Conducting a Risk Assessment

Ending Childhood Lead Poisoning Webinar Series

27 January 2024

END CHILDHOOD LEAD POISONING

PARTNERSHIP FOR A LEAD-FREE FUTURE

unicef

for every child

Proposed Webinars

Webinar #	Date	Topic
Webinar 1	21-Oct-24	Understanding sources of lead exposure
Webinar 2	25-Nov-24	Carrying out a Blood Lead Level survey
Webinar 3	27-Jan-25	Conducting an environmental risk assessment
Webinar 4	24-Feb-25	Developing country strategies on lead exposure
Webinar 5	31-Mar-25	Communicating on childhood lead poisoning
Webinar 6	28-Apr-25	Developing Health Systems capacity on lead poisoning
Webinar 7	26-May-25	Building lead surveillance system
Webinar 8	30-Jun-25	Regulatory frameworks
Webinar 9	28-Jul-25	Occupational exposure
Webinar 10	29-Sep-25	Developing environmental ministry capacity
Webinar 11	20-Oct-25	Used Lead Acid Batteries
Webinar 12	24-Nov-25	Remediation

Today's Speakers

Youth ambassador Zeineldin Elmikaty, 5th year Egyptian Medical Student

Larah Ortega-Ibañez, Country Director, Philippines for Pure Earth

Dr. Casey Bartrem, Executive Director and Senior Environmental Scientist at TerraGraphics International Foundation (TIFO),

Lead Exposure in Egypt: A Crisis

Zeineldin Elmikaty

5th Year Medical Student and IFMSA Public Health International Team Member

IFMSA International Federation of Medical Students' Associations | Medical Students Worldwide

Lead Exposure Stories from Alexandria’s University Hospital

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Lead Exposure: Children Working

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Lead Exposure: Industrial Areas & Manshyet Naser

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Lead Exposure: Urban Cities and High-traffic Areas

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Medical Students Worldwide

The Role of IFMSA and Youth Advocacy

- A world in which all medical students unite for global health, and are equipped with the knowledge, skills and values to take on health leadership roles locally and globally.

For further inquiries, please contact us at

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IFMSA
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Medical Students Worldwide

Lead Exposure Risk Assessment: Key Approaches and Considerations from PE PH Experience

Larah Ortega – Ibañez

Country Director, Pure Earth Philippines

larah@pureearth.org

www.pureearth.org

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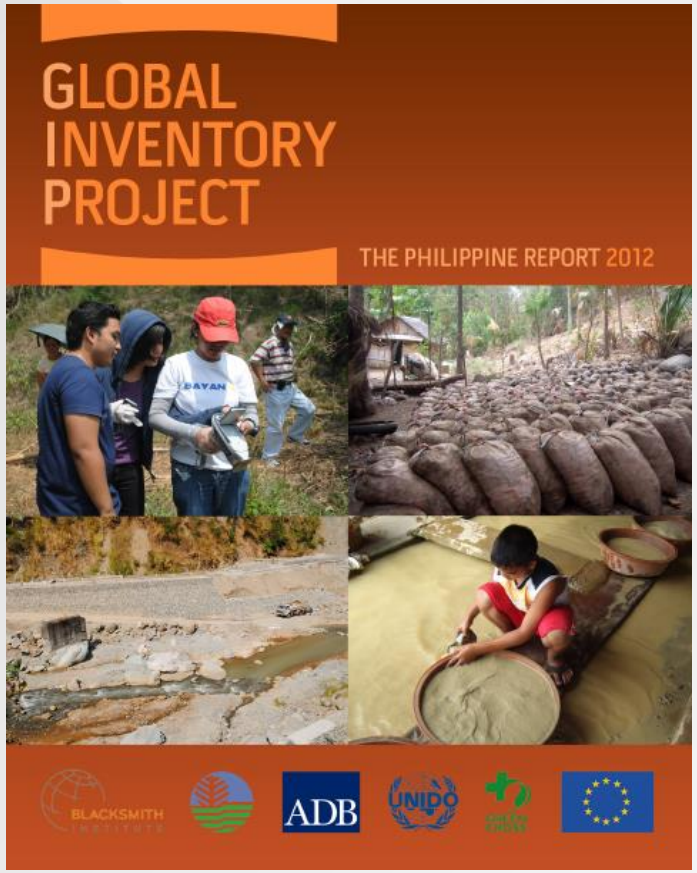
The Pure Earth Way

Collaborate	Identify and Implement	Prioritize
Government	Solutions, Sound Data	Stopping toxic exposures
Industry	Cost-effective	Protecting health
Academe	Sustainable	Restoring environments
CSOs	Impact	In LMICs

