SOUTH BRONX ENVIRONMENTAL HEALTH AND POLICY STUDY

Public Health and Environmental Policy Analysis

Funded with a Congressional Appropriation sponsored by Congressman José E. Serrano
and administered through the U.S. Environmental Protection Agency

Environmental Planning, Zoning, Land Use, Air Quality and Public Health

Final Report for Phase IV
December 2007

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TABLE OF CONTENTS

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Chapter I. Introduction

The main goal of the South Bronx Environmental Health and Policy Study is to analyze environmental and health issues affecting the South Bronx community, with particular emphasis on the relationships between air quality, transportation, waste transfer activity, demographic characteristics, and public health. It is a collaborative research project that involves the NYU School of Medicine's Nelson Institute of Environmental Medicine (NIEM), the NYU Wagner Graduate School of Public Service's Institute for Civil Infrastructure Systems (ICIS), and four community groups: The Point Community Development Corporation, We Stay/Nos Quedamos, Sports Foundation Inc., and Youth Ministries for Peace and Justice Inc. This report summarizes research work done by the ICIS component of the project during Phase IV of the study.[1]

Objectives of Phase IV of the Study

During Phase I of the Wagner/ICIS component of the South Bronx Environmental Health and Policy Study, data were identified and collected to describe environmental conditions in the study area. This phase of the work primarily focused on transportation, waste transfer, and related air quality data. The identification of water quality databases and conditions in the study area was also included. The transportation and air quality portions of the work advanced to the stage of analyzing the data needs for modeling relationships between the two areas to gain a better understanding of the relationship between transportation, waste transfer stations and air quality in the area. The Phase I report was completed in September 2002[2]. During Phases II and III of the project, air quality in the study area was compared to that of other parts of the city and an environmental justice analysis that evaluated demographic and socio-economic characteristics of the populations around waste transfer stations in the study area was conducted. In addition, transportation and air quality computer modeling was used to analyze traffic patterns and estimate pollutant levels associated with those traffic patterns in the South Bronx. The impact of alternative waste transfer scenarios on transportation and associated air quality was also included in the modeling work. The research outputs for Phases II and III of the project are included in the Phase II and III report which was completed in December 2004.[3] This modeling work provided a basis for environmental decisions and provided the foundation for the research work completed during Phase IV of the project and included in this report.

The overarching goal of Phase IV of the project was to assemble the data that was collected during prior stages of the project and to identify, develop, and adapt a set of decision tools to allow the community to leverage this data for policy making.

[1] Information about the study is found in the ICIS web page:
http://www.icisnyu.org/south_bronx/index_001.html
[2] The Phase I report is available online:
http://www.icisnyu.org/south_bronx/admin/files/PhaseIWagner930.pdf
[3] The Phase II and III report is available online:
http://www.icisnyu.org/south_bronx/admin/files/ICISPhaseIIandIIIreport.pdf

Components of the Phase IV report

The Phase IV report is divided into the following sections.

Chapter 1. Introduction

Chapter 2. Environmental Planning Frameworks and Decision Tools

Environmental planning began in a formal way in the early 1970s at the outset of the environmental movement. Such planning has provided many communities throughout the country with a comprehensive and integrated basis for decision-making about the environment and the ability to evaluate land development decisions and growth policies. In dense urban area communities, it provides a strong backbone for siting policies and an evaluation of environmental justice issues. This section of the report provides a literature review and a description of the main tools of environmental planning frameworks and a discussion of how they can be applied in the study area.

Chapter 3. Zoning along the Bronx River

Most of the Bronx River waterfront south of the Bronx Park is taken up by M1-1 zoning and industrial land use, and also a significant amount of transportation infrastructure, including highways and railways. This part of the research focuses on the different zoning designations along the Bronx River. The work suggests that increasing clean and safe public space along the waterfront in an area dominated by manufacturing could raise the environmental quality of life for South Bronx residents.

Chapter 4. Air Quality Monitoring, Spatial Location and Demographic Profiles

As part of Phase I of the project we examined the air pollution data collected by the New York State Department of Environmental Conservation (NYSDEC) ambient air quality monitoring stations for the period 1996-2000. In this part of the Phase IV report we examine the location of NYSDEC air pollution monitoring stations and the characteristics of the neighborhoods where the stations are located. Demographic data was obtained from Census 2000 5-digit Zip Code Tabulation Areas in order to compare the characteristics of the populations around the monitoring stations in Bronx County with other stations in New York City.

Chapter 5. Morbidity Rates in the South Bronx

In this section we examine morbidity data for the South Bronx on diseases commonly associated with air pollution. Phase I of the project already provided a literature review on the association between air quality and asthma, one of the main health concerns in the study area. In this part of the report we look at hospital admissions for selected respiratory and cardiovascular diseases.

Chapter 6. Proximity Analysis to Sensitive Receptors using Geographic Information Systems (GIS)

The computer modeling work included in the Phase II and III report provided a number of important results that guided a big component of Phase IV research. These results suggested that traffic patterns in the study area are characterized by extremely high densities along the major highways and truck routes that cross the South Bronx. The air pollution modeling also suggests that for particulate matter (PM) and nitrogen oxides (NOx) there are important hotspots around the highways that have very high traffic densities. A review of the air pollution literature indicates that air pollution concentrations tend to be significantly higher at distances of 150 meters from a highway relative to background concentrations. The results of the work from Phases II and III and the literature on air pollution around highways suggested a spatial analysis of the proximity of highways and truck routes, which constitute an environmental health hazard, and sensitive receptors. A high proportion of children in the South Bronx suffer from asthma. As discussed in the Phase I report asthma is a major public health concern in the study area, especially for children, and air pollution is a risk factor for asthma symptoms, asthma emergency room visits and asthma hospitalizations. Research from the NYU School of Medicine component of this study also shows an association between elemental carbon, which is associated with diesel truck traffic emissions, and asthma symptoms like coughing and wheezing in fifth-graders that attend schools in the study area.

In this section of the report we looked at the spatial location of public schools relative to major highways and truck routes in the study area to determine how many children in the South Bronx attend schools that are located in very close proximity to these sources of environmental health risks. The distance chosen as a buffer to determine whether a school is in close proximity to a major highway or truck route is 150 meters. That distance comes from the literature on air pollution concentrations around highways. We also compare the percentage of children attending schools within 150 meters of a major highway to comparable figures for New York City.

ICIS research team

The NYU Wagner/ICIS team during Phase IV of the study included:

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Chapter 2. Environmental Planning Frameworks and Decision Tools

Sara Clark and Rae Zimmerman

Introduction

The South Bronx, New York, is likely to continue to face land-use, transportation and other planning decisions that may affect air quality, water quality and other environmental indicators, with impacts on human health and well-being in light of ongoing social, economic and environmental needs and challenges. Community members have a pressing need for decision-making tools that will assist them in advocating for alternatives that best suit their specific values. By operationalizing and adapting existing tools in a way that is tailored to community-specific concerns, residents can evaluate the potential impacts of a proposed action, understand the potential tradeoffs among different alternatives, and present well-reasoned and supported arguments in the political decision-making process.

A broad range of existing decision-making tools exists that are potentially useful for community members in the South Bronx. In the early 1970s, following the adoption of the National Environmental Policy Act (NEPA) of 1969, a number of methods emerged that still are used or adopted to arrive at informed decisions today. These methods have been summarized in literature reviews from time to time (see for example, Shopley and Fuggle 1984 and Jain et al. 2002). Although many of these tools were developed quite a number of years ago, they are still being applied, and in general only marginal changes in the tools themselves have occurred since they were first developed, though analytical frameworks using them have changed. One major development has been in the area of accounting schemes, such as ecological footprint analysis (Wackernagle and Reis 1996), which has become adapted in many different ways to compute footprints of various kinds including those for carbon emissions and water ranging from individual to global levels. Other major developments have been in the area of the development of indicators or measures of environmental condition (Esty and Cornelius 2002; U.S. EPA 2003). A sample set of indicators or variables for environmental analysis is contained in the appendix. Methods of incorporating and applying these measures for environmental analysis vary in the degree to which these indicators are incorporated comprehensively. A third methodological development has been the introduction of Geographic Information Systems (GIS) to portray spatial relationships between land development activities and environmental characteristics, which was historically done manually (see for example, McHarg 1967).

Decision tools applied to environmental problems come in a variety of forms. One set of tools consists of tables or matrices that display relationships between activities and consequences. They range from being organized in terms of a simple two-dimensional table to a sequential set of matrices or “stepped” matrices with a variety of mathematical functions to connect the matrices. Another set of tools consists of decision sets some of which may or may not incorporate matrices, known under the general term of decision trees. A third set incorporates more complex models. Jain et al. (2002) suggested a similar typology. These different forms are not necessarily mutually exclusive and the outputs of one type are often used as inputs to another. This document focuses primarily on matrices and their different forms, as well as potential applicability in community decision-making, and decision trees and complex models are beyond the scope of this chapter. Many of the tools reviewed were developed in the context of environmental impact assessment but are broadly applicable to other kinds of environmental decision needs.

The available decision-making tools, while adopted to address specific concerns or questions, follow a more general process. Each tool follows a relatively similar progression of steps that help guide the decision making process, regardless of complexity, applicability, and data or technical requirements. Each tool requires a clear definition of the decision to be made, the development of criteria by which the decision can be understood, and an evaluation of the likely outcomes the project and its alternatives will result in. The tools are generally flexible and adaptable to new needs. The importance of these general steps is outlined in greater detail below (*Section 1: General Decision-making Techniques*).

The tools that are available are reviewed below in a way that operationalizes the tools (*Section 2: Summary of Decision-Making Tools*), and provides the potential for applicability to the South Bronx as the community seeks to make decisions relating to its future environmental health.

Each of the available decision-making tools has distinct advantages and disadvantages that make their use more or less helpful in individual decision-making exercises. Some of the tools provide a quick and general review of possible impacts, and may be useful when a decision must be made quickly or with relatively little information. Other decisions may be sensitive to detail, requiring a more finely-tuned tool for precise analysis. Section 3 (*Comparison of Available Tools)*, provides analysis of the tools discussed in Section 2. Specific applicability to the issues that have been raised in the South Bronx community (identified in previous reports) will be considered.

Section 1. General Decision-Making Techniques

While the sections below outline specific tools that can be used to display information, compare alternatives, and facilitate decision-making, these tools all require thoughtful analysis prior to their use as decision tools. The purpose of this section is to outline the general steps that must be made by a community or decision-makers prior to utilizing a specific decision tool.

The first step, while obvious, can also be the most important part of the decision-making process. In order to make a decision, one must first understand the scope of the specific decision to be made. Typically, community groups or decision-makers are confronted with a general issue, such as the relocation of waste transfer sites. Prior to delving into making a decision, it is best to first fully develop the issue at hand. This process includes evaluation of multiple factors, including:

- Scope of action to be taken;
- Scale of project;
- Location;
- Timeframe;
- Relevant stakeholders;
- An understanding of necessity; and
- Short term (construction) effects vs. Long term effects.

Many additional factors may exist for any given project. Developing a clear picture of the relevant issues in the beginning will make it easier to choose an appropriate decision-making tool and eventually arrive at the best outcome.

Following the development of the issue, the community or group of decision-makers should evaluate the ideal outcome of the process. Different situations call for different goals. For example, a group may be interested in evaluating a proposed project, in order to decide whether or not to offer its support. Alternatively, a group may have many options from which to choose from. For these groups, the goal might be to pick the best alternative. Other groups may want to see what elements of a proposed project are the most troublesome, in order to develop appropriate mitigation. All of these groups will be well served by the decision tools below, but defining the desired outcome will allow groups to pick the tool best suited for their analysis.

In situations where groups are deciding among alternatives, they may have the alternatives already defined, or may need to devise them for analysis. In either case, it is important that the alternatives be well defined. Groups will likely need to collect information about the feasibility of different alternatives as well as the relevant details for each of them. For all analysis including alternatives, groups should use a "no-action" alternative. This alternative represents the baseline; essentially, what would happen in the area without any of the other alternatives moving forward. The "no-action" alternative can often be difficult to determine, as actions outside of the scope of the project must be considered, particularly if alternatives are set to occur at some point in the future. In a simplified example, consider a proposed action of the construction of a new shopping mall in a growing area. The new shopping mall would likely increase traffic to the area, but traffic might also increase due to residential growth in the nearby area. Thus, the "no-action" alternative would include the residential growth in the area. Thus, when the proposed action is compared to the "no-action" alternative, only the traffic resulting from the mall would be considered.

After the proposed action, goals of the decision-making process and the possible alternatives have been defined, the next step in all decision-making tools it to establish the parameters that will be used to evaluate the project and its alternatives. Some of the decision tools below have pre-defined parameters, but all can be expanded or contracted to meet the needs of the particular group.

These parameters occur at various levels of complexity. In “An Environmental Evaluation System for Water Resource Planning,” Dee et al. establish a hierarchy that is useful for discussing these various levels (Dee et al. 1973: 524). At the highest level are *categories*, which include broad topics such as Ecology or Human Interest (Dee et al., 1973: 533). In modern analysis, broad categories might include Physical Environment, Economics, Human Health or Aesthetics. These categories are then broken down into *components*. Components, as Dee et al. describe them, “represent terms of intermediate generality” (Dee et al. 1973: 524). For example, categories under Human Health might include Air Quality, Safety or Well Water Quality. These components are comprised of a number of *parameters*. These parameters represent “an aspect of environmental significant worthy of separate consideration” (Dee et al. 1973: 524). It is at the parameter level that most analysis takes place. To continue the Human Health Example, the parameters of Air Quality may include Particulate Matter, Visibility, Nitrous Dioxides or Ambient Air Temperature. The last level of the hierarchy accounts for the various methods for measuring these different parameters, and is correspondingly labeled *measurements*.

Prior to beginning any sort of environmental decision making, groups must consider which parameters are important for them to consider. A number of the decision-making tools listed below include lists of possible parameters, and a sample list is contained in the Appendix. They may be good places for groups to start from. As a general rule, lists should remain broad at the beginning, to enable all possible effects of the decision to be considered. However, this may not be feasible, given the data or time restraints of particular efforts. Once these parameters have been set, the decision tools below can be used to continue the analysis.

Section 2. Summary of Decision-Making Tools

The Leopold Matrix

The Leopold Matrix was among the first responses to the National Environmental Policy Act of 1969 (NEPA), which required a means of displaying and analyzing the various environmental impacts of activities. As directed by the federal government, different agencies began to develop procedures for full disclosure and evaluation of projects and their impact on the environment. Developed by Luna Leopold at the U.S. Geological Survey, the Leopold Matrix has been adopted and widely used in environmental decision-making.

Instead of providing a true method for decision-making, the Leopold Matrix is used to display or categorize the impacts of a proposed action for further discussion and analysis. “The heart of the system,” according to the authors, “is a matrix which is general enough to be used as a reference checklist or a reminder of the full range of actions and impacts on the environment that may related to proposed actions” (Leopold et al. 1971: 1). By displaying the potential actions of the proposed project arrayed by the potential impacts that the actions have on the environment and evaluating both of them along two dimensions - the magnitude and importance of the of effects - the Leopold Matrix is useful for determining impacts and communicating results (Jain et al. 2002: 183).

The article provides a list of 100 potential actions as well as 88 environmental characteristics. While these may be helpful for decision-makers to define the project to be evaluated as well as the criteria they are concerned with, these lists of activities for a particular project should be tailored to the specific project. For example, the original matrix is heavily focused on the natural environment. For use in the South Bronx, additional urban factors such as traffic and proximity to residential development would be important to add.

