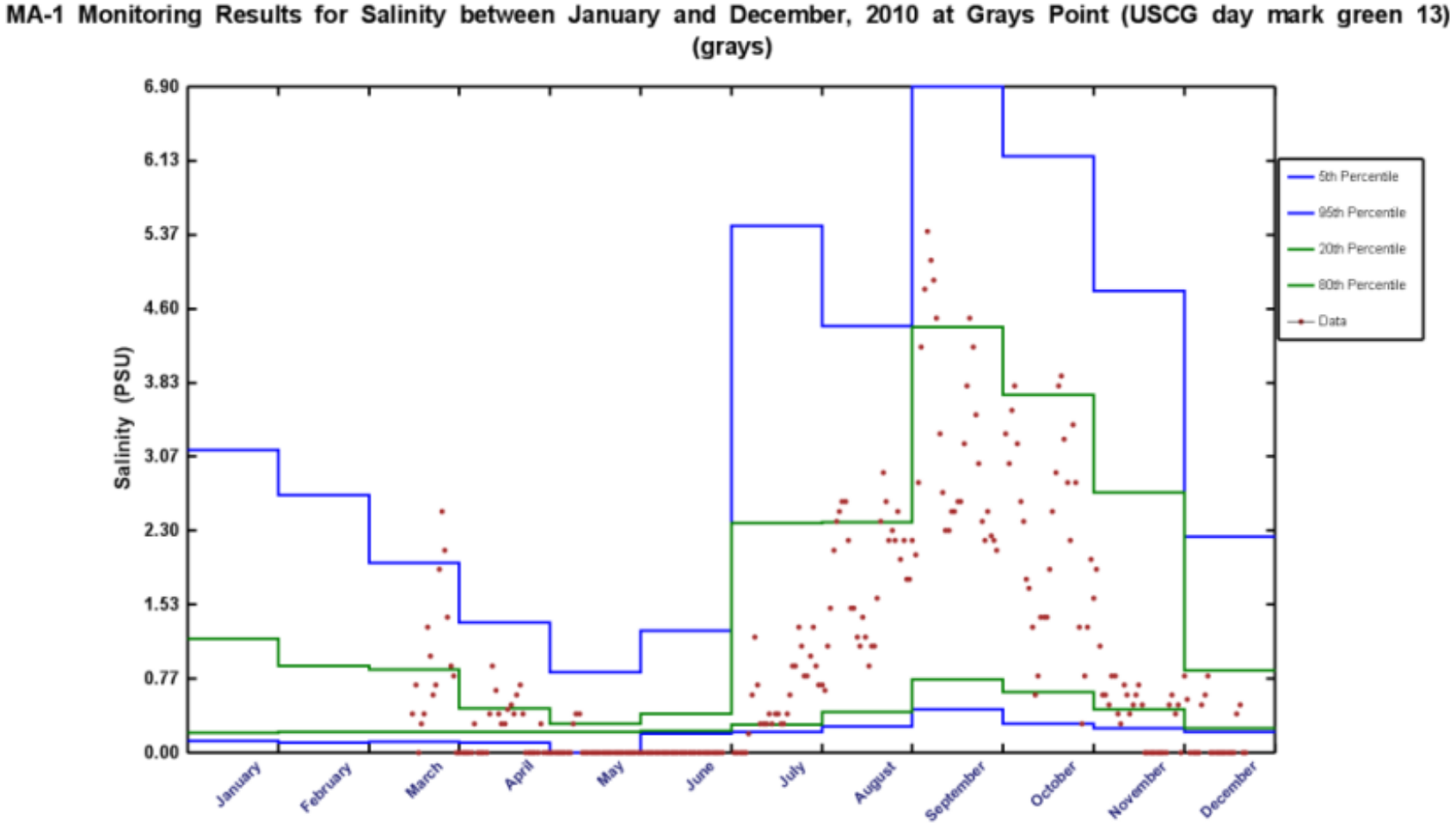
Based on the available 2010 data, monthly average salinity values for cbnc3 were ~zero or within the 20th–80th percentile decision criteria (Table 2-3.3). The 2010 results fail to demonstrate any evidence of saltwater intrusion or other impacts on salinity for this sampling location.

The MA-1 monitored salinity results for 2010 are consistent with those of the temperature data analysis and further suggest that the Project construction was producing no measurable impact on salinity at these three station locations in the LCR and estuary.

(a)


MA-1 Monitoring Results for Salinity between January and December, 2010 at Tansy Point (USCG front range board) (tansy)
Salinity (PSU)
28.90
25.69
22.48
19.27
16.06
12.84
9.63
6.42
3.21
0.00
January
February
March
April
May
June
July
August
September
October
November
December
5th Percentile
95th Percentile
20th Percentile
80th Percentile
Data

(b)


MA-1 Monitoring Results for Salinity between January and December, 2010 at Grays Point (USCG day mark green 13) (grays)
Salinity (PSU)
6.90
6.13
5.37
4.60
3.83
3.07
2.30
1.53
0.77
0.00
January
February
March
April
May
June
July
August
September
October
November
December
5th Percentile
95th Percentile
20th Percentile
80th Percentile
Data

(c)

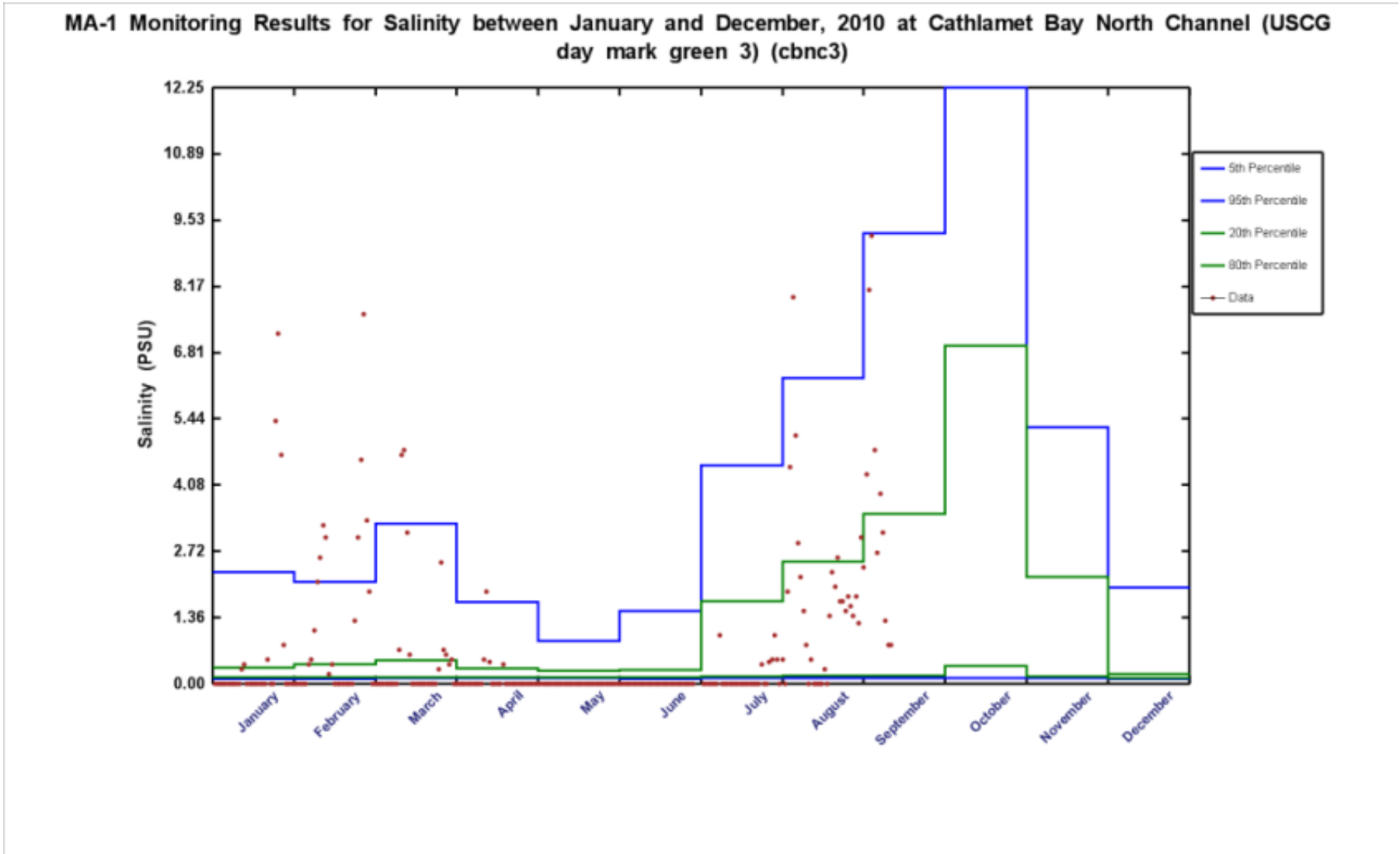
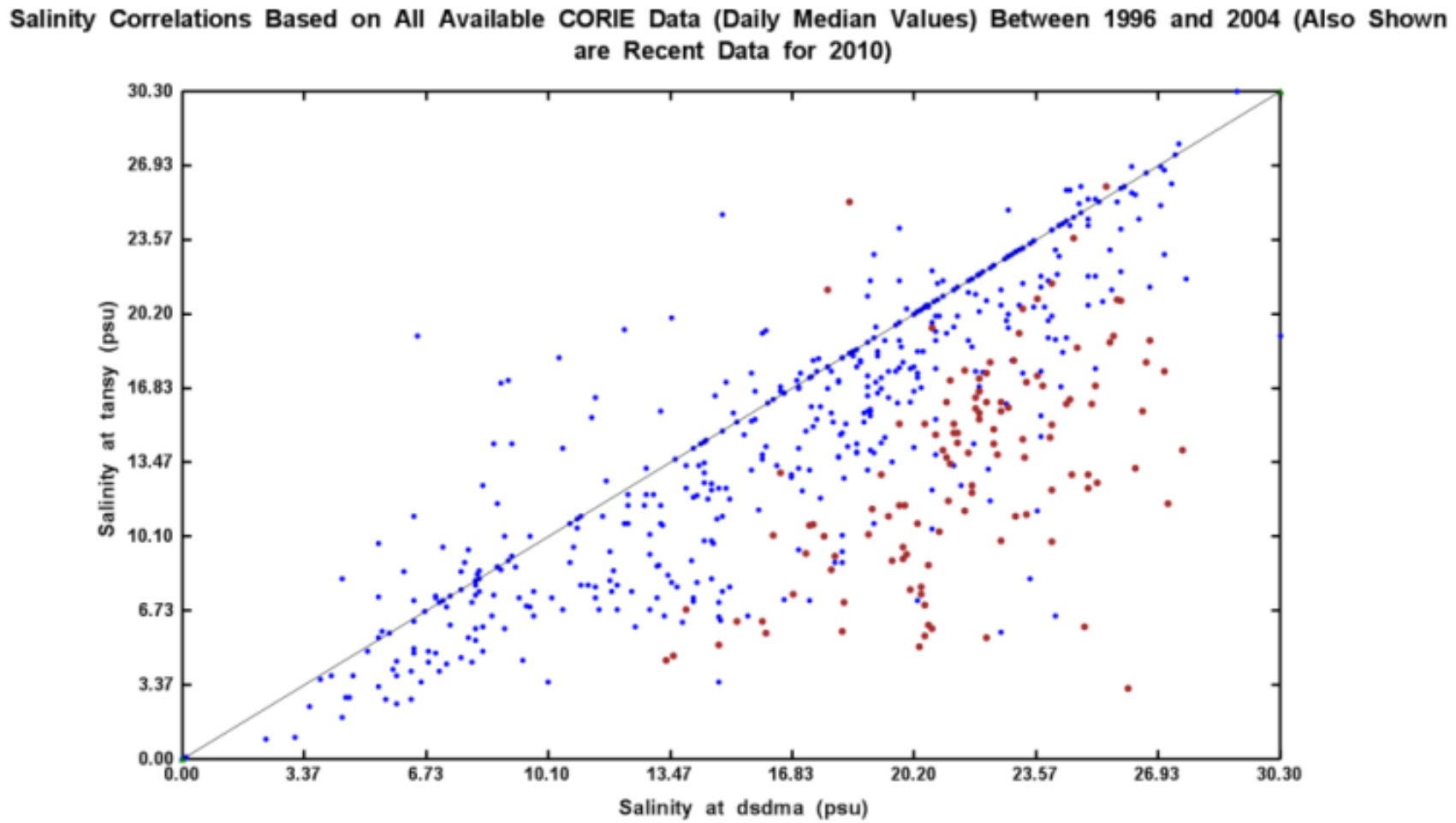
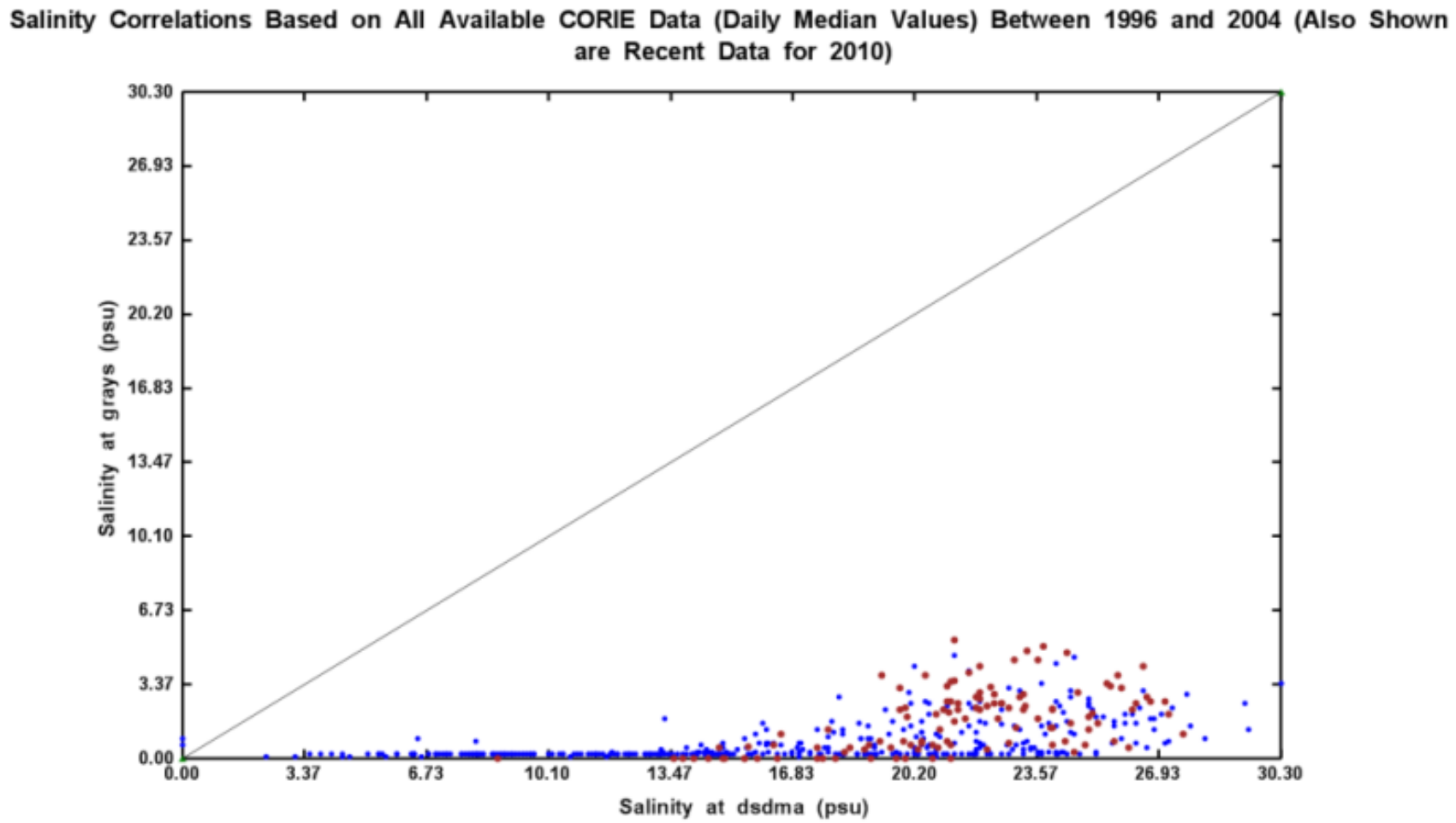


Figure 2-3.1. Daily median values of salinity for (a) tansy, (b) grays, and (c) cbnc3 sampling stations for 2010 plotted in relation to the CRCIP AEM decision criteria.

