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science for a changing world

Sediment Quantity and Quality in the Big River Basin October 2012-September 2013

Miya N Barr

Hydrologist

Missouri Water Science Center

U.S. Department of the Interior
U.S. Geological Survey

Mining history

- Missouri was a world leader in lead production for over a century
- Primary ore is galena
- 8.5 million tons of lead were mined in the Old Lead Belt

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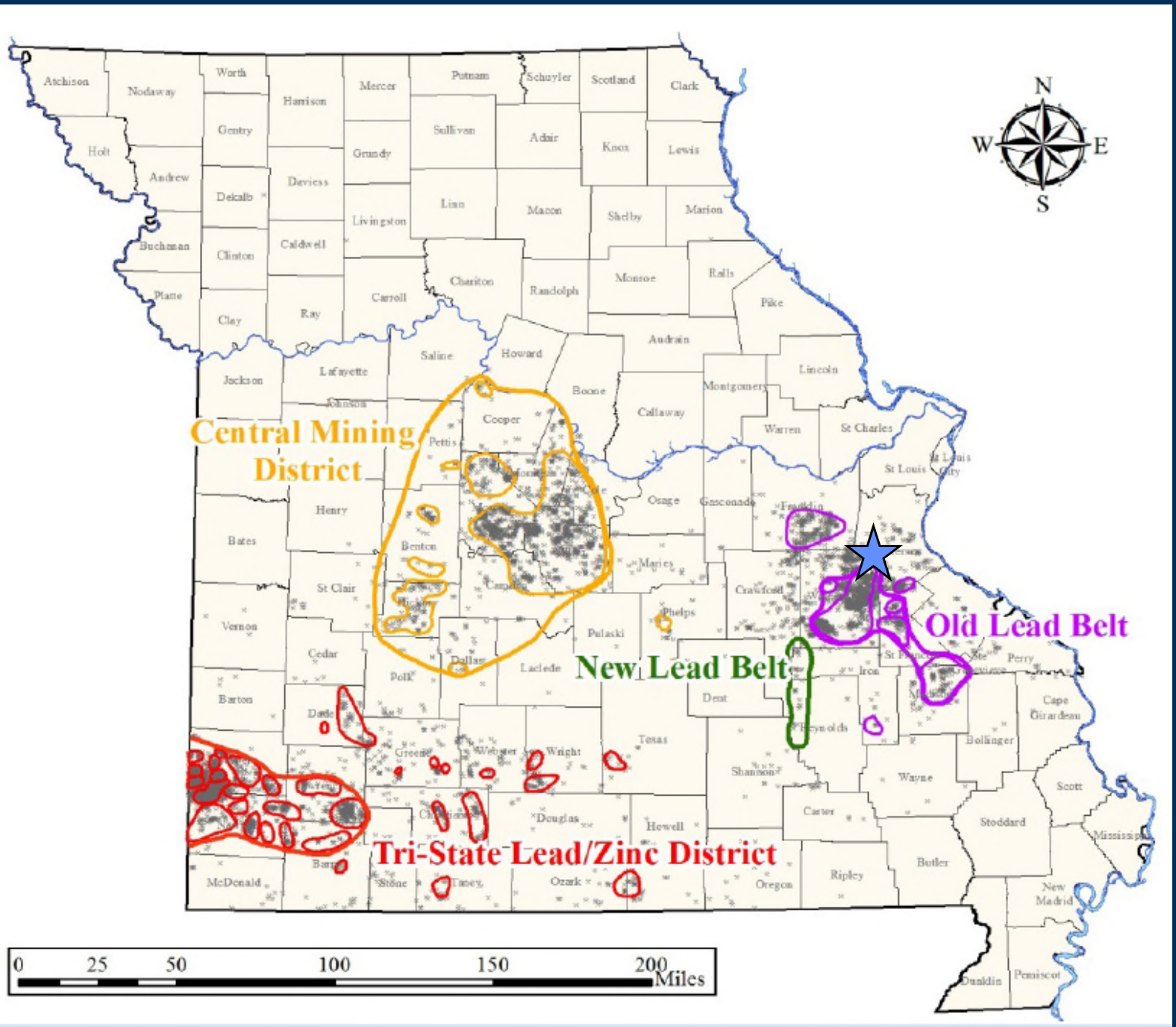
Central Mining District
Old Lead Belt
New Lead Belt
Tri-State Lead/Zinc District
N
W
E
S
0 25 50 100 150 200 Miles
Atchison
Nodaway
Worth
Harrison
Mercer
Putnam
Schuyler
Scotland
Clark
Holt
Gentry
Grundy
Sullivan
Adair
Knox
Lewis
Andrew
DeKalb
Daviess
Livingston
Linn
Macon
Shelby
Marion
Buchanan
Clinton
Caldwell
Carroll
Chariton
Randolph
Monroe
Ralls
Pike
Platte
Clay
Ray
Saline
Howard
Audrain
Jackson
Lafayette
Johnson
Boone
Callaway
Montgomery
Lincoln
Cooper
Warren
St Charles
St Louis
St Louis City
Pettis
Henry
Osage
Gasconade
Franklin
Bates
Benton
Maries
St Clair
Crawford
Vernon
Phelps
Pulaski
Cedar
Dallas
Laclede
Iron
Perry
Barton
Polk
Dent
Cape Girardeau
Dade
Reynolds
Greene
Webster
Wright
Texas
Hollinger
Shannon
Wayne
Scott
Carter
Douglas
Howell
Stoddard
Mississippi
Barry
Stone
Taney
Ozark
Oregon
Ripley
Butler
McDonald
New Madrid
Dunklin
Pemiscot

