NJDEP SAB Public Health Standing Committee
March 18, 2011, 1:00 – 4:00 PM
NJDEP, 401 E. State St.
6 fl large conference room

Prepared by Gloria Post

Recommendations are highlighted in yellow.
Action items are highlighted in green.

SAB Public Health Standing Committee Attendees: Mark Robson (chair), Judith Klotz, Michael Greenberg, Mark Maddaloni, Steven Marcus, Clifford Weisel, Judith Zelikoff

DEP Attendees: Alan Stern and Gloria Post (Office of Science Public Health Committee liaisons), Linda Cullen (Site Remediation Program)

Attendees were welcomed by Mark Robson, and introductions were made.

Alan Stern presented a PowerPoint (attached) entitled "Summary of the Draft Findings of the Acute Soil Standards Workgroup of the Public Health SAB (as of 3/18/11)" on the progress of the Acute Soil Criteria Workgroup in addressing the charge questions on this issue. The members of the Workgroup are C. Johnson, H. Kipen, M. Maddaloni, J. Mitala, and J. Zelikoff. DEP staff L. Cullen, G. Post, and A. Stern also participated. The Workgroup held two teleconferences (November and January) and one meeting at EOHSI (February).

The general topic of acute soil criteria and the draft recommendations of the Workgroup were discussed by the Public Health SAB Standing Committee, as follows:

It was noted that the issue being addressed is actually the development of acute soil ***criteria***, rather than acute soil ***standards.***

Members of the Public Health SAB panel asked for clarification of the purpose, duration, and intended application of the acute soil criteria.

Linda Cullen stated that initially DEP intended to develop acute criteria protective for up to 14 day exposures. The Site Remediation Program would like a recommendation from the Public Health Panel as to whether this exposure duration is appropriate.

Linda Cullen stated that if a cap is used to address contaminated soil, residences can then be built over the cap. Currently, there are no limits on the concentration of contaminants that can be left under a cap.

If the cap is breached, exposure may occur over a period of time before anyone is aware of the situation, so that acute criteria should protect for more than just a single exposure.

Acute criteria are intended to protect outdoor workers on a non-residential site in addition to non-workers. It was mentioned that OSHA does not protect outdoor workers.

On a residential site where a cap is in place, excavation of soil may occur such as when planting a tree, installing a playset, pool or deck, etc. and children may be exposed to contaminated soil if the cap is breached.

It was discussed that a breach in a cap could potentially be undetected for an extended period of time, resulting in extended exposure. In such a case, acute criteria would not be protective and chronic criteria would be more appropriate. However, recommendation of chronic criteria as the basis for such a scenario is not feasible, as this would defeat the purpose of using a cap instead of cleaning up to chronic criteria. It was suggested that, given the potential for extended exposure, the acute criteria should protect for at least 14 days. It was also suggested that the recommendations of the SAB Public Health committee should include the limitation that the recommended acute criteria are not protective for long term exposure. For example, it could be stated that these criteria are only protective if a breach is recognized within a specified period of time.

The acute criteria will also be used by Licensed Site Remediation Professionals (prvate consultants responsible for remediation of sites) and DEP to prioritize actions at sites that have not been remediated. Trespassers could access unremediated sites, and sites which exceed acute criteria will be addressed more rapidly to prevent such exposures.

Several Public Health committee members requested examples of levels of contaminants found at capped sites and comparisons with acute criteria based on acute MRLs.

Charge Question 1. Are sources of acute toxicity information (other than acute ATSDR Minimum Risk Levels) available? Can a hierarchy of sources be established?

There are 136 chemicals for which the DEP Site Remediation Program (SRP) would like to develop acute soil criteria. Sources of toxicity values for acute criteria and development of a hierarchy for these sources were discussed.

