



Lead Service Line Inventory Methodologies

Region 6 – Five State Meeting
Jan 31, 2024

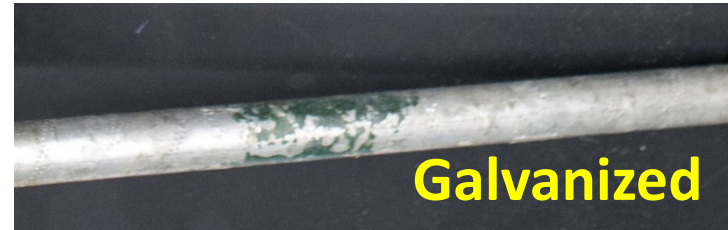
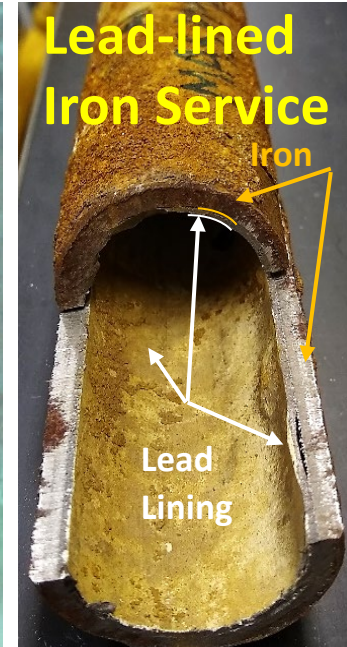
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Outline

- The challenge of legacy lead service lines
- Pros/cons of lead service line identification tools
 - Preliminary records screening
 - Community records screening
 - Basic/visual identification
 - Tap water sampling
 - Excavation
- Step-wise lead service line identification approach
- Case studies
- Summary

Sources of Lead in Drinking Water



Triantafyllidou et al., 2021
[Variability and sampling of lead \(Pb\) in drinking water.](#)

What constitutes a "lead service line"?
The definition may differ depending on context

Lead and Copper Rule Revisions

- The Lead and Copper Rule Revisions (LCRR) were published in 2021
- Requirement for Initial Service Line Inventory (by Oct. 2024) to identify public-side and private-side:
 - Lead Service Lines (LSLs)
 - Galvanized Requiring Replacement (GRR) Service Lines
 - Lead Status Unknown Service Lines
 - Non-Lead Service Lines
- EPA Guidance template available



Service Line Inventory Template

Date last updated: July 27, 2022

What is the purpose of this template?

The purpose of this draft template is to help water systems and states comply with the service line inventory requirements of the January 15, 2021 Lead and Copper Rule Revisions (LCRR). This template supplements the draft EPA document, **Guidance for Developing and Maintaining a Service Line Inventory** (2022) by providing fillable forms and tables that water systems can use to document their methods, organize their inventory, submit the initial inventory and inventory updates to the state, and document how they are making the inventory publicly available. This template also provides a checklist for state review. Note that EPA does **NOT** require systems use this template for their inventory. Refer to EPA's 2022 Inventory Guidance for minimum LCRR inventory requirements, recommendations, and disclaimers.

LSL Identification Tools

- Records review
 - **Preliminary Records Screening** - phase out dates after 1986 Safe Drinking Water Act lead ban, local/state plumbing codes, construction specifications
 - **Community Records** - SL installation records, inspection and maintenance records, plumbing permits, meter installation records, others
- **Basic/Visual Examination** – visual scratch/magnet test or lead test kit
- **Tap Sampling** - flushed, sequential, targeted
- **Excavation** - traditional, vacuum
- **Predictive Methods** - geospatial, machine learning
- **Alternative Methods** - electrical resistance, acoustic wave, eddy current, others

Considerations When Selecting LSL ID tools

- Utility Cost
 - Financial
 - Onsite time
 - Pre/post time
- Disturbance
 - Service line
 - Traffic flow
- Impact to homeowner
 - Water service disruption
 - Property damage
 - Homeowner involvement (includes pre/post time)
- Utility Skills Required
 - Technical Interpretation
 - Labor
- Overall Time & Accuracy

Table with comparison of relative pros/cons can be found in:
Hensley, Bosscher, Triantafyllidou , Lytle, 2021, AWWA Water Science “Lead Service Line Identification: A Review of Strategies and Approaches”

<https://awwa.onlinelibrary.wiley.com/doi/abs/10.1002/aws2.1226>

Records Review

Preliminary Records

- Historical plumbing codes
- Effective dates of Safe Drinking Water Act lead ban

Community Records

- SL instillation records
- Inspection and maintenance records, including replacement or repairs of specific SLs and larger water main replacement projects
- Plumbing permits
- Meter installation records
- Property tax records

Challenges/Limitations:

- Availability of records
- Legibility of records
- Accuracy of records
- Completeness of records

The image shows two handwritten plumbing service records. The left record is for 645 E. Moler St. and the right is for 101 East 1st Ave. Red boxes highlight '22 ft Lead' and 'Kind Lead'.