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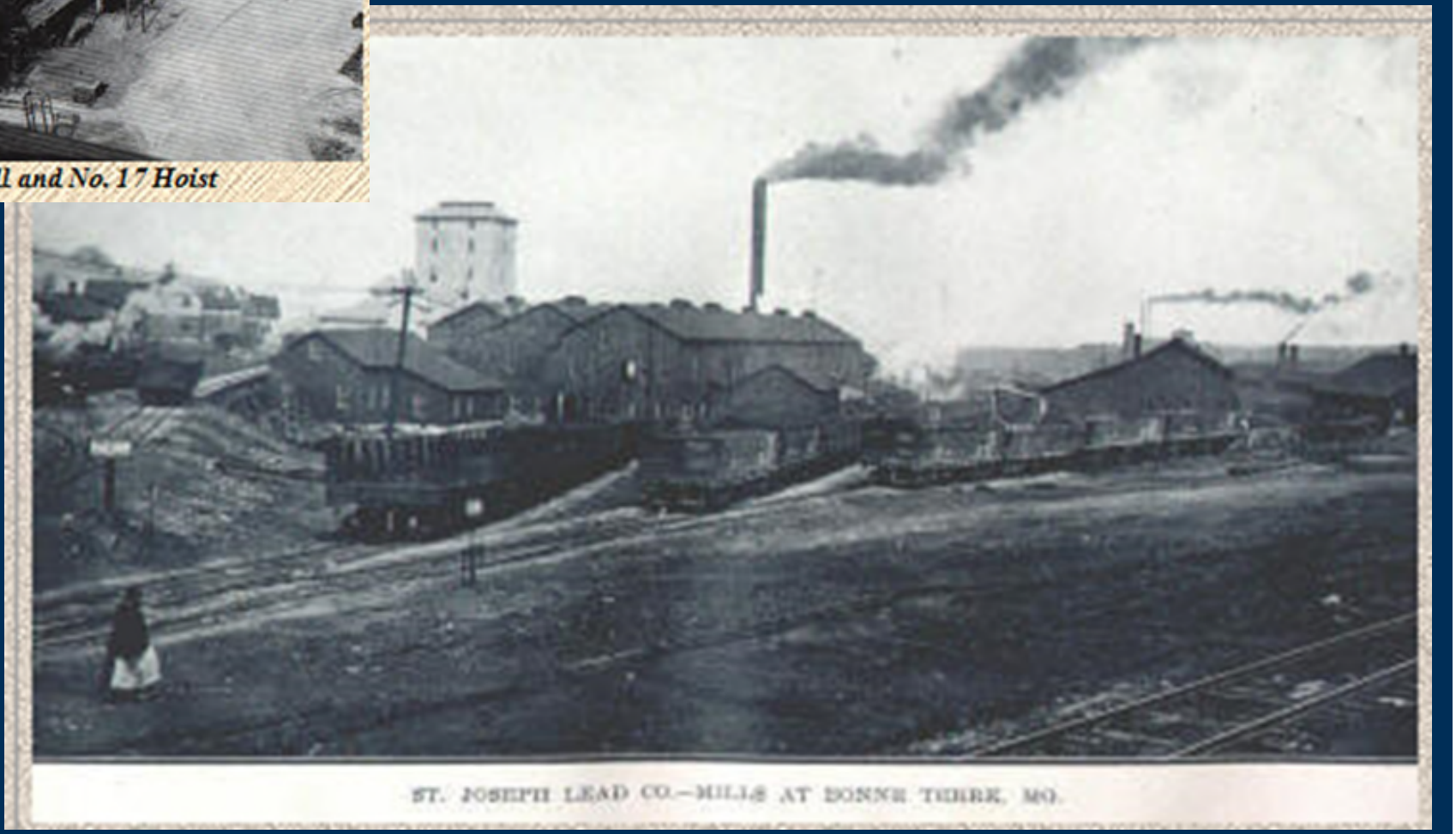
Early Mining in the Old Lead Belt

Federal Mill and No. 17 Hoist



ST. JOSEPH LEAD CO.—MILLS AT BONNE TERRE, MO.

