

Zamfara State Lead Poisoning Epidemic Environmental Remediation

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ZAMFARA MINISTRY OF ENVIRONMENT



World Health
Organization



BLACKSMITH
INSTITUTE



MEDECINS
SANS FRONTIERES



Where the Story Starts



- May 2010 – CDC & World Health Organization Investigation.
 - 163 deaths in two villages
 - About 33% of children < 5 years old died of lead poisoning
 - Emergency Response Begins

Where is Zamfara State, Nigeria?



Zamfara State – Cultural & Economic Context

- Socio-economic : extremely poor
- Religious: traditional Muslim/Sharia
- Family Structure: polygamous extended family
- Political/Governmental: intense/challenged



- Geographic: remote, unreliable power and water
- Climatic: hot and extreme wet or dry, harmattan
- Security: travel restrictions
- Health and Environment: several endemic diseases, limited medical facilities

Zamfara State Culture – Hausa



- Agrarian (Farmers)
- Villagers



Zamfara State Culture – The Fulani



- Herders
- Nomadic
- Indigenous group



Project Background



- The worst lead poisoning in history
- 400 to 500 children have died
- 30 to 43% of all children under the age of 5
- 45% of cases presented to clinics died in early stages
- 17,000 villagers lead poisoned
- Long-term irreversible health effects



