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Military

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Technical Review Report
Soil and Water Baseline Study Report
Former United States Air Force Installation
Pampanga, Philippines
August 22, 1998

Table of Contents

1.0 INTRODUCTION

Under contract to Arc Ecology, on behalf of the United States Working Group for Philippine Bases Cleanup and the People's Task Force for Bases Cleanup, Clearwater Revival Company (CRC) prepared this technical review report of the following document:

Weston International, 1997, "Soil and Water Baseline Study Report, Final Report," prepared for The Clark Development Corporation, August.

The Soil and Water Baseline Study Report (Weston Report) for the former US Air Force Military Complex evaluated the quality of groundwater from drinking water supply wells and the water distribution system. The Weston Report also evaluated soil contamination at 14 selected hazardous material storage sites. The Weston Report was not a comprehensive evaluation of the former Clark Air Force Base.

1.1 FINDINGS

The purpose of CRC's technical review was to determine if the conclusions and recommendations of the Weston Report are technically sound. CRC reviewed the assessment methods, sampling plans, and risk screening methods used during the Weston Report for consistency with practices commonly used to perform environmental assessments on industrial property.

One of the findings of the Weston Report is the recommendation to continue to use the drinking water supply system. CRC feels this recommendation is premature. CRC's concerns are based on the following facts:

1. The drinking water supply system includes three hand-pumped wells in the evacuee camp that provide water that is not fit for human consumption.

2. The groundwater baseline study was plagued by quality control problems, and as a consequence, the results of water analysis are of limited reliability.

3. No details exists on the groundwater supply wells construction details, though supply wells are believed to be highly vulnerable to contamination.

4. The Weston Report indicates a high probability that soil contamination identified at 10 of the 14 sites sampled may have impacted groundwater quality.

5. The pesticide dieldrin was detected above drinking water

standards at several of the wellheads and the source of this contamination is unknown.

Until a more detailed investigation of uncontrolled hazardous waste sites at Clark AFB is completed no conclusions can be reached about the present or future safety of the groundwater supply basin.

The sample depths and the Risk-Based Criteria (RBCs) used to evaluate soil sample results, clearly indicate that the purpose of the Soil Baseline Study was to evaluate human exposure to shallow soil contamination. The recommendations from the Soil Baseline Study, however, put little emphasis on human exposure at spill sites. Instead, surface contamination that exceeds the RBCs is related to a high potential for groundwater contamination. The soil baseline study was neither designed to evaluate the potential for soil contamination to impact underlying groundwater, nor are the RBCs useful for evaluating the potential for surface soil contamination to leach into underlying groundwater.

1.2 QUALIFICATIONS

CLEARWATER REVIVAL COMPANY

Since 1994, Clearwater Revival Company (CRC) has been working with community organizations and environmental justice stake-holders to increase the effectiveness of public participation in environmental decision making and to promote the proper assessment, remediation, and reuse of contaminated property. CRC performs independent technical reviews of environmental investigations, risk assessments, remediation plans and design specifications. CRC's clients include the Chemical Weapons Working Group, a United States national organization evaluating the proposed destruction processes for chemical warfare agents; the Fort Ord Toxics Project, a community-based organization evaluating the effectiveness of a hazardous waste landfill cap design at the Former Fort Ord Army Base; and a community-based organization developing a neighborhood emergency plan for hazardous material incidents.

KEY ANALYST

PATRICK LYNCH, PE: Mr. Lynch is a registered civil and chemical engineer who has been providing environmental consulting services for over 13 years. With a B.S. Degree in Chemical Engineering from the University of California, Berkeley, Mr. Lynch's expertise is in the evaluation and design of engineered systems for risk management and site cleanup projects. Mr. Lynch has been involved in all aspects of environmental compliance and restoration programs including spill discovery, site investigations, risk assessments, feasibility studies and cleanup effectiveness analysis. Mr. Lynch assists the National Council of Examiners for Engineers and Land Surveyor's Exam Committee which is responsible for preparing the Chemical Engineering professional engineering licensing exam.