(a)


Salinity Correlations Based on All Available CORIE Data (Daily Median Values) Between 1996 and 2004 (Also Shown are Recent Data for 2010)
Salinity at tansy (psu)
Salinity at dsdma (psu)
0.00
3.37
6.73
10.10
13.47
16.83
20.20
23.57
26.93
30.30

(b)


Salinity Correlations Based on All Available CORIE Data (Daily Median Values) Between 1996 and 2004 (Also Shown are Recent Data for 2010)
Salinity at grays (psu)
Salinity at dsdma (psu)
0.00
3.37
6.73
10.10
13.47
16.83
20.20
23.57
26.93
30.30

(c)

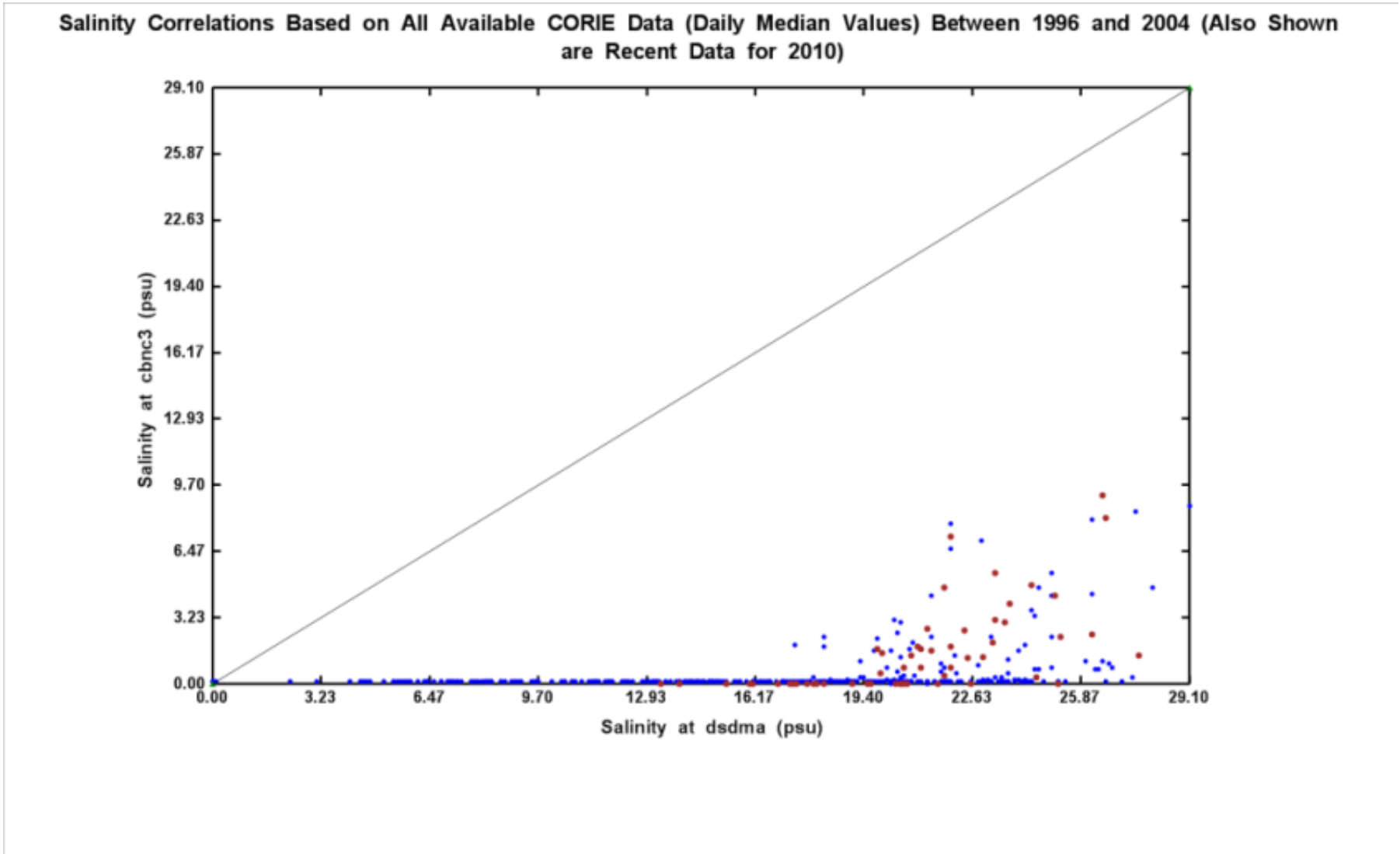


Figure 2-3.2. Daily median values of salinity for (a) tansy, (b) grays, and (c) cbnc3 sampling stations for 2010 plotted in relation to values for the dsdma station.

Table 2-3.1. Summary of 2010 Monthly Median Salinity Values (bold numbers) for tansy Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	1.2	0.9	0.7	0.7	0.9	0.4	1.6	3.5	4.8	5.9	3.3	2.4
						1.6						
20	4.2	3.7	3.4	3.0	2.7	1.7	3.8	8.7	10.4	10.7	6.8	5.9
	9.1	**11.7**	**11.1**	**6.3**	**4.3**		**6.7**	**13.1**	**16.8**	**14.9**	**9.1**	**No data**
80	23.9	23.4	21.5	23.0	22.9	22.9	24.1	26.3	26.0	26.0	23.9	24.6
95	27.3	26.7	25.5	26.6	26.5	27.2	28.4	28.9	28.6	28.0	26.9	27.6

Table 2-3.2. Summary of 2010 Monthly Median Salinity Values (bold numbers) for grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
				0	**0**	**0**						**0**
5	0.2	0.2	0.2	0.2	0.0	0.2	0.3	0.3	0.5	0.4	0.3	0.3
											0.4	
20	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.8	0.7	0.5	0.3
	No data	**No data**	**0.8**				**0.4**	**1.7**	**3.3**	**2.0**		
80	1.2	0.8	0.8	0.7	0.7	0.7	2.4	2.4	4.4	3.7	2.7	0.8
95	3.1	2.7	2.0	1.4	0.8	1.3	5.5	4.4	6.9	6.2	4.8	2.2

Table 2-3.3. Summary of 2010 Monthly Median Salinity Values (bold numbers) for cbnc3 Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
	0		**0**	**0**	**0**	**0**	**0**					
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
20	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.2	0.2
		0.4						**0.8**	**3.3**	**No data**	**No data**	**No data**
80	0.7	0.7	0.7	0.7	0.7	0.7	1.7	2.5	3.5	7.0	2.2	0.7
95	2.3	2.1	3.3	1.7	0.9	1.5	4.5	6.3	9.3	12.3	5.3	2.0

2-4 Columbia River Discharge

The collation and analysis of the Bonneville Dam discharge data continued through 2010 as the data became available (Figure 2-4.1). Potential outlier values of temperature and salinity observed at the MA-1 stations during the AEM Program have been related to changes in river flows. The seasonal pattern indicates that spring and autumn discharges for 2010 tended towards the lower values defined by the 1996–2004 pre-Project discharges. The late spring and early summer discharges for 2010 were consistent with the approximately average values recorded during the pre-Project years. The year of 2010 appeared overall to be characterized by average (mid-year) to low (spring and autumn) flows compared to the pre-Project baseline.

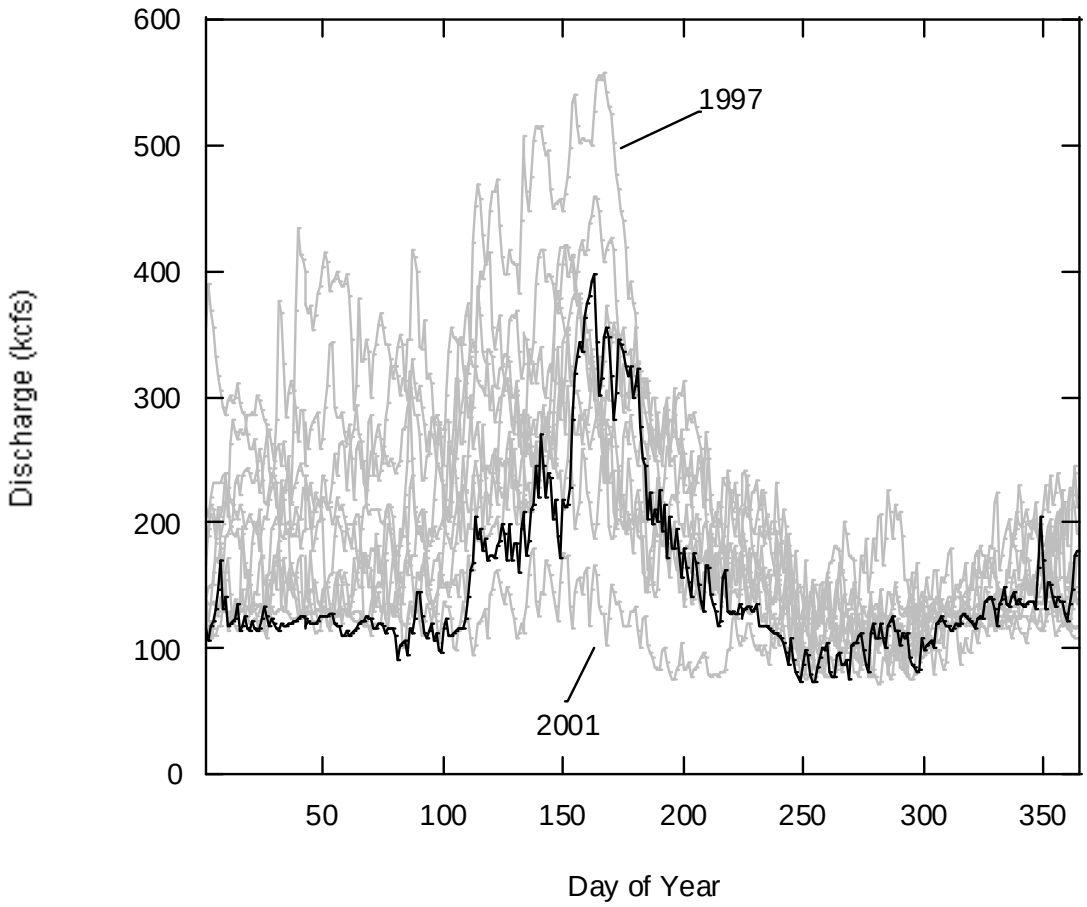


Figure 2-4.1. Daily flow values recorded at Bonneville Dam for calendar year 2010 (solid black line). Light gray lines show pre-Project (baseline) values for 1996–2004. (Data: Columbia Basin Fishery Agencies and Tribes http://www.fpc.org/river/flowspill/FlowSpill.asp).

2-5 AMT Decisions for MA-1

Table 2-5.1 summarizes the key discussions and decisions made by the AMT during the course of the quarterly meetings in relation to MA-1 monitoring and MA-1 monitoring results through calendar 2010.

Table 2-5.1. CRCIP AEM Plan Record of AMT MA-1 Decisions.

Date	Issue	MA-1 Decisions	Comments
16 Dec 2004	**MA-1**	Compare with different monthly confidence intervals (CI) (e.g., 70, 80, 90 percentiles).	
16 Dec 2004	**MA-1**	Develop plots of daily mean values against the CI.	
16 Dec 2004	**MA-1**	Add state water quality standards (e.g., temperature for Washington and Oregon).	
16 Dec 2004	**MA-1**	Produce plots in "real time" as data quality assurance/quality control process permits.	
16 Dec 2004	**MA-1**	Make plots (analyses) available to AMT via file transfer protocol (FTP) site-daily values posted every 1–5 days.	
16 Dec 2004	**MA-1**	At the end of each month, calculate monthly average and compare to the monthly CI values	
16 Dec 2004	**MA-1**	Meet monthly during construction phase to evaluate consensus on criteria.	
14 Jun 2005	**MA-1**	The team tentatively agreed to the water elevation decision criteria. The Science Center http://www.nwr.noaa.gov/ should have the opportunity to review the proposed criteria.	
21 Jun 2005	**MA-1**	Concerns were expressed that cbnc3 had incomplete data and that the Marsh station would provide better data. The cbnc3 station was selected because of the location (channel into Cathlamet Bay) and would be a good indicator of changes that could affect the bay. The Marsh station is too far upstream and would likely not show any changes in salinity or temperature from the deepening. The cnbc3 location is also important for connectivity and conductivity. (NMFS) agreed with the stated rationale for the selection of cbnc3.	
28 Jun 2005	**MA-1**	The team discussed the desire by WDOE and ODEQ to substitute cbnc3 for one of the other close proximity CORIE stations (e.g., Marsh), because of the limited historical data availability and it's susceptibility to bio-fouling. However, the change was not agreed to by the AMT and as a result the cbnc3 data that were interpolated will be flagged.	
28 Jun 2005	**MA-1**	At the last meeting, Cathy Tortorici (NMFS) was going to talk to the Science Center about the water elevation decision criteria. She stated that she was waiting for an e-mail back from Ed Castillas. She stated that Ed talked with Antonio Baptista who stated that the evaluation criteria were too broad and we would not to be able detect change. The USACE agreed to have a conference call between Steve Bartell, Antonio Baptista and Shyam Nair to discuss these concerns.	
28 Jun 2005	**MA-1**	Sample sizes will be added to the WA-1 tables. The numbers in the tables will be revised and presented to the 10th decimal point. Corrections to the salinity calculations (i.e., binning errors) will be included in the revised tables. Any reference to real-time data needs to be taken out of the decision criteria document. WDOE and ODEQ also requested that the depth at which each CORIE station is monitored is included in each data table provided to the AMT.	

Table 2-5.1. CRCIP AEM Plan Record of AMT MA-1 Decisions. (Continued).

Date	Issue	MA-1 Decisions	Comments
22 Aug 2005	**MA-1**	There was discussion of the normalization of daily median water temperature data for selected CORIE stations to daily median water temperature data for the "woody" sampling location. Temperature values at the woody station are largely determined by river flows. These normalizations have been summarized by simply plotting the data from selected stations against the woody data. Deviations from a linear relationship suggest increasing influence of ocean water on temperature. The suggestion is that alterations in circulation within the estuary due to channel modifications might be indicated by changes in the relations summarized in the plots.	
31 Aug 2005	**MA-1 Decision Criteria**	All agencies concurred on the triggers for MA-1. Two trigger tables will be developed showing triggers values set between the 5th–90th percentile and the 20th–80th percentile. Median daily water temperature values for the three MA-1 CORIE stations will also be plotted against corresponding values for the woody station. The data will be evaluated quarterly for the first year and/or after each contract for channel modifications starting October 12, 2005. These data will be reviewed and summarized annually.	
31 Aug 2005	**MA-1 Decision Criteria**	The group also agreed that if one of the stations being used breaks down, one of the other stations close to the unavailable station will be used as a surrogate, if possible.	
1 Sep 2005	**MA-1 Data Analysis**	E2 (Steve Bartell) will be responsible for analyzing and summarizing the MA-1 data.	
12 Oct 2005	**MA-1 Data Analysis**	Based on the results for depth, temperature, and salinity presented at the AMT meeting, the AMT concluded that adaptive management would not be initiated.	
12 Oct 2005	**MA-1 Data Analysis**	The AMT requested that normalized salinity plots be developed by E2 for the three MA-1 monitoring stations.	
11 Jan 2006	**MA-1 Salinity Plots**	E2 developed salinity plots for the three MA-1 stations and several candidate reference stations. After examining the results of these plots, the AMT agreed that the Desdemona station appeared to provide the best relationship between values of median daily salinity. The AMT concluded that these kinds of normalized salinity plots should become part of the Adaptive Management Process (AMP) and used in the same way as the normalized temperature plots.	
12 Apr 2006	**MA-1 Data Analysis**	Based on the results for depth, temperature, and salinity presented at the AMT meeting, the AMT concluded that adaptive management would not be initiated.	
12 Apr 2006	**Columbia River flow data**	The AMT requested that summaries of flow data be provided to assist in the interpretation of depth, temperature, and salinity data.	
12 Apr 2006	**MA-1 Current Velocity Data**	The AMT asked that the availability of current velocity data be reexamined in relation to MA-1 assessments of changes in physical habitat that might be associated with the CRCIP construction.	
11 Oct 2006	**MA-1 Data Analysis**	The AMT requested that the MA-1 analyses be performed in a timely manner. (This is largely determined by the availability of the data provided by CORIE.)	
10 Jan 2007	**MA-1 Data Analysis**	CORIE and the USACE have agreed that the verified MA-1 data will be available for public download and analyses 30 days after the end of a sampled month. This will essentially introduce a one-month time lag in the reporting of the CORIE analyses to the AMT.	
11 Apr 2007	**MA-1 CORIE Analyses**	Several January and February temperature and salinity values will be examined in relation to river flows and local climate data.	

Table 2-5.1. CRCIP AEM Plan Record of AMT MA-1 Decisions. (Continued).

Date	Issue	MA-1 Decisions	Comments
11 Jul 2007	**MA-1 CORIE Analyses**	No management decisions were required for MA-1.	
3 Oct 2007	**MA-1 CORIE Analysis**	Recommendations were made to examine alternative stations for red26, which has been lost from the CORIE network. Data for dsdma and tansy stations will be analyzed.	
9 Jan 2008	**MA-1 CORIE Analyses**	Analysis of salinity data for tansy station suggest that tansy can be substituted for red26 (which is out of service). Salinity outlier values for cbnc3 in January 2008 will be examined in relation to local climate and river flow data.	
29 Apr 2008	**MA-1 CORIE Analyses**	No decisions were made in relation to the CORIE analysis.	
9 Jul 2008	**MA-1 CORIE Analyses**	No decisions were made in relation to the CORIE analysis.	
8 Oct 2008	**MA-1 CORIE Analyses**	E2 will explore possible reasons to explain the variations in temperature observed in late May and early June.	
14 Jan 2009	**MA-1 CORIE Analyses**	No decisions were made concerning the MA-1 results at the January 2009 meeting.	
8 Apr 2009	**MA-1 CORIE Analyses**	The AMT decided to continue using publicly available CORIE data that have been through the CORIE quality assurance/quality control process.	
8 Jul 2009	**MA-1 CORIE Analyses**	Monitoring results for depth, temperature, and salinity were within the monthly decision criteria for MA-1.	
18 Nov 2009	**MA-1 CORIE Analyses**	Monitoring results for depth, temperature, and salinity were within the monthly decision criteria for MA-1.	
18 Nov 2009	**MA-1 CORIE Analyses**	The AMT decided by consensus that MA-1 monitoring activities should continue according to the terms and conditions specified in the Biological Opinion.	
20 Jan 2010	**MA-1 CORIE Analyses**	No decisions were made concerning the MA-1 results reported at the January 20 meeting. E2 will follow up on obtaining additional temperature data not currently reported for the grays station.	
14 Apr 2010	**MA-1 CORIE Analyses**	No decisions were made concerning the MA-1 results reported at the April 14 meeting. E2 will follow up on obtaining additional temperature data not currently reported for the grays station.	
14 Jul 2010	**MA-1 CORIE Analyses**	No decisions were made concerning the MA-1 results reported at the July 14 meeting. E2 will follow up on obtaining additional temperature data not currently reported for the grays station.	
13 Oct 2010	**MA-1 CORIE Analyses**	No decisions were made concerning the MA-1 results reported at the October 13 meeting.	

3 Monitoring Action 2—Dredging Volumes

MA-2 tracks and reports annual dredging volumes and their disposal associated with construction and operation of the 43-foot navigation channel.

3-1 Volumes of Dredged Materials

Volumes are reported for each dredging bar (~3-mile reaches). Adaptive management can be triggered if actual construction volumes exceed projected volumes (e.g., Table 3-1.1). In addition, the adaptive component of the proposed AEM Plan might be initiated if the volumes of dredged materials exceed the capacity for disposal. Volumes and disposal of O&M dredging are also tracked in relation to the Project. These three aspects of Project construction contribute to decision-making concerning adaptive management based on the MA-2 results.

Early Project construction included work at Desdemona, Flavel Bar, Upper Sands, Willow Bar, Morgan Bar, and Lower Vancouver. Construction in 2008 occurred at Tongue Point Crossing, Miller Sands, Pillar Rock, Brookfield Welch, Wauna-Driscoll (WAN), Westport Bar, Stella Fisher, Walker Island, Lower Dobelbower, Upper Dobelbower (UDB), Kalama Bar, Lower and Upper Martin Bar, St. Helens, Warrior Rock, Henrici Bar, Willow Bar, Morgan Bar, Lower Vancouver, and the Vancouver Turning Basin. Project construction in 2010 focused mainly on rock removal near St. Helens and Longview, and remaining dredging at Pillar Rock and Stella-Fisher. Several additional locations that required removal of hard materials by dredging were also part of construction activities in 2010.

The original construction volume was projected as the volume of material above 48 feet, and was approximately 19 million cys, e.g., 2001 Biological Assessment (USACE 2001). The projected volume of new work was estimated as the material between 45–48 feet, and totaled 14,473,613 cys (Table 3-1.1).

The overall Project new work volume was calculated as 19,088,483 cys, which is approximately 32% greater than the original estimated new work volume (Table 3-1.1). As explained in the 2009 annual report, the CRCIP new work quantities in the spreadsheet include quantity removed between 45 and 48 feet, but also quantity removed above 45 feet if there would have been no O&M of the 40 feet channel in the area at the time of deepening, and quantity removed below 48 feet in rock removal areas, which were deepened to 51 feet.

Phase 1 construction removed approximately 2,572,851cys, Phase 2 Project construction removed approximately 4,308,232cys, Phase 3 removed 11,462,014cys, and Phase 4 construction removed approximately 4,434,587cys.

The projected O&M volume was estimated as the quantity above 45 feet, but the actual O&M volume in the spreadsheet is calculated as the total quantity which would have been removed as part of O&M of the 40 feet channel at the time of deepening, as well as all O&M of the 43 feet channel after deepening.

The results indicate that the actual required dredging varied from the volumes originally forecasted for many of the reaches. This can be explained in part because the acceptance areas chosen for deepening did not match up with the limits of the CRM/shoals used for the initial construction estimate. Also, sand waves of material often move between shoals and quantities vary greatly by year and with changing flow rates in the river. Therefore, Table 3-1.1 should be more realistically interpreted as a bottom line number rather than shoal-by-shoal comparisons.

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2010.

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft) Volume	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-4		**Lower Desdemona**	04+20+00	04+00+00	317,100	222,412	94,688	3,894	78,755	DWS/IW
				05+00+00	550,640	353,916	196,724			
CL-5		**Upper Desdemona**	06+22+00	06+00+00	66,193	0	66,193	22,704	43,457	DWS
	Predicted Bar New Construction Volume =	473,894		07+00+00	1,039	0	1,039			
	Actual Bar New Construction Volume =	26.598		8+00+00	61,140	8,742	52,398			
	Percentage of Prediction =	6%		9+00+00	71,593	8,742	62,851			
CL-9		**Flavel Bar**	10+00+00	10+00+00	379,028	49,732	329,296	337,154	0	DWS/IW
	Predicted Bar New Construction Volume =	1,169,720		11+00+00	833,973	298,900	535,074	241,059	1,157,548	DWS
	Actual Bar New Construction Volume =	680,593		12+00+00	360,900	121,292	239,608	38,373	18,000	DWS/IW
	Percentage of Prediction =	58%		13+00+00	138,168	72,425	65,743	64,007	40,000	DWS/IW
CL-14		**Upper Sands**	13+30+00	14+00+00	226,017	54,585	171,432	102,699	280,443	DWS/IW
	Predicted Bar New Construction Volume =	858,622		15+00+00	323,787	51,945	271,842	202,911	694,245	DWS/IW
	Actual Bar New Construction Volume =	458,550		16+00+00	354,274	47,557	306,717	152,940	0	DWS/IW
	Percentage of Prediction =	53%		17+00+00	108,631	0	108,631			
CL-18		**Tongue Point Crossing**	17+28+00	18+00+00	188,889	14,775	174,113	165,325	200,179	IW
	Predicted Bar New Construction Volume =	464,196		19+00+00	169,841	6,976	162,864	207,932	371,250	IW
	Actual Bar New Construction Volume =	657,424		20+00+00	140,502	13,283	127,219	284,167	533,179	IW
	Percentage of Prediction =	142%								
CL-21		**Miller Sands**	21+20+00	21+00+00	220,662	48,572	172,090	233,323	2,033,262	DWS/IW
	Predicted Bar New Construction Volume =	457,860		22+00+00	536,271	397,564	138,706	241,015		DWS
	Actual Bar New Construction Volume =	906,823		23+00+00	16,212	2	16,210	116,866		DWS/BN

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2010. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft) Volume	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
	Percentage of Prediction =	198%		24+00+00	168,189	37,335	130,854	315,619		DWS/IW
CL-26		**Piller Rock**	25+10+00	25+00+00	384,769	112,426	272,344	194,323	262,213	DWS/IW
	Predicted Bar New Construction Volume =	449,324		26+00+00	171,408	44,197	127,211	55,796	0	IW
	Actual Bar New Construction Volume =	994,958		27+00+00	56,322	6,553	49,769	744,839	496,559	IW
	Percentage of Prediction =	221%								
CL-28		**Brookfield Welch**	28+40+00	28+00+00	193,261	28,356	164,905	191,091	286,637	UP/IW
	Predicted Bar New Construction Volume =	404,150		29+00+00	224,225	64,782	159,443			IW
	Actual Bar New Construction Volume =	191,091		30+00+00	89,561	23,615	65,947			
	Percentage of Prediction =	47%		31+00+00	40,513	26,657	13,855			
CL-33		**Skamokawa Bar**	32+30+00	32+00+00	167,896	31,955	135,941	243,063	243,063	UP/IW
	Predicted Bar New Construction Volume =	735,819		33+00+00	651,852	455,132	196,720			
	Actual Bar New Construction Volume =	568,502		34+00+00	90,709	9,367	81,342	325,439	700,955	IW
	Percentage of Prediction =	77%		35+00+00	358,874	37,059	321,816			
CL-36		**Puget Island**	36+31+00	36+00+00	17,288	354	16,934			
	Predicted Bar New Construction Volume =	522,842		37+00+00	162,466	17,838	144,628	610,292	578,480	IW
	Actual Bar New Construction Volume =	610,292		38+00+00	374,599	54,709	319,889			
	Percentage of Prediction =	117%		39+00+00	46,331	4,940	41,391			
CL-40		**Wauna–Driscoll**	40+40+00	40+00+00	164,427	26,349	138,077	258,062	538,749	IW
	Predicted Bar New Construction Volume =	860,535		41+00+00	226,584	40,230	186,354			
	Actual Bar New Construction Volume =	582,067		42+00+00	323,422	84,593	238,829	330,034	274,933	IW
	Percentage of Prediction =	68%		43+00+00	375,149	77,874	297,275			

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2010. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft) Volume	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-44		**Westport Bar**	44+27+00	44+00+00	251,076	32,800	218,276	927,116	2,541,275	Rehandled UP
	Predicted Bar New Construction Volume =	1,146,351		45+00+00	458,268	67,950	390,318			
	Actual Bar New Construction Volume =	927,116		46+00+00	285,678	26,341	259,337			
	Percentage of Prediction =	81%		47+00+00	338,946	60,526	278,420			
CL-50		**Eureka Bar**	48+10+00	48+00+00	200,332	41,415	158,918		337,666	
	Predicted Bar New Construction Volume =	229,554		49+00+00	73,575	4,751	68,824			
	Actual Bar New Construction Volume =	0		50+00+00	1,812	0	1,812			
	Percentage of Prediction =	0%		51+00+00	0	0	0			
CL-54		**Gull Island**	51+45+00	52+00+00	0	0	0			
	Predicted Bar New Construction Volume =	18,623		53+00+00	0	0	0			
	Actual Bar New Construction Volume =	174,379		54+00+00	19,107	485	18,623	174,379	87,296	IW
	Percentage of Prediction =	936%								
CL-56		**Stella Fisher**	55+30+00	55+00+00	9,824	0	9,824			
	Predicted Bar New Construction Volume =	594,677		56+00+00	181,756	34,201	147,554	683,050		
	Actual Bar New Construction Volume =	1,679,442		57+00+00	31,463	0	31,463			
	Percentage of Prediction =	282%		58+00+00	543,065	137,229	405,836	996,392	232,308	IW/UP
CL-59		**Walker Island**	59+22+00	59+00+00	95,243	15,759	79,484			
	Predicted Bar New Construction Volume =	209,676		60+00+00	82,387	3,116	79,270	146,009	170,277	IW
	Actual Bar New Construction Volume =	146,009		61+00+00	20,432	296	20,136			
	Percentage of Prediction =	70%		62+00+00	32,466	1,679	30,787			
CL-64		**Slaughters Bar**	63+10+00	63+00+00	195,190	15,000	180,190	1,015,926	253,982	UP/IW
	Predicted Bar New Construction Volume =	1,179,942		64+00+00	304,956	30,000	274,956			

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2010. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft)	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-64		**Slaughters Bar**	63+10+00	63+00+00	195,190	15,000	180,190	1,015,926	253,982	
	Predicted Bar New Construction Volume =	1,179,942		64+00+00	304,956	30,000	274,956			
	Actual Bar New Construction Volume =	3,390,387		65+00+00	338,641	67,058	271,583	2,374,461	0	
	Percentage of Prediction =	287%		66+00+00	561,173	107,960	453,213			
CL-67		**Lower Dobelbower**	67+06+00	67+00+00	192,962	54,691	138,271	310,697	509,106	UP/IW
	Predicted Bar New Construction Volume =	187,741		68+00+00	3,116	16	3,100	188,968	156,713	IW/UP
	Actual Bar New Construction Volume =	499,665		69+00+00	46,386	16	46,370			
	Percentage of Prediction =	266%								
CL-67		**Upper Dobelbower**	69+50+00	70+00+00	194,244	34,134	160,110	273,024	198,575	UP
	Predicted Bar New Construction Volume =	187,381		71+00+00	12,900	0	12,900			IW/UP
	Actual Bar New Construction Volume =	401,285		72+00+00	14,371	0	14,371	128,261	360,440	UP/IW
	Percentage of Prediction =	214%								
CL-73		**Kalama Bar**	72+40+00	73+00+00	115,482	0	115,482			
	Predicted Bar New Construction Volume =	307,268		74+00+00	78,329	5,381	72,948	143,777	48,633	IW/UP
	Actual Bar New Construction Volume =	348,638		75+00+00	135,429	16,591	118,838	204,861	106,035	IW/UP
	Percentage of Prediction =	113%								
CL-78		**Lower Martin Bar**	76+25+00	76+00+00	406,832	125,671	281,161	260,042	166,914	IW/UP
	Predicted Bar New Construction Volume =	654,718		77+00+00	169,712	14,880	154,833	159,112	0	UP
	Actual Bar New Construction Volume =	762,491		78+00+00	5,860	39	5,821	343,337	92,093	IW/UP
	Percentage of Prediction =	116%		79+00+00	281,891	68,988	212,903			IW/UP
CL-78		**Upper Martin Bar**	80+16+50	80+00+00	168,158	18,927	149,231	296,815	166,909	IW/UP
	Predicted Bar New Construction Volume =	409,017		81+00+00	68,884	22,936	45,948	142,936	0	IW/UP
	Actual Bar New Construction Volume =	736,649		82+00+00	226,583	12,745	213,838	296,898	515,062	IW/UP
	Percentage of Prediction =	180%								

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2010. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft)	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-84		**St. Helens**	83+44+00	83+00+00	113,920	8,610	105,311	186,561	51,675	IW/UP
	Predicted Bar New Construction Volume =	451,717		84+00+00	60,424	7,337	53,087	124,405	394,298	IW/UP
	Actual Bar New Construction Volume =	562,567		85+00+00	97,614	3,681	93,933	98,635		IW/UP
	Percentage of Prediction =	125%		86+00+00	268,809	69,223	199,386	152,966		IW/UP
CL-87		**Warrior Rock**	87+15+00	87+00+00	161,482	45,127	116,355	462,416	0	IW/UP
	Predicted Bar New Construction Volume =	354,413		88+00+00	157,476	21,660	135,816	411,942	38,266	IW
	Actual Bar New Construction Volume =	874,358		89+00+00	117,165	14,924	102,241			IW/UP
	Percentage of Prediction =	247%								
CL-90		**Henrici Bar**	90+20+00	90+00+00	481,852	100,142	381,709	306,720	191,060	IW
	Predicted Bar New Construction Volume =	642,166		91+00+00	232,015	51,233	180,781	279,964	0	IW
	Actual Bar New Construction Volume =	785,724		92+00+00	86,909	7,234	79,675	199,040	0	Rehandled UP
	Percentage of Prediction =	122%								
CL-94		**Willow Bar**	93+50+00	93+00+00	261,237	67,579	193,659	278,513	28,236	Rehandled UP
	Predicted Bar New Construction Volume =	537,183		94+00+00	156,838	45,286	111,552	136,003	54,003	Rehandled UP
	Actual Bar New Construction Volume =	770,139		95+00+00	78,237	6,356	71,881	355,623	505,670	Rehandled UP
	Percentage of Prediction =	143%		96+00+00	191,681	31,588	160,093			
CL-97		**Morgan Bar**	97+40+00	97+00+00	167,351	31,430	135,922			
	Predicted Bar New Construction Volume =	191,689		98+00+00	50,416	3,821	46,595	56,013	27,939	Rehandled Material
	Actual Bar New Construction Volume =	56,013		99+00+00	9,172	0	9,172			
	Percentage of Prediction =	29%		100+00+00	0	0	0			

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2010. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft) Volume	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-102		**Lower Vancouver**	101+18+00	101+00+00	87,054	10,311	76,744			
	Predicted Bar New Construction Volume =	556,043		102+00+00	84	0	84	406,064	186,266	Rehandled UP
	Actual Bar New Construction Volume =	406,064		103+00+00	87,909	1,810	86,099			
	Percentage of Prediction =	73%		104+00+00	393,116	0	393,116			IW/UP
CL-105		**Vancouver Turning Basin**	104+31+25	105+00+00	287,713	69,220	218,493	1,163,547	0	IW/UP-Hickey
	Predicted Bar New Construction Volume =	218,493		105+31+07			0			
	Actual Bar New Construction Volume =	1,163,547								
	Percentage of Prediction =	533%								
				TOTAL=	**19,047,502**	**4,573,889**	**14,473,613**	**19,088,483**	**16,116,174**	

3-2 Disposal of Project Dredged Materials

The USACE also provided a detailed summary of Project construction and disposal of construction materials for Phases 1–4. Summaries of Phases 1–4 have been developed as updates to existing Project MA-2 spreadsheets (Tables 3-2.1–3-2.4) included in previous annual reports. Therefore, there is some redundancy among the annual reports. Again, the reports were designed to be "stand-alone" documents to save the reader from having to search back through previous reports for purposes of making comparisons of the CRCIP AEM activities and deliberations.

It is important to understand that two independent methods are used to quantify the construction material removed and the disposed materials. The materials removed are calculated by bathymetric surveys of in-place quantity removed, while the volumes disposed are calculated by measurements of what is hauled. The dredging quantity will not exactly match the disposal quantity because of the two separate volume measurement methods, however both quantities are correct.

The volumes reported below are total volumes removed and include both new work and O&M removed at time of deepening, but not subsequent O&M of the 43-foot channel.

In Phase 1, approximately 2,572,851 cys were removed by the Dredge Sugar Island from the river locations indentified in Table 3-2.1. Approximately, 1,452,418 cys were disposed of in-water or flow lane, while 1,228,584 cys were disposed in the ocean DWS. In addition, the Dredge Oregon rehandled 724,843 cys from the W-101.0 flow lane location and placed these materials at the W-101.0 upland site (Gateway).

Table 3-2.1. Phase 1 Removal and Disposal of CRCIP Dredged Materials through 2010.

Limits		Total Removed	In-Water or Upland Disposal				Ocean Disposal
Downstream	Upstream						
Sugar Island Phase 1 Removal							
			O-9.0-FL	O-17.5-FL	O-18.8-FL	W-101.0-FL	
4+20+00	6+22+20	38,894	2,024				29,612
6+22+00	10+00+00	22,704					17,910
10+00+00	11+10+00	337,154	17,571				325,245
11+10+00	12+40+00	275,367					227,581
12+40+00	13+30+00	300					321
13+30+00	14+45+00	104,007	2,760				95,588
14+45+00	15+27+00	172,699	5,033				167,332
15+27+00	16+10+00	214,174		2,095			206,082
16+10+00	17+30+00	152,940	4,726	35,996			158,913
17+30+00	19+00+00	165,325		177,842	19,752		
19+00+00	20+10+00	207,932		95,459	111,717		
20+10+00	21+10+00	139,377		87,323	75,617		
95+00+00	98+00+00	355,623				371,909	
98+00+00	102+00+00	33,637				44,591	
102+00+00	104+20+00	352,718				398,003	
Oregon Phase 1 Rehandle							
			W-101.1-UD				
W-101.0-FL			724,843				

Approximately 4,308,232 cys were removed in Phase 2 of Project construction by the Dredges Stuyvesant, Essayons, and Oregon (Table 3-2.2). The DWS received ~1,034,864 cys. In Phase 2, approximately 1,312,665 cys were disposed/rehandled at an upland site on Brown Island (W-

46.3) and another 432,782 cys were placed upland at Gateway (W-101.0). The remainder of the dredged materials was disposed in-water or in the flow lane.

