U.S. Environmental Protection Agency
Lead in Urban Soil Workshop
September 15 & 16

Meeting Summary

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U.S. Environmental Protection Agency

Region 3 – Philadelphia, PA

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Lead in Urban Soils Workshop Agenda
September 15 and 16, EPA Region 3, Philadelphia, PA

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10:30am – 11:30am	• Charles Partridge, EPA Region 8 - *R8 Approach to Lead-Contaminated Sites* • Howard Mielke, Tulane University - *Soil Lead Matters: Urban Contamination and Children's Health* • Warren Friedman, U.S. Department of Housing and Urban Development (HUD) - *HUD Perspective*
11:30am - 12:30pm	Facilitated Discussion
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Lead in Urban Soils Workshop Agenda
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Day 2 – Wednesday September 16	
8:30am - 9:15am	Continue Discussions from Day 1
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11:30am - 12:00pm	Facilitated Discussion
12:00pm - 1:00pm	**Lunch (On Your Own)**
1:00pm - 2:00pm	Facilitated Discussion (Continued)
2:00pm – 3:00pm	**Soil Pb Source Attribution Approaches:** • Jon Gabry, EPA Region 2 - Jon Gabry, EPA Region 2 - *Constraining Sources using Pb Isotope ratios* • Jon Gabry, EPA Region 2 - *Forensic Chemistry Techniques for Source Attribution* • Aaron Betts, EPA ORD - *Speciating Soil Lead Contamination to Support Decision Making* • Glenn Adams, EPA Region 4 - *Region 4 Superfund XRF Field Operations Guide for Lead and Arsenic Sites*
3:00pm – 3:15pm	**Break**
3:15pm – 4:00pm	Facilitated Discussion
4:00pm – 4:15pm	**Closing Remarks:** • Shawn Garvin – EPA Region 3 Regional Administrator • Jack Kelly – EPA Region 3

Introduction and Purpose of Workshop

Although a controversial topic, past and ongoing research suggests that lead in urban soil may be as important as interior lead-based paint and interior lead-tainted dust as a pathway of childhood lead exposure. EPA's IUBEK model predicts that soil lead levels below 400 ppm are sufficient to result in childhood blood lead levels above the CDC's new reference value of 5.0 µg/dl. The 400 ppm soil lead concentration likely is below typical urban lead levels in inner city soils. This is due to historic emissions from numerous sources including past industries, leaded gasoline in vehicles, and the flaking and deterioration of lead-based paint. Research studies over the years have found inconsistent correlations between soil lead concentrations and children's lead absorption as measured by blood lead. In addition, there is insufficient evidence to draw strong conclusions about the effectiveness of soil lead interventions (e.g. removal of lead-contaminated soil) in reducing childhood blood lead values.

The Superfund programs in many EPA regions are evaluating whether lead emissions from former facilities located in dense urban areas have significantly raised residential soil lead concentrations above existing health screening criteria. Research data from numerous published studies for many U.S. cities suggest that soil concentrations in city neighborhoods can easily exceed the 400 ppm screening criteria. Contributing sources to elevated soil lead include lead paint carelessly removed and/or deteriorating from buildings, past emissions from vehicles using leaded gasoline and emissions from a variety of industrial facilities. A major obstacle to mitigation lies in the impracticability and lack of sufficient funds to address large areas of lead-contaminated soil using the traditional "dig and haul" approach, and the role of industrial Pb sources for Superfund actions. In addition, some public health and environmental professionals question the magnitude of soil lead's contribution to elevated childhood blood lead, at least under specific conditions.

EPA conducted this two-day workshop in the Region 3 Training Facility in Philadelphia, PA. The workshop was a balanced mix of presentations and open discussion coordinated by a moderator. It brought together over 100 practitioners who perform site assessment and cleanups at lead contaminated urban sites and more than 10 researchers who are investigating public health issues associated with soil lead contamination in urban environments. The goal of the workshop was to offer an opportunity for scientists and engineers to discuss urban soil lead issues, resulting in a greater understanding of the urban soil lead problem and its significance, and to identify possible ways to economically address those issues.

The Workshop's primary objectives were to:

1. Bring together individuals from a variety of disciplines, levels of government, and academia to meet and share knowledge and perspectives on the issues of lead in urban soil;
2. Use findings from the workshop to inform EPA and health agency efforts regarding the investigation and cleanup of urban sites; and
3. Use findings from the workshop to influence government policies on urban soil lead and potentially other contaminants.

Day 1 – Tuesday September 15

8:45am – 9:10 am Introductory Remarks

Jack Kelly, On-scene Coordinator (OSC) and Workshop Coordinator, EPA, Region 3

Jack Kelly began by welcoming participants to the workshop and explaining that EPA structured the workshop agenda to include many presenters with various expertise, points of view, and differences of opinion pertaining to lead characterization and exposure in urban areas. He explained that while the audience consisted mainly of EPA and state employees responsible for cleaning up hazardous sites, there were also urban agriculture practitioners, gardening stakeholders, and many others in the audience.

Cecil Rodriguez, Director, Region 3 Hazardous Site Cleanup Division

Cecil Rodriguez introduced the regional perspective of this high-priority issue. He explained that Superfund Division Directors, the Centers for Disease Control and Prevention (CDC), and other agencies have been discussing lead cleanup levels for years, and that this issue of lead in urban environments is important throughout the United States. Each EPA region, six states, the city of Philadelphia, and universities as far away as Washington State were represented at the workshop. He continued by referencing site investigations and the JT Lewis site in Philadelphia as examples of the successful collaboration between EPA Superfund, CDC, and the city of Philadelphia to address these issues. He spoke about the significant role of public outreach and education in addressing urban contamination, and about the negative economic impacts of such contamination. He also spoke about the value of urban gardening as a way to foster community and use space efficiently in an urban setting, and the connection between this and the technical issues being discussed at the workshop. He mentioned that the variety of participants at the workshop underscored the important issue of lead contamination in urban settings.

Mark Maddaloni, Toxicologist/Regional Risk Assessment Coordinator, EPA Region 2 – Workshop Facilitator

Mark Maddaloni welcomed workshop participants and introduced himself as the workshop facilitator. He expressed his anticipation of tackling tough issues during the workshop to help agencies responsible for site cleanup to characterize and use site background data, establish source attribution, and implement and measure the effectiveness of remedial strategies for urban environments.

Elisa Ruse-Esposito, City of Philadelphia, FarmPhilly Program

Elisa Ruse-Esposito introduced the perspective of cities dealing with lead contamination and cleanup. She offered her own experience in Philadelphia as a recipient of Brownfields funding and collaborating with many agencies to tackle these types of issues. She underscored the importance of being able to move forward with repurposing blighted lots in cities as productive areas (e.g., by implementing urban agriculture programs) as a way to solve other problems that cities face (e.g., crime rates). She expressed her enthusiasm about the participation in the workshop and learning from the other presenters to be able to support the over 400 community gardens and farms in Philadelphia.

9:10am – 10:15am Presentations

Mike Scozzafava, Chief, Science Policy Branch. Office of Site Remediation and Technology Innovation (OSRTI), EPA Headquarters - *EPA Pb Technical Review Workgroup (TRW) Issues and Challenges*

Mike Scozzafava presented the issues facing the EPA Lead TRW committee. He explained that the current EPA lead soil screening level of 400 ppm, based on the Integrated Exposure Uptake Biokinetic (IEUBK) model for lead in children, is used as an indication of the need for a site-specific study. This site-specific information is then used to inform remediation plans and cleanup. A review of EPA Superfund site cleanup level distribution revealed that many site cleanups are driven by a contaminant other than lead, meaning that a change to the lead screening level would not necessarily affect Superfund lead cleanup levels.

EPA's review of the lead policy is based on other factors and recent findings pertaining to health effects resulting from lead exposures made in the 2013 National Toxicology Program Monograph on Health Effects of Low-level Lead, EPA's 2013 Integrated Science Assessment, and the June 2012 Federal Advisory Committee on Childhood Lead Poisoning Prevention to the CDC. Mike examined success of Superfund sites at bringing community average blood lead levels below 5.0 µg/dL, and attributed some of this success to the catalyzing impact of Superfund in communities. He also discussed the caveats of the data: questionable community representativeness of blood lead levels, human health risk assessment goals in context of cleanup levels, and how success of the Superfund program coincides with a national drop in blood lead levels due to banning products containing lead.

Mike expounded on EPA's evaluation of the lead policy and the IEUBK model, citing coordination within EPA and across federal agencies, and the TRW's efforts to produce technical guidance and tools to aid decision makers. He encouraged more routine use of site-specific information in the IEUBK model, prioritization of sites by risk, and 5-year NPL site reviews during EPA lead policy development. He also mentioned issues identified by the TRW urban lead subcommittee specifically associated with urban lead contamination: numerous potential sources, historic discharges and legacy contamination, and logistical issues associated with accessing contaminated urban areas.

Mike closed by listing important topics for discussion during the workshop, including defining and determining background in urban areas, creating and improving source attribution methods, conducting cost-effective response actions and demonstrating their effectiveness, and addressing recontamination.

Q&A/Comments

No questions.

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Marc Stifelman, Toxicologist EPA Region 10 - *Bunker Hill Soil Pb and Dust*

Marc Stifelman presented on his experience at the Bunker Hill Superfund site in Smelterville, Idaho, where the three remedial action objectives were to decrease soil, dust, and blood lead to acceptable levels. The pathway of exposure to lead flows mainly through the dust portion of soil. Dust is what sticks to people's hands, gets transferred to food, gets into homes, and into blood. Marc also commented that

the spatial and temporal scales of the relationship between dust movement, exposure, and health effects is not well understood, but it certainly extends beyond the immediate residential property boundary.

He presented the modern problems associated with lead and argued that the greatest challenge today is to lower the background levels of lead over the long term, especially in cities. Marc then suggested that soil be considered a reservoir for dust, and in that metaphor, the reservoir does not need to be drained, but simply capped and contained. He also clarified that in urban environments, other sources of lead must be considered apart from soil, and emphasized the importance of source attribution. Along those lines, soil concentration is not always directly predictive of current risk, but is indirectly linked to a future risk due to the time it takes for lead to mobilize through soil into dust. He suggested that because the current EPA model does not recognize lead loading, this might be a potential problem in the process of estimating dose from measurable levels of lead in the environment.

Marc provided some details of cleaning up the Smelterville Superfund site, citing that replacing contaminated soil with clean soil here decreased levels of lead in house dust, even in the absence of any direct action on dust specifically. Graphs showed decreases in soil, house dust, and blood lead levels over time, with a notable decrease when the smelter closed, and a general long-term decrease over the 20 years after the smelter closed.

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Q&A/Comments

- **Richard Rupert (U.S. EPA):** You made a comparison between lead gasoline and the biggest drop in blood lead levels. Was that in addition to the removal of the lead in the soil?
    - **Marc Stifelman (U.S. EPA - Region 10):** The point is that we are showing our site blood lead levels along with U.S. average, which is the baseline. We cannot take credit for all of the decreases at our site, but we can for most of them. The point is that the baseline is not constant. It is a declining baseline.
    - **Richard Rupert (U.S. EPA):** My guess was that removing soil had a much bigger impact than removing lead from gasoline.
    - **Marc Stifelman (U.S. EPA - Region 10):** Part of it was the smelter closing in 1981. There were different stages in our cleanup. We were able to clean up common areas first, then residences with young children and finally, a block-by-block cleanup of all residences.
- **Rufus Chaney (USDA):** There have been smelter worker strikes in Australia and Canada and months after the strike, blood lead levels dropped remarkably. There is current deposition from the active smelter as well as residual lead dust, and active deposition was much more important than the residual soil source. Also, removing lead solder from food cans had a bigger effect on children's blood Pb than removing from lead from gasoline.
- **Lynn Wilder (ATSDR):** We have always had problems with indoor dust concentration versus loading. In the late 1980s, we found that if you clean indoor surfaces really well, concentration actually goes up, because you reverse loading. Have you dealt with that at all?

    - **Marc Stifelman (U.S. EPA - Region 10):** We did not see a decrease in loading, but we had a lot of dust and it replenished quickly. Our sample sizes were small and we did not have the power necessary to look at that. There is a lot of variability, so it is just difficult to parse. Some of it is environmental, some is the structure of the house, and some is the people living in the house. A relatively clean house would still be expected to pose less risks.
    - **Mark Maddaloni (U.S. EPA - Region 2):** Pb mass and load are huge issues that we will be exploring a bit more. Housekeeping is huge, but how do we control that?
    - **Marc Stifelman (U.S. EPA - Region 10):** Dust loading is a very strong independent risk factor.
- **Sally Brown (University of Washington):** I have spent time in that valley. It is a highly specialized and unique situation. Emissions are contained within the valley with a clear point source and very low population base. What you were able to do there is a very unique case. We are talking about cities with highly varied contamination from different sources, and the basic impracticalities of enacting a remedy like you did. Also in your graphs, you have a significant drop before yard soil remediation began.
    - **Marc Stifelman (U.S. EPA - Region 10):** That drop was the smelter closing.
    - **Sally Brown (University of Washington):** We should take this as a case study. There are lessons here, but this needs modification before it can be applied to other sites.
- **Sheri Bianchin (U.S. EPA - Region 5):** Did you have problems controlling people's behavior? Like cleaning their own houses before you could get there?
    - **Marc Stifelman (U.S. EPA - Region 10):** We did not give any direction for them not to clean. We cleaned houses with different levels (commercial cleaning services to HUD certified contractors). We measured pre-cleaning, immediately post-cleaning, and 6 months after cleaning. We relocated them during cleaning.
    - **Sheri Bianchin (U.S. EPA - Region 5):** That is clearly a confounding issue that needs to be addressed.

Mary Jean Brown, Centers for Disease Control and Prevention (CDC) & Lynn Wilder, Agency for Toxic Substances and Disease Registry, (ATSDR) - CDC Perspective on Soil Pb, Use of Blood Pb Studies

Mary Jean Brown gave details on the CDC blood lead level reference value. The CDC has adopted the view that children in the top 2.5 percent of blood lead levels represent the most affected population. She mentioned the current reevaluation of the reference value (set to occur every 4 years) and noted that it may result in a lower reference value. This might prove difficult for regulators, but there is a proposed solution: control and eliminate all sources of lead to which children could be exposed. If regulators decide against this, then the trade-off is eternal vigilance and maintenance.

Mary Jean then reviewed the JT Lewis site in Philadelphia, citing collaboration between many agencies, universities, and non-profits to conduct a population-based survey (versus a convenience sample of self-selected volunteers) conducted in July 2014. She noted the intensive work necessary to conduct population-based surveys (e.g., consent forms), but that they are worth this effort because of specific benefits including a more robust estimate of blood lead levels that can be generalized throughout the

population, capability to examine distributions and compare geometric means and standard deviations, real-time blood and environmental samples, and prioritization help.

A 2.7-kilometer radius was established as the area of most interest, based on other studies of the highest contamination areas, and households were selected randomly within this area. The target population was children 9–71 months of age living in the residence for at least 6 months. Questionnaires and measurements were collected. Measurements included child venous blood and environmental measurements including soil, household dust and tap water. . She expressed the importance of having the expertise of a biostatistician to help construct the sample design and assure enough statistical power to create an appropriate estimate. Mary Jean also stressed the benefits of using venous blood samples instead of Lead Care II capillary readings, due to the major drawback of the limit of detection of Lead Care II being 3.3 µg/dL, which was insufficient for the statistical analyses needed.

The study involved a sample size of 126 children with a maximum blood lead level of 11 µg/dL and a mean blood lead level of 2 µg/dL. Though there were no children with extraordinarily high blood lead levels, Mary Jean stressed that this population of children was largely from white, home-owning, college-educated families, which is not the typical population of children seen with levels of 5.0 µg/dL or higher. Soil samples, dust wipes, and drinking water samples showed a potential relationship between soil, wind direction, and the point source, which is being further explored.

The strengths of this type of study were the population estimate and the fact that blood lead samples and environmental samples were taken concurrently. One of the limitations was incomplete tax data for Philadelphia. Therefore, an assessment of the demographic differences between enrolled children and parents who refused participation was not possible. Mary Jean closed by underscoring the importance of making results available to the community, provide scientific assistance to evaluate results, and work with health departments to ensure that all children are tested for blood lead levels, not only those populations expected to have high blood lead.

Lynn Wilder began her presentation explaining that all ATSDR evaluations, recommendations, and follow-up are site-specific. ATSDR uses blood lead levels to prioritize cleanup and environmental lead levels to inform health education and focus for communities. Lynn stated that the effort that Mary Jean described was the first statistically based effort and that convenience sampling is the norm in most cases. ATSDR is trying to change that based on the success of the JT Lewis site population-based survey, but Lynn acknowledged the budget and time limitations preventing this transition from happening quickly, citing a timeline of 1–2 years to get official approval. Until that approval, only convenience sampling is possible.

Lynn emphasized the agency's increasingly holistic approach to lead cleanup. Education plays an important part in preventing lead exposure in the household.

