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INTERIM GUIDANCE
NATURALLY OCCURRING ASBESTOS (NOA) AT SCHOOL SITES
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This document is issued as an Interim Guidance subject to review and revision as necessary. This guidance does not supercede or implement laws or regulations governing asbestos containing materials. The information in this Interim Guidance is intended solely as guidance and as educational reference material and should not be considered enforceable or regulatory in nature.

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1.0 INTRODUCTION

This guidance supplements other currently available Department of Toxic Substances Control (DTSC) advisories for school projects by identifying strategies for environmental assessment, investigation, mitigation, and long-term maintenance at school sites where Naturally Occurring Asbestos (NOA) is a potential compound of concern. DTSC's intent is to prevent or reduce exposure to NOA, and thereby mitigate potential health risks. This guidance is being developed for use at California school sites and DTSC cautions against using the decision criteria contained in this document for other kinds of sites without first evaluating the site specific conditions and intended land use. This guidance uses conservative thresholds because children are typically more sensitive to exposures of hazardous substances including asbestos.

All asbestos minerals are hazardous to humans. Asbestos includes six regulated naturally occurring minerals, i.e., actinolite, amosite, anthophyllite, chrysotile, crocidolite, and tremolite. Asbestos is classified as a known human cancer-causing substance by local, state, and federal health agencies. In addition, asbestos is known to cause chronic respiratory diseases. Asbestos fibers may be released into the air as a result of activities which disturb NOA-containing rock or soils. Asbestos minerals can fragment into small fibers that readily suspend in air, and are of a size visible only under a microscope. Breathing these small fiber fragments may result in an increased risk of respiratory disease or cancer in exposed individuals.

To address potential asbestos concerns, the PEA should examine if NOA is present in the surface or subsurface soils or rock on the potential school site. At the PEA evaluation step, the potential school site is typically vacant and will need excavation, grading and other activities that alter the site topography in order to construct the school facility. DTSC believes that it is more cost effective and protective to determine if asbestos is present and take precautionary measures during construction to prevent future exposures from soils that contain asbestos, rather than first constructing the campus, assessing exposure, and then mitigating the site. Therefore, if asbestos is present above conservative thresholds described below, and the school district elects to proceed with developing the site for a school, plans will need to be developed that mitigate potential releases of asbestos in soil to students, staff and the surrounding community. These plans must be developed and approved by DTSC in a Remedial Action Workplan (RAW) described in Section 8.0 "Response Actions" in this guidance. The RAW should integrate school facility layout and design with asbestos measures to optimize facility placement with minimum NOA exposure.

2.0 REGULATORY AUTHORITY FOR DTSC OVERSIGHT OF SCHOOLS

NOA has recently been identified at several California school sites. Asbestos, including NOA, is classified as a hazardous substance under the Hazardous Substance Account Act, Chapter 6.8 of the California Health and Safety Code, and the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). A list of other applicable federal, state, and county laws and regulations pertaining to asbestos is included in Appendix A. Under these authorities, DTSC may require response actions be taken at existing or prospective school sites where NOA has been released to the environment, including air, water or soil.

Prior to acquisition and/or construction of prospective school sites, the Education Code (Sections 17210 et.seq., amended since January 2000) mandates that school districts complete environmental assessments and cleanups in order to qualify for state funding. DTSC's role is to evaluate these assessments and cleanups, to ensure that they are performed in compliance with state statutes and regulations, and in accordance with recognized standards. If prospective school sites are determined to have environmental contamination from hazardous materials, such as NOA, where there may be unacceptable health risks, they must be properly mitigated or remediated prior to occupancy for protection of human health and the environment.

This guidance does not address compliance with the Asbestos Hazard Emergency Response Act (AHERA), which was enacted in 1986 to ensure that school districts safely managed asbestos-containing-materials found in schools.

3.0 GEOLOGIC OCCURRENCE OF ASBESTOS IN CALIFORNIA

Six regulated asbestos minerals belong to two different mineral groups. Chrysotile belongs to the serpentine mineral group and the remaining asbestos minerals (actinolite, amosite, anthophyllite, crocidolite, and tremolite) belong to the amphibole mineral group. In California, the asbestos minerals are most commonly associated with ultramafic rocks and their metamorphic derivatives, including serpentinite (serpentine rock). Ultramafic rocks are those igneous rocks composed mainly of iron-magnesium silicate minerals that crystallize deep in the earth's interior. By the time they are exposed at the earth's surface, ultramafic rocks have typically undergone metamorphism, a process in which the mineralogy of the rock is changed in response to changing chemical and physical conditions. One of the commonly occurring types of metamorphism in ultramafic rocks is known as serpentinization, a process that alters the original iron-magnesium silicate minerals in ultramafic rocks to one or more water-bearing magnesium silicate minerals belonging to the serpentine mineral group and producing a rock called serpentinite. One of the asbestos minerals, chrysotile, is often present in the resulting rock. Less commonly, chrysotile may also occur in contact metamorphic rocks associated with carbonate rocks such as limestone and dolomite. Metamorphic processes may also lead to the formation of amphibole asbestos minerals in ultramafic rocks.

In California, amphibole asbestos most commonly occurs within the margins of, or immediately adjacent to, serpentinite or ultramafic rock bodies, but is less common than chrysotile asbestos. Tremolite-asbestos and actinolite-asbestos are the most common types of amphibole-asbestos in the State. They generally occur in veins associated with fault or shear zones in ultramafic rocks and serpentinite. In addition to association with ultramafic rock and serpentinite, amphibole asbestos minerals are also known to occur in association with some faults in particular geologic settings, certain non-ultramafic rock types such as schists, gabbroic rocks (in special cases), albitites, and contact metamorphic rocks associated with carbonate rocks such as limestone and dolomite. These amphibole asbestos occurrences are much less common than the ultramafic rock/serpentinite associations. Also, more recently, amphibole asbestos minerals have been found in metamorphosed volcanic rocks (e.g., Copper Hill and Gopher Ridge units) near hydrothermal and shear zones. These units have comparable units to the north and south along the Western Metamorphic Belt of the Sierra Nevada Mountains.

In addition to being associated with specific rock types, NOA may be more commonly found in or around certain geologic features such as faults or shear zones, near geologic contacts, or in or near zones of hydrothermal alteration. The asbestos minerals may be present in soils or alluvium derived from asbestos containing parent materials. Soils developed on NOA containing rocks may be transported away from the original outcrop by the actions of water, wind, and gravity. Alluvium containing NOA may be transported many miles by the action of streams or rivers and deposited in areas far removed from the original source.

The maps of the Geologic Atlas of California and Regional Geologic Map Series published by the California Geologic Survey (formerly Division of Mines and Geology) provide general locations of ultramafic rock and serpentinite around the State. These maps may be referenced to indicate the likelihood of NOA occurrence at a proposed or existing school site. However, because of their small scale, these geologic maps may not show small occurrences of ultramafic rock or serpentinite. A list of these geologic maps is included in Appendix B.

4.0 HEALTH EFFECTS OF ASBESTOS

Health effects of asbestos are dependent primarily upon human exposure to airborne asbestos fibers. Asbestos fibers are odorless. They do not dissolve in water, and are resistant to heat, fire, chemical and biological degradation. Asbestos fibers are very small, and can be easily suspended in air and dispersed by wind or water. Risks to human health are primarily associated with inhaling asbestos fibers, which can become airborne as a result of activities that disturb rock or soil that contains asbestos.

Asbestos fibers can be inhaled deep into the lungs, where they may be retained indefinitely. Asbestos fibers can cause health effects, including respiratory disease (asbestosis), lung cancer, and mesothelioma. Mesothelioma is a rare cancer caused almost exclusively by exposure to asbestos. In addition, asbestos and tobacco smoke have a strong interactive synergism which can produce even higher incidences of lung cancer. The longer a person is exposed to asbestos and the greater the intensity of exposure, the greater the chances for a health problem. Some forms of cancer may take as many as forty years to develop; however, there is concern that even short term exposures may have significant health impacts. All forms of asbestos are considered hazardous.

Exposures to airborne asbestos fibers generated from disturbing soils have been difficult to model and quantify. Therefore, it is difficult to predict airborne asbestos fiber concentrations from the concentration of asbestos fibers in rock or soil. Because of this, a quantitative human health risk assessment with corresponding cancer risk values can not be calculated based solely on concentration of asbestos in soil. DTSC has reviewed existing empirical exposure data in experimental situations and to qualitatively assess the potential for risk. This has lead to development of a strategy to prevent or reduce potential exposures to NOA by instituting mitigative measures based on the presence of NOA in soil or rock at proposed school facilities. The intent of these measures is to either eliminate or greatly reduce possible airborne entrainment of the asbestos fibers from NOA in the rock or soil. These proposed mitigative measures are discussed in Section 8.

5.0 DTSC's FOUR STEP PROCESS

The ***NOA Decision Flowchart for School Sites*** (Figure 1) has been developed to assist school districts and their consultants in conducting environmental assessments, investigations, and response actions (if needed) at new or expanding school sites with potential NOA. The four-step process includes identification, investigation, mitigation, and monitoring. This process should be followed for new or expanding school sites; Steps 1 through 3 ordinarily will be completed prior to commencement of construction activities to build a new school. Step 4 will be included as necessary on a site-by-site basis. These Steps are described in detail in Sections 6 - 9.

