

# **EPA Overview of Emerging Contaminants**

U.S. Environmental Protection Agency  
Office of Superfund Remediation and Technology  
Innovation (OSRTI)  
Assessment and Remediation Division  
Science Policy Branch

Federal Remediation Technology Roundtable  
November 14, 2013



# Contaminants

- Lead
- Dinitrotoluene
- 1,4 Dioxane
- Perchlorate
- Trichloroethylene (TCE)
- Dioxin



# Lead

- Since 1994, OSWER's policy has been to limit exposure to residential soil lead levels such that a typical (or hypothetical) child or group of similarly exposed children would have no more than a 5% probability of exceeding a  $10 \mu\text{g/dL}$  blood lead level as predicted by the IEUBK model.
- For non-residential sites, the health protection goal is to limit exposure to soil lead levels for women of child-bearing age such that their fetus would have no more than a 5% probability of exceeding a  $10 \mu\text{g/dL}$  blood lead concentration.



# Lead

- Recent Health Studies on Lead Toxicity
- 2012 CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) Recommendations
  - Most exhaustive review of lead toxicity studies to date.
  - Concluded that overall weight of evidence provides clear substantiation of neurocognitive decrements (as well as other systemic effects) in children in association with blood lead levels  $<10 \mu\text{g/dL}$ .



# Proposed Updates to IEUBK Model Variables

Variable and Current Default Value(s)	Proposed Default Values	Basis for Proposed Values
<b>Ventilation rate</b> 2–7 m <sup>3</sup> /day (age-specific)	3.22–8.89 m <sup>3</sup> /day (age-specific)	Energy expenditure from Institute of Medicine’s doubly-labeled water dataset and equations developed (Brochu et al. 2006 and Layton, 1993) to convert metabolic energy to inhalation rates
<b>Dietary lead exposure</b> ~2–2.3 µg/day (age-specific)	~2.7–6.0 µg/day (age-specific)	New FDA food residue information and NCI food consumption analysis
<b>Transfer of outdoor soil to indoor dust (MSD)</b> 0.7	To be determined (Analysis is needed; Likely between 0.4-0.8)	Information from Bunker Hill Superfund Site in Idaho
<b>Maternal Blood Lead Concentration</b> 1 µg/dL	0.8 µg/dL	NHANES
<b>Bioavailability</b> 60% RBA	80% RBA	Analysis of the full data set and a conservative policy decision
<b>Sieving</b> <250 µm fraction recommended	<150 µm fraction recommended	Dermally-adhered soil and dust is dominated by particles <150 µm
<b>Soil &amp; Dust Ingestion Rate</b> IRSD is Age-specific; 85-135 mg/day	To be determined (Preliminary information suggests ~62 mg/day)	Information from Bunker Hill Superfund Site in Idaho
<b>Age Range in the IEUBK model</b> 0-84 months	12-71 months	Alignment with the NHANES age range in the CDC recommendation



# Generic Soil Preliminary Remediation Goals (PRG) for Lead

**Soil Lead PRG based on no greater than a 5% probability of exceeding**

**5  $\mu$  g/dL PbB**

**10  $\mu$  g/dL PbB**

Based on Current Model Defaults

Residential Sites

153 ppm

418 ppm

Non-residential Sites

800 ppm

2200 ppm

Based on Proposed Model Defaults

Residential Sites

162 ppm

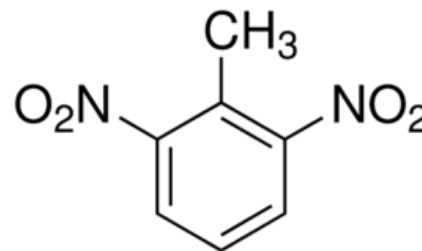
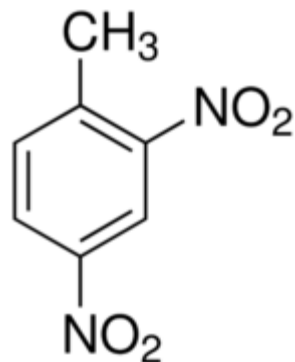
599 ppm



# Lead

- EPA Resources:
  - EPA Lead website <http://www2.epa.gov/lead>
  - Lead at Superfund sites  
<http://www.epa.gov/superfund/lead/index.htm>
    - Technical assistance link connects to Technical Review Workgroup (TRW) for Metals and Asbestos
    - Lead Risk Assessment – Bioavailability Guidance

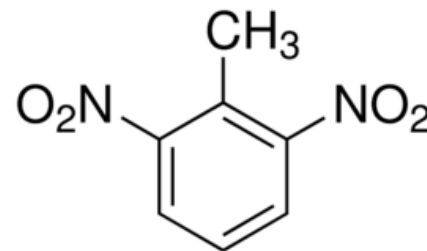
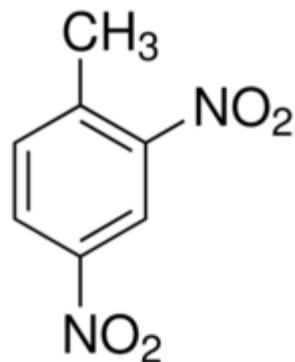
# Dinitrotoluene



