

CALIFORNIA COASTAL COMMISSION

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Tu14c

May 20, 1999

TO: Coastal Commissioners and Interested Parties

FROM: Susan Hansch, Deputy Director
Alison Dettmer, Coastal Program Manager
Ellen Faurot-Daniels, Supervisor, Oil Spill Program

SUBJECT: **Guadalupe Oil Field Spill Remediation Status Report – June 1999**

Staff Note:

In its staff report for the May 1999 Commission meeting, Coastal Commission staff provided a brief history of the Guadalupe Oil Field spill, Commission actions to date, the planned cleanup and remediation project, and addressed interim protective measures at the oil field's M4 site. This June status report provides updates on the most recent activities, including discussion of San Luis Obispo County's Determination of Substantial Conformance for site O13. A slide presentation is planned for the June Commission meeting.

PROJECT BACKGROUND

The Guadalupe Oil Field site (Field) is located on the central coast of California approximately 15 miles south of the city of San Luis Obispo. It covers approximately 2,700 acres within the Nipomo Dunes system. The site is bordered by the Pacific Ocean on the western side and by the Santa Maria River and estuary/lagoon system on the southern side. It includes valuable dune habitat, wetlands, fresh water marshes and ponds, rare, threatened and endangered plants and animals, sandy beach, and the Santa Maria River. Most of the oil field is within San Luis Obispo County (County). All of the site is within the coastal zone.

Unocal acquired the lease to the Field in 1950 and operated it until 1990, using "diluent" to assist in the pipeline transportation of the heavy crude oil pumped from the field. During the time that diluent was used at the site, numerous leaks developed in the tanks and pipelines used to distribute it around the field. Over time, these leaks led to serious contamination of the ground water below the site. Site characterization studies to date show that almost 60 percent of the field could be contaminated, with estimates of the amount of diluent leaked over 40 years ranging

between 8.5 million and 20 million gallons. To date, 90 diluent plumes have been identified within the Field. There are also at least 150 sumps (depressions of concentrated contamination) on the surface at various sites.

After years of characterizing the extent of soil and groundwater petroleum-hydrocarbon contamination at the site, Unocal is now under orders (Cleanup or Abatement Order (CAO) 98-38) from the Central Coast Regional Water Quality Control Board (RWQCB) to remediate 17 plumes identified by the RWQCB as posing the greatest threat to surface waters (called "Phase 1"). Two and one-half of the 17 Phase 1 plumes are located along the shoreline within the Coastal Commission's retained permit jurisdiction. The other 14½ plumes are located within the County's certified local coastal program (LCP) permitting jurisdiction.

On December 10, 1998, the County approved a Coastal Development Permit (CDP/DP D890558D) for the remediation of the 14 ½ plumes in its permitting jurisdiction. Many of the contaminated soil sites are to be excavated and then backfilled with clean material. Discovery of contamination by polychlorinated biphenyls (PCBs) in December 1998 at certain Phase 1 sites has caused the excavation schedules to slip. Before excavation proceeds, Unocal is conducting additional non-diluent compound sampling for further agency evaluation.

Unocal's Coastal Development Permit application for the 2½ plumes located within the Coastal Commission's jurisdiction is incomplete pending further PCB and other non-diluent compound testing.

MAY 1999 PROJECT ACTIVITIES

Site M4

The M4 site is located in the easterly portion of the Field. During the spring of 1998, and as a result of a very wet winter the preceding year, hydrocarbon-affected groundwater surfaced at the M4 site. Unocal began pumping the surfaced groundwater from the site, hoping that it would recede as the pumping progressed into the drier summer season. However, pumping ceased when PCBs were discovered at the site, and the pond of contaminated water began to refill with the resurfacing groundwater. The pond expanded further with the winter rains of 1998-99. Unocal attempted to isolate the area from wildlife by installing various types of fencing, but contamination continued to surface outside its perimeter.

The M4 site was originally scheduled for excavation as part of Stage 1 of Phase I (Phase 1 has six stages within it). Due to the presence of PCBs at M4, full excavation and remediation has been delayed while Unocal and the agencies agree upon an appropriate resolution. Excavation is tentatively scheduled for Stage 3, to commence in the year 2000.

To address the potential for wildlife exposure to affected material at the M4 site, Unocal proposed on April 6, 1999, a work plan to temporarily cover the affected area with sand to preclude wildlife exposure until excavation of contaminated material can be conducted. On April 19, 1999, the County issued a Substantial Conformity Determination. No appeals were

filed on the Substantial Conformity Determination. Work on the interim measures at site M4 began during the week of May 17, 1999.

Site 013

The O13 plume is located in the southeastern portion of the site near the Santa Maria River. The well pad itself is on top of a sand dune approximately 70 feet above the surrounding terrain. A separate phase diluent plume on groundwater is located under this sand dune with another smaller separate phase plume located in a shallow area west of the larger plume.

