Guidelines for Selection of Cleanup Endpoints During Oil Spill Responses

Department of Fish and Game
Office of Spill Prevention and Response

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Acronyms

BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CEQA	California Environmental Quality Act
CSM	Conceptual Site Model
CWA	Clean Water Act
DFG-OSPR	Department of Fish and Game - Office of Spill Prevention and Response
ER	Emergency Response
ERA	Ecological Risk Assessment
ES	Environmental Scientists
ESI	Environmental Sensitivity Index
ESLs	Environmental Screening Levels
FOSC	Federal On-Scene Coordinator
FRT	Field Response Team
IAP	Incident Action Plan
ICS	Incident Command System
LR	Long-Term Remediation
NEBA	Net Environmental Benefit Analysis
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration
NOECs	No-Observed-Effect Concentrations
NRDA	Natural Resource Damage Assessment
OES	Office of Emergency Services
OPA	Oil Pollution Act of 1990
PAHs	Polycyclic Aromatic Hydrocarbons
RCP	Regional Contingency Plan
RI/FS	Remedial Investigation/Feasibility Study
RP	Responsible Party
RWQCB	Regional Water Quality Control Board
SCAT	Shoreline Cleanup Assessment Team
SOFT	Sign-Off Field Team
SOSC	State On-Scene Coordinator
TPH	Total Petroleum Hydrocarbon
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

During an oil spill (inland and marine), responders must decide when cleanup efforts should be terminated, that is, answering the question of 'how clean is clean?' There are many different definitions of "clean", based on ecological, toxicological, legal, and socio-economic criteria (Baker, 1997). Therefore, at each spill, decision-makers must define "clean" by establishing cleanup endpoints. Cleanup endpoints are explicit expressions of the desired post-spill conditions at the site. The National Oceanic and Atmospheric Administration (NOAA) has developed general qualitative guidelines for determining oil spill cleanup endpoints during the shoreline assessment process (NOAA, 2000; Michel and Benggio, 1999). However, no specific guidelines are available that address all the types of oil spills to which the Department of Fish and Game - Office of Spill Prevention and Response (DFG-OSPR) responds. The purpose of this guidance document is to provide DFG-OSPR staff, primarily Field Response Team (FRT) members, with guidelines for developing cleanup endpoints for emergency response (ER) activities associated with petroleum releases. DFG-OSPR's pollution response jurisdiction follows DFG's mission, to protect wildlife and their habitat. The overall goal of these guidelines is to promote statewide consistency when it comes to developing cleanup endpoints for oil spill responses and cleanup activities.

This 'how clean is clean' question is complex due to the many variables that need to be taken into consideration when developing cleanup endpoints (e.g., oil type, cleanup technologies, habitat and species present, and logistical issues). There are many types of crude oils and refined petroleum products that require different response and cleanup strategies. The various types of oil "behave" differently in the environment due to different physicochemical properties such as flash point, specific gravity, and viscosity. Therefore, cleanup options and cleanup endpoints must be tailored to address the fate and transport of the specific product that has been released. Since each oil type is a complex mixture of many compounds, toxicological properties of the different oil types must also be considered when developing cleanup endpoints for the species present at the spill site. It is also necessary to evaluate the environmental trade-offs of each cleanup option. This evaluation is commonly termed 'net environmental benefit analysis' (NEBA) where an evaluation is made of the benefit(s) derived from continued cleanup efforts versus further environmental damage that continued cleanup efforts may cause. Additionally, logistical constraints such as beach access, cost of the cleanup and funding sources for the cleanup, need to be considered. Due to all of these variables, cleanup endpoints should be "spill specific" to an appreciable degree. As a result, this guidance document does not provide a prescriptive set of cleanup endpoints but, rather, outlines a process to follow and provides examples for selecting cleanup endpoints during an ER.

This document provides a definition of ER (Section 2.0) and then outlines the seven-step cleanup endpoint selection and ER 'sign-off' process (Section 3.0). In Attachments A to F, examples of the cleanup endpoint selection process and 'sign-off' forms used from a variety of petroleum spills have been included to highlight how "spill specific" issues have been addressed. Additionally, in Appendix 1, a discussion of a general process for selecting cleanup endpoints for long-term remediation (LR) responses is provided, as are a few examples of LR cases where DFG-OSPR has participated in the remediation process.

If there is subsurface contamination (of soil/sediment and/or groundwater) where the project can last a year or more, DFG-OSPR generally considers this to be a LR.

2.0 DESCRIPTION OF AN ER

For DFG-OSPR, an ER can be defined as containment and/or removal of an uncontrolled release of a deleterious pollutant impacting or threatening to impact state waters and/or soil/sediments that requires action by ER personnel to prevent or minimize: 1) loss of life; 2) impacts to wildlife (and other natural resources under DFG's trusteeship, including habitat); or 3) damage to property (lowest priority).

ER's are generally classified by the size of the spill and DFG-OSPR follows the U.S. Coast Guard (USCG) definitions of incident or event type, which helps determine the level of response required (USCG, 2006). Additionally, per the Homeland Security Act of 2002 and Homeland Security Presidential Directive Five, the standardized National Incident Management System (NIMS) is to be used during a disaster to coordinate federal, state and local ER. As part of NIMS, the Incident Command System (ICS) is used to manage an ER, including multi-agency, multi-jurisdiction emergencies.

DFG-OSPR has two primary functions during an ER. First, DFG is the designated off-highway spill response agency for the State of California and DFG-OSPR is specifically responsible for marine oil spills, per the California Oil Spill Prevention and Response Act[1]. A second spill response function of DFG is as a natural resource trustee.[2] This requires DFG to protect the natural resources, identify natural resource injuries and recover damages for those injuries during spill responses [commonly known as the Natural Resource Damage Assessment (NRDA) process]. This dual role is an important aspect of interactions between DFG-OSPR and other participating agencies.

Termination of an ER is incident specific and generally occurs when the Unified Command (as established per each spill) concurs that the objectives in the spill specific Incident Action Plan (IAP) have been met, that the agreed upon cleanup endpoints have been reached, and no further cleanup is practicable and/or warranted.

3.0 CLEANUP ENDPOINT SELECTION PROCESS IN AN ER

Following an oil spill, a seven-step process should be followed for selecting cleanup endpoints during an ER (Figure 1). These steps addressed in the following section include: 1) activate an emergency response; 2) conduct reconnaissance surveys; 3) establish response objectives; 4) establish consensus-based cleanup endpoints; 5) complete emergency cleanup activities according to agreed upon cleanup endpoints; 6) sign-off on emergency cleanup activities; and 7) complete post-emergency responses activities. These seven steps are not unique to the cleanup endpoint selection process, but are general steps used for spill response that have been customized for this guidance document to explain the cleanup endpoint selection process.

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[1] California Lempert-Keene-Seastrand Oil Spill Prevention and Response Act, Government Code § 9574.1, et seq.

[2] DFG has trustee authority pursuant to DFG Code §§ 711.7 and 1803.

3.1. Activate An ER

The first step involves determining whether an ER should be activated. The decision to activate an ER is spill specific and depends on the type of petroleum product, quantity spilled, habitat type, and logistical considerations. The decision is generally made by the DFG-OSPR FRT members, other agencies, and the Responsible Party (RP).

Coordinating with other agencies early on in the spill response is important for many reasons, one being development of cleanup endpoints. While it is spill specific as to which agencies should/may assist with ER, ICS provides for response flexibility. Most agencies with an interest in a spill are initially notified through the Office of Emergency Services (OES) and/or the National Response Center. If no response is made by other agencies whose jurisdictional authority is important to the ER, DFG-OSPR staff may attempt further contact with these agencies and invite their participation in the ER.

The USCG (coastal zone) or U.S. Environmental Protection Agency (USEPA; inland) are the lead federal agencies in spill response, and they will usually be the Federal On-Scene Coordinators for the ER. Other agencies that may be involved are designated Trustee Agencies [e.g., U.S. Fish and Wildlife Service (USFWS)] and there other federal, state and local agencies that should/may assist in ER. Interagency coordination is usually the responsibility of the Liaison Officer in ICS. In small spills, there likely will not be a Liaison Officer and these duties will be performed by another ICS position that is filled (e.g., Planning Section Chief).

3.2 Conduct Reconnaissance Surveys

After the ER has been activated, initial reconnaissance surveys are conducted to get an overall perspective on the spill, (Step 2 in Figure 1; Michel and Benggio, 1999). Initial reconnaissance is used for identifying response objectives, general spill planning and collection of initial information to help determine the cleanup endpoint(s). To that end, initial reconnaissance surveys should note:

- What media types have been contaminated (e.g., soil, sediment, surface water, groundwater, biota and air), including specific attributes such as sediment grain size and depth to groundwater;
- What potential ecological resources have been affected (e.g., habitat type and species), including special status species;
- Oil type, condition (e.g., dispersed or weathered), extent of contamination, and migration pathways;
- Safety issues;
- Logistical issues or constraints (e.g., site access); and
- Human use issues (e.g., economic, recreational, aesthetic, cultural resource, and political issues).

One useful tool for characterizing ecological resource information gathered during reconnaissance surveys is the development of a conceptual site model, as described in ecological risk assessment guidance (USEPA, 1997; Suter et al., 2000). The conceptual site model identifies the: 1) petroleum product, sources and release mechanisms; 2) media (e.g., surface water or sediment) of concern and exposure routes, 3) ecological receptors at potential risk, and 4) other resources that may be potentially affected by the release. By "tracing" contaminant movement through the ecosystem to the ecological receptors, media potentially requiring cleanup may be identified in an organized manner. Conceptual site model development is especially useful for decision-making in large or complex spill scenarios.

The model may consist of a relatively simple table or graph and should be developed to match site-specific conditions. An example of a conceptual site model for a gasoline pipeline release to a tidal marsh is presented in Table 1. Identification of the primary source of contamination and the primary release or transport mechanisms helps to identify the types of media that may be contaminated. In the case of the surface pipeline rupture example, the primary release is to the surface soil and air, because of the volatile nature of gasoline. The gasoline may be transported to adjacent surface water, sediments and biota. Volatilization of gasoline from these secondary sources may continue to contaminate the air, and leaching may contaminate subsurface soil, sediments, and groundwater. Considering these primary and secondary sources and release mechanisms, media of concern in this spill scenario would consist of soil, surface water, sediments, biota, and air. Each of these media may represent a potential exposure route for a variety of ecological receptors. The model should identify the major exposure routes for the general classes of ecological receptors at the site, usually represented as the major elements of the food chain. In the case of the gasoline spill, birds may be exposed by several routes but other receptors, such as aquatic invertebrates, may have a single route of exposure. By identifying the contaminated media, the exposure routes and the groups of ecological receptors that may be exposed, priorities for cleanup objectives and endpoints may be established.

Development of a conceptual model may also assist in the qualitative assessment of potential effects of oil spill response options and associated hazards to ecological resources (e.g., habitat loss, physical degradation of habitat or adverse biological effects). Table 2 provides an example of this type of conceptual model, from a spill response planning guidebook (Aurand et al., 2000), that identifies hazards to ecological resources from different response technologies. In this guide, a consensus-based ecological risk assessment process (i.e., a NEBA) is outlined to estimate and compare the relative environmental risks of spill response options, contributing to the development of cleanup objectives and endpoints.

As the spill cleanup progresses, reconnaissance surveys are continued (especially for medium to large spills) but they may develop into the more formal Shoreline Cleanup Assessment Team (SCAT) surveys to evaluate the progress and effectiveness of the cleanup. SCAT surveys are conducted following specific protocols outlined in the Shoreline Assessment Manual (NOAA, 2000).

3.3 Establish Response Objectives

Once reconnaissance surveys have been conducted to identify the spill conditions and affected resources, response objectives can be developed (Step 3 in Figure 1). Ideally, other agencies have also been identified and are participating in the development of response objectives. Response objectives generally define the goals of the cleanup effort which lead to the development of the specific cleanup endpoints. Michel and Benggio (1999) have outlined the following basic response objectives that lead to developing cleanup strategies that do not cause more harm than good to the environment:

- Ensure safety, minimize exposure hazards for human health and the environment;
- Speed recovery of impacted areas if possible; and
- Reduce threat of additional or prolonged natural resource impacts.

The USCG (2006) Incident Management Handbook outlines additional generic response objectives including:

- Initiate actions to control source of spill;
- Determine fate and effect of oil;
- Contain and recover oil; and
- Remove oil from impacted areas.

Each ER will have unique issues (e.g., oil type, species present, habitat type, and human use issues) that may lead to different response objectives and cleanup endpoints. Flexibility is important and response objectives and associated activities should be modified as needed to specific spill conditions.

3.4 Establish Consensus-Based Cleanup Endpoints

After response objectives have been developed, specific cleanup endpoints can be defined (Step 4 in Figure 1). If agencies in addition to DFG-OSPR are involved, a consensus-based approach is recommended for developing ER cleanup endpoints, but the Unified Command has the final decision-making authority. A consensus-based approach to developing cleanup endpoints during an ER does not have to include establishing cleanup endpoints for complete site remediation (e.g., if groundwater is contaminated and LR will be needed). This is particularly true if the time required to achieve consensus on a cleanup endpoint delays or impedes the ER.

Consensus-based endpoints are usually developed by the DFG-OSPR FRT Environmental Scientists (ES), as designated by the Unified Command, in consultation with other lead and Trustee agencies. The Unified Command makes the final approval of the cleanup endpoints. Cleanup endpoints can be qualitative or quantitative. Qualitative endpoints, such as “no visible oil on water”, are often used when only DFG-OSPR and/or USCG respond. The minimum cleanup level should be based on qualitative values, using best professional judgment. In the following sections, several types of cleanup endpoints are identified, along with their potential application at spills.

Cleanup endpoint selection should consider remedial options that will speed the recovery of the natural resources without using aggressive and inappropriate cleanup techniques that can make matters worse. Less intrusive methods or natural recovery are often preferable. The best cleanup strategy is often not the one that removes the most oil but that removes the oil that poses a greater risk of injury than would result from cleanup.