- Sources: explosives, manufacture of polyurethanes
- Health Effects: nervous and cardiovascular system, probable human carcinogen
- Exposure pathways: occupational – inhalation and dermal contact, drinking water, soil, surface water, groundwater



# Dinitrotoluene



- 6-isomers, 2,4-DNT and 2,6-DNT most common
- Toxicity values available for 2 most common isomers
- ATSDR suggests all isomers are equally toxic
- Screening level toxicity values available for technical grade DNT and 2,6-DNT as shown in appendix of PPRTV document [http://hhpprtv.ornl.gov/quickview/pprtv\\_papers.php](http://hhpprtv.ornl.gov/quickview/pprtv_papers.php)



# Dinitrotoluene

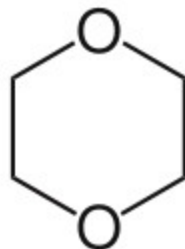
- Analytical Method: CLP Semivolatile target compounds (2,4-DNT and 2,6-DNT CRQLs 5.0 µg/L water, 170 µg/kg soil)
- Remediation Methods:
  - Naturally degrades by oxidation, photolysis, and biodegradation (aerobic and anaerobic)
  - Adsorption on activated carbon, atmosphere and munitions wastewater
  - Electrochemical oxidation of wastewater
  - *In-situ* chemical oxidation with iron sulfide activated persulfate
  - Incineration and alkaline hydrolysis for soils
  - Bioremediation under investigation for soil and wastewater



# Dinitrotoluene

- EPA resources:
  - 2008 Drinking water health advisory  
[http://www.epa.gov/safewater/ccl/pdfs/reg\\_determine2/healthadvisory\\_ccl2-reg2\\_dinitrotoluenes.pdf](http://www.epa.gov/safewater/ccl/pdfs/reg_determine2/healthadvisory_ccl2-reg2_dinitrotoluenes.pdf)
  - 2012 Technical factsheet  
[http://www.epa.gov/fedfac/pdf/technical\\_fact\\_sheet\\_dnt\\_january2013.pdf](http://www.epa.gov/fedfac/pdf/technical_fact_sheet_dnt_january2013.pdf)

## 1,4 Dioxane



- Sources: widely used solvent that is miscible in water, stabilizer for chlorinated solvents (TCA), impurity in consumer products
- Health effects: liver and kidney damage, probable human carcinogen
- Exposure pathway: occupational exposure (predominantly inhalation), detected in surface water and groundwater (migrates rapidly in groundwater)



# 1,4 Dioxane

- Analytical Method: CLP has modified semivolatile organics method to improve detection (CRQL 2.0  $\mu\text{g}/\text{L}$  water, 67  $\mu\text{g}/\text{kg}$  soil)
- Remediation Methods:
  - Pump and treat with advanced oxidation processes, e.g. hydrogen peroxide and UV or hydrogen peroxide and ozone
  - Ex situ bioremediation with bioreactors
  - Phytoremediation is being explored

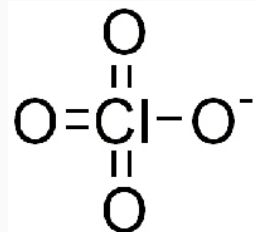


# 1,4 Dioxane

- EPA resources:
  - 2010 IRIS Toxicological Review  
<http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?id=205170>
  - 2013 Technical Factsheet  
[http://www.epa.gov/fedfac/pdf/technical\\_fact\\_sheet\\_14-dioxane\\_2013.pdf](http://www.epa.gov/fedfac/pdf/technical_fact_sheet_14-dioxane_2013.pdf)



## Perchlorate



- Sources: naturally occurring, rocket fuel, explosives, fertilizers, bleach
- Health effects: disruption of thyroid function, likely carcinogen
- Exposure pathway: drinking water, ingestion of food (detected in food crops and milk)



# Perchlorate

- Analytical method: Ion chromatography with mass spec. of water samples EPA Method 314.0, 314.1, 332.0, 6860 or LC/HPLC-MS EPA Methods 331.0, 6850
- Remediation methods:
  - *Ex situ* treatment – ion exchange (removal), bioreactor bioremediation (destruction), electro dialysis/reverse osmosis (removal)
  - *In situ* treatment – bioremediation (destruction), permeable reactive barriers (destruction)



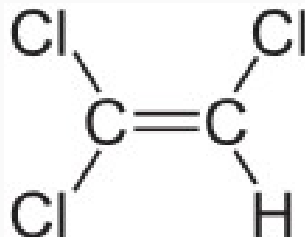


# Perchlorate

- EPA resources:
  - Perchlorate in Drinking Water  
<http://water.epa.gov/drink/contaminants/unregulated/perchlorate.cfm>
  - 2012 Technical Fact Sheet  
[http://www.epa.gov/fedfac/pdf/technical\\_fact\\_sheet\\_perchlorate.pdf](http://www.epa.gov/fedfac/pdf/technical_fact_sheet_perchlorate.pdf)



