Identifying the Locations of Debris Accumulation on San Francisco Bay Shorelines

Final Report

Submitted to the California Department of Fish and Wildlife

Office of Spill Prevention and Response

Sacramento, CA

Scientific Study and Evaluation Program (SSEP) project no. 2004-03

June 30, 2005

Principal Investigator: James Hardwick, Staff Environmental Scientist

California Department of Fish and Wildlife, Office of Spill Prevention and Response

Co-investigators: Randy Imai, Environmental Program Manager,

California Department of Fish and Wildlife, Office of Spill Prevention and Response

Paul Veisze, Research Manager, California Department of Fish and Wildlife, Currently, GIS Manager, California State Parks

Introduction

Spill responders have long considered the presence of debris on shorelines and how it may provide insights for them. These responders have often had to remove or clean large quantities of oiled debris from shorelines, and so have frequently considered removing it before it gets oiled. Some have noticed that the shorelines with the most debris were often those with the most oil. It stands to reason that oil and debris would be transported to the same place. Both float and are driven by wind, and scientists that study currents and oil trajectories often use floating substances such as rice hulls, popcorn, dog food, oranges, manufactured drift cards and buoys in their studies.

During the winter flooding of 1998 a large amount of woody debris washed out of the Sacramento and San Joaquin River drainages and into San Francisco Bay. People working on the bay began to notice and comment on this debris during this time period. California Department of Fish and Wildlife, Office of Spill Prevention and Response (CDFW-OSPR) field response team (FRT) staff saw this unusual event as an opportunity to observe and note where the most debris stranded and use the information to identify the most vulnerable shorelines with regard to oil stranding.

FRT staff within OSPR were especially interested in this information because it is part of their job to establish the shoreline protection priorities during oil spills and oil spill drills. This includes specifying which shoreline protection strategies must be deployed, and the time at which each must be in place. In many instances FRT staff are told that there are not enough personnel and equipment available to implement all of the specified protection strategies, and it is not uncommon to need to eliminate or reprioritize some of these. There was a clear need for some basis for choosing among equally sensitive sites. Site vulnerability, as indicated by the tendency for debris to strand at the site, seemed to be a logical factor to consider in these decisions. The goal of this study, then, was to elucidate and map in detail the shorelines in the San Francisco Bay area and indicate the amount of debris accumulation that was observed. This information can be useful for shoreline protection strategy decisions that aim to utilize information on debris accumulation. For instance, if oil is likely to impact a shoreline, directing it to one particular area can be done by electing a natural accumulation point to accomplish this. Maps of all the debris accumulation findings were created to aid such efforts and planning, and are the primary product from this study. This map layer has also been included on line in Southwest ERMA, which is supported by the National Oceanic and Atmospheric Administration (NOAA, https://erma.noaa.gov/southwest/erma.html#/x=-119.95105&y=36.61737&z=6&layers).

Methods

Three surveys were performed to gather data for this project. Each of these is described below.

1998 Survey

A technical team, consisting of a scientist and Geographic Information System (GIS) analyst, was assembled to conduct an overflight above San Francisco Bay shorelines to record the debris accumulations. The team flew in the Department of Fish and Wildlife's Partenavia Observer aircraft in April 1998. The pilot flew the plane and also recorded a GPS track line with waypoints, while others videotaped the shorelines and narrated observations of stranded debris onto an audio tape. Additionally, the locations of items of debris were recorded on navigation charts. The team flew at an elevation of 500 feet above the shoreline for these observations. The video camera was hand held due to the frequent changes of angle as the airplane turned to follow the shoreline.

After completion of the flight, team members spent several months in 2004 reviewing the video tapes and listening to the audio. Transcriptions of the audio were created and a map was produced with seven categories of stranded debris based on the width and continuity of the bands of debris observed on shorelines (Figures 1 to 4). As a final step, maps were created in ArcMap software.

