



Allegheny County  
Conservation District™

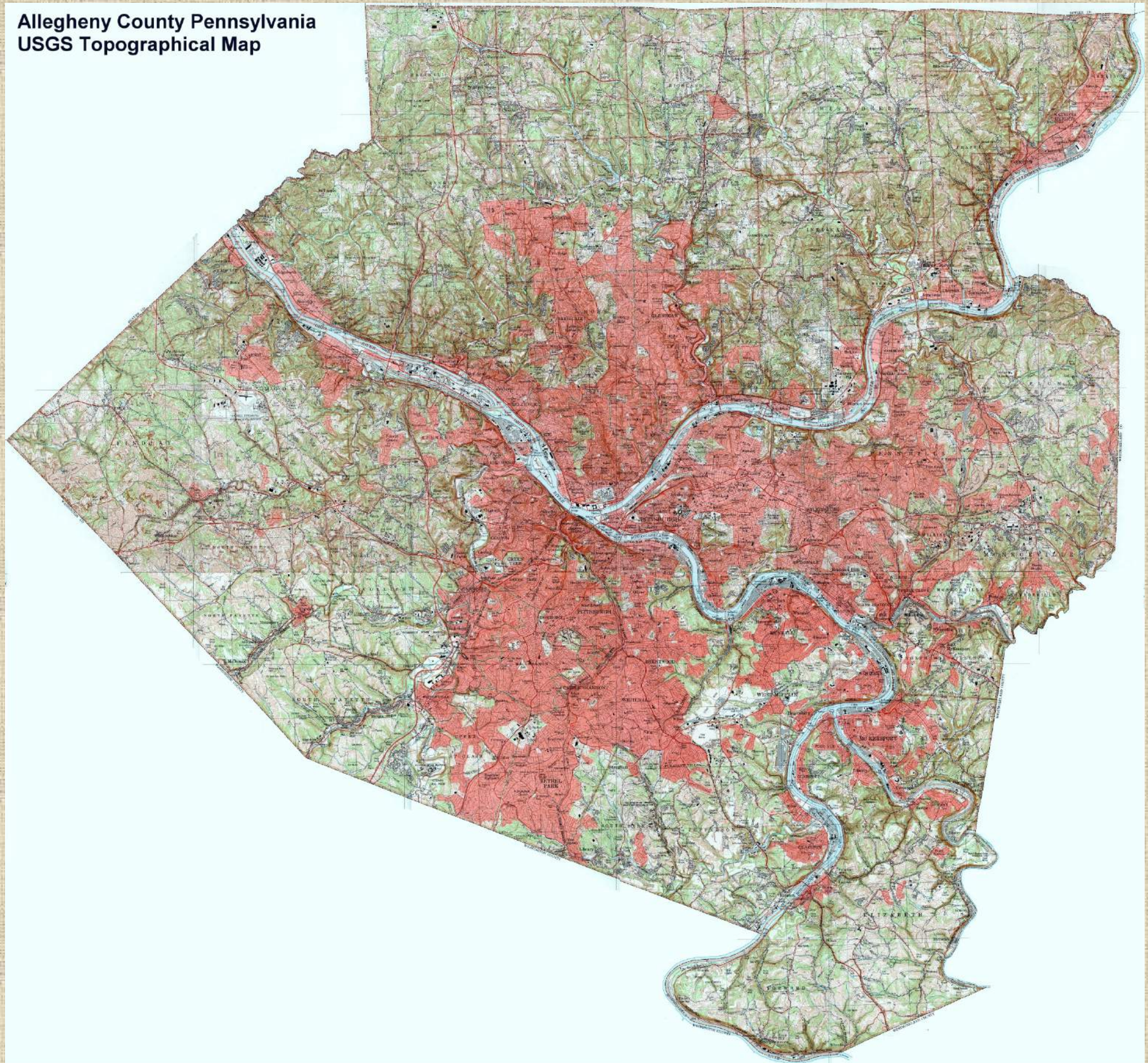
# Contamination and Urban Soils: Outreach and Assistance Using XRF Technology

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Senior Agriculture Conservationist  
Allegheny County, PA





**Allegheny County Pennsylvania  
USGS Topographical Map**





# Pittsburgh Urban Environment

- 30,000+ vacant lots in Allegheny County. 5,000+ in Pittsburgh.
- History of community and victory gardens.
- Active engagement through Grow Pittsburgh, PSU Extension, PFPC, GTECH, BUGS, etc.
- Loss of interest in using vacant space to grow vegetables.
- Push to create more green space for recreation, habitat and stormwater management.



# Pittsburgh Urban Agriculture

Braddock Farms  
with  
Edgar Thompson  
Steel Works.





# CD Enters Urban Ag Sector

- 2015- District expands education and technical assistance for urban residents.
- NACD grant awarded summer 2016.
- Focused on building relationships and assessing needs. Avoid redundancy.
- Lots of active non-profits and community groups working already.
- Outreach revealed the needs of communities and current resource gaps. One was the issue of soil contamination.

# Urban Soil Contamination

- Formerly industrial cities like Pittsburgh have higher rates of lead and other heavy metal contamination.
- This contributes to higher rates of elevated child blood lead levels ( $>5 \mu\text{g/d}$ ).
- Old pipes and lead paint in houses are publicized causes, but so is dust and soil contamination from outside.
- Soil lead is often relatively immobile and persistent; although, a portion is “available” for plants.



# Sources of Contamination

- Lead Smelters
- Slag heaps
- Car batteries
- Gasoline
- Stormwater
- Lead Paint
- Pipes
- Trash/Dumping



# Risks and Pathways

- Lead is a primary concern, although arsenic, cadmium, and other heavy metals can be an issue.
- Risks are from inhalation of dust, eating dirt, contaminated vegetables, hand to mouth pathways, and skin contact.
- Soil lead and dust are major contributors of toxic blood levels.





# Vacant Land and Lead





# Urban Soil Resource Gap

- Not a lot of regulatory clarity on lead. Can be confusing to know what is safe and what isn't.
- Guidelines are different for many agencies and States.
- Pittsburgh only requires a single lead test to allow for vacant lot use (1 test for 5000+ sq. ft.).
- Any high value ( $>1000\text{ppm}$ ) means lot is ineligible for adoption (vacant lots only).
- Limited to no resources for private property owners on how to test or remediate soil, or soil health generally.



# Urban Soil Working Group

- Collection of academic, private, public, non-profit, and regulatory organizations.
- Working to research and promote guidelines and policy recommendations.
- Experimented with testing technology and level of detail required.
- Goal was to find standards that keep people safe and give them realistic ways to remediate or mitigate risk from contaminated soil.



# Pittsburgh Lead Guidelines

- 0-150 ppm: Use with no or limited restrictions.
- 151-400 ppm: “Clean Hands” Policy and mulched pathways (3-4”).
- 401-1,000 ppm: Modified use only (raised beds, mulch).
- >1,000 ppm: Restricted use. Disqualified from Vacant Lot Adoption program.



# Trouble With Finding Lead

- Even composite tests must be in a small area to avoid dilution.
- Lead levels can be highly toxic in small area (“hotspot”) with clean soil nearby.
- Use records and historical maps to identify areas of concern.
- City only requires one test per lot for Adopt-A-Lot, so why would someone pay considerably more \$?



179	95	527 468 470	78 123	596 712
201	94	126	411	385
160	302	280	561 499	408 349
692 481	342	212	366 420	799 774
280	536 589	135	256 118 172	416
717 576 499	128	121	330 452 338	166
129	473 416	277	116 111	1135 2838 2405

**MONTICELLO STREET**

Lead Level	Risk
0 to 150ppm	None to very low
151 to 400ppm	Low
401 to 1,000ppm	Medium
Greater than 1,000ppm	High



# Lead/ Metals Test Resources

- UMass (acid digestion) or Penn State (ICP)
- Both can be expensive (\$15 per lead test up to \$66)