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Q&A/Comments

- **Marilyn Howarth (University of Pennsylvania):** What we are finding in other communities is just as you said, the urban scenario where children with high blood lead levels are not necessarily those in environmental justice communities. It is often in the urban environments where we do not have clear historical sources, but perhaps a whole series of lead contributions from industries and homes. Based on current CDC recommendations, doctors' only screen children with "at risk" criteria (e.g., poor housing conditions, Medicaid). I wonder if perhaps we are not giving doctors the right direction. Perhaps the place where we are not doing the best job is really the urban former industrial environment, and that should be identified as a risk factor.
    - **Mary Jean Brown (CDC):** I think it is important that states and local jurisdictions use all data available to them. I expect the geometric mean blood lead level for children in next National Health and Nutrition Examination Survey (NHANES) is less than 1, and it is difficult to get universal testing when the value is that low. When we put out the money last time, we made $60,000 available for places that wanted to do population-based studies, and nobody took us up on it. That was disappointing. Finally, the other thing we are working on is taking surveillance data and modeling it so that it approaches population-based data. If we could do that, it would be very helpful, but we have not figured that out yet.
- **Lora Werner (ATSDR, Regional office):** I wanted to mention the Philadelphia Department of Health. The capture rate for screening children is the highest in the state. We are not necessarily missing these kids, but there may be a source of exposure that needs to be recognized.
- **Marc Stifelman (U.S. EPA - Region 10):** I understand the difference between convenience and population sampling, but people still have the option to say yes or no. It will always be self-selected. We asked everybody and paid them, starting off with $20 and we went to $30 and $40 in recent years.
    - **Mary Jean Brown (CDC):** Any scientific study is subject to that limitation, but we do expect that before drugs are brought to market that drugs undergo rigorous trials. We are not doing anybody any favors if we do not subject our public health work to the same rigor. The most important thing is to work with community leaders and health care providers to make sure that most of the people you approach say yes. If English is not the primary language, field staff should speak the primary language. You make sure religious leaders are on board. I think we know how to do it, but it is just how you approach it.
    - **Lynn Wilder (ATSDR):** With either approach, we do not know if we have captured everybody that wants to be tested. But with the statistical approach, we just keep asking until we get the sample size we need.
    - **Marc Stifelman (U.S. EPA - Region 10):** I understand the advantages of the study you are putting together. We call it public health study and surveillance. We try to get participation rates high. We always have over 50 percent. It is great for us, but it is

unrealistic for everybody. If convenience sampling has a certain participation, it should have more value.

- **Mary Jean Brown (CDC):** I think 50 percent in field studies is great, but we did better than that in this study. It varies between 80-95 percent, which is very, very high. We do give small incentives, but we cannot give large incentives because of the Office of Management and Budget. My response to Marilyn Howarth is that yes, this data has a story to tell us, but we have not yet figured out the best way to get the story out. EPA may have some money to help us figure that out.

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10:30am – 11:30am Presentations

+Charles Partridge, EPA Region 8 - R8 Approach to Sites using Blood Pb Data

Charles Partridge filled in for Susan Griffin, Region 8 risk assessor, to present the Region 8 perspective. He noted that Region 8 cities (e.g., Denver, Salt Lake City) are not as urban as many cities on the east coast, but commonalities exist and findings might be useful for urban lead risk assessment. Historically, risk assessors have had to rely on available data for soil and blood lead values. He suggested that a paradigm shift is taking place in Superfund site risk assessment toward collecting more site-specific information to characterize contamination and exposure at sites with soil ingestion and bioavailability as the two main drivers.

CDC lowered its level of concern to a reference value of 5.0 µg/dL, which results in an acceptable soil Pb level of 150 ppm. The critical question is whether remediation to these lower soil levels actually results in a reduction in blood lead levels in a community. Charles discussed Region 8's engagement of city and state health departments as part of a holistic approach to address lead sources in the community. He pointed to the Vasquez Boulevard I-70 Superfund site where EPA collaborated with physicians and city and state regulators to achieve a reduction successfully. He pointed out that knowledge of the baseline blood lead level was critical to the effort. He also suggested the possibility of using EPA grants to establish and fund blood lead surveillance, abatement, and education programs to combat the issue of limited funding for local health departments.

He argued that you can never have too much data and that more data means better informed decisions. Existing data can be used to supplement the analysis. He also acknowledged that blood lead is not caused by a soil-centric exposure. Rather, it is a child's environmental exposure that determines blood lead levels.

Q&A/Comments

No questions.

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Howard Mielke, Tulane University - Perspective of a Long-Time Urban Pb in Soil Researcher

Howard Mielke stressed the importance of understanding environmental signaling that changes the clinical outcome from environmental exposure. He explained that children are the major concern, highlighting the potential of inhalation and hand-to-mouth ingestion as the two pathways of exposure. He listed the myriad of health effects associated with lead exposure in children (e.g., hypertension, chronic kidney disease, motor neuron diseases) and acknowledged that no interventions exist for lead, citing the Cochrane Collaboration that found no proven intervention for reducing child exposure as measured by blood lead levels. He quoted geochemist Clair C. Patterson's statement about urban lead, "older urban areas of the United States have been rendered more or less uninhabitable by the millions of tons of poisonous industrial lead residues…"

He described a study conducted in New Orleans to understand how much lead is found across the entire metropolitan area based on approximately 5,500 soil samples funded by ATSDR. The outer-city had low median lead levels (<5 ppm) when mapped using geographic information systems (GIS), which was considered the background level. The interior of the city had median lead levels of 500-1,000 ppm, which would be considered a Superfund site if it were industrial and suggests that there might be health problems associated with living in different parts of the city.

Lifespan in the outlying areas of New Orleans is up to 80 years, while in the interior, it is 55 years. Although many factors influence lifespan, lead could play an important role. He suggested a ten-fold margin of safety for soil lead exposure, citing that other nations have much lower regulator levels for lead in soil (e.g., 60 ppm in Norway). He also explained that blood lead levels in children go up in the summer when they are outdoors, with the youngest children seeing the biggest increases and decreases from winter to summer. Thus, inhalation might also be an important issue.

Hurricane Katrina flooded approximately 80 percent of the city, bringing in a huge amount of clean sediment, which when coupled with demolition of older homes and construction of newer homes, sent blood lead levels in the city plummeting. The changes demonstrate the feasibility and cost-effectiveness of soil lead intervention.

Q&A/Comments

- **Mark Maddaloni (U.S. EPA - Region 2):** Does it take Katrina for this to happen?
    - **Howard Mielke (Tulane University):** We want to find ways to reduce the exposures from the soil. The map is an important tool. The U.S. is not mapping contaminants in cities. Norway is mapping all of their cities. With their clean soil program, they are able to make a difference simply by changing the environment. They are not just using children to figure out contamination. They are getting environmental measures to respond and intervene so that children are not being exposed.
- **Jack Kelly (U.S. EPA - Region 3):** I continue to struggle with my skepticism a bit. When I see the summer/winter results, it puzzles me, because I have always assumed the primary exposure of concern is lead paint and exposure from it. Higher blood levels in the summer make me question why blood Pb values are not higher in the winter.

- **Howard Mielke (Tulane University):** There is a vitamin D approach. There is debate among clinicians. I cannot answer that controversy, but it is almost universal that increases in blood lead levels occur in the summer. The Detroit study is very solid.

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Warren Friedman, U.S. Department of Housing and Urban Development (HUD) - HUD Perspective

Warren Friedman outlined three important documents that HUD uses to award grants to state and local governments, universities, and non-profits: the HUD Guidelines, Lead Safe Housing Rule, and EPA 403 standards. HUD has done two major surveys of lead in housing. In partnership with National Institute of Environmental Health Sciences (NIEHS), HUD conducted the 1998-1999 National Survey of Lead and Allergens in Housing consisting of 831 nationally representative housing units. In partnership with EPA's Office of Research and Development (ORD), HUD conducted the 2005-2006 American Healthy Homes Survey consisting of 1,121 nationally representative housing units. The American Healthy Homes Survey showed higher lead concentrations in bare soil compared to all soil. It also showed more soil lead in the Northeast, renter-occupied homes, homes built before 1940, households with income less than $30,000, households with children less than 6 years, urbanized areas, and impoverished areas. He also noted differing soil lead based on race, ethnicity, and government support.

Q&A/Comments

No questions.

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11:30am – 12:30pm Facilitated Discussion

Q&A/Comments

- **Ann Carroll (U.S. EPA - OBCR):** My question is for Warren Friedman. Given that you were hoping for big checks, another part of HUD's urban development program is writing big checks. It is called Sandy and Resilience money. If we think of this as community block grants for resilience, does that get towards some of the larger interventions that Dr. Mielke mentioned?
    - **Warren Friedman (HUD):** Congress told HUD that when you do recovery grants to make sure housing is green and work is done in a green manner. The idea is that we have that opportunity working through communities. The typical way this happens is thorough development block grants, which the community has discretion on how to use. There is a call for people to go to their community to press the kinds of remediation that they want.
- **Mark Maddaloni (U.S. EPA - Region 2):** Many of you at EPA are familiar with a relatively new initiative "Making a Visible Difference in Communities". One of our communities in Region 2 is Newburgh, New York. We know the kinds of environments where elevated blood leads in pediatric environments exist. It is a post-industrial river town that is environmentally overburdened and stressed. It has one of the highest blood-lead levels in the state of New York. I am the team leader for Newburgh. We were on a call with HUD and the U.S. Department of

Health and Human Services (HHS) and others. HUD does not give funds to city-owned properties for lead abatement. This is a policy and not set in the regulation. They did not think there was much need for cities to be on the receiving end of these funds. After the 2008 economic collapse, many cities have found themselves distressed. Newburgh has 800 zombie properties. Many have been reverted to the city, but the city is not eligible to receive funding to improve those units. How do we get around that?

- **Warren Friedman (HUD):** Mark is relaying what the cities have conveyed to him. We have guidance issued in 1998-2002 that states if housing come into the ownership of counties, cities, etc., if has to be sold to eligible private owners who live there or rent there to receive funding. What Mark heard is incorrect. We had not gotten a plan, so we did not give funding right away. After the calls he mentioned, the city of Newburgh sent in their plan on Friday. One of the conditions is that they have to show the housing is going to be occupied by people who are eligible for having their homes fixed with federal money. Congress did not want the middle-class to be helped, but rather the working-class or poor. We are going to have an outreach program that sells it to people in need. Then, 90 percent should have kids under 6. Once they do that, we will be happy to have that housing taken care of. There is a lot of other housing in Newburgh. It does show complexity in multiple agencies dealing with the jurisdiction.

- **Stevin Foster (U.S. EPA - OSWER):** We heard a lot of different opinions. I thought I heard Marc Stifelman and Howard Mielke speak of the importance of capping reservoirs to reduce soil exposure, but I heard Charles start with a question alluding to the fact that soil cleanup does not lower lead levels. Then, Mary Jane, maybe we do not have the money to do this and we are on eternal vigilance. If we do not have the resources, the question to EPA is what is the right policy decision that reduces the reservoirs but acknowledges that we must still be vigilant and how can EPA contribute?
  - **Howard Mielke (Tulane University):** There are benefits to reducing exposures. Working on soil is an inexpensive way of changing the environment. We do it all the time in New Orleans every time a place is being built as new soil is brought in to raise the level of the building. We get various large areas with soil in them. From the sediment of the Mississippi River, the soil is clean to us.
  - **Marc Stifelman (U.S. EPA - Region 10):** The settlement pattern in North America is around estuaries. The dredge spoils are deposited offshore.
  - **Mary Jean Brown (CDC):** That is true. We know prevention works. If we say that a child has to have a blood lead level value before he qualifies, we are not doing society any favors. If I wait for you to get to a magic level and then do something for your environment, I am not doing much. The goal is to bring the baby home to a lead-safe environment. We do not have the option for the foreseeable future to bring the baby home to a lead-free environment. The big challenges around our success is that people think that lead is over and given the resource constraints, what do we do? I got this idea of eternal vigilance from somebody else (Ian). Those considerations have to come into this 5-year review. Without routine maintenance of whatever the solution is needs to

come into play (e.g., roads do not last forever, paint is not always intact). This is the price for not making it lead free.

- **Mark Maddaloni (U.S. EPA - Region 2):** Do not let the perfect be the enemy to the good. We will not get it all.
- **Marc Stifelman (U.S. EPA - Region 10):** With Bunker Hill, it is fine to do targeted interventions. We have empirical data that shows small benefit from your property, so it needs to be done at the neighborhood and census track. We funded street maintenance in Bunker Hill. It is the whole town. It does not matter where it is.
- **Mark Maddaloni (U.S. EPA - Region 2):** In your presentation, in addressing background, you said we need to lower the background levels of lead in urban environments. Howard mentioned one way of doing it being a massive intervention. You later gave a reservoir analogy. We cannot drain it, but we can cap it. He drained it more or less. How do you cap it?
- **Marc Stifelman (U.S. EPA - Region 10):** I will give it to Howard. I got the impression that he did cap it. We need to do it more places. It costs a ton of money to haul off soil and replace it with clean soil. Howard has done inches instead of feet, and there is no haul away. There is a ripple effect and it is amazing how much change can take place. A technique we have been using is geotextile. It is orange and has the advantage that water permeates through it and you put clean soil on top of it. The state learned from us after doing it for a while, and the state started requiring bark chips and other similar materials to be put on soil at child care centers.
- **Mark Maddaloni (U.S. EPA - Region 2):** How much of an obstacle are digging restrictions when just putting something on top? How much soil do you get rid of when you put something on top?
- **Howard Mielke (Tulane University):** There is a maintenance necessary. In Stockholm, I was showing the sites of their childcare centers. Every 5 years, they would bring new soil. It is a part of business.

- **Rufus Chaney (USDA):** I believe the data show that the blood lead is not nearly as strongly related to soil Pb as to the Pb in house dust and interior paint. It is the continuing bringing of dust into the homes that is affected by soil, even diluting interior Pb sources in house dust. House dust lead correlates with blood lead, but not so well with soil Pb. Paint is still by far the dominant source. It is always a multi-source factor. Paint lead is not done yet. A new study from northern Canada found the dominant source of household lead was cleaning guns in the house. I have joked that we should spread clean dirt in houses rather than outside. We will talk about bioavailability more tomorrow.
    - **Mark Maddaloni (U.S. EPA - Region 2):** Anybody familiar with historical patterns of childhood lead poisoning in New York City? There is a central lead belt of Central Brooklyn that is overlaid with deteriorated houses.
- **Steve Rock (U.S. EPA - ORD):** Rufus anticipated my question. There are two sources we are talking about. Katrina added soil and took out housing. There is a lot of lead paint that is missing. You move population before and after Katrina. Please amplify that. If you had the $7

billion that Warren mentioned HUD estimated for soil remediation , would you spend it on cleaning up soil or would you start on the housing situation?

- **Howard Mielke (Tulane University):** It is a changing population. Five-year-olds do not stay the same age. We are getting a different population, but the new population has much lower blood lead levels than the previous population. I have some questions about the data and I am looking at that. Children have blood lead levels over 10 in my community and they are struggling to figure out what to do with that. One of the characteristics of the home is you tend to walk from outside to inside. A lot of research has been done on track-in. It is an ongoing exposure route. What the children are telling us in Detroit, when the children go out in summertime, their blood levels go up at the end of summer. Air lead matches that. I am trying to pay attention to children and what they are telling us through their blood.

- **Carol Ann Gross-Davis (U.S. EPA - Region 3):** Outside of Superfund, urban areas are not one big Superfund site. ATSDR only works on site-specific. This is a struggle for EPA policy. What do we do about the public health risk of no safe level of lead when we do not address it as a general statute that we need to worry about lead? We have ongoing lead emission sources. We do not assess risk at a local or community level outside of Superfund. How do we address communities that have pollution that they did not create and we are still arguing about its source?
  - **Mary Jean Brown (CDC):** The first step is to stop arguing about whether we do the soil, water, or paint. If there is high lead in all of them, you are not doing any favors by focusing on one of them. I worry about doing soil without the others, because of the risk of contamination. If we spend the $7 billion now on soil, in a few years, you would have to go back and do it again. The answer about the local public health department is right. We need EPA to have evidence-based levels of lead in various media that we need to address. The Renovation, Repair, and Painting Rule (RRP) has gone a long, long way in improving things. The state and local health department people know how to get into the communities. They are the best conduit for these services.
  - **Carol Ann Gross-Davis (U.S. EPA - Region 3):** Beyond Superfund and Brownfields sites, we do not map things. Soil variability is big.
  - **Mary Jean Brown (CDC):** The public health department cannot geocode the data even if they have it. I have spoken to people with universal blood lead testing and the ability to get healthcare on board. What other kinds of surveillance systems can we put into place that tell us if something has changed in the environment (e.g., water treatment, new product in the market, new ethnic or refugee group) without continually referring to blood lead levels as our sole surveillance tool?
  - **Howard Mielke (Tulane University):** One of the things we are missing is a clean soil act. The way you do that, as done in Norway, was for their geological survey to say map the cities. Right now, the U.S. Geological Survey (USGS), in their mission statement, has non-urban soil. They have a wonderful survey of soils across the country. They are not allowed to do work in the city. If that were changed, we might actually get some maps.
- **Sally Brown (University of Washington):** One thing I have not heard mentioned is that despite the fact that the level of concern has decreased from 10 to 5, there has been a huge decrease in

blood lead levels in children. By many metrics, we are doing very well in terms of children's blood lead. The zero goal can be considered laudable, but not practical (like pre-birth weight) and there is not enough money to do it. Lead is the reason that one district of New Orleans has a reduced life expectancy according to Mielke's data, but according to Friedman, it is old versus new and urban homes. If you have goals to reduce it, you cannot do it in a vacuum without considering environmental justice, food deserts, obesity, etc., that have a much broader range and are getting a lot of traction for good reason right now.

- **Mark Maddaloni (U.S. EPA - Region 2):** I articulated some of the same sentiments at an epigenetics workshop a few weeks ago.
- **Warren Friedman (HUD):** What Howard and I are saying does not differ. There are a lot of other factors besides lead. I agree with you that it is complicated and there are many factors. We are talking about one element. A lot of others play a role.
- **Lynn Wilder (ATSDR):** Who are we missing at this table?
- **Sally Brown (University of Washington):** You will get that tomorrow. You need somebody like Will Allen, who has been instrumental in bringing community food into urban areas. Alice Waters is another name, who brings food into schools, which will impact blood lead levels.
- **Mary Jean Brown (CDC):** Everybody's problem is nobody's problem. We can lean in and hold hands, but we each have our own work to do.

