

Initiation of Thin-Layer Sediment Augmentation on the Pacific Coast
AGREEMENT # P1496011 00
U.S. Fish and Wildlife Service, San Diego NWRC

QUARTERLY PROGRESS REPORT
As of March 31, 2017

Date: April 25, 2017

Dates Covered by this Report: January 1 – March 31, 2017

Agreement No.: P1496011 00

Grant Term: March 1, 2020

Project Title: Initiation of Thin-Layer Sediment Augmentation on the Pacific Coast

Grantee: U.S. Fish and Wildlife Service, San Diego NWRC

FISCAL REPORT

Fund Source	Amount Awarded	Amount Invoiced as of March 31, 2017	Total Amount Remaining
CDFW GGRF Grant Funds	\$1,055,827	\$ 296,669	\$759,158
Cost Share	\$1,306,048	\$1,476,372*	<\$170,324>
Agreement Totals	\$2,361,875	\$1,773,041	\$588,834

* Includes in-kind staff time from USFWS (Refer to Attachment 1 for details.)

Invoice Submitted this Quarter: Yes (under separate cover) No

PROGRAM/TECHNICAL REPORT

Activities Performed from January 1 – March 31, 2017:

- **Monitoring:** Researchers continued their post-augmentation monitoring activities on the augmentation site and the control site and/or conducted lab work to analyze data/samples obtained at the sites during the last quarter.

USGS continued to maintain and upload data from YSI and ADCP monitoring equipment (to measure turbidity levels and sediment flux) adjacent to the augmentation site during this quarter, as well as to gather data related to the elevation changes at the control site and the augmentation site as measured by the surface elevation tables (SETs).

- **Site Observation:** USGS staff noted changes occurring on the augmentation site in mid-January. In the area next to SET 10, where the contractor applied too much sand, the "hill" of sand was losing elevation likely due to seasonally higher tides and storm activity. In the southeast corner of the site, near SET 15, the area still has a very "fluffy" sand surface and a lot of shells. Overall, there was more water pooling occurring on the site and algae growth

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was observed on the surface of the augmentation site. In the north and west sections of the augmentation site, USGS reported the growth of pickleweed (*Salicornia*) in an area 10 to 15 feet in from the inner edge of the buffer area. In addition, at the northwest section of the site within the buffer area, the density of cordgrass (*Spartina foliosa*) appears to be increasing and in several areas is expanding into the augmentation site.



Figure 1. Northwest corner of the augmentation site looking west: cordgrass is present within the augmented area in the foreground, ponded water and algae can be seen near the top of the photo. (Photo: Chase Freeman, USGS)

Refuge staff also observed cordgrass growth within the augmentation site during a site visit conducted on January 26. It was not clear if the cordgrass was recruiting from seed or was growing up through the sediment from buried rhizomes. Numerous pickleweed plants were also observed growing within the outer edge of augmentation boundary. Refuge staff also noted that the site received a significant amount of rainfall during this quarter. Approximately 6.4 inches of rain has been recorded since the beginning of January, with significant rainfall occurring on January 22, 2017.



Figure 2. Northwest corner of the augmentation site: arrows indicate pickleweed growing within the augmentation site. (Photo: Chase Freeman, USGS)

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Figure 3. Another area of cordgrass regrowth located near the project's western creek. Ponded water and algae are also present in this area. (Photo: Rick Nye, USFWS)

Project Coordination

- Effective February 1, 2017, Richard (Rick) Nye became the project manager for the augmentation project. Rick is the new Refuge Manager for the Seal Beach NWR, replacing Kirk Gilligan, who accepted the position of Deputy Project Leader at the Hopper Mountain NWR Complex. CDFW was informed of this change in a letter dated January 18, 2017 (attached).
- Team conference calls were held on January 27 and March 21, 2017.
- Researchers and monitors provided summaries of activities completed during the quarter and when available, provided relevant interim results.