# Examining Process and Costs

- Soils Working Group looked at various grid sizes for testing land accurately.
- Compared single tests vs composite.
- Comparison of a space at 40'x40', 20'x20', and 10x10'.
- Compared In-situ vs. processed samples.
- **Discovered that more tests representing smaller grids, less compositing, and dried/sieved samples gives highest confidence in lead values.**
- **Results showed 10'x10' grids = sweet spot for size. Up to 20'x'20' are acceptable.**



# Examining Process and Costs

Lot Size:  
120'x100'

1J	2J	3J	4J	5J	6J	7J	8J	9J	10J	11J	12J
1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A



# Turn to XRF Analysis

- Ability to accurately screen for total lead and heavy metals in ~60 seconds.
- Can be done in the office or on-site if conditions are dry enough (potential for GIS linking).
- In-situ use accurate enough for rapid screenings, but processed samples can give lab quality results.
- For the first year at least, 10% of samples lab verified to justify technology.



# Turn to XRF Analysis





# XRF Analysis for Urban Ag

- Units cost between \$20-30,000 for a portable, handheld unit. \$500/week to rent.
- Allows for timely and cost effective contamination mapping of sites.
- Ability to test hundreds of times a day.
- Soil moisture should be low to prevent dilution.
- If you want accurate results you need to process



# XRF at ACCD

- In 2016 ACCD used Hillman Foundation grant funds to purchase a handheld XRF Analyzer.
- In the first 10 months, ACCD has conducted over \$60,000 worth of soil heavy metal screenings.
- Can be done in the office or on-site if conditions are dry enough (potential for GIS linking).
- Allows for timely and cost effective contamination mapping of sites, helping groups garden safely.