The O13 project area is characterized as a back dune area containing sparse vegetation and no standing water. The Santa Maria River is located approximately 1000 feet to the south of the separate phase plumes. A dissolved phase plume has moved from the two separate phase areas, south to the river. A seep area that is discharging dissolved phase diluent into the river is downgradient from O13.

The O13 area was identified in the RWQCB's CAO-98-38 as an area that required further characterization and possible remediation. However, the CAO did not articulate how the area should be remediated. Unocal proposes to employ this site as a pilot study for a phytoremediation technique (phytoremediation uses plants to take up contaminated water).

Unocal proposes to excavate the smaller separate phase plume (O13-E) that lies at a shallow depth and is located in the western portion of the 0.5-acre planting area. Approximately 855 cubic yard of affected material will be removed from the excavation. The excavation site will be backfilled with soil from the graded planting area (if it is determined that no grading will be required for the planting site, other sand stockpiles will be used for clean backfill for the O13-W excavation).

Unocal proposes that the phytoremediation (planted) area at O13 be constructed within a 0.5 acre fenced area. Approximately 1,700 willow rods (9 feet long) will be installed in augured holes. The planting area will be approximately 340 feet by 90 feet and the rows will be spaced 4 feet apart. The willows will be planted, 8 feet apart, in June 1999 and the cottonwoods will be planted in the gaps the following year. The trees will be planted deep enough so that the roots are in the saturated zone with one foot of the pole above grade.

The RWQCB supports the O13 remediation project and is requiring Unocal to conduct post-planting monitoring sufficient to determine if the phytoremediation is successful.

The County has determined that Unocal's O13 Work Plan is in Substantial Conformance with the certified Final EIR and the provisions of the Coastal Development Permit issued by the County on December 10, 1998. Construction activities associated with the Unocal's proposed O13 project will be conducted in compliance with the conditions of approval of the County permit. County permit conditions requiring independent monitoring of authorized activities will be implemented. In addition to the Unocal proposed measures, the measures outlined in the Final EIR and the CDP are still in full force and effect for this project. Both the County's

Substantial Conformance Determination and Unocal's Work Plan for O13 are attached to this report.

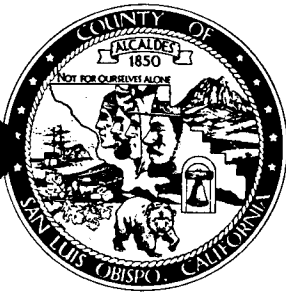
The County's Substantial Conformity Determination decision is appealable to the Planning Commission within 14 days of issuance of the County's staff approval. That appeal period runs until May 27, 1999. The County's final decision is also appealable to the Coastal Commission. That appeal period will run for 10-working days after receipt of the County's Notice of Final Action.

There are no changes to Unocal's Work Plan, or other conditions in addition to the County's existing conditions for the O13 phytoremediation project, that the Coastal Commission staff believes are needed.

The Commission staff thus recommends that the Commission not appeal the County's Substantial Conformity Determination decision for the O13 site.

Other Site Activities

- A sump at site B3 has been excavated and backfilled with clean sand.
- Site assessment activities at L11/M12 continue.
- Contaminated waters have been skimmed from site M4.
- Two monitoring wells have been installed at site O13.
- Pipelines have been removed from along several Field roads. Other pipelines will be flushed, filled with cement slurry, and left in place.
- Analytical results from the additional non-diluent compound testing for sites 5X and A2A have been received, and now need to be included in an ecological risk assessment before any decisions can be made about how staging for cleanup and remediation will actually proceed.
- Other decommissioning, infrastructure, and road improvement activities continue.



SAN LUIS OBISPO COUNTY
DEPARTMENT OF PLANNING AND BUILDING

ALEX HINDS
DIRECTOR

BRYCE TINGLE
ASSISTANT DIRECTOR

ELLEN CARROLL
ENVIRONMENTAL COORDINATOR

BARNEY MCCAY
CHIEF BUILDING OFFICIAL

May 13, 1999

Gonzalo Garcia
Unocal Corp.
P.O. Box 120
Guadalupe, CA 93434

SUBJECT: O-13 WORK PLAN (GUADALUPE OIL FIELD)

Dear Mr. Garcia:

RECEIVED
MAY 17 1999

CALIFORNIA
COASTAL COMMISSION

This office has received the draft work plan for the O-13 Phytoremediation Project¹ and staff has inspected the site with Coastal Commission and other agency staff. The remediation of the O-13 area was considered in the Regional Water Quality Control Board's Clean-Up or Abatement Order 98-38. This Department has determined, based on the facts stated below, that the proposed project is in **substantial conformance** with the provision of the certified Final EIR and the provisions of the Coastal Development Permit issued by the County on December 10, 1998.

O-13 Site

The O-13 plume² is located in the southeastern portion of the site near the Santa Maria River. The well pad itself is on top of a sand dune approximately 70 feet above the surrounding terrain. A separate phase diluent plume on groundwater is located under this sand dune with another smaller separate phase plume located in a shallow area west of the larger plume³.