- **Elsbeth Hearn (U.S. EPA - Region 1):** How is this dealt with in other regions? I was going to bring topsoil into my site, and I had it tested and it had 69 ppm lead. This contractor mulched leaves from the city.
  - **Joseph Rotola (U.S. EPA - Region 2):** There is no such thing as top soil. We have the same problem you did in two sites. We are having a hard time finding soil.
  - **Mark Maddaloni (U.S. EPA - Region 2):** In New York City, the Office of Environmental Remediation has a program in place (i.e., Soil Bank) deep excavation goes down into virgin soil and provides this soil where fill is needed. However, it is very sandy and has low nutrient value.
  - **Joseph:** That is the other problem. You cannot grow anything in it.
  - **Joshua Cheng (Brooklyn CUNY):** This is the first year we are doing a pilot study in New York City. Clean sediments are mixed with compost as growth medium and used for raised bed at community gardens. We tested compost from various sources. The one caveat is that a lot of compost is not clean.
  - **Mark Durno (U.S. EPA - Region 5):** We run into this urban lead situation. We are all over the board. Some regions are doing lead education. We have a site in our region that we cleaned to a high level because we had the resources (1,200 ppm from our lead guide). Is the lead guidance that is being revised going to address this so we can target low-hanging fruit where we do not have policy issues related to certain releases?
  - **Mike Scozzafava:** I do not think the revised draft addresses urban lead issues, but it has not gone out, so there is time. We wanted to have this workshop first.

    - **Charles Partridge (U.S. EPA - Region 8):** We wanted to address urban lead, but we realized it would delay the Superfund Residential Lead Handbook. We wanted to form a subgroup to create a document like you described to address specifically this issue.
- **Ramon Mendoza (Region 5):** I have two urban lead sites. The question is for Howard and Marc. Should I be looking at 0 to 1 inches for composites and taking water samples? Is your definition of clean 5 ppm?
    - **Marc Stifelman (U.S. EPA - Region 10):** I have worked on a lot of smelter sites and we try to sample the top inch separately. We consistently get higher readings in 0 to 1. Then, you can decide what do later. I recommend not going any deeper than an inch.
    - **Howard Mielke (Tulane University):** The amount of lead per square foot is the issue. The surface soil plop sampler is something we have published about. It is a way to get a handle on exactly what you might pick up if you put your hand down on the soil. It is a tool to give you some perspective on what it means to have a certain amount of lead in the soil.
    - **Marc Stifelman (U.S. EPA - Region 10):** I am used to clean soil at around 50 ppm.
    - **Charles Partridge (U.S. EPA - Region 8):** In Pueblo, we were asking how we could maximize our effort. We asked if there were horizons we could combine. We statistically compared different horizons. I think that is the only way you can effectively combine them. We did find that we could combine 0 to 6 inch, which makes money go further. Our sample size was small, so we were not sure it was representative of the whole site. Every so many homes, we go back and make sure those assumptions still hold. It is something you have to constantly reexamine and you have to be flexible in your sampling plan.
    - **Mike Scozzafava (U.S. EPA):** Consult the EPA Lead TRW with these types of questions.
    - **Lynn Wilder (ATSDR):** From the ATSDR perspective, if you give us a 0 to 1 ft soil sample, we will tell you to go back and take a surface soil sample first for us to process it (0 to 2 inch, 0 to 3 inch).
    - **Charles Partridge (U.S. EPA - Region 8):** If we provide you with the data and statistics that shows they are comparable, you could make that call.
- **Anne Preston (Philadelphia Parks & Recreation):** I supervise a junior farmers program with over 1,000 children doing education around gardening and healthy eating. In the last year and a half, we have been working to tackle the same questions. How do we get clean soil? How to fund city-wide measures? These are the biggest challenges. We have access, but we need resources.
    - **Charles Partridge (U.S. EPA - Region 8):** There is a lot of benefit in urban areas for fresh produce. We ran into a lot of questions. We did an extensive literature review. The best we could do based on current literature was to give you a broad bracket. This was recently published by the TRW. Do you get more benefit from fresh produce than what you are exposed to from the urban soil? A full belly reduces lead. I think I would get more bang for my buck in Superfund sites, especially because they are in poor neighborhoods, if I could establish a healthy eating program. It might be more helpful.

    - **Lynn Wilder (ATSDR):** If communities want their soil tested, there are soil shops (started in Philadelphia). We have picked this up and run with it in Region 2. People bring in their garden soil and have it tested and it is a grassroots effort supported by EPA, ATSDR, and regional representatives.
    - **Ana Pomales (ATSDR):** As Lynn said, we have soil shops. We do have a poster in the other room where we mapped the soil results we have. We have also included soil samples from Temple University and University of Pennsylvania. If you have questions, my contact information is there. Jack Kelly can also have questions.
    - **Howard Mielke (Tulane University):** Tulane University School of Medicine has a program for medical students to take a culinary arts class at Liberty Garden. I have worked with the gardens and they are getting the word out to the medical students and community that is located around that project.
- **Comment from Webinar:** It seems as though deteriorating housing is one of the highest sources of lead contamination. HUD requires cities to identify poor or working-class populations who will buy it and fix it up. Knowing the unlikelihood that they will purchase a home, could we initiate the cleanup before the buyer is identified?
    - **Warren Friedman (HUD):** I was referring to one situation in my presentation. Our lead control grants are primarily given to property owners of housing rented to low-income populations. Sometimes housing is not occupied, but would be occupied in the future. Sometimes it was owned by a community and was or was not occupied. For all of those, we allow funding. There is an explicit prohibition against public housing to be covered. The lead-safe housing sections (10-12 and 10-13) speak to this. If there is not federal assistance, the lead hazard control program helps out. The question concerned with whether we were waiting for occupancy is not correct.
- **Joseph Rotola (U.S. EPA - Region 2):** We can start a parking lot of issues that face all the regions (e.g., certified refill, sampling intervals) that we should resolve. The regions are not consistent, nor are the states.
- **Edwin Muniz (USDA):** Our agency is the leading agency in soil survey in the nation, not USGS. We have been working in urban areas (Los Angeles, Chicago, etc.). We call it high-detailed mapping with detail close to one acre. We also have a poster.
- **Lora Werner (ATSDR):** We think soil shops and soil kitchens are wonderful, but they are only good for people who are interested and people who come to you. Philadelphia is working on city-wide initiatives.
    - **Ann Carroll (U.S. EPA - OBLR):** Going back to Anne's question about soils. The brownfields program and grantees continue to have a lot of interest in gardens and urban agriculture projects as well as vacant lot greening and restoration in the Brownfield and Land Revitalization programs but grapple with the extent of clean material needed. At the National Brownfields Conference, several well-attended panels included representatives from ports authorities, state programs and EPA discussing soil reuse, soil recycling and even 'soil manufacture'. There are soil banks in New York and Chicago as well as private developer-to-developer transfers that happen. We are being

challenged to think about developing model processes for soil transfers for certain types of reuses as well as well as blending material (food waste digestate, biosolids, other material?) to manufacture soil. We cannot barcode soil. It is moving all the time so we need to develop clear, definable standards for how soils can be reused.

  - **Steve Rock (U.S. EPA - ORD):** In Region 3, we have a manufactured soil project going on to cover a 65-acre Superfund site. You have tens of thousands of cubic yards of clean soil available in the city. It is not together yet. You have Fort Mifflin. It has some contamination, some lead, some polycyclic aromatic hydrocarbons (PAHs). When you blend it with compost, it looks, smells, and grows a lot like soil. There is not any reason we cannot do this everywhere the USCOE has soil.

- **Mark Johnson (ATSDR):** We are seeing the lack of source attribution that leads to limitations in the cleanup. Regardless of the concentration, you will not be able to initiate a cleanup action.
  - **Mark Maddaloni (U.S. EPA - Region 2):** We had this same thing in New York. We put it in the lap of the New York City Health Department. You have to find creative ways to deal with things that Superfund simply cannot deal with.
  - **Mark Johnson (ATSDR):** The challenge is that it is still a hazard potentially. We are relying on health education and other outreach efforts to address those things. It raises the question of how do we sustain health education in communities and how do we protect people in the future?
  - **Marc Stifelman (U.S. EPA - Region 10):** What do we want to do with the results of this workshop? The TRW can address technical questions. Additional technical guidance will be helpful. There are at least two to three mischaracterizations of HUD programs. Mary Jean mentioned $60,000 for research that nobody knows about. What can we work on to give to site managers that can find all of the resources they need to manage these complex, unique sites? I am project-focused and I would like to capture these important issues.
  - **Ann Carroll (U.S. EPA - OBLR):** The less we define this as a Superfund-only program and more of a community-problem, we can start building partnerships with other agencies and organizations constantly reshaping cities and urban spaces, such as HUD, DOT and local organizations.
  - **Sally Brown (University of Washington):** The city of Tacoma had been a National Priorities List site. The city has inherited the issue of contamination and has owned it, so you have an active dirt mobile that goes around the city. The community garden program has been incorporated into the city municipality to help the program to succeed. All community gardens get cardboard mulch as barrier to soil, mulched wood, and raised beds with lead levels of about 12.
  - **Mark Maddaloni (U.S. EPA - Region 2):** Starting to initiate this is good.
  - **Sally Brown (University of Washington):** Superfund working with the municipality is important.
  - **Howard Mielke (Tulane University):** Question about funding and where resources are coming from. The state of California taxes paint and gasoline.

- **Mary Jean Brown (CDC):** In California the polluter pays. The California lead program has $20M per year and CDC has $15M per year.
- **Richard Rupert (U.S. EPA):** The presenters believe that lead in the soil is the big problem, or rather, lead is the problem. People see lead is associated with the home regardless of what is in the soil. Howard, your study says children have higher lead concentrations in the summer. In the winter, they are at school. In the summer, they are home and they might not be outside.
- **Howard Mielke (Tulane University):** Detroit and Minnesota show the same thing.
- **Mary Jean Brown (CDC):** There are a lot of questions about the summer-time thing. Kate Mahaffey debunked the vitamin D hypothesis. Children are outside, windows open and close, which creates a dust cloud. You will never find the smoking gun for a child with a blood-lead level of 6.
- **Richard Rupert (U.S. EPA):** You have to be careful on how we spend our money. We cannot make broad policies and say all of the soil above a certain amount has to be removed.
- **Lynn Wilder (ATSDR):** One of the comments I keep hearing is we have limited funding. Instead of approaching it like we used to do (i.e., this is a Superfund site and I did my part so I am going away), we need to go in and ask who else needs to be involved, whether Superfund needs to walk away or not, get HUD, local gardening, etc. involved. I do not think going in separately is going to do it.
- **Mary Jean Brown (CDC):** Do not forget the property owners. It is the cost of doing business.
- **Jack Kelly (U.S. EPA - Region 3):** This afternoon, can we talk about obstacles to using city-wide blood lead surveillance data?

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2:00pm – 2:40pm Presentations

Charles Partridge, EPA Region 8 - IEUBK Model

Charles Partridge provided a background of the Integrated Exposure Uptake Biokinetic (IEUBK) model for lead risk assessment. He explained that lead risk assessment is different than other environmental contaminants, because there is a low degree of uncertainty and a wide body of research. Blood lead concentration is a biomarker for lead exposure, and environmental exposures to lead are modeled to predict blood lead levels associated with these exposures. The IEUBK model predicts the blood lead concentration in children less than 7 years of age who are exposed to environmental lead from many sources, and the risk that a hypothetical child exposed to specified media lead concentrations will have a blood lead level ≥10 µg/dL, and cleanup levels for various media for residential land use.

The IEUBK model was developed over many years and has undergone several independent reviews. Validation exercises demonstrated good correlations between predicted and observed blood lead levels. Sensitivity analyses showed the model is very sensitive to soil and dust ingested per day and moderately sensitive (listed in decreasing relative sensitivity) to the absorption fraction for soil and dust and diet,

soil lead concentration, indoor dust lead concentration, dietary lead concentration, contribution of soil lead to indoor dust lead, and half-saturation absorbable intake (based on output-input ratio). The main strength of the IEUBK model is that it integrates multimedia exposure and relates it to a well-characterized biomarker of effect, but Charles acknowledged that its weaknesses include inability to assess short-term, periodic or acute exposures (exposures must be for ≥1 day/week for 90 consecutive days), pica exposures, dust exposures using loading data, and age groups >7 years.

Q&A/Comments

- **Sally Brown (University of Washington):** We have heard a bunch of other datasets this morning from other areas. Have you tried to see if IEUBK works with those datasets?
    - **Charles Partridge (U.S. EPA - Region 8):** Yes, we have been looking at that and made a data call asking for more data and did get some. It is in progress, and we are aware that some of our cross-checks are specific to certain regional data. If you have data, let me know, because we would love to look at and examine it. The model only gets better in predictions with larger datasets.
- **Joshua Cheng (Brooklyn CUNY):** What about variation in soil lead concentration which has been observed even at garden scale?
    - **Charles Partridge (U.S. EPA - Region 8):** It fits into the bigger lead problem. Sample design and sample preparation is so important. I have seen datasets where they take the samples, throw it in a bucket, and ship it off to the lab. In Pueblo, we found that you have such wide variation that it is almost worthless. The only way we got down clean is through drying, homogenization, and sieving. None of it was mechanical, just gentle. The R^2 was 0.99 or 0.98.
- **Mark Maddaloni (U.S. EPA - Region 2):** When you looked at the validation slide predicting observed and predicted, they are pretty high by today's standards (e.g., 5, 6, 7). The question is going to be is this model up to this task.
    - **Charles Partridge (U.S. EPA - Region 8):** I wanted to get there. When you look at the model, you started looking at 10 ug/dL. You never thought you would get to 2. This was 1990s data, so there was wide variation in the lead carrier. Validating it versus the old dataset in which there is a lot of variability is something we are looking at. We are looking at the latest datasets with lower levels (e.g., 2, 5).
    - **Mike Scozzafava (U.S. EPA):** We had some very low lead levels.
    - **Charles Partridge (U.S. EPA - Region 8):** That is the nature of the question.

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Lynn Wilder, ATSDR - ATSDR Plans for Use of All Ages Model

Lynn Wilder presented on ATSDR's research on the All Ages Lead Model (AALM), given the limitations of the IEUBK model and ATSDR's need to model shorter-term and less frequent exposures. The AALM provides an estimate of blood lead levels based on site-specific exposure conditions, including seasonality, frequency, duration, and concentration; a means of describing the degree of concern based

on the relationship to 5 ug/dL using probabilities; and an opportunity for ATSDR to design site-specific interventions, based on site-specific scenarios, to reduce lead exposures.

Lynn explained that a series of physiologically based pharmacokinetic models were considered for short-term, intermittent, and seasonal exposures. The AALM was selected due to its ability to predict short-term and pica exposures. Lynn acknowledged that issues still exist including pica exposures, assigning exposure fractions, averaging lead exposures, and consideration of peak lead exposures. She suggested that an even more difficult issue might be vetting and obtaining approval of this new approach for lead evaluation. ATSDR is currently testing the AALM model using JT Lewis data and data from other sites might be required down the road. Lynn emphasized that this is still a work in progress to determine the most appropriate method for determining exposure fractions and other assumptions used in the model.

Q&A/Comments

No questions.

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2:40pm – 3:15pm Facilitated Discussion

- **Jack Kelly (U.S. EPA - Region 3):** Charles said there are three or four things I do not understand about the IEUBK model. Should I be concerned about the fact that I could never understand the intricacies of the IEUBK model but am encouraged to use it for site decision-making ?
    - **Charles Partridge (U.S. EPA - Region 8):** I do not know how my car works, and I still use it. It is still a useful tool. It is such a complicated matter. You cannot know everything. You have to rely on people who do know to inform you and create the product that passes peer review. That is the reason we submit it for external review and get feedback. I do not think anybody should be intimidated into using the model. We are trying to make it as user-friendly as you can. We almost have a graphical user interface. If you are familiar with Windows, you can walk yourself through it. We have some training videos now that are very informative. You can start knowing nothing about the model and by the end of the training, you have a pretty good idea of how it works.
    - **Marc Stifelman (U.S. EPA - Region 10):** The model is a distraction. The uncertainties are not in the model. There are more uncertainties in how you sample the soil. There is tons of uncertainty in the soil ingestion rate and even more in the dust ingestion rate. The biokinetics are ok, but they are based on primate dosing studies from the 1980s. It is not just the model, but also the input parameters and the environmental data that have problems.
    - **Charles Partridge (U.S. EPA - Region 8):** Bad data in gives you bad data out. I cannot stress enough the importance of good sample design. If you go back and see how the data were collected, it might explain some of the variability. It might be more expensive and more intensive at the beginning, but it saves you so many headaches down the road.

- **Richard Rupert (U.S. EPA):** There are idiosyncrasies in the model and if you knew how it worked, you could put in parameters and make the model work. You have to trust it, but you should understand it. On the AALM, what assumptions do you make regarding soil cover?
    - **Mark Maddaloni (U.S. EPA - Region 2):** Soil ingestion rate is highly uncertain and highly variable.
    - **Marc Stifelman (U.S. EPA - Region 10):** We sample soil like we are digging a hole. That is not how people are exposed. That is why Howard's research is very interesting. There is a whole delivery system when it is dry in the summer. Our sample does not know that. The soil is just the engine, but the dust is what people are eating. You can overcome this by doing what Howard is using or by taking shallow samples. All the model does is go from the dose to the blood lead level. The hard part is estimating the dose (i.e., estimating right soil concentration, dust concentration, ingestion rate) that occurs outside the model. The model is based on those primate studies, but it can't be changed until other studies are conducted.
    - **Lynn Wilder (ATSDR):** Concentration goes into the model. It does not matter what the soil cover is.
    - **Charles Partridge (U.S. EPA - Region 8):** The capacity to define coverage is not built into the model, but grass is good.
    - **Mark Maddaloni (U.S. EPA - Region 2):** In the IEUBK model, it was relying on ape data from New York University. The exposure component is more variable than the model.
    - **James Brown (U.S. EPA - ORD):** There are other ways to deal with ground cover. You can account for it using ingestion rate or partitioning. A lot of the kinetics for AALM are also based on baboon, rodent, etc. data that Leggett was using based on first order kinetics and several compartments within the data.
    - **Mark Maddaloni (U.S. EPA - Region 2):** We know about that from pharmaceutical data.
    - **James Brown (U.S. EPA - ORD):** We are testing AALM against data. I do not think we can estimate per individual child, but rather community-level predictions. There will be variability between individuals (e.g., some have breakfast and some do not).
- **Mark Johnson (ATSDR):** How do you characterize the output from the IEUBK model? One is that it is predicting a percentage of the population above a certain level and the other is the probability of one child being above a certain level.
    - **James Brown (U.S. EPA - ORD):** For both, an average or a median exposure, median response, median blood. You can overlay a standard deviation and predict any distribution.
    - **Marc Stifelman (U.S. EPA - Region 10):** There is no predicting individual risk. It is saying that the *typical child* has a 5 percent risk. It applies to a population of children, either real or theoretical.
- **Comment from Webinar:** Can the user set up the IEUBK with assumptions with lead exposure from a separate source (e.g., grass, soil)?

