Solid-phase geochemical survey of the Red Hills Mine area, Choctaw County, Mississippi; an atlas highlighting the distribution of selected chemical elements in soil and stream sediment

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Following completion of the Mississippi I Data Set, a joint USGS-Mississippi Office of Geology project (Thompson and others, 1998, 2002), a supplemental suite of stream sediments and soils was collected. The Mississippi II Data Set was devised to: (1) resample areas with anomalous geochemical values, (2) obtain stream sediment samples in portions of the Delta for comparison with previously obtained soil geochemistry, and (3) sample soil and stream sediment encompassing the Red Hills lignite mine (proposed at the time of sampling) area. The Mississippi II set is a group of 116 samples, 97 of which are mainly soils collected near the planned Red Hills lignite mine site (Figures 1, 2, &3). The objective of the Red Hills mine study was to establish pre-mining geochemical baseline values for the area. All samples were analyzed by the ICP40, ICP10, As, Se, and Hg methods, and about three quarters were analyzed also by INAA.

Compared to the Mississippi I Data Set, a different, smaller scale technique was undertaken for the Red Hills Mine portion of the supplemental project. Due to the smaller area of interest, it was determined that an overall area of 9 x 9 square miles would suffice; with that area sub-divided into 1 square mile sample grids. Conveniently, public land survey sections provide a ready-made grid boundary. Each grid (section) was quartered; then a coin toss was utilized to determine a random quadrant for sampling. The majority of samples taken were soil, simply because many of the small, quartered sample areas contained no streams as an option. Sampling was conducted between July 1998 and March 1999. It is important to note that the geochemical values of toxic metals

in sampled soils appear to be relatively higher than the stream sediment batch when considering the maps and data.

This atlas includes geochemical point maps for the Red Hills mine area of the potentially toxic elements, As, Cu, Hg, Pb, Se, and Zn. Additional maps are included for Al, Ca, Fe, K, Mg, Mn, Na, P, Ti, Cr, Cd, Au, Hf, U, and Th.

Figure 1

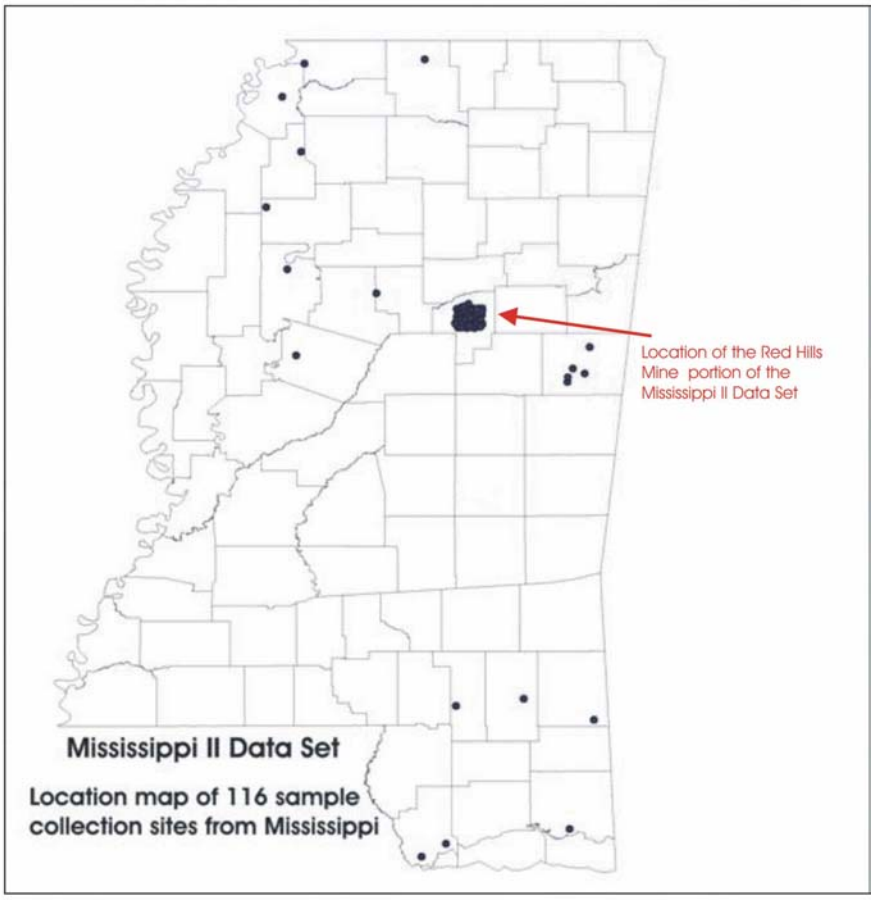


Figure 2

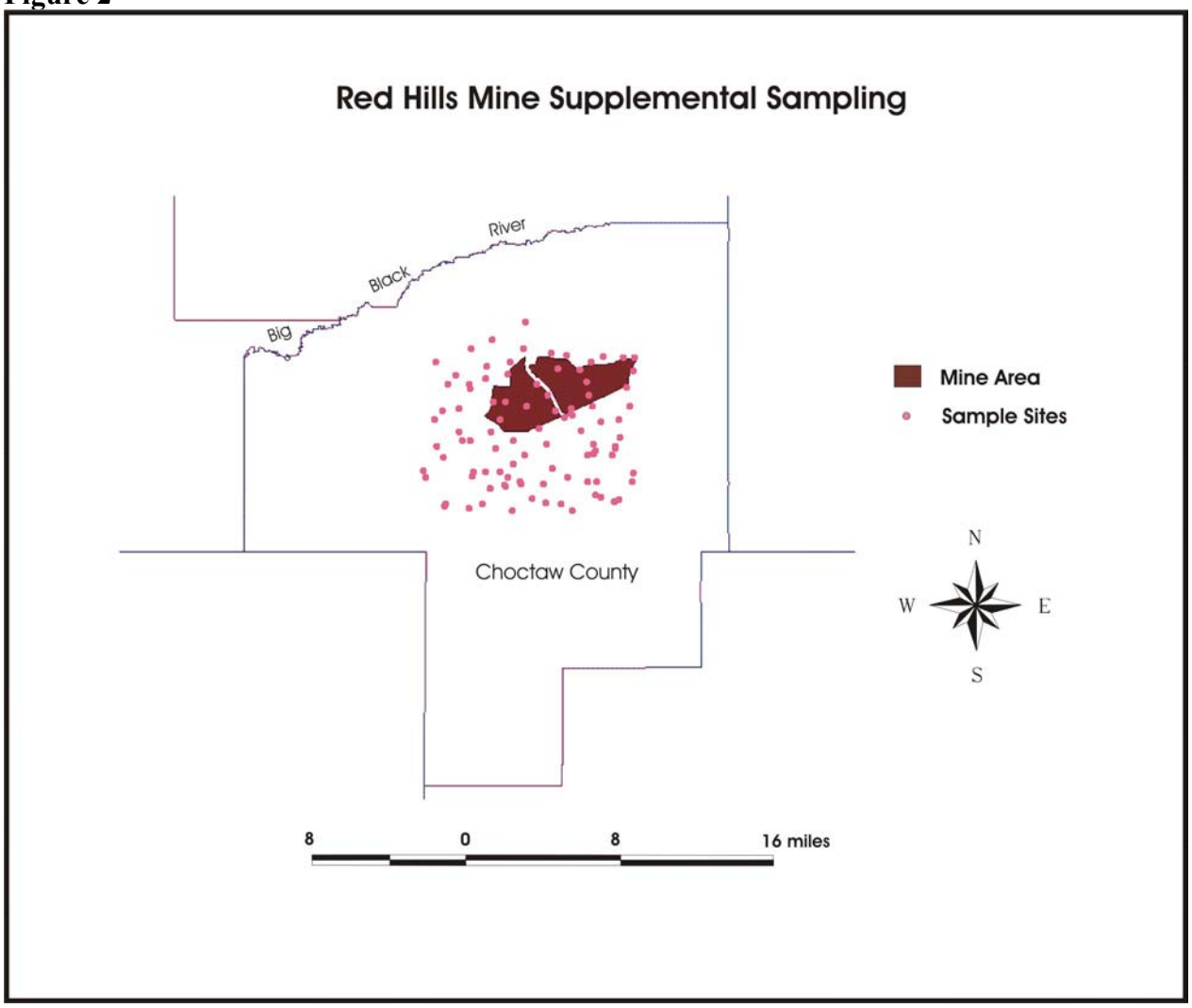

Red Hills Mine Supplemental Sampling
River
Black
Big
Choctaw County
Mine Area
Sample Sites
N
W
E
S
8
0
8
16 miles

Figure 3

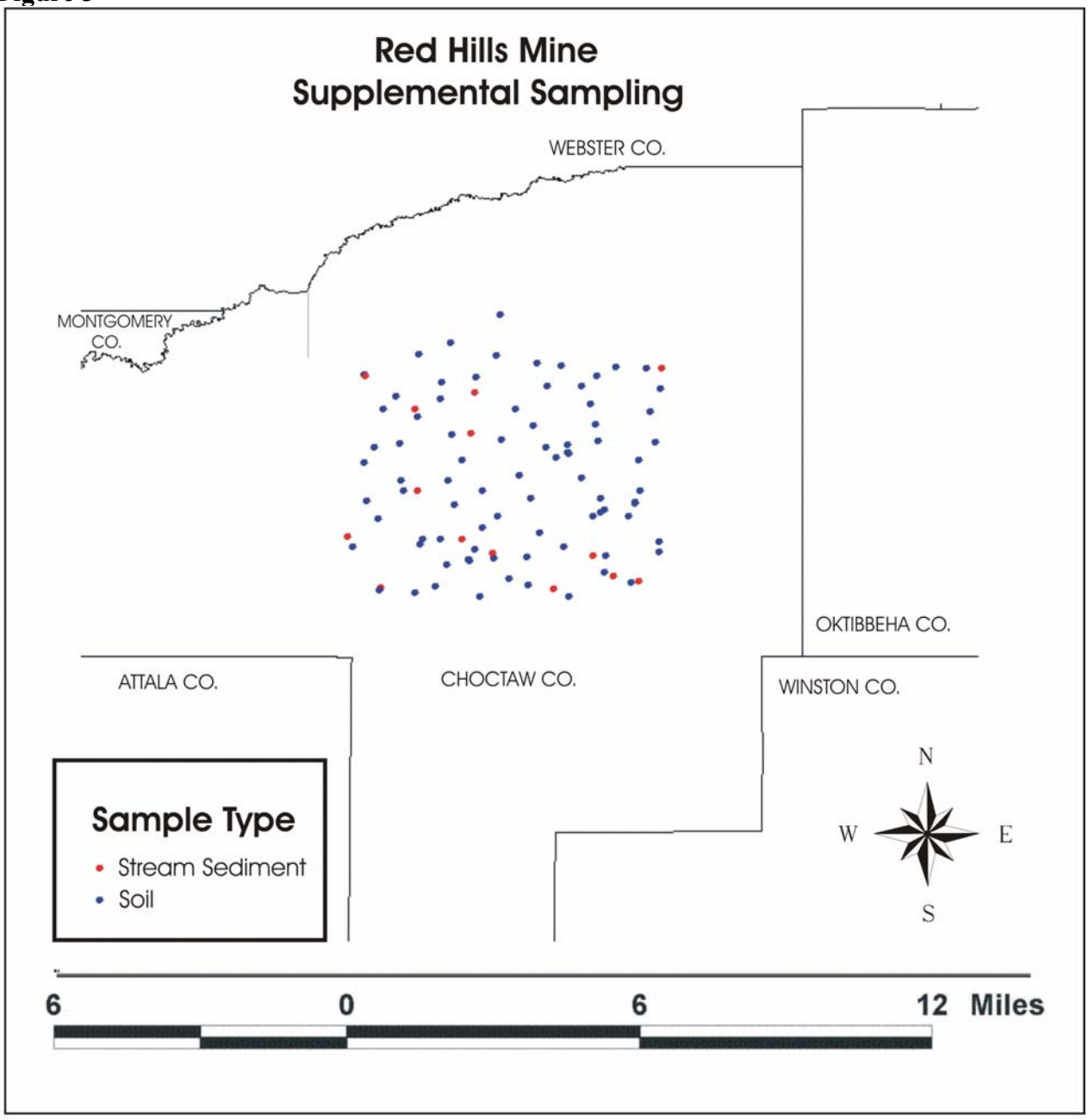

Red Hills Mine
Supplemental Sampling
WEBSTER CO.
MONTGOMERY CO.
OKTIBBEHA CO.
ATTALA CO.
CHOCTAW CO.
WINSTON CO.
Sample Type
Stream Sediment
Soil
N
W
E
S
6
0
6
12 Miles