As in the 2009 annual report, Table 3-2.3 summarizes the removal and disposal activities for Phase 3 of Project construction. This work was performed by the Dredges Terrapin Island, Liberty Island, Oregon, Megan-Renee and the Sea Horse. The latter two vessels were involved in removal of consolidated rock. Phase 3 removed ~11,462,014 cys. Phase 3 emphasized disposal in-water, flow lane, and upland. No construction materials were disposed in the DWS in Phase 3. The Terrapin Island and Liberty Island disposed of ~3,421,970 cys in-water or in the flow lane. These dredges also placed ~4,406,341 cys on upland disposal sites. The Oregon placed 2,180,014 cys in-water or flow lane and ~2,232,591 cys at upland locations. The Megan-Renee and Sea Horse removed ~1,163,547 cys of consolidated rock and disposed 1,530, 230 cys at upland locations (O-102.2-CM and Hickey).

Table 3-2.4 lists the removal and disposal activities for Phase 4 of Project construction. This work was largely rock removal and additional dredging performed in 2010. The rock removal work was performed by the dredges Megan-Renee and Paula Lee. The dredge Oregon performed some additional work in Phase 4 as well. Approximately 4,434,587 cys were removed in Phase 4. Rock removal accounted for 2,975,001 cys or 67% of the Phase 4 construction. In-water disposal accounted for 2,839,510 cys of removed materials. Approximately 1,284,038 cys were disposed in upland locations (Table 3-2.4).

Table 3-2.2. Phase 2 Removal and Disposal of CRCIP Dredged Materials through 2010.

Limits		Total	In-Water or Upland Disposal							Ocean Disposal
Downstream	**Upstream**	**Removed**	**O-18.2-FL**	**W-24.0-FL**	**W-26.0FL**	**W-30.2-FL**				
Stuyvesant Removal										
21+10+00	22+20+00	238,248								359,675
22+20+00	23+20+00	140,387								173,424
23+20+00	24+17+00	57,427								66,298
24+17+00	25+20+00	439,619		7,311	66,028					384,065
25+20+00	26+20+00	214,847	104,937		29,706	29,991				51,402
26+20+00	27+20+00	55,796				70,524				
Essayons Removal										
			W-97.0-FL	**W-101.0-FL**						
91+00+00	92+00+00	279,964	297,947							
92+00+00	93+00+00	199,040		227,114						
93+00+00	94+00+00	297,565	215,498	169,887						
94+00+00	95+00+00	162,953	8,085	35,791						
Oregon Removal										
			O-40.1-IW	**W-40.1-IW**	**W-40.6-IW**	**O-42.2-IW**	**W-43.5-IW**	**O-43.7-IW**	**W-43.7-IW**	
40+30+00	41+30+00	342,608	143,892	48,816	190,038					
41+30+00	44+00+00	399,496				278,125	147,848	40,581	46,824	
Oregon Rehandle										
			W-101.0-UP							
W-101.0-FL		-	432,792							
Essayons/Oregon Removal/Rehandle										
			O-46.2-IW	**W-46.3-UP**						
44+05+00	48+10+00	1,480,283	167,618	1,312,665						

Table 3-2.3. Phase 3 Removal and Disposal of CRCIP Dredged Materials through 2010.

Limits			In-Water or Upland Disposal									
Terrapin Island/Liberty Island Removal												
Downstream	Upstream	Total Removed	W-36.3-IW	W-55.3-IW	W-61.1-IW	W-67.7-IW	W-72.6-IW	W-77.9-IW	W-78.6-IW	W-81.9-IW	W-86.8-IW	W-97.0-FL
37+25+00	39+10+00	839,130	993,292									
58+00+00	59+40+00	996,392		418,720								
59+40+00	62+00+00	203,689		85,932	161,185							
67+05+00	68+25+00	458,680				28,744	49,424					
68+25+00	70+25+00	345,681				52,624						
70+25+00	72+20+00	340,087										
72+20+00	74+00+00	128,261				9,830	52,786					
74+00+00	75+00+00	183,402				4,928						
75+00+00	76+10+00	204,861					77,909					
76+10+00	77+00+00	371,263					32,886					
77+00+00	78+10+00	159,112										
78+10+00	80+00+00	417,420					45,779					
80+00+00	81+00+00	463,724						49,439				
81+00+00	82+00+00	142,936						44,985				
82+00+00	83+00+00	463,884						3,406	197,851			
83+00+00	84+00+00	238,236								250		
84+00+00	85+00+00	124,405								43,464	10,013	
85+00+00	86+00+00	98,635								5,144	32,915	
86+00+00	87+25+00	152,966									46,980	
88+25+00	90+00+00	450,208										498,259
90+00+00	91+00+00	456,476										475,225
Terrapin Island/Liberty Island Removal												
Downstream	Upstream		O-57.0-UP	W-70.1-UP	W-71.9-UP 1	W-71.9-UP 2	W-82.0-UP	W-86.5-UP				
37+25+00	39+10+00											
58+00+00	59+40+00		638,954									
59+40+00	62+00+00											
67+05+00	68+25+00			437,253								
68+25+00	70+25+00			307,115								
70+25+00	72+20+00			392,689								
72+20+00	74+00+00			83,362								
74+00+00	75+00+00			189,135								
75+00+00	76+10+00				39,792	93,750						
76+10+00	77+00+00					375,869						
77+00+00	78+10+00					141,515						
78+10+00	80+00+00				319,725	55,829						
80+00+00	81+00+00				202,471		198,879					
81+00+00	82+00+00						81,675					
82+00+00	83+00+00						273,576					
83+00+00	84+00+00							267,131				
84+00+00	85+00+00							82,191				
85+00+00	86+00+00							97,125				
86+00+00	87+25+00							128,305				
88+25+00	90+00+00											
90+00+00	91+00+00											
Oregon Removal												
Downstream	Upstream	Total Removed	W-29.9-IW	W-30.2-IW	W-30.7-IW	W-32.1-IW	W-32.6-IW	O-32.4-IW	W-35.5-IW	W-54.3-IW	O-62.1-IW	O-62.8-IW
28+40+00	31+00+00	477,728	375,349	220,950	120,906							
32+30+00	34+35+00	486,126				149,738	147,247					
34+35+00	36+10+00	650,878						238,453	585,561			
54+15+00	55+20+00	174,379								228,833		

62+00+00	65+00+00	1,269,908									55,156	57,821

Table 3-2.3. Phase 3 Removal and Disposal of CRCIP Dredged Materials through 2010. (Continued).

Oregon Removal												
Downstream	**Upstream**		**O-34.0-UP**	**O-63.5-UP**	**O-64.8-UP**							
28+40+00	31+00+00											
32+30+00	34+35+00		413,158									
34+35+00	36+10+00											
54+15+00	55+20+00											
62+00+00	65+00+00			196,252	1,623,181							
Megan-Renee/Sea Horse Consolidated Rock Removal												
			O-102.2-CM	**Hickey-UP**								
104+20+00	105+25+00	1,163,547	1,124,335	405,895								

Table 3-2.4 Phase 4 Removal and Disposal of CRCIP Dredged Materials through 2010.

Limits											
Dredge Megan-Renee Rock Removal											
Downstream	**Upstream**	**Total Removed**	**W-8.2-IW**	**Ktr Ross Island**	**W-101.5-FL**	**O-102.2-CM**				**Ktr Nygaard Astoria UP**	**Ktr O-64.8-UP**
12+40+00	14+00+00	56,373	29,434							26,939	
42+05+00	42+25+00	6,029								6,029	
65+00+00	65+40+00	884,158									1,001,579
87+25+00	88+25+00	462,416		714,211							
100+35+00	101+15+00	22,376				22,376					
103+50+00	104+20+00	53,346			26,877	26,469					
Dredge Paula Lee Rock Removal											
Downstream	**Upstream**	**Total Removed**		**Ktr Ross Island**							
65+40+00	67+05+00	1,490,303		2,020,143							
Dredge Oregon Removal											
Downstream	**Upstream**	**Total Removed**	**W-26.9-IW**	**O-27.5-IW**	**W-29.3-IW**	**W-55.3-FL**	**W-56.4-IW**	**W-57.9-IW**	**O-58.6-IW**	**O-57.0-IW**	
27+20+00	28+40+00	776,536	318,353	151,922	453,226						
56+10+00	58+00+00	683,050				35,555	206,031	110,813	230,112	249,491	

Table 3-2.5 lists in detail the potential disposal sites, their associated capacities and amounts of dredged materials disposed of through 2010. Thus far, upland disposal has exceeded the designated capacity only for the Rainier Industrial site (O-64.8), which was a Contractor-provided site. Disposal at Welch Island is at 93% of capacity. The Northport site appeared as one possible additional exception. However, further analysis indicated that the Northport location in the summary table was actually two separate disposal sites: Northport 1 and Northport 2 (W-71.9). The Northport 2 site received 561,988 cys in the form of beneficial use. Only 53% of the Northport 1 site disposal capacity has been used through 2010.

Table 3-2.5. Disposal of CRCIP Dredged Materials through 2010.

Disposal Site	Site Location/Name	CRCIP Construction		Projected O&M Volume	Actual O&M Volume Placed	Percent Full	Total Estimated Capacity
		Projected Volume	Volume Placed				
W-21.0	Rice island	0		5,500,000			5,500,000
O-23.5	Miller Sands	0	67,389	7,000,000			N/A
O-27.2	Pillar Rock Island	0		1,000,000			2,555,000
W-33.4	Skamokawa	0		Varies			250,000
O-34.0	Welch island	0	413,158	400,000		93%	446,000
O-38.3	Tenasillahe Island	0		2,300,000			2,300,000
O-42.9	James River	240,000		830,000			1,280,000
W-44.0	Puget Island (Vik Prop.)	500,000		2,700,000			3,500,000
W-46.3/W-46.0	Brown Island	1,200,000	1,312,665	3,400,000		28%	4,700,000
O-54.0	Port Westward	150,000		1,500,000			1,875,000
O-57.0	Crims Island	30,000	888,445	1,100,000		55%	1,600,000
W-59.7	Hump Island	400,000		900,000			1,500,000
W-62.0	Mt. Solo	300,000		2,100,000			2,500,000
W-63.5	Reynolds Aluminum	180,000		0			500,000
O-63.5	Lord Island Upstream	0	196,252	600,000		16%	1,255,000
O-64.8	Rainier Industrial	270,000	2,624,760	2,400,000		117%	2,235,000
W-67.5	International Paper	140,000		2,700,000			1,000,000
O-67.0	Rainier Beach	450,000		2,400,000			1,095,000
W-68.7	Howard Island	0		600,000			6,400,000
W-70.1	Cottonwood Island	240,000	1,409,554	1,300,000		44%	3,200,000
W-71.9	Northport 1	189,000	561,988	1,800,000		62%	900,000
W-71.9	Northport 2 (Beneficial Use)	750,000	666,963	0		89%	750,000
O-75.8	Sandy Island	120,000		860,000			1,100,000
O-77.0	Lower Deer Island	440,000		700,000			1,498,000
W-80.0	Martin Island Mitigation	370,000		0			550,000
W-82.0	Martin Bar	46,000	554,130	700,000		37%	1,500,000
O-82.6	Reichold	320,000		2,300,000			1,285,000
O-86.2	Sand Island	150,000		860,000			1,250,000
W-86.5	Austin Point	136,000	574,752	1,500,000		35%	1,645,000
O-87.8	Railroad Corridor	300,000		0			540,000
O-91.5	Lonestar	900,000		3,200,000			5,350,000
W-96.9	Adjacent to Fazio	0		Varies			475,000

Table 3-2.5. Disposal of CRCIP Dredged Materials through 2010. (Continued).

Disposal Site	Site Location/Name	CRCIP Construction		Projected O&M Volume	Actual O&M Volume Placed	Percent Full	Total Estimated Capacity
		Projected Volume	Volume Placed				
W-97.1	Fazio Sand & Gravel	112,000		1,000,000			650,000
W-101.0	Gateway	587,000	1,157,635	1,600,000		50%	2,300,000
O-105.0	West Hayden Island	600,000		3,900,000			5,750,000
Total Upland/ Shoreline		9,120,000	10,427,691			18%	58,505,858
Total DWS		6,500,000	2,483,930			1%	225,000,000
Total IW-FL		2,000,000	12,887,080				
Rehandled IW-FL to Upland			1,952,849				
Scour Holes W-40.6 and W-43.5	Welcome Slough/ Pankcake Pt.	N/A	349,844				
Beach Nourish W-43.8	Pancake Pt.	N/A	53,812				
Ktr Furnished Upland	Nygaard (Warrenton)	N/A	32,968				
Ktr Furnished Upland	Hickey (Vancouver)	N/A	405,895				
Ktr Furnished IW	Ross Island (Portland)	N/A	2,734,354				

During 2009, overwidth dredging was performed by the Dredge Oregon (Table 3-2.6) and the Dredge Terrapin Island (Table 3-2.7). These dredged materials were disposed mainly in-water or at the DWS, although 121,201 cys from the Oregon were used for beach nourishment. These 2009 overwidth dredging summaries are retained in the 2010 annual report simply for continuity in CRCIP AEM reporting.

Table 3-2.6. CRCIP Phase 1 and 2 Overwidth Dredging Summary for the Dredge Oregon.

Station Limits		Total Removed	In-water disposal				Beach nourishment	
Downstream	Upstream		HPS	O-21.4	W-43.5	W-43.7	O-23.5	W-43.8
21+25+00	21+45+00	18,367		18,367				
22+07+00	23+05+00	138,827	138,827					
23+30+00	24+03+00	67,389					67,389	
44+05+00	45+20+00	89,686			11,958	23,916		53,812

Table 3-2.7. CRCIP Phase 1 and 2 Overwidth Dredging Summary for the Dredge Terrapin Island.

Station Limits			In-water disposal		Ocean
Downstream	Upstream	Total Removed	W-13.9	O-49.9	DWS
11+00+00	21+45+00	75,692			75,692
15+35+00	23+05+00	78,737	78,737		
18+30+00	24+03+00	144,790			144,790
47+35+00	45+20+00	53,439		53,439	

3-3 AMT Decisions for MA-2

Table 3-3.1 lists the decisions made by the AMT in relation to project construction, dredging volumes, and dredged material disposal during the course of the quarterly meetings of the CRCIP AEM Program through 2010.

Table 3-3.1. CRCIP AEM Plan Record of AMT MA-2 Decisions.

Date	Issue	MA-2 Decisions	Comments
16 Dec 2004	**MA-2 Decision Criterion**	Compare actual dredging volumes with predicted volumes.	
16 Dec 2004	**MA-2 Decision Criterion**	Annual O&M dredging volumes plus construction volumes.	
16 Dec 2004	**MA-2 Decision Criterion**	Develop plots of predicted vs. actual dredged volumes for the contracted river mile segments; show percentages (e.g., 5, 10, 15, etc.) of possible exceedance.	
16 Dec 2004	**MA-2 Decision Criterion**	Develop similar summaries for dredge disposal.	
16 Dec 2004	**MA-2 Decision Criterion**	Communicate summaries, plots, etc., to the AMT within two months after each contract is completed.	
16 Dec 2004	**MA-2 Decision Criterion**	Trigger for other disposal options (e.g., in-water vs. upland), if larger than predicted volumes are dredged.	
5 Jul 2005	**MA-2 Decision Criterion**	Initial consensus was for reporting the results of dredging on a contract basis, although Washington expressed continued interest in a bar-by-bar summary as well as a summary by contract.	
5 Jul 2005	**MA-2 Decision Criterion**	The AMT achieved consensus that the decision criteria for MA-2 would derive from comparisons between estimated and actual dredging volumes, as summarized and presented in the March annual AMT meeting.	
1 Sept 2005	**MA-2 Decision Criterion**	All agencies concurred that if the dredging volumes exceed the projected amounts in the CRCIP Final Supplemental Environmental Impact Statement by 15% or more that the AMT members would be notified. Agreement was also reached, that at the quarterly meetings, the USACE would provide: dredging volumes updates for CRCIP construction and O&M, estimated amounts would be compared with actual amounts placed at individual upland sites and that volumes would be provide by bar and river mile.	
12 Oct 2005	**MA-2 Decision Criterion**	The AMT decision criteria refer to bar-by-bar summary of projected and actual dredging volumes. The spreadsheet currently provides a summary based on river miles. The spreadsheet will be modified to include additional rows that provide the bar-by-bar summaries. The location of disposal sites for Project dredging should also be included in the reporting for MA-2.	
11 Jan 2005	**MA-2 Decision Criterion**	It has proved difficult to determine the original source or relevance of the 15% proposed exceedance value. Therefore, following discussion, the AMT reached consensus to abandon the 15% decision criterion and simply compare projected dredging volumes to actual volumes.	
12 Apr 2006	**MA-2 Reporting**	The AMT made recommendations concerning the format of reporting dredging and disposal of dredged materials. A revised reporting template will be presented to the AMT at the next quarterly meeting.	

Table 3-3.1. CRCIP AEM Plan Record of AMT MA-2 Decisions. (Continued).

