

PRELIMINARY ASSESSMENT OF "SUPERFUND" REMEDIAL INVESTIGATION/
FEASIBILITY STUDY ACTIVITIES COMPLETED AND PROJECTED AND
ADEQUACY OF REMEDIATION PROGRAM FOR CLEAN-UP OF CHEMICAL
CONTAMINATION AT SPTC SACRAMENTO RAILYARD SITE

TECHNICAL REPORT

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EXECUTIVE SUMMARY

Overall Assessment

From an overall point of view, the re-development of the Southern Pacific Transportation Company (SPTC) property represents a valuable opportunity for additional development of downtown Sacramento and the region. However, because of the unique type of re-development of this state "superfund" site, the degree and type of site investigation, remediation, and future monitoring that will be necessary at the SPTC site should go beyond that typically provided at state and federal "superfund" sites. The current degree of contamination of that site by chemicals used by SPTC as part of its railyard operation or present at the site will require extensive remediation. While there are important issues that remain unresolved at this time associated with the completed or planned remediation, those issues, and likely others that could develop in the future, can be addressed with the technology available today to produce re-developed properties that would represent minimal risks to the public who would use the area. In order to assure that this is achieved, the City of Sacramento needs to exercise a highly active, technically competent, adequately funded, independent, third party review of the site investigation, remediation, and re-development.

In the discussion presented in this report, references are made to discussions between the authors and Department of Health Services (DHS) personnel on various issues pertinent to the SPTC site investigation and remediation. It is important to understand that the accounts of these discussions represent the understanding of the authors to the responses of DHS personnel to questions posed by the authors that have pertinence to the SPTC site investigation and remediation. The authors feel that the discussions presented below represent the views of the individuals with whom they discussed these matters but do not represent the official views of DHS. The DHS policy on a particular item will be established at the time that the item is formally reviewed by DHS. The results of the formal review could be significantly different from that indicated in this discussion.

Specific Areas of Concern

Lead-contaminated Soils

There is substantial chemical contamination of soils and groundwaters at the (SPTC) Sacramento Railyard site (the site). One of the contaminants of primary concern in the soils is lead. (While the discussions in this report focus on lead, similar situations could develop for a wide variety of other contaminants present at the site.) The DHS has established two different lead remediation-"clean-up" levels for the site soils depending on the re-development plans' anticipated uses of the land. For those areas that will be restricted to commercial or industrial uses, DHS will allow SPTC to leave soils that contain 950 mg lead/kg provided that a deed restriction is placed on the property that prohibits the use of the property in any

way that can result in the public's, especially children's, being exposed to ground surface that contains lead in concentrations greater than 174 mg/kg. If the area is to be used for residential purposes, DHS has thus far required that the lead concentration in the soils be less than 174 mg/kg. That stricter requirement is designed to protect children, who may eat the soil, from developing excessive blood levels of lead, which could cause them injury. DHS is requiring that all soils that contain lead in concentrations above 950 mg/kg be remediated. Thus far, SPTC is choosing to transport all soils having lead concentrations greater than 950 mg/kg off the site to a hazardous waste disposal facility. They have indicated, however, that this may not be the approach that they follow in the future.

Part of the site's lead contamination (Battery Shop Yard area) has already been remediated for future commercial/industrial uses, and the remediation has been approved by DHS. The remediation approved by DHS for the area involved placement of 2 ft of soil that contained less than 174 mg/kg lead on top of soils that could contain up to 950 mg/kg lead. The placement of 2 ft of low-lead soil was specified for the purpose of minimizing the transport of soils with elevated concentrations of lead over the property by wind or other means. DHS's approval also contains a deed restriction that requires that the owner of the property contact DHS and obtain approval before any excavation or other activities are begun that could result in the public's being exposed to soils that contain lead above 174 mg/kg. The deed restriction states:

"No use of the Property shall be allowed to disturb the integrity of the overlying clean fill material, unless it can be adequately demonstrated to the Department [DHS]: (1) that the disturbance is necessary to the present or proposed use of the Property and can be accomplished in a manner that will not materially increase any potential hazard to the public health and safety or the environment, or (2) that such disturbance is necessary to reduce an imminent threat to the public health and safety or the environment."

Sections of that deed restriction, however, can be interpreted to mean that the 2 ft of so-called clean fill (containing less than 174 mg/kg lead) above soils that contain up to 950 mg/kg lead would be acceptable to DHS for public contact with the soil surface. The DHS personnel with whom this matter was discussed, however, indicated that they did not feel that that was what was intended with the deed restriction, and stated, as indicated above, that the soils with which the public would have contact should contain no more than 174 mg/kg lead.

There are appropriate concerns about having two different remediation-"clean-up" levels that will allow substantial parts of the lead contamination at the site to be only partially "cleaned up," i.e., to 950 mg/kg lead. Concerns evolve out of the potential for children to come in contact with lead-containing surface soils in the industrial and commercial areas where there is a relatively thin veneer of 2 ft of low-lead soils over soils containing elevated lead concentrations. Further, there are appropriate questions about the ability of the deed restrictions and the ability of the City of Sacramento to properly administer a deed restriction that would prevent, in perpetuity, excavation or other activities that could cause surface soil contamination by soils

containing lead at concentrations greater than 174 mg/kg.

It has been found that thus far, apparently no consideration has been given by SPTC and DHS to the potential for plant roots to transport lead from depths below 2 ft to the surface to the plants' leaves and/or fruit. This topic needs attention as part of the evaluation of the hazards that the 2-ft low-lead soil veneer placed above soils with elevated concentrations of lead represents to children who could at some time in the future eat leaves or fruit and be exposed to its elevated lead via translocation of lead located more than 2 ft below the surface to the surface by trees, shrubbery, and other plants. The applicability of the 174 mg/kg lead remediation level to such translocation of contaminants is not known and needs to be evaluated.

A basic issue that needs to be resolved is whether the current DHS representatives' views (that it is not adequate for public health protection to have public contact in areas in which a few feet of "clean" soil have been placed above soils that contain elevated concentrations of lead compared to those that have been determined by DHS to be safe for public contact) will be supported in the future policy followed by DHS. Since that understanding is not a written policy, it is possible that the City of Sacramento representatives, as part of implementing the deed restriction, could at some time in the future allow a situation to develop where children could come in contact with elevated concentrations of lead on the re-developed SPTC property.

The City of Sacramento should have concern about this situation since through its responsibility in administering the deed restriction it could inadvertently approve activities in the area where children could be exposed to excessive concentrations of lead. While the City will be able to develop certain types of safeguards that would minimize the potential for improper land-use that could result in the transport of higher levels of lead to the surface in residential areas or exposure of children to elevated concentrations of lead in commercial and industrial areas than what DHS has determined to be a safe concentration of lead in soils with which children may come in contact for extended periods of time, it is unlikely that protection can be afforded for all readily plausible scenarios. For example, children in residential areas could go across the street to a industrial/commercial area and play in an area where 950 mg/kg lead soils has been exposed. The City should carefully evaluate its responsibility for long-term protection of children from excessive exposure to lead associated with the re-developed SPTC Railyard property.

The concentrations of lead in soils that are safe for children to be exposed to are not well-known. This is a result of the fact that lead exists in different chemical forms that are each taken up by the body in differing degrees. The lead in soil at the SPTC site would be expected to be in several forms. It also should be noted that future studies may show that the 174 mg/kg lead level does not adequately protect children from exposure to excessive amounts of certain forms of lead in soil. Further, future studies may show that 174 mg/kg lead is overprotective and that a higher concentration of lead may be allowed without significantly

endangering children to excessive lead exposure.

Because of the potential public health hazards associated with the elevated concentrations of lead left at the site and the concerns that the City should have about activities in open-space areas as well as in commercial/industrial and residential areas, it is appropriate for the City to consider requiring remediation of all soils that contain lead above 174 mg/kg in areas where the public could gain access or where vegetation could translocate lead to the surface, independent of the overall use of the area.

Groundwater Contamination

There is significant groundwater pollution caused by former activities at the SPTC site. The principal chemicals of concern are low-molecular-weight chlorinated solvents, such as trichloroethylene, and their transformation products, such as vinyl chloride. Those chemicals are suspected or known human carcinogens that may cause cancer over long periods of exposure at concentrations of a few ug/L. The full extent and degree of groundwater pollution associated with the site is not known at this time. Additional studies will be necessary to determine the extent and degree of groundwater contamination both on- and off-site caused by former SPTC Railyard activities and thereby provide a framework for groundwater remediation. While the degree and extent of the contaminated groundwater remediation is not known at this time, this remediation will require many years of groundwater extraction by pumping and treating. If properly executed, that treatment can be accomplished without adverse impacts on public health or the environment. Also, if properly executed, that treatment could be conducted concurrent with SPTC re-development and construction activities.

It has been found that inadequate attention has been given in the SPTC Railyard site investigations to the gas-phase transport of hazardous chemicals from the polluted groundwater plume to and through the overlying geological strata and soils. That transport is of concern because of the potential for accumulation of those chemicals in areas of restricted air circulation, such as in basements of commercial establishments and homes. It is recommended that a detailed soil gas study be conducted to determine whether that mode of contaminant transport is a potential concern over the existing groundwater contamination plumes, both under the SPTC site and on nearby properties.

Because of the potential for currently unknown contaminants and sources of contaminants at the site, prudent public health practice would indicate that "perpetual" monitoring of the area groundwater and soil gas will be in order.

Stormwater Management

At this time it appears that insufficient attention has been given to the potential impacts of the

management of stormwater and domestic wastewater on the re-development of the property. In addition to questions about the potential of those waters to be contaminated by residual contaminants at the site, there are questions about the possible curtailment of development at the site until the City of Sacramento solves its combined sewer overflow problems. Solution of those problems for the SPTC property re-development may require that treatment facilities be constructed to handle stormwater and domestic wastewater derived from the site.

Use of Central Shops Area Buildings

Attention needs to be given to the potential contamination of the Central Shops area structures that are to remain on the site. Contamination of those structures could be sufficient to impact re-use of the buildings.

Asbestos

The presence of asbestos in buildings and possibly buried at the site is of concern. SPTC has developed a program to manage the asbestos associated with buildings and other structures. DHS has indicated that it will likely require asbestos monitoring during construction at the site.

Air Quality

There are a number of air quality issues associated with re-development of the site. While the control programs that will be followed for many of those areas have not yet been defined, DHS personnel have indicated that they have already exercised control to minimize air quality problems associated with a number of those areas and plan to require that SPTC follow approaches to control excessive contaminant releases to the air as part of site re-development. Because of the long-term nature of some of the potential sources of contaminants, air quality monitoring and associated appropriate risk assessment should be practiced at the site for as long as sources represent a threat to air quality.

Investigation of Site for Unknown Hazards

While extensive studies have been conducted at the site to investigate the degree of contamination and its potential public health and environmental significance, many studies are still under way and as scheduled now will not be completed until 1992. At this time the study program has not adequately defined the full extent, degree, and type of contamination at the site. It is likely that studies beyond those currently planned will have to be undertaken in order to conduct a more comprehensive search for sources of contaminants at the site that are not now known.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
TABLE OF CONTENTS	vi
INTRODUCTION.....	1
QUALIFICATIONS	2
INITIAL FINDINGS	3
RELATIONSHIP BETWEEN PRESENCE OF CONTAMINATION AND RE-DEVELOPMENT	3
Adequacy of State "Superfund" Remediations	4
GROUNDWATER POLLUTION	5
Extent of VOC Pollution	5
Implications of VOC Pollution	6
Vapor-Phase VOC's	8
Remediation of VOC's.....	10
Existing Natural Contamination.....	11
Construction De-Watering and Other Activities	11
Sulfate Contamination.....	12
Additional Sampling	13
Pond and Ditch Area Plume.....	13
Groundwater Monitoring.....	14
LEAD-CONTAMINATED SOIL REMEDIATION.....	14
Translocation.....	18
City Interests and Costs of Additional Remediation.....	19
HAZARD EVALUATION FOR CENTRAL SHOPS.....	20
MANAGEMENT OF STORMWATER AND DOMESTIC WASTEWATER	20
WATER FEATURES	22
ASBESTOS	23

ADEQUACY OF SPTC SITE HAZARD EVALUATION	24
AIR QUALITY	26
OVERSIGHT OF INVESTIGATION, REMEDIATION AND CONSTRUCTION	26
CONCLUSION	26
ACKNOWLEDGEMENT	26
LIST OF ABBREVIATIONS	27

Attachment A - Biographical Information

Attachment B - Information Collection

Attachment C - Southern Pacific Railroad Yard

Attachment D - Southern Pacific Railyards Site: Planning Process/Environmental Clean-Up Schedule [Not included in this copy]

Attachment E - Enforceable Agreement - page 1 [Not included in this copy]