- **Step 1, Identification (Phase I Environmental Site Assessment)**: In the top third of the Flowchart, boxes show information needed through record searches and site inspection during the Phase I Environmental Site Assessment (Phase I). Unless DTSC approves a No Action determination, decision points note where the school district may elect to drop a site or may proceed with further investigation if potential NOA is identified.

- **Step 2, Investigation (Preliminary Environmental Assessment)**: If NOA is potentially identified at the site, and the school district elects to continue, environmental sampling and analysis will be needed in the Preliminary Environmental Assessment (PEA), shown in the center section of the Flowchart. If NOA is positively identified at the school site, the school district must decide whether or not to proceed with site acquisition, since mitigation may be required.

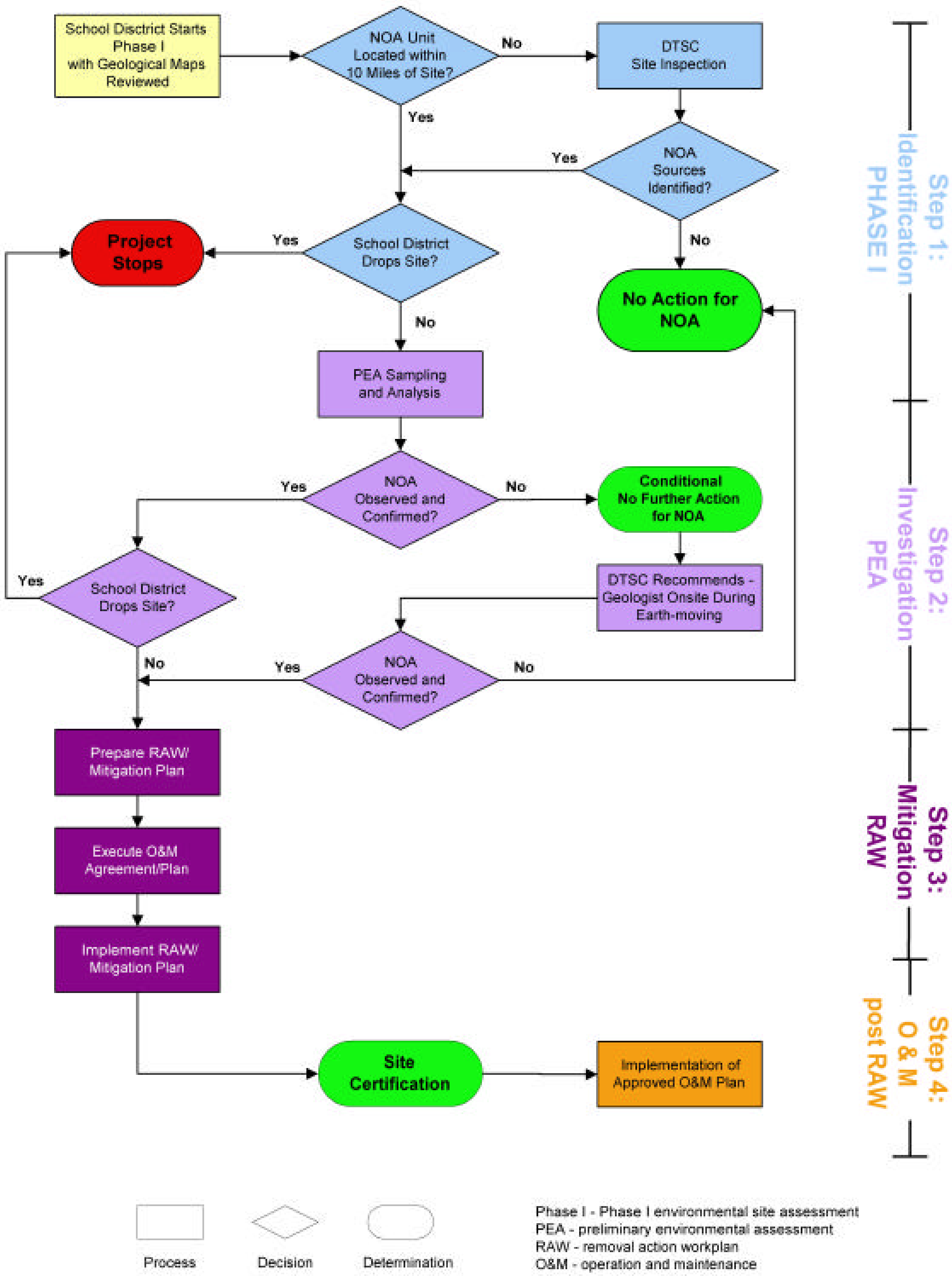
  Note: Even if Conditional No Further Action is approved, DTSC recommends that districts have a qualified professional (e.g., Registered Geologist) onsite so that geologic units that could potentially contain NOA may be identified during excavation, grading and/or construction activities that disturb the soil or rock. Such findings may necessitate re-opening of the environmental assessment process. Where NOA is later identified during excavation or school construction, school districts are required by statute to immediately stop work and notify DTSC. DTSC will evaluate site conditions before giving approval for site activities to continue.

- **Step 3, Mitigation (Response Action)**: As shown in the lower third of the Flowchart, DTSC may require a response action be taken, depending upon the concentration of NOA in soils. The response action will include preparation of a Removal Action Workplan (RAW) or Remedial Action Plan (RAP) to mitigate potential health risks by preventing or reducing exposure to NOA. The probable response action may include bringing in clean fill or other barriers to mitigate potential NOA exposures. Portions of the mitigation implementation may occur during the construction process.

- **Step 4, Long Term Operation and Maintenance (O&M)**: Prior to implementation of the response action, DTSC may require the school district enter into enforceable Agreement to provide ongoing operation and maintenance to ensure that the remedy selected for the response action will remain protective in perpetuity. Following approval of the Operation and Maintenance Plan and completion of the response action, DTSC will issue certification for the school site.

Figure 1

NATURALLY OCCURRING ASBESTOS (NOA) DECISION FLOWCHART FOR SCHOOL SITES



Phase I - Phase I environmental site assessment
PEA - preliminary environmental assessment
RAW - removal action workplan
O&M - operation and maintenance

6.0 STEP 1 – IDENTIFICATION – PHASE I ENVIRONMENTAL SITE ASSESSMENT

Note: While this guidance focuses on the identification of NOA at school sites, the possible presence of other chemicals or compounds of concern may also need to be assessed, depending on individual site history and environmental indicators.

6.1 Phase I Environmental Site Assessment

The environmental assessment of a proposed school site begins with a Phase I Environmental Site Assessment (Phase I). According to the Education Code and California Code of Regulations, Title 22, sections 69100-69104, the Phase I shall be conducted by a qualified professional, in accordance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, (ASTM Designation E 1527 and E 1528),* Please see DTSC's *Phase I Environmental Site Assessment Advisory: School Property Evaluation*, issued September 5, 2001, available on DTSC's website at www.dtsc.ca.gov.

Note: Where the presence of NOA is strongly suspected, a school district may proceed directly with a Preliminary Environmental Assessment of the site, incorporating Phase I information.

6.2 File Review

In accordance with the requirements listed above, the purpose of the Phase I is to review all available site information (e.g., records, files and maps) to determine if there is a Recognized Environmental Condition, such as NOA, at the site. Examples of sources of information include but are not limited to maps such as the statewide asbestos map, and mineral sheets, file reports such as the USGS & CGS open file reports, and other studies. Appendix B lists several sources of information on the occurrence of NOA. The Phase I Report should include findings and supporting documentation, and reach a recommendation as to the need for Further Action or No Action. The Phase I Report prepared by the school district's consultant should be submitted to DTSC for review and approval, and should include a site inspection report.

6.3 Site Inspections

It is not always possible to determine the presence of a geologic unit of concern at a site simply from review of the geologic maps for the site. A site inspection should be conducted to observe the site for possible presence of NOA if the Phase I recommendation will be No Action.

In accordance with the Business and Professions Code, Chapters 7 and 12.5, and the California Code of Regulations, Title 16, Chapters 5 and 29, a site inspection should be conducted by a California registered professional. The California registered professional should be appropriately trained and experienced in the identification of NOA. DTSC recommends that geologists use the California Geologic Survey's Special Publication # 124: "Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California" as reference for inspecting potential NOA sites.

DTSC's project manager and geologist will conduct a site inspection during the Phase I review. School districts and their consultants may accompany DTSC staff on this inspection.

NOA may occur in association with various geologic units, such as ultramafic and mafic rock and serpentinite, soils associated with these geologic units, or other geologic features such as faults, geologic contacts, or alteration zones. NOA may also be associated with fill or roadbase materials that have been imported onto the site. NOA can also be transported from off-site sources onto the site by geologic processes, such as erosion or alluvial transport. Care should be taken in the field to look for geologic units that could potentially contain NOA, such as ultramafic or mafic rock or serpentinite, and soils derived from these units. Indicators of geologic features should also be evaluated, such as fault or shear zones (scarps, overly steep slopes, disrupted drainage, etc.), geologic contacts (lithology changes, vegetation changes), alteration zones (mineralization, bleaching), or other features that may indicate potential NOA.

6.4 Determination

Based on the Phase I Report and site inspection findings, DTSC's project team and management will make a determination as to whether or not Further Action is needed for prospective school sites.

