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CROWS LANDING
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Pete Wilson, Governor

8 April 1998

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DRAFT FEASIBILITY STUDY REPORT INSTALLATION RESTORATION PROGRAM SITES 11 AND 17, NAVAL AUXILIARY LANDING FIELD (NALF) CROWS LANDING, STANISLAUS COUNTY.

We have reviewed the NALF Crow Landing Draft Feasibility Study Report for Sites 11 and 17 (Report), submitted 8 December 1998. The Report provides an overview of the site characterization data for both sites and pilot test data for evaluation of Soil Vapor Extraction and (SVE) and Air Sparging at Site 17. The Navy also provided an evaluation of spray irrigation as a treatment option for contaminated groundwater.

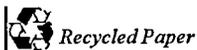
Overall, the Report appears not to include all necessary elements to support selection of remedial alternatives and cleanup levels, as required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), that are typically found in a Feasibility Study (FS). We have several general comments on the structure and objective of this Report. These general comments are followed by specific comments on how the Report should be modified to include adequate information to support a detailed feasibility study for these IRP sites. These comments require several changes to organization of the Report. We also have additional comments on the previous investigations conducted for site 11 and 17.

General Comments

1. The overall organization of the Report should be revised to provide more clarity and a basis for selecting state requirements (ARARs), remedial action objectives and appropriate remedial alternatives. Specifically, the Report should provide information developed during the Remedial Investigation that was used to evaluate if these sites threaten groundwater and its beneficial uses (i.e. water quality assessments).

No Further Action (NFA) Determination for Sites 10, 12, 13, 14, 16 and 18

2. It appears that many of the sites which were investigated in the RI were not further evaluated in the FS. It is not clear how the Navy has made the decision to no longer carry these sites to the



FS stage. Each site identified in the RI should be evaluated and if the Navy proposes NFA status for a site, such justification, as described under our Section 3.0 comments, should be provided. Briefly, the Report should include site summaries with field investigation findings. All groundwater monitoring data related to these sites should be provided in summary tables and indicate all analytes evaluated. Any recommendations for further actions (such as continued groundwater monitoring) should be discussed. Additionally, the Report should include a summary of the water quality assessments, human health and ecological risk assessments that were conducted at these sites.

Site 17 Data Gaps

3. We have several general comments that are related to the remedial investigation that was conducted for Site 17. As discussed in our specific comments, we are concerned that the Navy has not adequately characterized the VOC groundwater plume at Site 17. We believe that additional pre-design investigations are necessary before remedial action at this site can be initiated. Further, we believe the site represents an "old" vadose zone source area for VOCs as suggested by the Navy. However, it appears the contaminant concentrations detected in the vadose zone warrants soil cleanup activities which should be focused on removing as much contamination from the vadose zone as possible. Regardless of which transport mechanisms are associated with the distribution of contaminants detected at Site 17, it is generally much less costly to conduct cleanup of VOCs in the vadose zone than from groundwater.

Site 11 Data Gaps

4. We have reviewed the RI Report, quarterly groundwater reports and the *First Final Annual Groundwater Monitoring Report*, submitted 10 April 1996, to evaluate if any VOC's were detected in monitoring wells 11-MW-01 and 11-MW-02. Based on our review of the FS Report and the Annual Monitoring Reports it appears that these wells have been dry for an extended period of time. The Navy should provide information summarizing all groundwater analytical data obtained from these monitoring wells. We may have additional comments related to the presence or absence of VOCs at Site 11 after our review of this information.

Specific Comments

Section 3.0 Site Characterization

1. The Report should include brief descriptions of the investigation results, water quality assessments, and ecological and human health risk assessments that were conducted during the remedial investigation. A summary for the NFA sites 10, 12, 13, 14, 16 and 18, and the FS sites 11 and 17, should include site location maps with monitoring well, groundwater and soil sampling locations, any geologic and hydrogeologic cross sections that were prepared to evaluate the extent of contamination at these sites and summary tables indicating contaminants of concern that were evaluated.

