EPA Tools and Resources Webinar:

Research to Support Lead Exposure Mitigation – Targeting, Remediation and Regulation

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October 21, 2020

Lead: Top EPA and Federal Government Priority

FEDERAL
ACTION PLAN
To Reduce Childhood
Lead Exposures and
Associated Health Impacts

PRESIDENT'S TASK FORCE ON ENVIRONMENTAL
HEALTH RISKS AND SAFETY RISKS TO CHILDREN

DECEMBER 2018

- Goal 1: Reduce children's exposure to lead sources

- Goal 2: Identify lead-exposed children and improve their health outcomes

- Goal 3: Communicate more effectively with stakeholders

- **Goal 4: Support and conduct critical research to inform efforts to reduce lead exposures and related health risks**

Current Landscape: EPA is Taking Action on Lead

TSCA

- **Dust-Lead Hazard Rule (Final 2019):** EPA lowered the dust lead hazard standards (DLHS) from 40 µg/ft^2 to 10 µg/ft^2 on floors and from 250 µg/ft^2 to 100 µg/ft^2 on window sills.
- **Dust-Lead Post-Abatement Clearance Rule:** Post-abatement dust lead clearance (cleanup) levels are being revised given the 2019 updated DLHS. Proposed rule at OMB for review.

SDWA

- **Lead and Copper Rule (LCR) Revisions:** Proposed LCR revisions include a suite of actions to reduce lead exposure in drinking water where it is needed the most. Proposed rule published November 2019; extended comment period closed February 12, 2020.
- **Lead-Free Rule:** Current draft final rule includes third-party certification requirements and a list of non-potable products exempted from the lead-free requirements. Final draft rule at OMB for review.
- **WIIN Act:** Reduction in Lead Exposure Via Drinking Water grant solicitation ($39.9M).

CERCLA/RCRA

- **Soil Lead Guidance Update:** EPA's Office of Land and Emergency Management (OLEM) developing soil lead remediation strategy.

EPA Lead Regulations and Other Actions	
TSCA	[*] **Dust-Lead Hazard Rule** [*†] **Dust-Lead Post-Abatement Clearance Rule** **Renovation, Repair, and Painting Rule**
SDWA	[*†] **Lead and Copper Rule** [*†] **Lead Free-Rule**
CAA	**NAAQS – Integrated Science Assessment** **National Emission Standards for Hazardous Air Pollutants (NESHAPS)** **Aviation Lead Endangerment Finding**
CERCLA	[†] **Soil Lead Guidance Update**
RCRA	
CWA	**Effluent Guidelines** **Water Quality Criteria**
Title X	**Residential Lead-Based Paint Reduction Act**

[*] **Significant ORD input in 2019**

[†] **Pending actions**

- Lead is a potent developmental and adult toxicant that affects multiple human organ systems

- Lead is present in air, water, soil, consumer products and food

- Lead is regulated in all of these media

- Regulation of lead since the 1970s has resulted in steep drops in population blood lead levels

- CDC's current reference level of 5 µg/dl is defined as the childhood blood level that warrants public health action, close monitoring, or case management

