

Lead in Water & Water Filtration

Kyle Jennings, REHS

Macon County Environmental Health Section Administrator

Lead in Water & Water Filtration

- * Water Quality Complaint
- * Open Lead Investigation
- * Partnering with Virginia Tech
- * HUD & USDA Grant



Water Quality Complaint – 2006 Well Initial Results



North Carolina State Laboratory of Public Health

Environmental Sciences

Analytic Chemistry

Certificate of Analysis

P.O. Box 28047
306 N. Wilmington St.
Raleigh, NC 27611-8047
<http://slph.ncpublichealth.com>
Phone: 919-733-7834
Fax: 919-733-8695

Report To:

MACON CO ENVIRONMENTAL HEALTH

1830 LAKESIDE DR

FRANKLIN, NC 28734

EIN: 566000930EH

Name of System:

1st Sample

Courier # 08-49-01

StarLIMS ID: ES061112-0001001

Date Collected: 06/07/12

Date Received: 06/11/12

Time Collected: 09:30 AM

Collected By: B Hedden

Sample Type: Raw

Sample Source: Well

Sampling Point: Well Hedden

Temp. at Receipt:

Well Permit #:

GPS #:

Sample Description:

Comment: Ph# 369-9591

Inorganic Chemical I (Profile)

Analyte	Result	Allowable Limit	Unit	Qualifier(s)
Arsenic	< 0.005	0.010	mg/L	
Barium	< 0.1	2.00	mg/L	
Cadmium	0.004	0.005	mg/L	
Calcium	5		mg/L	
Chloride	< 5.00	250	mg/L	
Chromium	< 0.01	0.10	mg/L	
Copper	< 0.05	1.3	mg/L	
Fluoride	< 0.20	4.00	mg/L	
Iron	3.20	0.30	mg/L	
Lead	0.034	0.015	mg/L	
Magnesium	< 1.0		mg/L	
Manganese	0.08	0.05	mg/L	
pH	7.2		N/A	
Selenium	< 0.005	0.05	mg/L	
Silver	< 0.05	0.10	mg/L	
Sodium	3.40		mg/L	
Sulfate	< 5.00	250	mg/L	
Total Alkalinity	42		mg/L	
Total Hardness	13		mg/L	
Zinc	14.00	5.00	mg/L	

Report Date: 06/18/2012

Reported By: Debbie Mancoske

Water Quality Complaint – 2006 Well Confirmation Results



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Report To:

MACON CO ENVIRONMENTAL HEALTH
1830 LAKESIDE DR

FRANKLIN, NC 28734
EIN: 566000930EH

Name of System:

JOHN MCCABE

2730 CLEAR CREEK ROAD
HIGHLANDS, NC 28741

Courier # 08-49-01

StarLIMS ID: **ES070612-0002001**

Date Collected: 07/03/12

Date Received: 07/06/12

Time Collected: 10:45 AM

Collected By: John McCabe

Sample Type: Raw
Sample Source: Well

Sampling Point: Well head
Temp. at Receipt:

Well Permit #:
GPS #:

Sample Description:

Comment: Ph# 828-526-8788, pd 7/3/12.

Inorganic Chemical + Metals I (Profile)

Analyte	Result	Allowable Limit	Unit	Qualifier(s)
Arsenic	< 0.005	0.010	mg/L	
Barium	< 0.1	2.00	mg/L	
Cadmium	0.003	0.005	mg/L	
Calcium	4		mg/L	
Chloride	< 5.00	250	mg/L	
Chromium	< 0.01	0.10	mg/L	
Copper	< 0.05	1.3	mg/L	
Fluoride	< 0.20	4.00	mg/L	
Iron	3.40	0.30	mg/L	
Lead	0.055	0.015	mg/L	
Magnesium	< 1.0		mg/L	
Manganese	0.15	0.05	mg/L	
Mercury	< 0.0005	0.002	mg/L	
pH	7.3		N/A	
Selenium	< 0.005	0.05	mg/L	
Silver	< 0.05	0.10	mg/L	
Sodium	2.60		mg/L	
Sulfate	< 5.00	250	mg/L	
Total Alkalinity	40		mg/L	
Total Hardness	12		mg/L	
Zinc	16.00	5.00	mg/L	