Key Approaches

Global Inventory Project



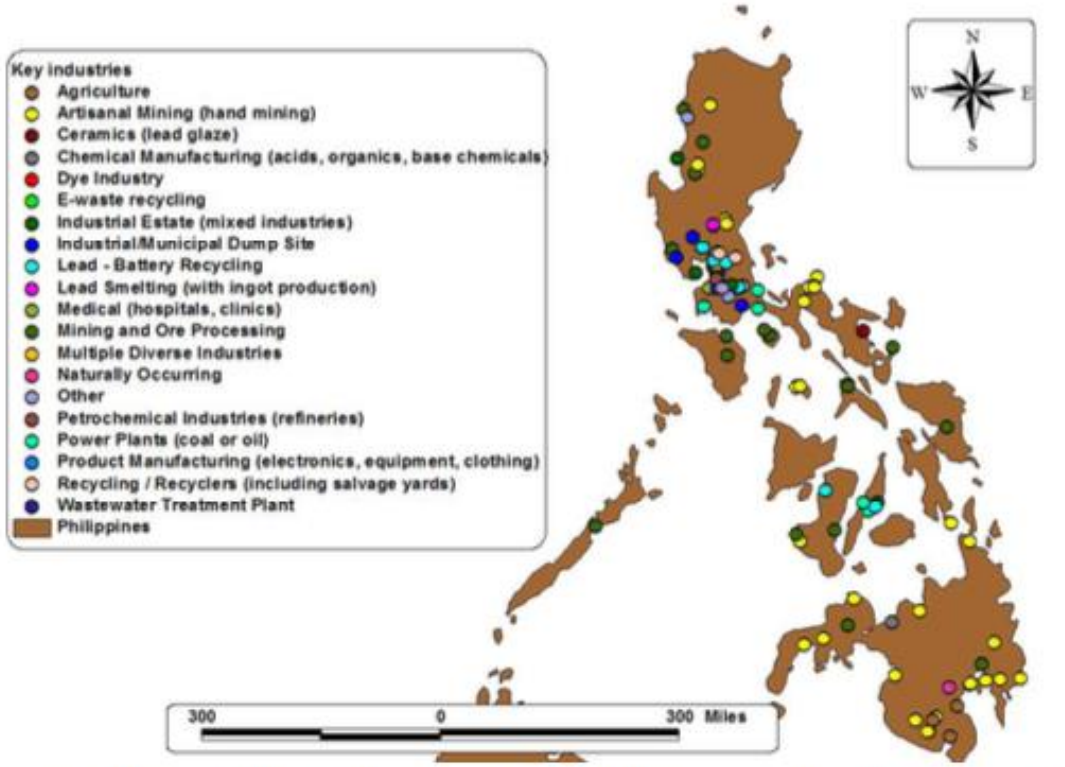


Figure 3. Key polluting industries in the GIP sites assessed in the Philippines

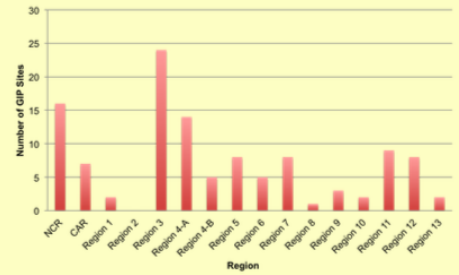


Figure 1. GIP sites assessed per region

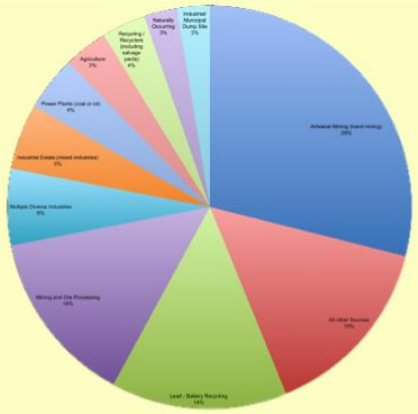


Figure 2. Key polluting industries in the GIP sites assessed in the Philippines

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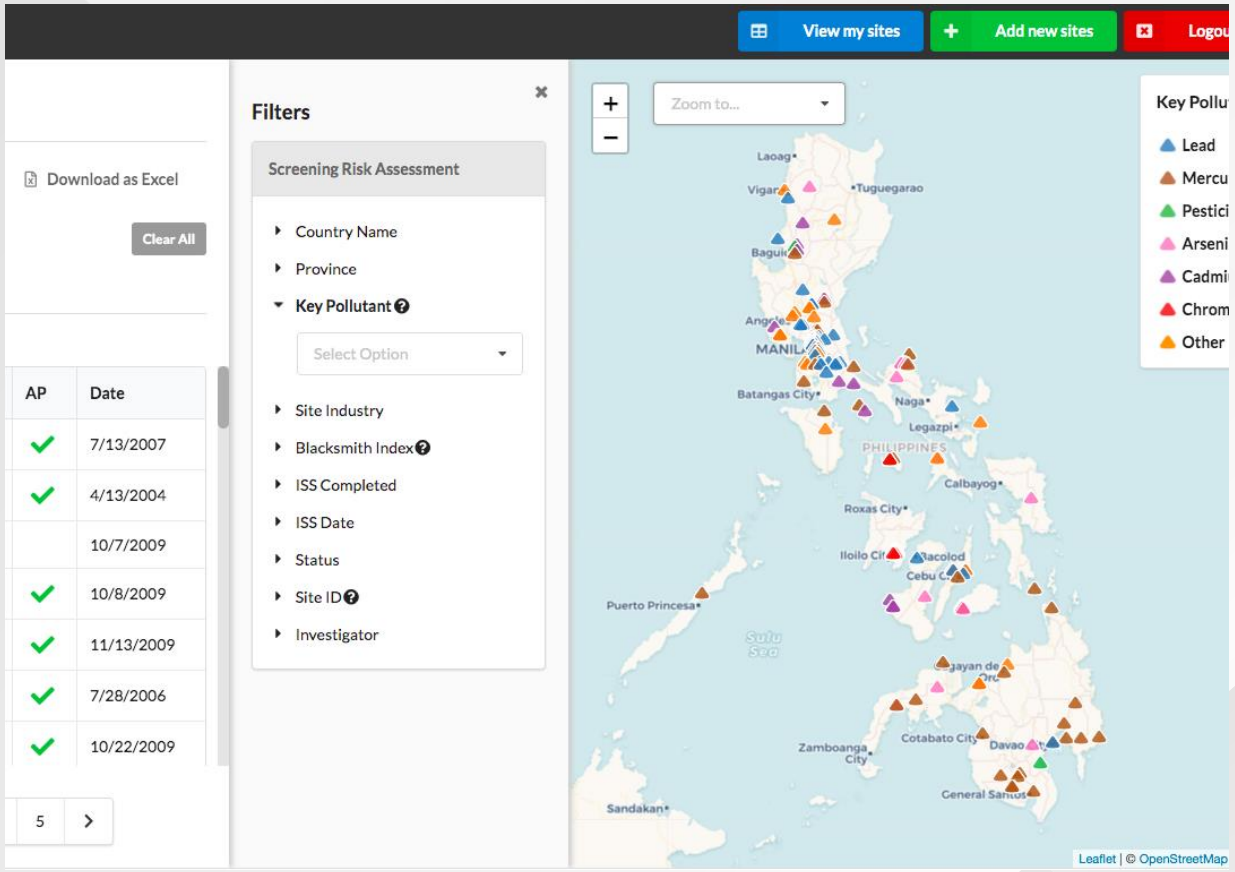
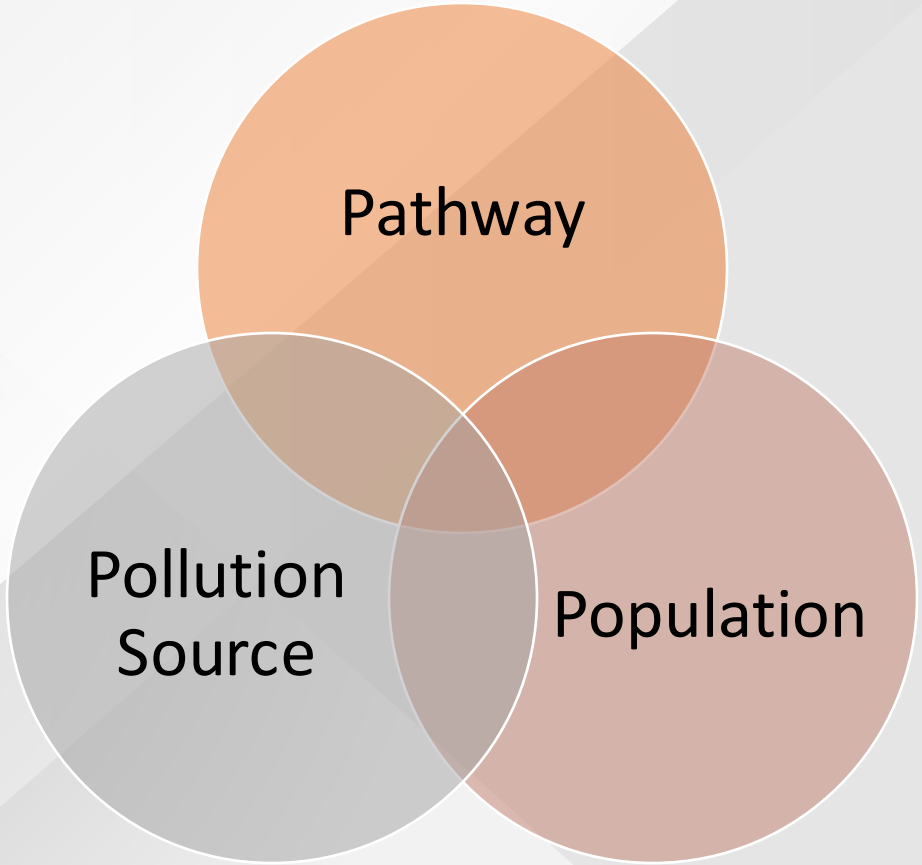
Toxic Sites Identification Program (TSIP)





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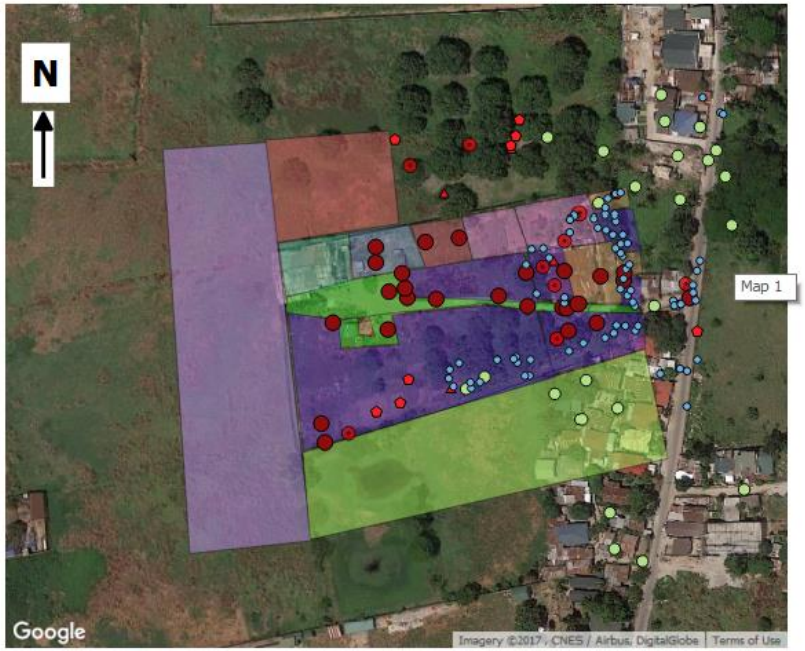
TSIP Methods in the Philippines

- **Targeted Site Assessment**

- from “point source” (a fixed location, not air pollution from cars and trucks),
- with concentrations that can cause adverse human health impacts,
- with clear migration route and exposure pathway to humans;
- initial site assessment (ISA), detailed site assessment (DSA)



Community Exposure Mitigation

Start

Sampling Goals
- Determine extent of contamination
- risk assessment model inputs
- prioritize response actions

Research Site history / nature of contamination

Delineate zone(s) of contamination

Prioritize response actions

Clean-up residential properties

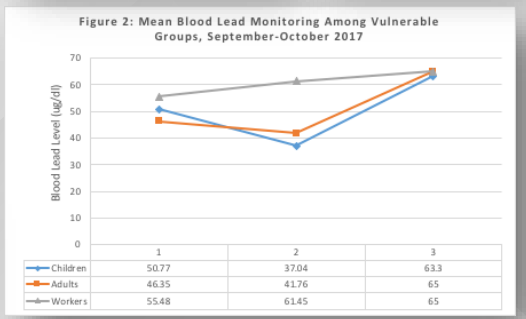
Five year review

END

Community Involvement

Health Education

Blood lead study / survey in children



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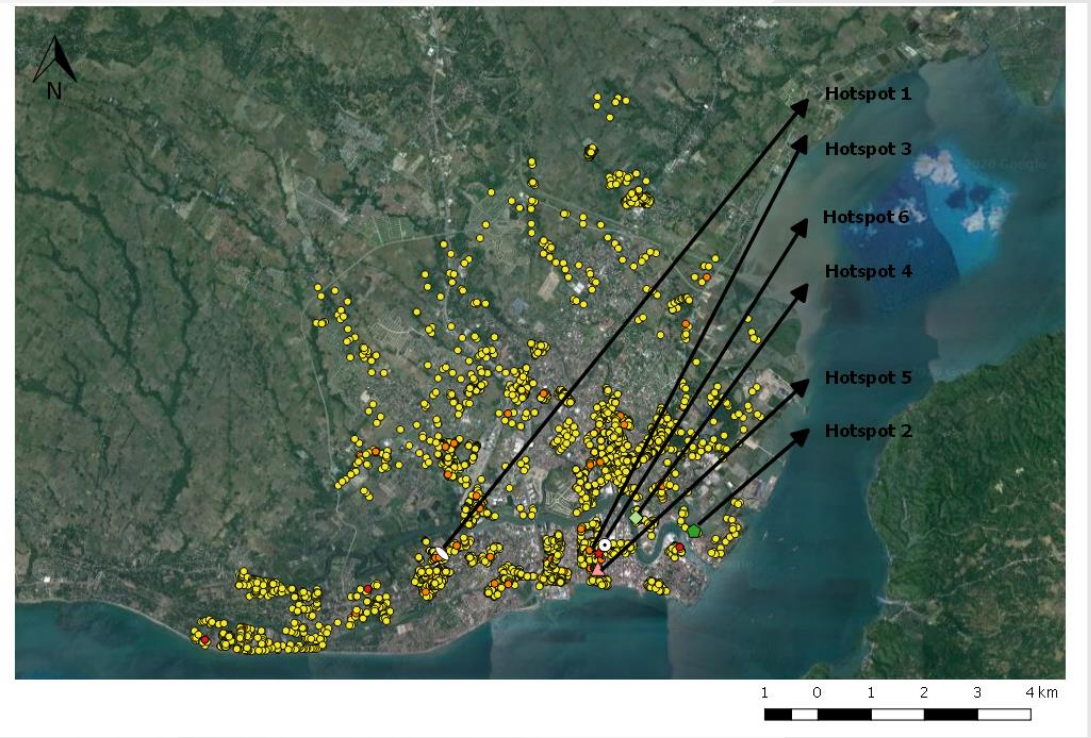
TSIP Methods in the Philippines

- **Investigative Site Assessment**

- more extensive and random (e.g., unbiased) sampling approach
- to evaluate heavy metals concentrations across the cities
- in an effort to understand the geographic distribution of selected heavy metals in surficial soil and
- to potentially identify sites for more targeted investigations.

