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# Geochemical Analysis of Surface Materials Surrounding the Bautsch-Gray Mine Superfund Site near Galena, Illinois

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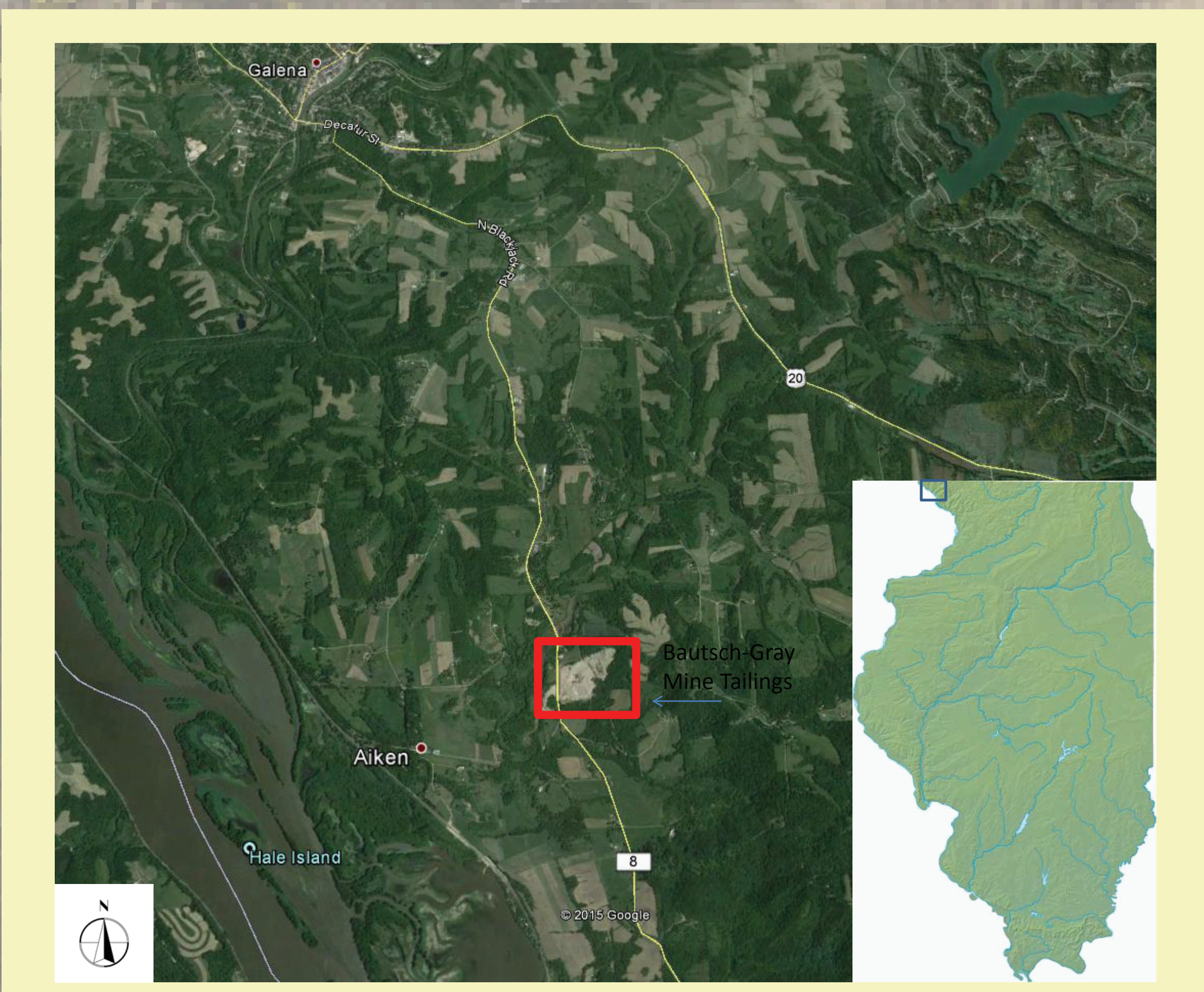
Augustana College

## ABSTRACT

The Bautsch-Gray zinc and lead mine, near Galena, IL, was in operation from the early 1900s until closing in 1975. The mine's tailings pile has documented elevated lead and zinc concentrations in the surface materials surrounding the site. Numerous floods have caused contaminated sediment to migrate off the mine tailings pile, across Blackjack Road and into an outwash basin, and towards Smallpox Creek. Since this site was designated an EPA Superfund site in 2010, the EPA has conducted numerous remediation efforts. This study attempts to develop a better understanding of the contamination within the soils of the outwash basin down-gradient of the mine as well as within the sediment bedload and vegetation of Smallpox Creek. Thirty-eight samples (mine tailings, soil, stream bedload sediment and algae) were collected, using a shovel or garden trowel, throughout this area and analyzed for lead and zinc contamination using X-ray fluorescence spectrometry. Samples from both the outwash basin and Smallpox Creek had concentrations of lead and zinc in excess of EPA limits for soils near a Superfund site. Excluding six samples from the mine tailings, that served as a baseline for contamination levels in mine tailing sediments, 17 samples exceeded the lead contamination limit of 400 ppm for soils near a Superfund site and 19 samples exceeded the zinc contamination limit of 7500 ppm for soils near a Superfund site. The highest concentrations of lead and zinc were 4,539 ppm and 94,537 ppm respectively. Though there have been mitigation efforts to remove contamination from the outwash area, these results indicate that there is still more work to be done. High concentrations of lead and zinc in the outwash basin indicate that Smallpox Creek is susceptible to continued contamination from this site.

## INTRODUCTION

Mining in the area surrounding Galena occurred as early as the 1800s. In 1927 the Mineral Point Zinc company began mining in the current Bautsch-Gray mine site. From 1946 until 1969 Tri-State Zinc and a few other companies mined this site. Mining and milling of the Galena dolomite and the Platteville limestone (middle Ordovician) at this site produced an approximately 55 acres mine tailings pile at the site when the mine was closed in 1975. Heavy metal (lead, zinc, arsenic, copper and cadmium) contamination is present to varying degrees in the tailings pile, in nearby residential properties, in a nearby marshland and in Smallpox Creek. In 2009 a heavy rain event caused roughly 1-2 feet of mine tailings to migrate across Blackjack Road and into a marshland that flowed towards Smallpox Creek. In 2010 the EPA designated the site a Superfund site and began mitigation efforts. In 2012 the site was placed on the NPL (National Priorities List), which is a list of the nation's most hazardous waste sites. This allowed for additional funding which prompted another round of testing and mitigation efforts. The aim of this study is to test surface materials at and around the site to see how effective mitigation efforts have been and if more mitigation efforts are necessary. A second goal of this study is to determine if Smallpox Creek is contaminated and how prone it is to contamination from site runoff.



## METHODOLOGY

In order to achieve a better understanding of the contamination occurring at and around the Bautsch-Gray mine thirty-eight surface material samples were taken from the mine tailings pile, the marshland (outwash basin) to the west of the mine tailings and the sediment bedload of Smallpox Creek. The samples were then prepared into pellets for mineralogical analysis with a X-Ray Fluorescence Spectrometer

## RESULTS

### Mine Tailings

Sample Name	Pb (In PPM)	Zn (In PPM)
Mt-1	1010	20088
Mt-2	1609	17946
Mt-3	446	11445
Mt-4	1282	3502
Mt-5	1366	13778
Mt-6	1943	14356
Average	1276	13519
Maximum	1943	20088
Minimum	446	3502
EPA TCR	1200	23000
EPA COL	400	7500
EPA EMT	107	5100
EPA Background 101	35.2	135
EPA Background 102	44.5	255

### Outwash Area

Sample Name	Pb (In PPM)	Zn (In ppm)
Ha-1	199	2939
Ha-2	4539	25821
Ha-3	194	1576
Ha-4	2401	6622
Ha-5 ALG	609	25437
Ha-6	4219	25677
Ha-7	1974	10125
Ha-8	815	10836
Ha-9	1727	12030
Ha-10	929	14134
Ha-11	915	14033
Ha-12	1427	16612
Ha-13	3167	20916
Ha-14	2034	6516
Ha-15	810	9293
Ha-16	166	11283
Ha-17	932	8987
Average	1592	13108
Maximum	4539	25821
Minimum	166	1576
EPA TCR	1200	23000
EPA COL	400	7500
EPA EMT	107	5100
EPA Background 101	35.2	135
EPA Background 102	44.5	255

### River Sediment

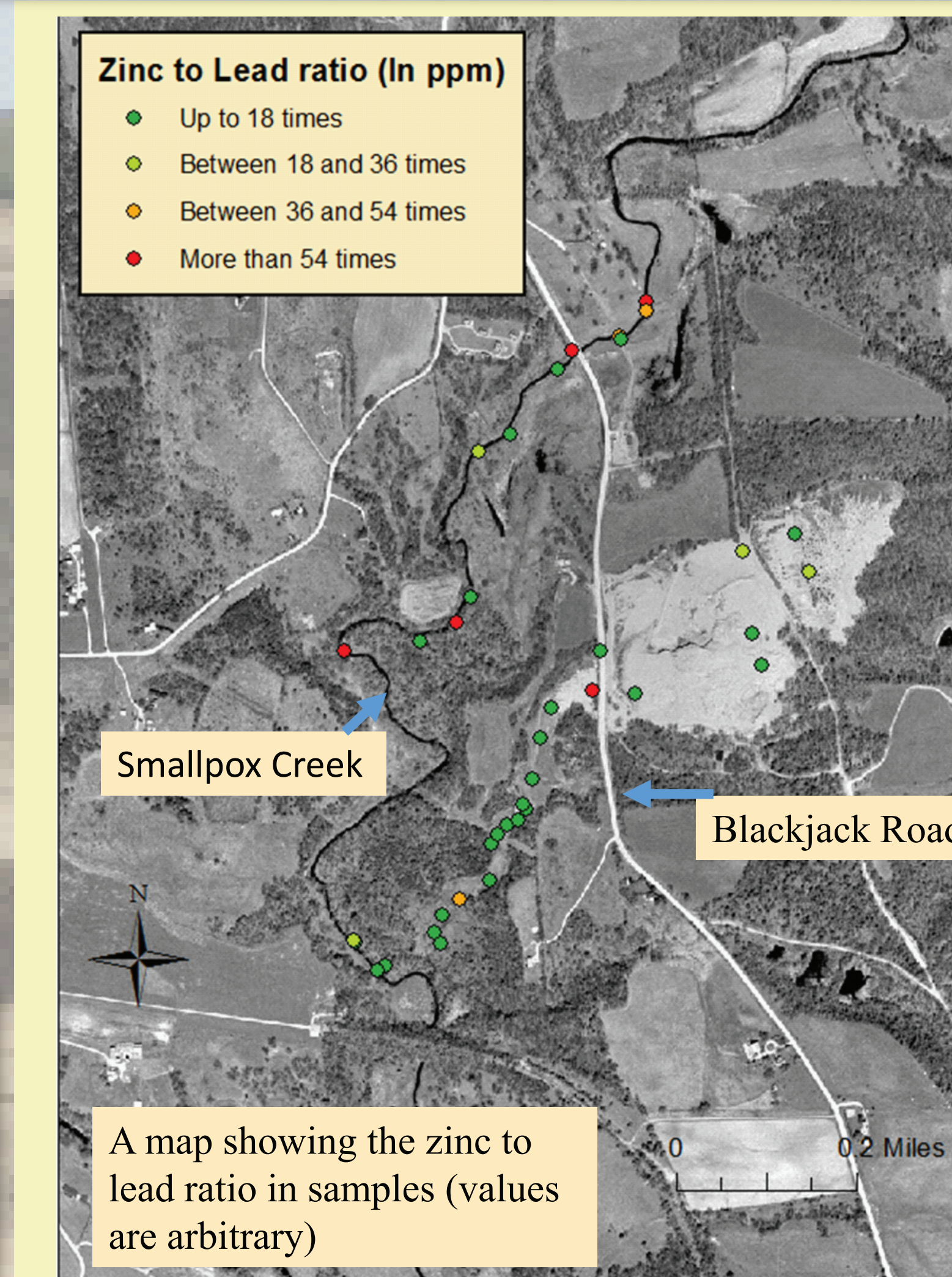
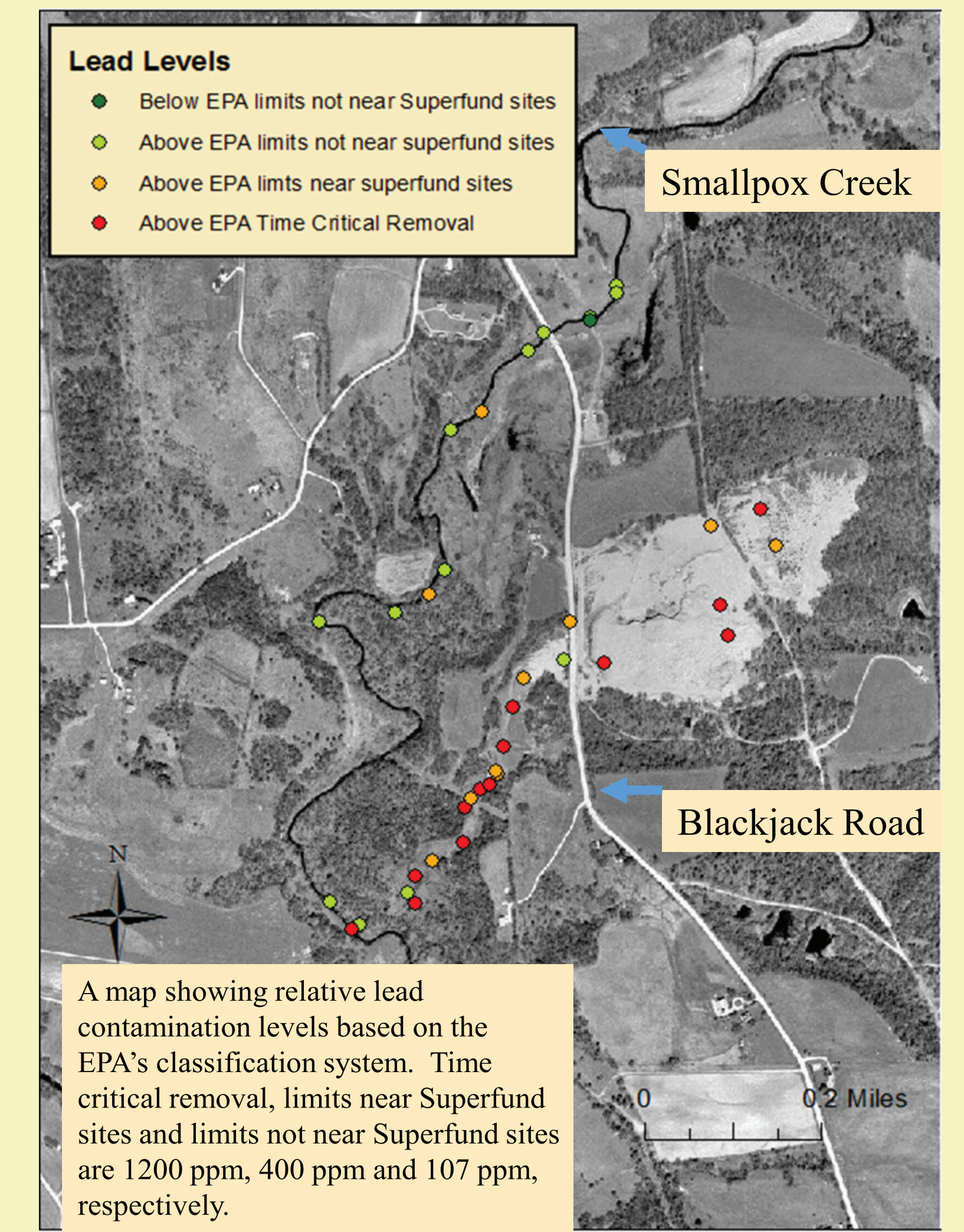
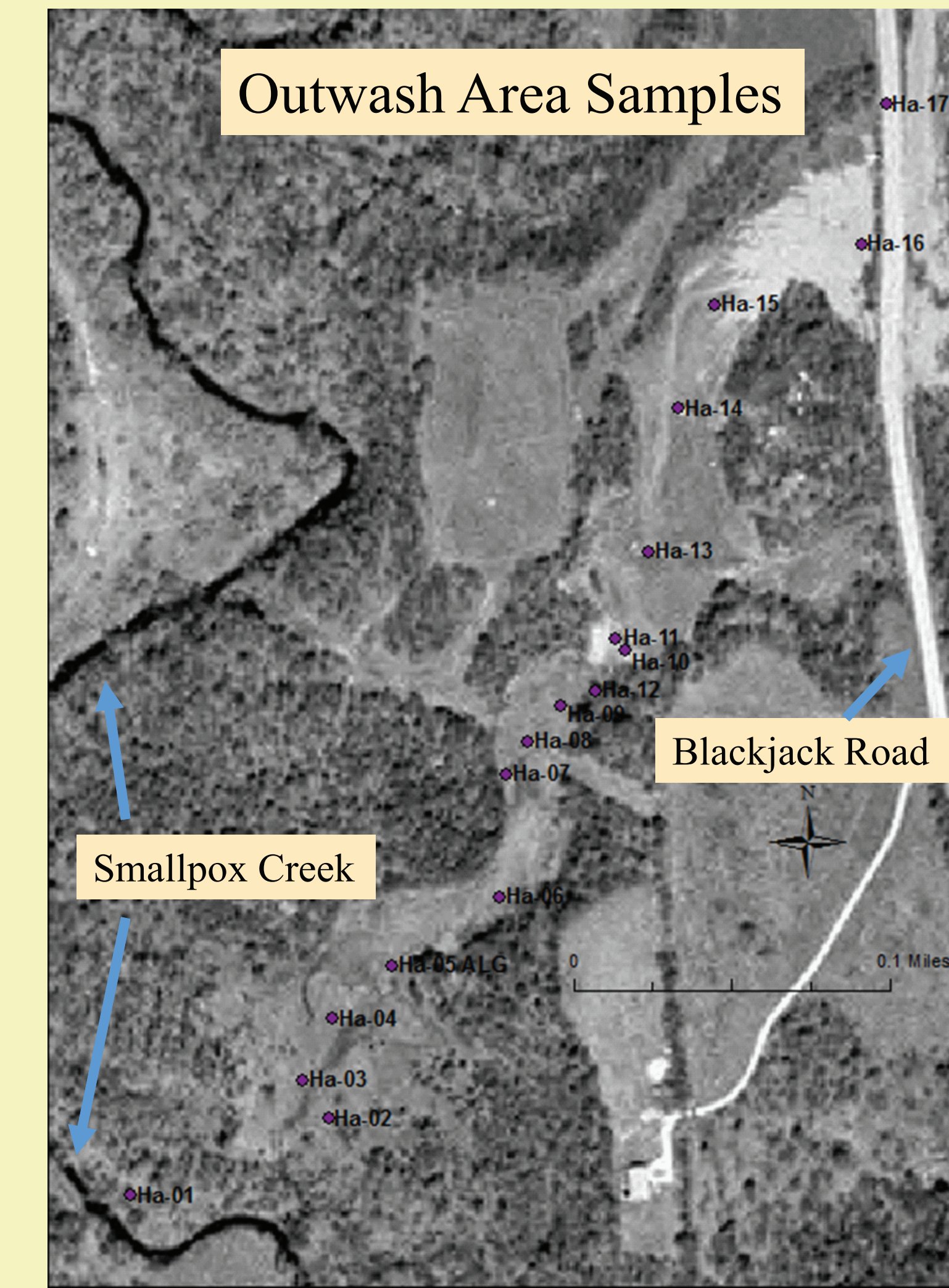
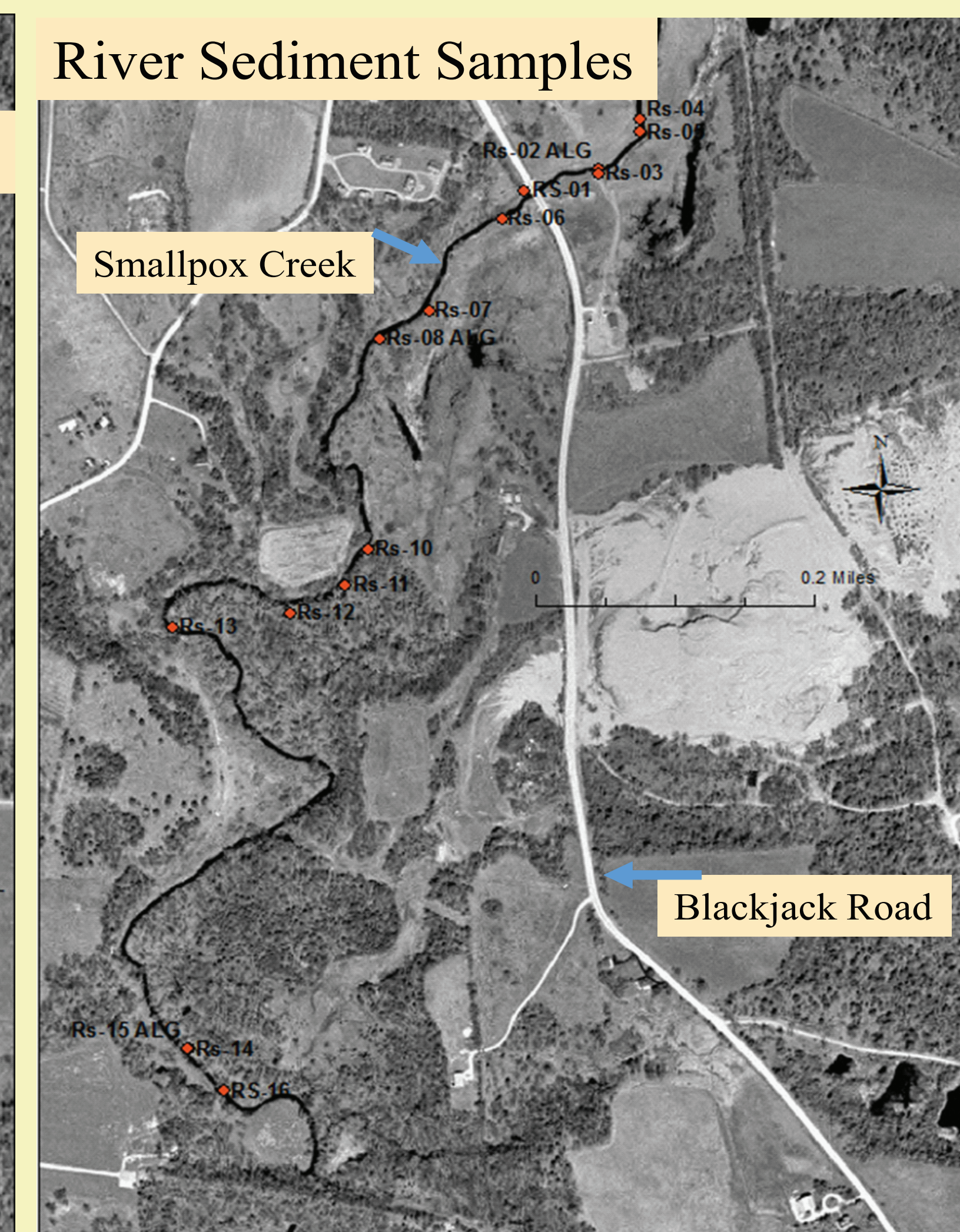
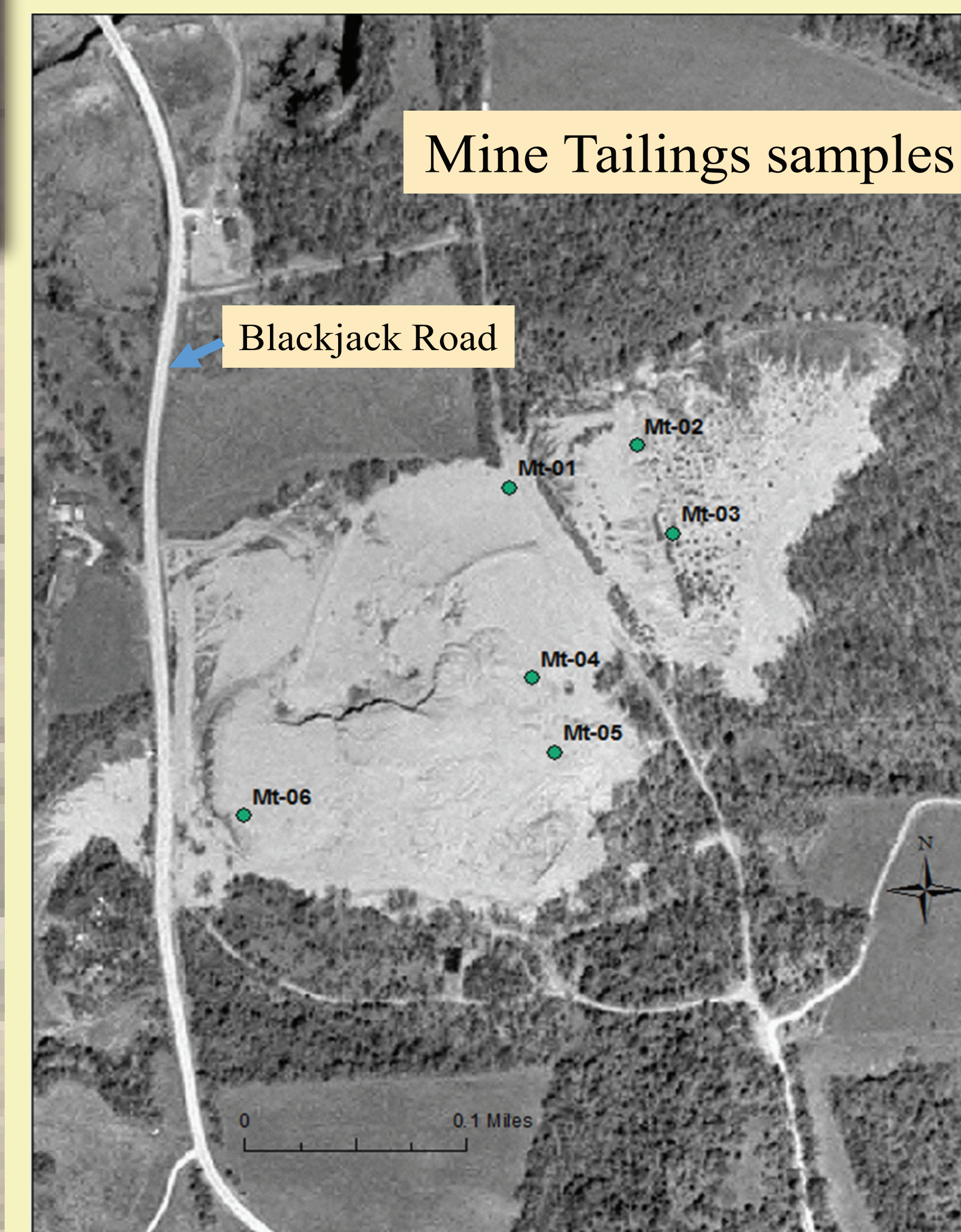
Sample Name	Pb (In PPM)	Zn (In PPM)
Rs-1	207	31565
Rs-2 ALG	135	6209
Rs-3	65	298
Rs-4	205	63118
Rs-5	173	8216
Rs-6	142	2131
Rs-7	460	4864
Rs-8 ALG	305	7038
Rs-10	122	1413
Rs-11	858	94537
Rs-12	134	1886
Rs-13	130	12164
Rs-14	210	3697
Rs-15	172	3314
Rs-16 ALG	1368	20554
Average	312	17400
Maximum	1368	94537
Minimum	65	298
EPA TCR	1200	23000
EPA COL	400	7500
EPA EMT	107	5100
EPA Background 101	35.2	135
EPA Background 102	44.5	255

EPA TCR= triggers a "time critical removal" by EPA

EPA COL= EPA Cleanup Objective Level for soils near Superfund site

EPA EMT= EPA regulatory limits for soils not near Superfund sites

EPA Background= An EPA background samples for the region



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## CONCLUSION

- Samples taken from the mine tailings and outwash area show that these areas still have elevated levels of heavy metals
- There is potential for the outwash area to contaminate Smallpox Creek. Data suggest that contamination has already occurred, but more samples would need to be collected to say this with greater confidence
- Samples of algae taken suggest that biological material is incorporating heavy metals into its structure near areas with high levels of surface contamination
- This study shows a strong correlation between gravel sediments and high levels of heavy metal contamination. Smaller sized particles such as clays tended to have lower levels of contamination
- Data suggest that fluvial processes tend to dissolve lead into solution and concentrate sediment with high levels of zinc into gravel bars

A future project on this site could look at contamination above and below the confluence of the outwash area with Smallpox Creek to determine whether the outwash area is contaminating Smallpox Creek. Approximately 20 samples could be taken upstream of the confluence and 20 below and analyzed for trace elements (heavy metals). If contamination is occurring near the confluence, this study could also provide insight into the distance downstream that contamination is affecting sediment in Smallpox Creek (contamination would likely decrease downstream).

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