Attachment F - Covenant and Agreement to Restrict Use of Property (Battery Shop Yard at the Southern Pacific Transportation Company, Sacramento Locomotive Works) [Not included in this copy]

Attachment G - October 18, 1989 Memorandum from Toxic Substances Control Program [Not included in this copy]

Attachment H - Inadequacies of State "superfund" Program

INTRODUCTION

Since the mid-1800's the Southern Pacific Transportation Company (SPTC) has conducted a variety of locomotive maintenance and repair operations at its Sacramento Railyard (the site). In recent years SPTC has significantly reduced its industrial locomotive yard activities at the site and has indicated that it plans to terminate all of the industrial activities at the site by the mid-1990's. SPTC is interested in selling the site property; its proximity to downtown Sacramento and its location on the Sacramento riverfront make it a desirable site for re-development. In the early-1980's, however, it was found that some areas of the Sacramento Railyard site were contaminated with a number of potentially hazardous chemicals. This site is now part of the California Bond Expenditure Plan Requirements. It is not a federal Superfund site. For the purposes of this report, it shall be considered as a state "superfund" site. Any re-development of the site, therefore, will require that the existing chemical contamination be appropriately cleaned up to ensure that future users of the area, and the environment, will not be adversely affected by residual chemical contamination at the site or at off-site locations to which contaminants from the site have migrated. In June 1988, SPTC signed an enforceable agreement with the California Department of Health Services (DHS) covering the remediation of hazardous chemical contamination at the site. SPTC is now in the process of investigating and remediation chemical contamination resulting from past industrial operations, under the supervision of the DHS and the Central Valley Regional Water Quality Control Board (CVRWQCB). While this site is not a federal Superfund site, the US EPA under its RCRA authority does exercise some control over the adequacy of remediation of some parts of the site where after those parts have been remediation to DHS specifications, the US EPA Region IX reviews and if appropriate approves the remediation. For the purposes of this report, the adequacy of site remediation will be based on review of DHS requirements and their implementation.

On July 19, 1990, the Department of Planning and Development of the City of Sacramento (the department) issued a contract for Drs. G. Fred Lee and R. Anne Jones of G. Fred Lee & Associates to act as independent technical advisors to the City of Sacramento on the remediation of the SPTC Sacramento Railyard site. Specifically, they were asked to critically review and comment on the information available on the current degree of contamination, the adequacy of the Remedial Investigation/Feasibility Studies (RI/FS) being conducted and planned to define contamination and its hazards to public health and the environment, the past and proposed approaches for remediation of the contamination, and the compatibility of proposed plans for re-development with the residual contamination that will exist after remediation of the site to the degree accomplished and proposed. This contract was not restricted to determining whether SPTC had conformed to existing regulatory agency requirements for site investigation and remediation. It specifically delineated evaluation of the adequacy of investigation and remediation to provide for public health and

environmental protection associated with re-development of the site.

The contract is administered by the Environmental Services Division of the Department of Planning and Development; G. Tholen is the Project Manager and Holly Keeler is the Project Coordinator for the City of Sacramento.

The contract calls for G. Fred Lee & Associates to make a presentation of initial findings to the City of Sacramento early in the contract period. This document summarizes the technical aspects of the initial findings made by Drs. Lee and Jones in the project areas noted above, and supports the contract report to the City that the authors have developed covering their findings. A presentation of these findings will be made to the Sacramento Environmental Commission currently scheduled for October 22, 1990.

Because of significant funding and time constraints, this report is an overview technical report and does not represent an in-depth investigation of the reliability and accuracy of the materials that SPTC's contractors have submitted to DHS covering various aspects of the studies and remediations that have been conducted thus far. Insufficient funds were available to conduct independent, third party sampling and analysis and site visits during times when SPTC representatives were collecting samples and conducting remediation operations. This type of sampling and observations is needed to properly evaluate the adequacy and reliability of the statements made by SPTC representatives in their reports to DHS. However, the time constraints and especially the limited funding available precluded this type of review of the SPTC site investigation and remediation. This review is limited because of funding constraints to documents made available to the authors through early September 1990.

QUALIFICATIONS

Drs. G. Fred Lee and R. Anne Jones have extensive experience in determining the sources of chemical contaminants, evaluating their environmental-water quality and public health significance, and the development and application of appropriate treatment technologies for chemical contaminants in aquatic and terrestrial systems. They also have extensive experience in Superfund site investigations, risk assessment, and remediation, and in the evaluation and management of chemical contaminants associated with development and re-development of property. A summary of their expertise and experience pertinent to this project is included in Attachment A.

This report is composed of the discussion of a series of topics pertinent to public health and

environmental hazards and concerns associated with the site, points of concern raised by members of the public and others about the adequacy of the site investigations, proposed remediation programs, DHS supervision of the site investigations and remediation, impact of residual hazardous chemicals left at the site after remediation, and areas of concern to the authors in those and other related topic areas that have arisen from their review of existing information. Rather than espousing a particular position on the actions that should be taken pursuant to any of the issues raised, the purpose of this report is to provide technical information out of the authors' technical experience and expertise to the City to enhance its understanding of the situation and potential ramifications of adoption of policy regarding characterization and remediation of hazardous chemicals associated with the site and re-development of the site. The sources of information used by the authors on the site, its characteristics and remediation, and potential impacts of chemical contamination and remediation on re-development are discussed in Attachment B.

INITIAL FINDINGS

Presented below is a summary and discussion of initial findings on the existing contamination at the site, its remediation, and impacts of the contamination and remediation on re-development of the SPTC site. Figure 1 shows the layout of the SPTC site and areas of contamination known as of January 1990.

RELATIONSHIP BETWEEN PRESENCE OF CONTAMINATION AND RE-DEVELOPMENT

Some of the soils and groundwater at the SPTC site are contaminated with a variety of hazardous chemicals (including heavy metals especially lead, chlorinated solvents and their transformation products especially vinyl chloride, diesel fuel-derived petroleum hydrocarbons, and polynuclear aromatics). Those areas of the site that are contaminated must be remediated before their re-development.

Attachment C presents the layout of the SPTC site showing areas of contamination known as of January 1990. It also includes some descriptive information about the various areas of the site. At this time, the full degree and extent of contamination of soil and groundwater associated with the site is not known. As shown in Attachments C and D, a phased investigation of the characteristics of the contamination at the site is being conducted by SPTC. As a result, the remediation programs for some areas of the site will not be defined for several years to come. That situation has important implications for the phasing of the re-development of the site. The current planning of property re-development by the ROMA Design Group seems to generally consider the phased site investigation and remediation currently envisioned.

Some members of the public are concerned that SPTC will not remediate contamination in all areas

of the site. It is clear from the documentation available (see Attachment E) that SPTC will be required to conduct remediation activities in contaminated areas of the site under the direction of DHS. However, it will not be required to remediate chemical contamination at the site to levels that would be considered safe for all potential uses of the site. The degree of remediation actually accomplished will control the future uses of various parts of the site; the degree of remediation that will be undertaken at much of the site has not yet been defined.

There are several aspects of the degree of remediation that will be judged to be adequate for re-development for certain uses in keeping with current federal and/or state "superfund" remediation guidelines that are of concern to the authors. The highest degree of lead remediation required by DHS, for example, is that for single-family residential development, open-space, and other areas to which the public would have access to the soil. If an area of the site is not remediated to the degree needed for the development of such uses, DHS staff currently involved in the project intend that deed restrictions be established for the area that preclude future use of any part of that area of the site for public contact at the surface without further remediation of that part.

The effectiveness of deed restrictions can and should be questioned in providing for public health, environmental protection, and the City's interests. While properly written and implemented deed restrictions could be an effective management approach for some areas for the initial re-development (e.g., for a few tens of years), the effectiveness of even properly written deed restrictions for providing long-term protection of public health and environmental quality (e.g., 50 to 100 or more years hence) is a matter for conjecture. A specific example of this concern is provided by the recently completed Battery Shop Yard area remediation discussed below.

Adequacy State "Superfund" Remediation

The DHS supervision of the site characterization and remediation is following traditional federal and state "Superfund" guidelines that are typically used at similar sites across the US. While the overall philosophy of characterization and remediation embodied in the guidelines is normally appropriate for protection of the public from uncontrolled releases of hazardous chemicals from the site to adjacent properties, the specific aspects of implementation of the guidelines, if followed by the study and review groups, can be inadequate to provide protection of public health and environmental quality for on-site land uses associated with re-developed properties.

From an overall point of view based on Lee's discussions with DHS staff, the authors have found that DHS's actions and overall approaches will in general provide for typical Superfund site remediation. However, important questions remain regarding the levels of remediation that are sufficient for long-term protection of public health and environmental quality in the various areas of the site especially when

considered in light of proposed re-development plans.

It is apparent to the authors that at this time insufficient attention has been given in the design of the remediation and site re-development to the long-term public health implications of the remediation practices allowed and the possible ranges of activities that could take place in specific areas of the site. It has been the experience of the authors that even after they have been remediated in accord with typical Superfund guidelines, Superfund sites are not considered suitable for intense re-development involving public contact. It is important to understand that Superfund guidelines at the federal and state level were primarily developed to protect the public from uncontrolled releases of hazardous chemicals from industrial properties that could be a threat to public health, the environment and to users of adjacent properties. In order to bring large numbers of people into close proximity to residual hazardous chemicals left at a Superfund site after remediation, it would likely be necessary to go beyond conventional Superfund guidelines for remediation in order to adequately protect the public. The authors have found that at this time there are significant differences in approaches on the degree of remediation and efficacy of deed restrictions that will be sufficient for public health and environmental protection for certain uses of contaminated areas of the site between SPTC representatives and DHS staff currently involved in the project. SPTC representatives are pursuing minimizing costs of site remediation, while DHS representatives are using best professional judgement on the degree of remediation necessary to provide for public health and environmental protection for certain types of generic land uses. The re-development of Superfund sites for intense public contact, such as that proposed for the SP site, is an area in which there are significant gaps in information and a lack of experience on appropriate approaches to be followed. It is basically an uncharted area of activity in which the City should proceed very cautiously. Additional discussions of the deficiencies of the federal and state "superfund" programs were developed for and are provided in the authors' project report to the City. A copy of that section is provided in this report as Attachment H.

GROUNDWATER POLLUTION

There is extensive groundwater pollution by chlorinated solvents and their transformation products (e.g., vinyl chloride) from several different sources at the SPTC site. That pollution will require extensive, long-term remediation. If not cleaned up, the groundwater pollution plume of vinyl chloride represents a threat to down gradient groundwater domestic supplies that could be developed in the future. It also represents an as-yet undefined threat to public health through gas-phase migration of VOC's (volatile organic compounds) from the groundwater pollution plume to basements in the areas overlying the plume. The potential migration of gas-phase VOC's needs further attention and evaluation as part of the site RI/FS and risk assessments.

Extent of VOC Pollution

The studies that have been conducted thus far by SPTC and its contractors have shown that there is

extensive pollution of groundwaters under the railyard site and off-site to the south and southeast of the Central Shops area, down to approximately O Street between 3rd and 8th Streets. Figure 2 shows Woodward-Clyde's estimate of the position of the VOC's plume emanating from the Central Shops area in the area groundwater. It is not clear to us that the groundwater pollution investigation has been conducted in such a way that would detect vinyl chloride at levels less than the state MCL. It is possible that the contour lines in the Woodward-Clyde map of the pollution plume does not represent the full extent of the contamination of off-site groundwater by SPTC-derived chemicals of concern to public health. More appropriate chemical, analytical methods need to be used by SPTC in their groundwater quality investigations to more adequately define the full extent and degree of contamination of groundwaters that has occurred at the SPTC site and under other properties.

One of the principal components of the groundwater contamination plume emanating from the Central Shops area that is of concern is vinyl chloride. Vinyl chloride is a known human carcinogen with the lowest MCL's of all of the VOC's established by the US EPA and the DHS. Vinyl chloride was not likely used at the SPTC site. However, it is likely that it was formed in the groundwater as a result of chemical and biochemical transformations of several of the chlorinated solvents, such as TCE, that were used by SPTC for degreasing purposes. Those solvents, which are low-molecular-weight chlorinated hydrocarbons, are converted in anoxic (oxygen-free) groundwater to less-chlorinated species, some of which can be transformed to vinyl chloride.

Implications of VOC Pollution

From an August 1990 report by Woodward-Clyde it appears that the vinyl chloride, and for that matter, some of the parent (unreacted) chlorinated solvents, and other transformation products have their highest concentrations in the Central Shops area of the site. Some measurements of vinyl chloride in that area exceeded 100 ug/L; concentrations of some of the other transformation products of chlorinated solvents exceeded thousands of ug/L in that area. The US EPA's MCL for vinyl chloride is 2 ug/L (ppb); the state of California's MCL for vinyl chloride is 0.5 ug/L. At 2 ug/L it is expected that one individual in 100,000 who drinks 2 liters of water per day for his or her 70-year lifetime would develop cancer from vinyl chloride in the drinking water. At 0.5 ug/L the upper-bound cancer risk for vinyl chloride in drinking water is about one additional cancer in a million people consuming 2 liters of water per day for 70 years.

