ENVIRONMENTAL INVESTIGATION

Referral for investigation

An environmental investigation is conducted to identify lead poisoning hazards in cases when children have **confirmed lead poisoning** (a blood lead concentration of 10 ug/dl or greater based on two samples within a 12 month period) or an **elevated blood lead level** (a blood lead concentration of 5-9 ug/dl or greater resulting from two samples within a 12 month period). Specific information on case identification and medical follow-up are contained in the "North Carolina Child Health Manual" maintained by the Division of Women's and Children's Health, Children and Youth Section. Documented information containing the child's date of birth, address and blood lead levels must be submitted to environmental health personnel prior to an investigation. Local health departments routinely use the DENR form 3651 "Evaluation of Child with Elevated Blood Lead Level" for this purpose.

Lead Investigation Team

An informal yet effective "investigation team" is usually involved throughout the investigation process. The team typically includes a local environmental health specialist, a public health nurse and a regional environmental health specialist. There is much to be done before and after the actual investigation. Referrals must be validated, pre-investigation home visits may be needed, numerous phone calls to schedule of "team members" and the child's family are usually required, follow-up visits, paperwork and external factors all play a part in determining each team member's involvement.

Parent Interview

The lead investigation's primary focus is to identify sources of environmental lead exposures. Also important is the opportunity to educate parents about lead poisoning hazards and methods to limit exposure. Both goals are achieved using an informational interview technique that involves a mix of providing general information and asking for specific information in return. The health effects of lead are discussed with the parents and the *why*, *what* and *how* of the investigation are explained. The "Environmental Investigation for Lead Hazards" DENR Form 3460 is completed during the interview and a signed consent form is needed for EBL 5-9 µg/dL range) investigations. DENR Form 3460 provides a summary of the child's environment including supplemental addresses, family structure, potential sources of lead, duration of exposure and habits that might contribute to the child's lead intake.

When questioning parents, it is important to get a complete and accurate description of the child's habits and environment. Parents may unknowingly withhold important information if they do not understand the significance and importance of the questions. Preface questions with explanations and allow parents the opportunity to expand on their answers. Before leaving the home, inform parents of lead poisoning hazards identified and suspected hazards requiring laboratory analysis. Inform parents of short-term measures they can take to protect their child from further lead exposure.

Quantitative Analysis

A thorough investigation for environmental sources of lead exposure will include extensive sampling of a child's environment. It is often necessary to test paint, soil, ash, dust, water and other items to determine where the child's exposure is occurring. Lead enters the body through either the nose or mouth. Therefore, intact painted surfaces are generally not areas of concern. Painted surfaces

in deteriorated condition are considered readily accessible and must be analyzed.

On painted surfaces, quick in-field results can be obtained using the x-ray fluorescence (XRF) analyzer. Dust, soil, water, paint and other suspected items are also collected and submitted for laboratory analysis. Identification of lead poisoning hazards must be based on a quantitative analysis such as XRF or laboratory analysis.

XRF readings and environmental samples should be numbered and recorded on the "Lead-Based Paint Inspection" DENR Form 3279. Corresponding numbers should be indicated on an accompanying sketch, which shows the general lay out of the structure and the sampling scheme.

XRF Testing for Lead in Paint

The primary method for providing quantitative analysis of lead poisoning hazards is the XRF analyzer. When exposed to radiation, lead emits x-rays of a specific energy. The XRF exposes a painted surface to gamma radiation and calculates the amount of lead present by measuring the number of characteristic lead x-rays produced. The lead content is expressed as in milligrams per square centimeter (mg/cm^2), and 1.0 mg/cm^2 or greater is considered a lead poisoning hazard. Since this measure is affected by both the lead concentration and thickness of the paint, it cannot be compared directly to laboratory analyses that are sensitive only to the concentration of lead in the paint. For this reason, lead poisoning hazards are defined both in terms of XRF readings and laboratory analysis. Either test can be used to identify lead poisoning hazards.

An XRF analyzer should be used as the primary method for testing lead in paint because it is the most cost effective method of screening a large number of sample sites. XRF testing has the advantage of being non-destructive. It gives immediate results that are helpful in communicating lead poisoning hazards to occupants during the inspection. XRF analyzers have an error inherent factor resulting in an accuracy rate of 95 percent. Depending on instrument type and testing mode, some XRF readings are considered inconclusive. Paint samples from these areas must be submitted for confirmatory analysis in the laboratory. XRF readings should be taken on all surfaces exhibiting readily accessible paint including any deteriorating paint, chewable surfaces, and friction and impact surfaces. XRF reading locations should be recorded on the site sketch and described on DENR Form 3279.

