## Action: Mobile monitoring around railyards to evaluate their potential impact on air quality in the community

### Background & Objective

Railyards are a complex mix of many source types including trains, stationary equipment, terminal operations, on-road vehicles, and heavy-duty diesel trucks. The San Bernardino BNSF Railyard is located next to residential areas within the San Bernardino, Muscoy community (SBM). Operation of locomotives and other heavy diesel equipment at the BNSF Railway Company is a known source of particulate matter (PM), black carbon (BC), nitrogen dioxide ($NO_2$), and volatile organic compounds (VOCs) emissions. Air pollution is mainly generated by equipment and vehicles that are used for railyard operations. These vehicles and equipment move containers and railcars into and around the railyard to load, unload, and transport goods in and out of the railyard. Emissions can also be generated during maintenance activities (e.g., load testing). Examples of equipment used for railyard operations include locomotives, drayage trucks cargo handling equipment, transportation refrigeration units, and other miscellaneous equipment such as fuel trucks.

During the fourth Multiple Air Toxics Exposure Study (MATES IV) conducted in 2012-2013, levels of BC and ultrafine particulate matter (UFP) measured near the BNSF railyard in San Bernardino were elevated and above typical ambient levels. The SBM community steering committee (CSC) identified emissions associated with railyards as one of their major air quality priorities in this area. Figure 1 shows the BNSF railyard and railroads within the SBM community.

The CSC suggested specific actions to identify opportunities for emission reductions from railyards. This includes conducting fenceline and/or mobile air measurements around railyards to identify activities that may cause increased levels of air pollution. Mobile air measurements (and fixed air monitoring, when appropriate) can be extended into the community to assess how railyard related emissions may contribute to the overall air pollution burden in SBM. If needed, air monitoring can also be conducted to determine source locations and track the progress of emission reduction strategies.

### Method

Air monitoring was conducted using a mobile platform capable of measuring a wide range of particulate and gaseous pollutants, including PM, BC, UFP, and $NO_2$. Mobile measurments focused on areas around BNSF railyard and extended into nearby communities.

### Results

- As of August 2020, a total of eight days of mobile monitoring was carried out around the railyards and in surrounding neighborhoods within the SBM community

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| • Mobile monitoring results indicate elevated $NO_2$, UFP, and BC levels near/downwind of the BNSF railyard in SBM, but these increased concentrations were not as significant as those observed on the I-215 freeway (see Attachment A for details)<br>• It was also observed that $NO_2$, UFP, and BC concentrations were generally lower in residential communities near Cajun Wash as compared to those near railyards and on the I-215 freeway (Attachment A) |
| **Next steps** |
| • Continue conducting mobile monitoring<br>• Use air monitoring data and emissions inventory information to help identify opportunities for emission reductions |

