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Schuylkill River Park Garden | 2022 | Urban Soils Report

Overview

Prior to sampling your garden, we conducted a site assessment to determine potential past land uses that might result in soil contamination that could limit your current goals. Appendix A presents maps of this Site Assessment with some simple interpretation. The assessment is based on data from the City of Philadelphia (https://atlas.phila.gov/).

The earliest available maps are from 1860-1962 and show that this site was underneath several industrial buildings throughout its history, including a coal yard and wood mill with several industrial buildings surrounding it. Industry and coal are potential sources of heavy metal pollution, such as lead (Pb) and cadmium (Cd).

We collected three soil samples in the first five inches of the soil; the depth of interest for gardeners, farmers, and plants, given that this is where most plant roots grow and acquire water and most of the necessary nutrients.

- Samples 1-3 were collected from the soil within the pathways throughout the garden since we did not receive permission to sample the beds.

The location of these samples is detailed in Figures 1 and 2. Once collected, samples were dried, ground, and sieved before being sent to Penn State's Agricultural Analytical Services Laboratory for analysis (https://agsci.psu.edu/aasl).

Soils were tested for routine soil fertility measurements including pH, Mehlich-3 extractable phosphorus, potassium, calcium, and magnesium, organic matter, and soluble salts (results are found in Table 1). Table 1 also includes general optimum levels for each measurement based on commercial vegetable production. A brief interpretation of the results is provided below. For further information regarding the fertility of your garden our Penn State Extension team can answer questions and provide you with informational documents.

Penn State's Agricultural Analytical Services Lab also tested samples taken from your site for heavy metals using USEPA 3050B, a standard method used to test trace element pollutants in soils. Three major heavy metal contaminants were measured: lead (Pb), cadmium (Cd), and arsenic (As). These data are presented in Table 2.

While there are no federal or state standards specifically for heavy metal contaminants in garden/farm soils, there are guidance values developed for other uses that we can consider. The Pennsylvania Department of Environmental Protect (PADEP) and the Environmental Protection Agency (USEPA) soil standards for residential areas are presented in Table 2. These values provide a comparison for your sample results. A general interpretation of the results is provided below. If you have further questions regarding your values, or the DEP and EPA limits, our Extension team can help you better understand the heavy metal levels in your soil.

Thank you again for collaborating with us! We look forward to working with you in the future and sharing the results of our study. We wish you the best of luck with your upcoming growing season.