To use the Leopold Matrix, the potential actions are arrayed on the horizontal axis, while the environmental characteristics are arrayed on the vertical axis. For each intersection, the square is divided in half by a diagonal line, and entries in each part of the box portray any interaction between the action and the environmental characteristic. According to the authors, "unnecessary replication can be avoided by concentrating on first-order effects of specific actions" (Leopold et al. 1971: 5).

Once the matrix has been created, the impacts of the proposed project are evaluated in terms of magnitude and importance. In this analysis, magnitude should incorporate the likelihood that an action will have an effect, as well as the scope and duration of the effect. The authors argue that the magnitude can be more readily evaluated on the basis of fact, such as potential impact of an action on the turbidity of water (Leopold et al. 1971: 2). In the upper left corner, a rating of magnitude should be given for each box where an impact is possible, with 1 as lowest magnitude and 10 and highest.

After magnitude has been determined, the decision-maker must then evaluate each potential impact in terms of its importance. The authors note that "evaluation of the *importance* of impact generally will be based on the value judgment of the evaluator" (Leopold et al. 1971: 2). Importance, in this analysis, attempts to capture whether or not the impact matters to the decision-maker or relevant stakeholder, as well as how much it matters. Though the authors do not explicitly explain this point, importance can be either negative or positive, depending on the effect. Again a scale of 1 to 10 is used, but a negative or positive sign should be used to indicate if the effective is detrimental or beneficial.

Once the scores for magnitude and importance are determined for each potential impact, the decision-maker is advised to go through and circle boxes with high scores in either category. This exercise will often reveal important trends. If a row contains many high numbers, then it becomes evident that the overall action likely has a significant effect on one environmental characteristic. If a column contains high numbers, then it is likely that a single piece of the action is likely to have significant environmental effects. If action can be minimized, then perhaps the overall impact of the action can be dramatically altered.

As noted, the Leopold Matrix is useful for identifying important impacts of project activities on an environmental condition or characteristic and displaying these results in a compact, easy-to-read format. It contains no formal analytical technique for combining the values assigned in each of the cells nor does it contain a method for making a decision, but may be useful as decision-makers begin to evaluate a project by organizing the impacts. Additionally, multiple Leopold matrices may be prepared for a project and its alternatives, and these may offer a useful tool for comparison. The matrix is very flexible in terms of both the number of items and level of detail for environmental impacts or project activities used.

The overall format for the Leopold matrix is shown in Figure 1 below (Zimmerman 2007 adapted from Leopold et al. 1971).

Figure 1. Basic Framework for the Leopold matrix

Individual Cell in a Matrix with 88 Items

	Actions
Environmental Characteristics Or Conditions	Magnitude (Scale: 1-10)
	Importance (Scale: 1-10)

Magnitude = Degree or scale of the activity ("objective")
Importance = Significance of the activity ("subjective")

The work of Rickert, Schneider and Spieker (1973) illustrates the adaptability of the Leopold et al (1971) approach through an application to water resources. This is shown in Figure 2 below.

Figure 2. Adaptation of the Leopold Matrix to Water Resources

Water resource	Action	
1 . . . n	X=Relative importance of action (0, 1, 2, 3)	
	Y=Importance of activity (0, 1, 2, 3)	X times Y

The impact of the action is the summation of the products X times Y

Source: Zimmerman (2007), adapted from Rickert, Schneider and Spieker (1973)

Lyle and von Wodtke Matrix

Similar to the Leopold Matrix, the Lyle and von Wodtke Matrix was developed as a direct result of the National Environmental Policy Act of 1969 (Lyle and von Wodtke 1974: 394). However, the Lyle and von Wodtke Matrix goes beyond the simple two-dimensional display techniques of the Leopold Matrix to a method of identifying the optimal location for development using a series of interrelated matrices. It allows users to identify and rank their evaluation criteria, determine how a proposed development might relate to or meet these criteria, and create a graphic display of the most suitable locations for the proposed development. The Lyle and von Wodtke Matrix is significantly more complex than the Leopold Matrix, but provides both a method for making locational decisions and easily displaying results to a general audience.

The Lyle and von Wodtke Matrix is only a portion of a larger system developed to evaluate environmental impacts. Though parts of the system may be omitted or analyzed in a different manner, it is helpful to outline the entire system and the sequence of steps in it in order to see how the Lyle and von Wodtke Matrix was originally conceived. Opportunities to change or omit sections will be discussed below.

Ecological Flow Diagrams

The first step in the Lyle and von Wodtke system is the development of ecological process diagrams (Lyle and von Wodtke 1974: 399). These diagrams set forth how energy and materials flow through environmental systems and provide a basis for understanding the processes that lead to their transformation. In the context of the environmental decision-making analysis, these flow diagrams are useful because they "provide the means of establishing the interrelationships of environmental effects, development actions, and location" (Lyle and von Wodtke 1974: 396). In this system, the diagrams are used to determine what potential impacts the proposed action may have on environmental systems.

Creating the Scoring Matrices

The second step in the evaluation technique is to create the matrices. Unlike the Leopold Matrix, the Lyle and von Wodtke Matrix is comprised of two different parts; the second is created using the results of the first. In the first matrix, shown in Figure 3, the horizontal axis (or columns) contains the environmental effects to be minimized or maximized (e.g. sediment transport or erosion). These are selected by those individuals making the decision and are value judgments based on the concerns of the community. These should be ranked in order of importance or concern, with the most important variable on the left and the least on the right.

Next, the land characteristics for the vertical axis (or rows) must be determined. They are based on the proposed action and include the characteristics of land that may be affected differently by the proposed action (e.g. vegetation types or runoff potential). In the Lyle and von Wodtke system, the flow diagrams from the first step are used to determine the land variables. While this step is helpful, it is not necessary – if the decision makers already have a sense of the important land characteristics to analyze, these may be used.

The scoring and weighting of the environmental effects are portrayed in Figure 3 below.

Figure 3. Scoring and Weighting the Importance of Environmental Effects

Table I. Scoring Matrix
(defined for one specific activity at a time)

	Environmental Effects (e.g., sediment transport
Land Variables (e.g., slope, soil)	z(1) z(n) w(i) . . . . .w(n) 100

Values for w are derived first as the sum of the columns; Values for z are the sum of the row values.

Table II

	Attribute codes and modal values
Land Variables as in Table I (e.g., slope, soil)	z(1) z(n)

Attribute scores are absolute values for a given land variable – the higher the value, the greater the impact. These are then converted into modal values. Z scores are maximums that modal values cannot exceed.

Adapted from Lyle and von Wodtke 1974: 404

Once the first matrix has been created, it can be used to analyze "relevant concerns and [to assign] weights and scores" (Lyle and von Wodtke 1974: 404). First, the environmental effects to be minimized or maximized are assigned weighted scores that reflect importance. The total of the scores must add up to 100. For example, with five environmental effects of equal concern, each would be given a score of 20 (100/5=20). If the first effect is very important, and the four others equally less so, then they might be assigned scores of 80, 5, 5, 5, and 5 (the total always equals 100). These scores are inserted into the bottom row of the matrix.

Next, the decision-maker must determine the scale or relative extent of the role each of the land characteristic plays in producing the environmental effects. For example, slope, water features and runoff potential (land characteristics) each play a role in sediment transport (environmental effect). Determine what percentage of total sediment transport is determined by each of the land characteristics (e.g. 50% of sediment transport is determined by slope, 20% by water features and 30% by runoff potential). This acts as a second level weighting system. Then multiply the number in the bottom row by the percentage for each land characteristic, and enter the result in the corresponding square. This method should be used for each of the environmental effects until the matrix is filled (the box at the intersection of the environmental effects that are not impacted by a land characteristic will contain nothing).

Finally, to complete this first matrix, the numbers in each row should be summed horizontally and the number imputed into the final box (indicated in blue). These numbers "represent the relative importance of [each] variable in shaping the model" (Lyle and von Wodtke 1974: 404-405). By combining the relative importance of each environmental effect (determined in the first step) with the relative importance of each land variable in impacting each environmental effect (determined in the second step), the matrix is ready for use in evaluating locations for a proposed development.

The second table in Figure 3 is used to assign scores for each possible attribute of the land characteristics. For example, there may be 3 different types of soil identified in the study area, some of which is more suitable for the proposed action than others. Again, the land characteristics are displayed on the vertical axis. In each square the attribute code is given (for example 1 might indicate the least fertile soil and 3 might indicate the most fertile soil[4]). Directly below the attribute code is the score given for that attribute. The highest score possible for each land characteristic is taken from the last column of the previous matrix. This system ensures that each land characteristic remains properly weighted.

Using the Weighted Characteristics to Determine Locational Suitability

Lastly, the scores are given a spatial dimension by being applied to a geographic map of the area. In the Lyle and von Wodtke article, the authors use 111.11 ft. by 111.11 ft. squares. Each square is evaluated to determine the predominant attribute for each land characteristic. Using the second matrix, the total overall score for each square is calculated, and assigned a shade from light to dark depending on how high the total score is. The highest scores are the most suitable for the proposed activity. These maps provide general guidelines for where the proposed activity would have the least impact on the environmental effects that the decision-makers determined were important.

With the increasing availability of GIS systems, it would be more helpful to use these matrices to create overlays in GIS. Using the scores determined in the second matrix, overlays could be created for each of the land characteristics and combined

[4] A series of charts that indicate attribute codes and their corresponding characteristics might be helpful.

mathematically. In sum, they would indicate those areas that are most suitable or least suitable for the particular development. Properly geocoded data and GIS skills would be needed to assemble these maps, but they would be useful for the general public after their creation.

Conclusions

"Although this sequence provides and orderly way of making and articulating judgments," the authors note, "it relies heavily on the knowledge and understanding of those formulating the model" (Lyle and von Wodtke 1974: 405). Particularly in the latter stages of the sequence, decision-makers must understand the particular roles of various land characteristics in impacting the environmental effect that they seek to minimize or maximize. The decision-makers must also have access to location-specific data in order to implement the decision making tool. Depending on the level of analysis needed, this task may be particularly data or research intensive.

In addition, this matrix was not developed to accommodate social or economic data, nor was it been applied in an urban setting. Social and economic analysis could be incorporated into the matrix, though collecting data on these factors may be difficult.

Dee et. al. Environmental Evaluation System

Similar to the Leopold Matrix and the Lyle and von Wodtke Matrix, the Environmental Evaluation System (EES) evolved from the need for methodologies to evaluate environmental impacts under the National Environmental Policy Act of 1969 (Dee et al. 1973: 523-524). Rather than a matrix, Dee et al develop a scoring methodology to directly evaluate the effect that a particular action has on the environment. By comparing the likely future impacts of taking an action with the likely future impacts of not taking an action, the method provides a clear picture of the impacts that are directly a result of the proposed action. Though the system was designed to evaluate water-resource projects, it may be possible to adapt it for other types of projects (Jain 2002: 178).

The EES provides analysis at the level of environmental parameters, which the authors define as "a unit or an aspect of environmental significance worthy of separate consideration" (Dee et al. 1973: 524). As such, these parameters are the environmental values that may be affected by an action. The methodology outlines 78 parameters, in the categories of ecology, environmental pollution, esthetics and human interest. These parameters could potentially be expanded by individual decision-makers to include economic or other values. The EES is valuable because it provides a technique to transform these parameters into commensurate units such that they can be directly compared.

The first step in the system is use the list of parameters to evaluate the likely future condition both with the action and without the action. For each parameter, the decision-maker should consider if an impact is likely. If so, measurements for both the future action and no-action conditions should be determined. For instance, if a project is likely to affect the dissolved oxygen content in water, the likely milligrams per liter for both the action and no-action conditions are needed. Using an established value function for the specific parameter, these measurements can be translated into a standardized score between zero and one. In the case of dissolved oxygen, the value function they provide shows that 4 mg/l of would correspond to an environmental quality score of approximately 0.35. These value functions have been established by the authors, and indicate whether or not the relationship between the value and environmental quality is linearly related. One potential difficulty in adding additional parameters would be developing new value functions for them.

Once the standardized scores for each parameter are determined, they must be weighted such that more important parameters are given a higher score than lower parameters. This weighting is determined by the use of "parameter importance units" (PIUs). According to the authors "the number of PIU assigned to a parameter is an indicator of the degree to which…projects may disturb or enhance the dynamic stability of man's relationship with the natural and social environment; all parameters were assigned relative weights" (Dee et al. 1973: 525). Again, these weights have been predetermined by the authors, who indicate that "they should not vary from project to project once they have been established by society" (Dee et al. 1973: 526). Any attempt to add additional parameters would require a reevaluation of relative weights.

The results of these two steps should then be arrayed in a table (Dee et al. 1973: 533). The parameters considered should be listed in the leftmost column of the table, under their more general categories (i.e. ecology) and components (i.e. species and populations). The PIU should be listed in the next column, followed by the standardized scores for both the no-action and action conditions. Each standardized score should be multiplied by the corresponding PIU, to determine the weighted, standardized environmental impact unit (EIU) for each parameter.

Once the all EIUs have been calculated, then can be used to show the corresponding change between the no-action and action condition, depicted here in the last column. Those scores which are negative indicate a loss of environmental quality in each parameter as a direct result of the action. Those changes which are significantly large (as determined by percentage change), should be considered a red flag. The authors note that "a red flag is only a warning, not an absolute definition of a problem," thought they do indicate areas that should be considered carefully in the decision-making process (Dee et al. 1973: 526).

The total environmental impact from a proposed project can be produced by adding the values in the last column together. Though the number is meaningless by itself, it can be used to compare one action to another, if multiple tables are developed. By standardizing the values into equal units, and by using an established method for weighting, this method is particularly useful for this type of comparison.

As with the Lyle and von Wodtke Matrix, the Environmental Evaluation System requires a large amount of specific data. Jain notes that these data requirements “may restrict the use of the approach to major project assessments” (Jain 2002: 178). However, the general approach of the system, directly comparing the impacts of no-action and action conditions, is one that has been widely adopted for use in environmental decision-making, and may prove useful to residents of the South Bronx.

Sorenson Step Matrix

As a graduate student at the University of California, Berkeley, Jens Sorenson developed a decision-making tool to address conflicts among users of California’s coastal resources. In the early 1970s, when this paper was written, population growth in California was placing enormous pressure on the coastline. Industrial, commercial, residential and recreational uses all competed for relatively scare coastline, leaving the environment worse off. The Sorenson Step Matrix was developed as a method for understanding the effects of these competing uses and to provide a potential framework for evaluating future decisions. It provides a systematic method for displaying the interactions between uses, the factors these uses may interact with, and the likely effects of the uses.

The Sorenson Step Matrix, the steps of which are shown in Figure 4, begins with the development of a list of *uses*. These uses were chosen based on “their direct contribution to known examples of resource conflict or degradation” and on the achievement of “a level of generality commensurate with the level of regional planning guidelines” (Sorenson 1971: 14). In Sorenson’s method, these uses relate specifically to the coastal zone, but the framework could be modified to suit any area or project. These uses are displayed in list format to form the first section of the Step Matrix.

The second step in the development of the matrix is to determine all possible *causal factors* relating to the identified uses. As Sorenson describes them, “causal factors are alterations commonly associated with a use that directly produces a change in condition” (Sorenson 1971: 14). In this conception, it is the causal factors that produce impacts, rather than the uses themselves. In developing the list of causal factors, decision-makers should consider all possible results from a particular use, regardless of if they are occurring now or are likely to occur in the future. This inclusiveness ensures that the step matrix can evolve as projects change or move forward. The causal factors for all uses should be displayed in columns below and to the right of the uses. The corresponding grid is then used to indicate which uses interact with which causal factors. Figure 4 is a schematic diagram of some of the key components of the matrix.