It was discussed that the hierarchy should be based on both quality (such as level of review that went into developing the toxicity value) of the data in each source of toxicity values and exposure duration for which each type of toxicity value is intended to protect. Different sources of toxicity values may be developed using different approaches such as uncertainty factors or other assumptions. It was recommended that the procedures and approaches used in the development of each source of toxicity data should be documented in the recommendations of the Public Health Committee for development of acute criteria. Additionally, there should be provision for flexibility as appropriate in using the hierarchy.

The following potential sources of toxicity values for acute criteria were discussed:

ATSDR Acute Minimum Risk Levels (MRLs) based on 1-14 day exposures, are available for 41 of the 136 chemicals.

ATSDR Intermediate Duration Risk Levels, based on 15-364 day exposures, are available for an additional 34 chemicals (with no acute MRLs).

USEPA Drinking Water Health Advisories have been developed for various exposure durations: 1 Day, 10 Day, Longer Term (up to 7 years) and Lifetime. Both 1 and 10 Day values are available for 58 of the 136 contaminants of interest. One Day or 10 Day Health Advisories are available for 17 contaminants with no ATSDR acute or intermediate values.

The Workgroup recommended that ATSDR acute and intermediate MRL values and USEPA 1 Day and 10 Day Drinking Water Health Advisory values are appropriate use as the basis for acute soil criteria. Information from these sources is available for 92 of 136 chemicals.

USEPA Provisional Advisory Levels (PALs) have been developed by the federal Homeland Security Research Center for acute exposure through air and water. The water levels are based on ingestion exposure and are potentially relevant to soil ingestion. They have been developed for exposure durations of 24 hours, 1-30 days, and 30 days-2 years. They are a potential source of toxicity information for acute criteria, but would need to be reviewed on a chemical-by-chemical basis. However, PALs are available for only 8 chemicals from list of 136 SRP priorities, and all of these 8 chemicals have ATSDR acute or intermediate MRLs. Thus, PALs are not a useful source of toxicity values for the acute soil criteria.

NAS AEGLs (Acute Exposure Guideline Levels) have been developed by by NAS for a consortium of EPA, DOD, etc. for air based on inhalation exposure. They are intended for exposure durations from 10 minutes to 8 hours, and for several levels of severity of toxic effect. USEPA AEGLs are not appropriate to use as the basis for acute soil criteria because they are inhalation-based and cannot easily be back extrapolated to a soil concentration. They are available for 23 of the 136 chemicals of interest, and ATSDR MRLs are available for all of these 23 chemicals.

TLVs/STELs are based on occupational inhalation exposures. It was the consensus of the Public Health Committee that these are not an appropriate basis for acute soil criteria.

Dermal Toxicity Values: A list of dermal toxicity values from the 6th edition of the textbook, "Fisher's Contact Dermatitis," by Rietschel and Fowler, was prepared by Alan Stern and is attached. It needs to be determined which of these chemicals are on the list of 136 of interest for acute criteria.
The dermal toxicity values are standard patch test concentrations (in percent mass/vol.) for chemicals with known allergic contact dermatitis (ACD) potential. The values chosen as an estimate of minimum concentration (in water or petrolatum) necessary to elicit

ACD in sensitized individuals, but not to result in an irritative response. They also do not address dermal absorption potential or systemic toxicity.

The Acute Soil Criteria Workgroup concluded that this is a reasonable approach for chemicals for which there is a significant background of sensitization in the population (e.g., Cr+6, Ni). The Public Health Committee agreed with this conclusion.

Charge Question 2: For a carcinogenic contaminant (for which there is no non- cancer risk-based criterion), is it appropriate to use cancer risk resulting from acute exposure as the basis for acute criteria?

The Acute Soil Criteria Workgroup discussed the fact that there are few studies on lifetime cancer risk from short exposures. Although there is some evidence that short-term exposures can result in long-term cancer risk (Calabrese), this risk is difficult to quantify. Cancer risk based on chronic data is sometimes scaled to less-than-chronic exposure durations, but this is generally for subchronic exposures, not acute exposures. In general, it is not appropriate to scale chronic risk, including cancer, to acute risk without mechanistic information specific to the chemical being addressed.

