

Cullinan Ranch Restoration Project

Monitoring Report: 2015-2017



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Prepared For

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March 31, 2018

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INTRODUCTION

The Cullinan Ranch Restoration Project is restoring approximately 1,500 acres of tidal wetlands on San Pablo Bay National Wildlife Refuge (Refuge) to benefit at-risk species, especially salt marsh harvest mouse, and Ridgway's rail (Figure 1). Ducks Unlimited (DU) is working in partnership with the Refuge to complete the restoration. In January 2015, approximately 1,200 acres of the project site was restored to tidal action. The eastern-most 300 acres of the property is still under construction and accepting beneficially re-used dredge material from SF Bay to raise the elevation of the site.

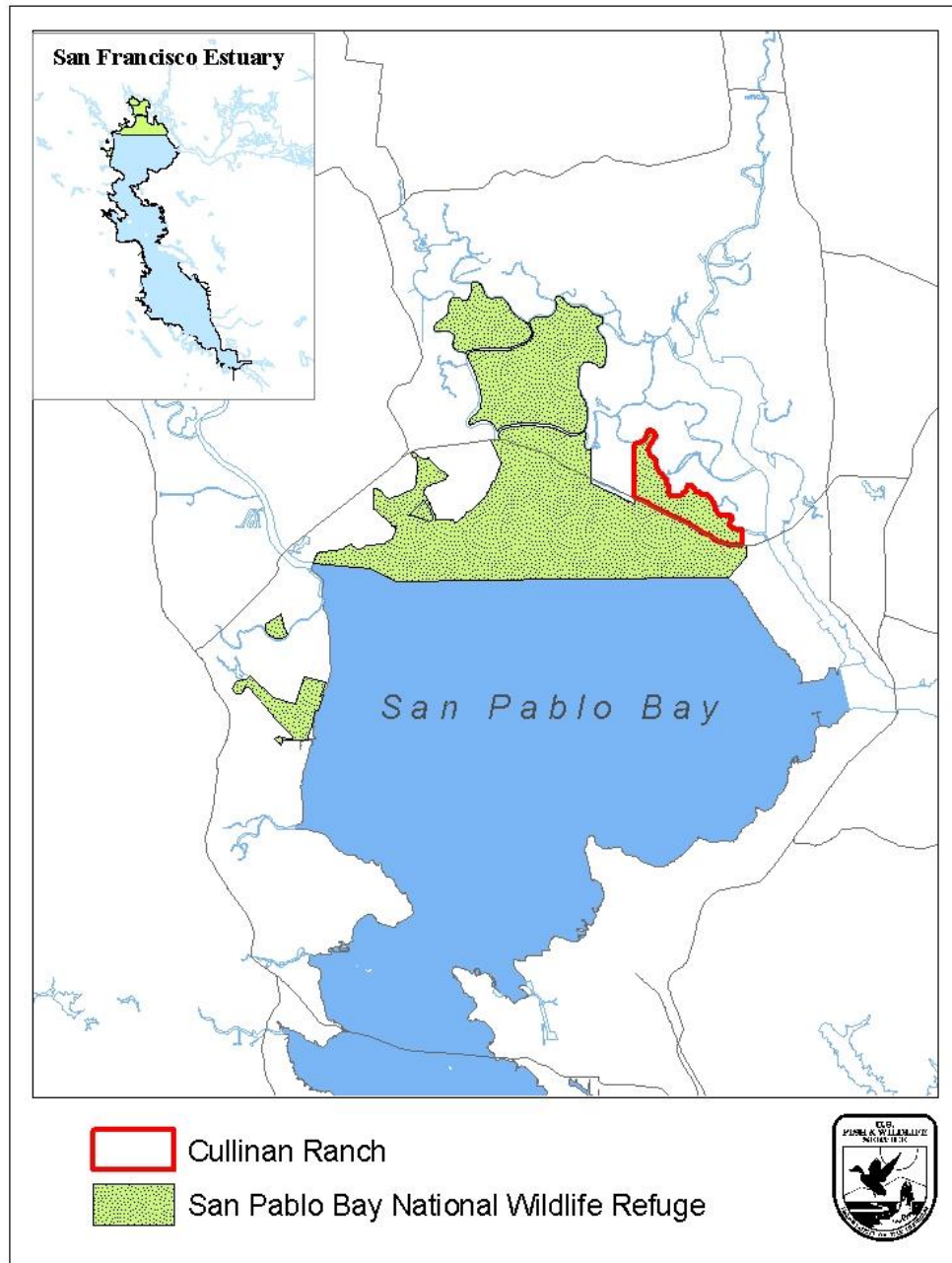


Figure 1. Regional map of restoration project location.

MONITORING

To evaluate project success, the project partners in coordination with regulatory agencies developed the Monitoring and Adaptive Management Plan (MAMP) for the Cullinan Ranch Restoration Project. The monitoring plan includes both biotic and abiotic parameters, performance standards, habitat targets, protocols, and sampling frequencies for the project.

The 15-year monitoring period began in 2015. Monitoring data has been reported previously in a Year 1 Monitoring Memorandum (Garner 2015) and a Breach Construction Completion Report (DU 2015). This report summarizes monitoring data collected through 2017 (Years 1-3 post restoration). The format of this monitoring report follows the MAMP and includes summaries of water quality, biota, and geomorphic evolution monitoring. Specific monitoring protocols include water quality, avian, small mammal, vegetation, tidal channel evolution, and sedimentation (Figure 2). In addition, aerial imagery review, field photo monitoring, and methyl mercury monitoring were conducted at Cullinan Ranch and are reported below.

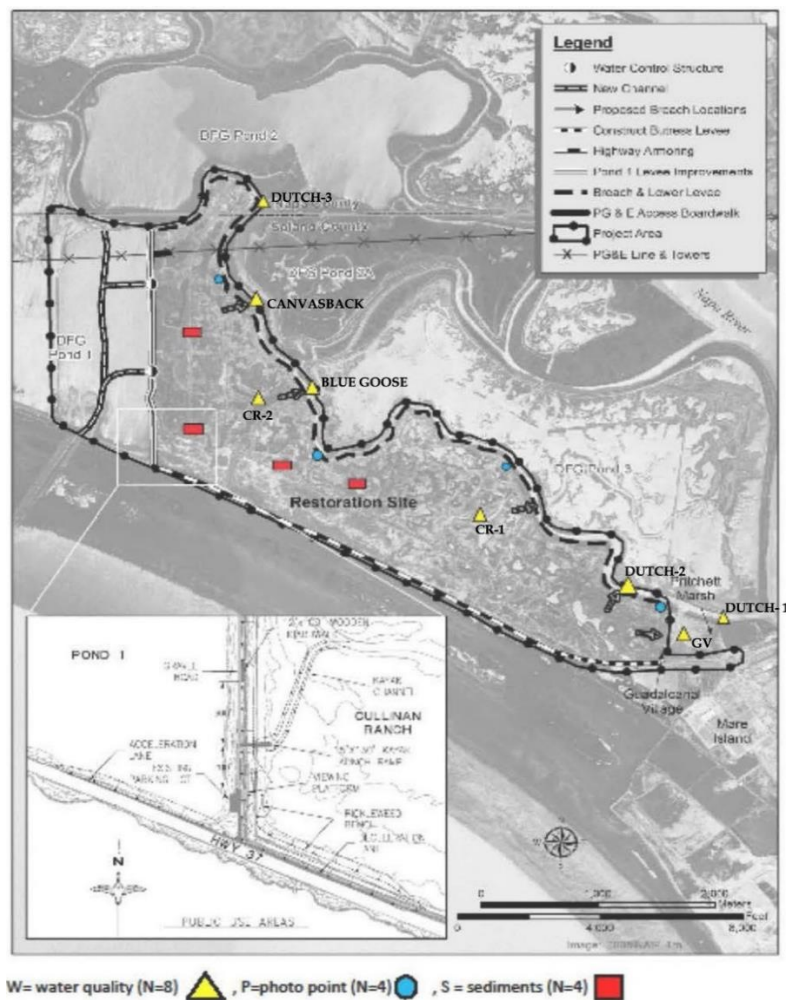


Figure 2. Monitoring locations at Cullinan

I. **Water Quality**

Water quality monitoring was specifically associated with project construction to assess the effects of breaching the perimeter levee on the receiving water quality. This data was summarized and reported in the Year 1 Monitoring Memo and the Cullinan Ranch Restoration Project Phase I Breach Construction Completion Report. Additional water quality monitoring will occur in association with future breaching of the eastern Cullinan site.

II. **Biota**

This section discusses biological monitoring, including avian monitoring, fish, small mammals, and vegetation.

Birds

Ducks Unlimited contracted with the U.S. Geological Survey (USGS) to conduct the first 3 years of avian monitoring, beginning in the fall of 2015. Surveys were conducted four times a year, during fall and spring migration periods, and encompassing high and low tides. Reports conclude that the project created open water habitat used at high and low tide by many species of waterbirds, especially waterfowl (De La Cruz and Graham 2016). In year 1 surveys (fall 2015-spring 2016), 30,690 birds were counted. The site was most used by dabbling ducks, including American Coots. In year 2, 25,103 birds were counted on site, and the site was most used by diving ducks, especially Canvasback (Graham et al. 2018). Similar bird use at both high and low tides indicated that there is currently little difference in the open water habitat available at both tidal cycles. Surveys continued through Spring 2017, and will now be conducted every 5 years or until vegetation cover reaches 75 percent and the predominant bird use shifts from shorebirds and waterfowl to resident marsh species.

Monitoring for Ridgway's Rail will be completed by the Refuge and will commence when appropriate quantity and quality of habitat has developed (e.g., 300 acres of contiguous vegetated marsh).

Fish

The Refuge has coordinated with the North Bay Mercury Biosentinel regional program to include Cullinan Ranch in their fish (as well as methyl mercury) monitoring. Monitoring took place in 2016 and 2017, and may continue in 2018, if funding is available. Thereafter, surveys will take place every 5 years or until the site supports fish communities similar to reference estuarine tidal marsh sites.

Fish sampling was led by Dr. Darrell Slotton at the University of California, Davis. Sampling methods for the region included midwater, benthic-tidal, and high marsh habitat sampling; with fish capture by active and passive seining, and minnow traps for high marsh habitat. A total of 219 individuals of 5 fish species were collected at Cullinan Ranch in 2016. Species collected at Cullinan Ranch included Mississippi Silverside, Topsmelt, Northern Anchovy, Yellowfin Goby, and Threespine Stickleback. The North Bay Mercury Biosentinel program has just released a

draft 2016-2017 North Bay Mercury Biosentinel Project Report, including Cullinan Ranch, and expect to release a final report in March 2018 (Robinson et al. 2018).

Small Mammals

The Refuge is monitoring the presence or absence of federally listed small mammals at Cullinan Ranch in accordance with the established recovery programs. When suitable habitat is present and vegetation cover averages at least 75%, surveys will occur once every year until salt marsh harvest mouse (SMHM) occupy available habitat for a period of at least 3 years.

Refuge staff have not documented any SMHM at Cullinan Ranch. Vegetation cover is far less than 75% and no suitable habitat is present. There is a source population at Guadalcanal Village and it is anticipated that once suitable habitat has developed this source population will utilize Cullinan Ranch.

Vegetation

Vegetation colonization in wetland areas is being monitored using aerial photography supported by ground-truthing. Vegetation assessment will begin when plant cover is approximately 20 percent, and will analyze species cover, richness, and composition. Prior to reaching the 20% level, the dominant pioneer species colonizing the marsh plain will be recorded.

Review of yearly aerial imagery from Google Earth (Attachment I) shows that tidal wetland plant cover is approximately 1% of the restored site. Tidal wetland vegetation is colonizing the lowered levees along Dutchman Slough and the transition ramp along Highway 37, but not yet within the main acreage of the interior of the site. Since tidal wetland plant cover is less than 20%, vegetation assessment has not yet begun.

Field photo monitoring shows that the tidal wetland plant colonization has begun to along the lowered levees of the restoration site (Attachment II). The dominant pioneer species colonizing the lowered levee and transition slope edges are pickleweed and salt grass.

As part of the Refuge's invasive plant management program, Refuge staff and volunteers have conducted control efforts to remove invasive species colonizing the levees surrounding Cullinan. The Refuge contracted with Point Blue's STRAW program to conduct revegetation efforts above the high water mark. In addition, DU hydroseeded the upland slopes of several of the external levees with native grasses in the fall of 2016.

III. Geomorphic Evolution

Tidal Channel Evolution

Aerial imagery and erosion pins were used to monitor development of tidal channels at the site. Review of aerial imagery (Attachment I) indicates that channel networks at not yet detectable within the interior of the site because it is inundated at both high and low tides.

Erosion pins were installed in both side of the constructed breaches (Pole Barn, Blue Goose, and Canvasback). PVC rods were installed at each breach at 50' offset from the erosion pin

locations. In May 2017, the pvc rods were monitored to document the breach width development. Between May 2015 and May 2017, breach widths have expanded between 10 to 26 feet (Table 1).

Table 1. Channel breach widths measured via erosion pins.

Breach	May, 2015	Width	May, 2017	Width
Pole Barn Breach	N038° 07' 53.43" W122° 18' 28.32"	121'	N038° 07' 53.32" W122° 18' 28.46"	147'
	N038° 07' 54.58" W122° 18' 28.72"		N038° 07' 54.72" W122° 18' 28.94"	
Blue Goose Breach	N038° 08' 33.01", W122° 19' 51.90"	120'	N038° 08' 32.92", W122° 19' 52.03"	140'
	N038° 08' 34.16", W122° 19' 52.25"		N038° 08' 34.25", W122° 19' 52.52"	
Canvasback Breach	N038° 09' 02.87", W122° 20' 14.70"	74'	N038° 09' 02.81", W122° 20' 14.85"	84'
	N038° 09' 03.57", W122° 20' 14.96"		N038° 09' 03.61", W122° 20' 15.16"	

Sedimentation

To measure deposited sediment within the site, plates were installed to serve as a fixed elevation at the onset of restoration to measure sedimentation amounts as the site restores. The 12"x12" stainless steel plate was welded to 4-12" legs and embedded into the ground so that the top plate was flush with the ground surface (Figure 3). Each plate was surveyed in using Trimble RTK GPS to establish horizontal and vertical locations. To facilitate locating the plates in the future, they were marked with 2 T-posts on either side of the plate and can be found by locating the "hard surface" in between the posts.

Four plates were installed in May 2015 and surveyed again in May 2017. The actual surface of sediment was difficult to detect because it is several feet below the water's surface and consists of fine, soft sediments. Since sediment was too difficult to measure with GPS, we used a field survey stick method. This method involved lowering a wooden survey stick straight down to reach the surface of the sediment plate, then measuring the length of the sediment residue (Figure 4). Three to four samples were measured in the field at each plate and the average for each plate is reported here. Monitoring data show that 2 years after breaching, some areas within Cullinan have as much as 13 centimeters of sediment accumulation (Table 2). Sediment accumulation varied across the site.

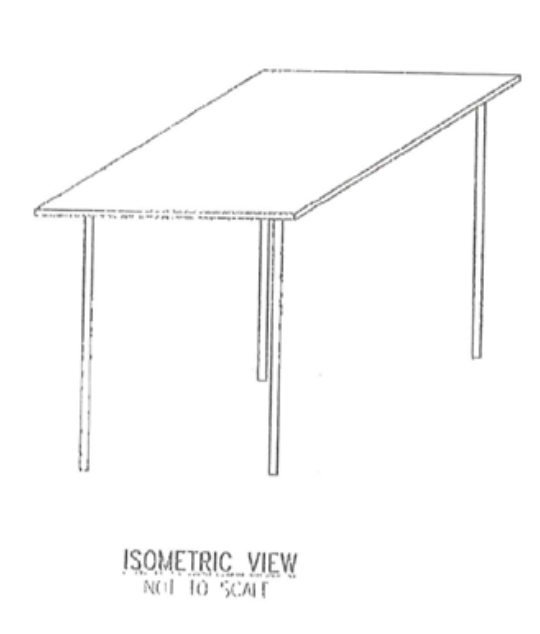


Figure 3. Sedimentation plate design



Figure 4. Field method for measuring sediment accumulation on plates

Table 2. Sediment accumulation on four plates measured in May 2017

Plate #	Coordinates	Location Description	Fixed Plate Elevation	May 2017 average sediment depth
1	38° 8'58.09"N, 122°20'25.89"W	Installed about 1000' from the Canvasback breach near a high berm that was constructed around a historic channel. A lot of vegetation is present in the area.	1.2' NAVD 88	13 cm
2	38° 8'21.6"N, 122°20'33.09"W	Installed about 500' due east of the water control structure between Pond 1 and Cullinan Ranch. A lot of open water surrounds this area and the remnant channel is 500' or more away.	0.57' NAVD 88	3 cm
3	38° 8'16.14"N, 122°19'46.16"W	Installed in the marsh mound area. Well protected from long fetch distances in all directions. Lowered levee along Dutchman Slough approximately 200' away.	0.59' NAVD 88	6.5 cm
4	38° 8'0.97"N, 122°19'28.51"W	Installed in a deeper portion of the ranch on what was low-lying playa area prior to breaching the site. There was no vegetation for quite some distance and the plate was approximately 500' from the lowered levee along Dutchman Slough.	-0.34' NAVD 88	6 cm

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