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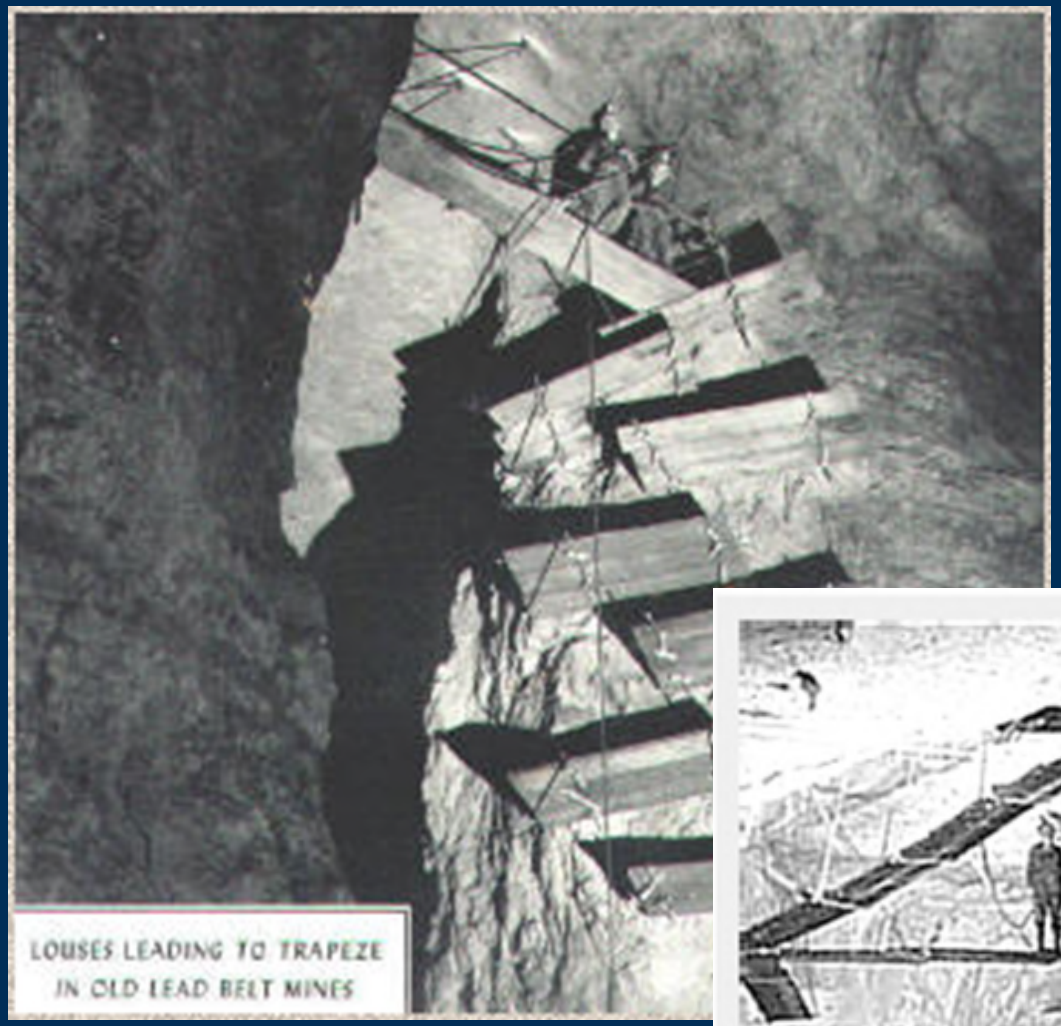
LOUSES LEADING TO TRAPEZE
IN OLD LEAD BELT MINES