    - **Marc Stifelman (U.S. EPA - Region 10):** Yes, that is possible. If you go to the TRW website and look for the training videos, the second video should walk you through how to do that.
    - **Comment from Webinar:** The starting point was animal but was extended due to children and epidemiological data soil ingestion rate for IEUBK
    - **Charles Partridge (U.S. EPA - Region 8):** The ingestion rate is all human data.
- **Comment from Webinar:** The only exposure that kids have is to their Xbox. Kids do not spend as much time outside as they once did.
    - **Charles Partridge (U.S. EPA - Region 8):** Yes, that is true. When we establish these parameters, we are looking at an average. Also, we look at younger kids. Their time outdoors is a bit limited.
    - **James Brown (U.S. EPA - ORD):** We get similar comments based on other pollutants. New activity pattern surveys still show that children spend time outdoors. We got the same comment regarding ozone. We would still be concerned about what we track in as adults.
    - **Marc Stifelman (U.S. EPA - Region 10):** Children do not eat soil. They eat soil dust. It comes from the whole community. We live on top of this reservoir of lead that just happens to be in dust and soil. It does not matter where we interact
    - **Ann Carroll (U.S. EPA - OBLR):** Do we factor in if people have pets?
    - **Charles Partridge (U.S. EPA - Region 8):** I have seen it on questionnaires. We do see it.
    - **Mark Maddaloni (U.S. EPA - Region 2):** There is no input on the IEUBK model parameter for pets.
    - **Marc Stifelman (U.S. EPA - Region 10):** Yes, having pets and more kids and occupants in the house, increases the level of lead. It is not like you get a different cleanup level based on this. It is a true route of exposure.
- **Kevin Koporec (U.S. EPA - Region 4):** What did you assume for the other 5-6 days/week for concentration for soil lead that kids were exposed to?
    - **Lynn Wilder (ATSDR):** Each of the figures represents this.
    - **Kevin Koporec (U.S. EPA - Region 4):** When running IEUBK, we can do a time-weighted average and do it that way, but if assuming exposure to a spike of lead one day per week, what amount of lead for the other days?
    - **Lynn Wilder (ATSDR):** This would be with 400 ppm lead. The red line at the bottom is one day per week.
    - **Kevin Koporec (U.S. EPA - Region 4):** For IEUBK, you have to assume something.
    - **James Brown (U.S. EPA - ORD):** They just zeroed that out.
    - **Mark Maddaloni (U.S. EPA - Region 2):** Kevin, your point is that the levels are higher because it is not realistic that you would be exposed to nothing any day of the week.
- **Mark Maddaloni (U.S. EPA - Region 2):** The AALM is very versatile. IEUBK gives you an average blood lead over time steps of a year and can be used with effects. We know a lot about long-term exposure in children to lead and can relate it to cognizant deficits. We do not know what it means if somebody has had a peak for a short duration. From a case study, geese had high

levels of lead and an organization was donating them to the needy. We modeled it with two one-pound exposures meals on back-to-back weekly exposures. It is helpful to know the kinetics, which allowed for short term modelling of PbB from the aforementioned exposure but the interpretation is more challenging.

- **Sally Brown (University of Washington):** In the case of lead ingested with food, kinetics are not understood and not incorporated into the model at all.
- **Mark Maddaloni (U.S. EPA - Region 2):** Lead ingestion with food is absorbed much less. That was the subject of my dissertation.
- **Sally Brown (University of Washington):** A big concern is lead in food stuffs cultivated in urban areas with potentially contaminated soil. That should be given some thought.
- **Ann Carroll (U.S. EPA - OBLR):** And nutrition.
- **Marc Stifelman (U.S. EPA - Region 10):** If we get a blood lead spike, we do not know what that means. The IEUBK model takes 84 months of exposure and averages it out. Some epidemiological studies look at blood lead levels averaged over 24-months. We know that 84 months is likely too long.
- **James Brown (U.S. EPA - ORD):** They equally predict IQ.
- **Rufus Chaney (USDA):** One was much better.
- **Lynn Wilder (ATSDR):** We have some current challenges. We are in discussion about what does one peak value mean? What does 3-month exposure mean versus 2 weeks? We do not know, but we should say something about it.
- **Charles Partridge (U.S. EPA - Region 8):** There should be a point where it is almost cumulative or the same across.
- **Mark Maddaloni (U.S. EPA - Region 2):** We addressed that with the IEUBK.
- **Rufus Chaney (USDA):** Refer to the analysis in the Stanek and Calabrese papers of measured soil/dust absorption by children based on fecal analysis of soil indicator trace elements. Over time they corrected flaws in the original analysis (Stanek and Calabrese, 2001), the statistics of soil/dust ingestion show a GM of only 24 mg/day with the 95th percentile at 91 mg/day. Only when they corrected for particle size of the soil and removed errors from several of the original elements used to estimate soil ingestion did they come to the numbers recommended for use in modeling of soil ingestion.
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- **Charles Partridge (U.S. EPA - Region 8):** It is something on our radar and something we want to address.
- **Mark Maddaloni (U.S. EPA - Region 2):** That is an upper-bound estimate, and the model uses central tendencies.

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3:30pm – 4:20pm Presentations

Karen Bradham, EPA ORD - Soil Pb Bioavailability

Karen Bradham provided an in-depth explanation of lead soil bioavailability and how it affects human health risk associated with soil ingestion. Bioavailability is the key to determining uptake of contaminants from soil after ingestion, and therefore potential health impacts. Karen explained the differences between absolute bioavailability (fraction of ingested lead absorbed from the gastrointestinal tract), relative bioavailability (ratio of absolute bioavailable lead to water-soluble reference compound), and in vitro bioaccessibility (fraction of lead in soil sample soluble in low-pH gastric-like extraction medium).

Karen explained the formation of the TRW Bioavailability committee to provide technical support to on-scene coordinators and human-health risk assessors by developing guidance for site assessments and cleanup. Some specific guidance from this committee includes a standard operating procedure for performing a rapid and inexpensive in vitro bioaccessibility assay for lead in soil (SW-846; Method 1340) to estimate soil lead bioavailability. These site-specific estimates of soil lead bioavailability are recommended due to the dependency of bioavailability on the physical and chemical properties of the soil; different forms of lead from different media ingested at equal doses may not be of equal concern to human health. This specific solid-waste method has been validated for use in lead-contaminated soil under field conditions and has been published (available online). Karen also enumerated the importance of sample design and collection as important parts of a holistic approach to the soil assay, and provided guidance on these as well.

ORD has been working with regional offices (e.g., Region 3) to develop in vitro bioavailability methods including: in vitro bioaccessibility methods, solid phase speciation, and relative bioavailability determination using animal assays. Also, EPA and USGS are collaborating to develop a soil surrogate reference material to help regions develop additional methods, or QC current extraction methods. The reference material will be available to regional labs in late 2015 or early next year. Finally, Karen provided the website with additional information on the methods she discussed.

Q&A/Comments

- **Mary Jean Brown (CDC):** I want to raise three cautions about bioavailability. There is more to bioavailability than what happens in your gastrointestinal tract. There are many variables to consider between what is in the soil and what is in a child. You cannot use the same number for a grown woman and small child.
    - **Mark Maddaloni (U.S. EPA - Region 2):** We know. We have an adult model, because we know that adults are not as efficient absorbers as children.
    - **Mary Jean Brown (CDC):** We fall in love with these values, and I caution against that because there are too many other factors that are not accounted for in this test.
    - **Mark Maddaloni (U.S. EPA - Region 2):** I agree, but when we use our models what are we going to put in them?
    - **Mary Jean Brown (CDC):** I do not know. I am just raising cautions, not giving answers. The second point is that bioavailability is not a permanent condition, because the

composition of the soil could change with weathering, acid rain, etc. So when you test it and it is not bioavailable, you are finished and just move on?

- **Karen Bradham (U.S. EPA - ORD):** No, but bioavailability probably is not a standard part of the 5-year reviews.
- **Mary Jean Brown (CDC):** $5,000 for a soil sample is very expensive.
- **Karen Bradham (U.S. EPA - ORD):** That is for the in vivo method that has not been tested. $75 per sample for a suite of inorganic analyses is what was said earlier.
- **Mary Jean Brown (CDC):** You can do it cheaper. Some countries are using bioavailability to justify increasing the allowable level of lead in residential house paint. We need to make it very clear that this should not be used to increase the amount of allowable lead.
- **Karen Bradham (U.S. EPA - ORD):** The bioavailability method has not been approved for use for that purpose.
- **Mary Jean Brown (CDC):** The Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) program in the European Union is to allow lead chromate in paints.
- **Mark Maddaloni (U.S. EPA - Region 2):** It is disturbing given what we have learned about lead-based paints that anyone would consider putting it back in.
- **Karen Bradham (U.S. EPA - ORD):** It would need to be validated for consumer products against an in vivo model. There is a caveat and it is very well stated that this is only validated for specific types of lead in soil.

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Alicia Frame, EPA OSWER/OSRTI - Soil Pb Background

Alicia Frame provided an overview of the existing policy regarding background levels of contaminants at Superfund sites. She pointed out that lead levels are higher, in general, in urban areas, and that Superfund's policy is not to cleanup below background levels. Naturally occurring lead as well as anthropogenically sourced lead both contribute to urban background levels. Background levels must be collected and determined when it affects site cleanup decisions. Previously collected site-specific data can be used in lieu of sampling as long as it meets certain criteria, and historical data can inform sampling locations.

Alicia expanded on appropriate sampling locations, stipulating that samples should ideally be taken from a nearby off-site location that matches the characteristics of the site as closely as possible. Characteristics to consider include soil properties like grain size, organic matter content, chemistry, etc. Alicia expressed the crucial importance of experience and expert judgment in determining appropriate background sampling sites. Background sampling should be conducted and analyzed in exactly the same way as contaminated site sampling, and a power analysis should be used to inform the appropriate number of samples necessary to answer questions of interest.

Alicia explained that in urban sites, it is possible that there are many off-site contributors to background levels of contaminants, and that it should not be assumed that data are normally distributed. Additionally, EPA guidance states that statistical tests alone are not justification to exclude outliers from

a dataset. Further review is needed to determine whether or not it is appropriate to throw out a specific data point. Alicia also reviewed some of the analytical approaches that can be used to partition site data from background data. She made it clear that, however, ideally, this should not be necessary if sampling has been conducted with appropriate regard for site influence. Alicia introduced a Geoplatform/ArcGIS tool available to EPA users as a useful resource for spatially plotting sampling sites and groundtruthing assumptions.

Quantitative measures of background, historically, have been represented by a number of different values (e.g., the highest value sampled, 95th percentile, etc.). Alicia stressed the importance of choosing an appropriately representative value that all collaborators can agree on. She recommended using a null hypothesis of no difference between site and background levels in comparative statistical analyses.

Q&A/Comments

No questions.

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Glenn Adams, EPA Region 4 and Joshua Cheng, Brooklyn CUNY - Short Briefing on Ongoing Background Projects

Glenn Adams presented the Region 4 urban background study funded by ORD's Regional Applied Research Effort (RARE) Grant program. The study is a collaborative effort between Region 4, ORD, and 7 states in the region to characterize urban background in several cities and develop a uniform method of determining background concentrations in the region. Glenn explained that getting field access in all cities has been complicated, and welcomed additional opportunities for collaboration.

Joshua Cheng presented his research on lead contamination in New York City garden soils, begun in 2009. The study accepted and analyzed samples sent to them from anyone in the city interested in finding out more about their soil for use in urban agriculture, resulting in a sample size of about 1700. From this sample, a comprehensive map of the city was produced, showing highest levels of gardening and of contamination in northern Brooklyn. Joshua also presented the fact that their study has shown that home garden contamination levels are much higher than those in community gardens. This study shows a mean background lead level of 600 ppm, and a median level of 355 ppm.

Q&A/Comments

No questions.

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4:20pm – 5:15pm Facilitated Discussion

- **David Williams (EPA Region 7):** We have been grappling with the background question on some dioxin stuff. If you show Joshua's last slide, it is a good illustration. You have a median and a mean. What are you going to do with this spread of background that ranges to 1200?

    - **Alicia Frame (U.S. EPA - OSWER):** For a Superfund site, you would use the local background. You would not use all of Brooklyn, you would use a local small-scale number.
    - **Mark Maddaloni (U.S. EPA - Region 2):** In the Port Richmond area of Staten Island there is an example of an impacted site surrounded by high background levels, making the determination of what Pb was site related as opposed to background difficult.
    - **Joseph Rotola (U.S. EPA - Region 2):** I will talk about this tomorrow.
    - **Mark Maddaloni (U.S. EPA - Region 2):** We cleaned up the site but we did not clean up all of Port Richmond. For background characterization, we chose another site that looked as much like that immediate area as possible and that I felt reasonably confident was not impacted by the site. That is what background should be, which is as much like the site as possible without being impacted by the site.
- **Mark Maddaloni (U.S. EPA - Region 2):** This last slide of Joshua's has a lot of data, but this is not a random sampling. This is people who sent their soil to Joshua because they thought they might have a problem.
    - **Joshua Cheng (Brooklyn CUNY):** Yes, we would be happy to receive funding to do a more organized survey.
- **Carol Ann Gross-Davis (U.S. EPA - Region 3):** Background for the Superfund or Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) is very specific terminology for Superfund, but we throw it around. From the public health perspective, it is a very different meaning (i.e., ambient exposure). EPA's mission is not to only work under policies that account for children's health. We do not have an acceptable level of lead. We need to be more specific about the terminology.
    - **Glenn Adams (U.S. EPA - Region 4):** Ours is not set up just for Superfund. We are trying to do the opposite of USGS, because ours is more anthropogenic background in urban settings. I have been at EPA for almost 29 years and everything you have heard is sky-high for New York and Philadelphia, but in the south we do not know. I am not familiar with very many studies in the south.
- **Nick Magriples (U.S. EPA - Region 2):** Joshua was showing the standard deviation of 767. Maybe it was a little biased, like you said, but it is quite common when sampling in Brooklyn to see large standard deviations. The key to that is to have a lot of samples.
    - **Alicia Frame (U.S. EPA - OSWER):** And you need to mix populations to get a random sample. Each urban entity has its own contribution, but when you control for sampling and sieve your soil, you can drive down through study design measures instead of getting thousands of data points, which is not practical.
    - **Mark Maddaloni (U.S. EPA - Region 2):** If you stratified your data between home and community gardens you could reduce the variability.
- **Howard Mielke (Tulane University):** After Katrina, they looked at my map and said that what was there after the storm was background/legacy lead and that they did not need to do anything. I was very disturbed by that.

- **Alicia Frame (U.S. EPA - OSWER):** That goes back to Superfund sites. You will not clean up below background levels.

- **Webinar:** The Geoplatform seems like a useful tool. Is there a plan to make it public?
  - **Alicia Frame (U.S. EPA - OSWER):** Not to the best of my knowledge. It is an internal tool.
- **Webinar:** How do you determine where to collect background data around a secondary smelter if the extent of lead contamination has not been established due to multiple sources?
  - **Glenn Adams (U.S. EPA - Region 4):** We are dealing with a site in Alabama and it is difficult to find the end of the contamination. We went to another community that had no industry with the same residential houses built in the 1940s, and we tried to mirror image that neighborhood as a similar neighborhood with no industry.
  - **Alicia Frame (U.S. EPA - OSWER):** that really highlights the importance of expert judgment.
  - **Mark Maddaloni (U.S. EPA - Region 2):** To select a background location, one should ask: What would this place have looked like but for this site?
- **Mark Johnson (ATSDR):** You are assuming that sample you are taking is representative of the exposure area you are assessing. If you are designing a sample for a cluster of residential properties, how many would you need?
  - **Karen Bradham (U.S. EPA - ORD):** There is some information in the soil guidance document about the number of samples you would need to take to override a default. You would have to use common sense and have a particular understanding of that site. It depends on the size of the site, exposure, etc. Lots of factors.
  - **Charles Partridge (U.S. EPA - Region 8):** To add on to that, when we are taking urban samples we want to make sure we cover all of the permutations represented in the neighborhood. You might have two different kinds of houses (e.g., stucco, bricks) and same age range and some close to and some far away from the smelter. And since the assay is so cheap now, you can start examining permutations of bioavailability. In Montana, there was a smelter next to a residence, and then a railroad that went into the smelter, and there were 2 distinct bioavailability measurements between the railroad bed and the residence yard. Sometimes geospeciation can help a lot too.
  - **Marc Stifelman (U.S. EPA - Region 10):** You could measure concentration first, archive your samples, and then take bioavailability measurements only in those samples above a certain concentration threshold.
- **Steve Rock (U.S. EPA - ORD):** I am really glad to see your data, Joshua. It fits with what we know about community versus home gardens. Community gardens tend to start with building boxes and not using ground soil, but both systems have highly manipulated soil (added phosphorous, raised pH, added organic matter, etc.) that makes lead less available.
  - **Joshua Cheng (Brooklyn CUNY):** I agree 100 percent.
  - **Karen Bradham (U.S. EPA - ORD):** Bioavailability becomes an important topic in urban gardens. As far as community versus home gardens, they are very different. Some community gardens are interested in knowing more about how much contamination

they have and some are not. At some Superfund sites people are digging or planting, which is something that community gardeners need to be very aware of. We need to get that information out and help people understand soil contamination in their area.

