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Interim Guidance for Sampling Agricultural Fields for School Sites (Second Revision)

California Department of Toxic Substances Control
California Environmental Protection Agency

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Preface

Effective January 1, 2000, new California Department of Education statutes require the Department of Toxic Substances Control (DTSC) of the California Environmental Protection Agency (CalEPA) to review environmental assessments for proposed new school sites and/or new construction school expansion projects. Some of these sites are situated on agriculture land where residual agricultural chemicals may remain in the soil. In June 2000, DTSC issued "Interim Guidance for Sampling Agricultural Soils" to provide a uniform approach for evaluating former agricultural properties where pesticides have been applied. Since this guidance was issued, over 75 agricultural sites have been evaluated across California with the majority in the Sacramento-San Joaquin Valley, Oxnard Plains, and Imperial Valley. The most commonly detected pesticides have been DDT and it's derivatives DDD and DDE, toxaphene, dieldrin, and aldrin. Of these pesticides, toxaphene has been the major pesticide driving unacceptable levels of risk requiring remediation by soil removal. These results and the experience of working with the guidance has allowed for refinement of the original guidance. The revised guidance contained in this document reflects these refinements.

This guidance is intended to supplement the DTSC Preliminary Endangerment Assessment (PEA) Guidance Manual (Manual), CalEPA 1994

(Second Printing, June 1999). Data obtained from the investigations should be evaluated for potential health risks according the PEA Manual. This guidance is not intended to diminish the need to take focused, authoritative samples at site locations commonly associated with hazardous substances releases nor replace guidance provided by the PEA Guidance Manual. This guidance in not applicable to areas where pesticides were mixed, stored, disposed, or areas where pesticides may have accumulated, such as ponds and drainage ditches.

The scope of this document is limited to evaluating only agricultural fields during a PEA or other initial sampling investigation related to proposed new and/or expanded school sites. These are properties (or portions of properties) where pesticides were uniformly applied for agricultural purposes consistent with normal application practices, and where other non-agriculturally related activities have been absent. The data obtained from the sampling analyses will be incorporated into the PEA Report, including performing a risk analysis in accordance with the guidance in the PEA Manual.

This guidance does not apply to disturbed land, such as, land that has been graded in preparation for construction, areas where imported soil has been brought in, or any other activity that would redistribute or impact the soil, other than normal disking and plowing.

This guidance is an on-going effort to streamline the characterization of agricultural sites. As additional knowledge and experience is obtained, DTSC may modify this guidance, as appropriate.

1.0 PURPOSE

This guidance was prepared for use in evaluating soil at proposed new school sites and/or new school construction expansion projects that are currently, or were previously used for certain types of agricultural activities where residual agricultural chemicals may pose a threat to human health and the environment. This guidance is intended to supplement the DTSC Preliminary Endangerment Assessment (PEA) Guidance Manual (Manual), CalEPA 1994 (Second Printing, June 1999), and provide a uniform and streamlined approach for evaluating agricultural soils. It is intended to assist environmental assessors in designing initial investigations or developing Preliminary Endangerment Assessment (PEA) Work Plans for sites with certain historical agricultural uses. The analytical data obtained are to be incorporated into a risk analysis and PEA Report performed in accordance with the guidance in the PEA Manual.

2.0 IDENTIFYING ELIGIBLE AGRICULTURAL SITES

2.1 Eligible Sites

This guidance is specific to agricultural lands where pesticides and/or fertilizers were presumably applied, more or less uniformly, for agricultural purposes consistent with normal application practices. It is applicable to agricultural land that is currently under cultivation with row, fiber or food crops, orchards, or pasture. It is also applicable to fallow and former agricultural land that is no longer in production and has not been disturbed beyond normal disking and plowing practices. Each field of the same crop is assumed to have been watered, fertilized and treated with agricultural chemicals to the same degree across the field. Because of this homogeneous application, contaminant levels are expected to be similar at any given location within the field. This is the underlying premise of the guidance, and one that must be verified at the scoping stage of the PEA process.

2.2 Sites To Which The Guidance Does Not Apply

This guidance is not applicable to agricultural land under or adjacent to structures such as residences, barns, or other outbuildings. Pesticide mixing/loading areas, fence lines, ditches, canals, berms, and other areas that may have been treated differently from an agricultural field are not considered in this guidance. Also excluded are animal facilities such as cattle and poultry barns, settling ponds, and manure piles. This guidance does not apply to former agricultural land that has been graded for construction or other purposes, that has received fill, or has had parking lots or structures placed on it following active use as an agricultural field. An urban residential area that was agricultural land in the past does not qualify for this guidance since the construction of the residences would have resulted in the disturbance and redistribution of potential agricultural contaminants in the soil. These excluded areas require biased, discrete sampling as opposed to the sampling for agricultural fields discussed in this document.

