

HARLEM ENVIRONMENTAL STATUS AND SOLUTIONS

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Abstract. *Elevated levels of Particulate Matter (PM) and decreasing levels of Dissolved oxygen (DO) are affecting Harlem's residents. With a disproportionate level of asthma incidence, lower IQ levels, and contaminated water fronts, young children are being subjugated to sub-standard living conditions. PM levels in the air exceed daily and yearly EPA standards and DO levels in the Harlem River are still dangerously low. Solutions to this include: promoting Urban Vertical Agriculture to grow food locally, curbing the use of diesel trucks, adding above ground filtering enclosures over major highways, diluting the proximity of bus depots throughout the city, and creating new green areas.*

Introduction

With over 8 million people and boasting the Nation's largest regional economy, New York City should be an example of sustainability in the world. However, quite the opposite is true. When we consider the elevated levels of Particulate Matter in the air and low levels of Dissolved oxygen in its water ways it becomes evident that somewhere along the line the people of New York have turned their back on their health. Harlem in particular has been targeted the worst (Fig. 01). Because of high levels of Particulate Matter produced by the same vehicles that bring us our goods and provide us with public transportation (6 of 8 diesel bus depots in New York City are located in Harlem, WeAct, 2009), asthma rates in Harlem are the highest in the nation (25% according to R. Perez-Pena, 2003) and children are being born with lower I.Q.s (Hoepner, et. al., 2009). In a sense, we are poisoning ourselves in order to obtain the very things we need. However, there are things we can do. This project will propose some solutions that are revolutionary. But if we're indeed the greatest city of the world then no idea can be too big or too difficult to prevent us from pulling together and changing it into the healthiest city on Earth.

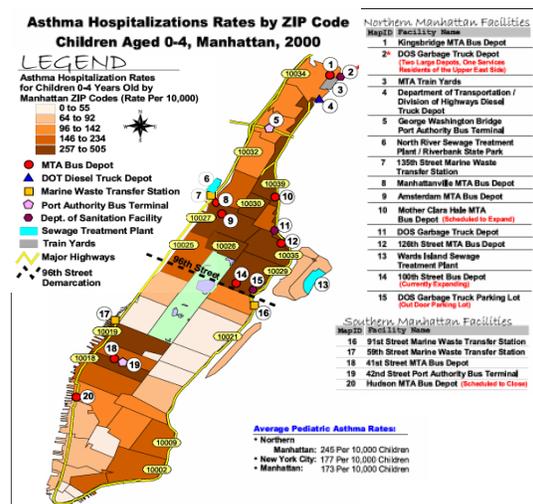


Fig. 01. Incidence of Asthma in children 0-4 yrs. Darker shades are more intense. (Source: WeAct, 2009)

Particulate Matter (EPA, 2009)

Particulate Matter (PM) is solid and liquid particles suspended in the air. Most are hazardous. They can contain for instance dust, pollen, soot, smoke, liquid droplets, and carcinogenic chemicals. Particles that are smaller than 10 microns will impact human health – in particular, the respiratory system. PM smaller than 3 microns causes cancer because it penetrates the body, its cells, and accumulates disrupting cellular processes. PM smaller than 3 microns is a byproduct of diesel engines found on the very trucks that deliver our goods. Most places in Harlem have a high incidence of PM proven to be the cause of at least 1 cancer patient out of every 10,000 inhabitants (Figure 02).

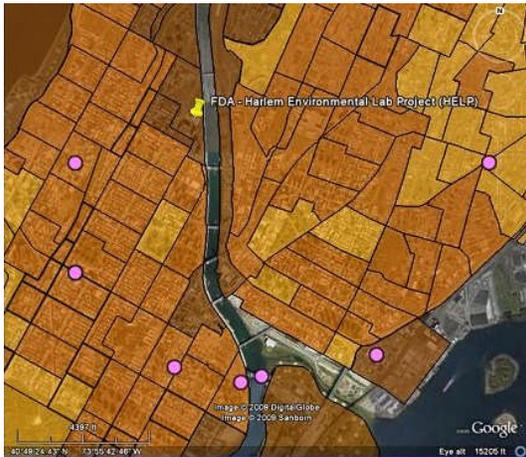


Fig. 02. Cancer rates in Harlem. Dark brown shade is 1 cancer patient in 10,000 inhabitants. Purple circles are monitoring stations. Pin is FDA station. (Source: EPA, 2009)

Dissolved Oxygen (Ministry for the Environment, 2009).

