Northern California Regional Office 41674 Christy Street, Fremont, CA 94538-3114 (415) 659-0404 Fax: (415) 651-4677 Lic. # 596545

EXCELTECH

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April 8, 1991

Ms. Pamela J. Evans
Hazardous Materials Specialist
Alameda County Health Agency
80 Swan Way, Room 200
Oakland, California 94621

SUBJECT: Health Risk Assessment
23830 and 23836 Saklan Ave., Hayward, California

Dear Ms. Evans:

Enclosed is a copy of the Health Risk Assessment prepared for Exceltech by Mr. Norman E. Riley. This assessment is in response to your letter request dated March 14, 1991, to Mr. Rob Robles, item number 2.

This document is being submitted in advance of a meeting we would like to schedule to discuss further activities on the site. Specifically, we intend to discuss the sampling procedures that you have requested and that Mr. Riley recommends in his assessment, to further characterize the site

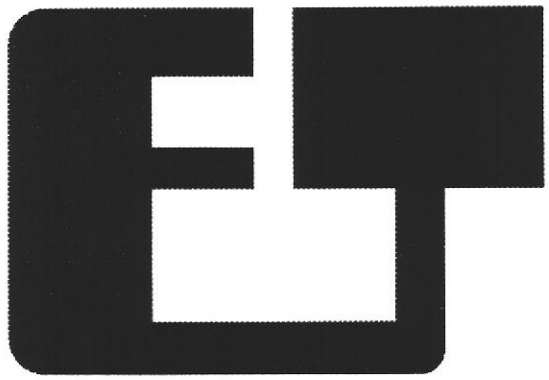
If you have any questions concerning the assessment or other activities in regard to this site please call.

Sincerely,

Jeff Willett, P.E., Manager
Assessment, Compliance, and Training

Enclosure

cc: Mr. F. Rob Robles
Mr. John D. Barbour



EXCELTECH

HEALTH RISK ASSESSMENT

FOR SAKLAN AVENUE PROPERTY

HAYWARD, CALIFORNIA

Prepared By Norman E. Riley
Exceltech Project No. 3-50058-51

HEALTH RISK ASSESSMENT

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for

Exeltech
41674 Christy Street
Fremont, Ca 94538

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HEALTH RISK ASSESSMENT
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BACKGROUND

The parcels of interest are located at 23830 and 23836 Saklan Avenue in the City of Hayward, California. The property is situated in the western portion of the city near the intersection with Middle Lane and is less than one mile south of the Hayward Air Terminal and approximately two miles east of the San Francisco Bay. The property is bounded on the north, east, and south by residential developments and on the west by light industrial business complexes situated across Saklan Avenue. The site is planned for residential development.

A preliminary environmental assessment of the property was conducted in 1989 by Ensco Environmental Services, Inc. Following a review of the subject property and other adjacent parcels (23718 through 23836 Saklan Avenue) to be developed concurrently, the consultants reported that no evidence of hazardous materials, hazardous waste, underground storage tanks, PCBs, ACMs (asbestos containing materials), surface stains or spills was observed during a September 6, 1989 visual inspection of the area. In a summary dated September 22, 1989, the Ensco consultants noted that aerial photographs of the area taken as late as September 1979 showed that "several large greenhouses" were present on the property.

The events of the following year are unknown to the author of this report; however, on November 8, 1990, Chips Environmental Consultants, Inc., based in Sunnyvale, California, corresponded with the Alameda County Department of Environmental Health regarding recent tests of surface soil within "the one existing

greenhouse structure". Four discrete samples were collected from the surface to about two inches in depth at that location. The resulting analytical data from this phase of the investigation were said to indicate fairly uniform pesticide levels (1-6 ppm). DDT and associated degradation products (DDD and DDE) were detected along with lindane and several related stereoisomers. The consultants also reported the occurrence of PCBs (Arochlor 1242) in one sample at a concentration of 19 ppm. Based on these findings, the collection of six additional samples was proposed to characterize the areas of concern. According to the sampling plan provided to the Alameda County Department of Environmental Health, five of these samples were to be collected from past greenhouse sites and one "background" sample was to be collected from an area where no greenhouses existed. The sample which was collected to ascertain background concentrations is not identified in the consultant's report or sampling plan.

Following these events, Exeltech, a Fremont-based environmental consulting firm, became involved in this project. A series of meetings were held and several letters concerning the resolution of this case were prepared. In its letter of March 14, 1991 to Venture Properties, the Alameda County Department of Environmental Health requested that a risk assessment be prepared for the site which addresses, at a minimum:

" a. Routes of exposure to onsite contaminants, taking into consideration oral, dermal and inhalation exposures to the soil for construction personnel, future residents, and other persons who might be affected by pesticide residues in soils at the site...[and]

b. The manner in which any significant health risks identified by the risk assessment will be mitigated."

The Department of Environmental Health noted that section 22-12705, Title 26 of the California Code of Regulations, specifies regulatory levels deemed to pose no significant health risk for a number of chemicals, including some of those found to be present at the Saklan Avenue site. Where no regulatory level for a specific contaminant is listed in section 22-12705, the Department directed that the risk assessment specify the level of no significant risk.

The approach that will be taken to address these directives can be divided into three steps. These are: (1) hazard identification, (2) hazard evaluation, and (3) risk evaluation. Together, these three steps constitute risk assessment. The identity and concentrations of contaminants at the site will be addressed in the first step. Hazard evaluation will involve qualitative and quantitative assessments of these data with particular emphasis on environmental fate and health effects associated with exposure by various routes. The final phase, risk evaluation, will involve quantitation of the relevant health and environmental threats posed. This risk assessment will thus provide:

1. Characterization of the types of health effects associated with exposure to identified toxicants;

2. A determination of whether the probability (risk) of occurrence of a specific health effect (cancer) in biological receptors of concern exceeds the level of acceptable risk.

The selection of a remedial action strategy is usually addressed in a feasibility study. Based on the conclusions reached in this report, an appropriate mitigative strategy will be suggested if corrective action is indicated. A complete evaluation of all

possible remedial actions will not be attempted, nor will a risk management decision be made in this report.

I. HAZARD IDENTIFICATION

The investigative results for the Saklan Avenue property are summarized in Table I. Samples collected from the surface soils at the site were analyzed by Trace Analysis Laboratory in Hayward. The results indicate that detectable concentrations of aldrin, alpha-BHC, delta-BHC, gamma-BHC (lindane), DDD, DDE, DDT and PCB (Arochlor 1242) are present in soil at the site. Copies of the analytical reports are included in the Appendix.

Aldrin (1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-dimethanonapthalene) is an organochlorine insecticide. Lindane (hexachlorocyclohexane or gamma benzene hexachloride), also an organochlorine insecticide, is the effective agent among the eight well described stereoisomers of hexachlorocyclohexane, including alpha-BHC and delta-BHC. DDT is an organochlorine insecticide. The term DDT is generally understood throughout the world and refers to p,p'-DDT (1,1'-[2,2,2-trichloroethylidine]-bis [4-chlorobenzene]) although different isomeric forms, for example, o,p'-DDT, are usually associated with technical formulations of DDT. DDD and DDE are derivatives of DDT resulting from metabolism or environmental degradation. Arochlor 1242 is a polychlorinated biphenyl compound containing approximately 42 weight percent chlorine. Data concerning the physical and chemical properties of these substances are presented in Table III.

TABLE I. SUMMARY OF ANALYTICAL RESULTS
FOR SOIL SURFACE SAMPLES COLLECTED AT THE SAKLAN AVENUE SITE

	Sample concentration (ppb)									
Compound	d1	d2	d3	d4	c1	c2	c3	c4	c5	c6
aldrin	2.5	2.5	25	2.5	2.5	34	15	10	10	10
a-BHC	31	17	25	25	4.5	10	4.5	25	25	25
d-BHC	590	49	25	610	14	210	54	10	10	10
g-BHC	120	17	25	24	13	79	33	10	10	10
DDD	250	240	840	460	57	300	120	590	25	220
DDE	1100	1300	1500	1500	230	1900	630	830	120	740
DDT	2100	1400	5200	3100	550	6500	1400	5600	110	640
PCB	2.5	2.5	19000	2.5	3.0	5.0	3.0	15	15	15

1. d = discrete sample, c = composite sample
2. underlined values represent one-half the limit of detection (LOD) recorded by the laboratory. One-half values are recommended in statistical evaluation to avoid introducing a positive or negative bias that occurs when ND values are assumed to equal zero or the LOD (Nehls and Akland, 1973). All values shown in this Table are used in the statistical calculations.

No information is available regarding whether the samples were randomly collected; however, the pattern of sampling (approximately 50 feet apart along the north/south axis and 50 feet apart along the east/west axis) and the fact that all sampling was confined to the uppermost horizon suggest that a judgmental approach was used. The sampling appears to have been conducted for purposes of contaminant identification rather than environmental fate determination or public health risk assessment. No data are available concerning other environmental media, in particular, groundwater. The physical and chemical properties of these contaminants do not necessarily suggest that contamination of other media should be suspected; however, confirmational data are absent.

The California Department of Health Services has established regulatory thresholds (STLCs and TTLCs) for aldrin, DDT and its derivatives, lindane, and PCBs. These criteria are presented in section 66699(c), Title 22, California Code of Regulations. Only DDT and its residues (DDTr) are present at a concentration above the adopted TTLC. The application of these standards to the assessment of hazard associated with the contamination at the Saklan Avenue site is not appropriate at this point because no "waste" has been released at the site and no waste been generated. Health and Safety Code section 25321(d) specifically excludes the normal application of pesticides from the definition of "release". While there is no evidence provided in the available record of this site which conclusively demonstrates that these residues resulted from the normal application of pesticides, the contamination is presumed to result from normal application given the historic use of the site. The occurrence of pesticide residues in each of the samples tested tends to support this assumption. Had the contamination resulted from waste disposal (e.g., container rinseates) the pattern of distribution would probably not be so diffuse. Excavation and removal of soil from the site would constitute waste generation,

thus activating the classification requirement established in section 66471, Title 22, California Code of Regulations.

While various statistical methods of may be used to evaluate these data, regulations adopted by the California Department of Health Services require, for purposes of waste evaluation, that analytical data be treated according to the methods specified in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, 2nd Edition, U.S. Environmental Protection Agency, 1982." The standard statistical tests used in this approach provide information concerning the mean, variance, standard deviation and standard error for any given set of data. Most importantly, these tests provide an indication of confidence which can be assigned to the data and the extent of any additional sampling which may be needed to achieve a desirable level of confidence. For characterization purposes, SW-846 specifies that a two-tailed, 80-percent confidence interval be used. A statistical analysis of the resulting data has been performed using these prescribed procedures and the results, summarized in Table II, indicate the following:

1. The mean concentration of DDT residues (DDTr, the sum of DDT, DDD and DDE compounds) is 3.95 ppm. The concentration at the upper confidence limit (UCL) is 5.25 ppm. The concentration at the lower confidence limit (LCL) is 2.65 ppm.

2. Aldrin residues were only detected in two of the 10 samples analyzed. The mean concentration of aldrin is 0.01 ppm . The concentration at the 80 percent UCL is 0.016 ppm. The concentration of aldrin at the 80 percent LCL is calculated to be 0.006 ppm.

3. Lindane residues were detected in 7 of the 10 samples tested. The mean concentration of lindane is 0.03 ppm. The

concentrations at the upper and lower 80 percent confidence limits are 0.05 and 0.01 ppm, respectively.