There is considerable controversy and inconsistency today regarding what is considered to be an "acceptable" cancer risk associated with exposure to chemicals in drinking water, food, and the environment. For trihalomethanes (THM's) in drinking water which are widespread contaminants in municipal water supplies across the US, the US EPA allows a cancer risk of one additional cancer in 10,000 people who consume 2 liters of water per day over 70 years. THM's are low-molecular-weight chlorinated chemicals

similar to, but not the same as, the chlorinated solvents formerly used by SPTC. It is generally agreed that that cancer risk is excessive, and the US EPA is in the process of lowering the MCL for THM's as part of its development of new THM drinking water standards.

The US EPA has established one additional cancer in 100,000 people as an acceptable risk for exposure through drinking water to chlorinated solvents and similar compounds including vinyl chloride that are all part of the group of compounds called VOC's. The state of California Department of Health Services has established one additional cancer in one million people exposed to VOC's in drinking water over 70 years as an acceptable risk. Many states have adopted that lower cancer risk for carcinogens in drinking water derived from industrial sources, which typically only affect a few people in the state. Yet at the same time they allow the majority of the population in the state to be exposed to very similar chemicals in their drinking water at levels associated with cancer risks 100 times that level. It is clear that there is considerable inconsistency in federal and state regulatory agency policies with respect to the acceptability of cancer risks associated with exposure to chemical contaminants in domestic water supplies. This situation leads to controversy in the field about the appropriateness of cleaning up groundwaters contaminated by chlorinated solvents of the type formerly used by SPTC to degrees of cancer risk far less than what the public typically accepts in their domestic water supplies.

Since there are no known uses of the SPTC Railyard area groundwater today for domestic supply purposes, and since at least near the site it is highly unlikely that domestic water supply wells would be constructed, there is little immediate hazard to domestic water supply water quality associated with the groundwater pollution plume of VOC's from the Central Shops area. The US EPA, DHS, and the Regional Water Quality Control Board will likely require SPTC to clean up the contaminated groundwaters by reducing the VOC's and other known, potentially hazardous chemicals to some yet-undefined level. Based on discussions with DHS personnel, the clean-up levels will likely be the state MCL's.

If such clean-up is not done, the groundwater pollution plume could continue to move down the groundwater gradient to the south and southeast, polluting even more waters under nearby property-owners' lands. At some time in the future, the groundwater resources to the south and southeast could become an important domestic water resource for the City or others. If sufficient groundwater clean-up is not conducted, that water resource could be further impaired by SPTC-derived hazardous chemicals. There is evidence for biological and chemical transformation of those chemicals and there is some dilution of the SPTC-derived contaminants in the groundwater system. Those processes could tend to limit the amount of additional groundwater pollution that would occur. At this time, insufficient information is available to determine how much further the groundwater pollution plume would spread if no remediation took place. However, it has

already spread well-beyond the SPTC property. It has been typically determined for Superfund sites across the country that a source such as SPTC should clean up the groundwater pollution resulting from its activities so that it does not adversely impact the ability of other property owners to use the waters associated with their properties. Based on the authors' discussion with DHS personnel, this appears to be DHS's policy. DHS policy, however, will be established when DHS approves the groundwater remediation plan for the Central Shops area that SPTC plans to submit in early November 1990.

There is a significant potential for using groundwaters under the SPTC site for industrial or commercial cooling purposes. This is already being done down-gradient from the groundwater pollution plume arising from the Central Shops area. Especially near the Central Shops area, where the concentrations of carcinogenic chlorinated chemicals are high in the groundwater, use of groundwaters for cooling or other industrial purposes could lead to exposure of individuals to elevated concentrations of these chemicals. It is suggested that a mechanism needs to be developed so that any permit for groundwater extraction by future property owners at the SPTC site that could be issued by a regulatory agency would require that a risk assessment be conducted to determine what, if any, hazards would exist to public health and the environment associated with the use of the waters for the proposed purposes. This would likely require some additional groundwater monitoring and other studies in order to define the conditions that exist at the time of permit review. It may also require a "deed restriction" that would preclude any extraction of groundwater unless the proper evaluation of the potential public health and environmental impacts has been made by the applicant. It will be important for the regulatory authorities to establish a procedure whereby any person conducting a review of a proposed groundwater extraction project would readily find in the files for the property, at any time in the future, the requirement that the above-mentioned studies should be made before a permit is issued.

Even after clean-up, there will be need to monitor the groundwaters essentially forever to ensure that other now-unknown sources of contaminants, such as buried containers of solvents, do not become important contaminants in the groundwater system at some time in the future. In a "superfund" site with as complex a history of activities as have been undertaken over the years at the SPTC site, it is possible that at some time in the past, containers of chlorinated solvent or other similar chemicals were buried on the site, which have not yet rusted out. It is very important to point out that the authors have found no evidence of buried containers of solvents or other chemicals at the SPTC site. However, as discussed elsewhere in this report, the degree of investigation that has been conducted thus far by SPTC is not adequate to rule out the possibility of further studies finding such containers. If they are present, when they do rust out, the solvent could contaminate groundwaters. A single 55-gallon container of TCE can pollute hundreds of millions of gallons of groundwater to levels above the drinking water MCL. Therefore, there will be need for very long-

term, careful monitoring of the groundwaters at the site.

Vapor-Phase VOC's

Review of the investigations that have been done on the groundwater pollution plume of VOC's from the SPTC site has shown that the potential for vapor-phase migration of VOC's from the groundwater pollution plume into and through the air space in the aquifer above the water table (unsaturated zone) has not been adequately considered or investigated. It is well-known that those chemicals, especially vinyl chloride, can readily move from contaminated groundwaters into the geological strata and soils above the groundwater table. There are some instances at Superfund sites where sufficient releases of chemicals of this type have occurred to represent significant hazards to individuals occupying structures, such as homes, above the groundwater contamination plumes. This is particularly important in basements of homes or other buildings that do not have good ventilation.

It is important to point out that while vinyl chloride and other VOC's readily migrate from a groundwater contamination plume through the air space of overlying soil, this does not mean that there will be problems in basements of homes or other buildings constructed above the groundwater pollution plume. There is a variety of physical barriers, such as layers of clay, and biochemical transformations that can occur in unsaturated groundwater systems to reduce or eliminate excessive concentrations of those chemicals in the surface layers of the soils. It is certainly prudent public health policy to conduct appropriate studies to determine whether there is any significant upward migration of the volatile contaminants in the groundwater plume that could represent a potential hazard to individuals utilizing basements or buildings above the plume, both on and off the SPTC site. A properly conducted risk assessment should also be part of the study to determine what worst-case potential hazards, if any, could exist for individuals in basements of buildings that overlie the contaminated groundwater plume.

It has been suggested by the authors that a fairly detailed soil gas analysis program be undertaken above the groundwater plume of VOC's, both on and off the SPTC site, to determine if there is a significant release and movement of the VOC's from the groundwater pollution plume upward through the unsaturated zone to near the surface of the soil where there would be a potential for basement accumulation of those carcinogenic gases. DHS representatives have indicated that they feel that such studies would be an appropriate study to undertake. SPTC representatives have indicated a willingness to undertake studies of this type. SPTC representatives pointed out, however, that they did do some soil gas analysis as part of their initial study several years ago and did not find problems of this type. Those studies, however, were done for a significantly different purpose than the studies suggested by the authors. They may not have been done with sufficient sensitivity and spacial and temporal intensity to adequately determine whether soil gas

migration from the groundwater contamination plume that exists on and off the SPTC site is a significant problem or not.

Should there be significant upward vapor-phase migration of vinyl chloride or other chemicals of concern within the area that will be re-developed, special precautions will have to be taken in constructing buildings above the groundwater plume to allow for proper ventilation of the areas to prevent hazardous chemical build-up in basements, etc. That technology is well-known and can be readily applied at the time of construction. It is not likely that vinyl chloride or other gases in the groundwater plume would represent a hazard to workers during construction or to individuals walking through or otherwise using the open areas after re-development. The amount of chemical released to the air in open-air situations will almost certainly be small compared to the amount of air dilution typically available. As the polluted groundwater plume is cleaned up, the potential problem of soil gas migration will eventually disappear.

It would be prudent public health policy to conduct monitoring of potentially hazardous gases in the basements of buildings that would be constructed at the site. As noted above, a currently unknown buried container of TCE could, when it rusts out, contaminate groundwaters and lead to the vapor-phase migration of VOC's that could contaminate the basements of certain buildings at some time in the future; soil gas analysis in those areas would not show excessive concentrations of those chemicals until the container for the chemical is breached.

Remediation of VOC's

While it is relatively easy to clean up high levels of chlorinated solvents, such as TCE, and their transformation products, such as vinyl chloride, by pumping the groundwater to the surface and air-stripping the pollutants from the water, it is becoming widely recognized that it is extremely difficult to clean up such contamination when the concentrations are at or near the federal MCL, much less the state MCL; this is especially true for vinyl chloride. It is highly likely that SPTC will be treating groundwaters from the pollution plume for many tens of years before satisfactory levels are achieved. Such treatment can be accomplished in such a way as to minimize adverse impacts on the public that could be caused by the release of the stripped chemicals to the atmosphere. In many parts of the US gas discharge from air-stripping devices is treated using vapor-phase activated carbon. SPTC should have to obtain appropriate local and state air pollution emission permits which should require an evaluation to be made of the potential public health impacts that could result from releases of chlorinated solvents and their transformation products to the atmosphere.

While SPTC has not yet submitted its proposed plan for remediation of the groundwater contamination plume emanating from the Central Shops area, from the discussion presented by M. Ransom

at the August 25 workshop, it appears that a series of extraction wells will be placed along the southern boundary of the SPTC site. The groundwaters would be pumped at a sufficient rate to prevent further off-site migration of chlorinated solvent-derived contaminants. The extracted waters would then be pumped to the northwest corner of the site where they would be stripped of the VOC's and then re-injected into the groundwater, discharged to the river, or discharged to the domestic wastewater treatment plant. Evidently SPTC has not yet proposed a preferred manner of disposal of the air-stripped waters. Those waters can be managed in such a way to prevent public health or environmental harm; SPTC will have to obtain appropriate permits for their management. No mention was made at the workshop, however, about the approach that would be followed for remediating the off-site groundwater pollution that has occurred. That would likely require extraction wells and air-stripping facilities in the area of the contamination plume.

Existing Natural Contamination

At the August 25, 1990 public meeting on the SPTC site re-development, it was stated that the groundwater in the area of the site was naturally of poor-quality because of the presence of iron and manganese in concentrations above drinking water standards. It is important to put that natural contamination of groundwater in perspective relative to the contamination by chlorinated solvents and their transformation products. Iron and manganese are common contaminants of groundwater; if not removed from a domestic water supply, they can cause aesthetic problems, such as staining of fixtures and clothes, and metallic tastes in the water. Those problems are not public health problems; neither iron nor manganese in domestic water supplies is considered to be toxic. Further, both of those chemicals are readily removed by conventional water treatment practices. The chlorinated solvents and their transformation products are of concern to public health at very low concentrations; some are known or suspected carcinogens. Further, at this time, while elevated concentrations of chlorinated solvents and known transformation products are easily removed from groundwater by air-stripping, there is no assurance that unknown transformation products are not formed in groundwater systems or that they could be removed by air-stripping. Some of those chemicals could be far-more hazardous than even vinyl chloride. There are chlorinated organics that have been found to be significant threats to domestic water supply water quality at concentrations on the order of 10,000-times less than the state MCL for vinyl chloride. Therefore, it would be expected to be prudent public health practice to be extremely careful about consuming groundwaters that have been contaminated by chlorinated solvents such as TCE, even though all of the measurable contaminants in the water are below MCL's, because of the potential for unknown carbon-chlorine-bonded material's being present that could be highly hazardous to public health. Those concerned with the protection of public health would be expected to consider the issue of "natural contamination" by iron and manganese in the groundwater to be largely extraneous to the issues of groundwater pollution by the chlorinated solvents and their transformation products.

Construction De-Watering and Other Activities

Another area of concern associated with groundwater contamination at the SPTC site is the de-watering that will be needed with construction of some of the buildings and other structures on the site. De-watering could be required during construction and possibly on a continuing basis after construction. The fact that the water table is only 20 ft or so below the surface of the soil and that some of the groundwater on the site is highly contaminated with hazardous chemicals creates concern about the de-watering activities since large amounts of pumped, contaminated groundwater would have to be managed at the site. Based on the review by the authors, the current staff of the Central Valley Regional Water Quality Control Board is aware of this concern and will likely require appropriate management of pumped, contaminated groundwaters so that they do not represent a significant threat to public health or the environment.