3.0 SAMPLING STRATEGIES

3.1 Sampling Frequency

Sampling frequency may vary depending on the size of the site and conditions found. When the site has been uniformly used for a single agricultural crop, the presumption is that agricultural chemicals were applied equally to the site in any given year and that their distribution will be relatively uniform. **When differing agricultural crops were produced on different areas of the site, each area should be**

addressed separately and the sampling rate should be sufficient to characterize each area.

The sampling pattern should be sufficient to characterize the site. Recommended numbers of sampling locations are provided in Table 1. For sites two acres or less, discrete samples should be collected on ¼ acre centers. For sites between two and four acres, a total of eight locations, evenly spaced across the site, should be sampled. For sites greater than four acres and up to 20 acres, discrete samples should be collected on ½ acre centers, and for sites between 21 and 100 acres, on 1-acre centers. For sites greater than 100 acres, DTSC should be consulted for the appropriate number of sampling locations. Compositing of samples is discussed in Section 4.5.

Table 1: Recommended Number of Sampling Locations

Land Size	Suggested Minimum Sampling Locations
One (1) to two (2) acres	Discrete samples taken on ¼ acre centers
Greater than two (2) up to four (4) acres	Discrete samples taken from eight (8) locations evenly spaced across the site
Greater than four (4) up to twenty (20) acres	Eight (8) composite samples from discrete samples taken on half-acre centers.
Twenty-one (21) to sixty (60) acres	Fifteen (15) composite samples from discrete samples taken on one (1) acre centers.
Sixty-one (61) to one hundred (100) acres	Twenty five (25) composite samples from discrete samples taken on one (1) acre centers
Greater than one hundred (100) acres	Consult with DTSC

3.2 Sampling Depth

Each location should be sampled to include one surface sample (0 to 6 inches) and one subsurface sample (2 to 3 foot range). [Note: 0 inches means first encountered soil. Thick mats of vegetable material, roots, and other extraneous material should not be sampled.]

3.3 Sample Collection

Sampling both the furrows and beds of existing rows will detect the greatest variability in the residuals. Some methods of pesticide application will favor residuals in the beds while others favor the furrows. In fields where rows remain, roughly half of the samples should be gathered from the furrows and half from the beds in an alternating pattern. Orchards should have the sampling locations placed at the current drip line for the trees, under the canopy, between the tree rows, and between the trees within a row. For sites with slopes, swales, or other uneven topography, sampling from centers should be modified to include samples from those areas where surface water would be expected to flow and accumulate.

3.4 Offsite Background Samples

A minimum of four offsite locations must be sampled at the surface (0 to 6 inches) to determine background or ambient levels of heavy metals in the area. The samples must be collected near the site, preferably one from each of the four sides. The soil type of the offsite samples should be the same as the site samples, and if possible, the offsite samples should be collected from areas that have not been impacted by agricultural or industrial chemicals. If other properties in the area have gone through the PEA process, it may be possible to use data from these sites for establishing background metal concentrations providing that soil types are compatible. This may only be done in consultation with the DTSC Project Manager.

4.0 ANALYSES

4.1 Identifying Agricultural Chemicals Used on the Site

When the land is under active agricultural production, the grower should be interviewed to determine the types and amounts of pesticides historically used at the site. The County Agricultural Commissioner should also be consulted to verify pesticide usage on the property. The Agricultural Commissioner is required to maintain this information for three years, but often will have extensive knowledge of the farming practices over many years. A local or specialized farm advisor such as the University of California Cooperative Extension Agent is another source of information for farming practices in the area. These consultations should occur during the scoping phase of the investigation. For those sites that have not been actively farmed in the past three years, obtaining accurate information is more difficult. Information from surrounding or neighboring agricultural operations on the types of crops grown in the area during the time of active farming can provide clues on what chemicals may have been applied.

4.2 Chemicals of Potential Concern (COPC): Pesticides

The chemicals of greatest concern are those that persist in the environment. For the majority of newer pesticides persistence is limited to a few days; however, organochlorine pesticides (OCPs) can still persist in soil at levels of health concern for many years following application. Unless it can be documented that OCPs were not used on the property, they must be considered COPC. Paraquat also has a relatively long persistence in the soil. Paraquat should also be considered a COPC if there is a history of its use on the property. Under certain conditions, such as in rice growing fields, near surface conditions exist that establish anaerobic soil over an extended time. For these situations, anaerobically stable pesticides such as ametryn, cryomazine, and thiabendazole should also be considered as COPC. The selection of COPCs should be done in consultation with the DTSC project manager and toxicologist assigned to the project.