2005 Survey

The flight was repeated on 30 August 2005, but was largely unsuccessful. There had been no flood event that year, unlike prior to the 1998 survey, so the debris had become over grown with vegetation by August when the survey was conducted. As before, the pilot flew the plane and recorded a GPS track and waypoints, and another team member recorded the location of debris on navigation charts. No video was recorded for this survey. This data set was ultimately deemed to be unusable due to the obscuring of debris by vegetation.

2006 Survey

After the heavy runoff during the winter of 2006, the team was able to schedule another survey flight. Again, the pilot flew the plane and recorded waypoints as the team members recorded the video and noted the location of debris on a navigation chart.

Results

Figure 1 shows the resulting map for the entire San Francisco Bay, and Figures 2-4 show more detailed views of the South Bay, San Pablo Bay, and Suisun regions. The 1998 flight yielded data on the heaviest debris accumulations along the northwest shore of Suisun Bay, the north shoreline of San Pablo Bay, and the east side of the South Bay. The South Bay was found to contain mostly anthropogenic debris that washes up on the East Bay side south of the airport down to just north of the Dumbarton Bridge. In contrast, the North Bay contains primarily woody debris that has washed down from the watershed and into the Central Bay. Honker Bay had more debris at the terminus than Grizzly Bay. Red

colored shorelines were those found to contain the most debris, followed by purple colored shorelines. This information is also available as a data layer accessible in the ERMA Southwest planning tool. The 2005 data set indicated debris distribution in the South Bay was much as it had been in 1998, however, there was much less debris elsewhere in the bay. The 2006 data set shows that there was a great increase in the amount of stranded debris when compared to that observed in August of 2005, and it was heaviest in the same locations where it was found in 1998.

Discussion

The investigators were surprised to observe significantly less debris in 2005 than in 1998 as the expectation had been that the large pieces of debris would persist for several decades. Initially it appeared that even the debris that had stranded high on the levies had been either removed or refloated at some time during the previous seven years. There had been no flooding since 1998, and therefore a much more limited supply of new debris.

Limited ground observations indicated that the debris may actually remain on the shoreline, but be hidden from view by vegetation. FRT staff have done an inspection of the Point Pinole Regional Park shoreline several times since the 2006 flight, and ith has become clear that the debris did not disappear between 1998 and August of 2005. Rather, it appears that vegetation has grown over it and obscured it from aerial observation. In some locations annual vegetation was observed, including radish and peppergrass, that had grown nearly a meter high in a few months. Pickle weed, however, grew only a few centimeters in the same season. Most of the debris seen in the spring of 1998 and 2006 had been deposited or had been moved during the previous winters. In contrast most of the debris present in August 2005 had persisted on the shoreline for several years during which time vegetation had grown over it and obscured it from aerial observation.

Regardless of whether the debris moves or is hidden by vegetation, it appears that the best time for aerial surveys for stranded debris can be obtained shortly after unusually high runoff events that have supplied a large amount of fresh debris. Debris is not always visible by later summer due to vegetation growth that covers it up. The months of May or June appear to be optimal for viewing stranded debris since vegetation would not yet have overgrown the debris by this time of the year.

The fact that Honker Bay (not shown on map) had more debris at the terminus than Grizzly Bay is presumably due to the fact that debris is moved into Honker Bay by the prevailing winds as they tend to blow up the waterways. This was reflected in the colors used on these particular shorelines (Figures 1 and 4). In general, heavy (red) and medium (purple) are the shoreline colors to pay attention to for protection strategy purposes. It is recommended that teams funnel oil to a part of these shorelines, in cases where keeping it off the shoreline

entirely is not achievable, because it tends to come to these shores anyway. Responders would be expected to have more success in collecting the oil on the red or purple colored shorelines than in other locations. In the South Bay, if oil manages to get there, these red and purple areas will be important. It is worth noting, however, that it is difficult to get oil to go down into the South Bay as debris moving down from the North Bay tends not to move south of the Central Bay due to wind and current factors.

These survey results should not be over-generalized, because wind and flow characteristics can vary over time and space. However, this study does identify areas where oil will tend to strand naturally given the currents and wind patterns that are predominant or typical in this region.