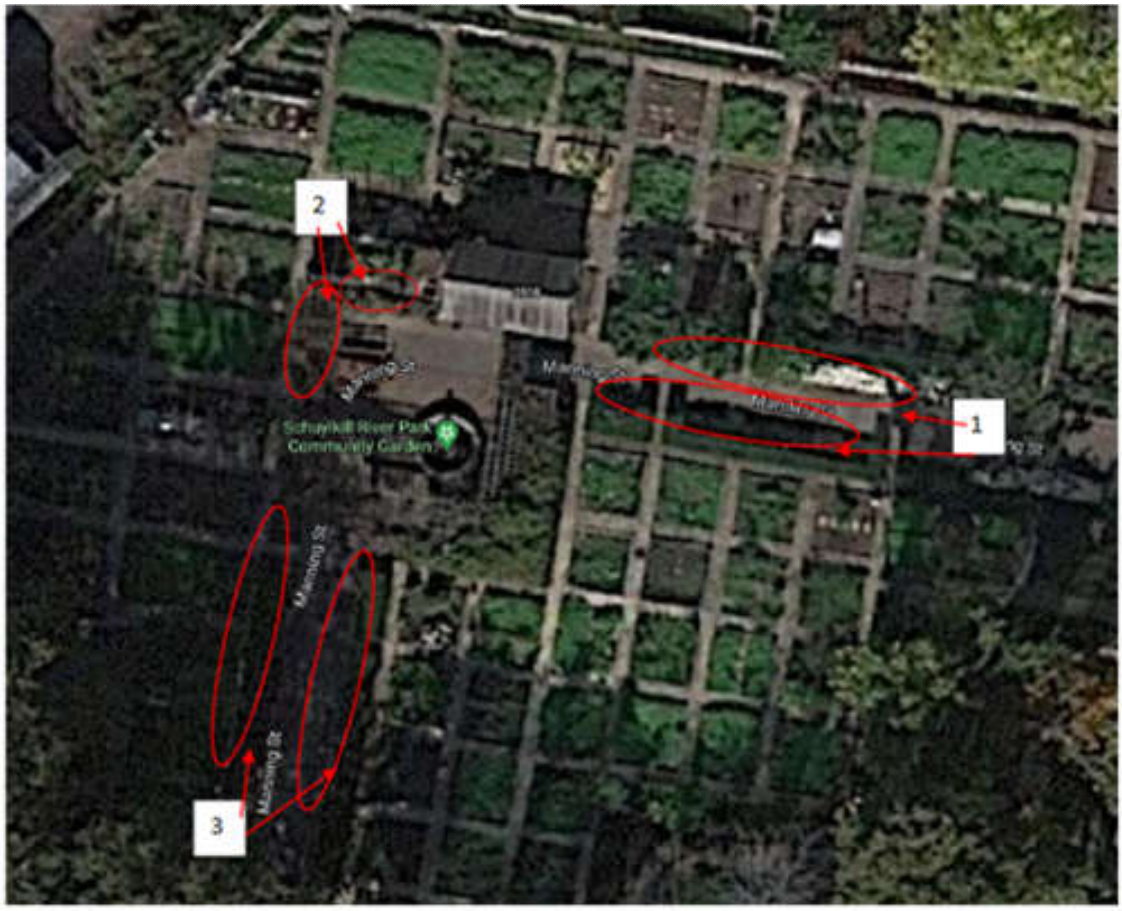

Figure 1: River Park Garden 2022 sampling scheme.

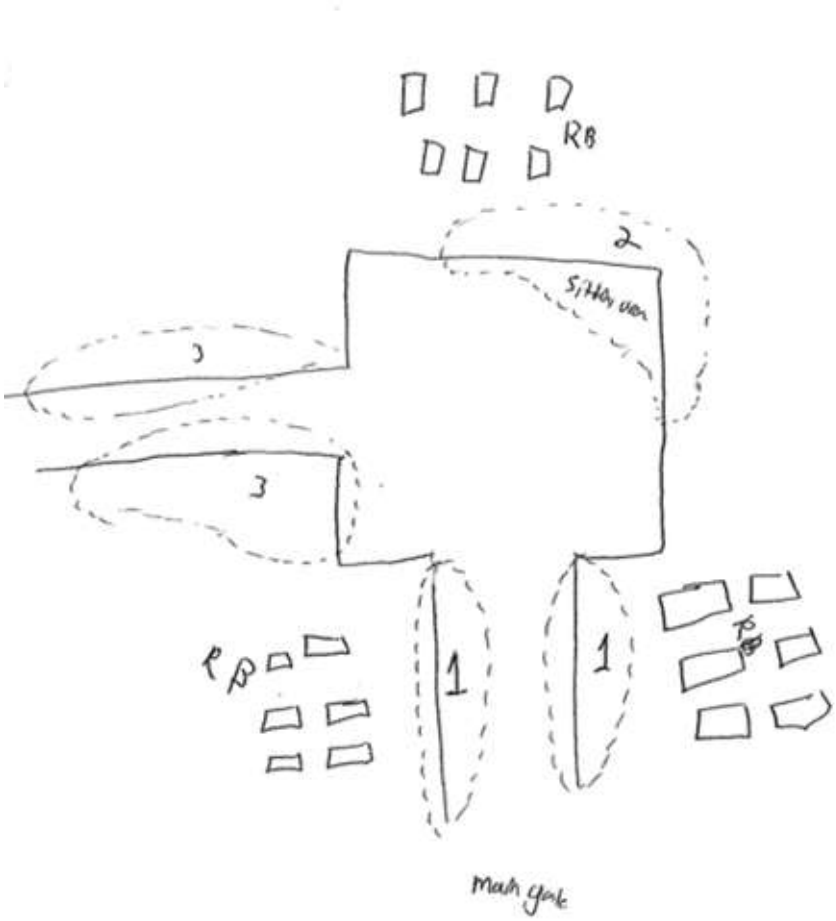

Figure 2: Site schematic of River Park Garden with sampling locations.

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Table 1. Soil fertility measurements for eleven of the samples collected at the site in August 2022. See Fig. 1 for sampling location.

	Sample No.			
Parameter	1	2	3	**Optimum range[1]**
pH	6.9	6.9	7.1	6.0 to 7.0
Mehlich 3 extractable nutrients, mg/kg[2]				
Phosphorus, P	283	455	345	35-70
Potassium, K	195	268	373	70-140
Calcium, Ca	3990	4808	5002	1,100-1,175
Magnesium, Mg	474	482	538	100-160
Organic matter, %	7.7	8.2	8.8	3.0 to 5.0
Sol. Salts, mmhos/cm	0.35	0.56	0.48	< 0.4

[1]Optimum pH and Mehlich 3 extractable nutrient levels for commercial vegetables crops (general) in Pennsylvania. Upper and lower limits of these ranges vary by crop.
[2]The unit, mg/kg, is equivalent to parts per million, ppm.

Table 2. Lead, cadmium, and arsenic concentration, mg/kg[1], determined by USEPA method 3050B+6010 in the twelve samples collected at the site in August 2022 compared to PADEP and USEPA soil standards. See Fig. 1 for sampling location.

	Sample No.				
Parameter	1	2	3	**PADEP[2]**	**USEPA[3]**
Lead, Pb	122.7	106.4	106.4	500	400
Cadmium, Cd	3.46	2.53	2.5	110	7.1
Arsenic, As	12.8	30.15	12.7	12	0.68

[1]The unit, mg/kg, is equivalent to parts per million, ppm.
[2]Pennsylvania Department of Environmental Protection statewide health standards for residential soils.
[3]United State Environmental Protection Agency bare soil, play area, standard for lead, and generic soil screening levels residential use, ingestion-dermal exposure, for cadmium and arsenic. Natural background concentrations of soil arsenic throughout much of the region exceed the USEPA generic soil screening level.

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Interpretation

Fertility

Soil fertility results in Table 1 indicate that no amendments should be added this year to adjust soil pH or the fertility parameters we measured. All nutrient measurements were within or above optimum (well above in most cases). The soluble salt levels were also high in most samples, but seasonal rainfall and snow melt may help lower these over time. Based on the high nutrient, organic matter, and soluble salt levels, you should evaluate whether amendments you are routinely adding, such as compost, have been applied at an excessive rate. You can ask your soil amendment supplier for a recent test report (or *guaranteed analysis* for fertilizers). If this information is not available from the supplier, please contact your extension educator and ask for guidance about testing and using compost you are considering buying.

Given the high soil organic matter and the levels of phosphorus, potassium, calcium, and magnesium in the samples obtained from the garden, it is not recommended that you add any fertilizer or compost this growing season. The only nutrient you may need to supplement is nitrogen. Nitrogen is generally the most limiting nutrient for plant growth (except for legumes.) Unfortunately, soil nitrogen is highly dynamic, changing rapidly in response to temperature and moisture. Consequently, soil testing does not provide a reliable estimate of nitrogen pools. Mineralization of organic matter in soils at this site may provide sufficient plant available nitrogen once soils warm up. If additional nitrogen is needed, you should use a source that does not contain phosphorus or potassium. Blood meal (12% N) is a good Organic option.

If you plan to carry out crop growing activities in 2024 at the specific sites we sampled, we recommend you submit soil samples from these sites again to assess the need for the incorporation of an amendment. Our Penn State Extension staff can advise you on appropriate tests.

Heavy Metals (Pb, Cd, As)

The lead (Pb) concentrations for all samples were below the USEPA and PADEP thresholds. The Penn State Extension factsheet, *Lead in Residential Soils: Sources, Testing, and Reducing Exposure*, provides guidance and best practices to reduce the risk of exposure to elevated lead in garden soils, https://extension.psu.edu/lead-in-residential-soils-sources-testing-and-reducing-exposure.

Soil cadmium (Cd) concentrations are below the standard thresholds established by both PADEP and USEPA.

The arsenic (As) concentration in all samples is above the PADEP and the USEPA standards. The natural background concentration of arsenic throughout much of the region exceeds the USEPA standard due to geologic parent materials. Therefore, these levels may not be the result of pollution from human activities. You can find the mapped results of a survey of soils across the continuous continental US by following this link: https://pubs.usgs.gov/sir/2017/5118/sir20175118_element.php?el=33.

Using raised beds, built using clean soil material, is an effective way to reduce the risk of exposure to soil contaminants. The Penn State Extension article, *How to Construct a Raised Bed in the Garden*, provides useful guidance, https://extension.psu.edu/how-to-construct-a-raised-bed-in-the-garden. You can ask our Penn State Extension staff for advice on appropriate options to create raised beds.

Please note that the soils in this study were sampled from in-ground locations between beds, and therefore represent the soil that is likely beneath the beds. Individual growers using raised beds may wish to sample their own plots for more specific information to their growing sites and management practices.

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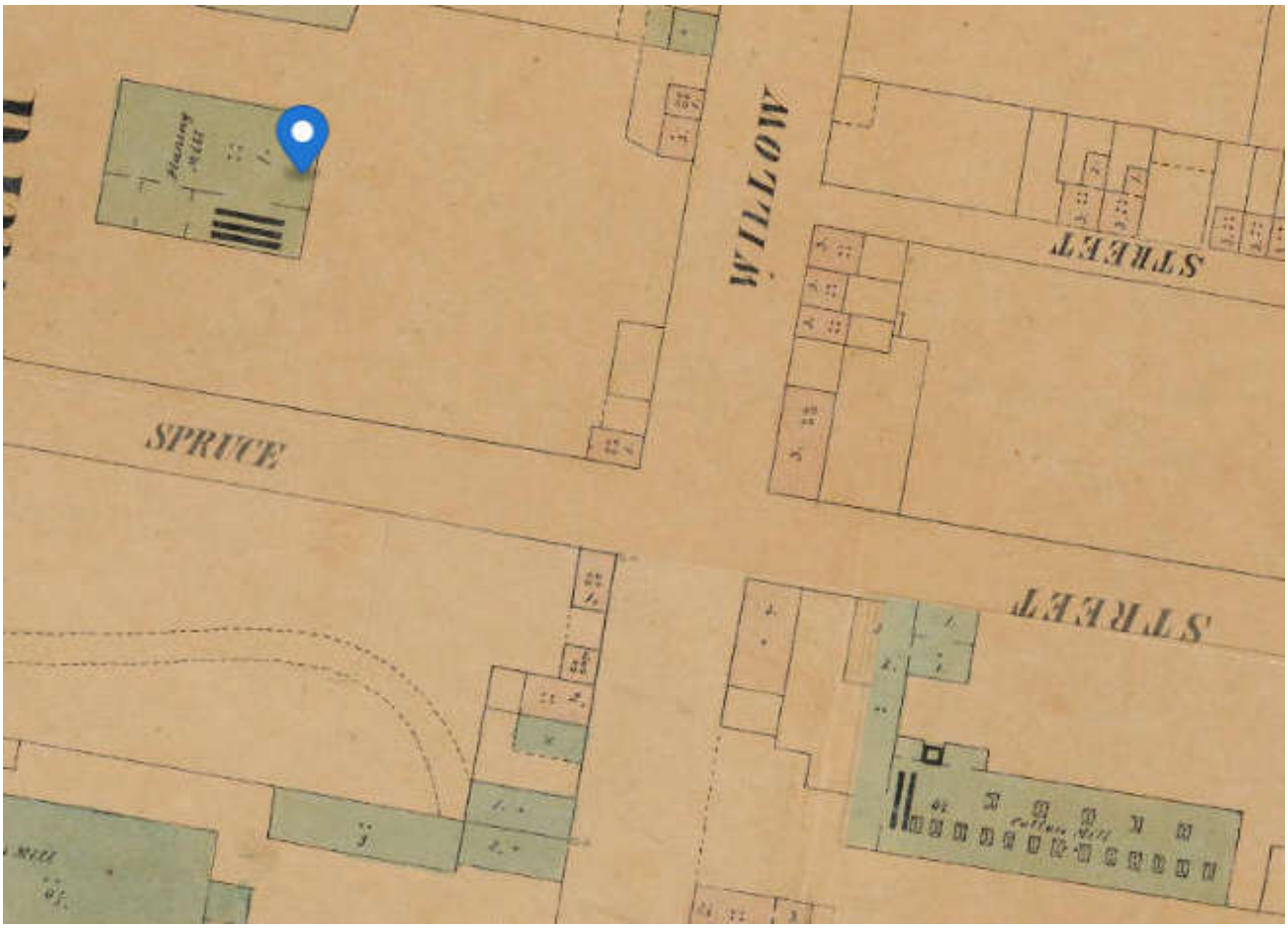
Appendix A: Historical Chronology

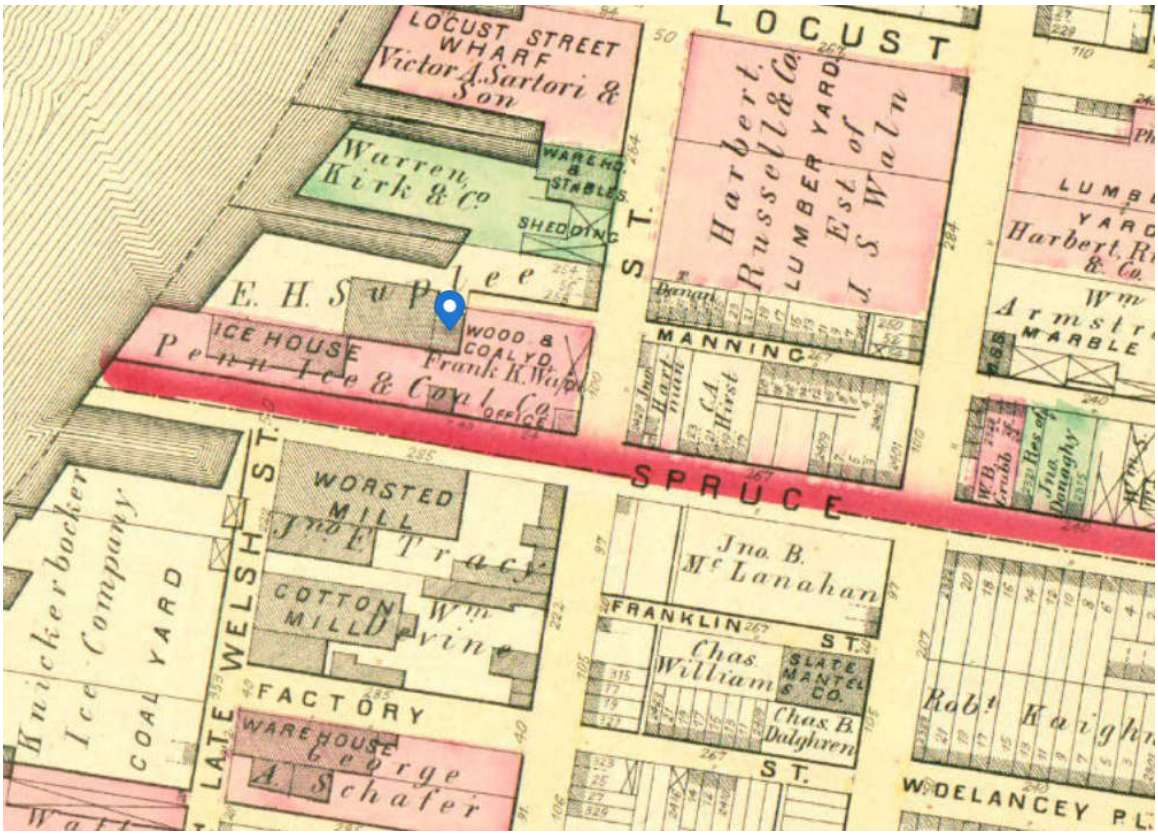
1860

The site is a part of a lumber planing mill, which sometimes use chemicals to preserve the wood. No other pollutants appear to be present around the lot.



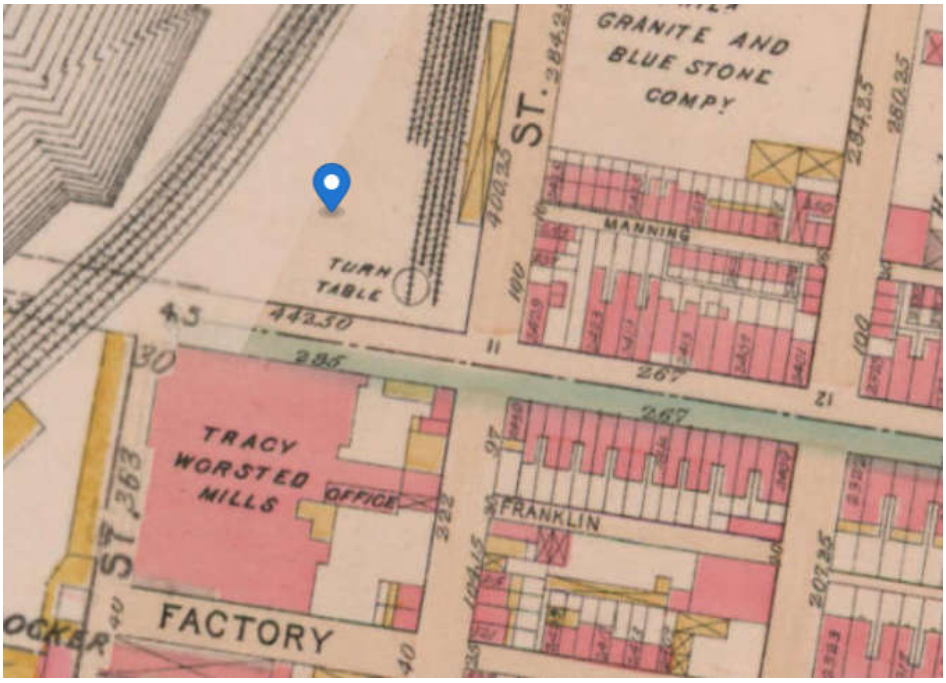
1875

Major increase of industrialization on and around the site. Site is now under a coal yard which can be a contributor of Lead (Pb) and Cadmium (Cd). There are several factories and mills now around the site.



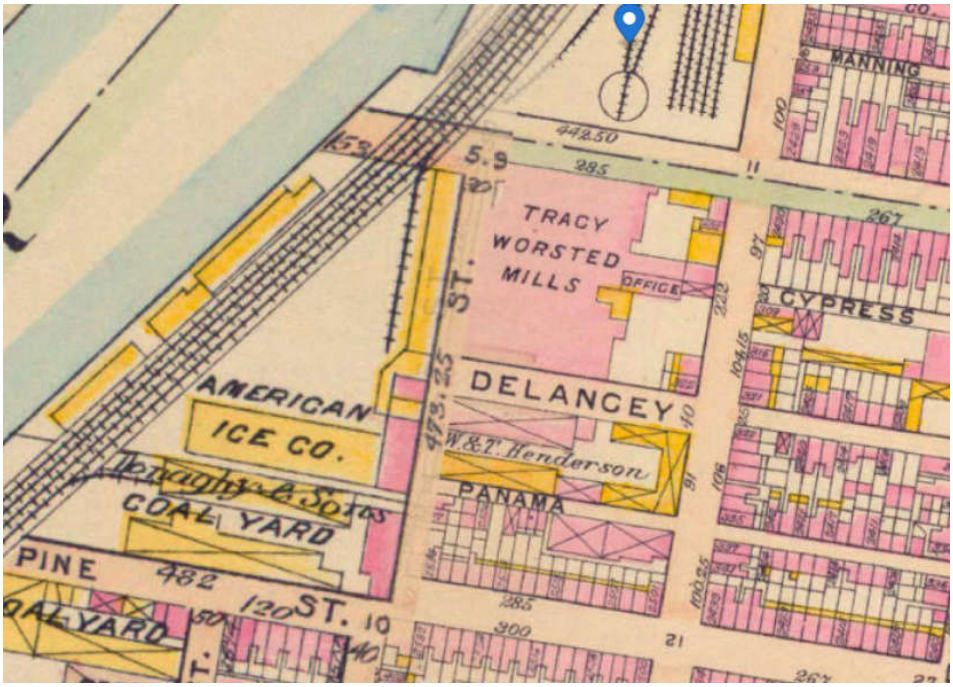
1895

The site is now a part of a railyard and is still surrounded by industrial buildings.



1910

The site remains the same and continues this way as of the last map in 1962.

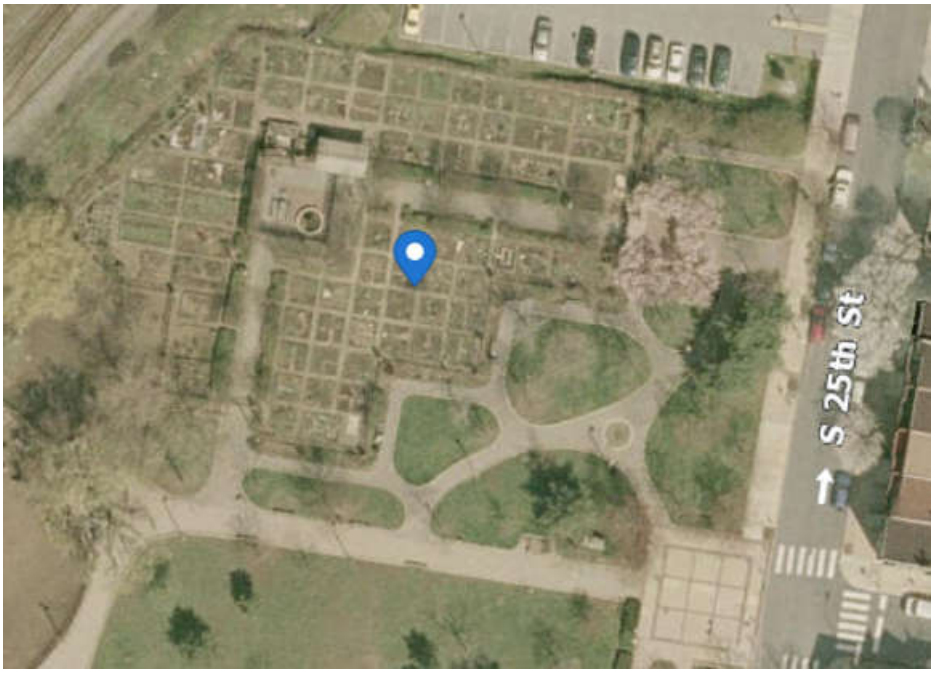


1996

The site is now being used as an urban garden. Surrounding area has been heavily deindustrialized and is primarily devoted to residential and recreational use.

2004

No major changes or sources of pollution at the site.



Present day

At this point a small section of the property is being used as a garden with raised beds.

Due to the proximity of the site to a coal yard, railway, and industrial buildings throughout most of its history, this garden could be considered a high-risk site, which means that the probability of having residual elevated heavy metal concentrations in-ground is high.