PREASSESSMENT SCREEN FOR THE

CHINO HILLS OIL SPILL, CHINO HILLS, CALIFORNIA

SUBMITTED BY:

Carol Roberts
Division of Environmental Contaminants
Carlsbad Field Office

April 1996

TABLE OF CONTENTS

INTRODUCTION AND SPILL INFORMATION

PURPOSE OF REPORT

This report has been prepared to provide a review of the available information on the natural resources potentially impacted by the Chino Hills oil spill which took place during the week of March 13, 1994 and was discovered on or about March 20, 1994. This review is to ensure that any future claim related to the natural resource damages adequately address U.S. Fish and Wildlife Service (Service) trust resources. Several agencies were involved in the response to the spill including the California Department of Fish and Game (CDFG), the California Regional Water Quality Control Board (RWQCB), the California State Parks and Recreation Department (State Parks), the U.S. Environmental Protection Agency (EPA) and the Service. This report is a synthesis of information pertaining to fish and wildlife resources known to utilize the area affected by the spill.

This report consists of a brief summary of the spill incident and response effort, an analysis of potential pathways by which the oil could contaminate or adversely impact natural resources, a preliminary identification of the resources at risk, a summary of the data collected, and results of the pre-assessment screen regarding natural resource damages.

INCIDENT HISTORY

During the week of March 13, 1994 a release of approximately 14 barrels of crude oil occurred from a separator operation owned at that time by Taylor-McIlhenny of Dallas, Texas on an unnamed tributary of Aliso Creek. The spilled crude oil was apparently covered with fresh soil by the operator, but was released with the rains that followed on or about March 20, 1994. The crude oil impacted the downstream portion of the tributary and entered Aliso Creek within the Chino Hills State Park. The crude impacted a three to four mile stretch of the tributary and Aliso Creek above its confluence with the Santa Ana River. Impacts to the Santa Ana River could not be determined with the high water flows which followed the rain. An initial site visit was made by Service personnel on March 22, 1994.

The initial response to the spill involved the construction of two coffer dams to trap the crude oil in positions where vacuum trucks could be used remove it from the stream. One was placed on the tributary just above its confluence with Aliso Creek, and the other was placed on Aliso Creek at the state park boundary. Vacuum operations at the Aliso Creek site continued for several days after

the initial response to the spill, but the upstream site was abandoned after only a few days.

Personnel from the EPA Technical Assistance Team, the Service, and CDFG toured the site on March 28, 1994, and the determination was made to federalize the spill. Clean-up resources were then mobilized for more thorough clean-up of the oiled stream course. Service personnel assisted with direction of clean-up efforts on April 1-6, 1994. Clean-up was conducted using sorbent pads and pom poms, and much oiled debris was removed by hand. Photographs taken over the course of these visits are included in Photos 1-10 on pages 13-17. Initial sampling for this preassessment screen was conducted in April, and follow-up sampling was conducted in August 1994.

The tributary was narrow and rocky in many places. The most common vegetation along most of its length included willows (*Salix* sp.), mulefat (*Baccharis salicifolia*) and poison oak (*Toxicodendron diversilobum*). Aliso Creek varies in width being somewhat narrow at the confluence with the tributary but widening downstream. It has willow/mulefat scrub along much of its length. The tributary and much of the downstream portion of Aliso Creek were dry when the second round of sampling was conducted in August.

RESPONSE AND CLEAN-UP STRATEGIES

When the spill was initially discovered, most of the clean-up efforts focused on control of the source - the oil pooled around the separator and the contaminated soil. Because additional rains were anticipated, the contaminated soil was covered with plastic in an attempt to minimize further run-off (Photo 2). Coffer dams were placed at two sites below the spill to collect product so that it could be removed by vacuum truck.

Once the pooled oil and the contaminated soils underneath had been removed, efforts focussed on clean-up of the impacted stream course. Hand crews were employed to remove oiled vegetation and debris, and pooled oil from the stream course. The decision was made by EPA not to excavate contaminated soils from the hillside below the spill site. A semi-permanent mortar dam was constructed in the tributary just below the site to allow for pooling of water in the creek and removal of any floating product which may have been carried from the contaminated soils by subsequent rain events. The Service was concerned that this structure would not be properly maintained and pooled oil would become a hazard to wildlife. The California Department of Oil and Gas, after discussions with EPA, subsequently agreed to take the responsibility for maintenance of the dam.