2. Section 3.0 or a separate section should include an analysis of the data and justification showing if remedial actions are necessary at an IRP site. In other words, the screening criteria that were used to determine a site would not be further analyzed in the FS should be presented. Specifically, the Navy should discuss how the water quality site assessment and human health risk assessment were used to screen out sites.
3. **Section 3.2 IRP Site 17 Characterization**
 - a. Field investigations and site history records indicate that this area was used during the 1940's and 1950's as a maintenance area. This suggests that spills or disposal of solvents in this area would represent an "old" source area for the observed VOC groundwater plume emanating from the area. The Navy has provided extensive soil, soil gas and groundwater investigations which indicate that this site should be remediated. We concur that the groundwater should be remediated. However, we also believe that these field results indicate that soil remediation (Soil Vapor Extraction) is warranted especially considering that mass removal of VOCs from the vadose zone is generally much less costly than from groundwater. Soil gas data indicate carbon tetrachloride concentrations ranging from 85 ppbv to 18750 ppbv. These soil gas concentrations suggest that the vadose zone may contain a significant mass of VOCs.
 - b. The soil gas concentration profiles provide a good assessment of the contaminant distribution suggesting that contaminant concentrations increase with depth. We believe that the Navy's interpretation that volatilization is occurring from water table is valid. However, the contaminant distribution may also indicate that the area represents an old source area (40 years) where contaminants have had the opportunity to migrate to greater depths. Similar sites (Mather AFB and Sacramento Army Depot) that have experienced more recent spills of VOCs in the vadose zone have been evaluated using vadose zone computer models (VLEACH). These evaluations suggest that the predicted VOC concentrations would increase with depth over time (and would indicate a soil gas profile similar to Site 17) if these contaminants had not been remediated. Therefore, regardless of how the VOCs arrived near the water table, the mass of VOCs that is suggested by this site characterization appears to be sufficient to warrant soil cleanup.
 - c. The groundwater investigations conducted at Site 17 indicate carbon tetrachloride concentrations as high as 390 ppb (17-MW-03) and benzene (2400 ppb). The Navy has indicated that the BTEX contamination observed at Site 17 is related to adjacent sites UST 117 and UST Cluster 1. The contaminant distribution for carbon tetrachloride indicates that the highest concentrations extend into the mid-shallow zone (approximately 50 feet below the water table). We believe that the groundwater investigation for Site 17 has been adequate to determine the vertical extent of contamination extending into the mid-shallow zone. However, the Navy appears not to have provided an adequate characterization to determine the lateral extent of contamination in the mid deep (approximately 125 feet below water table) and deep zones (200 to 250 feet below the water table to the Corcoran Clay), as discussed below.

- d. Based on Cross Section B-B' (Figure 3-3) it appears the northern and southern extent of the plume has not been identified in the mid-deep and deep zones. Monitoring wells 17-MW-14 and 17 MW-15 are the only monitoring wells that provide information on the lateral extent of contamination (presumably beneath the source area). Cross Section A-A' (Figure 3-4) suggests that the eastern extent of the VOC plume has been better defined by monitoring wells 17-MW-14 and 17-MW-06 for the mid-deep zone. However, the Navy must still determine the full extent of VOC plume (at a minimum to the MCL for carbon tetrachloride- 0.5 ppb) in the mid deep and deep zone. The western extent of the VOC plume has not been identified in the mid-deep and deep zones. The Navy should provide additional monitoring wells in order to characterize the carbon tetrachloride plume the mid deep and deep aquifer zones.

4. Section 5.0 Site Cleanup Objectives

This section discusses the remedial action objectives (RAOs) and the federal and state requirements to address cleanup actions at IRP sites 11 and 17. This section is not clear in its approach on how federal and state requirements, risk assessments and contaminant fate and transport evaluation results are used to identify RAOs. This section should indicate proposed numerical cleanup levels and how these cleanup levels are derived. The Navy should, at a minimum, identify cleanup levels that are based on levels that are protective of water quality and ecological and human health risks. We recommend that Section 5.0 is rewritten and discusses the following (**in this order**): *potential state and federal requirements* (or ARARs), Remedial Action Objectives and General Response Actions. The federal and state requirements discussion should be a separate discussion that should be referenced or repeated as necessary during a separate discussion of the general response actions that are those actions that will satisfy the remedial action objectives.

State Requirements

5. The state and federal requirements discussion (Section 5.2) should be revised as follows and should indicate the state and federal requirements that were developed to address cleanup at Sites 11 and 17. The Navy should indicate that these sites are considered further in the FS because of remedial investigation results on the nature and extent of contamination and risk assessment:
 - a. Section 5.2 should have the title *Identification of Potential Federal and State Requirements*. The text in Section 5.2 (page 5-4) should be revised and indicate that this FS has identified potential state and federal requirements that apply to Site 11 and 17. Also, the Report should indicate that the Record of Decision (ROD) will provide the final determination of state and federal requirements for these sites.
 - b. Section 5.2 should include tables which list all potential requirements for **both** Site 11 and 17. We have provided several tables, submitted in our letter dated 31 March 1998, which should be included and referenced in the discussion of federal and state requirements that would apply to the soil remediation at Site 11 and the groundwater and soil remediation for Site 17.