Note: At sites with possible NOA, where DTSC does not require Further Action, DTSC recommends that school districts employ a qualified professional (e.g., registered geologist) to be present during grading, excavation, construction and other earth-moving activities. Where NOA is later identified during building excavation or school construction, school districts are required by statute to immediately stop work and notify DTSC; DTSC will evaluate site conditions before giving approval for site activities to continue.

6.4.1 Further Action Determination

Further Action (i.e., completion of a Preliminary Environmental Assessment, as described in Section 7) should be recommended in the Phase I report if NOA is potentially present under any of the following conditions:

- When geologic units or features are present that could potentially contain NOA;
- When areas are identified that could have received NOA from erosion, run-off or other forces that could move soil or rock containing asbestos away from geologic units containing NOA;
- When fill soils or surfacing materials potentially containing NOA have been brought onto the site;
- When the site is located within a 10-mile radius or in a down-slope drainage area of a NOA geologic formation that could potentially contain NOA.

6.4.2 No Action Determination

A No Action Determination for NOA should be recommended if all of the following conditions are met:

- When geologic units or features that potentially contained NOA are not located within a 10-mile radius of the site;
- When no other potentially NOA related geologic features, such as geologic contacts, fault or shear zones, alteration zones, metamorphic contacts, mélanges, or alluvial deposits are identified at the site;
- When no fill soils or surfacing materials potentially containing NOA have been brought onto the site.

7.0 STEP 2 – INVESTIGATIONS – PRELIMINARY ENVIRONMENTAL ASSESSMENT

7.1 Preliminary Environmental Assessment

The Preliminary Environmental Assessment (PEA) provides basic information for determining if there has been or if there could be a release of a hazardous substance or hazardous material that presents a potential risk to human health or the environment. The PEA investigation requires collection and review of background information and chemical data to complete a screening level evaluation of the site. As required by the Education Code, the PEA should be conducted in accordance with DTSC's *Preliminary Endangerment Assessment Guidance Manual, Second Printing in June 1999.* However, as discussed in Sections 4.0 and 7.8, a Human Health Risk Assessment statistical model will not be utilized for schools with geologic units that could potentially contain NOA.

If a school district chooses to proceed with a project for which DTSC has issued a Phase I Determination requiring Further Action, DTSC will request that the school district enter into an Environmental Oversight Agreement with DTSC. This also applies to school districts which elect to bypass the Phase I and directly initiate a PEA. This agreement authorizes DTSC to oversee the PEA process, and to recover oversight costs.

Prior to commencing the required PEA field activities, the consultant for the school district should prepare a PEA workplan for DTSC review and approval. However, before the PEA workplan is submitted to DTSC for review, DTSC recommends that the school district representatives and their consultant participate in a scoping meeting to discuss the scope of work, sampling and analytical strategy for the required PEA. The school district and their consultant should gather all relevant information and prepare a conceptual strategy to share with DTSC's project team. For the investigation, DTSC's project team will likely include a project manager, unit supervisor, geologist, and toxicologist.

7.2 Preparation by Qualified Professional

School districts will need to employ a qualified and experienced professional environmental consultant to conduct the PEA, as required by Education Code Section 17210(b). For specific requirements, see DTSC Fact Sheets # 2 and 3, dated February 2001 and November 2001, respectively, available on DTSC's website at www.dtsc.ca.gov.

7.3 Sampling Strategy for Naturally Occurring Asbestos

The first task in the PEA is the characterization of the soil to determine if NOA is present at the school site. In order to accomplish this task expeditiously, a PEA Workplan should be prepared by the school district's consultant. Prior to preparing the workplan, sampling strategy proposals should be discussed before implementation with DTSC's project team to reduce the need for remobilization and repeated sampling.

7.3.1 Soil Sampling Considerations

Because NOA may be found in identifiable geologic units and features (such as faults and outcroppings) as well as in imported fill or present in soil, different sampling strategies may be employed depending on site conditions. NOA may be present across the site in soils, or it may be confined to a relatively small area of the site, such as NOA veins within a rock outcropping. NOA may not always be immediately visible; therefore, trenching, test pits, and borings are effective methods to assess the presence of NOA in the surface and subsurface soils at a school site. DTSC recommends the following approach:

- Samples should be collected from areas that are suspected of having the highest NOA concentrations;
- If soil or aggregate is sampled and pieces appear to contain asbestos, then those pieces should be selected for analysis;
- Soil should be tested even if there is no visible source of NOA;
- Each identified geologic unit should be sampled at the interface between different units. At least two samples of each rock type should be sampled and analyzed for NOA;
- If imported fill or surfacing materials are present which could potentially contain NOA, such as serpentine aggregate, the sampling strategy should include consideration of the volume and placement of the fill material. Please see DTSC's *Information Advisory—Clean Imported Fill Material, October 2001,* available on DTSC's website at www.dtsc.ca.gov, for an overview of sampling protocols for imported fill materials.

7.3.2 Proposed and Expansion School Sites: Sampling Protocol

Because many proposed school sites can extend over many acres, both a focused sampling strategy and a strategy for likely homogenous soil areas should be used. The PEA Workplan should include a description of the proposed number and location of proposed soil matrix samples. The actual number of samples and depths may be modified in the field, based on criteria defined in the PEA Workplan and approval from DTSC team's project manager or geologist.

7.3.2.1 Focused Sampling

For sites where there are identifiable geologic units or features, such as outcroppings and faults, focused sampling should be conducted. Areas where focused sampling should occur are listed above in Section 7.3.1. The actual number and locations of samples from these areas must be based on the site inspection and in consultation with the DTSC geologist and project manager.

7.3.2.2 Homogeneous Soil Areas

As determined in consultation with DTSC's geologist, DTSC recommends that a statistical approach to generalized sampling be used for school sites or areas of the school sites which appear to be relatively homogeneous with respect to topography, lithology, or soil unit. This approach may include the following strategies:

- A minimum of one trench should be excavated for every two acres;
- Trenches should be a minimum of 10 linear feet in length;
- For each location, two sample depths should be collected; i.e., at surface and at a depth of 1 foot below the deepest point of any potential excavation (e.g., the lowest proposed construction base, utility trench base, etc.);
- Each identified soil or rock type should be sampled at the interface between different soil or rock types. At least two samples of each mineral type should be sampled and analyzed for NOA;
- Deeper samples may be archived, to be analyzed selectively, in consultation with DTSC's project manager, if NOA is not detected in surface samples.

7.3.3 Existing School Sites: Sampling Protocol

Existing schools, which are not undergoing expansions, are not subject to the requirements of DTSC oversight per the Education Code. However, some school districts have requested DTSC's assistance in investigating current site conditions at existing schools. Sampling strategies for existing school sites should be developed specifically for the current school conditions.

The sampling strategy should address the following:

- Considerations described in Section 7.3.1, as well as site-specific conditions including exposed soil, play fields, unpaved walkways, and dirt/gravel roads and parking areas;
- Areas where soil could be disturbed, potentially producing airborne asbestos fibers should be assessed;
- Consideration of use of activity pattern sampling in exposed areas, to include disturbance of the soil and air monitoring for asbestos fibers. Activity pattern sampling may be a cost-effective sampling approach in some situations, especially at existing school sites.

7.4 Geologic Log

Geologic logging should be performed or supervised by a California registered environmental professional, in accordance with professional licensing requirements for geologists and engineers, at each trenching or boring location. See also Section 6.3.

7.5 Analytical Methods for Soil and Bulk Samples

Analytical laboratories should be certified by the National Voluntary Laboratory Accreditation Program (NVLAP) and have passed a USEPA audit for environmental asbestos analysis.

Laboratory analyses of collected asbestos soil samples should be performed by either the CARB Method 435 using Polarized Light Microscopy (PLM), or United States Environmental Protection Agency's (USEPA) Bulk Method using Transmission Electron Microscopy (TEM) as described in EPA/600/R-93/116. Both methods can speciate NOA, identifying specific minerals.

Note: Results from the two methods are not directly comparable, because PLM results are reported as number of asbestos structures, and TEM results are reported as percentage of asbestos by weight.

7.5.1 Polarized Light Microscopy (PLM)

PLM uses an optical microscope equipped with two polarizing filters to observe specific optical characteristics of a sample, including particle morphology and color. PLM can identify both serpentine and amphibole asbestos, although very thin fibers of amphibole may be missed. The CARB 435 method requires that results be reported as the number of asbestos particles identified among 400 total particles. Count sheets should identify those particles counted as asbestos by: a) specific type of asbestos; and b) the number that are less than 5 microns and those greater than 5 microns in length. Specific sample preparation and analysis procedures are described in the *California Air Resources Board Method 435 Determination of Asbestos Content of Serpentine Aggregate.*

7.5.2 Transmission Electron Microscopy (TEM)

In comparison with the PLM method, the TEM method allows for greater resolution of particles, including detection and identification of smaller diameter particles, which is important when identifying amphibole asbestos. TEM is considered by many to be the most effective way of determining the presence of asbestos. TEM works by passing electrons through a very thin sample onto a detector, which then displays the image onto a monitor. Quantitative analysis methods for the determination of asbestos content using TEM have been difficult to develop; however, it is widely held that US EPA Method 600/R-93/116, Section 2.5 (quantitative) is currently the best method available for TEM analysis. This method involves the preparation of soil samples through separating asbestos fibers from the surrounding matrix. Aspect ratios are counted to show the ratio of fiber length to width. Sufficient grids should be counted to achieve a sensitivity of 0.0005% by weight.