It was recommended by the Acute Soil Criteria Workgroup that cancer risk not be used as the basis for acute soil standards even if non-cancer values are not available. The Public Health Committee agreed with this recommendation. Additionally, there are likely to be few, if any, contaminants of interest with cancer data but no non-cancer information from the hierarchy of sources discussed in Charge Question 1.

Charge Question 3. Is it appropriate to use ATSDR's intermediate MRLs as the basis for acute criteria?

The Acute Soil Standards Workgroup noted that using a subchronic/intermediate value without "scaling up" would be protective of public health,, but could be overly stringent (i.e., restrictive). "Scaling up" by a factor of 10 would not "err" on the side of public health protection, since an acute value may be closer to a sub-chronic value than a factor of 10. This type of "scaling up" is the opposite of dividing a subchronic value by 10 to estimate a chronic value, and would involve multiplying the intermediate duration value by an uncertainty factor rather than dividing by the UF. There is some precedent for such "scaling up" in EPA's use of a Hazard Quotient of 10 (rather than 1) for some emergency cleanups.

It was discussed that acute and sub-chronic/chronic toxicity may differ qualitatively as well as quantitatively, i.e., different toxicological mechanisms, and that such differences in mechanisms would not necessarily be addressed by scaling. It was noted that some ATSDR intermediate MRLs are close to the USEPA chronic RfDs currently used for chronic exposure soil standards.

The Acute Soil Standards Workgroup concluded that it is appropriate to use longer-than-acute duration values (e.g., ATSDR intermediate MRLs) subject to a review of the

specific toxicology of acute and sub-chronic endpoints. Scaling of these values as a general approach, without evaluation of the toxicity basis, is not appropriate.

The Workgroup tentatively agreed to recommend the use of the ATSDR intermediate MRLs for acute exposure scenarios if no acute value and no appropriate dermal toxicity value are available. However, noting the inherent conservatism in this approach, the Workgroup agreed to solicit the recommendation of the full Public Health committee on this point.

The Public Health Committee recommended that intermediate duration MRLs not be "scaled up" by multiplying by a factor, such as 10, unless there is chemical-specific information indicating that this is appropriate. The basis for the intermediate MRLs for chemicals without acute MRLs can be checked to see if acute data was used to derive them. However, this is unlikely, since this information would probably have been used to derive acute MRLs for these chemicals.

For chemicals without acute MRLs or other sources of acute toxicity values (e.g. One Day or 10 Day Drinking Water Health Advisories, the Public Health Committee recommended that the more stringent of Intermediate MRLs or dermal contact elicitation values be used as the basis for acute soil criteria.

Linda Cullen stated thazt there are several chemicals for which the acute criterion based on 200 mg/kg soil and use of ATSDR Acute and Intermediate MRLs is lower or within 2-fold higher than the chronic criterion. Finalization of the recommendation for this charge question will await results of the evaluation of the toxicity basis for these contaminants for which the acute criteria is lower or within 2-fold higher than the chronic criteria, based on 200 mg/kg soil and use of ATSDR Acute and Intermediate MRLs. (see below).

Charge Question 4. Should a dermal component be added?

The Acute Soil Standards Workgroup noted that this question specifically refers to systemic effects resulting from dermal absorption, rather than to dermal toxicity. The promulgated soil standards based on chronic exposure are based on combined exposure from soil ingestion and dermal absorption, for contaminants for which dermal absorption data are available from EPA. USEPA guidance is used in considering dermal absorption for the chronic soil standards. When dermal exposure is considered, it usually significantly adds to the dose from exposures from assumed daily soil ingestion.

The Acute Soil Standards Workgroup discussed that non-polar volatile organics are well absorbed dermally, but are likely to rapidly volatilize from exposed soil. However, a Public Health Committee member noted that during scenarios such as digging soil from underground, dermal exposure to volatile organic chemicals will occur before the VOCs volatilize. Highly polar chemicals (e.g., metals) are poorly absorbed dermally.