c. **Soil Remediation at Site 11 and Groundwater Remediation at Site 17**

Section 5.2 should include a brief narrative discussion of the state requirements that apply to the soil remediation at Site 11 and the groundwater remediation at Site 17 which should be based on the ARARs (state and federal requirements) tables we provided in our letter, dated 31 March 1998. [Porter-Cologne Water Quality Control Act, Water Quality Control Plan (Basin Plan), State Board Resolutions 68-16, 92-49 and 88-63, Designated Level Methodology (DLM) for Waste Classification and Cleanup Level Determination, A Compilation of Water Quality Goals, applicable sections of Title 27 and Title 23 California Code of Regulations].

d. **Soil Remediation at Site 17**

Section 5.2 should include a brief discussion of state requirements that would apply to soil remediation at Site 17. As discussed in our comments on Section 3.2, soil remediation appears to be warranted at this site. The state requirements that would apply to this site are listed in the table *Site Specific ARARs for Soil Remediation at Sites 11 and 17 (dated 31 March 1998)*. Section 5.2 should also include a brief narrative discussion of state requirements that would apply to soil remediation at Site 17.

6. Section 5.5, Action Specific ARARs- IRP Site 17, should include discussion of State Board Resolution 68-16, 92-49, specific provisions of Title 27 and Title 23 CCR and the Basin Plan for the Central Valley Region

Section 6.0 Development and Screening of Remedial Alternatives

7. Generally Section 6.0, *Development and Screening of Remedial Alternatives*, should be rewritten to incorporate soil and groundwater cleanup levels for Site 17 and soil cleanup levels for Site 11. These soil and groundwater cleanup levels should be numerical levels that are protective of water quality and human health and should be discussed in a sub-section, *Remedial Action Objectives*, of Section 6.0. The basis for developing these cleanup levels should be provided in the discussion on the Remedial Action Objectives. After this, the FS Report should include a sub-section, *General Response Actions*, which should discuss which remedial actions would satisfy the remedial action objectives
8. The Navy should develop VOC cleanup levels for soil and groundwater at IRP Site 17. We have provided the attached recommended narrative cleanup standards for the vadose zone which have been used at similar sites in the Central Valley (DDRW Tracy, Mather AFB, McClellan AFB). We recommend that the narrative cleanup standards are included verbatim into the sub-section, *Remedial Action Objectives*. It should be noted that the narrative cleanup standards include a numerical cleanup level that is based on achieving soil vapor concentrations that would prevent the concentration in liquid phase from exceeding the water quality objective. In this case, the soil vapor concentration for carbon tetrachloride is 94 ppbv (assuming a cleanup level that is based

on the MCL for carbon tetrachloride- 0.5 µg/l) This approach also includes the development of model-based cleanup levels (see Item 2 a in *Narrative Cleanup Standard*) which would represent the maximum allowable residual total soil concentrations which could remain at the site so that groundwater concentrations do not exceed numerical beneficial use limits in the future. These model-based soil cleanup levels could be used to provide a benchmark concentration to evaluate the technical and economic feasibility of providing soil cleanup.

9. The General Response Action section (Section 6.1) should include discussions on which remedial technologies could be applied to provide cleanup of the VOC contamination in the vadose zone at Site 17 (i.e., soil vapor extraction, dual phase extraction). The narrative soil cleanup standard for VOCs in the vadose zone, discussed above, is applicable to sites where SVE is proposed for remediation.
10. Section 6.2, Screening of IRP Site 17 Remedial Alternatives, should include groundwater cleanup levels that are protective of beneficial uses. In developing groundwater cleanup levels, the Navy should conduct an evaluation to determine the technological and economical feasibility of achieving "background" (i.e., detection limits for VOCs) for contaminants of concern in groundwater. The basis for performing this analysis, to determine if background levels are achievable, is provided in State Board Resolution 92-49, Section III. G. Analysis to determine if remediation of groundwater is possible to detection limits could be conducted by performing 3-D groundwater flow and contaminant transport modeling. Remediation times and O&M costs should be evaluated for this scenario and other scenarios (i.e., remediation to MCLs for carbon tetrachloride). As a practical matter, the cost to provide remediation of the benzene plume from UST site 117, could also be included in this evaluation, since this plume appears to have commingled with the carbon tetrachloride plume from Site 17.

Section 7.0 Detailed Analysis of Alternatives

11. Generally, Section 7.0, must be modified to include remediation of the vadose zone at Site 17. The alternatives to be evaluated for Site 17 could include, as an example, a combination of SVE and, groundwater extraction and treatment.
12. Section 7.2, Detailed analysis of alternatives for Site 17, should indicate that groundwater must be remediated to background unless it can be demonstrated that achieving background concentrations is technically and economically infeasible.
14. Section 7.2, Long-term Effectiveness and Permanence, states that air sparging may be ineffective at depths in excess of 60 to 80 feet below the water table. Because the Navy has not demonstrated that air sparging can be effective at depth, the Navy should consider a combination of alternatives that have been listed as separate alternatives (i.e. pump and treat and air sparging). The Report should be revised to indicate that a combination of pump and treat and air sparging may be necessary to remediate all aquifer zones that are contaminated above aquifer cleanup levels.