PRELIMINARY IDENTIFICATION OF PATHWAYS OF EXPOSURE

PROPERTIES OF THE OIL

The spilled oil was locally produced crude oil from a separator operation. Samples analyzed by the Fish and Wildlife Water Pollution Control Laboratory of the CDFG identified material collected from the tributary and Aliso Creek as being consistent with that collected from the separator operation.

PATHWAYS OF EXPOSURE

Surface Water

The oil flowed from the site of the spill into the unnamed tributary and on into Aliso Creek. Approximately three to four miles of stream were oiled as a result of the spill. Smaller amounts of oil may have traveled into the Santa Ana River before the coffer dams were constructed. Standing product was found in pockets on the surface of the tributary and Aliso Creek. This material remained in the creek for up to 17 days when hand crews completed their work.

Food Chain Exposure

Fish and aquatic invertebrates were found within the oiled portion of the stream course. Contaminated fish and invertebrates in this stream system could be consumed by southwestern pond turtles and bird species known from the area such as snowy egrets (*Egretta thula*), green herons (*Butorides striatus*) and possibly great blue herons (*Ardea herodias*). While specific surveys were not conducted in response to the spill event, surveys had previously been conducted for the southwestern pond turtle in Aliso Creek.

NATURAL RESOURCES POTENTIALLY AT RISK

GENERAL SITE DESCRIPTION

The tributary portion of the spill course is a narrow stream that is steep and rocky in places. In several places the banks were quite steep, with no vegetation occurring at water level. In areas where the stream course was wider, dense vegetation occurred up to the stream channel. This is an intermittent stream, and during most months of the year there is no flow. However, after rainstorms the flow in this stream course can be quite strong. This was evidenced by the damage to the coffer dam in the tributary that occurred as a result of a rainstorm following the initial response to the spill.

Aliso Creek is a larger stream than the tributary and includes portions which are supplied by underground springs and thus have water year-round. Most of the portion in which the spill occurred dried up during the summer months. Much of this area is comprised of a wide

riparian zone with a meandering stream course. It is located at the base of a wider valley than the tributary, and the portion of its length within the park does not include narrow, rocky stretches.

VEGETATION

The vegetation along both the tributary and Aliso Creek is dominated by riparian species such as willows and mulefat. Cottonwoods (*Populus* sp.) occur sporadically along both stream courses, although they are more frequent along Aliso Creek. In places the tributary was surrounded by a dense cover of poison oak. Surrounding vegetation is dominated by annual grassland with patches of coastal sage scrub.

BIRDS

No oiled birds were located in the course of responding to the spill. However, several species are known to use the area including possible use by the federally endangered least Bell s vireo (*Vireo bellii pusillus*). A large population of the least Bell svireo occurs in Prado Basin in close proximity to Chino Hills State Park. It is possible that this species uses riparian vegetation along these stream courses, but no breeding has been documented in the park. Other species which may occur in the area include: house wren (*Troglodytes aedon*), song sparrow (*Melospiza melodia*), common yellowthroat (*Geothlypis trichas*), red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamaicensis*), and black-shouldered kite (*Elanus leucurus*).

MAMMALS

No oiled mammals were found in the course of response to the spill. Some mammal species which may occur there include: mountain lion (*Felis concolor*), bobcat (*Felis rufus*), coyote (*Canis latrans*), mule deer (*Odocoileus hemionus*), raccoon (*Procyon lotor*), and opossum (*Didelphis virginiana*).

REPTILES

The southwestern pond turtle (*Clemmys marmorata pallida*) has been found in Aliso Creek during previous surveys, including the area which was oiled. One turtle was found oiled in Aliso Creek in the course of response activities. It died during rehabilitation efforts. This population of southwestern pond turtles is regionally important because it is one of only four populations known to be protected in Orange, Riverside, and San Bernardino Counties (Roberts, memo dated June 10, 1990). The Service has concerns regarding planned flood control projects which may impact several populations in Orange County (U.S. Fish and Wildlife Service letter dated February 27, 1996), raising the regional importance of the Aliso Creek population.