7.5.3 Sample Preparation

California Air Resources Board (CARB) Method 435 should be used to prepare soil samples for TEM analysis. TEM analysis at school sites should incorporate US-Asbestos Hazard Emergency Response Act (AHERA) counting rules.

Sample preparation methods should be clearly described in the PEA Workplan. The Workplan should describe the kinds of equipment that the laboratory will use, and the specific steps they will employ in preparing the samples, including the filters to be counted by either PLM or TEM methods.

Note: The USEPA bulk method was originally designed for building materials, and includes preparation processes to minimize interference from glues and organic fibers often found in these products. These preparation processes, including acid digestion and ashing, should not be used for environmental samples, such as soil matrix and soil aggregate samples.

7.5.4 Data Quality

In order to assure reliable data is generated, Quality Assurance/Quality Control measures should be incorporated into the PEA Workplan and subsequent PEA Report. Because of the difficulty of preparing surrogate and spiked reference samples, duplicate sample analysis is an important tool to evaluate analysis precision. Data validation procedures should also be clearly described in the PEA Workplan and PEA Report.

Inter-laboratory and intra-laboratory analyses are recommended in order to monitor systematic errors that may develop among microscopists using the TEM method. These analyses should be designed to test both the overall method and the performance of individual microscopists. Repeating preparation of TEM grids from different sectors of a filter, followed by examination of the grids by a different microscopist is a test for the reproducibility of the whole method. However, non-uniformity of the particulate deposit on the filter may lead to differences which are not related to the performance of the microscopists. Verified fiber counting by two or more operators counting asbestos structures on the same grid penings of a TEM grid followed by resolution of any discrepancies may be used to address these differences.[1]

7.5.5 Analysis Strategy

DTSC recommends that the following steps should be taken to analyze soil and bulk samples collected from the potential school site:

- Analysis procedures should count all asbestos particles with the aspect ratio of 3:1, including those particles less than 5 microns in length;

[1] ISO 10312: 1995 Section 10.3.3

- After analysis, all soil and aggregate samples, the PLM slides and TEM filters should be archived until completion of the project, in case they are needed for data validation or if questions arise about the data results;
- All of the samples collected should be analyzed by PLM methodology, such as CARB 435, to screen a proposed school site;
- TEM analysis should be conducted at the discretion of DTSC's project management team; if sample results are non-detect or trace (below reportable detection limits) by the PLM method, 10% to 25 % of the samples should be selected and re-analyzed using the TEM method with a sensitivity of 0.0005% by weight.

7.5.6 Reporting Results

The PEA report should include the following information for NOA analyses:

- Description of any deviation from sample collection, preparation and analysis procedures described in the PEA workplan;
- Description of data validation results, including quality assurance and quality control results;
- Sample results shown on a summary table listing PLM results (percent by structures), TEM results (percent by weight) of asbestos fibers, and identification of the asbestos mineral species found in each sample;
- Count sheets for each analysis, specifying the number/dimensions of structures counted that are less than 5 microns, and those that are greater than 5 microns.

7.6 Preliminary Environmental Assessment Report

The PEA Report should be prepared by the school district's consultant to summarize fieldwork, findings and conclusions. The draft report should be submitted to DTSC for review and approval, in accordance with procedures specified in Education Code section 17213.1(a) (6). The PEA Report should also include maps illustrating surface features, sampling locations, laboratory results, and should specify locations of any areas where geologic units potentially containing NOA were visually identified at the site. The site figure should be properly scaled, and should include a north directional arrow and locations of site access roads.

Because the PEA Report requires a geologic evaluation and conclusions, the PEA Report should be stamped (required for professional engineers), signed, and dated (required for both registered geologists and engineers), and should specify the license number and expiration date of the California-registered professional who prepared the documents.

7.7 Risk Management Approach for School Sites with NOA

As discussed in Section 4.0, due to the difficulty in modeling and predicting health risks that may result from inhalation of airborne asbestos generated by disturbance of NOA containing rock or soil, a screening Health Risk Assessment will not be utilized for school sites where NOA has been identified. Instead, mitigative measures will be required where NOA is identified in order to prevent or reduce potential exposures to NOA.

For school sites where NOA has been identified, DTSC may require Further Action (mitigation), depending on concentrations of NOA identified in soil and geologic units. This decision will be based upon sampling results from either PLM or TEM analytical methods, as specified in Sections 7.7.1 and 7.7.2.

Note: Results from the two methods are not directly comparable, because PLM results are reported as number of asbestos structures, and TEM results are reported as percentage of asbestos by weight.

7.7.1 PLM-Based Criteria

The CARB 435 PLM method, with a detection limit of 0.25% or less, may be used to screen a proposed school site. If NOA is detected at greater than or equal to 0.25 % (PLM), DTSC may require further action at school sites. Once this determination is made, school districts have the option of dropping the NOA sites, or working with DTSC to complete mitigation of NOA exposures during and after school construction.

7.7.2 TEM-Based Criteria

If NOA is detected at concentrations greater than or equal to 0.001% by weight (TEM), DTSC may require further action at school sites, depending upon the frequency and location of soil samples exceeding this concentration.

7.8 Preliminary Environmental Assessment Determination

7.8.1 No Further Action Determination

DTSC will issue a "Conditional" No Further Action determination letter to the school district if NOA is not detected at a level of 0.001% by weight (TEM) at the school site.

However, due to the uncertainty and difficulty in identifying geologic units that could potentially contain NOA, DTSC recommends a California registered professional observe future grading, and excavation or other activities that disturb the soil during school construction to ensure that potential NOA will be identified if present.

In addition, even for sites where DTSC has issued a No Further Action determination, DTSC recommends that school districts contact their local Air Pollution Control District or Air Quality Management District to determine whether or not the CARB *Air Toxic Control Measure (ATCM) Section 93105 for Construction, Grading, Quarrying, and Surface Mining Operations* will be applicable during earth-moving activities for school sites located within geologic areas that could potentially contain NOA.

7.8.2 Further Action Determination

If the PEA Report identifies detection of NOA at a level equal to or exceeding 0.25% (PLM) or 0.001% by weight (TEM), DTSC may issue a Further Action determination letter to the school district, requiring that a response action be conducted to mitigate against possible future exposures to NOA. Some studies assessing air concentrations resulting from disturbing soils containing 0.001 % by weight (TEM) have shown elevated air concentrations of asbestos. [2] As a result, DTSC believes this concentration is an appropriate interim threshold for determining if further action or assessment is needed at a potential school site. This level may be modified in the future as more data is collected from activity/exposure studies and attendant soil concentrations.

8.0 STEP 3 – MITIGATION – RESPONSE ACTIONS

In accordance with the Education Code and the Health and Safety Code, response actions must be taken to abate or mitigate threats to human health and the environment. If a PEA identifies NOA above acceptable concentrations (as identified above in Sections 7.7 and 7.8.2) at a prospective school site, the school district may elect to drop the school project at such sites, or may proceed with the required response action.

8.1 Response Actions - Removal Action Workplan

A Removal Action Workplan (RAW), as defined by Section 25323.1 of the Health and Safety Code, is a remedy selection document required to carry out an effective removal or mitigation action that protects public health and safety, and the environment. The consultant for the school district should prepare and submit the draft RAW for DTSC's review and approval prior to implementation of any response actions.

Please see DTSC's *Schools Fact Sheet # 4, Removal Action Workplan,* revised June 2003, available on DTSC's website at http://www.DTSC.ca.gov for more information concerning the response action process. Additionally, DTSC has prepared several sample RAWs, and will provide consultation to school districts and their consultants to assist in preparation of RAWs for specific sites. DTSC will request that the school district enter into a Voluntary Cleanup Agreement (VCA) with DTSC, to allow DTSC to oversee the required removal action at the site, and to recover oversight costs. DTSC's project team may include: project manager, unit supervisor, geologist, engineer, toxicologist, public participation specialist, and industrial hygienist.

For school sites with NOA above acceptable concentrations, the RAW may generally require grading, backfill, and final surface finish (e.g. paving or clean fill) to protect students, faculty and staff from potential exposure. The RAW should also specify all measures needed to mitigate NOA releases during and after any grading, excavation, construction, other earth-moving, or operational activities at the site. The first step in preparing a RAW is to meet with the DTSC team to review specific school construction plans and discuss ways that NOA mitigation can be incorporated into the school facility so that exposure to students, staff and visitors can be minimized once the school has been built. Exposure can be minimized by preventing contact with NOA containing soils.

[2] This number is derived from studies by Mactec, Addison, USEPA Region VIII, Western Australia draft health report and the European Union rule on recycled asbestos debris.

Under Section 17213.2(g) of the Education Code, DTSC is required to notify the Division of the State Architect and the Office of Public School Construction in the Department of General Services of any required design modification requirements that may impact the architectural design or construction of a proposed school facility.

8.2 California Registered Professional

The RAW should be developed and implemented or supervised by a California registered professional in accordance with the Business and Professions Code, Chapters 7 and 12.5, and the California Code of Regulations, Title 16, Chapters 5 and 29. The California registered professional (such as a registered geologist or a professional engineer) should be experienced in the identification of NOA.