The third step in the development of the matrix is to determine the possible adverse effects that these causal factors have on the environment. These are determined through three steps. In the first column, the *initial condition*, or the immediate effect that a particular factor causes, must be listed. Sorenson groups these initial conditions into six categories: water, climate, geophysical conditions, biota, access conditions and aesthetics. Again, additional categories could be added dependent on the particular project. In the second column, Sorenson lists *consequent conditions*, which describe the changes induced by the initial condition that have particularly pernicious effects (beneficial effects are not included in this method). For some initial conditions, there will be no consequent condition, indicating that the initial condition has a direct effect. Lastly, Sorenson has an *effects* column, which list the actual use conflict or resource change.

Figure 4. Example of a Sorenson Step Matrix

Use (e.g., residential development)
↓
Action (e.g., change in impervious surface)
↓
Initial condition (e.g., increased fresh water flow into an estuary)
↓
Consequent condition (e.g., reduction in estuary salinity)
↓
Effect (e.g., decrease in size of commercial shellfish)

Adapted from Sorenson 1971: xv for the California Coastal Zone.

This methodology is particularly beneficial to help decision makers understand the often complex and interrelated relationships that tie together particular uses with effects on the environment. The step matrix embraces the assumption that every use may have multiple effects on the natural or human environment and that every use conflict or resource change may be due to multiple conflicts. By arraying these different relationships within a step matrix, decision-makers can trace these relationships easily. This methodology is flexible and easily transferable to different types of problems. However, it does require in-depth knowledge of many cause-effect relationships, and may be difficult to use with the public.

Section 3. Comparison of Available Tools

While these four tools have significant commonalities, including the necessity of arriving at a well-defined question or decision and the development of parameters for evaluation, their individual characteristics lend themselves more readily to different types of decision-making situations. This section evaluates the four tools based on four different considerations: data requirements, complexity of presentation, ease of comparison among alternatives and general flexibility of the tool. Finally, these tools will be evaluated for their use in community decision-making settings, where data is often unavailable, broad communication is highly important, and community members seek to present their point of view in a contentious atmosphere.

Data Requirements

When a community sets out to make decisions about the issues they face, one of the most difficult tasks can be to compile relevant data. In the types of decisions that face the South Bronx, such as where to site waste transfer stations or how to route truck traffic proximate to residential neighborhoods, a vast amount of data may be relevant. For example, decision-makers need to know not only the amount of new truck traffic that a waste transfer station may generate, but also what types of trucks will be used, when they may travel through neighborhoods, how loud or polluting they will be, and whether or not any viable alternatives exist. This type of information may not be readily available to the general public, or it may simply be unknown at the time the decision is to be known.

Unfortunately, three of the four tools described above have tremendous data demands. For the Lyle and von Wodtke matrix, decision makers must know the relevant ecological flow diagrams and must have access to land classification data to understand where to best site new infrastructure or industry. In Dee's Environmental Evaluation System, precise measurements in both the future action and future no-action conditions are used to generate the parameter importance units. Without those measurements, the EES system fails to generate a true comparison. Lastly, the Sorenson Step Matrix requires the user to understand the specific causal relationships between the proposed action and possible effects. These may be difficult to determine in advance or their may be unexpected consequences that are impossible to know.

The Leopold Matrix, on the other hand, requires less precision in data. It is important to know the different components of the proposed project and what impacts these components may have, but the importance to the community and the magnitude of the impact can be generalized. Therefore, when community groups are pressed to find precise information, the Leopold Matrix may be their best tool.

Complexity

For community groups advocating for specific alternatives, decision-making tools can be helpful in their capacity to easily display information. Decision makers may be more easily persuaded if they can easily see the reasoning behind a certain position. These tools can help community groups display their decision-making process, thereby strengthening their argument.

The tools described above accomplish this task with varying success. The best tool, especially for siting decisions, is the Lyle and von Wodtke matrix. Once the information has been processed, it can be used to generate a map that displays the most appropriate location for siting new infrastructure, industry or residences. Most people intuitively understand mapping, and so community groups may be well served to use this as a display tool. However, the steps that go into creating the map are less apparent and may require additional explanation.

The Leopold Matrix is also relatively easy to understand. Furthermore, community groups can use colors or bold fonts to illustrate which components of a project have the largest effects, thereby drawing attention to the most troublesome aspects of a particular project. The Dee Environmental Evaluation System, while the final results are easy to compare (each alternative is reduced to a single number), there is again a lack of transparency in how the community arrived at the particular outcome. Again, it may be necessary to provide additional background information to decision-makers.

Lastly, the Sorenson Step Matrix is a complicated diagram that may be difficult to use as a communication tool. While it illustrates the causal relationships between different actions and their effects, it doesn't readily display the outcome that community groups maybe advocating for. Therefore, it is not likely to be a helpful tool in communicating community desires and opinions to a decision maker.

Comparison among Alternatives

In some situations, it may be helpful for community groups to directly compare the effects of multiple alternatives. Two of these tools were designed to explicitly compare alternative scenarios: the Lyle and von Wodtke Matrix, and the Dee Environmental Evaluation System. The end product of the EES system is a ranking for each alternative, based on the parameters selected for evaluation. The Lyle and von Wodke Matrix produces a geographically explicit layer, which allows users to directly compare different sites in terms of the parameters selected.

The other two systems, the Leopold Matrix and the Sorenson Step Matrix, can also be used to compare alternatives, but the results are less explicit. Users of the Leopold Matrix must build multiple matrices to evaluate across alternatives, and these can be hard to compare directly. For the Sorenson Step Matrix, the pathways are fairly complex and can be difficult to use with multiple alternatives. However, if the Matrix is operationalized as a database system, it may be much easier to directly compare alternatives.

Flexibility

Lastly, it is important to remember that no two decision-making exercises are the same. The system to be used must be flexible and readily adaptable to changing situations if it is to be useful. This is especially true in the community decision-making framework, where change may happen quickly and community groups must be ready to offer their opinions in a changing landscape.

Out of all of the tools, the Leopold Matrix is the most flexible, in part because it requires less explicit data for evaluation. New project components or parameters for evaluation can be readily added to the framework at any time. In addition, any type of component or parameter may be added.

The other tools are less flexible. With the Lyle and von Wodkte matrix, data that cannot be geographically arrayed or is not readily available for different geographic areas cannot be incorporated into the matrix. However, given the expansion of GIS data, this may be less of a problem now than when the matrix was conceived. Similarly, the Sorenson Step Matrix can be expanded or manipulated, but only if the causal relationships between components and effects are well understood. Lastly, the Dee Environmental Evaluation System is hard to manipulate. The authors established the value function and the parameter importance units for only a limited number of parameters. If community members are concerned with additional parameters, it may be difficult to develop these as the authors reveal relatively little about their own process.

Section 4. Conclusion

While all four techniques mentioned above are somewhat constrained in their applicability to most community decision-making situations the South Bronx faces, the Leopold Matrix is likely to be the best option at least at the beginning. A general lack of data does not thwart the usefulness of the matrix, as items can be left blank or can be approximated without distorting the overall outcomes. The outcomes are easily displayed and provide a powerful communication tool that can be used both among community members and with decision-making bodies. By breaking down the relevant components of the proposed action and clearly illustrating both the magnitude of the impact and its importance to the community, both community members and decision makers can identify the components to redesign or potentially eliminate. Rather than fighting the entire proposal, community members can use the Leopold Matrix to identify those components of a proposal they're willing to compromise on. They can also use the Matrix to show why they may be unwilling to compromise on others, by indicating the magnitude of impacts of those components on the community.

However, for more complex decision, or those that require close deliberation among various alternatives, one of the other tools may be more appropriate. To use these tools, community member will need access to data, potentially complex analytical skills and significant resources, but the outcomes may be worth the effort.

References Cited

Dee, N., J. Baker, N. Drobny, and K. Duke. 1973. "An Environmental Evaluation System for Water Resource Planning." *Water Resources Research,* Vol. 9, No.3, pp. 523-535.

Esty, D. and Cornelius, P.K. (2002) Environmental Performance Measurement: The Global Report 2001-2002. New York, NY: Oxford University Press.

Jain, R., L.V. Urban, Gary S. Stacey and Harold Balback. 2002. *Environmental Assessment*. 2nd Edition. New York: McGraw-Hill

Lyle, J. and M. von Wodtke. 1974. “An Information System for Environmental Planning.” *Journal of the American Institute of Planners*, Vol. 40, No. 6, pp. 394-413.

Leopold, L., F. E. Clarke, B. B. Hanshaw and J. R. Baisley. 1971 “A Procedure for Evaluating Environmental Impact.” *Geological Survey Circular 645.* Washington D.C.

McHarg, Ian. 1967. *Design with Nature.* New York: Doubleday/Natural History Press.

Rickert, D., W. Schneider and A. Spieker. 1973 “A Procedure for Assessing Water Resources for Urban Planning.” *Water Resources Bulletin*, Vol. 9, No. 4, pp. 758-792.

Shopley, J.B. and R. F. Fuggle. 1984. “A Comprehensive Review of Current Environmental Impact Assessment Methods and Techniques.” *Journal of Environmental Management*, Vol. 18, pp. 25-47.

Sorenson, J.C. 1971. “A Framework for Identification and Control of Resource Degradation and Conflict in the Multiple Use of the Coastal Zone.” University of California, Berkeley.

U.S. Environmental Protection Agency (EPA) (2003) EPA’s Draft Report on the Environment 2003. Washington, DC: U.S. EPA. Available at http://www.epa.gov/indicators/

Wackernagel, M. and W. E. Reis. 1996. *Our Ecological Footprint: Reducing Human Impact on The Earth*. Gabriola Island, Canada: New Society Publishers.

Zimmerman, R. Lectures from P11.2610 Environmental Impact Assessment, New York University Wagner Graduate School of Public Service, Fall 2007.

Appendix 2-1.

EXAMPLES OF ENVIRONMENTAL IMPACT ASSESSMENT FACTORS (ENVIRONMENTAL FACTORS ONLY, EXCLUDING SOCIOECONOMIC FACTORS)

Topography
- Slope angle
- Slope length

Soils
- Type and distribution
- Depth to bedrock
- Depth to water table
  (seasonal high)
- Texture (below top six inches:
  rock, shale, clay, loam,
  sand, silt)
- Permeability (movement of water
  in inches/hr.)
- Flooding potential
- Load bearing potential
- Erosion potential*
- Fertility (humus, moisture), yield

Climate
- Temperature (mean daily and annual; variance; number of heating and cooling degree
  days – from 65° F.)
- Precipitation (rainfall frequency in Inches; snowfall)
- Wind speed and direction (wind rose)
- Relative humidity (ratio of moisture content to saturation)
- Hazardous weather conditions
  (tornados, hurricanes, hail,
  thunderstorms expressed as $
  damage, frequency)
- Ambient Air Quality
  (particulates, hydrocarbons,
  nitrogen and sulfur oxides,
  photochemical oxidants,
  carbon monoxide)

Geology
- Type, distribution, and depth of exposed rock formations
- Mineral resources

Hydrology

Surface water drainage patterns and delineation of watersheds

Physical properties of surface water (ave. & extreme flow, length, depth, width, direction; stream profiles and cross-sections)

Chemical properties of surface waters, water quality (dissolved oxygen, temperature, pH, hardness, total, suspended and dissolved solids, oil and grease, nutrients, color, chlorophyll content, fecal coli)

Biota of surface waters

Stream use and related characteristics, e.g, accessibility, shoreline, characteristics

Extent of impoundments

Ground water (depth of aquifers, yield location of aquifer recharge areas and type of surface cover, water quality, salt water intrusion)

Runoff potential

Ecology (terrestrial, aquatic, marine)

Type of plant species (location and extent of forested areas, stage in forest succession)

Type of animal species

Ecological profiles

Game and commercial species

Pest species

Rare and endangered species

Population size per species

Species diversity

Landscape and conservation resources

Acreage of wetlands

Length of shoreline

Source: R. Zimmerman, Lectures from P11.2610 Environmental Impact Assessment, New York University Wagner Graduate School of Public Service, Fall 2007.

Chapter 3. Zoning along the Bronx River

Alison Kling

Introduction

Air pollution is one environmental issue that impacts quality of life. However, many of the causes of pollution –trucks, waste transfer stations, highways, and industrial facilities—are linked to zoning and land use, which clusters these impacts in certain areas. These uses also impact quality of life by limiting opportunities for open space and recreational parkland, especially if they are grouped along a waterfront. In the South Bronx, many of the zoned uses that contribute to air pollution are also obstacles to residents who are trying to regain public access to potential parkland and green space along the Bronx River.

This report will begin with a general overview of zoning and land use along the Bronx River, starting at its mouth at the East River and ending just north of the River's exit from Bronx Park. After that context has been established, the paper moves on to examine current community environmental justice efforts, as well as a few examples of possible opportunities for brownfield remediation and use in the area.

Zoning and Land Use

East River north to Bruckner Expressway[5]

There are a few spots of green in this section of the Bronx River banks. The southernmost lot on the east side of the river is a large park with baseball fields (Soundview Park). Across the river lies the smaller Lafayette Avenue Park. Garrison Park also tops off the northernmost lot on the west side before the Bruckner (shown as a vacant lot on the map). Aside from parkland zoning, the rest of the land on either bank is zoned for medium and light manufacturing (M2-1 and M1-1)[6]. In New York City, permitted uses under M1 and M2 zoning range from dry cleaning to funeral establishments to trucking terminals to storage and more.[7] General land uses in these specific blocks include industrial/manufacturing, parking, transportation/utility, and vacant lots. The large lot at the southwest bank of the river is the Hunts Point Food Market.