Lead poisoning prevention policies have reduced population blood levels
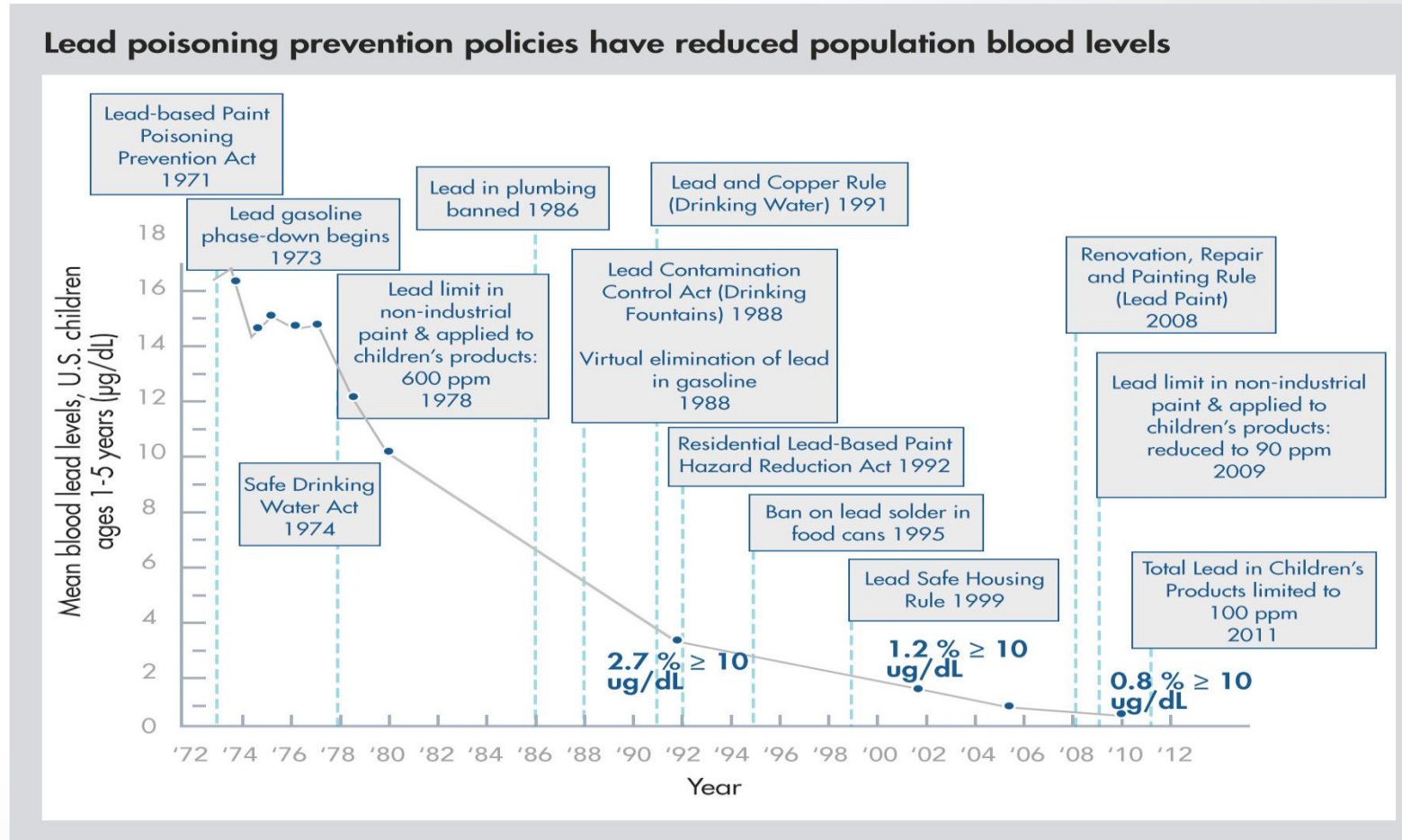
Lead: Cross-cutting Research Issue

- **Health and Environmental Risk Assessment (HERA)**
  - Research Area: Science Assessment Translation
  - Research Area: Essential Assessment and Infrastructure Tools

- **Safe and Sustainable Water Resources (SSWR)**
  - Research Area: Drinking Water and Water Distribution Systems
  - Research Area: Technical Support

- **Sustainable and Healthy Communities (SHC)**
  - Research Area: Chemicals of Immediate Concern – Lead
  - Research Area: Site Characterization and Remediation
  - Research Area: Waste Recovery and Beneficial Use

- **Regional Applied Research Effort (RARE)**
- **Superfund Technical Liaison Research (STLR) Projects**

The Federal Lead Action Plan and ORD's critical role in cleanup of contaminated sites guides ORD's Pb research.

EPA research and technical support focuses on:

- Strengthening the scientific basis of the Agency's lead-related regulatory and cleanup decisions;

- Developing rapid, inexpensive tests to evaluate the level of soil cleanup needed and innovative methods to mitigate exposure at contaminated sites;

- Identifying and mapping high exposure communities and analyzing for potential lead sources within those communities;

- Improving drinking water quality across the United States.

EPA research provides information and tools to the Agency, states, tribes, utilities and communities.