Left Record (645 E. Moler St.):

73481	645 E. Moler St.		SERVICE RECORD
LOT NO 230			KIND OF ACCOUNT
DATE SOLD 7-15-41			
SIZE OF MAIN 6	18 ft E of E LL of 18 th St		
SIZE OF STOP 3/4			
SIZE OF FERRULE 3/4	11 ft N of S LL of Moler St		
SIZE OF PIPE 3/4			
LENGTH OF PIPE 22 ft Lead			
RE ISSUED			
LOCATION OF METER North Wall			
NAME NUMBER SIZE DATE SET REMARKS			
M. 660921 5/8 9/12/41 rem. 11-3-12			
Rock 22214 9/4 5/8 11-3-72			

Right Record (101 East 1st Ave.):

3844	101 East 1 st Ave		Size of Ferrule
			Date Sold
			Lot No
	114 Ft 2/6 of - LL of Summit St.		
	12 Ft N of S LL of 1 st Ave.		
Remarks			
Main Size 6"	Stop Size 3/4	Pipe Length 26	Kind Lead
Date Renewed 9/14/14		Reissued	

Basic/Visual Examination

Scratch/Magnet Test

- Easy for residents if service line is accessible
- When scratched (coin, key, etc), the exposed outside pipe surface area will be shiny silver
- Magnet will not stick to Pb
- Can identify solid lead service lines but not lead-lined iron pipe

Lead Test Kit

- Surface swab kits approved for lead paint change color after contacting lead surface

Crowd Sourcing

- Residences examine pipes and uploading

Challenges/Limitations:

- Resident participation
- Access to service line
- Accuracy of contractor/ resident information