Project Outreach/Information Dissemination

- The Refuge webpage (https://www.fws.gov/refuge/seal_beach/what_we_do/resource_management/Sediment_Pilot_Project.html) was updated to include all quarterly and annual reports, new photos, updated time lapse photography, new project contact information, and links to the U.S. Army Corps of Engineers webinar series on Ecological Function of Coastal Salt marsh in Response to Sea Level, which included presentations related to this thin-layer sediment augmentation project.

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- The U.S. Army Corps of Engineers Research and Development Center is currently preparing a summary report of their 2016 summer webinar series, Ecological Function of Coastal Salt Marshes in Response to Sea Level. Kirk and Rick participated in the webinar, presenting the Seal Beach NWR sediment augmentation project as one of the case studies. The summary report will focus on approaches rather than data.

Status of Ongoing Research

- A. UCLA (SEDIMENT CORING):** Researchers at UCLA under the direction of Dr. Glen MacDonald are finalizing their report on pre-augmentation net sediment accretion rates and average carbon accumulation rate (CAR) at Seal Beach NWR. Cesium dating has been conducted at USC and radiocarbon dating is underway at UC Irvine. The results from six cores indicate that the age of the marsh at Seal Beach ranges from 620 years old to 1,600/1,700 years old. The individual cores interestingly are quite variable. Long-term sediment deposition rates vary by a factor of approximately 3. The radiocarbon dating, which indicates a 3mm per year deposition rate, will be fine-tuned with the Cesium dating. The final report is scheduled for completion in June 2017.
- B. UCLA (CHANGES IN MARSH PLAIN POST-AUGMENTATION):** Under the direction of Dr. Richard Ambrose, researchers are analyzing data obtained at the project site and control site following completion of the augmentation process. Lab work includes analysis of bulk density, sediment height, grain size, feldspar cores, and tidal creek cross-sections.
- C. CSU LONG BEACH (PLANT AND INVERTEBRATE STUDIES):** No field work was conducted during this period, but laboratory analysis, primarily invertebrate sorting, was ongoing throughout the quarter. All fall 2016 (2nd post-augmentation period) invertebrate samples (taken from the top 2 cm) have been sorted and are being processed to identify the invertebrates to species.

Invertebrate samples taken six months after augmentation, in fall 2016, show an increase in the abundance of invertebrates with 20 out of 21 sampling sites having invertebrates present. Although samples are still dominated by insects and insect larvae, sampling indicates an increase in representation of oligochaetes and polychaetes since initial post-augmentation samples were taken in spring 2016.

- D. CHAPMAN UNIVERSITY (GAS FLUX):** Dr. Jason Keller and his research team made three trips to the sites during this quarter (13 January 2017; 16 February 2017; 2 April 2017). On each sampling trip, gas samples were collected from both the control and augmentation sites and analyzed for carbon dioxide, methane, and nitrous oxide at Chapman University. On each sampling event, surface porewater was also collected to analyze chemical properties. The sampling technique was revised slightly to facilitate the collection of porewater from both the augmentation and control sites. This was necessary to address challenges related to collecting surface porewater at the augmentation site.

In an effort to identify any issues related to acidification of the augmentation site due to sulfide availability, Dr. Keller continues to measure pH in surface water in the field and in

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porewater collected at both sites. In addition, redox in surface water is also being measured. The team is actively working to test and refine the methods necessary to measure porewater collected over the course of this project for nitrate and sulfate/chloride.

Based on the data collected during this quarter, the team noted that significant CH₄ fluxes were minimal, but occasional positive fluxes were measured from *Spartina* and pond communities. Low CH₄ fluxes are common from salt marsh soils. Positive N₂O fluxes are rare and low N₂O fluxes are common in salt marsh soils without nitrogen pollution. CO₂ fluxes were generally lower from the control site pre-augmentation (possibly due to lower air temperatures during sampling), and were lowest from ponded communities. After completion of sediment augmentation, the augmentation site had very low CO₂ fluxes compared to pre-augmentation conditions and measurements taken at the control site.