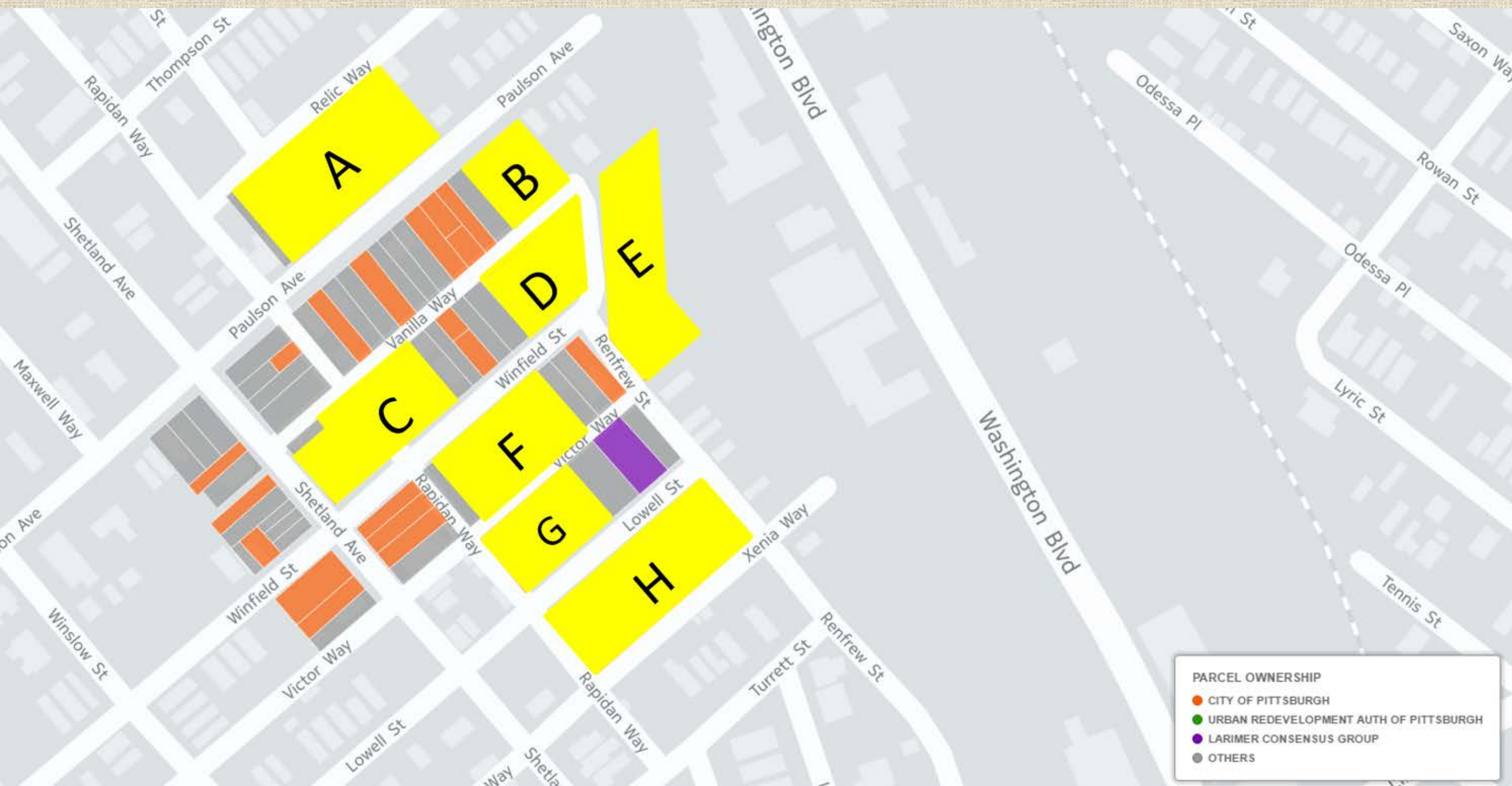


# XRF and Site Mapping

- Time consuming to take hundreds of samples.
- We require community/org involvement for larger requests.
- Using community volunteers ACCD is able to educate while sampling.
- Partnerships allow for responsibly thorough analysis.
- Gives communities a connection to the data and results.
- Develops relationships that can extend into further technical assistance and support.

