

Spatial Interpolation Analysis for Cuyahoga County

Technical Support for Lead Nonattainment Area Boundary Determination

August 2009

As a result of the recent enactment of a more-stringent National Ambient Air Quality Standard for lead, a single monitor in Cuyahoga County which shows compliance under the previous standard, now will show non-compliance under the new standard if it continues to exhibit readings similar to those of the recent past. Ohio is required to propose a suggested non-attainment area boundary indicative of the area where violations occur, which is defined as the region over which there may occur an airborne concentration greater than 0.15 microgram per cubic meter ($\mu\text{g}/\text{m}^3$), expressed as a rolling three-month average. The perimeter of that region will be estimated by constructing isopleths of concentration based on spatial averaging of nearby monitors. Because a value of 0.145 rounds upwards to 0.15, a concentration of 0.145 $\mu\text{g}/\text{m}^3$ will be taken as the bounding isopleth. The Kriging algorithm is commonly used for spatial averaging in various atmospheric and earth science contexts, is recommended by the U.S. EPA, and will be used here.

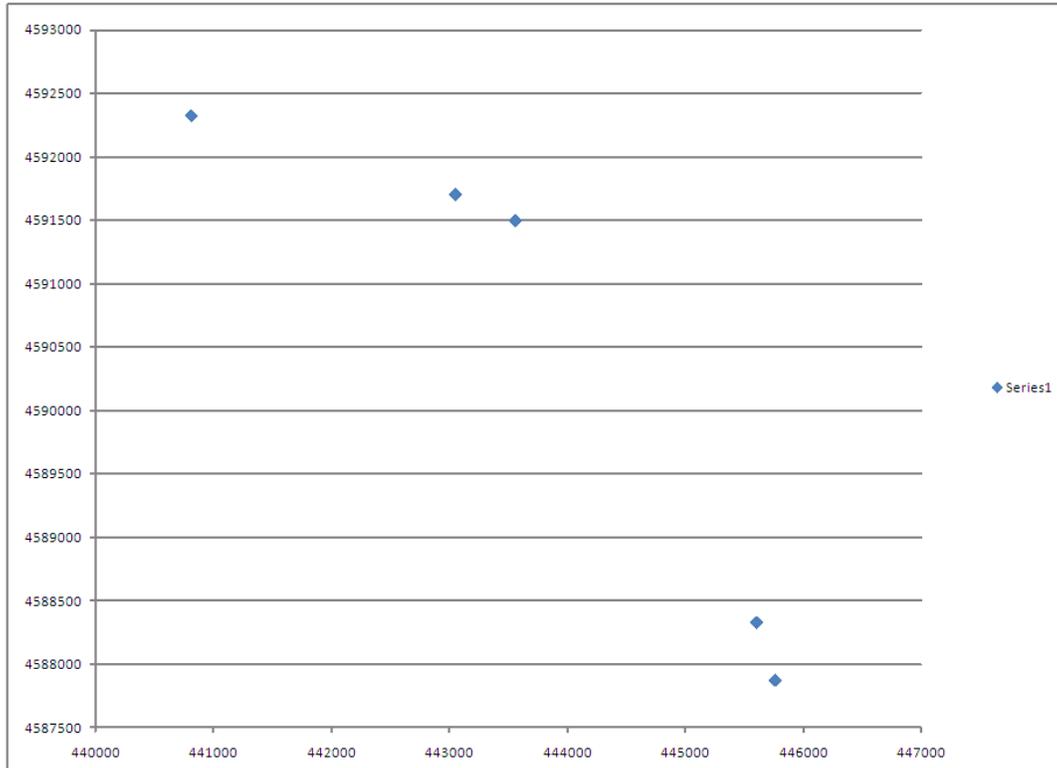
Five lead monitors are presently in operation in Cuyahoga County, including the one exceeding the 0.15 $\mu\text{g}/\text{m}^3$ limit, which is located near a facility on 56th Street operated by the Ferro Corporation. The five monitors are at the following locations:

Active lead monitoring sites in Cuyahoga Co.

Site name	AQS number	latitude	longitude	easting	northing
St. Tikhon	39-035-0038	41.476944	-81.681944	443050	4591700
Fire Sta. 4	39-035-0042	41.482222	-81.708889	440815	4592320
E. 56th Ferro	39-035-0049	41.446667	-81.651111	445600	4588330
Grant Road	39-035-0050	41.4425	-81.64917	445760	4587875
MM South	39-035-0061	41.472222	-81.675278	443559	4591496

They are shown on this plot:

Active lead monitors in Cuyahoga County
(zone 17 eastings and northings in meters)



Review of the Ferro Corporation monitor data shows three three-month periods with average concentrations above 0.15 ug/m3. It was decided that those three values would be spatially-averaged with the readings from the other four monitors for the identical time periods. Those three periods and associated concentrations for the five monitors are as follows:

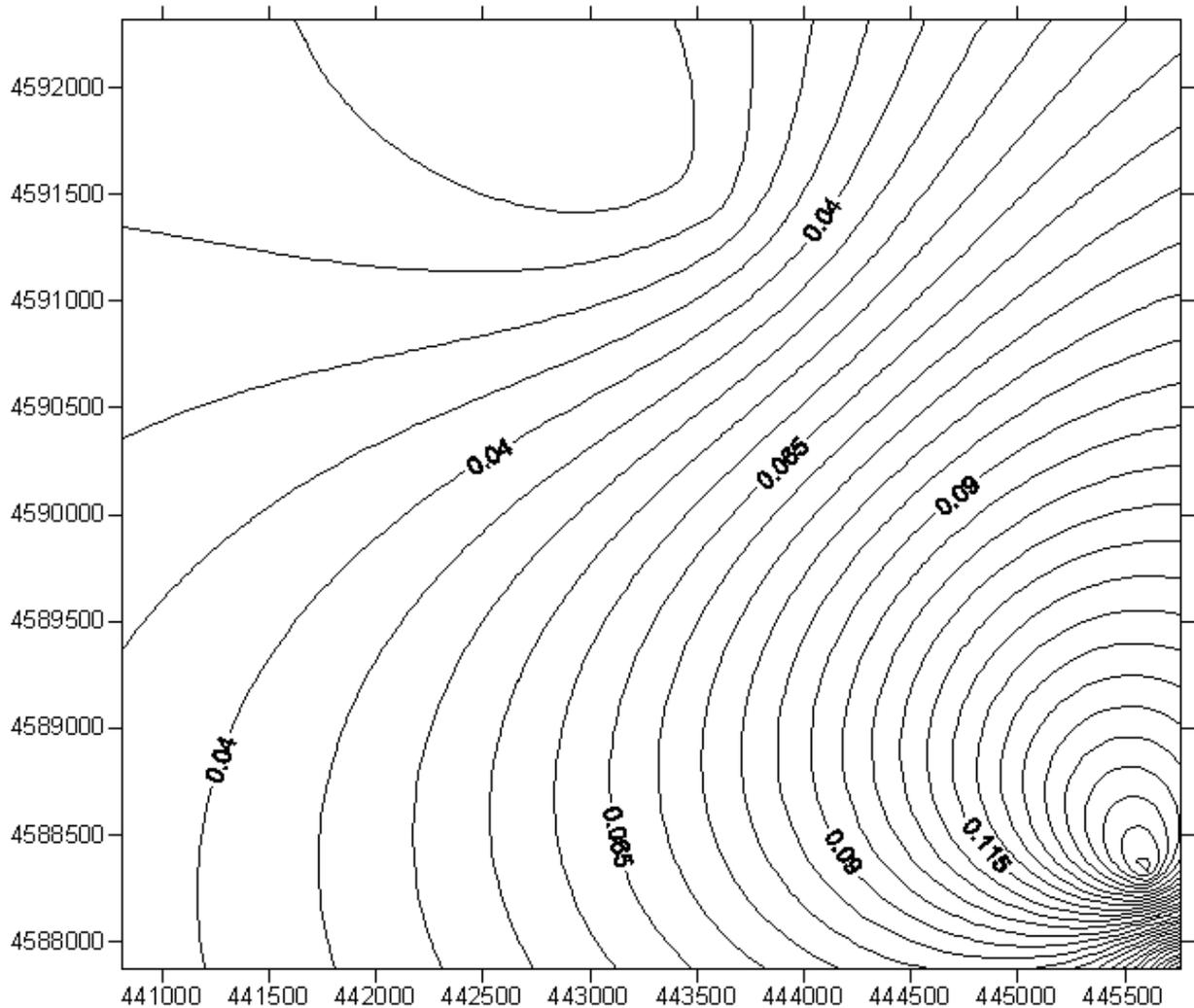
Concentrations for selected periods at active lead monitoring sites in Cuyahoga County

(ug/m3 - 3-month averages ending on the stated month)

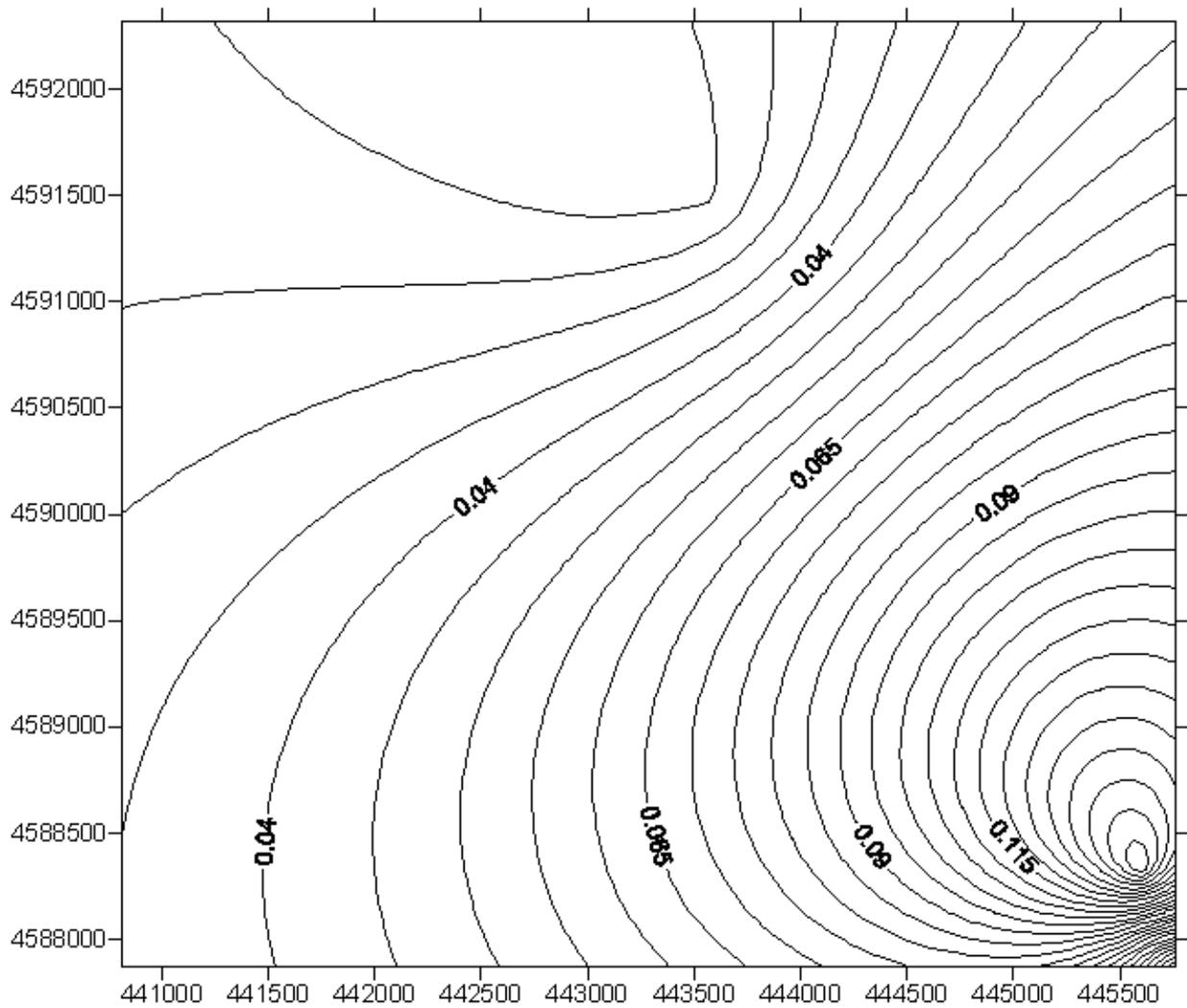
Period	<u>39-035-0038</u>	<u>39-035-0042</u>	<u>39-035-0049</u>	<u>39-035-0050</u>	<u>39-035-0061</u>
Nov. 2007	0.015	0.023	0.163	0.020	0.022
Dec. 2007	0.016	0.021	0.155	0.018	0.019
Oct. 2008	0.015	0.015	0.173	0.032	0.027

The procedure involves generating Krige plots for each of these time periods individually, and defining the non-attainment area to be every point falling inside the 0.145 isopleth on any of the plots. The plots were generated by Golden Software Surfer 8, using default Krige settings. Here they are:

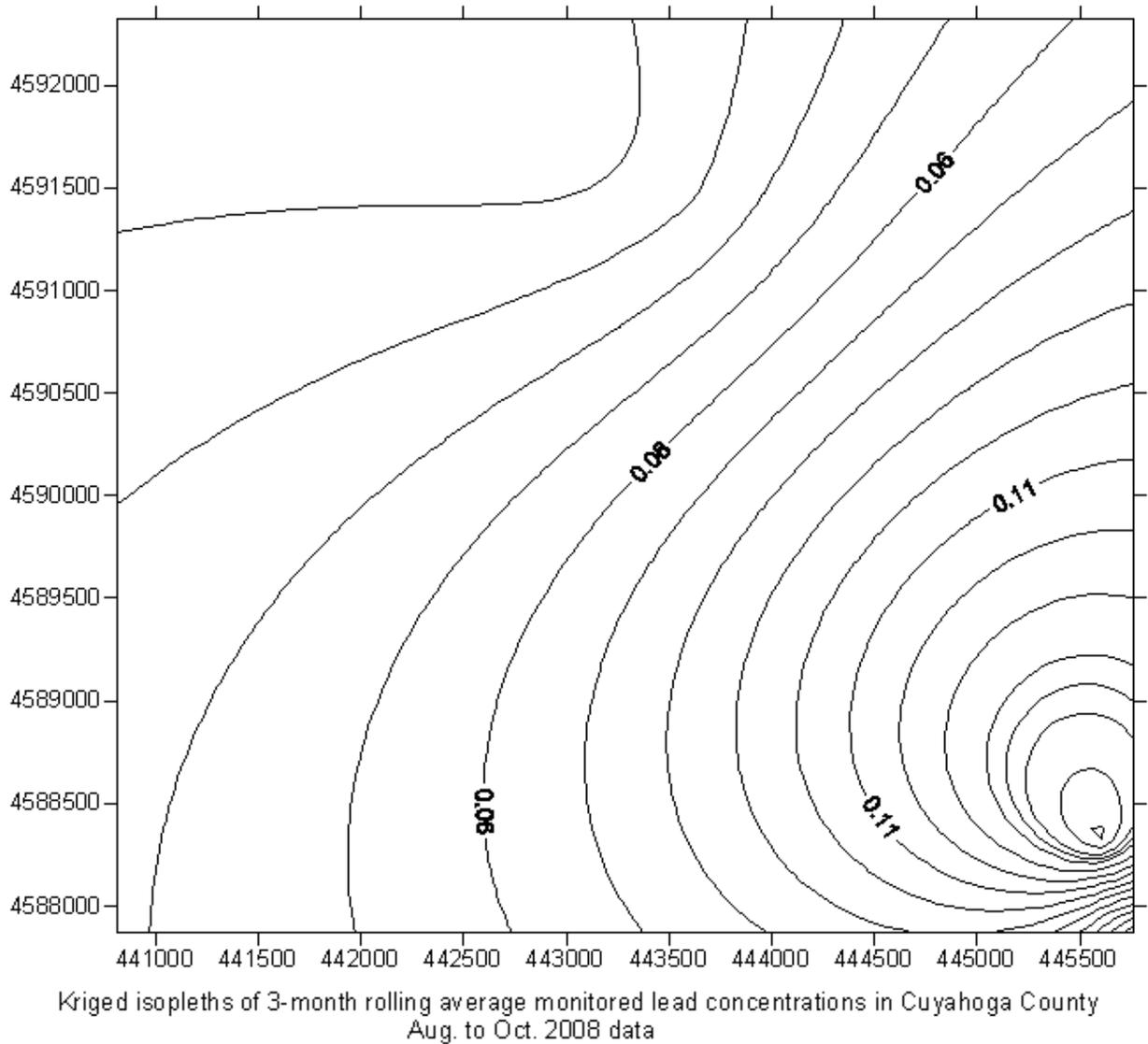
Kriged plots of 3-month average concentrations at lead monitors in Cuyahoga County



Kriged isopleths of 3-month rolling average monitored lead concentrations in Cuyahoga County
Sept. to Nov. 2007 data

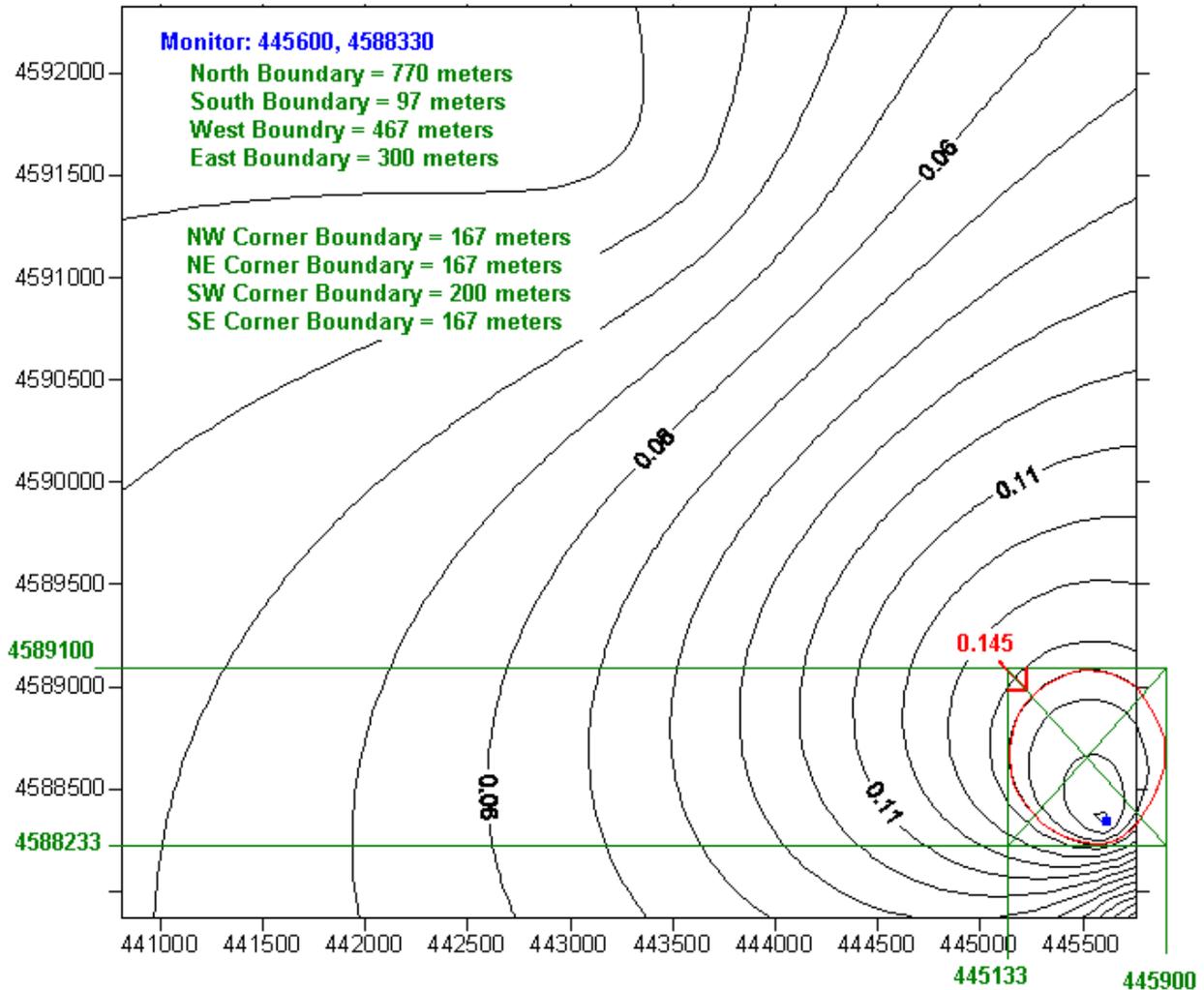


Kriged isopleths of 3-month rolling average monitored lead concentrations in Cuyahoga County
Oct. to Dec. 2007 data



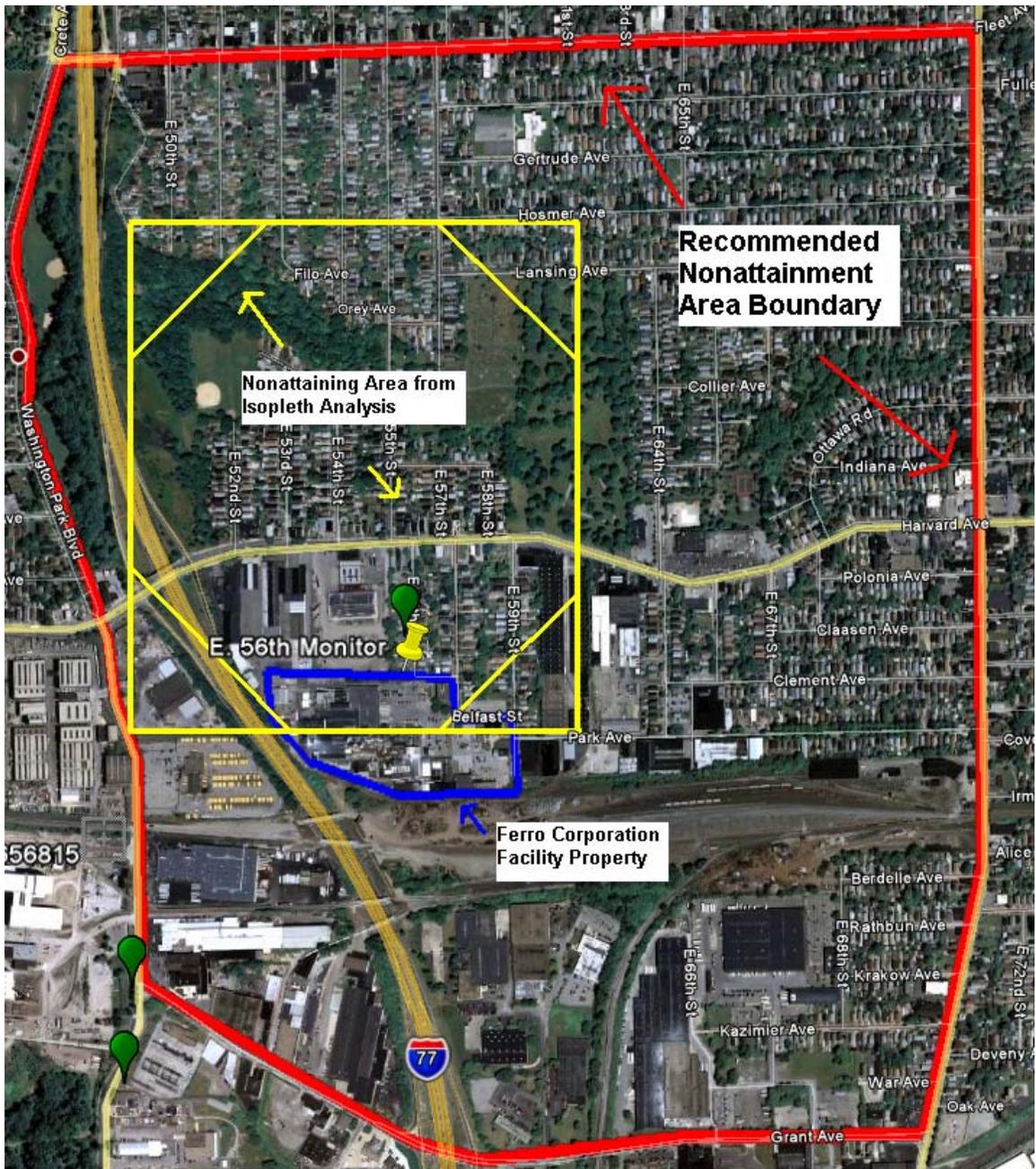
The Oct. 2008 period proved to be controlling, *i.e.* the area inside the 0.145 $\mu\text{g}/\text{m}^3$ isopleth was large enough to fully enclose the corresponding isopleth in each of the other two plots. Therefore, further analysis was conducted only on these isopleths. As depicted below, the outer north, south, east and west boundary edges of the 0.145 $\mu\text{g}/\text{m}^3$ isopleth were used to calculate the distance, in meters, from the violating monitor location. In addition, a similar computation was conducted to find the point at each corner tangent to the same isopleths of concern.

Kriged isopleths of 3-month rolling average monitored lead concentrations in Cuyahoga County
Aug. to Oct. 2008 data



The image shows a strong north-south asymmetry, with the bounds of the enclosed area extending about 770 meters to the north but only 97 meters to the south, relative to the violating monitor. The symmetry is good in the east-west direction, with an extension about 467 meters west and 300 meters east of the monitor, at the widest place.

These distances from the Krigé plot were then overlaid on a map of the area to help define an appropriate boundary that would conservatively encompass an area where violations could occur, as depicted below:



As can be seen above, the recommended nonattainment boundary is very conservative in encompassing the 0.145 ug/m3 boundary. The following streets demark the boundary for recommendation:

The area enclosed on the west by Washington Park Boulevard/Crete Avenue/East 49th Street, on the east by East 71st Street, on the north by Fleet Avenue, and on the south by Grant Avenue.