Opportunities for citizen science in reducing exposure to environmental hazards: Lead in soil and arsenic in well-water

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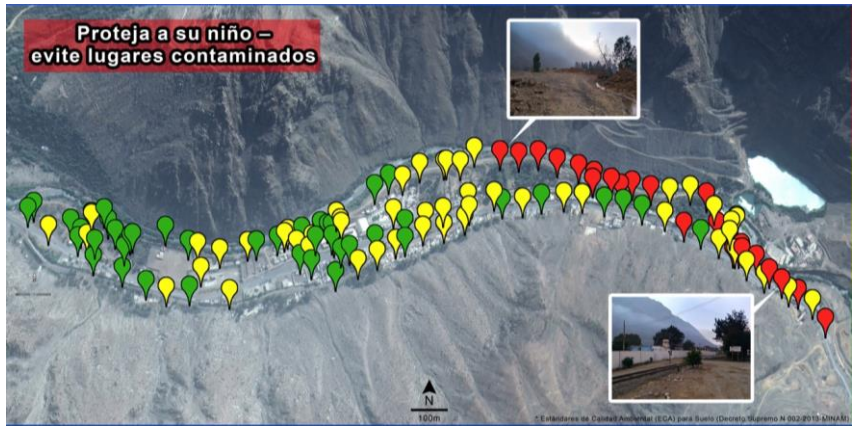
Key feature: highly heterogeneous distribution of contaminants

Soil lead (Pb) in the Andes

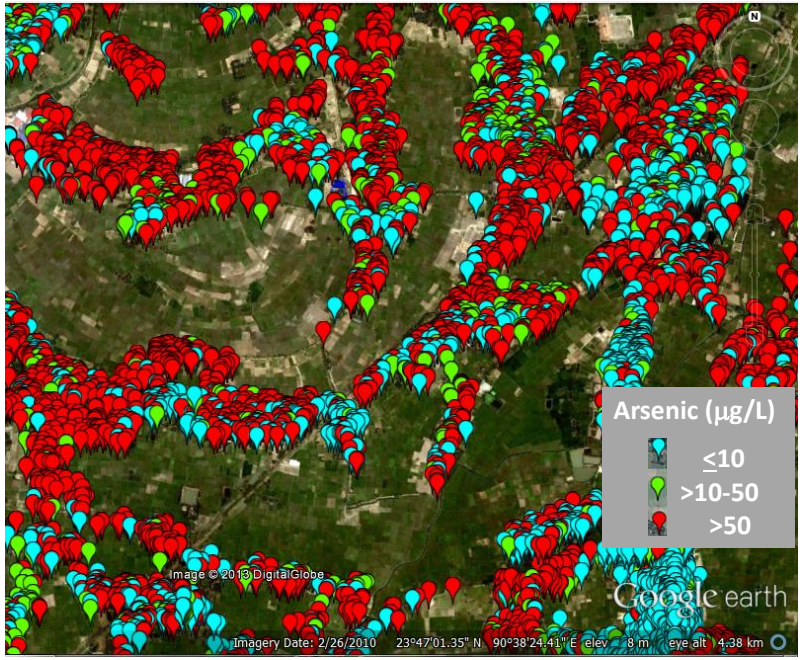
Landes et al. in prep.



Johny Ponce

Well-water arsenic (As) in Bangladesh

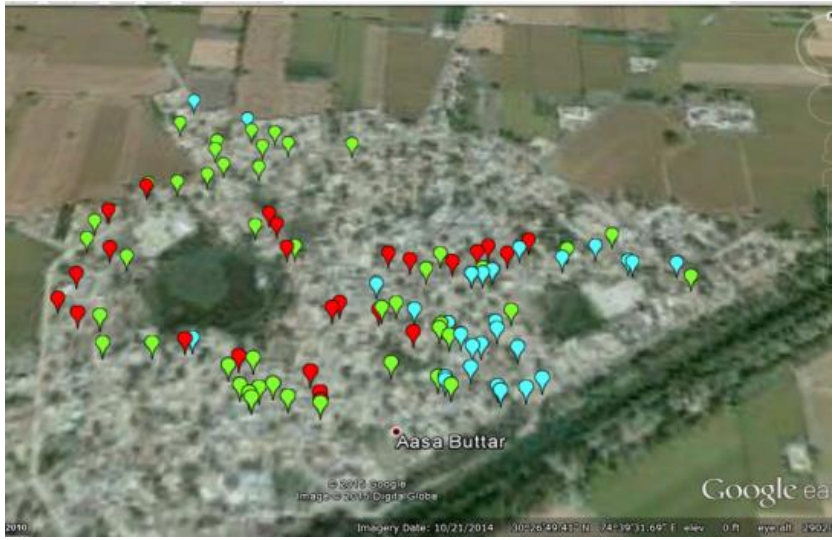
van Geen et al. *Sci Tot Env* 2014



Kazi Matin Ahmed

Well-water fluoride (F) in Punjab

Kumar et al. in prep



F (mg/L) ≤1.5 1.5-3 >3

Chander Kumar Singh

High-resolution testing required for (a) exposure assessment and (b) rapid exposure reduction at relatively low cost.

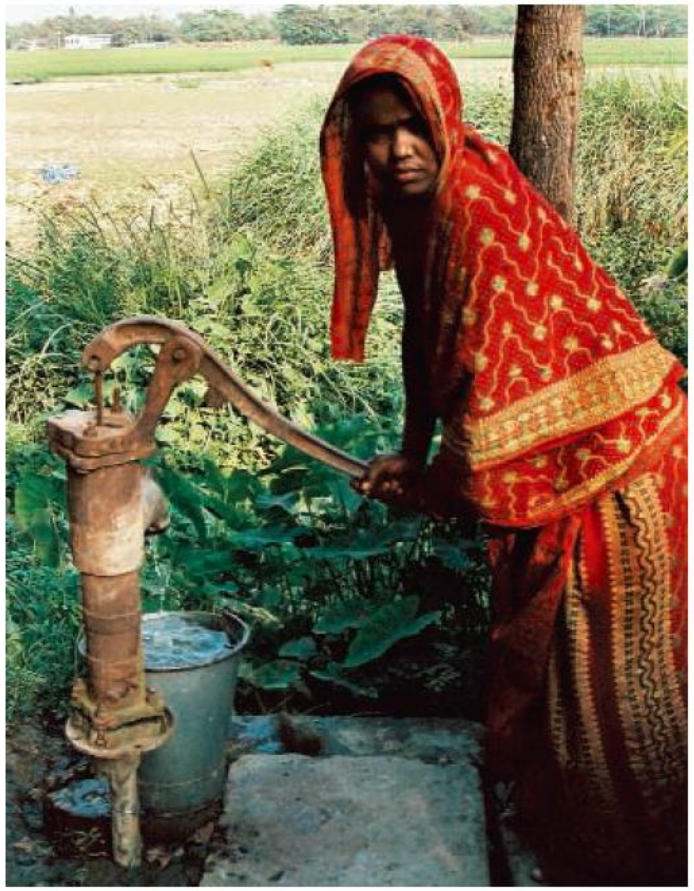
therefore, local participation is key for impact

Soil lead (Pb) in the Andes

Well-water arsenic (As) in Bangladesh

Well-water fluoride (F) in Punjab

Health effects of chronic exposure to arsenic



mid-1980s KC Saha
Department of Dermatology
School of Tropical Medicine
Kolkota, India

Dipankar Chakraborti
Jadavpur University, Kolkata

beyond skin lesions, cancers, amputations: cardio-vascular disease

all-cause deaths almost twice as high when drinking >150 ug/L As
compared to ≤10 ug/L (WHO guideline) in Araihazar, Bangladesh
=> about 20% of deaths in population