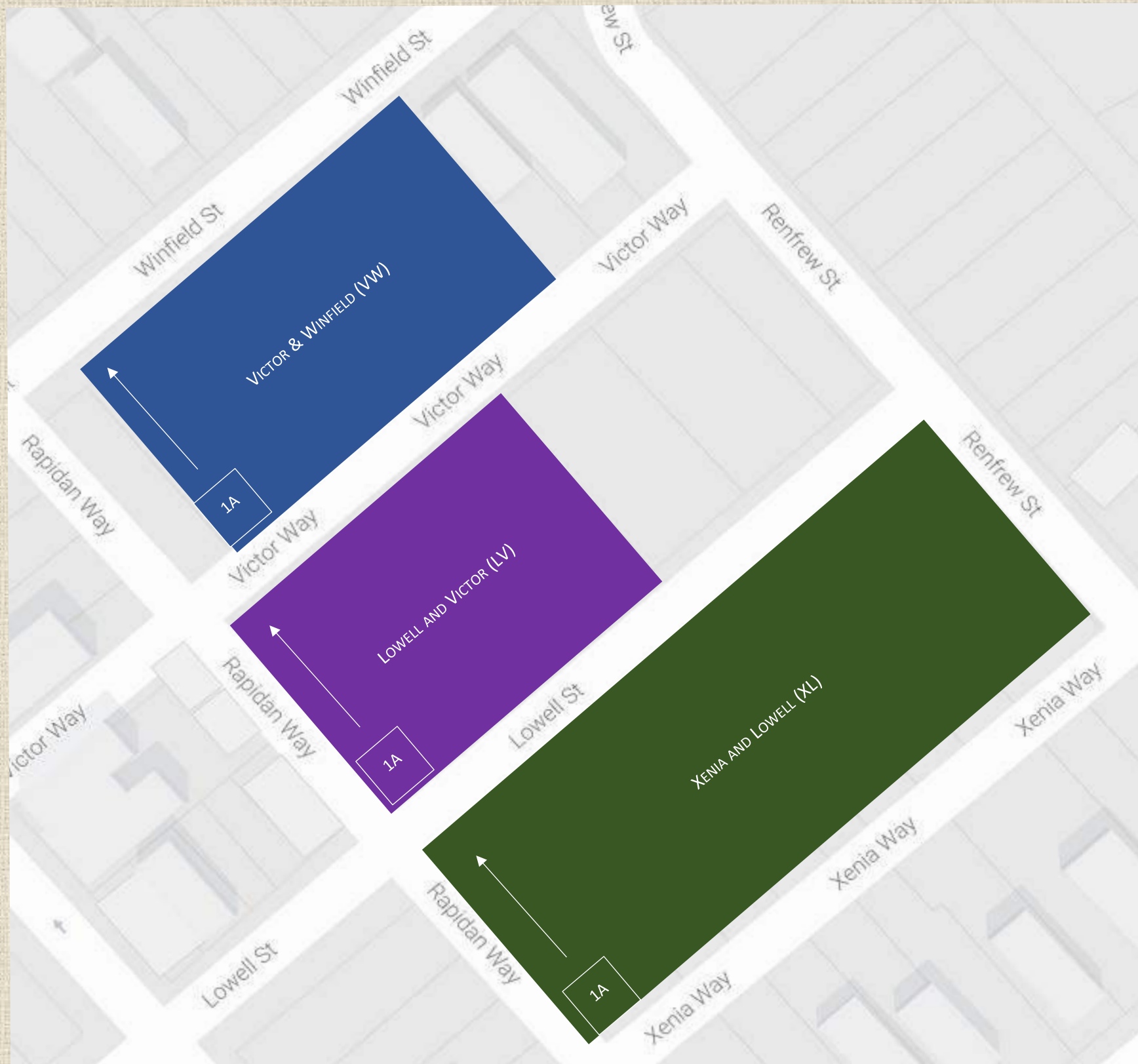


# XRF Neighborhood Project





# XRF Neighborhood Project Selected Lots





# XRF Neighborhood Project Selected Lots

1J	2J	3J	4J	5J	6J	7J	8J	9J	10J	11J	12J	13J	14J
▲													
1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A



# XRF Neighborhood Project Selected Lots





# XRF Neighborhood Project Selected Lots





# XRF Neighborhood Project Selected Lots





# XRF and Soil Mapping





# XRF and Soil Mapping





441	387	675	663	220	353	671	324	325	127	914	448	672	1034
523	387	874	616	115	344	37	29	41	149	607	916	840	913
621	175	1348	792	616	347	28	<18	29	81	383	1342	1092	1157
402	263	897	827	658	359	<22	<19	33	114	329	432	599	403
280	1091	915	789	734	555	160	55	101	203	784	557	576	497
815	760	1279	882	567	379	176	109	220	104	674	349	934	901
779	892	877	394	313	201	149	382	109	203	1436	446	2010	860
858	470	491	484	424	227	326	192	340	298	1623	899	2673	1982
1833	344	396	351	437	417	114	262	937	1487	1809	752	1207	2282
1082	941	1156	621	833	518	1142	1209	909	1585	1065	1200	1129	2133

2010-2011

Lead Level	Risk
0 to 150ppm	None to very low
151 to 400ppm	Low
401 to 1,000ppm	Medium
Greater than 1,000ppm	High



701	621	620	912	456	373	188	169	455	452	1568	311	644	508	193	325	1781	494	164	242	62	136
747	565	1100	488	1038	967	223	245	365	640	833	141	636	239	43	237	282	52	263	85	202	647
918	998	1048	1305	1988	911	347	104	304	549	454	276	1459	402	54	280	6255	171	562	291	187	1126
800	662	1740	859	1134	1243	181	103	997	107	411	2759	704	205	28	277	2208	394	105	171	153	277
1220	938	2425	1155	1983	339	464	128	650	197	749	2344	231	391	35	187	229	402	341	92	148	357
4036	1601	3003	2063	1815	560	281	673	429	354	2159	899	237	267	42	70	460	1200	538	518	335	276
1036	1976	2939	1242	836	1361	548	445	599	115	1949	2034	314	699	104	523	410	1338	658	302	796	265
1578	2234	3019	2035	481	1255	1417	1664	756	239	1496	1776	1143	338	120	746	1486	1305	1441	491	298	119
924	2150	2140	1258	1511	1176	1627	1639	1147	106	2280	1266	1393	566	485	1152	1556	1735	1268	282	1151	45
X	X	905	907	646	1031	1733	2291	1128	192	397	181	1127	1032	326	797	1467	1082	733	267	50	234