E. USGS (SEDIMENT FLUX PATTERNS AND SETS): During this quarter, USGS staff continued monitoring surface elevations at the augmentation site and the control site, while monitoring of sediment fluxes also continued adjacent to the control site (deep channel site) and near the augmentation site (eelgrass site). Based on the monitoring results from this quarter, post construction mean suspended sediment concentration (SSC) and sediment fluxes were recalculated to include the most recent monitoring periods. SSC and sediment fluxes were also calculated for ten isolated storm events where the daily precipitation rate was above 0.5 inches per day measured at a nearby weather station (CIMIS #174, Long Beach). Recalculated post construction mean SSC values were 8 mg/L for the eelgrass and 6 mg/L for the deep channel site, with a small amount of export sediment (Table 1 and Figure 4). Mean post construction SSC is still equal to baseline levels observed in the deep channel, but is now only 2.7 times greater, compared to four times greater in the last quarterly report, than mean pre-construction SSC at the eelgrass site.

Table 1- Instantaneous SSC and Sediment Fluxes Averaged across Date Range of Activities			
<i>Activity</i>	Eel SSC (mg/L)	Deep SSC (mg/L)	Deep Flux (g/m ² /s)
<i>Pre-construction</i>	3	6	-0.3377 ¹
<i>Construction² - Hay Bale Install</i>	11	6	-0.25193
<i>Construction - Silt Fence Install</i>	21	6	-0.05157
<i>Construction - 8" Spray Dredge</i>	9	6	-0.26248
<i>Construction - 12" Spray Dredge³</i>	30	6	0.005773
<i>Construction - Dredge Clam Shell</i>	18	6	-0.11731
<i>Construction - Demobilization</i>	35	5	0.23947
<i>Post Construction⁴</i>	8	6	-0.00785

¹ Negative flux values indicate export

² Items are ordered in chronological order, but there is some overlap between construction events

³ Spraying dredged sediment using a 12-inch pipe and demobilization of equipment resulted in the highest SSC adjacent to the augmentation site

⁴ Post construction values have been updated since last report

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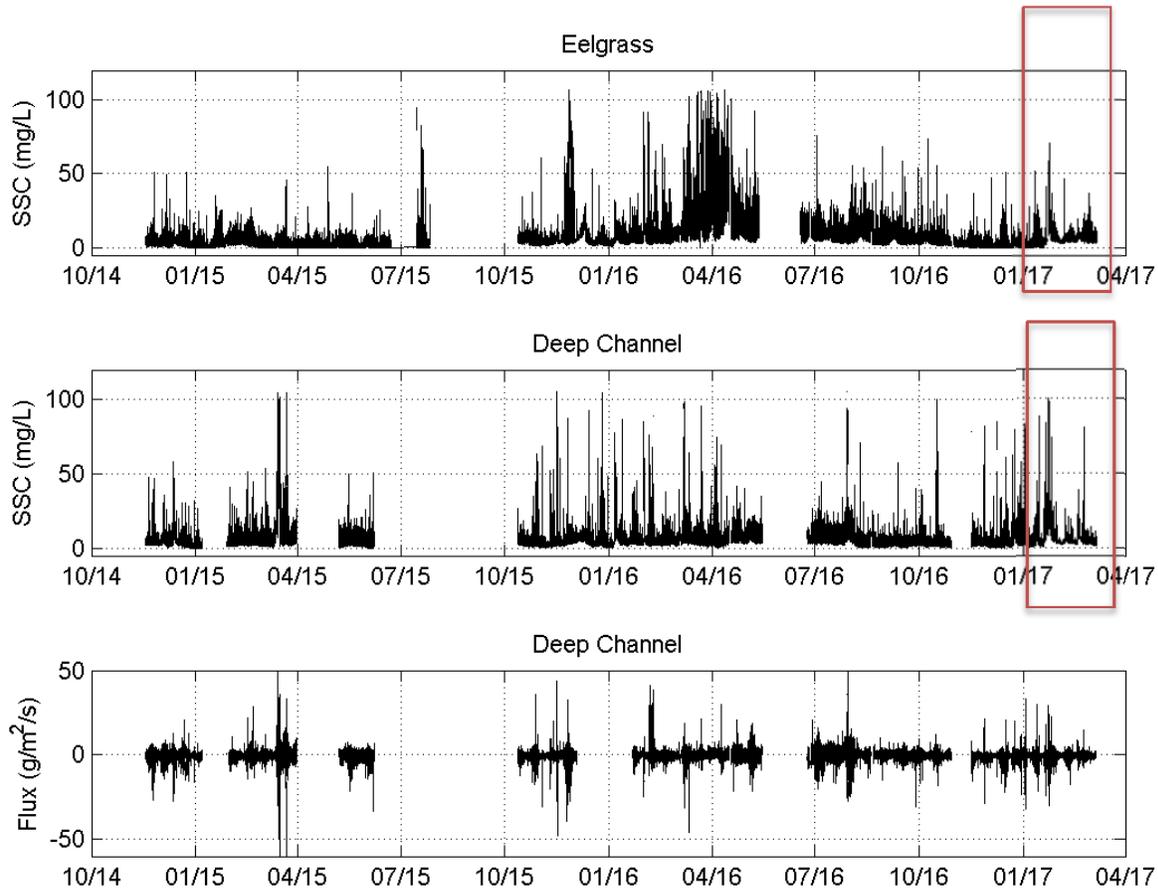