Argos et al. *The Lancet* 2010; Chen et al. BMJ 2011

Also dose-response relationships for reduced intellectual function in children

Wasserman et al. *Env. Health Perspect.* 2004

9% loss in household income per income earner exposed to As

Pitt et al. PSTC Working Paper Series 2012-02

Where groundwater could be high in arsenic

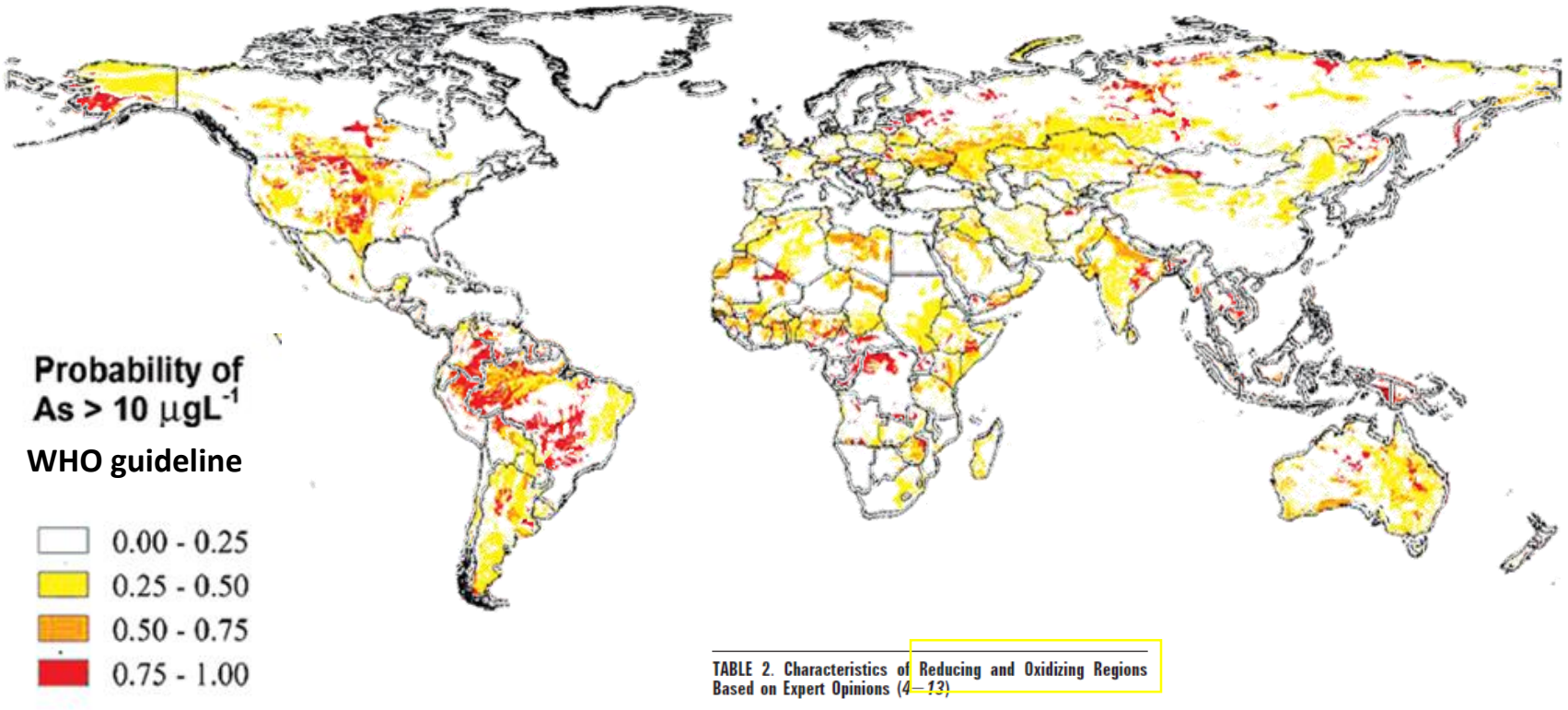
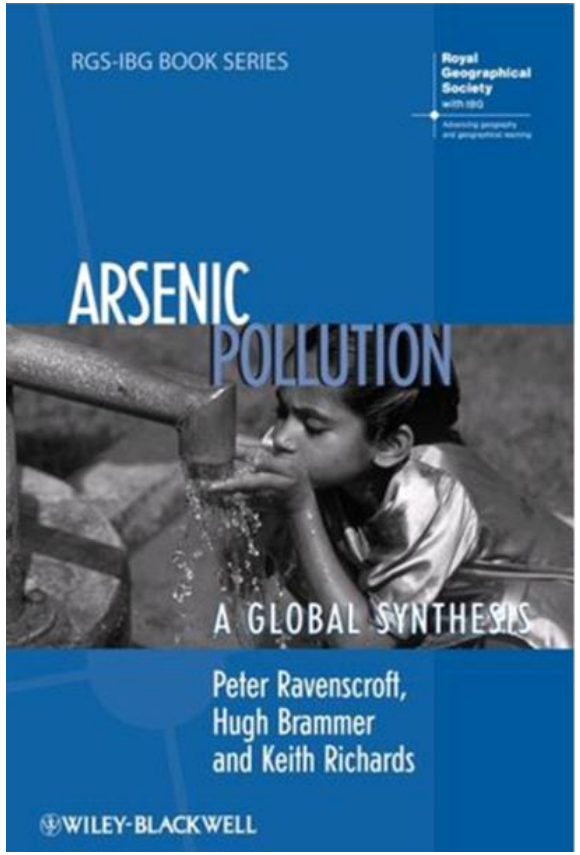


TABLE 2. Characteristics of Reducing and Oxidizing Regions Based on Expert Opinions (4–13)

variable[a]	reducing	oxidizing
ET/P	<1	>1
drainage condition	imperfect to poor	imperfect to poor
hydrologic basin	deltas	closed
slope	flat	flat
organic carbon	high	
salinity	low	high
temperature	high	
pH		high
geology	young sediment	young sediment

[a] ET = evaptranspiration, P = precipitation.