3.4.1 Qualitative Endpoints

Qualitative cleanup endpoints are primarily based on visual, tactile or olfactory observations and do not require collection of analytical chemistry data. Qualitative endpoints can be used for the protection of wildlife because it is known that the presence of petroleum products on skin, fur, or feathers can cause a variety of adverse effects (e.g., loss of water repellency, hypothermia, and irritation of the skin, oral, ocular, respiratory, and gastrointestinal mucous membranes; Jessup and Leighton, 1996). In addition, qualitative evaluation of petroleum levels in the environment may be used to indicate whether wildlife exposures would result in toxic or adverse physical effects (e.g., smothering, coating or entrapment). Qualitative cleanup endpoints are often tailored for different shoreline and media types (e.g., high energy rip rap shoreline vs. sheltered mudflats), based on the physical behavior of petroleum in these environments. Logistical and economic issues are often taken into consideration when establishing qualitative cleanup endpoints.

NOAA’s Office of Response and Restoration has developed several qualitative cleanup endpoints that are commonly used by DFG-OSPR (NOAA, 2000) which include:

- No visible oil on the water or sand/soil/sediment. Or oil is not detectable by sight, smell, or feel (this includes sub-surface oiling). Or no visible oil except scattered tarballs or swash lines of minute tarballs may occur as the sand is reworked by the waves and remaining tarballs and tar patties should be at or below normal background frequency.

  These types endpoints are often used for sandy beaches (Environmental Sensitivity Index [ESI] 3 and 4) where wave action ‘polishes’ the sand. The sand beach cycle is short, so reworked and relocated sediments often can be rapidly returned to their normal distribution on exposed beaches.

- Oil visible but no more than background.

  This endpoint requires establishment of ‘background’ by surveying similar areas nearby but not impacted by the spill, and/or having staff familiar with the area. This endpoint is used in areas such as harbors, or areas with known natural seeps.

- Oil no longer releases thick rainbow sheen that will affect wildlife, sensitive areas, or human health. Or, residual light sheening persists over a relatively short time period. Or, only small isolated patches of silver sheen may remain. Or, no recoverable oil or “mousse” remains on the water or shore (mousse is defined as a frothy mixture of oil, water and organic debris). Or, cleanup can be terminated when all liquid oil in the sediments has been removed and no more than a stain may remain on the gravel-sized sediments, and there should be no oil layers in pits.

  When selecting these types of endpoints, one should consider the degree of exposure, such as high winds or waves which break up sheen versus sheltered areas where sheen will be more persistent. These types of endpoints are often used for surface water or for shorelines with high energy.

These endpoints are often used for exposed rocky cliffs, wave-cut platforms (where shoreline access is often dangerous and limited), rip rap (difficult to remove oil from crevices), mixed sand and gravel, gravel beaches, and tidal flats (ESI types 1, 2, 5, 6, 7, 8, and 9).

Beaches with a significant amount of gravel are relatively difficult to clean because they have high potential for deep penetration and burial. Deeply penetrated oil can be a chronic source of sheens for months or longer.

- Oil no longer rubs off on contact, defined as oil removal to a stain or coat or weathering to point that oil is no longer sticky.

  This endpoint is often used for rocky shores, wave-cut platforms, rip rap and gravel beaches (ESI 1, 2 and 6); and for vegetation.

- Will not result in ‘asphalt-like conditions’ (i.e., cohesive, thick or solid oil).

  This endpoint is often used for sandy beaches (ESI 3 and 4).

- Heavy oil has been removed to the point at which further cleanup will result in excessive habitat disruption, causing more harm than natural removal of oil residues (NEBA).

  This cleanup endpoint is often used in sensitive habitats such as wetlands or tidal flats (ESI types 7, 9, and 10) where aggressive oil removal may result in excessive habitat disturbance (e.g., trampling muddy sediments causing oil to penetrate deeper). All response options have limitations and potential benefits that need to be evaluated relative to each other and to baseline (no response).

The USCG uses similar qualitative endpoints, per the USCG Marine Safety Manual, Vol. IX, Chapter 5 – Response (USCG, 1997). It states, “…Generally, for oil discharges, removal is “complete” when:

- There is no longer any detectable oil present on the water, adjoining shorelines, or places where it is likely to reach the water again; or
- Further removal operations would cause more environmental harm than the oil to be removed; or
- Cleanup measures would be excessively costly in view of their insignificant contribution to minimizing a threat to the public health or welfare, or the environment; and
- Activities required to repair unavoidable damage resulting from removal actions have been performed.”

In addition to the above, the USCG often uses the “no longer releases a sheen” endpoint. Per the Oil Pollution Act of 1990 (OPA 90), which is codified in 40 CFR §110.3(b), oil can not be discharged in such quantities as ``may be harmful'', pursuant to §311(b)(4) of the Clean Water Act (CWA). This section of the CWA states discharges of oil may be harmful to public health or the environment and defines discharges of oil as those that: (a) violate applicable water quality standards; or (b) cause a film or sheen on the water or adjoining shorelines, [61 FR 7421, Feb. 28, 1996].

3.4.2 Quantitative Endpoints

Quantitative endpoints rely on measurements or quantitative data, as opposed to qualitative data such as categorical observations (e.g., sheen or no sheen). Quantitative endpoints generally involve measurements of chemical concentrations in affected water, sediment, soil, or biotic tissue. Quantitative endpoints can be identified from regulations such as water quality criteria, can be required by County Health or HazMat Departments or can be risk based using toxicological effects data that are used as benchmarks [e.g., a specific total petroleum hydrocarbon (TPH) concentration, or compound specific concentration based on toxicity reference values]. In the following paragraphs, descriptions of the various types of quantitative endpoints are provided, along with a discussion of the potential use of these endpoints as cleanup levels for the protection of ecological receptors. In some cases, more than one endpoint may be measured, and the final cleanup endpoint may be selected considering all the lines of evidence. It should be noted that human health impacts may have to be considered but these endpoints should be selected in conjunction with agencies responsible for human health protection.

<u>TPH Concentrations</u>: A TPH concentration in water, sediment, or soil (Table 3) may be the basis of a cleanup endpoint. Non-risk based endpoints may be for example, water quality objectives selected by the Regional Water Quality Control Boards (RWQCBs); or may be site-specific ambient concentrations established by monitoring; or may be based on other agency's regulation or policy.

A risk-based approach may also be selected to identify TPH concentrations in media that are not associated with adverse effects, often termed no-observed-effect concentrations (NOECs). These NOECs may be for acute effects, such as lethality, or chronic effects, such as altered growth, reproduction or survival. Since toxicity is a function of the chemical composition of the TPH measurement, NOECs vary by petroleum product, degree of weathering of the mixture, and the exposure route of the organism. As a result, TPH NOECs must be selected to match the conditions and receptors at the spill site. Many toxicity studies have been conducted with fresh product. As a result, developing cleanup endpoints for unweathered petroleum products may be easier to achieve than for weathered mixtures. TPH cleanup endpoints may be developed for many aquatic, benthic, and terrestrial organisms that are in direct contact with contaminated media, but toxicity data are limited for some receptors. Since TPH cannot be directly measured in biotic tissue, TPH concentrations that are protective of bird and mammal exposure via the food chain cannot be developed directly. DFG-OSPR ESs or Toxicologists should be consulted in the development of risk-based TPH cleanup endpoints. Presently, there are no risk-based regulatory criteria for TPH concentrations that are protective of ecological receptors.

Since TPH measurements may be confounded by natural organic matter, such a humic acids, consultation with an analytical chemist is recommended to select appropriate TPH analytical methods.

Example TPH-based quantitative endpoints include:

- No oil on water, sand, soil or sediment that is above background concentrations of TPH (as measured in samples).
- No oil on water, sand, soil or sediment that is above a predetermined cleanup concentration established by regulatory agencies (e.g., RWQCB), such as TPH level of 100 mg/kg in sand, soil or sediment.
- TPH soil concentrations do not exceed xx mg/kg, an estimated NOEC for terrestrial plants and soil invertebrates exposed to petroleum contaminated soil at a refinery site.
- Per the USCG**,** 33 CFR § 151.10 states vessels are prohibited to discharge any oil or oily mixtures into the sea except when… the oil content of the effluent without dilution is less than 15 parts per million (ppm).

Indicator Chemical Concentrations**:** Benzene, toluene, ethylbenzene, xylene (BTEX) and polycyclic aromatic hydrocarbons (PAHs) are often used as indicator chemicals for TPH toxicity (Table 3). That is, it is assumed that the toxicity of the petroleum mixture may be described by the toxicity of one or more of these toxic constituents (French-McCay, 2002). Therefore, water, sediment or soil (Table 3) concentrations of BTEX or PAHs that are protective of ecological receptors may be selected by reviewing toxicity literature. Since BTEX are likely to evaporate quickly, these indicators may be most useful as cleanup endpoints for very light or light petroleum products that contain high concentrations of these compounds such as gasoline or jet fuel. Toxicity literature is widely available for the more persistent PAHs. PAH cleanup endpoints may be useful for releases involving medium or heavy petroleum products such as bunker fuel or crude oil that tend to contain higher concentrations of persistent PAHs. Development of indicator chemical cleanup endpoints may be achieved for many aquatic, benthic, and terrestrial organisms that are in direct contact with contaminated media, for a variety of acute and chronic endpoints. For example, PAH sediment quality guidelines for the protection of benthic organisms are available (Long et al, 1995; MacDonald et al., 2000). Since BTEX and PAHs can be measured in biotic tissue, indicator chemical concentrations that are protective of birds and mammals exposed via the food chain may also be developed. DFG-OSPR ESs or Toxicologists should be consulted in the development of risk-based indicator chemical cleanup endpoints.

Example indicator chemical based quantitative endpoints include:

- Total PAH concentrations in freshwater sediment do not exceed xx mg/kg (dry weight), an estimated threshold effects concentration for benthic invertebrates.
- Sediment naphthalene concentrations do not exceed xx mg/kg, a sediment concentration that has been estimated to not present a significant risk, via sediment or dietary exposure, to the western sandpiper.

TPH Fraction Concentrations: The premise of the TPH fraction approach is to break the complex TPH mixture into fractions based on common chemical and toxicological characteristics (Table 3). For example, the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG, 1998) selected 6 aliphatic fractions and 7 aromatic fractions, using equivalent carbon ranges, when developing criteria for the protection of human health (ATSDR, 1999; McMillen et al., 2001). For each fraction, a protective NOEC, based on toxicity data may be selected, and cumulative risk can be calculated to develop a risk-based cleanup level for the petroleum mixture (McMillen et al., 2001). Since concentrations of the TPH fractions change with product and weathering, toxicity assessment of a wide variety of mixtures can be evaluated using the fraction approach. This approach has been widely used for human health risk assessments but has not been frequently applied to ecological risk assessment. For many aquatic and terrestrial organisms, there is adequate toxicity data to develop NOECs for individual fractions but there are currently no universally accepted set of toxicity benchmarks. Additionally, risks to birds and mammals may only be evaluated by water, sediment or soil ingestion pathways because TPH fractions cannot be directly measured in biotic tissues. This approach requires a special analytical method to quantify TPH fractions in the media of concern (McMillen et al., 2001).

Example of a TPH fraction based quantitative endpoint:

- A human health based protective TPH concentration for site soils is xx mg/kg, based on evaluation of site-related risks for a TPH mixture containing x% aliphatic and x% aromatic fractions.

Toxicity Testing Results: Toxicity testing results can be used to define the exposure-effect relationship in a standardized manner for petroleum mixtures (Table 3). For example, one can use the test results to identify what TPH concentration is associated with no significant adverse effects and establish a cleanup objective at that value. Toxicity tests results can also be used to determine if current conditions are toxic, relative to a reference condition, or if toxicity is diminishing via natural attenuation over time. Toxicity tests may be advantageous where there is high likelihood of exposure to sensitive biological resources and where adequate data are not available on the toxicity of the spilled product. Many standard bioassays are available for aquatic invertebrates, fish, benthic invertebrates, algae, plants and soil invertebrates. It is important to clarify whether the samples are marine, estuarine, or freshwater as this will dictate the test organism selection. Acute tests, lasting a few hours to several days, evaluate mortality or interference with normal development, growth or reproduction. Chronic toxicity tests usually run for a significant portion of the life cycle of the test organism and non-lethal effects (growth, reproduction and development) are monitored over time. Due to the wide variety of protocols, toxicity tests should be selected in consultation with scientists with expertise in this area in order to match test conditions to the spill scenario. The DFG-OSPR Aquatic Toxicology Laboratory currently conducts several types of bioassays.

Example toxicity testing based quantitative endpoints include:

- Site sediment produces no significant toxicity to amphipods, compared to laboratory controls, using the 10-day sediment toxicity test with *Eohaustorius estuarius*.
- TPH concentrations in soil do not exceed xx mg/kg, an estimated no effect concentration for plants based on site-specific toxicity tests with lettuce.

Bioassessments: Bioassessments include a variety of field surveys designed to enumerate and characterize biological populations, communities and ecosystems (Table

3). Results of these bioassessments may be used as cleanup endpoints. For example, the DFG-OSPR Aquatic Bioassessment Laboratory utilizes the California Stream Bioassessment Procedure to assess the biological, physical and habitat conditions of wadeable streams. Using this protocol, bioassessment metrics characteristic of a reference condition for the benthic macroinverbrate community may be established as cleanup endpoints. Bioassessments are advantageous because they provide direct measurement of the community response to the contaminated media. However, in some cases, it may be difficult to interpret variation or evaluate responses in a timely manner.

Example of a bioassessment based quantitative endpoint:

- Bioassessment metrics for the impacted stream are characteristic of the applicable reference condition for the benthic macroinvertebrate community.

3.5 Completion of ER Cleanup and Sign-Off Process

When planned cleanup activities have been completed (Step 5 of Figure 1), a post-cleanup inspection should be conducted to determine whether cleanup endpoints have been achieved. This evaluation is often referred to as the “sign-off” process (Step 6 of Figure 1). Each spill-specific IAP should contain a statement that cleanup is complete when the agreed upon cleanup endpoints have been reached (see Attachment F for example IAP language). Generally speaking, cleanup may normally be terminated when the following conditions occur:

- For marine oil spills, best achievable protection has been met and best achievable technologies have been used; and
- The agreed upon cleanup endpoints have been reached; and
- The objectives in the spill specific IAP have been met; or
- The DFG-OSPR cleanup endpoints have been reached but the project needs to be handed-off to another agency that has additional quantitative endpoint(s) defined by regulation or policy; or
- No further cleanup is practicable because:
    - The area/habitat is inaccessible (e.g., an exposed rocky cliff); or
    - Remedial actions are no longer effective; or
    - The environmental damage caused by the cleanup efforts is greater than the damage caused by leaving the remaining or residual oil in place; or
    - The cost of cleanup operations <u>significantly</u> outweighs the environmental or economic benefits of continued cleanup [per the Regional Response Team Regional Contingency Plan (RCP; USEPA/USCG, 2005) section 1002.05].