4. Arochlor 1242 was found in one of the ten samples analyzed. If the results are averaged over the entire site, the mean concentration of PCB is 1.9 ppm. The discovery of a single positive value is unexpected. Spot contamination due to leakage from a capacitor or transformer might be the cause. PCBs were also used in the formulation of lubricating and cutting oils, pesticides and as plasticizers in paints, adhesives, sealants and various plastic products. The reported percent recovey for the sample is within acceptable limits, but the value should still be regarded as suspect. The concentration is not high (19 ppm) and the contamination is evidently not widespreasd; however, further investigation may be warranted. The result could be due to a number of extraneous factors. At a minimum, duplication of the results should be attempted if extraneous factors are ruled out as the cause.

TABLE II. STATISTICAL RESULTS FOR SAKLAN AVENUE DATA
(all concentrations shown in ppb)

1. Aldrin. (RT = 1400)

2.5, 2.5, 25, 2.5, 2.5, 34, 15, 10, 10, 10, n_1 = 10

Mean = 11.4
Variance = 114.6
Standard deviation = 10.7
Standard error = 3.38
Tvalue = 1.383
UCL = 16.08
LCL = 6.71
n_2 = 0.00

2. Lindane. (RT = 4000)

120, 17, 25, 24, 13, 79, 33, 10, 10, 10, n_1 = 10

Mean = 34.1
Variance = 1340.1
Standard deviation = 36.6
Standard error = 11.57
Tvalue = 1.383
UCL = 50.1
LCL = 18.0
n_2 = 0.00

3. DDTr. (RT = 1000)

3450, 2940, 7540, 5060, 837, 8700, 2150, 7020, 255, 1600,

n_1 = 10

Mean = 3955.2
Variance = 8831524.8
Standard deviation = 2971.7
Standard error = 939.7
Tvalue = 1.383
UCL = 5254.8
LCL = 2655.5
n_2 = 1.9

4. PCB. (RT = 50000)

2.5, 2.5, 19000, 2.5, 3.0, 5.0, 3.0, 15, 15, 15, n_1 = 10

Mean = 1906.3
Variance = 36073225.9
Standard deviation = 6006.0
Standard error = 1899.2
Tvalue = 1.383
UCL = 4533.0
LCL = -720.3
n_2 = 0.02

RT = regulatory threshold (TTLC)
Tvalue = value for n-1 degrees of freedom from standard Student's T-test table
UCL = 80 percent upper confidence limit
LCL = 80 percent lower confidence limit

The confidence interval of 80 percent assumes normal distribution of data about the mean and is effectively a one-tailed 90 percent confidence test (i.e., given the observed variance, standard deviation and standard error, a randomly collected sample would be expected to exceed the concentration at the upper confidence limit less than 10 percent of the time).

With respect to the representativeness and adequacy of sampling, the statistical results using normalized data indicate that a sufficient number of samples have been collected and analyzed to conclude that the surface soils have been adequately characterized for lindane residues, DDT residues, PCB and aldrin ($N_2 - N_1$ is less than one in each case tested).

While the data appear to be sufficiently representative of the surface soils, they are not necessarily representative of the entire site because they do not reflect concentrations of pesticide residues (and possibly PCBs) beneath the surface. This conclusion is unavoidable regardless of what level of confidence is used in the statistical calculations. Nothing is known about the depth of contamination at this location. Additional sampling would be needed to ascertain whether the contaminants are confined to the upper strata or whether these substances have migrated to significant depths beneath the surface layer. Assuming the contamination resulted from the normal surface application of pesticide, or in the case of PCB, leakage from a capacitor, for example, migration to significant depths below the surface would not be expected (see discussion of environmental fate in section II); however, the confinement of toxicants to the surface layer (which was evidently suspected by the Chips consultants) has not actually been confirmed. At a minimum, additional sampling would be necessary to confirm the effect, if not success, of most conventional remedial actions, if any are implemented. The preliminary results and nature of this

particular problem suggest that a stratified random sampling approach should be used.

For purposes of this assessment, it will be assumed that the estimated mean concentrations are representative of the entire site. As the following discussions suggest, the true mean concentrations are probably much lower (assuming the contamination results from normal surface application) because the effect of lower concentrations beneath the surface will be to lower the mean values (and the level of risk associated with exposure to these soils). Reynolds, et al., (1990) suggested that the upper 10 feet of the soil profile should be considered available for exposure in residential settings because typical home construction projects in California frequently involve disturbance of soil to that depth. The construction plans for this site do not call for disturbance of soil to such depths, therefore, factoring the conentrations at those depths into the statistical analyses would be unreasonable unless the soil is contaminated to that extent or is excavated to that depth afterall. While a more limited assessment is made in this case, it is important to keep in mind that if the ture mean concentrations of contaminants at the site are below those assumed in this report, the conclusions reached in this report regarding risk associated with exposure to the Saklan Avenue soils will be overestimated.

II. HAZARD EVALUATION

To effectively evaluate the risk associated with identified hazards; estimate acceptable concentrations; establish appropriate cleanup levels; and develop appropriate remedial strategies, the environmental fate of the identified contaminants must be known. Understanding the environmental fate of

contaminants is critical to evaluating the risks associated with exposure to identified contaminants because the effects of exposure will be moderated by the concentrations of contaminants in any given medium of exposure (response is a function of dose). The concentrations of chemicals in various media to which individuals may be exposed (air, water, soil, food) must be known and these must be compared to the levels of exposure which will produce adverse effects. If the environmental levels are lower than the adverse-effect levels and are likely to remain below those levels given factors which influence the environmental fate of chemicals (e.g., adsorption, desorption, volatilization, solubilization and bioconcentration), concern may not be warranted because exposure would not result in any adverse effect.

A detailed procedure for environmental fate determinations has been outlined by the California Department of Health Services (CDHS, 1986). The environmental fate of a contaminant and specifically, its transfer between environmental media (air, soil, water and biota) is influenced by a combination of site-specific factors (e.g., soil type, soil adsorption) and the physical and chemical characteristics of the contaminant(s), (e.g., soil/water distribution coefficients, octanol/water partition coefficients, vapor pressure, water solubility). To predict the environmental fate of chemicals it is necessary to know something about site-specific factors and the physical and chemical characteristics of the substances in question. With this information, reliable predictions can be made concerning the environmental fate of the chemicals and the risks associated with exposure to contaminated media. Most of these data are available in the scientific literature but some may have to be obtained by field measurements. Most of the information used in this assessment has been obtained directly from the literature.

Site-Specific Factors

The Alameda County area has a marine climate characterized by moderate temperatures which vary little throughout the year. The mean annual temperature is approximately 57 degrees Fahrenheit (range 104 to 22). In normal years the average annual precipitation in Hayward ranges between 20.38 inches and 25.42 inches according to measurements at two stations in the Hayward area. Rains fall primarily in the winter months. Strong winds are unusual in this area. Wind speed is less than 6 mph more than 50 percent of the time and exceeds 12 mph only 10 percent of the time. The Saklan Avenue Property is situated on soils that are characterized as "Clear Lake clay" (0 to 2 percent slopes). Clear Lake clay is described by surveyors as a very deep, poorly drained soil. The surface layer is typically dark grey and is comprised of neutral and moderately alkaline clay about 37 inches thick. The underlying material is calcareous, dark gray and grayish brown clay and silty clay to a depth of 60 inches or more. The erodibility of this soil is poor (K factor = 0.24) and the permeability is slow (USDA, 1975). The particle sizes for the Saklan Avenue soil are not precisely known; however USDA surveyors report that clay particles are generally less than 0.004 mm in diameter. Other sources indicate that some clay fractions are below 10 microns in size. The depth to groundwater at the site is approximately 30 to 40 feet (Exeltech, personal communication, 3/26/91). The nearest principal body of water is the San Francisco Bay approximately 2.3 miles to the west. Alameda Creek runs approximately 3.5 miles to the south.

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TABLE III. PHYSICAL AND CHEMICAL CHARACTERISTICS OF IDENTIFIED CONTAMINANTS

1. DDT. The relevant physical and chemical properties of DDT (for p,p'-DDT and o,p'-DDT) are reported as follows:

Vapor Pressure at 20°C	1.9×10^{-7} mm Hg for p,p'-DDT (IARC, 1973, WHO, 1989a)
Water Solubility at 25°C	1.2-25 ug/l for p,p'-DDT 26-85 ug/l for o,p'-DDT (Callahan, et al., 1979)
Bioconcentration Factor (BCF)	103 to 106 (Callahan, et al., 1979) variable (ranging up to 154,100) according to species, duration of exposure, concentration, flow rate, temperature and organ system examined (WHO, 1989a)
Half-life in water	56-110 days in lake water (USEPA, 1984a)
Half-life in soil	3-15 years (IARC, 1973) 5 - 8 years (Wheatly, 1965)

2. Aldrin. The relevant physical and chemical properties for aldrin are reported as follows:

Vapor Pressure	7.5×10^{-5} mm Hg at 20°C 1.4×10^{-4} mm Hg at 25°C (USEPA, 1987) 6.4×10^{-5} at 25°C (WHO, 1989b)
Water Solubility	27 ug/l at 27°C (USEPA, 1987, WHO, 1989b)
Log octanol/water partition coefficient	3.01 (USEPA, 1987) 7.4 (WHO, 1989b)
Half-life in water (evaporation)	185 hours at 25°C and 1 m depth (USEPA, 1987)

3. Lindane. The relevant physical and chemical properties for lindane are reported as follows:

Vapor Pressure	1.6×10^{-4} mm Hg (Mabey, et al., 1981)
Water Solubility	7.8 mg/l at 25°C (Horvath, 1982) [alpha and beta isomers are practically insoluble in water] IARC, 1973)
Log octanol/water partition coefficient	3.85 (Veith, et al., 1979)

Log BCF	2.26 - 2.67 (Veith, et al., 1979)
Half-life in water	5 - 10 days (estimated) (USEPA, 1984b)
Half-life in soil	56 days in clay loam (Callahan, et al., 1979) 378 days in sandy loam (Callahan, et al., 1979)

4. PCB. The relevant physical and chemical properties for Arochlor 1242 are reported as follows:

Vapor Pressure	4.06×10^{-4} (USEPA, 1984c)
Water Solubility	0.24 mg/l at $25^{\circ}C$ (Mackay and Leinonen, 1975)
Log octanol/water partition coefficient	4.11 - 5.58 (USEPA, 1984c)

Environmental Fate - Soils

The environmental fate of compounds detected at the Saklan Avenue site has been investigated by many different researchers. With the possible exception of lindane, each of the identified contaminants at the site are considered resistant to breakdown and are readily adsorbed to sediments and soils which act as sinks and as long-term sources of exposure. The tendency to adsorb strongly to soils is consistent with the high solubility in lipids and comparatively low water solubility of these compounds. For example, Shin et al., (1970) investigated the adsorption of DDT by soils of various types and by isolated soil fractions. Strong adsorption was reported in clays and was closely related to the organic matter content. Wheatly (1965) estimated the half-times for loss of DDT applied to soils. After surface application, 50 percent of the DDT was lost within 16 to 20 days. The estimated time for loss of 90 percent of the surface applied DDT was 1.5 to 2 years. When DDT was mixed into the soil, 50 loss occurred in 5 to 8 years. It was estimated that 90 percent of the applied DDT would be lost in 25 to 40 years. Some researchers have estimated that the average time for 95 percent disappearance of DDT from soil would be 10 years (range 4 to 30 years) with an average of about 50 percent remaining after 3 years (WHO, 1989a). Other investigators have estimated that 50 percent of applied DDT would remain in soil for at least 15 years (Chisholm and MacPhee, 1972).

