TRUCK COUNTS AND AIR QUALITY MONITORING ON FIRST STREET, ELIZABETH ON MAY 24, 2013 **Robert J. Laumbach M.D., M.P.H, C.I.H**

On May 24, 2013 members Brand New Day and EPort Presbyterian Center joined a team from the Rutgers University to begin to assess the impact on the EPort community of heavy diesel truck traffic on First Street, the designated truck route through EPort. Many trucks use the First Street route as a thoroughfare for longer distance travel as well as to and from points locally within Elizabeth and the immediate environs. The purpose of the initial study on 5/24/13 was twofold: to count trucks and to measure particulate matter air pollutants during a typical weekday morning. The investigators counted trucks passing two intersections: 1) First Street and South Park Street and 2) First Street and Trumble Street. They made simultaneous, real-time measurements of air quality at the truck count locations as well as a background site on S. Park Street that was approximately 200 meters upwind (to the West) of the First Street and S. Park Street monitoring location.

Adverse Health Effects of Diesel Exhaust

Based on multiple lines of evidence, diesel exhaust air pollution is believed to have a number of harmful effects on human health. Diesel exhaust is a major component of particulate matter air pollution, especially "fine particles" of less than 2.5 microns in diameter (PM2.5). These invisible microscopic particles, a small fraction of the width of a human hair, have been linked to worsening of asthma, other lung diseases, heart disease, and increased risk of death from heart attacks and stroke. Increased exposure to PM2.5 has also been linked to premature birth and adverse pregnancy outcomes. In addition to particulate matter, diesel exhaust contains a number of toxic gases and vapors including carbon monoxide, nitrogen oxides, formaldehyde, and acrolein, which are among about 40 compounds with recognized toxicity. Many of these compounds are irritants which have been associated with worsening of asthma. Studies have shown higher risk of asthma and worsening of asthma with increased exposure to traffic air pollution. Diesel exhaust also contains several chemicals that are known to cause cancer, and diesel exhaust itself has recently been determined to cause cancer in humans be the International Agency on Cancer Research (IARC).

The effects of diesel exhaust on asthma are particularly troubling in Elizabeth, where there is concern about high rates of asthma, especially among children. Asthma is a serious chronic medical condition characterized by intermittent closing of the airways, which can lead to respiratory failure, and, in extreme cases, to death. In addition to medical care and medication use, asthma causes limitations in activity that impair a child's ability to lead a normal, healthy lifestyle. As the leading cause of school absenteeism due to chronic disease, asthma can impede education and contribute to poor school performance. Moreover, caring for a child with asthma often causes parents to take time away from work, creating an additional social and economic burden.

In addition to its contributions to ambient air pollution, diesel exhaust has a greater effect on people who live, work, walk or recreate near heavily trafficked roadways. In contrast to emissions from industrial smoke stacks, diesel exhaust is regularly emitted in the immediate vicinity of individuals in the course of their daily lives. There is a strong gradient of traffic-related air pollutants from vehicle emissions near busy roadways, with high concentrations close to the roadway. Dilution reduces concentrations further from the roadway, leading to disproportionate impact on community members in close proximity to the roadway. In addition to exposure outdoors near the roadway, local residents, students, and workers are exposed when contaminated outdoor air infiltrates homes, workplaces, and other buildings near the roadway. Additional impacts of heavy truck traffic on First Street include noise and increased risk of

accidents as trucks travel back and forth on the narrow street passing several intersections with stop signs or traffic lights.

Methods

At the counting sites, trucks travelling in both directions on First Street were counted. At the Trumble Street location, trucks passing the intersection on Trumble Street were also counted. Container trucks, bobtails (truck tractors without trailers), other trucks (straight trucks, garbage trucks, other miscellaneous trucks) and buses were tallied for two hours at each location. The counts took place in two 1-hour shifts from 7:50 to 9:50 AM at First and S. Park (Team A), and in two 1-hour shifts from 8:15 to 10:15 AM at First and Trumble (Team B). The teams at each site had a sheet on which to mark the number of trucks passing by in each 1-minute segment. They also had a timer and a reference sheet with photographs and descriptions of the different types of trucks, including "container trucks" (tractor trailors), "bobtails" (tractor trucks without a trailer or load), and "other trucks" (primarily 'straight trucks,' which are single units). After meeting to review the uniform counting procedures, the teams proceeded to their sites where they performed independent truck counts. The count at First and S. Park was conducted by Phillip Barton, Edwin Brown, Vera Atkinson, and Glenn Arnold. The count at First and Trumble was conducted by Clarimel Cepeda, Joshua Wienick, and Robert Laumbach.