Agriculture to Artisanal Mining

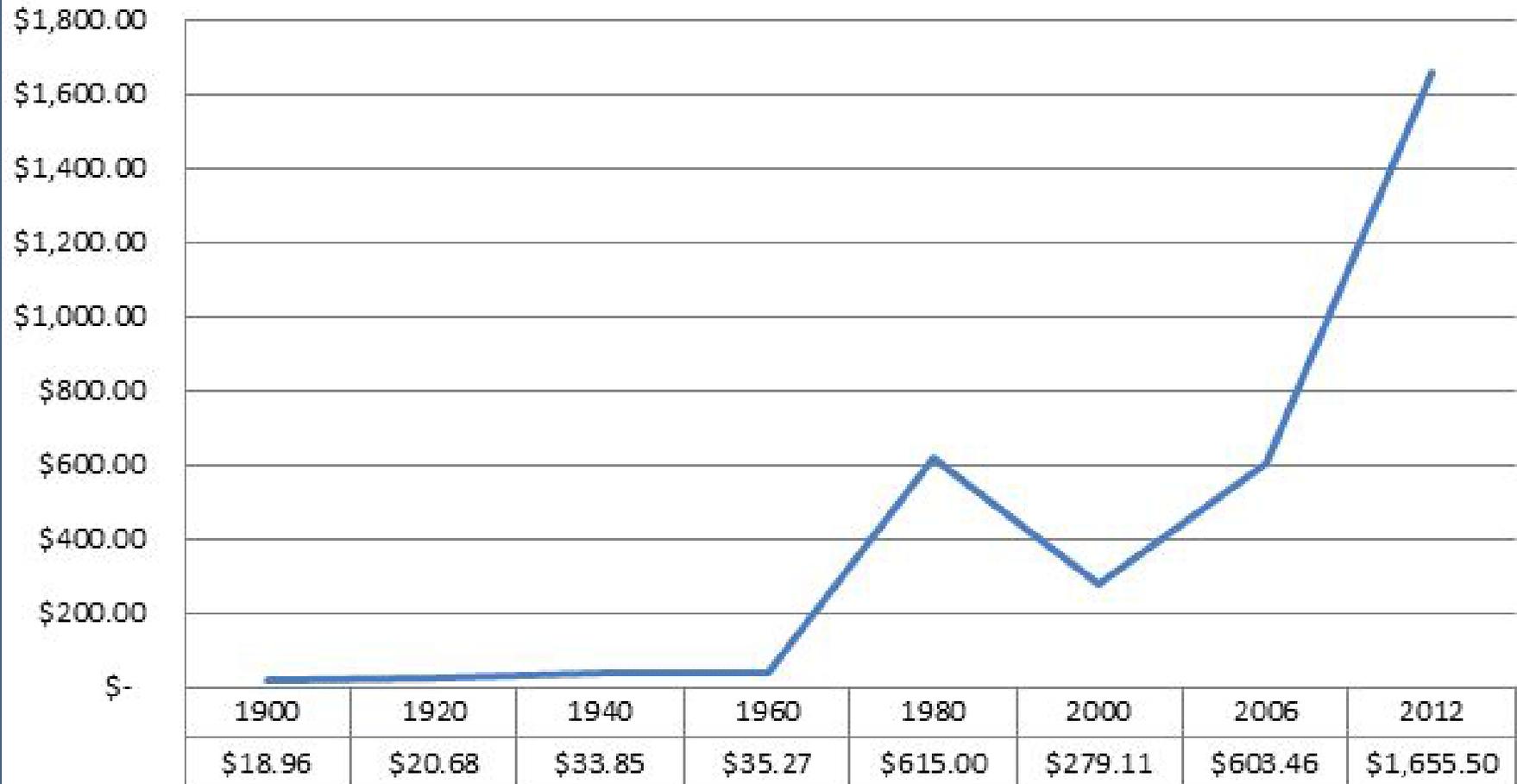


Agriculture to Artisanal Mining

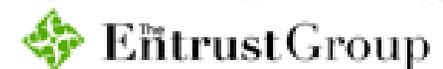


- Agriculturally, a family typically makes/lives on \approx 700 NGN/day (5 USD)
- Processing the gold ore, they can make $>$ than 2,000 NGN/day (13 USD)

Price of Gold: 1900 - 2012



Sources: National Mining Association, GoldPrice.org



In the Villages: From Ore to Gold

Ore



Villages

Gold



- Breaking
- Grinding
- Washing
- Drying
- Cooking

Sunke Mine



NW Nigeria Ore - Gold occurs in quartz veins within hydrothermally altered schist



Breaking in the Village



Grinding the Ore





Washing





Cooking



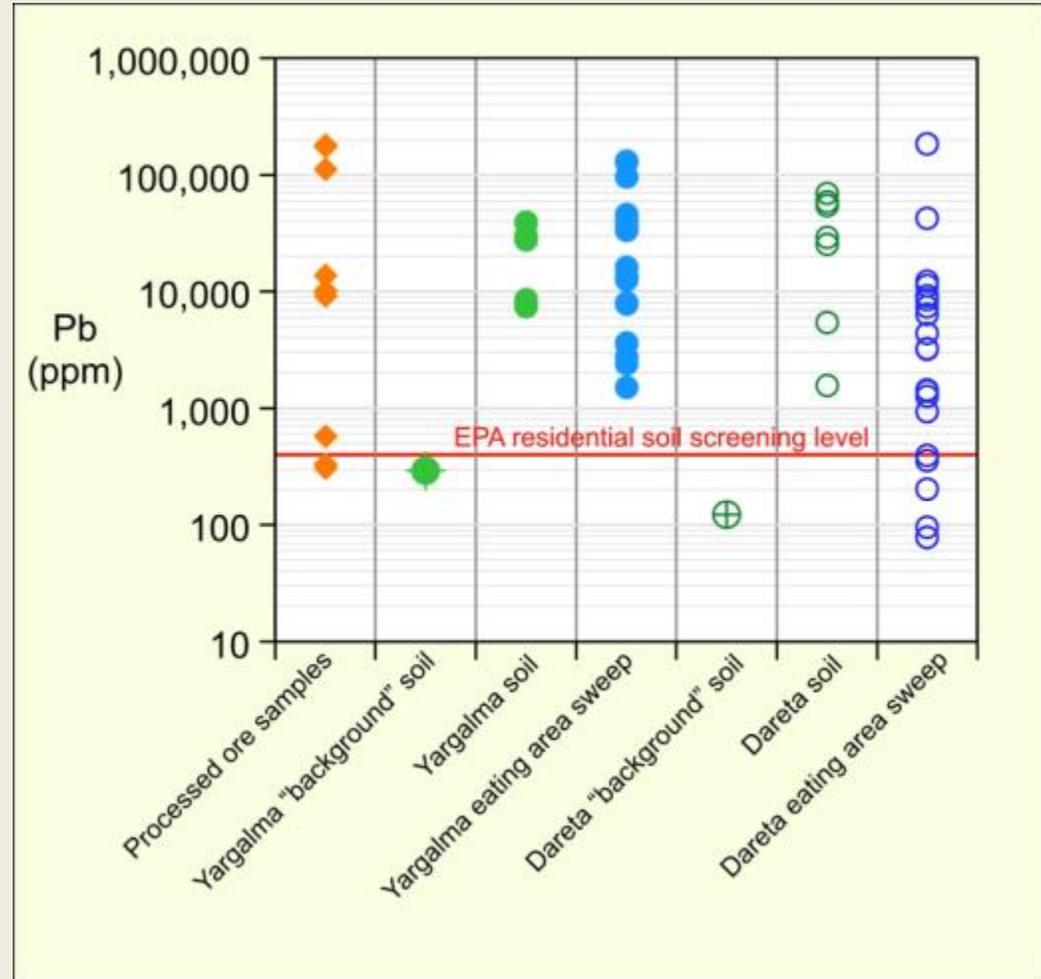
The Final Product



Lead Concentrations

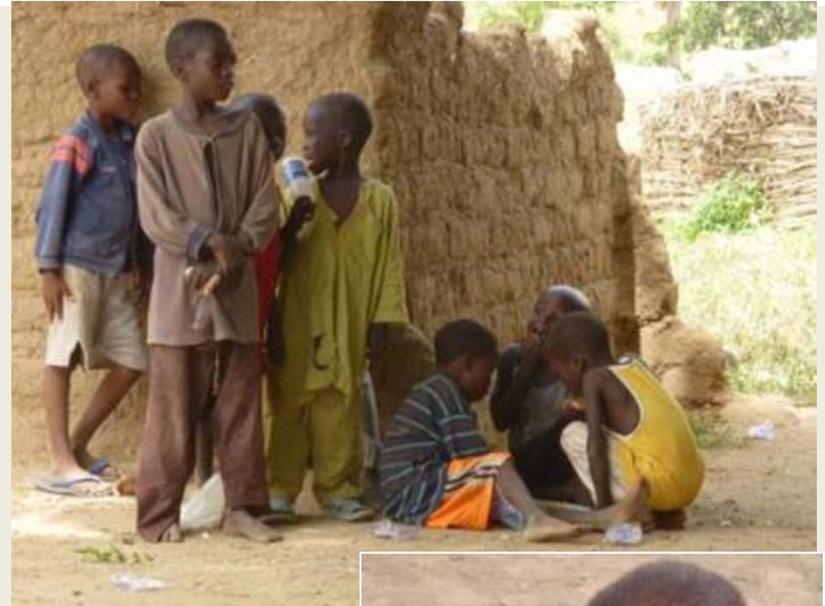


- Lead levels as high as 9 percent (90,000 ppm) in soils and 18 percent (180,000 ppm) in sweep samples



Lead Exposure Routes

- Children eat soil! Most at risk
- High ingestion rates



Discoveries During Phase I

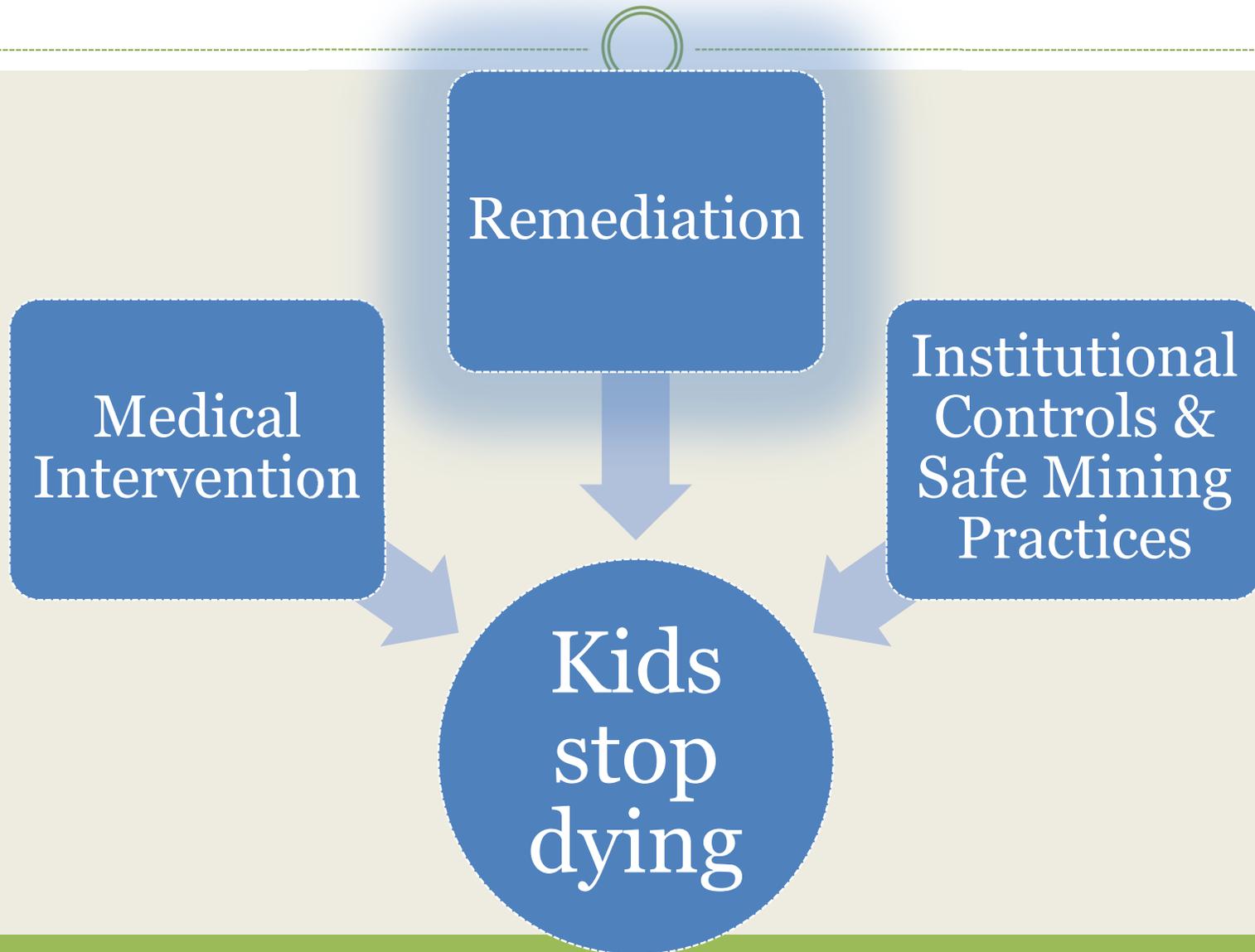


- Much worse than initially conceived
 - Price of Gold highly favorable
 - Ore Processed in the Villages and in Compounds
 - Ore with High Lead Content Produced Lead Dust
 - Lead Dust Contaminated Soil, Food, and Water
 - Villagers Consumed Lead by Eating / Breathing Dust
 - Nearly Every Villager was Poisoned and Damaged
 - Killing and Disabling the most vulnerable Villagers – Pregnant Women and Small Children



Response Plan

Integrated Response



Remediation – Work Summary



- **General Process**

1. Characterize Lead Contamination (Mapping)
2. Excavation
3. Disposal
4. Clean Soil/Capping



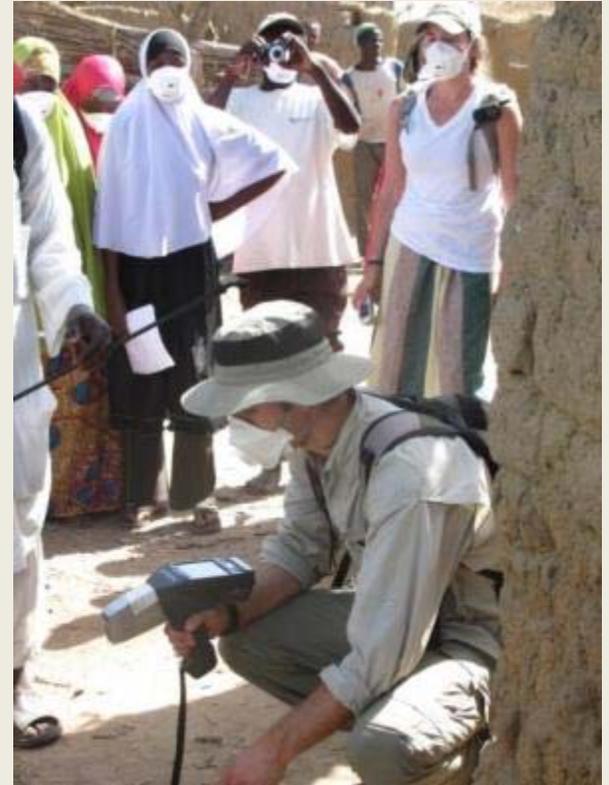
Remediation – Characterization

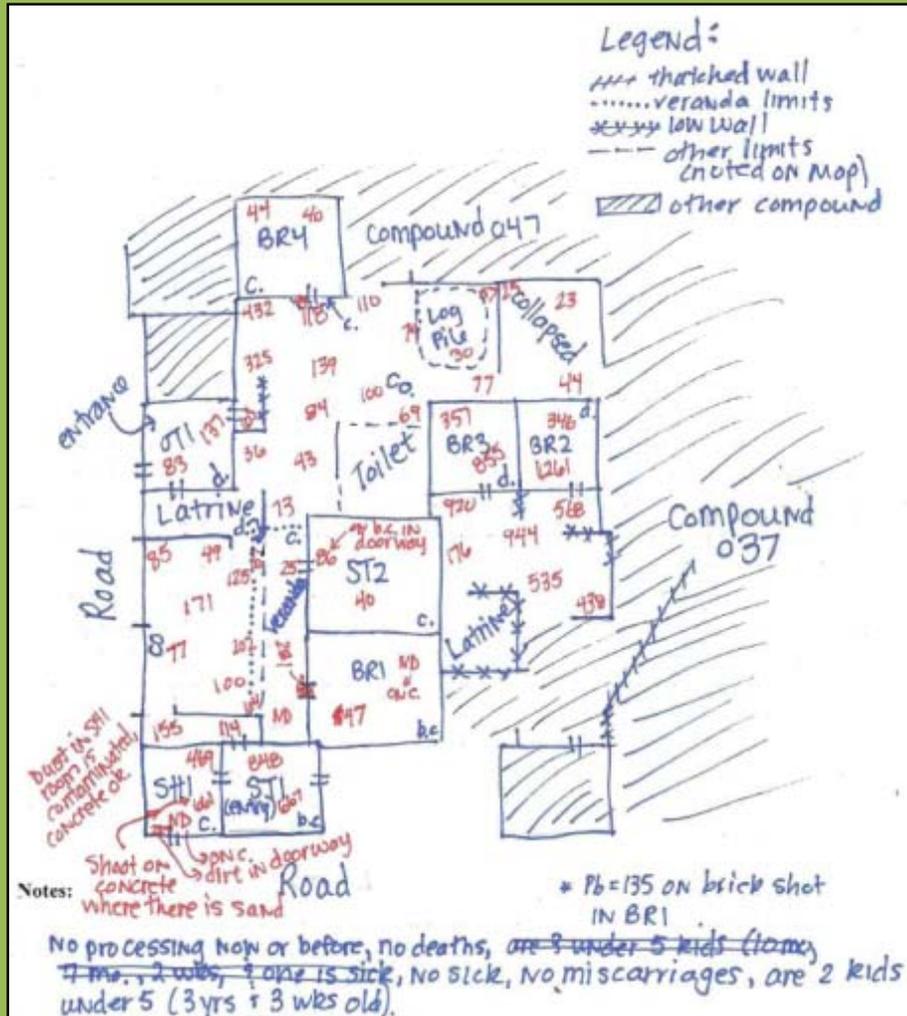


- Characterization Elements
 - Map each compound – plan view
 - Interview household members



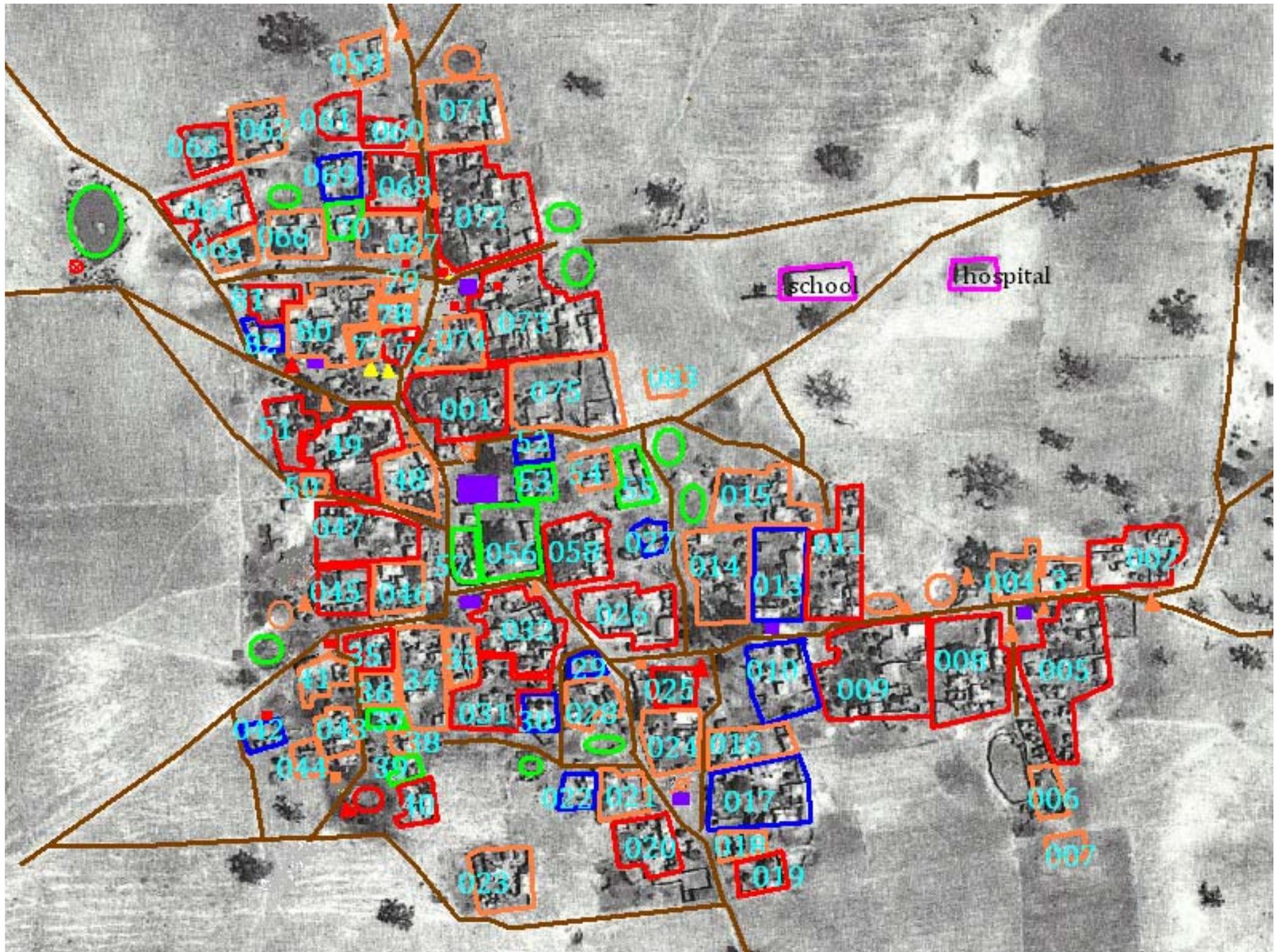
- XRF Sampling
 - ✦ Grid Pattern
 - ✦ Biased Sampling
- Define action areas
- Wipe samples – mortars & concrete





Initial Mapping





Remediation – Excavation

- Excavation Work

- Performed by excavation crews
- Scrape/dig using hoes & picks
- Bag up contaminated soil
- Verification XRF sampling









Disposal



• Disposal Work

- Performed by disposal crews
 - ✦ Managers & supervisors
 - ✦ 7 villagers per crew
- Collect sacks with excavated soil
- Load onto cantors
- Haul to landfill
- Unload and slash sacks
- Compact sacks w/equipment



















Seven Landfills Closed with Monuments



Remediation – Clean Soil/Capping

- Performed by clean soil crews
 - ✦ Managers & supervisors
 - ✦ 5 villagers per crew
- Clean soil staging – pay loader
- Haul into compounds with wheel barrows
- Spread clean soil over designated areas (including any excavated area)
- Thickness \approx 3 inches
- Verification XRF sampling
- Concrete capping as necessary