Modified from Amini et al. *Env. Sci. Technol.* 2008

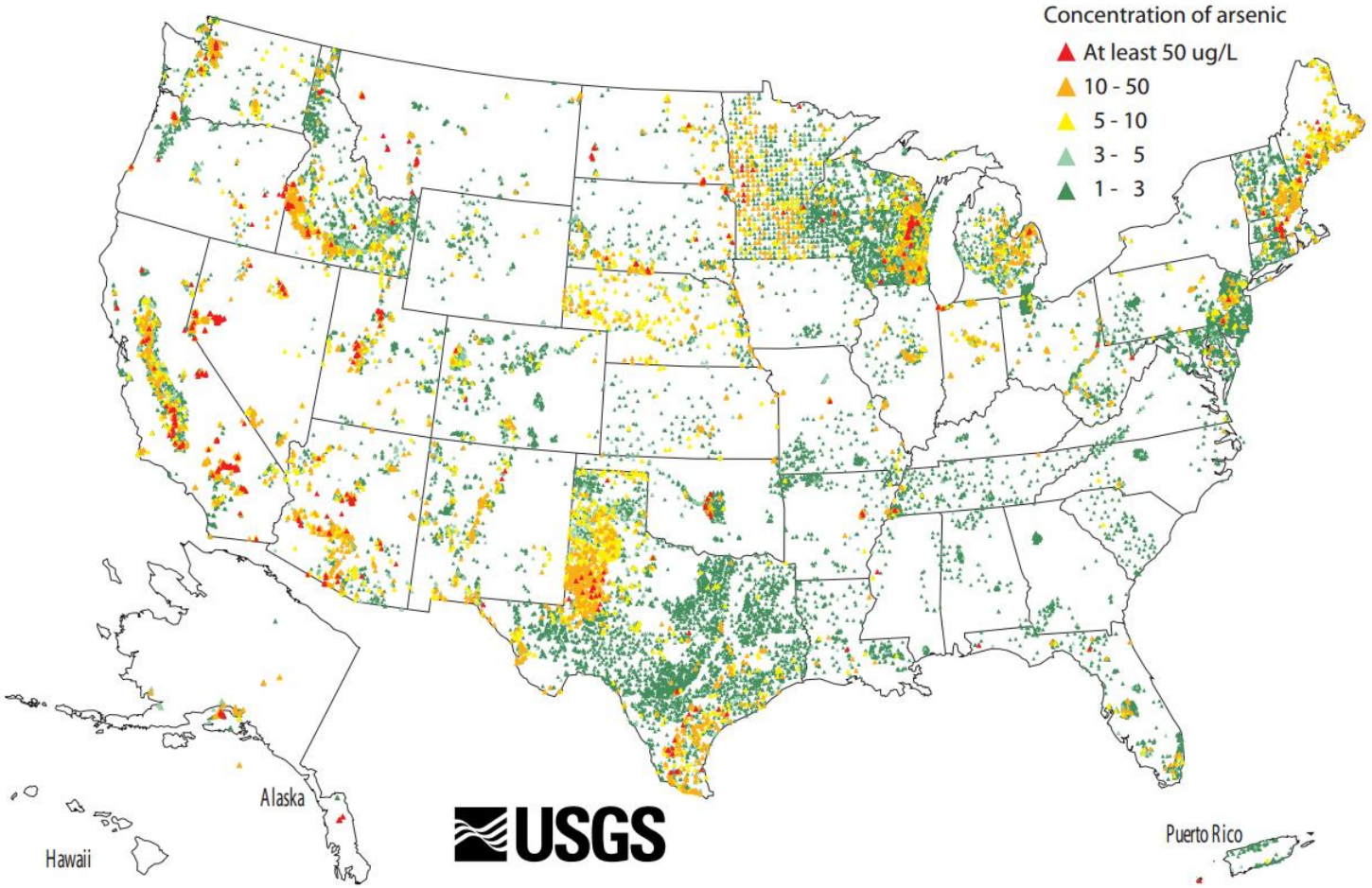


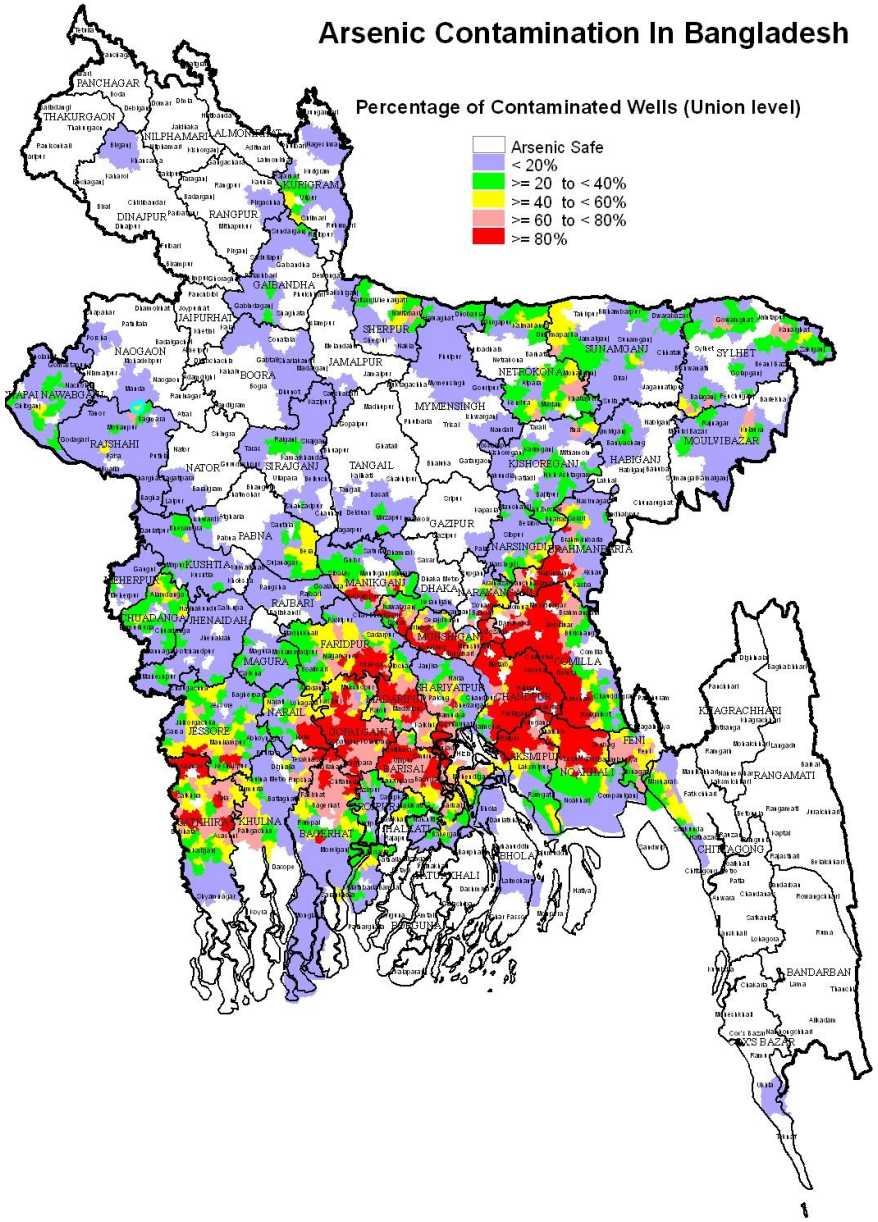
Population exposed to As in drinking water (millions)

Country	>50 μg/L	>10 μg/L	per capita GNI*
1. Bangladesh	27	50	520
2. India	11	30	1,070
3. China	5.6	15	2,940
4. USA	3.0	30	47,580
5. Myanmar	2.5	?	
6. Pakistan	2.0		980
7. Argentina	2.0		7,200
8. Vietnam	1.5	?	890
9. Nepal	0.6	2.5	400
10. Cambodia	0.5	0.6	600
.			
.			
.			
TOTAL	58	144	