It is important to note, however, that at some time in the future a building owner-operator within the SPTC project could find it necessary to begin to de-water an area near the building because of a significant rise in the water table that would occur during a period of several wet years. It is possible that those de-watering activities would be conducted without obtaining the necessary permits for discharge of the water to either the sanitary sewer or storm sewer in the area. It is unlikely, however, that such a scenario involving the introduction of contaminated groundwaters into area surface waters would cause a significant environmental quality problem, since in order for significant amounts of those contaminants to be added to a sewer system, the de-watering flows would have to be substantial and therefore would likely be detected as an increased hydraulic load on the storm sewer or sanitary sewer system.

Concern has been expressed about the possible contamination of lower aquifers during construction at the site when piles used for building support are driven through the contaminated upper aquifer into lower strata. From the information available, it does not appear that this will be a problem since the aquifers into which the piles would be driven are already contaminated by the site and will be included in site remediation.

Sulfate Contamination

Mention has been made in the SPTC studies conducted in the Battery Shop Yard area that for a period of time it was standard practice for SPTC personnel to dump sulfuric acid into what are called "dry wells" which were open areas in a concrete pad. That acid was also apparently allowed to run off the concrete pad onto the soil. Sulfuric acid contains high concentrations of sulfate, which when discharged to the ground would lead to the formation of a sulfate plume originating from the Battery Shop Yard area. Sulfate is of concern in domestic water supplies because of its laxative effect and its contribution to the total dissolved solids, which increase corrosion. The US EPA recently announced that it will establish an MCL for

sulfate at 400 to 500 mg/L in the near future; DHS has a secondary MCL for sulfate of 250 mg/L.

In reviewing that matter with SPTC representatives and DHS, the authors found that the potential existence and significance of a sulfate plume in the groundwater had not been considered. While the studies that have been recently reported on the groundwater contamination plume show elevated concentrations of sulfate where they would be expected based on the information on groundwater flow direction, an insufficient number of wells have been sampled and insufficient numbers of water samples have been analyzed thus far to adequately define the full extent and degree of groundwater pollution from the Battery Shop Yard area sulfate.

Because of the close proximity of the Battery Shop Yard to the Central Shops area where the chlorinated solvent contamination originates, the two plumes are in the same area and likely to be coincident. It is not at all clear, however, because of the inadequate amount of work done thus far in the groundwater investigations, whether the information that has been developed adequately describes the current situation with respect to sources of either chlorinated solvents or sulfate. Both the chlorinated solvents and sulfate in the form of sulfuric acid tend to be considerably denser than water and therefore would tend to sink to the bottom of the aquifer. The sulfate, however, would tend to mix in with the aquifer water more readily than the chlorinated solvents because of its high solubility in the water. While the sampling for sulfate has been very limited, none of the samples analyzed thus far have shown excessive sulfate concentrations compared to the DHS MCL.

Additional Sampling

It is not known at this time if any additional groundwater sampling is planned by SPTC or will be required by DHS or the Regional Water Quality Control Board. DHS personnel have indicated to the authors that some additional groundwater sampling may be required. Based on the author's experience in conducting studies of this type, additional groundwater sampling at existing wells and additional wells will likely be required. The number and location of the additional wells should depend on the reliability of the groundwater flow and contaminant transport modeling in and near the Central Shops plume.

Pond and Ditch Area Plume

At this time it appears that there is at least one other groundwater contamination plume at the SPTC site. That plume is associated with the Pond and Ditch area in the northcentral part of the site. The studies reported thus far have shown that groundwater contamination in the uppermost aquifer is about 2000 ft long and 250 to 550 ft wide, and is centered on the Pond and Ditch. Deeper-level contamination is still being evaluated. As with the Central Shops groundwater contamination plume, SPTC has not yet defined the full

extent of groundwater contamination under the Pond and Ditch area as a result of using analytical methods without sufficient sensitivity to detect the contaminants at concentrations that DHS considers to be of potential significance for domestic water supply water quality. The principal known contaminants in that plume are nickel and VOC's (e.g., TCE) and their transformation products (e.g., 1,1-dichloroethane, 1,1,1-trichloroethane, and vinyl chloride). SPTC has recently developed a Remedial Action Plan for the Pond and Ditch area that has received DHS approval. According to that plan DHS believes that it will likely prevent further spread of contaminants from the area and will initiate clean-up of the contaminants.

The situation on the northern part of the site is somewhat confused by the potential for groundwater contamination by activities of adjacent-nearby property owners. There is a potential for northerly migration of contaminants from the Pond and Ditch area due to intense pumping of groundwater by the state printing shop.

From the information available, it appears unlikely that the pollution of groundwater under the Pond and Ditch area will have an adverse impact on the re-development of the SPTC property as long as no attempt is made to use the groundwater for domestic, or for that matter, other purposes that could threaten public health or environmental quality. As with the Central Shops area plume, there is also need to determine whether there is significant transport of gas-phase pollutants, such as vinyl chloride, from the plume through the overlying soils to the surface of the soil.

Groundwater Monitoring

It is recommended that a groundwater monitoring program be incorporated into the overall site closure plan, that would require monitoring of groundwater at selected locations on the site in perpetuity. Further, basements in all buildings at the site should be monitored for toxic chemicals to ensure that hazardous conditions do not develop sometime in the future due to the release of toxic chemicals to the groundwaters from currently unknown sources which could then migrate to the basements of buildings.

LEAD-CONTAMINATED SOIL REMEDIATION

There are concerns about the adequacy of the protection of public health that will be afforded by the approved remediation programs for soils contaminated with lead and other contaminants at the SPTC site.

There are DHS-approved hazardous chemical closure plans for several parts of the SPTC Railyard site. DHS has approved the closure of the Battery Shop Yard that was contaminated with lead. The remediation of that area included removal of all soil containing lead in concentrations greater than 950 mg/kg to a Class I hazardous waste disposal site. Since SPTC has classified the Battery Shop Yard area as commercial/industrial future use, DHS has allowed SPTC to leave in the area soils that contain lead in

concentrations up to 950 mg/kg. In order to minimize the possibility of those soils becoming scattered over the site by wind, DHS required that a 2-ft veneer of soil containing less than 174 mg/kg lead be placed above all soils in the Battery Shop Yard that contain lead concentrations greater than 174 mg/kg. DHS has also required that a deed restriction be placed on that area of the site that limits its use for residential, open-space, and other purposes that could result in the exposure of the public to elevated concentrations of lead. DHS personnel currently associated with the site have indicated to the authors that it is not the intent of DHS to allow residential or other public-contact activities in those areas without significant further remediation of the lead-contaminated soils.

Concern should be raised about the long-term public health implications of the remediation program that was undertaken and approved at the Battery Shop Yard area. There are areas within that region in which soils below the 2-ft depth have significantly elevated concentrations of lead which, if brought to the surface, could represent a hazard to children, based on DHS criteria. There is a wide variety of activities that could cause lead-contaminated soils beneath the 2 ft low-lead soil veneer to be brought to the surface. Excavation in the area, such as that associated with digging holes for fence posts, shrubbery, large shade-trees, etc., and trenching could result in contamination of surface soils with lead and other contaminants. The basic issue that has to be resolved is whether the deed restriction for this area as developed provides for adequate public health protection of children to exposure to elevated concentrations of lead. As worded now the deed restriction could be interpreted to mean that the Battery Shop Yard area is suitable for residential development or other open-space activities provided that such use does not lead to conditions that would disturb the soil and thereby bring soil with elevated concentrations of lead to the surface where children could be exposed.

While DHS is responsible for developing a deed restriction, according to the State Health and Safety Code, it is the City that is responsible for its administration. This situation should be of concern to the City since the adequacy of administration of the deed restriction by City employees will be a major factor in determining the public health and environmental protection as well as protection of the City's interests associated with the re-developed property in those areas where a thin veneer of low-lead soil exists over soils that contain concentrations of lead currently considered by DHS as potentially hazardous to children.

There has been considerable controversy for many years about the critical concentrations of lead in the environment. There are wide-ranging, diverging opinions on what a safe concentration of lead is in soils, water, and air. While everyone seems to agree that lead is potentially highly hazardous to man, environmental levels that are safe, however, differ among investigators by factors of 100 or more. Part of the differences of opinion relates to the fact that lead, like many other chemicals, exists in a wide variety of

chemical forms, including metallic lead, tetraethyl-lead that has passed through internal combustion engines, forms of lead in paint, lead ores, and lead forms released from smelters to the atmosphere. The uptake of various forms of lead by humans varies depending on the form. The availability and therefore uptake of lead from various environmental media, and hence its impact, depends on its specific forms. There are reports in the literature that show that children and others exposed to high concentrations of lead in certain soils in which they are playing or working have relatively low levels of lead in their blood. Yet in other locations, lower concentrations of lead-containing soils have led to higher lead blood levels. It is highly likely that the specific chemical forms of lead in the two study areas were significantly different. Thus far, very little work has been done on the chemical species-specific uptake of lead. This leads to the wide divergence of opinion as to what is a safe concentration of lead in the soils. It is generally agreed, however, that somewhere between 100 mg/kg and 1000 mg/kg depending on the form, is a safe concentration of lead in soil. If there were sufficient information on uptake of various forms of lead by children, it would be possible to analyze the soils and establish a site-specific critical concentration of lead. However, in the absence of such information, regulatory agencies have to somewhat arbitrarily select a critical concentration for lead; in the case of the SPTC site, DHS has selected a conservative remediation level of 174 mg/kg lead for areas in which people will come in contact. Based on what is known about the toxicity of lead today, that concentration should not result in children playing and eating the soil acquiring excessive concentrations of lead in their blood.

As discussed in Attachment G, DHS in its analysis of the safe concentrations of lead in surface soils that would be left in residential areas has concluded that 174 mg/kg presents little risk to children. DHS has also established that 950 mg/kg lead in soil is a safe concentration for workers and other non-residential, non-children-related activities. The 950 mg/kg is a somewhat arbitrary concentration which is not related to potential human health impacts. As shown in Appendix G, DHS believes that workers can be exposed to soils containing on the order of 3000 mg/kg lead with little risk of developing excessive blood concentrations of lead. However, 1000 mg lead/kg was the arbitrarily established DHS Total Threshold Limit Concentration (TTLC); soils containing higher concentrations of lead are classified as "hazardous waste." Therefore, DHS chose 950 mg lead/kg as the remediation level for lead in soils at the SPTC site except in those areas where children could come in contact with the lead-containing soil.

The controversy arises however about the adequacy of SPTC's proposed remediation of lead-contaminated soils out of the perceived difference between the industrial-commercial 950 mg/kg lead and the 174 mg/kg residential area lead. It is felt by the authors that most would consider 950 mg/kg as excessive concentration for children exposure to lead in soils. It is highly likely that there will be lead concentrations of even greater values which under worst case scenarios would not lead to high blood levels of lead in children. There will also likely be situations where 200 to 300 mg/kg would represent an excessive concentration of

lead in soil for children. As noted above, this difference relates to the chemical species of lead in the soil and the ability of the body to take up the various species.

As noted previously, a variety of scenarios exist in which 950 mg/kg lead in soils could be brought to the surface by individuals without their even being aware of the deed restriction or the fact that at one time the area was a "superfund" site and that the site has elevated levels of a variety of contaminants remaining in the soils. It is very important to note that the lead in the soils will be there forever. It has little tendency to migrate and while it is possible to control land uses associated with the initial property re-development, there will be considerably less consciousness about the residual contaminants, such as lead, left at the site by SPTC as part of the site remediation during re-re-development 50, 100, or more years hence. It appears that most of the focus of SPTC and DHS is on the initial re-development-associated hazards. Longer term hazards should also be considered, especially in light of the fact that SPTC is choosing, with the approval of DHS, not to remediate the site to levels of contaminants that are considered by DHS as safe for unlimited human exposure.

What are thought to be acceptable concentrations of lead, or for that matter other contaminants in the environment, will almost certainly change in the future as new information becomes available. While sometimes the new information shows that higher levels of contaminants than previously thought can be allowed in the environment, the preponderance of situations arising out of new information causes the critical concentrations in the environment to be lowered. A situation of this type has occurred with lead during the past year, where the US EPA has recently concluded that the safe concentration of lead in drinking water will be reduced from 50 ug/L to 5 ug/L. In discussing these matters with DHS, they make it clear that the 174 mg/kg lead in soils, which is now considered safe for unrestricted residential use, may not be considered appropriate in the future. As shown in the attached deed restriction for the Battery Shop Yard area, Attachment F, the deed restriction allows DHS to determine at the time that an application for excavation or other activity is made, what the acceptable level of lead in soils can be.