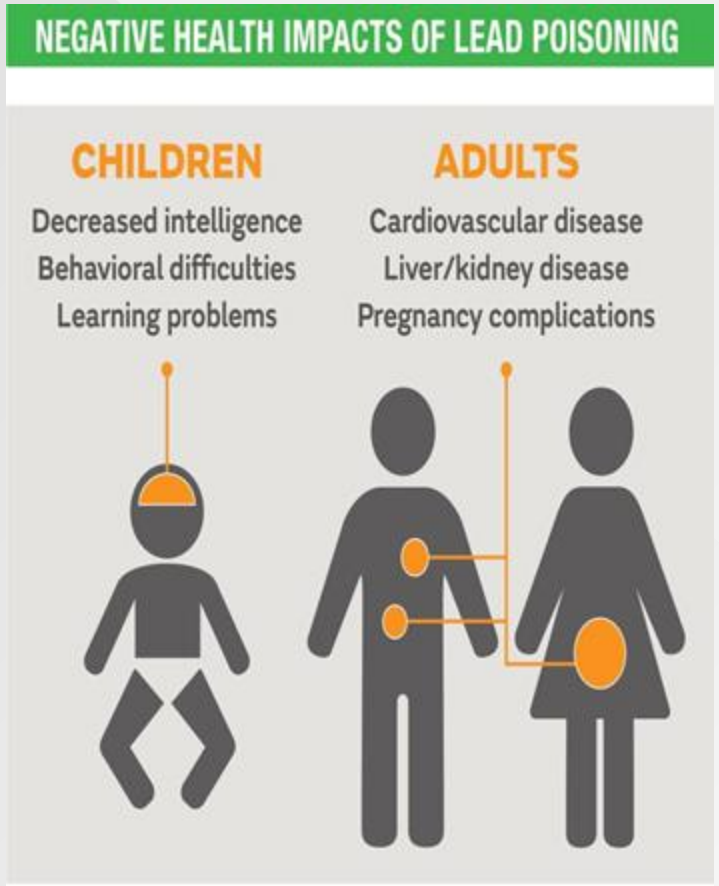


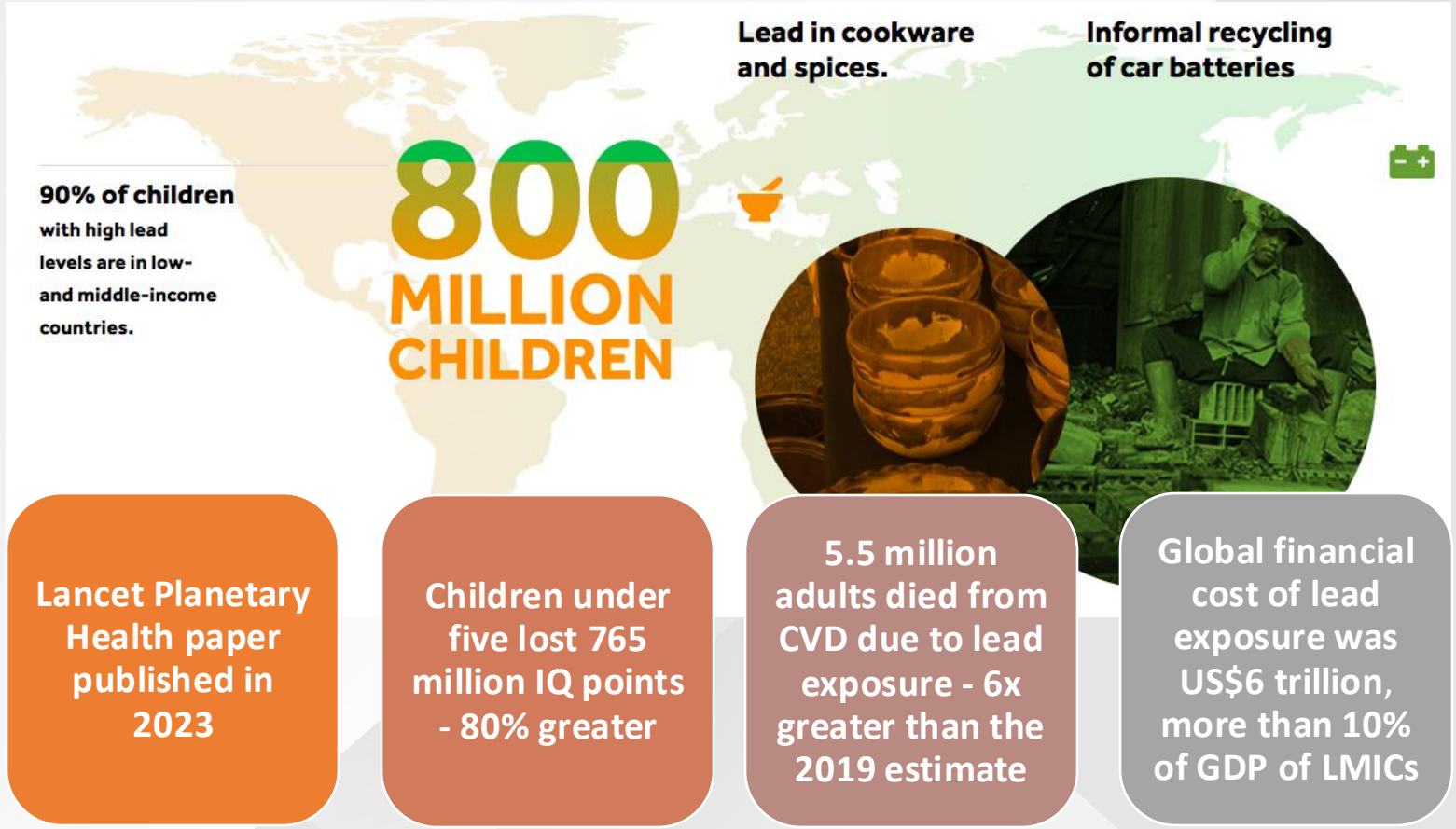
Data on Lead Exposure Sources

Parameters	Previously	Recently
Lead releasing industries	Mining, smelting and used lead acid battery (ULAB) handling and recycling industries, waste dumps, junkshops, radiator shops, etc.	**No recent assessment** - **data may be available for registered industries** - **data limited or lacking for unregistered industries**
Lead handling establishments	282 nationwide	
Lead contaminated sites	50 with lead as main pollutant	**No recent assessment** - **who will carry out the responsibility to do so?**
X-ray Fluorescence (XRF) reading	56,945.06 ppm on the average	

*US EPA – 200 ppm for residential/play areas, 1200 for industrial/non-play areas

Make a Stronger Case for Lead





Lancet Planetary Health paper published in 2023

Children under five lost 765 million IQ points - 80% greater

5.5 million adults died from CVD due to lead exposure - 6x greater than the 2019 estimate

Global financial cost of lead exposure was US$6 trillion, more than 10% of GDP of LMICs

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Policies and Standards in Place

ITEM/MEDIUM	STANDARD	SOURCE/REFERENCE
Consumer Products		
Food	0.01 – 0.05 ppm	Philippine National Standard, Bureau of Agriculture and Fisheries Standards 194:2017
Drinking Water	0.01 ppm	Philippine National Drinking Water Standards, 2017
Cosmetics	20 ppm	Department of Health, Bureau of Food and Drugs, Bureau Circular 2006-012
Children's Articles (Toys, School Supplies), Paint, Packaging Materials, Fuel Additives, Pipes	90 ppm	DAO 2013-24: Chemical Control Order for Lead and Lead Compounds
Environment		
Water	0.01 – 0.1 mg/L	DAO-2016-08: Water Quality Guidelines and General Effluent Standards
Air	1 – 1.5 ug/NCM	National Ambient Air Quality Guideline Values (NAAQGV) based on the Clean Air Act
Soil	200 ppm play areas, 1200 non-play areas	EPA
Blood	3.5 – 5 ug/dL	US CDC/WHO

Previous Studies on Consumer Products














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Rapid Market Screening (RMS)

Obtaining representative consumer goods samples available to the public and testing them for lead levels

Rapid Market Screening Sampling Protocol

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March 2023

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Home-based Assessments (HBA)

Investigating potential sources of exposure within and around the home, analyzing both environmental and consumer goods for lead levels

X-ray Fluorescence (XRF) Analyzer

HOME-BASED SOURCE ASSESSMENT PROTOCOL

Version: October 2023

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Recent Data on Lead Exposure Sources

Products/Items	Global Rapid Market Screening (RMS) - 5000 samples, 25 countries	Local Rapid Market Screening (RMS) – 256 samples, LuzViMin	Home-based Assessments (HBA) – 21 homes, Metro Manila
Metal cookware	51% 119,500 ppm	24% 1,470 ppm	48% 3,700 ppm
Ceramic food ware	45% 397,100 ppm	13% 1,159 ppm	25% 205,000 ppm
Household paints	41% exceedance 807,309 ppm	16% 41,800 ppm	44% 13,400 ppm

*Chemical Control Order for Lead – 90 ppm

LEAD ENVIRONMENTAL INSPECTION PROCESS

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Key Considerations

1. Protocol – viable how to

- ISA/scoping process
- Portable equipment
- Template forms
- Train tech/non-tech local personnel
- Applicable or adaptable to local contexts

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New Protocols – Source Specific

Metal Cookware Leaching Test

Protocol Document

PURE EARTH October 2024

Protocol for Testing Metal Cookware for Lead and Other Toxic Metals

PURE EARTH October 2024

https://www.pureearth.org/protocols-and-technical-guidelines/

2. Partners – we can’t stand alone

- Investigators
- Government
- Academe
- Industry, Professionals
- Civil Society Organizations
- Local Champions,

  Community Members

3. Preparation – appropriate messaging

- Government – Here to help
- Industry – Help not halt
- Community
  - Assured feedback
  - Intervention if possible
  - Clear expectations
  - Care as motivation

3. Intervention – everyone contributes

- Mitigation or remediation – Stop the Source
- Pre- and post-BLL screening – Show Effectiveness
- Government – Sustain by Institutionalizing Interventions
  - Policy development/amendment
  - Programming with fund allocation
- Industry – Process Improvement
- Academe/Professionals – Capacity Building
- Community – Raise Awareness/Advocates, Create Linkages

4. Other Key Considerations

- Pilot or proof of concept
- Pro-active, and preventive in cases like ours
- People of skill and principle

Drive Action on All Fronts, The Children Deserve Lead-Free Futures

Poisoning Sources

Comprehensive Source Assessment and Alternatives, Compliance to Lead-Free Standards

Poisoning Migration / Pathways

Awareness Raising, Capacity Building especially among environment and health front liners; general public on Mitigation Measures

Population at Risk

BLL Screening,
“Early Detection, Early Intervention”

Thank you

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Zamfara, Nigeria Lead Poisoning Response

Simba Tirima, PhD, Country Representative for Nigeria, Médecins Sans Frontières
Casey Bartrem, PhD, Executive Director, TerraGraphics International Foundation

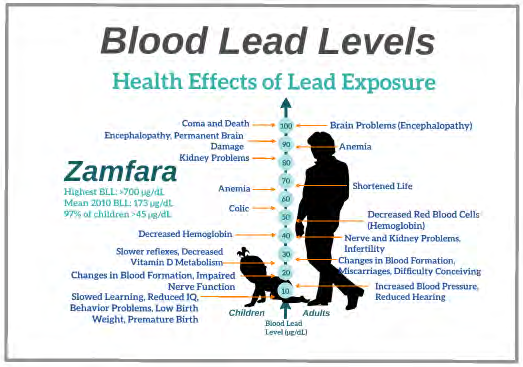
Outbreak discovery and initial investigations

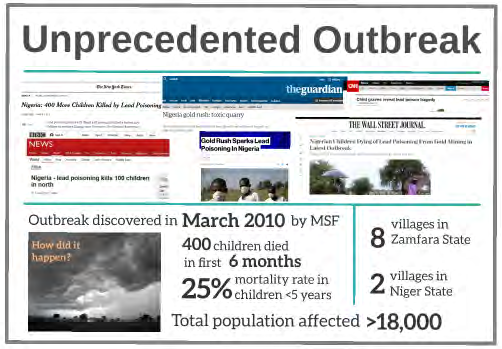
Anka and Bukkuyuym Local Government Areas

- Remote, rural locations
- Villages without cell signal, electricity
- Many roads impassible during rainy season
- Impacted villages 1-4 hours from nearest town with basic infrastructure

March-May 2010

- Rural health workers began seeing strange, severe symptoms in young children (<5 years)
- Doctors Without Borders (MSF) outbreak surveillance teams contacted
- MSF investigated
- Children did not respond to treatment for malaria, menengitis, etc.
- Local leaders suspected relationship between artisanal mining and outbreak
- MSF sent blood samples to Europe for analysis
- Exceptionally high blood lead levels (BLLs) reported
- State authorities, US CDC, WHO, TIFO engaged in investigation