These findings suggest that the amount of DDT present in the Saklan Avenue soil was probably higher at one time and that further losses can reasonably be expected with a concomitant reduction in risk to long-term residents and persons entering the area (assuming no corrective action is taken). Such losses would be slow given the exponential (first order) nature of pesticide dissipation.

The environmental fate of PCBs is similar to that of DDT by virtue of the fact that they have similar structures. Higher chlorinated PCBs (e.g., Arochlor 1242) are not leached from soils by percolating water and those with lower chlorine contents are removed only slowly, particularly from soils with high clay content (Tucker, 1975). PCBs are considered to be refractory by many scientists. Losses can occur by volatilization from soil although no reports were found which describe such transfer as appreciable. The Environmental Protection Agency has reported measuring 1 to 50 ng/m^3 in air (WHO, 1976).

Aldrin has a low propensity for movement away from soil either through volatilization or by leaching (WHO, 1989b). Aldrin rarely penetrates more than 20 cm beneath the top treated layer of soil. The compound adheres to soil particles to such an extent that only traces can be removed by water. For this reason, groundwater contamination does not generally occur (WHO, 1989b). There is a possibility of migration by way of soil erosion, wind drift, sediment transport and surface runoff.

The measured organic carbon/water partition coefficient for lindane (K_{OC} = 735) suggests a low soil mobility (USEPA, 1984b), although there have been some reports of groundwater contamination by lindane where soils have been low in organic content (ibid). Among the contaminants identified at the Saklan Avenue site, lindane disappears from soil most quickly due to a combination of factors, principally faster evaporation and lesser adsorption by organic material (IARC, 1973).

Based on the preceding observation, the mobility of contaminants at the Saklan Avenue site can be predicted to be extremely slow. This conclusion is consistent with the hydrophobic and lipophillic character of these substances, and the type of soil present at the site. The limited mobility of these compounds suggests that most of the contaminants in the Saklan Avenue soils

can be expected to remain in the soil. The tenacity of these compounds in soil means that contact via dermal, oral or inhalation exposure is an appropriate concern for risk assessment.

An additional potential source of chemical exposures for residents in the area which merits discussion might be exposure from locally grown garden fruits and vegetables absorbing contaminants from the soil. Experience suggests that such exposures are likely to be insignificant in this case. For example, it has been reported that very little DDT or related compounds are detected in foliage of plants grown in soils containing DDT. Fuhremann and Lichtenstein (1980) reported that the uptake of labelled DDT into oat plant tops was so low that it could not be analyzed. DDT was not translocated into the foliage of alfalfa when applied to the soil (Ware, 1968 and Ware, et al., 1970) or into soybeans (Eden and Arthur, 1965). Harris and Sans (1967) found only trace amounts of DDT and metabolites in the storage roots of carrots, radishes and turnips growing in soils containing up to 14 ppm DDT. These reports are consistent with the findings of a recent study conducted by the California Department of Food and Agriculture which examined the concentrations of DDT in various fruit and vegetable commodities grown in the state (CDFA, 1985). Concentrations of DDT were found in citrus fruits, squash, collards, onions, parsley, beets, carrots, peppers, potatoes, spinach, tomatoes and many other plants. Generally, the commodities having the highest levels of DDT were those which grow on or in the soil (e.g., carrots). In all cases the levels of DDT were well below established tolerance limits. The investigators concluded that the source of this DDT was residual pesticide remaining in California soils thirteen years after the use of DDT had been discontinued.

In assessing the extent of residual DDT contamination in California soils, the Department of Food and Agriculture

collected samples from various locations throughout the state where DDT was known to have been used. A total of 99 samples were collected from 32 counties. DDT residues were detected in every one of the samples tested. Concentrations exceeding the TTLC for DDT, DDE and DDE adopted by the Department of Health Services (i.e., 1.0 ppm) were reported at many locations. A statewide average was not calculated. In Los Angeles County, samples were found to contain total DDT and degradation product concentrations of 27.4 and 31.0 ppm. The two samples collected in Alameda county were reported to contain total concentrations of .08 and 1.86 ppm (mean = 0.97 ppm).

The translocation of aldrin from soil into plants is influenced by the levels in soils, the strength of adsorption and the depth of application. The World Health Organization (1989b) reports that researchers have found food crops grown in the soil (e.g, carrots, radishes and turnips) generally take up more aldrin residue than other types of crops. The extent of uptake is likely to be insignificant in this case given the strong adsorptive character of the pesticide and low concentration of aldrin. Reports concerning the movement of PCBs and lindane to plants were not found.

Environmental Fate - Water

The movement of contaminants from the soil compartment to water is a principal concern which must be considered in environmental fate analyses. Contamination of waterways may result in adverse impacts to aquatic organisms, livestock, wildlife or human populations that rely on the water for drinking, recreation, agriculture, domestic, habitat or other uses. Aquatic organisms, wildlife and livestock will not be considered in this risk assessment because they have not been identified by the Alameda

County Department of Environmental Health as receptors of concern. This conclusion is consistent with the fact that there are no water courses in the immediate vicinity of the Saklan Avenue property, and consistent with the intended land use.

With respect to question of migration from soil to water and secondary impacts to human health, the two plausible scenarios ordinarily considered are (1) migration to groundwater and (2) migration to surface waters via surface runoff, or redeposition of volatilized compounds and contaminated particulates removed from the site.

The mobility of DDT and related products in soils has been studied by various authors and has been reported to be extremely slow. Therefore, the leaching of these substances from soil is expected to be very slow, particularly from clay soil where these contaminants are strongly partitioned. The depth to groundwater at the site is reported to be 30 to 40 feet. The probability that any of these contaminant will migrate from the surface to groundwater is virtually nil given the tendancy of these compounds to adsorb to soil, the low permeability of the soil, arid climate, low concentrations and other factors present in this case. Any contaminants which might reach groundwater would be potentially subject to re-adsorption and to chemical as well as microbial transformation (Mabey., 1985). The velocity of contaminants in ground water can be calculated; however, information concerning flow velocity, soil porosity and other variables in the equation are not available in this case. The established or planned use of the underlying aquifer and its hydraulic characteristics were not available to this author. Practical considerations (e.g., the quality of the aquifer and whether it has domestic or other use) should also be taken into account in evaluating the real impacts of any such contamination. Experience has shown that the movement of compounds which are sparingly soluble in water is slow. For example, the movement of

PCB in groundwater has been calculated to be on the order of 0.01 to 1 inch per year (Mabey, 1985). It is not unreasonable to expect that other compounds having similar structures and/or physical properties (e.g., DDT, DDD, DDE, lindane and aldrin), will behave similarly; however, information concerning the measured velocity rates for these contaminants could not be located in the literature.

There are no surface waters in the immediate vicinity of the site. Moreover the site is level and there is consequently little potential for runoff, particularly when it is considered that soils at this location are assigned a low erodibility factor (K = 0.24), i.e, the susceptibility of the soil to erosion by water is considered to be low (USDA, 1975). Conversely, these soils drain poorly. The movement of DDT residues, aldrin, or Arochlor 1242 from soil to water pooling at the site or running over the site is likely to be insignificant given the distribution pattern of the contaminants and low water solubilities. Lindane has a higher water solubility but the concentrations are so low that the amount of lindane moving to water is likely to be very small. The solubility of aldrin in water is so low that it is characterized as "practically insoluble" (WHO, 1989b).

Environmental Fate - Air.

The third major area of concern is airborne dispersal. The Alameda County Department of Environmental Health has specifically directed that this be assessed as a potential route of exposure to construction workers, residents and other persons in the area. This concern is relevant because the presence of toxicants in the atmosphere may result in inhalation exposures to individuals on the property and neighboring residential properties. Also, airborne dispersal of toxic air contaminants

may lead to secondary dermal exposures, or contamination of receiving lands and waters.

The presence of PCB and insecticide residues in the atmosphere due to soil contamination at the Saklan Avenue site is not likely to be significant. There are several factors which support this conclusion. First, the vapor pressure of these compounds is relatively low and second, each is strongly partitioned to the soil. This means that the volatile emissions of contaminants from the surface soils will be extremely slow and the resulting concentrations of contaminants in the atmosphere will be extremely low. The Department of Health Services (CDHS, 1986) has suggested that volatile emissions at hazardous waste sites be disregarded as insignificant when the vapor pressure of a given contaminant is less than 10^{-5} mm Hg. The vapor pressures for DDT and aldrin are 1.9×10^{-7} mm Hg and 7.5×10^{-5} mm Hg, respectively. The vapor pressures for lindane and arochlor 1242 are only slightly higher at 1.6×10^{-4} and 4.06×10^{-4} mm Hg, respectively.

It is possible that particulate emissions may include chemical residues and that persons inhaling particulates could be exposed to toxicants by this mechanism. The probability and effect of such exposures is limited because an undisturbed soil with clay content above 20 percent is generally considered resistant to wind erosion due the presence of a surface crust (CDHS, 1986) and the Clear Lake clay soil at this site has greater than 40 percent clay (USDA, 1975). Therefore, little dust is likely to be generated in the course of normal events. The presence of housing structures, pavements and vegetation would be expected to obstruct wind flow to such an extent that particulate emissions would not be significant under normal conditions. Also, the wind speed necessary to initiate erosion of uncovered soil in unobstructed areas is about 12.5 mph (Cowherd, et al., 1985). Such wind speeds are only prevalent about 10 percent of the time

in this area (USDA, 1975). Consequently, inhalation exposure should not be a significant concern for residents in the area. Under the prevailing conditions at the site, inhalation exposure is not likely to be significant to construction workers; however, some construction activities (e.g., grubbing and grading) may involve a number of activities that disturb large quantities of soil that can potentially result in the generation of airborne dust if the soil is dry.

The inhalation concern is only relevant to the extent that particulates generated during these construction activities, e.g., grading, will be respirable (i.e., less than 10 microns in size). The particle sizes of the Saklan Avenue soils have not been measured; however, clays are typically characterized by particle sizes less than 0.004 mm (Morris and Johnson, 1967). Some components of clay can be very small, in fact, well within the respirable range. The concentration of contaminants in the air can be estimated using a method developed by Cowherd, et al. (1985). Taking DDT as an example:

1. mean concentration = 3.95ppm
2. area = 2 acres or (4840 y^2/acre) x (.8361 m^2/y^2) = 8093 m^2
3. assumed aggregate size distribution mode = 100 microns
4. threshold friction velocity = 25cm/s
5. roughness height, Zo = 0.1
6. equivalent 7m threshold wind speed = 22.5(25 cm/s) = 5.62 m/s
7. mean annual wind speed = 6 mph (2.68 m/s)
8. The annual average PM_{10} emission factor is:
   $E_{10} = 0.036 \times (2.68/5.62)^3 F(.5) = 1.86 \times 10^{-3} = .001$ g/hr/m^2
9. The annual average PM_{10} emission rate is found by:
   (8093 m^2)(.001 g/hr/m^2) = 8.09 g/hr = 2.2×10^{-3} g/s = .002 g/s
10. The annual emission rate is:

$3.95(10^{-6})(.002) = .0079$ micrograms/s

11. The worst-case 24 conditions are:
    $E_{10} = 0.036(6.94)^3 = 12.0$ g/hr/m^2
12. Contaminant emission rate is:
    $3.95(10^{-6})(12$ g/hr/$m^2)(8093) = .38$ g/hr = 10.5 mg/s
13. Worst case emission factor:
    (10.5)(.8 micrograms/m^3) = 8.4 nanograms/m^3 at a distance of 3 km
14. (10.5)(5 micrograms/m^3) = 52.5 nanograms/m^3 at a distance of 1 km
    (10.5)(500 micrograms/m^3) = 5250 nanograms/m^3 at a distance of 0 km or .005 mg/m^3

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* DDT is used because it is present at the highest mean concentration in the soil. The concentration of other contaminants in the area under these conditions would be substantially lower.