At each counting location, we set up three instruments to measure different types of particulate matter air pollution: PM2.5 (SidePak, TSI), ultrafine particles (Condensation Particle Counter 3007, TSI), and black carbon (AE51 microaethalometer, Aethlabs). The instruments were placed on a chair on the sidewalk at each location, The same set of instruments was also set up in a car parked on S. Park, ½ block west of First Street to take "background" measurements, with sampling ports protruding through an opening in the car window. Each of these instruments was programmed to make measurements at one-second time intervals during the truck count periods. One second data was then averaged for one-minute interval data and overall averages during the trucking counting periods.

As noted above, PM2.5 consists of fine particles smaller than 2.5 um in diameter. PM2.5 is regulated by the US EPA. The current standard is 15 ug/m3 for an annual average, and 35 ug/m3 for a 24 hour period. The EPA is currently in the process of lowering the standard to 12 ug/m3. Like PM2.5, ultrafine particles and black carbon have been associated with health effects, but they are currently not regulated by the state of federal government. Ultrafine particles (UFP) are less than 0.1 um in diameter. A large proportion of the particles emitted by diesel engines are UFP. There is some concern that these smaller particles may be more toxic than the somewhat larger PM2.5 particles. UFP impact air quality close to roadways, because they collide and stick together, growing into larger particles (primarily PM2.5) with time and distance further away from the road. Black carbon particles are essentially soot particles. Many black carbon particles are also measured as PM2.5 and/or UFP, but black carbon is more specific to diesel exhaust compared to PM2.5 or UFP. Black carbon can be used as a "marker" for diesel exhaust, and higher levels of black carbon measured near roadways with diesel trucks can be attributed to the diesel trucks. Although neither UFP or black carbon have health-based regulatory standards, elevated levels of these pollutants have been associated with cardiovascular and respiratory health effects.

TRUCK COUNTS AND AIR QUALITY MONITORING ON FIRST STREET, ELIZABETH ON MAY 24, 2013 **Robert J. Laumbach M.D., M.P.H, C.I.H**

Results

Team A at 1st and S. Park counted a total of 57 trucks (25 container trucks, 12 bobtails, 20 "other" trucks) in the first hour (7:50-8:50 AM) and 61 trucks (27 container trucks, 7 bobtails, 27 other trucks) in the second hour (8:50-9:50 AM).

Team B at 1st and S. Park counted a total of 271 trucks over a 2-hr counting period from 8:12 AM to 10:12 AM (158 per hour). The total included 100 container trucks, 66 bobtails, 105 straight trucks.

Average ultrafine particle number concentration was almost twice as high at the 1st/S. Park site compared to the background site (26,599/cc vs. 14, 669/cc), and in turn almost twice as high at the 1st/Trumble site compared to the 1st/S. Park site (50,796/cc vs. 26,599/cc), see Figure 1. Average black carbon concentration was more than twice as high at the 1st/Park site compared to the background site (2.92 vs. 1.43) and more than twice as high at 1st/Trumble compared to 1st and Park (6.72 vs. 2.92). The PM2.5 concentration was only marginally increased at the 1st/S. Park site compared to the background site (6.06 vs. 5.71). The PM2.5 monitoring instrument at 1st/Trumble malfunctioned. The relatively small difference in PM2.5 between background and 1st Street, compared to the large differences for ultrafine particle numbers and black carbon, is due to the fact that the large number of very small ultrafine particles emitted from trucks does not contribute significantly to the mass of particles in the air (PM2.5 is the mass of particles less less 2.5 um in diameter, which includes particles with much more mass than the ultrafine particles of less than 0.1 um in diameter.)

It should be noted that the "background" site on S. Park Street is not a "clean air" comparator, as this site was located in an urban area about ¼ mile downwind of the NJ Turnpike. However, this site represented background conditions in the neighborhood away from the roadway at this particular time.

Graphs of the real-time (1-minute average) data during the truck counting sessions shows numerous peaks and spikes in the ultrafine particle concentration and black carbon concentrations that correspond to emissions from passing trucks.