1.3 PEER REVIEW

Clearwater Revival Company's assessment was subjected to peer review by members of the Technical Committee of the United States Working Group for Philippine Bases Cleanup. The following individuals provided the peer review and endorse the contents of this report:

Dr. Paul R. Bloom, Ph.D., University of Minnesota
Dr. Jorge Emmanuel, Ph.D., PE, CHMM
Mr. Matthew Plate, Environmental Scientist
Dr. Theodore Schettler, MD

1.4 COORDINATION

Coordination for the project was provided by Arc Ecology and its Executive Director Saul Bloom. Mr. Bloom has served as Executive Director of Arc Ecology since November 1983. Mr. Bloom is currently a member of numerous official entities including the California Environmental Protection Agency Base Closures Environmental Advisory Committee (advising the Governor of California on the cleanup policies for the state's 30 closing bases); the East Bay Conversion and Reinvestment Commission (studying the impacts of base closures on Alameda

County in California); the Hunters Point Citizens Advisory Committee (advising the Mayor of San Francisco on base conversion strategies); as well as the Restoration Advisory Boards (RABs) for the Oakland Army Base and the Presidio Army Base (RABs advise the military on base cleanup strategies).

Arc Ecology is one of the United States leading environmental organizations focused on military pollution and its cleanup. With 14 years experience in the field, Arc Ecology maintains environmental programs in the United States, Great Britain and currently serves as the Secretariat for the National Caucus of Restoration Advisory Board Community Members and the United States Working Group for Philippine Bases Cleanup. Arc Ecology's staff includes environmental scientists, economist planners and community organizers.

2.0 GROUNDWATER BASELINE STUDY

The groundwater investigation included the collection of 24 groundwater samples from the Clark Air Force Base water supply system. All 15 operational water supply wells (including two stand-by wells), and two of the 15 abandoned water supply wells were sampled. Also sampled were three evacuee camp water supply wells and four points within the Air Force water distribution system. Each sample was analyzed for asbestos, total coliform, herbicides, radioactivity, pH, general minerals, metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCBs), pesticides, volatile organic compounds (VOCs), radioactivity.

2.1 Comments on Groundwater Baseline Study Methodology

Holding times were exceeded for many of the groundwater sample analyses.

Groundwater samples were collected on four separate dates. On two of the sample dates, 5 February (15 days to analyze), and 7 February (25 days to analyze), VOC holding times were exceeded. Samples for VOCs, asbestos, radiological, and TDS are to be analyzed within 14 days of collections. TDS holding times were also exceeded for samples collected on 7 February (19 days to analyze). Asbestos and radiological test dates were not provided on the laboratory reports to verify holding times were met.

In order to meet the extraction holding times, the laboratory would

have had to extract the samples from the other two sample dates, 14 February and 26 February, on the same day they were received. Samples analyzed for PAHs, organochlorine pesticides, herbicides, and PCBs must be delivered to the laboratory and extracted within 7 days. Specific extraction dates were not provided on the laboratory reports to verify these holding times were met.

The 14 day holding time for VOC samples was exceeded by one day for the samples from the abandoned wells.

Improper preservation of VOC samples.

The results of water VOC data may have been biased by the lack of sample preservation. Current US EPA methods, Method 8010/8020, for VOC analysis call for field preservation with hydrochloric acid. Appendix D, Table 6-1, indicates these practices were not followed. Field sample preservation extends sample holding time prior to analysis from 7 days (for unpreserved samples analyzed by EPA Method 602), to 14 days (for a sample preserved with hydrochloric acid and analyzed by EPA Method 8020). The lack of preservation and the extended holding times of VOC samples would result in rejection of these results under current EPA Data Validation procedures.

Lack of well construction information.

The report has stated that two groundwater bearing zones (aquifers) exist throughout Clark Air Force Base. These aquifers are separated by a lower permeability layer from 85 to 125 meters below ground surface. Table 2-1, lists the depths of only four of the 30 wells. These well depths as 85, 40, 14, and 10 meters, indicating that these wells are screened in the shallow groundwater water bearing zone. The report states that the 15 operational and 15 abandoned wells are believed to be ".. most likely screened between 60 and 180 meters." On this assumption wells would be screened across the low permeability zone in both the shallow and deeper groundwater bearing zones. Without well construction information it is not possible to determine whether the shallow or deeper aquifer is being evaluated.