- **Joshua Barber (U.S. EPA - Region 3):** We got a small research grant from ORD tied to a Superfund site in Philadelphia looking at PAH levels. We also collected lead data. We sampled 35-40 parks in Philadelphia using incremental sampling hoping to inform the Superfund site, but also (and we need help processing this data) to see if there is a signature for Philadelphia PAHs. Can it be used to bolster public education? It was meant to provide a roadmap for looking at background levels in urban sites.
    - **Glenn Adams (U.S. EPA - Region 4):** We have looked at your work.
- **Rufus Chaney (USDA):** I wanted to address Mary Jean's question from earlier about whether a certain bioavailability would persist over time.
- We have decreased bioavailability (based on a human feeding test) after a phosphate amendment, but we do not have evidence of it going back up again post soil treatment.
    - **Mark Maddaloni (U.S. EPA - Region 2):** How many years of data are there?
    - **Rufus Chaney (USDA):** Several years. The claim that the Pb will become more available post phosphate treatment is based on fungi incubated in soil in the lab and fed sugar. Which is very different than soil environments in the real world.
    - **Mark Maddaloni (U.S. EPA - Region 2):** The studies on phosphate-amended soils look pretty good, but let us not take something that has been amended and go to a firing range. Overtime, there is going to be further degradation of those.
    - **Rufus Chaney (USDA):** A firing range is a special case. Paint dust in houses is almost all bioavailable while soils are variable in effect on Pb bioavailability.
    - **Mary Jean Brown (CDC):** My question is about when you make a decision based on bioavailability not to make any changes, and how permanent that is.
    - **Rufus Chaney (USDA):** Several very long term Pb sites with enough phosphate showed presence of pyromorphite formed in the field without deliberate intervention. Mining and smelter sites are other special cases of especially high soil Pb bioavailability.
- **Lynn Wilder (ATSDR):** I have a broader question. We see a U.S. view of lead sites. It worries us when we see the same kind of site being handled differently. Decisions about background are being made differently. It has more policy implications than anything else. Have you thought about facility or source-specific approaches?
    - **Mark Maddaloni (U.S. EPA - Region 2):** The Superfund program has presumptive remedies for certain types of sites.
    - **Lynn Wilder (ATSDR):** So you think background is different in one site versus another?
    - **Mark Maddaloni (U.S. EPA - Region 2):** Yes.
    - **Glenn Adams (U.S. EPA - Region 4):** I think the crux of your question is why it is ok to clean up to different background levels based on what is sampled at each site.
    - **Alicia Frame (U.S. EPA - OSWER):** Different regions handle things differently. Things are slow when you are trying to do regulatory work. It is something we are aware of. You

can make the case that backgrounds are different in Philadelphia versus Detroit, or that different remedies work better in different places.
    - **Charles Partridge (U.S. EPA - Region 8):** As risk assessors we have a lot of latitude and can make a best scientific judgment. It does not come down to bioavailability or soil matrix, but to risk assessors and their experience and what they are comfortable with. We have a lot of tools in our box, and everybody has their favorite tool and they tend to go to it again and again.
    - **Glenn Adams (U.S. EPA - Region 4):** In Florida, they have different regulations than the state of Alabama, even magnitudes different than the same contaminant. There are different regulations in different states.
- **Sheri Bianchin (U.S. EPA - Region 5):** We are responsible for a legacy site where we have done the 5-year review. After these discussions today, I am wondering if our messaging should be different in a 5-year review. That we should communicate that there are all these other factors and to be vigilant.
    - **Glenn Adams (U.S. EPA - Region 4):** From the Region 4 perspective with the reevaluations, we are dealing with this with dioxins. I definitely think you evaluate wholly but look at the values you have now and not before cleanup.
- **Jack Kelly (U.S. EPA - Region 3):** Did you bring up the federal disclosure rule? At the JT Lewis site, we could not get people to let us sample based on the federal disclosure rule and we could not promise to clean the soil up prior to adequate data collection.
    - **Glenn Adams (U.S. EPA - Region 4):** We had a similar issue in Athens. They wanted us to promise we would not do anything with data, and we could not do that.
    - **Warren Friedman (HUD):** If the seller or landlord has knowledge or records/reports about lead pertaining to house, including soil levels, that would require disclosure, and once it is disclosed it has to go forward. We have seen lots of situations like this where someone says “do not tell me, I do not want to know,” or “do not do x because then you will have to tell me.”
- **Glenn Adams (U.S. EPA - Region 4):** From the question earlier about the cost of sampling, when we looked at doing the study we started with 15 cities then backed off to 11 cities, which cost 125K including a report. All of our lab data is free to us. I started looking up the cost of lead and arsenic and it was 30-45 dollars per sample. Our metals data are done through our Athens laboratory. It is an expensive proposition to collect a significant amount of data.
- **Webinar:** We talked earlier about how critical sampling design was. What is the recommended sampling plan design rationale? Is there an EPA guide for sampling design?
    - **Glenn Adams (U.S. EPA - Region 4):** The short answer is yes. The long answer is that it is very complicated. There is definitely lots of guidance out there, but not one specific one.
    - **Alicia Frame (U.S. EPA - OSWER):** The Visual Sampling Plan (VSP) is a great tool that can be used for sample planning. You can manipulate it as a model. It is a great start for power calculations and where to take samples. This is just a personal suggestion.
    - **Charles Partridge (U.S. EPA - Region 8): Charles Partridge (U.S. EPA - Region 8):** The Interstate Technology & Regulatory Council (ITRC) website has some great documents

for incremental sampling. The TRW site has documents for lead and will be updated soon. It is not just sample design and where to take the sample, it is also sample processing. TRW has recommendations on sieving and making the sample as homogenous as possible.

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Day 2 – Wednesday September 16

8:30am – 9:15am Continue Discussions from Day 1

- **Mark Maddaloni (U.S. EPA - Region 2):** The issue of background is still huge. We know urban background is high due to many sources (e.g., lead-based paint, gasoline, smelting, secondary sources). We need to deal with it in some way. Yesterday we heard about regulatory background and also about how much of a public health threat background levels are. We see much higher levels than 400 in major cities. Even though Joshua's work was not a random sample, when you have a sample size of 1700, it starts to paint a picture. In New Orleans there was a herculean effort to address lead and it worked, but it took tons of topsoil. We also know that there is no blank check. We have to operate in an economically efficient way. We have high background. What can we do about it? What are our regulatory restraints? From the Superfund perspective, we are cleaning only to background because it cannot be attributed to a specific source, but this does not sit well with the general public, so how do we address that? No one agency can do it alone. We need to improve methods of collaboration and partnership from the community level to the federal level. In Staten Island, the New York City Health Department worked with EPA to address the elevated pediatric blood lead levels in the Port Richmond community. We can only do so much about legacy lead levels, but at least it is being addressed. We need to do more of that in urban areas where one agency cannot get the job done. I am a pragmatist. You cannot clean it all up, but where is the point of diminishing returns? That sweet spot is where you get the most bang for your buck.
- **Marc Stifelman (U.S. EPA - Region 10):** With regard to diminishing returns, we have to be careful. Obviously we cannot get it all, but we need to be cautious because biology shows that cognitive deficits are not proportional. They are actually worse between 1 and 5 than 5 and 10. The dose response is also not linear for health effects. This argues against diminishing returns
    - **Mark Maddaloni (U.S. EPA - Region 2):** I do not think it argues against it. Obviously you cannot go to zero, so where is the line?
- **Rufus Chaney (USDA):** When you look at datasets used to arrive at the conclusion that lead levels below 5 ug/dL are still dangerous, they are looking at exposure effects on IQ, HOME score, mother's education, father's IQ, etc.). With the large variance in these covariance corrections, is it legitimate to say that there is an effect there at all?
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    - **Mark Maddaloni (U.S. EPA - Region 2):** When CDC gave those recommendations in 2012, it was after a huge amount of review of the data.

- **Rufus Chaney (USDA):** We can all agree that primary prevention, rather than secondary, is a goal. But to overuse this IQ argument when you understand the variation in mother's IQ is suspicious.
- **Mark Maddaloni (U.S. EPA - Region 2):** Your suspicion is noted, but this data was well reviewed.
- **Marc Stifelman (U.S. EPA - Region 10):** What would compel EPA to react accordingly?
- **Mark Maddaloni (U.S. EPA - Region 2):** We do have a history of following CDC recommendations. I do not want to get bogged down in whether CDC or EPA followed the other. CDC has made recommendations and EPA is deliberating on that.

- **Sally Brown (University of Washington):** It seems like this is an issue people are very passionate about. There is no disagreement that in a perfect world urban soils would have 5 ppm lead, but how do we get there? People are recommending replacing soil in Brooklyn, others say that is not practical. It is complicated by our lack of understanding of sources and effects. We are heavily weighted on bioavailability as a path forward. There are very different viewpoints on how to go about making it better. The most productive use of time would be to get agreement and consensus that this is something we would all like to make better, and not get caught up on 5.
  - **Mark Maddaloni (U.S. EPA - Region 2):** That is a good point. We need to start looking at innovative remedial strategies and how to measure their effectiveness.
- **David Williams (U.S. EPA - Region 7):** Yesterday there were some really great pieces to the puzzle of how to proceed on urban lead, but I have more questions than answers now on how to proceed. What are our tools to deal with things when we do not have regulatory authority? I have heard that some education is not effective. I am hoping today we can wrap some of these ideas into paths forward. A big thing managers are dealing with is consistency amongst regions on addressing these things.
  - **Charles Partridge (U.S. EPA - Region 8):** I would like to follow up on the point that education is not effective. It is a yes and no. We can see that the model assumes a naïve population, but when you start talking about the site and gets out in press, behaviors immediately change.
  - **Mark Maddaloni (U.S. EPA - Region 2):** Like people cleaning up dust in houses before you get there to sample.
  - **Charles Partridge (U.S. EPA - Region 8):** Yes. We stress education and working with ATSDR and local health departments. We have a very good public education component and we have seen it is very effective at first. The first 5 years have an 80-90 percent participation rate. Fifteen years down the road the same handouts get less participation. People get complacent, which is human nature. For education to be effective, it needs O and M. It all comes down to money. Superfund likes to dig and then leave and come back in 5 years, but that is no longer our world. No matter what, we will be leaving something in place. Whatever level we leave in place, it needs continuing education. ATSDR and local health are going to have to be involved continually. In the sites where we have that, and have blood lead monitoring programs, we get lots of participation in

the first few years, but 10 years later when we only get 3-5 percent participation, is that data even really representative of the population of children?

- **Jack Kelly (U.S. EPA - Region 3):** At the JT Lewis site, we could not get folks to allow us to take samples, because people did not want to know. The few samples we were getting were high. I proposed stockpiling various materials (e.g., stone, mulch) for folks to use. I could not attribute it to the site without enough data, so we could not get approval. The facility was long gone and asphalted over. But Superfund removal authority always tries to attribute contamination to a site. Generally, we cannot take action on lead in petroleum as part of blending process, in the structure of a house (lead paint), or if it is naturally occurring. But if you can declare it a public health/environmental emergency, you can. No one has defined that (save the actions at the Libby Asbestos Site). No one wants to say x value in a yard is an emergency, but you could probably do that if a value warrants an action.
    - **Janine Dinan (U.S. EPA - OSWER):** With regard to defining action levels, I think our only option at this point would be the IEUBK model. If we use the least conservative inputs, we may be able to get what would be considered action level. Because no matter what site-specific data you get, it is not going to give you a less conservative cleanup or action level. I would like to hear more about some of the inputs that are still being debated like soil ingestion, the soil-to-indoor-dust mass transfer factor, etc. The least conservative inputs could yield numbers like 1100 ppm. That is what I propose.
    - **Mark Maddaloni (U.S. EPA - Region 2):** Perhaps using the least conservative input parameters in the IEUBK model as a screening guideline for removal might be up in the 1100 range. In the past they have used 1200, have they not?
    - **Janine Dinan (U.S. EPA - OSWER):** Yes, but we would like to peg that to something.
    - **Mark Durno (U.S. EPA - Region 5):** We would be interested in whether or not we can use our authority to pluck low hanging fruit and clean up the worst of the worst sites.
    - **Lynn Wilder (ATSDR):** You can give us the data and let us look at it. If we say it is urgent or imminent, then you can take action. But we look at bioavailability, blood lead, the site-specific situation, etc., so we cannot give you a soil value cutoff.
    - **Jack Kelly (U.S. EPA - Region 3):** I concur.
- **Alizabeth Olhasso (U.S. EPA - Region 3):** One thing I do not hear that I would like to is more coordination and participation from the Toxic Substances Control Act (TSCA) program. Their primary goal is education and prevention, and as time goes on and Superfund cannot be involved for 20-30 years, TSCA could target these areas.
    - **Mark Maddaloni (U.S. EPA - Region 2):** That is a good point. TSCA and HUD have been in coordination with the definition of the level of lead of concern in interior dust (40 $\mu g/ft^2$). They need to revisit that value because every analysis I have seen says that is not consistent with CDC goals. But if TSCA took a lead role, it could give EPA more tools. But how do you get them moving? Rulemaking is not done overnight.
- **Steve Rock (U.S. EPA - ORD):** We have not talked about what to do about trigger levels. We talked about a 2-inch cap and went on to talk about atmospheric redeposition. I thought that atmospheric deposition was over since we took lead out of gasoline but apparently not. If you

take up a foot of soil and replace it with clean soil, and then you have to do it again in 5-10 years, why not add 2 inches of mulch and then remove that surface? You could do that without excavation, and it would be cheaper.

  - **Glenn Adams (U.S. EPA - Region 4):** We just did that on a site in Florida. It was a remedial site, so it was going to take many years. Anytime they found lead over 400, they brought in inches of mulch to alleviate exposure. It could be done within and without Superfund as an inexpensive way to deal with exposure. At that site it ended up being lead paint that was driving the blood lead levels.

- **Mark Maddaloni (U.S. EPA - Region 2):** Typically, from an exposure point of view, airborne lead is not a big driver compared to soil dust, water, diet, etc. I have not seen many sites where it has contributed significantly. So how big of an issue is this in the urban environment? Do we need to pay more attention to airborne lead, resuspension, and deposition?
  - **Rufus Chaney (USDA):** With regard to the issue of recontamination, a site in Boston was neighboring a lead painted exterior wall. If there is a lead painted wall it is a very short remediation. One interesting site in Baltimore is a brick structure with a lead painted stoop on the back, which is garden adjacent. When we look at non-Superfund lead urban soil issues, we need to look at recontamination from walls adjacent to the property.
  - **Mark Maddaloni (U.S. EPA - Region 2):** I agree. We have to deal with recontamination, and, on the flipside, ways to protect the remediation. In Region 2, we were doing soil removals, and the lead paint was flaking off of a church nearby.
  - **Joseph Rotola (U.S. EPA - Region 2):** It was a condominium complex with levels of 2000-3000 ppm, but next door was a church. The attribution can help you or hurt you. Speciation of the lead on the paint from the church and the soil showed that the lead was not from the smelter. It was an area that kids used a lot, but we could not do anything about it. The state can protect the remedy.
- **Joseph Rotola (U.S. EPA - Region 2):** I have two questions, what is the recommendation, and what is the number? Yesterday's discussion sheds doubt on the process we are using now. If the number is going down (and it is) there is doubt about using the IEUBK model for low values. We are out there now, digging yards, and this stuff takes years to develop. We talk about consistency, but we are not getting anywhere with removal managers. There are lot of factors going into it. We do not do bioavailability. My recommendation is if it is over 400, we clean up to 400, and if it is lower, we clean up to lower.
- **Lynn Wilder (ATSDR):** I think the air pathway is important, especially with an active source. But how many smelters are active in the country now? The way that people clean indoors is another potential pathway, if you do not use a high-efficiency particulate air filter then you are creating a pathway inside. Do we have site-related air data or do we use the defaults?
  - **Sally Brown (University of Washington):** My talk will answer these questions. The whole excavation has shown limited success in the literature, because unless you excavate the entire town (like in Smelterville). You cannot do that in Philadelphia. Where you see legacy contamination there is conflicting guidance which confuses

internet-savvy homeowners and makes them unwilling to allow Jack Kelly to sample. Maybe the approach of excavation is flawed. We could reimagine based on what is feasible and can be done on a large scale. Point sources or air sources in urban areas are now vacant lots with dust, rather than factories. We need an approach that envisions how we address cities and urban soils.

    - **James Brown (U.S. EPA - ORD):** I pulled up computations for the last National Ambient Air Quality Standards in 2008. If you look at 0.15 µg/m^3, it was less than 0.05 percent. That does not mean resuspension is not important, but it might not be an inhalation route of exposure to lead.
    - **Mark Maddaloni (U.S. EPA - Region 2):** It might not be that much through inhalation, but it does mean relentless deposition. What do you do if you wipe it away and it is re-deposited a week later?
- **Richard Rupert (U.S. EPA):** All the stuff that we have done in urban/suburban areas, which is different than out west, does not work. It sounds like what you have to do is remove everything, which is impossible. Mississippi is sinking all the time and has lots of dredge material, which is ideal. We also need to try to find a remedy that does not impact arsenic levels.

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9:15am – 11:30am Cost Effective, Simple Approaches to Soil Remediation; Urban Gardening Soil Pb Exposure Issues

Michele Mahoney, EPA OSWER/OSRTI & Ann Carroll, EPA Brownfields

Michele Mahoney provided an introduction to the researchers investigating soil amendments. Her goal is to work with site practitioners and others with experience working with soil amendments to document case studies so other managers can learn from what is being done around the country. She stated that the Clu-In.org website contains helpful information and findings, including some management practices for urban gardening (e.g., locating gardens, building raised beds, and reducing exposure to contaminated soil).

Ann Carroll reviewed Brownfields program efforts to help communities clean up urban areas. Brownfields, began as a Superfund pilot program in the mid-1990s to help revitalize abandoned property affected by contamination and fear or stigma associated with potential contamination. Ann made a point to emphasize that Brownfields is not Superfund, and is not a federal enforcement program. She also stressed that Brownfields should be considered as a potential solution to some of the problems discovered in urban areas that Superfund is unable to address.

Ann explained that Brownfields operates on a continuum of contamination and addresses unoccupied areas like closed gas stations, old scrapyards, and vacant lots that present continuing potential lead

exposure risks. She stressed the difficulty involved with partnering with local health departments, because of their limited resources and capacity.