Cleanup usually cannot be terminated when the following conditions exist (from the RCP section 1002.05):

- Recoverable quantities of oil remain on water or shores;
- Contamination of shore by fresh oil continues; and/or
- Oil remaining on shore is mobile and may be refloated to contaminate adjacent areas and nearshore waters.

Frequently, spill sites are subdivided into areas, divisions, or segments in order to aid discussion and activities related to planning and cleanup. These areas/divisions/segments are often based on distinctive landmarks, habitat types, or access constraints. In large spills, when an area/division/segment is ready for inspection to determine if the agreed upon cleanup endpoints have been reached, a Sign-Off Field Team (SOFT) is usually used. It is highly recommended that the SOFT consist of the same staff that were on the SCAT (NOAA, 2000). The SCAT inspects areas during the spill response and makes recommendations regarding how the area/division/segment should be cleaned. It is generally the SCAT Specialist in the Planning Section who recommends the cleanup endpoints to the Unified Command. Once the SCAT believes an area has been cleaned to the agreed upon cleanup endpoint, the SCAT at that point becomes a SOFT. The SOFT should consist of one representative from the DFG-OSPR, one representative from the RP, and one federal representative. The federal representative could be from the USCG, USEPA, USFWS or one of their representatives. In smaller spills, a federal agency representative may not be present and the cleanup assessment may be made by DFG-OSPR staff only and/or by another designated state or local agency representative(s). Every effort should be made to keep the SOFT representatives consistent throughout the site inspection and 'sign-off' process. All SOFT representatives must have signature authority from their respective agency in order to participate in the inspection and 'sign-off' process. For DFG-OSPR, the SOFT representative is usually a FRT ES. The decisions of the SOFT should be documented by use of a sign-off form. Examples of cleanup endpoint decision-making procedures, guidelines, and sign-off forms from spills are provided in Attachments B-E. Attachment F includes an example IAP from a small spill and a small spill sign-off form which should be the minimum level of documentation used.

The decision by the team that a segment is clean should be unanimous. If the team judges the cleanup to be thorough and complete, they recommend to the Unified Command that the area or segment be 'signed-off' and that no further cleanup is recommended. If further remedial action is warranted, the team should identify specific, additional cleanup recommendations for areas that do not meet the agreed upon cleanup criteria.

If other agencies have cleanup endpoints that are based on regulation, policy, or are risk-based, their input (often via coordinating with the Liaison Officer) should be taken into account as early on as possible during a response. Ideally, cleanup requirements of federal, state, or local agencies with jurisdiction should be coordinated so that the ER cleanup and/or removal actions are done only once and there is not considerable delay between close of ER and initiation of LR, if required. Circumstances leading to re-opening a site to conduct further cleanup in order to comply with additional requirements of an agency that did not participate during the ER of a spill event should be avoided, if possible. DFG-OSPR ER cleanup endpoints may not be as rigorous or strictly quantitative as those that may be required by other agencies. With some spills, one of DFG-OSPR's roles is to inform other agencies that the best cleanup strategy is at times not the one that removes the most oil. Ultimately, the decision on whether ER cleanup endpoints have been reached resides within the Unified Command.

'Sign-off' can also specify additional maintenance or monitoring activities (e.g., continue to change-out boom as long as sheens are being released or continue to remove tarballs from an area as they wash ashore after storms). In these cases, it is important that the criteria for ending the maintenance or monitoring also be clearly spelled out in the sign-off sheet (NOAA, 2000).

It is important that the responsible party (RP) clearly understand that even if an ER cleanup has been signed-off, that the sign-off is conditional. Site sign-off should always carry the provision that the RP will have to return to the site to perform additional cleanup should further contamination from the incident be discovered at some later time, or if previously undiscovered contamination is found (i.e. buried or sunken oil, oiled vegetation or sediments, etc), or if other agencies have additional cleanup requirements. See Attachment A for example language to be included in all IAPs and sign-off forms that release is conditional.

3.6 Post ER Activities

When an ER is terminated and "signed-off," the incident may require long-term maintenance and monitoring or LR may be necessary (Step 7 on the Figure 1). If the incident requires additional LR, the agency with jurisdiction and authority to require additional cleanup takes over as lead agency (e.g., RWQCB for groundwater contamination). If there is extensive subsurface contamination (e.g., soil, sediment, or groundwater) or where the project can last a year or more, this generally is considered a LR project. LR may be required in cases where there is on-going release potential (e.g., seepage), large-scale releases, complex habitats (e.g., wetlands), groundwater impacts or where uncertainties exist regarding cleanup decisions made during the ER (e.g., chronic effects of persistent constituents). DFG-OSPR FRT members can assist with LR in an advisory capacity (e.g., reviewing monitoring reports, and/or conducting periodic site inspections), but their primary role ends when the ER is terminated by disbanding the Unified Command (as established per each spill). LR activities are coordinated directly between the RP and the lead agency. The RP needs to be told upfront that, if LR is needed after the ER is "signed-off", agencies other than DFG-OSPR will be the lead. See Appendix 1 for details on LR.

FIGURE 1. JOB AID FOR CLEANUP ENDPOINT SELECTION AND SIGN-OFF PROCESS FOR OIL SPILL ER.

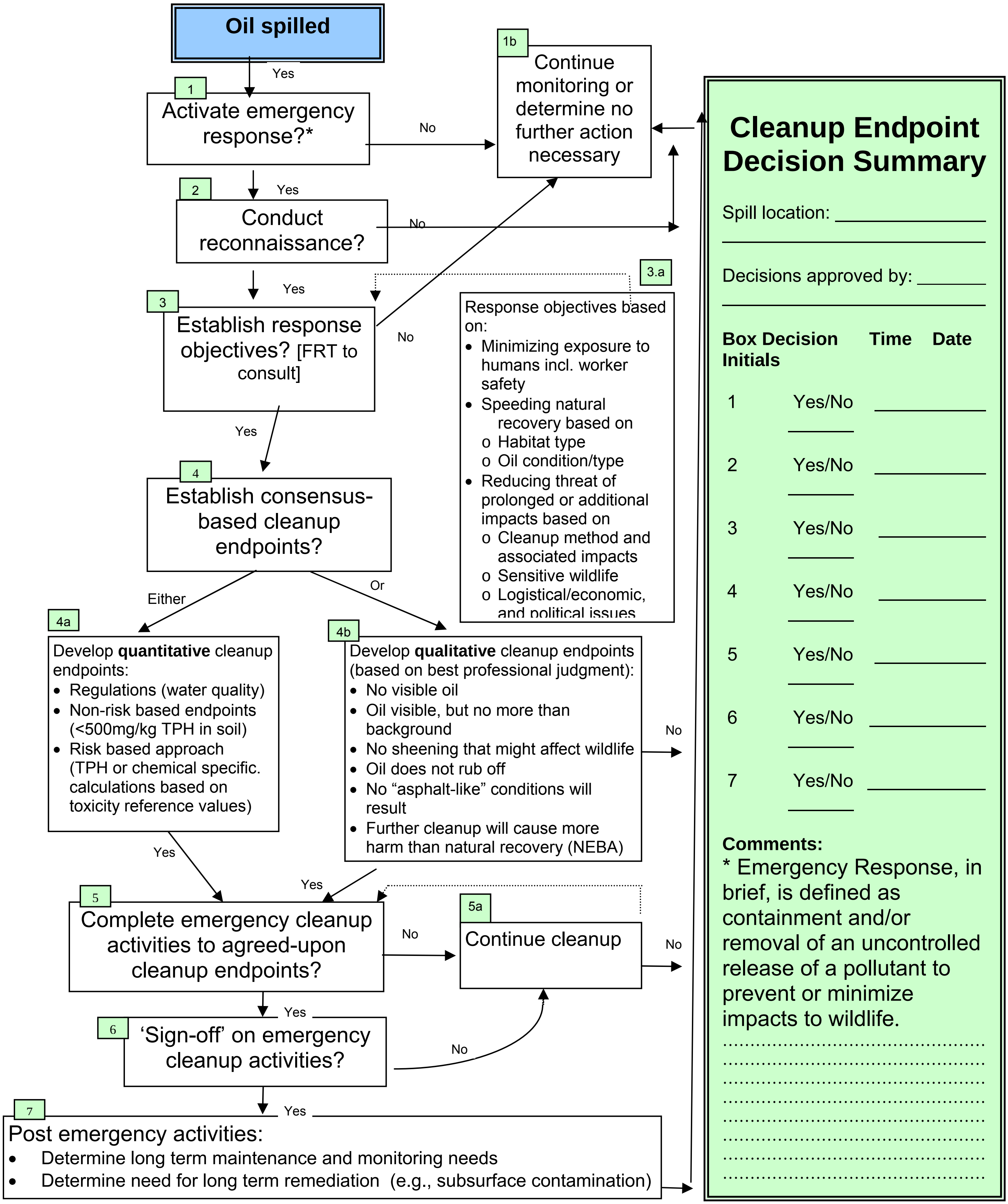

Table 1. Conceptual Site Model for a Gasoline Release to a Tidal Marsh

Primary Source	Primary Release Mechanisms	Media of Concern	Exposure Routes[a]	Aquatic Inverts	Fish	Birds	Mammals	Sediment Inverts	Plants	Soil Inverts
Releases to surface soil (surface pipeline rupture)	Runoff	Surface Water	Uptake	X	X					
			Ingestion			X	X			
			Dermal/Coating			X	X		X	
		Sediments	Uptake					X	X	
			Ingestion			X	X			
		Contaminated Biota	Ingestion			X	X			
	Direct Contact	Soil	Uptake						X	X
			Ingestion			X	X			
			Dermal/Coating			X	X			
	Volatilization	Air	Inhalation			X	X			

[a] Uptake of contaminants in water is considered to be the major exposure pathway for aquatic invertebrates and fish but dietary exposures may be important for bioaccumulative compounds. Uptake of contaminants in sediment or soil (including porewater) is considered to be the major exposure pathway for benthic or soil invertebrates and rooted plants.

X = Complete exposure pathway to be evaluated

Table 2. Example Conceptual Model from USCG "Developing Consensus Ecological Risk Assessments: Environmental Protection In Oil Spill Response Planning A Guidebook" (Aurand et al, 2000).

Zones:	Terrestrial					Water Surface				Intertidal				
Habitats: / **Sub-Habitats:**	Upland and Supratidal									Marsh				
RESOURCES:	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Vegetation	Mammals	Birds	Fish	Crustaceans	Mollusks
STRESSORS:														
Natural Recovery	7	1,7	1,7	1,7	1,7	1,4,7	1,4,7	1,4,7	2,4	1,4,7	1,4,7	2,7	2,4,7	2,4,7
On-Water Recovery	3	3,6	3,6	3,6	3,6	3	3	3	3	3	3	3	3	3
Shoreline cleanup	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	4,7	4,7	4	3,4	3,4	3,4	3,4	3,4	3,4
Oil + Dispersant	NA	NA	NA	NA	NA	7	7	NA	2	4,7	4,7	2,7	2,7	2,7
ISB	1	1	1	1	1	1,5	1,5	1,5	4,5	1,4,5,7	1,4,5,7	5,7	4,5,7	4,5,7

Note: On-water recovery includes protective and diversion booming

Note: N/A indicates that stressor and resource do not contact each other

These hazards represent changes from oil only scenario.

Shaded zones indicate areas of emphasis for the risk analysis

Hazards:

1. Air Pollution
2. Aqueous Exposure
3. Physical Trauma (mechanical impact from equipment, aircraft, people, boat bottoms, etc.)
4. Physical Oiling/Smothering
5. Thermal (heat exposure from ISB)
6. Waste
7. Indirect (food web, etc.)

Table 3. Types of Quantitative Endpoints for Surface Water, Sediment and Soil

Quantitative Endpoints	**Description**	**Potential Application**
TPH Concentration		
Non-Risk Based Ambient	TPH concentration reflective of ambient or non-spill impacted (background) conditions in water, sediment or soil.	Establish cleanup endpoints for cases where ambient levels are acceptable (e.g., harbors) and easily defined or where TPH measurements are not confounded by organic matter.
Protection of Water Resources	TPH concentration in water based on taste and odor thresholds for humans or other non-risk based water resource protection standards for water or soil.	Broadly applied policy that may be used by State and Regional Water Quality Control Boards, such as Ambient Water Quality Criteria
Risk-Based No-Effect Concentrations	TPH concentration in water, sediment or soil based on toxicity thresholds for the aquatic, benthic, plant, or soil invertebrate community.	Establish cleanup endpoint for unweathered mixtures in situations where residual petroleum remains.
Indicator Chemical Concentration		
Risk-Based Benzene, Toluene, Ethylbenzene, Xylene (BTEX) No-Effect Concentrations	BTEX concentrations in water, sediment or soil based on toxicity thresholds for the aquatic, benthic, plant or soil invertebrate community. Food chain and inhalation exposure may be considered for higher trophic levels.	Establish cleanup endpoints for very light or light petroleum products based on these indicator compounds.
Polycyclic Aromatic Hydrocarbons (PAHs) No Effect Concentrations	Sum PAH or individual PAH concentrations in water, sediment or soil based on toxicity thresholds for the aquatic, benthic, plant or soil invertebrate community. Food chain exposure may be considered for higher trophic levels.	Establish cleanup endpoints for medium or heavy petroleum products based on these indicator compounds.
TPH Fraction Concentration		
Risk-based No-Effect Concentrations	Overall TPH toxicity expressed as a function of the TPH fraction toxicity thresholds for aquatic, benthic, plant or soil invertebrate community. Toxicity thresholds may be developed for higher trophic level exposure to contaminated water, sediment or soil.	Address toxicity of weathered petroleum. Has been used for human health risk assessment. Availability of toxicity data may limit application for some ecological receptors.
Toxicity Testing Results		
Lethal or sublethal endpoints	Toxicity tests with contaminated water, sediment or soil can be utilized to determine if existing conditions are acceptable or to identify a threshold TPH concentration.	Evaluate toxicity of unique petroleum products or mixtures. Toxicity testing is commonly done for organisms in the aquatic, benthic, plant, or soil invertebrate community.
Bioassessment Results		
Community metrics	Field evaluation of species composition and densities can be utilized to determine if existing conditions are acceptable, compared to reference sites.	Monitoring tool to evaluate effectiveness of cleanup or to identify chemical concentrations associated with no significant effects in sensitive aquatic, benthic or terrestrial habitats.