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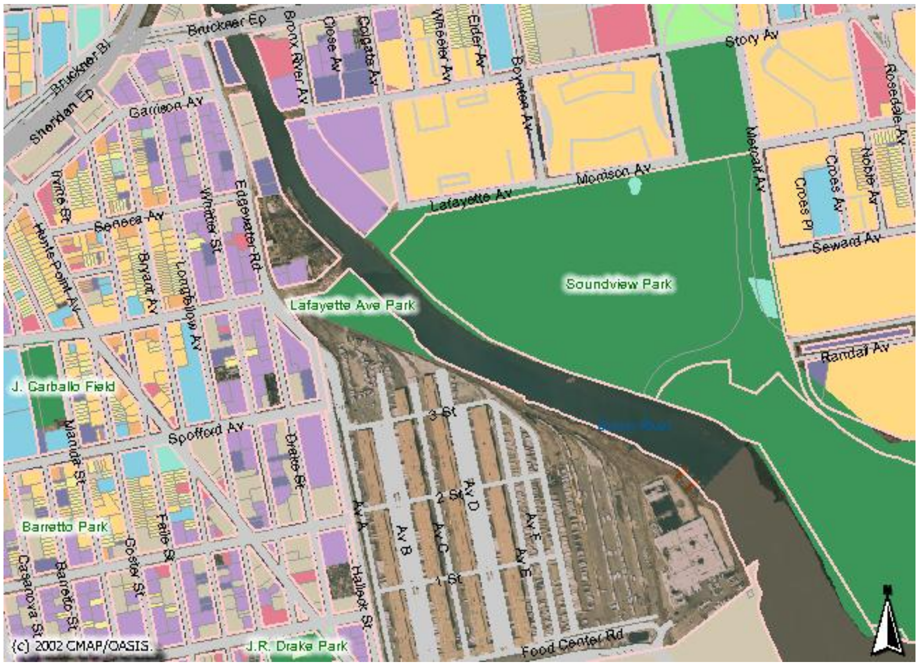
5 All maps created at and land use information from: <http://www.oasisnyc.net>. February 2006. Map Legends reflect land use categories.
6 All zoning information obtained from NYC Department of City Planning zoning maps of the Bronx. Accessed March 2006: <http://www.nyc.gov/html/dcp/html/zone/bx_zonedex.shtml>.
7 New York City Department of City Planning. Zoning Resolution web version, The City of New York: Appendix A, Index of Uses. September 9, 2004. Accessed 4/13/06: <http://www.nyc.gov/html/dcp/pdf/zone/appendixa.pdf.>



Legend:

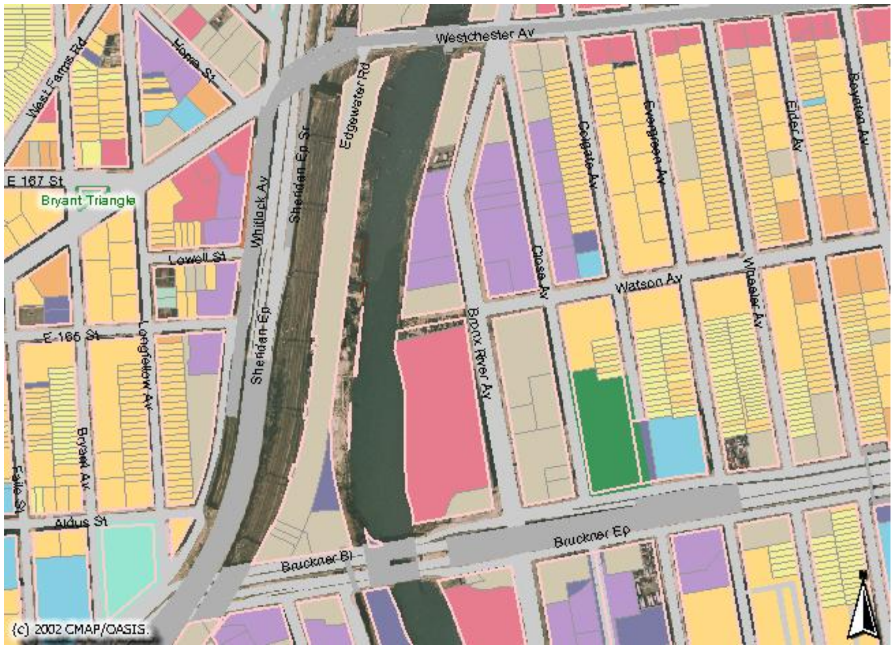
Block/Lot Boundaries
New Jersey State Parks
Green Spaces Along Streets
1 & 2 Family Residential
Commercial
Industrial

Streets
Historic Houses
NYC Parks
Cemeteries
Multi-family Residential
Institutions
Vacant Lots

Bridges/Overpasses
Community Gardens
Playgrounds
Piers
Mixed Use
Transportation & Parking
Streams, Lakes, Waterbodies

Bruckner Expressway north to Westchester Avenue

This continues a strip of land zoned for manufacturing (M1-1) around the riverbank, with the exception of Edgewater Park on the west side (between Edgewater Road and the River). This park seems to be a continuation of Garrison Park on the northern side of the Bruckner. The rest of the uses bordering the river are industrial/manufacturing, transportation/utility, or vacant lots. Amtrak (National Railroad Passenger Corporation) owns most of the land on the west side of the river, and the east side is parceled out to various commercial or manufacturing tenants. As visible on the map, the Sheridan Expressway and rail lines cut off any residential access to the water on the west side.



Legend:

	Streets	Bridges/Overpasses
Block/Lot Boundaries	Historic Houses	Community Gardens
New Jersey State Parks	NYC Parks	Playgrounds
Green Spaces Along Streets	Cemeteries	Piers
1 & 2 Family Residential	Multi-family Residential	Mixed Use
Commercial	Institutions	Transportation & Parking
Industrial	Vacant Lots	Streams, Lakes, Waterbodies

Westchester Avenue north to Cross Bronx Expressway

Up until Starlight Park, the west side of the river continues to be zoned M1-1. Uses continue to be transportation/utility, industrial/manufacturing, or vacant lots. Above 174th street, the border of Starlight Park on the west side, it is zoned R-7.

The east side zoning is a mixture of M1-1, R6, R7-1, and C8-1. The southernmost parcel is R6-1 zoned with multi-family walk-up buildings. The Bronx River Park then stretches up to East 174th Street along the water on the east side. Running along the park, on the east side, is land zoned R7-1 but owned by Amtrak and used for transportation/utility. The walk-up apartment buildings (yellow/orange) to the east are actually zoned C8-1.

North of East 174th is zoned C8-1 and owned by Amtrak, NYC Transit, or small realty companies.

Legend:

- Block/Lot Boundaries
- New Jersey State Parks
- Green Spaces Along Streets
- 1 & 2 Family Residential
- Commercial
- Industrial
- Streets
- Historic Houses
- NYC Parks
- Cemeteries
- Multi-family Residential
- Institutions
- Vacant Lots
- Bridges/Overpasses
- Community Gardens
- Playgrounds
- Piers
- Mixed Use
- Transportation & Parking
- Streams, Lakes, Waterbodies

Cross Bronx Expressway north to Bronx Park

This zoning continues up the west side to the park as R7-1, with a small C1-4 lot at the intersection of East Tremont Avenue and Boston Road for commercial office building use by Lambert Houses Community Development. The other uses are a multi-family elevator building, a lot owned by NYC Transit used for transportation/utility, and vacant land. Bronx River Park extends south from main section of the park on the west side.

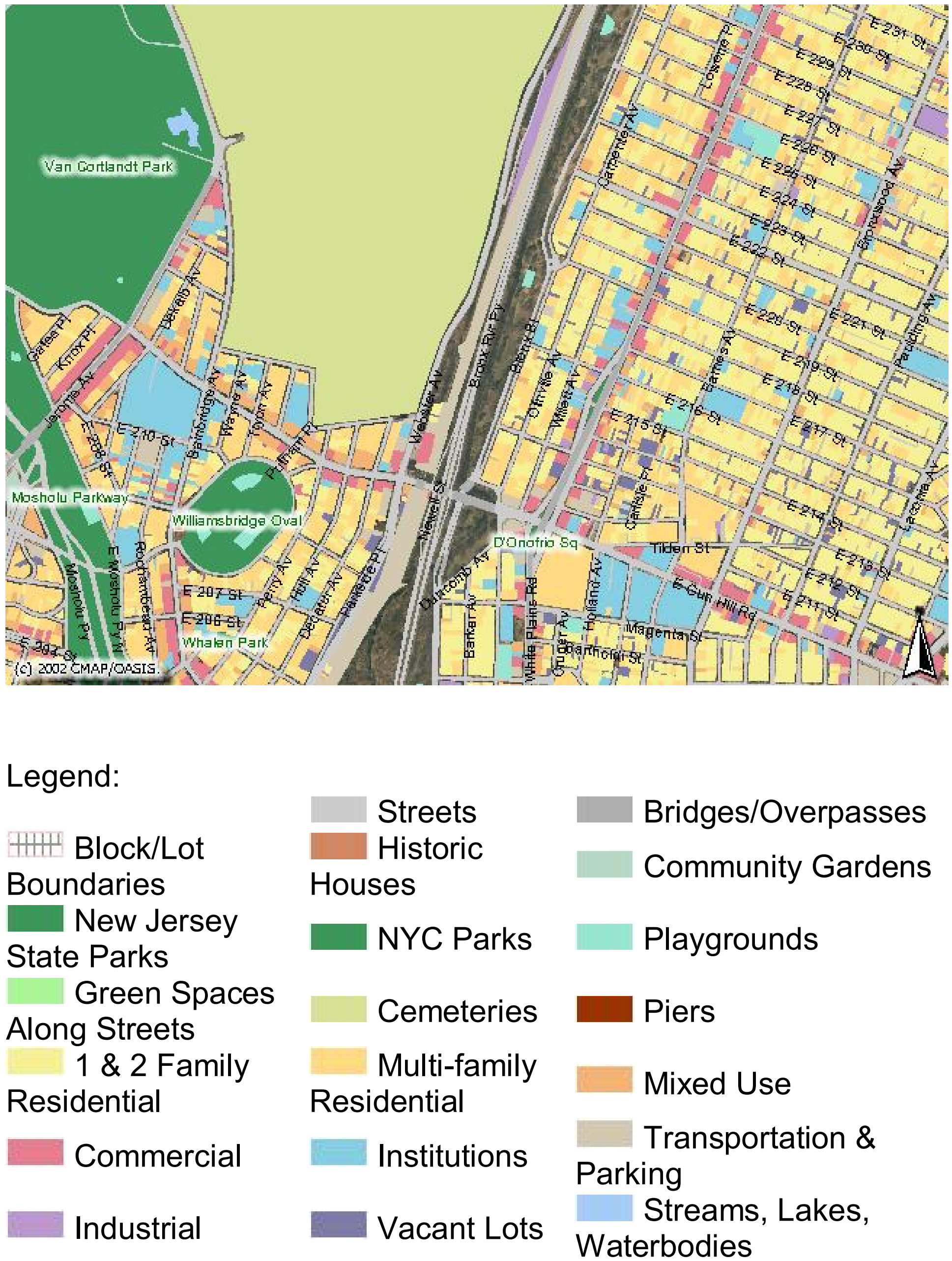
The east side of the river, however, maintains M1-1 the whole way up to the park until the River Garden Park just south of the Bronx Park. Uses are transportation/utility, industrial/manufacturing and parking.

Legend:

Block/Lot Boundaries	Streets	Bridges/Overpasses
	Historic Houses	Community Gardens
New Jersey State Parks	NYC Parks	Playgrounds
Green Spaces Along Streets	Cemeteries	Piers
1 & 2 Family Residential	Multi-family Residential	Mixed Use
Commercial	Institutions	Transportation & Parking
Industrial	Vacant Lots	Streams, Lakes, Waterbodies

North of Bronx Park

The Bronx River exits the park at the northeast corner (bottom center of map) and from there runs beside the Bronx River Parkway. Woodlawn Cemetery is on the west side, and on the east the zoning is R7-1 next to the water and R5 or R6 further inland, with some commercial overlays along White Plains Road. The Bronx River here is separated from development on the west by the cemetery and on the east by the Bronx River Parkway and Bronx Boulevard. As one can see on the map, the uses have become residential and commercial.



Zoning Map

As described above, most of the Bronx River waterfront south of the Park is taken up by M1-1 zoning and industrial land use, as well as a fair amount of transportation infrastructure, either highways or railways. As can be seen in the zoning map below[8], there is manufacturing and commercial zoning along the river for most of its path up to the park. The one peninsula of R7-1 zoning that is along the river is surrounded M1-1 and C8-1 zones, and part of it is in the middle of a highway interchange. In the larger

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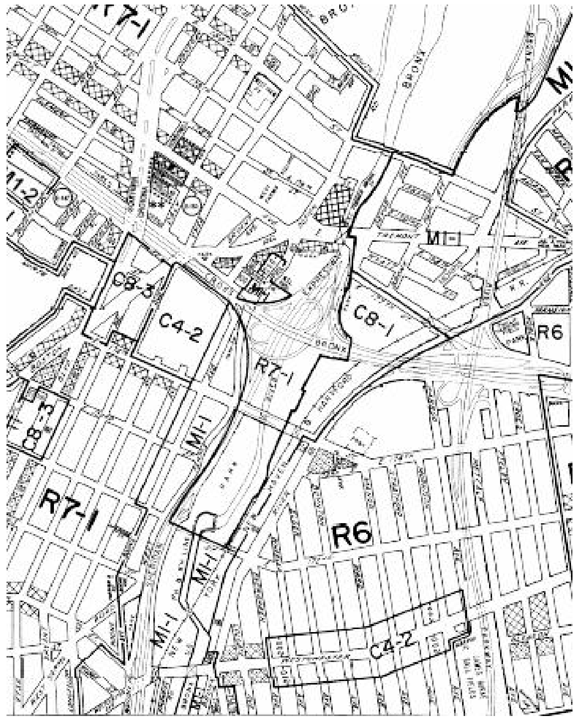
[8] Zoning map obtained from New York City Department of City Planning website. Accessed 3/29/06. <http://www.nyc.gov/html/dcp/pdf/zone/map3d.pdf>.

residential zoned areas, there is not much of a buffer between residential and industrial use. In fact, one zoning line between R7-1 and M1-1 goes through the middle of a block. North of the Park, the river is still paralleled by an expressway, but the zoning shifts to residential.



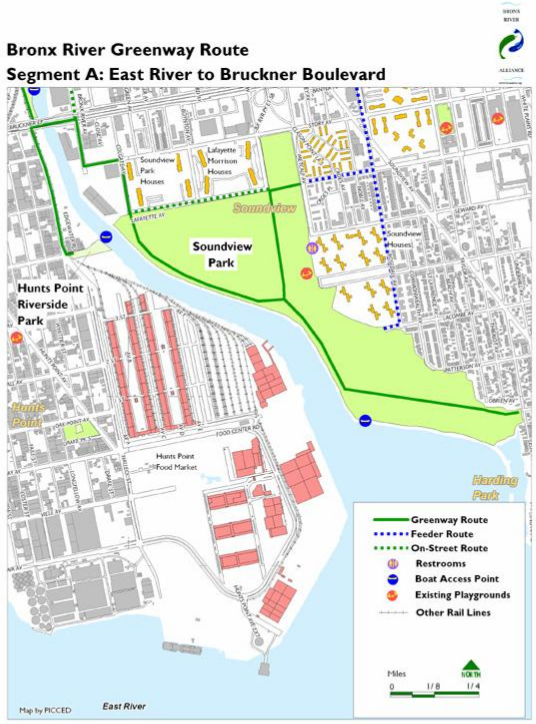
Open Space, Brownfields, and Environmental Justice

The South Bronx is an area where many minorities and low-income families live and also one that faces a disproportional burden of environmental threats. Decades of industry has left pollution in much of the soil, a network of highways crisscrosses the neighborhood and dirties the air, and the residents have few, if any, options if they want to enjoy safe and clean open space.

Current Community Action

There are many strong and committed community groups in the South Bronx working to change the environmental inequities in their neighborhoods. These individual groups include Mothers on the Move, The Point Community Development Corporation, Pratt Institute Center for Community Economic Development, Sports Foundation, Inc., Sustainable South Bronx, Youth Ministries for Peace and Justice, and We Stay/Nos Quedamos. These groups also work together under other organizational entities. This report will summarize a few of these projects and then explore some additional specific sites for possible action.

The Bronx River Alliance is an organization that brings together community groups, federal, state, and local officials, NGOs, and businesses to help restore and maintain the quality of the Bronx River. Their Greenway Program is a plan to create a 23-mile long path of open space along the river, though the Bronx up into Westchester. This plan would bring a stretch of uninterrupted green space to residents in the South Bronx who currently have no such options. As seen in the map below, the Greenway Route would enable people on both sides of the River to access Soundview Park.[9] $33 million of funding commitments for the Bronx River Greenway project has been given in equal parts by Governor Pataki, New York City, and Congressman Serrano.[10]



The New York City Environmental Justice Alliance is another umbrella organization working for positive change in low-income and minority communities. Open space equity and brownfield redevelopment are two of their primary campaigns.[11] They are involved with environmental justice projects undertaken by some of their partners in the Bronx. The first is the cleanup and design of a River House for Starlight Park by Youth Ministries for Peace and Justice (YMPJ) with help from the Pratt Institute Center for Community Economic Development (PICCED). Starlight Park was the site of a Con Edison Manufactured Gas Plant and needs remediation of contaminated soil before any improvements can begin; Con Edison is responsible for cleaning up the site.[12] A second

[9] Bronx River Alliance, "Bronx River Alliance Greenway Program." Bronx River Alliance, 2006. Accessed 3/6/06: <http://www.bronxriver.org/whatWeDoGreenWay.cfm>.
[10] Youth Ministries for Peace and Justice, Bronx River Waterfront Development Fact Sheet. YMPJ, 6/28/05. Conversation July 11, 2005.
[11] New York City Environmental Justice Alliance, "NYCEJA Campaigns." NYCEJA, 2006. Accessed 3/28/06: <http://www.nyceja.org/index.html>.
[12] YMPJ, ibid.