Date	Issue	MA-2 Decisions	Comments
10 Jan 2007	**MA-2 Project Construction**	The form and content of the MA-2 spreadsheet summary for the AEM Workbook were accepted by the AMT.	
11 Apr 2007	**MA-2 Dredging Summary**	The spreadsheet summary of disposal will be updated to address concerns regarding disposal capacity.	
11 Jul 2007	**MA-2 Dredging Summary**	MA-2 spreadsheets were updated to address capacity for disposal, especially in the deep ocean areas and Gateway.	
3 Oct 2007	**MA-2 Dredging Summary**	The MA-2 dredging summary tables in the AEM Project Workbook will be updated to include recent construction and disposal of dredged materials.	
9 Jan 2008	**MA-2 Dredging Summary**	Spreadsheet summaries of dredging volumes and disposal locations will be updated upon completion of the year's dredging.	
29 Apr 2008	**MA-2 Dredging Summary**	No decisions were made concerning Project dredging for MA-2.	
9 Jul 2008	**MA-2 Dredging Summary**	Disposal of Project dredged materials will be updated and summarized for the October AMT meeting.	
8 Oct 2008	**MA-2 Dredging Summary**	The summary for disposal at Northport will be revised to reflect that it is actually two disposal sites. Disposal capacity has not been exceeded.	
14 Jan 2009	**MA-2 Dredging Summary**	The upland disposal summary table was modified to show that the Northport site includes two disposal locations.	
8 Apr 2009	**MA-2 Dredging Summary**	Upland disposal has not exceeded capacity for any of the disposal locations used thus far in the CRCIP construction.	
8 Jul 2009	**MA-2 Dredging Summary**	No new information was presented for MA-2. However, the AMT will continue to be informed concerning monitoring plans being developed for rock removal as part of the CRCIP construction.	
18 Nov 2009	**MA-2 Dredging Summary**	No new information was presented for MA-2.	
20 Jan 2010	**MA-2 Dredging Summary**	MA-2 monitoring and assessment activities will transition into the post-project O&M phase for reporting.	
14 Apr 2010	**MA-2 Dredging Summary**	MA-2 monitoring and assessment activities will transition into the post-project O&M phase for reporting.	
14 Jul 2010	**MA-2 Dredging Summary**	Revisions will be made to the annual reports for 2007 and 2008 to clarify the in-water disposal at the Fazio site, previously reported incorrectly as upland disposal.	
13 Oct 2010	**MA-2 Dredging Summary**	No new information was presented concerning MA-2.	

4 Monitoring Action 3—Crossline Surveys

MA-3 examines accretion/erosion and changes in bathymetry of the main channel in relation to the channel deepening. Crossline surveys will be performed annually for two years prior to construction, during construction, and three years after construction. Annual surveys are performed at Columbia River mile (CRM) 42, 46, 72, 75, 86, and 99. These river mile locations were identified through previous USACE analysis of locations that appeared potentially sensitive to accretion and erosion. Additional surveys will be performed at 0.5 miles up-river and 0.5 miles down-river from each of the selected CRM locations. Comparisons of survey results obtained during and after construction (year 2005+) with the MA-3 decision criteria will determine any need for adaptive management.

4-1 MA-3 Decision Criteria

In 2006, the results of pre-construction surveys (1996–2004) were used to develop consensus decision criteria to evaluate surveys performed in relation to Project construction (Table 4-1.1). The resulting depth "envelopes" define upper and lower depths that should not be exceeded as the result of construction dredging at these locations. The envelopes were calculated by subtracting the value of one standard deviation (SD) (sigma) from the minimum reported depth and adding one SD (sigma) to the maximum reported depth. The SD are based on analysis of the 1996–2004 pre-construction data reported for each location. The calculation of depth envelopes did not include the change of the authorized channel from 40 to 43-feet, or the 100 feet overwidth.

The first post-construction survey was completed in 2008. The results of the 2008 MA-3 crossline surveys were compiled and presented in relation to the previously developed decision criteria (i.e., depth envelopes). The results of the 2008 surveys suggested two possible outlier values: one at CRM 75 (Kalama Bar) on the Washington side and the other at CRM 42.5 (Wauna/Driscoll Bar) also on the Washington side. The 2008 surveys also showed that channel alterations suggested by the 2007 outlier value observed at CRM 45.5 (Westport Bar) had returned to conditions that were within the decision envelopes.

Additional post-construction surveys were performed in 2009 (Table 4-1.2). Based on comparisons with the decision criteria, the 2009 survey results indicated the following outliers:

- CRM 42.5–WAN exceeds the lower envelope value and suggests erosion on the northern sideslope;
- CRM 45.5–Westport (WST) exceeds the lower envelope value and suggests erosion on the northern sideslope;
- CRM 45.5–WST exceeds the upper envelope value and suggests acretion on the southern sideslope;
- CRM 46.0–WST exceeds the lower envelope value and suggests erosion on the northern sideslope;

- CRM 71.5–UDB exceeds the lower envelope value and suggests erosion on the southern sideslope; and

- CRM 72.5–UDB exceeds the upper envelope value and suggests accretion of ~5 feet on the northern sideslope.

Outlier values at WST (CRM 45.5) that appeared in 2007, but not 2008 were evident again in 2009. Given that much of the Project construction had been completed (except for rock removal) well before the 2009 surveys, the conditions at WST might simply reflect the dynamics of sand waves moving through the system.

The AMT noted that the UDB is a location of active in-water disposal. In 2008, prior to the 2009 surveys, approximately 250,000 cys of materials were disposed. The accretion at CRM 71.5 might simply reflect the disposal activities at this location.

Table 4-1.2 lists the post-construction survey dates performed in 2010. Based on the previously derived decision criteria (i.e., depth envelopes), the results of the 2010 surveys identified three possible outliers:

- CRM 98.5–possible erosion at Morgan Bar;

- CRM 45.5–possible erosion at Westport Bar; and

- CRM 72.5–possible side slope accretion at UDB.

Importantly, all but two of the 2009 survey outliers had returned to values within envelope limits prior to the 2010 MA-3 survey and analysis.

The updated crossline survey analysis for 2010 has been posted to the MA-3 folder in the AEM Workbook at the E2 CRCIP website. The MA-3 surveys are scheduled to continue for three additional years following the end of Project construction (i.e., through 2013).

Table 4-1.1. Adaptive Management Depth Envelopes for MA-3 Crossline Surveys.

	Pre-construction Depth Values (ft)			AEM Envelope Depth (ft)	
CRM	**Minimum**	**Maximum**	**Sigma[1]**	**Upper**	**Lower**
41.5 South	47.94	50.48	0.69	47.25	51.17
North	46.17	52.02	1.48	44.69	53.50
42.0	51.38	55.60	1.48	49.90	57.08
	43.58	48.74	1.64	41.94	50.38
42.5	47.17	54.54	2.71	44.46	57.25
	41.90	44.95	1.07	40.83	46.02
45.5	44.98	47.13	0.71	44.27	47.84
	40.71	44.31	1.20	39.51	45.51
46.0	46.53	52.64	1.67	44.86	54.31
	40.46	46.72	1.93	38.53	48.65
46.5	42.41	47.83	1.55	40.86	49.38
	41.43	46.83	1.45	39.98	48.28
71.5	40.75	46.79	1.61	39.14	48.40
	45.10	50.98	1.73	43.37	52.71
72.0	47.30	53.48	1.93	45.37	55.41
	44.37	50.44	2.13	42.24	52.57
72.5	61.39	77.15	4.40	56.99	81.55
	60.71	69.81	2.46	58.25	72.27
74.5	43.32	46.25	0.95	42.37	47.20
	52.33	59.04	1.85	50.48	60.89
75.0	42.17	47.14	1.60	40.57	48.74
	42.44	47.90	1.49	40.95	49.39
75.5	41.92	46.86	1.51	40.41	48.37
	45.84	49.54	1.29	44.55	50.83
85.5	42.18	46.55	1.46	40.72	48.01
	43.92	49.88	1.69	42.23	51.57
86.0	41.11	46.70	1.63	39.48	48.33
	46.78	55.77	2.68	44.10	58.45
86.5	39.64	44.42	1.50	38.14	45.92
	45.35	49.66	1.65	43.70	51.31
98.5	49.43	52.69	1.21	48.22	53.90
	43.15	46.94	1.26	41.89	48.20
99.0	50.35	54.55	1.25	49.10	55.80
	43.76	48.81	1.65	42.11	50.46
99.5	48.65	49.92	0.46	48.19	50.38
	45.13	47.36	0.77	44.36	48.13

[1]One SD of mean depth based on analysis of pre-Project surveys.

Table 4-1.2 lists the locations and dates of the crossline survey data used in developing the MA-3 decision criteria and the dates of the post construction surveys conducted through 2010.

Table 4-1.2. Columbia River Cross-Line Hydrosurvey Dates.

	Morgan Bar	St. Helens Bar	Kalama Bar	UDB	Westport Bar	WAN
Year	CRM 98-101	CRM 84-87	CRM 73-76	CRM 70-73	CRM 45-48	CRM 41-44
1996	24-Feb	21-Feb	20-Feb	20-Feb	20-Feb	20-Feb
1997	-	24-Feb	12-Feb	12-Feb	10-Feb	6-Feb
1998	5-Jan	-	21-Jan	21-Jan	28-Jan	28-Jan
1999	12-Jan	19-Jan	26-Jan	26-Jan	1-Feb	27-Jan
2000	20-Jan	11-Jan	10-Jan	6-Jan	26-Jan	25-Jan
2001	13-Feb	5-Feb	31-Jan	30-Jan	30-Jan	29-Jan
2002	13-Feb	12-Feb	7-Feb	6-Feb	24-Jan	24-Jan
2003	7-Jan	14-Jan	23-Jan	28-Jan	5-Feb	5-Feb
2004	22-Jan	31-Mar	28-Apr	29-Apr	17-May	13-May
2005	4-Apr	10-May	24-May	25-May	22-Jun	18-May
2006	12-Jan	25-Jan	7-Feb	7-Feb	31-Jan	24-Jan
2007	12-Feb	14-Feb	21-Feb	22-Mar	27-Mar[a]	26-Mar
2008	27-Mar	10-Apr	8-Apr	8-Apr	1-May	2-Apr
2009	12-Feb	26-Feb	5-Mar	10-Mar	2-Feb	27-Jan
2010	25-Jan	3-Feb	18-Feb	18-Feb	24-Feb	10-Feb

[a]Dates in blue indicate post-construction surveys.

4-2 AMT Decisions for MA-3

Table 4-2.1 briefly summarizes the key AMT discussion points and decisions concerning potential effects of Project construction on channel bathymetry through calendar 2010.

Table 4-2.1. CRCIP AEM Plan Record of AMT MA-3 Decisions.

Date	Issue	MA-3 Decisions	Comments
16 Dec 2004	**MA-3 Decision Criterion**	Develop plots that compare pre-construction variations in side slopes with post-construction slopes using results of crossline surveys; show percentages (e.g., 5, 10, 15, etc.) of measured changes in side slopes.	
16 Dec 2004	**MA-3 Decision Criterion**	Focus on six locations identified in the Environmental Impact Statement.	
16 Dec 2004	**MA-3 Decision Criterion**	Use recorded dredging volumes to identify other possible locations for impacts on slopes. O&M dredging volumes that substantially exceed predicted values might indicate locations of increased side slope adjustments.	
16 Dec 2004	**MA-3 Decision Criterion**	Communicate summaries, plots, etc., to the AMT 2 years prior, 2 years during, and 3 years after construction is completed.	
16 Dec 2004	**MA-3 Decision Criterion**	Trigger for adaptive management if larger than predicted changes in side slope adjustment are observed.	
9 Aug 2005	**MA-3 Decision Criterion**	Crossline data are available at approximately 500-foot intervals throughout the navigable river. The results also summarized the minimum, maximum, and SD for surveyed depths at the southern and northern edges of the navigation channel. An envelope defined by the minimum + 1 SD and the maximum +1 SD was also plotted for each of the cross sections.	
9 Aug 2005	**MA-3 Decision Criterion**	Concerns were expressed that the selected few locations did not provide a sufficient description of potential impacts of channel dredging on slide slope adjustments and corresponding potential impacts on shallow water habitats. Requests were made to include two additional cross sections, upriver and downriver, to the locations currently included in the MA-3 design. Inclusion of more cross sections at other selected river miles into the MA-3 effort was also desired by several AMT members.	
9 Aug 2005	**MA-3 Decision Criterion**	Concerns were raised about the number of years included in the analysis. The years represent different flow conditions, for example, with 1996–97 being years with comparatively higher flows, and 2001 being an example of a low flow year. The surveys are part of an ongoing activity in support of navigation the CRCIP was funding several surveys in relation to the time periods outlined in the terms and conditions of the Biological Opinion - i.e., 2 years before, 2 years during, and 2 years after project construction.	
1 Sept 2005	**MA-3 Decision Criterion**	The consensus AMT decision criteria for MA-3 are defined as an "envelope" calculated as the minimum surveyed depth + 1 SD and the maximum depth + 1 SD. The envelope is defined across the channel for each survey with particular emphasis on the northern and southern boundaries of the navigation channel.	

Table 4-2.1. CRCIP AEM Plan Record of AMT MA-3 Decisions. (Continued).

Date	Issue	MA-3 Decisions	Comments
1 Sept 2005	**MA-3 Decision Criterion**	All agencies concurred that the crossline survey results will be reviewed for exceedances and will reported yearly after the cross line surveys are completed. The MA-3 will examine accretion/erosion and changes in bathymetry of the main channel in relation to the channel deepening. Surveys will be conducted annually for two years prior to construction (by individual contract), two years during construction, and three years after construction. Crossline surveys will be conducted within a December–February time period to coincide with the end of the dredging season. Surveys will be conducted along the navigation channel from CRM 3 to CRM 106. Statistical analyses will produce estimates of mean and median depth at each sampled location across the channel; minimum and maximum values as well as SD and coefficients of variation will also be determined.	
11 Jan 2006	**MA-3 Decision Criterion**	The AMT agreed that the "envelope" calculations for side slope adjustments would serve as initial decision criteria for MA-3. The AMT requested that the O'Brien-Michalsen' plots be incorporated as part of the AEM Plan implementation.	
10 Jan 2007	**MA-3 Crossline Surveys**	Additional pre-construction crossline survey data were used to revise the decision "envelopes" for MA-3.	
11 Apr 2007	**MA-3 Crossline Surveys**	An outlier value in reference to the decision "envelopes" at CRM 45.5 will be examined.	
11 Jul 2007	**MA-3 Crossline Surveys**	No new information was reported for MA-3.	
3 Oct 2007	**MA-3 Crossline Surveys**	No new information was available for MA-3.	
9 Jan 2008	**MA-3 Crossline Surveys**	No new information was available for MA-3.	
29 Apr 2008	**MA-3 Crossline Surveys**	No new information was available for MA-3.	
9 Jul 2008	**MA-3 Crossline Surveys**	Available 2008 survey results will be summarized and presented at the October AMT meeting.	
8 Oct 2008	**MA-3 Crossline Surveys**	The 2008 surveys suggest two possible values that lie outside the decision envelopes on the Washington side at CRM 75 and 42.5. The 2008 survey also shows that an outlier observed in 2007 at CRM 45.5 had returned to conditions within the envelope decision criteria. The AMT will continue to review future crossline survey results for these locations.	

Table 4-2.1. CRCIP AEM Plan Record of AMT MA-3 Decisions. (Continued).

Date	Issue	MA-3 Decisions	Comments
14 Jan 2009	**MA-3 Decision Criterion**	No new information was presented regarding MA-3.	
8 Apr 2009	**MA-3 Decision Criterion**	No new information was presented for MA-3 at the April 2009 meeting.	
8 Jul 2009	**MA-3 Crossline Surveys**	No new information was presented for MA-3 at the July 2009 meeting.	
18 Nov 2009	**MA-3 Crossline Surveys**	No new information was presented for MA-3 at the November 2009 meeting.	
20 Jan 2010	**MA-3 Crossline Surveys**	MA-3 activities will continue for three years post-Project construction.	
14 Apr 2010	**MA-3 Crossline Surveys**	MA-3 activities will continue for three years post-Project construction.	
14 Jul 2010	**MA-3 Crossline Surveys**	The USACE will determine if crossline surveys are available for 2009.	
13 Oct 2010	**MA-3 Crossline Surveys**	Results of the 2009 MA-3 surveys were reported at the October 13 meeting. No decisions were made in relation to adaptive management.	

5 Monitoring Action 4—Habitat Opportunity

Following the completion of Project construction, MA-4 will augment the estuary habitat surveys currently being conducted by NMFS as part of the Anadromous Fish Evaluation Program (AFEP) (Bottom and Gore 2001). The objective is to determine if changes in habitat opportunity and habitat capacity result from modifications to the channel. Habitat opportunity is defined as the number of hours within a 30-day (720-hour) month, wherein values of physical habitat criteria are consistent with criteria developed for juvenile salmonids (Bottom et al. 2001). Pre-construction characterizations of habitat opportunity have been provided for juvenile chinook and chum in terms of suitable water depths and current velocity. These estimates can serve as a basis for comparing post-Project estimates of habitat opportunity to determine any impacts of channel modifications on physical habitat for juvenile salmonids.

The MA-4 activity will not occur until three years after the Project construction is completed (~2013). As a result, the AMT did not address this monitoring action directly during 2010. Therefore, the following sections are identical to the 2009 annual report and are presented in order that the 2010 annual report can stand as a separate document without having to refer to previous annual reports of the AEM Program for the CRCIP.

However, it is important to point out that initial considerations to changes in the MA-4 studies and decision criteria were deliberated by the AMT during several of the 2010 AMT meetings. These discussions were very preliminary in nature and the AMT agreed to focus on MA-4 during the 2011 AEM Program activities.

5-1 MA-4 Decision Criteria

Originally, estimates of habitat opportunity were to be calculated using the post-Project bathymetry of the LCR. Pre- and post-Project comparisons may require re-calculation of pre-Project opportunity values given the availability of more recent pre-Project bathymetry than used in the original Bottom et al. (2001) analyses. The post-construction MA-3 survey data can also contribute to the calculations of habitat opportunity. Discussions during several 2010 AMT meetings revisited the feasibility of the pre- and post-Project estimation of habitat opportunity.

The CRCIP had intended to fund one habitat survey conducted under the AFEP. The survey will be conducted three years following Project construction. As a result of the AFEP, there will be approximately 10-years of pre-Project habitat survey data. The results of the pre- and post-Project habitat comparisons will be evaluated in the AEM process.

Threshold values of change (i.e., decision criteria) will be defined for each habitat type as a result of the pre-Project survey data. Measures that exceed any of the decision criteria may result in adaptation to current management actions. Table 5-1.1 illustrates a template for future use in evaluating results of MA-4 habitat surveys.

In 2010, Blaine Ebberts, USACE, discussed the history of previous efforts and potential future work in relation to MA-4. The USACE contributed funds (2001–2007) to support the National

Oceanic and Atmospheric Administration (NOAA) AFEP. NOAA has continued studies primarily on the upper river with one small project in the lower river. The results of studies thus far completed suggest that the variance in the data will not likely permit the drawing of any inferences concerning the effects of channel improvements (or other potential stressors) on salmonids.