Sample Collection and Analysis

Laboratory analyses are another quantitative method used to determine lead poisoning hazards. Paint, dust, soil, water and other (investigation dependant) items are collected and submitted to the State Laboratory of Public Health where lead content is determined by atomic absorption spectroscopy (AAS). Because of the cost associated with laboratory testing and limited resources, the XRF is the primary method of identifying hazards. However, most investigations utilize both methods of testing. The "Environmental Sciences Laboratory Analysis Report" DENR Form 2364 and "Chain of Custody" DENR Form 3759 must be mailed with the samples.

Paint Sampling

It is generally necessary to collect paint samples for laboratory analysis from each address suspected of contributing to a child's lead exposure. Paint samples are only collected from ***readily accessible*** locations. Samples should be collected from any surface not accessible to the XRF and any location with inconclusive XRF readings. At least one "positive" tested XRF surface should be sampled for validation purposes. Samples of any paint highly suspected of being a source of exposure should also be collected. This includes paint chips or flakes found in

areas where children sleep or play and from any surface that shows signs of chewing. Parents can be helpful in identifying such high-risk sources of paint exposure. Laboratory results are reported as percent lead by weight. Paint containing 0.5 percent or greater is considered a lead poisoning hazard.

Soil Sampling

Soil contaminated with lead is a potential contributor to lead poisoning in children. Soil can be contaminated from lead-based paint that has weathered or been scraped, industrial emissions or even historic automobile emissions from the leaded gasoline era. Play areas in bare soil are of most concern due to hand-to-mouth exposure and the potential for foot traffic creating indoor hazards.

A lead-based paint inspection should include an examination of children's play areas to determine if lead exposure from soil is likely. Soils with the highest lead content are generally found near the house foundation, particularly around porches, where lead from weathering lead-based paint is may have settled. Bare soil is common on dirt driveways, in play areas, in sand boxes and around swing sets. Soil should be sampled in any area where parents report having seen a child eat soil, as well as any bare soil in play areas or where toys are found, and from bare soil within three feet of the house or other structures if deteriorated lead-based paint is evident. Soil should also be sampled in areas where leaded materials may have been burned and where battery or auto salvage operations or paint stripping has taken place. Ashes from a wood stove or burn pile are considered soil for lead poisoning hazard identification purposes.

Soil analyses are reported in parts per million (ppm). Soil containing a concentration of 400 ppm or greater is considered a lead poisoning hazard.

Dust Sampling

Lead dust hazards occur when lead-based paint deteriorates, breaks down or is disturbed. Examples include loose paint chips falling to the floor and getting swept, vacuumed or walked on, a door "sticking" when closed, and remodeling a home. Dust samples are collected during the investigation and again when remediation work has been completed. Floors, windowsills and miniblinds are routinely sampled for lead dust content during an investigation. However, other items and areas may also be sampled.

If lead-contaminated dust from a parent's occupation is suspected, samples can be taken from soiled work clothing or shoes, floors in areas used to change clothes, and entryway floors. Automobile floorboards and seats may also be sampled. Hobbies may also indicate the need for samples.

As previously indicated, dust sampling is also necessary to assure that residual lead-contaminated dust, invisible to the human eye, has been thoroughly cleaned up after lead hazard remediation activities. Paint stripping, abrasive methods of paint removal, component removal and component replacement can increase the amount of lead-contaminated dust in a home. Dust sampling is required at the completion of these activities ***after*** the area has been thoroughly cleaned.

Dust wipe sample results are reported in micrograms (ug) of lead. The lead poisoning hazard standards and clearance levels are:

Floors:	40 ug/ft^2
Window sills:	250 ug/ft^2
Window troughs:	400 ug/ft^2 (clearance only)

Water Sampling

Water supplies are usually free of lead contamination at the source but can become contaminated by leaching lead from pipes or lead soldered joints in the distribution system. Water should be tested for lead in older homes with lead plumbing or in houses with lead soldered copper plumbing. It is also desirable to test water in cases where no other potential sources of lead exposure can be found.

"First draw" samples are collected before any water has been run in the morning. While first draw samples are desirable for detecting the highest potential lead contamination, they may not be practical for initial sampling. Do not flush the tap before collecting the sample because the initial flow will generally contain the highest lead concentration. If the sample is not a first draw sample, label if "flushed". If excessive lead is detected, the tap should be retested with both a "first draw" sample and a sample after "flushing" 2-3 minutes at a subsequent visit.

Water samples are reported in milligrams per liter (mg/L). A lead poisoning hazard is identified if the level is greater than or equal to 15 ppb (0.015 mg/L).