The Acute Soil Standards Workgroup concluded that, in theory, there is no reason not consider exposure from dermal absorption in developing acute soil criteria. However, if

intermediate duration ATSDR-MRLs are used without "scaling up," addition of the dermal component will increase the inherent conservatism of using intermediate toxicity values for acute criterion (see Charge Question 3)

The Acute Soil Standards Workgroup had discussed that trans-dermal exposure is of approximate equal magnitude to ingestion exposure when the (dermal) "soil absorption fraction" ≥ 0.1, based on standard exposure assumptions, such as the amount of skin normally exposed. . The soil absorption fraction is an EPA-derived value (Appendix C of the Supplemental Guidance For Developing Soil Screening Levels For Superfund Sites, http://www.epa.gov/superfund/health/conmedia/soil/pdfs/ssg_appa-c.pdf) . Mark Maddaloni, a Public Health Workgroup member, was one of the authors of this guidance. It is a generally applicable number intended to represent the average dermal absorption values across a range of soil types, loading rates, skin surface locations, and chemical concentrations.). For all 136 DEP-SRP chemicals absorption factor ≥0.03, corresponding to a contribution of more than 10% of dose.

The Acute Soil Standards Workgroup recommended that dermal exposure should be considered, and applied quantitatively to the calculation of the acute soil standard if it contributes more than 10% to total exposure. This is the case for all contaminants with dermal absorption factors available from USEPA. This recommendation does not apply to values based on dermal toxicity (allergic contact dermatitis) values since trans-dermal absorption is not a factor for these effects. The Public Health Committee endorsed including dermal absorption in developing acute soil criteria for those contaminants for which it was considered in developing chronic soil criteria. It was noted that this pathway is associated with significant uncertainty, and that the dermal absorption factors are based on conservative assumptions.

Charge Question 5: Should short-term individual variability in soil ingestion behavior be considered?

For the soil remediation standards based on chronic exposure, 200 mg/day is the assumed soil ingestion for a child under the chronic exposure scenario. This ingestion rate represents the 90th percentile average daily soil ingestion (upper bound estimate of average daily ingestion over the long term), and is intended to protect the non-pica child.

On a given day, soil ingestion by a child can be exceeded in two ways: First, children with pica behavior may ingest several grams of soil per day on a chronic basis. Pica behavior for soil is defined as ingestion of ≥ 500 mg/day. By policy, soil remediation standards developed by DEP do not consider exposure resulting from pica behavior. Second, intra-individual variability in soil ingestion behavior in normal children can result in soil ingestion over 200 mg on a given day even if the long-term average is ≤ 200 mg/day

From data in the most recent USEPA Exposure Factors Handbook (draft), the distribution of soil ingestion rates among non-pica children is as follows: Arithmetic mean – 60 mg/day ± 80 mg/day, Median – 29.8 mg/day, 25th % - 11.9 mg/day, 75th % - 73.4

mg/day, 95th % - 236 mg/day (95% range among studies 217-449 mg/day), and 99th % - 402 mg/day. It was requested by the Public Health Committee that the age range which this data represents be included in the writeup of this issue.

Based on the data presented above, at the 99th percentile of intra-individual variability for daily soil ingestion among non-pica children, the soil intake could be double the assumed long-term average. Acute soil standards based on the long-term average value of 200 mg/day could conceivably lead to acute toxicity. It was discussed by the Public Health Committee that the potential for toxicity to occur depends on the margin of safety that was used to derive the toxicity factor used as the basis for acute soil criteria.

Dr. Steven Marcus stated that, based on his experience as a clinician working in the poison control field, these soil ingestion values seem very low and he is not comfortable with using them. Dr. Cliff Weisel stated that a child eating a lollipop that he had dropped onto soil could easily ingest over 200 mg of soil that adhered to the lollipop. It was then discussed that these data represent all children including those who were not outdoors and thus were not exposed to soil, as well as children who spent time outdoors. Thus, these data do not represent the 50%, 95%, 99%, etc. for children who were actually exposed to soil. It was discussed that a reasonable worst case scenario for exposure for acute soil criteria would be based on children who spent time outside on a given day.