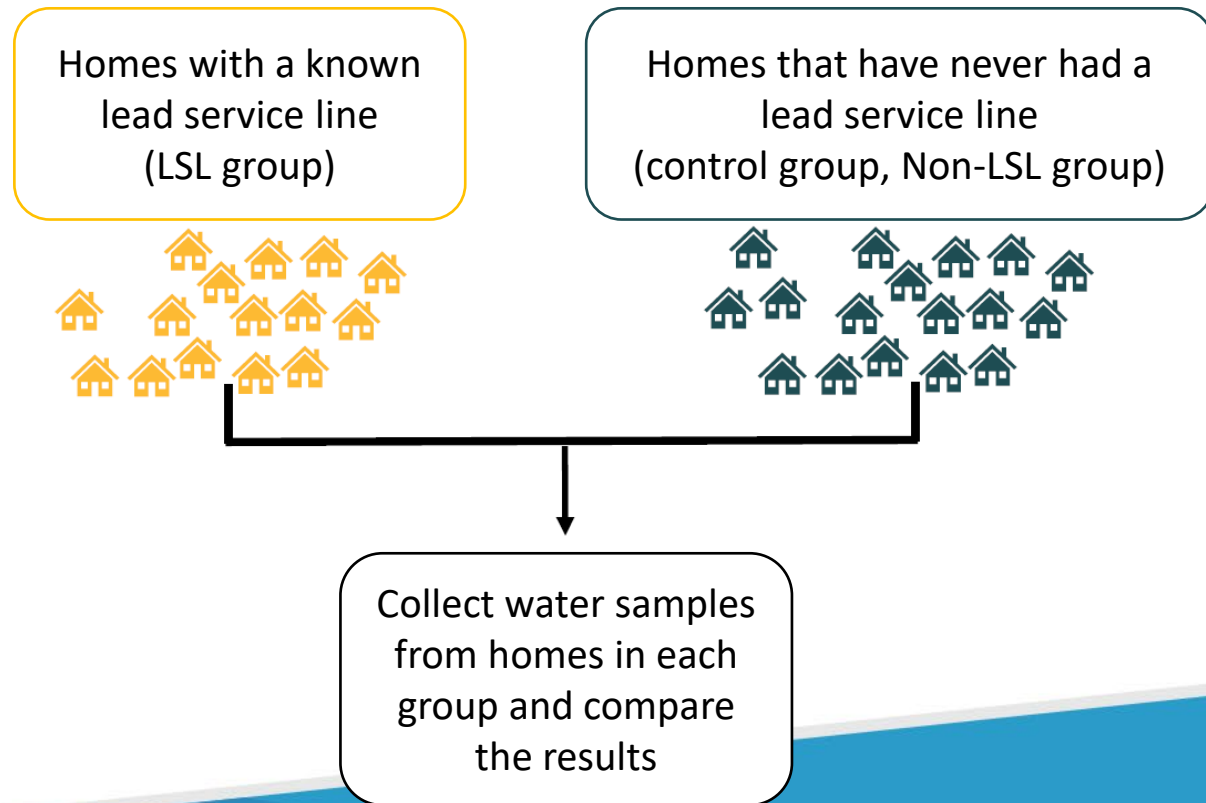


Tap Sampling

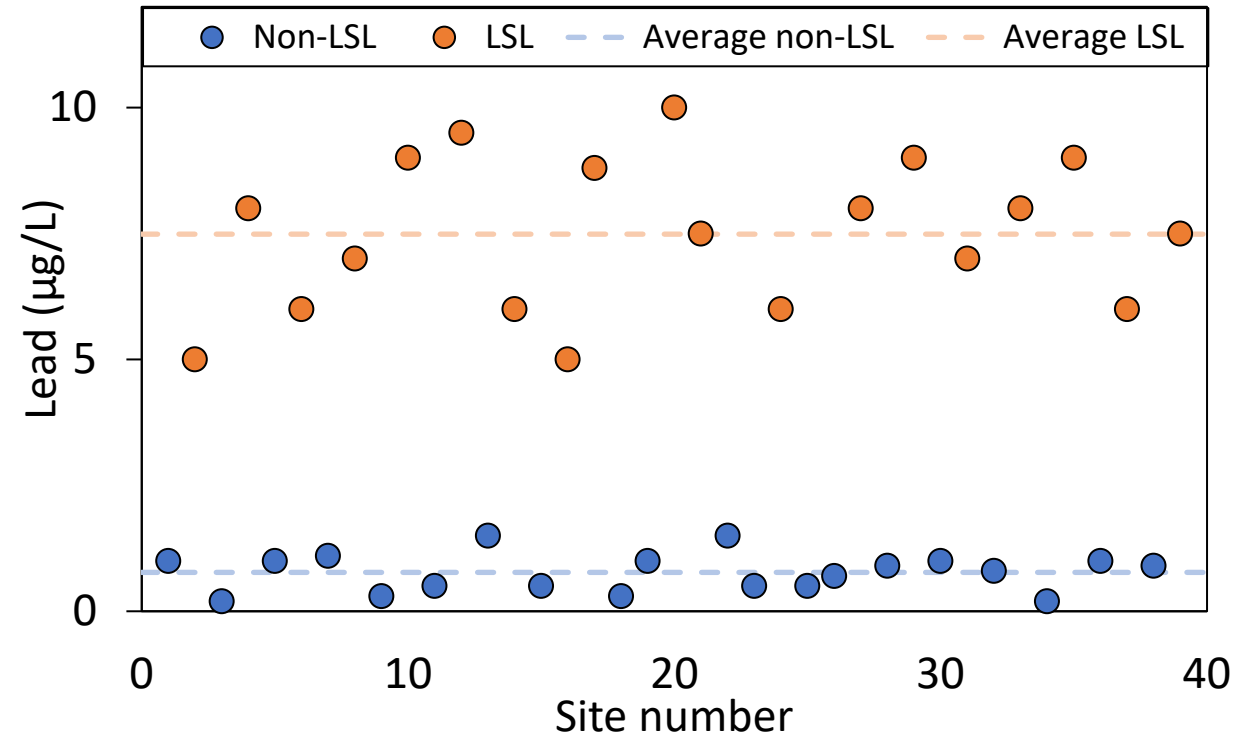
Water sampling methods:

1. **Flushed Sampling**
2. **Sequential Profile Sampling**
3. **Passive Water Sampling**
4. First Draw Sampling
5. Manual Composite Sampling
6. Random Daytime Sampling