Multimedia Research

- **Update and evaluate regulatory and site clean up models of blood lead levels**
  - Integrated Exposure Uptake Biokinetic Model 2.0
  - All Ages Lead Model
  - Linking stochastic exposure-dose modeling, e.g. SHEDS-IEUBK (described in the below articles)
    - https://pubs.acs.org/doi/10.1021/acs.est.0c00479
    - https://ehp.niehs.nih.gov/doi/10.1289/EHP1605

- **Lead exposure targeting and mapping**
  - Coordinated approach to identifying locations of high potential lead exposure and key drivers in those locations
  - Technical support and collaboration to apply approach to lead mitigation targeting

Media-Specific Research

- **Water system and home drinking water safety**
  - Water sampling methods to evaluate drinking water lead exposure and to identify lead service lines
  - Corrosion control research: Water chemistry, scale analysis, premise plumbing
  - Evaluation and tools to improve point-of-use (POU) water filtration methods
  - Technical support on corrosion control and filtration

- **Soil and dust, other media**
  - American Healthy Homes Survey (AHHS) II Department of Housing and Urban Development (HUD) nationally representative sample – national estimate of Pb levels and bioavailability
  - Improved estimates of childhood exposures through soil and dust ingestion
  - Methods to evaluate bioaccessibility for site-specific cleanup determinations
  - Innovative methods for *in situ* remediation

- **Updated Lead Integrated Science Assessment**
  - Support for Lead National Ambient Air Quality Standard (NAAQS)

Examples of Lead Research Products

# Determining Pb Exposure in Homes

Problem: Need better estimates of lead in drinking water for estimating exposures

Action: Design sampling techniques to measure drinking water Pb in premise plumbing; update models for complex premise plumbing arrangements

Results:

- Patent pending automated sampling technology to measure drinking water Pb levels in homes and buildings
- Developed a prototype extension of EPANET to model fate and transport of lead in premise plumbing

Impact: Recommendations on improved sampling techniques can help inform health and regulatory efforts
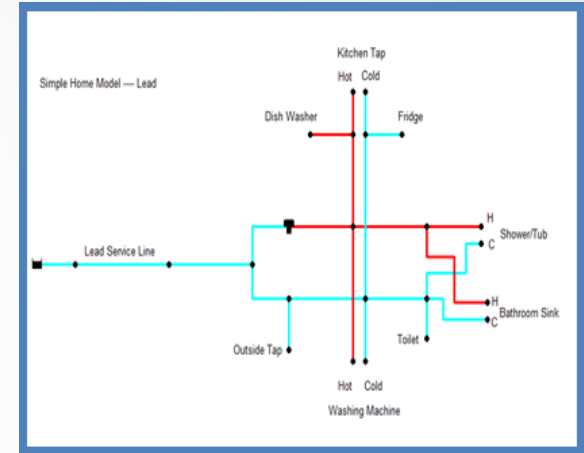
Identifying Lead Service Lines

Problem: 3-6 million American homes and businesses are still connected to water systems by lead service lines (LSLs), but their locations remain unknown in many communities. An updated sampling protocol is needed to locate these remaining LSLs

Approach: Update LSL Identification Methods

- ORD is developing sequential water tap sampling profiles and a Lead Exposure Assessment Device to augment current methods of identifying LSLs

Impact of this research:
- Inform LCR sampling approaches
- Provide cheaper, less invasive, highly accurate ways of identifying LSLs
- Developing patent-pending faucet-mounted point-of-use (POU) device to detect LSLs and estimate exposure in homes

Drinking Water – Pipe Scale Analysis
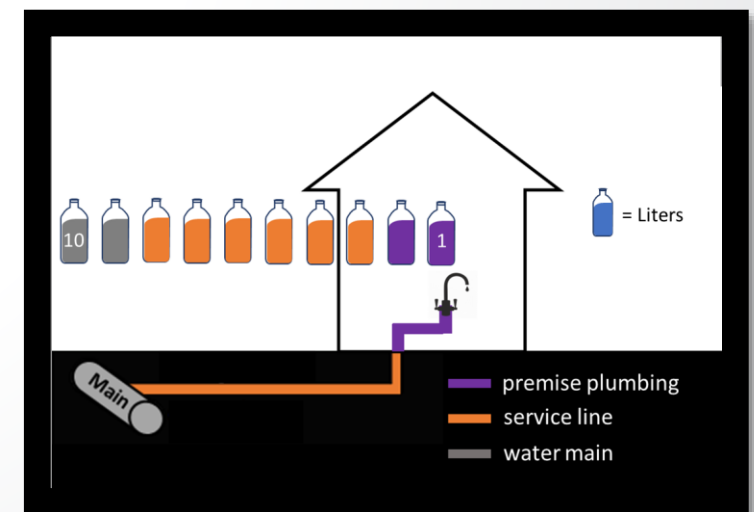
Problem: Understand the likelihood of lead release from lead pipes