Figure 4. Time series of SSC and sediment fluxes during and after augmentation construction activities. Red boxes indicate the most recent monitoring period.

Mean SSC was greatest at both the eelgrass site and deep channel site during a storm on Jan 22, 2017, which yielded approximately 3.66 inches of rain as measured at weather station CIMIS #174, Long Beach (Table 2). Using Surface Elevation Tables (SETs), an initial surface elevation loss has been documented at the augmentation site SETs (Figure 5), presumably from a combination of compaction of the marsh platform and sediment being suspended during high tides and leaving the marsh. SETs at the control site have had gains and losses of elevation since installation, but have a mean cumulative increase of 4.08 mm from the date of installation (Figure 6). The SETs at the augmentation site had a mean increase in elevation of 216 mm with sediment application, but between April and October 2016, there was a decrease in elevation of 63.16 mm. During the latest measurement period, October through December 2016, the mean elevation increased 0.93 mm, indicating that elevation in the marsh has stabilized.

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Table 2 - Instantaneous SSC and Sediment Fluxes Averaged across Date Range of Storms¹ after Demobilization			
<i>Storm Date</i>	Eel SSC (mg/L)	Deep SSC (mg/L)	Deep Flux (g/m ² /s)
<i>Storm 20161121</i>	2	5	-0.30847 ²
<i>Storm 20161216</i>	5	7	-0.978
<i>Storm 20161221</i>	1	6	-0.30249
<i>Storm 20170105</i>	1	2	-0.08104
<i>Storm 20170109</i>	2	3	-0.27097
<i>Storm 20170112</i>	5	5	-0.62627
<i>Storm 20170119</i>	4	11	-0.08076
<i>Storm 20170122</i>	14	29	0.225957
<i>Storm 20170206</i>	5	6	-0.17776
<i>Storm 20170217</i>	6	6	0.166094

¹ A storm was defined as one or more consecutive days of rain with at least 0.5 inches per day of precipitation

² Negative flux values indicate export

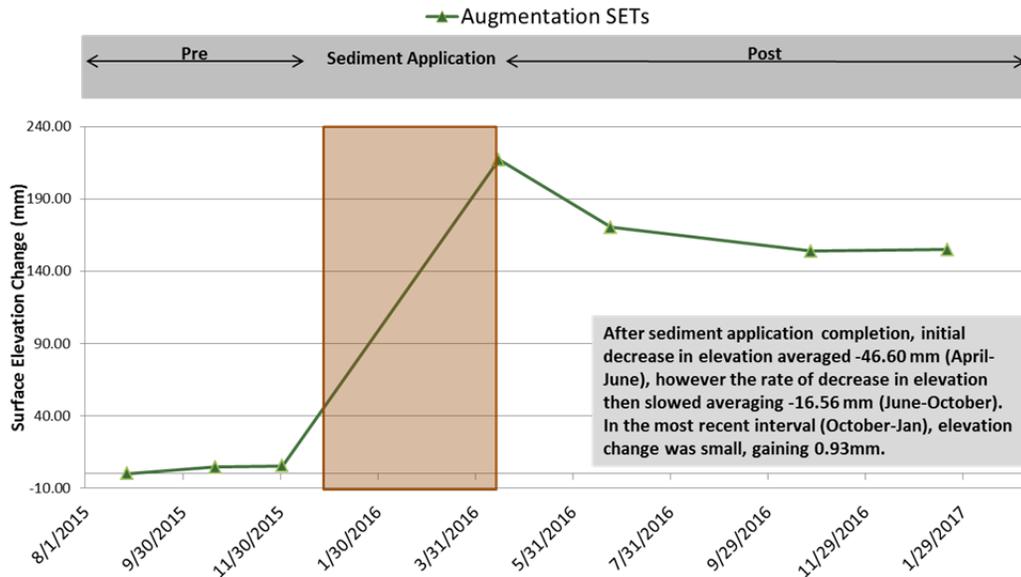


Figure 5. Mean surface elevation change at the augmentation site.

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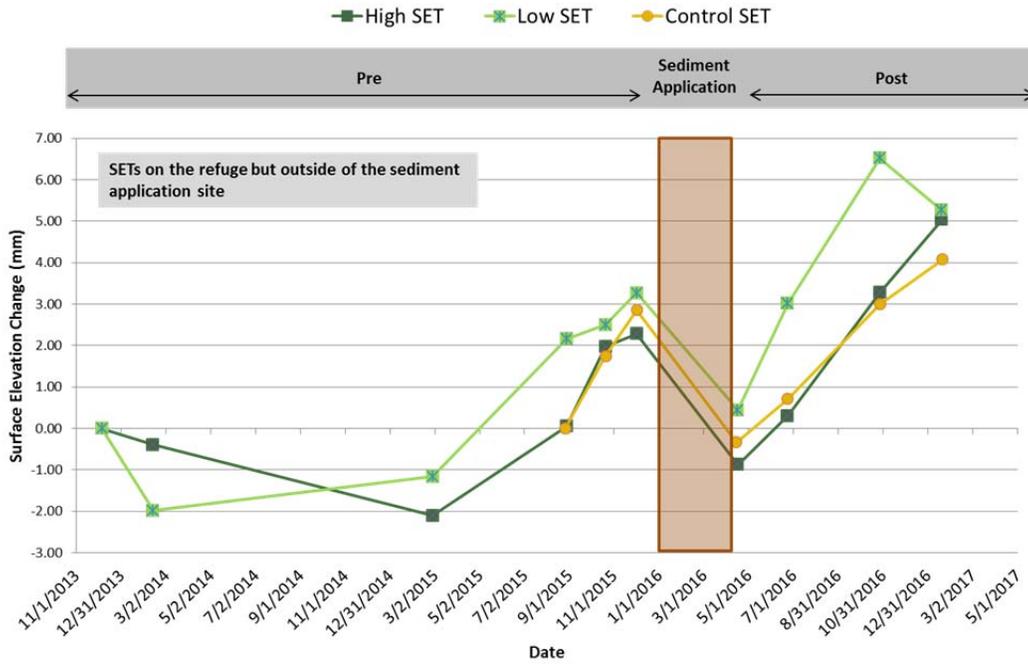


Figure 6. Mean surface elevation change at the control site.

F. BIRDS SURVEY RESULTS FOR THIS QUARTER:

As presented in Table 3, bird use on the site remains low during high and low tide surveys. Surveys to determine the extent of light-footed Ridgway's rail use on the site will begin in April 2017.