Dissolved Oxygen (DO) is an indicator of the health of a fresh water system. Oxygen is a gas produced by plants during photosynthesis. It is required by all organisms that use organic compounds as a source of energy including plants and animals. When the levels fall below approx. 2.10 mg/L (30%) in the water the environment is said to be anoxic. Anoxic environments cause most major forms of life to die off very quickly only allowing very simple forms of life to live like some species of anaerobic worms and microorganisms. These organisms produce waste that makes the water smell and makes it harmful for people to use. Oxygen depletion is commonly caused by organic pollutants breaking down in waterways, elevated water temperatures or night-time respiration by dense algal blooms in nutrient-rich waters.

Methods

We sampled air above the Frederick Douglass Academy (FDA - 150 and 7th Ave. Manhattan; see Fig. 03) using an Aero model 212 Particulate Matter

sensor (Fig. 04) between the months of April and July 2009. We measured dissolved oxygen (DO), temperature, and salinity with a YSI 6000 sensor (Fig. 05) by the edge of the Harlem tidal straight between the months of April and July of 2009 at a depth of 20 feet.

Project Design

Scientific Problem

What are the environmental conditions in Harlem and what improvements can we suggest?

Objectives

- 01. Determine the physical chemical parameters of the Harlem River.*
- 02. Determine the levels of air quality around a school in Harlem.*
- 03. Propose improvements.*

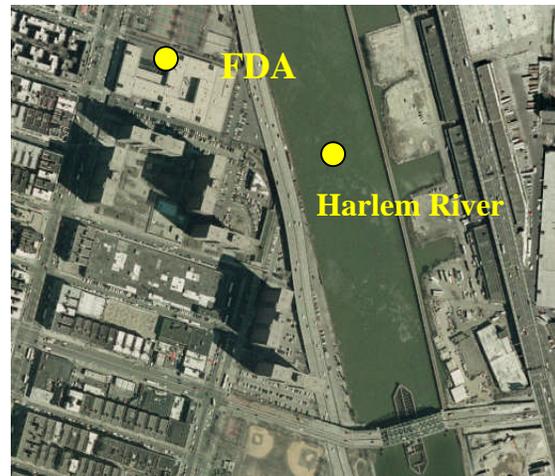


Fig. 03. FDA and the Harlem River tidal straight.

Particulate matter data was recorded every 60 seconds and blue-toothed to a lab computer. DO data was collected every 15 minutes and manually uploaded to a computer approximately every 30 days. MatLab, Microsoft Excel, SpipaQ, and EcoWatch were used to handle and process the files. ArcView was used to make maps. PM data was transformed from counts to concentration and Water quality parameters were kept raw.



Fig. 04. Aero 212 Particle Matter Sensor at FDA's roof.



Fig. 05. A 6" PVC pipe is embedded 20 feet deep and attached to the side of this piling containing a YSI 6000 series DO sensor.

Results

PM spiked on various given days to over 100 ug m⁻³ (Fig 06). DO's trend was to decrease to as low as 4 mg/L in the month of July (Fig. 07). Captured in a survey of the Harlem River was a rare Toad fish (*Opsanus sp.*) and crabs (*Hemigrapsus sanguineus*). Sargassum was also seen floating by on several occasions.

Analysis

In figure 06 PM 3.0 exceeds the maximum concentration levels recommended by the NYSDEC (2009) of 15 ug/m³ per year on more than half the days sampled and often exceeds the daily maximum allowable concentration

of 65 ug/m³. These results support the findings of the EPA NATA report (2009) and highlights the high level of concern of exposure of high school children in Harlem to known cancer causing agents. Harlem's high incidences of asthma and cancer are directly related to PM and are far above the rates of the rest of the city.

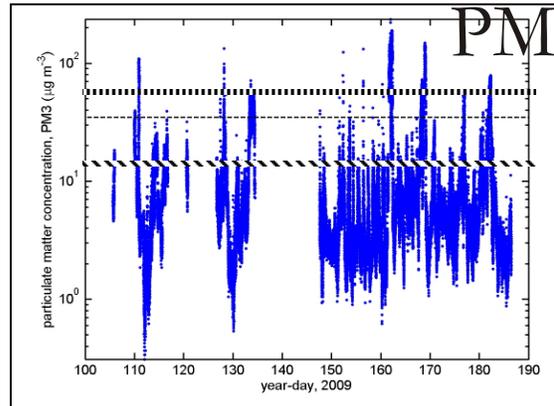


Fig. 06. PM during the months of April to July 2009. Dotted line indicates max. daily exposure value and angled line, annual exposure level (EPA (2009).