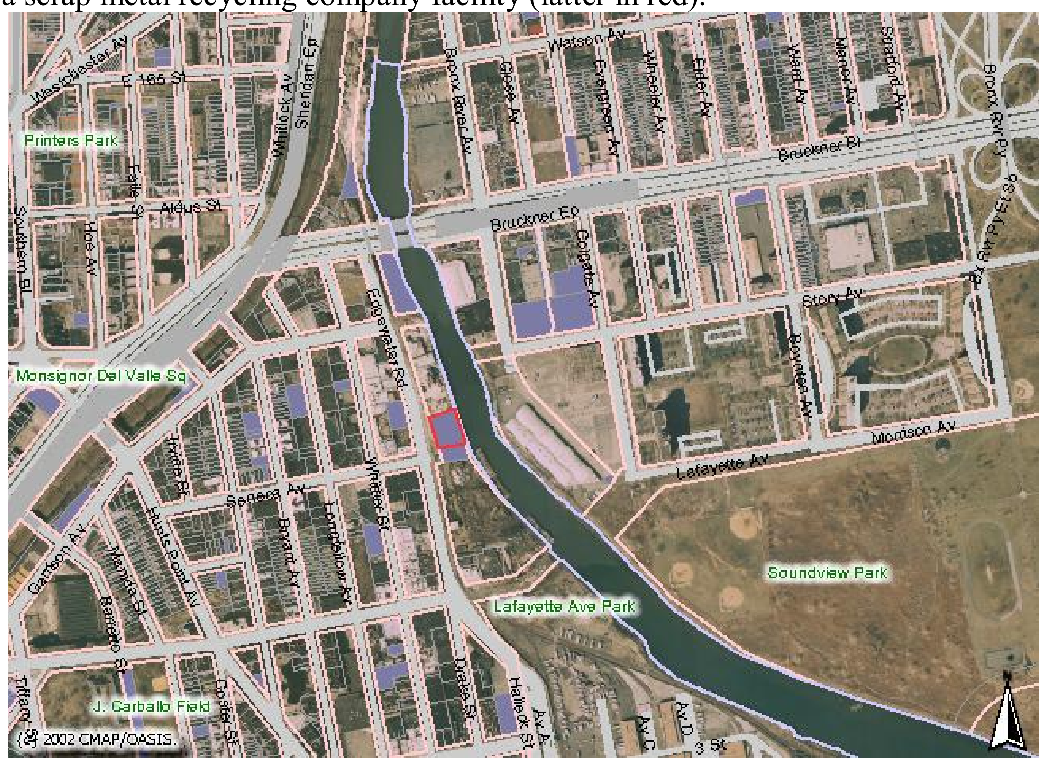
project is the community-based plan to tear down the Sheridan Expressway, put together by the Southern Bronx River Watershed Alliance, a partnership of community groups. This plan, which would provide alternate routes for truck traffic to the Hunts Point Food Market and turn the open space from the Sheridan Expressway site over to the public, is an alternative to expansion of the Expressway, which would further impede community access to the River.[13]

These are just a few of the major projects that community groups in the South Bronx are collaborating on and fighting for, but they all involve the same principles of active community involvement in planning and environmental justice.

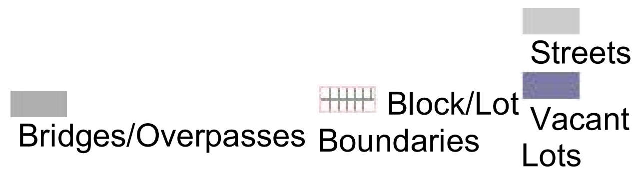
Future Possibilities: Brownfields

As the South Bronx is an area with an industrial and manufacturing land use history, it makes sense to turn to brownfield redevelopment as a powerful tool for community improvement (as the community has already started to do).

The map below shows vacant lots in Hunts Point (in purple). Some of these are near current parks (one of them actually is a park, Garrison Park just south of the Bruckner), and some are scattered among residential buildings. Former uses include a gas station and a scrap metal recycling company facility (latter in red).[14]



[13] Southern Bronx River Watershed Alliance, "The Community Plan for the Sheridan". SBRWA, 2006. Accessed 3/28/06: < http://www.southbronxvision.org/complan.html>.
[14] Information from www.oasisnyc.net and NYC Buildings Department (through Oasis).



Depending on the old use of the land, these sites could be redeveloped for new uses or would have to be remediated. If the soil has been contaminated, the site is a brownfield.

Redeveloping brownfields is usually seen as a cost burden, but the end result brings many benefits to a neighborhood. A cleaned and usable brownfield removes environmental hazards and contamination, lowering health risks for the surrounding population. The end result also removes ugly eyesores, encourages infill development (therefore reducing sprawl), creates jobs, housing, and new tax revenue, and in general leads to economic development.[15]

In conjunction with the collaborative efforts being undertaken to create green space in the South Bronx, there are many brownfield programs that could be taken advantage of to try and regain the use of these vacant lots. If contaminated, there are several methods of cleaning up the ground: removal, containment, biodegradation (using bacteria or microbes to naturally break down pollutants)[16], and phytoremediation (using living plants to clean up low levels of contamination)[17] are a few possible solutions.

Funding is often a major deterrent to taking action about brownfields, but there are many government programs that provide funding in some way for brownfields, whether it is to study the area to determine the need for cleanup, or the actual cleanup itself. A complete list of federal grants is provided by the EPA and a few are mentioned here.[18] The EPA itself of course gives out grants, mostly to governments and universities. The National Oceanographic and Atmospheric Association gets involved with coastal communities that are trying to clean up their waterfronts. The National Institute of Environmental Health Services gives support to low-income communities in the form of research and training programs. The National Park Service offers workshops on greenway development and complementing brownfield remediation. More programs can be found at the EPA website.

New York State also provides grants through its Brownfields Opportunity Areas program, which was signed into law in 2003. Applications are generally accepted through June for the following year.[19] New York City has also received funds and grants

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[15] Northeast-Midwest Institute, "Brownfield Basics: An Issue Primer." NEMW, May 31, 2005. Accessed 6/3/05: <http://www.nemw.org/BFprimer.pdf>.

[16] Michigan State University, sponsored by National Institute of Environmental Health Services, "EnviroTools: Remediation Overview." Michigan State University, May 20, 2005. Accessed 6/3/05: <http://www.envirotools.org/remediation/remediation_overview.shtml>.

[17] Environmental Protection Agency, "Brownfields Technology Primer: Selecting and Using Phytoremediation for Site Cleanup". EPA, July 2001. Accessed 6/3/05: <http://www.brownfieldstsc.org/pdfs/phytoremprimer.pdf>.

[18] Environmental Protection Agency, "Brownfields Federal Programs Guide." EPA, August 2005. Accessed 3/29/06: <http://www.epa.gov/brownfields/partners/bf_fed_pr_gd.htm>.

[19] New York State Department of State Coastal Resources Online,"New York State Brownfield Opportunity Areas Program." NYS Waterfronts, 2004. Accessed 3/29/06: <http://www.nyswaterfronts.com/grantopps_BOA.asp>.

from the EPA to assist in brownfield cleanup, some specifically geared towards low-income and minority communities.[20] Some of these programs may be of use to community groups who are targeting specific sites or want to complement the environmental justice efforts they are already undertaking.

[20] Environmental Protection Agency, "Brownfields 2005 Grant Fact Sheet." EPA, 2005. Accessed May 18, 2005. <http://www.epa.gov/swerosps/bf/05grants/newyork.htm>.

Appendix 3-1.
Explanation of Zoning Terms

M1 Light Manufacturing Districts (High Performance)
"These districts are designed for a wide range of manufacturing and related uses which can conform to a high level of performance standards. Manufacturing establishments of this type, within completely enclosed buildings, provide a buffer between Residence (or Commercial) Districts and other industrial uses which involve more objectionable influences. New residential development is excluded from these districts, except for joint living-work quarters for artists in M1-5A and M1-5B Districts, dwelling units in M1-5M and M1-6M Districts, and dwelling units in M1-1D, M1-2D,M1-3D, M1-4D and M1-5D Districts, where authorized by the City Planning Commission, both to protect residences from an undesirable environment and to ensure the reservation of adequate areas for industrial development."

M2 Medium Manufacturing Districts (Medium Performance)
"These districts are designed for manufacturing and related activities which can meet a medium level of performance standards. Enclosure of such activities is not normally required except in areas along the boundary of a Residence District. No new residences or community facilities are permitted." [21]

R3-2, R4, R4B, R5, R6, R7, R8, R9 and R10 - General Residence Districts
"These districts are designed to provide for all types of residential buildings, in order to permit a broad range of housing types, with appropriate standards for each district on density, open space, and spacing of buildings. However, R4B Districts are limited to single- or two-family dwellings, and zero lot line buildings are not permitted in R3-2, R4, (except R4-1 and R4B), and R5 (except R5B) Districts. The various districts are mapped in relation to a desirable future residential density pattern, with emphasis on accessibility to transportation facilities and to various community facilities, and upon the character of existing development. These districts also include community facilities and open uses which serve the residents of these districts or are benefitted by a residential environment. R7-3 and R9-1 Districts may be mapped only within the #waterfront area# and in the #Special Mixed Use District# and, in addition, R7-3 Districts may be mapped in the #Special Long Island City Mixed Use District#."[22]

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[21] All manufacturing zoning text from: New York City Department of City Planning. Zoning Resolution web version, The City of New York: Article IV: Manufacturing District Regulations: Chapter 1, Statement of Legislative Intent. December 21, 1989. Accessed 4/13/06: <http://www.nyc.gov/html/dcp/pdf/zone/art04c01.pdf.>

[22] All residential zoning text from: New York City Department of City Planning. Zoning Resolution web version, The City of New York: Article II: Residence District Regulations: Chapter 1, Statement of Legislative Intent. July 26, 2001. Accessed 4/13/06: <http://www.nyc.gov/html/dcp/pdf/zone/art02c01.pdf.>

C8 General Service Districts

"These districts are designed to provide for necessary services for a wider area than is served by the Local Service Districts. Since these service establishments often involve objectionable influences, such as noise from heavy service operations and large volumes of truck traffic, they are incompatible with both residential and retail uses. New residential development is excluded from these districts."[23]

[23] All commercial zoning text from: New York City Department of City Planning. Zoning Resolution web version, The City of New York: Article III: Commercial District Regulations: Chapter 1, Statement of Legislative Intent. May 13, 1982. Accessed 4/13/06: <http://www.nyc.gov/html/dcp/pdf/zone/art03c01.pdf.>

Chapter 4. Air Quality Monitoring, Spatial Location and Demographic Profiles

Carlos E. Restrepo

The Wagner/ICIS South Bronx Environmental Health and Policy Study Phase II & III report included a detailed analysis and discussion of the height of New York State Department of Environmental Conservation (DEC) air pollution monitoring stations and compared DEC pollution measurements taken 15 meters above ground to measurements taken by the NYU School of Medicine team using a mobile van at a height of 4 meters above ground.[24] In this section of the Phase IV report we include a complementary analysis of the spatial coverage and location of the New York State Department of Environmental Conservation's (DEC) ambient air quality monitoring stations. Demographic profiles for the areas around these monitoring stations were obtained from Census 2000 5-digit Zip Code Tabulation Areas in order to compare air quality with minority and low-income prevalence in different parts of New York City and potential health risks. Data on DEC's monitoring stations in New York City can be found online at: http://www.dec.ny.gov/chemical/29310.html. That web page also includes maps of the locations of DEC's air pollution monitoring stations by type of pollutant. The DEC monitoring stations included in the analysis presented here are those that were operational in the year 2006.

Table 1 lists the name and ID of the DEC monitoring stations in New York City that measured air pollution concentrations in 2006. The table also includes locational information (borough and zip code) and the pollutants measured. The current list of monitoring stations and the pollutants measured reflect the interest among environmental policymakers and the academic community in monitoring the concentrations of fine particulate matter ($PM_{2.5}$). Detailed information about the concentrations of these pollutants, their health effects and the environmental standards established to regulate them was included in the Wagner/ICIS South Bronx Environmental Health and Policy Study Phase I report.[25] As described in the Phase I report New York City is currently a non-attainment area for $PM_{2.5}$ as the annual standard is exceeded. $PM_{2.5}$ has also been associated with numerous morbidity and mortality health outcomes.

In the case of $PM_{2.5}$ there are two measurement methods used by these stations. An F next to $PM_{2.5}$ refers to the Federal Reference Method. These measurements are used for decisions regarding the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$. A T next to $PM_{2.5}$ refers to the TEOM (Tapered Element Oscillating Mirobalance) method.

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[24] The full Wagner/ICIS South Bronx Environmental Health and Policy Study Phase II and III report is available on-line at: http://www.icisnyu.org/admin/files/ICISPhaseIIandIIIreport.pdf. This material was also included in: Carlos Restrepo, Rae Zimmerman, George Thurston, Jessica Clemente, John Gorczynski, Mianhua Zhong, Martin Blaustein, Lung Chi Chen. 2004. "A comparison of ground-level air quality data with New York State Department of Environmental Conservation monitoring stations data in South Bronx, New York." *Atmospheric Environment*. 38 5295-5304.

[25] See Chapter 4 of the Wagner/ICIS South Bronx Environmental Health and Policy Study Phase I report, available on-line at: http://www.icisnyu.org/admin/files/PhaseIWagner930.pdf .

TEOM measurements are considered acceptable for Air Quality Index (AQI) estimates but not for NAAQS decisions.[26]

Table1. New York State Department of Environmental Conservation (DEC) Monitoring Stations, 2006

DEC Monitoring Station Name	DEC Monitoring Station ID	Borough	Zip Code	Pollutants
JHS 45	7093-08	Manhattan	10035	PM2.5 (F)
PS 59	7093-10	Manhattan	10022	PM2.5 (F), SO2, CO, NO2
IS 143	7093-15	Manhattan	10033	PM2.5 (T)
PS 64	7093-16	Manhattan	10009	PM2.5 (T)
Manhattanville PO	7093-17	Manhattan	10027	PM2.5 (T)
Park Row	7093-18	Manhattan	10038	PM2.5 (T) (WTC)
PS 19	7093-21	Manhattan	10003	PM2.5 (F)
Canal Street	8100-02	Manhattan	10013	PM2.5 (Fand T)
Morrisania	7094-05	Bronx	10452	PM2.5 (F)
Botanical Garden	7094-06	Bronx	10458	PM2.5 (F), SO2, CO, O3, NO2
IS 52	7094-07	Bronx	10455	PM2.5 (F), SO2, O3, NO2
IS 52	7094-07	Bronx	10455	PM2.5 (T)
IS 74	7094-08	Bronx	10474	PM2.5 (T)
PS 154	7094-09	Bronx	10454	PM2.5 (T)
PS 314	7095-07	Brooklyn	11220	PM2.5 (T)
JHS 126	7095-43	Brooklyn	11222	PM2.5 (F)
IS 293	7095-44	Brooklyn	11201	PM2.5 (T)
PS 274	7095-98	Brooklyn	11221	PM2.5 (T)
Maspeth Library	7096-13	Queens	11378	PM2.5 (T)
Queens College 2	7096-15	Queens	11367	PM2.5 (F), SO2, CO, O3, NO2
PS 219	7096-14	Queens	11367	PM2.5 (F and T)
Susan Wagner	7097-01	Staten Island	10314	PM2.5 (F)
Port Richmond	7097-03	Staten Island	10302	PM2.5 (F)
Freshkills West	7097-17	Staten Island	10314	PM2.5 (T)
PS 44	7097-18	Staten Island	10303	PM2.5 (T)
Brooklyn Transit	8100-03	Brooklyn	11201	CO

Source: Table constructed using DEC data available at: http://www.dec.ny.gov/chemical/29310.html

Table 2 describes some of the socioeconomic characteristics of the people living in the area where the monitoring stations are located. These data were obtained from Census 2000 using the 5 digit Zip Code Tabulation Areas, which are representations of U.S.