The O-13 project area is characterized as a back dune area containing sparse vegetation and no standing water. The Santa Maria River is located approximately 1000 feet to the south of the separate phase plumes. A dissolved phase plume has moved from the two separate phase areas, south to the river. A seep was discovered by the State downgradient from the O-13 area that

¹ The Work Plan is attached to this letter. The complete plan, including analytical results of stockpile sampling, is on file with the Department.

² Oilfield locations are denoted by the nearest well pad. Well pad id's were letter/number combinations such as O-13, 5X and A2A.

³ The two plumes are identified as O-13 E and O-13 W. See attached Work Plan for site locations.

discharges dissolved phase diluent into the river. The purpose of the project is to stop this discharge into the river.

Project Description

The project is described in detail in the Action Plan to Address Dissolved-Phase Diluent at the O-13 Area prepared by International Technologies Corporation (IT) et al. dated March 1, 1999 and the Work Plan Addendum to the Action Plan dated April 26, 1999. In this work plan, Unocal proposes to excavate the smaller separate phase plume (O-13 W) that lies at a shallow depth and is located in the western portion of the 0.5 acre planting area. The excavation will be conducted without sheetpiling with 2:1 side slopes. Approximately 855 cubic yards of affected material will be removed from the excavation and stored at Tank Battery 8 for screening. The excavation site will be backfilled with soil from the graded planting area. If it is determined that no grading will be required for the phytoremediation project, other sand stockpiles will be used for clean backfill for the excavation⁴.

The Phytoremediation system will be constructed within a 0.5 acre fenced area. Approximately 1,700 willow rods (9 feet long) will be installed in augured holes. Black cottonwood trees will be planted in the year 2000 after enough cottonwoods are harvested. The planting area will be approximately 340 feet by 90 feet and the rows will be spaced 4 feet apart. The willows will be planted 8 feet apart and the cottonwoods will be planted in the gaps the following year. The trees will be planted deep enough so that the roots are in the saturated zone with one foot of the pole above grade. Soil amendments will be added to the augured holes based on a soil analysis. Watering of the area will be conducted as needed by a water truck or with water drawn from the well at N13-4.

Pre-Construction Activities: The construction boundaries will be surveyed and staked and construction fencing installed to minimize entry of construction vehicles into areas outside of the project footprint. Unocal monitors (approved by the County and the Coastal Commission)⁵ will conduct biological and botanical surveys for the project site. All surveys will be conducted in accordance with the Wildlife Monitoring Plan and the Protocol for Resource Protection During Off-road Assessment Activities.⁶

Prior to construction of the phytoremediation system, sampling will be conducted within the inter-dune area to assess the chemical, physical and biological parameters with the dune sand aquifer (DSA). Establishing the baseline condition will allow for effective monitoring of

⁴ Clean backfill sources include sand from road maintenance activities, C7 and Q11-Q12 areas.

⁵ A list of approved monitors has already been established.

⁶ These plans have already been approved by the County and Coastal Commission for general use on the site.

changes within the DSA. Existing monitoring wells will be used to assess depth-to-groundwater up gradient and down gradient from the planted area.

Applicant Proposed Measures

Unocal proposes the following measures to minimize impacts of this interim project:

1. Unocal shall mark environmentally sensitive areas on project plans and on the site and shall avoid these areas during all elements of project implementation.
2. Training session shall be conducted addressing sensitive resources for project personnel.
3. Minimize traffic in areas off existing roads and defined work areas. Where off road travel is necessary, conduct surveys using approved biological monitors to determine least environmentally damaging routes.

In addition to these applicant proposed measures, the measures outlined in the certified Final EIR dated March 1998 and the requirements of Coastal Development Permit D890558D are still in full force and effect for this project.

Substantial Conformance Determination

Pursuant to the requirements of the County's Coastal Zone Land Use Ordinance section 23.02.038, Unocal may proceed with this proposed project as outlined in the Action Plan dated March 1, 1999 and amended in the Work Plan dated April 26, 1999 without review and approval of another Coastal Development Permit and additional CEQA review. This determination is based on the following findings of fact:

1. The Phase I remediation project was subject to CEQA review in a certified Final EIR prepared by the County and dated March 1998. The certified Final EIR evaluated similar projects in similar areas through out the site.
2. The O-13 area was identified in the RWQCB's CAO 98-38 as an area that required further characterization and possible remediation.
3. The proposed project is similar to a biosparging system that is designed to stop the mobility of dissolved phase plumes. Such systems have been approved at the field in at least four locations.
4. The proposed O-13 project will result in a smaller area of disturbance than the activities approved as part of the CDP for this site.
5. Construction activities associated with the interim project will be conducted in compliance with the conditions of approval of CDP D890558D.
6. No new impacts to the site's resources will occur due to this project.
7. CDP D890558D conditions requiring independent monitoring of authorized activities will be implemented for the proposed O-13 project. Monitoring will be conducted under the existing County contract with A.D. Little and Science Applications International Corporation (SAIC).