Nigeria ... Other Areas of Interest

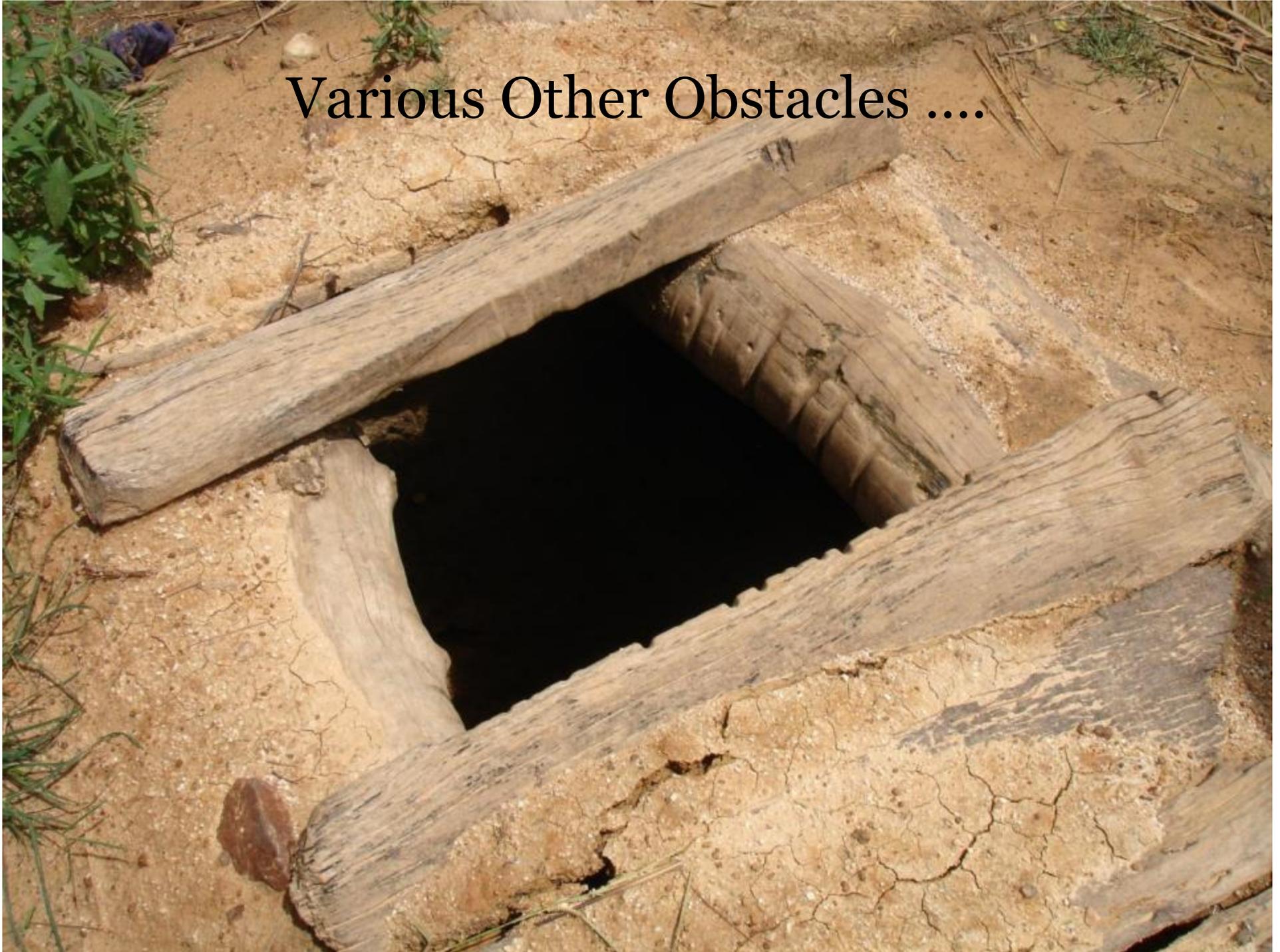


On the Road





Various Other Obstacles







Hope for the Future



- 8 Villages Remediated
- Lead Exposure Relief to Thousands
- Thousands of Children Treated
- 300 Community Members Trained
- Villagers Amiable to Safer Mining Practices





Questions?