[26] See New York State Department of Environmental Conservation: http://www.dec.ny.gov/chemical/29310.html

Postal Service ZIP Code service areas built by aggregating Census 2000 block data.[27] The variables chosen refer to race, ethnicity and income and were obtained from Summary File 3 of the U.S. Census 2000.[28]

The number of stations that monitor pollutants other than PM2.5 are limited in number. With the exception of ozone, which sometimes exceeds the EPA standard in the summer months, all the pollutants regulated by the NAAQS are currently well within the established ambient pollution standards. However, some communities could benefit substantially from knowing more about the concentration of pollutants such as NO_2, SO_2 and CO which are good proxies for pollutants associated with traffic. One station in Manhattan, two in the Bronx and one in Queens measure the concentration of these other pollutants. In the case of Manhattan there is no station in Harlem that measures these other pollutants despite the fact that the area has very high asthma rates.

In terms of the socio-economic characteristics of the zip codes where the stations are located there is much variety in terms of the figures, ranging from very poor to very wealthy, and from predominantly white to predominantly minority communities, often exceeding the borough and city-wide averages.

[27] See U.S. Census Bureau: http://www.census.gov/geo/ZCTA/zcta.html - access date May 16, 2003.
[28] See U.S. Census – American FactFinder: http://factfinder.census.gov/servlet/BasicFactsServlet

Table 2. Monitoring Stations: Socioeconomic Characteristics of Zip Codes around Them

Zip Code	Pollutants	Population	White (%)	Black (%)	Hispanic (%)	Asian (%)	Individuals below poverty level (%)	Per capita income (1999)
10035	PM2.5 (F)	32,702	20.8	48.7	50	0.9	43.7	10,457
10022	PM2.5 (F), SO2, CO, NO2	30,642	89.8	1.2	4.8	6.6	4.9	95,196
10033	PM2.5 (T)	58,259	34.6	8.3	74.3	1.8	27.7	15,640
10009	PM2.5 (T)	58,595	60	10.5	30.2	10.1	22.3	27,460
10027	PM2.5 (T)	56,168	24	54.6	22.5	5.8	35.5	16,769
10038	PM2.5 (T) (WTC)	15,574	47.5	9.8	18	31.8	26.2	25,926
10003	PM2.5 (F)	53,673	77.6	4.4	7.6	12.1	12.2	53,591
10013	PM2.5 (Fand T)	25,042	44.2	4.8	4.7	45.9	21	40,820
10452	PM2.5 (F)	72,138	16.6	36	64.7	1.3	41.3	9,033
10458	PM2.5 (F), SO2, CO, O3, NO2	77,840	31.3	23.2	58.8	4.7	39.4	10,415
10455	PM2.5 (F and T), SO2, O3, NO2	37,465	23	27.6	74.7	0.7	40.7	9,403
10474	PM2.5 (T)	11,354	25.8	34.3	71.1	0.5	48.4	7,030
10454	PM2.5 (T)	34,976	24.5	29.9	73.2	0.4	48.4	8,831
11220	PM2.5 (T)	92,718	36.2	3.2	46.2	29	27.9	13,141
11222	PM2.5 (F)	39,360	80.3	1.6	19.5	3.8	17.7	17,562
11201	PM2.5 (T)	47,746	62.6	20.7	14.4	6.8	20	44,779
11221	PM2.5 (T)	76,363	8.8	64.7	34.4	0.9	36.4	10,890
11378	PM2.5 (T)	34,053	81.9	0.7	19.1	6.1	9.7	20,777
11367	PM2.5 (F), SO2, CO, O3, NO2	38,216	61.1	8.9	15	17	12.6	21,522
11367	PM2.5 (F and T)	38,216	61.1	8.9	15	17	12.6	21,522
10314	PM2.5 (F)	84,821	81.5	3	8.4	10.8	6.6	25,216
10302	PM2.5 (F)	16,406	60.5	19	25.7	3	17.5	18,798
10314	PM2.5 (T)	84,821	81.5	3	8.4	10.8	6.6	25,216
10303	PM2.5 (T)	23,530	42.1	34.1	27.6	5.2	17.4	16,722
11201	CO	47,746	62.6	20.7	14.4	6.8	20	44,779

Source: Table constructed using DEC data and Census 2000 data. Locational data for the stations was obtained from DEC's 2007 Annual Monitoring Network Plan. Census data is available online at: http://factfinder.census.gov/servlet/BasicFactsServlet.

Chapter 5. Hospital Admissions for Selected Respiratory and Cardiovascular Diseases in Bronx County, New York

Carlos E. Restrepo

A number of epidemiology studies have found important associations between air pollution and cardiovascular and respiratory disease morbidity and mortality.[29] In the South Bronx Environmental Health and Policy Study Phase I Report we included a detailed review of the literature on the association between air pollution and asthma.[30] In this section we examine the spatial variation at the zip code level of hospital admissions records for Bronx County for selected cardiovascular and respiratory diseases. The data were obtained from www.infoshare.org and the original source of the data is the New York Statewide Planning & Research Cooperative System (SPARCS) database. The data are for 2005 the latest year for which data are available at the time of writing of this report. However, Census population data from the year 2000 were used in estimating rates of hospital admissions and to standardize the values. These population figures are considered the most accurate. Table 1 includes the population data for Bronx County at the zip code level and Figure 1 shows these figures as part of a map of Bronx County. As the table and figure show population is not evenly distributed across Bronx County and this reflects the different land uses and socio-economic characteristics of each zip code.

Table 1. Population in Bronx County by Zip Code

Area Name	Percent in Area	Population
New York City	100	8008278
Bronx	100	1332650
10451 - Melrose	100	41021
10452 - Highbridge	100	71802
10453 - Morris Heights	100	76928
10454 - Mott Haven/Port Morris	100	35012
10455 - The Hub/Longwood	100	37482
10456 - Morrisania	100	76868
10457 - Tremont/East Tremont	100	69259
10458 - Belmont/Fordham/Bedford Park	100	77699
10459 - Longwood/Morrisania	100	39174
10460 - West Farms/Crotona	100	53505
10461 - Westchester/Morris Park	100	49916
10462 - Parkchester/Van Nest	100	72159
10463 - Kingsbridge (Bronx only)	88.5	57283
10464 - City Island	100	4625

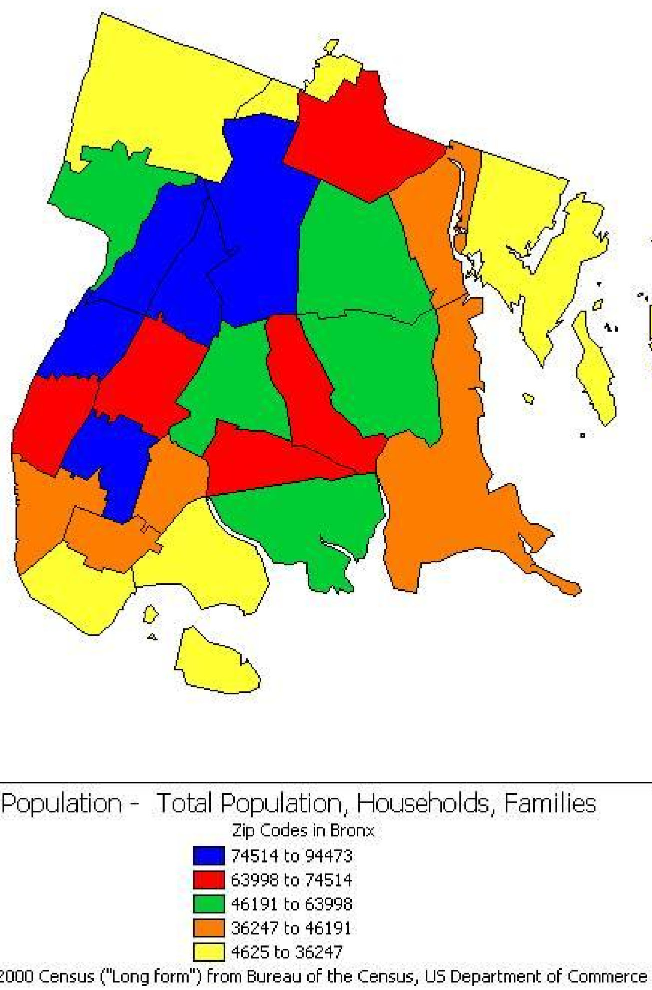
[29] See Leikauf, George D., Sharon Kline, Roy E. Albert, C. Stuart Baxter, David I. Bernstein, Jonathan Bernstein and C. Ralph Buncher. "Evaluation of a Possible Association of Urban Air Toxics and Asthma." *Environmental Health Perspectives*. Vol. 103, Supplement 6, September 1995. Pages 253-271; and Dockery DW, Pope CA 3rd, Xu X, Spengler JD,Ware JH, Fay ME, et al. 1993. "An association between air pollution and mortality in six U.S. cities." *New England Journal of Medicine* 329:1753-9.

[30] See Restrepo, Carlos. 2002. Asthma and Air Pollution: A Literature Review. In Wagner/ICIS South Bronx Environmental Health and Policy Study Phase I Report. Chapter 5. Available online: http://www.icisnyu.org/admin/files/PhaseIWagner930.pdf.

10465 - Throgs Neck/Country Club	100	42466
10466 - Wakefield	100	68638
10467 - Norwood/Williamsbridge	100	94473
10468 - University Heights	100	78717
10469 - Williamsbridge/Baychester	100	63700
10470 - Woodlawn/Wakefield	100	15867
10471 - Riverdale/Fieldston	100	23415
10472 - Soundview	100	64296
10473 - Clasons Point	100	56139
10474 - Hunts Point	100	11361
10475 - Co-op City/Eastchester	100	38065
11370 - Jackson Heights-Rikers Island (Bronx only)	100	12780

Source: Census 2000 data obtained from www.infoshare.org.

Figure 1. Total Population in Bronx County by Zip Code



Source: Mapped using www.infoshare.org.

The observed differences in population at the zip code level are very important in comparing different geographical areas. Some areas may have significantly higher hospital admissions records for a particular disease relative to others but that could also be a reflection of significantly higher population values. When the values are standardized by population to obtain rates of hospital admission per 1,000 or per 10,000 people one obtains a more meaningful indicator to compare different geographical areas such as different zip codes. The rest of this section of the report presents data and figures on hospital admissions for selected disease categories. Part I includes data on pulmonary diseases including acute upper respiratory infections, acute bronchitis and bronchiolitis, bronchitis nos, chronic bronchitis, emphysema, asthma, and chronic airway obstruction. Part II includes data on hospital admissions for the following cardiovascular diseases: acute myocardial infarction, ischemic heart disease, angina pectoris, and chronic ischemic heart disease.

Part I. Pulmonary Diseases

A. Acute Upper Respiratory Infections

Acute upper respiratory infections refer to any infection of the upper respiratory tract. Table 2 shows the data. The rate of hospital admissions for acute upper respiratory infections per 10,000 people for New York City is 2.04. In Bronx County these rates vary considerably by zip code, ranging from 0 to 5.46. Several zip codes have values significantly higher than the New York City figure. Figure 2 shows total number of hospital admissions for acute upper respiratory infections by zip code for Bronx County. In terms of total numbers there are also important differences, with the zip codes shaded in blue having the highest overall numbers.

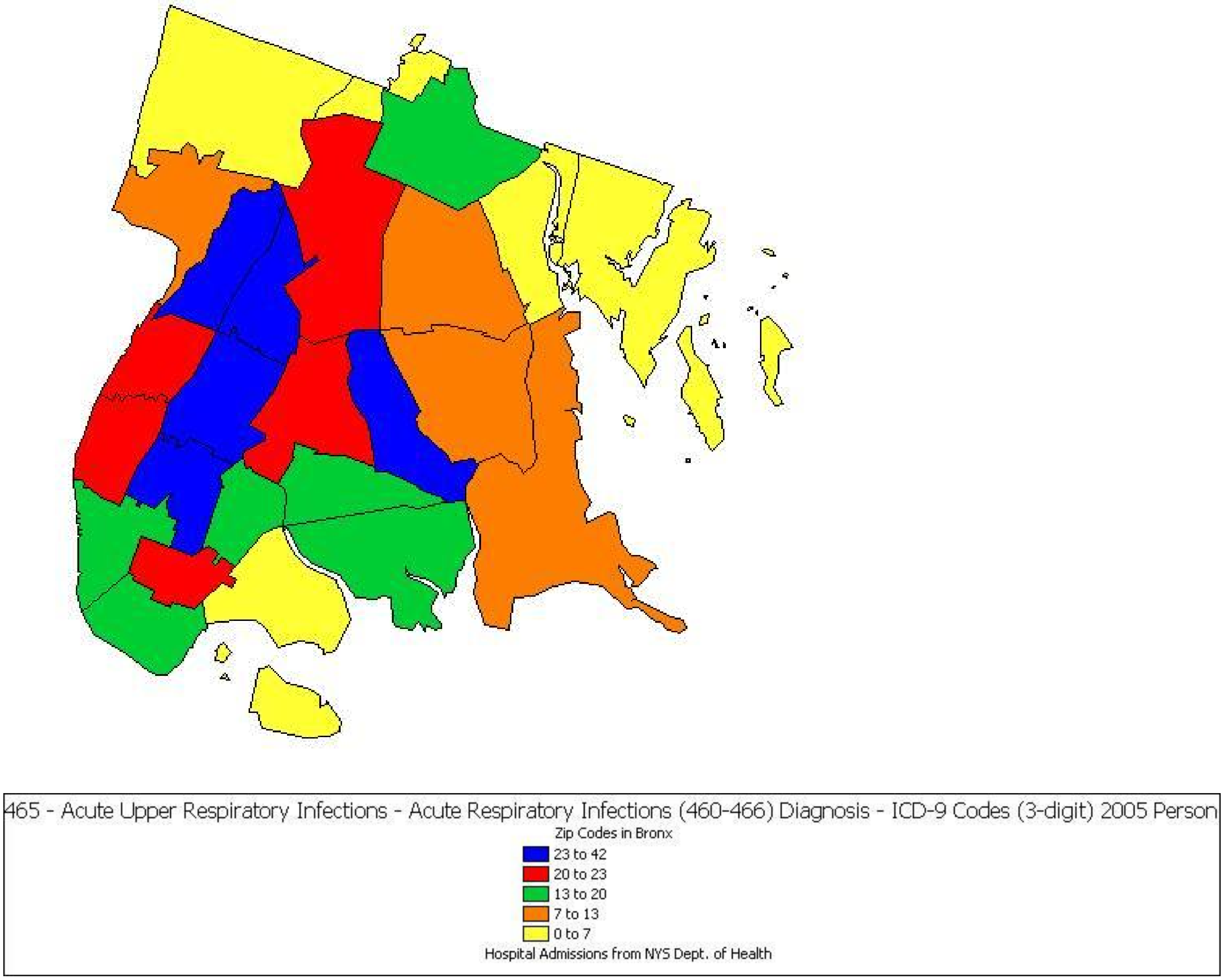
Table 2. Hospital Admissions for Acute Upper Respiratory Infections

Area Name	**Percent in Area**	**465 - Acute Upper Respiratory Infections**	**Population**	**Hospital Admissions per 10,000 people**
New York City	100	1634	8008278	2.04
Bronx	100	404	1332650	3.03
10451 - Melrose	100	15	41021	3.66
10452 - Highbridge	100	20	71802	2.79
10453 - Morris Heights	100	20	76928	2.60
10454 - Mott Haven/Port Morris	100	16	35012	4.57
10455 - The Hub/Longwood	100	20	37482	5.34
10456 - Morrisania	100	42	76868	5.46
10457 - Tremont/East Tremont	100	34	69259	4.91
10458 - Belmont/Fordham/Bedford Park	100	25	77699	3.22
10459 - Longwood/Morrisania	100	19	39174	4.85
10460 - West Farms/Crotona	100	21	53505	3.92
10461 - Westchester/Morris Park	100	12	49916	2.40

10462 - Parkchester/Van Nest	100	25	72159	3.46
10463 - Kingsbridge (Bronx only)	88.5	9	57283	1.57
10464 - City Island	100	1	4625	2.16
10465 - Throgs Neck/Country Club	100	8	42466	1.88
10466 - Wakefield	100	14	68638	2.04
10467 - Norwood/Williamsbridge	100	21	94473	2.22
10468 - University Heights	100	26	78717	3.30
10469 - Williamsbridge/Baychester	100	11	63700	1.73
10470 - Woodlawn/Wakefield	100	0	15867	0.00
10471 - Riverdale/Fieldston	100	5	23415	2.14
10472 - Soundview	100	17	64296	2.64
10473 - Clasons Point	100	14	56139	2.49
10474 - Hunts Point	100	4	11361	3.52
10475 - Co-op City/Eastchester	100	4	38065	1.05
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 2. Total Acute Upper Respiratory Infections by Zip Code, Bronx County



Source: Mapped using www.infoshare.org.