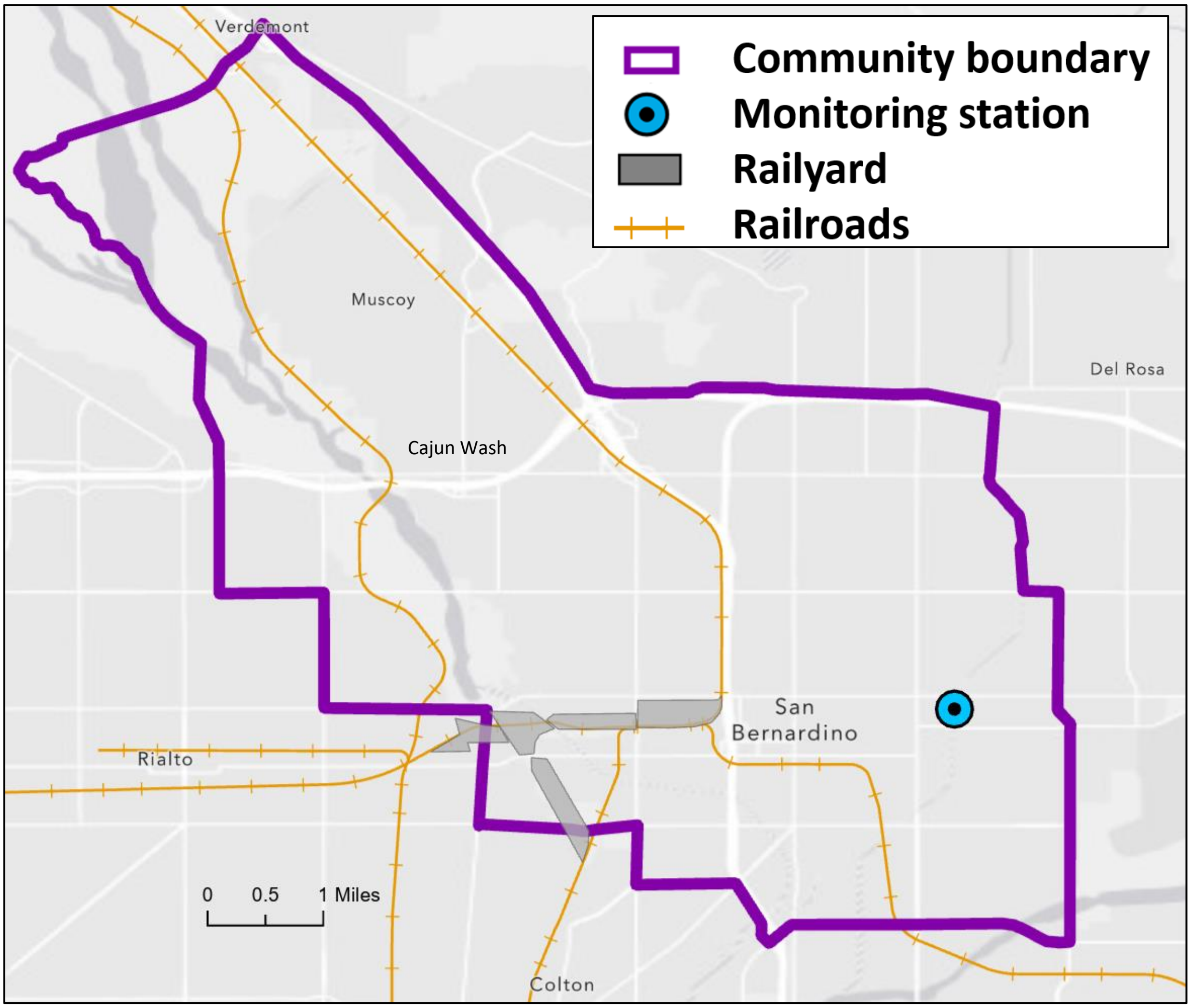


**Figure 1.** Map showing the location of the BNSF railyard and railroads in the SBM community, as well as the location of the monitoring station for baseline measurement operated by the South Coast AQMD

# Attachment A

As of August 2020, a total of 8 mobile monitoring surveys have been conducted in the San Bernardino Muscoy (SBM) community to measure diesel emissions. Diesel engines emit a complex mixture of air pollutants, including both gaseous and solid material. The solid material in diesel exhaust is known as diesel particulate matter (DPM), which is a component of PM2.5. There is no technique to directly measure DPM (a major contributor to health risk); therefore indirect measurements based on surrogates for components of diesel exhaust are used, specifically black carbon (BC). DPM is typically composed of carbon particles ("soot", also called BC) and numerous organic compounds. Diesel exhaust also contains gaseous pollutants, including volatile organic compounds (VOCs) and NOx. Mobile measurements were conducted using a mobile platform capable of monitoring a wide range of particulate and gaseous pollutants, including particulate matter (PM), black carbon (BC), ultrafine particles (UFP), and nitrogen dioxide ($NO_2$), as part of the area-wide surveys. Nonetheless, the routes traversed by the mobile platform were defined in a way to perform monitoring around the railyards within the SBM community.

Typically, measurements from a mobile platform at a given location are relatively short, ranging from seconds to a few minutes when the platform is moving. Therefore, given the high temporal variability of most air pollutants, mobile survey measurements do not necessarily capture the typical air quality conditions of a specific location. One way to address this limitation is to increase the number of measurement runs (passes, or transects) to obtain a more representative and consistent map of the spatial and temporal variability of the measured air pollutants. Figure A-1 shows the routes traversed by the mobile monitoring platform around the BNSF railyard within the SBM community. In this figure, number of passes, that is a measure of representativeness of the measured concentrations, is shown as a white-to-green color gradient, with darker green representing areas where more passes were taken.