Report Date: 07/20/2012

Reported By: *Arnold Hall*





Biofilm / Corrosion
Mixture









111309-PO 58594-CHINA



104-2325100 T101





G-FBI 190 NUC 10423251330



Water Quality Complaint – 2006 Well Drop Pipe Results

North Carolina State Laboratory Public Health

N.C. Department of Health and Human Services

P.O. Box 28047 - 306 N. Wilmington St. - Raleigh, NC 27611-8047

(919) 733 -7308

Environmental Lead Report

Name: [REDACTED]

Address: [REDACTED]

County: **MACON**

Report To: **HAROLD FAIRCLOTH**

Collected By: **H FAIRCLOTH**

Address: **MACON CO ENVIRONMENTAL HEALTH
1830 LAKESIDE DR
FRANKLIN, NC 28734**

Telephone: **8283492490**

Date Collected: **09/18/2012**

Analysis Desired: **LEAD**

Courier: **08-49-01**

EIN: **566000930EH**

NC State Laboratory of Public Health Standard Operation
Procedure 313.7, Referencing SW-846, 3050B Hotblock
Acid Digestion and Standard Methods 3111B, analysis by
Flame Atomic Absorption Spectrometry.

Inorganic Chemistry -

StarLIMS Sample ID	Field Number	Sample Type	Surface Type	Length x Width (in inches)	Final Result	Reporting Limit
ES092412-0016001	1	S			4,100 mg/kg	15 mg/kg
ES092412-0016002	2	S			6,800 mg/kg	15 mg/kg
ES092412-0016003	3	S			7,800 mg/kg	15 mg/kg
ES092412-0016004	4	S			20 mg/kg	15 mg/kg