In addition, the following species were observed in the course of response activities. A southern alligator lizard (*Elgeria multicarinatus*) was noted during the course of sample collection along the tributary. Two rattlesnakes were seen in the course of conducting the March 28 walk through: the southern Pacific rattlesnake (*Crotalus viridis helleri*) and a red diamond rattlesnake (*Crotalus ruber*). No other reptiles were seen in the spill area, but the following species are known to occur in the park: western fence lizard (*Sceloporus occidentalis*), San Diego horned lizard (*Phrynosoma coronatum blainvillei*), and possibly orange-throated whiptail (*Cnemidophorus hyperythrus beldingi*).

AMPHIBIANS

Tadpoles were seen in Aliso Creek during the course of spill response activities. These were most likely tadpoles of the western toad (*Bufo boreas*). Other amphibians known from the park are: Pacific tree frog (*Hyla regilla*), slender salamander (*Batrachoseps* sp.) and western spadefoot toad (*Scaphiopus hammondi*) in the upper watershed.

FISH

Two species were observed in the course of sampling activities: arroyo chub (*Gila orcutti*) and fathead minnow (*Pimephales promelas*).

AQUATIC INVERTEBRATES

Aquatic invertebrates were collected in the course of sampling. Please see the attached report from the U.S. Forest Service Aquatic Ecosystem Monitoring Center for a list of those identified from the samples.

CRITERIA AND DATA AVAILABLE TO PURSUE ASSESSMENT

FIELD MEASUREMENTS MADE DURING THE SPILL

Field work following the spill included visual surveys of the spill s extent, photographic documentation of the spill, and collection of samples for chemical analysis. A subset of photographs taken during the course of response and assessment activities is included at the end of the report.

Sediment samples were collected on April 13, 1994 and again on August 18, 1994. Sample locations were documented in the April sampling so that the second set of samples were collected as close to the first as possible. Landmarks were described and photographed to facilitate sample site identification. By August much of the stream course had dried so streambed soils were collected in lieu of sediments. All sediment/soil samples were collected using an aluminum foil-wrapped

stainless steel spoon or the lid of the chemically-clean sample jar. Samples were placed on wet ice for transport. Upon returning to the Carlsbad Field Office, the sediment samples were decanted and all were kept frozen until shipment to the analytical laboratory.

The Santa Ana Regional Water Quality Control Board collected water samples in early August 1994 as a follow-up to water quality concerns raised at the time of the spill. Grab samples were collected in conjunction with the aquatic invertebrate sampling described below. The samples were analyzed for total resolved petroleum hydrocarbons.

In August aquatic invertebrates were also collected. Aquatic invertebrates were collected by San Marino Environmental Associates for biodiversity analysis, and invertebrates for chemical analysis were collected by staff from the Carlsbad Field Office. Biodiversity analyses were conducted by the U.S. Forest Service Aquatic Ecosystem Monitoring Center. Their report is attached. Due to the drying conditions at the site, a limited number of composite samples were submitted for chemical analysis from a reference location upstream of the spill site and at the confluence of the tributary and Aliso Creek. Macro-invertebrate samples were collected using kick nets, and sieves and stainless steel forceps were used to sort materials collected in the nets. Snail samples were collected using this technique combined with removing individuals directly from the substrate with stainless steel forceps. Samples were placed in chemically-clean jars and placed on wet ice. Upon returning to the Carlsbad Field Office, samples were kept frozen until shipment to the analytical laboratory.

Fish were collected at the same sites as the invertebrates during the August sampling. Arroyo chubs were collected using dip nets in the upstream reference site for a single composite sample. At the confluence of the tributary and Aliso Creek, no live fish were found. This portion of the creek was drying up when this sampling was conducted. Several arroyo chubs were found in various states of decay and were collected for analysis. Both samples were placed in chemically-clean jars and placed on wet ice for transport. Upon returning to the Carlsbad Field Office, the samples were kept frozen until shipment to the analytical laboratory.

Separate surveys were conducted and samples collected by San Marino Environmental Associates to examine the potential impacts to the arroyo chub. The methods used and results of these studies will be included in that report to be submitted under separate cover.