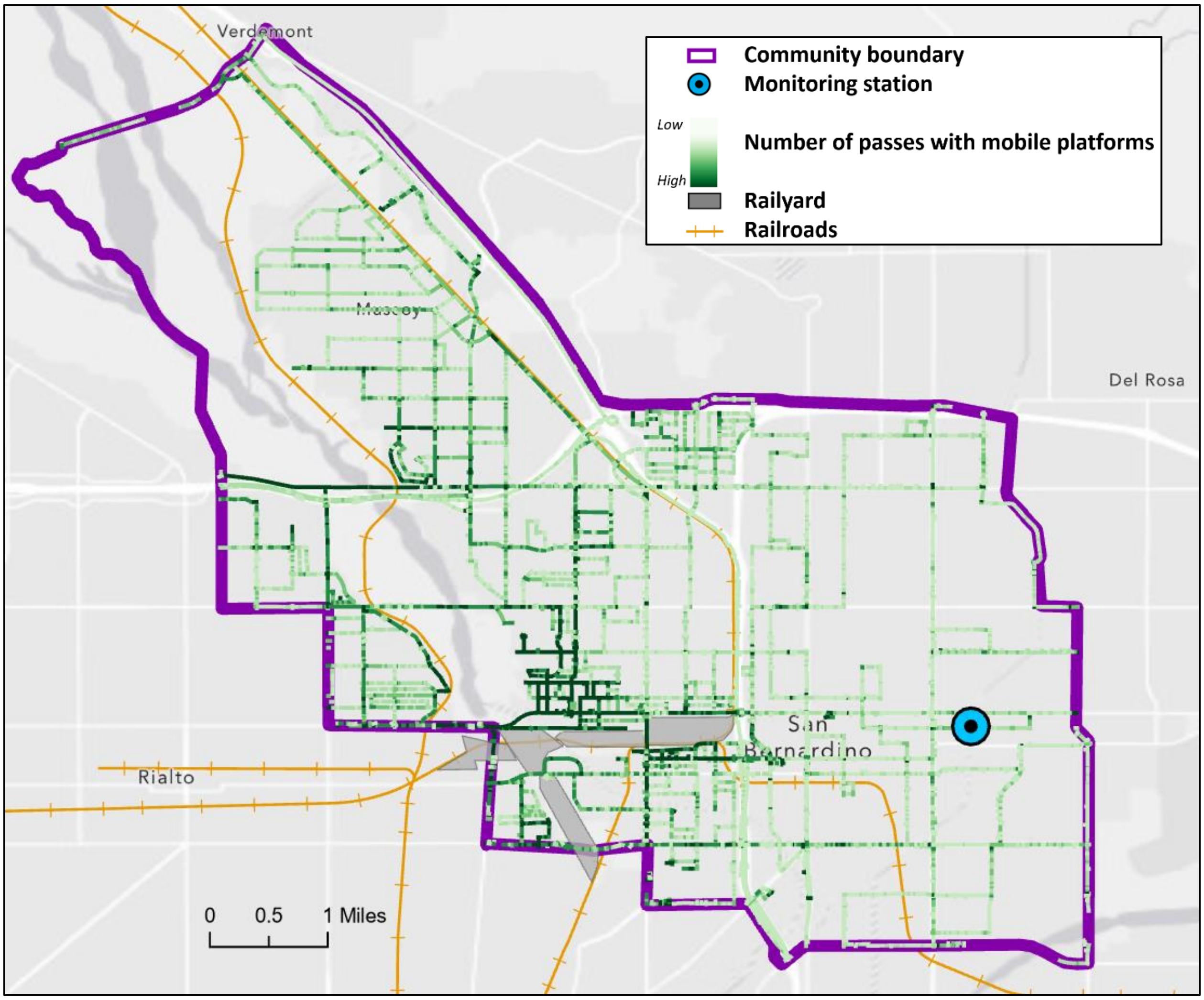


**Figure A-1.** the routes traversed by the mobile platform around the railyards as well as within nearby neighborhoods. A total of eight days of mobile monitoring was conducted around the railyards and nearby neighborhoods within the SBM community

Figure A-2 shows the duration and time window for the area-wide mobile measurements performed within the SBM community in and around freeways, major roadways, truck idling hotspots, and truck traffic-related air quality concerns. As shown in this figure, mobile monitoring was performed at different times of day during the eight weekdays.

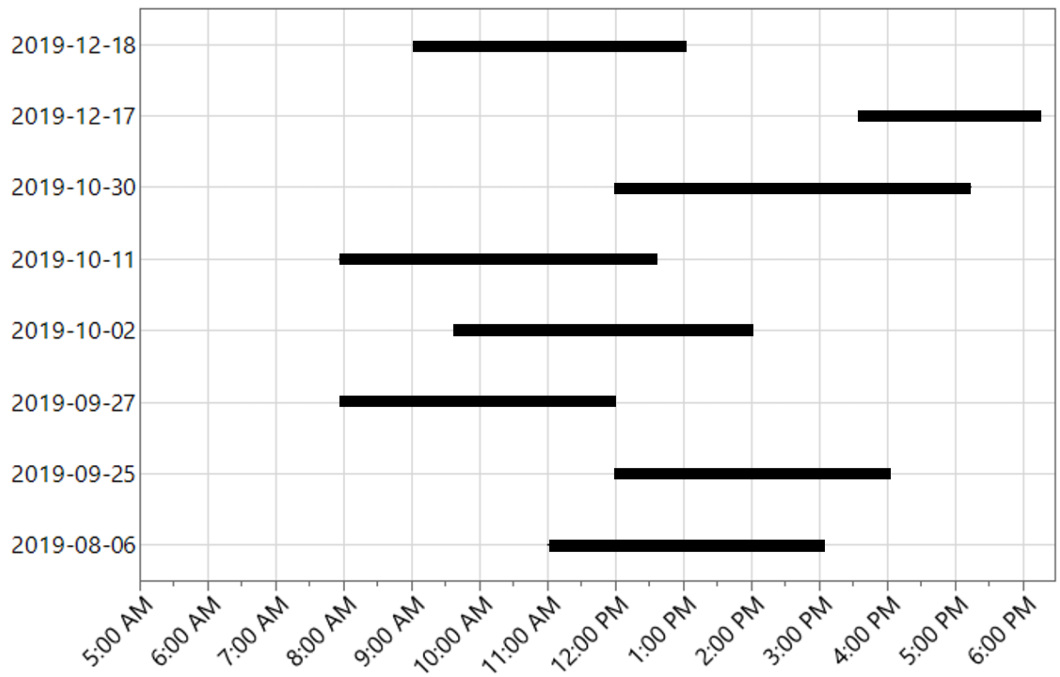


**Figure A-2.** The duration and time window for the area-wide mobile measurements performed related to railyard air quality concerns within the SBM community. The time windows only include hours of active mobile measurements within the community, excluding the commute time between the South Coast AQMD Headquarters and the community

Upon extensive screening and pre-processing of the data, UFP and $NO_2$ measurements were found to be the most robust and reliable set of diesel exhaust markers measured, with 8 and 7 (out of 8) valid days of measurements respectively and minimum instrument down time, followed by BC measurements, with 6 days of valid measurements. Figures A-3, A-4, and A-5 illustrate "aggregated" maps of the spatial patterns (or concentration gradients) of $NO_2$, UFP, and BC concentrations in and around the BNSF railyard within the SBM community, as measured by the mobile monitoring platform during those eight days. To ensure that the concentration gradient map is representative of the variations in the pollutant concentrations, individual measurements taken within each 30-meter street segment in different passes and on different days were "aggregated", by calculating their arithmetic average, and shown by different on the map. Therefore, each segment on the map represents multiple measurements taken at different passes. In addition, it should be noted that mobile measurements taken on different days and hours cannot be directly compared, mainly because of the day-by-day and diurnal (i.e., hour-of-the-day) variability in pollutant concentrations as a result of changes in meteorology and source emission strengths. Therefore, in order to account for the day-by-day as well as diurnal variability in the pollutant concentrations, the mobile monitoring data need to be normalized with stationary data from a fixed site monitoring station, according to a commonly used method in the literature. To achieve this, hourly data from the San Bernardino monitoring station was collected for the time period corresponding to the period when mobile monitoring was conducted (Figure A-2). For example, on August 6$^{th}$, 2019, mobile monitoring was performed from 11 am PST to 3 pm PST, therefore, a total of 4 hourly averages were calculated for each pollutant from the San Bernardino monitoring station. Subsequently, the mobile monitoring data with 1-second or 3-second time resolution was divided by the hourly averaged stationary data that corresponded to the hour in which that measurement was taken.