The assumptions made in the preceding calculation are overly conservative, yet the resulting estimate is three orders of magnitude less than the TWA/TLV of 1 mg/m3 established by the American Conference of Governmental Industrial Hygienists (1989) and the California Divison of Occupational Safety and Health (Cal-OSHA). Therefore, the inhalation concern for construction workers can be discounted as insignificant. Even if 100 percent of the soil was respirable, adverse health effects associated with the inhalation of dust would more likely be due to inhalation of the dust itself rather than the pesticide residue. It should be noted that normal construction practices require wetting of dry soils to supress fugitive dust emissions and protect workers. Although occupational health standards are not designed for application to the general population, the insignificant scope of such exposures combined with an absence of information in the scientific literature concerning chronic inhalation of these contaminants indicates that the inhalation concern should be disregarded.

With respect to the long-term and distant effects of fugitive dust emissions, the contamination of land and water resulting from airborne dispersal is likely to be insignificant due to the low probability of sustained airborne dispersal. The preceding calculation suggests that under worst-case conditions the concentration of DDT and related products in atmospheric dust resulting from fugitive emissions at the Saklan Avenue site is likely to be so small that it would be virtually undetectable, even at short distances from the site. The redeposition of particles to distant land or water will not result in significant contamination.

Environmental Fate - Biota.

The movement of of contaminants from soil to various organisms by direct or secondary contact (e.g., via plants or airborne dispersal) has been mentioned within the context of the preceding sections. The principal biological receptors of concern in this instance are humans; specifically residents and construction workers sustaining oral, dermal and inhalation exposures. The effects of DDT in plants, marine and freshwater microorganisms, terrestrial and aquatic invertebrates, birds and mammals have been extensively studied; however, these receptors are not considered to be of concern in the problem presented at the Saklan Avenue site.

Exposure Characterization.

Based on the preceding discussion of environmental fate it appears that the only potentially significant health effects in this case would be associated with direct oral or dermal exposures to soil.

To focus on the question of who is potentially at risk, it is necessary to define who will be exposed, what the concentration of the exposure will be, what the route(s) of exposure will be and what the duration of exposure will be. To ensure adequate protection of the public's health, the upper estimates of exposure are frequently used. The effect of this approach is conservative and ensures that risk will not be underestimated; however, it is often unrealistic. Exposure to shallow soil over extended periods of time would not be expected to occur at a single location on a residential lot, but rather, can reasonably be expected to occur throughout accessible portions of the property. Therefore, the average concentration over a significant portion of a residential lot is judged to represent the toxicant level at the point of exposure and this average concentration should be used in assessing the risks associated

with exposure. Hadley and Sedman (1990) have suggested a detailed procedure for estimating exposures from surface soils in residential areas based on parcel size and the configuration of development. This method will not be used in the current assessment because the exact configuration of the planned development is not known. An architectural map of the planned housing project suggests that the areas of greatest contamination will be covered by a roadway and sidewalks extending approximately 45 feet from the southern boundry of lot 23836; however, these data points have been included in the statistical calculations to derive mean concentrations (excluding these data would lower the calculated mean concentrations and affect conclusions regarding the risk associated with exposure to cntaminated soil).

Generally speaking, all individuals exposed at levels above background concentrations comprise a risk group. For many toxicants not commonly found in the environment, there is no background level. Consequently, all individuals exposed at detectable levels would be considered at risk. In this case, the substances in question, principally DDT and its degradation products, are not naturally occurring; however, DDT residues are so persistent and widespread as a result of agricultural use that it would not be too far-fetched to consider some level of DDT as "background" and to assume that there is a certain level of inherent risk associated with residing in agricultural areas where DDT has been applied; particularly in areas where such property has been converted to residential use.

For purposes of this review and consistent with the directive from the Alameda County Department of Environmental Health, it will be assumed that only residents and construction workers will be exposed. Since inhalation exposures have been determined to be unimportant, only dermal and oral exposures will now be considered. The degree of the exposure will be based on

assumptions regarding the mean concentration of available contaminants in the soil, daily oral intake, daily skin loading rates and the degree of absorption by these routes. The duration of exposure can be assumed to be less than one year for construction workers. This assumption is reasonable because the extent of their exposure will be limited to the period of housing construction which is typically less than one year. A 70-year lifetime exposure will be assumed for residents. It is usually necessary to know something about the behavior of the risk group, e.g., whether affected persons will travel to work or other activities away from their homes, what portion of time will be spent in the residential area, whether individuals will travel into the contaminated area, and so forth. Also, because a toxic response may be influenced by factors such as age, sex, body weight, hypersusceptibility, genetic composition, nutritional status and other factors, knowledge of these characteristics is desirable. Since this information is frequently not available (it is not available in this case), certain standard assumptions regarding some of these variables will be used (see Table VI).

The Department of Environmental Health has also directed that other persons potentially at risk be considered. The only other persons who may be exposed would be visitors to the area and persons travelling though the area (e.g., pedestrians and vendors). It may be assumed that the brief nature of their visits will not entail a risk exceeding that which lifetime residents will experience. If the risk associated with lifetime exposure is insignificant to residents it will certainly be insignificant to persons with less exposure.

Signs and Symptoms of Acute and Subacute Poisoning.

Signs and symptoms of poisoning in humans and animals resulting from high doses of DDT include paresthesia of the tongue, lips

and face; apprehension; hypersusceptibility to stimuli; irritability; dizziness; disturbed equilibrium; tremor; and tonic and clonic convulsions. Motor unrest and fine tremors associated with voluntary movements progress to coarse tremors without interruption in moderate to severe poisoning. Symptoms appear several hours after large doses, and in animals poisoned with fatal doses, death occurs in 24 to 72 hours. It has been estimated that a dose of 10 mg/kg of body weight will cause signs of poisoning in man (Casarett and Doull, 1975). Unlike many organophosphates, DDT is poorly absorbed after dermal exposure. Undissolved DDT is so poorly absorbed through the skin that its toxicity by this route is difficult to measure. Even dissolved DDT is poorly absorbed (WHO, 1979). This poor absorption from the skin may account for the remarkably good safety record of DDT in spite of its wide and occasionally careless use by applicators and formulators (Hayes, 1971). how abt DDE, DDD since DDE more poisoning *

Signs and symptoms associated with acute aldrin poisoning include headaches, dizziness, nausea, general malaise and vomiting, followed by muscle twitchings, myoclonic jerks and convulsions. Death may result from cerebral anozaemia. The amount required to cause death in an adult male has been estimated to be 5 grams. Cases of poisoning have occurred as a result of accidents (e.g., children ingesting baited granules) or suicide attempts in adults. The World Health Organization (1989b) reported that a survey of the world literature for all cases of aldrin and dieldrin poisoning uncovered only 13 cases of such poisoning. No cases of fatal poisoning have been associated with the manufacture or formulation of the pesticides.

Clinical studies of Arochlor 1242 indicate an acute oral LD_{50} (median lethal dose) for rats between 4 and 10 g/kg. Severely poisoned animals show ataxia and diarrhea. In rats vacuolation in the liver and kidneys has been observed and ulceration of the gastric and duodenal mucosa have been reported (WHO, 1976).

Humans appear to be the most sensitive species to PCBs. The consumption of relatively small amounts have resulted in severe disease. The most famous case of mass poisoning in humans occurred in Japan after rice oil contaminated with PCBs was consumed (Yusho rice disease). One brief report concerning inhalation of PCBs was reviewed by the Environmental Protection Agency (1984c); however, the study did not quantify absorption factors and is therefore not useful in predicting the risks associated with inhalation exposures.

Lindane produces signs of poisoning that resemble those produced by DDT, i.e., tremors, ataxia, convulsions and prostration, with stimulated respiration. Fatty changes in the liver and kidney have been noted in fetal cases.

The most acutely toxic of the contaminants present in this soil is aldrin. Given the assumed average concentration of 0.01 mg/kg soil and the estimated toxicity of aldrin, an adult male would have to consume roughly 5×10^5 kg of soil to experience acute poisoning due to aldrin. The concentrations of contaminants in the Saklan Avenue soils do not appear to be sufficient to justify concern over acute or subacute poisoning.

Chronic Health Effects.

A considerable number of studies have investigated the effects of chronic exposure to DDT in laboratory animals. Chronic feeding studies (rats and mice) have generally demonstrated hepatic effects (e.g., liver lesions, hypertrophy and increased enzyme activity) and increased mortality, particularly among neonates. Nervousness, tremors and convulsions have been observed in some animals. Reproductive disturbances were generally not seen in rats, mice and dogs although some decreases in fecundity and mammary gland development, delayed female

estrus, and increased fetal mortality have been reported (USEPA, 1984a). DDT has been demonstrated to be carcinogenic in rats and mice, with virtually all tumors developing in the liver.

The evidence of carcinogenicity of DDT in humans is regarded to be insufficient. In a study of occupational exposures, 40 men employed in the manufacture or formulation of DDT were examined. Twenty-eight of the men were under 39 years of age, seven were between 40 and 49 years of age and five were over 50 years of age. Twenty-four of the workers had also been exposed to other pesticides. The length of exposure at the time of the study was less than one year for 2 workers, one to four years for 21 workers and five to eight years for 17 of the workers. The medical examination included a complete history, physical and neurological examinations, a sulpho-bromophthalein test, plasma and erthrocyte cholinesterase determinations and measurement of urinary DDA concentration. DDT intake was calculated for 38 of the workers. In ten cases the calculated intake was 10 to 20 mg/man/day, 30 mg/man/day in fifteen cases and approximately 40 mg/man/day in thirteen cases. No evidence of cancer was found among the 40 workers at the time of the investigation (Ortelee, 1958).

Another study was conducted on 35 workers with occupational exposure to DDT. The average age of this group was 43 years and the average length of exposure was 15 years (range 11 to 19 years). The investigation included medical histories, physical examinations, chest X-rays, blood and urine tests and measurements of fat, urine and serum concentration of DDT residues. On the basis of DDT storage and metabolite excretion, the intake of DDT was estimated to be 3 to 6 mg/man/day in three workers with low exposure, 6 to 8 mg/man/day in twelve with moderate exposure and 17 to 18 mg/man/day in twenty with high exposure. No cancer was reported in any of the workers (Laws, et al., 1967).

In a separate study, a group of prison volunteers ingested daily doses of DDT (35 mg/man/day) for 21.5 months. No ill effects ascribed to DDT ingestion were reported four to five years after the start of the experiment. During World War II DDT was used extensively in the control of lice and other insects by application directly to humans. There is no evidence that harm to these people resulted from this direct application (Casarett and Doull, 1975).

Lindane is a known carcinogen in mice; however, other animal studies have been negative or equivocal in this respect. No morbidity was observed in rats exposed to diets containing up to 30 ppm lindane, and one researcher has estimated that rats can tolerate up to 50 ppm lindane in the diet (USEPA, 1984b). In other studies, administration of 10 ppm lindane in the diet of rats resulted in noxious effects in adults and their offspring and both hepatic and adrenal changes have been noted. Administration of 100 ppm in the diet of dogs for two years resulted in slightly enlarged livers without histopathological changes (USEPA, 1984b). No epidemiological studies of cancer in humans assoicated with exposure to lindane have been reported; however, lindane is considered to be a probable human carcinogen (IARC Group 2B) due to evidence of carcinogenicity in test animals. Tolerance levels established by the U.S. Environmental Protection Agency (in 40 CFR 180.133) for foods are quite high (e.g., 7 ppm in or on fat of meat from cattle, 4 ppm in or on fat of meat from hogs, 3 ppm in cucumbers, lettuce, mushrooms, tomatoes and other vegetables, etc.). The levels of lindane in Saklan Avenue soils are well below those considered to be tolerable in foods for human consumption.