Figures

Figure 1. Shoreline debris map for San Francisco Bay region.

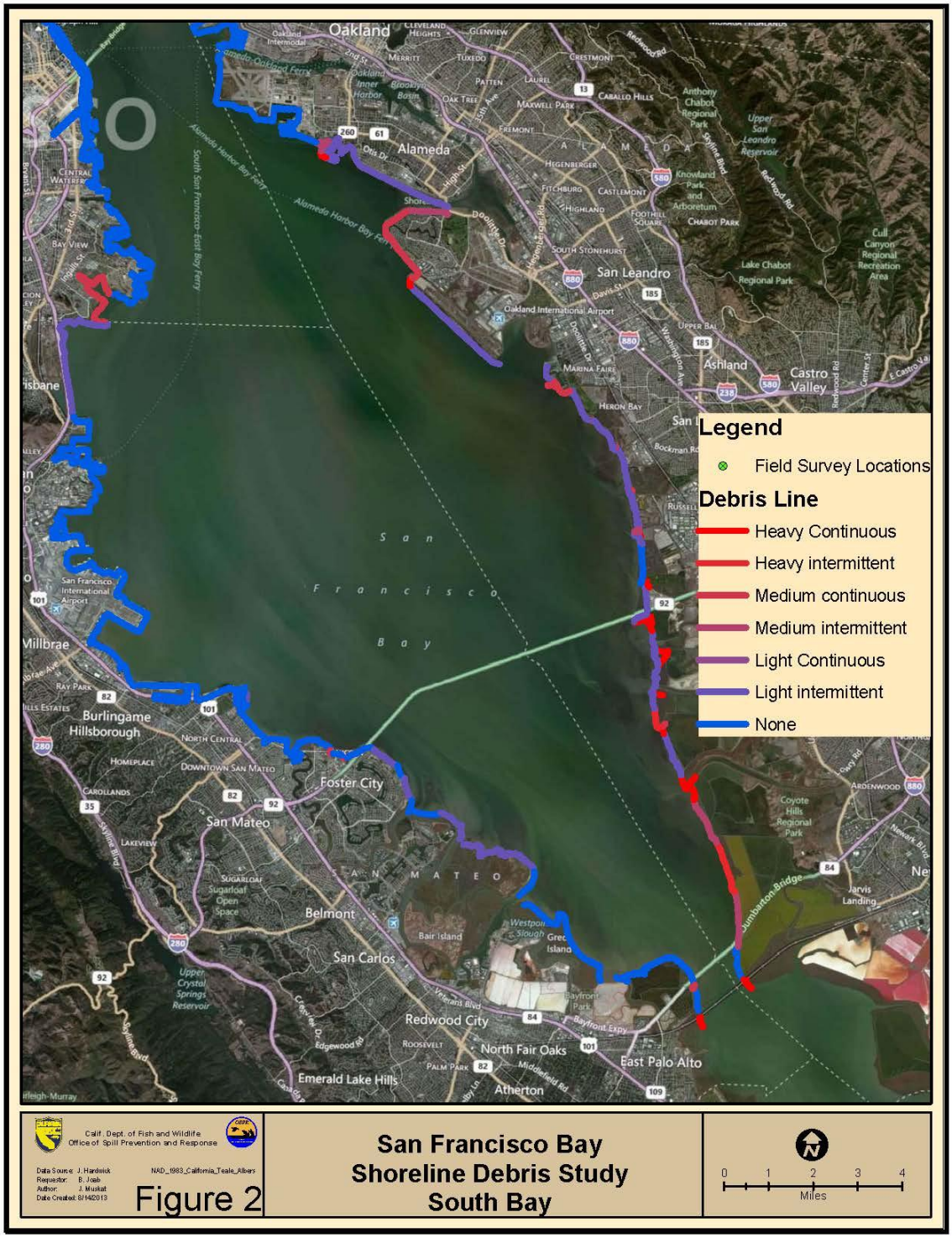

Figure 2. Shoreline debris map for South San Francisco Bay.