In Table 3 the hospital admissions per 10,000 people for acute upper respiratory infection are ranked in descending order by zip code for Bronx County. Morrisania has the highest hospital admission rate for this disease.

Table 3. Hospital Admissions per 10,000 people for Acute Upper Respiratory Infection by zip code, Bronx County

Area Name	**Hospital Admissions per 10,000 people**
10456 - Morrisania	5.46
10455 - The Hub/Longwood	5.34
10457 - Tremont/East Tremont	4.91
10459 - Longwood/Morrisania	4.85
10454 - Mott Haven/Port Morris	4.57

10460 - West Farms/Crotona	3.92
10451 - Melrose	3.66
10474 - Hunts Point	3.52
10462 - Parkchester/Van Nest	3.46
10468 - University Heights	3.30
10458 - Belmont/Fordham/Bedford Park	3.22
Bronx County	**3.03**
10452 - Highbridge	2.79
10472 - Soundview	2.64
10453 - Morris Heights	2.60
10473 - Clasons Point	2.49
10461 - Westchester/Morris Park	2.40
10467 - Norwood/Williamsbridge	2.22
10464 - City Island	2.16
10471 - Riverdale/Fieldston	2.14
New York City	**2.04**
10466 - Wakefield	2.04
10465 - Throgs Neck/Country Club	1.88
10469 - Williamsbridge/Baychester	1.73
10463 - Kingsbridge (Bronx only)	1.57
10475 - Co-op City/Eastchester	1.05
10470 - Woodlawn/Wakefield	0.00
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Data obtained from www.infoshare.org.

B. Acute Bronchitis and Bronchiolitis

The figures for acute bronchitis and bronchiolitis are shown in Tables 4 and 5 and in Figure 3.

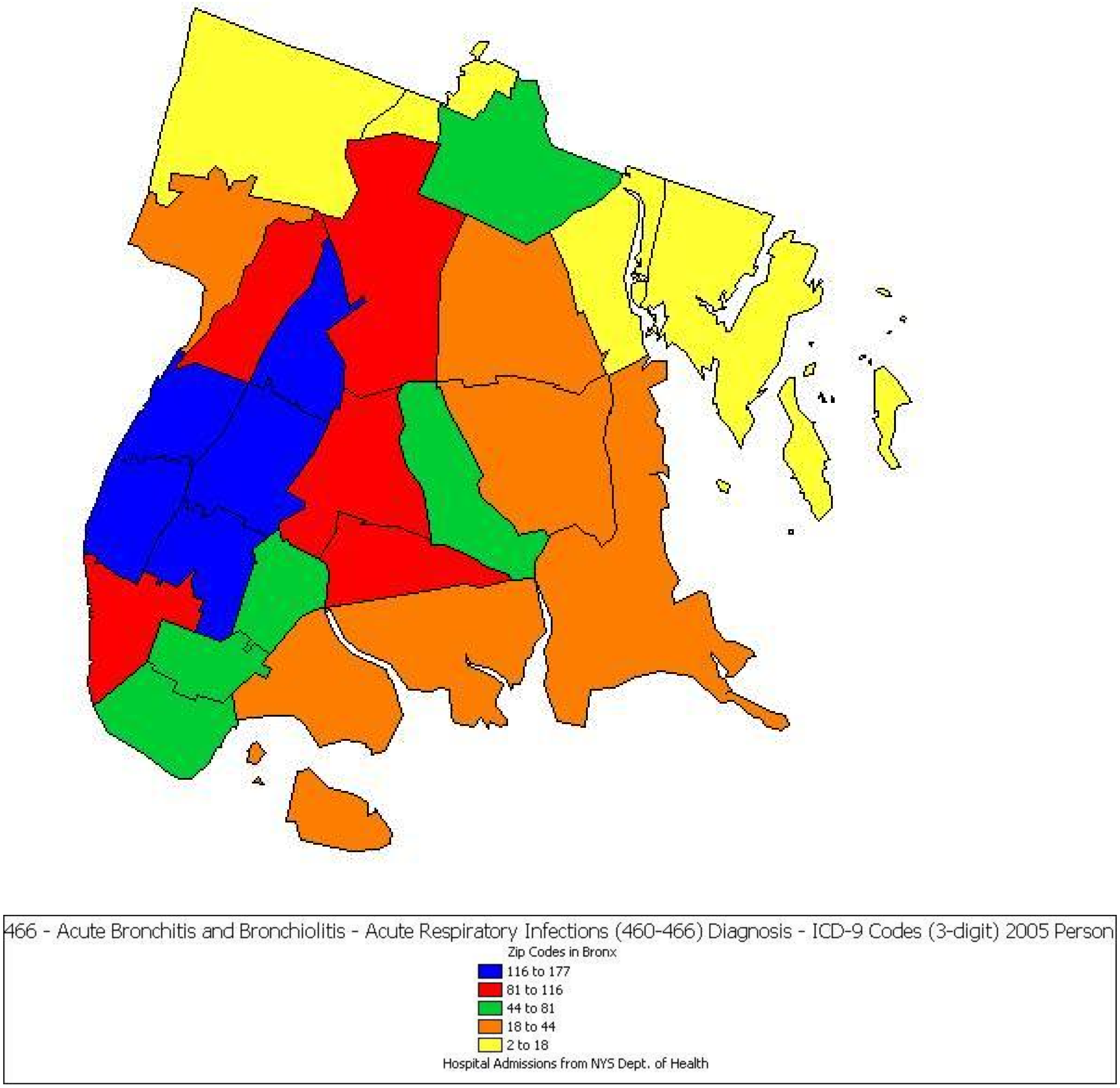
Table 4. Hospital Admissions for Acute Bronchitis and Bronchiolitis by zip code, Bronx County

Area Name	**Percent in Area**	**466 - Acute Bronchitis and Bronchiolitis**	**Population**	**Hospital Admissions per 10,000 People**
New York City	100	6222	8008278	7.77
Bronx	100	1759	1332650	13.20
10451 - Melrose	100	81	41021	19.75
10452 - Highbridge	100	154	71802	21.45
10453 - Morris Heights	100	151	76928	19.63
10454 - Mott Haven/Port Morris	100	65	35012	18.57
10455 - The Hub/Longwood	100	80	37482	21.34
10456 - Morrisania	100	177	76868	23.03
10457 - Tremont/East Tremont	100	163	69259	23.53
10458 - Belmont/Fordham/Bedford Park	100	125	77699	16.09
10459 - Longwood/Morrisania	100	70	39174	17.87
10460 - West Farms/Crotona	100	107	53505	20.00
10461 - Westchester/Morris Park	100	23	49916	4.61
10462 - Parkchester/Van Nest	100	53	72159	7.34
10463 - Kingsbridge (Bronx only)	88.5	40	57283	6.98
10464 - City Island	100	2	4625	4.32
10465 - Throgs Neck/Country Club	100	29	42466	6.83
10466 - Wakefield	100	48	68638	6.99
10467 - Norwood/Williamsbridge	100	96	94473	10.16
10468 - University Heights	100	83	78717	10.54
10469 - Williamsbridge/Baychester	100	37	63700	5.81
10470 - Woodlawn/Wakefield	100	13	15867	8.19
10471 - Riverdale/Fieldston	100	7	23415	2.99
10472 - Soundview	100	83	64296	12.91
10473 - Clasons Point	100	39	56139	6.95

10474 - Hunts Point	100	23	11361	20.24
10475 - Co-op City/Eastchester	100	8	38065	2.10
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 3. Total Hospital Admissions for Acute Bronchitis and Bronchiolitis by zip code, Bronx County



Source: Mapped using www.infoshare.org.

In table 5 the hospital admissions for acute bronchitis and bronchiolitis per 10,000 people are ranked in descending order by zip code. Tremont/East Tremont and Morrisania are the zip codes with the highest hospital admissions rates for this disease. The hospital admissions rates in these counties are almost three times as high as the New York City figure and almost twice as high as the Bronx County figure.

Table 5. Hospital Admissions for Acute Bronchitis and Bronchiolitis per 10,000 People by zip code, Bronx County

Area Name	Hospital Admissions per 10,000 People
10457 - Tremont/East Tremont	23.53
10456 - Morrisania	23.03
10452 - Highbridge	21.45
10455 - The Hub/Longwood	21.34
10474 - Hunts Point	20.24
10460 - West Farms/Crotona	20.00
10451 - Melrose	19.75
10453 - Morris Heights	19.63
10454 - Mott Haven/Port Morris	18.57
10459 - Longwood/Morrisania	17.87
10458 - Belmont/Fordham/Bedford Park	16.09
Bronx	**13.20**
10472 - Soundview	12.91
10468 - University Heights	10.54
10467 - Norwood/Williamsbridge	10.16
10470 - Woodlawn/Wakefield	8.19
New York City	**7.77**
10462 - Parkchester/Van Nest	7.34
10466 - Wakefield	6.99
10463 - Kingsbridge (Bronx only)	6.98
10473 - Clasons Point	6.95
10465 - Throgs Neck/Country Club	6.83
10469 - Williamsbridge/Baychester	5.81
10461 - Westchester/Morris Park	4.61
10464 - City Island	4.32
10471 - Riverdale/Fieldston	2.99
10475 - Co-op City/Eastchester	2.10
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

C. Bronchitis Nos

Tables 6 and 7 and Figure 4 show the data on hospital admissions for bronchitis nos per 10,000 people by zip code in Bronx County.

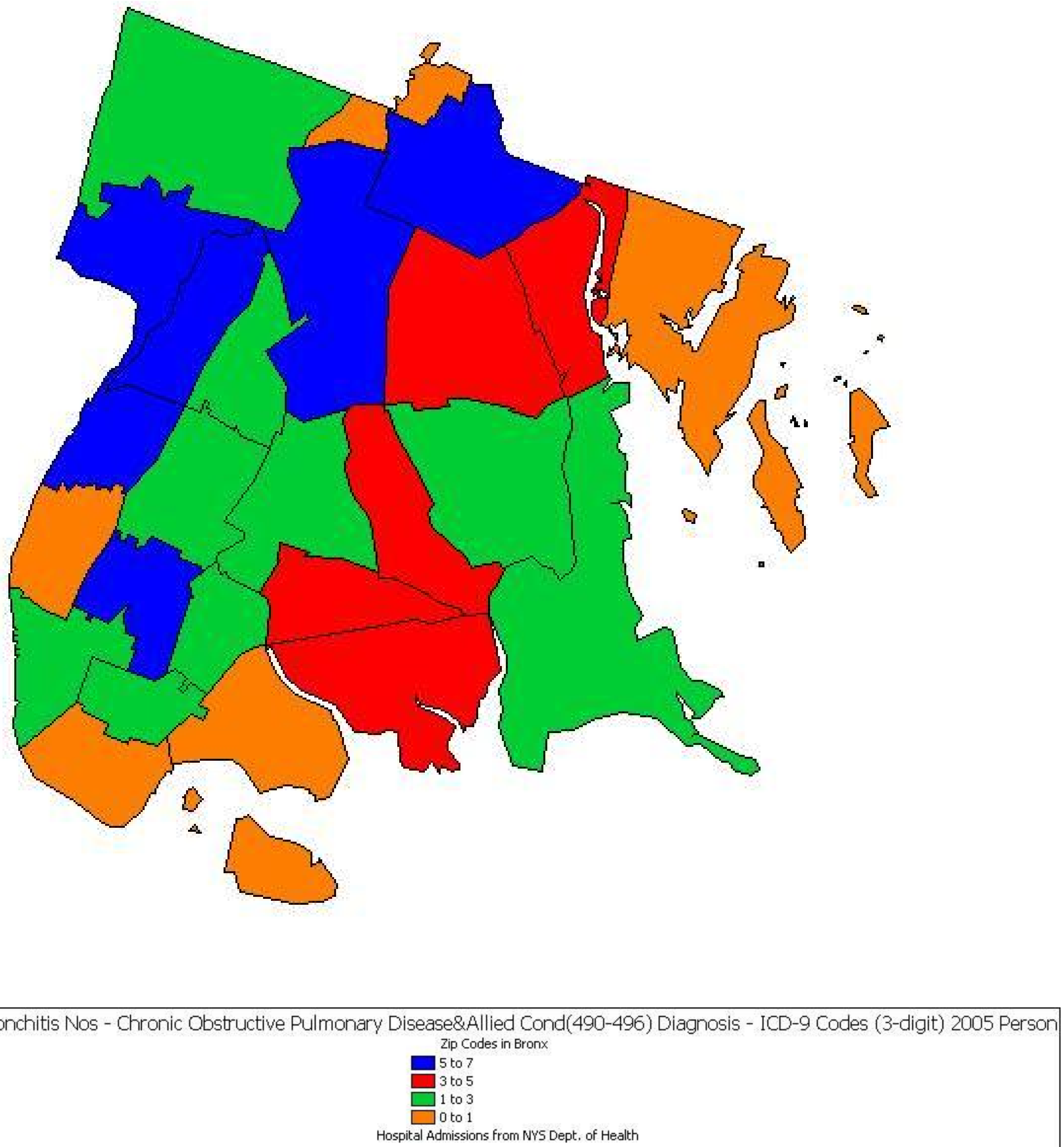
Table 6. Hospital Admissions for Bronchitis Nos per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	490 - Bronchitis Nos	Population	Hospital Admissions per 10,000 People
New York City	100	433	8008278	0.54
Bronx	100	65	1332650	0.49
10451 - Melrose	100	1	41021	0.24
10452 - Highbridge	100	0	71802	0.00
10453 - Morris Heights	100	5	76928	0.65
10454 - Mott Haven/Port Morris	100	0	35012	0.00
10455 - The Hub/Longwood	100	1	37482	0.27
10456 - Morrisania	100	7	76868	0.91
10457 - Tremont/East Tremont	100	1	69259	0.14
10458 - Belmont/Fordham/Bedford Park	100	2	77699	0.26
10459 - Longwood/Morrisania	100	1	39174	0.26
10460 - West Farms/Crotona	100	1	53505	0.19
10461 - Westchester/Morris Park	100	2	49916	0.40
10462 - Parkchester/Van Nest	100	3	72159	0.42
10463 - Kingsbridge (Bronx only)	88.5	6	57283	1.05
10464 - City Island	100	0	4625	0.00
10465 - Throgs Neck/Country Club	100	1	42466	0.24
10466 - Wakefield	100	6	68638	0.87
10467 - Norwood/Williamsbridge	100	5	94473	0.53
10468 - University Heights	100	6	78717	0.76
10469 - Williamsbridge/Baychester	100	4	63700	0.63
10470 - Woodlawn/Wakefield	100	0	15867	0.00
10471 - Riverdale/Fieldston	100	1	23415	0.43
10472 - Soundview	100	4	64296	0.62
10473 - Clasons Point	100	4	56139	0.71
10474 - Hunts Point	100	0	11361	0.00
10475 - Co-op City/Eastchester	100	3	38065	0.79

11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 4. Total Hospital Admissions for Bronchitis Nos by zip code, Bronx County



Source: Mapped using www.infoshare.org.