Comment: Reference Starlim ID: ES070612-0002

Date Received: **09/24/2012**

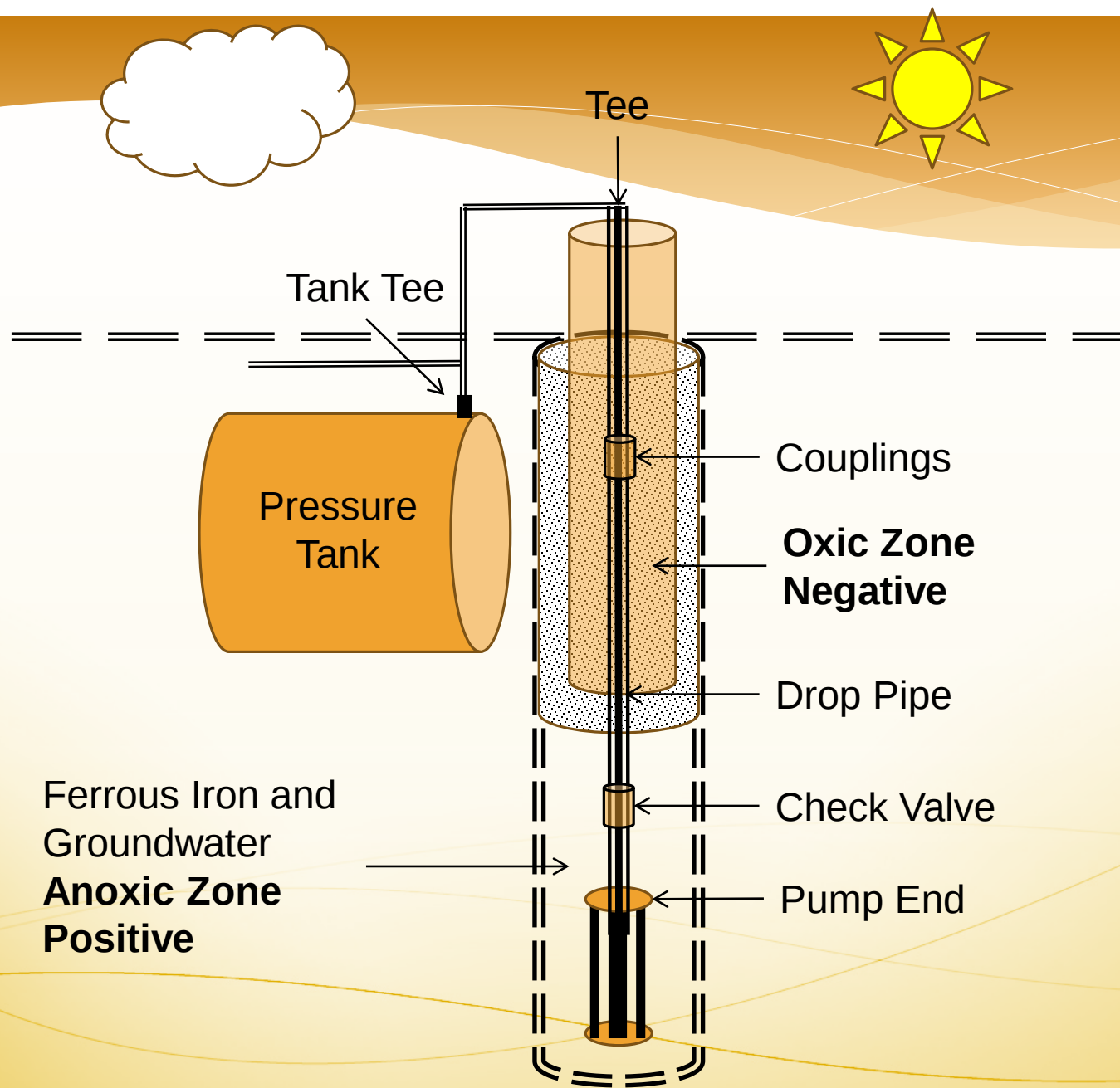
Date Analyzed: **10/16/2012**

Report Date: **10/25/2012**

Reported By: **Debbie Moncol**

No corrections made for field blanks.
All quality control within specified limits.
These results only apply to the samples submitted for analysis.
Paints and soils are analyzed in duplicate with the higher value reported.

Debbie J. Moncol, Supervisor
Environmental Inorganic Chemistry



Water Quality Complaint – Follow-up Wellhead Results



North Carolina State Laboratory of Public Health

Environmental Sciences

Inorganic Chemistry

Certificate of Analysis

P.O. Box 28047
4312 District Drive
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Fax: 919-715-8611

Report To:

Name of System:

MACON CO ENVIRONMENTAL HEALTH
1830 LAKESIDE DR

JOHN MCCABE

FRANKLIN, NC 28734
EIN: 566000930EH

Courier # 08-49-01

2730 CLEAR CREEK RD PO BOX 414
HIGHLANDS, NC 28741

StarLIMS ID: ES102513-0009001

Date Collected: 10/21/13

Time Collected: 12:30 PM

Date Received: 10/25/13

Collected By: John McCabe

Sample Type: Raw
Sample Source: Well

Sampling Point: Well head
Temp. at Receipt:

Well Permit #:
GPS #:

Sample Description:

Comment: Ph# 828-526-8788, call with results 850-830-2114.

Inorganic Chemical + Metals I (Profile)

Analyte	Result	Allowable Limit	Unit	Qualifier(s)
Arsenic	< 0.005	0.010	mg/L	
Barium	< 0.1	2.00	mg/L	
Cadmium	< 0.001	0.005	mg/L	
Calcium	10		mg/L	
Chloride	6.00	250	mg/L	
Chromium	< 0.01	0.10	mg/L	
Copper	→ 0.10	1.3	mg/L	
Fluoride	0.28	4.00	mg/L	
Iron	→ 0.18	0.30	mg/L	
Lead	→ 0.021	0.015	mg/L	
Magnesium	< 1.0		mg/L	
Manganese	→ 0.04	0.05	mg/L	
Mercury	< 0.0005	0.002	mg/L	
pH	6.8		N/A	
Selenium	< 0.005	0.05	mg/L	
Silver	< 0.05	0.10	mg/L	
Sodium	6.50		mg/L	
Sulfate	13.00	250	mg/L	
Total Alkalinity	32		mg/L	
Total Dissolved Solids	80	500	mg/L	
Total Hardness	28		mg/L	
Total Suspended Solids	< 1		mg/L	
Zinc	→ 6.00	5.00	mg/L	

→ = fingerprint for galvanized components

Report Date: 11/06/2013

E-mail 11-13-13

Reported By:

Arnold Hall

HF

Water Quality Complaint – Follow-up Guesthouse Results

e-mailed 11/13/13



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Fax: 919-715-8611

Report To:

Name of System:

MACON CO ENVIRONMENTAL HEALTH
1830 LAKESIDE DR

JOHN MCCABE

FRANKLIN, NC 28734
EIN: 566000930EH

Courier # 08-49-01

2730 CLEAR CREEK RD PO BOX 414
HIGHLANDS, NC 28741

StarLIMS ID: ES102513-0010001

Date Collected: 10/21/13

Time Collected: 12:40 PM

Date Received: 10/25/13

Collected By: John McCabe

Sample Type: Raw
Sample Source: Well

Sampling Point: Guest house
Temp. at Receipt:

Well Permit #:
GPS #:

Sample Description:

Comment: Ph# 828-526-8788, call with results 850-830-2114.

Inorganic Chemical + Metals I (Profile)

Analyte	Result	Allowable Limit	Unit	Qualifier(s)
Arsenic	< 0.005	0.010	mg/L	
Barium	< 0.1	2.00	mg/L	
Cadmium	< 0.001	0.005	mg/L	
Calcium	1		mg/L	
Chloride	< 5.00	250	mg/L	
Chromium	< 0.01	0.10	mg/L	
Copper	< 0.05	1.3	mg/L	
Fluoride	< 0.20	4.00	mg/L	
Iron	< 0.10	0.30	mg/L	
Lead	< 0.005	0.015	mg/L	
Magnesium	< 1.0		mg/L	
Manganese	< 0.03	0.05	mg/L	
Mercury	< 0.0005	0.002	mg/L	
pH	7.3		N/A	
Selenium	< 0.005	0.05	mg/L	
Silver	< 0.05	0.10	mg/L	
Sodium	1.50		mg/L	
Sulfate	< 5.00	250	mg/L	
Total Alkalinity	14		mg/L	
Total Dissolved Solids	20	500	mg/L	
Total Hardness	< 7		mg/L	
Total Suspended Solids	< 1		mg/L	
Zinc	↓ 4.80	5.00	mg/L	

60 mg/L reduction by filtration

Report Date: 11/06/2013

11-13-13

Reported By:

Arnold Hall

HF

Water Quality Complaint Follow-Up Springhead Results



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Inorganic Chemistry
Certificate of Analysis

P.O. Box 26047
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Raleigh, NC 27611-6047
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Phone: 919-733-7534
Fax: 919-733-5695

Report To: HAROLD FAIRCLOTH
MACON CO ENVIRONMENTAL HEALTH
1830 LAKESIDE DR

Name of System:
JOHN MCCABE
2730 CLEAR CREEK RD.
HIGHLANDS, NC 28741

FRANKLIN, NC 28734
EIN: 566000930EH

Courier # 08-49-01

StarLIMS ID: ES080312-0008001

Date Collected: 08/01/12

Time Collected: 2:30 PM

Date Received: 08/03/12

Collected By: McCabe

Sample Type: Raw
Sample Source: Spring

Sampling Point: At spring
Temp. at Receipt:

Well Permit #:
GPS #:

Sample Description:

Comment: Ph# 828-526-8788, pd 8/01/12

Inorganic Chemical + Metals I (Profile)

Analyte	Result	Allowable Limit	Unit	Qualifier(s)
Arsenic	< 0.005	0.010	mg/L	
Barium	< 0.1	2.00	mg/L	
Cadmium	< 0.001	0.005	mg/L	
Calcium	< 1.0		mg/L	
Chloride	< 5.00	250	mg/L	
Chromium	< 0.01	0.10	mg/L	
Copper	< 0.05	1.3	mg/L	
Fluoride	< 0.20	4.00	mg/L	
Iron	< 0.10	0.30	mg/L	
Lead	< 0.005	0.015	mg/L	
Magnesium	< 1.0		mg/L	
Manganese	< 0.03	0.05	mg/L	
Mercury	< 0.0005	0.002	mg/L	
pH	6.3		N/A	
Selenium	< 0.005	0.05	mg/L	
Silver	< 0.05	0.10	mg/L	
Sodium	1.30		mg/L	
Sulfate	< 5.00	250	mg/L	
Total Alkalinity	6		mg/L	
Total Hardness	< 7		mg/L	
Zinc	< 0.05	5.00	mg/L	