Groundwater sampling method.

Appendix D, p. 3-4, indicates that one to three well volumes of groundwater will be removed prior to collecting a sample. The

depths of the sampled wells are not known. Well construction information is not available to do a well volume calculation. Instead the report text indicated that a submersible pump was allowed to run for 10 minutes in CDC-4 and CDC-12 before a sample was collected. Based on this information it is not possible to determine if an inadequate volume of groundwater was purged from these wells before sampling was performed.

CDC-4 is listed as an operational well.

Table 2-1 indicates that only one abandoned well, CDC-12, was sampled by Weston during February 1997. CDC-4 is listed as operational in both Table 2-1 and Table 2-3, though photographs included in Appendix A indicate that the pump has been removed from the well.

2.2 Specific Comments on Groundwater Sampling Results

Results of Groundwater Analysis mistated.

The report states that for groundwater samples: "The following analytes were not detected in any of the water samples collected: asbestos, PCBs, herbicides, and radiation." Page 39 of Appendix D, page 39, lists the results for radiation tests on groundwater samples. Gross alpha is reported to range from <0.02 to 0.25 becquerel per liter (Bq/L) and gross beta is reported to range from 0.06 to 1.4 Bq/L. These results are not reported with other detected analytes in Table 2-5 of the main report. Water Quality Criteria for radionuclides are not listed with other Drinking Water Standards in Table 2-2.

Results of groundwater analysis for asbestos were not fully reported.

The asbestos lab report (Appendix D, p. 21-22) does not include a "date tested" as do all other reports. The asbestos results are reported as "ND" with no detection limit as on other lab reports. No reporting units are included. Table 2-2 lists the detection limit for asbestos as 0.99 fibers/L, and the drinking water standard as 7 fibers/L.

Analytes above PNS/WHO Standards were not fully identified.

Table 2-6 lists nitrates, mercury, and coliform bacteria as the only analytes exceeding the PNS or World Health Organization standards in at least one of the three evacuee camp wells. The pH of water in the three wells was reported as 6.39, 6.2, and 6.22. The PNS standard for the pH of drinking water is 6.5 to 8.5. The pH standard was also exceeded.

Sources of Contamination in CDC-4.

The Weston Report attributes solvents found in CDC-4 to vandalism from an unlocked well (solvent wastes poured into well). This conclusion was not supported by observations at the wellhead, such as staining of the interior of the well casing. It is equally likely that the contamination is a result of an uncontrolled toxic waste release site. The Weston Report did not recommend sampling shallow groundwater in the vicinity of CDC-4 to determine if a contaminant source existed in the area.

Sources of Contamination in CDC-12

Despite the drinking water standards for pH, dissolved solids, lead, sulfate, and coliform being exceeded, no source was attributed to contamination found in well CDC-12. The groundwater in CDC-12 appears to be impacted by leachate from a land disposal site which includes both industrial and sanitary wastes.

Sources of Dieldrin

The detection limit for dieldrin is three times the drinking water standard. Despite this dieldrin was detected in five of the 15 operations supply wells that were sampled.

2.3 Comments on Groundwater Baseline Study Recommendations

The three principle recommendations of the Groundwater Baseline Study are improving well construction and abandonment standards, the development of a groundwater basin water quality model, and further sampling of the distribution system for dieldrin. While there is agreement that these Weston Report recommendations are necessary, further action beyond these recommendations is needed to fully address groundwater contamination as described in the following paragraphs.

Evacuee Camp - New Water Supply Source; Improved sanitation.

Shallow groundwater from the evacuee camp supply wells has been impacted by human waste (coliform and nitrates), is toxic (mercury), and is therefore not suitable for human consumption. The presence of high levels of coliform and nitrates in shallow groundwater is associated with poor sanitation and poorly constructed supply wells. Despite these conditions, the Weston Report has not recommended identifying an alternate drinking water source, providing wellhead treatment and improving sanitation at the evacuee camp. A new source of drinking water, and improved sanitation should be provided to the evacuee camp.