8.3 Major Elements of a Removal Action Workplan (RAW)

Major elements of a RAW include:

- Removal action objectives for each media, chemical and exposure pathway;
- Site background, including site location, historical activities, geology and hydrogeology, and summary of historical investigations;
- Nature, source, and extent of NOA; summary of risk evaluation and potential health effects;
- Evaluation of remedial alternatives, individual and comparative alternative analysis, and basis for remedy selection;
- Identification of applicable or relevant and appropriate requirements (ARARs), such as, California Environmental Quality Act, Occupational Health and Safety Act, Air Toxics Control Measures, Resource Conservation and Recovery Act; Health and Safety Code, etc.;
- Removal Action Implementation Plan, including a detailed engineering plan for conducting the response action, an implementation plan, health and safety plan, transportation plan, quality assurance and quality control plan, sampling and analysis plan, site restoration, air monitoring and dust control measures;
- Implementation schedule;
- Public participation activities.

8.4 Remedy Selection

In accordance with USEPA's national guidelines, *National Oil and Hazardous Substances Pollution Contingency Plan*, the preferred response action should provide the most long-term protection, effectiveness, and permanence.

8.4.1 Applicable Remedies for NOA at School Sites

Response actions at school sites with NOA may include a combination of the following actions:

- Removal of surfacing materials or imported fill materials containing NOA;
- Covering the site with imported clean fill materials to create a barrier and prevent future exposure pathways;
- Covering or capping specified areas with buildings, hardscape, sod, or landscaping sufficient to create a barrier and prevent future exposure pathways;

- Development of an Operations and Maintenance/Monitoring Plan to ensure that the remedy remains protective in perpetuity;
- Recording a Land Use Covenant to restrict future land uses or activities at the site due to presence of hazardous materials;
- School Board Resolution prepared with restrictions on future land use or designated activities due to presence of hazardous materials.

8.4.2 Considerations for Remedy Selection

Remedy selection should also take into consideration school design and land uses at different areas of school sites, if available. Mitigation measures may vary in accordance with placement of structures, intended activities, and varying requirements for finished surfaces.

For example, higher NOA concentrations may be acceptable in limited areas where disturbances and access will not occur, such as under buildings or hardscape. DTSC may require mitigation criteria (such as 0.001% (TEM) in high use areas where soil disturbance is likely, such as playfields and dirt roads. Alternatively, DTSC may approve mitigation criteria of 0.01% TEM in areas where heavy activities are not anticipated, such as in planter boxes or in undisturbed landscaped areas). The depth of clean fill cover may also vary depending on activity level.

DTSC recommends the following mitigation actions:

- Over-excavating utility line trenches to one foot below grade, and backfill with clean soil so that future repair work will not require excavation into potential NOA materials;
- Where excess soil is generated from earth-moving activities and the proposed method of disposal is on-site burial, a colored geo-textile fabric should be used as a marker, in addition to at least one or two feet of clean soil topped with a vegetative cover or hardscape surface. The burial location should be mapped and copies retained by the school district and DTSC;
- Commitment to an architectural design, since changes or revisions may require resubmission of plan for approval by DTSC and re-notification to Division of State Architect and Office of Public School Construction.

Table 1 presents recommendations for varying thicknesses of clean fill based on the final surface finishes and anticipated activities at school sites with NOA.

TABLE 1

Surface Finishing/Feature	Recommended Mitigation Measures and/or Clean Fill Thickness
Hardscaped Areas (Buildings, Concrete/Asphalt Paved Areas, parking lots, sidewalks)	No fill
Landscaped Areas	Cover with geo-textile marker and a minimum of 1 to 2 feet of clean fill
Play Fields	Cover with geo-textile marker and a minimum of 1- to 2-feet of clean fill
Utility Corridors	Over-excavate 1 foot and clean backfill
Steep Embankments with potential storm water erosion	Shotcrete or other form of retaining wall with appropriate drainage controls
Steep Embankments	Geo-textile marker, landscape cover with hydro-seeding

8.5 Imported Fill Materials

Most RAW projects for mitigation of NOA at school sites will require imported clean fill as a barrier to prevent exposure to NOA. All sources of imported fill should be tested for NOA and other chemicals. Since there are no regulations currently in place defining requirements for clean fill, fill materials labeled as clean may in fact contain chemicals of concern that could contaminate school properties. DTSC recommends that school districts obtain DTSC approval of analytical results prior to using imported fill materials.

DTSC recommends that school districts follow the recommended sampling schedule on *DTSC Information Advisory – Clean Imported Fill Material*, available on DTSC's website at www.dtsc.ca.gov.

If the fill source is located within the 10-mile radius or in a down-slope drainage area of a known or suspected NOA containing geologic unit or feature on a geologic map, asbestos should be included as a target compound. All collected samples should be analyzed using PLM. If sample results are non-detect or trace, 10% to 25% of the samples should be selected and re-analyzed using the TEM method with a sensitivity of 0.0005% by weight.

8.6 Transportation Plan

Precautions to prevent dust generation and NOA releases during transportation should be developed and implemented as part of the Air Monitoring and Dust Mitigation Plans (see Sections 8.8 and 8.9).

A site-specific Transportation Plan should be prepared as an appendix to the RAW to address all potential concerns related to offsite transport of soils containing NOA. The Transportation Plan should include a project summary, characterization data, soil volumes, soil loading operations, decontamination procedures, transportation controls, transportation routes, offsite soil receiving facilities, shipping documentation, recordkeeping, health and safety measures, license, insurance, and contingency plan.

8.7 Health and Safety Plan

Prior to any field activities, a Health and Safety Plan should be prepared as an appendix to the RAW to comply with state and federal Occupational Safety and Health Administration (OSHA) regulations to protect on-site workers, and to ensure that students, workers, and near-by residents are not exposed to NOA.

8.8 Air Monitoring Plan

An air monitoring plan should be developed as an addendum to the RAW to establish activities to prevent asbestos fibers from becoming airborne during RAW implementation at areas where NOA could impact students, workers, and near-by residents. This program should include personal and fixed ambient air monitoring during the grading, excavation, construction and other activities that may disturb soils potentially containing NOA. The Air Monitoring Plan should be overseen by an Air Monitoring Officer at the site. Sampling frequency may be modified in consultation with DTSC's project manager and Industrial Hygienist, depending on site-specific circumstances.

8.8.1 Air Monitoring Officer

Qualifications for the Air Monitoring Officer include relevant education and experience coupled with the knowledge, skills and abilities to perform the following responsibilities:

- Perform real time particulate monitoring, as appropriate, to ensure contaminants are not migrating off the site, and record results;
- Perform personnel and area samples, and record results;
- Monitor weather conditions using a meteorological station and/or Internet information;
- Inform all site personnel of existing conditions.

8.8.2 Meteorological (Met) Station:

Onsite ambient weather conditions (wind speed and direction, and relative humidity) should be monitored by an onsite Met Station. Data from real-time Internet weather locations and/or the National Weather Service may supplement the data from the onsite Met Station. The Air-Monitoring Officer will monitor onsite meteorological instrumentation and coordinate with offsite meteorological professionals to identify conditions that require cessation of work (e.g., winds in excess of 25 mph). All earth-moving activities should be ceased in times of high wind conditions, defined as sustained wind speeds exceeding 25 miles per hour, and/or if two wind gusts in excess of 25 mph are recorded in a 30 minute period.

8.8.3 Worker Protection - Personal Air and Dust Monitoring

Worker protection is governed by the California Occupational Safety and Health Administration (Cal-OSHA), statutes and regulations. Within the Cal-OSHA asbestos regulations, specific allowable levels are prescribed for the 8-hour time-weighted average (TWA). All results for air monitoring of workers during the

RAW implementation should be faxed to DTSC's project manager within 24 hours.

8.8.3.1 Phase Contrast Microscopy (PCM)
PCM is the method that should be used for all worker protection asbestos air samples, because NIOSH 7400 (PCM Method) is the method prescribed by Cal-OSHA. The CalOSHA Permissible Exposure Limit (PEL) is based on this sampling method. The use of other methods for determining worker exposures would not be applicable or relevant for CalOSHA compliance determinations.

PCM, manual fiber counting, uses a positive phase-contrast microscope coupled with a Walton-Beckett graticule. PCM is primarily used for estimating asbestos concentrations, though PCM does not differentiate between asbestos and other fibers. All fibers meeting the following criteria are counted: longer than 5 microns, and an aspect ratio of at least 3:1. This method does not allow for differentiation of fibers based on morphology. Although some experienced counters are capable of selectively counting only fibers which appear to be asbestiform, there is presently no accepted method for ensuring uniformity of judgment between laboratories.

8.8.3.2 Worker Protection Air Monitors
Personal air monitors should be worn by workers in the work and exclusion zones. The current Cal-OSHA 8-hour time-weighted average (TWA) Permissible Exposure Limits are: 1) asbestos 0.1 fibers per cubic centimeter of air (PCM); 2) total dust 10 milligrams per cubic meter; and 3) respirable dust 5 milligrams per cubic meter. Personal asbestos air samples should be analyzed by NIOSH 7400 PCM method with the 8-hour TWA calculation.

8.8.3.3 Action Levels
Action levels for worker exposure to asbestos dust are calculated based upon one-half of the Cal-OSHA TWA. If an action level is exceeded, the frequency or extent of control measures should be increased to reduce levels of asbestos or dust in the air. If the site cannot be reliably controlled within 15 minutes, all work shall cease. If action levels are exceeded, DTSC's project manager should be notified immediately.