Fundamentally, the bottom line issue that officials in the City of Sacramento must face as part of approving the re-development of the SPTC site is whether there are significant hazards to children that can arise out of the fact that SPTC is doing only a partial clean-up of the site where they are putting relatively thin veneers of less contaminated soils above more highly contaminated soils in those areas where the properties could be re-developed for residential purposes, such as the Battery Shop Yard area.

From the information available at this time, SPTC with DHS approval plans to remediate all areas of the Railyard site which will be used for commercial or industrial purposes so that the soils contain no more than 950 mg/kg lead. The use of these areas will be restricted to commercial and industrial purposes. A

reasonable question to ask is whether there are plausible scenarios where leaving 950 mg/kg lead in the surface soils covered by a thin veneer of low-lead soil, would represent a hazardous situation. To construction workers or occasional users, passers-by, and so forth, this does not appear to represent a highly hazardous situation since as noted above concentrations of several thousand mg/kg would be allowed for adult exposure. However, is it possible that children could be exposed to the 950 mg/kg lead-containing surface soils in a commercial or industrial setting? Certainly with the increased day-care activities in commercial and industrial facilities it is fairly easy to envision a plausible scenario where 10, 20, 50, or so years from now, a commercial or industrial establishment decides to or is forced to provide day-care facilities for employees' children. The building superintendent or supervisor could decide that this could be done by converting an existing office area and adjacent patio area into a day-care facility. While the establishment would likely have to get a permit for this purpose, it is possible that the day-care facility permit inspector would not be aware of or understand the deed restrictions on the property. Since little or no remodeling is being done, the establishment would not require a city building inspector's inspection and therefore it is possible that children could be exposed to 950 mg/kg lead-containing soils in the courtyard area of the commercial or industrial establishment under the condition where a thin veneer of low-lead soil covers soils containing up to 950 mg/kg lead. This type of situation is one of the reasons there is concern about only partial clean-up of the SPTC site, and the imposition of future-use restrictions. The current DHS SPTC site project staff have indicated to the authors that it would be their intent to require further clean-up of all areas, such as court-yards and other open spaces in order to significantly reduce the potential for the public to be exposed to elevated concentrations of lead in these areas. While those DHS staff have indicated that it would be their policy to require additional remediation, there are no assurances that future staff would address the situation in the same manner.

The DHS personnel with whom the authors discussed this matter felt that there is some ambiguity in the deed restriction for the Battery Shop Yard regarding those points and have suggested that the City may wish to develop alternate wording that would more explicitly indicate the desired restriction. Consideration should be given in revising the deed restriction to making it explicit that remediation of all open-space areas in commercial/industrial areas will be required to 174 mg/kg lead at any locations where there is a potential for public exposure to the surface soils. All lead-contaminated soils left in commercial/industrial areas at the SPTC site should be covered by buildings, pavement, or other structures. Adoption of that approach would significantly reduce the likelihood of the public, and especially children, being exposed to elevated lead in surface soils in residential and commercial/industrial areas as a result of the 2 ft of low-lead soil veneer.

Translocation

The authors have found that neither SPTC nor DHS has addressed the potential for the plethora of

trees and other plantings planned for all areas of the re-development to translocate contaminants from the underlying soils to the environment where children and others could be exposed to elevated-potentially hazardous concentrations of contaminants. Translocation is the process by which plant roots take up soil-associated chemicals and expel them through the leaves or fruit. Neither the US EPA nor DHS included this mechanism of contaminant transport in their respective "Superfund" guidance manuals; it is therefore not evaluated in the typical "Superfund" site RI/FS. Translocation may be a relatively unimportant transport mechanism for the typical "Superfund" site on which only shallow-rooted vegetation is planted, and at which there is little human contact after closure. However, it could be a significant transport mechanism at the SPTC site which will not only likely have more deeply rooted vegetation but also have intense human activity and long-term contact.

Roots of many types of trees and plants can readily penetrate through 2 ft of soil. It is possible that certain kinds of plants that would be used in residential areas could transport and concentrate lead in their leaves or fruit to a sufficient extent so that children who eat the leaves or fruit would be exposed to dangerously elevated levels of lead. To the knowledge of the authors, this has not been adequately investigated. Studying the vegetation currently growing at the SPTC site might provide some information on whether this mechanism of transport is occurring today, although the extent and potential impact of such transport will certainly depend on the types of plants and the forms of lead in the soils, as well as other factors.

While the significance of this transport mechanism at the SPTC site is unknown, it is of particular concern if there is no assurance that there will be no restrictions on open-space, residential development, or landscaped-vegetated areas (including tree-plantings in paved areas) in which the soil column has greater than 174 mg/kg lead. The 174 mg/kg lead level has not been evaluated for its applicability to providing public health and environmental quality protection from the translocation of lead, or other contaminants, from soils; as noted above, that value has reference to children eating dirt. It could be that the translocation mechanism could cause contamination of land surface or people when roots are in contact with substantially lower concentrations of soil lead. This situation raises further questions about the appropriateness of thin veneers of low-lead soil above soils containing elevated concentrations of lead.

City Interests and Costs of Additional Remediation

The City, through its administration of deed restrictions and permitting of various types of land use activities, including issuing of building permits, remodeling permits, business licenses, day-care facilities use permits, etc., could find itself with considerable concerns for having approved a situation in which children become exposed to excessive amounts of lead or other contaminants at concentrations above those

considered safe by DHS. As discussed above, there are a number of plausible scenarios where the safeguards that the City might impose as part of its regulatory functions could be circumvented through employee negligence in failing to implement deed restrictions, etc., where the City could be judged by the courts to have assumed some responsibility for the exposure of children to excessive concentrations of lead. It is important to emphasize that those problems will not likely occur as part of the initial re-development of the SPTC Railyard site, but could become important 50 or 100 years in the future when the fact that this was a former "superfund" site has long been forgotten.

One of the important issues that should be assessed by the City in evaluating the appropriateness of the SPTC approach for site remediation of attempting to restrict in perpetuity children's access to 950 mg/kg lead-containing soils is what would be the additional cost of cleaning up all soils to a depth of 5 ft or some other greater depth so that there would be at least a 5-ft barrier between the children contact area and the 950 mg/kg lead-containing soils. While the highest levels of soil lead contamination at the site are typically in the upper few feet of soil, there are areas in which it extends deeper. A 5-ft layer of low-lead soil above soils containing elevated lead concentrations provides a significantly greater degree of public health protection in those areas to which children have access to surface soils or vegetation, than a 2-ft or so veneer of low-lead soil. At this time, information is not available from SPTC on the estimated costs for removing the lead, and for that matter other contaminants, in areas that are remediation to industrial-commercial DHS requirements to the requirements that DHS considers safe for exposure of children to soils containing these contaminants over long periods of time. This is an area that the City needs to explore with SPTC and the re-developers of the site areas that are only remediation to industrial-commercial requirements.

HAZARD EVALUATION FOR CENTRAL SHOPS

Thus far apparently no consideration has been given to assessing the degree of contamination of the buildings/structures of the Central Shops area that are anticipated to be left at the site.

The re-development plans call for saving some of the Central Shops area buildings because of their historic nature. It is possible, however, that some parts of the walls and foundations of those structures are contaminated with hazardous chemicals. It is also possible that the future use of those structures may be limited by the ability to remediate that contamination. The re-development plans should include a detailed review, appropriate risk assessment for future occupants and users, and remediation consideration for those structures. Based on the information the authors have reviewed to date, this has not been done. The risk assessment should not be a conventional "Superfund"-type risk assessment but should include consideration of plausible worst-case exposure scenarios considering how the buildings could be used.

MANAGEMENT OF STORMWATER AND DOMESTIC WASTEWATER

The potential importance of the management of combined sewers and stormwater runoff to the future re-development of the site has not been adequately addressed.

There is concern that the combined sewerage system and urban stormwater management issues associated with the re-development of the site have not been given adequate attention in the planning for the re-development of the site. In June, 1990, the Region 5 Water Quality Control Board came very close to placing a moratorium on all future development/re-development in Sacramento until the City properly addresses and solves its combined sewer overflow problems. Further, the City is now a party to a permit in which it must achieve water quality objectives at the edges of arbitrarily defined mixing zones in the Sacramento and American Rivers associated with each urban stormwater drainage discharge to those rivers.

It is the authors' understanding that while separate sanitary and storm sewers would exist in the re-development of the SPTC site, and therefore combined sewer overflows would not be a problem within the re-developed site, it is understood that the existing separate sewers in the region are connected to a combined sewer that has severe back-up problems. It is also the understanding of the authors that the City does not have the funds to adequately address those sewer back-up problems in the near future. If the back-up problems persist, the Region 5 Water Quality Control Board could place a moratorium on further development/re-development. If this occurs, this could have a significant impact on the re-development of the SPTC site.

While the combined sewer and urban stormwater drainage issues were discussed to some extent in the June, 1990 Draft Volume 2 of the "Southern Pacific Railyards Master Plan - Existing Conditions" report, the potential impacts of necessary management of combined sewer overflow and stormwater drainage on re-development have not been adequately considered. While it was indicated in that document that those issues for the City as a whole are under review at this time, the Master Plan for the re-development of the site should proceed with considering the impact on re-development of the imposition of plausible worst-case management requirements. For example, would site re-development as planned now be viable if the possible stormwater runoff discharge site mentioned in the June, 1990 draft, "SP Railyards Master Plan" required end-of-pipe treatment to achieve water quality objectives at the edge of a mixing zone in the Sacramento River? The City of Sacramento has committed itself to achieving that level of contaminant control for all stormwater drainage to the American and Sacramento Rivers. The SPTC site re-development may have to obtain a permit for its urban stormwater drainage discharges which contains this limitation. Since the rest of the city will not likely pay for controlling the urban stormwater contaminant control problems in the SPTC development, will those in the development be willing to assume the cost for this treatment? As a plausible

worst-case scenario, the ROMA Design Group should consider whether the site could be re-developed to handle appropriate treatment of its own domestic wastewater and urban stormwater runoff.

Mention was made in the discussions in the Master Plan of the development of the waterfront area in the project to include boat tie-ups, walkways, etc. Consideration should be given to the potential location of discharge pipes for treated stormwater or domestic wastewater and their sphere of influence on water quality relative to areas that people would use. Even with treatment, those discharges would introduce materials or conditions that could be detrimental to the aesthetic quality of the river water.

During the August 25 workshop, M. Ransom mentioned that there will be some storm sewers in the SPTC site area that will be below the water table; such storm sewers would be subject to infiltration of contaminated groundwater. Effective control of the contaminants that are added to the stormwater from the site's groundwater will have to be considered as part of site re-development. Consideration of that issue could affect the approaches that can be considered for treating stormwater before discharge to the river. Contaminants added from the groundwater would have to be removed since they are not common contaminants in urban stormwater drainage. The re-development project could be required to pay for the additional cost of removing those contaminants.

WATER FEATURES

There is concern about water quality in the water features proposed for the site re-development.

Detailed information on the sources of water and their characteristics for the anticipated water features of the re-development have not been made available to the authors, and apparently have not yet been developed. However, mention has been made about the possibility of using "water features" as storage and treatment areas for urban stormwater drainage in the project. Caution should be exercised in following that approach; additional steps may be needed to ensure that the water features do not become new avenues of contaminant transport from the site to the public and the environment. The authors are aware of a situation in Colorado in which elevated concentrations of lead in the water of a recreational fishing pond caused sufficiently elevated concentrations of lead in the fish in the pond to render them hazardous for consumption by children who fished the pond. If fish or other aquatic life were to be maintained in water features, or if the water features are such that they would attract water fowl, a monitoring program should be conducted to ensure that the water features do not become a significant source of lead or other contaminants for fish or water fowl, or people who use those organisms for food. Further, if the water features include fountains or involve other generation of aerosols, an evaluation should be made of the potential transport of the aerosols

to the area and exposure of the public to their contaminants.

Similarly, information on the nature of the water features and their design, construction, and operation has not been made available to the authors; it appears that detailed plans for those features have not yet been developed. However, at the August 25 workshop, those features were described as probably being lined ponds. If the design of these ponds involves reliance on a flexible membrane liner, it is important to note that such liners are known to leak from the time of installation and to deteriorate over time; they eventually have to be replaced. If contaminated surface water is placed in the lined ponds, groundwater contamination could result; the ponds could then represent a new source of contaminants that would have to be addressed if the integrity of the liners is not adequately maintained.

The fact that a water feature is not designed for human contact does not mean that children and possibly others would not have contact with or consume waters of the water feature. For example, if such features were to include fountains, it would be expected that at times children would play in and inevitably consume some of the water. Plausible worst-case risk assessments should be carefully made on all water features.