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ATTACHMENT A:

EXAMPLE LANGUAGE REGARDING TERMINATION OF AN ER

Example language to be included in all Incident Action Plans:

Termination of an ER cleanup should occur when the Unified Command concurs the agreed upon cleanup endpoints have been reached and the objectives in the Incident Action Plan have been met.

Example language to be included in all Sign-Off Forms that sign-off is conditional:

NOTICE

This release is based on the best available data that exists on the date this release is executed. By executing this release, the Department of Fish and Game and/or the Administrator of the Office of Spill Prevention and Response does not waive any of his/her rights to require the responsible party to conduct additional clean up activities pursuant to Fish and Game Code sections 5655 or 12015, or Government Code sections 8670.25 or 8670.27, or any other applicable laws, should additional contamination be discovered that in the opinion of the Department or the Administrator requires further clean up. This release also does not preclude other actions required by other agencies with jurisdiction from requiring further action as they deem appropriate.

ATTACHMENT B:

EXAMPLE OF A QUALITATIVE CLEANUP ENDPOINT SELECTION AND SIGN-OFF PROCESS

STUYVESANT/HUMBOLDT MARINE OIL SPILL

Spill Overview: On September 6, 1999, the *Stuyvesant* spilled at least 2100 gallons of Intermediate Fuel Oil 180 into the Pacific Ocean near the mouth of Humboldt Bay, near Eureka, California. A dredge arm on the *Stuyvesant* punctured one of its fuel tanks. It appeared that most of the escaped oil was released within four miles of the coastline. Overflights by National Oceanic and Atmospheric Administration (NOAA) identified oil slicks and tarballs in the ocean as far as 15 miles offshore and as far north as Patrick's Point. Clam Beach was closed to public access from September 9 through 12. Indian Beach, north of Clam Beach, remained closed through September 16. Approximately 162 acres of rocky intertidal habitat and approximately 3,054 acres of sandy beach habitat were impacted by this spill. As part of the response activities, wildlife response teams collected 1,251 injured or dead birds, most of them oiled, along the shoreline or at sea between September 7 and 25. Shoreline Cleanup and Assessment Teams (SCAT) conducted surveys daily through September 15.

Participants: The United States Coast Guard (USCG), the DFG-OSPR along with other State, Federal and local agencies, established a unified command in responding to the spill. The sign-off teams consisted of representatives from the Federal On-Scene Coordinator, State Incident Commander, the Responsible Party, and where applicable, the Trustee/landowner.

The Cleanup Endpoint Selection and Sign-Off Process for the ER: Shoreline inspection procedures were prepared and shorelines were inspected using the agreed-upon cleanup guidelines listed in the attached sheet. Following notification by the Operations Section Chief that treatment of a shoreline segment had been completed, the Signoff Team inspected the segments to determine, by consensus, whether the agreed-upon cleanup guidelines had been met. After approximately six weeks the Signoff Teams re-inspected the shorelines to verify no further shoreline treatment was needed.

Example Sign-Off Sheet:

Cleanup Sign-off Sheet
Stuyvesant/Humboldt Oil Spill
September, 1999

The area indicated below is determined by the Unified Command shoreline inspection team to need no further cleanup at this time. This release is based on the best available data that exists on the date this release is executed. By executing this release, the Department of Fish and Game and/or the Administrator of the Office of Spill Prevention and Response does not waive any of his/her rights to require the responsible party to conduct additional clean up activities pursuant to Fish and Game Code sections 5655 or 12015, or Government Code sections 8670.25 or 8670.27, or any other applicable laws, should additional contamination be discovered that in the opinion of the Department or the Administrator requires further clean up. This release also does not preclude other actions required by other agencies with jurisdiction from requiring further action as they deem appropriate.

Date: ______________________________ Time____________________

Area Name: ____

Division: ____

Segment: ____

Tidal stage and time: ____

Signatures

Federal On-Scene-Coordinator
Representative____

State Incident Commander
Representative____

Responsible Party Representative____

Trustee/Landowner Representative____

Guidelines

The shoreline inspection team will determine when each shoreline segment has been cleaned to a reasonable* degree based on minimizing risk of impact to the environment and preventing human contact with the spilled oil. The following guidelines provide criteria for assessing shoreline status.

Guidelines for Selecting Cleanup Endpoints

Water Surface:
No, or only marginal, sheen on the water Surface.

Sand Beaches:
The shoreline should be free of liquid oil. Tarballs, tar patties, oiled stranded wrack and debris that could contaminate wildlife should be removed - to the extent that removal using reasonable cleanup techniques is feasible. Oil stain on sand that does not produce sheen may be allowed to degrade naturally.

Marshes:
Marsh vegetation should be free of oil that could contact and contaminate wildlife. Oil that is not likely to affect wildlife may be allowed to weather and degrade naturally.

Rocks, riprap, and seawalls:
Oiled riprap and seawalls should not release free oil or sheen. Rocks should be free of bulk oil except for oil stain (defined as a thin layer that cannot be scraped off using a fingernail), or small amounts of attached tarballs, which may be allowed to weather and degrade naturally.

* *Reasonable*, for the purposes of these shoreline inspections, is defined as when the shoreline inspection team members concur that further shoreline treatment would not yield a net environmental benefit.

Planning sheet for determining sign-off locations - 09.17.99 Stuyvesant/Humboldt
Update time 09.17.99 1900hrs

Trustees: HC-Humboldt Co. SP-State Parks.

Cleaning method: HC-hand crew removal; WP-wipe-down with sorbents; V-vacuum. NC-not cleaned. NO-not oiled

Segment Code	Name	Signing Trustee	Principal Habitat or ESI Type	Cleaning Method	Ready for Inspection Y or N	Signed Off Y or N
Z	Dry Lagoon	SP	ESI-4	NO	Y	Y
Z	Big Lagoon	SP	ESI-4 coarse sand	HC	Y	Y
Z	Patricks Pt Park Agate Beach	SP	pocket cove ESI-4, 5	NO	Y	Y
Z	Patricks Pt Park Agate Beach to Abalone Pt	SP	pocket cove ESI-2, 3,4,5	HC	Y	Y
A1	Baker Beach	HC	ESI-3, 4	HC	N	N
A1	Luffenholtz	HC	ESI-3	HC	Y	Y

ATTACHMENT C:

EXAMPLE OF A QUALITATIVE CLEANUP ENDPOINT SELECTION AND SIGN-OFF PROCESS

SUISUN MARSH SPILL

Spill Overview: On April 27, 2004, approximately 100,000 gallons of diesel fuel were released from an underground pipeline transporting refined product. The pipeline is located along the Southern Pacific Rail line within Suisun Marsh in Solano County. The released product flowed to the land and waterways of a privately owned duck hunting club property. The property is an approximately 225 acre managed saltmarsh enclosed with levees and tidally influenced via tide gates. This area is managed for wildlife habitat and waterfowl production. The entire release appears to have been confined to this enclosed acreage. About ten acres of a 25 acre saltmarsh habitat immediately adjacent to the release site were contaminated with diesel in surface and subsurface soils to varying degrees. The remainder of the contamination was associated with the margins of the waterway network by which diesel spread to the other 200 acres of the property. Active removal of free product from the marsh and contaminated soils continued though June 2004. By July 2004, all free product was considered removed and *in situ* treatment of residual product was continued using bioremediation until September 2004, prior to the fall rains. Soil and groundwater at the site continues to be monitored at this time.

Participants: The response included over a hundred personnel. Initial agency response was by U.S. Environmental Protection Agency (U.S. EPA), DFG-OSPR and the responsible party (RP) who formed a Unified Command. A local agency, the Suisun Resource Conservation District, was critical in controlling the spread of the spill because of their access to private property and knowledge of the waterways and tide gate structures within the marsh. The U.S. Coast Guard (USCG) Pacific Strike Team was brought into the Unified Command on the second day. A number of the response personnel were employees of, or clean-up contractors hired by the RP. The landowner participated indirectly through the RP. Other agency personnel that responded days to weeks after the initial response included local agencies, such as Solano County Environmental Health; State agencies, such as the California Office of Emergency Services (OES) and San Francisco Regional Water Quality Control Board (SFRWQCB); and Federal agencies, such as the National Oceanic & Atmospheric Administration (NOAA), U.S. Fish & Wildlife Service (USFWS) and U.S. Army Corps of Engineers (USACE). State and Federal Trustee agencies also sent natural resource biologists. Representatives of the Trustees and the RP have conducted various natural resource damage assessment (NRDA) activities, including fish and wildlife surveys, vegetation transect surveys, and chemical analyses of waters and sediments.

The Cleanup Endpoint Selection and Sign-Off Process for the ER: The site was divided into two primary operational divisions: Area A and Area B. Both Areas A and B had similar types of impacts: diesel soaked or contaminated soils, diesel soaked vegetation, diesel coated vegetation, diesel killed or moribund vegetation, diesel soaked or contaminated plant litter. In Area A, about 10 acres were severely affected. Soils in this area were in prolonged contact with the diesel and became saturated. The most saturated soils in the vicinity of the pipeline rupture were excavated and disposed of offsite. The degree and depth of diesel in the remainder of Area A was probably limited by the groundwater level below and the extent of desiccation cracks as the site began to dry out. Free movement of diesel within this system of cracks was unpredictable and influenced by not only the connectivity but also by obstructions within cracks. In some parts of Area A, topography permitted product to surface and pool. The peaty soils readily absorbed diesel but did not appear to allow much lateral movement (aside from cracks). Initially, trenching and removal of free product from the desiccation cracks was the primary cleanup method employed for Area A. When free product (gross contamination) removal was discontinued, the site was prepared for cleanup of residual contamination using bioremediation methods agreed upon by the Unified Command. In Area B, the sloughs and their various side channels provided a pathway for the diesel. Most habitat impacts occurred along the margins of the sloughs and their various side channels as well as the bed sediments. Diesel penetration into soil was influenced by the length of contact with the product, fluctuations in surface water level, the water table level, and the porosity of the impacted soils. The majority of the impacts were to surface soils and waters. Except for one small location in Area B in which small scale bioremediation was employed, the majority of cleanup effort was focused on vegetation removal and scraping of surface soils.

At about the time that active bioremediation in Area A was slowing down in August 2004, the SFBRWACB began to play a more active role in establishment of long-term quantitative cleanup endpoints and oversight of monitoring of site soils and groundwater. They indicated that they felt somewhat excluded from the cleanup operations that had occurred prior to their involvement, but had in fact received initial notifications plus courtesy phone calls from DFG-OSPR staff throughout the process. The RP was very reluctant to disband the Unified Command because the cleanup was occurring rapidly and efficiently under Unified Command. The SFRWQCB prepared a Cleanup and Abatement Order (CAO) for the site which established them as the lead agency for further remediation, but which also included DFG-OSPR as a participating agency for cleanup-related meetings and recipient of all subsequent site monitoring reports. No formal handoff or signoff for Area A occurred between SFRWQCB, and DFG-OSPR, but OSPR continues to receive all monitoring reports as soil and groundwater levels continue to decrease with natural attenuation. In Area B, cleanup was discontinued once surface soil levels were considered within a range of allowing natural attenuation to remove residual contamination. A more formal signoff procedure was followed for Area B which was based on results from qualitative sheen testing performed by representatives of the Unified Command, to determine cleanup endpoints (see attached sign-off sheet).

Example Sign-Off Sheet
Procedures for Completion of Unified Command Marsh Treatment Operations
Suisun Slough Pipeline Oil Spill, April 2004

The Unified Command's emergency response objective for marsh/wetland treatment in Division B is to remove all free product and allow oil residues to degrade naturally. It is anticipated that after free product removal, remaining residues in the soil and on vegetation will degrade within a period of weeks to a few months. It is recognized that any contaminated soils in Division B may involve longer-term remedial actions requiring further soil and water investigations. Cleanup in Division A will require further study and delineation of the oil plume in the soils before remediation and sign-off can occur. It is expected that remediation in Division A will take several months to complete.

Shoreline Inspection
All oiled shorelines will be inspected by a Unified Command inspection team (a.k.a. Sign-Off Field Team or SOFT). The SOFT should be comprised of representatives of the Federal On-Scene Coordinator (FOSC), the California Department of Fish and Game, the Responsible Party. In addition, a landowner representative is encouraged to accompany the SOFT during field surveys. The representatives assigned to the inspection team must have authority to discontinue shoreline treatment. Continuity of team members is to be maintained to the extent possible in order to facilitate consistency and efficiency.

Inspection Phase I
The Sign-Off Field Team (SOFT) will inspect segments once notified by the Operations Section Chief that removal of free oil, “mousse,” and/or contaminated debris has been completed. The SOFT must reach consensus that the status and condition as reported by SCAT teams is accurate. The purpose of the inspection is to agree that free product removal by reasonable means has been completed. The SOFT will use the “Sign-Off Field Team Recommendation Options” and “Guidelines for Shoreline Cleanup Endpoints” as a basis for their decisions (see attached).

Inspection Phase II – Flood Up
After all known free product, mousse and oil-contaminated debris has been collected and removed, water level in the marsh will be elevated slowly and incrementally in an attempt to lift any stranded free product onto the water surface. SCAT and cleanup recovery crews will be present at this time to identify, contain and recovery floating product.

Cleanup Re-initiation Phase
This release is based on the best available data that exists on the date this release is executed. By executing this release, the Department of Fish and Game and/or the Administrator of the Office of Spill Prevention and Response does not waive any of his/her rights to require the responsible party to conduct additional clean up activities pursuant to Fish and Game Code sections 5655 or 12015, or Government Code sections 8670.25 or 8670.27, or any other applicable laws, should additional contamination be discovered that in the opinion of the Department or the Administrator requires further clean up. This release also does not preclude other actions required by other agencies with jurisdiction from requiring further action as they deem appropriate.