Human toxicity to lindane by inhalation in occupational settings has been reviewed (Sasinovich et al., 1974). Pathological liver changes were observed after exposures ranging from 11 to 23

years. Chronic pancreatitis was observed in some workers and unspecified "biochemical abnormalities" were observed in others.

PCBs have been shown to be carcinogenic in laboratory animals and therefore, are classified as probable human carcinogens (IARC group 2B). There are few data regarding the carcinogenicity of PCBs in humans. 35 percent of deaths among Yusho patients who died by 1979 resulted from malignancies involving different body sites (Urabe et al., 1979). The significance of these data is uncertain because there were no control group regarding the expected incidence of cancer in this population. Two cases of malignant melanoma among 31 heavily exposed workers to Arochlor 1254 have been reported (USEPA, 1984c).

Aldrin has been reported to produce various reproductive effects in different species, including decreased fertility and decreased viability of the young; however, the dietary concentrations required for these effects were as high or higher than those producing other effects such as histologic changes in livers of adult animals and were thought to result from hormonal imbalance (Casarett and Doull, 1975). Aldrin is classified as a central nervous system stimulant and has been shown to be carcinogenic in laboratory animals. There is no convincing evidence that the compound is carcinogenic in humans.

In risk assessment, the use of epidemiological studies is preferable to animal studies because the biological systems of epidemiological subjects are similar to those of the risk group with respect to such factors as uptake, distribution, deposition, activation, detoxification, retention and excretion of contaminants. In this instance the characteristics of the study groups are similar to those of the construction workers who may be at the Saklan Road site for a brief period of time. From a qualitative point of view it would seem that the potential for health effects in these construction workers will be negligible

given the absence of health effects in workers exposed to much higher levels of DDT and other contaminants for longer periods of time.

III. RISK EVALUATION

According to summaries prepared by USEPA (1984a, 1984b, 1984c) and IARC (1973) there is not sufficient evidence to classify any of the contaminants at the Saklan Avenue site as human carcinogens; however each is considered a probable human carcinogen based on evidence of carcinogenicity in test animals. DDT was identified by the Health and Welfare Agency as a chemical "known to the State to cause cancer" on October 1, 1987. DDD and DDE were similarly listed on January 1, 1989. Aldrin was added to the list on July 1, 1988; lindane on October 1, 1989, and PCBs on October 1, 1989. Pursuant to sections 12705 and 12711, Title 22, California Code of Regulations, the agency has established the levels of daily exposure that do not pose a significant risk to exposed persons within the meaning set forth in Health and Safety Code section 25249.10(c). This level of exposure is considered to pose no significant risk when all routes of exposure are considered and is regarded to be the risk level which represents no significant risk that is calculated to result in one excess case of cancer in an exposed population of 100,000.

In its letter of March 14, 1991 to Venture Properties, the Alameda County Department of Environmental Health suggested that these levels be used in evaluating risks associated with exposure to the Saklan Avenue soil. Where an established regulatory level is not available, the Department of Environmental Health directed that the level used be specified.

The no significant risk levels developed by the Health and Welfare Agency are derived from the use of a multilinearized

model with the upper 95 percent confidence limit of the linearized term expressing the upper bound of potency. The same method and 95 percent confidence limit are used by the U.S. Environmental Protection Agency in developing oral slope factors (q_1*, carcinogenic potency estimates) for known or suspected carcinogens and it is the method recommended by the California Department of Health Services as the most conservative among those that can be used for the evaluation of nonthreshold (i.e., cancer-causing) agents. Table IV summarizes the selected no significant risk levels.

No regulatory level has been established by the Health and Welfare Agency for lindane. The World Health Organization has recommended an acceptable daily intake (ADI) of 1 microgram/kg/day (i.e., 70 micrograms/day for an adult). For purposes of this report, a value of 1 microgram/day will be used as the no significant risk level. Table VI summarizes various thresholds which have been developed for different purposes.

TABLE IV. NO SIGNIFICANT RISK LEVELS FOR CONTAMINANTS AT THE SAKLAN AVENUE SITE

Compound	No Significant Risk Level
Aldrin	0.04 microgram/day[1]
Lindane	1.0 microgram/day[2]
DDTr	2.0 micrograms/day[1]
PCBs	0.09 microgram/day[1]

all for an adult

= 1/million

1. Health and Welfare Agency, No Significant Risk Level
2. Derived from ADI of 1.0 microgram/kg/day recommended by WHO (USEPA, 1984b)

TABLE V. ASSUMPTIONS USED IN RISK ASSESSMENT
FOR SAKLAN AVENUE SOILS

1. ADULT, 70 KG BODY WEIGHT

2. DAILY SOIL INGESTION = 150 MG/KG

from DHS.

3. ABSORPTION OF INGESTED TOXICANT = 10 %

4. DAILY SKIN LOADING RATE = 450 MG

5. DERMAL ABSORPTION = 10 % (5 % FOR DDT BASED ON FINDINGS OF WESTER, ET AL., 1990)

TABLE VI. ADOPTED AND RECOMMENDED THRESHOLDS FOR CONTAMINANTS AT THE SAKLAN AVENUE SITE

Compound	Mean in ppm	Prop 65 µ/day	q_1*	PEL mg/m^3	MCL mg/l
Aldrin	.01	0.04		0.25	
Lindane	.03	na	1.326	0.5	0.004
DDTr	3.9	2.0	0.34	1.0	
PCB	1.9	0.9	4.3396	1.0	

1. mean = mean concentration based on data in TABLE I
2. Prop 65 = no significant risk level in micrograms/day developed by the Health and Welfare Agency (from Table IV)
3. q_1* = carcinogenic potency factor estimate developed by USEPA
4. PEL = permissible exposure limit, mg/m^3, developed by Cal-OSHA Division of Industrial Safety (TWA-TLV equivalents), Title 3, CCR, Division 7, Article 3, Section 12125
5. MCL = Maximum Contaminant Level, mg/l, (Drinking Water Standard) developed by California Department of Health Services, Title 22, CCR, Section 64444.5

Whether individuals exposed to the Saklan Avenue soil will be at placed at significant risk of developing cancer as a result of lifetime exposure to the Saklan Avenue soil can be determined by comparing the anticipated extent of exposure to the prescribed no significant risk level. Using the assumptions for lifetime exposure outlined in Table V and the average concentrations of contaminants in the soil, the following exposures can be calculated:

1. Exposure to Aldrin

a. oral

(.01 mg/kg soil) x (0.15 x 10^{-3} kg/day) =
0.0015 x 10^{-3} mg/day = 0.0015 micrograms/ day

b. dermal

(.01 mg/kg soil) x (.450 x 10^{-3} kg soil/day) x 10% =
0.00045 x 10^{-3} mg/day = 0.00045 micrograms/day

TOTAL EXPOSURE = 0.0015 + 0.00045 = 0.00195 micrograms/day

2. Exposure to Lindane

a. oral
(.03 mg/kg soil) x (0.15 x 10-3 kg/day) =
0.0045 x 10^{-3} mg/day = 0.0045 micrograms/day
b. dermal
(.03 mg/kg soil) x (.450 x 10^{-3} kg soil/day) x 10% =
0.00135 x 10^{-3} mg/day = 0.00135 micrograms/day

TOTAL EXPOSURE = 0.0045 + 0.00135 = 0.00585 micrograms/day
[assuming mean BHCr = .2 mg/kg, oral = .03 micrograms/day,

dermal = .009 micrograms/day, TOTAL EXPOSURE = 0.039 micrograms/day]

3. Exposure to DDTr

a. oral
(3.95 mg/kg soil) x (0.15 x 10^{-3} kg/day) =
0.5925 x 10^{-3} mg/day = 0.5925 micrograms/day
b. dermal
(3.95 mg/kg soil) x (.450 x 10^{-3} kg soil/day) x 5% =
0.088 x 10^{-3} mg/day = 0.08 micrograms/day

TOTAL EXPOSURE = 0.5925 + .08 = 0.67 micrograms/day

4. Exposure to PCBs

a. oral
(1.9 mg/kg soil) x (0.15 x 10^{-3} kg/day) =
0.285 x 10^{-3} mg/day = .285 micrograms/day
a. dermal
(1.9 mg/kg soil) x (.450 x 10^{-3} kg soil/day) x 10% =
0.085 x 10^{-3} mg/day = 0.08 micrograms/day

TOTAL EXPOSURE = 0.285 + 0.085 = 0.37 micrograms/day

The results indicate that lifetime residents (and therefore, individuals experiencing lesser exposures) would not be at significant risk of developing cancer due to oral or dermal exposure to the Saklan Avenue soil given the nature and extent of contaminantion thought to be present. Based on these calculations, the incidence of cancer due to exposures to Saklan Avenue soil would not be expected to exceed one case in a population of 100,000 (i.e., 10^{-5}) because the total exposure is

less than the no significant risk level established in each of the respective cases. Other exposure scenarios outlined by Martz (1990), including exposures to children and adults spending varying amounts of time at residences, each involve lower levels of risk. The scenario selected above represents a reasonable maximal exposure.

TABLE VII. COMPARISON OF ESTIMATED EXPOSURE AND ACCEPTABLE DAILY INTAKE FOR THE SAKLAN AVENUE CONTAMINANTS

Compound	Estimated daily exposure (in micrograms)		Acceptable daily exposure (in micrograms)
Aldrin	0.002	0.006	0.04
Lindane	0.006	0.018	1.0
BHCr	0.039	0.117	1.0*
DDTr	0.67	2.01	2.0
PCB	0.37	1.11	0.9

Title 26 fm

* assumes equivalent toxicity for stereoisomers

A more conservative level of acceptable risk which is traditionally used in risk assessment is one-in-one-million (10^{-6}). The 10^{-6} level of risk is advisory in nature, not regulatory. For DDTr, an upperbound cancer risk from exposure dermal and oral exposure to soil containing 1 ppm DDTr has been estimated to be 6.5×10^{-7} (Martz, 1991). Because the estimate is based on a concentration of 1 ppm, the result can be taken as a "unit risk" value and the level of risk associated with higher DDT concentrations can be estimated by multiplying this factor by the concentration of interest. Thus, the risk associated with exposure to DDT in the Saklan Avenue soil may be estimated as $(3.95)(6.5 \times 10^{-7})$ or 2.5×10^{-6}.

A similar evaluation of risk at the 10^{-6} level can be made using q_1^* values developed by the USEPA; however, the results have little practical application because the oral slope factors do not consider dermal exposure and because they are usually derived on the basis of applied dose rather than absorbed dose. The conclusion reached regarding 10-6 risk does not take into account the inherent and unresolvable risk associated with exposure to background concentrations (CDFA, 1985 mean DDTr backgound for Alameda County = 0.97 ppm). When this is factored into the unit risk calculation, 3.95 - 0.97 = 2.98; and $2.98 \times (6.5 \times 10^{-7}) = 1.9 \times 10^{-6}$.