Report Date: 08/22/2012

Reported By: Arnold Hall

Results of Complaint Investigation

- * Galvanized components removed from well
- * Sample galvanized components and received elevated lead results
- * Informed local drillers
- * Notified Well Contractors Certification Commission
- * Notified State Epidemiological Laboratory

Open Lead Investigation

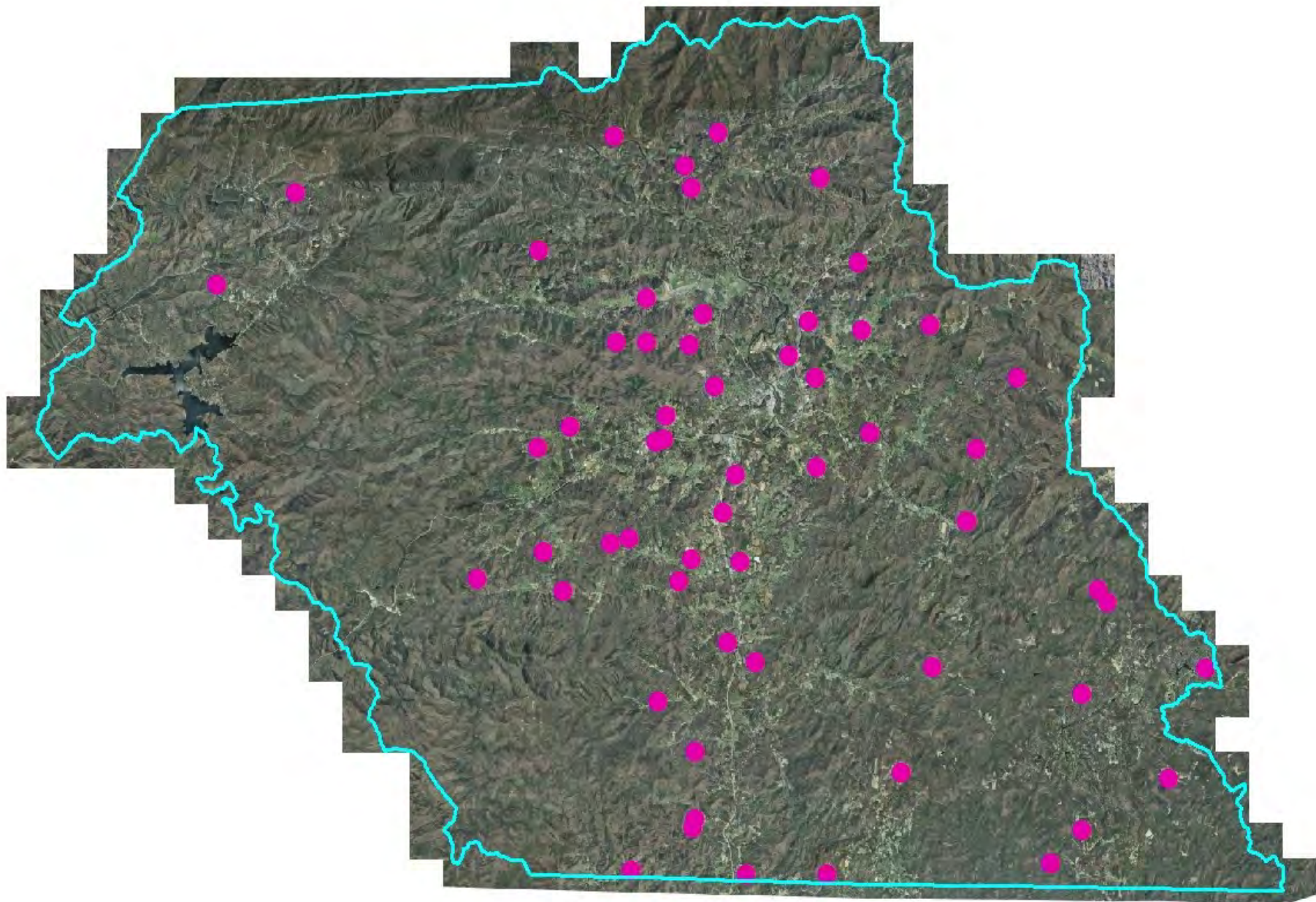


STARLIMS

- * Cross reference data bases at state and local levels
 - * StarLIMS
 - * Macon County PDWW database
 - * Pulled GW1a of all samples with lead $.011\text{mg/L}$