For school sites with NOA, the work zone action levels are: 1) 0.05 fibers per cubic centimeter for asbestos (PCM); 2) 5 milligrams per cubic meter for total dust; and 3) 2.5 milligrams per cubic meter for respirable dust.

8.8.3.4 Personal Asbestos Air Monitors
The number of personal asbestos air monitors for workers should be proportionate and be determined in consultation with DTSC's Industrial Hygienist on a case-by-case basis.

All worker protection asbestos air monitoring should be done in compliance with Cal-OSHA (Title 8, California Code of Regulations, Sections 5208 and 1531). Instrumentation may include direct read dust monitors, such as the PDR or fiber monitors, such as the FAM, selected in consultation with DTSC's Industrial Hygienist.

8.8.3.5 Personal Dust Air Monitors

Initial dust monitoring can be accomplished with direct read dust monitors, such as the PDR. Dust levels should be data-logged in the work zone continuously for the first week. After the first week, modification of the dust monitoring plan should be discussed with DTSC's project manager and Industrial Hygienist.

If direct-read dust monitors show dust levels less than the action level, then integrated long-term dust monitoring of worker's should not be necessary. If long-term dust monitoring of the workers is necessary, an OSHA or NIOSH approved method should be utilized. The number and location of samples should be discussed on a case-by-case basis with DTSC's project manager and Industrial Hygienist.

8.8.4 Community Fenceline Monitoring

Community ambient air-monitoring stations should be used at school sites during soil removal and mitigation to measure dust and asbestos levels generated by onsite activities. The purpose of community monitoring is to ensure the effectiveness of the dust mitigation measures.

8.8.4.1 Asbestos Monitoring

8.8.4.1.1 Location and Number of Monitors

- Community reference monitor: one offsite non-directional monitor in a nearby location, such as a park or open space;
- Fenceline monitors: a minimum of two directional monitors should be placed on the property boundaries. The exact number of directional monitors, locations and air volumes should be determined by the DTSC project manager and Industrial Hygienist;
- Air samples should be collected in the breathing zone, approximately 5 feet above ground level.

Just before excavation or grading, the contractor should use a smoke tube or windsock to verify the wind direction at the site to determine where monitors should be placed,. Monitoring stations may need to be moved if the wind direction changes. These methods should be used daily to best determine monitor locations.

8.8.4.1.2 Frequency of Sampling

Daily sampling should occur for the first week of activity for all monitors. Depending on the results of the first week of air sampling and the planned field activities, the asbestos air sampling frequency may be modified in consultation with the DTSC project manager and Industrial Hygienist.

8.8.4.1.3 Analytical Methods

All asbestos air samples should be analyzed, using a TEM Method in accordance with 40 CFR Part 763 Final Rule with analytical sensitivity of 0.0005. In addition, all fibers with an aspect ratio greater than 3:1 should be counted. All sample/monitor results should be transmitted to the DTSC project manager within 24 hours during the first week. Turnaround times for subsequent weeks should be determined by the DTSC project manager and Industrial Hygienist.

8.8.4.2 Total Dust Air Monitoring

Total dust may be sampled with direct-read or integrated monitors. Direct-read instruments may continuously record data for later analysis and also provide information on a real-time basis. Integrated samples collect a known volume of air over a specified time-period, and then the sample is sent to an analytical lab for analysis. Integrated monitors are generally in compliance with local and state regulations. However, direct-read instruments should be used to screen sites and provide valuable real-time information, as follow:

- A minimum of one upwind and two or three downwind monitors should be used in a data logging mode at the perimeter fence lines on a continuous basis;
- Dust meter readings should be taken hourly during the first day of each new field activity type (e.g., excavating, grading, backfilling) and may be modified in consultation with the DTSC project manager and Industrial Hygienist;
- Use of handheld dust monitors for dust monitoring is appropriate.

8.8.4.3 Fenceline Action Levels

Whenever any trigger or action levels listed below are exceeded, the frequency or extent of dust control measures should be increased to maintain asbestos or total dust in air concentrations below the corresponding action levels; in addition, DTSC's project manager should be notified immediately. If conditions continue to exceed the trigger level(s), earth-moving activities may be stopped by DTSC after a consultation with DTSC's Industrial Hygienist. If the site air contaminants (total dusts or asbestos) cannot be controlled reliably within 15 minutes (e.g., based on dust monitor readings), all work will cease in consultation with a Certified

Industrial Hygienist. The following community action levels are applicable at fence lines:

- The fenceline trigger levels are: 1) 0.005 fibers per cubic centimeter for asbestos; 2) 0.05 milligrams per cubic meter for total dust;
- Dust levels: Consult with the Air Quality Management District for applicable dust monitoring requirements, including action levels;
- A nominal value of 0.01 fibers/cubic centimeter (PCM) or less is listed as the measure of work site cleanliness by USEPA.

8.9 Asbestos Dust Mitigation Plan

An Asbestos Dust Mitigation Plan should be prepared as an appendix to the RAW, in accordance with the requirements of the CARB Air Toxics Control Measure (ATCM), contained in Section 93105 of the California Code of Regulations [CCR]. The Plan should specify measures to control asbestos emissions during earth-moving activities. The school district and their consultant should contact the appropriate Air Quality Management District (AQMD) or Air Pollution Control District (APCD) officer for site-specific requirements. DTSC will require receipt of approval or acknowledgement of the Plan from the AQMD or APCD prior to DTSC's issuance of RAW approval.

8.9.1 Protective Measures - Pre-Construction

- Secure the NOA removal areas (e.g. signs and fencing);
- Apply sufficient water to the areas to be excavated prior to any ground disturbance.

8.9.2 Protective Measures – During Construction

- Perform work only when students are not present (if project is expansion of existing school);
- Limit on-site vehicle speed to 15 miles per hour or less as needed to prevent dust generation;
- Cover onsite traffic routes with non-asbestos materials;
- Apply sufficient water to the areas to be excavated, and continue watering throughout the removal activities to prevent dust generation yet not have runoff;
- Suspend removal activities when wind speeds are high enough to result in dust emissions (e.g. greater than 25 miles per hour);
- Keep soil stockpiles adequately wetted or covered at all times during the removal activities;
- Wash down and decontaminate all equipment and truck tires before moving them from the property onto a paved public road, and prevent any track-out of contaminated materials;
- If accidental track-out occurs, clean visible track-out on paved public roads using a high efficiency particulate air filter (HEPA filter)

equipped vacuum device within 24 hours; upgrade decontamination procedure to prevent future track-out;

- Maintain vehicles used to transport NOA materials such that no spillage can occur from holes or other openings in cargo compartments;
- Keep soil stockpiles adequately wetted, treated with a chemical dust suppressant, or covered;
- Manage the removed NOA materials in accordance with local, state, and federal laws and requirements; dispose of NOA-containing rock or soils to facilities certified to receive NOA.

8.10 Storm Water Pollution Prevention Plan

A Storm Water Pollution Prevention Plan should be prepared for prevention and control of storm water runoff from the site. The local Regional Water Quality Control Board (RWQCB) should be consulted for site-specific requirements. An approval or acknowledgement of the Storm Water Plan should be obtained from RWQCB prior to DTSC's approval of the RAW.

8.11 Removal Action Completion Report

Following implementation and completion of the removal action, the School District's consultant should prepare a Removal Action Completion Report and submit it to DTSC for review and approval. The Completion Report should document whether or not objectives stated in the DTSC-approved RAW were met. The Completion Report should also verify, if appropriate, that the ongoing operation and maintenance (O&M) activities have been implemented in accordance with a DTSC-approved post-construction O&M Plan. At a minimum, the final NOA Removal Action Completion report should include the following information:

- Current physical site setting;
- NOA sampling locations and delineation of potential NOA units at and around the site;
- Areas of NOA removal;
- Depths of excavation and backfill thickness throughout the entire site, along with depths of utility lines and building foundations;
- Final finished grade after completion of school construction;
- Data collected from air and soil, and observation during monitoring activities;
- As-Built documents;
- Statement summarizing residual risk from NOA;
- Observations, findings, and conclusion;
- A post-construction O&M Plan.

9.0 STEP 4 - LONG-TERM MONITORING AND MAINTENANCE

After completion of NOA removal and school construction, the site should no longer have any exposed NOA above the criteria specified in Section 7.7 and the approved RAW ; pathways for exposure should be reduced or eliminated by barriers. Unless all asbestos containing material has been removed from the school site, the selected remedy should also include institutional controls and long-term operation and maintenance (O&M) activities. Before DTSC can approve a RAW, DTSC will request that the school district enter into an O&M Agreement with DTSC to monitor and protect the remedy, to ensure no future NOA exposures will occur, and to have a contingency plan in case the remedy should fail. The O&M Agreement is an enforceable document that requires the school district to implement an approved O&M Plan under DTSC oversight. DTSC will prepare the O&M Agreement, while the consultant for the school district should prepare the O&M Plan.