Guidelines for Shoreline Cleanup Endpoints, Suisun Slough Pipeline Oil Spill, April 2004

The Sign-Off Field Team (SOFT) will determine when each shoreline segment has been cleaned to a reasonable* degree, based on minimizing risk of impact to the environment and preventing human contact with the spilled oil. The following guidelines provide criteria for assessing shoreline status.

<u>Water Surface</u>
No recoverable floating oil or “mousse” should remain on the water surface. Mousse, in this case, is defined as a frothy mixture of spilled product, water and organic debris, reddish-orange in color. Only small isolated patches of silver sheens may remain. Channels and ponded areas have less than 50% cover of sheen.

<u>Mudflats and Channel Banks</u>
The shoreline should be free of pooled oil. Mousse, oiled stranded vegetation, and oiled debris that could contaminate wildlife should be removed – to the extent removal using reasonable cleanup techniques is feasible. Oil stain on sediments that do not produce sheens may be allowed to degrade naturally. Oil stained sediments might be hand-raked to enhance natural degradation.

<u>Marshes/Wetlands</u>
Marsh vegetation should be free of pooled oil, mousse, and oiled debris that could contact and contaminate wildlife. Oil stained vegetation and silver sheens that are not likely to affect wildlife may be allowed to remain in place to weather and degrade naturally.

<u>Division A: Soils and Subsurface Areas</u>
Cleanup endpoint has yet to be determined by the RWQCB and DFG.
* *Reasonable*, for the purposes of these shoreline inspections, is defined as when the risk of injury to natural resources from additional cleanup is greater than the benefit of removing remaining oil (no net environmental benefit).

Sign-Off Field Team (SOFT) Recommendation Options
Suisun Slough Pipeline Oil Spill, April 2004

Upon inspection of a shoreline or segment, the SOFT may choose to act on one or more of the following three options:

A. No Further Cleanup Required:
Emergency cleanup operations of the Unified Command will be discontinued when one or more of the following conditions become true:
1. Natural degradation of remaining oil poses low risk of injury to natural resources, human use of natural resources, and cultural values (e.g. no pooled product, no sticky residues on shorelines or vegetation, only silver sheens remain).
OR
2. Risk of injury to natural resources from additional cleanup is greater than the benefit of removing remaining oil (no net environmental benefit). For example, further oil removal would risk increasing subsurface contamination via trampling in the mud, and/or kill root structures of existing vegetation, potentially make shorelines subject to erosion and reducing viable plant biomass.
OR
3. Oil has been removed to the maximum extent practicable using approved oil spill cleanup techniques.

B. More Cleanup Activity Required:
Area still contains some amount of recoverable product and/or cleanup activity is required. Specific instructions will be noted on the "Shoreline Cleanup Sign-Off Sheet." This option should be used when general area cleanup of stray absorbent pads and litter is required.

C. Maintenance or Monitoring Required:
Areas requiring follow-up monitoring and/or cleanup maintenance will be identified on the "Shoreline Cleanup Sign-Off Sheet." The SOFT will agree upon and specify the frequency and schedule for monitoring inspections, nature of cleanup operations, and procedures for modifying and discontinuing cleanup monitoring and/or maintenance.

D. Cleanup Re-initiation:
This release is based on the best available data that exists on the date this release is executed. By executing this release, the Department of Fish and Game and/or the Administrator of the Office of Spill Prevention and Response does not waive any of his/her rights to require the responsible party to conduct additional clean up activities pursuant to Fish and Game Code sections 5655 or 12015, or Government Code sections 8670.25 or 8670.27, or any other applicable laws, should additional contamination be discovered that in the opinion of the Department or the Administrator requires further clean up. This release also does not preclude other actions required by other agencies with jurisdiction from requiring further action as they deem appropriate.

ATTACHMENT D:

EXAMPLE OF A QUALITATIVE AND QUANTITATIVE CLEANUP ENDPOINT SELECTION AND SIGN-OFF PROCESS

SULPHUR SPRINGS CREEK SPILL

Spill Overview. The Sulphur Springs Creek spill is an example of a prolonged ER because it involved both surface and subsurface contamination and the cleanup took place over a nine-month period under a Unified Command. The release occurred during a very significant storm event on November 11, 2004 during which an above-ground 72-inch stormwater line was overwhelmed and residual petroleum was released out of a cement vault, to a small storm drain, out through a small, rusted outfall, and to a small ditch which feeds into Sulphur Springs Creek. The release consisted of a large volume of stormwater containing a mixed petroleum product consisting of both crude oil residue and particulate petroleum coke. Sulphur Springs Creek is a tidally influenced creek which empties to Suisun Bay. The upper reach of Sulphur Springs Creek, into which the release occurred, is located in a highly industrialized area of Benicia and receives runoff from adjacent facilities to both the east and west.

Participants. Of all notified agencies, only the U.S. Coast Guard, DFG-OSPR, and county environmental health responded initially to the release. Over the course of cleanup operations, the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) attended one meeting and indicated support of the planned cleanup activities. They did not respond to subsequent calls or e-mails as the cleanup progressed, until just before sign-off was initiated in August 2005. At this time a different SFBRWQCB representative attended a signoff meeting and provided a cleanup value of 100 mg/kg TPH to the Unified Command that did not consider site-specific factors or remediation efforts implemented to that point. At this time, the DFG-OSPR Environmental Scientist prepared a justification of the cleanup recommendation of 500 mg/kg TPH, on behalf of the Unified Command, and submitted it to the SFBRWQCB. There was no additional follow-up by the SFBRWQCB.

The Cleanup Endpoint Selection and Sign-Off Process for the ER. Initial cleanup focused on removal of gross contamination from the bottom of the creek, and removal of oiled vegetation adjacent to the creek and on the creek floodplain. Initial sediment removal focused on uniform hand-scraping of 6” from bottom and banks of creek downstream of release location approximately 500 feet, which was observed to be the area of greatest contamination. Hand-scraping of sediments from the creek was employed to avoid the necessity of obtaining a streambed alteration agreement from DFG. Subsequent sediment removal events focused on areas where there was still visible contamination and/or where the average of composite samples were greater than cleanup endpoint level of 500 mg/kg TPH determined by the Unified Command. The only location where average sediment TPH values remained above the cleanup recommendation level was in the ditch adjacent to the release outfall.

Inclement weather and high water and tide levels prevented further site assessment or remediation efforts during the winter months. It was decided to perform additional site characterization and cleanup in the spring when operations could occur under safer and more predictable conditions. Site sign-off was postponed until those efforts were completed. In the spring, work resumed. Further sediment sampling indicated that residual contamination in the ditch required additional cleanup to be below the 500 mg/kg TPH level established by the Unified Command. Site-specific factors and published (and unpublished) cleanup values were all supportive of the recommended cleanup level of 500 mg/kg TPH established by the Unified Command for sediments at this industrial site. Irrespective of whether the cleanup goal was achieved, the Unified Command agreed that the point of diminishing return had been reached and continued sampling and remediation were causing more ecological damage than would occur from allowing natural degradation of any residual petroleum remaining in the sediments. It was decided that the proposed SFRWQCB level of 100 mg/kg TPH was unreasonable given the industrial nature of the site, contaminant influences to the creek from other sources, and continued disruption of natural recovery already underway. An additional round of sediment removal was conducted only in the outfall ditch because levels there remained over 500 mg/kg TPH. Mechanical excavation of sediments from the ditch was ultimately employed to remove additional contamination within the deeper sediments. Upon achievement of the cleanup level, site sign-off inspections were conducted and documentation prepared and signed by the SOFT (see attached example). Primary restoration of the ditch area was also performed to enhance the habitat for fish and other aquatic species prior to closure of the ER.

Published SFRWQCB environmental screening levels (ESLs) are described as “conservative” and particularly “beneficial for use at sites with limited impacts…” (SFRWQCB, 2005). This is one of those sites. The most conservative value for residential land use and shallow soils of 500 mg/kg TPH (residual fuel) was recommended to the responsible party. Given the industrial land use of this area, a recommendation of 1000 mg/kg TPH (residual fuel) could also have been considered. However, given the degree to which wildlife utilize this creek, the more protective criteria selection seemed most appropriate.

Also referenced was the unpublished document entitled "Cleanup Goals vs. Soil Concentrations – KM/Suisun Marsh“ that was provided by the responsible party’s consultant (Levine-Fricke) at a meeting with the SFBRWQCB (Levine-Frike, 2004). This document mentions the use of residential soil ESLs, but also describes a back-calculation from the estuarine water ESL, assuming two levels of fraction of organic carbon in soil (0.14 and 0.277) as measured in Suisun Marsh sediments (geographically close to Sulphur Springs Creek). These values are 445 mg/kg and 887 mg/kg, respectively (average 666 mg/kg for TPH – middle distillate). Again, supportive of a cleanup recommendation of 500 mg/kg TPH.

Additionally, an DFG-OSPR Toxicologist was asked to prepare a brief assessment of cleanup recommendations for the more terrestrial portions of this site (Joab, 2005). His findings from the scientific literature were focused primarily on terrestrial (floodplain) receptors. Some soil toxicity studies were summarized, suggesting a range from 144 mg/kg to 688 mg/kg (average 416 mg/kg) TPH as cleanup guidelines. The 144 mg/kg TPH value has been used to protect sediment-dwelling organisms, and because we conducted both bottom and bank/floodplain sediment removal may have applicability to the sediment portions of this site. Rounding up to 500 mg/kg seemed justified given all the site-specific factors described above.

Based on review of the literature, the recommended cleanup goal of 500 mg/kg TPH was deemed reasonable by the Unified Command for this petroleum release. We regret, however, that there was no input from the San Francisco Bay Regional Water Quality Control Board on this cleanup recommendation.

References:

Joab, B. 2005. Memorandum: Recommendations for Cleanup Values for the Valero Refinery/Sulphur Spring Creek Incident on 11/11/04. May 19, 2005.

Levine-Fricke. 2004. Cleanup Goals vs. Soil Concentration - KM/Suisun Marsh. Presentation to or comments from SFBRWQCB.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 2005. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (Interim Final - February 2005). Oakland, CA.

Example Sign-off Sheet:

Benicia Sulphur Springs Creek Petroleum Spill (11/11/04)

Procedures for Completion of
Unified Command Cleanup Operations

August 30, 2005

Objective
The Unified Command's emergency response objective for remediation of Sulphur Springs Creek and associated release outfall ditch was to remove all visible product from vegetation and sediments and allow any remaining oil residues to degrade naturally. It is anticipated that after removal of visible product, remaining residues in sediments will degrade within a period of a few months. A cleanup endpoint of 500 mg/kg total petroleum hydrocarbons was established by the Unified Command to further define the extent of cleanup operations.

Shoreline Inspection
Oiled shorelines were inspected by a Unified Command inspection team (a.k.a. Sign-Off Field Team or SOFT). The SOFT consisted of representatives of the U.S. Coast Guard Federal On-Scene Coordinator (FOSC), the California Department of Fish and Game Office of Spill Prevention and Response State On-Scene Coordinator (SOSC), and the Responsible Party. Continuity of team members was maintained to the extent possible in order to facilitate consistency and efficiency.

Signatures:

____
, USCG Date
Federal On-Scene Coordinator (FOSC)

____
Warden , DFG-OSPR Date
State On-Scene Coordinator (SOSC)

____
Date
Responsible Party

Shoreline Cleanup Sign-Off Sheet

August 30, 2005

The area identified below was inspected by representatives of the Unified Command Sign-Off Team(s). Recommended actions for this area are detailed below. It is understood that if additional oil is discovered or if future conditions change, cleanup activities may be re-initiated.

Date Inspected: __________8/30/05_________Area Name: Sulphur Springs Creek and Release Outfall Ditch

Recommendation:

☐ No further cleanup required.

☐ More cleanup activity required.

☐ Maintenance or monitoring required.

☐ Cleanup re-initiation.

☐ Additional site recommendations

Signatures:

____
Representative for the FOSC

____
Representative for the SOSC

____
Representative for Responsible Party

ATTACHMENT E:

EXAMPLE OF A SIGN-OFF PROCESS WITH NO FORMAL CLEANUP ENDPOINTS

SUNKEN VESSEL INCIDENT

Spill Overview. The grounding of a fishing vessel on a state-owned beach in Half Moon Bay is an example of a case where there were additional and unanticipated impacts after cleanup was considered complete. On July 10, 2005 at 0100, a 52-foot fishing vessel ran aground on Venice Beach in Half Moon Bay. The vessel was reported to have approximately 1,500 gallons of fuel on board. The keel of the wooden vessel was broken and one of the fuel tanks was breached. Responders were on scene at first light. There was a strong diesel odor, but no visible product, and only minimal sheen in the water near the vessel. Because there was not extensive fuel release, it was correctly assumed that most of the fuel was still on-board the vessel and could be removed. Venice Beach is an area of designated habitat for the western snowy plover (*Charadrius alexandrinus nivosus*) which is a state Species of Special Concern and federally threatened species. At the time of the grounding, snowy plovers were actively nesting at the beach.

Participants. The grounding took place on Venice Beach in Half Moon Bay which is owned and managed by the State Parks and Recreation Department. The State Parks Rangers were on-scene and somewhat cooperative, but it required several calls and exchanges before fuel salvage and response vehicles were allowed to drive onto the beach to the grounded vessel. The State Parks biologist was on-scene and assisted with identification of resources at risk. Because of the presence of a listed species, the DFG-OSPR notified the Gulf of the Farallones National Marine Sanctuary (GFNMS) and U.S. Fish & Wildlife Service staff on behalf of the Coast Guard, but neither agency responded to the initial event. The responsible party was the private owner of the vessel and representatives of his insurance company were in attendance. The insurance covered only hull replacement, so only fuel removal was planned and authorized by the unified Command to minimize the likelihood of additional product release.