The Acute Soil Standards Work Group recommended that day to day variability in soil ingestion behavior be considered. They concluded that the appropriate value (e.g. 95th percentile, 99th percentile, etc.) is partly a policy decision, but it is appropriate for the Public Health SAB to give a recommendation on this issue.

It was noted that by the Acute Soil Standards Workgroup that it is common to look at the 95th percentile in scientific studies, but for acute toxicity, it may be desirable to be more protective and choose the 99th percentile. The assumed long-term average value of 200 mg/day used for chronic soil standards is already close to the 95th percentile. Two Workgroup members recommended using the 99th percentile, while one member felt more comfortable recommending the use of a value in the 97.5 to 99th percentile range.

Dr. Cliff Weisel expressed the opinion that the soil exposure percentile data presented above are not applicable to a scenario such as disturbing the ground by digging or excavating, and are not conservative enough for such a scenario. No data on soil ingestion exposure is available for scenarios such as these.

It was suggested that a decision tree be developed showing the logic of the basis for the acute and chronic values. The acute and chronic soil criteria might be based on different soil ingestion assumptions, as discussed above. One proposed approach would be to use the chronic value if it is higher than the acute value. Another proposed approach would be that, even if acute soil criteria are lower than chronic criteria, the acute criteria should be used if the scientific basis of the value is sound. No consensus was reached on which of these two approaches should be recommended by the Public Health SAB. It was discussed that the acute criteria should be qualified as being applicable to a child of a

certain age in a residential setting. It was then discussed that the toxicity values based on intermediate duration exposure may be overly conservative, while the exposure assumptions for soil ingestion may not be conservative enough.

Linda Cullen expressed concern that acute soil criteria will be lower than chronic ones if a higher soil ingestion rate is used. Linda will send the list of about 18 chemicals for which the chronic standard is higher or within a factor of 2-fold lower than acute criteria based on 200 mg/day soil ingestion without including dermal exposure for chemicals with available dermal absorption factors. Gloria Post will review the toxicity basis for the acute and chronic criteria to determine why the acute and chronic values are so close. It was noted that if soil ingestion greater than 200 mg/day (e.g. 400 mg/day) is assumed and/or dermal exposure is considered, additional acute criteria will be lower than or close to the chronic criteria for the same chemical.

The Public Health Committee will await the information on the toxicity basis for the approximately 18 chemicals before finalizing recommendations on Charge Questions 3 and 5.

Charge Question 6: Acute soil criterion for lead
The current NJDEP chronic soil standard for lead is 400 mg/kg. It is based on the USEPA IUBK model that relates multimedia lead exposure to blood lead levels. The model considers lead contribution from all exposure sources as well as background blood lead levels in the population. The model is used to calculate the lead concentration in soil which will not result in a blood lead level of >10 ug/dl for 95% of the population of children between 6 months and 7 years of age, assuming 200 mg/day soil ingestion. It uses steady-state (non-acute) assumptions, and thus is not appropriate for calculating short term blood-lead levels

Current NJDEP SRP acute soil guidance for lead is based on CDC/NJDHSS clinical response guidance found at http://www.cdc.gov/nceh/lead/CaseManagement/chap3.pdf According to this guidance, response actions are triggered by various blood-lead concentrations, and, at 20 µg/dL, intervention is triggered. Based on this guidance, NJDHSS recommends a blood lead level of 20 ug/dl as the basis for an acute soil standard for lead.

The Acute Soil Standards Workgroup concluded that, although this recommendation is problematic, a more specific basis is not evident and this can be considered a reasonable value. However, there is still need for a model that relates a short term blood-lead of 20 µg/dL to a soil concentration.