RESULTS OF THE CHEMICAL ANALYSIS AND SURVEYS

The general trend seen from the chemical analysis was that the heaviest oiling occurred along the downstream portion of the tributary (encompassing Sites 2 and 3) and moderate oiling occurred along the

portion of Aliso Creek between the confluence with the tributary and just upstream of where it exits Chino Hills State Park. Concentrations of most analytes dropped to levels at or near reference concentrations in sediments sampled between April and August (Table 1).

Data from the chemical analyses can be evaluated in a number of ways in order to determine that the source of the hydrocarbons is petrogenic as opposed to biogenic (Table 1). Total resolved petroleum hydrocarbon concentrations will be used to provide a basic comparison between reference and oiled sites and at sample sites across time. The presence of phytane in samples generally signifies a petrogenic source, as does the presence of an unresolved complex mixture (Everett Wilson-Robinson, written comm.). Phenanthrene can also be used to identify a petrogenic source (NRC 1985). The ratio of pristane (a biogenic hydrocarbon) to phytane can also help determine whether the source was biogenic (ratio of >20) or petrogenic (ratio in the range of 1-3; NRC 1985). The carbon preference index (CPI, Farrington and Tripp 1977) provides a ratio of odd to even-numbered aliphatics. Because biogenic sources tend to produce predominantly odd-numbered aliphatic hydrocarbons, a ratio near one indicates a petrogenic source. These indicators were evaluated for the sediment/soil and biological samples collected from oiled and reference sites. Finally, the concentrations measured were compared to available guidelines and literature values for assessment of the potential for impacts resulting from this spill.

Total resolved petroleum hydrocarbon (TRPH) concentrations in the April sediments were higher for sites within the oiled portions of the tributary and Aliso Creek than at the respective reference sites. However, the distribution appeared to be somewhat patchy as one of three sites on the tributary (Site 1) and one of two sites on Aliso Creek (Site 1) were only slightly above values for the reference sites. The two other sediment samples collected from the tributary were the only samples with TRPH concentrations above 100 parts per million (ppm). In the August samples, all TRPH concentrations in soils or sediments were very near, at, or below reference concentrations from the respective reference samples. Invertebrate samples from both the reference and oiled sites had very similar TRPH concentrations. The fish sample from the reference site had a slightly higher TRPH concentration than the sample from the oiled site. Because of the possibility for movement between areas when water levels were high, fish collected at both sites could have been exposed to oil. Fish collected within the spill area were also not collected fresh, but were in varying states of decay which could have confounded the analytical results.

Phytane concentrations in soils/sediments followed a pattern that was very similar to the pattern for TRPH. Sites 2 and 3 on the tributary

and Site 2 on Aliso Creek were substantially above the corresponding reference values. However, the samples from these sites collected in August were very near or below the reference concentrations. Invertebrates from the oiled portion of the river had higher phytane concentrations than those from the reference site. However, all concentrations measured in the invertebrates were relatively low. As in the case of TRPH, the fish sample collected from the reference site had a higher phytane concentration than the sample collected from the oiled site. Again, concentrations at both sites were relatively low.

Unresolved complex mixtures were detected in all sediment/soil samples, both fish samples, and in all but two invertebrate samples (one from the reference site and one from the oiled site) as there was not adequate material for this analysis in these two samples. The tributary reference site was high in comparison to the three reference samples collected on Aliso Creek. There is oil production in the vicinity of this tributary site which is upstream and may have contributed to contamination of the site. This site was chosen to eliminate only the spill as a petrogenic source for this site. However, two of the downstream sites (2 and 3) were still higher than this reference in the April sampling. Both samples from August were below the reference concentration. Site 1 on the tributary had concentrations below the reference concentration in both April and August, and the August concentration was lower. Both Aliso Creek sites had concentrations above the Aliso Creek reference in the April sampling. In August Site 1 was higher than in April (suggesting a patchy distribution) and Site 2 was lower than the reference. The sediment samples collected from Aliso Creek with the invertebrates had very low concentrations of unresolved complex mixture at that reference site in August when these samples were collected, and the two samples collected near Site 1 were above both Aliso Creek reference concentrations. Invertebrate and fish sample concentrations overlapped between reference and oiled sites.