9.1 Institutional Controls

For all sites where response actions are overseen by DTSC, and hazardous materials/substances remain at the property at levels which are not suitable for unrestricted use, California Code of Regulations (Title 22, Section 67391.1), requires that a land use covenant be executed and recorded in the county where the site is located. The remedy selected in the RAW must include institutional controls to prevent exposure to NOA. Institutional controls include land use covenants to restrict use of property (e.g., deed restrictions on specified activities, such as no digging below a specified depth), administrative controls (such as annual inspection reports); and engineering controls (such as installation of protective barriers). As a result of recent legislation (Assembly Bill 2436, effective January 2003), DTSC is required to post all sites where deed restrictions are included as part of response actions on DTSC's webpage, to be available to the general public. Additionally, annual inspections of each site must be conducted to ensure that the remedy remains protective. Results of these inspections must be provided to the county in which the site is located, to current property owners, and be kept on file at DTSC's offices. Notification of land use covenants should also be provided to Division of the State Architect and Office of Public School Construction.

In most cases, DTSC will also require notification of any activities where the remedy could be disturbed. DTSC oversight may be required to oversee such activities in order to prevent or minimize exposure to NOA. Land use covenants and deed restrictions may not be routinely reviewed for school districts, which are not required to obtain local permits prior to many school construction or modernization activities. Therefore, for school sites where NOA response actions include institutional controls, DTSC may request that school boards approve a resolution which contains the same land use restrictions as specified in deed restrictions.

9.2 Engineering and Administrative Controls

For all sites where response actions are overseen by DTSC, engineering controls, such as barriers to control exposures, may be required at sites where hazardous materials/substances are left in place. Examples of engineering controls include installation of:

- Caps or covers (paving, fill soils);

- Protective retaining walls and drainage systems (such as shotcrete);
- Geotextile liners or markers;
- Landscaping to prevent erosion and contact.

Additionally, in order to ensure that engineering controls are adequately monitored and maintained, administrative controls may also be required, to include activities such as:

- Access limitations;
- Inspections and maintenance of caps or covers;
- Worker health and safety awareness training;
- Maintenance of security measures.

9.3 Operation and Maintenance Agreement and Plan

DTSC will periodically monitor sites to ensure that the remedy remains protective of human health and the environment. Monitoring and maintenance must be provided throughout the life cycle of the remedy, which may extend for the duration of operating the facility as a school. In order for DTSC to approve a remedy where hazardous materials/substances are left in place, DTSC will require that school districts enter into an Operations and Maintenance Agreement with DTSC before site certification. This enforceable agreement will be prepared by DTSC, and will require the school district to implement an approved Operations and Maintenance Plan (O&M Plan) under DTSC oversight.

The O&M Plan should be prepared by the school district's consultant, and should contain a detailed description of the mitigation action. The O&M Plan should identify procedures for long-term operation, monitoring, inspections, data acquisition, reporting, and maintenance. Future repairs, such as equipment replacement or maintenance, or bringing in of additional fill, must be performed and documented in accordance with the approved O&M Plan. Maintenance practices may include periodic cleaning, using HEPA vacuums, and wet dusting/mopping. In accordance with state and local ordinances, leaf blowers should not be used at school sites with NOA. In the event that the remedy fails, additional investigation and remediation under DTSC will be required.

The O&M Plan should include, but not be limited to, the following:

- A map depicting all buildings, utility line trenches, finished grade elevations, and thickness of clean fills throughout the site;
- Description of periodic, routine inspection and maintenance work to be conducted at the site;
- Description of measures to clean classrooms including HEPA vacuuming and wet mopping floors and wet dusting surfaces;
- Description of repair procedures should geo fabric markers become exposed;
- Description of soil management and handling if repair or construction work is needed that requires digging into asbestos containing soils;
- Description of maintenance and monitoring activities for which DTSC oversight/approval is needed;
- Description of reporting format and frequency;

- Restrictions on any future intrusive activities that may potentially expose the NOA materials. Such activities should only be conducted after the school district has notified DTSC and obtained DTSC's approval;
- Any NOA materials brought to the surface by future excavation or trenching should be managed in accordance with the approved O&M Plan and applicable local, state, and federal laws and requirements;
- Submission of site inspection reports on a periodic basis or after triggering events (e.g. earthquake, heavy rain) that may result in exposure of NOA materials at the site;
- Deed Restrictions and/or Board Resolution.

DTSC should be contacted to provide input during the planning stages for any new construction of buildings, athletic fields, utility realignment or installation, or other activities requiring grading or excavation in soils that could contain NOA at the school.

9.4 Site Certification

DTSC will issue a certification for the school site when all of the following conditions have been met:

- All necessary response actions have been completed;
- The approved response action standards and objectives have been met and the ongoing O&M activities are maintained in accordance with an approved O&M plan;
- Post-RAW site conditions do not pose a significant risk to children or adults at the school site.

APPENDIX A

REFERENCES

- Addison, J, LST Davies, etal *The Release of Dispersed Asbestos Fibres from Soils*; Institute of Occupational Medicine Research Report, September 1988

- California Environmental Protection Agency, Air Resources Board, Final Regulation Order, Section 93105, *Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surfacing Mining Operations*.

- California Environmental Protection Agency, Air Resources Board, *Implementation Guidance Document for the Asbestos Airborne Toxic Control Measure for Surfacing Applications, July 2002*.

- California Department of Conservation, California Geologic Survey, *Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California, 2002, Special Publication 124.*

- MACTEC *Oak Ridge High School Naturally Occurring Asbestos (NOA) Mitigation Workplan Final Report,* Prepared for El Dorado Union High School District June 2003

- MACTEC *Oak Ridge High School Naturally Occurring Asbestos (NOA) Indoor/Outdoor Air Sampling Plan* Prepared for El Dorado Union High School District July 22, 2003

- MACTEC *Oak Ridge High School Naturally Occurring Asbestos (NOA)/Mitigation Workplan Appendix B Addendum 1* Prepared for El Dorado Union High School District August 7, 2003

- MACTEC *Oak Ridge High School Naturally Occurring Asbestos (NOA)/Mitigation Appendix C Addendum 2* Prepared for El Dorado Union High School District *September 17, 2003*

- USEPA *Amphibole Mineral Fibers in Source Material in Residential and Commercial Areas of Libby, Montana, Pose and Imminent and Substantial Public Health Endangerment;* Memo to Paul Peronard, On Scene Coordinator, from Chris Weiss, Ph. D, D.A.B.T., Senior Toxicologist; December 2001

Libby activity/exposure scenario results
ORHS track/baseball study

APPENDIX B

AVAILABLE CALIFORNIA GEOLOGIC MAPS

Geologic Atlases of California (Scale 1:250,000)

- GEOLOGIC ATLAS OF CALIFORNIA: ALTURAS
  Compiled by Gay, T.E. and others, 1958
- GEOLOGIC ATLAS OF CALIFORNIA: BAKERSFIELD
  Compiled by Smith, A.R., 1964 (reprinted 1992)
- GEOLOGIC ATLAS OF CALIFORNIA: DEATH VALLEY
  Compiled by Streitz, R.L. and Stinson, M.C., 1974 (reprinted 1991)
- GEOLOGIC ATLAS OF CALIFORNIA: FRESNO
  Compiled by Matthews, R.A. and Burnett, J.L, 1965 (reprinted 1991)
- GEOLOGIC ATLAS OF CALIFORNIA: LONG BEACH
  Compiled by Jennings, C.W., 1962 (reprinted 1992)
- GEOLOGIC ATLAS OF CALIFORNIA: LOS ANGELES
  Compiled by Jennings, C.W. and Strand, R.G., 1969 (reprinted 1991)
- GEOLOGIC ATLAS OF CALIFORNIA: MARIPOSA
  Compiled by Strand, R.G., 1967 (reprinted 1991)
- GEOLOGIC ATLAS OF CALIFORNIA: NEEDLES
  Compiled by Bishop, C.C., 1963 (reprinted 1992)
- GEOLOGIC ATLAS OF CALIFORNIA: REDDING
  Compiled by Strand, R.G., 1962
- GEOLOGIC ATLAS OF CALIFORNIA: SALTON SEA
  Compiled by Jennings, C.W., 1967 (reprinted 1992)
- GEOLOGIC ATLAS OF CALIFORNIA: SAN LUIS OBISPO
  Compiled by Jennings, C.W., 1958 (reprinted 1992)
- GEOLOGIC ATLAS OF CALIFORNIA: SAN DIEGO - EL CENTRO
  Compiled by Strand, R.G., 1962 (reprinted 1992)
- GEOLOGIC ATLAS OF CALIFORNIA: SANTA ANA
  Compiled by Rogers, T.H., (reprinted 1992)
- GEOLOGIC ATLAS OF CALIFORNIA: SANTA CRUZ
  Compiled by Jennings, C.W. and Strand, R.G., 1958 (reprinted 1992)

- GEOLOGIC ATLAS OF CALIFORNIA: SANTA MARIA
  Compiled by Jennings, C.W., 1959 (reprinted 1992)

- GEOLOGIC ATLAS OF CALIFORNIA: UKIAH
  Compiled by Jennings, C.W. and Strand, R.G., 1960 (reprinted 1992)

- GEOLOGIC ATLAS OF CALIFORNIA: WALKER LAKE
  Compiled by Koenig, J.B., 1963 (reprinted 1992)

Regional Geologic Map Series (Scale 1:250,000)

- GEOLOGIC MAP OF THE SACRAMENTO QUADRANGLE
  (set of four sheets)
  Compiled by Wagner, D.L. and others, 1981

- GEOLOGIC MAP OF THE SANTA ROSA QUADRANGLE
  (set of five sheets)
  Compiled by Wagner and D.L., Bortugno, E.J. (reprinted 1999)