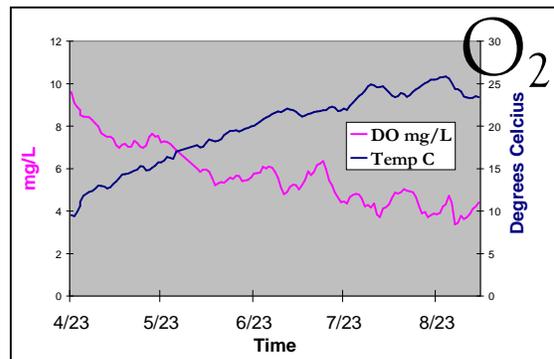


Figure 07. DO concentration in mg/L at the edge of the Harlem River at a depth of 20 feet during the months of April to September of 2009.

FDA is located just north of the Mother Clara Hale Bus Depot which stores diesel consuming buses that have been proven to be major sources of fine PM of the kind studied here. Prevailing southerly winds constantly blow the plume of particles to the school. This major source of contamination is compounded by the presence of various other Stationary Point Source emitters and TRI sites in the area, highways that encircle Harlem, and a valley that keeps the PM enclosed in the area. The risk of

cancer in the area immediately surrounding the high school within a 5 block radius in any direction is higher than one in every 10,000 people (EPA, 2009).

In figure 07 the levels of DO in the Harlem River fall to as low as 4.01 mg/L as the temperature gets warmer in the spring time but not below the anoxic line of 2.0 mg/L as defined by the Ministry for the Environment of Sweden (2009). This can be explained by the increase in water temperature as the tidal straight warms up during the summer season (Fig. 08). Hot water loses its ability to store dissolved gases. Maximum seasonal temperatures have not yet been recorded to date.

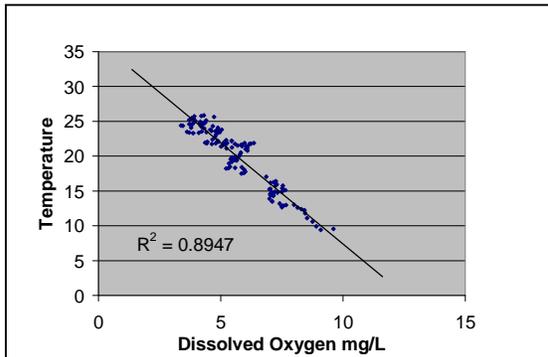


Fig. 08. Correlation between Temperature and DO in the Harlem River. As temperature increases the level of DO decreases.

Conclusions - Solutions

One way to bring PM in the atmosphere down and improve the environment around Harlem is to employ Urban Vertical Agriculture (UVA). UVA is a practical extension of an idea called [Vertical Farming](#) developed by Dr. Dickson Despommier. UVA will grow food locally curbing the use of trucks to deliver food which in turn will reduce the amount of diesel particulates which elevate the concentration of harmful 3.0 micron PM that causes cancer. UVA will use alternative energy sources that will curb the burning of fossil fuels that

contribute to PM and CO₂ thus making our city cleaner. UVA will recycle water and not use fertilizers that run off into our water ways thus reducing eutrophication. We also propose: using alternative energy such as aeolic and solar power on the roofs of buildings can generate enough clean electricity to completely stop the use of burning fossil fuels for the production of electricity; putting above ground enclosures over major highways with filters to clean the air produced by the trucks that use the roads that line Harlem; continuing the construction of phases IV and V of the Harlem River Piers Park (HRPTF, 2009) and winning back the Harlem River water front promoting healthy leisure alternatives for the residents; re-locating the Diesel Bus Depots, particularly the Mother Clara Hale Depot now that it has been demolished for reconstruction, to dilute their emissions from northern Manhattan and spreading them out equally along the city. Failure to take action will lead to an increase in acute health disorders and an unfair substandard of life for the residents of Harlem.

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