All phenanthrene concentrations in soils/sediments were relatively low with no concentrations above 1 ppm. Sites 1 and 2 on Aliso Creek and Sites 2 and 3 on the tributary were above the respective reference concentrations. Decreases were seen for all oiled sites from the April sampling to the August sampling. Phenanthrene concentrations were either not measured or were below the detection limits for the invertebrate and fish samples.

The pristane/phytane ratios were calculated for all samples, and the resulting values (0.028-3.623) were within the range of 1-3 expected in samples influenced by petrogenic sources (Everett Wilson-Robinson, written comm.). However, high ratios (>20) are a better indicator of the absence of petrogenic oil than low ratios are of indicating the presence of petrogenic oil. In sediments and fish, reference samples had lower ratios than oiled sites which is the opposite of what was

expected. The invertebrate samples did show the expected higher ratios for reference samples, but the highest was still well below that which would be indicative of areas with no petrogenic oil. The overall low concentrations detected may have confounded the usefulness of this ratio to some degree.

The CPI was calculated for all samples. The indices for all sediment/soil samples collected in August were indicative of non-oiled matrices. In April all tributary sites including the reference had indices indicative of oiled sites. As mentioned previously, the tributary reference site could have been influenced by upstream sources, particularly since rain had occurred in the area in the three weeks before sample collection. In April on Aliso Creek the reference concentration was indicative of an unoiled site, but the samples from Sites 1 and 2 had indices suggestive of the source being plant-related rather than petrogenic. In August Site 1 had an index indicative of an unoiled site, but Site 2 had an index indicative of oiling and higher than that calculated for the sample collected in April. This again suggests a patchy distribution of the contamination. Invertebrate samples had indices which were indicative of unoiled sites, but the fish samples both had indices more indicative of oiling. The oiled site was lower than the reference site, as would be expected. As mentioned previously, there is the possibility for fish movement between areas when water levels were high, so fish collected at both sites could have been exposed to oil.

Sediment/soil concentrations were compared to effects levels given by Persaud et al. (1993) and Long and Morgan (1990). Tissue concentrations were compared to values given by Eisler (1987) for select polycyclic aromatic hydrocarbons (PAHs). These values are used to assess the potential for impacts to benthic organisms as a result of the hydrocarbon contamination detected.

Sediment and soil concentrations were compared to the Ontario aquatic sediment quality guidelines (Persaud et al. 1993) for freshwater sediments. There are no established No Effect Levels given for any of the PAHs. However, several of those measured in this study have Lowest Effect Levels (LELs) established in the Ontario guidelines. The LEL indicates a level of contamination which has no effect on the majority of sediment dwelling organisms. No samples collected in the course of this study exceeded the LEL for: anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene. The sample collected from the middle tributary site exceeded the LELs for fluorene and phenanthrene, and in both cases the downstream tributary sample was close to the LEL. This middle tributary site also had concentrations of anthracene and chrysene close to the LEL. However, none of the sample concentrations came at all close to the Severe Effect Level (SEL). The SEL is the concentration at which the sediment is considered

heavily polluted and likely to affect the health of sediment dwelling organisms. Based on these guidelines, the residue levels did not appear to pose a threat to the riparian community at the time of the spill. Definite decreases occurred for most analytes between April and August suggesting that long-term, chronic effects are not anticipated.

The effects ranges identified in Long and Morgan (1990) are for marine sediments, but provide a frame of reference for concentrations measured in this study. Below the Effects Range-Low (ER-L) few impacts are expected to benthic organisms. This appears to be a more conservative threshold than the LELs given above. Above the Effects Range-Medium (ER-M) impacts are likely to benthic organisms. Following the general trend, sediments/soils from the two downstream tributary sites were most consistently elevated relative to the ER-L. The two sites on Aliso Creek had mixed results relative to the ER-L with the upper site exceeding the ER-L more frequently than the downstream site. None of the samples exceeded the ER-M values, supporting the conclusions drawn from comparisons to the LELs.

No detectable TRPH concentrations were found in the water samples collected by the Santa Ana Regional Water Quality Control Board in August 1994 (Allan Bacon, pers. comm.).

Invertebrates samples did not show detectable concentrations for most PAHs for which background concentrations have been measured (Eisler 1987). The two fish samples also did not have detectable concentrations of the few PAHs for which comparison values were available. This suggests that significant bioaccumulation was not occurring.