An alternative to the IUBK model, the All Ages Lead model, can, in principle, address acute lead exposure. This is because it uses a one-day time step
The All Ages Lead model is based on the Leggett model developed at Oak Ridge National Laboratories and is based on the kinetics of radioactive calcium, which distributes in the body similarly to lead. The All Ages model is currently under development by USEPA

Mark Maddaloni requested outputs from the EPA's current developmental version of the All Ages Lead model from a colleague at Syracuse Research Institute. (NOTE: A conference call was held on 3/23 with M. Maddaloni, A. Stern, G. Post, and Dr.Gary Diamond of Syracuse Research Institute. Minutes of the conference call and outputs of the model for 1, 10, and 30 day exposures are provided at the end of these minutes.) The model will be run for exposures of 1, 10, and 30 days resulting in blood lead levels of resulting in blood lead levels of 10 and 20 ug./dl. Consecutive days of exposure will be assumed, as this is a worst case scenario. Bioavailability of lead will be assumed to be 100%, as this is a worst case assumption. Results will be presented to full committee to the Public Health SAB to be used in making a recommendation on the appropriate as the basis for the acute criterion. It was discussed that even if the spike in blood lead level from a short term exposure to lead can be predicted by the model, it is not expected that an immediate clinical effect will be observed and the long term effect of acute lead exposure is unknown.

Charge Question 7: Is the narrative requirement of "None Visible" appropriate and defensible as the acute soil criteria for elemental mercury?

The acute standard for elemental mercury is based on inhalation, not ingestion. It addresses only outdoor exposures and does not address exposure in structures built above contaminated soil which has been capped. Development of an acute criteria for elemental mercury is problematic due to the fact that it is volatile, but does not mix well in the air column and because it is toxic by inhalation, but relatively non-toxic when ingested.

There does not appear to be an acute standard available from other sources for (elemental) Hg vapor inhalation. The chronic EPA Reference Concentration (RfC) for elemental mercury in air is 0.3 μg/m3 and homes have been evacuated at levels of 10 μg/m3. The RfC is based several epidemiologic studies of neurologic effects in workers, such as tremors, EEG abnormalities, and memory and behavioral changes. These studies are based on average durations of exposures 2-16 years. It was not immediately clear to the Acute Soil Criteria Workgroup whether it is appropriate to extrapolate from these chronic observations to acute health risk

(**ADDITIONAL INFORMATION PREPARED BY G. POST – BASIS FOR IRIS RfC FOR ELEMENTAL MERCURY OF 0.3 ug/m^3**: See: http://www.epa.gov/iris/subst/0370.htm. This chronic Reference Concentration was developed in 1995. It is based on neurological effects (hand tremor, increases in memory disturbance; slight subjective and objective evidence of autonomic dysfunction) in chronically exposed workers. The Lowest Observed Adverse Effect Level was 25 ug/m3, which after adjustment for hours per day and days per week results in an adjusted LOAEL for continuous exposure of 9 ug/m^3 in the workers. A No Observed Adverse Effect Level (NOAEL) was not identified. The RfC of 0.3 ug/m3 is based on applying an uncertainty factor of 30 to the adjusted LOAEL. The uncertainty factor includes a factor of 10 for inter-individual variability and a factor of 3 for database deficiencies, particularly lack of developmental and reproductive studies. ***Notably, no uncertainty***

factor for extrapolation from LOAEL to NOAEL was used, which is not consistent with current standard approaches for RfC derivation.)

The Acute Soil Criteria Workgroup concluded that there is still a need to evaluate whether it is appropriate to extrapolate the health endpoints and doses from the chronic studies to acute exposures, and how Hg^0 vapor measurements outdoors on sites should be related to inhalation exposures. Mark Maddaloni noted that residents are evacuated when at indoor air mercury levels of 1-10 ug/m3.

It was suggested by Dr. Judy Zelikoff that air monitoring should be conducted at sites known to have mercury contamination, in addition to the "none visible" criterion. The criterion for an unacceptable level for acute exposure could be detection above ambient background levels in air with an instrument with a sensitive detection limit. Another proposal was that the air concentration at the soil surface or below should not exceed 10 ug/m3.