CONCLUSION

Based on information currently available and considering the level of acceptable risk prescribed by the Alameda County Department of Environmental Health, there does not appear to be a significant health risk at this site. Consequently, it may be appropriate to conclude that the Saklan Avenue soils can remain in place. When a more conservative and traditional measure of

significant risk is used, it appears that the probability of excess cancer is unacceptable and therefore, some form of remedial action is necessary. These conclusions are tentative because the true extent of the contamination at this site is not known due to the lack of adequate sampling. Additional samples need to be collected and analyzed to ascertain whether the contamination is confined to the surface layer or is more widespread. If the results of this sampling indicate that the underlying soils do not contain higher concentrations of contaminants than the surface horizon, the conclusions reached in this report may be regarded as valid with respect to associated risk. If the recalculated mean values are higher than indicated by the available data, further evaluation would be necessary. It is strongly recommended that the sampling and testing be completed and the results evaluated before any construction activities begin at the site. A stratified random sampling plan is suggested.

While the identification and selection of a final remedial strategy is not within the scope of this study or possible given the existing paucity of data, the following thoughts are offered for consideration by those who will make final decisions regarding the disposition of the Saklan Avenue property soil. In cases such as this which involve competing interests, a strategy should be selected that is above all, consistent with the objectives of protecting human health and the environment; and then, is cost-effective and responsive to the needs of affected responsible parties. Solutions such as a pavement cap would not be given serious consideration because they would be incompatible with the interests of the developers and are unnecessary in this case. Conversely, the "no action" alternative might not be considered appropriate because it could result in exposures and some degree of incremental risk. Given the level of risk deemed acceptable, the conclusions reached in this report with respect ot 10^{-5} and 10^{-6} risk, the nature and distribution of

contaminants, and the proposed land use, there is no apparent reason why the soils cannot remain in place. Mixing the contaminated surface soils with underlying clean soils would be a cost-effective measure reducing the average concentrations of contaminants well below levels deemed to pose a significant risk. Additional protection might be gained by amending the soil with activated carbon; however such steps are unnecessary given the expected retention in soil. The tangible benefit gained by requiring the excavation and removal of these soils would be extremely small and the monetary costs associated with achieving these meager benefits would be large, while the health and safety risks associated with alternative management strategies are low. The successful implementation of the suggested alternative would be sufficient to adequately protect human health and the environment in this case given the various factors reviewed in this report.

BIBLIOGRAPHY

American Conference of Governmental Industrial Hygienists, 1989. Theshold Limit Values and Biological Exposure Indices for 1989-1990. Cincinnati, Ohio.

Callahan, M.A., Slimak, M.W, Gabel, N.W., et al., 1979. Water-Related Environmental Fate of 129 Priority Pollutants, Vol. I, USEPA Office of Water Planning and Standards. EPA/440/4-79/029.

California Department of Food and Agriculture, 1985. Agricultural Sources of DDT Residues in California's Environment: A Report Prepared in Response to House Resolution No. 53 (1984).

California Department of Health Services, 1986. The California Site Mitigation Decision Tree Manual.

Casarett, L.J. and Doull, J., 1975. Toxicology, the Basis Science of Poisons. Macmillan Publishing Company, New York.

Chisholm, D. and MacPhee. A.W., 1972. Persistence and Effects of some Pesticides in Soil. J. Econ. Entomol., 65: 1010 (cited in IARC, 1973).

Cowherd, C., Muleski, G., Englehart, P. and Gillette, D., 1984. Rapid Assessment of Exposure to Particulate Emissions From Surface Contamination Sites. EPA/600/8-85-002 (cited in DHS, 1984).

Eden, W.G., and Arthur, B.W., 1965. Translocation of DDT and Heptachlor in Soybeans. J. Econ. Entomol., 34: 161-162.

Fuhremann, T.W., and Lichtenstein, E.P., 1980. A Comparative Study of the Persistence, Movement, and Metabolism of Six Carbon-14 Insecticides in Soils and Plants. J. Agric. Food Chem., 28: 446-452.

Hadley,P.W., and Sedman, R.M., 1990. A Health-Based Apporoach to Sampling Shallow Soils at Hazardous Waste Sites Using the AAL (soil contact) Criterion. Environ. Health Persp., 84: 203-207.

Harris, C.R., and Sans, W.W., 1967. Absorption of Organochlorine Insecticide Residues from Agricultural Soils by Root Crops. J. Agric. Food Chem., 15: 861-863.

Hayes, W.J., Dale, W.E., and Pirkle, C.I., 1971. Evidence of Safety of Long-Term, High, Oral Doses of DDT for Man. Arch. Environ. Health. 22: 119-136.

Horvath, A.L., 1982. Halogenated Hydrocarbons: Solubility and Miscibility with Water. Dekker, Inc., New York. p 533.

International Agency for Research on Cancer (IARC), 1973. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man, Some Organochlorine Pesticides, Volume 5.

Mabey, W. R., 1985. Evaluation of Chemical Fate and Mobility; Proceedings of the Hazardous Materials Management Conference and Exhibition in Oakland, California, April 23-25, 1985: 288-297.

Mackay, D., and Leinonen, P.J., 1975. Rate of Evaporation of Low-Solubility Contaminants from Water Bodies to Atmosphere. Environ. Sci. Technol. 9: 1178-1180.

Martz, F., 1991. Total Threshold Limit Concentration Values are not Appropriate for Remediation of Pesticides in Farmland. Toxicologist, 11(1): 199.

Morris, D.A., and Johnson, A. I., 1967. Summary of Hydrologic and Physical Properties of Rock and Soil Materials, as Analyzed by the Hydrological Laboratory of the U.S. Geological Survey, 1984-1960, U.S. Geological Survey Water Supply Paper 1839-D, 42pp., 1967 (cited in DHS, 1984).

Nehls, G.J, and Akland, G.G., 1973. Procedures for Handling Aerometric Data. J. Air Pollut. Cont. Assoc., 23: 180-184.

Ortelee, M.F., 1958. Study of Men With Prolonged Intensive Occupational Exposure to DDT. Arch. Ind. Health. 18: 433-439 (cited in USEPA, 1984a).

Reynolds, S.D., Hadley, P.W. and Sedman, R.M., 1990. A Health-Based Approach for Evaluating Soil at Depth Contaminated by Hazardous Waste: Utilizing the AAL 9soil contact) Criterion., Risk Analysis, 10: 571-573.

Sasinovich, L.M., Alekhina, S.M., and Odintsova, I.L., 1974. Toxic Hepatitis due to Prolonged Exposure to BHC. Vrach. Delo. 10-:133-135 (cited in USEPA, 1984b).

Sedman, R.M., 1989. The Development of Applied Action Levels for Soil Contact: A Scenario for the Exposure of Humans to Soil in a Residential Setting. Environ. Health Perspec. 79: 291-313.

Shin, Y.O., Chodan, J.J., and Wolcott, A.R., 1970. Adsorption of DDT by Soils, Soil Fractions, and Biological Materials. J. Agric. Food Chem., 18: 1129-1133.

Tucker, E.S., Litschgi, W.S., and Mees, W.M., 1975. Migration of Polychlorinated Biphenyls in Soil Induced by Percolating Water. Bull. Environ. Contam. Toxicol., 13: 86-93 (cited in WHO, 1976).

United States Department of Agriculture, Soil Conservation Service, 1975. Soil Survey of Alameda County, California, Western Part.

United States Environmental Protection Agency, 1984a. Health Effects Assessment for DDT. EPA/540/1-86/026.

United States Environmental Protection Agency, 1984b. Health Effects Assessment for Lindane. EPA/540/1-86/056.

United States Environmental Protection Agency, 1984c. Health Effects Assessment for Polychlorinated Biphenyls (PCBs). EPA/540/1-86/004.

United States Environmental Protection Agency, 1987. Carcinogenicity Assessment of Aldrin and Dieldrin. EPA/600/6-87/006.

Urabe, H., Koda, H., and Asahi, M., 1979. Present state of Yusho Patients. Ann. NY Acad. Sci. 320: 273-276 (cited in USEPA, 1984c).

Veith, G.D., DeFoe, D.L., and Bergstedt, B.V., 1979. Measuring and Estimating the Bioconcentration Factor of Chemicals in Fish. J. Fish. Res. Board. Can. 36: 1040-1048.

Ware, G.W., 1968. DDT-C^{14} Translocation in Alfalfa. J. Econ. Entomol., 61: 1451-1452.

Ware, G.W., Estesen, B.J., and Cahill, W.P., 1970. Uptake of $C-^{14}$DDT from Soil by Alfalfa. Bull. Environ. Contam. Toxicol., 5: 85-86.

Wester, R.C., Maibach, H.I., Bucks, D.A., et al., 1990. Percutaneous Absorption of [^{14}C]DDT and [^{14}C]Benzo[a]pyrene from Soil. Fund. Appl. Tox. 15:510-516.

Wheatly, G.A., 1965. The Assessment and Persistence of Residues of Organochlorine Insecticides in Soils and their Uptake by Crops. Ann. Appl. Biol., 55: 325-329 (cited in WHO, 1989a).

World Health Organization, 1976. Polychlorinated Biphenyls and Terphenyls. Environmental Health Criteria 2.

World Health Organization, 1979. DDT and its Derivatives. Environmental Health Criteria 9.

World Health Organization, 1989a. DDT and its Derivatives, Environmental Aspects. Environmental Health Criteria 83.

World Health Organization, 1989b. Aldrin and Dieldrin. Environmental Health Criteria 91.

DISCLAIMER

The statements contained in this report are solely those of the author and do not necessarily represent the official views of the California Department of Health Services.

Trace Analysis Laboratory, Inc.
3423 Investment Boulevard, #8 • Hayward, California 94545
Telephone (415) 783-6960
Facsimile (415) 783-1512

TAL

LOG NO.: 9224
DATE SAMPLED: 10/22/90
DATE RECEIVED: 10/22/90
DATE EXTRACTED: 10/25/90
DATE ANALYZED: 10/27/90 and 10/28/90
DATE REPORTED: 10/29/90

CUSTOMER: Chips Environmental Consultants

REQUESTER: Mark Chips

PROJECT: R. Robles

Sample Type: Soil

Method and Constituent:	Units	4450 Concentration	4450 Detection Limit	4451 Concentration	4451 Detection Limit
EPA Method 8080:					
Aldrin	ug/kg	< 5	5	< 5	5
Alpha-BHC	ug/kg	31	5	17	5
Beta-BHC	ug/kg	< 5	5	< 5	5
Delta-BHC	ug/kg	590	5	49	5
Gamma-BHC (Lindane)	ug/kg	120	5	17	5
Chlordane	ug/kg	< 5	5	< 5	5
4,4'-DDD	ug/kg	250	5	240	5
4,4'-DDE	ug/kg	1,100	5	1,300	5
4,4'-DDT	ug/kg	2,100	5	1,400	5
Dieldrin	ug/kg	< 5	5	< 5	5
Endosulfan I	ug/kg	< 5	5	< 5	5
Endosulfan II	ug/kg	< 5	5	< 5	5
Endosulfan Sulfate	ug/kg	< 5	5	< 5	5
Endrin	ug/kg	< 5	5	< 5	5
Endrin Aldehyde	ug/kg	< 5	5	< 5	5
Heptachlor	ug/kg	< 5	5	< 5	5
Heptachlor Epoxide	ug/kg	< 5	5	< 5	5
Methoxychlor	ug/kg	< 5	5	< 5	5
Toxaphene	ug/kg	< 5	5	< 5	5

LOG NO.: 9224
DATE SAMPLED: 10/22/90
DATE RECEIVED: 10/22/90
DATE EXTRACTED: 10/25/90
DATE ANALYZED: 10/27/90 and 10/28/90
DATE REPORTED: 10/29/90
PAGE: Two