Initial Investig

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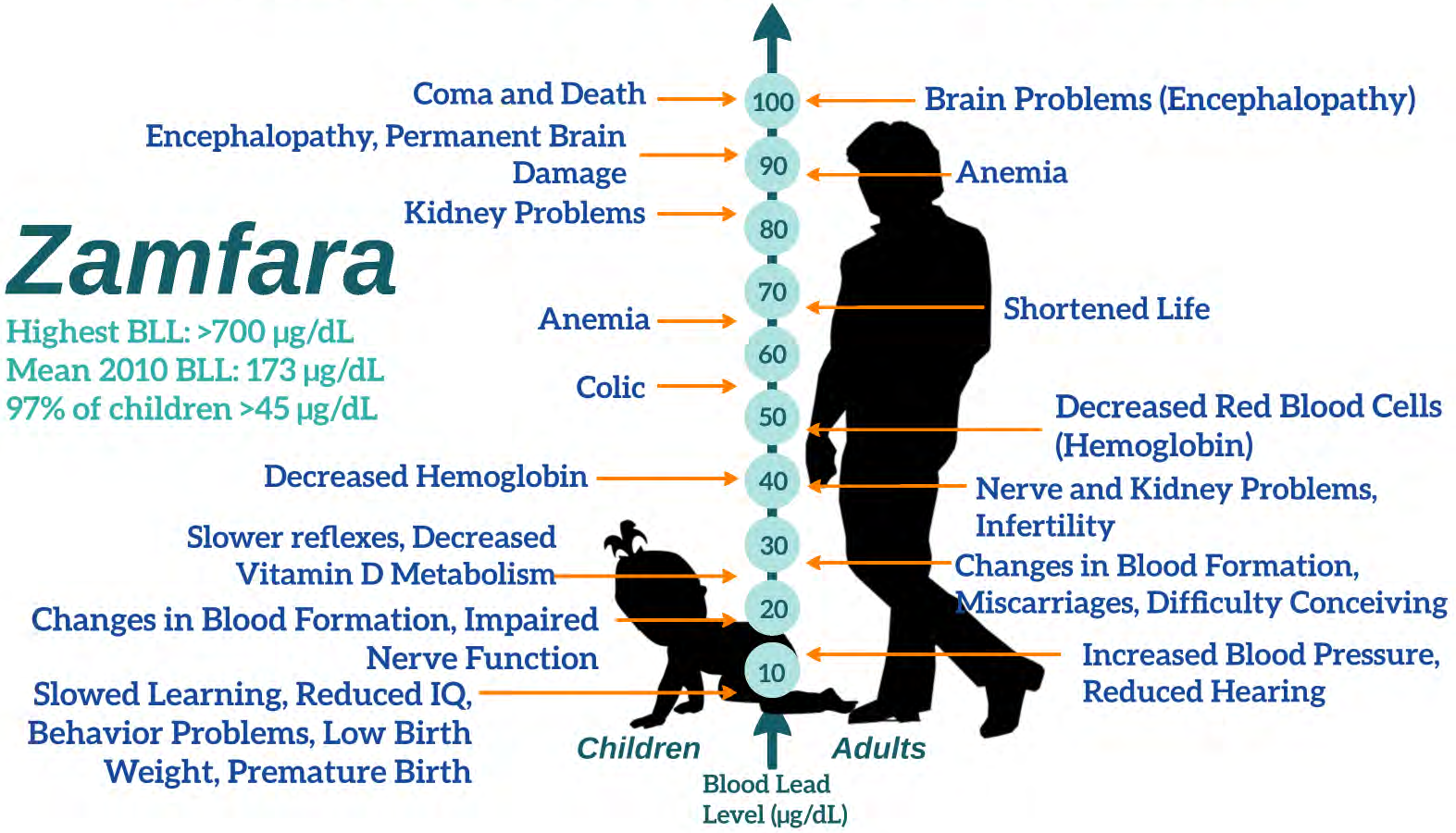
Blood Lead Levels

Health Effects of Lead Exposure



Zamfara

Highest BLL: >700 µg/dL
Mean 2010 BLL: 173 µg/dL
97% of children >45 µg/dL

Unprecedented Outbreak

Outbreak discovered in **March 2010** by MSF

400 children died in first **6 months**

25% mortality rate in children <5 years

8 villages in Zamfara State

2 villages in Niger State

Total population affected **>18,000**

Zamfara, Nigeria Lead Poisoning Response

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Assessing Exposure and Risk





Environmetal Sampling

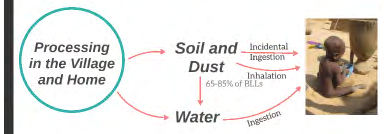
1. Interview
2. Draw the site
3. Test using XRF
   - Gridded sampling
   - Judgmental sampling
4. Assess contamination depth
5. Report results to household

USEPA Screening Level: 200 mg/kg



Gold Mining and Processing

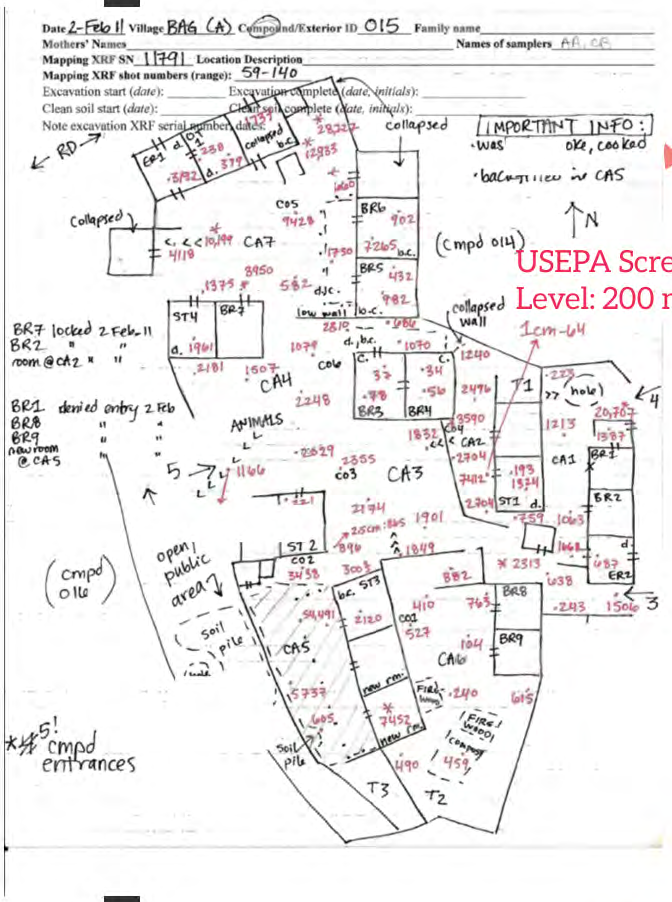
Conceptual Site Model



Dietary Exposures in Zamfara


Estimated dietary contribution to BLL: 11-34% of children's BLLs

Environmetal Sampling



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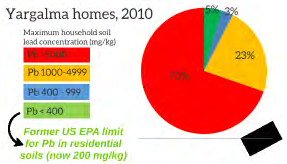