Actions:

- Evaluate the state of corrosion control treatment (CCT)
- Predict impacts of changes to CCT or other water treatment processes
- Practical evaluation of CCT approaches used in different locations
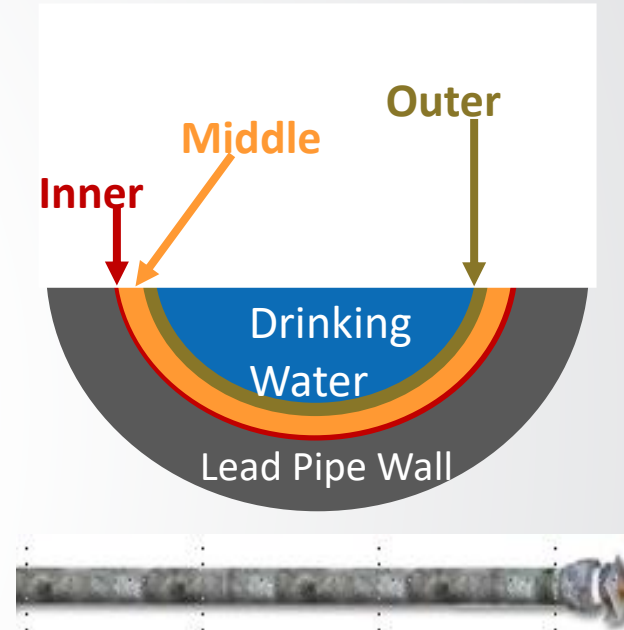
Impact:

- Tech support to multiple communities (CO, MA, MI, NJ, OH, PA, RI, WI)
- Inform EPA Office of Water CCT training
- Improve understanding of the impacts of water quality & CCT on the stability of lead scales

Drinking Water – POU Treatment

Problem: Evaluate Point of Use (POU) devices provided to water customers for removing lead; analyze cases when lead bypasses filter

Action: Provided data to the regions, states and cities on the effectiveness of the provided POU devices

Results: Determine treatment effectiveness for different forms of lead (dissolved versus particulate, and valence state); devise method to produce lead nanoparticles
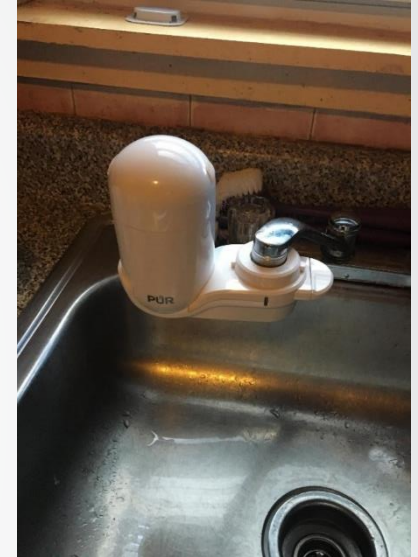
Impact of this research:
- Identify conditions under which water chemistry, corrosion control treatment, and premise plumbing interact to produce lead nanoparticles
- Helps National Sanitation Foundation-International in their efforts to set treatment standards for POU devices

Technical Support to Reduce Pb in Drinking Water

Problem: Limited technical expertise regarding corrosion control and LCR exceedances

Actions: Review and make recommendations on corrosion control plans, diagnose distribution system issues, perform scale analysis, review sampling data and reports, POU filtration

Impact: Examples of ORD support include:

- Providence, RI – innovative use of orthophosphate at elevated pH as their treatment and follow up evaluation

- Sebring, OH, Ohio EPA – sampling procedures and data integrity

- Newark NJ – POU filtration

- University Park, IL – corrosion control
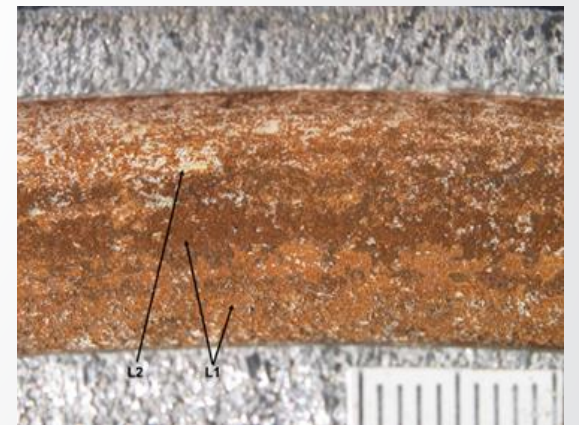
# Innovative Multimedia Exposure and Dose Modeling