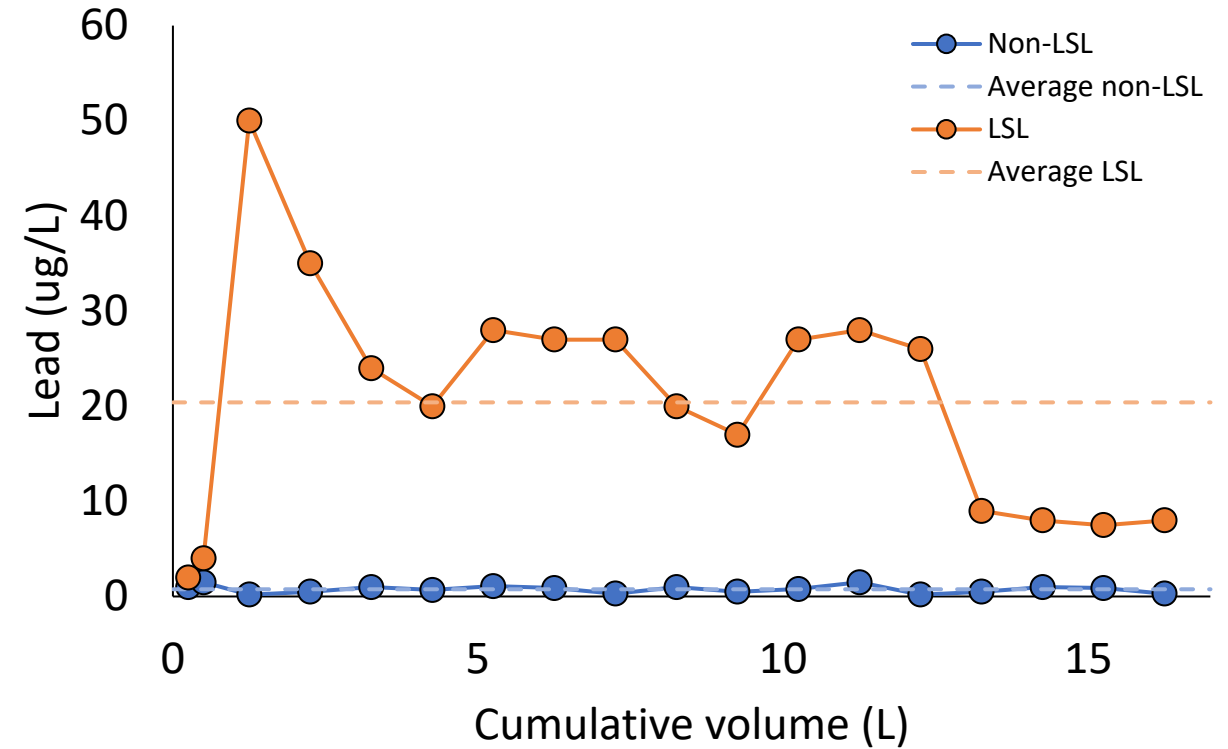
Two sampling groups:



Example results for fully flushed sampling



Example results for sequential profile sampling



Challenges/limitations:

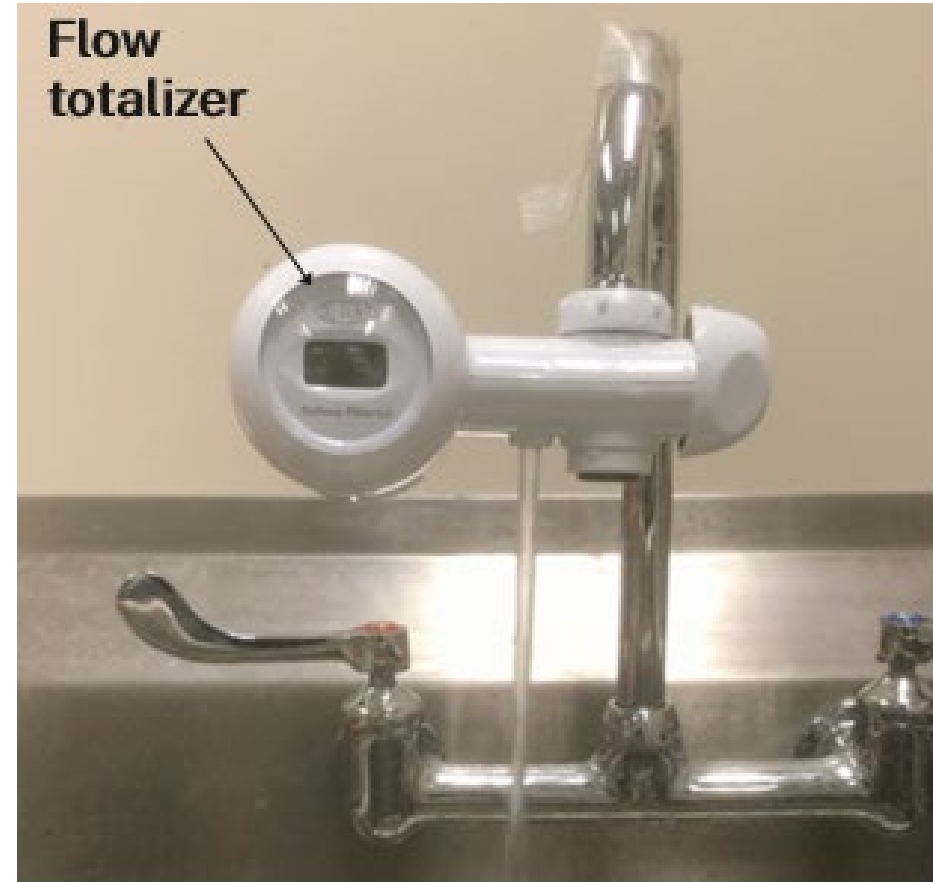
- Need to enter customer's home
- Community and sample method-specific LSL ID water lead thresholds needed
- Community-specific SL volumes needed
- If effective corrosion control leads to low lead release, LSL sites harder to differentiate through water sampling

Passive Water Sampling

EPA ORD research in-progress

Lead Evaluation and Assessment Device (LEAD): Install point-of-use (POU) filter at kitchen tap, use per manufacturer, return cartridge for analysis

- Extract total lead mass (μg) accumulated on the POU filter
- Average lead mass in home with LSL is expected to be much greater than a home that never had a LSL



Excavation

Mechanical Excavation

Backhoe or another mechanical excavator to dig a test pit down to the SL to expose it

- Reliable
- Higher accuracy rate than other excavation methods



Vacuum Excavation

Hydro-vacuum truck consists of a high-pressure water jet and industrial vacuum. Jet loosens soil, vacuum removes it into a holding tank until the SL is exposed

- Smaller hole, less expensive, less disturbance

Challenges/ Limitations:

- High cost and time
- Disturbance
- Heterogeneous SL may have lead segments that could be missed by single hole

Predictive Modeling

Geospatial

- Spatial patterns and proximity to **known LSLs**
- Predictions can be made for unsampled sites

Machine Learning

- Uses a predictive self-learning algorithm with a geospatial model

Challenges/Limitations

- Provides % likelihood output – not definitive
- Relies on data inputs (e.g., LSL ID approaches on previous slides)
- Data quality and confidence?