The intention is to generate new data through a proposed project to meet the requirements of MA-4. The USACE will support studies to evaluate habitat utilization by Evolutionary Significant Unit (ESUs). The focus will be on species that occupy habitats in the LCR and estuary at different times. The studies intend to evaluate the impacts of habitat changes on salmonids throughout their life cycle. The studies will be performed at selected locations from the mouth of the river to the Bonneville Dam. The proposal for the work was provided to the AMT and discussed at the July 2010 meeting.

In 2010, Steve Bartell (E2) summarized the discussion of MA-4 habitat analysis contained in the original CRCIP AEM Plan. Issues relevant to MA-4 (e.g., habitat opportunity, habitat capacity, and the juvenile conceptual model) were reviewed in relation to pre-Project computations made by Bottom et al. (2001) Salmon at the River End. Key findings of recent field investigations concerning juvenile salmonid habitat availability and utilization studied by Bottom and his colleagues were also discussed. A pending proposal by Bottom et al. to perform additional field studies and revise previous calculations of habitat opportunity was also briefly outlined in the presentation to the AMT. The MA-4 presentation made by Steve Bartell is available at the E2 CRCIP website.

The intention of the presentation was mainly to review what the AMT had developed in relation to MA-4 activities as described in the CRCIP AEM Plan and to initiate discussion concerning post-Project activities that would fulfill expectations concerning MA-4. Kim Larson and Robert Anderson will take the lead in developing future discussions in relation to MA-4 post-construction actions. These discussions will occur throughout the 2011 AEM Program as part of the transition to the O& M phase of channel improvement.

The example template for MA-1 pre- and post-construction comparisons (e.g., Table 5-1.1) may be revised as a result of the 2011 deliberations by the AMT.

Table 5-1.1. Template for Evaluating Changes in Habitat Opportunity (Velocity, Depth) using Results from MA-4 Habitat Surveys.

	Habitat Opportunity (h/month)[2]											
LCR	Pre-construction[3]			Post-construction[5]			Percent change			Decision criteria (%-change)[6]		
Region[1]	Velocity	Depth	Combined	Velocity	Depth	Combined	Velocity	Depth	Combined	Velocity	Depth	Combined
1	580 - 620[4]	125 - 160										
2	275 - 310	~50										
3	590 - 610	210 - 240										
4	350 - 550	190 - 210	140 - 180									
5	390 - 500	155 - 180										
6	50 - 490	10 - 90										

[1] Regions defined by Bottom et al. (2005)

Region 1	Baker Bay
Region 2	Lower mainstem
Region 3	Youngs Bay
Region 4	Cathlamet Bay
Region 5	Grays Bay
Region 6	Upper estuary

[2] Calculated for 30-d (720 h) month

[3] Results reported in Bottom et al. (2005)

[4] Ranges reflect seasonal variations in river discharge

[5] Post-Project values of habitat opportunity will be estimated using the same methodology as Bottom et al. (2005) and bathymetry data revised in relation to channel deepening

[6] MA-4 decision criteria have yet to be defined by the Adaptive Management Team

5-2 AMT Decisions for MA-4

Table 5-2.1 outlines the key discussion and decisions regarding potential CRCIP impacts on habitat through calendar 2010 of the AEM Program.

Table 5-2.1. CRCIP AEM Plan Record of AMT MA-4 Decisions.

Date	Issue	MA-4 Decisions	Comments
16 Dec 2004	**MA-4 Decision Criterion**	Re-evaluation of Bottom et al. (in prep.) calculations of habitat opportunity.	
16 Dec 2004	**MA-4 Decision Criterion**	Detailed survey to be conducted 3 years after project construction.	
16 Dec 2004	**MA-4 Decision Criterion**	Presentation of ongoing studies (Science Center) that are further elaborating salmonid utilization of the lower river and estuary.	
5 Jul 2005	**MA-4 Decision Criterion**	The Channel Improvement Project will fund one of the 10 years and include support for in-depth analysis of the data obtained during this study. Discussion continues concerning which one of the 10 years will be funded by the CRCIP. It was proposed to select the year corresponding to 3 years after Project completion.	
5 Jul 2005	**MA-4 Decision Criterion**	NOAA Fisheries (C. Tortorici) expressed an interest in selecting the year of Project funding for the more intensive studies to be supported by MA-4. The NOAA emphasis resides in ensuring that the intensive study is performed. NOAA was silent concerning the USACE proposed target year designated as three years post-construction.	
5 Jul 2005	**MA-4 Decision Criterion**	The USACE noted that additional discussion is needed to come to an agreement on identifying the post-construction year selected for MA-4. This should be a topic of future AMT meetings until resolved.	
1 Sep 2005	**MA-4 Decision Criterion**	The agencies concurred that setting triggers at this time would be premature and that this MA would be reviewed quarterly. It was also agreed that either NOAA or the USACE would report the study findings at the yearly AFEP meeting.	
10 Jan 2007	**MA-4 Habitat Surveys**	The AMT made no new decisions concerning MA-4.	
11 Apr 2007	**MA-4 Habitat Surveys**	No decisions were required for MA-4.	
11 Jul 2007	**MA-4 Habitat Surveys**	No new information was reported for MA-4.	
3 Oct 2007	**MA-4 Habitat Surveys**	No new information was reported for MA-4.	
9 Jan 2008	**MA-4 Habitat Surveys**	No new information was available for MA-4.	
29 Apr 2008	**MA-4 Habitat Surveys**	No new information was available for MA-4.	
9 Jul 2008	**MA-4 Habitat Surveys**	No new information was available for MA-4.	

Table 5-2.1. CRCIP AEM Plan Record of AMT MA-4 Decisions. (Continued).

8 Oct 2008	**MA-4 Habitat Surveys**	No decisions were made for MA-4 at the October 2008 meeting.	
14 Jan 2009	**MA-4 Habitat Surveys**	No new information was available for MA-4.	
8 Apr 2009	**MA-4 Habitat Surveys**	No new information was presented for MA-4 at the April 2009 meeting.	
8 Jul 2009	**MA-4 Habitat Surveys**	No new information was presented for MA-4 at the July 2009 meeting.	
18 Nov 2009	**MA-4 Habitat Surveys**	No new information was presented for MA-4 at the November 2009 meeting.	
20 Jan 2010	**MA-4 Habitat Surveys**	No new information was presented for MA-4 at the January 2010 meeting. MA-4 will be discussed at the April 2010 AMT meeting.	
14 Apr 2010	**MA-4 Habitat Surveys**	The USACE will support studies to evaluate habitat utilization by ESUs in the lower river and estuary. A submitted research proposal for MA-4 related work will be discussed at the July 2010 AMT meeting.	
14 Jul 20010	**MA-4 Habitat Surveys**	Discussions concerning post-construction MA-4 activities will continue at upcoming AMT meetings.	
13 Oct 2010	**MA-4 Habitat Surveys**	Discussion of MA-4 activities was re-scheduled for the January 2011 AMT meeting.	

6 Monitoring Action 5—Sediment Contaminants

MA-5 addresses the potential for existing sediment contaminants to be suspended by dredging activities. This action includes the collation and evaluation of existing data that describe sediment contaminants in the LCR and estuary. Given limitations in available data, MA-5 has initially focused on samples that were collected well before the onset of the CRCIP. More recent data will be included as they are identified and become available to the AMT.

Importantly, as of December 2010 the CRCIP construction requirements for MA-5 have been completed and the assessment of sediment contaminants will transition into the Project O&M phase in subsequent adaptive management related to channel improvement.

6-1 Sediment Contaminants

During 2008, sediment samples were obtained for chemical analysis from CRM 3–106.5 by the USACE. However, the results of the chemical analysis were not available at the end of calendar 2008. The 2008 USACE sediment quality sampling results were presented at the April 2009 AMT meeting (Tim Sherman, USACE).

Maps were presented that showed the locations of the separate sampling efforts subsequently described. Characterization of 12 surface sediment samples collected on March 25, 2008, in locations relevant to overwidth areas demonstrated that the sediment quality was consistent with sediments in the Federal Channel. Ten surface sediment grab samples obtained in June 2008 by the United States Environmental Protection Agency (USEPA) research vessel OSV Bold were determined to be of acceptable quality for in-water placement or beach nourishment. As part of the Columbia River Federal Navigation Channel Characterization, 96 box core samples were obtained in August 2008. Physical analyses were performed for samples obtained from all locations.

Chemical analyses were performed for samples from 23 locations (Table 6.1-1). Analytes included metals, total organic carbon (TOC), pesticides, polychlorinated biphenyl (PCBs), chlorinated hydrocarbons, phthalates, polycyclic aromatic hydrocarbon (PAHs), phenols, miscellaneous extractables, and petroleum. Initial evaluation of the results of the chemical analysis indicated suggested that the materials obtained within the Channel were suitable for in-water placement. Based on this evaluation further characterization of sediment contaminants might not be necessary for another ten years (i.e., 2018).

Table 6-1.1. Locations of 23 Columbia River Sediment Samples Collected in August 2008 and Analyzed for Metals.

Sample Location (CRM)	Sample Identification Number
9+00-WA	082608CRWA- 9+00BC-04
9+30-OR	082608CROR - 9+30BC-04A
12+45-OR	082608CROR-12+45BC-12
13+05-OR	082608CROR-13+05BC-14
20+30-OR	082608CROR-20+30BC-22
33+10-OR	082608CROR-33+10BC-30
33+20-OR	082608CROR-33+20BC-31
35+15-OR	082608CROR-35+15BC-33
41+00-OR	082608CROR-41+00BC-38
56+25-OR	082608CROR-56+25BC-47
67+00-WA	082708CRWA-67+00BC-57
80+40-CL	082708CRCL -80+40BC-65
84+40-OR	082708CROR-84+40BC-68
86+00-OR	082708CROR-86+00BC-70
86+20-OR	082708CROR-86+20BC-71
86+50-OR	082708CROR-86+50BC-72
97+00-OR	082708CROR-97+00BC-83
97+00-WA	082708CRWA-97+00BC-85
99+30-WA	082708CRWA-99+30BC-88
100+25-WA	082708CRWA-100+25BC-90
100+40-OR	082708CROR -100+40BC-91
102+20-WA	082708CRWA-102+20BC-93
102+40-WA	082708CRWA-102+40BC-94

Twelve samples were collected from six locations within the Chinook Channel on October 21, 2008. Physical analyses showed that sediments from the outer channel were 19.4% sand and 81% fine-grained material. Samples from the inner channel were 1.5% sand and 98.1% fine-grained material. The sediments were chemically analyzed for metals, TOC, pesticides, PCBs, chlorinated hydrocarbons, phthalates, PAHs, phenols, miscellaneous extractables, petroleum, and tributyl tin (only samples from inside the breakwater). Results of the analyses and weight-of-evidence determined that the sediments collected on October 21, 2008, to be of sufficient quality for in-water placement.

The Project Review Group (PRG) reviewed the September 2009 "Columbia River Mainstem Federal Navigation Channel Sediment Quality Evaluation Report" (SQER). The review addressed the management area ranking and recent data for sediment quality data in relation to the 2009 SEF for the Pacific Northwest.

Based on this review, the PRG verified that sediments from CRM 3 through CRM 106.5 (except CRM 100.7) ranked as "very low" within the SEF. According to the PRG review, the sediment quality data reported for this area in the SQER are sufficient for ten years before any evaluation

of the need for retesting. The ODEQ questioned whether the material needed to be re-tested in 5 or 10 years.

The sample from CRM 100.7 contained PCB (Arochlors) at concentrations slightly greater than the SEF screening level for freshwater benthic invertebrates. As a result, the PRG lists this site as "moderate" and this location will need to be retested in five years. The USACE plans to re-test this CRM location this year. Results will be provided to the PRG and the AMT.

The sediment quality presentation was posted to the E2 CRCIP website and placed in the AEM Workbook folder for MA-5 Reporting–Sediment Quality.

6.2 AMT Decisions for MA-5

Table 6-2.1 summarizes the important AMT discussion points and decisions concerning the possible impacts of Project construction on redistribution of sediment contaminants through calendar 2010.

Table 6-2.1. CRCIP AEM Plan Record of AMT MA-5 Decisions.

Date	Issue	MA-5 Decisions	Comments
16 Dec 2004	**MA-5 Decision Criterion**	AMT will solicit summaries of sediment contamination data from the technical group already performing this work.	
16 Dec 2004	**MA-5 Decision Criterion**	The AMT will interact with the LCR and Estuary Program (LCREP) to acquire additional data and information concerning chemical contaminants in the lower river and estuary.	
1 Sep 2005	**MA-5 Decision Criterion**	WDOE agreed to verify whether they would be housing the system. (Update: WDOE e-mailed the USACE on September 6, stating that WDOE "…will always maintain the SEDQUAL system as for their purposes so it will always be available to use of the AMT.)	
1 Sep 2005	**MA-5 Decision Criterion**	As for the triggers, the team discussed using the new SEF as triggers for sediment quality upon approval and adoption of the SEF.	
12 Oct 2005	**MA-5 Decision Criterion**	While there are some gaps, the SEF largely addresses the sediment contaminants of interest to Washington, Oregon, and Idaho. The AMT agrees that decision criteria for MA-5 should be made on the basis of the final SEF.	
12 Apr 2006	**MA-5 Reporting**	The AMT agreed that the SEDQUAL input template was adequate to describe newly obtained sediment contaminants data.	
10 Jan 2007	**MA-5 Sediment Contaminants**	The USACE will convene a meeting to review available sediment contaminant data.	
11 Apr 2007	**MA-5 Sediment Contaminants**	No decisions were required for MA-5.	
11 Jul 2007	**MA-5 Sediment Contaminants**	No new information was reported for MA-5.	
3 Oct 2007	**MA-5 Sediment Contaminants**	The USACE (Mark Sippola) will be contacting ODEQ to provide sediment toxic chemical information for the base period and optional work that was awarded to the Great Lakes. The AMT also discussed tracking in the decision summary the areas that ODEQ has approved for dredging.	
9 Jan 2008	**MA-5 Sediment Contaminants**	ODEQ has provided a summary of river miles that have been approved for dredging. This information will be summarized in a spreadsheet and posted at the E2 CRCIP website (Folder: MA-5 Sediment Quality).	
29 Apr 2008	**MA-5 Sediment Contaminants**	No decisions were made concerning MA-5.	
9 Jul 2008	**MA-5 Sediment Contaminants**	No new information was available concerning MA-5.	
8 Oct 2008	**MA-5 Sediment Contaminants**	Results of sediment testing from CRM 3-106.5 will be presented at the January 2009 AMT meeting.	

Table 6-2.1. CRCIP AEM Plan Record of AMT MA-5 Decisions. (Continued).

Date	Issue	MA-5 Decisions	Comments
14 Jan 2009	**MA-5 Decision Criterion**	No decisions were made regarding MA-5 monitoring activities.	
8 Apr 2009	**MA-5 Decision Criterion**	Based on chemical analysis of 23 samples from the Columbia River navigation channel, dredged sediments were judged as suitable for in-water placement.	
8 Jul 2009	**MA-5 Decision Criterion**	No new information was presented for MA-5 at the July 2009 meeting.	
18 Nov 2009	**MA-5 Decision Criterion**	No new information was presented for MA-5 at the November 2009 meeting.	
20 Jan 2010	**MA-5 Decision Criterion**	MA-5 activities will transition into the O&M phase for compliance with the SEF.	
14 Apr 2010	**MA-5 Decision Criterion**	MA-5 activities will transition into the O&M phase for compliance with the SEF.	
14 Jul 2010	**MA-5 Decision Criterion**	MA-5 is completed for the CRCIP AEM Program. Sediment contaminant activities will transition into the O&M phase of channel improvement. The SEF PRG will be requested to review previous sediment findings concerning disposal of dredge materials.	
13 Oct 2010	**MA-5 Decision Criterion**	The PRG verified that sediments from CRM 3 through CRM 106.5 will not require further testing for ten years, with the exception of one sample from CRM 100.7 that will require testing in five years. The USACE plans to re-sample and test this location in 2011.	

7 Monitoring Action 6—Fish Stranding

Similar to MA-4, the monitoring of fish stranding in relation to Project construction was originally planned to be based on a before-and-after comparison of field studies. Because Project construction was anticipated to be completed in December 2010; the AMT discussed the necessity, practicality, and feasibility of performing the post-construction field studies during several of the 2010 quarterly meetings. At issue were the noted minimal changes in commercial navigation during the construction period and the possible use of one of the three pre-construction stranding study locations for beach nourishment. The consensus agreement of the AMT was to pursue the post-construction fish stranding studies as originally planned.

In addition, Dr. Walter Pearson, Peapod Research Inc., was contracted by E2 and the USACE to evaluate the expected changes in fish stranding probabilities as a result of channel improvements. Dr. Pearson was also tasked with estimating the number of field samples that would be necessary to demonstrate changes in stranding probabilities. The analysis performed by Dr. Pearson was based on a statistical model developed using the results of the pre-construction field studies of fish stranding.

7-1 Frequency of Stranding

The following sections are identical to the 2009 annual report, which are provided for the convenience of the reader. The proposed decision criteria for fish stranding are based on a comparison of pre- and post-Project numbers of stranded fish. An increase in the number of stranded fish following channel improvements could initiate the adaptive components of the AEM Program for the CRCIP. Table 7-1.1 summarizes the results of intensive field studies aimed at understanding the potential for fish stranding by commercial navigation in the Columbia River and estuary (Pearson et al. 2005a). On average across all three locations, approximately 26% of the vessel passages were associated with stranding events. This frequency ranged from ~18 to 30% for these 3 locations. If corresponding post-Project stranding frequencies are statistically greater than the values summarized in Table 7-1.1, the adaptive components of the AEM Plan could be invoked to determine the likely cause for the measured increase.

Table 7-1.1. Frequency of Fish Stranding Events at Study Sites (Pearson et al. 2005a).