We award grants to communities to assess areas or site specific properties and clean specific properties for reuse. In addition, brownfields awards grants for area-wide planning for multiple site remediation that will catalyze larger scale redevelopment of abandoned areas. Ann provided the example of regional and state plans to reimagine Cleveland for urban agriculture, where sampling revealed contamination with lead and arsenic at such high levels that 100 percent of sites exceeded residential use standards. Another example of a community garden used in Sacramento, California for 30+ years that was only recently tested showed high levels of lead, PAHs, and pesticides. Ann closed by stating the importance of urban agriculture as a way to revitalize urban cores and potentially solve other problems like poverty and food deserts at the same time.

Q&A/Comments

No questions.

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Joshua Cheng, Brooklyn CUNY - Phosphate Amendments in Soil

Joshua Cheng opened by acknowledging the importance of land-use in deciding remediation and action levels. He stated that it is important to keep in mind that contaminated soil used in urban agriculture has a two-fold exposure: potentially contaminated food grown in the soil that is then eaten, and direct exposure to gardeners working in the soil. He then went on to present his research funded by a RARE grant to experimentally examine phosphate amendment effects on arsenic mobilization and lead stabilization in soil.

Two sites were studied. In the first various vegetables were planted, and various types of phosphate were added to the soil in 25 plots. Results showed that addition of phosphates or compost did not consistently reduce lead concentrations in the produced vegetables. Measuring aluminum also revealed that particulates could be a larger contributor to lead and arsenic in vegetables than uptake. Ongoing research is being conducted into bioaccessibility and phytoavailability of lead.

Tatiana Morin, NYC Urban Soils Institute

Tatiana Morin began by explaining that urban soils are at the heart of the entire green movement in New York City. It is important to dispel the misconception that there are not soils in cities, and to start a conversation about “urban soils” specific to cities. Tatiana expressed the need for increased communication and dissemination of information pertaining to soils and urban gardens among the interested stakeholders. From that need, the Urban Soils Institute (USI) developed their mission to “advance the scientific understanding and promote sustainable use of urban soils through research, education, conservation, and restoration.” In April 2015, The USI started an education and outreach program, and they hope to also implement hands-on training for professionals and eventually, an urban soils minor degree program and/or certificate program at Brooklyn College. Tatiana expressed their ultimate desire to have a data depository that would function as a spatial map that would provide

information about soil sampling, remediation strategies, names of green practitioners, etc. to those interested.

Q&A/Comments

No questions.

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Rufus Chaney, U.S. Department of Agriculture – USDA Perspective

Rufus Chaney laid out the discussion of the agricultural view of urban soils, discussing the remediation of bioavailability and phytoavailability of lead in soils. Rufus cited US national surveys that show that geologic background of lead in soils is 10-20 ppm, and that even after phasing lead out of gasoline, blood lead levels were still at an average of 10 µg/dL. Removal of Pb from food cans gave the further reduction so that today, the geometric mean for blood lead in children is 1.5.0 µg/dL. He suggested considering research in aboriginal populations to determine what blood lead levels are in a population totally unexposed to anthropogenic lead sources. Rufus then affirmed that interior paint lead sources have been a much better explanatory source of lead in children's' blood than lead in soil, and that the predominant soil exposure pathway is from inadvertent house dust and soil ingestion by children. He suggested that the lead particles on the food, rather than lead uptake within the vegetables, are mainly responsible for ingested lead in garden foods. Rufus asserted that the key to understanding soil exposures is understanding the wide variation of bioavailability of lead in soils. Bioavailability when lead is ingested with food is much lower than when lead is in water, and even lower if ingested with a calcium-rich meal.

This variability of bioavailability of lead in soils was examined in various studies examining effects of soil amendments on bioavailability. Phosphate rich biosolids compost added to Joplin soil with 3000 ppm Pb markedly reduced lead bioavailability to rats, pigs and humans! Rufus then reviewed a study of the in situ remediation of Joplin soils, a field test showing continued low bioavailability years after phosphate amendment. He emphasized using the 2.5 pH bioaccessibility method, because it showed better much better relationship to reduction in blood Pb in humans than the extraction at pH 1.5. Rufus also showed that even placing phosphate-rich compost on the soil surface decreased bioavailability and increased vegetative cover, which is also important to reduce exposure.

Rufus went on to examine the differences in uptake between various vegetables grown in lead contaminated soils. He explained that the biology of the vegetables themselves was important to understand. Carrots and other root (not tuber) vegetables store lead uptake in the interior of the root instead of the peel because the xylem grows through the center. The lesson here is that lead in vegetables is more related to the type of crop than to the level of lead in the soil, and to the crop capacity for uptake of lead from the soil versus adherence of lead particles to its surface. When soils are high in Pb, raised beds with clean soil can be installed for the crops which attain high Pb from uptake or spash (low growing leafy crops and root vegetables). Rufus closed by affirming that, by and large, urban soils are highly contaminated, but with appropriate soil amendment and attention to limiting soil splash,

urban soils can have low risk for use in gardening. The main source of lead risk with regard to soil is ingestion, not garden fruits and vegetables.

He also reviewed the evidence of phytoextraction of soil Pb which has often been lauded in the general press. But because of the solubility of soil Pb and phosphate added to support plant growth, Pb uptake is quite limited. Effective phytoextraction requires 10,000 ppm Pb in the dry shoots of a crop, but no plant species achieves even 100 ppm other than by soil contamination. Phytostabilization of soil Pb using composts and phosphate achieve the desired reduction in Pb bioavailability (risk) and should be stressed.

Q&A/Comments

No questions.

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10:30am – 11:30am Cost Effective, Simple Approaches to Soil Remediation; Urban Gardening Soil Pb Exposure Issues (Continued)

Sally Brown, Research Associate Professor, University of Washington

Sally Brown explained that urban soils have been contaminated for a very long time and are now of interest due to urban agriculture. Urban agriculture can mitigate climate change, in addition to benefiting habitat and primary productivity. Many urban gardeners make their own compost and peer-reviewed literature cite increased food security, diets, physical activity, and community strength as a result of urban agriculture.

She emphasized that "lead is bad" and has been around for a very long time. She highlighted the intersection of urban agriculture and soil lead and how using residual materials (e.g., biosolids or composts from food and yard wastes) offers protection from soil contaminants and easy success for an urban grower. She argued that the relationship between soil lead and blood lead in urban areas is not clear, and that you would not see a significant decrease in blood lead levels in children even if you replaced all of the urban soils. She suggested residuals-based soil amendments as an effective source of clean soil for urban gardening, as compost can dilute soil lead concentrations and reduce absolute availability of lead. Changes in lead speciation were also seen with compost, suggesting that the benefits of urban agriculture might outweigh the risk posed by lead in the soil.

Q&A/Comments

- **Mark Maddaloni (U.S. EPA - Region 2):** I could not agree with you more on the many benefits of urban gardening.
    - **Anna Herman (Pennsylvania State University Extension):** I am an urban garden educator. We do a lot of soil health work. People do want a number. We tell them not to be afraid and we give them tools, but they do what some sense of a number that is too high. That is where we get stuck.
    - **Mark Maddaloni (U.S. EPA - Region 2):** We have urban lead guidance that speaks directly to it.

- **Anna Herman (Pennsylvania State University Extension):** We use 600 as our number.
- **Sally Brown (University of Washington):** What is really good to do if they want a number is using a fertility test for soil. That gives you a low, medium, or high reading. Rick is going to talk about that later. Even if you have super high, there are tools (e.g., raised beds, mulched pathways).

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Ganga Hettiarachichi, Kansas State University

Ganga Hettiarachichi discussed a project funded by EPA Brownfields investigating approaches to minimizing human exposure to contaminants in urban soils. The study looked at the efficacy of soil amendments in reducing food-chain transfer using leafy, root, and fruiting vegetables. The study also looked at the efficacy of soil amendments in reduction direct exposure risk. The first example site was located in Kansas City, Missouri and consisted of a heavy texture soil. The distribution of soil total lead concentrations was determined using the EPA 3051 method. She explained that a neutral pH is preferable as acidity enhances lead bioavailability. She went on to say that nitrogen levels are important to monitor, as phosphate levels are generally sufficient to transform lead into a less bioavailable form. She found that contamination was diluted through the addition of compost. She also found that Swiss chard and tomatoes had surface contamination that was largely reduced after cleaning, but the lead concentrations found in carrots were higher.

Ganga made bioaccessibility measurements according to Mike Ruby's Physiologically Based Extraction Test (PBET) method (i.e., pH 2.5 and pH 1.5), which yielded bioavailability measurements below 6 percent at pH 2.5. She also stated that phytobioavailability of metals is low relative to the potential for exposure to metal contaminants in soil that adhere to the exterior of the produce and that lead was largely bound to iron and organics. Two other example sites for the study were located in Philadelphia, Pennsylvania and Tacoma, Washington.

Q&A/Comments

No questions.

Rick Stehouwer, Pennsylvania State University A lower cost alternative for soil lead screening
Rick Stehouwer discussed the possibility of lower-cost soil testing for soil lead screening using the Mehlich-3 assay in a commercial soil testing laboratory using data from Penn State University's Agricultural Analytical Services Laboratory. The laboratory runs approximately 45,000 soil samples annually and has a data set of 1,952 soil samples analyzed for both M3 and total Pb with total Pb ranging from 0 - 4,000 mg/kg. He explained that the M3 Pb to total Pb correlation is good for the entire data set (r^2=0.86) and very strong for samples with total Pb in the range 0 - 400 mg/kg (r^2=.089). However, correlations are poorer for samples with higher Pb contents. In the critical mid-range of 300 to 1,000 mg/kg total Pb the correlation is very weak (r^2=0.53). He found no evidence that soil pH or cation exchange capacity correlated with lead extraction. He suggested that the Mehlich-3 assay could be used as a screening tool for levels below 400 mg/kg, but could not reliably predict total Pb in the higher ranges. The laboratory now has an expanded dataset with more than 5,000 samples which he will use to

further investigate the M3 - total Pb relationship as well as the possibility of using other soil fertility variables to improve total Pb prediction.

Q&A/Comments

No questions.

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11:30am – 12:00pm Facilitated Discussion

- **Charles Partridge (U.S. EPA - Region 8):** I am a pessimist and working for the government has not helped that. If by some miracle, the decision was made to lower the blood lead level to 5.0 µg/dL for EPA, the IEUBK model will work. We spent the last few years analyzing this. We are confident the model will be accurate and predictive at 5.0 µg/dL.
- **Mark Maddaloni (U.S. EPA - Region 2):** Joshua, your data between the two gardens showed one had a lot of phosphate, yet bioaccessibility of lead was indistinguishable. There is a wealth of data indicating otherwise.
    - **Joshua Cheng (Brooklyn CUNY):** Some of these might be organic phosphate and might not be as effective. There is a difference between total phosphate and available phosphate.
    - **Ganga Hettiarachichi (Kansas State University):** There are new research data from Ohio State University looking at pH 2.5 versus pH 1.5.
    - **Mark Maddaloni (U.S. EPA - Region 2):** Extraction tested at 1.5 is not very predictive, but 2.5 is not either, so maybe we need to do even better?
    - **Ganga Hettiarachichi (Kansas State University):** Chemistry that might be going on in the extracting vessel might be positive or negative on lead bioaccessibility, which complicates things in urban soils treated with compost. With phosphate, it might be easy and be a different type of extraction. Nick Basta dropped glycine and they are seeing better differences.
    - **Mark Maddaloni (U.S. EPA - Region 2):** You are looking at the issue of yard samples from a non-garden and one from a garden area, and you had some results on bioaccessibility. What have you found?
    - **Joshua Cheng (Brooklyn CUNY):** There is not really a difference. We found that the total phosphate correlates with the bioaccessibility well and is an inverse relationship. Rick, how much does the test cost? You could probably look at the phosphate versus the ratio to see if it would correlate.
    - **Rick Stehouwer (Pennsylvania State University):** The cost of the test of running and adding lead as an analyte is essentially zero. In our lab, the standard fertility soil test is about $10. Our lab is a bit of an exception. Because we are connected to a land grant university (Pennsylvania State), about 80 percent is agriculture and 80-90 percent of calls are from gardeners. The lab has to support the staff time to answer the calls. Our lab faces that unique challenge that other commercial labs would not. Probably in the

range of $10-$15. Looking at phosphate is a good suggestion. We have phosphate, calcium, and magnesium that we are looking at.

- **Ann Carroll (U.S. EPA - OBCR):** When we are working with communities, we are talking about testing, but communities are not talking about testing and rather forging ahead and gardening. Some communities are even preventing tests. For community organizations and enthusiastic gardeners, they might not have even thought to test their soil yet. They might not have heard of a metal panel.
- **Mark Maddaloni (U.S. EPA - Region 2):** Warren Friedman pointed out that if you get a lead test, you are obliged to disclose this in a land transfer.
- **Ann Carroll (U.S. EPA - OBCR):** When Title X was passed, we solved one problem and it created other downstream effects.
- **Mary Jean Brown (CDC):** CDC and HUD never signed on to having soil as part of disclosure. The general counsel at EPA decided to have it as part of the disclosure.
- **Rufus Chaney (USDA):** The first thing they need to do is something like the MALIC3, which is inexpensive. If it is above a certain level, they can use X-ray fluorescence (XRF) to look at variability. Different areas can have very different concentrations near old, painted buildings. We need a first-level test of a composite of the garden. Then, the issues of what to plant can be decided. Some of our urban soil worries are fairy tales if we can use raised beds
- for the crops which accumulate Pb or have high soil splash contamination in areas that that have high levels of bioavailable soil Pb.
- **Sally Brown (University of Washington):** If you look at the plant uptake data, the site soil lead can be an order of magnitude difference, but you see very low differences in soil crops. The big issue is carrots and similar vegetables. Washing your vegetables and reducing soil splash is important. Even with carrots, how much is absorbed and how much you will eat a year makes it a small risk most likely. Are you tracking dirt back? Are you bringing your kid with you? It is not what you grow, but rather what you are tracking back and stirring up into dust.
- **Rufus Chaney (USDA):** The matrix of the crop reduces bioavailability. The risk from Pb in carrots was never a real risk because the matrix of carrot reduces bioavailability. We need more tests of crop Pb bioavailability to improve gardening advice.
- **Mark Maddaloni (U.S. EPA - Region 2):** Soil ingestion during urban gardening was identified as a major pathway. The last part was the track in, which we lack data on, but you will have more dirt in the home if you do not take your shoes off.

- **Hannah Chattergee (Mayor's Office of Sustainability):** The food policy advisory council is trying to develop guidance to the city about how gardeners can grow safely here. We sent around a draft report. On a basic level, do you think it is worth it to set a policy number for above a certain level to do this, this, and this? Is that a practical decision or something we should not be pursuing?
    - **Mark Maddaloni (U.S. EPA - Region 2):** EPA has developed guidance. It is not a bright line, but we set it at 1,000. At a level above that, you are better off with a raised bed and clean soil. Otherwise, you will have to be very careful and do it at your own peril.

- **Jack Kelly (U.S. EPA - Region 3):** If you look at the back of that guidance, there was an attachment. There must be 30-40 individual lead values from different organizations, anywhere from 60 ppm and up.
- **Mark Maddaloni (U.S. EPA - Region 2):** We felt compelled to add a value.
- **Sally Brown (University of Washington):** Two things that were critically missing. Lead is your big contaminant. A lot of your other elements in terms of urban agriculture will just scare people (e.g., not commonly found, less uptake, no pathway). Rick has great, affordable testing. Include that tool. The other part is you say to get clean soil, but make it known where and what partnerships exist, so you have cost-effective tools so you do not deter or frighten people.
- **Ann Carroll (U.S. EPA - OBCR):** There are some FAQs on the Brownfields website. In the general community, people do not realize that clean fill is not necessarily clean. You need to decide how you want to define it for growers. You need to define what these things mean in specific context.
- **Glenn Adams (U.S. EPA - Region 4):** In the South, when you see clean fill, it means it does not have debris in it. Period. Were the leafy vegetables washed? We did studies on washed versus unwashed and pretty much all of the lead was in the unwashed vegetables.
- **Rufus Chaney (USDA):** About 70 percent of iron in washed commercial spinach is in fine soil particles imbedded in the cuticle of leaves.. You can only wash part of the adhering soil off. Most of the important soil lead can be washed off in the kitchen sink; home food preparation is good enough for most garden crops, but when soil Pb is higher than 400, it is better to grow the plant species which bear soil splash Pb in raised beds with clean soil .
- **Steve Rock (U.S. EPA - ORD):** As much as I love urban gardening, we can build a clean garden in about 6 minutes. It is fun and easy. One of the things we have to realize is that we are making people healthier by the exercise and eating healthier food. We need to look at the entire lifecycle. Given the attention we are giving this, it is 0.01 percent of the unpaved space that is urban gardens. It is a tiny fraction of the soil. I would like to get confirmation from others. If you add up hundreds and hundreds of gardens, it makes a smallish city park.
- **Sally Brown (University of Washington):** A student did a survey in Seattle and it came out to 4 acres were community gardens and parking strips were 144 acres.

- **Justin (Region 3):** Could you comment on ways to landscape community gardens?
  - **Ann Carroll (U.S. EPA - OBCR):** Maybe it is not going to be a garden. Maybe it is a flower garden or just green space. I would like us to think of the risk analysis.
  - **Rufus Chaney (USDA):** Lead uptake is stopped by soil. I had noted earlier that phytoextraction of soil Pb is not a valid option because there is no crop in the world that takes up lead without added EDTA at very high cost and environmental contamination/dispersion of the PB.
  - **Tatiana Morin (Brooklyn College/NYC Urban Soils Institute):** We have a lot of work being done here scientifically and policy wise. Part of the whole lead uptake reduction

starts with proper education. It is easier said than done. A lot of the people we serve with soil shops. It becomes an education gap. Let us take contamination out of the urban equation, so we do not freak people out.
    - **Ann Carroll (U.S. EPA - OBCR):** HHS and agriculture have a refugee resettlement program in the country. They want to grow food and come from food-growing areas.
- **Anne Preston (Philadelphia Parks & Recreation):** There are many refugee gardens. Our soil safety report is a draft report, and it is not the final recommendations. We are working to build partnerships to access clean soil and other resources to implement clean gardening practices. Ganga, it seemed like the lab cleaning made a bigger difference from the kitchen cleaning.
    - **Ganga Hettiarachichi (Kansas State University):** A lot of people ask if we recommend using something similar to detergent (e.g., soapy water). I do not recommend it. My take on it is to soak it before you wash it to reduce dust. The lab cleaning dissolves some of the cuticle, which explains the large reduction.
- **Ramon Mendoza (U.S. EPA - Region 5):** This question is more for the TRW. What is your position as far as soil amendments using phosphate as a viable, long-term alternative? That EPA playbook is from 2003 and we are in 2015 now.
    - **Mark Maddaloni (U.S. EPA - Region 2):** We just published a paper (EPA-ORD's Kirk Scheckel is the primary author) on the state of the science on phosphate amendments. I would suggest you read that paper for a lay of the land. We believe it works. There is no magic bullet, but it is one more tool in the box. You need to be cognizant of some of the concerns. It could potentially mobilize arsenic. If you have an apple orchard, I would not recommend it, or if you are near a water body where eutrophication is a concern. Or if you want a large reduction, I would not use it.