The Sign-Off Process. The State Parks biologist was able to confirm that the nesting snowy plovers were at the southern end of the beach and unlikely to be impacted by the grounded vessel and cleanup activities occurring at the northern end of the beach. Parker Diving was hired and ultimately were able to remove most of the fuel from the vessel prior to the flood tide, which engulfed the vessel and prevented further access. There was a number of hazardous substances carried on board the vessel, including motor oil, wood varnish, miscellaneous cleaning products that were also removed from the vessel prior to it being engulfed by the rising tide. Additionally, 400 legally caught salmon were removed from the vessel and transported to Pillar Point for sale once it was determined that they were not in contact with the released product. Informal sign-off (no written documentation) of the cleanup occurred after all accessible fuel was removed from the vessel. No specific, formal cleanup endpoints were identified because there was little evidence that fuel impacted the beach and/or ocean. At this point the Unified Command disbanded and what remained of the vessel was left on the beach for the land owner, State Parks, to address.

A week later, the DFG-OSPR was informed by the Resource Protection Specialist at the GFNMS, as well as the State Parks biologist, that the vessel had broken up on the beach, and that the debris included a large quantity of insulation material. This small diameter insulation material was blowing all over the beach and presented a hazard not only to marine birds and mammals which might ingest the material, but was found in the vicinity of the active western snowy plover nests. Because there was no threat to wildlife from petroleum, the OSPR response was considered complete and we did not perform follow-up response.

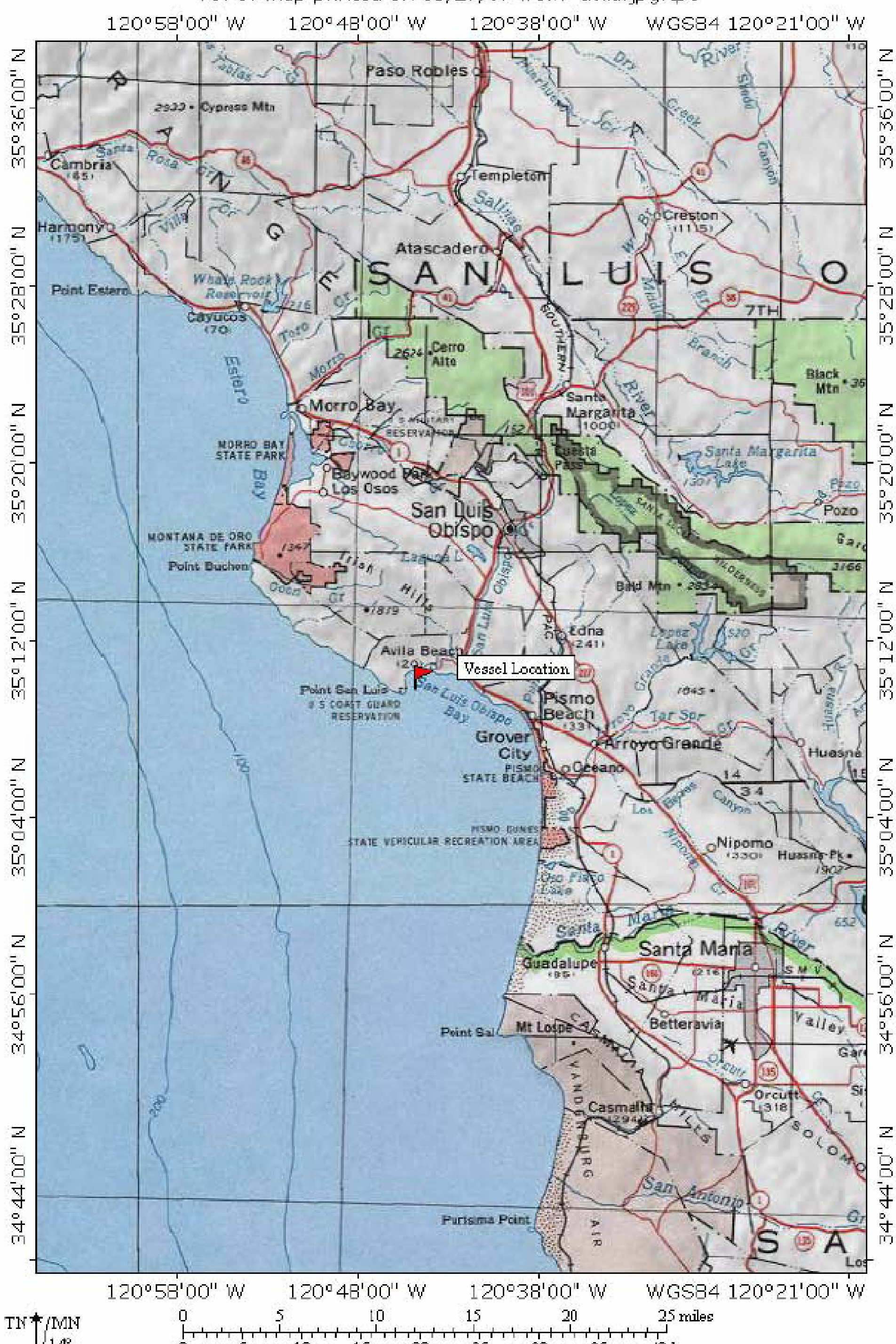
The lesson learned was because it is our responsibility to prevent impacts to wildlife resources; we may need to discuss the option for the sign-off to include a contingency for secondary impacts from the debris especially if there are listed species in the area.

ATTACHMENT F: EXAMPLE IAP WITH SIGN-OFF FORM FOR SMALL SPILLS

1. Incident Name	2. Prepared by: (name)	INCIDENT BRIEFING ICS
ABC Vessel	Date: 3-1-07 Time: 15:00	201-OS (pg 1 of 4)

3. Map / Sketch (Include maps drawn here or attached, showing the total area of operations, the incident site/area, overflight results, trajectories, impacted shorelines, or other graphics depicting situational and response status)

TOPO! map printed on 03/27/07 from "avila.jpg.tpo"



Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

INCIDENT BRIEFING	June 2000	ICS 201-OS (pg 1 of 4)

Electronic version: NOAA 1.0 June 1, 2000

1. Incident Name ABC Vessel	2. Prepared by: (name) Date: 3-1-07 Time: 15:00	INCIDENT BRIEFING ICS 201-OS (pg 2 of 4)

4. Initial Incident Objectives

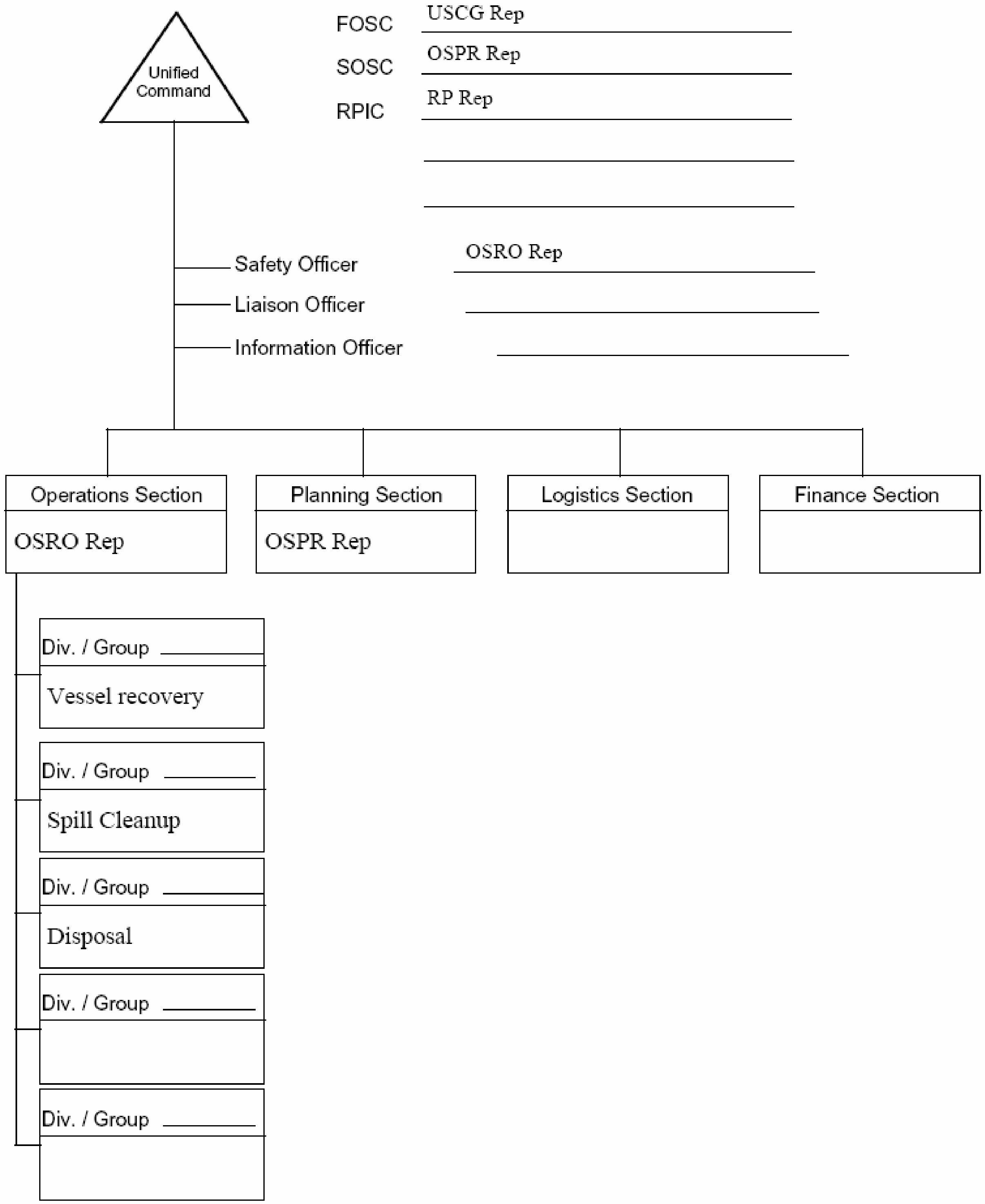
Ensure safety; control source of spill; contain and recover spilled material; implement wildlife operations; minimize impacts to environmentally sensitive areas; remove oil from impacted areas per agreed upon cleanup endpoints as described below.

5. Summary of Current Actions

Time	Action / Note
15:00	Vessel raised
	Spilled diesel fuel contained by booms and being recovered with sorbents
	Agreed upon cleanup endpoint is no rainbow sheen visible on water surface; only small isolated patches of silver sheen may remain.
	Making arrangements for disposal of contaminated materials per all applicable regulations

1. Incident Name	2. Prepared by: (name)	INCIDENT BRIEFING ICS 201-OS (pg 3 of 4)
ABC Vessle	Date: 3-1-07 Time: 15:00	

6. Current Organization



INCIDENT BRIEFING June 2000 ICS 201-OS (pg 3 of 4)

Electronic version: NOAA 1.0 June 1, 2000

1. Incident Name	2. Prepared by: (name)	INCIDENT BRIEFING ICS 201-OS (pg 4 of 4)
ABC Vessle	Date: 3-1-07 Time: 15:00	

7. Resources Summary

Resources Needed	Time Ordered	Resources Identifier	ETA	On-Scene? (X)	NOTES: (Location / Assignment / Status)
3,000' 12" containment boom	12:00			☑	Surrounding vessel
2 bales sorbents	12:00			☑	
				☐	
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INCIDENT BRIEFING June 2000 ICS 201-OS (pg 4 of 4)

Electronic version: NOAA 1.0 June 1, 2000

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME
OFFICE OF SPILL PREVENTION AND RESPONSE

INITIAL SITE SAFETY PLAN

SECTION A: SITE INFORMATION

SITE NAME	DATA COLLECTOR	DATE	TIME

SOSC	PHONE NUMBER	SAFETY OFFICER	PHONE NUMBER

☐ Inland Response ☐ Marine Response ☐ Drill/Training ☐ Other | PCA | INDEX

WEATHER

☐ Calm ☐ Breezy ☐ Windy Temp. Range ____________ ☐ Clear ☐ Fog ☐ Snow ☐ Rain

SECTION B: CHEMICAL INFORMATION

CHEMICAL NAME	CHEMICAL STATE	APPROX. VOLUME RELEASED
	☐ Solid ☐ Liquid ☐ Gas/Vapor	

CHEMICAL PROPERTIES

☐ Flammable LEL _______ % UEL _______ % Flashpoint _______ Current Level _______ %

☐ Toxic PEL _____ ppm – mg/m^3 STEL/Ceiling: _____ ppm – mg/m^3 Current Level _____ ppm – mg/m^3

☐ Reactive Incompatible(s):

☐ Corrosive pH _______ (If known) ☐ Acid ☐ Base ☐ Neutral

DIRECT READING LEVELS

CO _______ VOCs _______ H_2S _______

LEL _______ O_2 _______

OTHER CHEMICALS PRESENT

____

____

____

EXPOSURE / TOXICOLOGY

☐ Inhalation ☐ Absorption ☐ Ingestion ☐ Injection ☐ Open wounds ☐ Other: ________________

☐ Asphyxiant ☐ Corrosive ☐ Sensitizer ☐ Eye / Skin / Respiratory Irritant ☐ Carcinogen / Teratogen / Mutagen

☐ Other: ____

SECTION C: EMERGENCY RESPONSE

Medical Facility (NAME)	PHONE

Med. Facility Location

Phone / Comm Sys. Available

First Aid Kit Location

Fire Extinguisher Location

Eye Wash / Deluge Shower Location

Evacuation Area

Evacuation Route

SECTION D: HAZARD IDENTIFICATION

HAZARD TYPE	HAZARD DESCRIPTION
☐ Slips / Trips / Falls	
☐ Lifting / Material Handling	
☐ Equipment / Machinery	
☐ Open Trench	
☐ Electrical	
☐ Insect	
☐ Animal	
☐ Other Biological	
☐ Heat Stress	
☐ Hypothermia	
☐ On / Over Water	
☐ Overhead Hazards	
☐ High Pressure (tanks / lines)	
☐ Elevated Work / Falls	
☐ Traffic	
☐ Night Operations	
☐ Noise	
☐	
☐	
☐	

SECTION E: PPE

☐ **Level D** ☐ **Level C** ☐ Hard Hat ☐ Nomex ☐ Work Gloves ☐ PFD ☐ Safety Boots

☐ Safety Glasses / Goggles ☐ Ear Plugs ☐ Safety Vest ☐ Respirator ☐ CPC ☐ Chem. Boots

☐ Chem. Gloves ☐ Respirator ☐ Other: ____________________

SECTION F: DECONTAMINATION

☐ None ☐ Limited ☐ Dry ☐ Full ☐ Emergency ☐ Equipment

Location

____________________	____________	____________
SIGNATURE	DATE	TIME

Small Spill Short Form Spill Response Sign-Off

Spill Name:________________________ **Sign-Off Date:_____________________**

Cleanup and Assessment: Oiled areas were inspected by a Unified Command inspection team (Sign-Off Field Team, "SOFT"). The SOFT consisted of representatives from the Federal On-Scene Coordinator, the California Department of Fish and Game - Office of Spill Prevention and Response State On-Scene Coordinator, the Responsible Party, and other parties as signed below. The area/division identified below was inspected by representatives of the SOFT and recommended actions for this area are detailed below.