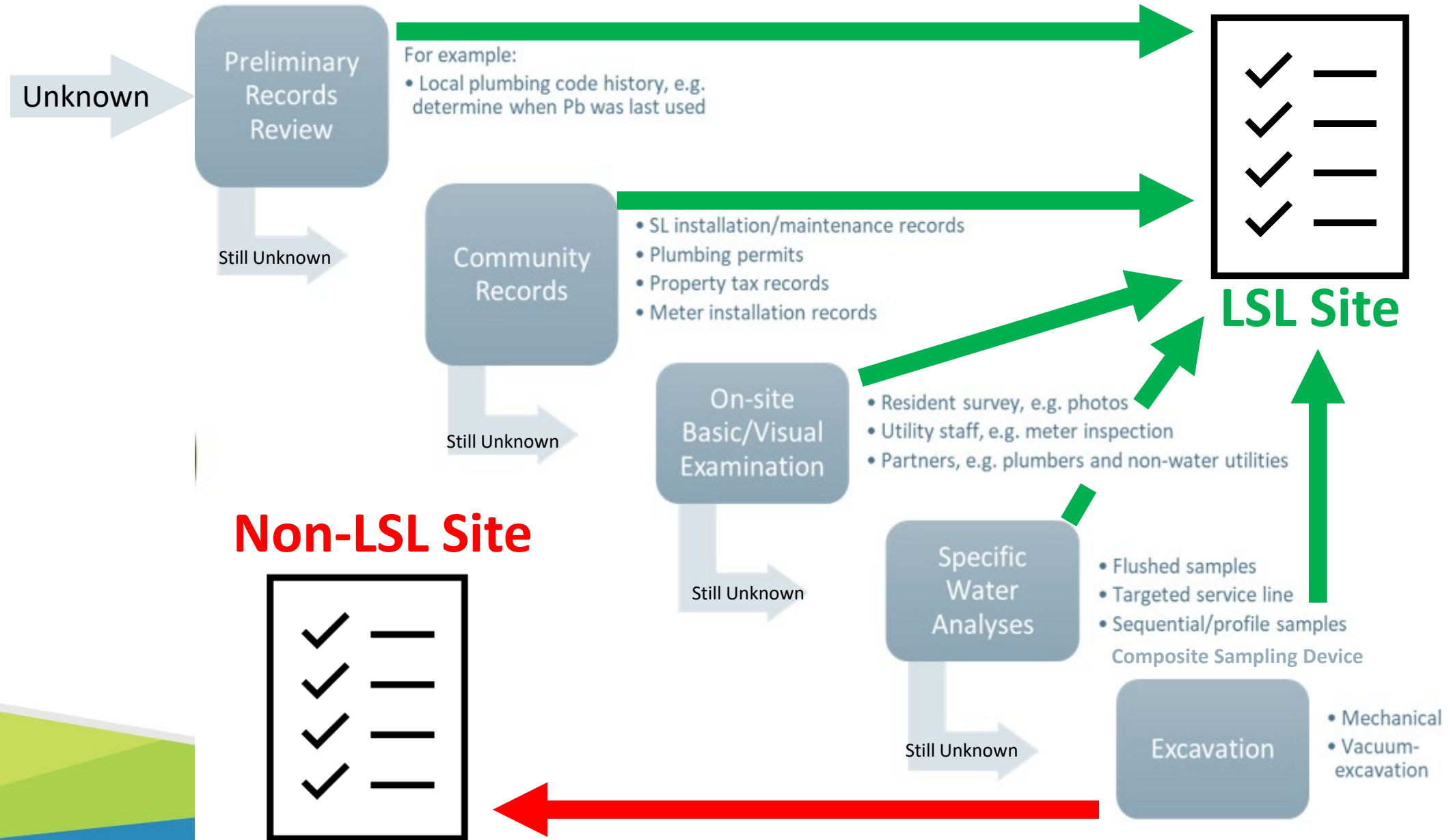
Alternative Methods

- Electrical resistance
- Acoustic wave
- Eddy current
- CCTV
- Metal detectors
- Magnetometers/Gradiometers – locate iron, not lead/copper
- Ground penetrating radar