Open Lead Investigation

- * $\approx$ 450 wells drilled in Macon County since PDWW program began until beginning of open elevated lead investigation
- * 55 wells met the criteria for elevated lead levels in this open lead investigation Macon County since PDWW program



Protocol for Open Lead Investigation

- * Questionnaire developed for homeowners with elevated lead in water source
- * Follow-up sampling procedure
 - * “Lead Copper Rule”
 - * Three flush protocol (1, 5 and 15 minute)

Initial Sampling Results

- * Lead found primarily at the wellhead (generally on first draw, occasionally also in the 5 and 15 minute samples)
- * Lead also found in wells with PVC drop pipe
- * Excessively elevated lead found in pleated filters

Galvanized Component



Follow-Up to Initial Sampling Results

- * Press release for wells drilled before well program
- * Health information sheet from state lead program
- * Conversations with drillers about materials used in wells construction

Investigation Conclusions

- * Suspecting components other than drop pipe may also be responsible for lead contamination
- * Brass components (including couplings and tees)



New Protocol for Sampling



- * Sampling protocol based on volumetric calculations
- * Use flow meter to determine when sample is to be taken

Next Steps: Partnering with Virginia Tech

- * Elevated Lead in Water of Private Wells Poses Health Risks: Case Study in Macon County, North Carolina published in *Environmental Science & Technology*, March 14, 2018

Abstract

Recent research has indicated that lead in water of private wells is in the range of that which caused problems in Flint, Michigan. However, there is limited understanding of the mechanisms for water lead release in these systems. We evaluated water lead at the homes of two children with elevated blood lead in Macon County (North Carolina), which did not have identifiable lead paint or lead dust hazards, and examined water lead release patterns among 15 private wells in the county. Water lead release patterns differed among the 15 private wells. Problems with lead release were associated with (1) dissolution of lead from plumbing during periods of stagnation; (2) scouring of leaded scales and sediments during initial water use; and (3) mobilization of leaded scales during continued water use. Accurate quantification of water lead was highly dependent on sample collection methods, as flushing dramatically reduced detection of lead hazards. The incidence of high water lead in private wells may be present in other counties of North Carolina and elsewhere in the United States. The underestimation of water lead in wells may be masking cases of elevated blood lead levels attributed to this source and hindering opportunities to mitigate this exposure.



Preparation

- * Recruitment of wells with known lead problems (StarLIMS)
- * Coordination of Virginia Tech researchers and Macon County Public Health staff to visit homeowners
- * Homeowners requested to allow water to sit idle for 6+ hours

Procedures

- * Samples taken prior to house plumbing
- * Multiple samples taken over 15 minutes
- * Water filtered on site to test for particulate lead



Results

- * Majority of lead present showed up in first and second draws
- * Most wells showed decreasing lead levels as flushing continued
- * A large minority of wells (6 of 15) did show irregular periodic spikes as flushing continued



Why is this important?

- * Common recommendation to reduce lead exposure is to flush plumbing before use
- * Flushing to reduce lead exposure assumes premise plumbing is to blame for lead
- * Flushing may not eliminate lead exposure in all cases



Public Health Results

- * Two cases of children with elevated Blood Lead Levels
- * Similarities:
 - * Elevated water lead levels in wells
 - * Families advised to not use the water
 - * Blood lead levels drop
 - * Follow up testing at both houses reveal dissolved and particulate lead

HUD & USDA Grant

- * Partnering with Virginia Tech and Louisiana State University to study point of use filtration



Objectives

- * Examine efficiencies of filters;
- * Evaluate filters ability to function beyond rated capacity;
- * Discover challenges and barriers to filter use;
- * Evaluate awareness and risk perceptions of lead in drinking water; and
- * Study appropriate strategies for intervention in different communities

Acknowledgements

- * Harold Faircloth, REHS
 - * Environmental Health Specialist, MCPH
- * Kelsey Pieper, PhD
 - * Research Scientist, Virginia Tech