Monitoring results indicated somewhat elevated concentrations of $NO_2$ near the BNSF railyard within the SBM community, as shown in Figure A-3. These elevations were still lower than the ones observed on the freeway I-215. As shown in the map, most elevated $NO_2$ concentrations were observed on freeways. It can also be observed from the map that $NO_2$ concentrations were relatively lower in residential communities around Cajun Wash as compared to those near railyards and on major streets and freeways. It should be noted that $NO_2$ (and the other diesel emission tracers measured) are emitted from multiple sources. This includes trains with diesel engines, diesel trucks, off-road diesel equipment, and other diesel engines. Therefore, inferences cannot be made (at least with a high level of certainty) on how much of the levels measured using the mobile platform is attributed to each source. Nonetheless, near-source measurements are performed in close proximity to or within the source (e.g., measurements inside freeways, or right downwind of railyards) and are likely to be most impacted by the source in their vicinity, providing a qualitative measure to compare potential contributions of each emission source to the ambient levels. The more accurate quantitative evaluation of source contributions would require proper source apportionment studies.

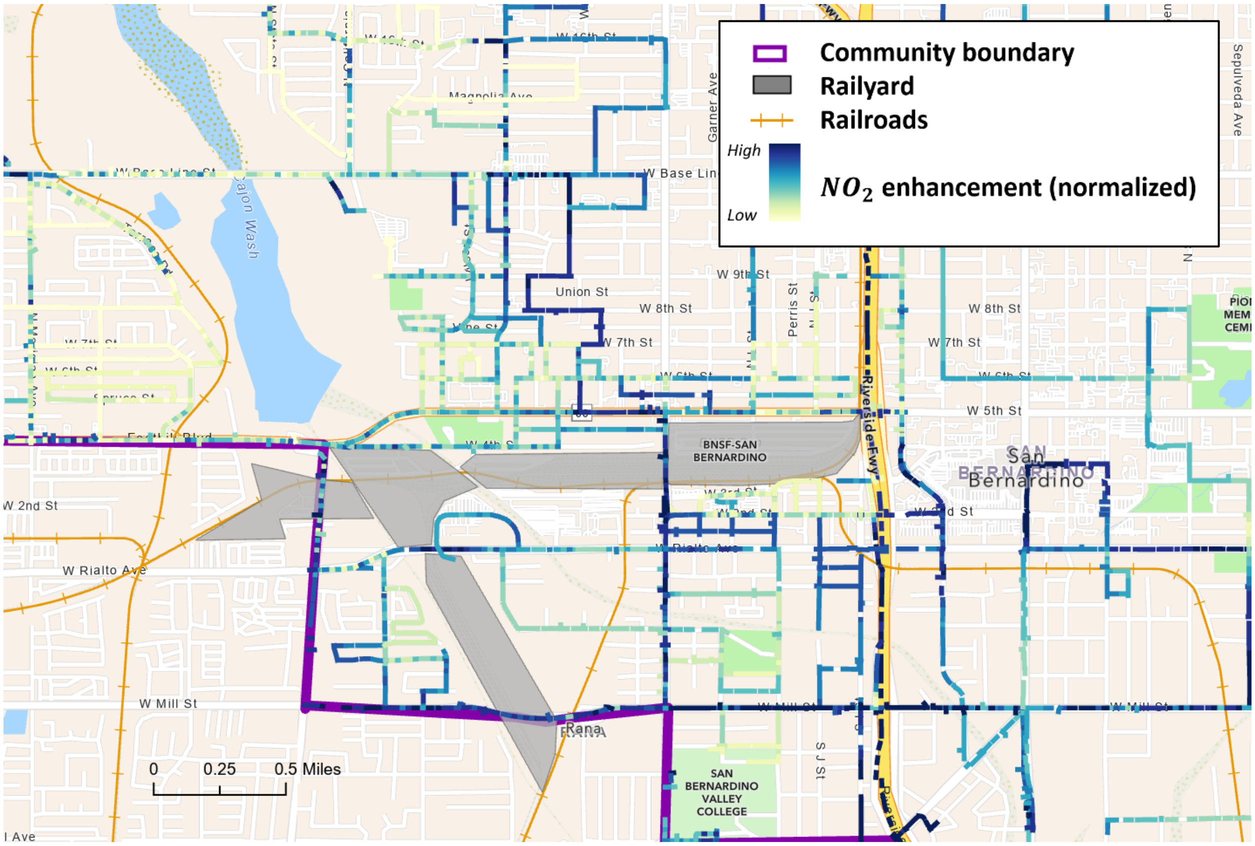


**Figure A-3.** Aggregated map of the spatial pattern of $NO_2$ concentrations within the SBM community and around the railyard, as measured by the mobile monitoring platform

UFP concentrations were elevated near BNSF within the SBM community (Figure A-4). However, these elevated levels were lower than concentrations observed on the I-215 or on some of the major roadways. Similarly, to $NO_2$, UFP concentrations were generally lower in residential communities around Cajun Wash as compared to those measured near railyards and on major streets and freeways within SBM.

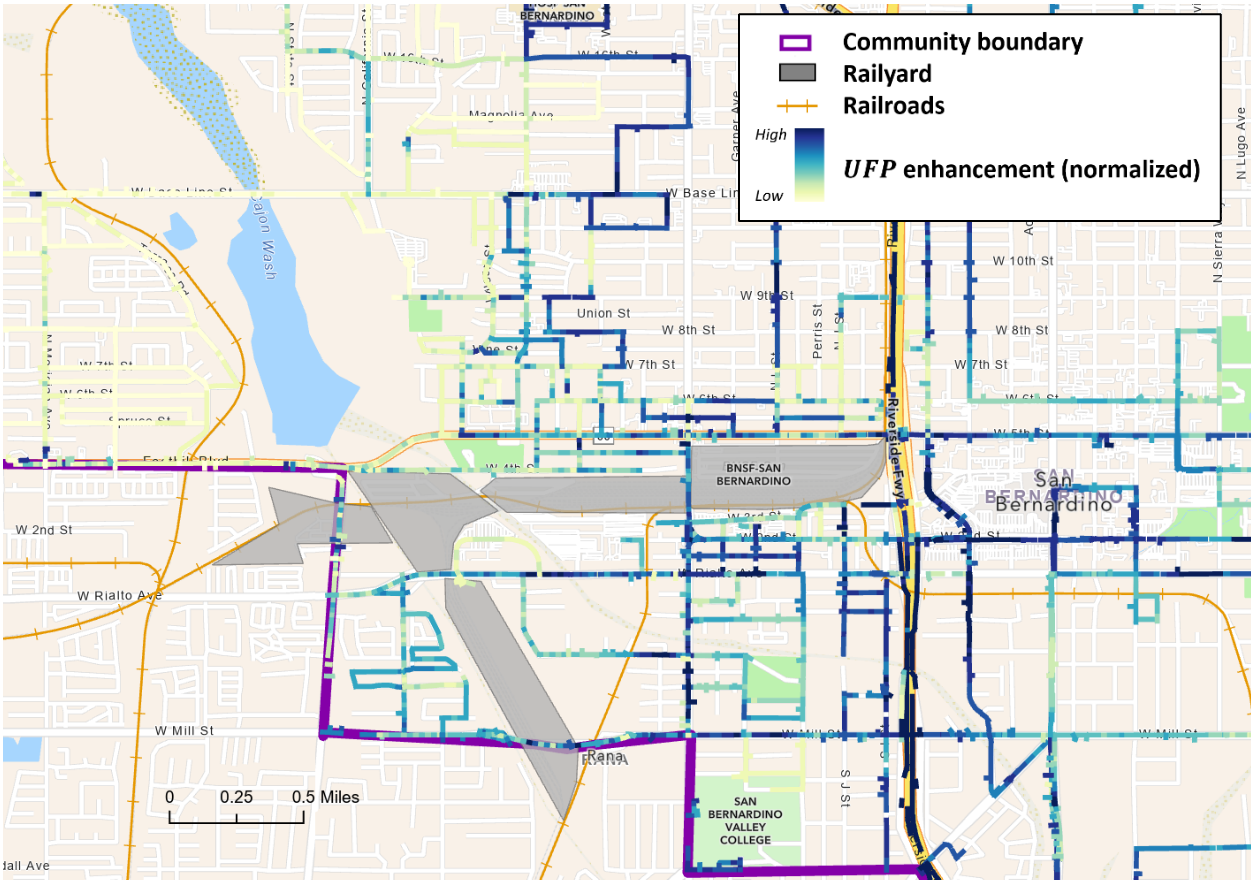


**Figure A-4.** Aggregated map of the spatial pattern of UFP concentrations within the SBM community and around the railyard, as measured by the mobile monitoring platform

As shown in Figure A-5, BC concentrations also showed the highest elevations on the freeway. We also observed somewhat elevated BC levels near BNSF, but these elevations were not as significant as those observed on major streets and freeways.

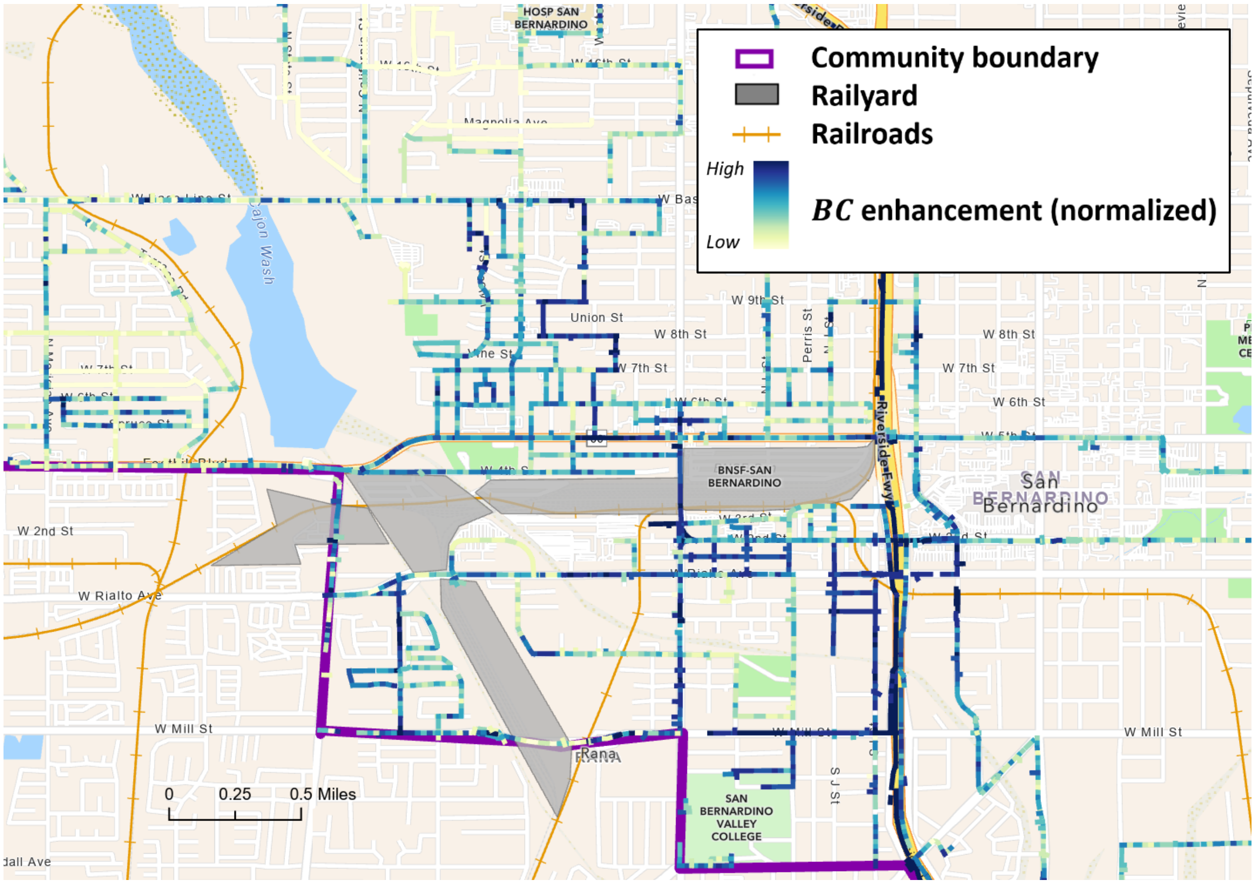


**Figure A-5.** Aggregated map of the spatial pattern of BC concentrations within the SBM community and around the railyard, as measured by the mobile monitoring platform