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# Public Outreach: Screening Events

- Education and Outreach
- Tests residential soil
- Offers safe gardening recommendations
- Going out to the community
- Free screening







## SHARPSBURG COMMUNITY LIBRARY

*1212 Main Street  
Pittsburgh, PA 15215*

Join the Allegheny County Conservation District and partners on September 10th at the Sharpsburg Community Library to learn why soil lead contamination is a serious problem in Pittsburgh. Bring a properly collected, dry soil sample from your yard or garden and we will screen it for lead and other heavy metals free of charge. Staff will be available to answer questions and provide information.

## FREE SOIL LEAD SCREENING

*with soil contamination and  
remediation information*

ALLEGHENY COUNTY  
CONSERVATION DISTRICT  
DECO RESOURCES  
GROW PITTSBURGH  
SHARPSBURG  
NEIGHBORHOOD  
ORGANIZATION

**SEPTEMBER 10<sup>TH</sup>**  
**10AM-1PM**



*FOR MORE INFORMATION, CONTACT:  
JONATHAN BURGESS (ACCD) @ (412) 291-8017*

Instructions on how to collect a soil sample can be found at:  
<http://www.growpittsburgh.org/start-a-garden/growers-resources/soil-compost/>  
*see Soil Sampling diagram on reverse*





SERVICE

QUEST

www.wcccdpa.org

Worcester County  
Conservation District

Your Conservation  
Solution Center

TESTING  
STATION  
CAUTION  
X-RAYS  
PLEASE  
STAY  
BACK

WATER  
WASHEDS

River Walk Camp



# Sample Information



**Sample Number:** \_\_\_\_\_  
**Name of closest intersection and zip code:** \_\_\_\_\_

Sample

**Type of soil**

Original Soil  
Amended (mulch, compost, topsoil)  
Raised Bed  
Other: \_\_\_\_\_

**Current or planned use:**

Garden  
Play Area  
Other: \_\_\_\_\_

**Was this sample taken from more than one spot?**

Yes      No

**Depth (inches):** \_\_\_\_\_

**How Many?** \_\_\_\_\_

**Was sample location less than 5 feet away from house or building?**

Yes      No      Unsure

**Was sample location less than 5 feet away from street?**

Yes      No      Unsure

**Age of nearest structure:** \_\_\_\_\_ **Structure type:**    House    Fence    Shed    Other

**Was structure painted before 1978?**      Yes      No      Unsure

**Was structure painted lead paint?**      Yes      No      Unsure

**Are there paint chips in the soil?**      Yes      No      Unsure

**Are there pieces of brick/debris in the soil?**      Yes      No      Unsure

**Are you using any treated wood products, such as railroad ties or other treated wood (children's play-sets can contain treated wood).**

No    Unsure    Yes (if yes, was the wood there before 2003?)

**Results:** \_\_\_\_\_



**Sample Number:** \_\_\_\_\_  
**Name of closest intersection and zip code:** \_\_\_\_\_

Sample

**Type of soil**

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Amended (mulch, compost, topsoil)  
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**Results:** \_\_\_\_\_



# Safe Use





# Remediation Strategy

- Bio-availability and Phytoremediation or...
- Limitation and Dilution with pH and organic control
- Soil Removal
- Soil Washing with Chelates or phosphorus binding





# Next Steps

- Develop a more detailed policy at City level with improved remediation resources. Advocacy at all levels.
- Continued outreach to low-income communities
- Comprehensive site testing and mapping around city.
- Research plots and pilot programs with community groups . Communicate with research teams elsewhere.



# Questions?







Allegheny County  
Conservation District™

# For more information...

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