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1:00pm – 2:00pm Facilitated Discussion (Continued)

- **Mark Maddaloni (U.S. EPA - Region 2):** Mary Jean Brown want to say something about this morning's presentations.
    - **Mary Jean Brown (CDC):** Thank you for giving me the time and giving me your attention. The CDC is to adopt a reference value for a childhood blood lead level in the United States. In terms of neurological effects of lead, it is true that blood lead is only one of many factors that predict intelligence or IQ and life success. Parents are the best indicator of life success and IQ. The idea of why are you cleaning up lead when we are worried about food deserts, I do not see why there has to be competition there. I want both. Fixing lead is simple compared to fixing the other things. The National Toxicology Program has reviewed literature and looked at academic performances and has found a causal relationship. My own opinion is that a blood lead level of 5.0 µg/dL is a risk factor, not a diagnosis. We have to be very careful when dealing with individuals. If you compare an entire class of kids exposed to kids not exposed, the class as a whole will do less well, but you cannot use it to determine individual intelligence. CDC came out with a document saying that we need to figure out how to address the kids left behind.

- **Mark Maddaloni (U.S. EPA - Region 2):** Rufus mentioned the three cities lead study. It showed a modest reduction in children's lead levels after interventions. When I looked at that, I had a couple of critiques on the way they measured the effectiveness of the cleaning. Essentially what they did was follow the children for not that long (i.e., 15 months). If you already have a load, their levels will not come down according to first-level kinetics of 30 days. They probably were not followed out long enough to get the full determination. It would have been better if they had taken a snapshot before intervention and theoretically replaced that with a naïve population and seen what their blood lead would have stabilized at. That would have determined what the impact of intervention would have had. I think it was biased against showing a reduction.
    - **Rufus Chaney (USDA):**
    - It is unfortunate that we cannot move suburban children into urban Pb-free housing in high soil lead environments to achieve the most valid test of soil Pb risk, but we can't do that test. Somebody calculated the kinetic model for what happened in the Boston study. They believed the limited 1 year follow-up blood Pb data would have underestimated the potential effect of soil replacement.. It was still strong evidence for some conclusions about the utility of soil removal and replacement.
    - **Sally Brown (University of Washington):** That is one study, but there have been other studies that have had trouble establishing causality. We heard a lot of talk within EPA about excavation and what number to excavate at. The difficulty in distinguishing from the point source and what is background, the relative uncertainty about the efficacy of excavation might be justification for alternative approaches.
- **Mary Tierney (U.S. EPA - Region 5):** I appreciate the work you are doing. I am a big supporter of urban agriculture. Right now it feels like I can leave the room and know what to do about the urban gardens. I am not quite sure what to do about other yards, lead outside the house, lead inside the house, and so on. We agree urban lead is bad. That is the starting point. We cannot come up with answers today. I would be interested in preliminary ideas (e.g., school lunches). We need to start thinking about how we can do this.
    - **Mary Jean Brown (CDC):** I want to get back to Mark's comments. There have been studies with a small sample size that suggest once you remove source, it takes months to years for blood lead levels to go down in children. The surest bet is a house that had blood lead poisoning to a child in the past and nothing had been done. We looked at houses where lead paint hazards have been controlled or eliminated and children who moved in there were 4 times less likely to have lead poisoning.
    - **Sally Brown (University of Washington):** It sounds like dealing with the house is one thing in the toolbox.
    - **Charles Partridge (U.S. EPA - Region 8):** Michelle Burgess (HQ OSRTI) has been briefing upper management for years. She carries forward TRW's concerns to management. She could not be here today. We acknowledge the number will go down.
    - **Mary Jean Brown (CDC):** Unfortunately, CDC is on the hook for that. Yes, in NHANES, the 97.5 percentile is lower than 5.0 µg/dL, and we will propose that the standard be lowered. It may be because we no longer have a Federal Advisory Committee, maybe

we need to go make that proposal in a Federal Register notice. I understand that having a regulatory approach to changing thresholds puts you in an impossible place.

- **Charles Partridge (U.S. EPA - Region 8):** Risk assessment and how we are handling lead is changing. If the number is lower, that will increase the number of sites we have and the number of yards we are dealing with. Money comes into that equation. Phosphate amendments are one way and another way is the idea of mixing. But states are weary about this. It is cheap and effective. If we do lower the value and we have this influx of sites and increase in yards, mixing with amendments can knock soil Pb exposure and bioavailability down. We are going to have to come up with creative solutions.
- **Howard Mielke (Tulane University):** There is a natural experiment that has taken place in New Orleans. We might be able to squeeze out some new understanding. I have been interested in bone lead. It is an intergenerational problem. Mothers are passing that lead almost preferentially from the bone to the fetus. The woman's blood lead levels do come down. The second child gets benefit of the first child's exposure to lead. There is a possibility of getting gardeners together from three different parts of the country out of this meeting (Seattle, New Orleans, and New York City on the East coast).
- **Ann Carroll (U.S. EPA - OBCR):** I was going back to the lead paint on the house and the soil around. In Brownfields, we have cleaned up lead paint and asbestos. We do not do it as a rule. How do we better align the Superfund response, Brownfields assessment and cleanup, and other money? Is there a way we can better deploy our resources to create safer lead levels and create places to move people at high risk?

- **Comment from Webinar (Charlie Armstead - WVDEP):** Is anyone doing work on the effects of Christmas tree farming?
  - **Ann Carroll (U.S. EPA - OBCR):** They have looked at fast-growing lumber for the wood industry. There is a whole urban forestry program. Send me an email offline and I will connect you, but check out Delta Institute.
  - **Sally Brown (University of Washington):** It goes into the same boat as sunflower. It will not lower totals.
  - **Rufus Chaney (USDA):** There is the surface inch contamination issue. The soil next to an old structure is over 14,000 ppm. Two inches lower, it is much lower. When we analyze soils, we need to know if it is virgin or tilled, which reduces risk.
- **Lora Werner (ATSDR):** There have been so many journal articles that you have referenced. Would EPA consider making a library list of all of the journal articles referenced?
  - **William Hagel (U.S. EPA - Region 3):** We will come out with proceedings from this workshop. Didn't answer Lora's question….
- **Mary Jean Brown (CDC):** This has been one of the best conferences I have been to in a long time. How do I get this information to these programs? Most of our programs are based on maternal health. The stretches are long ones. I know Ann Carroll and I have had some conservations about overlap. It is something that is desperately needed and would be a useful outcome.
  - **Mark Maddaloni (U.S. EPA - Region 2):** We need that to be standardized.

- **Sally Brown (University of Washington):** The master gardener program has started in Pierce County, WA. They developed an urban farming tract. There is a lot of coordination there with Women, Infants, and Children (WIC) programs.
- **Mary Jean Brown (CDC):** If they work with WIC people, they understand the vocabulary.
- **Ann Carroll (U.S. EPA - OBCR):** A local government can spend up to 10 percent of their grant on health monitoring. We had only 31 health-related organizations apply for a Brownfields grant. I have tried to spread the word. Those health departments are collecting the surveillance data and can make the research health connection. We are going to try to make that connection. Are there other ways with Superfund or response actions? We are not delineating the industrial zone with Brownfields. I do not care where the contamination came from. You can think of parcels that might be part of Brownfields rather than Superfund sites.
- **Mark Maddaloni (U.S. EPA - Region 2):** Maybe Joe and Wally can comment. They do removal.
- **Joseph Rotola (U.S. EPA - Region 2):** We do that now if it meets our eligibility requirements. In Region 2, we used to have a buddy system and it worked out really well. Now the OSCs are involved in the Brownfields sites to see what they could do at sites that were being reused for any purpose. A lot of the grantees dropped out and we are trying to revitalize that. On the change from 5 to 4 µg/dL, what is the timing of that?
- **Mark Maddaloni (U.S. EPA - Region 2):** 2016?
- **Joseph Rotola (U.S. EPA - Region 2):** I am trying to read between the lines. I am a numbers guy. If it goes to 4 µg/dL, what is our new soil screening number?
- **Mark Maddaloni (U.S. EPA - Region 2):** IEUBK is becoming decreasingly reliable as it goes down.
- **Rufus Chaney (USDA):** Let us remember that bioavailability assumptions in the IEUBK are an arbitrary choice compared to available human (adult) feeding data.
- **Mark Maddaloni (U.S. EPA - Region 2):** it is not entirely arbitrary and it is an average value.
- **Ann Carroll (U.S. EPA - OBCR):** For Brownfields, all but four of the states are using a soil screening level of 400 ppm. We have to get the states to think about what their new cleanup level is. It will have a big impact on Brownfields grants. We do not do bioavailability testing, so that will be an additional test.
- **Charles Partridge (U.S. EPA - Region 8):** If you took the model right now and you ran it at 5 ug/dL, you are around 150 ppm. If you do it at 4 µg/dL, you are at a different number, you are below 150 ppm. That is running the model as is. The data for the default parameters haven not been revisited since the mid-1990s. The past 3-4 years, we went back and looked to see if literature has been updated. For some there are enough new data to revisit. That is one of the possibilities if EPA does move to 5.0 µg/dL. It makes sense to see if there is updated literature. The arbitrary nature of the bioavailability that Rufus mentioned is yes and no. They were not all mining and smelter

related. There are only a few regions that collect the data that are co-located. It tends to be Regions 8 and 10 and others.

- **Rufus Chaney (USDA):** When we are trying to make decisions about urban soil, we make our warning based on bioavailable lead, not total lead..
- **Charles Partridge (U.S. EPA - Region 8):** You get so much more bang for your buck developing site-specific data bringing in your technical support team early on the sites so you can collect the right data. We have all had sites where we got a data dump and had to make a best decision. That introduces variability and uncertainty.
- **Mary Jean Brown (CDC):** We have danced around what happens after four years if we lower the blood lead level to 4 µg/dL. What happens if we lower it to 3, 2, etc. At some point, this approach is no longer a valid approach to this whole problem. We are probably there already in my opinion. I am beginning to believe we are at the outer edge of the model being particularly useful, and it might be time to do the difficult work to think about how to approach this so that lead safety is not tied to a particular blood lead threshold. That is a hard job and will take all of us to work together to try to do that.
- **Mark Maddaloni (U.S. EPA - Region 2):** The urban environments are not always consistent with the goals we are aspiring to. What you did in New Orleans is not exactly what I was talking about, but it was similar. After Katrina, everybody got moved out. Then you did massive soil intervention. Not everybody who lived there came back. The point now is that you showed data that the reduction in blood lead per unit of soil seemed greater than what the three cities study has demonstrated.
- **Howard Mielke (Tulane University):** The curve we have is very different from what people are describing. What we are now looking at is the new data and we might see some different curves and relationships, but that is a work in progress right now.
- **Marc Stifelman (U.S. EPA - Region 10):** We have begun discussions with Howard, so we are working on that. Howard has too much soil to analyze, so we need to figure out a system. The three cities study was not large enough. It needs to be an inch thick and a mile wide. We are suffering from the fallout of 50-100 years of lead rain. There will always be dirt in the house. We need to focus on cleaning it up, not educating people, because there will always be dirt.
- **Ann Carroll (U.S. EPA - OBCR):** Do we need to think more about the 2.5 percent of children exceeding 5 ug/dL and where they are?
- **Mary Jean Brown (CDC):** The easiest way to do that is to work with the local health departments. The parts of the town that had blood lead levels 50 µg/dL and higher, 25.0 µg/dL and higher, and 10 µg/dL and higher. One of the reasons why the approach that we have collectively taken to lead over the last 30 years not only reduced the mean level, but also reduced those most at risk. At a blood lead level of 10 or 5.0 µg/dL, it is not statistically significant. That means the approach worked. We have been able to reduce the mean and leave the high levels hanging out there. You need to talk to Paulette in the Philadelphia Department of Public Health. There might be a privacy issue, but there are ways to think of that creatively. All of the systems we have do not

oversample for the most vulnerable children (e.g., refugee and immigrant children). You can map that. That needs to happen at the local level.

- **Mary Tierney (U.S. EPA - Region 5):** I have a practical approach. Regarding 400 ppm versus 150 ppm. We cannot clean urban levels to 400 pm, let alone 150 ppm. I am cleaning up 4,000 yards. I have been asked by management to run the numbers. At 150 ppm, instead of cleaning up 40 percent, it would be 95 percent. Background was 80 ppm from the farm fields.
    - **Mark Maddaloni (U.S. EPA - Region 2):** That is why appropriate background is important.
    - **Mary Tierney (U.S. EPA - Region 5):** There is no hot spot and no smelter.
    - **Mark Maddaloni (U.S. EPA - Region 2):** What is the source?
    - **Mary Tierney (U.S. EPA - Region 5):** It is urban lead. It is a post-industrial river town, which had a variety of industries. We sampled and found high levels. We tried to identify particular sources. After 25,000 samples, we have a better idea of what could be sources. It is an anomaly. It is a good thing to look at, because if we did clean up urban areas, this is what it would take.
    - **Mark Johnson (ATSDR):** Even though we work with county and health departments, we have been making some progress on soil shops. We can then connect with maternal health officials regarding good nutrition for mothers and children. We can build on these relationships and build partnerships.
    - **Mark Maddaloni (U.S. EPA - Region 2):** In Region 2, we sent out the blast to any homeowner. If you want your soil tested, come bring it in.
    - **Howard Mielke (Tulane University):** In 2004 before Katrina, we looked at effect of putting 6 inches of clean soil at properties being redeveloped. They clean soil has 5 ppm lead. After 10 years, there was a gradual increase in the amount of lead. We look forward to doing a new survey after Katrina to see if soils have remained clean.

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2:00pm – 2:45pm Soil Pb Source Attribution Approaches

Jon Gabry, EPA Region 2 - Pb Isotope, Metals Correlation

Jon Gabry delivered Mike Pribil's (USGS) presentation regarding using lead isotope ratios for source-receptor studies. He stressed the need to have a distinct isotopic signature of the source area and area of interest for isotopic analysis to work. In one example, he discussed using lead as a surrogate for manganese. He acknowledged that the main reason lead isotopes do not work is when the lead isotopic composition of the source is similar to the background. In cases where there is not a difference, you can use a surrogate.

Jon also presented on forensic chemistry techniques for source attribution, including characteristic ratios of inorganics or organics. He suggested consulting old maps using cemeteries, churches, and old parks to find background levels as they have been there a long time and are largely undisturbed. He described a Barth Smelting facility in Newark, New Jersey located on top of a big zinc smelter. The stable

isotope to zinc was used a surrogate metal. Jon also commented that some states recognize the problem with urban background (e.g., New Jersey).

Q&A/Comments

No questions.

Aaron Betts, EPA ORD ORISE - Pb speciation

Aaron Betts presented his research on using chemical speciation as it relates to lead. He argued that total element concentration is generally a poor indicator of risk as different species have different solubility and therefore different bioavailability. He emphasized that speciation needs to be direct and cannot use indirect evidence. He compared various chemical speciation methods, including XRF (electron microprobe), X-ray diffraction (XRD), X-ray absorption spectroscopy (XAS), Mössbauer spectroscopy, and Fourier transform infrared spectroscopy (FTIR). XAS is the best way to directly speciate lead in soil samples, due to its low detection limit (1 ppm). It gives you coordinated elements and distance of the elements and is important for fingerprinting chemistry. He acknowledged the downside is that you need a synchrotron source, and there are only a few in the world (i.e., 80; 12 in the United States). He went on to explain how chemical speciation can be done with minimal sample preparation (e.g., grab sample straight from field that is still wet), which makes it useful for environmental sciences.

He referred to the Omaha Superfund Site as a good example of how this method can be used for lead speciation. A cap was put over the soil to see if lead dug up would still pose a risk or whether it would weather and change into something else. In work done by Todd Luxton and Kirk Scheckel (EPA ORD), they found that high levels of phosphate in the soils has resulted in the in-situ formation of pyromorphite species. This suggest very low lead bioavailability. He concluded that chemical speciation aids in understanding fate and transport, bioavailability, and remediation effectiveness. He identified XAS as the best tool to directly speciate lead in environmental samples, but it depends heavily on supporting information and good selection of standards.

Q&A/Comments

No questions.

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Glenn Adams, EPA Region 4 - Use of XRF for Pb Soil Analysis

Glenn Adams discussed the use of his Region's XRF Field Operations Guide (FOG) for lead soil analysis. The FOG improves lead and arsenic soil sample results for decision making, is time- and cost-effective, allows for informed and defensible decisions in the field, and helps control soil variability. Glenn highlighted the importance of determining whether to not to sieve samples based on a preliminary comparison of sieved and non-sieved XRF results for the first 10 samples. He documented the steps in the XRF FOG including collecting soil samples, measuring moisture content, determining duration time needed for specific XRF, controlling outside variables (e.g., calibration and Bag Test), taking 4 XRF

readings of soil, and recording results in a spreadsheet. The FOG addresses sample replicates relative to risk-based screening level, and an accompanying spreadsheet tool provides summary statistics for the analyses.

Q&A/Comments

No questions.