Typical mine could be 200 feet below surface

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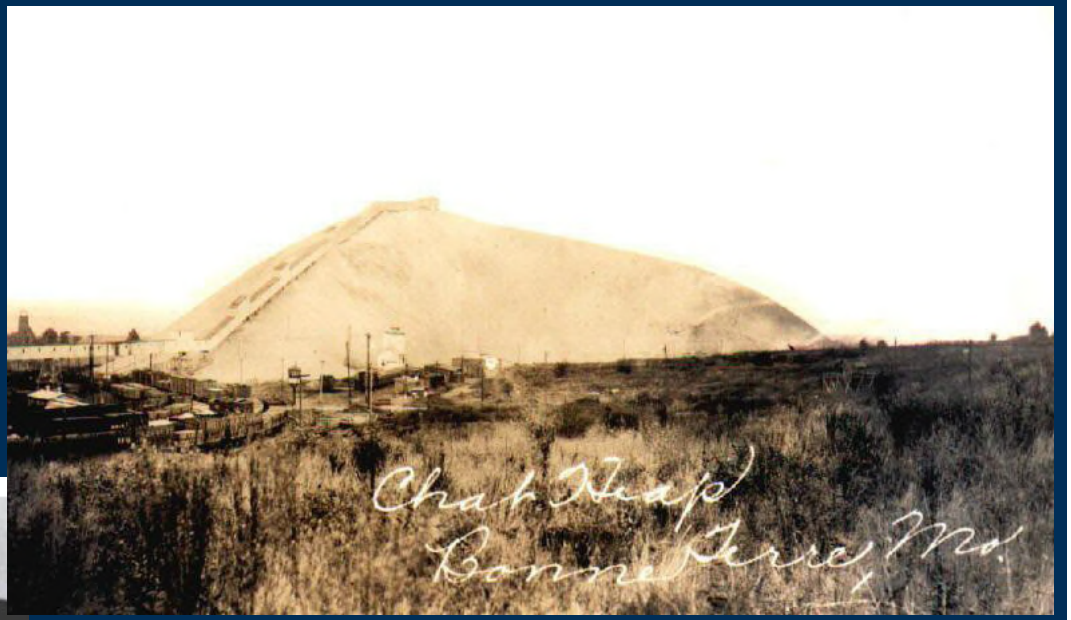
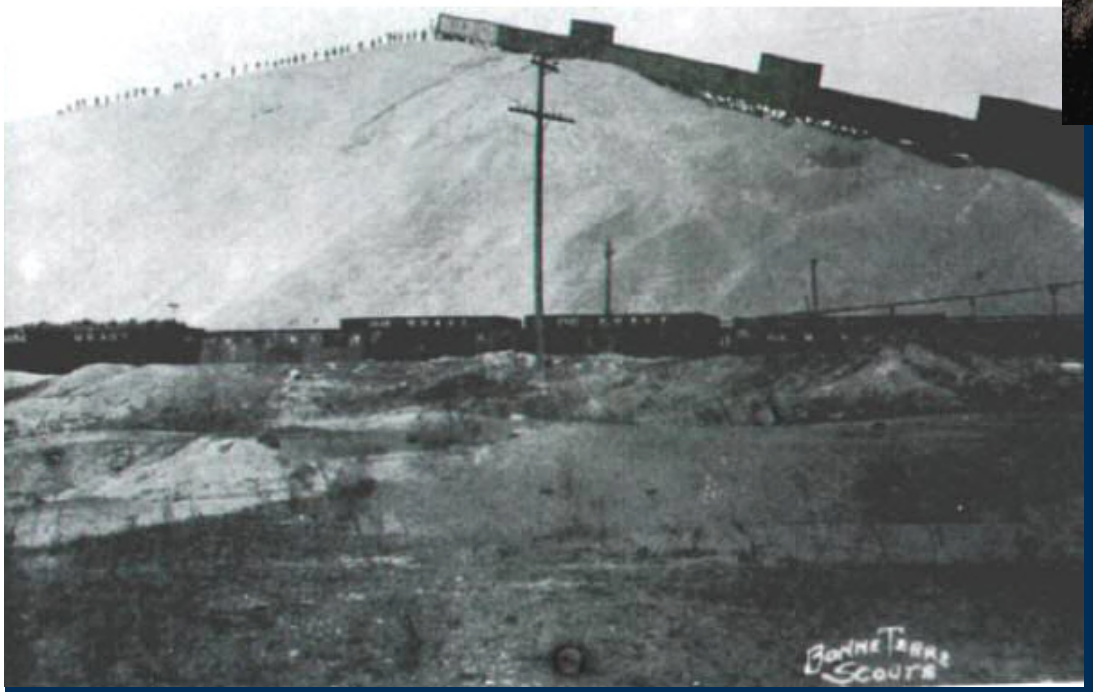
What is a pile?





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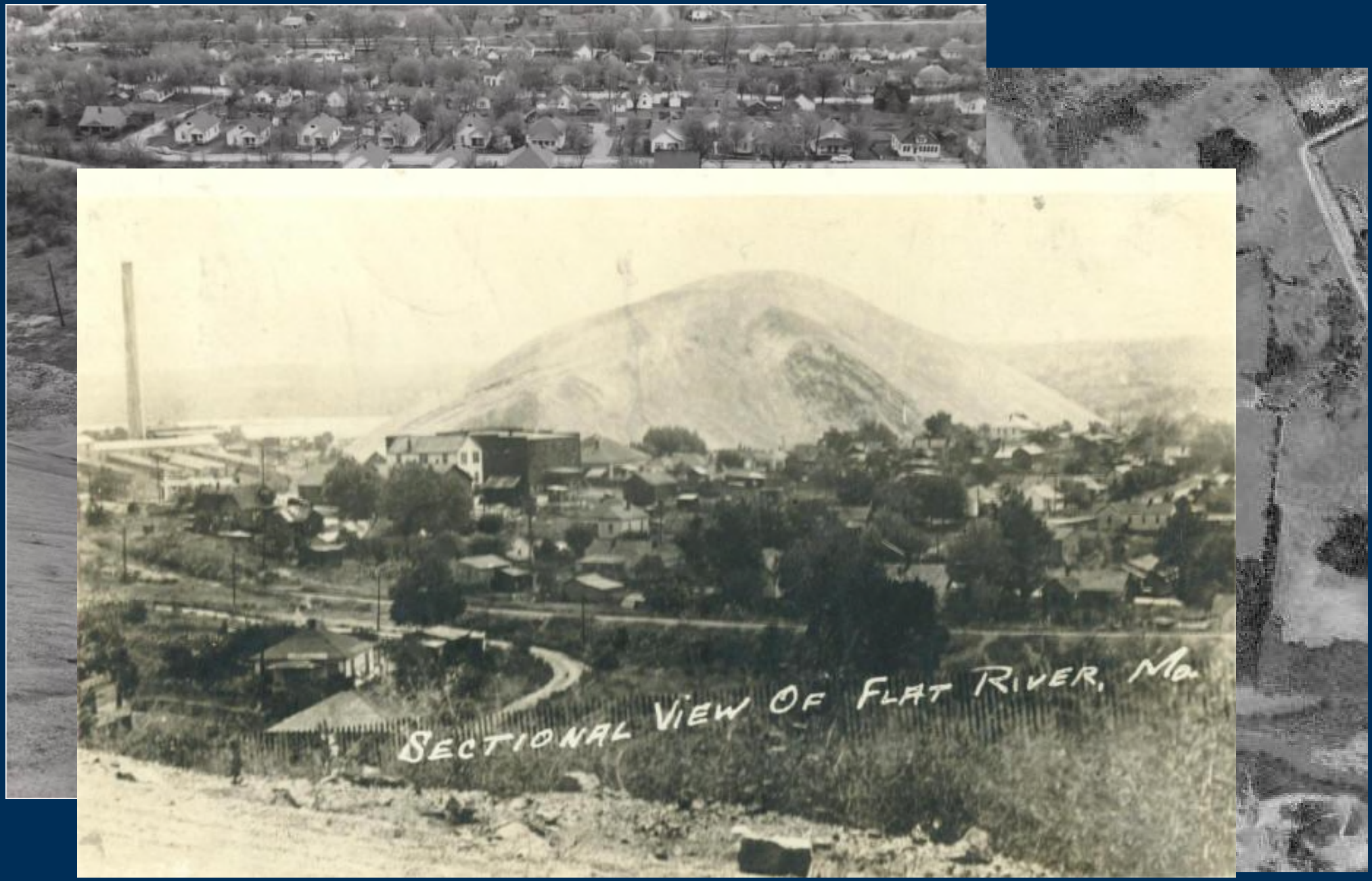