Sites	Stranding Events	Total Passages	Frequency (%)
County Line Park (RM 51)	3	17	17.6
Barlow Point (RM 62)	7	23	30.4
Sauvie Island (RM 97)	4	14	28.6
Overall frequency: 25.9% Chi square: p=0.64			

7-2 Susceptibility to Stranding

In addition to potentially changing the frequency of fish stranding events, channel modifications in the Columbia River and estuary might alter the susceptibility of different fish species to stranding. Pearson et al. (2005a) estimated the relative percentage of 11 species commonly collected in the locations of the stranding studies (Table 7-2.1). The results of seining indicated that the relative abundance of fish subject to stranding was dominated by the three-spine stickleback, peamouth, American shad, and age 0+ chinook salmon. The relative abundances of these species among the stranded fish were also calculated. Dividing the relative frequency of stranding by the relative abundance produced a ratio that defines the susceptibility for each of the 11 species (Table 7-2.1). Ratios greater than 1.0 indicate greater susceptibility to stranding. That is, the species is proportionally over-represented among the stranded fish compared to its relative availability. In contrast, susceptibility ratios less than 1.0 indicate some ability of the species to reduce its likelihood of stranding.

Bass (fry) were the most susceptible of the 11 species to stranding by commercial vessel passage. Sunfish (bluegill), crappie, and age 0+ chinook were also susceptible. The remaining species demonstrated some capability to avoid stranding. The susceptibility ratios can also serve as decision criteria for fish stranding in the AEM Plan. Potential modifications in fish habitat and changes in fish behavior associated with channel modifications could increase the local availability or susceptibility of these (or other) species. If post-Project susceptibility ratios increase significantly compared to those reported in Table 7-2.1, the adaptive components of the AEM Plan should be followed to determine the likely reason for the increases.

Table 7-2.1. Relative Susceptibility of Different Fish Species to Stranding (Pearson et al. 2005a).

Species	Percent Stranded	Percent Seined	Susceptibility Ratio
Chinook salmon (0+)	30.1	12.5	2.4
Three-spin stickleback	25.9	28.7	0.9
Peamouth	5.7	22.3	0.3
Banded killifish	10.6	12.3	0.9
Bass (fry)	16.0	0.2	80.0
American shad	8.2	20.1	0.4
Yellow perch	0.8	1.7	0.5
Mountain whitefish	0.6	0	0
Starry flounder	0.8	2.0	0.4
Crappie	0.4	0.1	4.0
Sunfish/bluegill	0.8	0.1	8.0

The pre-construction evaluation of fish stranding was completed in 2007 and the final report has been posted to the E2 Project website (www.e2tm.com/CRCIP). The form and content of these tables of decision criteria have been accepted by the AMT. The above decision criteria have been included in the AEM Workbook.

7-3 Post-Construction Probability of Stranding

As agreed upon during the January 2010 AMT meeting, the post-construction follow-up experiments are currently scheduled to be performed in March 2012–2013. However, the AMT also agreed to the analysis of the likely changes in stranding probabilities that might result from channel improvement. Of primary interest were the magnitude of changes in stranding probabilities associated with various scenarios of commercial navigation (e.g., fleet characteristics, and vessel speed) and the intensity of field sampling required to demonstrate anticipated changes with known statistical confidence (i.e., statistical power).

At the July 2010 AMT meeting, Dr. Walt Pearson described previous work related to characterizing the various contributions of river conditions and navigation to fish stranding. He outlined an approach to estimating the likelihood of measuring changes in fish stranding as a result of the CRCIP. An empirical model developed from the results of pre-Project field studies will be used to assess different scenarios regarding ship traffic and corresponding estimates of fish stranding. The results of the empirical assessments will contribute to future discussions by the AMT concerning the efficacy of planned post-Project studies of fish stranding.

Dr. Pearson presented the results of his calculations of post-Project fish stranding at the October 2010 AMT meeting. Dr. Pearson's report and October presentation have been posted to the fish stranding component of the electronic version of the AEM Workbook available at the E2 CRCIP website.

Following the October 2010 meeting, the AMT reviewed the preliminary report produced by Dr. Pearson and provided comments that will be addressed in developing a final report. Further discussions by the AMT concerning the efficacy of performing the post-construction field stranding studies are planned for 2011.

7-4 AMT Decisions for MA-6

Table 7-4.1 summarizes the key discussion points and decisions concerning the possible impacts of CRCIP construction on fish stranding through calendar 2010 for the AEM Program.

Table 7-4.1. CRCIP AEM Plan Record of AMT MA-6 Decisions.

Date	Issue	MA-6 Decisions	Comments
16 Dec 2004	**MA-6 Decision Criterion**	Studies of fish stranding will continue in 2005.	
16 Dec 2004	**MA-6 Decision Criterion**	Need to examine the statistical model to identify the factors and interaction terms that can be effectively incorporated into the AEM process.	
16 Dec 2004	**MA-6 Decision Criterion**	Revisit decision criteria after studies are completed (approx. November–December 2005).	
1 Sep 2005	**MA-6 Decision Criterion**	Post-construction studies of stranding will be performed and the results will be compared to pre-construction stranding study results.	
12 Oct 2005	**MA-6 Decision Criterion**	No decisions were made concerning fish stranding at the October 2005 AMT meeting.	
12 Apr 2006	**MA-6 Reporting**	The AMT suggested that tables describing fish stranding be modified to focus on species of concern (i.e., salmonids).	
10 Jan 2007	**MA-6 Fish Stranding**	The final report of the pre-construction evaluation of fish stranding has been completed and will be posted to the E2 FTP site.	
11 Jul 2007	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
3 Oct 2007	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
9 Jan 2008	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
29 Apr 2008	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
9 Jul 2008	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
8 Oct 2008	**MA-6 Fish Stranding**	No decisions were made for MA-6 at the October 2008 meeting.	
14 Jan 2009	**MA-6 Fish Stranding**	No new information was presented regarding MA-6.	
8 Apr 2009	**MA-6 Fish Stranding**	No new information was presented for MA-6 at the April 2009 meeting.	
8 Jul 2009	**MA-6 Fish Stranding**	No new information was presented for MA-6 at the July 2009 meeting.	
18 Nov 2009	**MA-6 Fish Stranding**	The AMT requested that the post-construction (Phase 2) fish stranding studies be performed as originally specified in the Biological Opinion.	
20 Jan 2010	**MA-6 Fish Stranding**	Post-Project construction studies will be performed in March 2012–2013.	
14 Apr 2010	**MA-6 Fish Stranding**	Post-Project construction studies will be performed in March 2012–2013. Additional discussion concerning the design of the studies is planned for the July 2010 AMT meeting.	
14 Jul 2010	**MA-6 Fish Stranding**	Dr. Walter Pearson has been contracted to evaluate the efficacy of post-construction experiments for fish stranding. Dr. Pearson will present initial results of his analysis at the October 2010 AMT meeting.	
13 Oct 2010	**MA-6 Fish Stranding**	Dr. Pearson presented the results of his analysis of the probability of fish stranding in the post-Project channel for several scenarios of commercial navigation. The AMT will review the report prepared by Dr. Pearson for discussion at the January 2011 AMT meeting.	

8 Sturgeon

Criteria to protect sturgeon as part of the AEM process address the possible CRCIP impacts on the mortality, survival, growth, movements, feeding behavior, and habitat utilization of these fish in relation to the dredging process and the disposal of dredged materials. These actions emphasize the selection of alternative sites for disposing of dredged materials if significant impacts are observed. Alternatively, the dredging schedule can be modified to minimize impacts on sturgeon.

No further discussion of potential Project impacts on sturgeon occurred during the 2010 AMT meetings. The following sections are identical to the 2009 annual report and are reproduced for convenience to the reader.

8-1 Decision Criteria for Sturgeon

AMT discussions during 2009 focused on status of the reports that summarized the results of the previous studies of the impacts of dredging on sturgeon and sturgeon habitat.

The two reports that summarize the studies of dredging activities have been essentially finalized during 2009. The first study describes the behavioral response of tagged white sturgeon to dredging activities. The second study developed a model that predicts sturgeon habitat quality based on physical descriptions of channel physical characteristics. The resulting reports were posted on the E2 website. The investigators are in the process of publishing the results of these studies in the open technical literature.

8-2 AMT Decisions regarding Sturgeon

Table 8-2.1 summarizes the key discussion points and decisions concerning the possible impacts of Project construction on sturgeon through calendar year 2010 for the AEM Program.

Table 8-2.1. CRCIP AEM Plan Record of AMT Decisions for Sturgeon.

Date	Issue	Sturgeon Decisions	Comments
16 Dec 2004	**Sturgeon**	Slope characteristics will be further analyzed to identify categories of slope and bed form using existing data. Results will be used to guide dredging and dredge disposal.	
16 Dec 2004	**Sturgeon**	Awaiting completion of report (due mid-January 2005).	
16 Dec 2004	**Sturgeon**	Mitigation strategy to be developed during January.	
16 Dec 2004	**Sturgeon**	Ongoing studies will look at disposal impacts.	

Table 8-2.1. CRCIP AEM Plan Record of AMT Decisions for Sturgeon. (Continued).

5 Jul 2005	**Sturgeon**	Previous monitoring studies of tagged sturgeon suggest minimal or no impacts of dredging or disposal of dredged materials on these fish. Additional analyses of the data are awaited to determine the nature of bottom type (flat or presence of structure) that seem important to sturgeon in the lower river and estuary. With the exception of a desire for additional studies by Washington (L. Randall), there is general consensus among the AMT that sturgeon can be removed from further consideration in relation to implementing the Project AEM Plan.	
1 Sep 2005	**Sturgeon**	At the July 5, 2005, weekly AMT meeting, the AMT agreed that previous monitoring studies of tagged sturgeon suggested minimal or no impacts due to dredging or disposal of dredged materials and that adaptive management will be required only if dredging activities alter habitat. The USACE had previously indicated that additional work would be done on correlating sturgeon abundance with habitat using the existing data.	
1 Sep 2005	**Sturgeon**	The USACE at the current meeting had concerns with funding stating that the work plan for this study was stopped and the study plan was not finalized. The agencies also requested that any study plans for this work be reviewed by all agencies.	
10 Jan 2007	**Sturgeon**	The USACE will check the status of the sturgeon habitat analysis.	
11 Apr 2007	**Sturgeon**	No decisions were required for sturgeon.	
11 Jul 2007	**Sturgeon**	The habitat analysis report for sturgeon has not yet been completed.	
3 Oct 2007	**Sturgeon**	It is anticipated that the United States Geological Survey will finalize the sturgeon report in time for the January 2008 AMT meeting. If the report is available in time, the results will be discussed at the meeting.	
9 Jan 2008	**Sturgeon**	The report describing habitat analysis for sturgeon should be available for the April 2998 AMT meeting.	
29 Apr 2008	**Sturgeon**	Oregon Department of Fish and Wildlife (ODFW) had some remaining issues and requested time at a future meeting to discuss them with the original investigators, who will be contacted concerning availability.	
9 Jul 2008	**Sturgeon**	The sturgeon habitat analysis and model developed by Parsley and Hatten will be posted to the E2 CRCIP website.	
8 Oct 2008	**Sturgeon**	No decisions were made for sturgeon at the October 2008 meeting.	
14 Jan 2009	**Sturgeon**	No new information was available for sturgeon at the January 2009 meeting.	
8 Apr 2009	**Sturgeon**	Finalization of the sturgeon report was re-scheduled for the July 2009 AMT meeting.	
8 Jul 2009	**Sturgeon**	The two reports that summarize the responses of sturgeon to dredging have been finalized.	
18 Nov 2009	**Sturgeon**	No new information was available concerning sturgeon for the November 2009 meeting.	

Table 8-2.1. CRCIP AEM Plan Record of AMT Decisions for Sturgeon. (Continued).

20 Jan 2010	**Sturgeon**	A green sturgeon study program is underway as part of the CRCIP O&M phase.	
14 Apr 2010	**Sturgeon**	A green sturgeon study program is underway as part of the CRCIP O&M phase.	
14 Jul 2010	**Sturgeon**	No new information was available concerning sturgeon for the July 2010 meeting.	
13 Oct 2010	**Sturgeon**	No new information was available concerning sturgeon for the October 2010 meeting.	

No new information concerning project impacts on sturgeon was presented or discussed during 2010. A green sturgeon program is included as part of the O&M phase. The sturgeon component of the AEM Program is therefore considered completed for the CRCIP project.

9 Smelt

Criteria to protect smelt (Eulachon) as part of the AEM process address the possible CRCIP impacts on the survival, movements, and habitat utilization of these fish in relation to the dredging process. Water Quality Certificates dated 2008 from the states of Oregon and Washington prohibit in-water disposal between the eighth and 20th weeks of the year (out migration) between CRM 35 and CRM 75.

9-1 Decision Criteria for Smelt

Decision criteria concerning disposal of dredged materials on smelt were provided in the 2006 annual report for the CRCIP AEM Plan (Table 9-1.1). The criteria are essentially compliance or non-compliance with state requirements for disposal of dredged materials during smelt migration. The AMT concurred that no variances with the decision criteria for smelt were reported for 2010.

Table 9-1.1. Compliance Measures Offered as Decision Criteria for Smelt in Implementation of the CRCIP AEM Plan.
Washington
In-water disposal of dredged material will not occur in areas shallower than 43-feet between CRM 35 and CRM 75 along the Washington shoreline. These areas are defined by depths determined in the pre-construction bank-to-bank bathymetry supplemented by additional channel bathymetry.
Washington, Oregon
In-water disposal will not occur during the period of peak Eulachon out migration (between the 8th and 20th weeks of the year) from the identified spawning areas (CRM 35–CRM 75). If in-water disposal is essential during the period of peak out migration, then the USACE shall further study the potential for Eulachon losses as a result of dredged material disposal impacts. Appropriate mitigation measures shall be developed based on the study outcomes, as determined through an AMP.

9-2 AMT Decisions regarding Smelt

The information summarized from the quarterly AMT meetings indicated that no decisions were required concerning project impacts on smelt during 2010 (Table 9-2.1).

Table 9-2.1. CRCIP AEM Plan Record of AMT Decisions for Smelt.

Date	Issue	Smelt Decisions	Comments
16 Dec 2004	**Smelt**	Regularly report compliance with state issues concerning flow-lane disposal.	
16 Dec 2004	**Smelt**	If flow-lane disposal becomes necessary, the abundance of smelt and time of peak out-migration will be documented by the USACE and provided to the AMT to determine timing and guidance for dredge disposal.	
28 Jun 2005	**Smelt**	The team agreed that dredging will occur between CRM 35–75 between August 1 and September 30.	
10 Jan 2007	**Smelt**	No issues or decisions concerning smelt were raised at the January 10, 2007, AMT meeting.	
11 Apr 2007	**Smelt**	No decisions were required for smelt.	
11 Jul 2007	**Smelt**	No decisions were required for smelt.	
3 Oct 2007	**Smelt**	No decisions were required for smelt.	
9 Jan 2008	**Smelt**	No new information was provided for smelt, although there was some discussion and recognition concerning smelt in the diet of sturgeon.	

Table 9-2.1. CRCIP AEM Plan Record of AMT Decisions for Smelt. (Continued).

Date	Issue	Smelt Decisions	Comments
29 Apr 2008	**Smelt**	No new information was available regarding smelt.	
9 Jul 2008	**Smelt**	No new information was available regarding smelt.	
8 Oct 2008	**Smelt**	No decisions were made for smelt at the October 2008 meeting.	
14 Jan 2009	**Smelt**	The AMT was informed that smelt might be listed as an endangered species during the spring of 2009.	
8 Apr 2009	**Smelt**	NMFS indicated that smelt would not likely be listed prior to the Project rock removal planned for the November–December 2009 and January–February 2010 in-water work window.	
8 Jul 2009	**Smelt**	It seems unlikely that smelt will be listed before completion of Project construction.	
18 Nov 2009	**Smelt**	No new information was available regarding smelt.	
20 Jan 2010	**Smelt**	The O&M phase of adaptive management will need to address the inclusion of smelt. Conditions may be placed on smelt in relation to an anticipated O&M Biological Opinion due from NMFS in April or May of 2010.	
14 Apr 2010	**Smelt**	The O&M phase of adaptive management will need to address the inclusion of smelt. Conditions may be placed on smelt in relation to an anticipated O&M Biological Opinion due from NMFS in April or May of 2010.	
14 Jul 2010	**Smelt**	No new information was available regarding smelt.	
13 Oct 2010	**Smelt**	No new information was available regarding smelt.	

The assessment of potential CRCIP impacts on smelt has been completed in relation to Project construction. However, smelt was listed as a threatened species on March 16, 2010. The effective date of listing was May 17, 2010. The new O&M Biological Opinion expected June 2011 will include consultation for smelt.

10 Dungeness Crab

The objectives of the AEM Plan concerning Dungeness crab are to avoid or minimize (1) entrainment mortality during dredging and (2) crab burial by disposal of dredged materials. The underlying intent is "no net loss" of these organisms as a result of channel improvement. Two studies were performed prior to Project construction to assess the potential impacts on crabs. Phase I studies addressed the physical forces associated with dredging on crabs. Phase II studies focused on the response of crabs to burial in experimental tanks. Phase III studies were proposed to examine crab burial under field conditions. However, it is logistically very difficult to perform the necessary experiments under field conditions and Phase III studies will not likely be conducted in relation to the AEM Program for the CRCIP.

In 2010, the CRCIP completed its obligations under Oregon and Washington's 401 requirements and DLCD's Coastal Zone Consistency Determination in relation to Dungeness crab. The following sections are reproduced from the 2009 annual report for the reader's convenience.

10-1 Decision Criteria for Dungeness Crab

As indicated in previous CRCIP AEM annual reports, entrainment studies were performed at several locations within the estuary, including the mouth of the Columbia River (MCR), Desdemona Shoals, Upper Sands, Miller Sands, and Flavel Bar (Pearson et al. 2005b). Estimated crab entrainment rates varied by location, age-class, and year. Entrainment rates decreased progressively upriver from the mouth of the estuary, presumably in relation to the reduced abundance of crabs (Table 10-1.1).

Table 10-1.1. Crab Entrainment Rates (crabs/cys) Estimated for 2004 (Pearson et al. 2005b).