Improved Water Distribution System

The design of the existing water distribution system may create a source of contaminants. Construction materials which may be a source of contamination should be identified and removed from the system (the Weston Report identifies lead as one construction material contaminating the water supply). Back-flow preventers should be installed at industrial facilities to prevent the introduction of contaminants into the system from industrial processes (e.g. mixing tanks, boilers, pesticide sprayers).

Groundwater Quality Monitoring.

Changes in groundwater depth, recharge rates and extraction rates can result in seasonal variations in contaminant concentrations. Conclusions about groundwater quality should be based on periodic monitoring that has been completed over the course of at least one year.

Given the presence of dieldrin, arsenic and radioactivity in groundwater at or in close proximity to acceptable drinking water standards groundwater monitoring should be performed regularly. The proposed groundwater basin water quality modeling, and monitoring results can be used to ensure that groundwater from different wells is blended in a manner that will ensure these water quality standards are met.

Improved sanitation services in groundwater basin

Two of the wells sampled during the study were apparently

impacted by human wastes. An improvement in sanitation services in the groundwater basin is an necessity if the groundwater is to be successfully restored and protected from bacterial contamination.

3.0 SOIL BASELINE STUDY

The soil investigation included the collection of 30 shallow (less than two meters deep) soil samples from 14 sites. These sites included nine priority sites, three secondary sites and two PCB sites. Each site was first screened using test pits. Field screening for volatile organic compounds, and observations made in test pits were used to determine sampling locations. Targeted analysis was performed on soil samples. Depending on the potential contaminants at a site analysis for herbicides, metals, PAHs, PCBs, pesticides, VOCs, and total petroleum hydrocarbons (TPH) was performed. Results of soil sampling were compare the RBCs developed by US EPA Region III.

3.1 Overall Comments on Soil Baseline Study Methodology

Shallow soils were the target of Weston Report.

The soil baseline study did not adequately evaluate potential sources of groundwater contamination. The Weston Report only sampled soils within two meters of the ground surface. These sample depths are not sufficient to evaluate potential sources of contamination such as underground storage tanks and fuel piping, which are generally buried at greater depths.

Field screening ineffective.

High levels of petroleum hydrocarbons, pesticides and metals were found in soil samples from Malacat Landfill (MLF) that were analyzed by an analytical laboratory. The field screening results however were negative. The limitations of the field screening process should be recognized in reviewing the reported conditions at each of the sites.

VOC sampling not representative.

The results of VOC analysis can not be seen as representative of site conditions because of the shallow depths of VOC samples and the failure to collect "undisturbed" soil samples. At shallow depths

evaporation of volatile contaminants to the atmosphere is expected to occur, thereby yielding analytical results that are not indicative of the actual contamination that may be present. Samples collected from less than one meter below ground surface are therefore not expected to yield reliable results for volatile organic analysis.

Current US EPA methods for collection of soil samples for VOC analysis call for sample collection in intact cores (SW-846 method 5035). These practices were not followed during the Weston Report. VOC losses, which are often orders of magnitude, have been observed in improperly collected and preserved samples. Decisions on the magnitude or absence of contamination can therefore not be made using the soil VOC data collected.

Quality Control problems invalidate some of the study results.

Long periods of time passed between sample collection and the receipt of samples by the analytical laboratory. These delays often caused sample holding times to be exceeded invalidating sample results. These three week periods between collection and lab receipt also raise questions about the chain of custody, and the proper preservation of samples at 4 degrees centigrade.

CEE, CBL, DRMO, MLF sample holding times were exceeded for all analysis except metals (180 day holding time). CC, PAX, PP, JETC, FSR, MP sample holding times were exceeded for BTEX analysis. FTA sample holding times were exceeded for dioxin and all other analyses except metals. WWTP sample holding times were exceeded for pesticide and PCB analysis.

Results need to be confirmed with follow-up soil and groundwater sampling.