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Still a problem…

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Ruler
Line
Path
Measure the distance between two points on the ground
Map Length: 0.41 Miles
Ground Length: 0.41
Heading: 148.06 degrees
Mouse Navigation
Save
Clear
E Desoto Rd
Rongey St
Huff Ct
Young St
Jane St
Louise St
Rock St
Plum St
St Joseph St
Pear St
State Hwy E
Brand Pl
Fite St
N Allen St
S Young St
Park Ave
Bonne Terre
Hazel St
Berry Rd
Benham St
State Hwy K
Hedge Apple Ln
67
47

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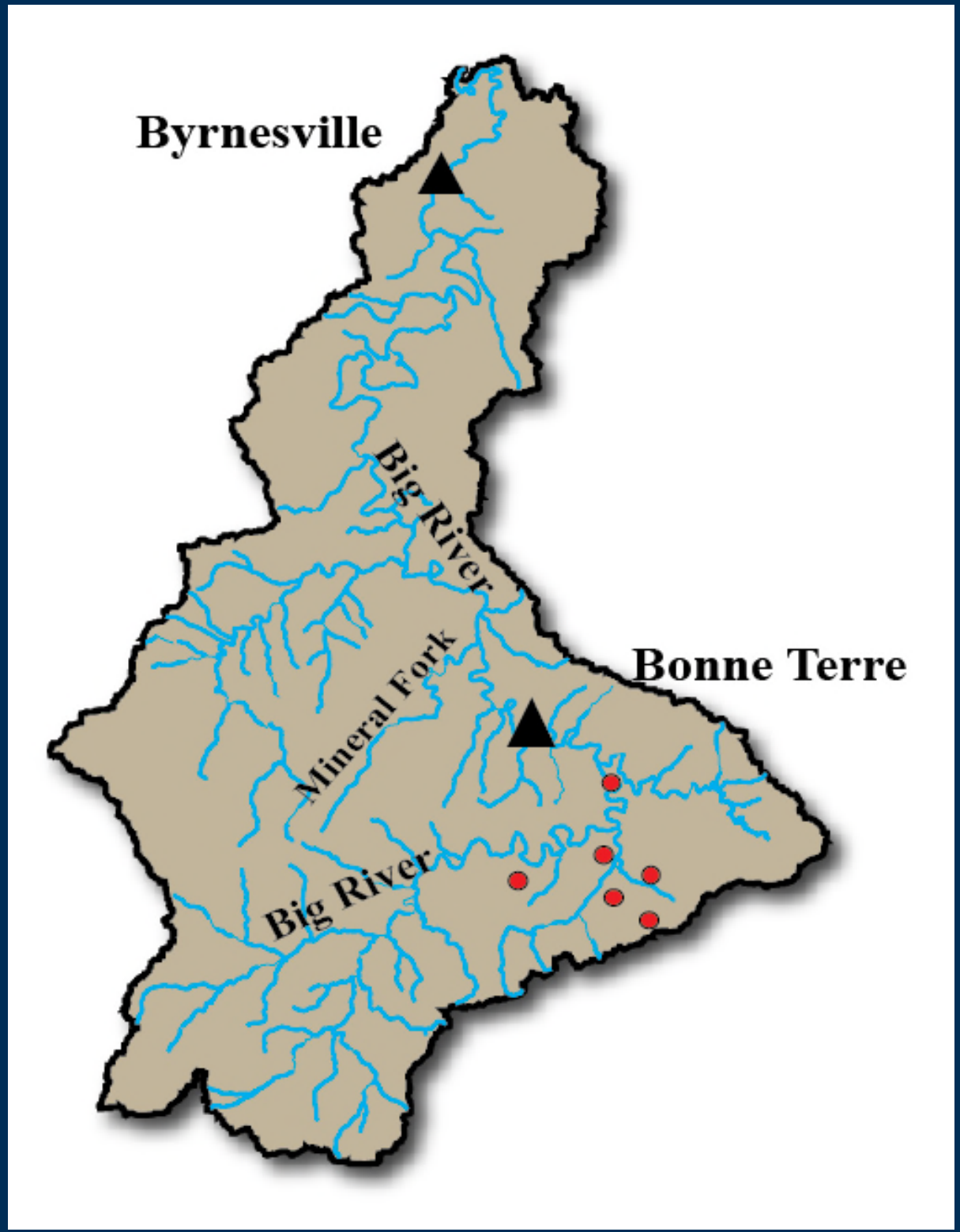

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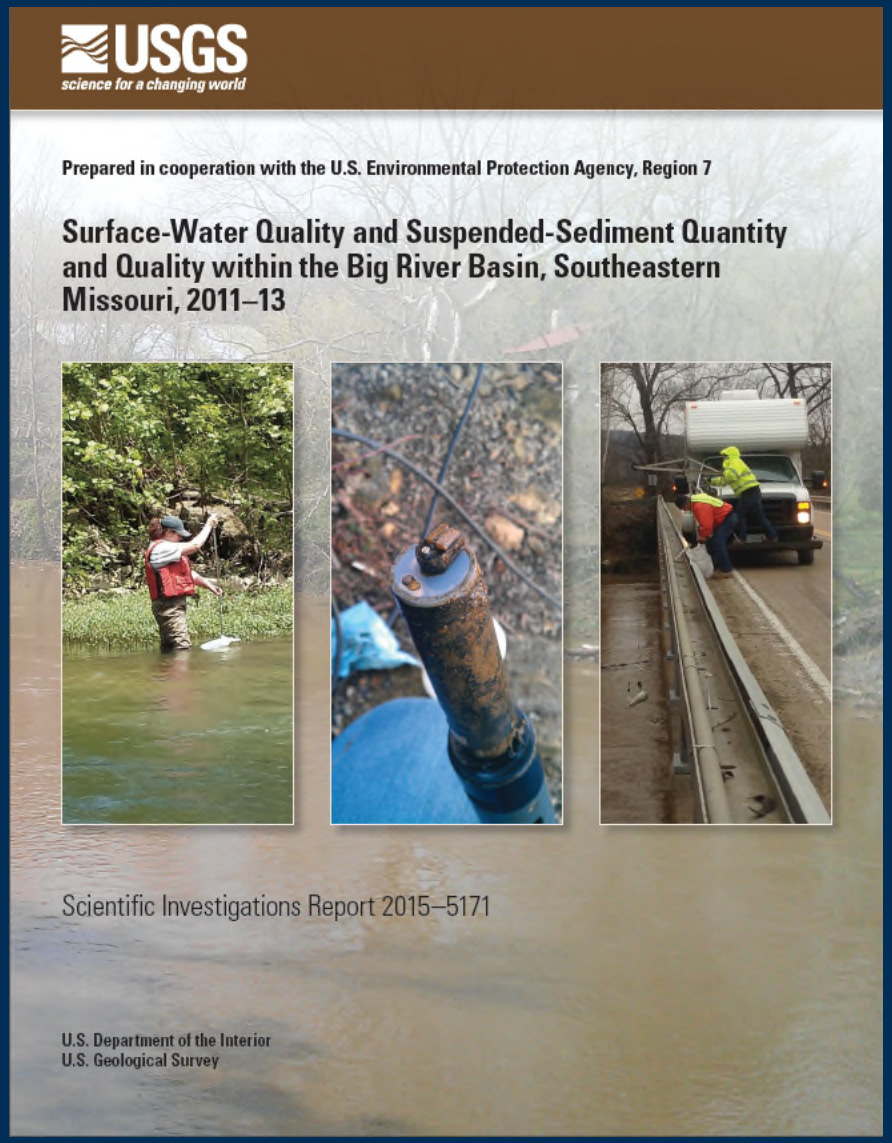
USGS Study

- October 2011 – September 2013
- Two streamflow gaging stations:
  - 07017610 Big River below Bonne Terre, MO
  - 07018500 Big River at Byrnesville, MO
- Assessed suspended-sediment quantity & quality



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Data Collected

- CWQM of turbidity and water temperature
- Discrete sediment collections and stormflow event collections
  - Suspended-sediment concentration (mg/L)
  - Sediment chemistry (mg/kg)

- Regression model created using SSC and Turbidity at both sites for daily SSC and SSL computation

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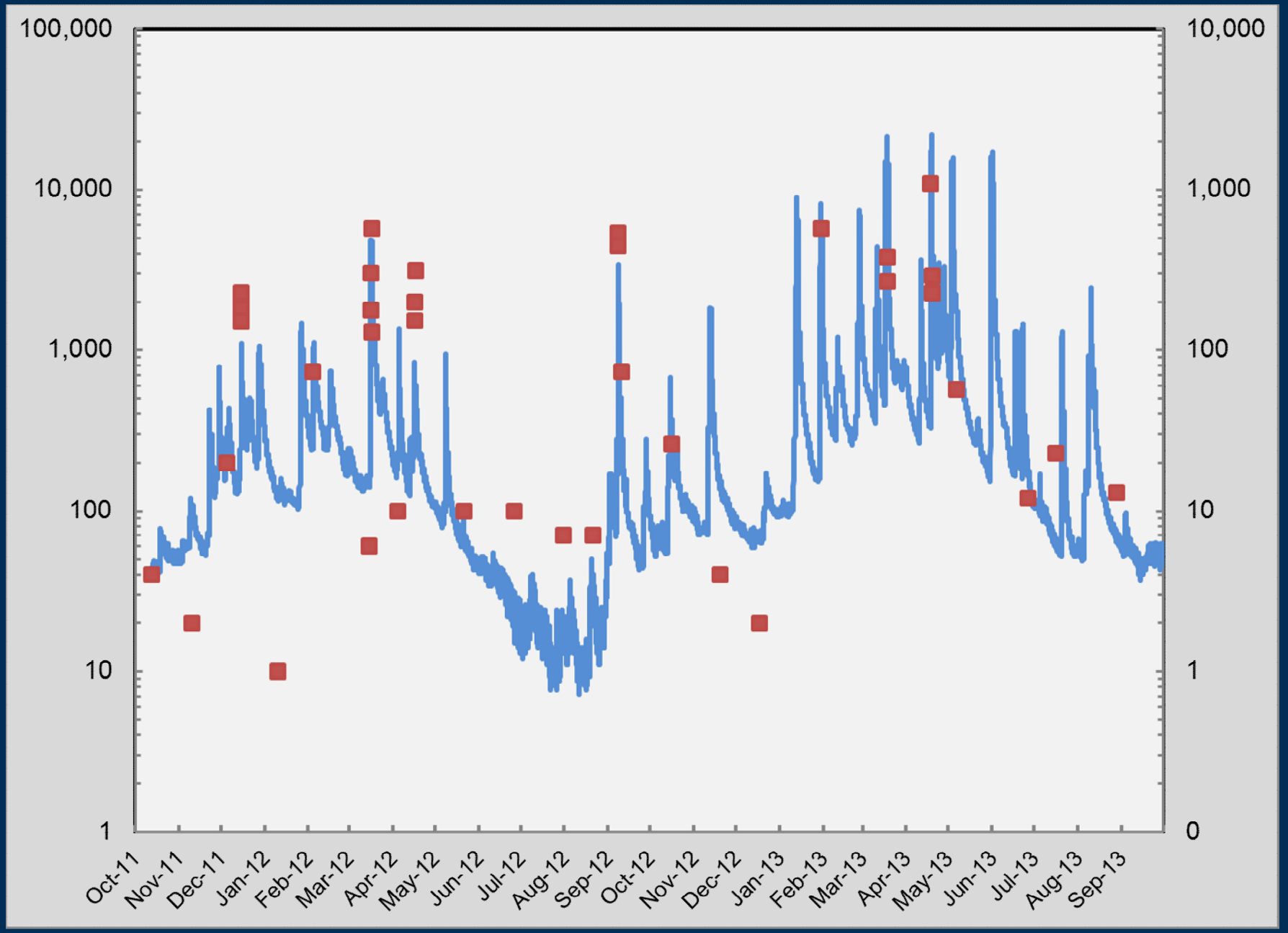
Streamflow (ft3/s)
Suspended-sediment Concentration (mg/L)
100,000
10,000
1,000
100
10
1
10,000
1,000
100
10
1
0
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Mar-12
Apr-12
May-12
Jun-12
Jul-12
Aug-12
Sep-12
Oct-12
Nov-12
Dec-12
Jan-13
Feb-13
Mar-13
Apr-13
May-13
Jun-13
Jul-13
Aug-13
Sep-13

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Results: Suspended Sediment

Bonne Terre

- SSC
  - Baseflow: 1-74 mg/L
  - Stormflow: 74-1,000 mg/L
    - 75 – 98% < 0.063 mm

Byrnesville

- SSC
  - Baseflow: 4-130 mg/L
  - Stormflow: 30-870 mg/L
    - 60 – 98% < 0.063

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Results: Maximum Daily Means

Bonne Terre

- Streamflow
  - 2,400 cfs in 2012
  - 19,000 cfs in 2013
- SSC
  - 617 mg/L in 2012
  - 1,000 mg/L in 2013
- SSL
  - 2,900 tons in 2012
  - 50,500 tons in 2013

Byrnesville

- Streamflow
  - 4,300 cfs in 2012
  - 26,000 cfs in 2013
- SSC
  - 520 mg/L in 2012
  - 930 mg/L in 2013
- SSL
  - 6,100 tons in 2012
  - 66,000 tons in 2013

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Results: Sediment Chemistry

- Stormflow events sieved to 0.063 mm
- Sand and fine portions dried and analyzed for trace elments
- Computed mass-accumulation over time of event
- Compared to consensus-based sediment quality guidelines (MacDonald and others, 2000)