Conclusions

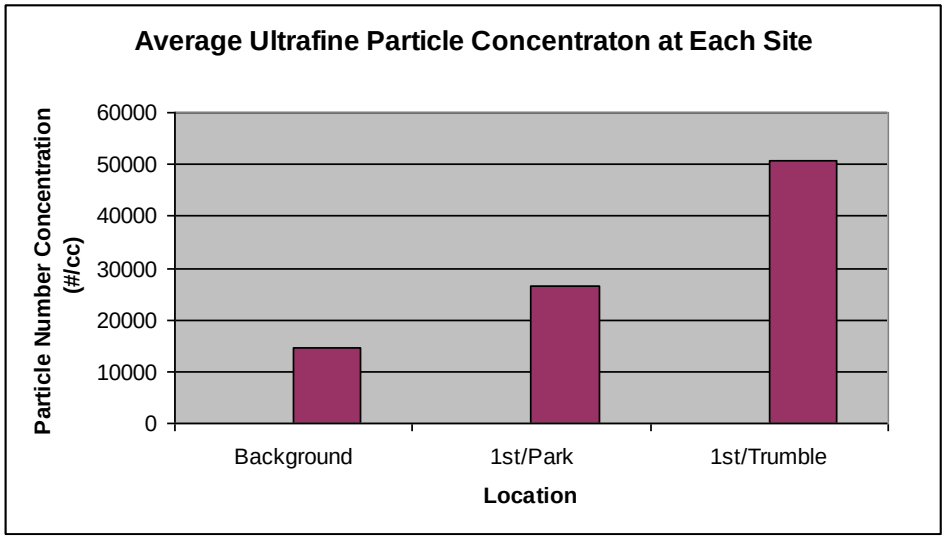
Citizen truck counts documented approximately 1 truck per minute, on average, passing the 1st/S. Park site and more than 2 trucks per minute passing the 1st/Trumble site, during 2 hours of observation on what was likely a fairly typical Friday morning between approximately 8 AM and 10 AM. Average measurements of black carbon (an indicator of diesel exhaust pollution) and ultrafine particle counts (also a sensitive indicator of traffic pollution) were consistent with the truck counts, showing levels approximately twice as high on average comparing the Trumble site to the S. Park site. Both of these sites had higher levels of black carbon and ultrafine particles compared to a "background site" that reflected the urban air quality away from the heavily diesel truck traffic on 1st Street (Figure 1). Real-time (1-minute average) measurements of black carbon and ultrafine particle concentrations on 1st Street at both sites (S. Park and Trumble) show the impact of trucks causing high peak levels of these pollutant measurements on 1st Street. Both black carbon and ultrafine particle concentrations have been associated with adverse health effects including exacerbation of asthma and cardiovascular health effects. It should be noted that in addition to passing directly in front of local residences and business, 1st Street and

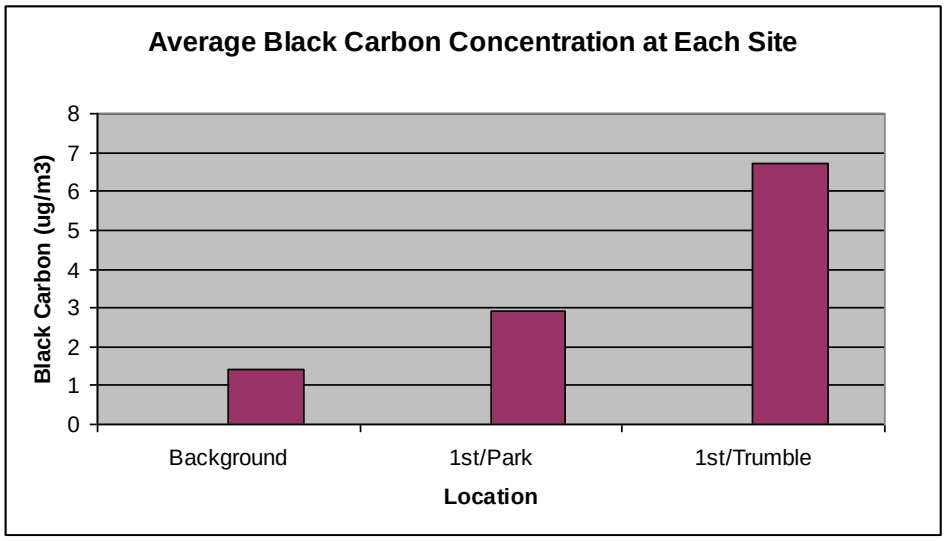
TRUCK COUNTS AND AIR QUALITY MONITORING ON FIRST STREET, ELIZABETH ON MAY 24, 2013 **Robert J. Laumbach M.D., M.P.H, C.I.H**

Trumble Street pass by several public schools where students are likely to be affected by emissions from the heavy truck traffic.