Please feel free to contact me at (805) 781-5702 if you have any questions regarding this matter. Please be advised that this decision is appealable to the Planning Commission within 14 days of the date of this letter. At the close of this 14 day appeal period, this decision is appealable to the California Coastal Commission within ten working days of the start of the appeal period.

Sincerely,

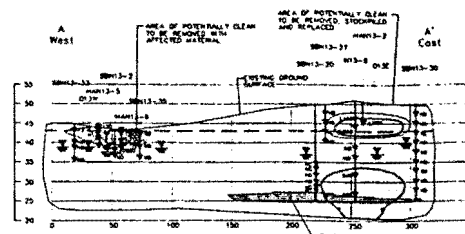
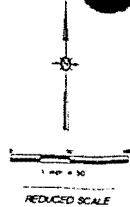


James Caruso
Project Manager

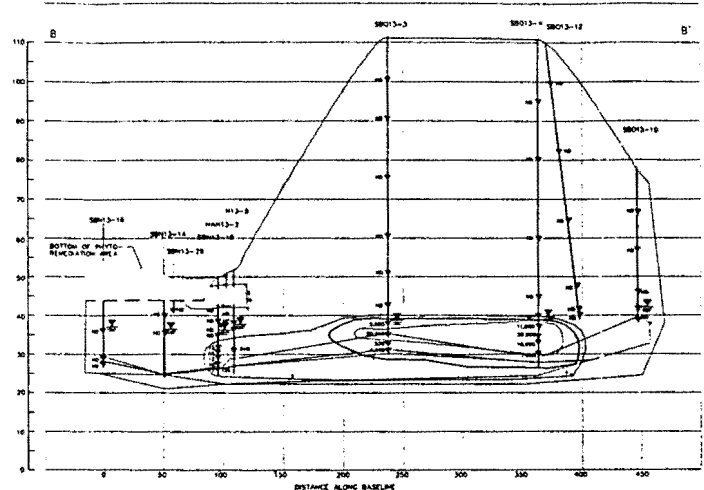
cc: California Coastal Commission
Regional Water Quality Board
Dept. of Fish and Game
U.S. Army Corps of Engineers

attachments

c:\quad\subconf.m4



AREA O13 - SECTION A-A



AREA O13 - SECTION B-B

ASSUMPTIONS/BASIS FOR DESIGN:

- * SLOPE BELOW WATER LEVEL ASSIGNED TO BE 10:1
- * SLOPE ABOVE WATER LEVEL ASSIGNED TO BE 1.75:1
- * SLOPE STABILIZATION SHALL BE IMPLEMENTED AS REQUIRED TO ACHIEVE 1.75:1 SLOPE
- * SLOPE USED FOR ORIGINAL PLANS WAS ASSIGNED 3:1
- * ASSUME NO PENETRATION ALLOWED INTO CLAY/SH1 MATERIAL (CL 9 SH1)
- * DRAINAGE AREA ASSIGNED AS 20 PERCENT OFFSET OF WETLAND LINE

GRADING QUANTITIES:

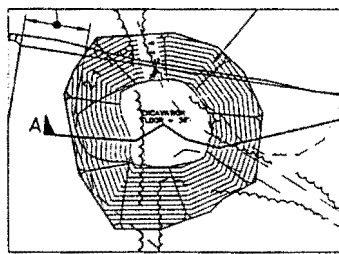
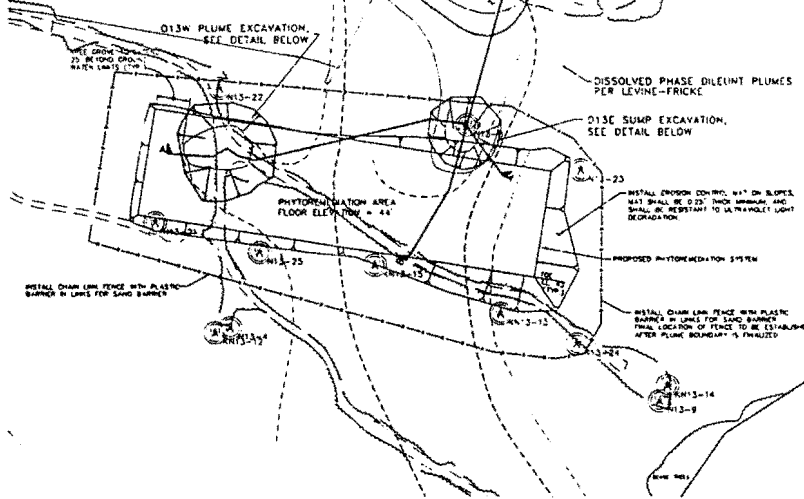
CUT:	
CLEAN OVERBURDEN	7,336 C.Y.
DILUENT - AFFECTED SOIL	830 C.Y.
SUMP MATERIAL	483 C.Y.
FILL:	
CLEAN OVERBURDEN	810 C.Y.
EXPORT:	
CLEAN OVERBURDEN	6,426 C.Y.
DISTURBED AREA	75,823 S.F. (1.74 ACRES)