*http://siteresources.worldbank.org/DATASTATISTICS/Resources/GNIPC.pdf

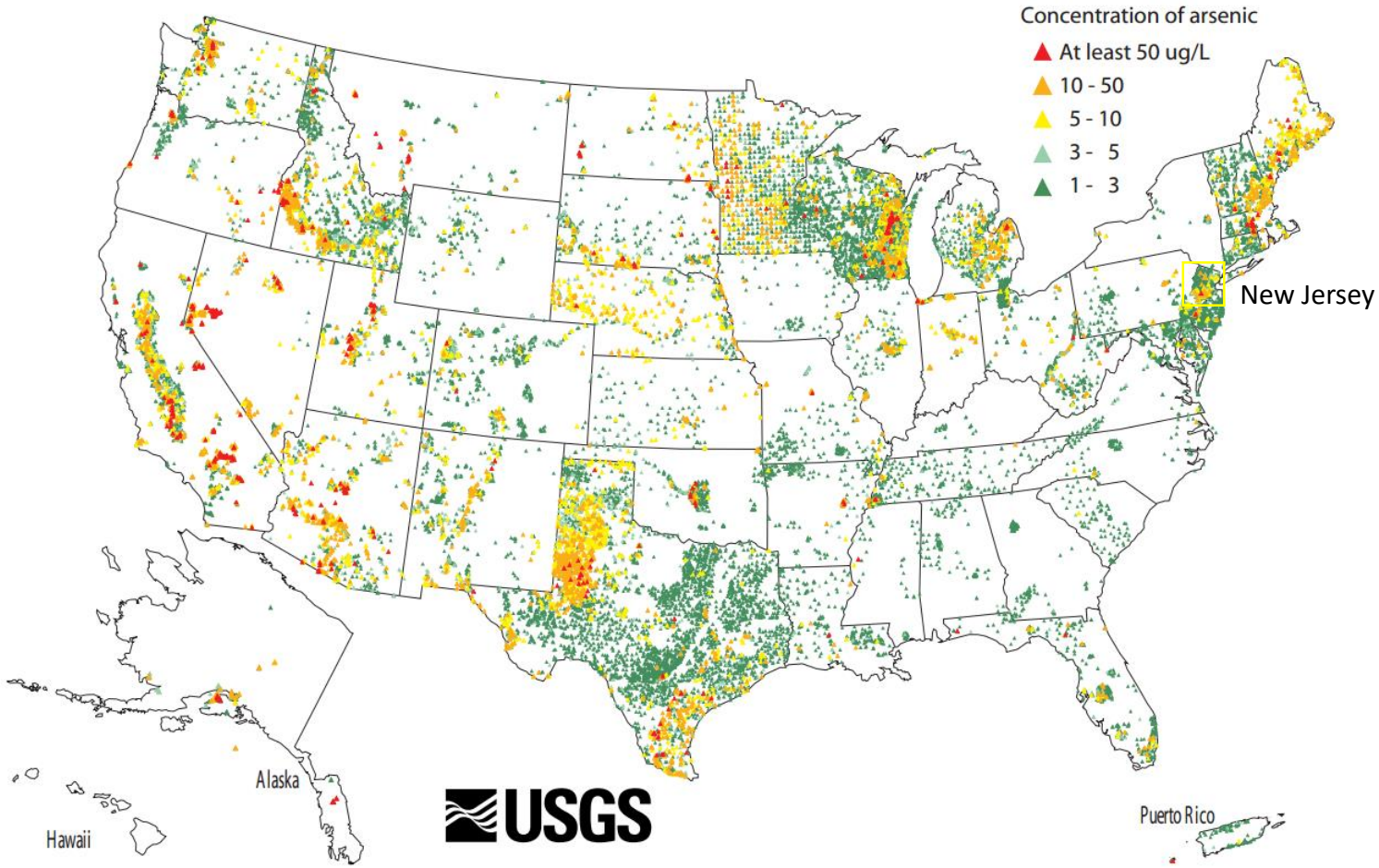
Two countries affected by elevated arsenic in well water

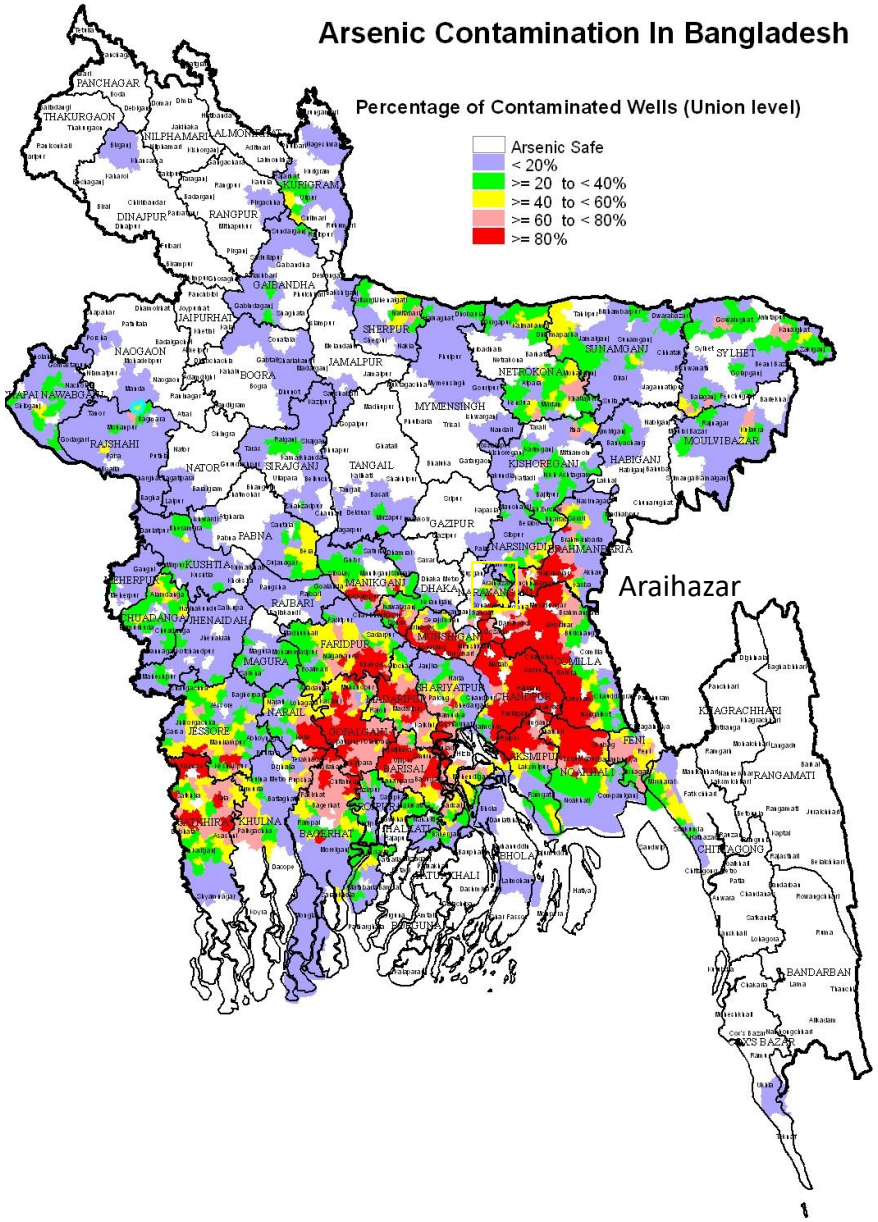




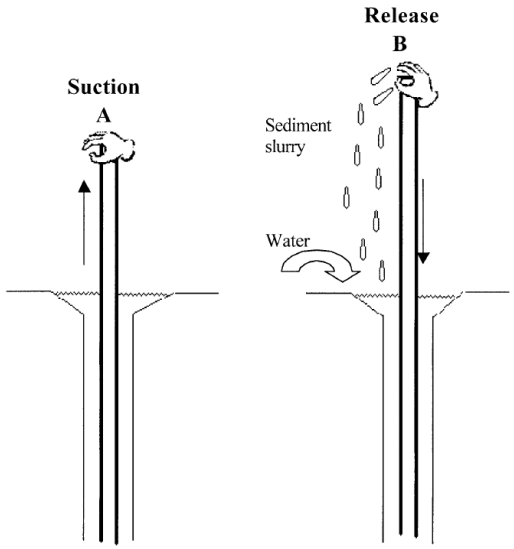
Health-based standards and guidelines

Bangladesh	50 µg/L
WHO	10 µg/L
US EPA	10 µg/L
NJ	5 µg/L





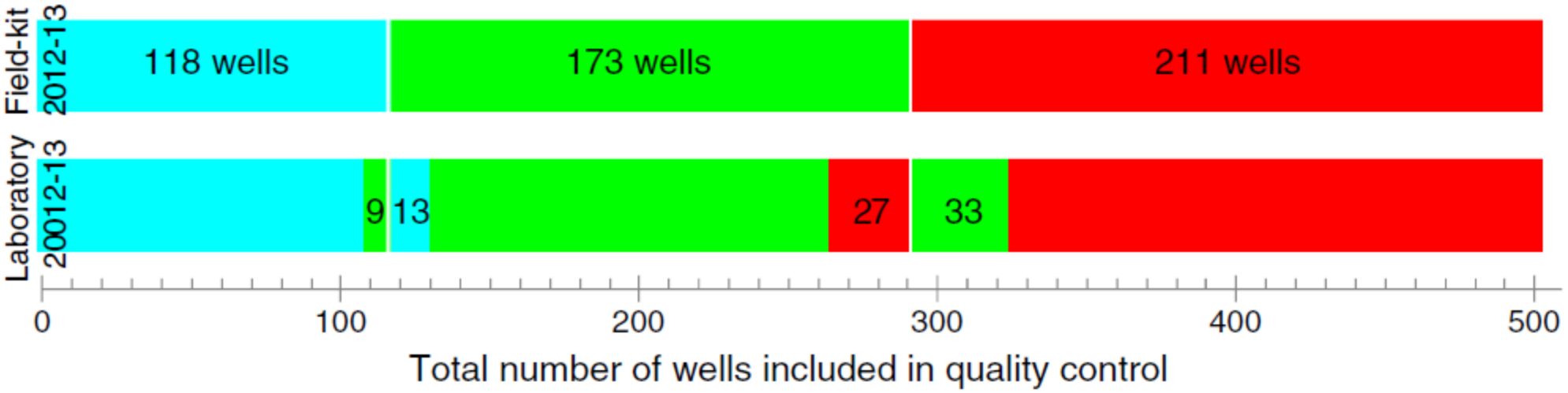
Install a 300 ft well by hand in a single day ($1/ft)



Testing wells with field-kits

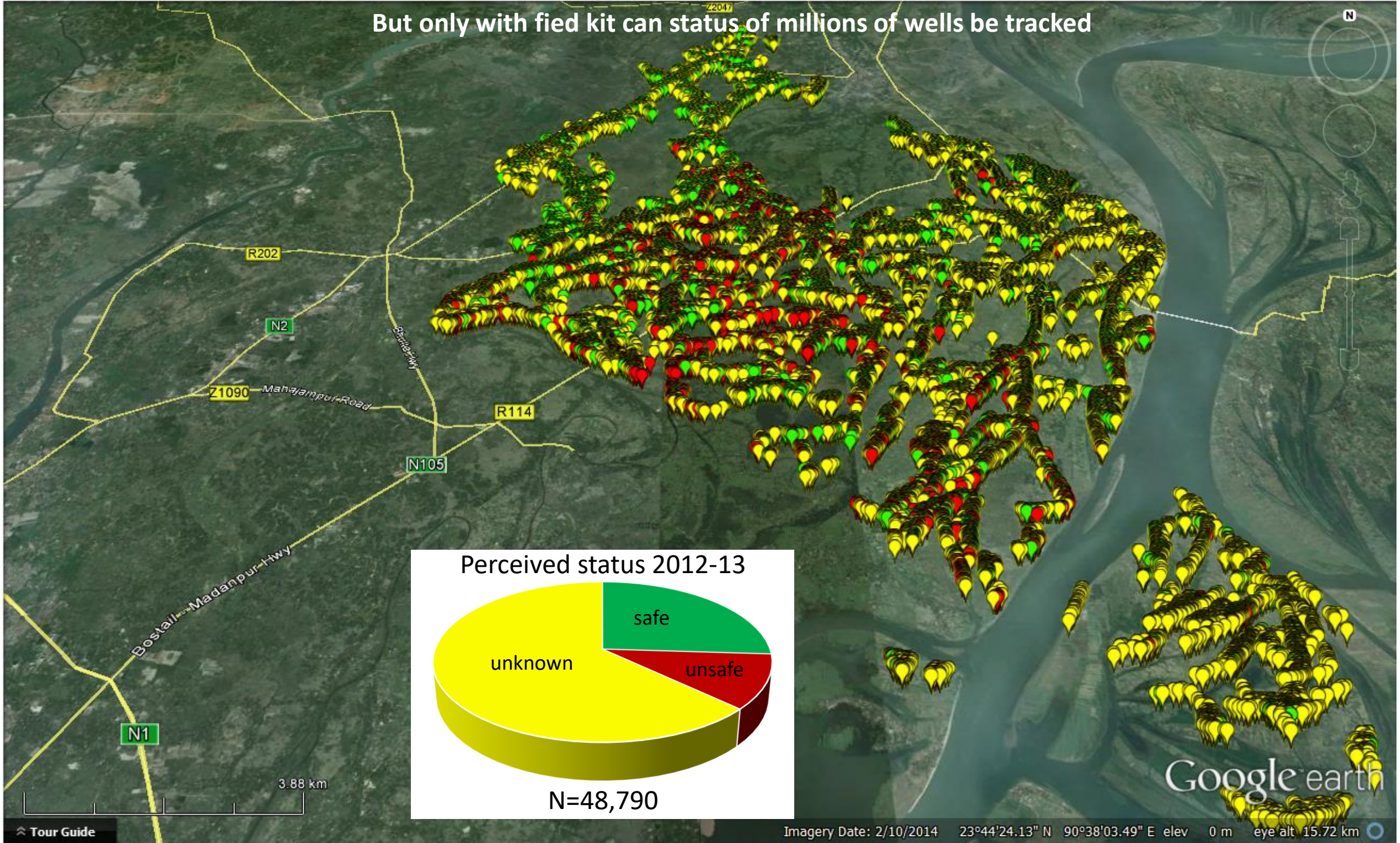
Kazi Matin Ahmed, Ershad Bin Ahmed, U Dhaka