- GEOLOGIC MAP OF THE SAN BERNARDINO QUADRANGLE
  (set of five sheets)
  Compiled by Bortugno, E.J., and Spittler, T.E. (reprinted 1998)

- GEOLOGIC MAP OF THE WEED QUADRANGLE
  (set of four sheets)
  By Wagner, D.L. and Saucedo, G.J., 1987

- GEOLOGIC MAP OF THE SAN FRANCISCO-SAN JOSE QUADRANGLE
  (set of five sheets)
  By Wagner, D.L., Bortugno, E.J. and McJunkin, R.D., 1990
  Color-coded faults

- Diblee Foundation Maps: Coverage over 80 7½ Minute USGS Quadrangles in Santa Barbara, Ventura and Los Angeles Counties. SOURCE: Mr. E.R. Jim Blakley; 958 Isleta Avenue; Santa Barbara California 93109: Phone of Fax (805) 962-9730

- Mineral Land Classification Maps: Coverage over numerous special study areas throughout California. SOURCE: California Geologic Survey; 801 K Street, MS 14-33; Sacramento, California 95814

Local Geologic Maps

- AREAS MORE LIKELY TO CONTAIN NATURALLY-OCCURRING ASBESTOS
  IN WESTERN EL DORADO COUNTY, CALIFORNIA
  By Ron Churchill, March 2000
  Scale 1:100,000

- SERPENTINITE SURVEY OF LAKE COUNTY, CALIFORNIA – MAP A, ULTRAMAFIC, ULTRABASIC, AND SERPENTINE ROCK AND SOILS OF LAKE COUNTY, Adopted: March 2, 1992
  Scale: 1:100,000

Sources of USDA Soils Maps
Natural Resource Conservation Service
430 G Street. No. 4164
Davis, California 95616

California Department of Forestry and Fire Protection
6105 Airport Road
Redding, California 96002
www.fire.ca.gov

Open File Maps and Reports:

OFR 84-50 Mineral Land Classification of the Folsom [15'] Quadrangle, Amador, El Dorado, Placer, and Sacramento Counties, California. by Loyd, R.C.

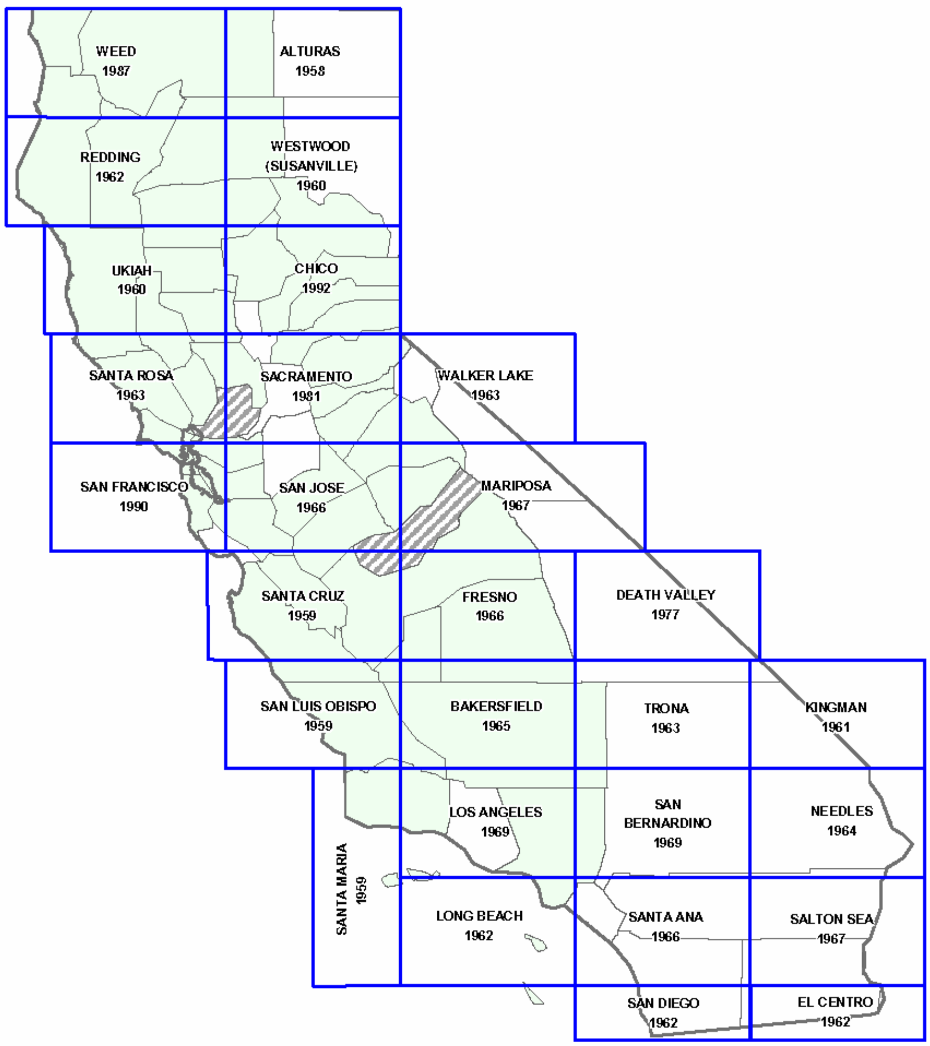
OFR 83-37 Mineral Land Classification of the Auburn [15'] Quadrangle, El Dorado and Placer Counties, California by Kohler, S.L.

OFR 83-35 Mineral Land Classification of the Georgetown [15'] Quadrangle, El Dorado and Placer Counties, California by Kohler, S.L.

OFR 83-29 Mineral Land Classification of the Placervill [15'] Quadrangle, Amador and El Dorado Counties, California by Loyd, R.C. and others

OFR 86-12 Mineral Land Classification of the Southern Half of the Bald Mountain/Browns Flat Gold Mining District, Sonora and Tuolumne Counties, California by Loyd, R.C.

INDEX TO GEOLOGIC ATLAS SERIES AND REGIONAL GEOLOGIC MAP SERIES MAPS



Counties in solid green contain ultramafic rock areas shown on the adjacent map. These areas are shown in more detail on the Division of Mines and Geology 1:250,000 scale Geologic Atlas and Regional Geologic Map Series maps. Madera and Solano counties, in diagonal pattern, have ultramafic rock areas shown on the Geologic Atlas and Regional Geologic Map Series maps that are too small to show on the adjacent map. Los Angeles County has small ultramafic rock occurrences on Catalina Island and a small occurrence is present in Kern County. Source: DMG Open-File Report 2000-19: A General Location Guide for Ultramafic Rocks in California - Areas More Likely to Contain Naturally Occurring Asbestos (DOC 2000b)

APPENDIX C

STATUTES AND REGULATIONS - ASBESTOS AND NATURALLY OCCURRING ASBESTOS

Federal Regulations

- Asbestos Standard for the Construction Industry. 29 Code of Federal Regulations (CFR) Part 1926.1101.
- Asbestos Standard. 29 CFR Part 1910.1001.
- Respiratory Protection Standard. 29 CFR Part 1910.134.

California Regulations

- CARB Section 93105-Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations and CARB Section 93106-Asbestos Airborne Toxic Control Measure for Surfacing Applications. Authority cited: Sections 39600, 39601, 39650, 39658, 39659, 39666, and 41511; and Health and Safety Code. Reference: Sections 39650, 39658, 39659, 39666 and 41511.
- Cal/OSHA Asbestos Standard. Title 8, California Code of Regulations (CCR), Article 4, Section 1529, Article 110, Section 5208 and Article 2.5, Section 341.6 et seq.
- Cal/OSHA Injury and Illness Prevention Program Standard. Title 8, Sections 1509 and 3203.
- Owner Requirements. Business and Professional Code, Division 3, Chapter 9, Article 11, Section 7180 et seq.
- Hazardous Substance Removal Criteria. Health and Safety Code Section 25914.1-3.
- Asbestos Notification Act. Health and Safety Code Section 25915 et seq.
- Real Estate Disclosure. Health and Safety Code Section 25359.7
- Building Owners Responsibilities. California Labor Code Section 6501.9.
- California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65)
- Building Demolition. Health and Safety Code Section 19827.5.

County Regulations

The Naturally Occurring Asbestos and Dust Protection Ordinance; Chapter 8.44, El Dorado County Ordinance; Effective June 12, 2003

APPENDIX D

LIST OF ACRONYMS

APCD - Air Pollution Control District
AQMD - Air Quality Management District
ARAR - applicable or relevant and appropriate requirements
ASTM - American Society for Testing and Materials
Cal-OSHA – California Occupation Safety and Health Administration
CARB - California Air Resource Board
CCR - California Code of Regulations
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
DTSC - Department of Toxic Substances Control
ELAP - Environmental Laboratory Accreditation Program
HEPA - high efficiency particulate air filter
HSAA - Hazardous Substance Account Act
NIOSH – National Institute for Occupational Safety and Health
NOA - naturally occurring asbestos
O&M - operation and maintenance
PCM – phase contrast microscopy
PEA - preliminary environmental assessment
PEL - permissible exposure limit
Phase I - phase I environmental site assessment
PLM - polarized light microscopy
RAW – removal action workplan
RWQCB - Regional Water Quality Control Board
TEM – transmission electron microscopy
TWA - time-weighted average
USEPA – U.S. Environmental Protection Agency