Sample Type: Soil

Method and Constituent:	Units	4450 Concentration	4450 Detection Limit	4451 Concentration	4451 Detection Limit
EPA Method 8080 (Continued):					
Aroclor 1016	ug/kg	< 5	5	< 5	5
Aroclor 1221	ug/kg	< 5	5	< 5	5
Aroclor 1232	ug/kg	< 5	5	< 5	5
Aroclor 1242	ug/kg	< 5	5	< 5	5
Aroclor 1248	ug/kg	< 5	5	< 5	5
Aroclor 1254	ug/kg	< 5	5	< 5	5
Aroclor 1260	ug/kg	< 5	5	< 5	5

LOG NO.: 9224
DATE SAMPLED: 10/22/90
DATE RECEIVED: 10/22/90
DATE EXTRACTED: 10/25/90
DATE ANALYZED: 10/28/90 and 10/29/90
DATE REPORTED: 10/29/90
PAGE: Three

Sample Type: Soil

Method and Constituent:	Units	4452 Concentration	4452 Detection Limit	4453 Concentration	4453 Detection Limit
EPA Method 8080:					
Aldrin	ug/kg	< 50	50	< 5	5
Alpha-BHC	ug/kg	< 50	50	25	5
Beta-BHC	ug/kg	< 50	50	< 5	5
Delta-BHC	ug/kg	< 50	50	610	5
Gamma-BHC (Lindane)	ug/kg	< 50	50	24	5
Chlordane	ug/kg	< 50	50	< 5	5
4,4'-DDD	ug/kg	840	50	460	5
4,4'-DDE	ug/kg	1,500	30	1,500	5
4,4'-DDT	ug/kg	5,700	50	3,100	5
Dieldrin	ug/kg	< 50	50	< 5	5
Endosulfan I	ug/kg	< 50	50	< 5	5
Endosulfan II	ug/kg	< 50	50	< 5	5
Endosulfan Sulfate	ug/kg	< 50	50	< 5	5
Endrin	ug/kg	< 50	50	< 5	5
Endrin Aldehyde	ug/kg	< 50	50	< 5	5
Heptachlor	ug/kg	< 50	50	< 5	5
Heptachlor Epoxide	ug/kg	< 50	50	< 5	5
Methoxychlor	ug/kg	< 50	50	< 5	5
Toxaphene	ug/kg	< 50	50	< 5	5

LOG NO.: 9224
DATE SAMPLED: 10/22/90
DATE RECEIVED: 10/22/90
DATE EXTRACTED: 10/25/90
DATE ANALYZED: 10/28/90 and 10/29/90
DATE REPORTED: 10/29/90
PAGE: Four

Sample Type: Soil

Method and Constituent:	Units	4452 Concentration	4452 Detection Limit	4453 Concentration	4453 Detection Limit
EPA Method 8080 (Continued):					
Aroclor 1016	ug/kg	< 60	60	< 5	5
Aroclor 1221	ug/kg	< 60	60	< 5	5
Aroclor 1232	ug/kg	< 60	60	< 5	5
Aroclor 1242	ug/kg	19,000	60	< 5	5
Aroclor 1248	ug/kg	< 60	60	< 5	5
Aroclor 1254	ug/kg	< 60	60	< 5	5
Aroclor 1260	ug/kg	< 60	60	< 5	5

QC Summary:

% Recovery: 112%
% RSD: 3.1%

Louis W. DuPuis
Quality Assurance/Quality Control Manager

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

9224

5 Day turn

PROJ. NO.	PROJECT NAME
	R. Robles

SAMPLERS: (Signature)

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Soil	8050
1	10-21-96	1320		X	4450	1	X	X
2	10-22-96	1325		X	4451	1	X	X
3	10-22-96	1330		X	4452	1	X	X
4	10-22-96	1335		X	4453	1		

004450

004451

004452

004453

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	10-22-96 1445				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	
		[signature]	10/22/96 14:45		

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

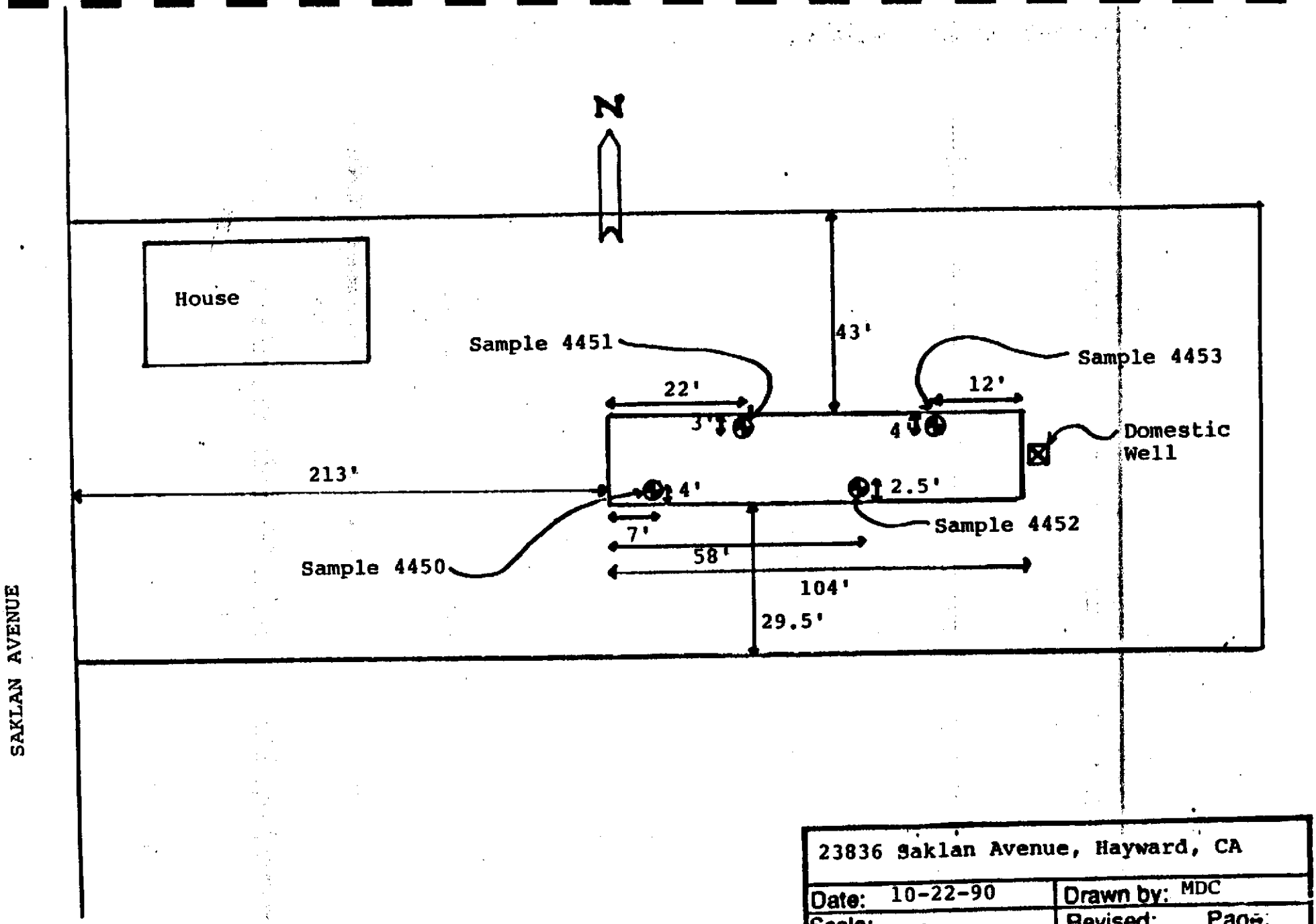
TRACE ANALYSIS LABORATORY
3423 INVESTMENT BLVD., UNIT 8
HAYWARD, CA 94545
(415) 783-6960

3-0605

Y-8
BT, ICP
tech

K. MW

sample taken on 10/22/90 (sample container) GMS



23836 Saklan Avenue, Hayward, CA	
Date: 10-22-90	Drawn by: MDC
Scale: none	Revised: Page
Legend	CHIPS Environmental Consultants
Sample Location	

Trace Analysis Laboratory, Inc.
3423 Investment Boulevard, #8 • Hayward, California 94545
Telephone (415) 783-6960
Facsimile (415) 783-1512

TAL

LOG NO.: 9317
DATE SAMPLED: 11/16/90
DATE RECEIVED: 11/16/90
DATE EXTRACTED: 11/21/90
DATE ANALYZED: 11/27/90
DATE REPORTED: 11/28/90

CUSTOMER: Chips Environmental Consultants, Inc.

REQUESTER: Mark Chips

PROJECT: No. 1056, R. Robles

Sample Type: Soil

Method and Constituent:	Units	Composite #1 of 4238, 4239, 4240, and 4245 Concentration	Composite #1 of 4238, 4239, 4240, and 4245 Reporting Limit	Composite #2 of 4241, 4242, 4246, and 4247 Concentration	Composite #2 of 4241, 4242, 4246, and 4247 Reporting Limit	Composite #3 of 4243, 4244, 4248 and 4249 Concentration	Composite #3 of 4243, 4244, 4248 and 4249 Reporting Limit
EPA Method 8080							
Aldrin	ug/kg	ND	5	34	7	15	5
Alpha-BHC	ug/kg	ND	9	ND	20	ND	9
Beta-BHC	ug/kg	ND	9	ND	20	ND	9
Delta-BHC	ug/kg	14	5	210	9	54	5
Gamma-BHC (Lindane)	ug/kg	13	5	79	8	33	5
Chlordane	ug/kg	ND	9	ND	20	ND	9
4,4'-DDD	ug/kg	57	9	300	20	120	9
4,4'-DDE	ug/kg	230	5	1,900	10	630	5
4,4'-DDT	ug/kg	550	8	6,500	20	1,400	8
Dieldrin	ug/kg	ND	9	ND	20	ND	9
Endosulfan I	ug/kg	ND	9	ND	20	ND	9
Endosulfan II	ug/kg	ND	9	ND	20	ND	9
Endosulfan Sulfate	ug/kg	ND	9	ND	20	ND	9
Endrin	ug/kg	ND	9	ND	20	ND	9
Endrin Aldehyde	ug/kg	ND	9	ND	20	ND	9
Heptachlor	ug/kg	ND	9	ND	20	ND	9
Heptachlor Epoxide	ug/kg	ND	9	ND	20	ND	9
Methoxychlor	ug/kg	ND	9	ND	20	ND	9
Toxaphene	ug/kg	ND	9	ND	20	ND	9

Concentrations reported as ND were not detected at or above the reporting limit.

LOG NO.: 9317
DATE SAMPLED: 11/16/90
DATE RECEIVED: 11/16/90
DATE EXTRACTED: 11/21/90
DATE ANALYZED: 11/27/90
DATE REPORTED: 11/28/90
PAGE: Two

Sample Type: Soil

Method and Constituent:	Units	Composite #1 of 4238, 4239, 4240, and 4245 Concentration	Composite #1 of 4238, 4239, 4240, and 4245 Reporting Limit	Composite #2 of 4241, 4242, 4246, and 4247 Concentration	Composite #2 of 4241, 4242, 4246, and 4247 Reporting Limit	Composite #3 of 4243, 4244, 4248, and 4249 Concentration	Composite #3 of 4243, 4244, 4248, and 4249 Reporting Limit
EPA Method 8080 (Continued):							
Aroclor 1016	ug/kg	ND	6	ND	10	ND	6
Aroclor 1221	ug/kg	ND	6	ND	10	ND	6
Aroclor 1232	ug/kg	ND	6	ND	10	ND	6
Aroclor 1242	ug/kg	ND	6	ND	10	ND	6
Aroclor 1248	ug/kg	ND	6	ND	10	ND	6
Aroclor 1254	ug/kg	ND	6	ND	10	ND	6
Aroclor 1260	ug/kg	ND	6	ND	10	ND	6

Concentrations reported as ND were not detected at or above the reporting limit.