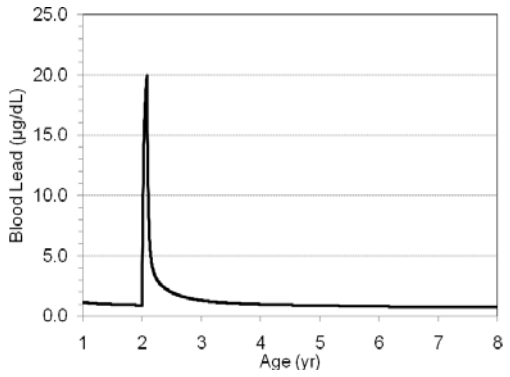
The Public Health SAB voted to recommend that the acute soil criteria for elemental mercury should be "none visible" and not detected above 10 ug/m3 in air at the soil surface or below.

It was mentioned that the Acute Soil Standards Workgroup will meet at least one more time to resolve outstanding issues, including lead and elemental mercury. A draft report will be submitted to the Public Health committee.

ADDENDUM: Minutes of 3/23/11 conference call on modeling of short term lead exposures, and output of model runs for 1, 10, and 30 day exposures.

On 3/23/11, Alan Stern, Gloria Post, Mark Maddaloni, and Gary Diamond of Syracuse Research Institute discussed modeling of lead blood levels resulting from short term exposure of children, using the All Ages Lead Model which is based on the Leggett Model.

Gary Diamond had used the model to determine the daily lead ingestion (ug/day) by a two year old for 30 days which would result in a peak blood lead level of 20 ug/dl. In this modeling, background (non-soil) lead ingestion of 3/2 ug/day and lead absorption fraction of 0.3 were assumed. As shown in the figure and data below, it was predicted that ingestion of 146 ug/day from soil would result in a peak blood lead level of 20 ug/dl.



ICRP model
Air exposure: zero
Ingest baseline: 3.2 µg/day
Short-term exposure: 146 (+3.2) µg/day
Short-term exposure duration: 30 days (age 730-760 days)
Absorption fraction: 0.3 (model default)
Blood maximum: 20 µg/dL

Blood mean (730-760): 13.7 µg/dL
Blood mean (730-790): 11.2 µg/dL

It was discussed that there are no data to validate blood lead levels from short term exposures to children. The model is based on one day exposures to radioactive isotopes of elements that have similar pharmacokinetic behavior as lead. It is reasonable to assume that blood lead levels from short term exposure are related linearly to the blood lead levels predicted to result from one day exposures.

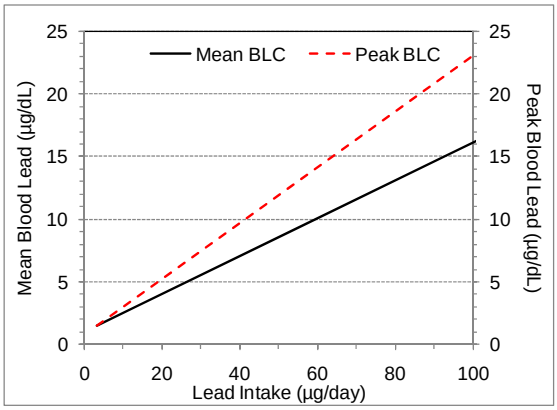
Gary Diamond was requested to develop additional modeling outputs on blood lead levels from short term lead exposures in children. It was requested that the relationship between lead intake from soil (ug/day), X axis) and mean and peak blood lead levels (mg/dl, Y axis) be modeled for exposure durations of 1, 10, and 30 days in a two year old child.

Baseline non-soil exposure of 3.2 ug/day resulting in a baseline blood lead level of 1.5 ug/dl will be assumed. The baseline exposure assumptions are central tendency estimates from the IUBK model and are lower than what is predicted by NHANES.