LEGEND

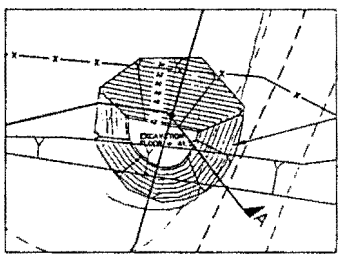
- PC PROPOSED GRADE
- LINES OF PLUME (1000 PPM LIMIT PER EXISTING LEAKAGE-FENCE SITE ASSESSMENT DATA)
- LINES OF PLUME (1000 PPM LIMIT PER EXISTING LEAKAGE-FENCE SITE ASSESSMENT DATA)
- DRAIN LINE FENCE
- ⊙ MONITORING WELL
- DISSOLVED PHASE DILUENT PLUME (GREATER THAN 100 µG/L TPH)
- DISSOLVED PHASE DILUENT PLUME (FROM 1 TO 10 µG/L TPH)
- DISSOLVED PHASE DILUENT PLUME (FROM 0 TO 1 µG/L TPH)
- TOP OF SLOPE

ASSUMPTIONS/BASIS FOR DESIGN:

- * SLOPE BELOW WATER LEVEL ASSIGNED TO BE 10:1
- * SLOPE ABOVE WATER LEVEL ASSIGNED TO BE 1.75:1
- * SLOPE STABILIZATION SHALL BE IMPLEMENTED AS REQUIRED TO ACHIEVE 1.75:1 SLOPE
- * SLOPE USED FOR ORIGINAL PLANS WAS ASSIGNED 3:1
- * ASSUME NO PENETRATION ALLOWED INTO CLAY/SH1 MATERIAL (CL 9 SH1)



O13W PLUME EXCAVATION DETAIL



O13E SUMP EXCAVATION DETAIL

FILE: C:\PROJECTS\O13\O13\O13_PRELIM\O13_PRELIM.DWG DATE: 08/25/99 10:15:45

NO.	DATE	REVISIONS
1	8/25/99	ISSUED FOR REVIEW

NOTES:



NO.	DATE	REVISIONS
1	8/25/99	ISSUED FOR REVIEW

NO.	DATE	REVISIONS
1	8/25/99	ISSUED FOR REVIEW

FIGURE 7
PRELIMINARY GRADING PLAN
O13 AREA
FORMER GUADALUPE FIELD

UNOCAL
C-002

UNOCAL - Former Guadalupe Oil Field

Work Plan

Addendum to the Action Plan to Address Dissolved-Phase Diluent at the O13 Area

April 26, 1999

1.0 Introduction

The "Action Plan to Address Dissolved-Phase Diluent at the O13 Area of the Guadalupe Oil Field San Luis Obispo County, California," was submitted to the Regional Water Quality Control Board (RWQCB) pursuant to the Cleanup or Abatement Order No. 98-38, Section I F. 3, which states that Unocal will prepare a cleanup plan for the O13 Plume Area at the former Guadalupe Oil Field (the Site). This Work Plan was prepared as an addendum to the Action Plan. This Work Plan identifies revisions from the Action Plan, results of the phytoremediation pilot study, and outlines the activities planned for the installation of the phytoremediation system at the O13 Area.

As stated in the Action Plan, portions of the Dune Sand Aquifer (DSA) immediately upgradient of the Santa Maria River at the O13 Area are affected with dissolved-phase diluent. In addition, a seep, located along the bank of the Santa Maria River downgradient from the O13 Area, occasionally discharges groundwater containing dissolved-phase diluent. As a result, the RWQCB has expressed concerns about the potential release of dissolved-phase diluent into surface water.

The source of the dissolved-phase diluent is two separate-phase plumes, O13 E and O13 W. O13 E, the larger of the two plumes, is located approximately 70 feet under a dune. A sump is also associated with the O13 E plume. The O13 W plume is located near the ground surface.

Unocal proposes to excavate the accessible separate-phase diluent at O13 W, then install a phytoremediation system at the O13 Area to remediate the dissolved-phase diluent plume and minimize migration into surface water. The system will be made up of a dense, 0.5-acre (or larger) stand of deep-rooted native willows and poplars (approximately 2,175 trees) planted on an upland portion of the O13 Area. It is anticipated that the willows will be planted this year and the poplars next year.

To allow for the necessary growing season and increase the survival rate of the planted willow poles, it is essential that the willow poles be planted as soon as possible (no later than the first of June).

2.0 Revisions to Action Plan

Subsurface monitoring sensors and monitoring wells will be installed. The subsurface monitoring sensors will be used to evaluate the groundwater properties and evidence of hydrocarbon degradation. The monitoring wells will be installed upgradient, downgradient, and within the phytoremediation system to sample the groundwater and assess the properties and monitor the efficiency of the phytoremediation system.