TRUCK COUNTS AND AIR QUALITY MONITORING ON FIRST STREET, ELIZABETH ON MAY 24, 2013 **Robert J. Laumbach M.D., M.P.H, C.I.H**

Figure 1. Mean levels of measured pollutants during the 2-hr truck counting periods on 5/24/13





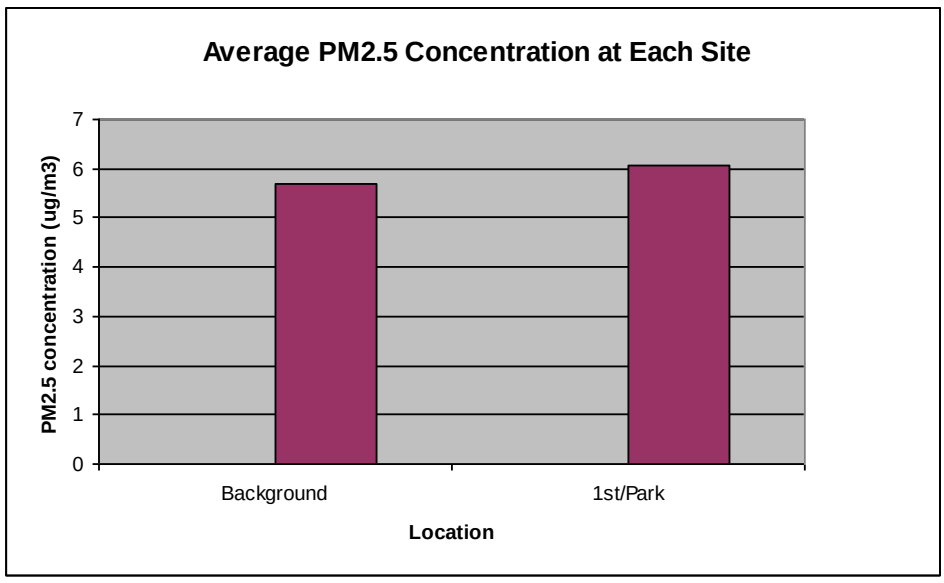
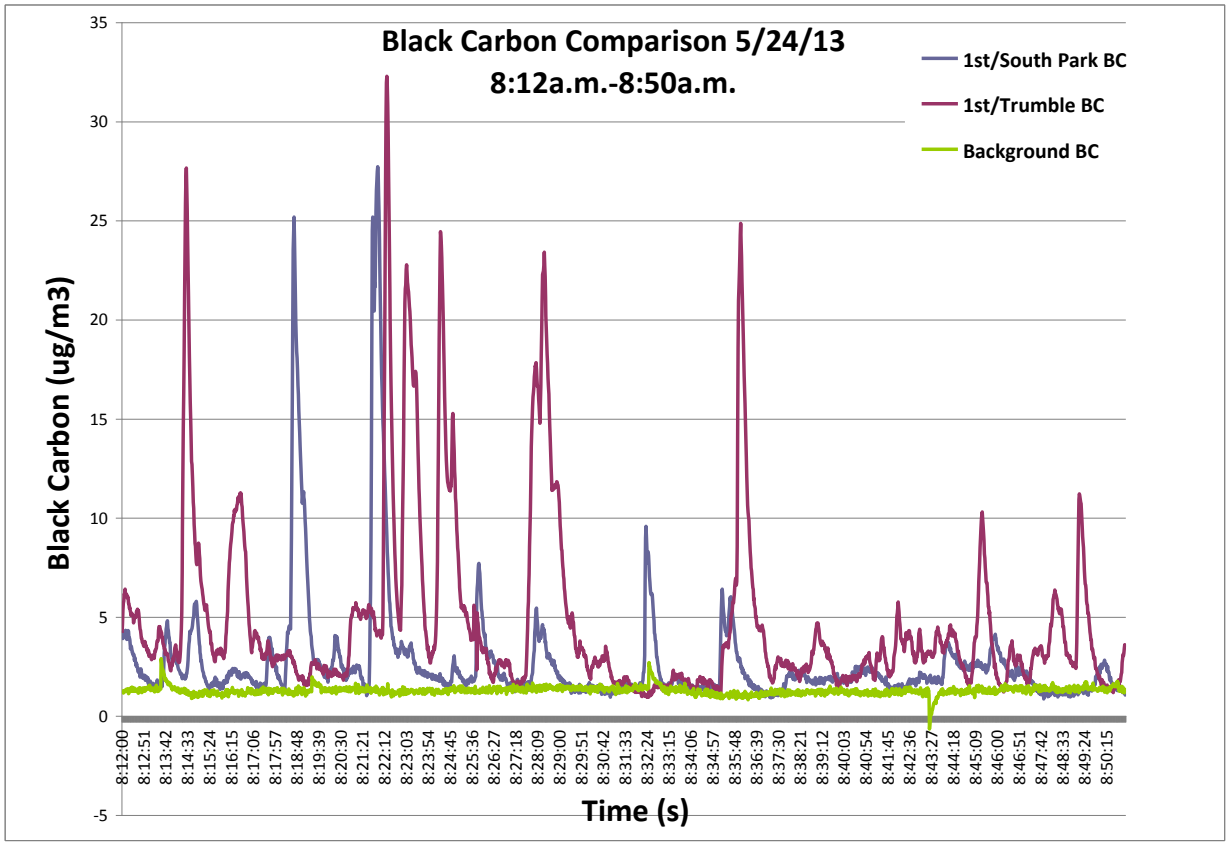