A stated objective of the Weston Report sampling plan was to collect soil samples that represented the maximum contaminant level at each site. Given the level of sampling that was performed, one to four shallow soil samples per site, an adequate dataset has not been developed to statistically evaluate whether this sampling objective was met.

The comparison of a few sample result from each site to risked base cleanup criteria for soils may therefore result in decision errors. Sites that pose a risk maybe recommended for no further action. Any detection of contaminants above background

concentrations should be considered significant, and follow-up soil and groundwater sampling should be performed to verify the representativeness of existing sample results.

Test pitting was impractical; Groundwater investigations recommended at several sites.

The Weston Report indicates: "concern that the large area of the DRMO could not be adequately characterized using a test pit approach." The Weston Report also concluded that it was impractical to attempt to characterized the CC site using test pits because of thick concrete surface at the site. The test pits and soil sampling at the JETC site failed to detected any evidence of soil contamination but groundwater sampling was recommended by the Weston Report to confirm these results. In retrospect the soil baseline study was not adequately designed, and soil sampling should have been performed at greater depths the two-foot maximum sample depth used in the study.

3.2 Comments on Conclusions of Soil Baseline Study

Combined risk from multiple contaminants not considered.

Soil samples from the FSR site showed the presence of acenaphthene, fluorene, naphthalene, benzene, chlorobenzene, cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene, toluene, xylenes, and high levels of TPH. The Weston Report indicates that no contaminant exceeded a safe risk levels set by the industrial RBCs. The Weston Report did not evaluate the collective risk from all contaminants detected at the FSR site.

Unanticipated results.

The Weston Report indicates that "it is unclear why numerous pesticides at such significant levels are at the Philippine Area Exchange Motor Pool (PAX)." The Soil Baseline Study included nine priority sites and three secondary sites. The PAX, one of the secondary sites, appears to contain one of the most significant human health and environmental problems and in hindsight should have been recognized as a priority site. The site selection and prioritization process should be revisited to determine if other sites with significant problems may have also been overlooked.

No further action is a premature conclusion.

A composite of two samples collected from the WWTP evaporation ponds were analyzed for metals and pesticides. No elevated levels were found in the composite sample and no further action has been recommended for the WWTP site. Before the dried sludge in the evaporation ponds are removed, further characterization sampling should be performed to verify the

representativeness of the previous two samples. **Baseline study impacted by ongoing pollution.**

The Weston Report may not provide an accurate picture of the baseline environmental conditions at Clark Field following the US Air Force's departure. The Weston Report indicates that an ongoing leak from an underground diesel storage tank is suspected at the MP site and that "work practices observed at the currently operating Power Plant (PP) continue to adversely affect the environment." Future environmental studies will be complicated by trying to distinguish contamination caused by the Clark Development Corporation, and pre-existing Air Force contamination.

3.3 Comments on Recommendations of Soil Baseline Study

The principle recommendation of the Soil Baseline Study was to perform shallow groundwater sampling at 10 sites. In addition to further investigation of groundwater the following recommendations should also be implemented. **Digging restriction is appropriate for other sites.**

The Weston Report recommended a prohibition of digging at MLF due to soil contamination. Similar recommendations were not made for other soil contamination sites where this restriction is appropriate. High levels of pesticides, petroleum hydrocarbons, arsenic, mercury, and VOCs are found in soil samples from the CEE site. High levels of pesticides, petroleum hydrocarbons, and lead are found in soil samples from the CBL site. Until the extent and magnitude of the contamination is determined at these sites they should be fenced and posted with warning signs.

Corrective Action at Spill Sites

Spills at a number of sites were confirmed during the soil baseline survey. These and other potential sources of groundwater

contaminants be identified and removed.

Corrective Action at Landfill Sites

The boundaries of landfill sites that received military wastes should be identified. Engineered caps, drainage systems and leachate monitoring and control systems should be installed at each identified landfill cell.

Future sampling should expand scope of pesticide analysis.

Future sampling of the CEE sites should include organophosphate pesticides and carbamate pesticide analyses, in addition to organochlorine pesticide analysis performed during the baseline study.

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June 1, 1999