By executing this release, the Department of Fish and Game and/or the Administrator of the Office of Spill Prevention and Response does not waive any of his/her rights to require the responsible party to conduct additional clean up activities pursuant to Fish and Game Code sections 5655 or 12015, or Government Code sections 8670.25 or 8670.27, or any other applicable laws, should additional contamination be discovered that in the opinion of the Department or the Administrator requires further clean up. This release also does not preclude other actions required by other agencies with jurisdiction from requiring further action as they deem appropriate.

Date Inspected: _________________ **Area/Division Name:** ____________________

Agreed Upon Cleanup Endpoint is: ____

____

Recommendation:

☐ - No further cleanup required

☐ - More cleanup activity required

☐ - Additional site recommendations

☐ - Cleanup re-initiation

☐ - Maintenance or monitoring required

Signed:

____

____________________, ________Date
Federal On-Scene Coordinator (FOSC)

____

CDFG-OSPR________, __________Date
State On-Scene Coordinator (SOSC)

____

____________________, ________Date
RP Representative

____

____________________, ________Date
Other (e.g., land owner, local government)

APPENDIX 1

SELECTING CLEANUP ENDPOINTS DURING LONG-TERM REMEDIATION RESPONSES

Description
Long-term remediation (LR) may be defined (to some extent subjectively), as cleanup activities lasting a year or more, in some cases, after an emergency response has been completed (after surface contamination has been contained and/or collected such that the incident is no longer acutely deleterious to wildlife). Long-term cleanup may be required where there is on-going release potential (e.g., seepage), large-scale releases (e.g., Type I or II), groundwater impacts, complex habitats such as wetlands, or where uncertainties exist regarding cleanup decisions made during an emergency responses (e.g., chronic effects of persistent constituents). Long-term cleanup may also apply to chronic petroleum releases that have occurred over an extended period of time (e.g., months to years), such as at petroleum exploration or production sites. A few examples of LR cases in California are described in this Appendix. In general, this type of remediation requires a significant planning period (e.g., 6 months or more) before on-site remedial activities can begin and the remediation and monitoring activities may take several months or years to complete.

Participating Agencies
Similar to the Incident Command System for emergency response, LR is generally a multi-agency effort because federal, state, and local agencies may all have jurisdiction over the site and associated activities. However, there will most likely be a federal or state lead agency that coordinates input from the agencies. For petroleum contamination, if impacted resources are waters of the State, it is likely that one of nine Regional Water Quality Control Boards (RWQCB) will lead cleanup efforts for the State. Federal, State and local agencies that may be involved are those identified for emergency and interim responses. As needed, other permitting agencies may need to be involved. Depending on the impacted resources, members of the community are often involved in the decision-making via advisory committees and or public meetings.

Cleanup Endpoint Selection Process for LR Projects
Multi-Agency Coordination Committee. The first step in the cleanup endpoint decision making process is to identify the agencies and responsible parties that will be participating in the process (Figure 1). This is generally a coordinated effort between the lead agency and the responsible party. It is recommended that a Multi-Agency Coordination Committee (MACC) be formed to provide an organizational framework for agency participation. The structure of the MACC should be tailored to meet the needs of the cleanup effort. For example, it may be helpful to have sub-groups of technical experts to provide information to the decision-makers on the MACC. Specific examples are provided in case studies detailed below. The roles and responsibilities of each participating agency should be clearly defined. Additionally, selection process goals should be established and agreed upon by all participants.

Remedial Investigation/Feasibility Study. The second step is to identify the appropriate decision-making process. The remedial investigation/feasibility study (RI/FS) process, developed for Comprehensive Environmental Response Compensation and Liability Act (CERCLA) sites (U.S. EPA, 1988; Figure 2), is suitable and has been utilized for long-term remediation of petroleum sites, although petroleum contaminated sites do not generally qualify as Superfund sites under CERCLA. The intent of the RI/FS process is to gather sufficient information to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site. The RI serves as a mechanism for collecting data to characterize site conditions, assess risk to human and ecological receptors and to conduct treatability testing as necessary to evaluate treatment technologies. The FS serves as the mechanism for the development, screening and detailed evaluation of alternative remedial actions.

Remedial Investigation. The major component of the RI is the risk assessment. Extensive guidance has been developed for human health risk assessment at hazardous waste or petroleum contaminated sites (U.S. EPA, 1989; ASTM, 1995; McMillen et al., 2001). Several guidance documents have also been developed for the parallel process of ecological risk assessment (ERA) at hazardous waste sites (CalEPA, 1996; U.S. EPA, 1997; 1998; Figure 3) and petroleum contaminated sites (Suter, 1997; Aurand et al., 2000). The reader is referred to these guidance documents for detailed information on the risk assessment process. As Trustees, it is desirable for DFG-OSPR to develop cleanup goals for the protection of fish and wildlife; this guidance document will briefly summarize the ERA process.

An ERA facilitates the cleanup decision making process by providing a structured analytical approach to determine the need for remediation or the adequacy of completed remediation. It also can be used to develop risk-based cleanup goals. The ERA consists of three steps; problem formulation, analysis, and risk characterization, which can be phased to meet decision-making needs (U.S. EPA, 1998).

The problem formulation step is the organization of existing information concerning the characteristics of the contaminant source and a site and development of preliminary hypotheses about what ecological effects have occurred or may occur at the site. At a petroleum site, this would involve identifying the characteristics of the petroleum product, the contamination sources and the extent of the contamination (Figure 1). The ecosystem and ecological resources at risk should also be identified so that assessment endpoints can be selected. This information can be used to develop a conceptual site model (CSM); a representation of how the contamination may affect the endpoints. The CSM generally identifies the sources of contamination, the exposure pathways and the ecological receptors that are likely at risk. By compiling all the existing site information, it is then possible to identify any data needs for the risk assessment. An analysis plan can then be developed to determine how the data needs will be filled and how the risk assessment will be conducted.

The analysis step of the ERA examines the primary components of risk, exposure and effects (Figure 1). After necessary data are collected, an exposure assessment is conducted. Here, the potential exposure to each assessment endpoint is quantified. For example a concentration of a petroleum constituent in soil might serve as an exposure estimate for a plant. Next, the effects assessment is conducted to identify toxicological data (e.g., published toxicity data or site-specific bioassay or bioassessment data) that can be used to evaluate potential effects from site exposures. For example, exposure levels for a particular chemical that are associated with no adverse effects may be identified.

The risk characterization step of the ERA integrates the results of the exposure and effects assessments to characterize risks to the selected endpoints (Figure 1). Depending on the complexity of the assessment, there may be multiple lines of evidence that need to be integrated and discussed. Uncertainties associated with each line of evidence and the uncertainties associated with the final risk estimates are also discussed. Finally, an interpretative summary of the risk assessment is provided for the decision-makers. This generally involves a summary of the significance of the potential risks associated with current or anticipated site conditions. The decision-makers can use this information to determine whether remediation is required. Information from the exposure and effects assessment may also be utilized by the risk assessor to develop preliminary remediation goals or remediation goal options. These goals might be specific chemical concentrations in the affected media that have not been associated with adverse effects in the ecological receptors of interest.

Feasibility Study. A FS is a study and analysis process for developing, evaluating and selecting remedial actions (U.S. EPA, 1988). Two major activities are completed (Figure 1). First, the remedial action objectives (RAOs) are established to assist in determining what any remedial action needs to accomplish in order to be protective of human health and the environment. The RAOs are typically statements that specify the contaminants and environmental media of concern, the potential exposure pathways to be addressed by remedial actions, the exposed receptors to be protected, and the acceptable contaminant concentrations or concentration ranges (remediation goals) in each environmental medium (US EPA, 1988). These remediation goals may be concentrations found in Federal and State applicable or relevant and appropriate requirements (ARARs; e.g., water quality criteria) or risk-based concentrations that are protective of human health and the environment. Remediation goals may also be referred to as cleanup endpoints. Secondly, a detailed analysis of the remedial alternatives is conducted, utilizing nine criteria:

1. Overall protection of human health and the environment,
2. Compliance with ARARs,
3. Long-term effectiveness and permanence in maintaining protection of human health and the environment,
4. Reduction of toxicity, mobility and volume through treatment,
5. Short-term effectiveness of protecting human health and the environment during the construction and implementation of the remedy,
6. Implementability or technical and administrative feasibility of the remedial alternative,
7. Cost,
8. Agency acceptance, and
9. Community acceptance.

These criteria are used to rank the acceptability of the various remedial alternatives, including no further action.

Remedial Decision. The RI/FS serves as the basis for the remedial decision by the MACC. As per the CERCLA guidance (U.S. EPA, 1998), the process consists of several steps (Figure 1). First, the lead agency, in conjunction with the MACC, prepares a plan that briefly describes the remedial alternatives that were analyzed, proposes a preferred remedial alternative, and summarizes the information used to select the remedy. The proposed plan may be presented to the public, and revised in accordance with the comments received, if necessary. After evaluating all the comments received on the proposed plan, the lead agency makes the final remedy selection decision. The lead agency documents the final decision in a record of decision (ROD), which is signed by the designated decision-maker for the responsible agencies. The ROD contains significant facts, analysis of facts, and the site-specific policy determinations considered in the remedy selection process, and explains how the nine criteria were used to select the remedy. The ROD is a major element of the administrative record and is made available for public inspection. Next, the remedial design, the engineering plan used to guide implementation of the selected remedy, is completed. After the plan is in place, the remedial action is conducted. Once the remedial action is completed, monitoring and other activities may be conducted at the site to ensure that the methods are working properly. If the CERCLA process is followed, a periodic review of the remedial actions, at least every 5 years after initiation of such action, is required if potential threat to human health or the environment remains at the site.

Long-term Remediation Examples

Since the guidance for long-term remediation of petroleum sites must be applied in a site-specific manner, examples of the process at LR sites in California are presented.

Guadalupe Oil Field

Site Overview. The Guadalupe Oil Field is an example of a LR project because extensive subsurface contamination required thorough investigation, planning, remediation and restoration. Oil production began in the 2,700 acre Guadalupe Oil Field, San Luis Obispo County in the late 1940s. In the 1950s, diluent, a kerosene-like hydrocarbon, was placed into wells to help the heavy crude oil flow better. Over the years, the diluent allegedly leaked from pipelines in the field, causing contamination of the surface and subsurface areas. In 1990, there were reports of oil on the beach and the Responsible Party (RP) discontinued the use of diluent. The RP ceased all oil production from the field in 1994. In 1994-1995, under order from the U.S. Coast Guard, the RP conducted excavation activities at a site near the beach. In 1998, the Regional Water Quality Control Board (RWQCB) issued Cleanup or Abatement Orders for the Guadalupe Oil Field, outlining remediation requirements for specified plumes and sumps. As of 2006, remediation and restoration activities for the entire site have not been completed.

Participants. A Multi-Agency Coordination Committee (MACC) was formed to oversee long-term remediation and restoration at the site. Member agencies included the RWQCB, San Luis Obispo County Department of Planning and Building, California Coastal Commission, DFG-OSPR, U.S. Army Corps of Engineers, USFWS, San Luis Obispo County Air Pollution Control District, and the Santa Barbara County Planning and Development, Energy Division. To resolve specific issues associated with remediation, a

Policy Group was formed and discussions were formally mediated by an outside consultant. The Policy Group consisted of RWQCB staff (including the Executive Officer) and RP representatives (including the Environmental Affairs Manager). A Joint Fact-Finding Working Group was also formed, under the mediation process, to resolve technical issues associated with investigations on site characterization, as directed by the Policy Staff. Members included technical staff from the RWQCB and their consultants, RP representatives and their consultants, DFG-OSPR, USFWS, National Oceanic and Atmospheric Administration and the U.S. EPA. A neutral scientific review panel was also formed to provide expertise and peer review on various technical issues for the Joint Fact-Finding Group. Public participation was solicited at various stages of the decision-making process.

The Process. The RP worked with the MACC to develop project descriptions which included a variety of treatment, beneficial reuse and disposal methods. Project descriptions were submitted to agencies as part of an application to amend existing permits and to provide information for California Environmental Quality Act (CEQA) review. In 1998, the County of San Luis Obispo certified an environmental impact report that evaluated and determined mitigation measures for remedial actions, including excavation of diluent plumes and treatment methods for excavated materials for the sumps and plumes specified in the Cleanup or Abatement Orders. While these interim remedial actions were underway, the agencies began to evaluate long-term remediation and restoration activities for the entire site. To evaluate risks associated with residual contamination, the Joint Fact-Finding Working Group participated in the development of a human and an ecological risk assessment by the RPI's consultants (McDaniel Lambert, Inc., 2002; CH2MHill, 2004). These assessments were used to prioritize additional areas for remediation and to begin to develop long-term cleanup goals for the site. In the ecological risk assessment, screening toxicity benchmarks, based on total petroleum hydrocarbons and indicator chemicals were developed for a wide range of ecological receptors. For example, site specific bioassays with lettuce were used to develop plant no-effect (60 mg/kg) and low-effect (154 mg/kg) levels for total petroleum hydrocarbons in the sandy soils at the Guadalupe Oil Field. Literature-based toxicity data for soil invertebrates were used to estimate no-effect (1008 mg/kg) and low-effect (5620 mg/kg) levels for total petroleum hydrocarbons in soil. These values will be considered when developing cleanup goals for the site. Planning for additional remediation and restoration activities is currently on-going.