Problem: Estimate blood lead levels for children of different ages (national-scale analysis) resulting from exposure through drinking water, soil, dust, air and food

Approach: Update model parameters and functional capacity; evaluate model blood lead estimates

- All Ages Lead Model

- IEUBK 2.0

- Linked EPA's SHEDS-Multimedia & IEUBK models
  - https://pubs.acs.org/doi/10.1021/acs.est.0c00479
  - https://ehp.niehs.nih.gov/doi/10.1289/EHP1605

Impact:
- Used in updated Lead and Copper Rule (SDWA), Lead Dust Hazard Rule (TSCA) to quantify relative exposure pathway contributions across population distributions

Zartarian, et al. 2017 EHP https://doi.org/10.1289/EHP1605
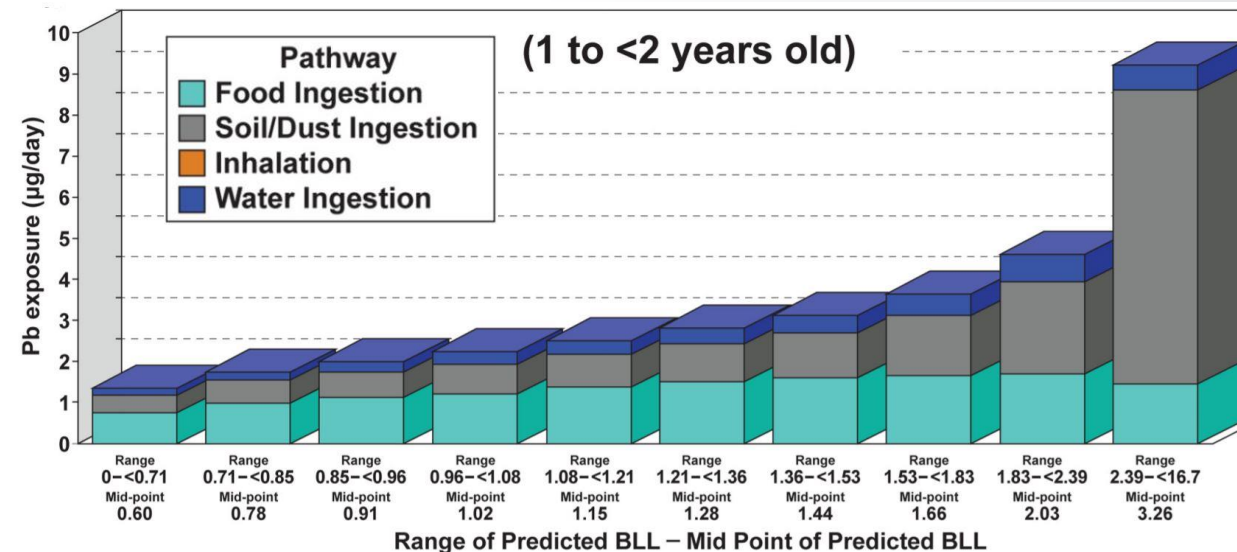
Identify High Pb Exposure Sites

Problem: While average childhood blood lead levels have dropped across America, children in some communities remain at risk of elevated lead exposure

Approach: Science-based approaches for identifying communities with high exposure potential and key sources of exposure in those communities

- Use spatial analysis and other statistical or mathematical modeling methods to analyze available blood lead level data and census-tract scale environmental factors
- Collaborate with states and other federal agencies

Results: Technical assistance provided to EPA regions 1, 5, 6 and 7

Impact: Inform joint EPA and state planning for Pb exposure reduction actions

Innovative Soil-Testing Methods: Saving Cleanup Costs at Superfund Sites Across the United States

Problem: Site-specific Pb bioaccessibility is a critical factor in setting cleanup levels and determining the cost of cleanup. Established methods to estimate Pb bioaccessibility have been very expensive and time consuming

Approach: ORD-OLEM collaboration to develop reliable and inexpensive rodent and *in vitro* methods for assessing Pb bioaccessibility in contaminated soils

Results: ORD has developed an inexpensive bioaccessibility standard method for use in setting site-specific cleanup levels.