Bioavailability of lead varies among soil types. The default bioavailability assumption used in the IUBK model is 0.3, which represents the average bioavailability from several studies of multiple soil types. This value of 0.3 refers to absolute bioavailability, and is equivalent to relative bioavailability of 0.6 compared to bioavailability of lead in the reference compound, solubilized lead acetate.

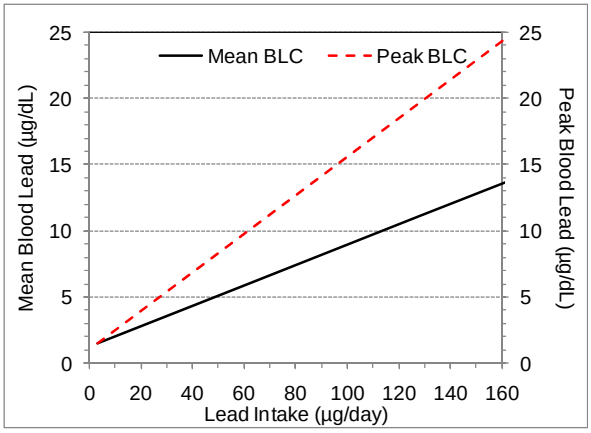
It was decided that for the purpose of developing an acute criterion for soil lead, bioavailabilty of 100% should be assumed. Absolute bioavailability of 0.5 is equivalent to relative bioavailability of 1 (100%), so 0.5 absolute bioavailability will be assumed in the modeling.

The output from the requested modeling is shown below. These data, in combination with assumptions on daily soil ingestion rate and peak and average blood levels of concern, can be used to develop acute soil criteria for lead.



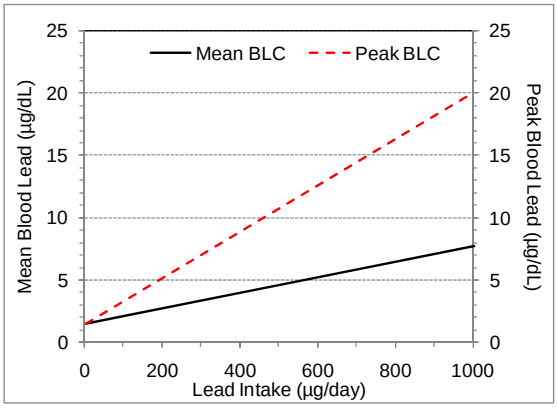
Plot shows predicted relationship between lead intake (µg Pb ingested/day) and blood Pb concentration for a **30 day exposure** beginning at age 730 days.
Mean BLC: mean blood Pb (age 730-760 days)
Peak BLC: peak blood Pb (age 730-760 days)

ICRP model
Air exposure: zero
Ingest baseline: 3.2 µg/day (blood Pb concentration at age 730 days = 1.5 µg/dL)
Short-term exposure: 0-100 (+3.2) µg/day
Short-term exposure duration: 30 days (age 730-760 days)
Absorption fraction: 0.5



Plot shows predicted relationship between lead intake (µg Pb ingested/day) and blood Pb concentration for a **10 day exposure** beginning at age 730 days.
Mean BLC: mean blood Pb (age 730-740 days)
Peak BLC: peak blood Pb (age 730-740 days)

ICRP model
Air exposure: zero
Ingest baseline: 3.2 µg/day (blood Pb concentration at age 730 days = 1.5 µg/dL)
Short-term exposure: 0-160 (+3.2) µg/day
Short-term exposure duration: 30 days (age 730-740 days)
Absorption fraction: 0.5



Plot shows predicted relationship between lead intake (µg Pb ingested/day) and blood Pb concentration for a **1 day exposure** beginning at age 730 days.
Mean BLC: mean blood Pb (age 730-731 days)
Peak BLC: peak blood Pb (age 730-731 days)

ICRP model
Air exposure: zero
Ingest baseline: 3.2 µg/day (blood Pb concentration at age 730 days = 1.5 µg/dL)
Short-term exposure: 0-160 (+3.2) µg/day
Short-term exposure duration: 30 days (age 730-731 days)
Absorption fraction: 0.5