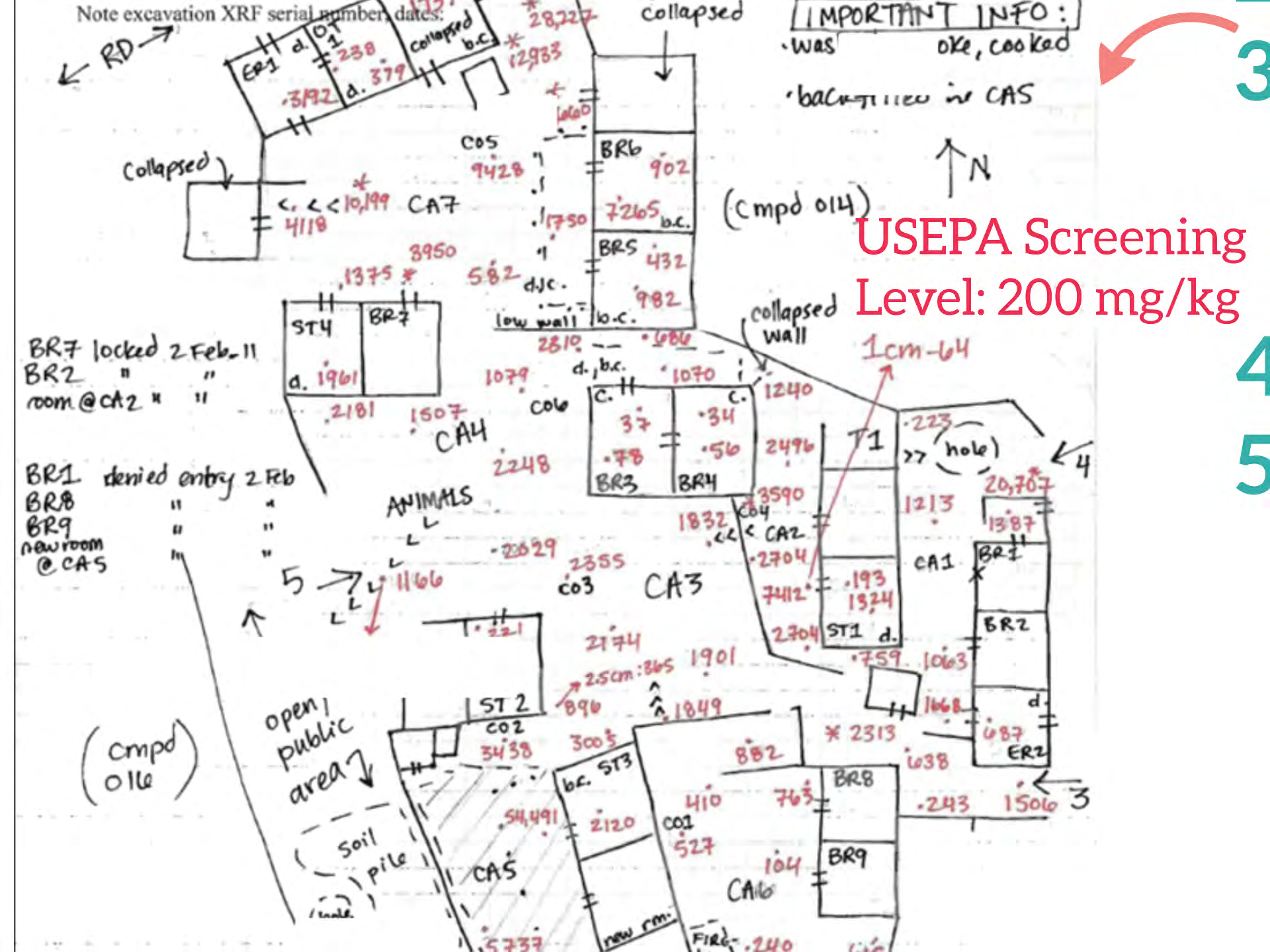
Note excavation XRF serial number, dates:
IMPORTANT INFO:
·was oKe, cooked
·backfilled in CAS
USEPA Screening Level: 200 mg/kg
collapsed
collapsed wall
(cmpd 014)
(cmpd 016)
BR7 locked 2 Feb-11
BR2 " "
room @CA2 " "
BR1 denied entry 2 Feb
BR8 " "
BR9 " "
new room @CA5
open/ public area
soil pile
ANIMALS
1cm-64
CA1
CA2
CA3
CA4
CA5
CA6
CA7
CO1
CO2
CO3
CO4
CO5
CO6
ST1
ST2
ST3
ST4
BR1
BR2
BR3
BR4
BR5
BR6
BR7
BR8
BR9
ER1
ER2
T1
new rm:
FIRE
N
1
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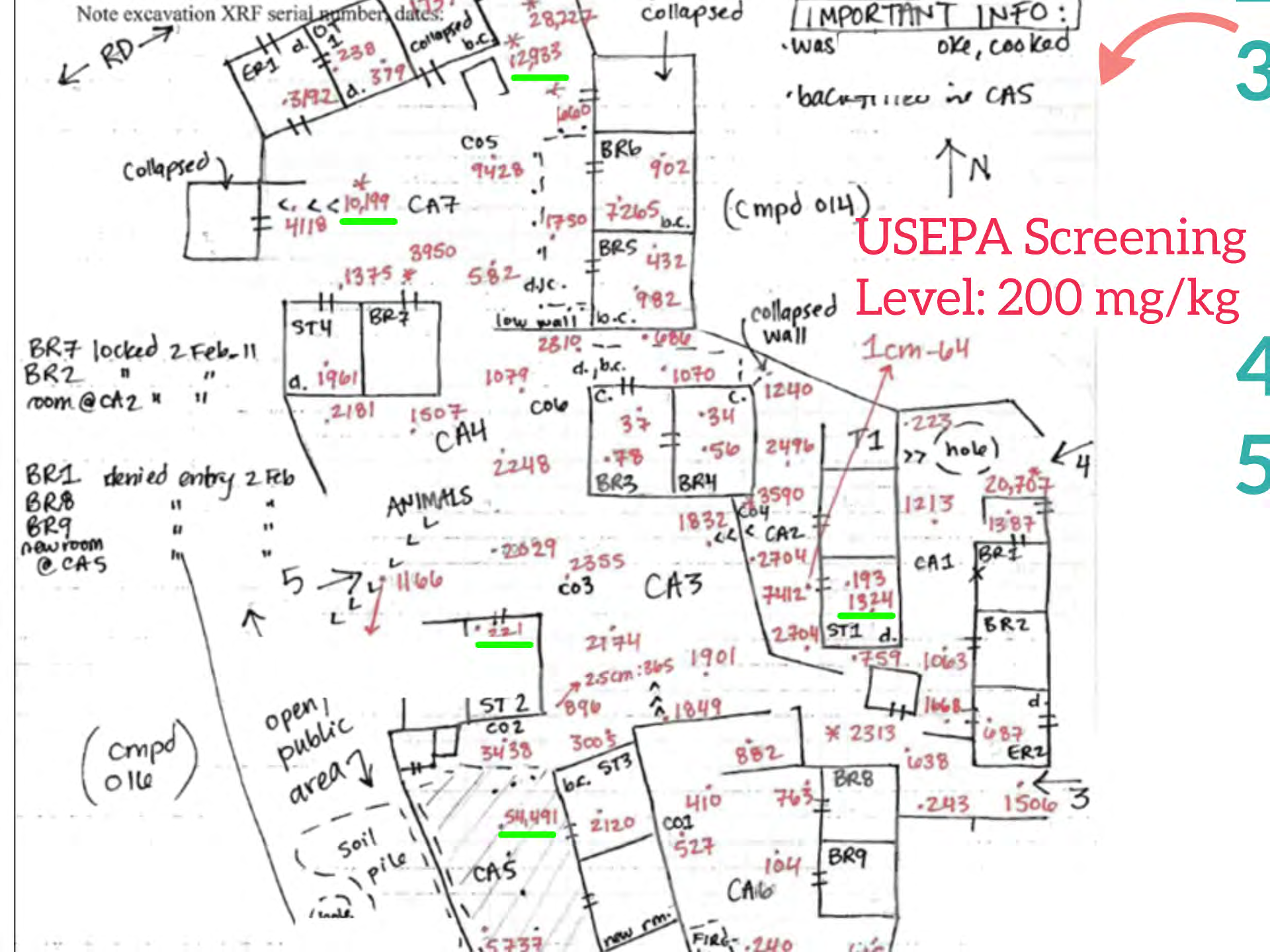
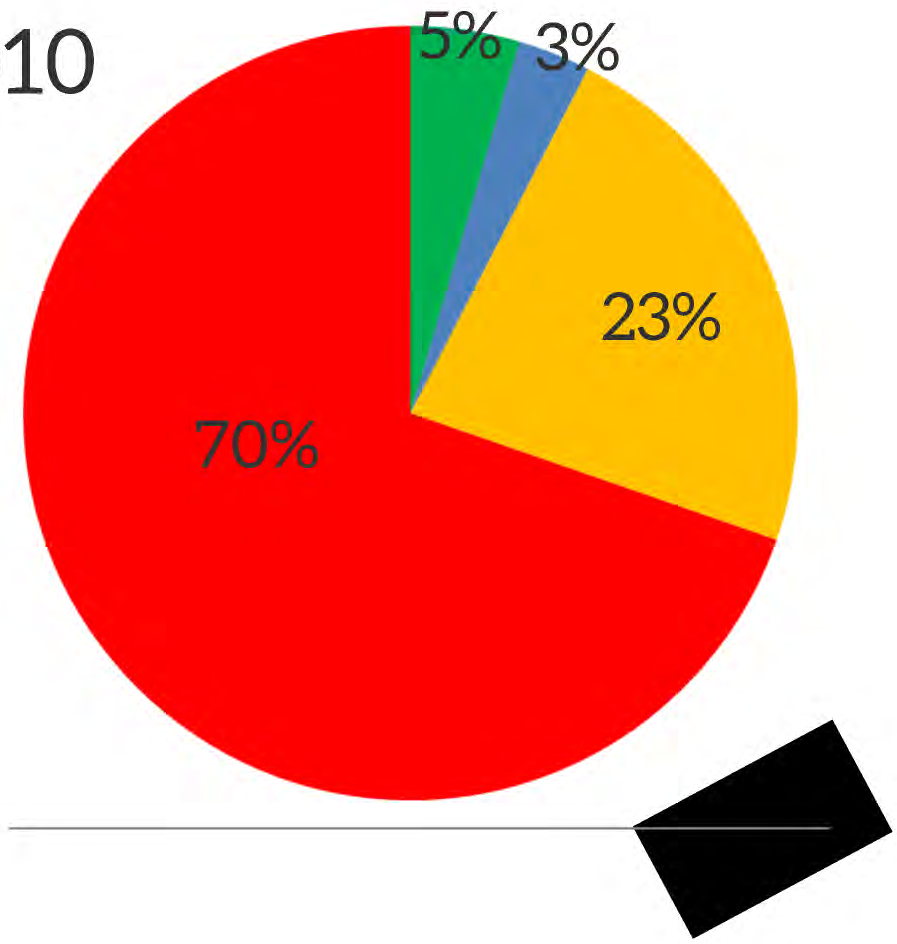

Note excavation XRF serial number, dates:
IMPORTANT INFO:
·was OK, cooked
·backfilled in CAS
N
(cmpd 014)
USEPA Screening Level: 200 mg/kg
collapsed
collapsed wall
low wall
BR7 locked 2 Feb-11
BR2 " "
room @CA2 " "
BR1 denied entry 2 Feb
BR8 " "
BR9 " "
new room @CAS
ANIMALS
open/ public area
Soil pile
(cmpd 016)
1cm-64
(hole)
CA1
CA2
CA3
CA4
CA5
CA6
CA7
CO1
CO2
CO3
CO4
CO5
CO6
ST1
ST2
ST3
ST4
BR1
BR2
BR3
BR4
BR5
BR6
BR7
BR8
BR9
ER1
ER2
T1
new rm:
FIRE
1
2
3
4
5

Yargalma homes, 2010

Maximum household soil lead concentration (mg/kg)

- Pb >5000
- Pb 1000-4999
- Pb 400 - 999
- Pb < 400



Former US EPA limit for Pb in residential soils (now 200 mg/kg)

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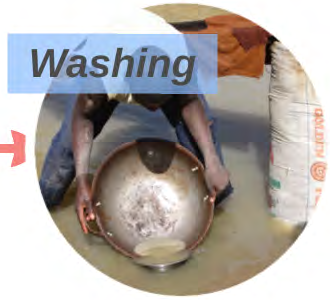
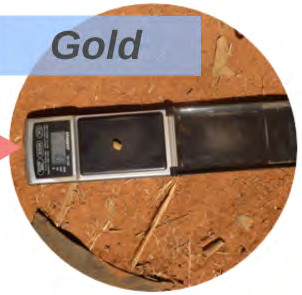




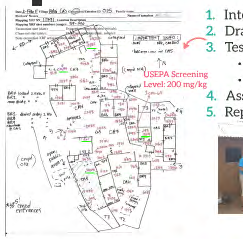
Profit

Assessing Exposure and Risk





Environmetal Sampling



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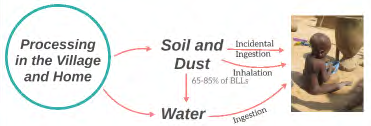
Gold Mining and Processing

Conceptual Site Model



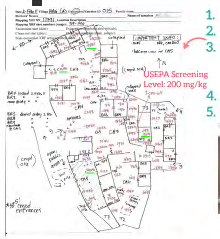
Dietary Exposures in Zamfara




Estimated dietary contribution to BLL: 11-34% of children's BLLs

Assessing Exposure and Risk

Environmetal Sampling



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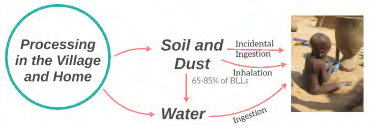

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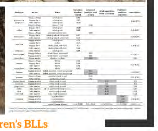