The volume of grading necessary for installation of the system has been changed due to the results of the phytoremediation pilot study (see Section 3.0 and the revised grading plan for details). Additional pilot activities are still underway to determine the feasibility of further reducing the grading requirements. The volume of grading will be re-evaluated at the time of implementation. There is the chance that the implementation of the phytoremediation system will not require grading. See Section 4.1.2 for more details.

3.0 Results of the Phytoremediation Pilot Study

A pilot phytoremediation study (pilot study) was conducted on April 15 and 16, 1999 to evaluate drilling methods that could be used to plant native willows and black cottonwood (*Populus trichocarpa*) at the O13 Area. The two drilling methods evaluated in the pilot study were high pressure hydraulic jetting (hydraulic jetting) and hollow stem-auger drilling. Another objective of the study was to define the deep-planting procedures required to install willows and black cottonwood for the full-scale phytoremediation system at O13.

On April 15, 1999, a Levine-Fricke-Recon (LFR) plant ecologist performed a brief reconnaissance at the proposed pilot study area to characterize, qualitatively and quantitatively, the native vegetation. The survey did not find any Federal- or State-listed plant species or any California Native Plant Society (CNPS) 1B plants at the pilot study area. One CNPS 4 plant (suffrutescent wallflower) was identified in the area near groundwater monitoring well N13-4. The plants were flagged by LFR, and pilot study activities were conducted around the flagged area, to avoid the plants.

The pilot test was conducted at the O13 area, along the southernmost border of the proposed full-scale phytoremediation system (see Action Plan, Figure 7). The depth to groundwater in this area ranged from 7.9 to 15.5 feet below ground surface (bgs). The willow poles were placed approximately 6 inches into the groundwater table, with a minimum of 6 inches left aboveground and exposed to sunlight. The willow poles used in the pilot study had an average diameter of approximately 1.5 inches and an average length of 10.5 feet.

The following sections outline the drilling methods and results of the two planting methods.

3.1 Hydraulic Jetting

On April 15, 1999, the high-pressure hydraulic jetting method was field-tested at the Guadalupe Oil Field, O13 area. Prior to field activities, the field crew was staged at the N-13 pad to await the County biological monitor and LFR plant ecologist.

Sample borings were located near groundwater monitoring well N13-4, with depth to water measuring 7.3 feet bgs.

The hydraulic jetting system consisted of a specially machined jetting tip that was welded to a 14-foot length of ½ inch steel pipe. A 4,000-gallon water truck provided a high-pressure stream and flow of water through approximately 600 feet of ¾ inch diameter rubber hose to the jetting pipe. The recommended water pressure for the jetting pipe was 80 pound per square inch (psi). Water pressure measurements recorded in the field determined the water pressure to be 100 psi at the end of the 600-foot length of rubber hose.

IT field personnel pushed the jetting pipes to depths of 3 to 3.5 feet bgs at three locations within the O13 area using the hydraulic jetting method. Sand compaction within the borings prevented the jetting pipe from being pushed to greater depths. Additionally, as the jetting pipe was being removed, the borings caved inward.

3.2 Hollow Stem Auger Drilling

On April 16, 1999, the hollow stem auger drilling method (HSA) was field-tested at the Guadalupe Oil Field, O13 location. Gregg Drilling (Gregg) conducted the drilling activities. Prior to field activities, the sampling crew was staged at the N-13 pad to await the County biological monitor and LFR plant ecologist.

A limited-access "Rhino Rig" with 4.25-inch diameter augers was utilized at the site in order to render minimum impact to the vegetation.

IT field personnel tested nine locations within the O13 pilot study area using the HSA (W1 through W9). Sample borings were located in the vicinity of groundwater monitoring wells N13-4 and N13-15 with depth to water measuring 7.8 to 15.5 feet bgs.

Nine soil borings were drilled to total depths ranging from 8.3 to 16 feet bgs (Table 1). Willow poles were inserted through the auger flights and into the groundwater table once the augers reached a depth determined in the field to be 6 inches into the groundwater table. Five fertilizer packets (slow releasing nutrient source) were staggered through each hole after the willow pole was inserted and as the soil was replaced. Following the planting of each willow pole, the area was saturated with water pumped from groundwater monitoring well N13-4 to compact and stabilize the soil around each pole. (Groundwater monitoring well N13-4 has historically not contained detectable TPH or BTEX concentrations since it

was first monitored in February 1997.) Willow poles W1 through W7 extended approximately 6 inches to 2 feet above ground surface upon completion.

Additional pilot testing was conducted using two willow poles (W8 and W9), which were planted such that the tops were not allowed to naturally extend above ground surface. One to two-foot lengths of 6-inch diameter PVC pipe were placed around the willow poles to prevent soil from covering the poles and to allow sunlight to reach the top of the poles. This method was used to evaluate the potential for deep planting of willow in areas where the depth to groundwater is greater than the length of willow poles. If successful, this planting method may allow Unocal to minimize or even eliminate grading activities that are described in the Action Plan (Section 4.3).