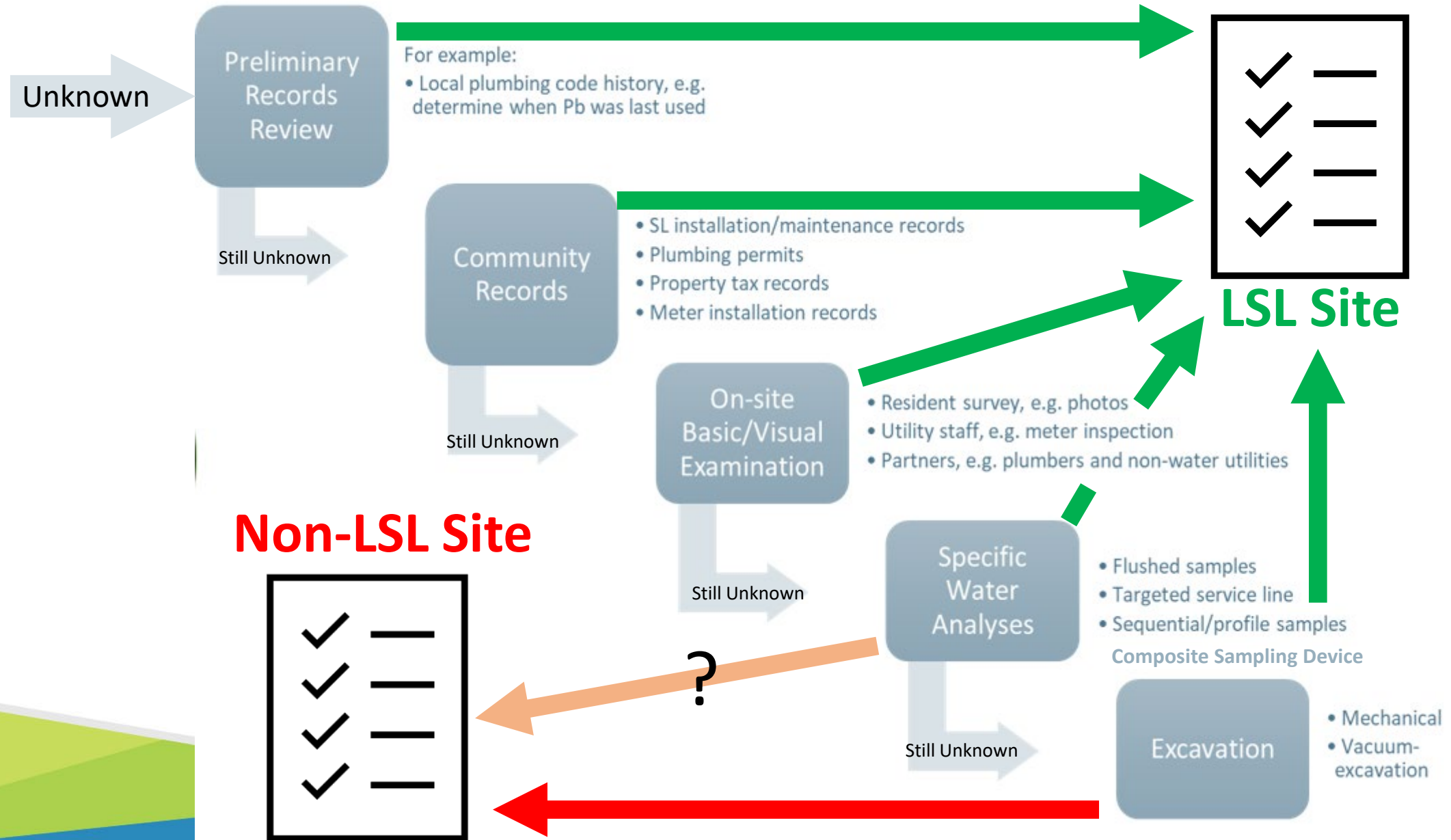
Challenges/Limitations:

- Some methods are yet to be proven
- Some methods are still in development (not commercially available)
- High potential for disturbance that needs to be addressed (i.e. CCTV the camera runs through the pipe)

Stepwise Approach to LSL ID



Stepwise Approach to LSL ID



LSL Identification Research Areas

1. Field Community Studies to Evaluate a Stepwise Approach to LSL Identification (ID) Technologies

Collect information and assess a combination of promising LSL identification approaches including historical records, visual inspection, water sampling-based approaches, and mechanical excavation that optimizes accuracy while minimizing costs

2. No-Dig Approaches Including Innovative/Advanced Technology Evaluation

Collect information and assess promising no-dig LSLs identification approaches including water sampling and novel approaches such as passive sampling

3. Identifying Other Lead-Containing Services Lines

Document identification best practices for identifying galvanized pipe downstream of LSLs, brass service lines, lead-line iron , others