4.3 Chemicals of Potential Concern (COPC): Metals (Inorganic Elements)

Heavy metals have been applied to agricultural fields, both as pesticides and fertilizers. To ensure that the concentrations of these metals in site soils do not pose a potential heath risk or hazard, the CAM 17 metals must be considered as COPC. Heavy metals are also evaluated to detect natural mineral deposits that may pose an unacceptable risk.

4.4 Discrete Samples

For sites four acres or less, each of the surface discrete samples must be analyzed for OCPs and CAM 17 metals. Analysis for other pesticides may be necessary, depending on the history of agricultural activities at the site. Offsite background samples should be analyzed for CAM 17 metals only. Subsurface samples should be frozen and held for analysis pending the outcome of the surface sampling results. No deterioration is expected during the time period required to complete the PEA.

4.5 Composite Samples

While the analysis of discrete samples is preferred, it is recognized that for large sites this may not be practical. Since this guidance assumes a relatively even distribution of chemicals across the site, compositing of discrete samples may be considered when the area to be sampled is greater than four acres.

4.5.1 Number of Composite Samples

The minimum number of composite samples analyzed is dependent on the size of the site (see Table 1). Compositing is not applicable for sites four acres or less. For sites greater than four acres and up to 20 acres, a minimum of eight composite samples is required. For sites 21 to 60 acres, a minimum of 15 composite samples is required. For sites between 61 and 100 acres, the minimum number of composite samples is 25. For sites over 100 acres, DTSC should be consulted for the appropriate number of composite samples.

4.5.2 Makeup of Composite Samples

Composite surface samples may be made up of a maximum of four discrete surface samples. The discrete samples must be from adjacent sampling locations. In cases where two crops were grown on the site, only discrete samples from within the same crop area may be composited.

4.5.3 Preparation of Composite Samples

The discrete samples should be individually mixed and uniformly split by the laboratory or trained field staff prior to compositing. Mixing and compositing should be performed under uniform, controlled conditions. The unused portion of each discrete sample should be frozen and archived in case additional analysis is warranted from the composite results. The samples may be discarded when the PEA process has been completed and approved by the DTSC.

4.6 Laboratory Analyses

4.6.1 Methods

The analytes of primary concern are OCPs and some of the CAM 17 metals. Depending on the site history, analysis of other types of pesticides may be required. OCPs should be analyzed using U.S. EPA 8081A or equivalent. Metals must be analyzed using the U.S. EPA 6000/7000 series. If the site history indicates other classes of persistent pesticides should be evaluated, DTSC should be consulted for the acceptable method of analysis and appropriate detection limits.

4.6.2 Detection Limits

The actual detection limits obtained will vary depending on the particular analyte. For OCPs, the analytes typically causing detection limit concerns in agricultural fields

are aldrin, dieldrin, and toxaphene. The detection limits should be 0.005 mg/kg for aldrin, dieldrin, and 0.100 mg/kg for toxaphene. Table 3 lists the detection limits for several OCPs and paraquat.

In samples with elevated DDT, the detected concentration may be above the range of calibration. This can result in the analytical laboratory diluting the sample for reanalysis, and then reporting only the final result. In these cases, the reported detection limits for aldrin, dieldrin, and toxaphene may exceed the detection limits needed for determining potential health effects. Ideally the laboratory should be asked to report if those three analytes were detected in the first analysis prior to dilution. Multiple analyses of the same samples may be required to obtain the data necessary for risk assessment purposes.

Table 2. Analytical Methods and Detection Limits for Selected OCPs and Paraquat

Pesticide	Methods	CAS No.[1]	DL[2] mg/kg
ALDRIN	8081A, 8270C	309-00-2	0.005
CHLORDANE	8081A	57-74-9	0.10
CHLORONEB	8081A (R)	2675-77-6	100
DBCP	8081A	96-12-8	0.01
DDD	8081A	72-54-8	0.10
DDE	8081A	72-55-9	0.10
DDT	8081A	50-29-3	0.10
DIELDRIN	8081A	60-57-1	0.005
HEPTACHLOR	8081A, 8270C	76-44-8	0.10
HEXACHLOROBENZENE	8081A, 8121, 8270C, 8275, 8410	118-74-1	0.30
LINDANE	8081A	58-89-9	0.10
METHOXYCHLOR	8081A	72-43-5	0.40
MIREX	8081A(R), 8270C	2385-85-5	0.10
PARAQUAT_DICHLORIDE	Zeneca SOP RAM 272/01; Chevron RM 8-10; 549.1*	4685-14-7	270
TOXAPHENE	8081A, 8270C	8001-35-2	0.1
TRIFLURALIN	8091, 8081A(R), 8270C	1582-09-8	63

*Water and Wastewater Methods. Soil must be extracted and the method validated by the laboratory for a soil matrix.
(R) = must be requested for inclusion in the method
CAS No[1] = Chemical Abstract Service registry number
DL[2] = Detection Limit recommended for risk assessment purposes

4.6.3 Pesticide Analyses

Each of the surface samples, discrete or composite, must be analyzed for OCPs. Analysis for other classes of persistent pesticides may be required as indicated by the agricultural history of the site. When using composites, each discrete sample associated with the composite sample having the highest detected concentration of OCPs must be analyzed.