3.3 Results

Results of the pilot test determined that the hydraulic jetting method was not an efficient boring method for deep-planting willows or black cottonwoods. With rejection at 3.5 feet, the jetting pipe would not allow the willows or black cottonwoods to reach the groundwater surface without extensive grading. In addition, the borings repeatedly collapsed upon themselves as the jetting pipe was removed, making it impossible to insert poles (and soil additive) to the desired depths.

The HSA method was successful in planting all nine of the willow poles that were attempted (see Table 1 for details). The average amount of time spent drilling and planting each willow pole was ten minutes. The use of auger flights with an ID of 4-¼ inches provided more than enough space to place the poles and additives at the desired depths. It was determined that the poles can be planted successfully to a depth of 10 feet bgs, 4 feet deeper than determined in the original Action Plan. Therefore, the grading plan was modified in this Work Plan for a phytoremediation area 10 feet above the water table, resulting in a reduction of approximately 5,600 cubic yards of soil that must be excavated.

Since April 16, 1999, IT has conducted field assessments of the pilot study willow poles planted below the surface. On Friday, April 23, 1999, new growth was observed on five of the willow poles. It will take an additional two to three weeks before IT is able to fully assess the pilot study willows and determine if the deep planting method described above will allow Unocal to reduce the quantity of grading required to plant willows and black cottonwood.

Table 1

**Phytoremediation Pilot Test
Hollow Stem Auger Planting Method**

LOCATION	DEPTH TO WATER (feet bgs)	TOTAL DEPTH (Planting Depth) (feet bgs)	COMMENTS
W1	7.75	8.3	
W2	7.75	8.3	
W3	7.75	8.3	
W4	8.0	8.5	
W5	7.9	8.5	
W6	7.9	8.5	
W7	12.0	12.5	
W8	15.5	16.0	Willow pole planted with top of pole extending approximately 2 feet below ground surface
W9	9.0	9.3	Willow pole planted with top of pole extending approximately 2 feet below ground surface

4.0 Work Plan for the O13 Area

4.1 Project Description

Unocal proposes to install a dense 0.5-acre (or larger) stand containing approximately 2,175 willow and poplar trees within the central, inter-dune portion of the O13 Area. Both types of trees are phreatophytic, and can use water directly from the saturated zone. Using special cultivation practices to obtain deep-rooted plants, the trees will use groundwater as their primary source of moisture. Based on the lush growth of willows downgradient from the

O13 Area, as well as the analytical data, the quality of the groundwater appears to be adequate.

The proposed planting area transects the dissolved-phase diluent plume from east to west. The trees will extend approximately 25 feet beyond the edge of the dissolved-phase plume to ensure that the entire dissolved-phase plume is treated.

The major actions to implement protective measures are outlined below.

4.1.1 Pre-Construction Activities

The construction boundaries will be surveyed and staked. Construction fencing will be placed to minimize entry of construction vehicles into areas outside of the project footprint.

Prior to construction of the phytoremediation system, sampling will be conducted within the inter-dune area at O13 to assess the chemical, physical, and biological parameters within the DSA. Establishing baseline conditions at the O13 Area will enable Unocal to monitor for changes within the DSA, such as hydraulic control, enhanced biodegradation, and phytostabilization.

Existing monitoring wells will be used to assess the depth-to-groundwater up gradient and down gradient from the planted zone. In-well pressure transducers may be installed in some wells to facilitate measurements. The high rate of water use expected for the stand, relative to the rate of flow of the aquifer, may result in a substantial zone of depression of the water table in the area of the planted zone. However, down gradient of the planted zone, in the area of the seep, the depth-to-groundwater may remain at its current level and will probably not be affected by the water use of the phytoremediation system. Thus, the riparian habitat down gradient from the planted zone will not be disturbed.

4.1.2 Construction Activities

Excavation and grading of dune sand will be carried out around the 0.5-acre (or larger) planting area. The objective will be to remove as much of the separate-phase hydrocarbons as is feasible and to create a planting area in which the saturated zone is uniformly approximately 10 feet bgs. (If the pilot study shows that deep planting is successful, the grading requirements will be re-evaluated.) Excavation and grading of the planting area are important because they will facilitate the pole planting technique. In order to keep excavation to a minimum, the topography of the inter-dune area was considered in the positioning of the planting area.

It is anticipated that some of the sand excavated from the planting area will be used as clean fill for the O13 W plume excavation, and extra material will be used as backfill for another location at the Site. The existing depth-to-groundwater in the planting area ranges from 6 to 22 feet bgs. A rough estimate of the disturbed area and volume of dune sand that will be graded at O13 is approximately 1.7 acres and 3,000 cubic yards. This includes about 855

cubic yards of diluent-affected material that will be excavated from the O13W plume and removed from the O13 Area, and about 2,160 cubic yards of clean overburden that will be exported from the O13 Area for use as backfill material for another excavation project at the Site.

A chain-link fence will be installed around the planting area to prevent cattle from damaging the newly planted trees. A gate will be installed that is wide enough to allow access for drilling and maintenance equipment. Vertical vinyl slats will be placed in the chain-link fence to prevent migration of sand into the phytoremediation system, particularly at the start of the project when the willow and poplar trees are only 1 to 2 feet out of the ground.