Macro-invertebrate analysis indicated that the invertebrate fauna is dominated by sediment and stress tolerant species in both the reference areas and the oiled area. In fact, based on the August invertebrate sampling, the oiled site was determined to be the least stressed.

Fish histopathology studies did not demonstrate the occurrence of gonadal atresia. Such atresia would have been expected if a severe exposure to oil had occurred. Fish sampling was carried out periodically from the time of the spill in March to July 1994, and sampling was repeated in the fall of 1995. During the course of the 1994 sampling, the fish found were small and their numbers appeared to be low. In the 1995 sampling the fish population appeared to be more robust and their numbers more appropriate for the available habitat. More detailed information on the fish studies will be available in the report to follow under separate cover.

PREASSESSMENT SCREEN DETERMINATION

Based on the information gathered for this preassessment screen report, it is the determination of the U.S. Fish and Wildlife Service that the uncontrolled release of oil on or about March 20, 1994 into riparian habitat on an unnamed tributary and Aliso Creek in Chino Hills State Park did not result in quantifiable impacts to wildlife resources and their habitat beyond the initial impact and clean-up. It is the Service s recommendation that continued damage assessment activities relating to this spill not be pursued. In addition, the financial solvency of the potentially responsible party s operation is in doubt at this time. The potentially responsible party s ability to fund restoration activities appears to be very limited.

PRELIMINARY COMPENSATION OBJECTIVES

The only restoration need that has resulted from this spill is the continued maintenance of the mortar dam below the site. As a result of negotiations between EPA and the California Division of Oil and Gas (DOG), DOG has agreed to oversee the maintenance requirements of this structure. No further compensation will be sought in this case as a result, and therefore no compensation objectives have been developed for this incident.

COORDINATION

The Service and the CDFG have executed a Memorandum of Understanding designating the Department as the primary contact for fish and wildlife issues in the event of oil and toxic substance spills within the State of California. This agreement also states the CDFG and the Service will work cooperatively to assess damages to natural resources. In the case of this spill, the CDFG has pursued a criminal case against the potentially responsible party. Due to staffing constraints within the CDFG, the damage assessment initiation has been conducted by the Service independently. However, where possible and necessary, documents regarding the spill have been shared between the two agencies. The RWQCB and State Parks also provided assistance and information needed to complete this pre-assessment screen.

REFERENCES

Eisler, R. 1987. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85(1.11). 81pp.

Farrington, J.W. and B.W. Tripp. 1977. Hydrocarbons in western North Atlantic surface sediments. Geochim. Cosmochim. Acta 41:1627-1641.

Long, E.R. and L.G. Morgan. 1990. The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, Seattle, Washington. 175pp.

National Resource Council (NRC). 1985. Oil in the Sea - Inputs, Fates and Effects. National Academy Press, Washington, D.C.

Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Report prepared for the Ontario Ministry of the Environment and Energy. 24pp.

Roberts, F. 1993. Memo. Re: Threat Assessment of the Southwestern Pond Turtle within the Carlsbad Field Office Jurisdiction to Tom Davidson, Ventura Field Office.

U.S. Fish and Wildlife Service, 1996. Ltr. Re: Proposed modification to permit No. 94-00245-BH, Eastern Transportation Corridor (ETC), Orange County, California. From Gail C. Kobetich, Field Supervisor to Colonel Michal R. Robinson, District Engineer, U.S. Army Corps of Engineers.

Photo 1. Oil around the base of tanks in separator operation where spill occurred

Photo 2. Temporary cover to prevent run-off from contaminated soil

Photo 3. Standing oil behind the temporary coffer dam on the tributary

Photo 4. Standing oil and loose booms in Aliso Creek

Photo 5. Oiled vegetation along Aliso Creek in Chino Hills State Park

Photo 6. Oiled southwestern pond turtle found in Aliso Creek

Photo 7. Sheen being released by standing oil in Aliso Creek

Photo 8. Back-up of heavy oil just upstream of temporary coffer dam on Aliso Creek

Photo 9. Oil and debris behind temporary coffer dam on Aliso Creek

Photo 10. Mortar dam constructed on the tributary below contaminated soils

SUBMITTED TO:

U.S. Fish and Wildlife Service
911 NE. 11th Avenue
Portland, Oregon 97232-4181