15. Section 7.2.4, Alternative 3B-Pump and Treat, Spray Stripping, Discharge, indicates that the Navy will consider spraying VOC contaminated water on crop lands during the irrigation season and during the rainy season will spray water onto runways or other nonagricultural areas. Although the pilot test results appear to indicate that this treatment option may be successful at Site 17, the Navy would have to demonstrate that all contaminated water is remediated to concentrations below aquifer cleanup levels. The Navy would have to provide a detailed proposal on how the system would be monitored to meet the discharge limits.

If you have any questions prior to our conference call scheduled 20 April 1998, please call me at (916) 255-3050.



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Narrative Cleanup standard for Vadose Zone VOCs at Crows Landing

The Navy will remediate volatile organic COCs in the vadose zone at sites overlying contaminated groundwater to the extent technically and economically feasible to minimize further degradation of the groundwater by the contaminants in the vadose zone. It is generally preferable from a technical and cost perspective to clean up contamination in the vadose zone before it reaches the groundwater. The vadose zone cleanup will be achieved when it is demonstrated that:

- 1) The remaining vadose zone volatile organic COCs no longer cause concentrations in the leachate to exceed the aquifer cleanup levels, based on an interpretation of soil-gas data using an appropriate vadose model; and
- 2) Volatile organic COCs have been removed to the extent technically and economically feasible.

The Navy shall operate the SVE system until it makes the demonstration that Items 1 and 2 above have been met.

The Navy will make the demonstration that the vadose zone cleanup has been achieved for Item 1 through contaminant fate and transport modeling, trend analysis, mass balance, and/or other means. This demonstration will include examination of the current effects of remaining vadose zone contamination on the groundwater, using an appropriate vadose zone model if necessary. In the case that the Navy can demonstrate that the soil vapor concentration for carbon tetrachloride has been met (96 ppbv) in the vadose zone, the parties agree that the Navy has met Item 1 of the vadose zone cleanup.

To achieve Item 2 of the vadose zone cleanup, the Navy shall operate the SVE system until it makes the demonstration that volatile organic COC removal is no longer technically and economically feasible. The feasibility analysis will include but not be limited to consideration of the following factors:

- a) Whether the predicted concentration of the leachate from the vadose zone (using an appropriate vadose zone model that interprets soil-gas data) will exceed the groundwater cleanup standard;
- b) Whether the mass removal rate is approaching asymptotic levels after temporary shutdown periods and appropriate optimization of the SVE system;
- c) The additional cost of continuing to operate the SVE system at concentrations approaching asymptotic mass levels;
- d) The predicted effectiveness and cost of further enhancements to the SVE system (e.g., additional vapor extraction wells, air injection) beyond system optimization, which should occur throughout operation of the remedial action, to remove additional volatile organic COCs;
- e) Whether the cost of groundwater remediation will be significantly more if the residual vadose zone contamination is not addressed;
- f) Whether residual mass in the vadose zone will significantly prolong the time to attain the groundwater cleanup standard; and

- g) The incremental cost over time of vadose remediation compared to the incremental cost over time for groundwater remediation on the basis of a common unit (e.g., cost of pound of TCE removed) provided that the underlying groundwater has not reached aquifer cleanup levels.

The regulatory agencies (DTSC and Regional Board) agree that the Navy may cycle the SVE system (or other appropriate treatment technology) on and off in order to optimize the SVE operation and/or to evaluate all feasibility analysis factors.

The signatory parties to the ROD will jointly make the decision that cleanup of volatile organic COCs in the vadose zone has been achieved and that the SVE system may be shut off permanently.

If at some later date the parties determine that it is technically or economically infeasible to achieve Item 1, after all reasonable efforts have been made, the parties will re-evaluate the need to achieve Item 1, as long as Item 2 has been fully achieved to the satisfaction of DTSC and the RWQCB. In demonstrating the infeasibility to achieve Item 1, a more rigorous feasibility analysis is required because the incremental benefit of removing VOCs from the vadose zone is generally much higher as long as Item 1 has not been achieved. The Navy will have to meet aquifer cleanup levels even though Item 1 has not been achieved.

Once the groundwater has reached the aquifer cleanup level, the parties agree that it is not technically or economically feasible to operate the SVE system beyond the contaminant concentrations required by item 1. At this point, there is relatively little benefit in continuing SVE because the aquifer cleanup level has been achieved and the contaminants in the vadose zone will not cause contaminant concentrations in the groundwater to increase.