Table 3 - Monthly High and Low Tide Survey Results of Avian Usage at the Sediment Augmentation Site (January – March 2017)						
Species	Jan. 14 high tide	Jan. 24 low tide	Feb. 24 low tide	Feb. 28 high tide	March 11 high tide	March 26 low tide
Canada goose					2	
Red-breasted Merganser	19					
Great egret	2			1		
Surf scoter	4					
Northern harrier			1			
Long-billed curlew	1				12	
Western gull	1			1	2	
Total Birds Counted	27	0	1	2	16	0

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Percentage of Task Completed as of March 31, 2017:

Task 1 – Project Management and Administration	40%
Task 2 – Sediment Augmentation	100%
Task 3 – Project Monitoring (overall)	40.7%
1) Carbon Storage/Sequestration Benefits	90%
2) Percent Total Plant Coverage	20%
3) Pacific Cordgrass Analysis	20%
4) Site Elevations	25%
5) Sediment Analysis (compaction, movement, bulk density)	30%
6) Turbidity Levels	50%
7) Eelgrass	50%
Task 4 – Engineering Design/Environmental Documentation (overall)	100%
1) Engineering Plans for Sediment Augmentation Site	100%
2) Environmental Documentation*	100%
*CEQA/NEPA has been completed by SCC/USFWS	
Task 5 – Public Participation/Presentations (overall)	40%
1) Oral/Poster Presentations	45%
2) Workshops and/or Webinars	30%
<u>Overall Project</u>	64.1%

Deliverables Completed for Each Task:

Task 1 – Project Management and Administration

- | | |
|------------------------------|-------------------------------------------|
| 1) Quarterly Progress Report | 6 to date |
| 2) Monthly Invoices | 17 to date |
| 3) Subcontractor Selection | Orange County Parks & SWIA selected |
| 4) Data Management | preliminary data for monitoring locations |
| 5) Acknowledgement of Credit | ongoing |

Task 2 – Sediment Augmentation

- | | |
|--------------------------------------|------------|
| 1) Sediment Application | completed |
| 2) Adaptive Management | on going |
| 3) Reporting Results/Lessons Learned | in process |

Task 3 – Project Monitoring

- | | |
|------------------------------------------|-----------------------------------------------------------------------------|
| 1) Carbon Storage/Sequestration Benefits | pre-augmentation site monitoring
completed/core data processing underway |
| 2) Percent Total Plant Coverage | pre-augmentation work completed/post
augmentation work underway |
| 3) Pacific Cordgrass Analysis | pre-augmentation work completed |

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- | | |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 4) Site Elevations | pre-augmentation RTK survey and initial post-augmentation photogrammetry work completed; continuing data collection from SETs |
| 5) Sediment Analysis | initial core samples retrieved/data processing underway; more coring to occur |
| 6) Turbidity Levels | monitoring ongoing; prel. data available |
| 7) Eelgrass | pre-augmentation and initial post-augmentation work completed |

Task 4 – Engineering Design/Environmental Documentation

- | | |
|-----------------------------------------------------------------------|----------------------------------------|
| 1) Engineering Plans for Augmentation Site | 100% engineering plans completed |
| 2) Environmental Documentation*
*for USFWS and Coastal Conservancy | CEQA/NEPA documents final; ND recorded |

Task 5 – Public Participation/Presentations

- | | |
|------------------------------|------------------------------------------------------------------------------------------------------------------|
| 1) Oral/Poster Presentations | Presentations ongoing |
| 2) Workshops and/or Webinars | Participated in U.S. Army Corps webinar; Lessons learned/first-year post augmentation workshop/webinar fall 2017 |

Problems/Delays Proposed Resolution:

No delays have been identified for post-augmentation monitoring. We continue to monitor eelgrass recovery, which is occurring, adjacent to the site and will conduct another eelgrass survey in the surrounding tidal channels in April 2017.

Project Benefits and Results:

It is too early in the project to address project benefits and results, but we have learned quite a bit about the sediment augmentation process. Our “lessons learned” document will benefit those land managers contemplating the initiation of this process elsewhere on the Pacific Coast. The data being collected to better understand carbon sequestration rates at this site will also benefit other land managers along the southern California coast.

Summarize Benefits to Disadvantaged Communities (if applicable):

Not applicable to this project.

List of Proposed Activities and Tasks for the Next Quarter:

Task 1 – Project Management and Administration

Tasks include coordination of pre-project monitoring reports, which are due from the research teams no later than June 9, 2017; preparation of a “lessons learned” document for the sediment augmentation process will be completed, assisting researchers with site access; preparing invoices and the next quarterly/annual report; and all other responsibilities needed to successfully complete the project.

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Task 2 – Sediment Augmentation

The sediment augmentation process has been completed. Preparation of the “lessons learned” document is underway, with a draft expected in May. The draft will be distributed to the project team for review and comment to ensure accuracy and completeness. A final document should be available in June 2017.

Task 3 – Project Monitoring

Refuge staff will begin recording the locations (GPS) of cordgrass regrowth within the augmentation site, and will attempt to determine if cordgrass reestablishment is the result of seed distribution or regrowth from buried rhizomes. Photo documentation of changes on the augmentation site over time will also continue.

USGS will continue providing SSC and flux data, along with elevation data from the SETs. There will also be an estimate of sediment depth from the pre and post sedimentation elevation data.

Dr. MacDonald and his team at UCLA will complete their core sample analyses and provide a final report.

Dr. Ambrose and his team at UCLA will conduct field sampling (i.e., bulk density, sediment height, feldspar cores, tidal creek cross-sections) at the augmentation site and control site in April 2017 and continue to analyze bulk density, grain size, and carbon content (loss on ignition [LOI]) for newly collected samples, as well as conduct data entry and analysis.

Dr. Whitcraft and her team will conduct spring sampling of invertebrates and photosynthetic rates April 20 – 24, 2017, followed by lab analysis and invertebrate sorting.

Dr. Keller and his team are developing a method for the analysis of porewater ions (e.g., chloride, sulfate) using a Dionex ion chromatograph, which has been repaired and is now functioning. Future work will include continuing to measure greenhouse gas fluxes from the sites as more of the marsh habitat continues to reestablish following augmentation. Seasonal patterns in fluxes and their relationship to porewater chemistry will also be explored as the dataset expands.

MTS is currently scheduling a time to conduct the year one post-augmentation eelgrass survey as required by NOAA. The results of the field survey will be forwarded to NOAA and other interested parties, once the associated report has been completed.

Task 4 – Engineering Design/Environmental Documentation

This task has been completed.

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Task 5 – Public Participation/Presentations

The projects lead researchers are working on a session focused on sediment augmentation that will be presented at the fall 2017 Coastal and Estuarine Research Federation meeting. The Refuge webpage will continue to be updated, and we will participate in conferences and webinars as opportunities arise. Once the “lessons learned” documentation is completed and we have some initial post-augmentation monitoring results, we will begin preparations for a workshop or webinar. In the meantime, information about the project continues to be disseminated through presentations from various team members at conferences, meetings, and agency-sponsored webinars. Upcoming conferences and other science-related meetings include:

- **Annual Meeting of the Southern California Academy of Sciences (April 2017)**
Students working with Dr. Keller will present a poster of their findings to date at the annual meeting. The poster will also be presented at the Chapman University Student Research Expo in mid-May.
- **Headwaters to Oceans (H₂O) Conference (UC Irvine, May 23-24, 2017)**
Team members Evyan Sloane, California Coastal Conservancy, and Elizabeth Murray, U.S. Army Corps of Engineers, will be participating in the H₂O Conference. Participants will address various aspects of the thin-layer sediment augmentation process, including how this sea-level rise adaptation process compliments the discussion of living shorelines on the west coast.
- **Society of Wetland Scientists’ 2017 Annual Meeting (Puerto Rico June 5-8, 2017)**
Rich Ambrose’s (UCLA) submittal has been accepted and he will be presenting data related to this project. Christine Whitcraft and M.S. student Kaelin McAtee (CSULB) will present the results of their work thus far in two posters, one addressing the overall project and one addressing an invertebrate colonization experiment conducted on the augmentation site.
- **Coastal & Estuarine Research Federation Meeting (Rhode Island, Nov. 2017)**
Rich Ambrose, Evyan Sloane, Christine Whitcraft, Karen Thorne (USGS), and Kaelin McAtee will be presenting various aspects of this project at the meeting. More details will be provided in the next quarterly report.

Description of Amendments and Modifications to Grant:

No amendments or modifications were made this quarter. We previously made a minor modification to the existing grant by redirecting \$4,950 of unallocated research funds to additional eelgrass survey work, which was approved by CDFW on June 10, 2016.

Attachments

1. Itemized Cost Share Items and Activities
2. Letter to CDFW, dated January 18, 2017, regarding a project manager change.

Attachment 1 Itemized Cost Share Items and Activities

Cost Share (June 1, 2015 to March 31, 2017)		
Activity or Item ¹	Funding Source	Expenditure
Total Cost Share from June 1, 2015 to September 30, 2016		
Pre and Post-augmentation monitoring ¹	California State Coastal Conservancy	\$170,776
Purchase boat to access site	USFWS CRI Grant	\$2,425
RTK elevation survey	US Army Corps of Engineers	\$50,252
USFWS staff time ²	USFWS CRI Grant	\$137,592
Sediment augmentation ³	Orange County Parks	\$670,500
Sediment augmentation	USFWS CRI Grant	\$350,000
Subtotal		\$1,381,545
Total Cost Share from October 1, 2016 to December 31, 2016		
Post-augmentation monitoring	California State Coastal Conservancy	\$45,179
USFWS staff time ²	USFWS CRI Grant	\$10,575
Subtotal		\$55,754
January 1 – January 31, 2017		
Post-augmentation monitoring	California State Coastal Conservancy	\$7,222
USFWS staff time ²	USFWS CRI Grant and Station Funds	\$1,071
Subtotal		\$8,293
February 1 – February 28, 2017		
Post-augmentation monitoring	California State Coastal Conservancy	\$384
USFWS staff time ²	USFWS CRI Grant and Station Funds	0
Subtotal		\$384
March 1 – March 31, 2017		
Post-augmentation monitoring	California State Coastal Conservancy	\$30,396
USFWS staff time ²	USFWS CRI Grant and Station Funds	0
Subtotal		\$30,396
Total Cost Share to Date		\$1,476,372

¹ Costs associated with bird surveys and light-footed Ridgway's rail monitoring are not included.

² This does not include staff time accounted for on monthly invoices.

³ The bids for sediment augmentation came is much higher than estimated by the project engineer, therefore, some of the cost for sediment augmentation was covered by the Orange County Parks.



United States Department of the Interior



FISH AND WILDLIFE SERVICE
San Diego National Wildlife Refuge Complex
1080 Gunpowder Point Drive
Chula Vista, CA 91910

January 18, 2017

Erin Aquino-Carhart
California Department of Fish and Wildlife
Watershed Restoration Grant Branch
1416 9th Street, Room 1266
Sacramento, CA 95814

SUBJECT: Agreement No. P1496011- Initiation of Thin-Layer Sediment Augmentation on
the Pacific Coast - Notification of a Change of Project Manager

Dear Ms. Aquino-Carhart:

The project manager for the thin-layer sediment augmentation project (Agreement No. P1496011) will be changing to Richard Nye as he will be taking over the duties and responsibilities as Refuge Manager at Seal Beach National Wildlife Refuge (NWR) effective February 1, 2017. The outgoing project manager, Kirk Gilligan, has accepted a new position as Deputy Project Leader at the Hopper Mountain NWR Complex. Rick has been serving as the project's lead refuge biologist; therefore, he is very familiar with this project and will require no time to transition into the role of project manager. Rick can be contacted via email at richard_nye@fws.gov or by telephone at (562) 598-1024.

Invoices to and checks from the California Department of Fish and Wildlife will continue to be processed from the San Diego NWR Complex office, therefore, no change in current addresses is necessary at this time.

Feel free to contact me at (619) 476-9150 extension 100, should you have any questions.

Sincerely,

Andy Yuen
Project Leader