Estimated dietary contribution to BLL: 11-34% of children's BLLs

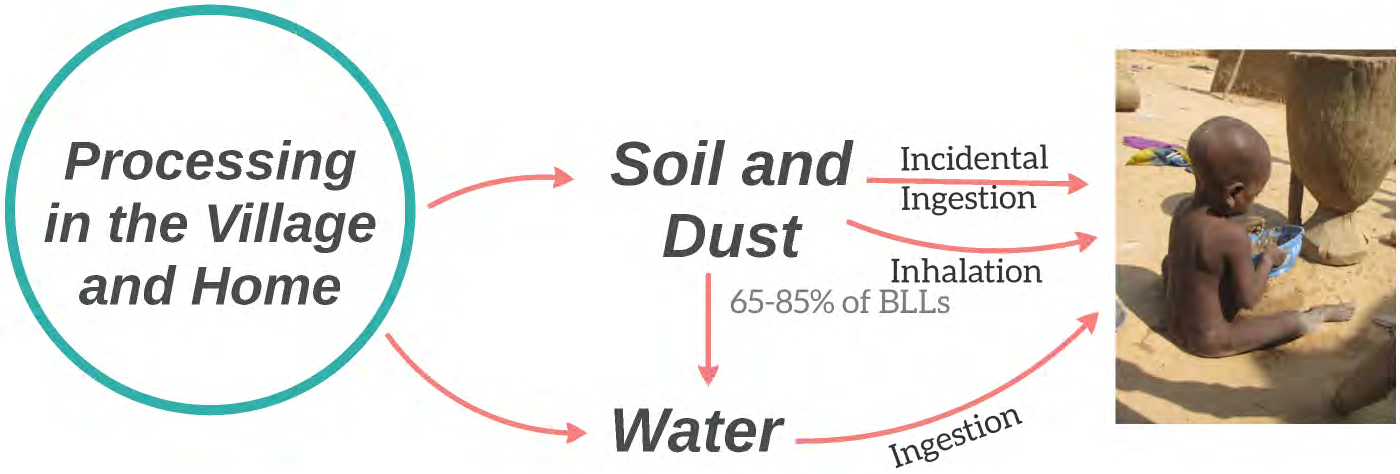
Dietary Exposures in Zamfara

food type	source	Notes	harvested, thrashed, stored	processed (ready to cook or eat)	dried vegetables, herbs, and spices	traditional medicines and herbs	mean (stdev)
guinea corn (sorghum)	Bagega village	whole grain	0.93				0.86 (077)
	Bagega farm	whole grain	0.41				
	Anka market	whole grain	<0.05				
	Bagega village	dried, milled		2.06			
millet	Bagega farm	whole grain	<0.05				0.41 (0.27)
	Anka market	whole grain	0.53				
	Bagega village	ground, ready to cook		0.66			
maize (corn)	Bagega farm	whole grain, dried kernels	0.27				0.20 (0.08)
	Anka market	whole grain, dried kernels	0.12				
local rice	Bagega market	whole grain	0.73				0.30 (0.26)
	Bagega farm	Hulled	<0.05				
	Bagega farm	whole grain, with hulls	0.2				
	Anka market	whole grain, with hulls	0.44				
white rice	Anka market	whole grain	0.09				
bread (white)	Bagega bakery	dried 3 days, pulverized		0.31			0.52 (0.29)
	Bagega bakery	dried 3 days, pulverized		0.92			
wheat flour	Gusau market	sifted wheat flour		0.32			0.32
cowpea	Bagega village	Whole	0.24				0.27 (0.12)
	Bagega farm	Whole	0.39				
	Anka market	Whole	0.36				
tapery bean	Anka market	Whole	0.081				
dadawa	Bagega market	boiled, pounded, dried, ready to eat		3.41			1.93 (1.49)
	Anka market	boiled, pounded, dried, ready to eat		0.44			
peanuts	Bagega village	pounded, ready to eat		0.92			0.51 (0.41)
	Anka market	paste ready to eat		0.1			
baobab leaves	Bagega market	dried, ready to cook			146		146
tomatoes	Bagega market	dried, ready to cook			0.3		0.3
ginger root	Anka market	dried, ready to cook			1.86		1.86
chillies	Anka market	dried, pulverized, ready to cook			0.62		0.62
okra	Anka market	dried, ready to cook			0.18		0.18
tamarind	Anka market	pods, ready to cook/eat			0.48		0.48
medicine	Bagega market	local medicine				0.69	1.40 (0.93)
	Bagega market	local medicine				0.79	
	Bagega market	local medicine				2.72	
	overall means (stdev)		0.32 (0.29)	0.85 (0.64)	24.91 (54.16)	0.74 (0.93)	0.66 (0.77)[1]

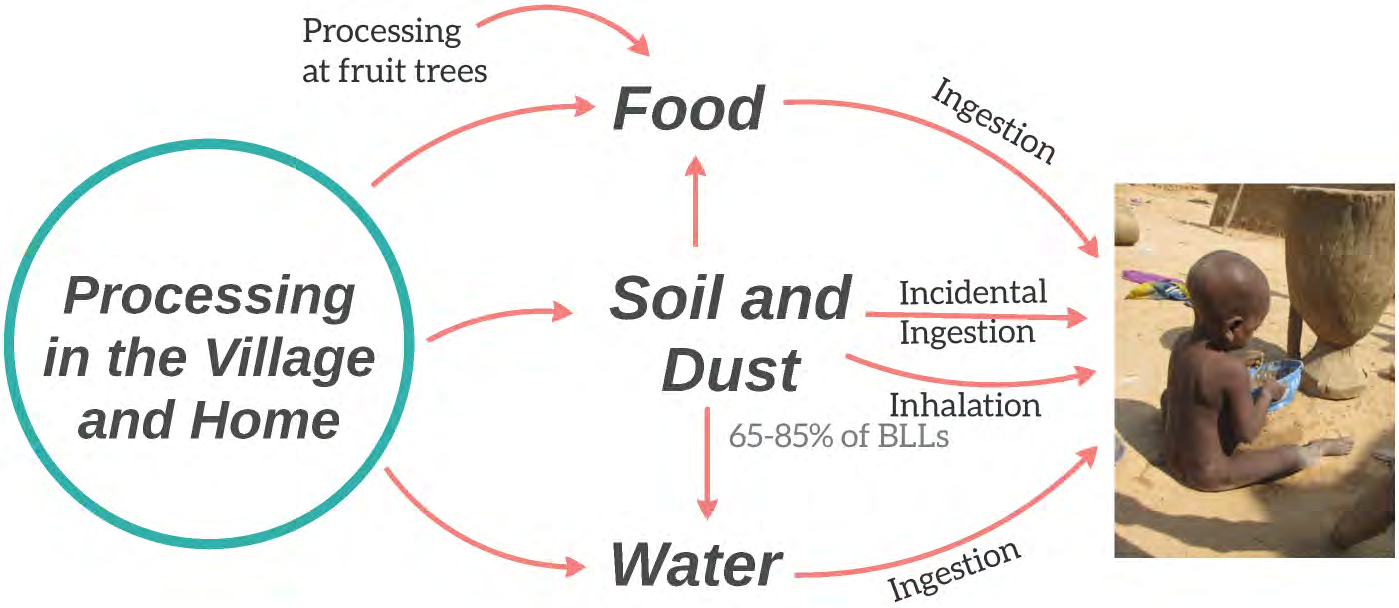
Table 3.2. Matrix of lead contamination levels (µg/g) in local foodstuff (ICP-AES results – dry weight) by food type and processing stage. Cells in gray were not included in dietary Pb intake analyses.

Estimated dietary contribution to BLL: 11-34% of children's BLLs

Conceptual Site Model



Conceptual Site Model



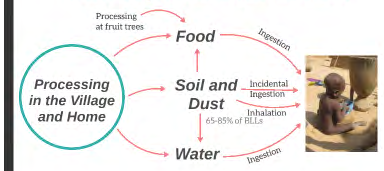
Assessing Exposure and Risk

Environmetal Sampling

1. Interview
2. Draw the site
3. Test using XRF
   - Gridded sampling
   - Judgmental sampling
4. Assess contamination depth
5. Report results to household

Gold Mining and Processing

Conceptual Site Model



Dietary Exposures in Zamfara

Estimated dietary contribution to BLL: 11-34% of children's BLLs

Environmental Health Intervention

Interdisciplinary Response

MEDECINS SANS FRONTIERES
DOCTORS WITHOUT BORDERS

MSF provides medical treatment (heavy metal chelation or "succimer")

http://www.doctorswithoutborders.org/

http://www.doctorswithoutborders.org/

TERRAGRAPHICS INTERNATIONAL FOUNDATION
Working with Communities to Mitigate Environmental Pollution

TIFO advises government on implementing environmental remediation

Objectives of Remediation

- Implement emergency environmental remediation to abate exposures;
- Facilitate chelation treatment of children ≤ 5 years old;
- Establish local capacity to prevent future disasters

Environmental Remediation

- Modification of US (Superfund) hazardous waste removal protocols to local resources and culture
- Progressing from an emergency response to comprehensive cleanup funded and accomplished by the Nigerian government.

Excavation

Clean Soil

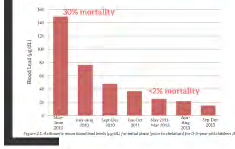
Disposal

Health Messaging

Results (Zamfara)

Village	Phase	Compounds Tested	Compounds Remediated	Exteriors Remediated	Ponds Remediated	Pre-rem. Mean Pb Conc. (mg/kg)	Post-rem. Mean Pb Conc. (mg/kg)	Exposure Reduction
Dareta	I	94	85	13	4	3582	83	98%
Yargalma	I	66	63	11	3	4143	179	96%
Abare	II	96	74	20	0	1343	90	93%
Tungar Guru	II	39	31	6	1	874	83	91%
Sunke	II	93	83	38	10	1119	106	91%
Tungai Daji	II	78	75	21	10	780	72	91%
Duza	II	57	57	8	2	300	70	77%
Bagega	III	423	352	54	1	670	90	87%
Total		944	820	101	31	3111	94	98%

Table 2.1. Pre- and post-remediation soil Pb concentrations and ranges of residential compounds, common areas, and ponds.



89% reduction in soil lead concentrations

88% reduction in blood lead concentrations

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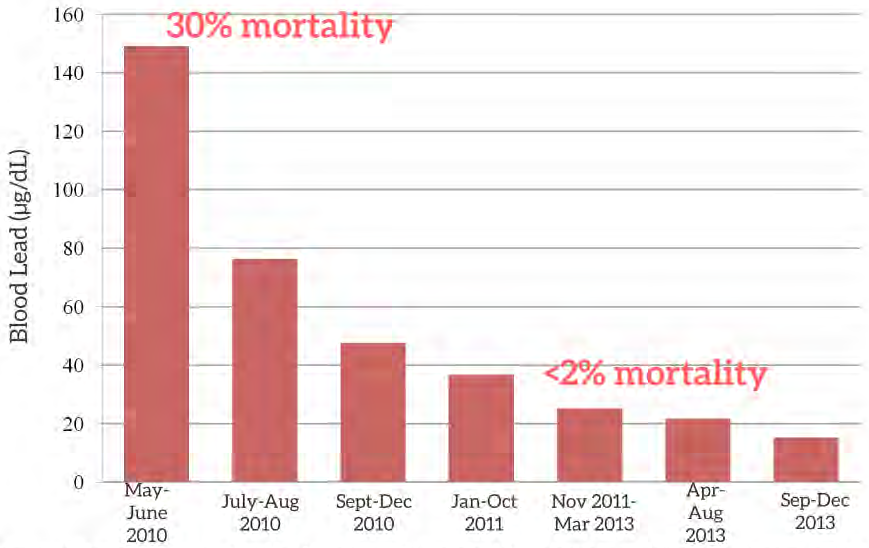

Figure 2.1. Arithmetic mean blood lead levels (µg/dL) for initial draw (prior to chelation) for 0-5-year-old children (MSF 2014).

89% reduction in soil lead concentrations

88% reduction in blood lead concentrations

Zamfara, Nigeria Lead Poisoning Response

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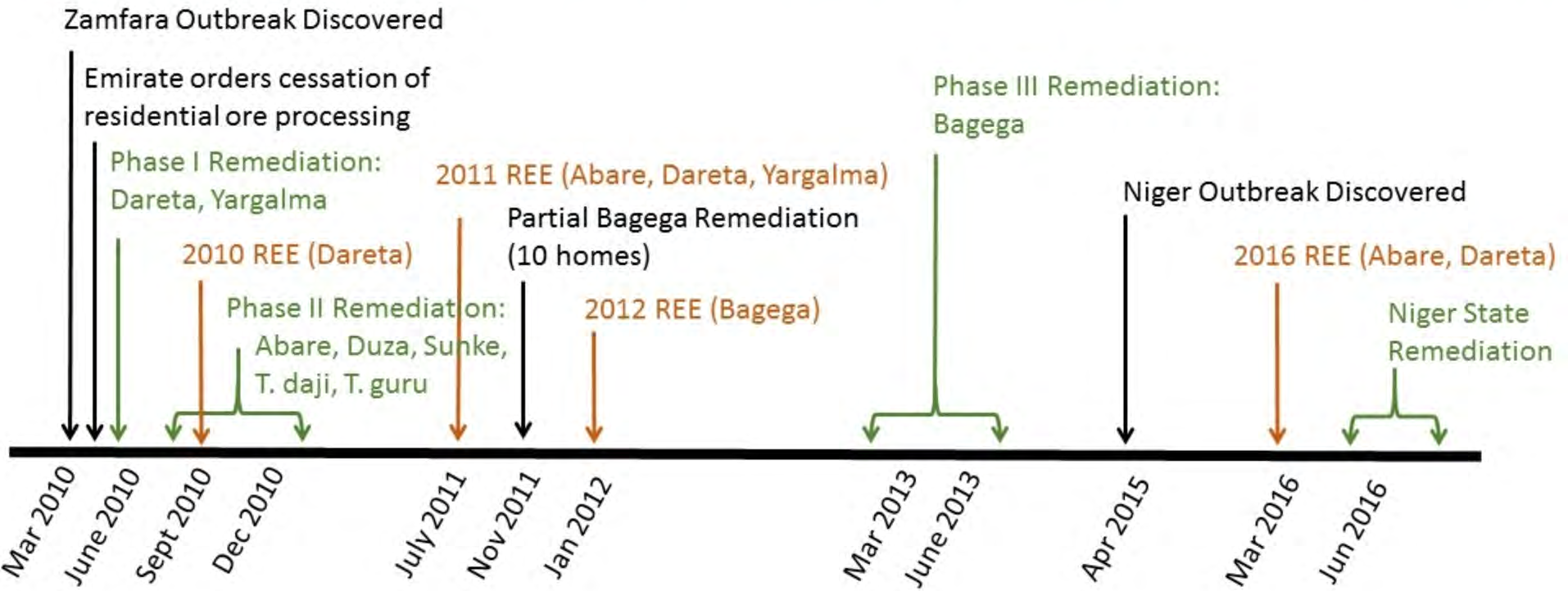
Casey Bartrem, PhD, Executive Director, TerraGraphics International Foundation

Remedial Effectiveness Eval



Objectives

1. Assess the efficacy of remediation in reducing BLLs.

Methods

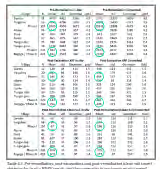
Two subsets of homes tested:
- "Biased" homes with elevated BLLs
- Random homes
- *In situ* XRF testing

XRF validation
- Collect samples to compare *in situ* XRF to *ex situ* sieved ICP-MS results

Interviews
- Child's daily activities
- Where child eats/sleeps/plays
- Places visited during the day
- Observations of child's behavior

Community Discussions

Soil Results



Significant recontamination in villages with increasing BLLs

Abare reached pre-remediation soil lead levels

Dareta had ubiquitous, lower-level recontamination

SIA Res

Objectives

1. Assess the efficacy of remediation in reducing BLLs.

2. Assess the degree of any recontamination.

3. Assess the effectiveness of institutional controls in sustaining the remedy.

4. Assess the capacity of Nigerian governments to prevent and respond to future crises.

Soil Results

Village	N	Pre-Remediation *in situ* Mean	std	Geomean	gstd	Pre-Remediation Converted Mean	std	Geomean	gstd
Dareta	91	3490	4421	1366	4.9	9773	12379	3826	4.9
Yargalma	66	4143	4786	2206	3.5	11601	13400	6177	3.5
Phase I	157	3765	4574	1671	4.3	10541	12808	4679	4.3
Abare	96	1343	2724	457	4.1	3761	7628	1280	4.1
Duza	42	300	367	179	2.8	841	1027	501	2.8
Sunke	82	861	879	547	2.7	2410	2460	1531	2.7
Tungar daji	75	780	848	522	2.4	2183	2374	1461	2.4
Tungar guru	38	1118	2087	486	3.9	3129	5843	1360	3.9
Phase II	333	940	1756	440	3.3	2633	4917	1233	3.3
Bagega / Phase III	423	831	1574	360	3.3	2328	4407	1008	3.3

Village	N	Post-Excavation XRF *in situ* Mean	std	Geomean	gstd	Post-Excavation XRF Converted Mean	std	Geomean	Gstd
Dareta	12	120	43	111	1.5	336	121	312	1.5
Yargalma	20	161	64	148	1.6	451	179	414	1.6
Phase I	32	146	60	133	1.6	408	167	372	1.6
Abare	50	118	30	114	1.4	331	85	318	1.4
Duza	26	116	44	106	1.6	323	124	296	1.6
Sunke	68	163	120	130	2.0	457	335	365	2.0
Tungar daji	59	125	59	115	1.5	349	166	321	1.5
Tungar guru	26	209	103	190	1.5	584	287	532	1.5
Phase II	229	143	87	125	1.7	401	244	349	1.7
Bagega / Phase III	266	156	132	127	1.9	438	371	356	1.9

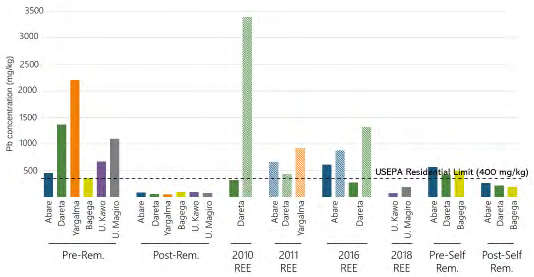
Village	N	Post-Remediation Clean Soil *in situ* Mean	std	Geomean	gstd	Post-Remediation (Clean Soil) Converted Mean	std	Geomean	Gstd
Dareta	91	69	42	58	1.9	165	130	111	2.7
Yargalma	66	64	39	56	1.7	144	119	108	2.2
Phase I	157	67	41	57	1.8	156	126	110	2.5
Abare	96	96	42	86	1.7	253	128	211	2.0
Duza	42	95	33	88	1.6	261	90	241	1.6
Sunke	82	107	37	100	1.5	283	110	253	1.7
Tungar daji	75	112	34	106	1.5	296	101	272	1.6
Tungar guru	38	108	42	97	1.7	284	119	252	1.7
Phase II	333	104	38	95	1.6	275	113	242	1.8
Bagega / Phase III	423	103	33	97	1.4	277	97	257	1.5

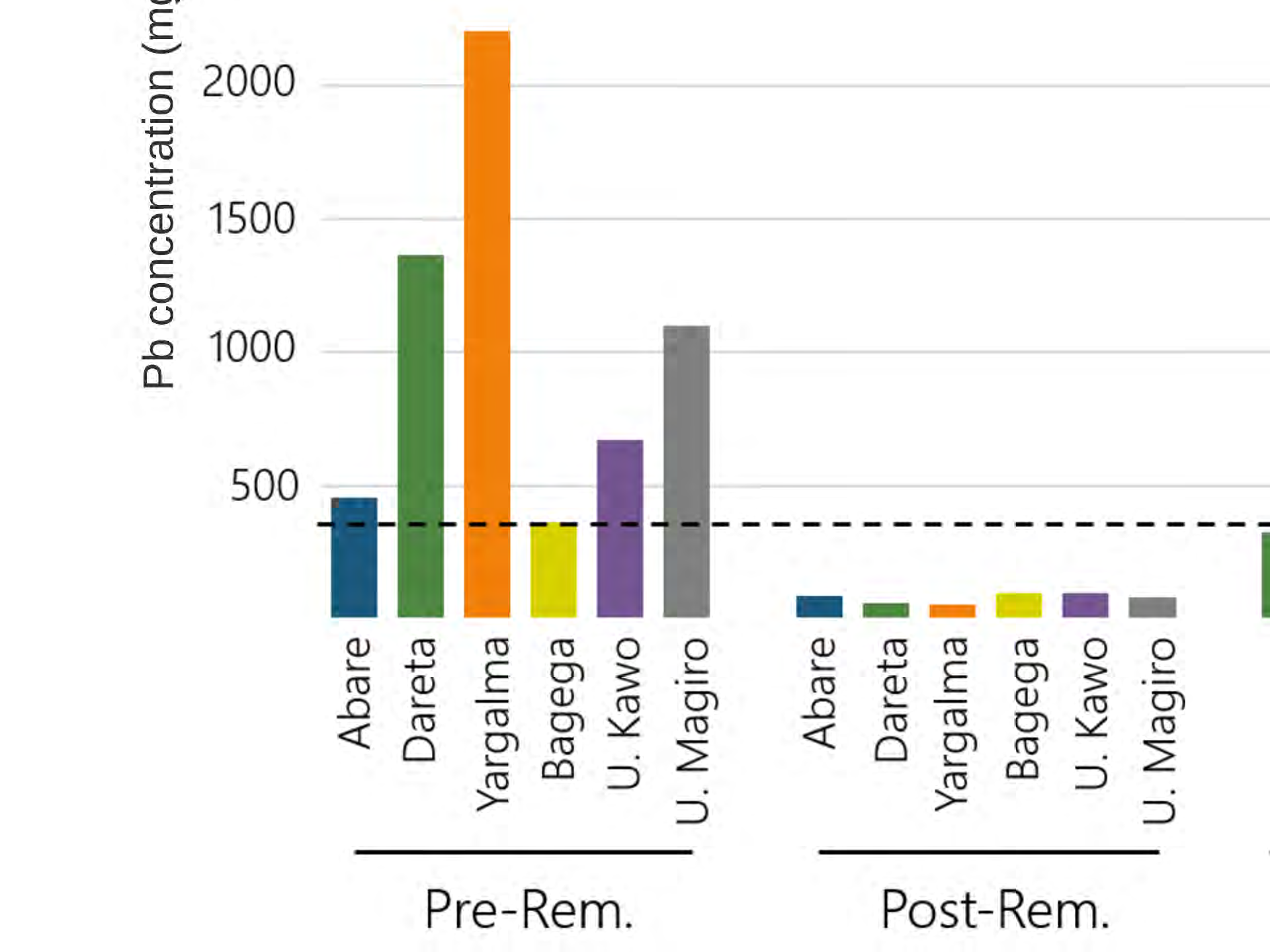
Table 4.5. Pre-remediation, post-excavation, and post-remediation (clean soil cover) statistics for in situ *PXRF results and the conversion to analogous* ex situ *sieved (-80 mesh) ICP-MS results (mg/kg).*