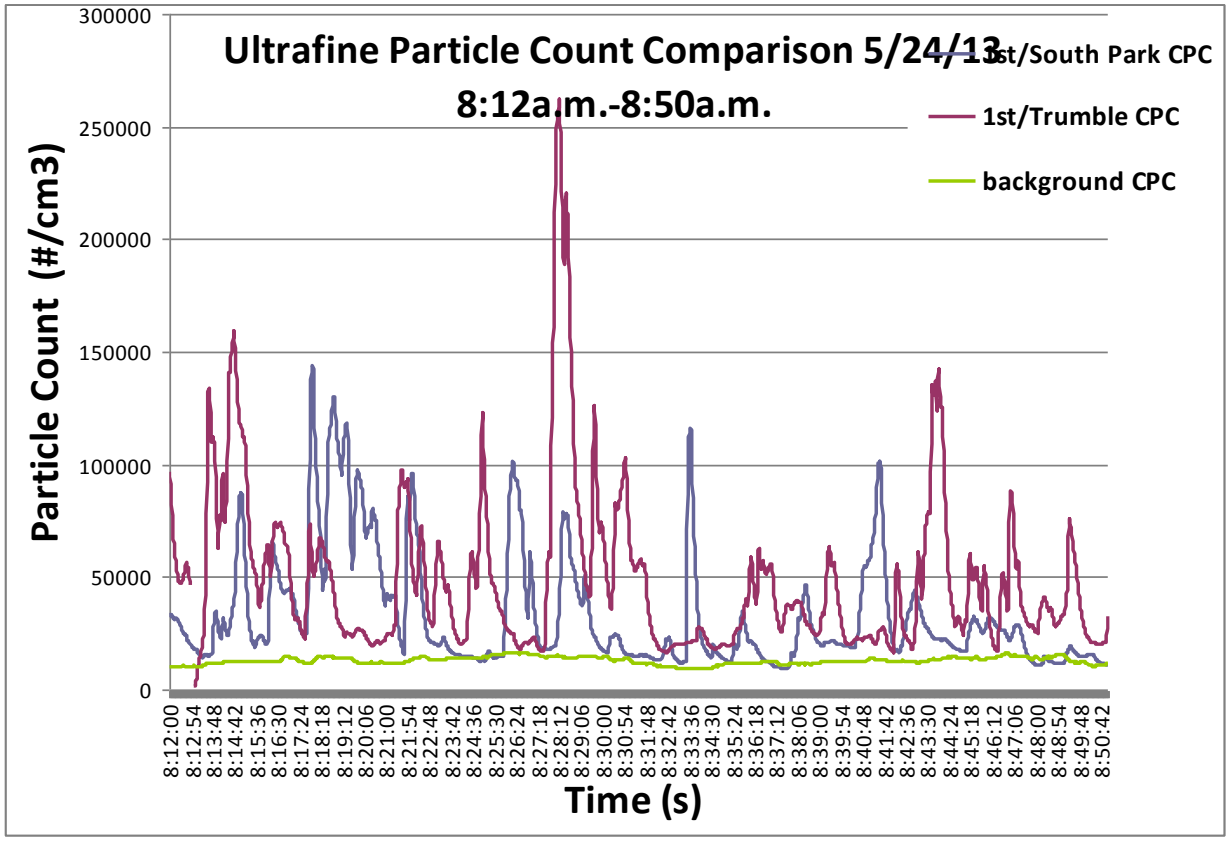


Figure 2


Black Carbon Comparison 5/24/13
8:12a.m.-8:50a.m.
1st/South Park BC
1st/Trumble BC
Background BC
Black Carbon (ug/m3)
Time (s)


Ultrafine Particle Count Comparison 5/24/13
8:12a.m.-8:50a.m.
1st/South Park CPC
1st/Trumble CPC
background CPC
Particle Count (#/cm3)
Time (s)