4.6.4 Metal Analyses (Inorganic Elements)

Each of the background and a minimum of four (4) on-site surface samples must be analyzed for the CAM 17 metals. In addition, each of the on-site discrete surface samples must be analyzed for arsenic. When samples are composited, one (1) discreet sample from each composite must be analyzed for arsenic. The number of discrete samples analyzed for arsenic does not need to be greater than the number of total composite samples used for OCP analysis. The subsurface samples need only be analyzed for CAM 17 metals and arsenic if the concentration of an element detected is above the background concentration for that element. Analysis of additional subsurface samples may be requested by DTSC.

4.6.5 Quality Control

Quality control procedures specified in SW-846 must be followed. A matrix spike/matrix spike duplicate on one soil sample per batch of samples must be performed to demonstrate that the targeted pesticide(s) can be recovered from the soil investigated. Highly organic topsoil may interfere with proper extraction of pesticides. The laboratory data package must include a summary of the quality control sample results: blanks, matrix spike/matrix spike duplicate, surrogate recoveries, laboratory control samples, etc., as specified by the method. The laboratory should provide a signed narrative stating whether the QC was met and listing any discrepancies.

5.0 REPORTING

5.1 Format

The results of the sampling effort are to be reported in a Preliminary Endangerment Assessment (PEA) as described in the DTSC Preliminary Endangerment Assessment (PEA) Guidance Manual (Manual), CalEPA 1994 (Second Printing, June 1999).

5.2 Evaluating Metals (Inorganic Elements) Data

Using a robust statistical procedure to determine if on-site metal concentrations are indicative of background conditions or the result of site-related activities can be problematic because of the limited number of background samples collected at any one site. DTSC is in the process of establishing background metals concentrations for specific school districts. If the site is in a school district for which DTSC background levels have been established, those values should be used. If DTSC background levels are not available, then a defensible procedure for comparing on-site with background metals should be used. The Staff Toxicologist assigned to the project should be consulted on the most appropriate method of comparison.

5.3 Data Interpretation

All detected pesticides, and any onsite metals above background must be evaluated in a risk assessment as described in the DTSC PEA Guidance Manual. In the initial screening analysis, the highest concentration of each detected pesticide and metal above background must be used as the exposure point concentration in the risk assessment. If the maximum concentrations detected on site pose an unacceptable risk or hazard, a spatial analysis should be conducted to determine if the elevated levels represent a “hot spot”, or are representative of concentrations across the site. In those cases where the elevated concentrations are determined to be one or more “hot spots”, risk or concentration isopleths should be constructed to differentiate between those areas of the site in need of further action, and those where no further action is required. Any deviations from these analyses must be approved by the Staff Toxicologist assigned to the project. For sites with elevated levels of chlordane, it may be necessary to determine if the concentrations detected would pose an unacceptable risk from indoor air exposures, as evaluated with the Johnson and Ettinger Indoor Air Model. The DTSC Staff Toxicologist assigned to the project should be consulted for further guidance if necessary.

6.0 ADDITIONAL SOURCES OF INFORMATION

6.1 Pesticide Physical Properties and Half-Lives

http://ace.orst.edu/info/extoxnet/pips/ghindex.html
http://www.arsusda.gov/rsml/ppdb1.html

6.2 Active Pesticide Ingredient by Brand Name

http://www.cdpr.ca.gov/docs/label/prodnam.htm
http://www.cdpr.ca.gov/ - see databases
Farm Chemicals Handbook, current edition, Meister Publishing Company, Willoughby, Ohio.

6.3 Maximum Application Rates

http://ace.orst.edu/info/extoxnet/
Agricultural Chemicals – Thomas Publications, Fresno, CA

6.4 Pesticide Usage by Year, County, and Crop

http://www.ipm.ucdavis.edu/PUSE/puse1.html
http://www.cdpr.ca.gov/ - see databases

6.5 Test Methods

http://www.epa.gov/epaoswer/hazwaste/test/
SW-846: USEPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, Current Revision*

6.6 Pesticide Toxicology Information

http://ace.orst.edu/info/extoxnet/ghindex.html
http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm