

Project Introduction

The Environmental Integrity Project (EIP), in collaboration with the Breathe Project and Carnegie Mellon University (CMU) CREATE Lab, conducted an 18-month community monitoring project focused on the presence of benzene in the Monongahela (Mon) Valley region of Pennsylvania. The project spanned from December 2021 to June 2023. The project aimed to investigate the presence of benzene in the communities surrounding the Clairton Coke Works facility, with a particular emphasis on understanding its potential impact on public health.

To accomplish this, the project utilized eight full-time passive benzene monitoring stations that regularly assessed average benzene concentrations over two-week intervals. Additionally, a monitor was placed at Thomas Jefferson High School, which operated during the initial six months of the project.

The positioning of the eight long-term monitoring stations, located at distances ranging from 0.6 miles away from the Clairton Coke Works facility, was aimed at assessing the spread and potential health implications of benzene emissions on nearby communities. Notably, six of these monitoring stations were located within a two-mile radius of the plant.

Methods

EIP used sorbent tubes that measured two-week average concentrations of benzene at each of the monitoring stations. This type of passive sampling aligns with [EPA Method 325B](#), which is the same methodology used at refineries to measure benzene concentrations at their fence line. In addition to its alignment with EPA methodology, which ensures the reliability and comparability of the data, we also chose this sampling methodology because it proved to be an affordable and practical choice. After each two-week sampling period, the sorbent tubes were sent to [Enthalpy Analytical](#) for analysis. Typically, each sampling period was conducted for two weeks, although occasionally, a day or two was added to accommodate the schedules of the volunteers responsible for sample collection and shipment to the lab. While no duplicate measurements were performed concurrently, each round of sampling included a trip blank for quality control purposes.

Monitoring locations were chosen based on where community members who were willing to host them were located. The distance between the monitoring location and USS Clairton Coke Works was determined by measuring the distance between the monitor and the closest point along the Clairton Coke Works boundary. The boundary was drawn around the operating portion of the property and excludes the portion of the property allocated for storage and office use.

Due to an instrument failure at Enthalpy Analytical, data for the monitoring period between May 23rd, 2022 and June 6th, 2022 was lost. Additionally, the sample tube for Monitor 01 during April 25th, 2022 to May 9th, 2022 was accidentally left out of the return shipment to the lab and not discovered until a few days later. The decision was made to exclude the sample altogether, as it was no longer being kept in proper conditions at the time of discovery. Finally, the sample tube for Monitor 03 was missing (likely stolen) when the team went to change out the samples at the end of the monitoring period ending on June 19th, 2022.

Findings

Environmental Integrity Project Study

After 18 months of monitoring, EIP's findings underscore unhealthy concentrations of benzene within communities neighboring Clairton Coke Works and Irvin Works. By the end of the study, three monitoring locations in the Mon Valley had long-term average concentrations over three micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), with the highest long-term average reaching $4.5 \mu\text{g}/\text{m}^3$. The California EPA has determined that repeated exposure to benzene concentrations above $3 \mu\text{g}/\text{m}^3$, over a period of eight or more years, could increase the risk of noncancerous health effects such as blood cell damage and a weakened immune system. According to the California EPA, lifetime exposures to concentrations greater than $3 \mu\text{g}/\text{m}^3$ also result in an increased risk of cancer (specifically leukemia) of more than 1 in 10,000.

Two-week average concentrations were found to be as high as $16.7 \mu\text{g}/\text{m}^3$ and $10.4 \mu\text{g}/\text{m}^3$ at two of the monitoring sites during the month of October 2022. Assuming these concentrations fluctuate day-to-day, there may be 24-hour periods within these two-week periods that are unsafe for short-term exposure, for example by exceeding California's acute (one-hour) guideline of $27 \mu\text{g}/\text{m}^3$. Table 1 below shows the three monitoring locations with long-term averages over $3 \mu\text{g}/\text{m}^3$ highlighted in yellow, and all three were within one and a half miles of the Clairton Coke Works fenceline. See Attachment A for a map of all the monitors and their long-term averages.

Table 1. Benzene Concentrations by Monitoring Location in the Monongahela Valley, PA, December 2021 to June 2023

Monitoring Location*	Distance from Clairton Coke Works (miles)	Long-term Average Benzene Concentration ($\mu\text{g}/\text{m}^3$)	Minimum 2-Week Average Benzene Concentration ($\mu\text{g}/\text{m}^3$)	Maximum 2-Week Average Benzene Concentration ($\mu\text{g}/\text{m}^3$)
1**	2.3	2.02	0.76	4.68
01A	0.9	4.50	0.67	16.70
2	1.5	3.71	0.80	10.40
3**	1.5	1.61	0.70	3.34
4	7.3	0.70	0.43	1.08
5	0.6	3.05	0.61	7.60
6	0.6	1.70	0.56	8.06
7	1.8	1.75	0.62	4.85
8	2.9	0.68	0.47	1.00

* All monitoring began on December 20th, 2021, with a few exceptions: Sampling started on January 3rd, 2022 for Monitor 03 and on January 31st, 2022 for Monitor 01A. Monitor 08 was the monitor located at Thomas Jefferson High School, which finished sampling on May 23rd, 2022.

The benzene concentrations measured at these locations displayed variability over time, see Attachment B, with discernible spikes that corresponded to either weather inversion events or significant emission events at Clairton Coke Works. Notably, in October 2022, Monitors 01A and

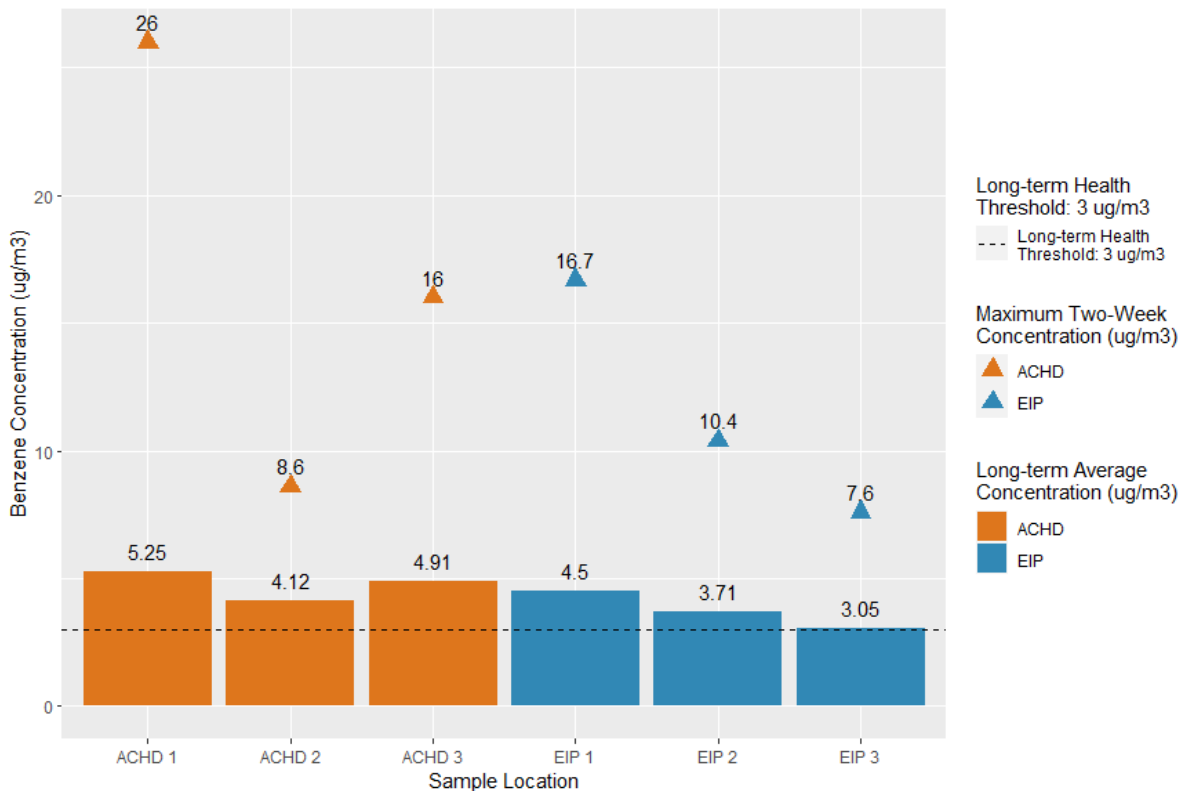
02 recorded their highest-ever concentrations during the project, $16.7 \mu\text{g}/\text{m}^3$ and $10.4 \mu\text{g}/\text{m}^3$, respectively. This occurred during a period of [pollution inversion in the Mon Valley](#), where cold air settled near the ground and a layer of warmer air formed on top, trapping the pollution within the valley. In these stagnant atmospheric conditions, emissions from Clairton Coke Works and other sources become trapped, resulting in the accumulation of pollutants within the river valley. These inversions are a common occurrence in the Mon Valley, usually in cold weather months.

Additionally, there are a number of examples of excessive emission events at the Clairton Coke Works facility, where all the flares at Clairton Coke Works light up and cause high pollution levels in the valley. Most recently, on August 12th, there was a massive flaring event, [captured by a camera](#) operated by CMU CREATE Lab and The Breathe Project.

Allegheny County Health Department Study

The Allegheny County Health Department (ACHD) conducted a similar 18-month study, from July 2021 to January 2023, using the same benzene monitoring technique as EIP. They monitored for benzene at 16 locations across the Mon Valley. Six of the monitoring locations were centered around Edgar Thomson Works in Braddock, eight around Clairton Coke Works, and the remaining two were positioned slightly farther from both sites. None of the six monitoring locations around the Edgar Thomson plant had a long-term average above $3 \mu\text{g}/\text{m}^3$, but three of the eight monitors around Clairton Coke Works did, with the highest long-term average reaching $5.25 \mu\text{g}/\text{m}^3$. All eight monitors around Clairton Coke Works were within two and a quarter mile. The highest two-week average concentrations measured during the ACHD study were $26 \mu\text{g}/\text{m}^3$ and $16 \mu\text{g}/\text{m}^3$, at separate locations during October 2022.

Figure I. ACHD and EIP monitors with 18-month average concentrations over the long-term health threshold.



ACHD monitored benzene from July 2021 to January 2023. EIP monitored benzene from December 2021 to June 2023.

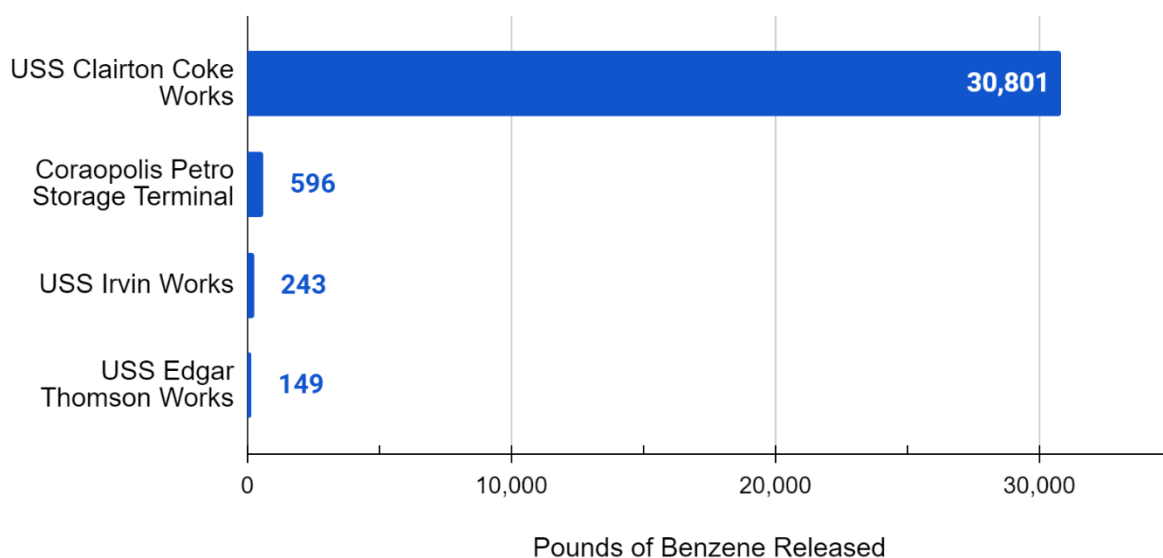
Additionally, the ACHD operates a continuous monitor in Liberty, PA that’s 1.3 miles away from Clairton Coke Works’ fenceline. This monitor measures 24-hour average concentrations of benzene every three days. Between 2014 and March 2023, over nine years of data, the average concentration measured at the Liberty monitor was 4.2 $\mu\text{g}/\text{m}^3$. There were also 13 days during this period where the daily concentration was over 29 $\mu\text{g}/\text{m}^3$. The highest concentration ever recorded was 95.12 $\mu\text{g}/\text{m}^3$, on October 11th, 2022. The U.S. Agency for Toxic Substances Disease Registry’s (ATSDR) Minimal Risk Level (MRL) for benzene is 29 $\mu\text{g}/\text{m}^3$, which estimates that exposure to benzene concentrations above this level for as little as 24 hours can increase the risk of noncancerous health effects like a weakened immune system.

Toxics Release Inventory

The monitoring results from the EIP and ACHD project point to Clairton Coke Works as the main source of benzene pollution in the valley, as does data reported to EPA’s 2021 Toxics Release Inventory (TRI). When reporting to TRI, regulated facilities use emission estimation methods to calculate how much of a certain pollutant they’re emitting, and that’s the value they submit as part of federal reporting requirements. The table below illustrates that for all the reported benzene emissions to EPA’s TRI in Allegheny County in 2021, U.S. Steel’s Clairton Coke Works accounts for 97 percent of benzene released. It’s also worth noting that these reported emissions to

TRI are [likely to be underestimates](#), especially given a recent analysis of fenceline monitoring data required by Clairton Coke Works. Clairton Coke Works' 30,801 pounds of reported benzene emissions in 2021 make the plant the 23rd largest emitter of benzene air emissions reported to the Toxics Release Inventory, meaning it emitted more benzene than most petroleum refineries, which are currently required to monitor for benzene at their fencelines.

Figure 2. Pounds of benzene released in Allegheny County in 2021, as reported to EPA's TRI



Request for Community Monitoring

Exposure to benzene at the concentrations described above poses serious health risks for Mon Valley communities and plant workers. Benzene causes a variety of serious health problems, including anemia, nervous system damage, weakened immune system, and leukemia. One method that would help protect plant workers and the surrounding communities would be for U.S. Steel to install fenceline monitoring around their plants for benzene. By requiring fenceline monitoring, U.S. Steel would have to investigate the cause of these high levels of benzene and take steps to fix the problem, which would reduce overall benzene emissions. EPA currently requires this type of monitoring at over a hundred petroleum refineries across the country.

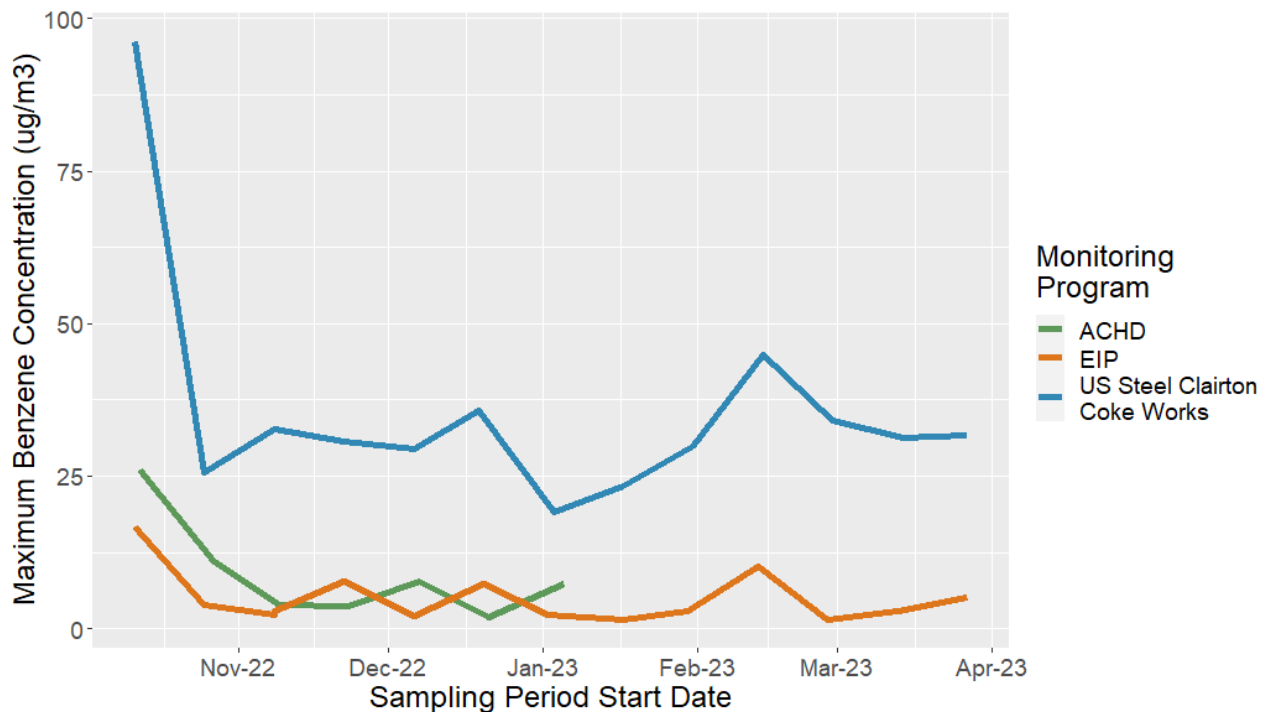
On August 16, 2023, [EPA proposed revisions](#) to the Clean Air Act standards for hazardous air pollutants. This rule would require facilities like Clairton Coke Works to install fenceline monitoring for benzene and require the facility to clean up those emissions through a corrective action plan if the concentrations measured at the fenceline get too high. As a part of creating this new requirement, EPA asked Clairton Coke Works to conduct six months of fenceline monitoring for benzene to better understand fugitive emissions from the plant. The methods used by USS for this rule were the same methods used by EIP and ACHD, but there were 12 monitors used and they were located along the fenceline, rather than spread out among the surrounding communities. The proposed rule sets an action level concentration of 3 $\mu\text{g}/\text{m}^3$ for benzene at the fenceline. Compliance

with this proposed action level would be determined by calculating an annual average of net benzene concentrations. The net benzene concentration is the difference between the highest and lowest concentrations (representing “background” benzene levels) detected by the facility’s fenceline network during a two-week monitoring period. After six months of monitoring, the average net benzene concentration measured at the fenceline was $33.3 \mu\text{g}/\text{m}^3$. This is ten times greater than both the proposed action level for benzene at coke oven facilities and California EPA’s long-term health threshold, both of which are $3 \mu\text{g}/\text{m}^3$. This is only a six-month average, whereas compliance with the action level is based on an annual average, but it would be impossible for the annual average concentration at Clairton to be less than the action level after a year of monitoring. Only four refineries, out of 118, in the U.S. experienced an annual average concentration higher than Clairton’s, and one of them has since shut down.

This fenceline monitoring data collected at Clairton Cok Works helps illustrate that high concentrations measured at the fenceline, usually the result of emission events, correlates with high concentrations found in the community. Coincidentally, EIP and Clairton Coke Works both collected samples from October 11th to October 25th, 2022, when the highest concentrations were recorded at most of the monitors involved in EIP’s project. The highest two-week average concentration measured at Clairton Coke Works during that two-week period was $96.2 \mu\text{g}/\text{m}^3$ and the highest concentration EIP measured was $16.7 \mu\text{g}/\text{m}^3$, at a residential location located just about a mile away from Clairton Coke Works.

The figure below shows how increased benzene concentrations measured at the fenceline correspond with, and are the likely cause of, higher concentrations in the surrounding communities.

Figure 3. Highest two-week averages reported by Clairton Coke Works, EIP monitors, and ACHD monitors, October 2022 to April 2023



Conclusion

In summary, a number of monitoring studies have confirmed the presence of benzene in the community surrounding Clairton Coke Works at unhealthy levels. However, the good news is that EPA has just proposed a new fenceline standard for coke oven benzene emissions. In EPA's proposed revisions facilities like Clairton Coke Works are required to install fenceline monitoring for benzene. If the measured concentrations ever exceed the proposed action level, which is $3 \mu\text{g}/\text{m}^3$, then the facility would have to investigate the cause of these high levels of benzene and take steps to fix the problem through a corrective action plan. As mentioned earlier, these corrective action plans would help reduce overall emissions, not just benzene emissions, by addressing root causes of excess emissions. Reduced emission means reduced pollution levels in the surrounding communities and better air quality. Based on six months of data, Clairton Coke Works is currently 10 times over EPA's proposed action level, so the proposed fenceline standard could have a huge impact on improving air quality for residents that live downwind from the plant.

Life of the data

To date, the data collected in from this study have been used in the following ways:

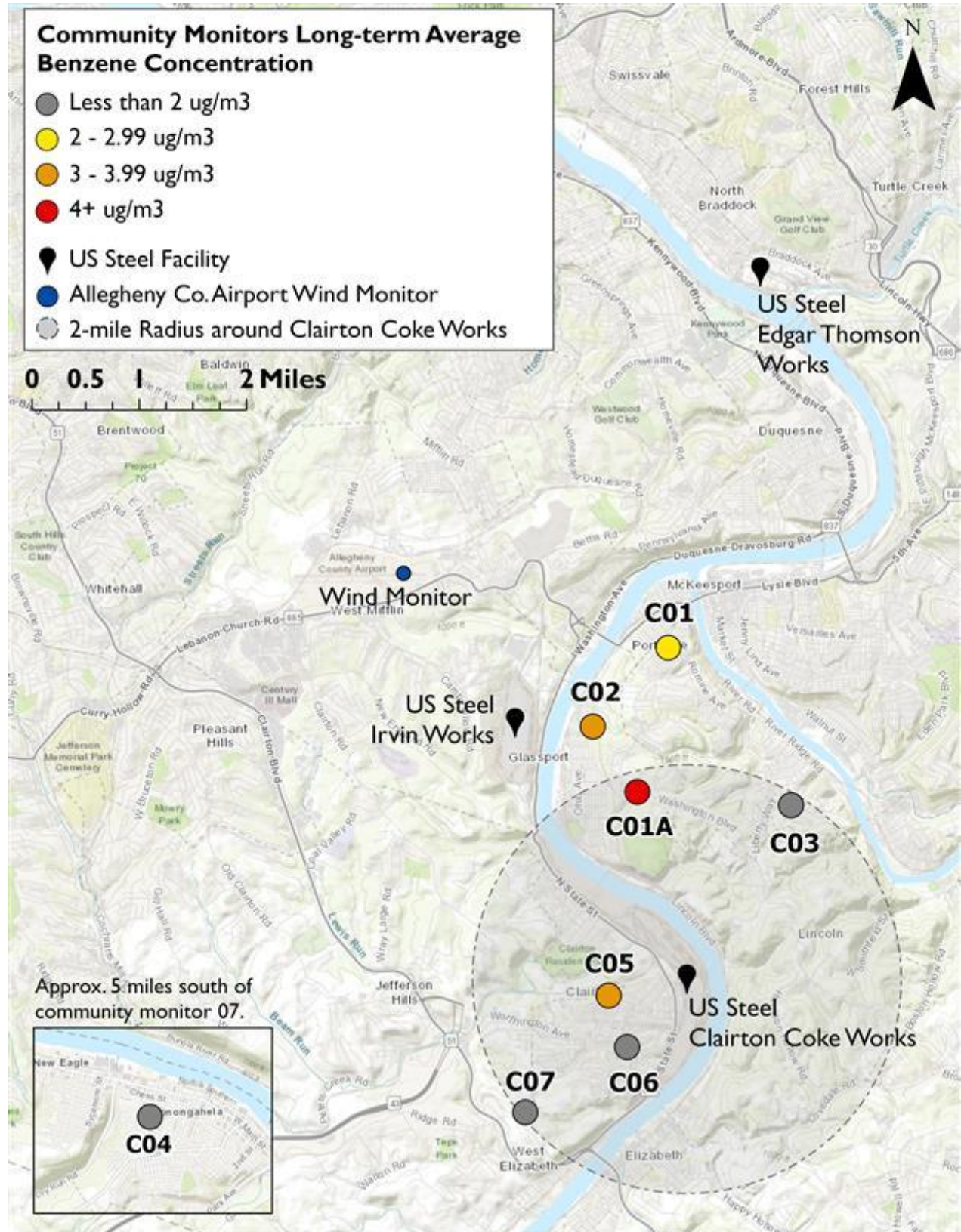
1. EIP has shared the data with our partners in the project, CMU CREATE Lab and The Breathe Project, as well as with the hosts of the monitoring stations.
2. Numerous community handouts have been generated and shared amongst community members at meetings and rallies, summarizing the benzene data as well as asking for EPA to require fenceline monitoring at Clairton Coke Works.
3. Three letters have been sent to EPA Region 3 Administrator Adam Ortiz asking for immediate action to abate benzene emissions and other toxic air pollution in the Mon Valley communities. EIP has not yet heard a response from EPA Region 3 regarding our requests for action.
4. The data was used in writing comments supporting EPA's decision to require fenceline monitoring at coke oven facilities.

Thanks

The Environmental Integrity Project would like to thank its partners in this project, CMU CREATE Lab and The Breathe Project, as well as the community members that hosted the benzene monitoring stations.

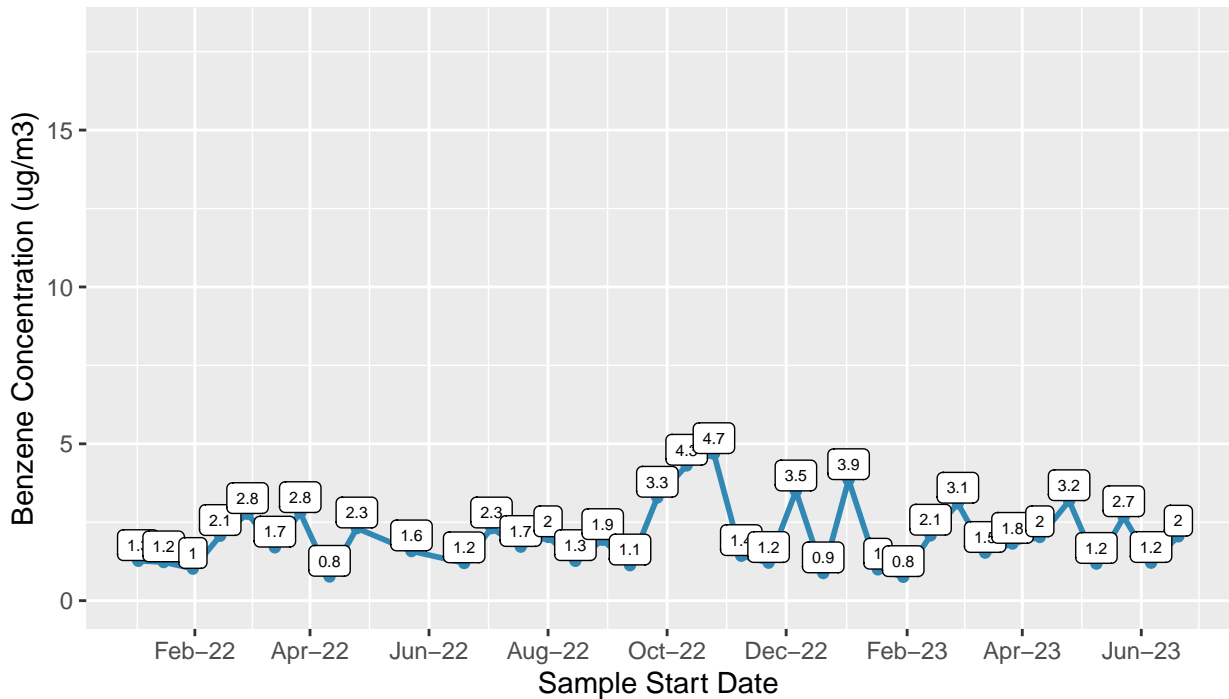
**Attachment A: Map with each monitoring location and
its long-term benzene concentration,
December 2021 to June 2023**

Environmental Integrity Project's Benzene Monitoring Project – December 2021 to June 2023

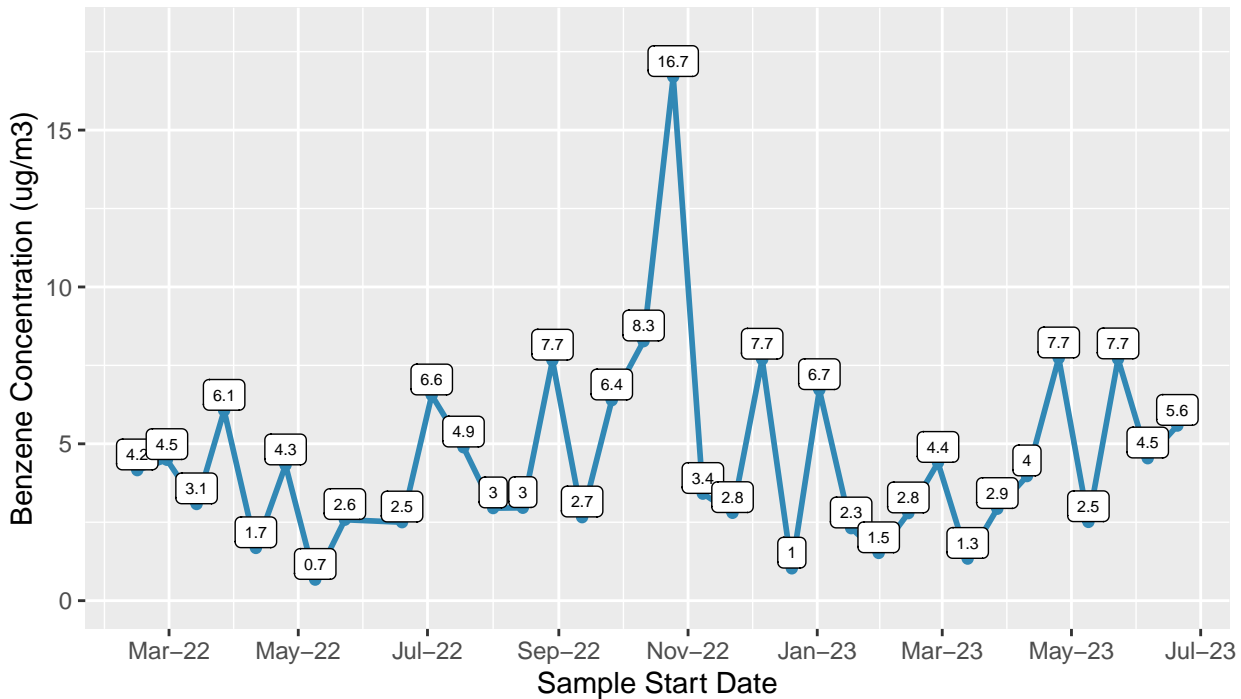


**Attachment B: Benzene concentrations at each monitoring location,
December 2021 to June 2023**

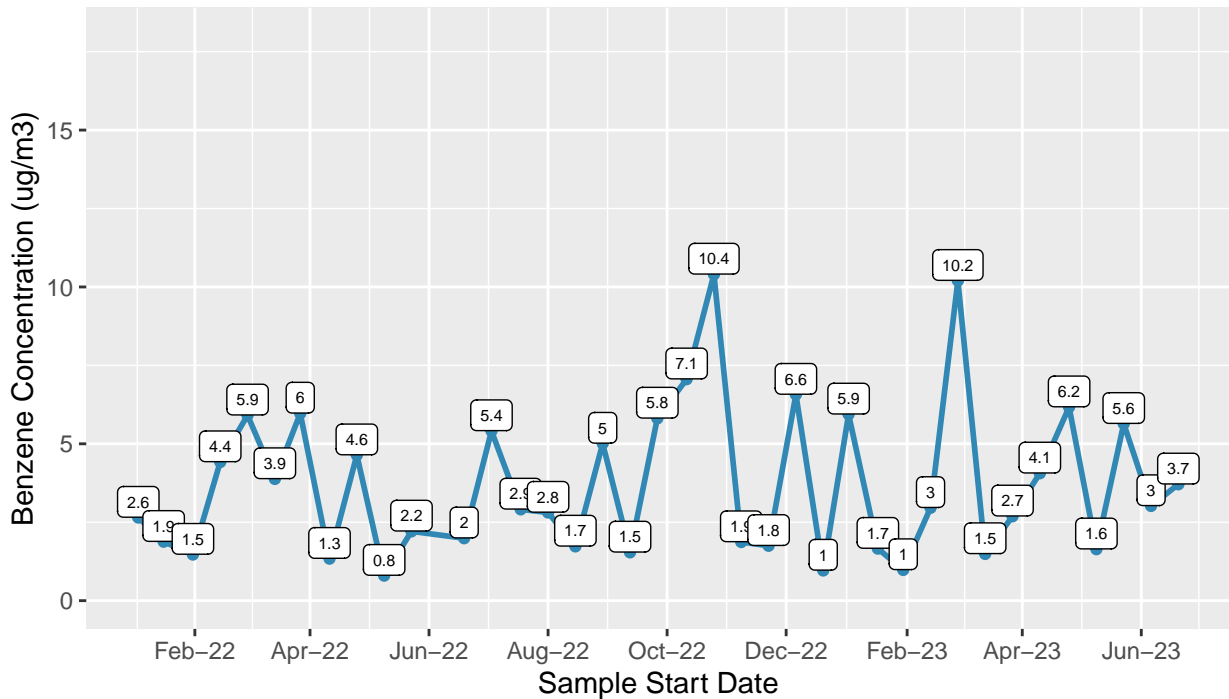
Benzene Concentrations at Monitor 01, 2021-12-20 to 2023-06-20



Benzene Concentrations at Monitor 01A, 2022-01-31 to 2023-06-20



Benzene Concentrations at Monitor 02, 2021-12-20 to 2023-06-20



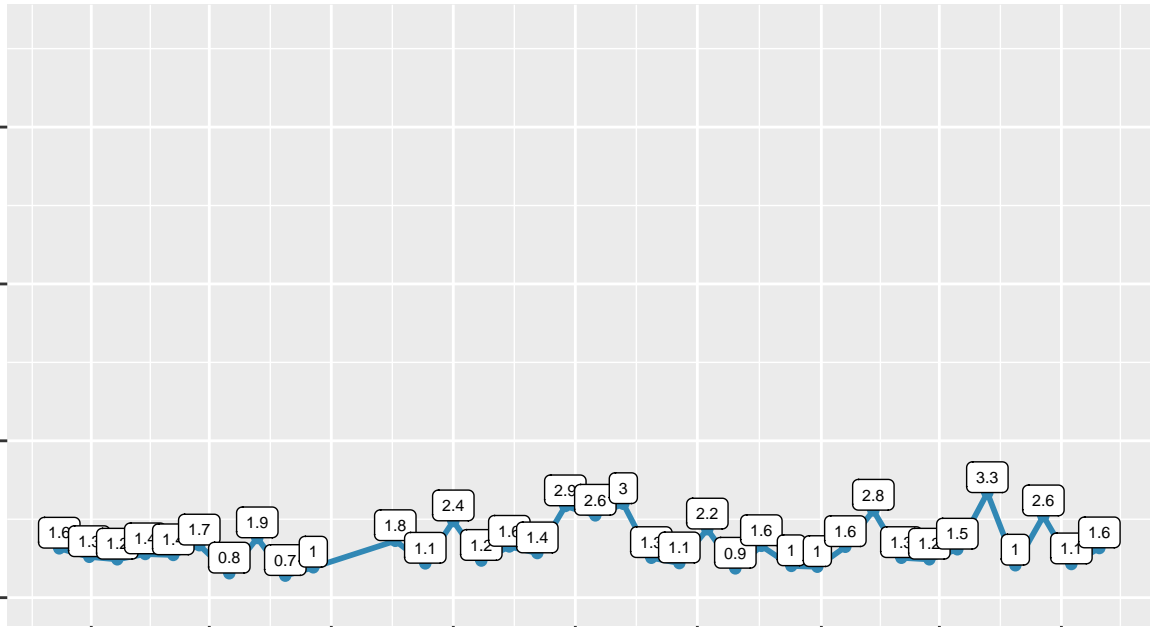
Benzene Concentrations at Monitor 03, 2022-01-03 to 2023-06-20

Benzene Concentration (ug/m3)

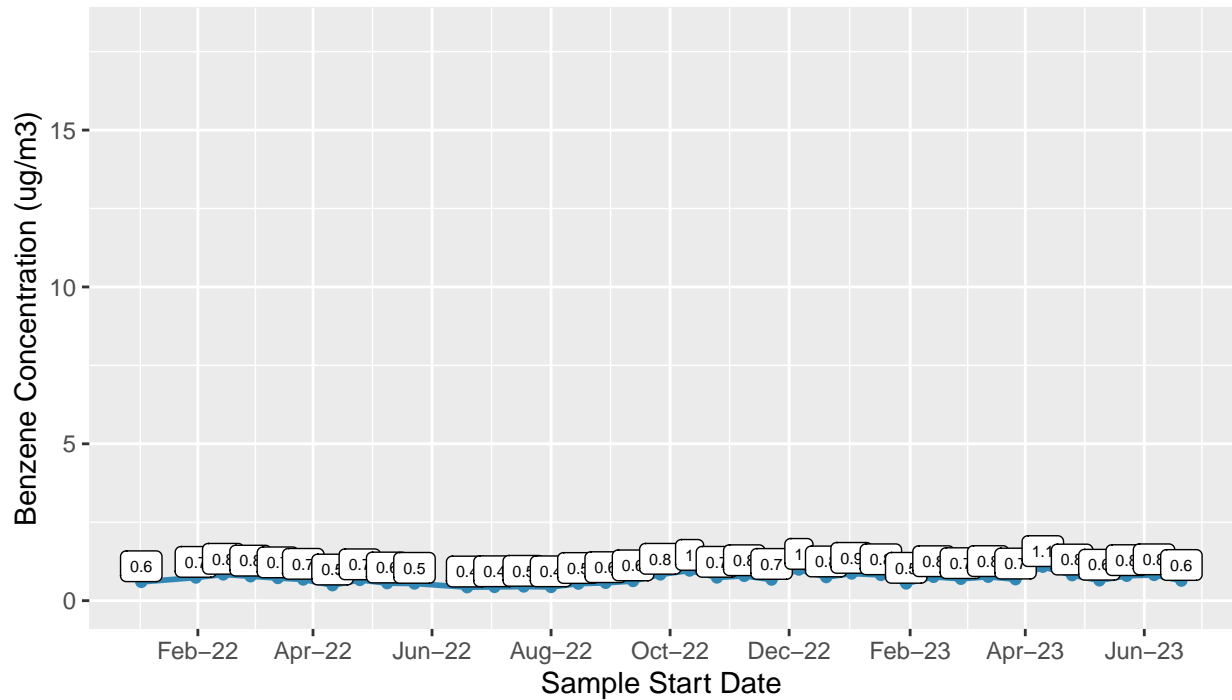
15
10
5
0

Feb-22 Apr-22 Jun-22 Aug-22 Oct-22 Dec-22 Feb-23 Apr-23 Jun-23

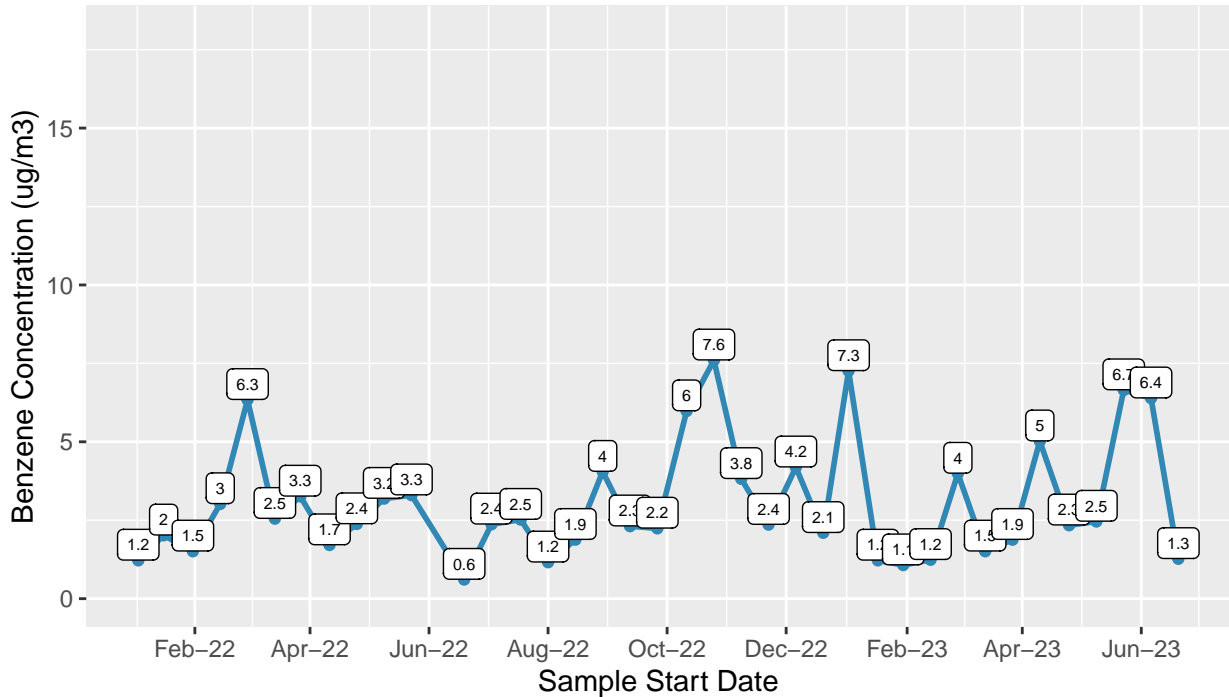
Sample Start Date



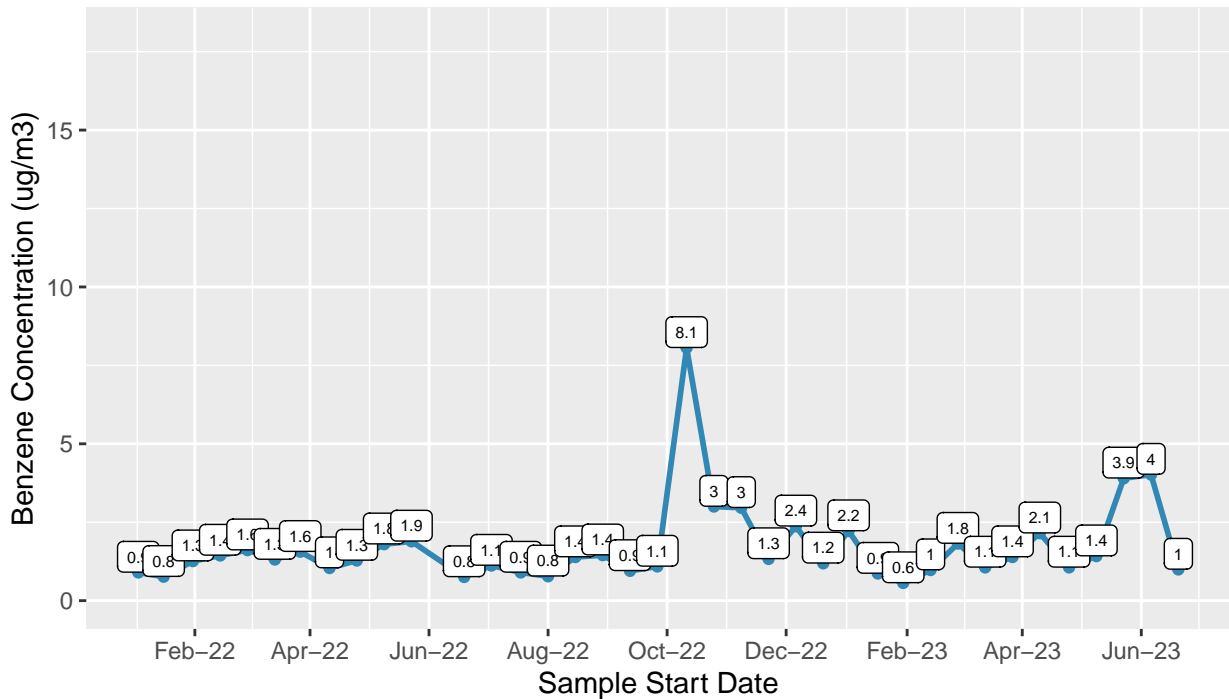
Benzene Concentrations at Monitor 04, 2021-12-20 to 2023-06-20



Benzene Concentrations at Monitor 05, 2021-12-20 to 2023-06-20



Benzene Concentrations at Monitor 06, 2021-12-20 to 2023-06-20



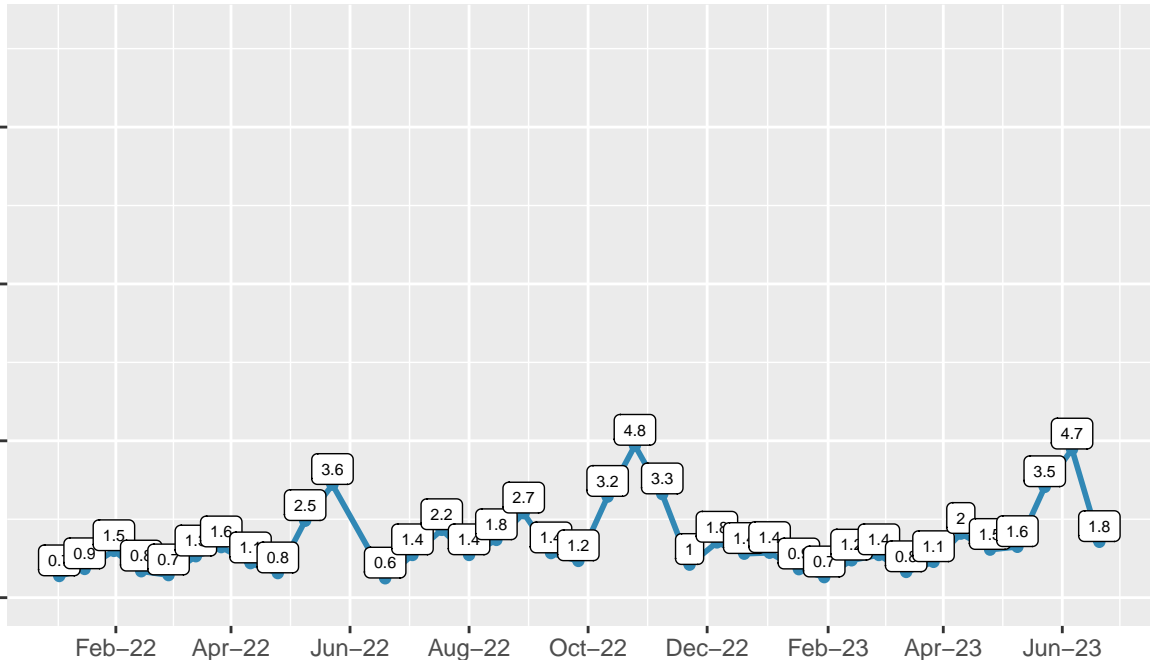
Benzene Concentrations at Monitor 07, 2021-12-20 to 2023-06-20

Benzene Concentration (ug/m3)

15
10
5
0

Feb-22 Apr-22 Jun-22 Aug-22 Oct-22 Dec-22 Feb-23 Apr-23 Jun-23

Sample Start Date



Benzene Concentrations at Monitor 08, 2021-12-20 to 2022-05-23