In Table 7 the hospital admissions for bronchitis nos per 10,000 people by Zip Code in Bronx County are ranked in descending order. Kingsbridge and Morrisania have the highest hospital admissions rates for this disease. The hospital admissions rates for bronchitis nos in these two counties are about twice as high as the figure for New York City. The figure for New York City is higher than the corresponding rate for Bronx County.

Table 7. Hospital Admissions for Bronchitis Nos per 10,000 People by Zip Code, Bronx County

Area Name	Hospital Admissions for Bronchitis Nos per 10,000 People
10463 - Kingsbridge (Bronx only)	1.05
10456 - Morrisania	0.91
10466 - Wakefield	0.87
10475 - Co-op City/Eastchester	0.79
10468 - University Heights	0.76
10473 - Clasons Point	0.71
10453 - Morris Heights	0.65
10469 - Williamsbridge/Baychester	0.63
10472 - Soundview	0.62
New York City	**0.54**
10467 - Norwood/Williamsbridge	0.53
Bronx	**0.49**
10471 - Riverdale/Fieldston	0.43
10462 - Parkchester/Van Nest	0.42
10461 - Westchester/Morris Park	0.40
10455 - The Hub/Longwood	0.27
10458 - Belmont/Fordham/Bedford Park	0.26
10459 - Longwood/Morrisania	0.26
10451 - Melrose	0.24
10465 - Throgs Neck/Country Club	0.24
10460 - West Farms/Crotona	0.19
10457 - Tremont/East Tremont	0.14
10452 - Highbridge	0.00
10454 - Mott Haven/Port Morris	0.00
10464 - City Island	0.00
10470 - Woodlawn/Wakefield	0.00
10474 - Hunts Point	0.00
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

D. Chronic Bronchitis

The data on hospital admissions for chronic bronchitis per 10,000 people by zip code in Bronx County are shown in Tables 8 and 9 and in Figure 5.

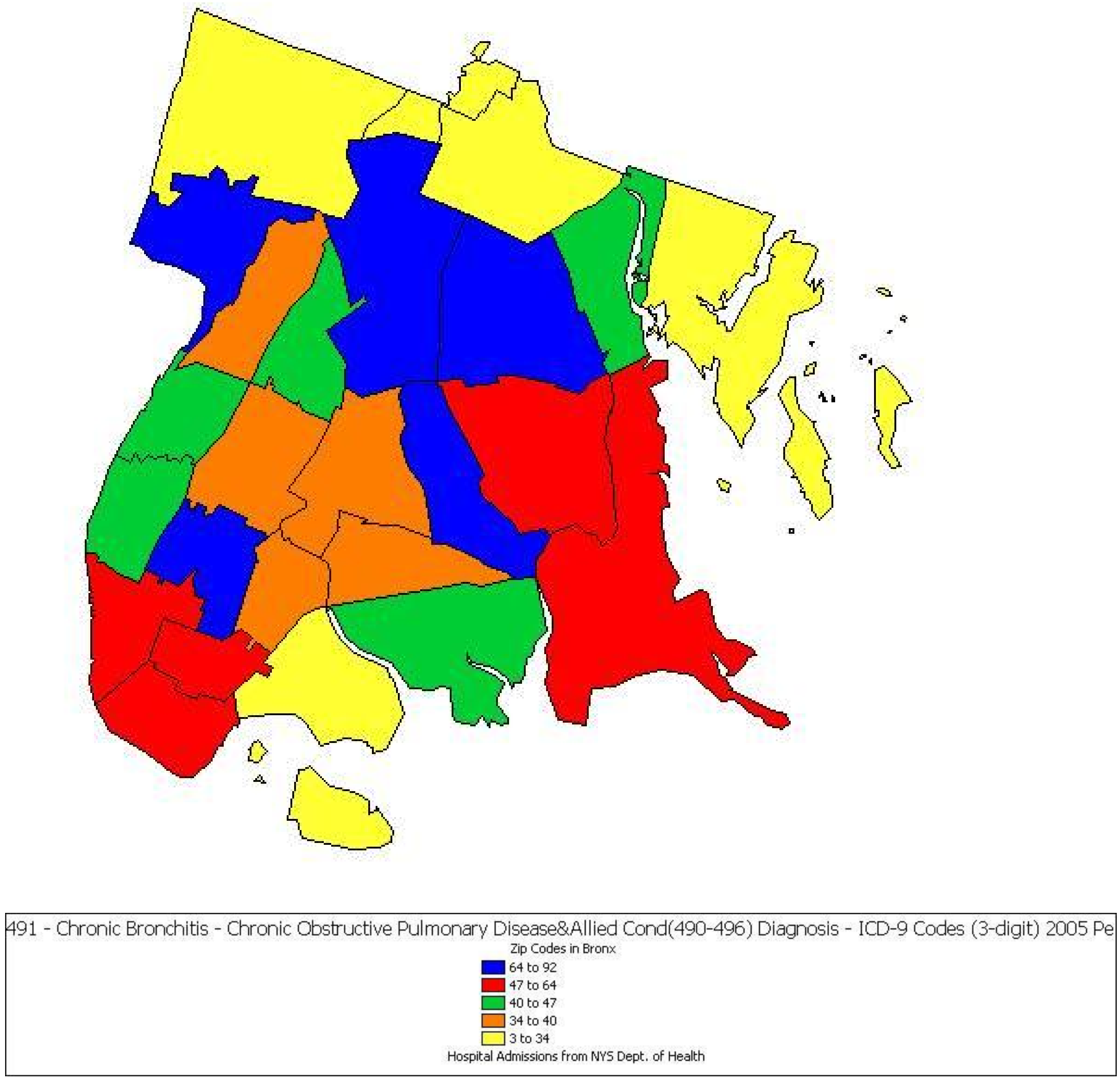
Table 8. Hospital Admissions for Chronic Bronchitis per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	491 - Chronic Bronchitis	Population	Hospital Admissions for Chronic Bronchitis per 10,000 People
New York City	100	6801	8008278	8.49
Bronx	100	1133	1332650	8.50
10451 - Melrose	100	48	41021	11.70
10452 - Highbridge	100	44	71802	6.13
10453 - Morris Heights	100	40	76928	5.20
10454 - Mott Haven/Port Morris	100	48	35012	13.71
10455 - The Hub/Longwood	100	56	37482	14.94
10456 - Morrisania	100	92	76868	11.97
10457 - Tremont/East Tremont	100	35	69259	5.05
10458 - Belmont/Fordham/Bedford Park	100	42	77699	5.41
10459 - Longwood/Morrisania	100	38	39174	9.70
10460 - West Farms/Crotona	100	38	53505	7.10
10461 - Westchester/Morris Park	100	57	49916	11.42
10462 - Parkchester/Van Nest	100	74	72159	10.26
10463 - Kingsbridge (Bronx only)	88.5	71	57283	12.39
10464 - City Island	100	3	4625	6.49
10465 - Throgs Neck/Country Club	100	59	42466	13.89
10466 - Wakefield	100	33	68638	4.81
10467 - Norwood/Williamsbridge	100	71	94473	7.52
10468 - University Heights	100	36	78717	4.57
10469 - Williamsbridge/Baychester	100	69	63700	10.83
10470 - Woodlawn/Wakefield	100	18	15867	11.34
10471 - Riverdale/Fieldston	100	24	23415	10.25
10472 - Soundview	100	39	64296	6.07
10473 - Clasons Point	100	45	56139	8.02
10474 - Hunts Point	100	11	11361	9.68
10475 - Co-op City/Eastchester	100	41	38065	10.77

11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 5. Total Hospital Admissions for Chronic Bronchitis by zip code, Bronx County



Source: Mapped using www.infoshare.org.

In Table 9 Hospital Admissions for Chronic Bronchitis per 10,000 People are ranked in descending order by area. For chronic bronchitis the zip codes with the highest hospitalization rates are The Hub/Longwood and Throgs Neck/Country Club. Bronx County and New York City have very similar hospitalization rates for this disease.

Table 9. Hospital Admissions for Chronic Bronchitis per 10,000 People by Zip Code, Bronx County

Area Name	Hospital Admissions per 10,000 People
10455 - The Hub/Longwood	14.94
10465 - Throgs Neck/Country Club	13.89
10454 - Mott Haven/Port Morris	13.71
10463 - Kingsbridge (Bronx only)	12.39
10456 - Morrisania	11.97
10451 - Melrose	11.70
10461 - Westchester/Morris Park	11.42
10470 - Woodlawn/Wakefield	11.34
10469 - Williamsbridge/Baychester	10.83
10475 - Co-op City/Eastchester	10.77
10462 - Parkchester/Van Nest	10.26
10471 - Riverdale/Fieldston	10.25
10459 - Longwood/Morrisania	9.70
10474 - Hunts Point	9.68
Bronx	**8.50**
New York City	**8.49**
10473 - Clasons Point	8.02
10467 - Norwood/Williamsbridge	7.52
10460 - West Farms/Crotona	7.10
10464 - City Island	6.49
10452 - Highbridge	6.13
10472 - Soundview	6.07
10458 - Belmont/Fordham/Bedford Park	5.41
10453 - Morris Heights	5.20
10457 - Tremont/East Tremont	5.05
10466 - Wakefield	4.81
10468 - University Heights	4.57
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

E. Emphysema

The data on hospital admissions for emphysema per 10,000 people by zip code in Bronx County are shown in Tables 10 and 11 and in Figure 6.

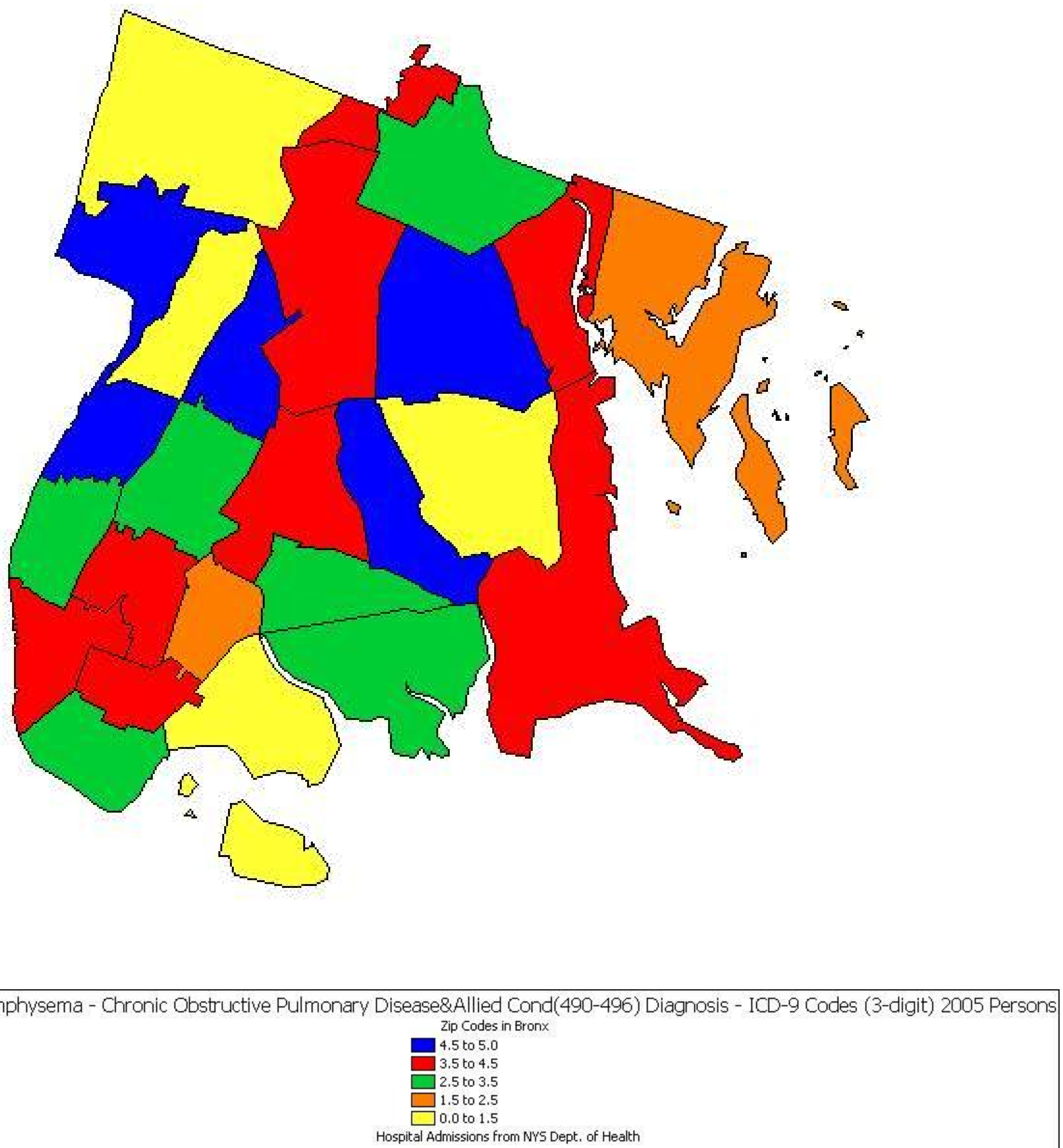
Table 10. Hospital Admissions for Emphysema per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	492 - Emphysema	Population	Hospital Admissions for Emphysema per 10,000 People
New York City	100	402	8008278	0.50
Bronx	100	81	1332650	0.61
10451 - Melrose	100	4	41021	0.98
10452 - Highbridge	100	3	71802	0.42
10453 - Morris Heights	100	5	76928	0.65
10454 - Mott Haven/Port Morris	100	3	35012	0.86
10455 - The Hub/Longwood	100	4	37482	1.07
10456 - Morrisania	100	4	76868	0.52
10457 - Tremont/East Tremont	100	3	69259	0.43
10458 - Belmont/Fordham/Bedford Park	100	5	77699	0.64
10459 - Longwood/Morrisania	100	2	39174	0.51
10460 - West Farms/Crotona	100	4	53505	0.75
10461 - Westchester/Morris Park	100	1	49916	0.20
10462 - Parkchester/Van Nest	100	5	72159	0.69
10463 - Kingsbridge (Bronx only)	88.5	5	57283	0.87
10464 - City Island	100	2	4625	4.32
10465 - Throgs Neck/Country Club	100	4	42466	0.94
10466 - Wakefield	100	3	68638	0.44
10467 - Norwood/Williamsbridge	100	4	94473	0.42
10468 - University Heights	100	1	78717	0.13
10469 - Williamsbridge/Baychester	100	5	63700	0.78
10470 - Woodlawn/Wakefield	100	4	15867	2.52
10471 - Riverdale/Fieldston	100	0	23415	0.00
10472 - Soundview	100	3	64296	0.47
10473 - Clasons Point	100	3	56139	0.53
10474 - Hunts Point	100	0	11361	0.00

10475 - Co-op City/Eastchester	100	4	38065	1.05
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 6. