SciAps ApNotes
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# XRF Evaluation of Heavy Metals in Parks of Newark, N.J.

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## Highlights

- Heavy metal concentrations in seven parks in Newark, N.J., were determined by XRF
- As, Co, and Pb were measured at concentrations above NJDEP limits
- As had the highest frequency of occurrence, and was elevated in six of seven parks
- Atmospheric deposition or direct application may be sources of detected metals
- Future work will determine the speciation and potential mobility of the elevated metals

## Introduction

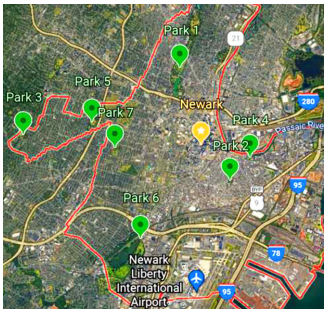


**Fig. 1.** Location of Newark, N.J., parks evaluated in this study.

Approximately 92 percent of New Jersey residents reside within urbanized areas, of which the City of Newark is the most populated. Significant industrial, commercial, and transportation activity in Newark can expose residents to heavy metal contaminants in air, water, and soil. Soils are common repositories for airborne and waterborne metals, and contaminated soils in high-contact residential or recreational areas can impact human health. The objective of this project was to determine the types, concentrations, and spatial distribution of heavy metals in high-contact soils in Newark's major parks (Fig. 1). A comprehensive evaluation of heavy metals in Newark's recreational soils has not been previously performed.

## Method

In July and August 2021, seven parks in Newark, N.J., were selected for soil/sediment metal surveys (Fig. 1). Areas evaluated were in or near athletic fields, playgrounds, trails, entrances, and adjacent to roads. Measurements were performed using a SciAps X-200 XRF instrument following EPA Method 6200 protocols. Samples of interest were selected based on exceedance of New Jersey Department of Environmental Protection (NJDEP) standards for remediation of residential direct-contact soils.

| Metal | Samples *n* | High *mg/kg* | Avg *mg/kg* | NJDEP *mg/kg* |
|---|---|---|---|---|
| As | 34 | 67.17 | 30.11 | 19 |
| Co | 19 | 43.36 | 30.22 | 23 |
| Pb | 7 | 693.11 | 540.24 | 400 |

**Table 1.** Number of samples with As, Co or Pb in exceedance of NJDEP limits. Highest and average concentrations are also reported.

## Results

From approximately 200 measurements, arsenic, cobalt, and lead were detected above NJDEP residential limits in 49 samples (Table 1). Elevated As was the most frequently detected metal(loid), occurring in 34 samples. With the exception of Park 3, two or three metals were elevated in all parks (Fig. 2). Park 6 and Park 4 had the highest incidence of As and Co, respectively. All three metals were detected in Park 1 and Park 2. Elevated concentrations of either As and Co or As and Pb coincided in some samples. The spatial distributions of As, Co, and Pb were each plotted for the park in which the largest number of samples with elevated metal was observed (Fig. 3). The As in Park 6 and Co in Park 4 were detected in and around the athletic fields and walking paths, whereas Pb in Park 2 was located near to major roadways. Of all samples with elevated metal concentrations in the seven parks evaluated, 13 were either inside or adjacent to children's playgrounds or play areas. The As and Co in park soils may be contributed by atmospheric deposition from sources such as fossil fuel combustion and waste incineration. However, the prevalence of these two metals suggests direct addition, for example, As in pesticides and Co in fertilizers, particularly in manicured areas of the parks. The location of elevated Pb suggests deposition from vehicular traffic and transportation activity.

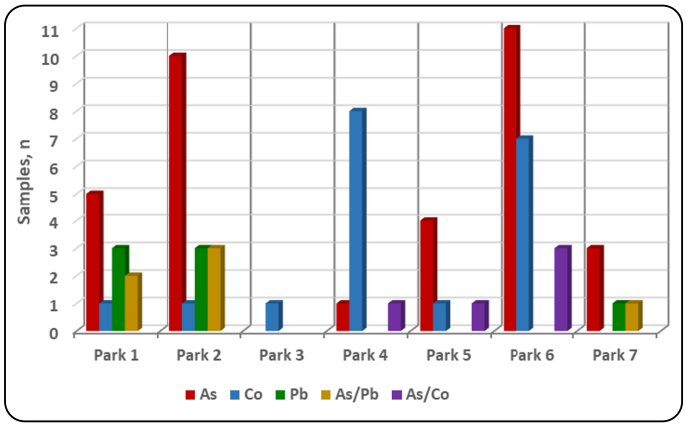


**Fig. 2.** Number of samples with As, Co, or Pb in exceedance of NJDEP limits for each of the seven parks. The number of samples with both As/Pb or As/Co are also reported. No Pb/Co samples were observed.

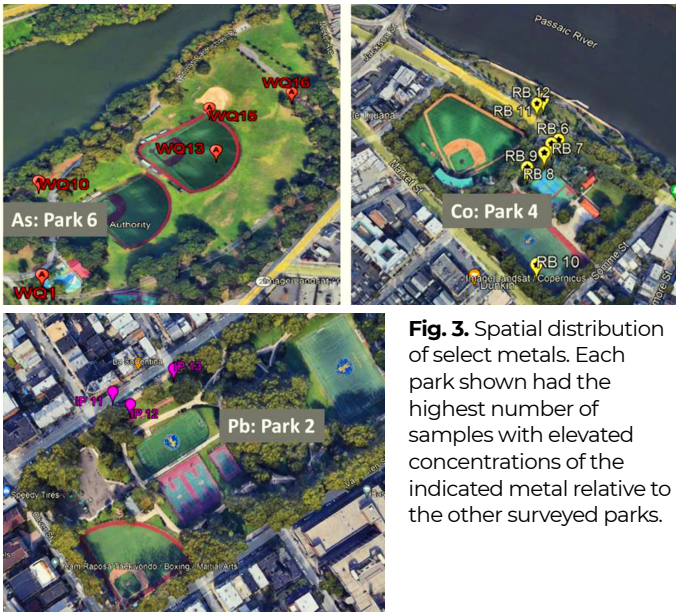


**Fig. 3.** Spatial distribution of select metals. Each park shown had the highest number of samples with elevated concentrations of the indicated metal relative to the other surveyed parks.

## Conclusions and Future Work

The metals As, Co, and Pb were detected in concentrations above NJDEP limits in high-contact recreational soils in Newark, N.J. parks. This is of concern, particularly in locations that may expose vulnerable populations to these contaminants. For As, which is detected most frequently, pesticides may be a source of the metal(loid). However, a follow-up XRF survey of contaminated areas and a more in-depth evaluation of potential metal sources are to be conducted as part of future work. Also for future work, soils and sediments with the highest metal concentrations will be subject to in-lab extractions and further analysis. The extraction data will complement field XRF analysis by determining the speciation and potential mobility of metals in the most contaminated soils.

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