Figure 3. Shoreline debris map for San Pablo Bay region.

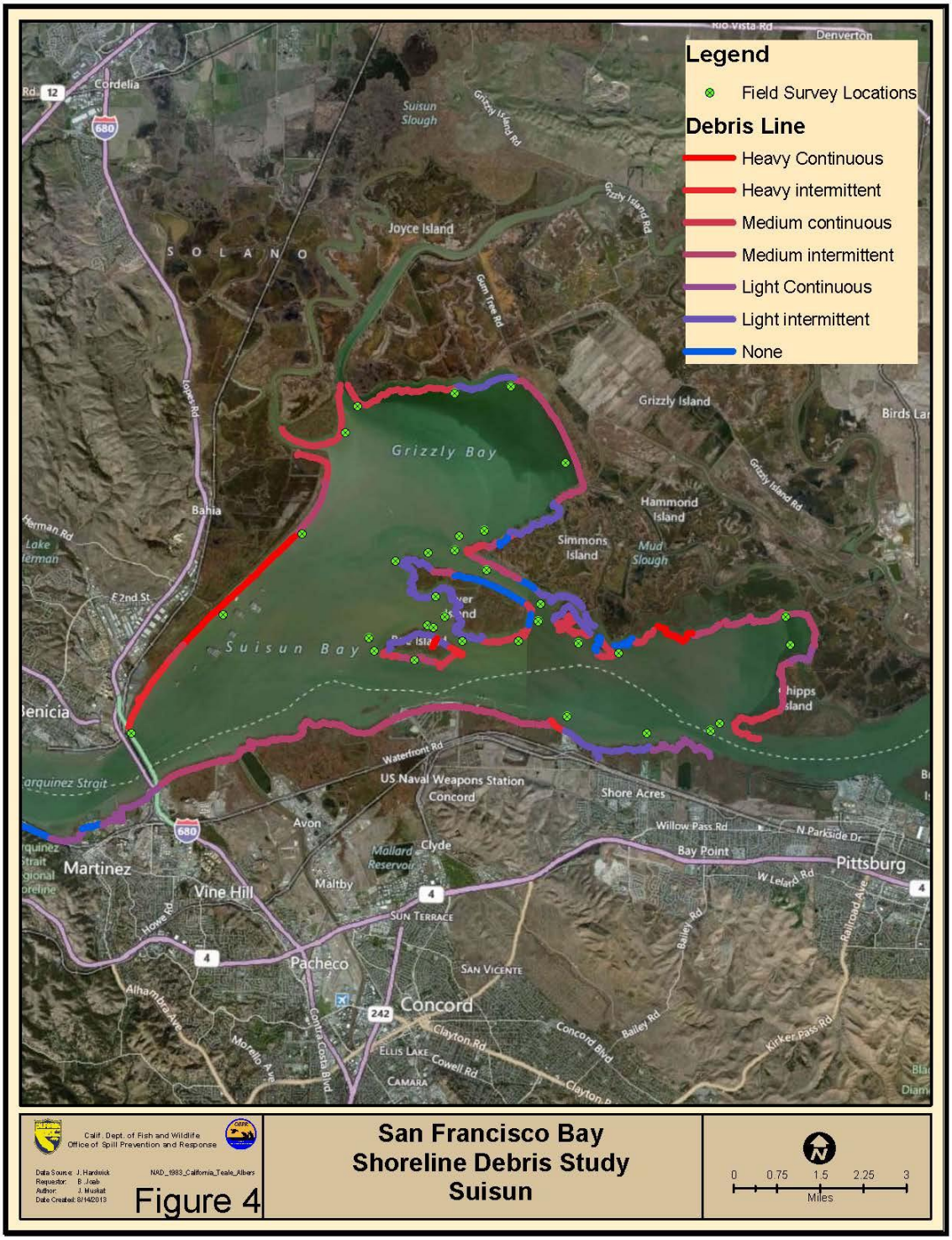

Figure 4. Shoreline debris map for Suisun region.