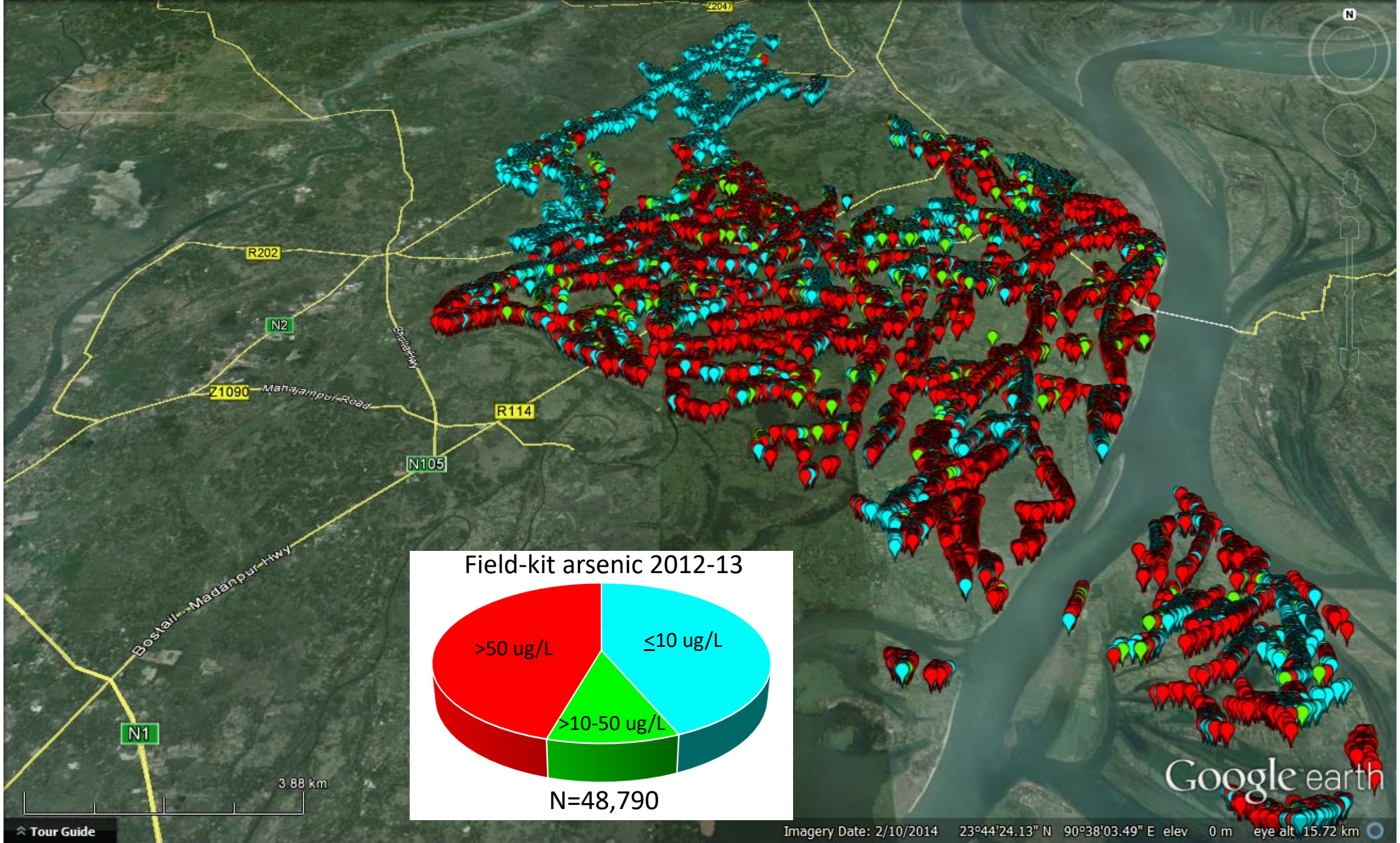
A field kit is not perfect



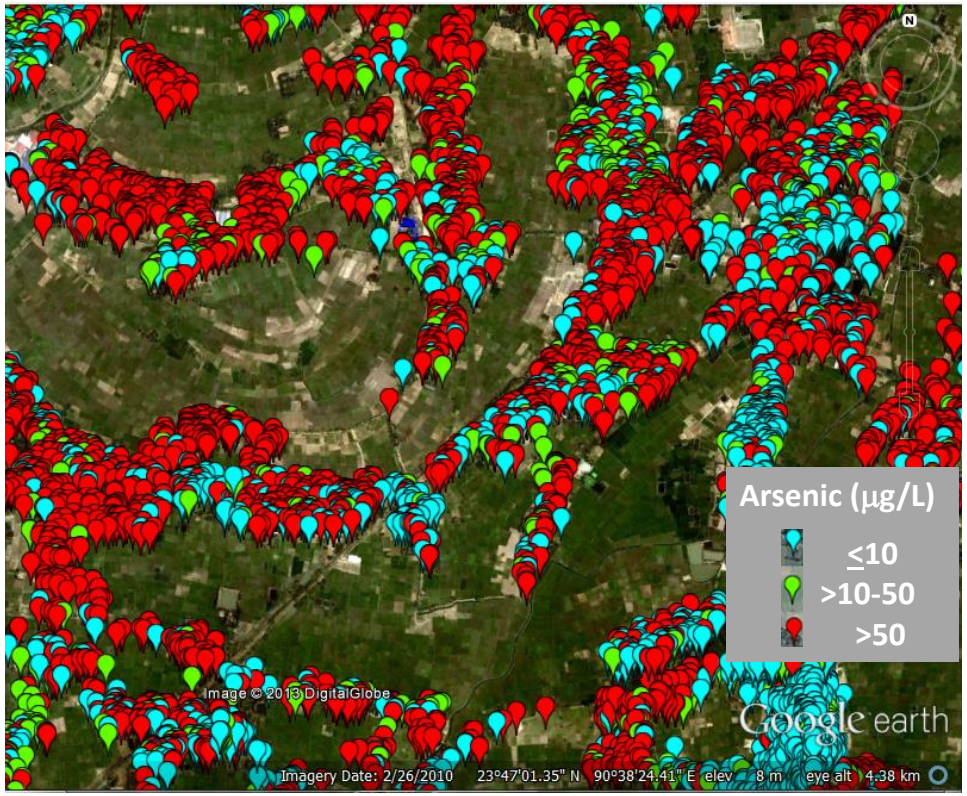
0-10 ug/L >10-50 ug/L >50 ug/L

But only with fied kit can status of millions of wells be tracked

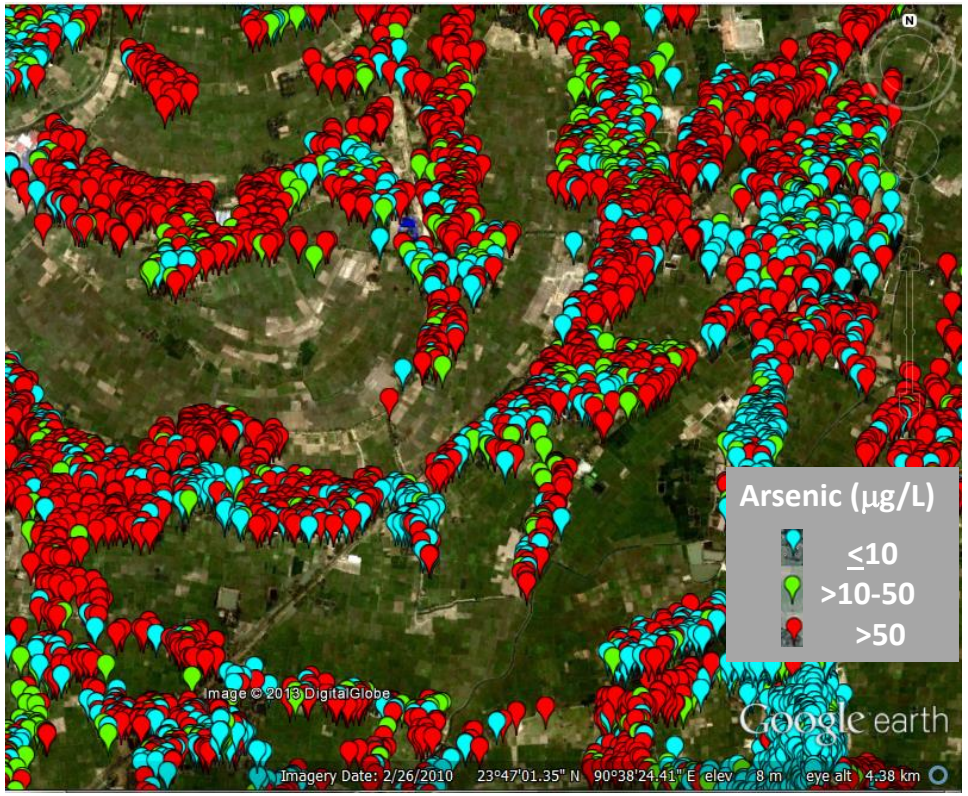


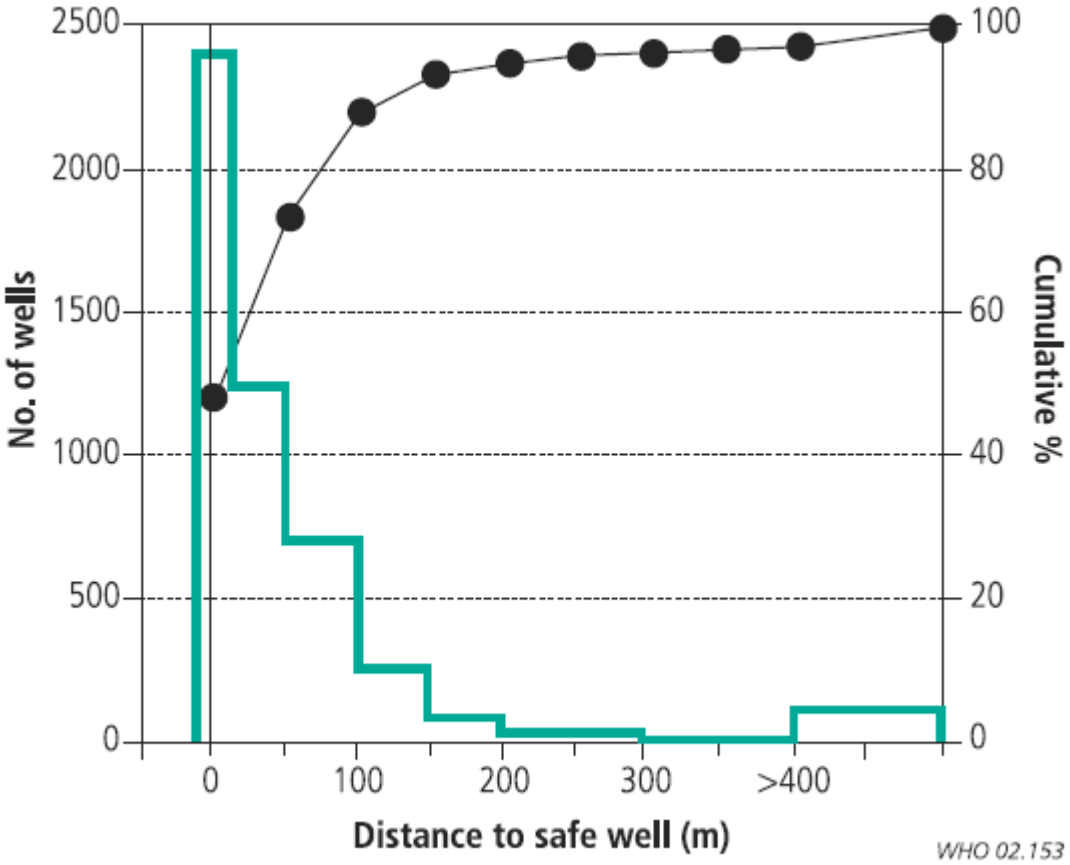

Field-kit arsenic 2012-13
>50 ug/L
≤10 ug/L
>10-50 ug/L
N=48,790
R202
N2
Z1090
Mahajanpur Road
R114
N105
Bostail-Madanpur-Hwy
N1
3.88 km
Google earth
Tour Guide
Imagery Date: 2/10/2014 23°44'24.13" N 90°38'03.49" E elev 0 m eye alt 15.72 km

Status important for mitigation



50% of wells unsafe but 90% of households within 100 m of safe well

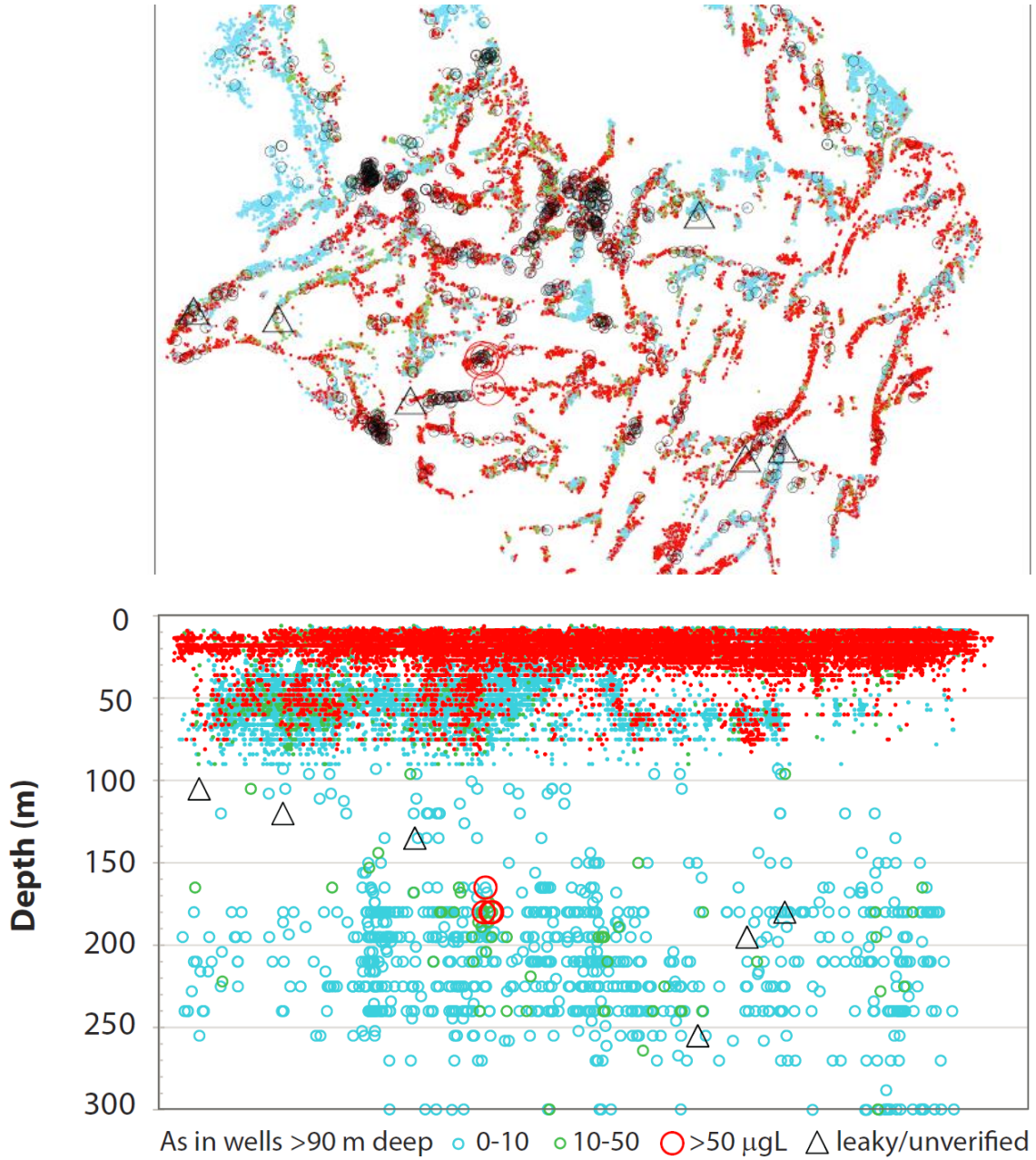




Not all wells are privately installed

Deep (>150 m) wells take a week to drill by a larger team

Deep wells also important for mitigation



http://www.nj.gov/dep/dsr/pwta/

State of New Jersey
Department of Environmental Protection

Division of Science, Research and Environmental Health

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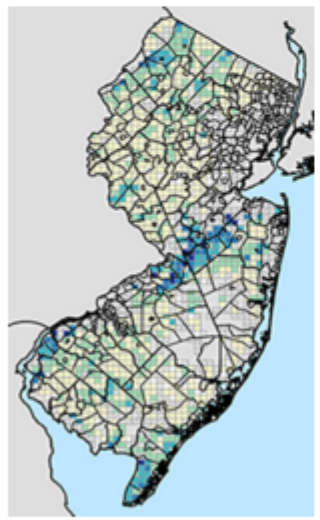
Private Well Testing Act

Click on the map below to get detailed information for PWTA data.



Once the map opens, click on different tabs for information and the map for data.

Google Chrome is recommended to view this map.

Click here for a list of County Health Department contact information.

In March 2001, the New Jersey Private Well Testing Act (PWTA) was signed into law, and its regulations became effective in September 2002. The PWTA is a consumer information law that requires sellers (or buyers) of property with potable wells in NJ to test the untreated ground water for a variety of water quality parameters, including up to 32 of human health concern, and to review the test results prior to closing of title. Landlords are also required to test their well water once every five years and to provide each tenant with a copy of the test results. The test data is submitted electronically by the test laboratories to the NJ Department of Environmental Protection for retention, notifying health department of water quality issues, and statewide analysis of ground water quality.

Approximately 20 to 25% of the wells in the State have been tested under this program. Several maps were created to summarize PWTA data. These maps are intended to provide information to homeowners about potential risks . Homeowners with private wells are encouraged to routinely test their wells for bacteria, nitrates and other contaminants that have been found to be a problem.

NJDEP regulates the construction of private wells. A newly constructed well is tested once for the presence of the contaminants regulated under the Safe Drinking Water Act. Post construction regulation of private wells is the responsibility of individual counties or other local agencies.