LOG NO.: 9317
DATE SAMPLED: 11/16/90
DATE RECEIVED: 11/16/90
DATE EXTRACTED: 11/21/90
DATE ANALYZED: 11/27/90
DATE REPORTED: 11/28/90
PAGE: Three

Sample Type: Soil

Method and Constituent:	Units	Composite #4 of 4292, 4293, 4334, and 4335 Concentration	Composite #4 of 4292, 4293, 4334, and 4335 Reporting Limit	Composite #5 of 4294, 4295, 4336, and 4337 Concentration	Composite #5 of 4294, 4295, 4336, and 4337 Reporting Limit	Composite #6 of 4296, 4297, 4338 and 4339 Concentration	Composite #6 of 4296, 4297, 4338 and 4339 Reporting Limit
EPA Method 8080							
Aldrin	ug/kg	ND	20	ND	20	ND	20
Alpha-BHC	ug/kg	ND	50	ND	50	ND	50
Beta-BHC	ug/kg	ND	50	ND	50	ND	50
Delta-BHC	ug/kg	ND	20	ND	20	ND	20
Gamma-BHC (Lindane)	ug/kg	ND	20	ND	20	ND	20
Chlordane	ug/kg	ND	50	ND	50	ND	50
4,4'-DDD	ug/kg	590	50	ND	50	220	50
4,4'-DDE	ug/kg	830	20	120	20	740	20
4,4'-DDT	ug/kg	5,600	40	110	40	640	40
Dieldrin	ug/kg	ND	50	ND	50	ND	50
Endosulfan I	ug/kg	ND	50	ND	50	ND	50
Endosulfan II	ug/kg	ND	50	ND	50	ND	50
Endosulfan Sulfate	ug/kg	ND	50	ND	50	ND	50
Endrin	ug/kg	ND	50	ND	50	ND	50
Endrin Aldehyde	ug/kg	ND	50	ND	50	ND	50
Heptachlor	ug/kg	ND	50	ND	50	ND	50
Heptachlor Epoxide	ug/kg	ND	50	ND	50	ND	50
Methoxychlor	ug/kg	ND	50	ND	50	ND	50
Toxaphene	ug/kg	ND	50	ND	50	ND	50

Concentrations reported as ND were not detected at or above the reporting limit.

LOG NO.: 9317
DATE SAMPLED: 11/16/90
DATE RECEIVED: 11/16/90
DATE EXTRACTED: 11/21/90
DATE ANALYZED: 11/27/90
DATE REPORTED: 11/28/90
PAGE: Four

Sample Type: Soil

Method and Constituent:	Units	Composite #4 of 4292, 4293, 4334, and 4335 Concentration	Composite #4 of 4292, 4293, 4334, and 4335 Reporting Limit	Composite #5 of 4294, 4295, 4336, and 4337 Concentration	Composite #5 of 4294, 4295, 4336, and 4337 Reporting Limit	Composite #6 of 4296, 4297, 4338, and 4339 Concentration	Composite #6 of 4296, 4297, 4338, and 4339 Reporting Limit
EPA Method 8080 (Continued):							
Aroclor 1016	ug/kg	ND	30	ND	30	ND	30
Aroclor 1221	ug/kg	ND	30	ND	30	ND	30
Aroclor 1232	ug/kg	ND	30	ND	30	ND	30
Aroclor 1242	ug/kg	ND	30	ND	30	ND	30
Aroclor 1248	ug/kg	ND	30	ND	30	ND	30
Aroclor 1254	ug/kg	ND	30	ND	30	ND	30
Aroclor 1260	ug/kg	ND	30	ND	30	ND	30

Concentrations reported as ND were not detected at or above the reporting limit.

QC Summary:

% Recovery: 103%
% RSD: 10.9%

Louis W. DuPuis
Quality Assurance/Quality Control Manager

CHIPS ENVIRONMENTAL CONSULTANTS INC.
718 E. Evelyn Ave.
Sunnyvale, CA. 94086 (408) 736-1380 CHAIN OF CUSTODY

PROJECT#	PROJECT NAME	PROJECT SITE ADRESS
1056	R. Rohler	Stelzer Rd. Hampton

SAMPLER: B. McCabe

9317

DATE	TIME	GRAB	COMP	SAMPLE ID NUMBER	BTEX 602	EPA 8080	REMARKS
4/6/92		X	X	004238	✓	✓	#1
		X	X	004239	✓	✓	#2
		X	X	004240	✓	✓	#3 Brass tube
		X	X	004241	✓	✓	#4 Y-2
		X	X	004242	✓	✓	#5 GW
		X	X	004243	✓	✓	#6
		X	X	004244	✓	✓	#7

Relinquished by:	Recieved by Date Time	Relinquished by:	Recieved by: Date Time
6:15 PM.			

Page 1

PHIPS ENVIRONMENTAL CONSULTANTS INC.
18 E. Evelyn Ave.
Sunnyvale, CA. 94086 (408) 736-1380 CHAIN OF CUSTODY

PROJECT#	PROJECT NAME	PROJECT SITE ADRESS
SAMPLER		

DATE	TIME	GRAB	COMP		BTEX 8020	EDB 8080	REMARKS
11-16-90		X	X	004245	✓	✓	#8
		X	X	004246	✓	✓	#9
		X	X	004247	✓	✓	#10
		X	X	004248	✓	✓	#11
		X	X	004249	✓	✓	#12
		X	X	004292	✓	✓	#13
		X	X	004293	✓	✓	#14

Relinquished by:	Recieved by Date Time	Relinquished by:	Recieved by: Date Time
6:15 P.M. 11-16-90	TAT 24 HOURS		

CHIPS ENVIRONMENTAL CONSULTANTS INC.
718 E. Evelyn Ave.
Sunnyvale, CA. 94086 (408) 736-1380 CHAIN OF CUSTODY

PROJECT#	PROJECT NAME	PROJECT SITE ADRESS
1006	R. Rabler	874 Clinton Ave. Hayward

SAMPLER: B. McGuire

DATE	TIME	GRAB	COMP.		BTEX 8015 Analysis	EPA 8010				REMARKS
11-16-90		X	X	004294	✓	✓				#15
		X	X	004295	✓	✓				#16
		X	X	004296	✓	✓				#17
		X	X	004297	✓	✓				#18
		X	X	004334	✓	✓				#19
		X	X	004335	✓	✓				#20
		X	X	004336	✓	✓				#21

Relinquished by:	Recieved by Date Time	Relinquished by:	Recieved by: Date Time
[signature] 6:15 P.M. 11-16-90	[signature]		

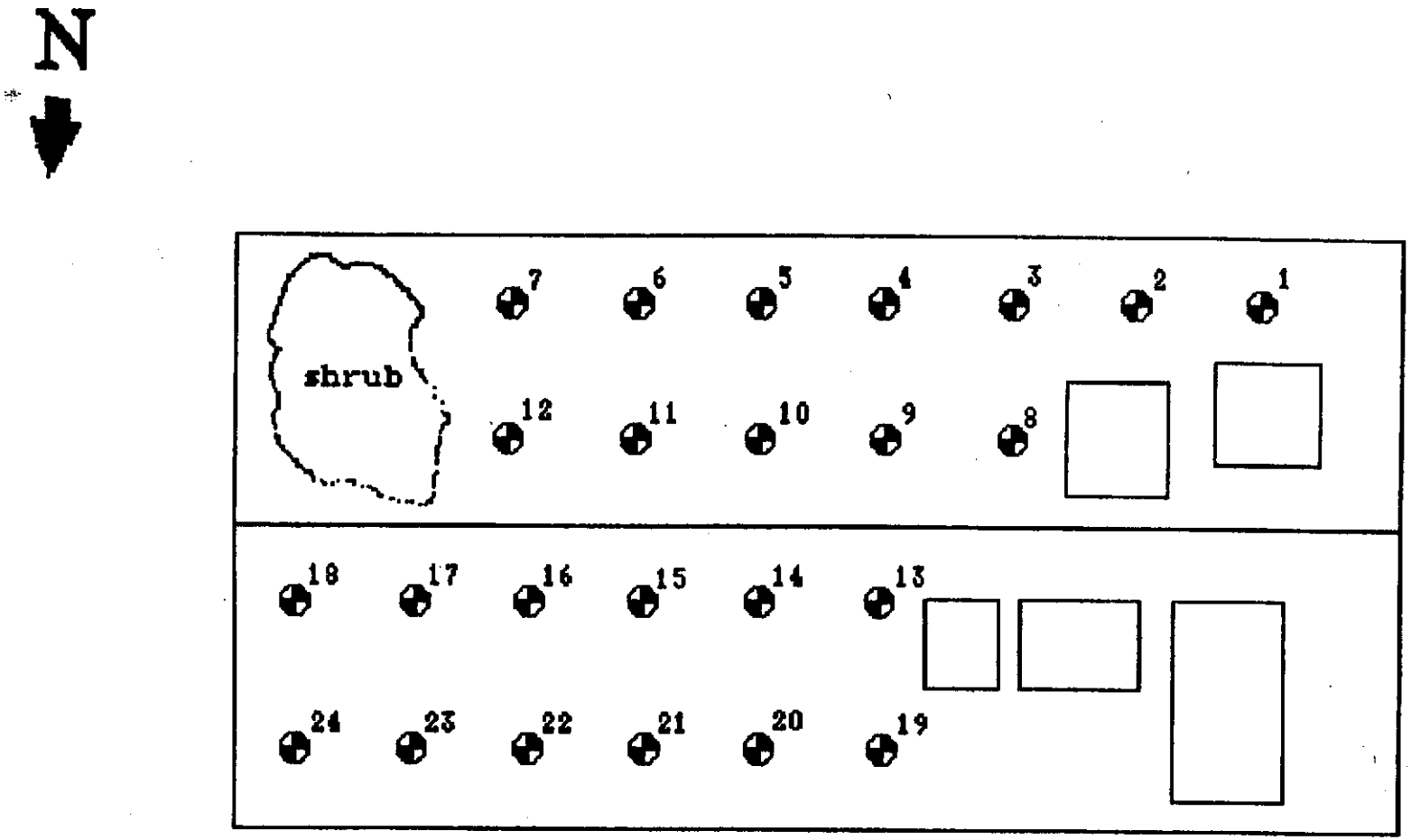
CHIPS ENVIRONMENTAL CONSULTANTS INC.
718 E. Evelyn Ave.
Sunnyvale, CA. 94086 (408) 736-1380 CHAIN OF CUSTODY

PROJECT#	PROJECT NAME	PROJECT SITE ADRESS
SAMPLER		

DATE	TIME	GRAB	COMP.	NUMBER	BTEX ANALYSIS REQ. EPA 8080					REMARKS
11-16-90		X	X	004337	✓	✓				#22
"		X	X	004338	✓	✓				#23
"		X	X	004339	✓	✓				#24
				Mark Chips called 10:45 AM 11/29/90 asked to keep samples on HOLD until further notice GM						

Relinquished by:	Recieved by Date Time	Relinquished by:	Recieved by: Date Time
6 PM 11-16-90	11-26-90		

Page ____



SCALE

0 50' 100'

Robles Property 23836 Saklan Avenue, Hayward, CA.	
Date: 3-19-91	Drawn By: B.D.M.
Scale:	Revised: Pp.:
Legend	
Sample location	CHIPS Environmental Consultants