Plate 1

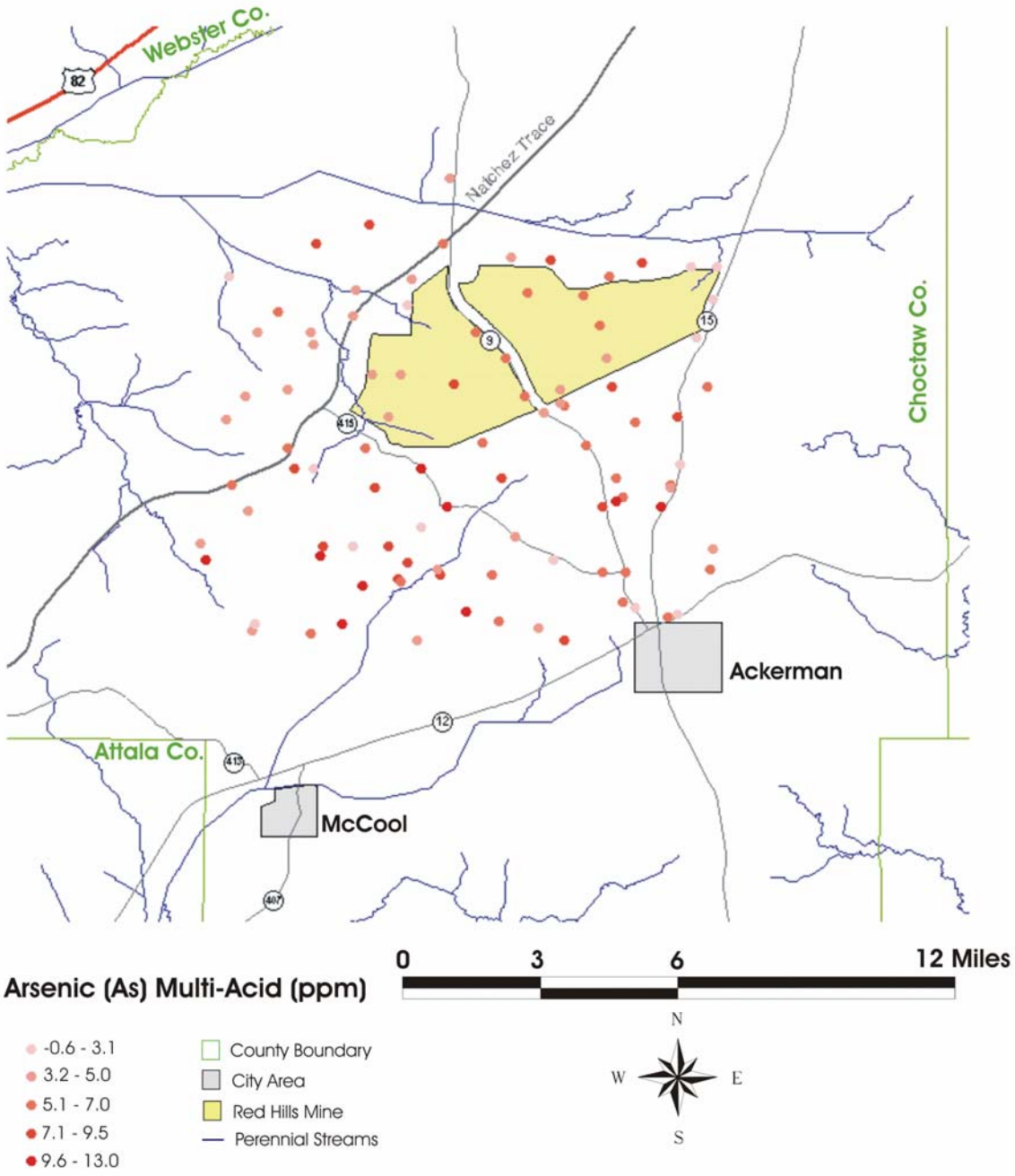

Webster Co.
82
Natchez Trace
9
15
Choctaw Co.
415
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Arsenic (As) Multi-Acid (ppm)
-0.6 - 3.1
3.2 - 5.0
5.1 - 7.0
7.1 - 9.5
9.6 - 13.0
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 2

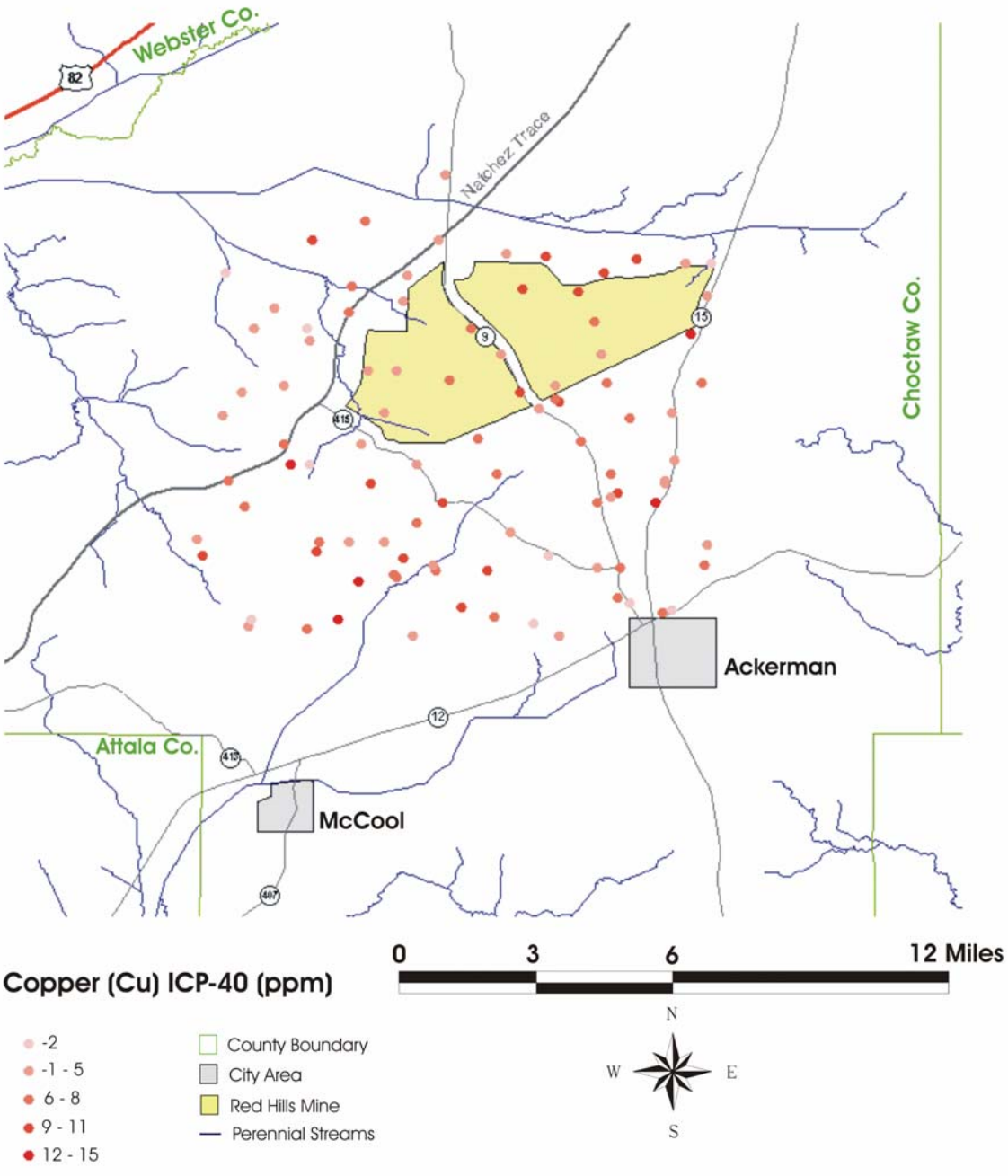

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
415
McCool
407
0
3
6
12 Miles
Copper (Cu) ICP-40 (ppm)
-2
-1 - 5
6 - 8
9 - 11
12 - 15
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 3

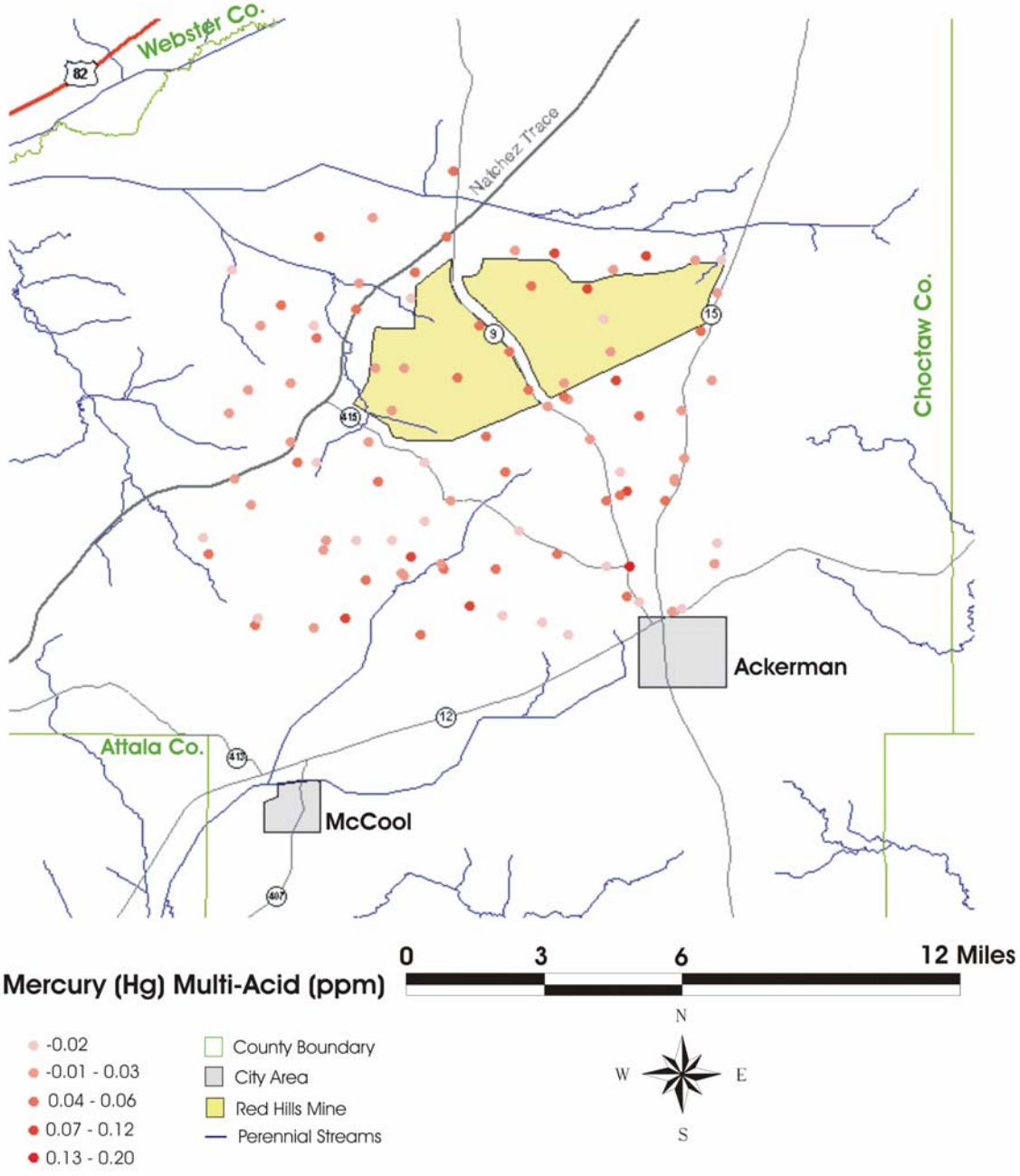

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Mercury (Hg) Multi-Acid (ppm)
-0.02
-0.01 - 0.03
0.04 - 0.06
0.07 - 0.12
0.13 - 0.20
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 4

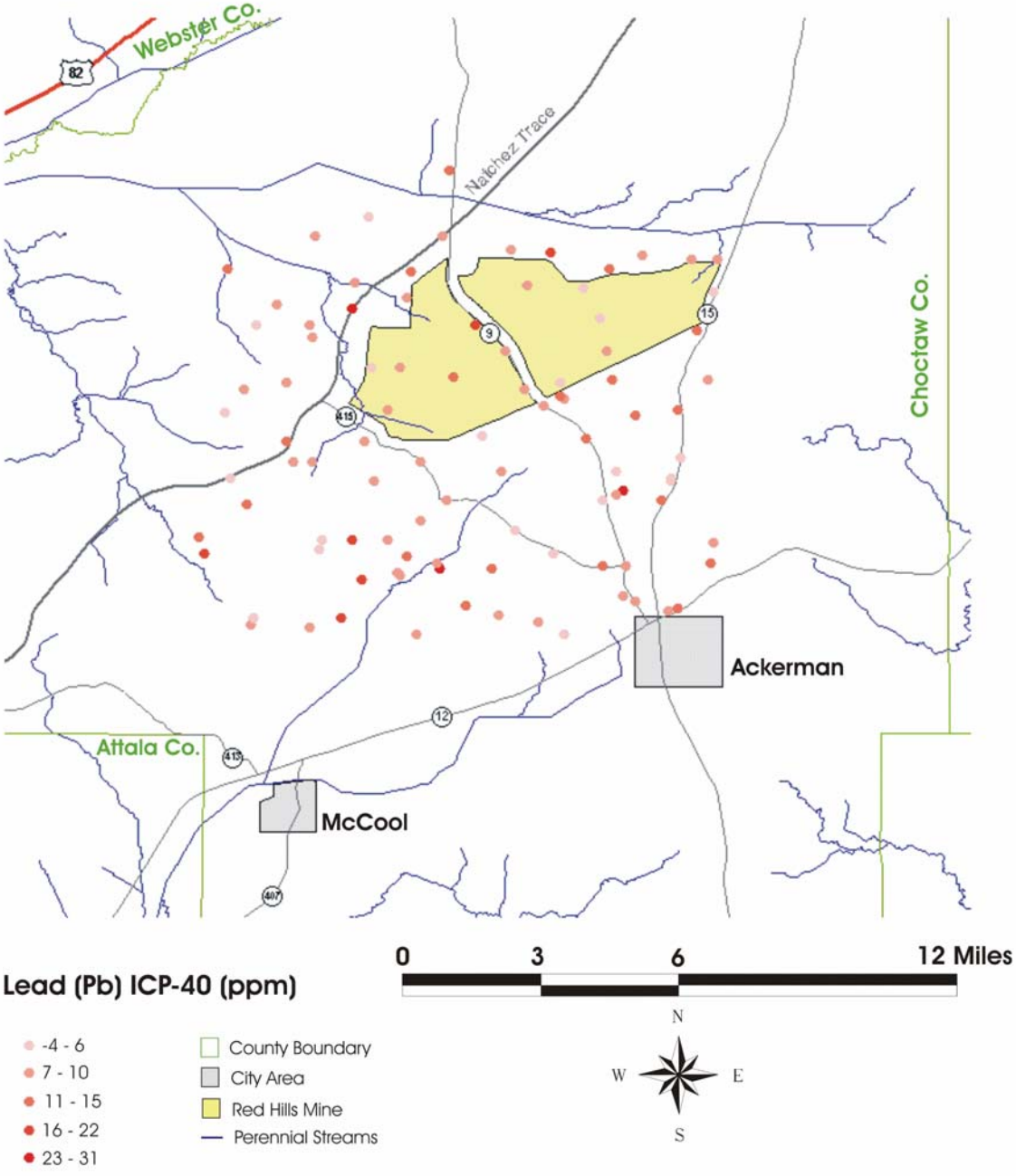

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
415
McCool
407
0
3
6
12 Miles
Lead (Pb) ICP-40 (ppm)
-4 - 6
7 - 10
11 - 15
16 - 22
23 - 31
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 5

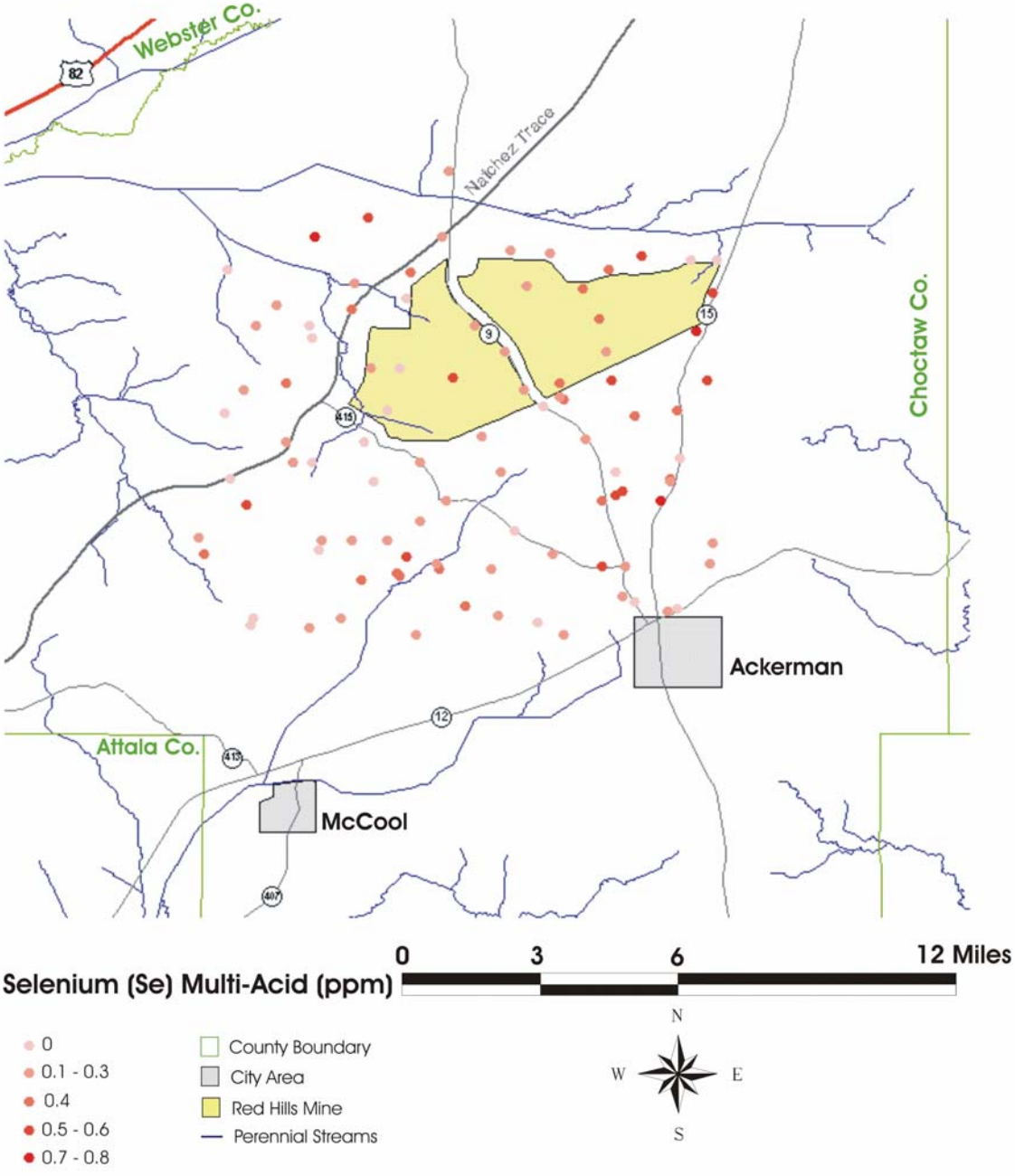

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
413
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Selenium (Se) Multi-Acid (ppm)
0
0.1 - 0.3
0.4
0.5 - 0.6
0.7 - 0.8
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 6

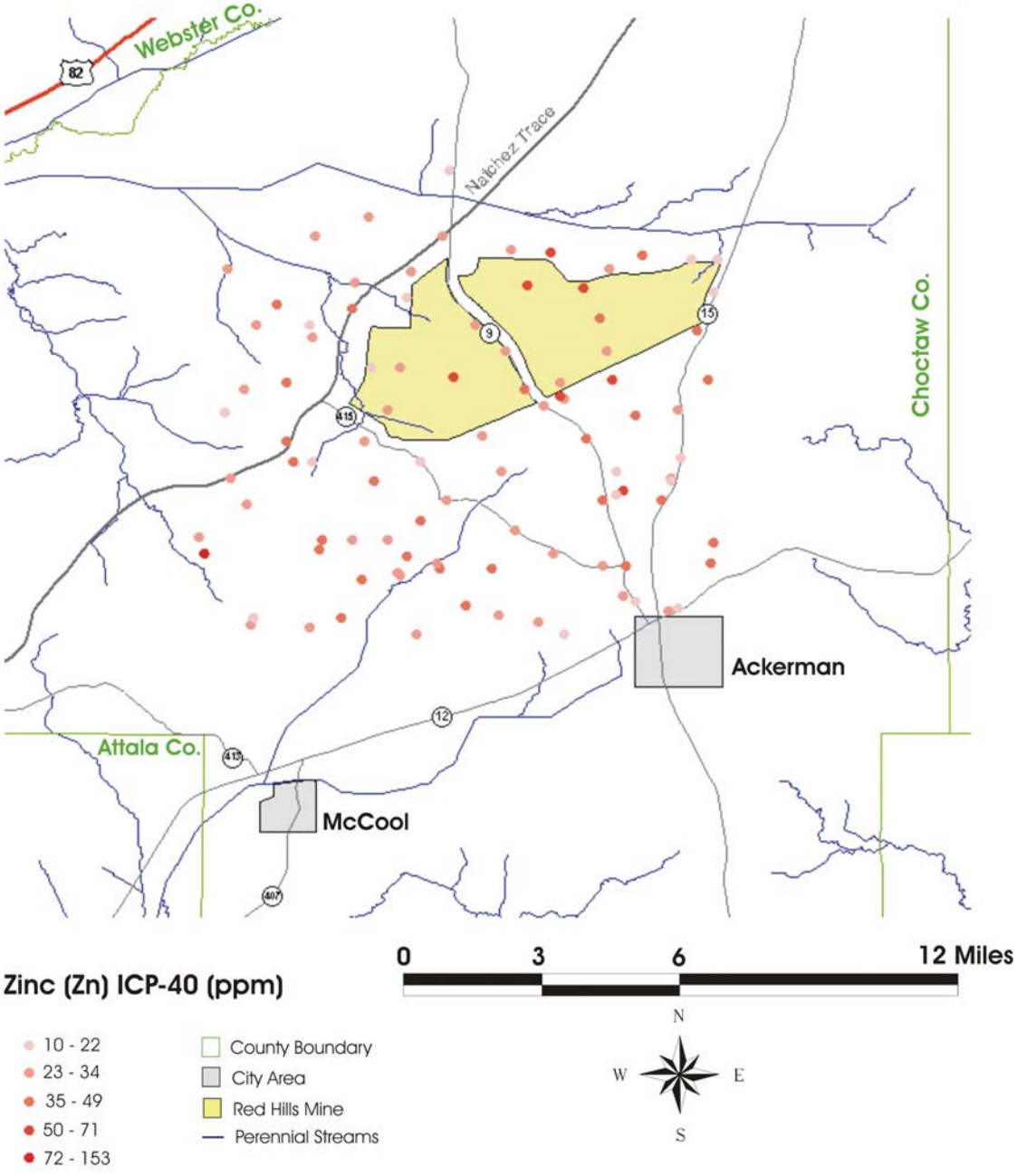

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Zinc (Zn) ICP-40 (ppm)
10 - 22
23 - 34
35 - 49
50 - 71
72 - 153
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 7

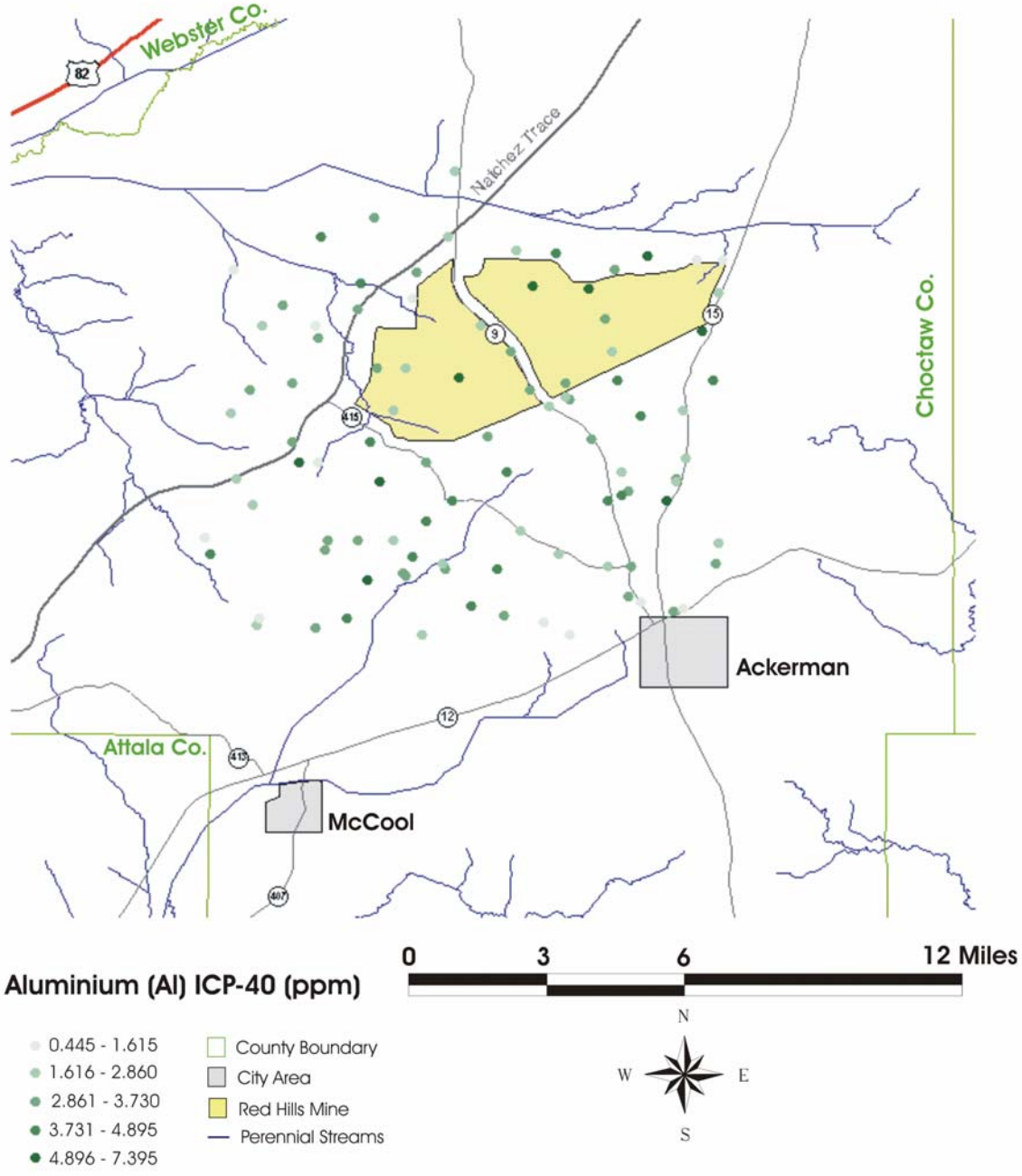

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Aluminium (Al) ICP-40 (ppm)
0.445 - 1.615
1.616 - 2.860
2.861 - 3.730
3.731 - 4.895
4.896 - 7.395
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 8

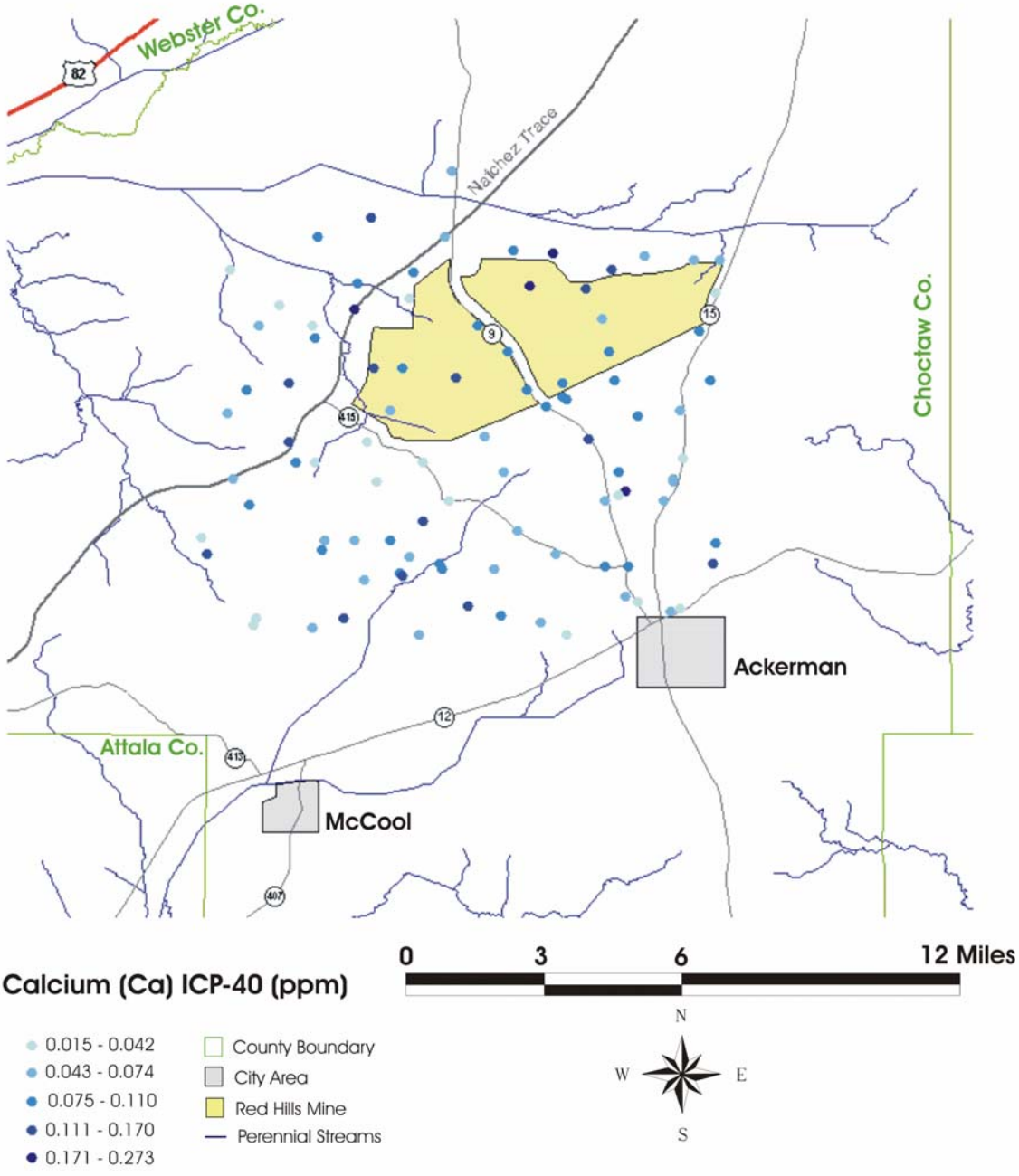

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
415
McCool
407
0
3
6
12 Miles
Calcium (Ca) ICP-40 (ppm)
0.015 - 0.042
0.043 - 0.074
0.075 - 0.110
0.111 - 0.170
0.171 - 0.273
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 9

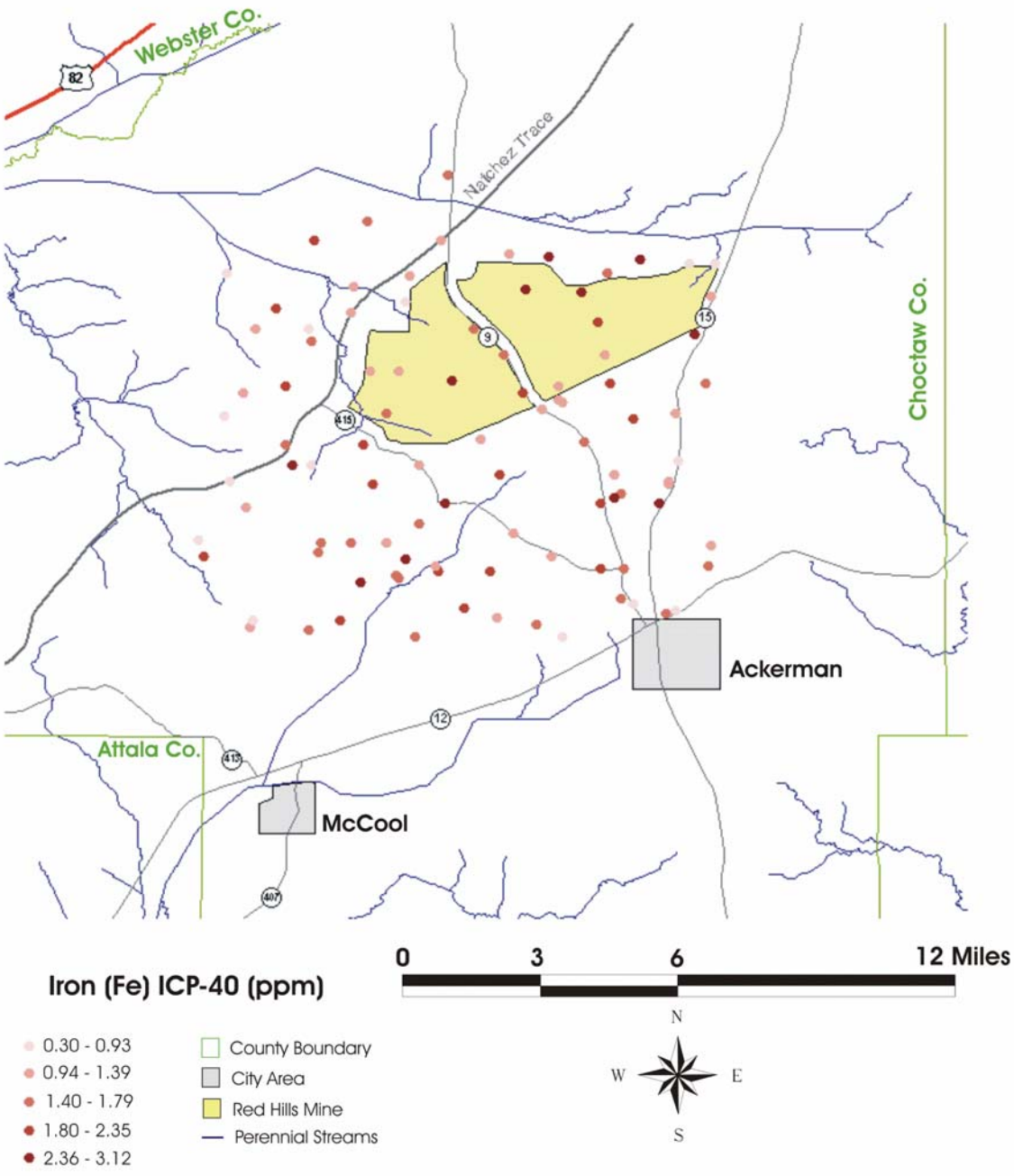

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
413
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Iron (Fe) ICP-40 (ppm)
0.30 - 0.93
0.94 - 1.39
1.40 - 1.79
1.80 - 2.35
2.36 - 3.12
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 10

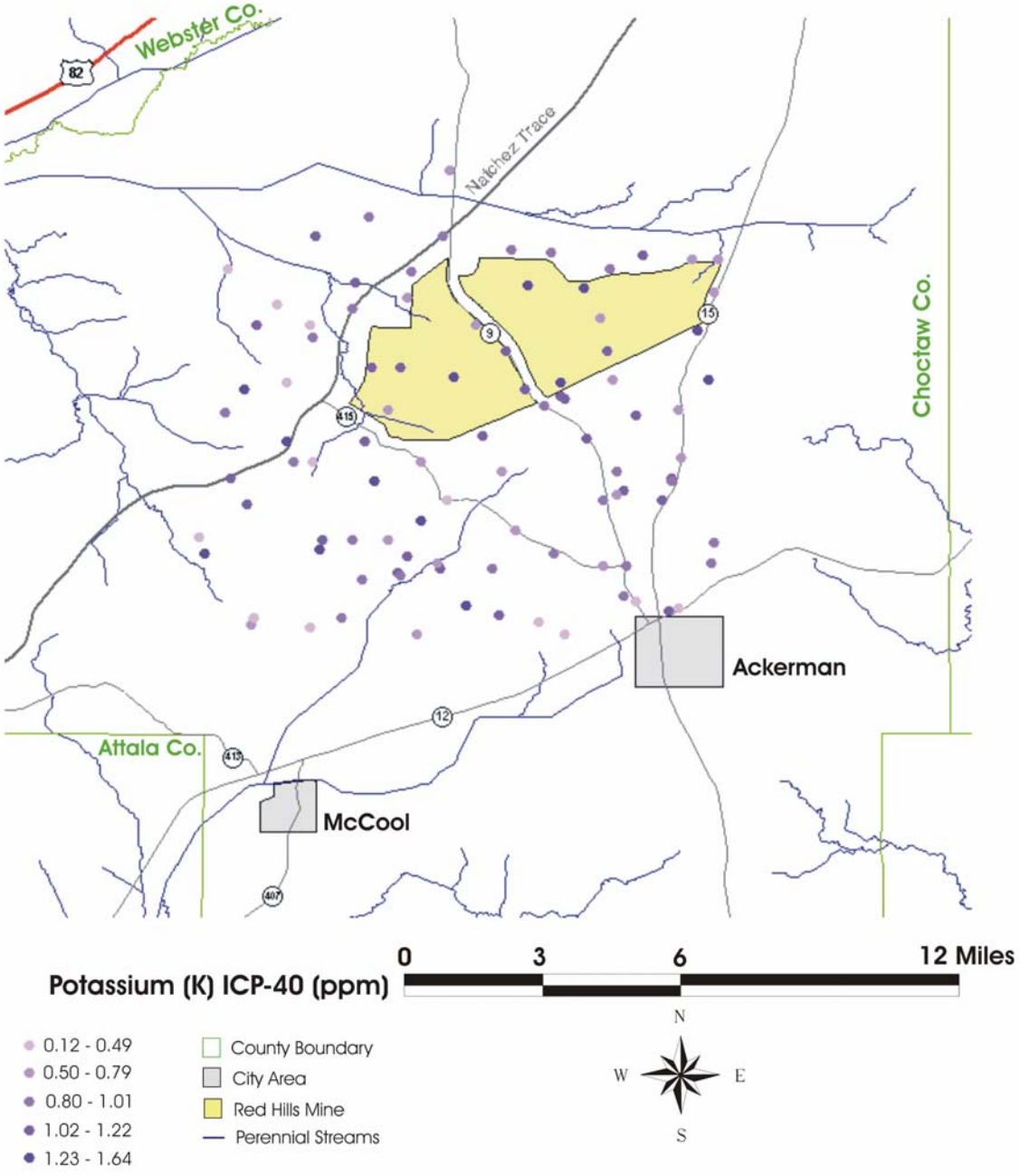

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
413
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Potassium (K) ICP-40 (ppm)
0.12 - 0.49
0.50 - 0.79
0.80 - 1.01
1.02 - 1.22
1.23 - 1.64
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 11

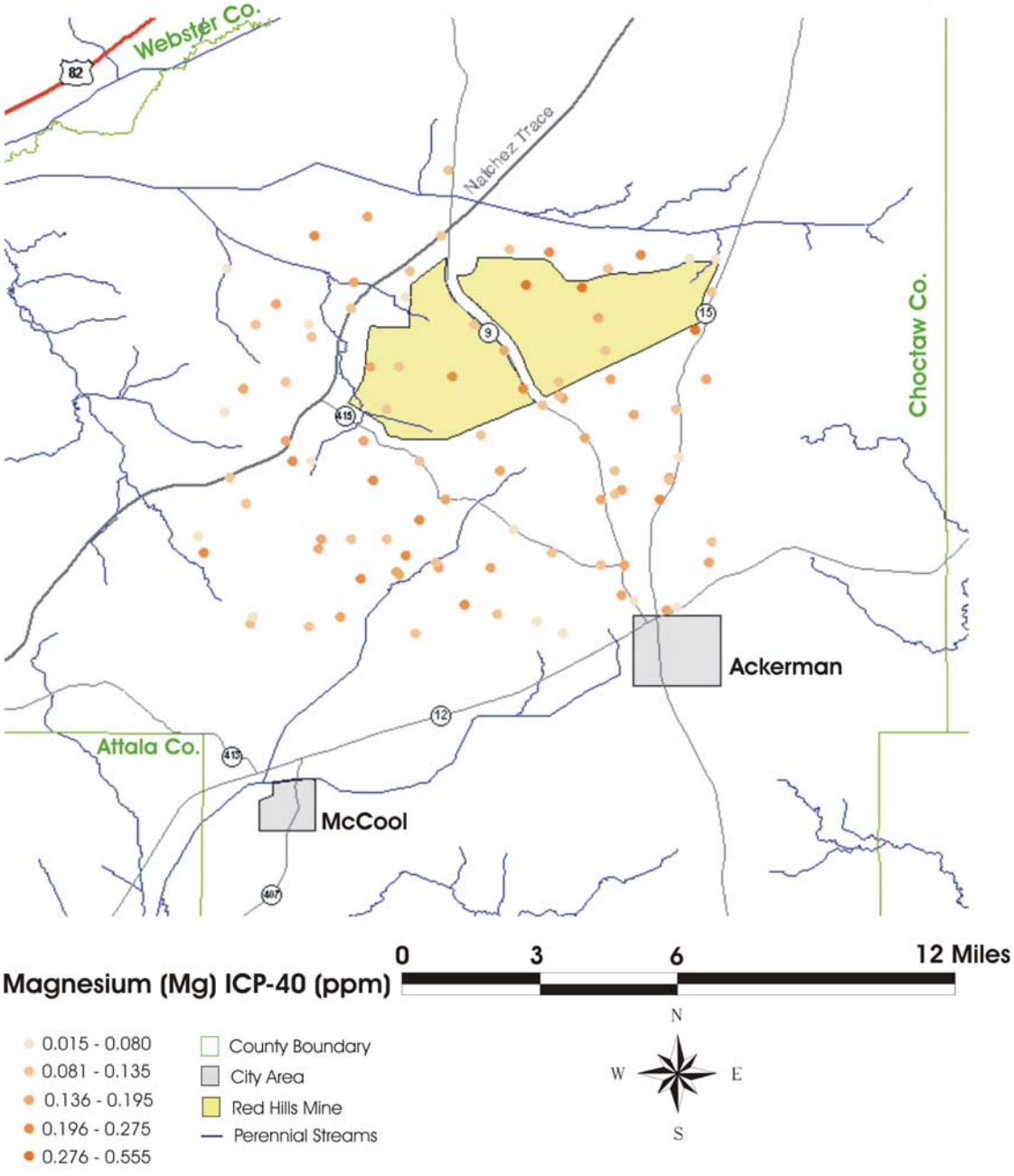

Webster Co.
82
Natchez Trace
9
15
415
Choctaw Co.
Ackerman
12
Attala Co.
415
McCool
407
0
3
6
12 Miles
Magnesium (Mg) ICP-40 (ppm)
0.015 - 0.080
0.081 - 0.135
0.136 - 0.195
0.196 - 0.275
0.276 - 0.555
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 12

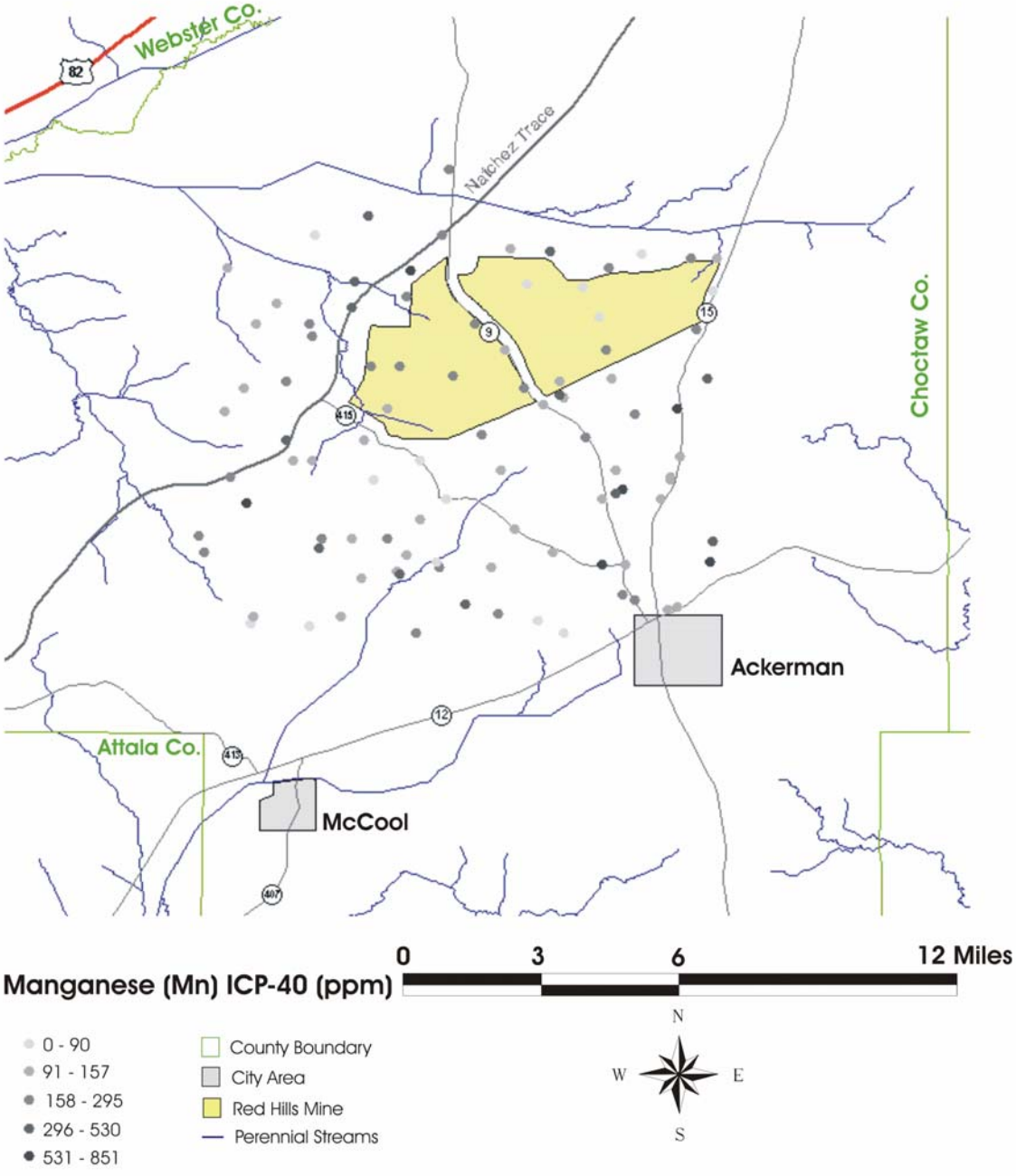

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
415
McCool
407
0
3
6
12 Miles
Manganese (Mn) ICP-40 (ppm)
0 - 90
91 - 157
158 - 295
296 - 530
531 - 851
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 13

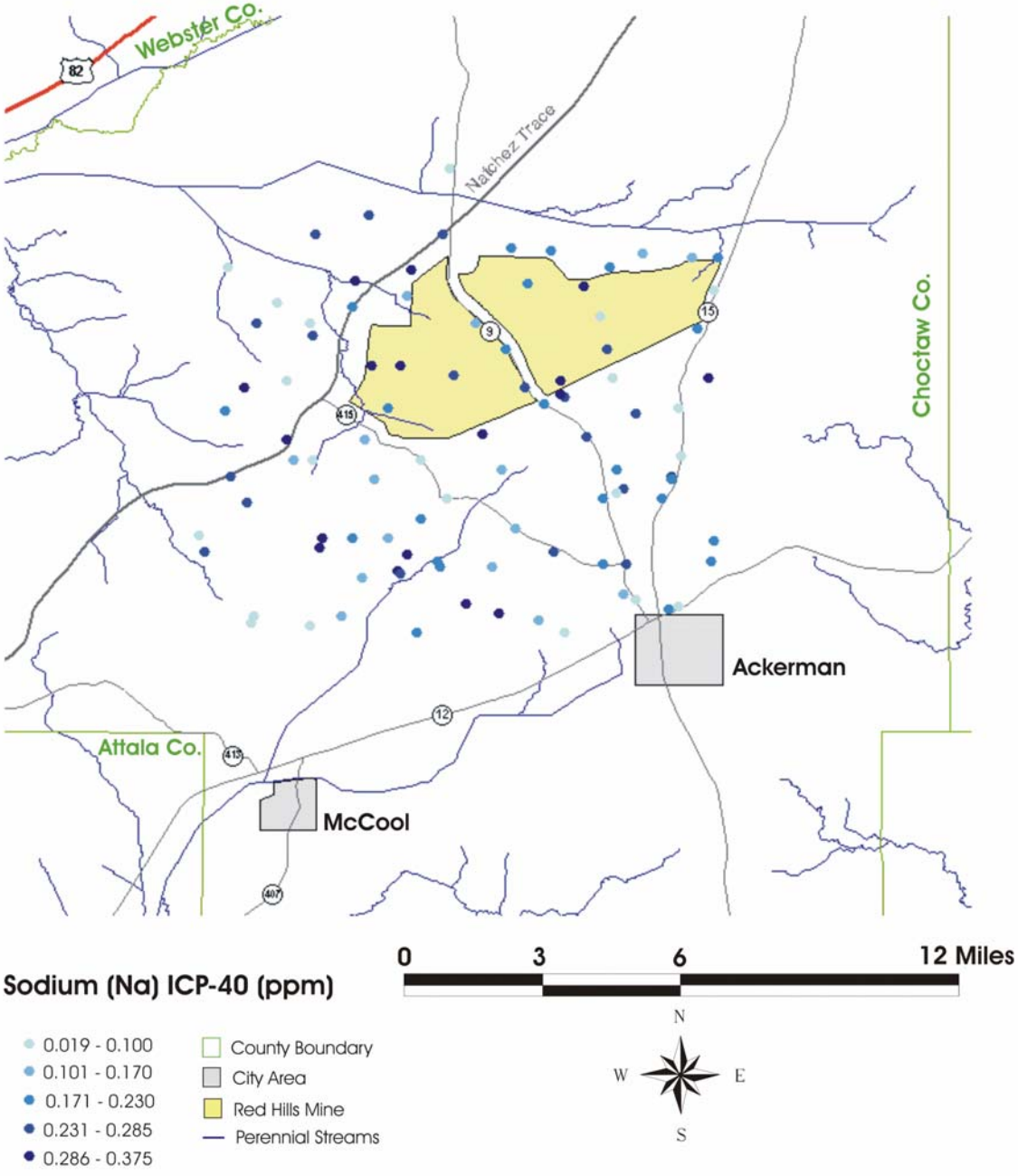

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
413
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Sodium (Na) ICP-40 (ppm)
0.019 - 0.100
0.101 - 0.170
0.171 - 0.230
0.231 - 0.285
0.286 - 0.375
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 14

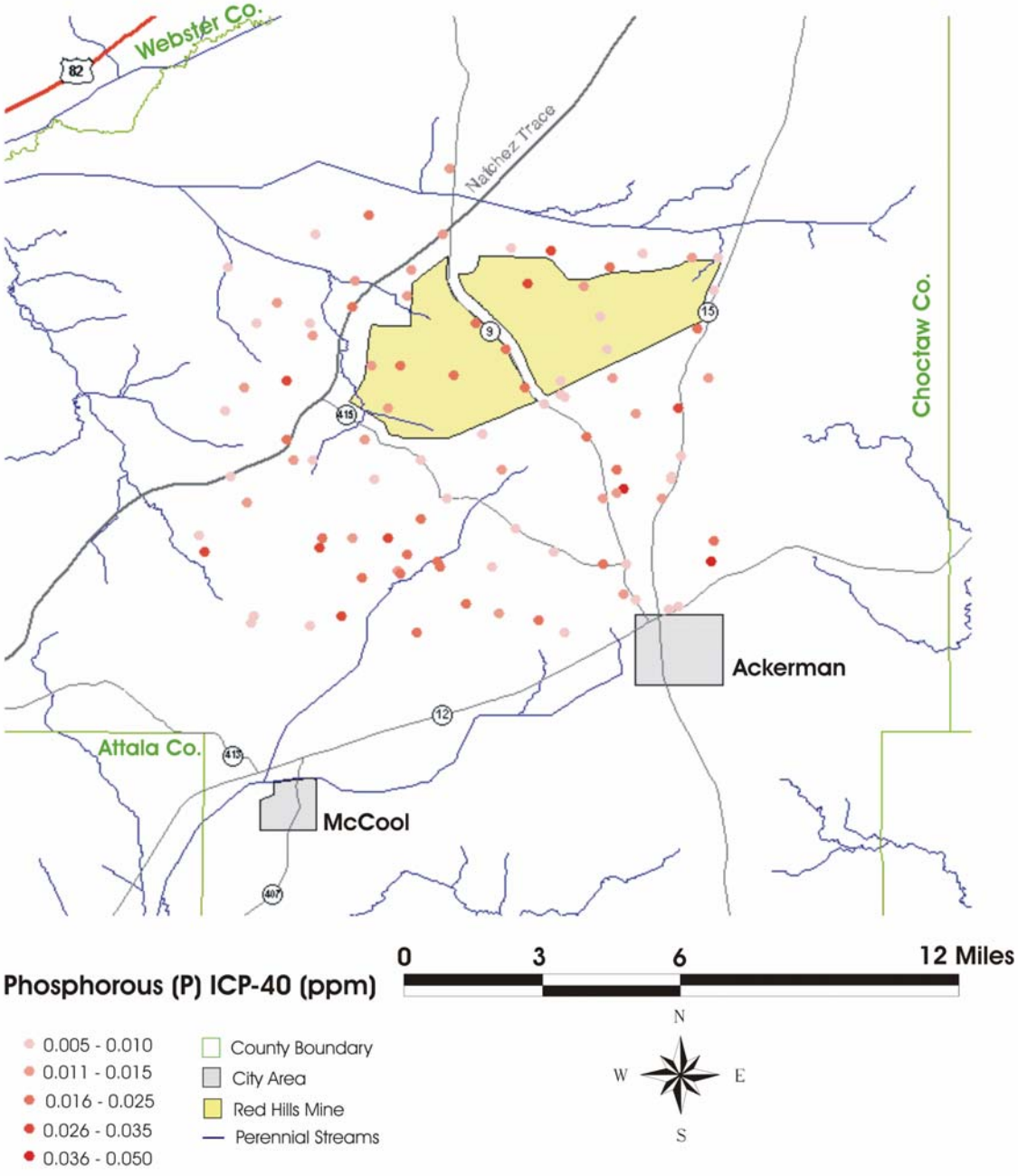

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
413
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Phosphorous (P) ICP-40 (ppm)
0.005 - 0.010
0.011 - 0.015
0.016 - 0.025
0.026 - 0.035
0.036 - 0.050
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 15

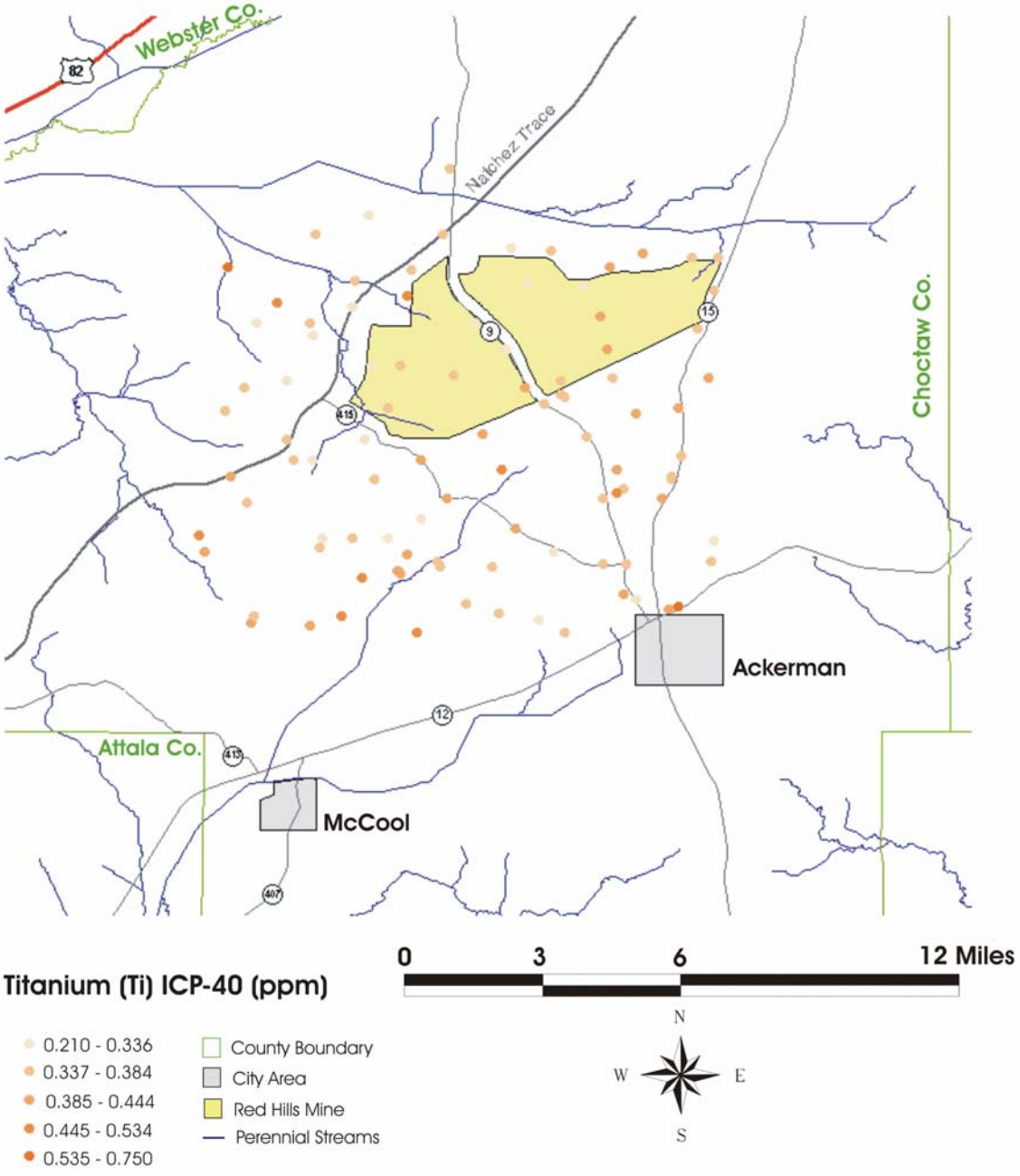

Webster Co.
82
Natchez Trace
9
15
Choctaw Co.
Ackerman
12
Attala Co.
McCool
Titanium (Ti) ICP-40 (ppm)
0.210 - 0.336
0.337 - 0.384
0.385 - 0.444
0.445 - 0.534
0.535 - 0.750
County Boundary
City Area
Red Hills Mine
Perennial Streams
0
3
6
12 Miles
N
W
E
S

Plate 16

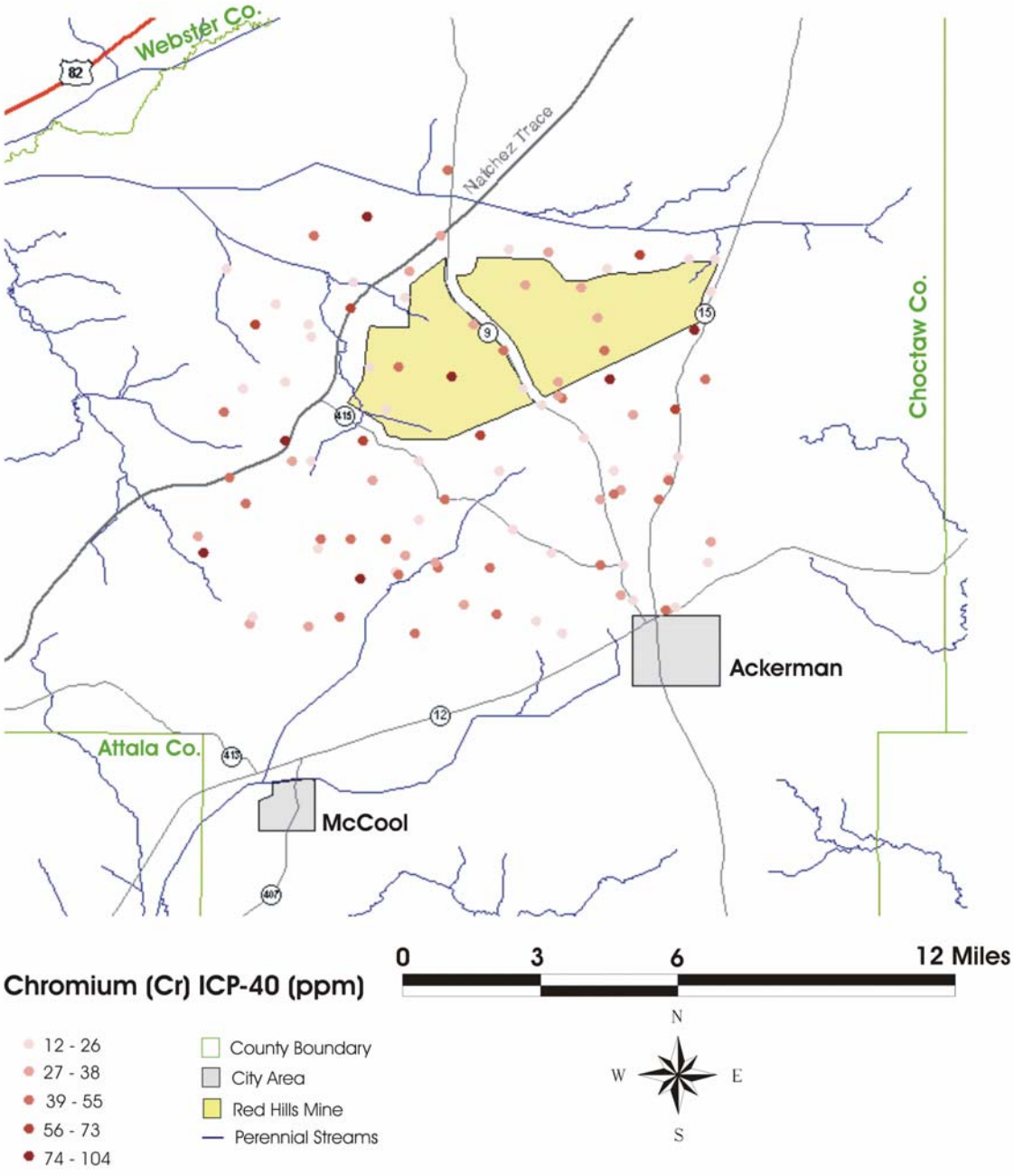

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
415
McCool
407
Chromium (Cr) ICP-40 (ppm)
12 - 26
27 - 38
39 - 55
56 - 73
74 - 104
County Boundary
City Area
Red Hills Mine
Perennial Streams
0
3
6
12 Miles
N
W
E
S

Plate 17

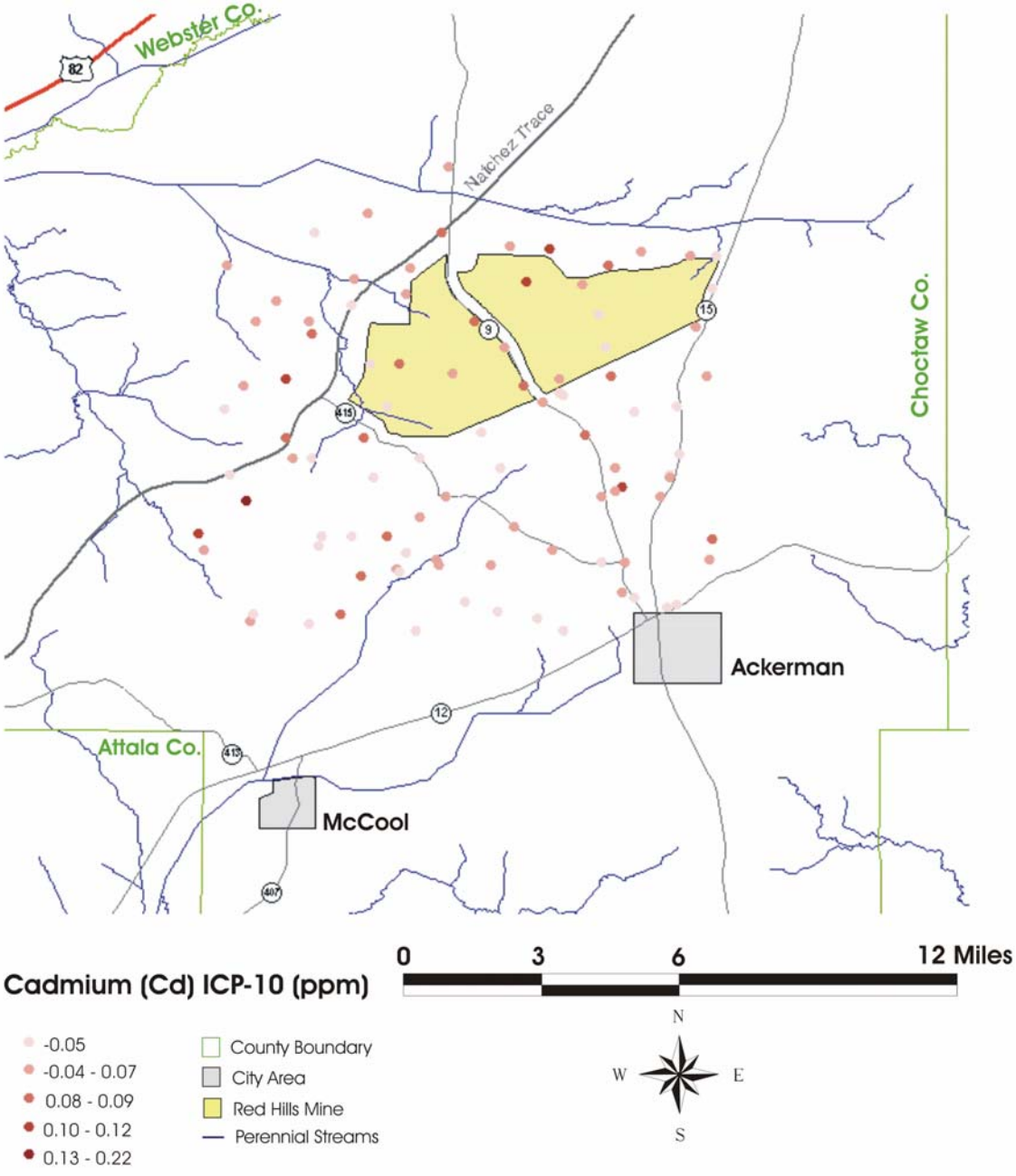

Webster Co.
82
Natchez Trace
9
15
415
Choctaw Co.
Ackerman
12
Attala Co.
415
McCool
407
0
3
6
12 Miles
Cadmium (Cd) ICP-10 (ppm)
-0.05
-0.04 - 0.07
0.08 - 0.09
0.10 - 0.12
0.13 - 0.22
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 18

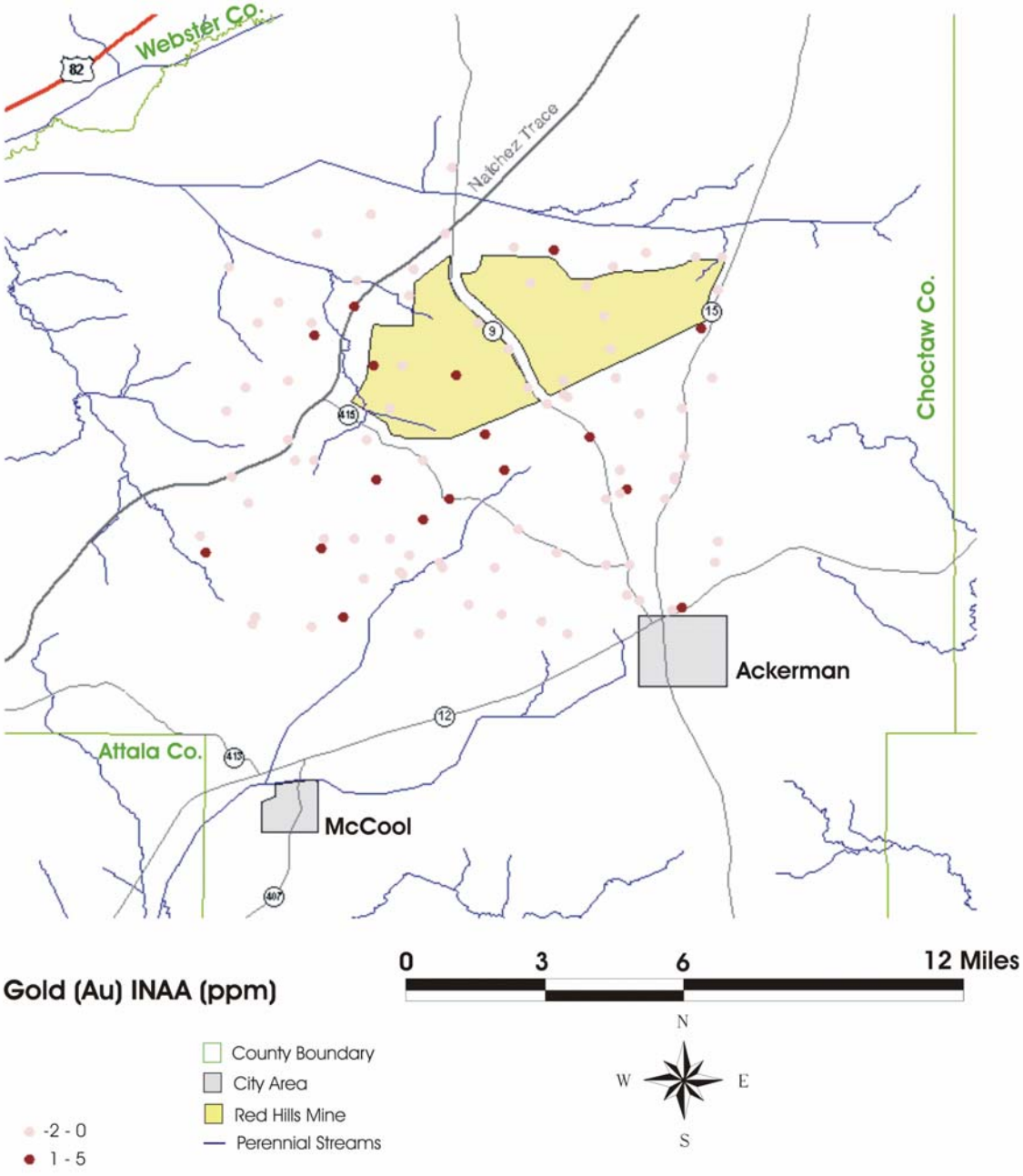

Webster Co.
82
Natchez Trace
9
15
415
Choctaw Co.
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Gold (Au) INAA (ppm)
County Boundary
City Area
Red Hills Mine
Perennial Streams
-2 - 0
1 - 5
N
W
E
S

Plate 19

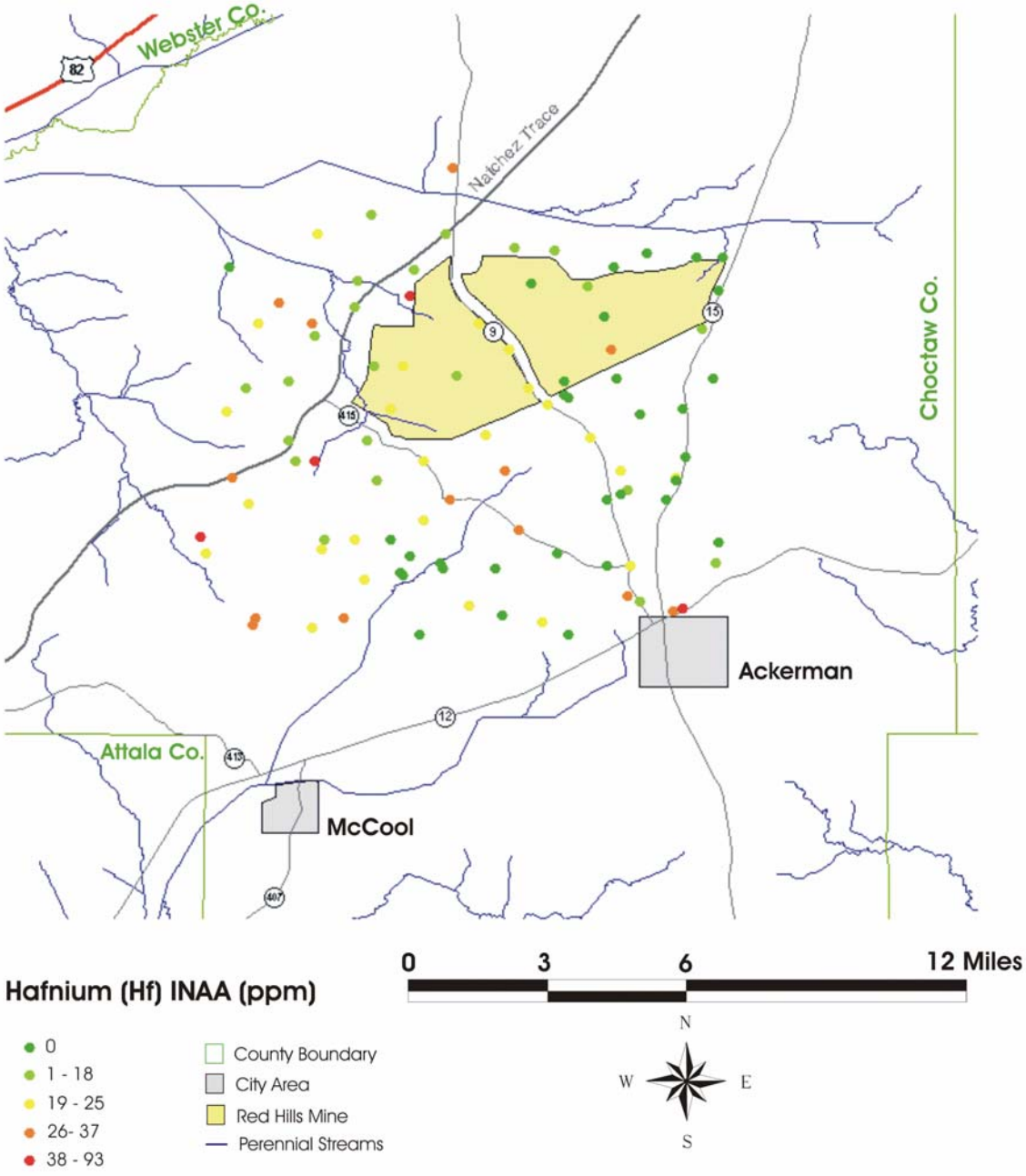

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
413
McCool
407
Hafnium (Hf) INAA (ppm)
0
1 - 18
19 - 25
26- 37
38 - 93
County Boundary
City Area
Red Hills Mine
Perennial Streams
0
3
6
12 Miles
N
W
E
S

Plate 20

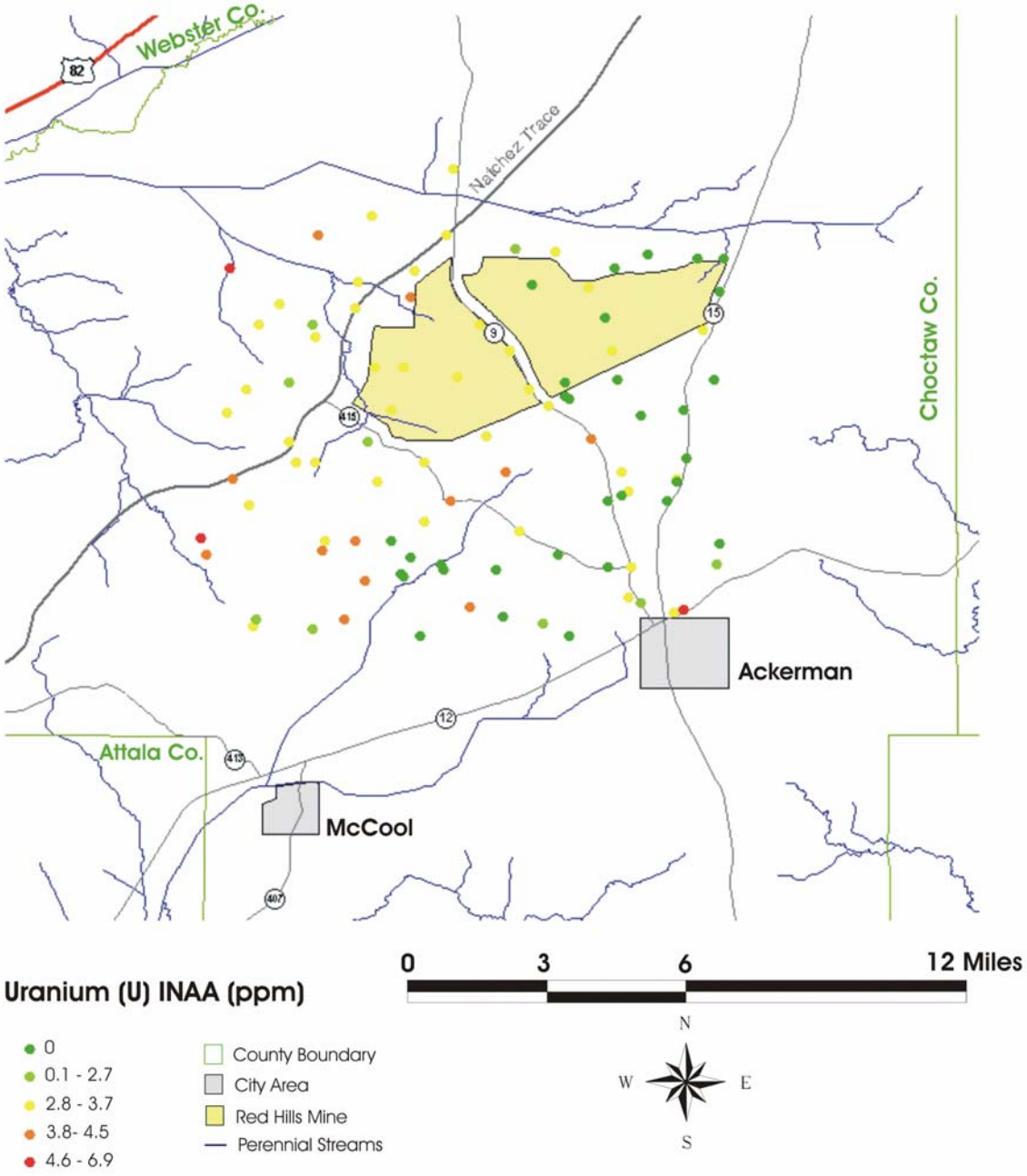
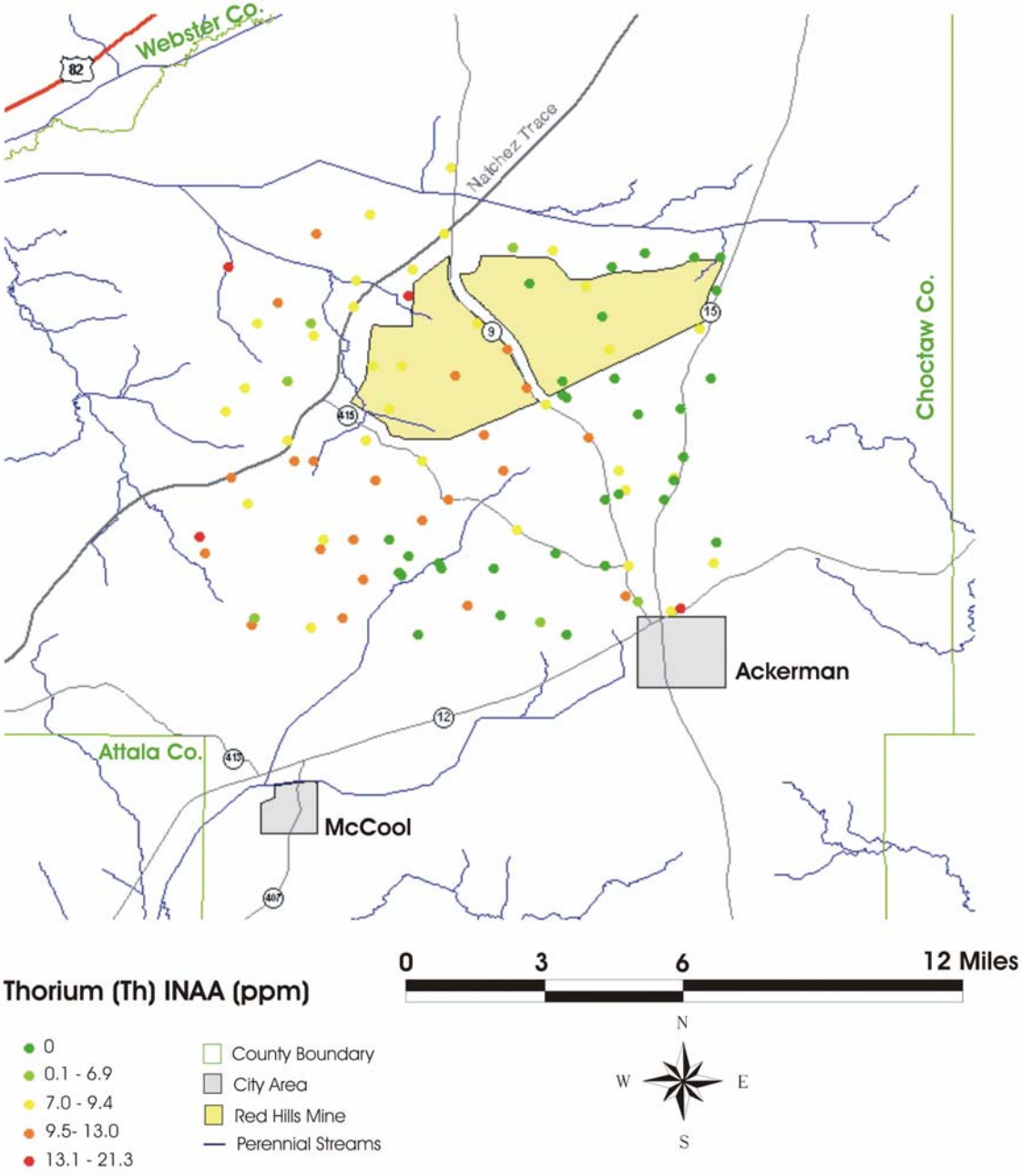

Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
413
Ackerman
12
Attala Co.
413
McCool
407
0
3
6
12 Miles
Uranium (U) INAA (ppm)
0
0.1 - 2.7
2.8 - 3.7
3.8- 4.5
4.6 - 6.9
County Boundary
City Area
Red Hills Mine
Perennial Streams
N
W
E
S

Plate 21


Webster Co.
82
Natchez Trace
Choctaw Co.
9
15
415
Ackerman
12
Attala Co.
415
McCool
407
Thorium (Th) INAA (ppm)
0
0.1 - 6.9
7.0 - 9.4
9.5- 13.0
13.1 - 21.3
County Boundary
City Area
Red Hills Mine
Perennial Streams
0
3
6
12 Miles
N
W
E
S

Acknowledgements
U. S. Geological Survey personnel, cooperative partners with this project, provided crucial analytical funding and technical expertise. Andrew E. Grosz developed the project concept and design, developed and supervised the sampling protocols and field methods, and offered outstanding leadership. Paul G. Schruben provided crucial GIS support. Jeffrey N. Grossman developed the database design, processed the data; developed geochemical mapping methods and computer methods in support of geochemical sampling. This project should stand as a shining example of successful federal and state government cooperation.

Resources

Thompson, D. E., A. E. Grosz, J. M. McNeal and J. N. Grossman, 1998, Surface geochemistry of Mississippi to be surveyed: Mississippi Geology v. 19, no. 2, p. 13-19.

Thompson D. E., A. E. Grosz, P. G. Schruben and J. N. Grossman, 2002, Solid-phase geochemical survey of the State of Mississippi; on the nature and distribution of As, Se, Hg, Cu, Pb, and Zn in stream sediments and soils [abs.]: Journal of the Mississippi Academy of Sciences, v. 47, no. 1, p. 42.