ASBESTOS

Questions have been raised about the public health significance of asbestos at the site.

As in nearly all commercial/industrial and many residential sites, asbestos-containing materials have been used as insulation, in wall siding material, and for other purposes at the SPTC site. Since asbestos is an airborne carcinogen, concern should exist about the potential hazards associated with the presence of asbestos at the site. SPTC has provided the authors with a copy of a January 10, 1990 SPTC letter to its employees concerning the presence of asbestos-containing materials at the site in buildings and the actions that SPTC plans to take with respect to minimizing exposure-hazards that those materials represent to employees.

Apparently, attention is being given to the potential hazards of known sources of asbestos at the site in the re-development. There are concerns, however, about the possibility that asbestos-containing materials could have been buried at the site in the fill materials used there; such buried material could become airborne and therefore hazardous as part of site re-development. DHS personnel have indicated that DHS will likely require monitoring of airborne asbestos as part of construction activities at the site. From an overall point of

view, it does not appear that asbestos would represent a significant threat to public health during site re-development provided that those responsible for building demolition and re-development take the necessary precautions to prevent excessive concentrations of airborne asbestos from occurring at the site. It is suggested that monitoring of airborne levels should be carried out periodically during ground-disturbance activities that could lead to excessive concentrations in the air at or downwind from the disturbance area.

ADEQUACY OF SPTC SITE HAZARD EVALUATION

Additional attention needs to be given to possible unknown hazards that exist at the SPTC site that could be adverse to those who use the re-developed property.

One of the primary questions that has to be addressed is whether SPTC has (or more properly will have, since the RI/FS process is still under way) found and adequately defined all of the potentially significant hazardous conditions that exist at the SPTC site that could in any plausible worst-case scenario cause excessive exposure of people who would reside in or otherwise use the re-developed properties at any time in the future. Basically, this question comes down to one of determining whether the RI/FS process and implementation that are used at the federal and state levels by the US EPA and the DHS are adequate to define to a reasonable degree all unknown hazards at a complex site such as the SPTC site. There have been some situations such as those noted elsewhere in this report where potentially significant topic areas have apparently not been contemplated for investigation in the remaining studies based on discussions with SPTC and DHS personnel. The issue that has to be resolved, however, is whether the typical "Superfund" RI/FS is adequate for a "superfund" site which is proposed to be intensely re-developed for public and private sector use in which large numbers of people will be in the area after re-development. That type of re-development is highly unusual for "Superfund" sites.

The SPTC site is a fairly large site (240 acres) that has been used for more than 100 years. SPTC and DHS have followed the normal approach of trying to ascertain from available past-use records the likely chemical contamination that would have occurred at the site. They have or will focus their investigative efforts on those areas of the site where substantial contamination was likely or has been found. In the opinion of the authors, the public health and environmental hazards that those identified areas represent could likely adequately be defined for the about 100 to 150 chemicals (principally Priority Pollutants) on which the federal and state "Superfund" programs are currently focusing their attention. However, the Priority Pollutants were selected in a somewhat arbitrary manner in a court order of the mid-1970's. They certainly do not represent all of the chemicals that could be hazardous to public health and the environment at the SPTC site or at other "superfund" sites.

At this time, the "Superfund" programs at the federal and state levels are basing their studies on chemical approaches in which excessive concentrations of Priority Pollutants in water, soil, or air serve as a basis for developing remediation programs. No efforts are being made at the SPTC site, or for that matter, at other "Superfund" sites, to use any of the biological response tests available that would detect potentially harmful concentrations of combinations of Priority Pollutants or of unmeasured or unknown contaminants. Tests of this type are just now beginning to be considered for use at "Superfund" sites in some parts of the country. While a number of biological tests, such as the Ames test for mutagenicity, have been available for many years, a problem with their use is interpretation of the test results. It is known, however, that some "Superfund" site waters and soils after remediation in accordance with typical remediation approaches used today, contain substances that cause mutations in the Ames test organisms. Positive Ames test mutagenicity responses have also been found in other contamination sources such as domestic wastewaters, and even in some municipal water supplies. How the mutations found in the test conditions relate to human and other organism exposure is largely unknown at this time.

At some time in the future through the use of additional chemical testing or by biological response testing, it may be found that the current SPTC and DHS approaches for remediation of the SPTC Railyard site have not eliminated all of the potentially significant hazards to the public and the environment. That situation provides additional justification for using more than conventional investigation approaches and instituting more than the currently required remediation.

Over much of the site where industrial operations have not been known to take place, SPTC thus far has used a 400-ft soil-sampling grid as an arbitrary spacing that has no technical justification to detect the presence of Priority Pollutants. It is possible that at some time during the past 100 years that the site has been used by SPTC, containers of hazardous chemicals have been buried on the site or "spills" of hazardous chemicals have occurred that would not be detected by the RI/FS sampling program used thus far.

Geophysical exploration techniques are often used at "Superfund" sites to detect potential unknown hazards. In discussing this matter with SPTC representatives, it was indicated that because the SPTC site is largely a "fill" site, many of the geophysical techniques would not work very well to detect buried containers of hazardous chemicals. It is not clear to the authors at this time that adequate attention has been given by SPTC to the use of those techniques even with their shortcomings at the site to try to reduce the risks of not discovering buried containers of material located on the site. Therefore, in summary, it is felt by the authors that additional attention needs to be given by SPTC and its contractors to locating currently unknown sources of contaminants at the site. DHS representatives have indicated that they plan to require that SPTC undertake additional investigation of potential contaminants at the site; the studies that will be required have not yet been defined.

AIR QUALITY

There are a number of air quality concerns associated with the plans for the re-development of the SPTC site.

A number of air quality concerns associated with the plans for re-development of the SPTC site have been reviewed in previous sections of this report. Areas of concern include releases of toxic gases to the atmosphere as part of groundwater clean-up (air stripping); gas-phase transport of contaminants from the polluted groundwater plumes through the overlying soils to basements of existing structures and those to be constructed in the future, both for the currently known pollution plumes as well as for pollution plumes that may occur or be identified in the future; handling of volatile contaminants in de-watering near construction sites; airborne lead and asbestos; contaminated structures in the Central Shops area; and aerosols from water features. For many of those aspects of re-development, air emissions permits will have to be obtained from appropriate regulatory agencies. While the control programs that will be followed for many of those areas have not yet been defined, DHS personnel have indicated that they have already exercised control to minimize air quality problems associated with a number of those areas and plan to require that SPTC follow approaches to control excessive contaminant releases to the air as part of site re-development. Because of the long-term nature of some of the potential sources of contaminants, air quality monitoring and associated appropriate risk assessment should be practiced at the site for as long as sources represent a threat to air quality.

OVERSIGHT OF INVESTIGATION, REMEDIATION AND CONSTRUCTION

It is the authors' opinion that there is need for independent oversight of all investigation, remediation and reconstruction by one or more individuals whose primary concern is ensuring that the activities are carried out in accord with the plan and that workers and the public will be protected against unforeseen or unusual situations associated with chemical contamination at the site.

CONCLUSION

From an overall point of view, the re-development of the SPTC property represents a valuable opportunity for the overall development of downtown Sacramento and the region. However, because of the unique type of re-development of this "superfund" site, the degree and type of site investigation and remediation, future monitoring that will be necessary at the SPTC site should go beyond that typically provided at federal and state "Superfund" sites. The current degree of contamination of that site by chemicals

used by SPTC as part of its railyard operation or present at the site will require extensive remediation as part of re-development. While there are important issues that remain unresolved at this time associated with the completed or planned remediation, those issues and likely others that could develop in the future can be addressed with the technology available today to produce re-developed properties that would represent minimal risks to the public who would use the area. The authors' report to the City, "Final Remediation Program Report - Southern Pacific Railyards Hazardous Materials Remediation Review" (October, 1990) provides additional discussion of many of the topics covered in this technical report and provides specific recommendations on the approaches that the City should consider in exercising its responsibility in overseeing the SPTC site re-development that will provide for increased public health and environmental protection as well as protection of the City's interests.

ACKNOWLEDGMENT

Many individuals have been of significant assistance to the authors in their development of this report. Special acknowledgement is made of the assistance provided by G. Tholen, Project Manager and Holly Keeler, Project Coordinator, and other members of the City of Sacramento Department of Planning and Development. The authors also wish to acknowledge the assistance of Mark Dockum of SPTC and Mark Ransom of ERM-West, and the SPTC contractors including members of the ROMA Design Group in providing information to the authors.

W. Kilgore and J. Tjosvold and other members of the DHS Toxic Substances Control Program staff; M. Knight and R. Knight of the Sacramento County Environmental Management Department, Hazardous Materials Division; Alex MacDonald of the Central Valley Regional Water Quality Control Board staff; and various members of US EPA Region IX staff have provided significant assistance to the authors in their development of this technical report.

LIST OF ABBREVIATIONS

CP – Closure Plan

CVRWQCB – Central Valley Regional Water Quality Control Board, Region 5

DHS – California Department of Health Services

FS – Feasibility Study - defines remediation alternatives for the types of contamination found at a site. Often discussed in conjunction with RI, RI/FS

MCL's – Maximum Contaminant Levels - federal or state limits established for the maximum concentrations of selected contaminants allowed in drinking water

MSL – Mean Sea Level

PAH, PNA – Polynuclear Aromatic Hydrocarbon - organic compounds typically associated with petroleum products and residues and with products of combustion; many are known or suspected human carcinogens

RAP – Remedial Action Plan - plan for remediation of an area

RI – Remedial Investigation - defines degree and extent of contamination of a site

SPTC – Southern Pacific Transportation Company

THM's – Trihalomethanes - chloroform-like compounds commonly present in municipal drinking waters derived from surface water sources; suspected human carcinogens

TTLIC's – Total Threshold Limit Concentrations - concentrations of selected chemicals in soil (or other solids) used to classify soils (or other materials) for disposal as "hazardous" or "non-hazardous" waste

VOC's – Volatile Organic Compounds - a group of organic compounds that are highly volatile, including benzene, TCE, and vinyl chloride; many are known or suspected human carcinogens

WET – California Waste Extraction Test - laboratory procedure for leaching contaminants from soil samples as part of the classification process for disposal of materials as "hazardous" or "non-hazardous" waste

Chemical Name Abbreviations:

TCE – trichloroethylene

PCE – tetrachloroethylene

1,1 DCA – 1,1-dichloroethane

1,1,1 TCA – 1,1,1-trichloroethane

1,2 DCE – 1,2-dichloroethene

Units of Measure:

mg/L – concentration unit, milligrams of contaminant per liter of water; in many applications it is equivalent to "parts per million" (ppm)

ug/L – concentration unit, micrograms of contaminant per liter of water; in many applications it is equivalent to "parts per billion" (ppb)

mg/kg – concentration unit, milligrams of contaminant per kilogram dry weight of solid; equivalent to "parts per million" (ppm)

ATTACHMENT A

BIOGRAPHICAL INFORMATION

G. FRED LEE, Ph.D., P.E. (Texas)

B.A. Environmental Health Sciences, San Jose State University, 1955
M.S.-Public Health, Environmental Sciences, University of North Carolina, 1957
Ph.D. Environmental Engineering/Environmental Sciences, Harvard University, 1960

30 Years University Graduate Teaching and Research

Hazardous Waste Site Remediation, Treatment of Groundwater and Contaminated Soils, Risk Assessment, Water Quality, and Related Areas
Retired from Position as Distinguished Professor of Civil and Environmental Engineering, July 1989

25 Years Part-Time (20 - 30 hrs/wk) Advising/Consulting to Governmental Agencies, Industry, and Others

1 Year Full-Time Consulting

Owner & Principal of G. Fred Lee & Associates

Published More Than 450 Professional Papers and Reports on Sources, Significance, Fate, and Control of Chemicals in Aquatic Systems (Fresh, Marine, and Groundwater)

R. ANNE JONES, Ph.D.

B.S. Biology, Southern Methodist University, 1973

M.S. Environmental Sciences, University of Texas Dallas, 1975

Ph.D. Environmental Sciences, University of Texas Dallas, 1978

12 Years University Graduate Teaching and Research

12 Years Part-Time (10 hrs/wk) Advising/Consulting to Governmental Agencies, Industry, Others

0.5 Year Full-Time Consulting

Co-Owner & Principal of G. Fred Lee & Associates

AREAS OF SPECIALIZATION - G. Fred Lee & Associates

Solid & Hazardous Waste Management, Water & Wastewater Treatment, Water Pollution Control, Water Supply Water Quality, Aquatic Toxicology

Areas of Experience in Hazardous Waste Evaluation and Treatment

Fixation of Waste- and Soil-Associated Contaminants
Groundwater Remediation - Pump and Treat, In-Situ Treatment
Extraction of Contaminants from Soils
Bioremediation of Contaminated Soils and Groundwater

Extensive Experience with Many Contaminants of Concern at SP Site

TCE, Vinyl Chloride, Other Solvents
Heavy Metals
Petroleum Hydrocarbons
PAH's/PNA's

EXAMPLES OF RELATED PROJECT EXPERIENCE

Research and Private Consulting Associated with Landfills and Contaminated Soils since the Mid-1960's.

Several Years Part-Time Staff of Ebasco-Envirosphere of Lyndhurst, NJ as Internal Consultants on Its US EPA REM III Superfund Contract.

- Assisted Project Managers on Special Problems

- Assisted in Planning RI/FS Studies

- Led and Instructed on Interpretation of RI/FS Data

- Assisted in Development of RI/FS Reports

 - Re-wrote Inadequately Prepared Reports

- Provided Guidance on Site Remediation

- Provided Staff Development in Report Preparation, Data Interpretation, Technical Aspects of Site Evaluation and Remediation

Newport City Development

- Evaluation of Hazards Associated with Redevelopment of Former Industrial Site on Hudson River near Jersey City, NJ for Residential/Business Complex

- Advised Jersey City Health Department on Impact of Proposed Clean-Up on Existing Chemical Contamination of Soils and Groundwaters on Future Use of Lands in Newport City Development and on Hudson River Water Quality

Several Governmental Agencies and Industries in Conducting and Reviewing RI/FS and Similar Studies, and in Providing Review/Second Opinion on Conclusions

Advisor to the California Water Resources Control Board Staff in the Development of Subchapter 15 Governing Land Disposal of Wastes, and in the Development of the Long-Range Groundwater Management Strategy for the State. Active at This Time in Helping to Update and Revise Articles of Subchapter 15.

NJ ECRA (Environmental Clean-up Responsibility Act)

- Worked with New Jersey Regulatory Agency Staff and Others in Development of Approaches for Evaluating the Hazards Posed by Chemicals Associated with Structures and Grounds of Industrial Properties

Liberty State Park (NJ) Commission

- Evaluation of Water Quality Impacts of New Harbor Port Liberte Development on Water Quality near Liberty State Park

Worked with Property Developers and Re-Developers and Regulatory Agencies on Impact of Development on Water Quality, and Impact of Existing Land Use on Future Development

- Impact of Commercial and Residential Development on Lake Tahoe Water Quality

- Advised Inland Steel Development Corporation on Impact of Development on Water Quality in Lake Monroe, IN

- Evaluated Potential Water Quality in the Proposed Trinity River Development Reservoir for City of Dallas, TX

- Advised Developer on Impact of Lakeshore Development on Minnesota Lake

- Advised State of Wisconsin and Several Developers on Impact of Septic Wastewater Disposal Systems to Be Used in Proposed Development on Lake Water Quality

- Advised City of Boonton, NJ Health Department on Impact of Septic Tank Wastewater Disposal Systems on Boonton Lake

ATTACHMENT B

INFORMATION COLLECTION

Mark Ransom, formerly of the SPTC, and currently with ERM-West of Walnut Creek, CA, has been designated by SPTC as its project coordinator for the SPTC site remediation. In late June, 1990, G. Fred Lee contacted Mark Dockum of SPTC and requested a copy of all reports that had been developed on the contamination of the site and on-site remediation. Mr. Dockum, in turn, contacted the various contractors who had worked or are currently working on the site and requested that they provide copies of their reports to G. Fred Lee & Associates. By mid-July several feet of reports had been received. At this time G. Fred Lee & Associates has conducted a preliminary review of all documents that have been received through early September, 1990 and has reviewed a number of them in detail. Funding constraints prevented G. Fred Lee & Associates from reviewing documents beyond those received in early September, 1990.

Also in late June, 1990, Dr. Lee contacted William Kilgore, Project Manager for the Department of Health Services for the site and requested copies of Fact Sheets and other information on the site in DHS files. Kilgore has provided Lee with copies of some written information and, on several occasions, has discussed various aspects of the site with Lee and Jones. He has also provided guidance to others in DHS who should be contacted for background information on DHS policy for remediation of sites of this type. Lee and Jones have had a number of discussions with various members of the DHS Toxic Substances Control Program staff on the site. In mid-August, 1990, Dr. Lee met with Mr. Kilgore and Mr. Tjosvold to discuss the SPTC site investigation and remediation.

Mel Knight and Robert Knight, both of the Sacramento County Environmental Management Department, Hazardous Materials Division, made the county health department files on the site available to Lee and Jones in late July, 1990. The materials in those files have been reviewed by Lee and Jones and were found to be valuable in providing background information on DHS review of the site.

In early August, 1990, Alex MacDonald of the Central Valley Regional Water Quality Control Board (Region 5) staff made available the regional board's staff's files on the SPTC site. Lee and Jones have reviewed those files and have discussed various aspects of the site investigation and remediation with Mr. MacDonald.

Mention was made in various SPTC contractors' reports of certain US EPA and state of California documents that served as bases for approaches followed in the RI/FS and site remediation processes.

Copies of those documents have been obtained by G. Fred Lee & Associates and have been reviewed. Discussions have been held with representatives of US EPA Region IX regarding approaches used in Region IX to assess the hazards of chemicals in soil and water. A manual covering Region IX's policies and approaches has been reviewed. Further, Lee has discussed the Region's approach for remediation of lead-contaminated soils with representatives of US EPA Region IX.

Because of the importance of combined sewers and urban stormwater drainage to the City of Sacramento, and especially to the re-development of the site, Lee attended a Region 5 Water Quality Control Board hearing on June 21, 1990, devoted to those topics. From that hearing it became clear that the management of stormwater and domestic wastewater for the site could become an important factor in its re-development.

To obtain a perspective of overall aspects of development in the Sacramento area, Lee and Jones attended the July 26, 1990, workshop, "Sacramento: Development Challenges for the '90's." Lee has also attended two public meetings organized by the ROMA Design Group (ROMA) at which preliminary plans for re-development of the site were discussed. Lee and Jones have also attended several of the City of Sacramento Department of Planning and Development "site management" meetings at which various aspects of the plans for re-development of the site were discussed. Also at those meetings, there was some discussion of environmental aspects of the site and the potential impact of existing and residual contamination on the re-development of the site. Lee and Jones have presented a synopsis of their findings as presented in this technical report to the Department's "Site Management" team where a discussion of these results was conducted.

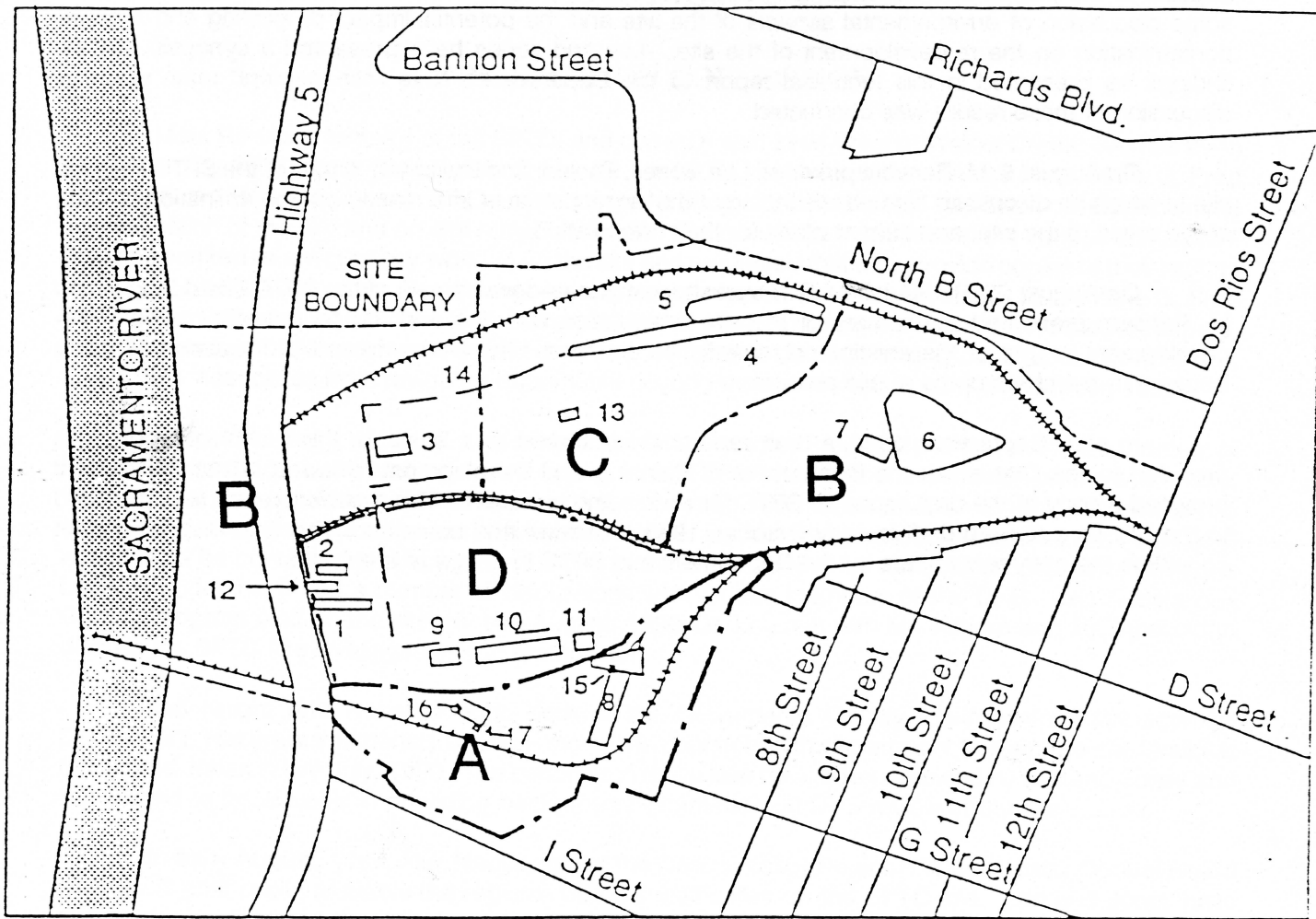
On August 9, M. Ransom provided Lee, Jones, Tholen, and Boxer with a tour of the SPTC Railyard site in which he discussed his understanding of the current state of information on contamination of each of the areas of the site, and current plans for their remediation.

On August 25, ROMA held a fifth workshop on the re-development of the SPTC site during which M. Ransom presented a summary of the site remediation activities and the proposed phasing of re-development in light of the anticipated remediation activities. There was extensive discussion of those issues with members of the public present.

In early September, 1990, a draft report, which served as a basis for this technical report, was provided to the City which the Department of Planning and Development reviewed. That Department provided a copy of the draft report to SPTC for review and comment. This technical report was provided to

the City as a revised draft in early October, 1990, for review and comment. This final technical report considers the comments made by the Department and SPTC in review of the drafts.

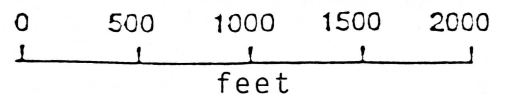
ATTACHMENT C



SOUTHERN PACIFIC SACRAMENTO RAILROAD YARD

LEGEND

- | | |
|---|--|
| 1. Painting Facility Area | 10. Former Forge Shops |
| 2. Locomotive Cleaning Area | 11. Former Battery Shop |
| 3. Former Brass Foundry | 12. Sand Piles |
| 4. Former Ponds and Ditch | 13. Former Drum Storage Area |
| 5. Former Lagoon | 14. — — Industrial Waste Collection System (Trunk Lines) |
| 6. Former Sandblasting Area and Former Painting Sheds | 15. Metals-contaminated Soil |
| 7. Former Car Shop No. 9 | 16. Hydrocarbons-contaminated Soil |
| 8. Former Wheel Foundry | 17. Soil Sampling Unit 23 (SS-23) |
| 9. Sheet Metal Shop and Former Radiator Shop | |



SOUTHERN PACIFIC SACRAMENTO RAIL YARD

SUMMARY OF ENVIRONMENTAL ANALYSIS

Area A - 37 Acre Parcel (Sacramento Station)

General - Field investigation conducted in early 1989 identified two soil contaminants: metals (primarily lead) and petroleum hydrocarbons.

15 & 17) Metals-contaminated soils will be excavated and fixed and removed to a licensed disposal facility by November 1990.

16) Hydrocarbon-contaminated soil will be excavated and bioremediated or shipped off-site for use in an asphalt mixing process by November 1990.

Area B East - Car Shop 9 of the Overall Site

General - Field investigations conducted as part of Phase I of the Overall Site investigation in 1989. Phase I was conducted in response to the Enforceable Agreement negotiated and signed in mid-1988. Over 25 individual site areas were sampled in Phase I. No operations exist in Area B East.