Excavation and grading of dune sand will be carried out in the planting area. The objective will be to remove as much of the separate-phase hydrocarbons as is feasible and to create a planting area in which the saturated zone is a maximum of 10 feet bgs. The planting area is a 0.7-acre area, approximately 335 feet long by 90 feet wide. The eastern half of the planting area will be graded to lower the ground surface to an elevation of 48 feet (10 feet above ground water). Lowering the eastern half of the planting area will create 2:1 side slopes to daylight with the existing surface. The slopes will be covered with erosion control fabric to stabilize the slope. The western half of the planting area will not require grading because it is relatively flat and is already less than 10 feet above the water table.

Prior to beginning grading operations for the planting area, the O13W plume will be excavated. O13W is a separate-phase diluent plume in the western half the planting area. The plume will be remediated using an open excavation with 2:1 (horizontal: vertical) side slopes. Approximately 855 cubic yards (CY) of affected material will be removed from this excavation. The affected material will be transported to Tank Battery 8 for screening prior to treatment. It is expected that the clean backfill required (855 CY) for O13W will come from the grading of the planting area.

If it is determined that no grading is required for the planting area, then another source of clean backfill (such as sand from road maintenance operations) will be used. Also, rather than scarifying the area, the plants will be left in place and driven over to install the poles. This method is recommended by the project botanist to facilitate revegetation and keep the dunes stabilized.

4.2 Plant Species

Both willow and poplar trees will be established within the planting area. Two species will be planted because stands of trees containing a variety of species are more resistant to disease than stands of a single species and mixed plantings are more beneficial in regard to enhancement of the Site environment. The source harvesting methods for each are described below.

4.2.1 Willow Trees

Willow tree cuttings (poles) were obtained from the banks of the Santa Maria River in February 1999. Approximately 1,700 long, hardwood poles (approximately 9 feet long and 3/4 to 2 1/2 inches in diameter) were harvested, wrapped in bundles of 50 in plastic, and stored at 33° to 40° F. The variety of the willow trees (species and subspecies identification) will be determined during the 1999-growing season.

4.2.2 Poplar Trees

California poplar, also referred to as black cottonwood, (*Populus trichocarpa*) is native to the Site. Though the poplar tree is native to the Site, there are not enough on site from which to obtain the required amount of poles. Therefore, poplar trees will be grown during the summer of 1999, and poles will be harvested in the winter of 1999 for planting at the O13 Area in the spring of 2000. These poplar poles will be supplied to Unocal by either Dr. V.L. Holland of the Biological Sciences Department at California Polytechnic State University at San Luis Obispo or by a commercial grower in Oregon.

4.3 Planting Methods

A dense 0.5-acre (or larger) stand of willows and poplars will be installed within the area shown in Figure 7. Approximate dimensions of the planting area will be 340 feet from west to east, and 90 feet from north to south. The two species will be planted in alternating rows with a 4 feet spacing between each row. Spacing between the willow trees within a row will be 2 1/2 feet; spacing between the poplar trees will be 5 feet. Approximately 1,450 willows and 725 poplars will be planted (a total of 2,175 trees). The dense planting will ensure that the rate of water use by the stand will increase rapidly and probably reach a maximum by the fourth or fifth growing season. After the fifth year some crowding will occur, as in a native stand, and the dominant trees will thrive and the smaller trees will die.

4.3.1 Staggered Planting

The willows will be planted in rows, 8 feet apart, in the spring of 1999. The rows of poplars will be planted between the willow rows in the spring of 2000.

4.3.2 Pole Planting Technique

Trees will be planted as poles (that is long, hardwood cuttings without roots or branches). For each pole, a 5-inch diameter hole will be drilled down to the saturated zone using a hollow stem auger mounted on a small drill rig (wheel base about 6 feet wide). The long hardwood poles (approximately 8 to 12 feet in length) will be placed in the bottom, and the hole backfilled with sand (the material drilled from the hole) mixed with mineral nutrients and other amendments. Typically, approximately 1 foot of the pole will extend above ground. However, if determined feasible, deep planting techniques may be utilized to minimize grading.

It is crucial to the procedure that approximately 1 foot of the bottom of the pole extend into the saturated zone, because roots develop only along the portion of the pole in contact with moisture (that is the bottom 1 to 2 feet of the pole).

Amendments (slow-releasing nutrients, such as peat) will be added in order to obtain optimal tree growth. The nature of the amendments will be based on a soil analysis currently being performed at Utah State University's Soil Testing Laboratory.

After backfilling, each tree will be watered to ensure that the dune sand is well settled and there is a close sand to root contact. Watering will be carried out using the water from well N13-4 or a tank truck.

4.4 *Post-Construction Activities*

The subsurface monitoring sensors and groundwater monitoring wells will be used to evaluate the groundwater properties and assess the efficiency of the phytoremediation system.