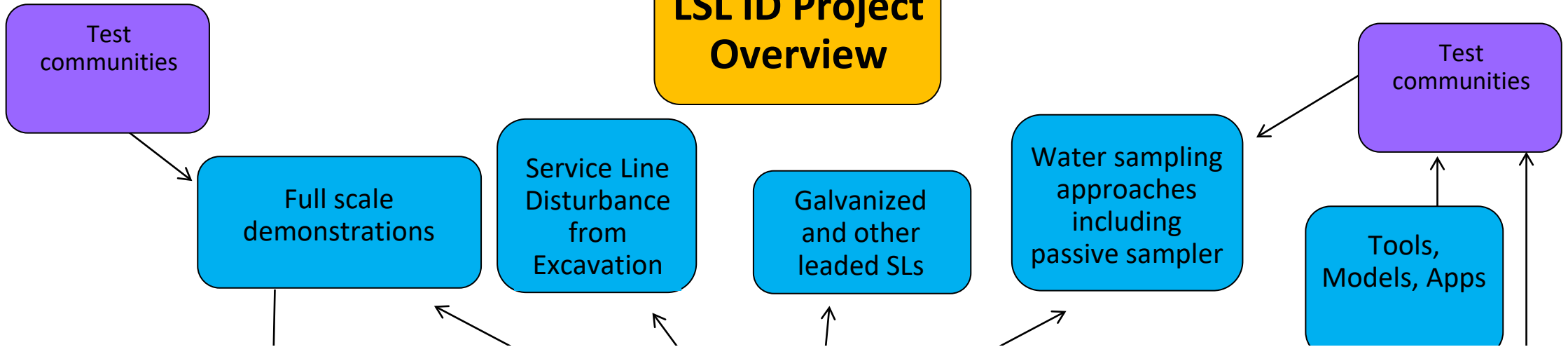
4. App/Model/Tool/Website Development

Document LSL identification best practices (performance, ease of use, and cost) and develop tools that communities can use to support their decision-making regarding LSL identification

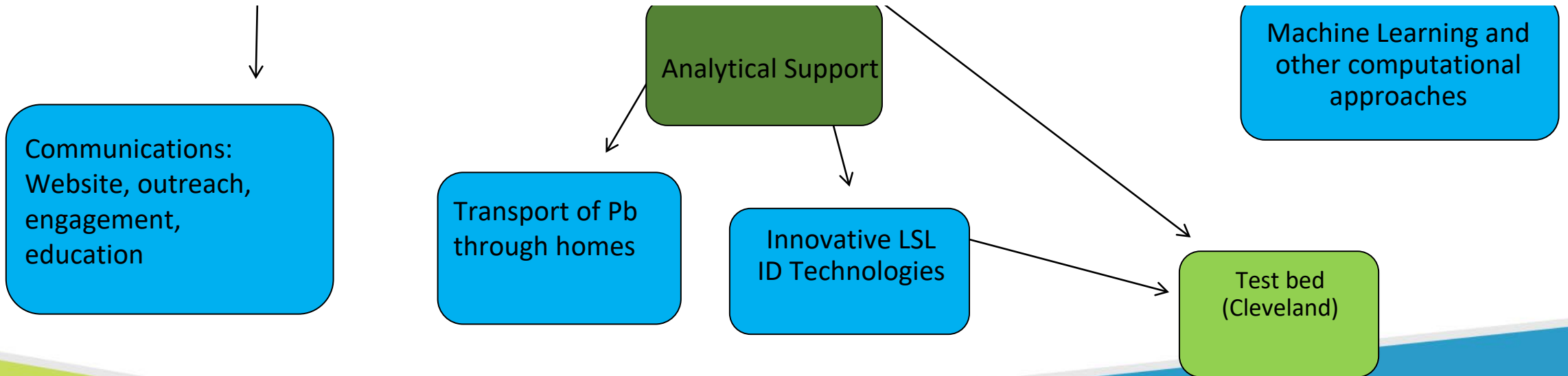
5. Community Engagement

Develop effective communication strategies on the health risks of lead in drinking water and the importance of LSL replacement

LSL ID Project Overview



We are looking for partners all aspects of this effort!



Summary

- Variety of LSL ID tools available, combinations of tools needed
- Tool selection criteria may include:
 - Accuracy
 - Overall time
 - Cost
 - Skill (labor, technical interpretation)
 - Disruption to homeowner (water service interruption, property damage, participation)
 - Disturbance (service line, traffic flow)
- As more utilities share their experiences, the pros/cons in different situations will be better defined

Summary

- Step-wise identification is one suggested approach that we will keep refining
 - VT case study demonstrated no step is 100% accurate, but that cost-savings could be realized in prior steps depending on regulatory approval
- Some parts of the country have long history of LSLs, whereas others do not
- Customization of approach and combination of tools can meet specific needs

Contact

Christina Devine

Engineer

Center for Environmental Solutions
and Emergency Response

Devine.Christina@epa.gov

(513) 569-7534

Darren Lytle

Environmental Engineer

Center for Environmental Solutions
and Emergency Response

Lytle.Darren@epa.gov

513-569-7432

Acknowledgements

- Lytle D. (EPA ORD) Hensley K. (EPA Region 2) and Bosscher V. (EPA R5) for article “Lead Service Line Identification: A Review of Strategies and Approaches”
- Liggett, J., Baribeau, H., Deshommes, E., Lytle, D., Masters, S., Muylwyk, Q (AWWA Lead-in-Water Subcommittee) for article “Service Line Material Identification Strategies: Experiences From North American Water Systems”
- All other authors for resources cited herein

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Questions?