Ramon Mendoza, EPA Region 5

Ramon Mendoza presented a brief overview of a Chicago site at which the smelter is currently in operation and was the largest lead emitter to the air of Chicago until 2011. Ramon explained their approach of implementing phases of soil investigations outward and downwind from the smelter. The results showed morphology of lead particles consistent with slag material used in industrial processes, as well as copper, lead, and zinc concentrations consistent with the composition used in the brass foundry. Ramon emphasized that in this case, these results provide strong evidence for a case that could be presented to a judge.

3:30pm – 4:00pm Facilitated Discussion

- **Karen Bradham (U.S. EPA - ORD):** A pH of 1.5 is currently the standard operating procedure (SOP) for glycine solutions.
- **Mark Maddaloni (U.S. EPA - Region 2):** Glenn, when you do the 95 percent upper confidence limit, do you default to the maximum if the level is above the maximum? Like Superfund?
    - **Glenn Adams (U.S. EPA - Region 4):** Yes.
- **Nick Magriples (U.S. EPA - Region 2):** We have worked with Kirk Scheckel. I appreciate the effort in setting that up. For the non-EPA people, how much would it cost and how easy is it to get that type of analysis?
    - **Aaron Betts (U.S. EPA – ORD ORISE):** Kirk Scheckel has an arrangement with a collaborative access team. The majority of people using the synchrotron are academics and are awarded free time after putting in a proposal. This is why you need to know about your site. In your proposal you can say you know you can get information worthy of publication and you are much more likely to be awarded time. Private industries also pay for their time. You might have to contact someone in collaborative access team or put in a proposal.
    - **Nick Magriples (U.S. EPA - Region 2):** So It could take many months. It is not easy.
    - **Aaron Betts (U.S. EPA – ORD ORISE):** Yes. Also it is a U.S. Department of Energy facility, so you have to get clearance just to enter.
- **Charles Partridge (U.S. EPA - Region 8):** The regional labs that do the in-vitro bioavailability right are in Regions 7, 9, and 10. Region 4 is working on it.
- **Glenn Adams (U.S. EPA - Region 4):** I answered the previous question incorrectly. There are so many variations to account for. We do not have the rule that if the 95 percent upper confidence limit is higher than the maximum then you use the maximum. Instead, you go back and look at your dataset.

- **Mark Maddaloni (U.S. EPA - Region 2):** But you are saying that if your XRF is very low, then there is no need for sieving. But the 300-500 ppm range is where you want to go to a next step?
- **Glenn Adams (U.S. EPA - Region 4):** Yes that is what we were using. If you were between 200-600, you need to sieve and send to the lab. We have done studies since then to try to use XRF and get away from that, because it gives better information than going to the lab.
- **Rufus Chaney (USDA):** Digging more holes is more important than taking more measurements on a single composite sample no matter how many sub-samples are used to make the composite. Every urban site studied shows at least 3-4-fold variation in soil Pb across the site, sometimes more than 10-fold because of the "wall effect".
- **Glenn Adams (U.S. EPA - Region 4):** All of these are composite samples, so there are multiple holes. You might have to go back and look.

- **Mark Durno (U.S. EPA - Region 5):** In the absence of source material, can we still distinguish between different forms of lead using this method?
  - **Aaron Betts (U.S. EPA – ORD ORISE):** Yes, but it is your starting point, so it is valuable piece of information to have. It is what the starting material has turned into over time after weathering. Soil chemistry like pH could help you figure out what it turned into.
- **Mark Johnson (ATSDR):** If you had a lead sample from a residential area that you suspected might be related to a smelter source, but you did not have that original material, what tools would you use to determine if the lead in the sample was from the source or not?
  - **Aaron Betts (U.S. EPA – ORD ORISE):** If it was a smelter mineral, it would not be natural. This is not like attributing to a single source, it would just be identifying the mineral that was there.
  - **Jack Kelly (U.S. EPA - Region 3):** I always thought that lead speciation was something you would do at the beginning. Would I use lead isotopic analysis if I could obtain the original material? Or lead speciation?
  - **Jon Gabry (U.S. EPA - Region 2):** Yes, if you could get source material, you could use ratio analysis to see if it was a solder or what type of material it was. It is a crap shoot. It depends. In one site on Staten Island the soil was deep and came from a source that you are not sure about. It changes the isotopes when it goes through a smelter. But when it comes out it has a typical signature and that is what we are looking for.
  - **Mark Maddaloni (U.S. EPA - Region 2):** That is certainly my experience. It is rare that you can use isotopic analysis to attribute lead from paint or gasoline s because it comes from so many different sources, so the fingerprint is obscured.
  - **Aaron Betts (U.S. EPA – ORD ORISE):** I want to re-emphasize that what you are getting with synchrotron analysis is "right now, what is it?" It is not as good for source identification. It is more of a snapshot.
  - **Ramon Mendoza (U.S. EPA - Region 5):** For the analysis that we did, we were able to visually identify a piece of slag. That is not gasoline- or paint-related. Slag can only be produced by industrial source. That is one way to make that determination.

- **Suhasini Patel (CalEPA Department of Toxic Substances Control):** Glenn, what depths did you collect samples from, and what was your composite?
    - **Glenn Adams (U.S. EPA - Region 4):** 5 composites of 0-4 inches, some at deeper levels, with arsenic, using top 4 inches.
    - **Suhasini Patel (CalEPA Department of Toxic Substances Control):** When you start cleaning up, I assume 400. How deep do you clean?
    - **Glenn Adams (U.S. EPA - Region 4):** We clean down to 2 feet.
- **Webinar:** At several small firing ranges being investigated for residential use, they are finding the metals being released from the bullets over time. You run into problems where people are unwilling to sample. How are we going to address human health and future use?
    - **Jon Gabry (U.S. EPA - Region 2):** The U.S. Department of Defense handles it by using a multi-incremental sampling methodology. They divide the range into decision units. It involves a lot of sieving, and you will always have a nugget effect. In some sites in Hawaii they use phosphate to try to immobilize it and that was successful in those soils, but its efficacy depends on the soil morphology. That is the extent of my experience.
    - **Mary Jean Brown (CDC):** Under Title 10 of the transfer act Check … I think TSCA Act, the firing range must notify the potential buyers about this now that they know about it. That might be sufficient to convince them that they will have to do something to clean up the site. Indoor firing ranges can also leave behind a considerable amount of contamination.
    - **Steve Rock (U.S. EPA - ORD):** ITRC wrote a series of documents about this. Cleaning up firing ranges turns out to be one of the simplest remediations out there.
- **Webinar:** The table related to XRF sampling is useful. How can we get copies of materials to the online audience?
    - **William Hagel (U.S. EPA - Region 3):** We are working on getting permissions. We cannot send the entire presentations out at this moment.
- **William Hagel (U.S. EPA - Region 3):** With regard to XRF data and quality assurance/quality control, we may have been doing it wrong. Was that the impetus for the XRF SOP you talked about?
    - **Glenn Adams (U.S. EPA - Region 4):** Sort of. It was a combination of things that got us looking at that.
    - **Jon Gabry (U.S. EPA - Region 2):** There are a lot of issues with XRF, so you have to know the limitations in order to get good data (i.e., dry, same size, sieved). It took 2 weeks to do 1,000 samples. One of the key things too is the background fluorescence of the parental material. So if your site has different parental materials as well as different metal readings, it could change your values.
    - **Mark Maddaloni (U.S. EPA - Region 2):** The XRF has lots of potential for quick and semi dirty method of characterizing a site. So what is the sweet spot? How much do you have to do to get for acceptable data?

- **Mark Maddaloni (U.S. EPA - Region 2):** We have a number of soil shops in Region 2, and have lots of these samples. Should we be sending that to a lab and see how that compares to the XRF data?
    - **Joshua Cheng (Brooklyn CUNY):** We are producing screening data. We are not subject to strict liability. You have to have that perspective. The benefits of XRF screening are great. People need it quickly, and lots of commercial labs do not accept all samples. Another thing is understanding that the soil-lead to blood-lead correlation is not a straight line, so the uncertainty is very big from that front.
    - **Jon Gabry (U.S. EPA - Region 2):** That is a valid point. It is a powerful screening tool, but you need to be aware of the limitations, and of course labs are better. XRF is a lot more variable. Every number is a little fuzzy.
    - **Mark Maddaloni (U.S. EPA - Region 2):** There are a number of things that you can do to easily reduce variability of XRF samples, like sieving. We need to focus on the low-hanging fruit. Screening with XRF is fine.
    - **Jon Gabry (U.S. EPA - Region 2):** It is a great tool, but you need to be aware of the limitations so it is not misused.
    - **Glenn Adams (U.S. EPA - Region 4):** Reducing the variability makes XRF no longer cheap and quick. We had an XRF reading and a lab reading for one sample. 98-99 percent of the lab readings came back within the range of readings with XRF.
- **Mark Johnson (ATSDR):** There is quality assurance for the soil shops. One strategy is to take 10 percent of the samples, and the second is to do replicates.
    - **Mark Maddaloni (U.S. EPA - Region 2):** We do that. That is the SOP.
    - **Mark Johnson (ATSDR):** Another option would be to get confirmation from the lab on high lead level readings before we give information to homeowners.
- **Rufus Chaney (USDA):** I wanted to compare an urban garden to urban forestry. When we look at a large community garden, it is potentially near a lead painted wall, a street, and a house. Parts of the garden are going to be >1,000 ppm and other parts are going to be >100ppm lead. You need a lot of point samples on a site to make sure you take the appropriate enforcement action. We can put in a plastic barrier and bring in raised beds and gardens, but if we can do a little bit more and remove (or remediate with soil amendments) the danger, then that is better than covering it up.
    - **Glenn Adams (U.S. EPA - Region 4):** The nature of the beast for EPA is that if it clean against the house, we cannot spend the taxpayers' money cleaning it up. These problems are definitely not resolved with just Superfund for sure.
    - **Eric Wilson (U.S. EPA - Region 2):** We do have the ability to protect our remedies. If we are going to spend money to clean up soil in a residential setting, it makes no sense to ignore lead paint on a house. We do have the ability under our statute to take those actions.
    - **Mark Maddaloni (U.S. EPA - Region 2):** But is not that for the exterior only? Because track in is the big problem. Can we go in and remediate peeling paint on the interior?
    - **Eric Wilson (U.S. EPA - Region 2):** You have the ability to protect the remedy.

    - **Glenn Adams (U.S. EPA - Region 4):** The short answer would be no.
- **Jack Kelly (U.S. EPA - Region 3):** I could not find raw materials from the closed facility to do source attribution work at my site. If I take a sample next to a road that has been there forever, from some soil that has never been amended, from next to a house with lead paint exterior, and then from a vacant lot away from the road and house, and all are 50 feet from the lead emitter, would they all give different signatures?
    - **Jon Gabry (U.S. EPA - Region 2):** You are looking for a magic key that does not exist. You need more and various data. You need more historical data and source samples. Metal data tells you a lot. In the church sample next to the lead smelter, we could see that the lead was different. It was not from solder, but still high in zinc, because of the lead paint. You could also do the stable isotopes analysis.
    - **Mark Maddaloni (U.S. EPA - Region 2): E**stablishing source attribution is a weight-of-evidence exercise. It is not a single line.
    - **Aaron Betts (U.S. EPA – ORD ORISE):** If you had aerial deposition, you would be seeing it a little bit everywhere. You would see lead paint and the aerial deposited material.
    - **Ramon Mendoza (U.S. EPA - Region 5):** At my site, they found source material from a smelter that closed in 1962. If you get lucky, it might still be there. This site was grass covered and in a neighborhood.

Return to Agenda

Parking Lot Issues on Easel

- Clean fill requirements
- Sampling depth
- Bioavailability/bioaccessibility (pH 1.5 versus pH 2.5)
- Lead contamination with no specific CERCLA source release
- Background definition (Superfund versus public health)
- What is the soil screening and/or cleanup number?

4:00pm – 4:15pm Closing Remarks

Shawn Garvin – EPA Region 3 Regional Administrator

Shawn Garvin began by thanking those that made this 2-day workshop so successful. This was a collaborative effort between EPA Region 3, ORD, and the Office of Solid Waste and Emergency Response (OSWER). He thanked the speakers and the attendees for coming from so far away.

Shawn asserted that addressing these impacts of legacy lead in urban soils on children, one of the most susceptible populations, is critically important. Early treatment and interventions are the key. He

encouraged participants to stay connected and continue to share information moving forward after the workshop. He ended by emphasizing EPA's responsibility to educate, communicate, and remediate.

Jack Kelly – EPA Region 3

Jack Kelly closed by thanking attendees for their participation and interest in this topic, especially from those outside of EPA. He also encouraged continued collaboration.

APPENDIX A - List of References

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APPENDIX B - Registered Participants

Registrant	Affiliation	Attendance
Ayat Abdelbaki	Virginia Department of Health	Webinar
Glenn Adams	U.S. EPA - Region 4	In Person
Barbara Allerton	Pennsylvania Department of Health	Webinar
Somia Aluwalia	New Jersey Department of Health and Senior Services	Webinar
Robert Alvey	U.S. EPA - Region 2	Webinar
Cathy Amoroso	U.S. EPA - Region 4	In Person
Charlie Armstead	West Virginia Department of Environmental Protection DLR OER	Webinar
Gail Austin	City of Philadelphia, Law Department	In Person
Andrea Bain	U.S. EPA - Region 3	Webinar
Lorie Baker	U.S. EPA - Region 3	In Person
Jean Balent	U.S. EPA - OSWER	Webinar
Mary Ballew	U.S. EPA - Region 1	Webinar
John Banks	U.S. EPA - Region 3	In Person
Joshua Barber	U.S. EPA - Region 3	In Person
Felicia Barnett	U.S. EPA - Region 4	Webinar
Patrick Beckley	U.S. EPA - Region 3	In Person
Aaron Betts	U.S. EPA – ORD ORISE	In Person
Sheri Bianchin	U.S. EPA - Region 5	In Person
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Karen Bradham	U.S. EPA - ORD	In Person

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Sally Brown	University of Washington	In Person
Mary Jean Brown	CDC	In Person
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Deborah Burgin	ATSDR	Webinar
Tonia Burk	ATSDR	Webinar
Craig Cameron	U.S. EPA - Region 10	Webinar
Ann Carroll	U.S. EPA - OBCR	In Person
Sue Casteel	ATSDR	Webinar
Rufus Chaney	USDA	In Person
Hannah Chatterjee	Mayor's Office of Sustainability	In Person
Zhongqi Cheng	Brooklyn CUNY	In Person
Robert Cheung	Geosyntec Consultants	Webinar
Mary Cooke	U.S. EPA	Webinar
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Emily Hansen	Minnesota Pollution Control Agency	Webinar
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Andrew Hass	U.S. EPA - Region 3	In Person
Elsbeth Hearn	U.S. EPA - Region 1	In Person
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Marilyn Howarth	University of Pennsylvania	In Person
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Rick Jardine	U.S. EPA - Region 4	In Person
C Jeng	CalEPA Department of Toxic Substances Control	Webinar
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Stephen Johnson	BrightFields, Inc.	In Person
Jack Kelly	U.S. EPA - Region 3	In Person
Cathleen Kennedy	U.S. EPA - Region 3	In Person

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Kevin Koporec	U.S. EPA - Region 4	In Person
Jamal Lewis	University of Pennsylvania	In Person
Jewel Lipps	U.S. EPA	In Person
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Mark Maddaloni	U.S. EPA - Region 2	In Person
Allaa Mageid	U.S. EPA	In Person
Nick Magriples	U.S. EPA - Region 2	In Person
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Henry Mason	University of Pennsylvania	In Person
Vivek Mathrani	CalEPA Department of Toxic Substances Control	Webinar
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Suril Mehta	U.S. EPA	Webinar
Ramon Mendoza	U.S. EPA - Region 5	In Person
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Howard Mielke	Tulane University	In Person
Wally Moon	U.S. EPA - Region 10	In Person
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Nuria Muniz	U.S. EPA - Region 5	In Person
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Efrem Neuwirth	California Department of Toxic Substances Control	Webinar
Caroline Nielsen	Cabrini College	In Person
Ashley Nilsen	U.S. EPA	In Person
John Nolen	U.S. EPA - Region 4	In Person
Alizabeth Olhasso	U.S. EPA - Region 3	In Person
Norka Paden	IDHW	Webinar
Charles Partridge	U.S. EPA - Region 8	In Person
Suhasini Patel	CalEPA Department of Toxic Substances Control	In Person
Walter Payne	Pennsylvania Department of Environmental Protection	In Person
Richard Pepino	University of Pennsylvania	In Person
Stephen Peterson	GEI Consultants	In Person
Todd Phillips	U.S. EPA - Region 7	In Person
Bruce Pluta	U.S. EPA - Region 3	Webinar
Ana Pomales	ATSDR	In Person
Anne Preston	Philadelphia Parks & Recreation	In Person
Elizabeth Quinn	Not Reported	Webinar
Aimee Reynolds	Montana Department of Environmental Quality	In Person
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Hans Scheifele	U.S. EPA	Webinar
Julianne Schrader Ortega	Pennsylvania Horticultural Society	In Person
Mike Scozzafava	U.S. EPA	In Person
Karen Scruton	ATSDR	Webinar
Sophia Serda	U.S. EPA - Region 9	In Person
Paulette Smith	Philadelphia Department of Public Health	In Person
Madeline Smith-Gibbs	Philadelphia Food Policy Advisory Council	In Person
Gina Soscia	U.S. EPA - Region 3	In Person
Kimberly Staiger	U.S. EPA - Region 2	In Person
Abbey States	U.S. EPA - Region 2	Webinar
Rick Stehouwer	Pennsylvania State University	In Person
Brie Sterling	Pennsylvania Department of Environmental Protection	In Person
Marc Stifelman	U.S. EPA - Region 10	In Person
Michael Taurino	U.S. EPA - Region 3	In Person
Andrew Taylor	U.S. EPA - Region 9	Webinar
Debra Taylor	CalEPA Department of Toxic Substances Control	Webinar
Dennis Terry	Temple University	Webinar
Bill Thayer	SRC, Inc.	Webinar
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