<u>Avila Pier Outlier Plume</u>

Site Overview. In 1997, during the investigation of the Front Street hydrocarbon plume beneath Avila Beach, California, an area of buried hydrocarbons was discovered under the beach and beneath an area around the Avila Pier, and was named the Avila Pier Outlier Plume. During the spring of 2000, RWQCB and DFG-OSPR began an investigation in the vicinity of the Avila Pier to better determine the exact location and depth of the Avila Pier Outlier Plume.

Participants. In the fall of 2000, DFG-OSPR, the RWQCB, the San Luis Obispo County Public Health Department (SLO County Health), and the RP, began a cooperative effort to assess the potential impacts to human health and the environment associated with the

Avila Pier Outlier Plume. Other agencies involved include the Port San Luis Harbor District, California State Lands Commission, California Coastal Commission, San Luis Obispo County Air Pollution Control District, San Luis Obispo County Planning and Building Department, U.S. Army Corps of Engineers, the California Office of Environmental Health Hazard Assessment and USFWS. The goal of this cooperative effort was to evaluate the potential impacts to (1) human health, (2) the environment, and (3) water quality from sediment-associated petroleum related contaminants near the Avila Pier, and to evaluate potential remediation strategies if impacts were determined to be unacceptable. Two groups were formed from the various parties listed above to assess the Avila Pier Outlier Plume, the Avila Pier Technical Committee and the Avila Pier Coordinating Committee. The Technical Committee focused on the technical aspects of the Avila Pier goals while the Coordinating Committee focused on the policy issues. Public meetings were held to inform the public.

The Process. With the Coordinating Committee's consent, the Technical Committee cooperatively discussed, agreed upon, and carried out, a series of studies aimed at determining if the presence of hydrocarbons in the Avila Pier Outlier Plume posed an unacceptable risk to human health and/or the environment under different modeled storm scenarios. The potential for hydrocarbon exposure to humans and the environment associated with current and future scenarios was subsequently used to determine if there were any unacceptable risks to human health and the environment. The human health risk assessment (SOMA, 2001) and the ecological risk assessment (Windward, 2001) concluded that risks were not significant under current or anticipated future conditions. Based on the results of these assessments, as well as a complete evaluation of pertinent data, the Technical Committee recommended that no remedial action was warranted but that continued monitoring of the location of the plume be conducted for a given time period. The RWQCB accepted this conclusion and a monitoring program and contingency plan were initiated.

San Luis Obispo Tank Farm

Site Overview. The San Luis Obispo Tank Farm is located on approximately 340 acres of undeveloped land north and south of Tank Farm Road on the outskirts of San Luis Obispo, California. The RP used the property as a petroleum storage and distribution facility for more than 70 years from 1910 to the early 1980s. Throughout the operational use of the property, crude oil was transported via pipeline from the San Joaquin Valley to the Tank Farm's 21 aboveground steel storage tanks and six large earthen reservoir tanks, lined with reinforced concrete. A fire-fighting school and offices for the management of regional pipeline operations were also located on the property. In 1926, a lightning strike ignited a major fire at the Tank Farm, destroying many of the tanks and reservoirs. Millions of barrels of crude oil flowed out of the tanks and reservoirs and burned, leaving behind tar and asphalt-like material on the surface distributed over portions of the property. Crude oil released during this fire also impacted subsurface soils and groundwater. Since 1988, the RP has been conducting environmental studies at the Tank Farm property under the direction of the RWQCB. The purpose of these studies is to define the nature and extent of petroleum and associated chemicals in subsurface soils and groundwater at the property.

Participants. A team comprised of public agencies and the RP was brought together to evaluate conditions at the former Tank Farm and to determine an acceptable site cleanup plan, given a range of potential future uses of the site. This collaborative work was not mandated by any regulatory agency. The RP initiated the collaborative process to expedite the implementation of remediation plans as agreed upon with the applicable public agencies and other stakeholders and to conclude the RP activities at the property. The collaborative group was called the Surface Evaluation, Remediation and Restoration Team (SERRT). The SERRT members included representatives of the RWQCB, DFG-OSPR, the California Office of Environmental Health Hazard Assessment, the San Luis Obispo County Environmental Health Department, the San Luis Obispo County Air Pollution Control District, and the City of San Luis Obispo and the RP. The SERRT process was designed to help expedite the preparation of cleanup plans by bringing all parties together from the initial stages of plan development. A Human Health Risk Assessment Working Group and an Ecological Risk Assessment Working Group was formed by the SERRT to provide technical expertise and agency representation. Informational materials were prepared for the public.

The Process. In a collaborative effort, a human health risk assessment (McDaniel Lambert, Inc., 2004) and an ecological risk assessment (BBL Sciences, 2004) were completed by the Working Groups. The SERRT was kept informed by periodic meetings. Results of the risk assessments were subsequently used by the Working Groups to make recommendations to the SERRT regarding priority areas for remediation. In the ecological risk assessment, a number of toxicity benchmarks for total petroleum hydrocarbons and polycyclic aromatic hydrocarbons were developed for a wide range of receptors. Based on these benchmarks, the group concluded that plants (no-effect concentration of 782 mg/kg total petroleum hydrocarbons in soil) and soil invertebrates (no-effect concentration of 842 mg/kg total petroleum hydrocarbons in soil) were the more sensitive terrestrial receptors. Remedial recommendations considered the need to reduce total petroleum hydrocarbon levels in the soil to protect these receptors. Feasibility studies are currently underway.

FIGURE 1: Example Long-Term Remediation Process

Multi-Agency Coordination Committee
- Identify participants
- Define roles and responsibilities
- Establish process goals

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REMEDIAL INVESTIGATION – ECOLOGICAL RISK ASSESSMENT
Problem Formulation:
- Evaluate petroleum characteristics, sources and extent of contamination
- Identify ecosystems or ecological resources at risk
- Choose assessment endpoints (e.g., identify receptor groups or representative species at risk)
- Develop a conceptual site model (CSM, e.g., sources, pathways, receptors)
- Identify data needs
- Develop analysis plan

Analysis:
- Collect data, as needed
- Quantify exposure for each endpoint
- Quantify effect levels for each endpoint

Risk Characterization:
- Integrate and weigh evidence
- Uncertainty Analysis
- Risk Summary
- Remediation Goal Options (includes consideration of non-risk based goals)

Acceptable Risk?

Yes → No further action

No ↓

FEASIBILITY STUDY
- Establish Remedial Objectives
- Development and Analysis of Alternatives (includes no further action)

↓

REMEDIAL DECISION
- Remedy Selection (Includes no further action alternative)
- Record of Decision
- Remedial Design
- Remedial Action
- Monitoring, as needed

FIGURE 2: Phased RI/FS Process under Superfund Program (U.S. EPA, 1998)

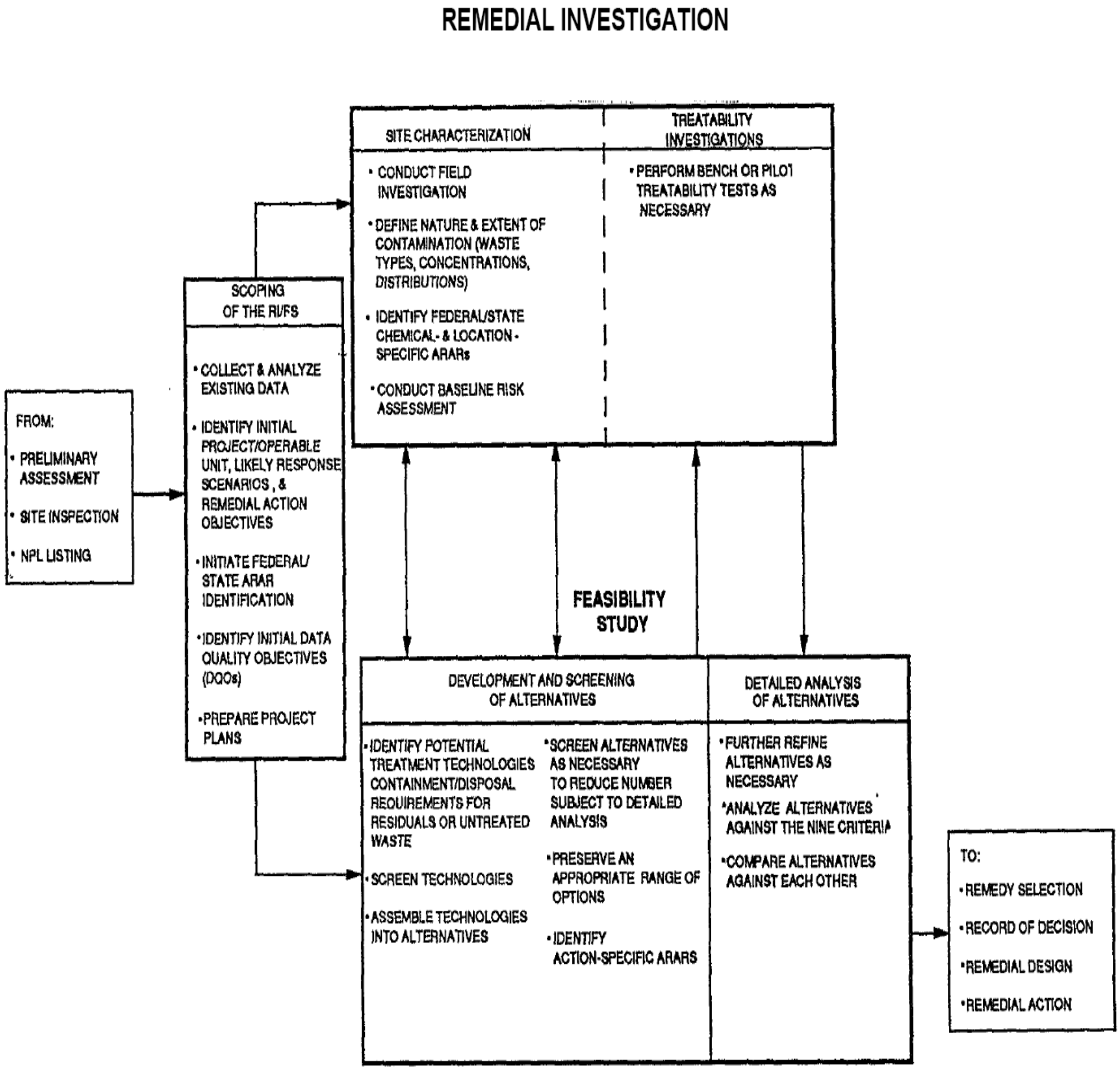
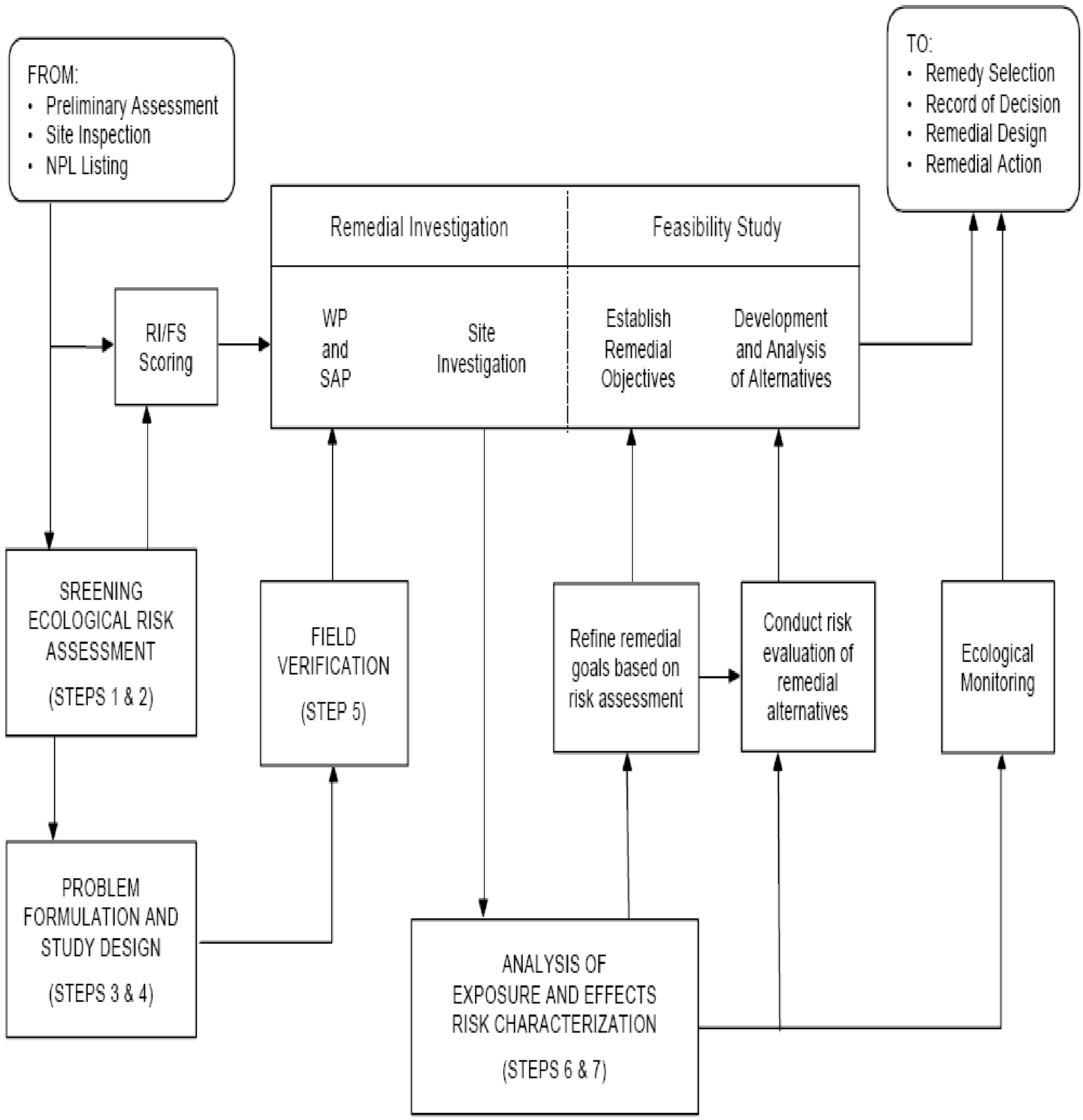


FIGURE 3: Ecological Risk Assessment in the RI/FS process (U.S. EPA, 1997)



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