Impact: Site remediation levels that protect human health, while reducing costs ($100s M) and volumes of contaminated media in hazardous landfills from Superfund sites

Reducing Children's Risk from LEAD in Soil

Reducing bioavailability of soil-borne lead

Problem: Soil removal and replacement are expensive and complex procedures

Action: Develop methods for *in situ* lead remediation to mitigate the impacts of ingested soil
- Evaluate addition of soil amendments, e.g., phosphate, to reduce bioavailability of lead
- Reduce the bioavailability of by reducing the solubility of Pb
- Evaluate the effect of formation of plumbojarosite, an insoluble iron-sulfate mineral

Results: Soil amendments and other methods can significantly reduce lead bioavailability
- Phosphate can combine with lead to form very low solubility complexes; unintended release of other compounds, e.g., arsenic, needs further analysis
- Treatment of Pb-contaminated soils to promote plumbojarosite formation results in substantial reductions (>90%) in estimates of relative bioavailability of Pb in these soils

Impact:
- *In situ* lead remediation can potentially reduce the cost of cleanup by mitigating the impacts of ingestion of lead-contaminated soil
- Remediation of soils by plumbojarosite formation *in situ* may be a valuable tool to reduce lead exposure
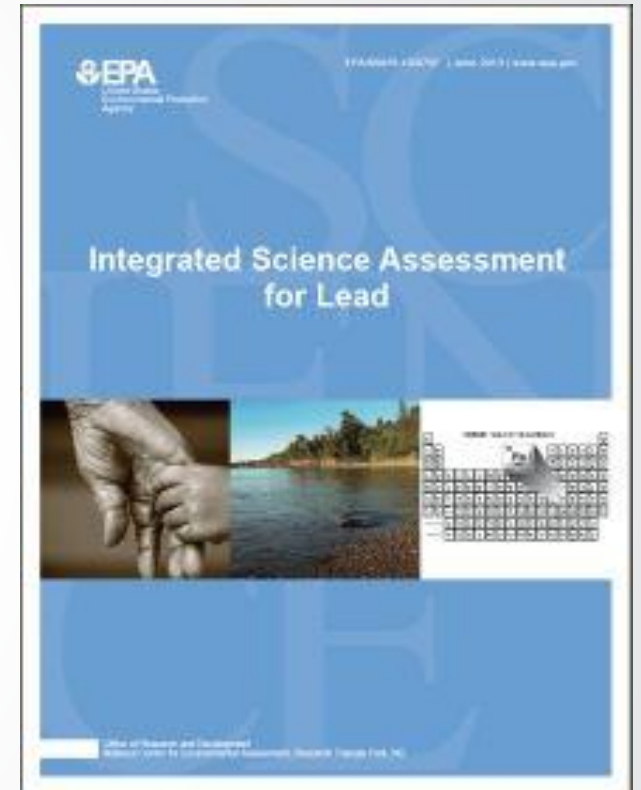
Integrated Science Assessment for Lead

Problem: Identify critical human health and welfare effects of lead exposure to inform policy options and EPA decisions on standards

Approach: Systematic review of ~ 1500 health and ~ 700 ecological effects studies by ORD

Product: Integrated Science Assessment (ISA) for Lead June 2013; initiated update summer 2020

Impact: The Lead ISA (previously the Air Quality Criteria Document) is the scientific foundation for the Lead National Ambient Air Quality Standard (NAAQS); Lead ISA also serves as a primary summary for lead health impacts for other regulatory analyses

Regional Applied Research Effort (RARE) Projects

- The use of POU filtration devices for lead service line identification (Region 5), January 2019 – January 2021

- Soil amendments to reduce bioavailability of toxic metals in contaminated soils and sediments (Region 10), January 2018 – December 2020

- Long-term fate evaluation of lead in phosphate treated waste materials that pass the Toxicity Characteristic Leaching Procedure (TCLP): Are municipal solid waste landfills a safe disposal option? (Region 6), October 2015 – June 2020

Superfund Technical Liaison Research (STLR) Project

- Fluidized bed soil preparations method for analysis of heavy metals in respirable air – application to dirt bike and indigent trespasser exposure analysis scenarios at the Colorado Smelter Superfund Site (Region 8), July 2018 – September 2019

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Brief descriptions of ORD's Lead research and links to recently published research can be found here: **https://www.epa.gov/land-research/epa-lead-pb-research**

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