Location	Age 0+	Age 1+	Age 2+	Age 3+	All
MCR All	0.0572	0.0028	0.0210	0.0128	0.0937
MCR-1	0.0535	0.0023	0.0147	0.0179	0.0883
MCR-2	0.0445	0.0022	0.0341	0.0126	0.0934
MCR-3	0.0760	0.0042	0.0137	0.0067	0.1007
Desdemona	0.0139	0	0.0035	0.0065	0.0239
Flavel Bar	0	0.0031	0.0035	0.0046	0.0112

Pearson et al. (2005b) recommended actions to mitigate the potential impacts of Project dredging on Dungeness crabs. One, understanding of seasonal patterns of salinity values throughout the lower river and estuary could be used to schedule dredging operations when salinity values are low (<16 psu) and crabs are correspondingly less abundant. Additionally, disposal of dredged materials should be avoided at the North Jetty Site thus reducing potential impacts on 1+ crabs that migrate through this area during the October–November time frame.

The AMT had previously agreed that the results of the crab entrainment studies provided useful information for evaluating the effects of Project-related dredging on crab mortality and distribution. However, during 2008, the AMT was informed that several issues of potential concern to the ODFW remained with regard to crab entrainment and burial. ODFW raised the need for additional information concerning dredging impacts on year of young (YOY) and age 1+ crabs.

The remaining issues concerning crab were further pointed out by the ODFW during the calendar year 2009. These issues concerned the potential impacts of dredging and disposal of dredged materials on crabs. While the ODFW recognizes the value of the Phase I and Phase II studies of crab entrainment and burial, the agency remains concerned about the comparative lack of information for YOY and smaller sized individuals. Previously proposed Phase III studies were to extend the laboratory entrainment and burial studies to field conditions. However, the logistical challenges posed by field conditions in further studying potential impacts on crabs have thus far precluded the Phase III studies. ODFW would like to see additional studies that describe the spatial-temporal variability in the distribution and abundance of crabs in areas potentially impacted by dredging or the in-water disposal of dredged materials.

The USACE underscored the difficulties of studying crab burial under field conditions and indicated that, as a result, Phase III studies will not likely be performed. In addition, the recent commercial harvests do not indicate that the crab populations are declining. Surveys of crabs following dredging and disposal indicate that crabs inhabit and utilize the newly deposited dredged materials. Despite the remaining issues and data gaps, ODFW indicated that no additional actions seemed necessary on the part of the AMT at this time.

Nevertheless, ODFW asked for confirmation that the OCMP crab conditions [II.a.(i)–(iv)] would apply to O&M following the completion of the Channel Improvement Project construction. These conditions primarily address activities to minimize crab entrainment and burial (e.g., use of the crab distribution model to schedule dredging and disposal), restrictions on dredging and flow lane disposal below CRM 17 during periods of high crab abundance, and a crab mitigation strategy. The opinion of the ODFW was that the conditions have been satisfied in relation to Project construction, but indicated that the final OCMP provisions apply to maintenance activities, as well as construction.

ODFW cautioned that although there is an ongoing and continuing AMP, state decisions (i.e., 401 and CZMA) are requirements that must be met by the USACE. This caution refers not only to crabs, but also to the sediment issues referred to previously (i.e., MA-3 and MA-4 above). It was noted, however, that the new 401 water quality certification does not identify crabs, although the sediment monitoring requirements are retained in the current CZMA.

10-2 AMT Decisions regarding Dungeness Crab

Table 10-2.1 summarizes the accumulated decision and key discussion points through calendar year 2010 concerning the CRCIP and potential impacts on Dungeness crab in the LCR and estuary.

Table 10-2.1. CRCIP AEM Plan Record of AMT Decisions for Crab.

Date	Issue	Crab Decisions	Comments
1 Sep 2004	**Crab**	The draft crab mitigation strategy document was sent out for review by the AMT on June 21, 2005. The agencies had no feedback on the document but considered it to be a living document that could potentially change as new information on crabs was obtained. They also indicated that additional information should be obtained on the distribution and abundance of 1+ crab at Desdemona shoal.	
12 Apr 2006	**Crab**	The AMT agreed that reporting on crab entrainment would mainly take the form of including new data that became available during the course of the Project.	
12 Apr 2006	**Crab**	The WDOE accepted the USACE crab mitigation plan subject to the collection of additional data in 2007 at the Desdemona sampling location.	
11 Oct 2006	**Crab**	The final version of the Pearson et al. (2005b) report on crab entrainment will be posted at the E2 Project website.	
10 Jan 2007	**Crab**	DLCD and ODFW indicated some remaining issues concerning project impacts on Dungeness crab. Conversations will occur separately outside the context of the AMT.	
11 Apr 2007	**Crab**	Final crab entrainment and burial report was posted to the E2 website.	
11 Jul 2007	**Crab**	The final report was posted for review on the E2 FTP site.	
3 Oct 2007	**Crab**	Awaiting possible comments from ODFW on crab report.	
9 Jan 2008	**Crab**	Dale Blanton will check to see if ODFW has any remaining issues regarding the crab study report. He will report at the July 2008 AMT meeting.	
29 Apr 2008	**Crab**	No decisions were made concerning crab.	
9 Jul 2008	**Crab**	ODFW indicated that there were some unresolved issues to be discussed concerning potential dredging impacts on crab. ODFW will summarize these issues at the October AMT meeting. There was also recognition of possible dredging conflicts between the time period for outmigration of juvenile salmonids and movement of Age 1+ crab.	
8 Oct 2008	**Crab**	No decisions were made for crab at the October 2008 meeting.	
14 Jan 2009	**Crab**	ODFW indicated that there were some remaining concerns regarding dredging and disposal for crabs, but no actions of the AMT were required.	
8 Apr 2009	**Crab**	ODFW requested confirmation that OCMP crab conditions [II.a(i)–(iv)] would apply to O&M following completion of the CRCIP construction.	
8 Jul 2009	**Crab**	No new information was presented concerning crab at the July 2009 meeting.	

Table 10-2.1. CRCIP AEM Plan Record of AMT Decisions for Crab. (Continued).

Date	Issue	Crab Decision	Comments
18 Nov 2009	**Crab**	No new information was presented concerning crab at the November 2009 meeting.	
20 Jan 2010	**Crab**	The CRCIP completed requirements concerning crab in relation to Oregon and Washington 401 requirements and the DLCD Coastal Zone Consistency Determination.	
14 Apr 2010	**Crab**	The CRCIP completed requirements concerning crab in relation to Oregon and Washington 401 requirements and the DLCD Coastal Zone Consistency Determination.	
14 Jul 2010	**Crab**	The CRCIP completed requirements concerning crab in relation to Oregon and Washington 401 requirements and the DLCD Coastal Zone Consistency Determination.	
13 Oct 2010	**Crab**	No new information was presented concerning crab at the October 2010 meeting.	

11 Sediments

Given completion of Project construction in December 2010, the sediment management activities will move to the O&M phase and Mike Ott (USACE) will be the USACE contact for this work. The sediment management component of the CRCIP AEM Program is considered complete.

The following sections are reproduced from the 2009 report for continuity across the CRCIP AEM annual reports.

11-1 Decision Criteria for Sediments

Discussions continued among the AMT participants in 2009 about the relationship between the CRCIP and recognized needs for regional sediment management for the LCR and estuary. Concerns were expressed among the AMT that opportunities for beneficial uses of Project dredged materials might have been or were being missed. Throughout 2009, USACE reinforced its intentions of looking for beneficial uses of Project post-construction dredged materials. With a transition of the Project from construction to O&M, the USACE will continue its interest in contributing to regional sediment management activities.

Doris McKillip (USACE) briefly described regional sediment management activities. An omnibus bill was pending that will provide funds for regional sediment management. The Water Resources Development Act (WRDA) has been amended to specifically address sediment management. The south jetty project includes sites in the MCR proposal for littoral zone restoration. The sites are located mainly along the Oregon coast. Approximately $450K has been added to the south jetty regional sediment management budget. Other stakeholders interested in regional sediment management include the Lower Columbia Solutions Group (LCSG). The LCSG has been examining potential restoration and replacement sites on the Washington side of the river. There might be as much as $1.7 million in USACE matching funds for beneficial uses of sediments intended for upland disposal.

The USEPA has been interested in a regional sediment management plan through its LCREP to apply from Bonneville Dam to the MCR. The AMT wants to ensure that the CRCIP Sediment Management Plan is also noted and considered in the development of the regional framework.

11-2 Summary of Decisions

Table 11-2.1 summarizes the decisions made through 2010 regarding the relevance of Project disposal of dredged materials to regional sediment management.

Table 11-2.1. CRCIP AEM Plan Record of AMT Decisions for Sediments.

Date	Issue	Sediments Decisions	Comments
11 Jan 2006	**Sediment Management**	The USACE and E2 agreed to collaborate with WDOE in the development of language concerning sediments (i.e., management of disposal of dredged materials) for incorporation into the Project of the AEM Plan.	
12 Apr 2006	**Sediment Management**	The USACE agreed to further consultation with WDOE concerning the incorporation of sediment management language into the AEM Plan.	
10 Jan 2007	**Sediment Management**	The AMT requested that the exact state language be incorporated into documentation of the sediment management component of the AEM. The USACE will continue to work with the AMT on achieving consensus regarding sediment management in relation to the Project.	
11 Apr 2007	**Sediment Management**	No decisions were required for sediment management. Discussion was deferred to the July AMT meeting.	
11 Jul 2007	**Sediment Management**	Discussions of sediment management were rescheduled for the October AMT meeting.	
3 Oct 2007	**Sediment Management**	Discussions of sediment management will continue at the January 2008 AMT meeting.	
9 Jan 2008	**Sediment Management**	The April 2008 AMT meeting will focus on conceptual models and approaches to regional sediment management. E2 will propose a "strawman" conceptual model in advance of the April meeting.	
29 Apr 2008	**Sediment Management**	The April AMT meeting developed an initial process for sediment management in relation to Project construction. The process has been summarized in a draft sediment management workshop report.	
9 Jul 2008	**Sediment Management**	Sediment management will likely occur under LCR channel operation and maintenance. The AMT agreed to look more broadly across USACE projects for opportunities in regional sediment management. The future of sediment management in relation to CRCIP AEM Program will be addressed at the October AMT meeting.	
8 Oct 2008	**Sediment Management**	The 2008 AMT sediment management workshop report was approved as final.	
14 Jan 2009	**Sediment Management**	The AMT expressed a desire that the CRCIP Sediment Management Plan be communicated to regional sediment management activities underway.	
8 Apr 2009	**Sediment Management**	Mike Ott (USACE) will replace Doris McKillip (USACE) with regard to future AMT discussions of regional sediment management.	
8 Jul 2009	**Sediment Management**	The USACE reinforced its intentions of looking for beneficial uses of Project construction dredged materials. This interest will continue into the O&M activities.	
18 Nov 2009	**Sediment Management**	Sediment management (i.e., beach nourishment) was discussed in relation to post-construction fish stranding studies. A decision was made to go forward with the Phase 2 fish stranding studies.	
20 Jan 2010	**Sediment Management**	No new information was presented in relation to sediment management.	
14 Apr 2010	**Sediment Management**	No new information was presented in relation to sediment management.	
14 Jul 2010	**Sediment Management**	No new information was presented in relation to sediment management.	
13 Oct 2010	**Sediment Management**	No new information was presented in relation to sediment management.	

12 Integration with 2009 AEM Results

Each annual report refers to AEM activities and conclusions in the prior year to provide continuity during the AEM Program for the CRCIP. The following sections briefly review the 2009 AMT activities and summarize AEM monitoring results. Additional detail can be found in the notes from the quarterly AMT meetings and the AEM Program workbook that are available through the project website hosted by E2 (www.e2tm.com/CRCIP).

12-1 Results for Analyses of 2009 Data for MA-1

The primary MA-1 decision criteria are the monthly percentile values for depth, temperature, and salinity. Monthly median values calculated from the CORIE data for tansy, grays, and cbnc3 are compared against these criteria. Tables 12-1.1–12-1.7 list these decision criteria and corresponding MA-1 monthly results for 2009. Detailed plots of daily median values and normalized values of temperature and salinity can be examined by downloading the corresponding files at the E2 website.

Depth

Table 12-1.1 lists the 2009 monthly median depths for the grays station. All 12 monthly values are within the 20–80th percentile decision criteria.

Temperature

With only three exceptions (January, April, and November) the 2009 monthly median values of water temperature are all within the 20–80th percentile ranges for tansy (Table 12-1.2). All but two of the 2008 grays monthly median values of water temperature are within the 20–80th percentile ranges (Table 12-1.3). Similarly, all but two of the 2008 cbnc3 monthly median values of water temperature are within the 20–80th percentile ranges (Table 12-1.4). Only one of the monthly median values calculated for 2009 was outside of the 5–95th percentile ranges.

Salinity

Tables 12-1.5–12-1.7 present the monthly median salinity values for tansy, grays, and cbnc3. The 2009 results are quite similar to those observed in 2010. The available 2009 data for tansy are all within the 20–80th percentile decision criteria. The 2009 monthly median values for grays are more variable in relation to the decision criteria. The monthly median salinity values for January through June were effectively zero at grays. Values for July through November were within the 20–80th percentile decision criteria. The December value was within the 80–95th percentile range.

Salinity data were not available for cbnc3 during 2009.

Table 12-1.1. Summary of 2009 Monthly Median Depth Values (bold numbers) for Grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly median depth (m)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	0.6	0.5	0.5	0.5	0.4	0.3	0.2	0.2	0.3	0.3	0.4	0.5
20	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.9	0.9	1.1	1.2
	2.0	**No data**	**No data**	**No data**	**1.8**	**1.8**	**1.9**	**1.8**	**1.7**	**1.8**	**2.0**	**No data**
80	2.8	2.8	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.7	2.8
95	3.4	3.3	3.2	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.3	3.3

Table 12-1.2. Summary of 2009 Monthly Median Temperature Values (bold numbers) for tansy Station in Relation to AEM Percentile Decision Criteria.

	Monthly median temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	4.9	5.3	6.3	8.4	9.2	9.4	9.4	9.3	9.4	9.3	8.3	6.5
												6.8
20	6.2	6.4	7.4	9.3	10.6	10.9	10.8	11.0	11.0	11.1	9.4	7.6
	6.3	**6.8**	**7.2**	**9.1**	**11.6**	**15.6**	**14.9**	**15.1**	**16.0**	**13.0**	**10.4**	
80	9.2	8.9	9.7	11.2	13.4	15.6	16.9	17.4	16.1	13.9	11.6	9.9
95	10.3	9.9	10.8	12.0	14.5	16.8	18.9	19.3	17.7	15.1	12.5	10.8

Table 12-1.3. Summary of 2009 Monthly Median Temperature Values (bold numbers) for Grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly median temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	4.0	4.1	5.2	8.0	10.5	14.1	16.6	18.3	16.3	11.8	7.4	5.2
	4.4	**4.5**										
20	4.7	4.7	6.0	9.0	11.6	15.2	18.0	19.3	17.3	12.9	9.0	6.2
			6.2	**9.3**	**12.7**	**17.2**	**19.6**	**20.5**	**19.0**	**14.1**		**No data**
80	6.6	6.5	8.4	11.4	14.8	17.6	20.6	21.1	19.5	15.9	11.3	8.0
											11.9	
95	7.7	7.3	9.4	12.6	15.9	18.8	21.8	21.9	20.5	17.3	12.3	8.8

Table 12-1.4. Summary of 2009 Monthly Median Temperature Values (bold numbers) for cnbc3 Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	3.2	4.2	5.1	8.1	11.1	14.9	17.4	18.4	16.0	11.9	7.7	5.2
		4.2	**5.9**									**5.2**
20	4.1	4.8	6.0	8.9	12.1	15.6	18.4	19.5	17.1	13.4	9.0	6.1
	4.8			**9.2**	**12.7**	**17.1**	**19.5**	**20.7**	**19.2**	**14.0**	**9.8**	
80	6.4	6.5	8.3	11.2	15.0	17.7	21.1	21.5	19.5	16.7	10.9	7.6
95	7.3	7.2	9.0	12.6	16.0	18.8	22.3	22.3	20.6	17.8	12.0	8.6

Table 12-1.5. Summary of 2009 Monthly Median Salinity Values (bold numbers) for Tansy Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	1.2	0.9	0.7	0.7	0.9	0.4	1.6	3.5	4.8	5.9	3.3	2.4
20	4.2	3.7	3.4	3.0	2.7	1.7	3.8	8.7	10.4	10.7	6.8	5.9
	No data	**19.5**	**13.4**	**5.9**	**4.8**	**6.7**	**15.8**	**17.8**	**18.6**	**15.2**	**9.9**	**8.3**
80	23.9	23.4	21.5	23.0	22.9	22.9	24.1	26.3	26.0	26.0	23.9	24.6
95	27.3	26.7	25.5	26.6	26.5	27.2	28.4	28.9	28.6	28.0	26.9	27.6

Table 12-1.6. Summary of 2009 Monthly Median Salinity Values (bold numbers) for grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
	0			**0**	**0**	**0**						
5	0.2	0.2	0.2	0.2	0.0	0.2	0.3	0.3	0.5	0.4	0.3	0.3
	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.8	0.7	0.5	0.3
20			**0.4**				**0.7**	**2.3**	**3.5**	**3.1**	**1.8**	**No data**
80	1.2	0.8	0.8	0.7	0.7	0.7	2.4	2.4	4.4	3.7	2.7	0.8
		1.3										
95	3.1	2.7	2.0	1.4	0.8	1.3	5.5	4.4	6.9	6.2	4.8	2.2

Table 12-1.7. Summary of 2009 Monthly Median Salinity Values (bold numbers) for cbnc3 Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
		0	**0**	**0**	**0**	**0**	**0**				**0**	**0**
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
20	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.2	0.2
	No data							**1.7**	**2.8**	**2.8**		
80	0.7	0.7	0.7	0.7	0.7	0.7	1.7	2.5	3.5	7.0	2.2	0.7
95	2.3	2.1	3.3	1.7	0.9	1.5	4.5	6.3	9.3	12.3	5.3	2.0

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