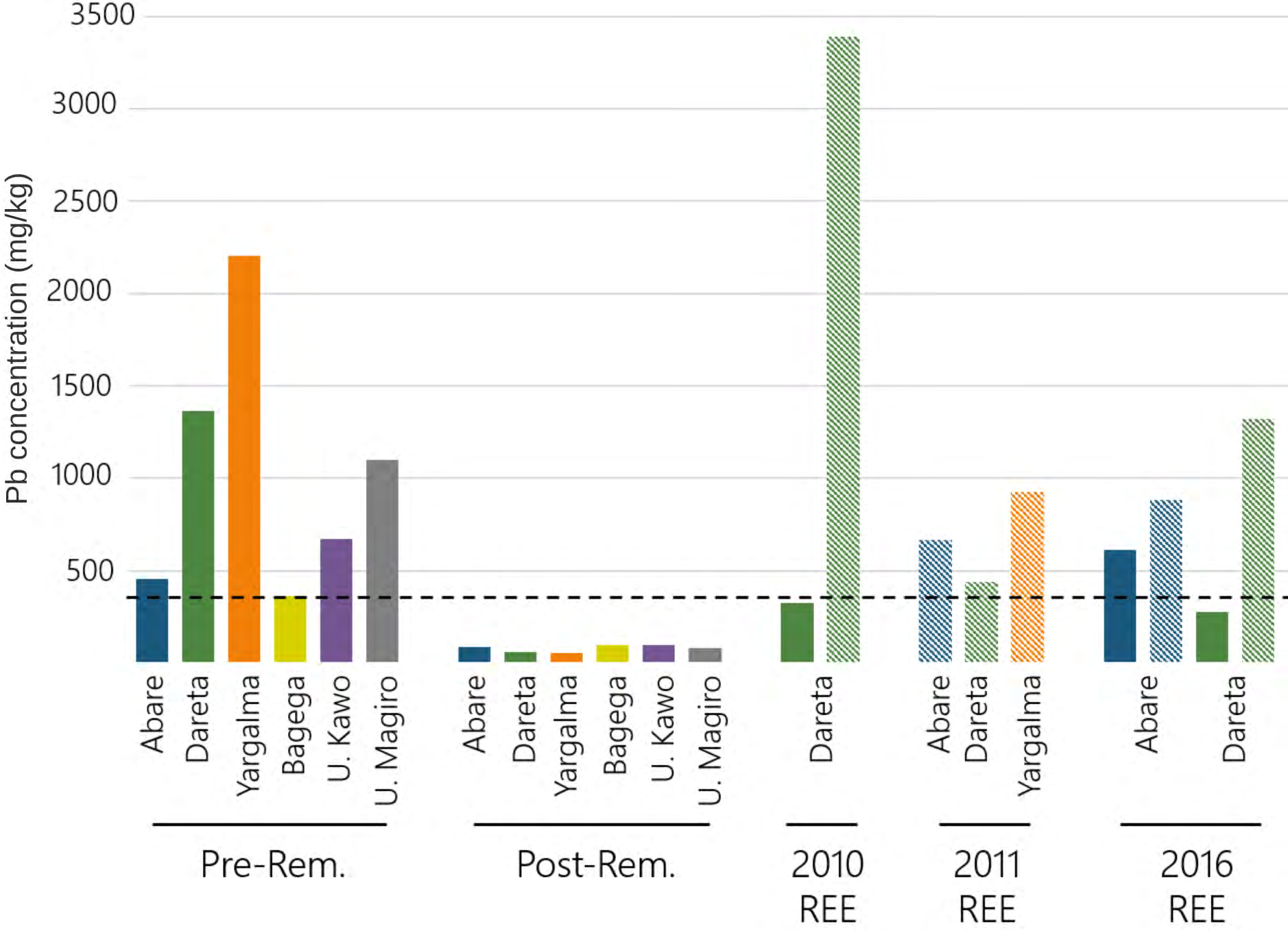
Significant recontamination in villages with increasing BLLs

Abare reached pre-remediation soil lead levels

Dareta had ubiquitous, lower-level recontamination



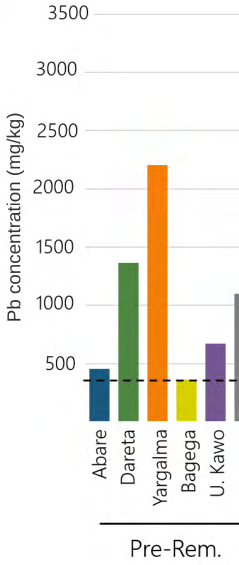

Pb concentration (mg
2000
1500
1000
500
Abare
Dareta
Yargalma
Bagega
U. Kawo
U. Magiro
Abare
Dareta
Yargalma
Bagega
U. Kawo
U. Magiro
Pre-Rem.
Post-Rem.


Pb concentration (mg/kg)
3500
3000
2500
2000
1500
1000
500
Abare
Dareta
Yargalma
Bagega
U. Kawo
U. Magiro
Abare
Dareta
Yargalma
Bagega
U. Kawo
U. Magiro
Dareta
Abare
Dareta
Yargalma
Abare
Dareta
Pre-Rem.
Post-Rem.
2010 REE
2011 REE
2016 REE

10	2.5
11	2.0
41	1.6
53	1.7
72	1.6
52	1.7
42	1.8
57	1.5

an soil cover)
itu sieved

lower



Institutional Controls Program

- Administrative & legal controls to minimize exposures & protect remediation
- Maintained in perpetuity
- Coordinated medical/ environmental/ occupational health/ community effort
- Based on scientific principals/ high-quality data
- Developed and/or adapted locally

ICP in Nigeria

- Health promotion, occupational health & safety training, environmental monitoring, biomonitoring
- Culturally & economically appropriate
- Village councils
- Long-term maintenance includes
  - Self-reporting
  - Institutional surveillance
  - Self-remediation

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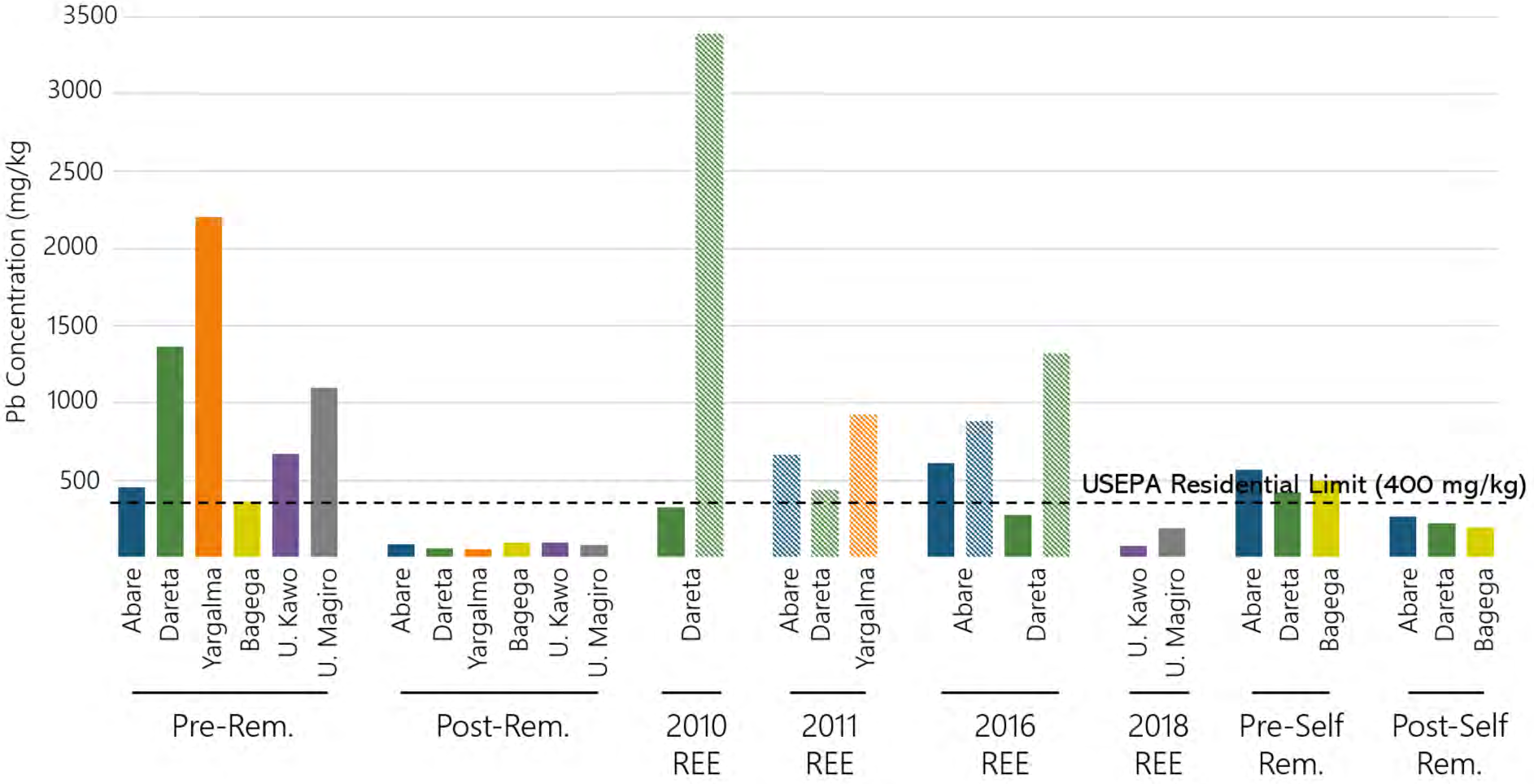
Pb Concentration (mg/kg
3500
3000
2500
2000
1500
1000
500
USEPA Residential Limit (400 mg/kg)
Abare
Dareta
Yargalma
Bagega
U. Kawo
U. Magiro
Pre-Rem.
Post-Rem.
2010 REE
2011 REE
2016 REE
2018 REE
Pre-Self Rem.
Post-Self Rem.

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1. Engage local and regional leaders from day 0.

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1. Engage local and regional leaders from day 0.
2. Tackle major sources of exposure, then start investigating and addressing secondary sources.

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1. Engage local and regional leaders from day 0.
2. Tackle major sources of exposure, then start investigating and addressing secondary sources.
3. Always be working towards development of an intervention that removes the exposure source.