6 & 7) Contaminant of concern is lead in soil samples collected in the sandblasting area and painting sheds.

Future Schedule - Phase II workplan will be developed in early 1990. Phase II will be implemented in mid-1990. Phase II second step will be conducted in 1991 to complete the RI, and an FS will be conducted in 1992.

Area B West - Riverfront Parcel

General - Field investigations conducted as part of the Phase I of the Overall Site investigation in 1989. Only one area of concern was identified in Area B West. Some operations exist in Area B West.

3) Metals in elevated levels were found in soil samples near the former brass foundry.

Future Schedule - Phase II is planned as described above for Area B East.

Area C - Northern Area

4) Pond and Ditch - Site has been characterized through the preparation of the RI/FS/RAP Reports. RAP approved by DHS in July 1989. Field investigations identified metals contamination (primarily lead) in the soil. Sampling of ground water identified volatile organics as the primary contaminant. No operations exist in this area.

13) Drum Storage Area - Preliminary and Phase I Field investigations identified volatile organics and in particular vinyl chloride as the primary contaminants in both the soils and ground water. Phase IIA, IIB and IIC site investigations conducted and completed in November 1989. Currently seven remedial alternatives are proposed for the contaminated soils and three ground water remedial alternatives for the water. Some operations exist in this area.

5) Lagoon and Other Areas - Field investigations conducted as part of Phase I of the Overall Site investigation. Sampling indentified the presence of elevated levels of metals in a waste dump area west of the pond and ditch. Volatile organics were found in soil samples from a small area north of the pond and ditch. Volatile organics are deteced in the ground water in this area. No operations exist in these locations or in the remaining areas of Area C.

Future Schedule

Pond and Ditch - Metals-contaminated soil will be excavated and fixed and replaced and capped on-site by November 1990. A ground water extraction system will be installed in early 1991 to extract contaminated ground water which will be sent to the POTW.

Drum Storage Area - Plans are to obtain DHS approval on Phase II RI and to submit DRAP to DHS in April 1990. Obtain DHS approval on Final RAP by the end of 1990.

Lagoon and Other Areas - Phase II investigations are planned as described previously for Area B.

Area D - Central Shops Area

General - Enforceable Agreement negotiated and signed in mid-1988. Workplans for the RI/FS process were developed in the end of 1988. The investigation will be conducted in a four phase approach. Phase I was conducted in 1989. Over 25 individual site areas where targeted for sampling.

Central Shops, 1, 2, 9, 10, and 14) The results of phase I indicated that lead at elevated levels is found in the soil in the areas of the painting facility and the cleaning areas. Petroleum

hydrocarbons were also found in the cleaning area. Volatile organics were detected in soils throughout the central shops. Organic compounds similar to those in the soil contaminate the ground water in the central shops area.

Future Schedule - Phase II workplan will be developed in early 1990. Phase II will be implemented in mid-1990. Phase II second step will be conducted in 1991 to complete the RI, and an FS will be conducted in 1992.

11) Battery Shop - Field investigations identified lead in the soil as the primary contaminant. Source area has been identified. Results of ground water sampling indicate that lead is not a ground water contaminant. However the ground water wells are right in the middle of the organic plume from the central shops. The RI/FS/RAP process has been completed in Feb/March 1989. SP is awaiting DHS comments on the RAP.

Future Schedule - The proposed remedial action is to remove the soil down to 8-10 feet and fixed and disposed of at the pond. That action, however, would not meet the Pond and Ditch remediation schedule. The plan is to submit final RAP to DHS in mid-1990, submit RAW to DHS at the end of 1990, and implement cleanup in 1991.

Sand Piles Area

General - Field investigations identified copper as the primary contaminant. RI/FS/RAP process was completed in 1989. The RAP was implemented in Sept/Oct of 1989. Remediation consisted of removing the piles from the site and shipping the sand to Reed and Gram who used the sand in the asphalt mixing process. Site remediation is complete.

SOUTHERN PACIFIC SACRAMENTO RAIL YARD

SUMMARY OF GROUND WATER RELATED WORK

Pond and Ditch Site Plume

RAP approved for implementation of pump and treat remedial action. Plume consists of volatile organics (solvents) primarily in the shallow sand zone. Currently SP is in the final design phase and plans to initiate pumping and treatment at the POTW toward the end of 1990.

Drum Storage Area Plume

Plume consists of volatile organics in the shallow sand zone. SP is currently planning to conduct aquifer pumping tests at the site and will design a pilot pumping program subsequent to test analysis.

Southeast Plume

Plume consists of volatile organics in the shallow sand and upper gravel zones. A program is underway to characterize the limits of contamination both horizontally and vertically at locations both onsite and offsite. Based on this characterization, preliminary designs for a ground water recovery and treatment system will be developed and presented in the RAW by 1 September 1990.

ATTACHMENT H

Inadequacies of State "superfund" Program

Discussion of Inadequacies of the State Superfund Program in Providing for Long-Term Protection of Public Health and Environmental Quality, and the Interest of the City, Associated with the Redevelopment of the SP Site

The federal Superfund program began as a crash program out of the Love Canal situation, to guide the definition of the hazards associated with industrial areas or areas in which industrial chemicals had been deposited such as landfills. It was also designed to guide the remediation of such contaminated areas so that they would not represent significant threats to uses of adjacent properties. In the beginning the focus of the Superfund program was not the protection for re-use of the site, itself, but rather for the protection of uses of adjacent properties. The program has however been evolving to consider protection needed in order to re-use Superfund properties. For various reasons, only a few of the sites across the country at which significant amounts of hazardous chemicals are present, are listed as federal Superfund sites. States have the responsibility for managing contaminated industrial sites that are not included within the federal Superfund program. States' regulations for their own "superfund" sites are typically patterned after the federal regulations. The SP site is one of California's state "superfund" sites.

The "superfund" review and remediation process requires that the details of the evaluation of the type and degree of contamination, the amount of clean-up needed for subsequent use of the property, and other issues, be developed on a site-specific basis. Since the technical community has not come to consensus about minimum requirements for these details, and since the degree of protection of public health and environmental quality that should be assured is subjective, some degree of "negotiation" is involved in establishing what must be done at each particular location. In California, representatives of the applicant make a proposal to DHS to follow a particular approach in site investigation and/or remediation. The DHS reviewers comment on the proposal, indicating deficiencies they perceive in the approaches. The outcome of the "negotiations" is typically highly influenced by the applicant's trying to spend the least amount of money for investigation and remediation, and the state's trying to develop appropriate levels of investigation and remediation. The position of the state is based to a considerable extent on the understanding that the negotiator(s) has of the hazards that could be present at the site, and of the type and degree of remediation needed to protect future users of the property based on what the applicant states is the intended use.

The members of the technical community - professionals developing and evaluating approaches - are

far from coming to agreement on what is adequate for site investigation and about "how clean is clean?" especially for the public re-use of contaminated properties. Many of the details of the studies that need to be done are thus established somewhat arbitrarily. One example is how close together should samples be taken all over the site to be satisfied that all of the contaminated areas are found. Another example is how many and which chemicals should be measured in samples of soil and groundwater at the site and away from the site. A third example is "how clean is clean" for the re-use of the property. Since the degree of public health protection that should be achieved is a subjective assessment, and since the investigative and remediation approaches necessary to achieve any given degree of public health protection are not well-defined, the comprehensiveness of a site investigation, the degree of remediation needed, and the degree of public health protection that is actually provided with the remediation can vary from site to site and within a given site.

There are significant pressures on the personnel of regulatory agencies that can cause less-than-optimum review of a particular site. Regulatory agencies are often significantly under-funded and understaffed. There is a well-recognized national shortage of adequately trained personnel to conduct the federal and state "superfund" programs. Further, because of the newness of superfund-type investigations and high turn-over rates among agency personnel, and the considerable legislative pressure to demonstrate completion of site remediation given the money being spent, there is opportunity for less-than-optimum site characterization and remediation. There is, therefore, concern about the adequacy of the state and federal "superfund" programs to produce appropriate evaluations of site hazards, and remediation objectives and methodology. There is also concern in the technical community about the appropriateness of intense public re-use of "superfund" sites. We have found through our work on evaluating the presence of contaminants, the approaches for remediation, and clean-up effected, that there is ample justification for the national concern about the adequacy of the "superfund" programs as they are being implemented to provide for long-term protection of public health and environmental quality where there is to be intense redevelopment. Just meeting the minimum requirements accepted by DHS for site evaluation or remediation does not necessarily provide assurance that there will be long-term protection of public health or environmental quality associated with the planned redevelopment of the SP site.

One of the major controversies that has existed throughout the federal and state superfund programs is "how clean is clean?" For years, professionals in the field have been struggling with this issue, and the answers are still evolving. As discussed above, the issue has two components, the degree of public health protection that can and should be afforded both on and adjacent to remediated superfund sites, and the nature and comprehensiveness of investigation and remediation needed to achieve a given degree of public health protection. The American Public Health Association held a national conference in early October of this year that included a session, "Superfund: Where Are We Ten Years Later." An International Specialty

Conference - "How Clean is Clean?" Clean-up Criteria for Contaminated Soil and Groundwater - is scheduled for early November 1990 in Boston, MA. There is still no general agreement on the degree of investigation necessary, appropriate treatment-remediation technology, and the appropriateness of redeveloping for intense public use so-called "remediated areas." Generally, the principal responsible parties for superfund sites are trying to do the least possible investigation and remediated in order to save money. The public, on the other hand, who could be affected by residual chemicals left at a site after the "remediation" generally advocate a more comprehensive investigation, a more effective clean-up, and unequivocal protection from chemicals from the site. The regulatory agencies try to develop compromises on these issues; what they adopt typically provides a high degree of protection of public health and environmental quality for off-site concerns. However, the introduction of intense public use of these sites after "remediation," adds another dimension to the concern about long-term protection of public health and environmental quality. Since redevelopment of the type being considered for the SP site is rare for superfund sites, that additional dimension has not had to have been addressed to the extent necessary to develop consensus on what should be done to provide adequate protection. Further, there is no long-term experience with such redevelopments from which to draw information on the adequacy of particular approaches to or degrees of remediation.

As noted above, there is a significant number of somewhat arbitrary decisions negotiated in establishing the overall remediation for superfund sites. An example of negotiated compromise that frequently occurs at superfund sites which has relevance to the SP site is the issue of the spacing between soil samples over the site. At this time, SP has used a 400-foot grid spacing for collection of soil samples to look for the presence of contaminants across much of the site where specific sources of contaminants are not known. That means that a distance greater than a football field would exist in any direction between one sampling point and the next. Based on our own experience and based on discussions with numerous other professionals in the field, those sampling points are too far apart for this type of site and its proposed redevelopment. Based on the nature of the site and the types of activities that did and could have taken place over the past 100 years (whether they were recorded in company logs or not), there could well be contamination that would go undetected with that spacing. The actual spacing that will be required will be negotiated; the shorter the distance between sampling points, the lower the probability of not detecting a "hot spot" or contaminated area, the greater the assurance of public health and environmental quality protection, but the greater the cost to SP for sampling and analysis. At this time the spacing that will actually be achieved is uncertain since this issue has not yet been addressed by DHS.

Another concern noted above relates to the policy adopted by DHS regarding which chemicals to measure at the SP site. Of the many hundreds of chemicals that could be present at the SP site, DHS is

requiring that only 150 or so - basically those on the list of Priority Pollutants, be determined. However, that list does not represent a comprehensive group of all chemicals that could be present at that site that could be hazardous or detrimental to future uses of the site or on-site and off-site groundwaters; that list was not developed for that purpose. The list of Priority Pollutants was developed under court order and did not receive the scrutiny of the technical community due to it. Further, the list was developed to include chemicals that had been reported in surface waters and to focus on contaminants discharged from industrial and domestic wastewater sources to surface waters. It was not developed based on chemicals that could be in soils or groundwaters at industrial sites. None-the-less, the DHS policy for state "superfund" site investigation, as well as the US EPA policy for federal Superfund sites, is to focus on Priority Pollutants. That policy has evolved out of somewhat arbitrarily established federal legislation governing the Superfund program, and the fact that analytical methods are readily available for the Priority Pollutants. It is well-known that there is a wide variety of other chemicals that can be present at superfund sites, that can be readily measured by other techniques. At this time, neither the federal nor state program is requiring such measurements.

These comments about the negotiation process in establishing site investigation and remediation are not directed toward indicating that DHS and its personnel are not in general adequately performing their responsibilities in the state "superfund" work at the SPTC site. However, it is likely that few DHS personnel would not admit that if they had more time and resources to devote to each superfund site project, and most importantly, if there were more information available on the approaches that should be adopted to provide a high degree of reliability in finding "hot spots" of hazardous chemicals at superfund sites and in providing adequate remediation for re-use, they could provide for increased public health and environmental protection.