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Results: Sediment Chemistry

Bonne Terre

- Barium 240-750 mg/kg
- Cadmium 4-35 mg/kg
- Lead 700-2,400 mg/kg
- Zinc 400-1,800 mg/kg

Byrnesville

- Barium 45-1,500 mg/kg
- Cadmium 2-8 mg/kg
- Lead 50-1,800 mg/kg
- Zinc 31-760 mg/kg

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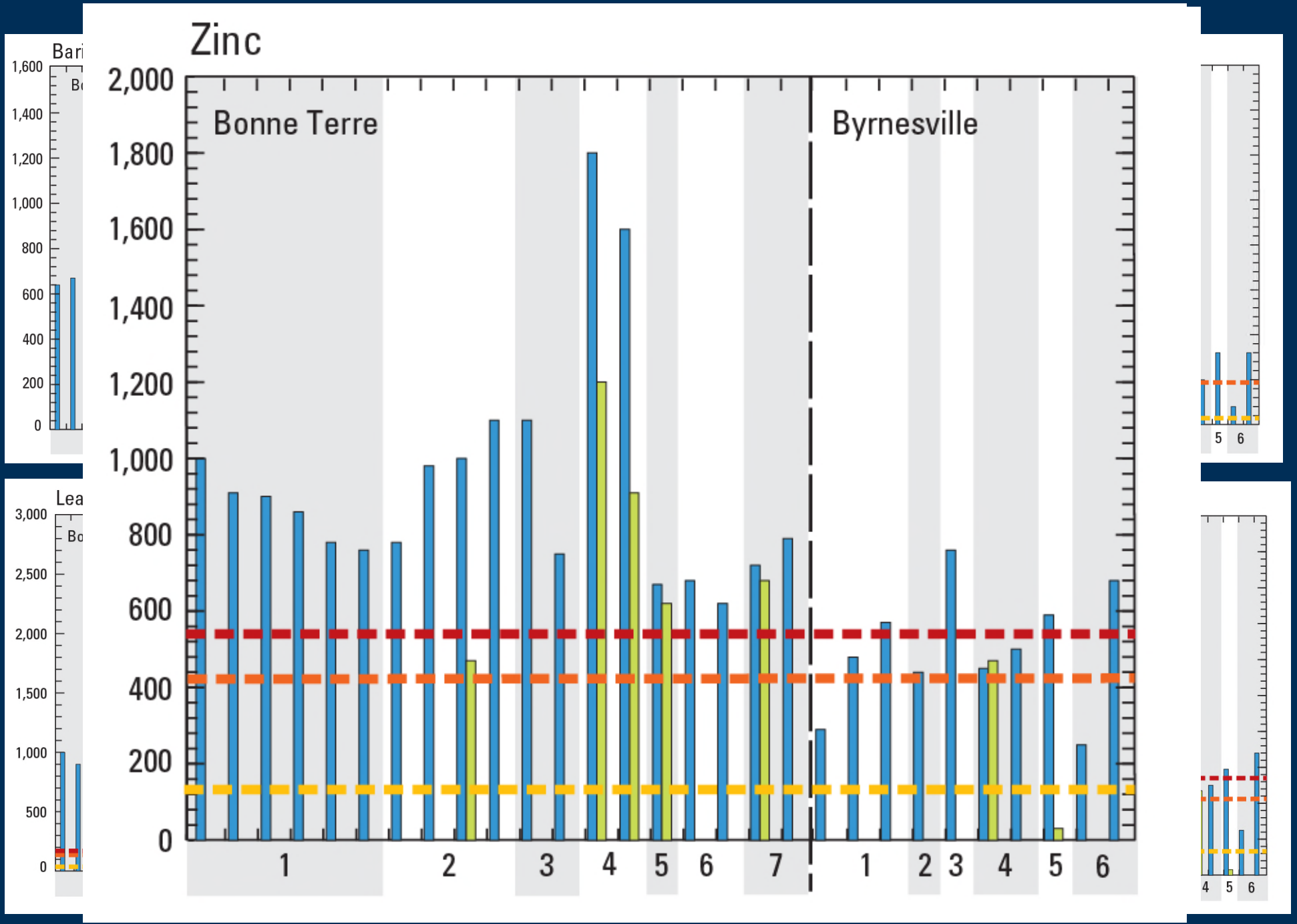
Zinc
Bonne Terre
Byrnesville
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1
2
3
4
5
6
7
1
2
3
4
5
6

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		Annual load (tons)
Bonne Terre		
Water Year 2012	**Barium**	3
	Cadmium	0.11
	Lead	7
	Zinc	6
Water Year 2013	**Barium**	29
	Cadmium	0.43
	Lead	52
	Zinc	36
Byrnesville		
Water Year 2012	**Barium**	9
	Cadmium	52
	Lead	43
	Zinc	3
Water Year 2013	**Barium**	70
	Cadmium	0.34
	Lead	69
	Zinc	32

2,900 tons in 2012
50,500 tons in 2013

6,100 tons in 2012
66,000 tons in 2013

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Lessons Learned

- Short term studies are difficult
- Experiment with different equipment to reduce loss of data
- Consistency is key
- It NEVER rains between 8 am – 5 pm

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Questions?

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