For more information on the Private Well Testing Act please go to

http://www.state.nj.us/dep/pwta/

Additional Information

The Department, in collaboration with Barnard College, Lamont-Doherty Earth Observatory and others, has developed a series of arsenic-related educational videos. The videos provide arsenic awareness for adults and children and information on testing your well water. Watch the videos here.

NYC to DAC Flights | Expedia

njdep.maps.arcgis.com/apps/MapSeries/index.html?appid=826ec9fae77543caa582a787d5f088e7

NJ Private Well Testing Act Data Summary (Sep. 2002 to Apr. 2014)

New Jersey Department of Environmental Protection

Click a tab for more information then click a location on the map for data.

Background | Counties | Municipalities | Grids | Arsenic | Fecal coliform or E. coli | Gross Alpha | Iron | Manganese | Mercury | Nitrate | pH | Volatile Organic Compounds (VOCs)

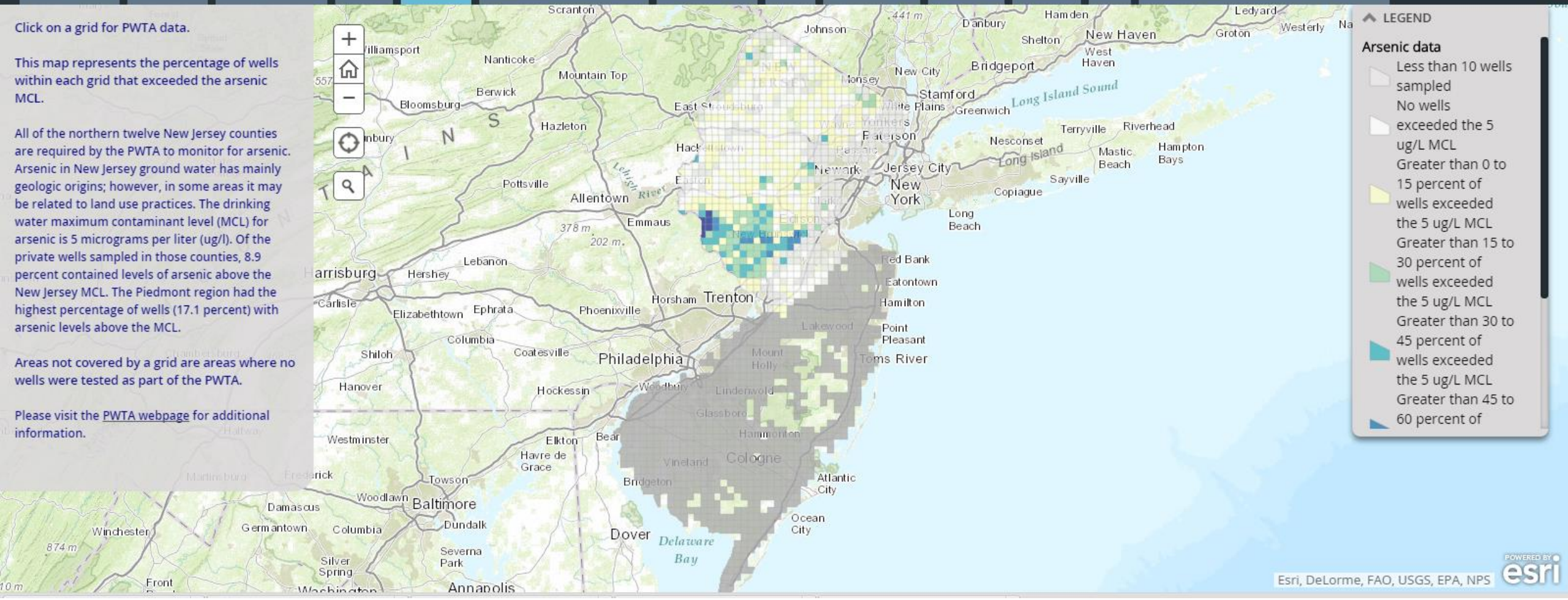
Click on a grid for PWTA data.

This map represents the percentage of wells within each grid that exceeded the arsenic MCL.

All of the northern twelve New Jersey counties are required by the PWTA to monitor for arsenic. Arsenic in New Jersey ground water has mainly geologic origins; however, in some areas it may be related to land use practices. The drinking water maximum contaminant level (MCL) for arsenic is 5 micrograms per liter (ug/l). Of the private wells sampled in those counties, 8.9 percent contained levels of arsenic above the New Jersey MCL. The Piedmont region had the highest percentage of wells (17.1 percent) with arsenic levels above the MCL.

Areas not covered by a grid are areas where no wells were tested as part of the PWTA.

Please visit the PWTA webpage for additional information.



njdep.maps.arcgis.com/apps/MapSeries/index.html?appid=826ec9fae77543caa582a787d5f088e7

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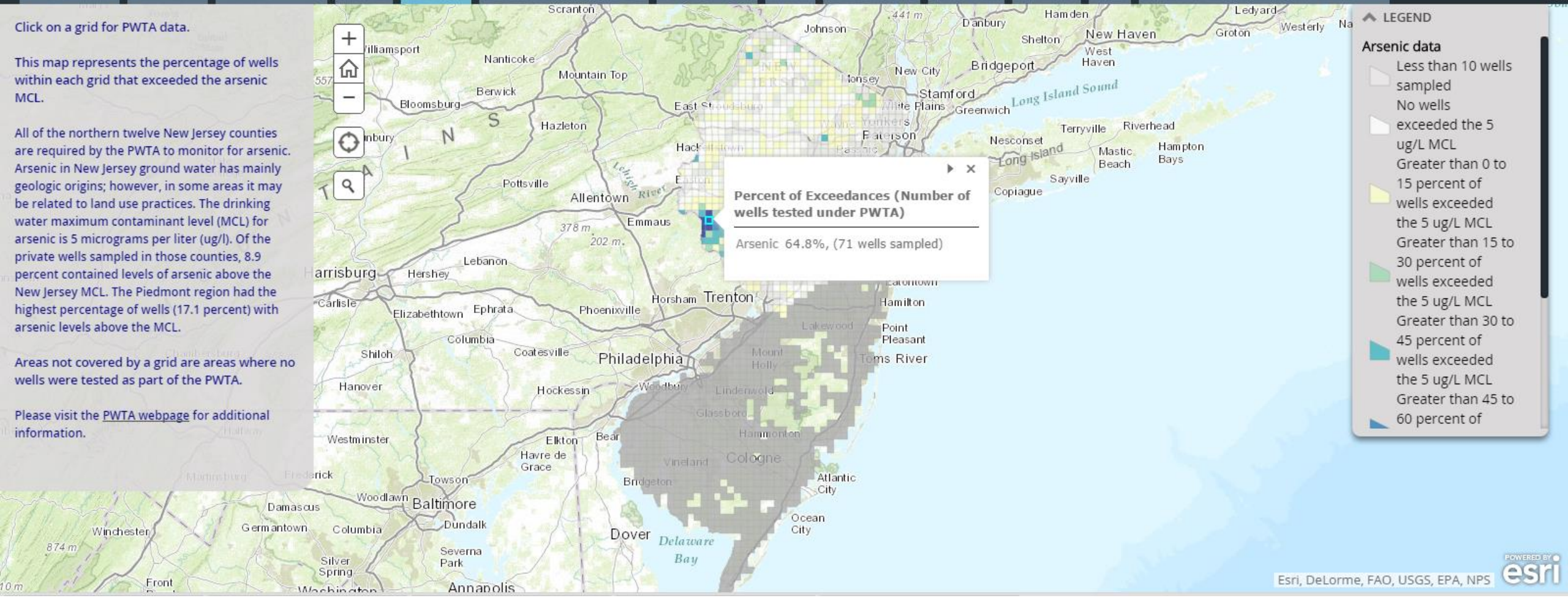

Why not decouple location and measurement for individual wells?