## Trichloroethylene (TCE)



- Sources: metal degreaser, textile production, intermediate in dechlorination of perchloroethylene
- Health effects: neurotoxicity, liver and kidney toxicity, endocrine effects, carcinogen
- Exposure routes: Vapor intrusion inhalation, drinking water



# Trichloroethylene (TCE)

- Prevalent at many hazardous waste site:
  - To date, TCE has been detected in soil and groundwater at ~ 761 Superfund sites.
  - As of 2006, ~ 45% RCRA Corrective Action Sites.
- Superfund screening levels are developed using Superfund current default exposure parameters [http://www.epa.gov/reg3hscd/risk/human/rb-concentration\\_table/](http://www.epa.gov/reg3hscd/risk/human/rb-concentration_table/)
- EPA ORD published new IRIS toxicity values September 2011



## Trichloroethylene (TCE)

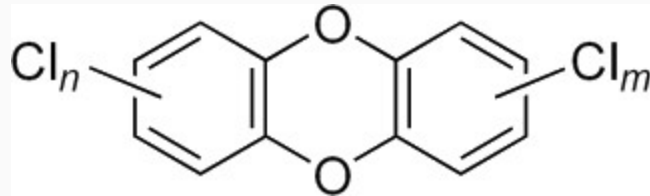
- Analytical method: GC/MS laboratory or field instruments
- Remediation Method:
  - Pump and treat: air stripping or granulated activated carbon
  - Bioremediation
  - Monitored natural attenuation
  - Phytoremediation



# Trichloroethylene (TCE)

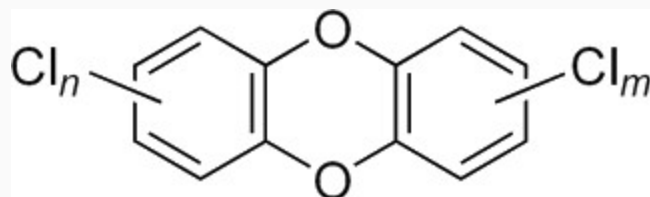
- EPA Resources:
  - September 2011 IRIS toxicity values  
<http://www.epa.gov/IRIS/subst/0199.htm>
  - TCE in drinking water  
<http://water.epa.gov/drink/contaminants/basicinformation/trichloroethylene.cfm>
  - Vapor Intrusion Guidance  
<http://www.epa.gov/oswer/vaporintrusion/>

# Dioxin



- Sources: By-product of certain industrial activities and combustion (Agent Orange, paper pulp bleaching, forest fires)
- Health Effects: highly toxic, reproductive and developmental problems, carcinogenic
- Exposure pathways: persistent environmental pollutant found throughout the world, bioaccumulates, human exposure predominantly through food

# Dioxin



- n and m are 0 or 4, 208 possible congeners
- Toxicity of congeners varies, with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) considered the most toxic
- Toxicity of other dioxin congeners expressed relative to TCDD as toxicity equivalence factor (TEF). WHO has identified TEFs for 29 compounds including dioxin congeners other than TCDD, furans, and dioxin-like PCBs.
- The TCDD equivalent concentration of a mixture of congeners is expressed as Toxicity Equivalence (TEQ) which is calculated from the TEFs and concentrations of individual congeners.



# Dioxin Reassessment

- On February 17, 2012, EPA issued the final *Reanalysis of Key Issues Related to Dioxin Toxicity and Response to NAS Comments, Volume 1*.
- The review report provides hazard identification and dose-response information on TCDD and the most up-to-date analysis of non-cancer health effects from TCDD exposure.
- The report includes an oral reference dose (RfD) for TCDD of 0.7 pg/kg-day, which has been placed in EPA's Integrated Risk Information System (IRIS).
- <http://cfpub.epa.gov/ncea/CFM/nceaQFind.cfm?keyword=Dioxin>





# Dioxin Tool Box

- Useful information for developing dioxin soil cleanup levels is found at <http://www.epa.gov/superfund/health/contaminants/dioxin/dioxinsoil.html>
- The Dioxin Tool Box is composed of technical documents intended to assist Superfund Project Managers in the sampling and analysis of dioxin contaminated soils.
- The Tool Box includes:
  - A template and user guide for a Uniform Federal Policy Quality Assurance Project Plan for Soils Assessment of Dioxin Sites.
  - Fact sheets on the Non Routine Analytical Services provided by Analytical Services Branch of OSRTI/TIFSD that allow for analysis of dioxins and PCBs.
  - Fact sheet on the management of dioxin contaminated soils.
  - Dioxin Relative Bioavailability Assay Evaluation Framework (2013)
  - Additional supporting documents.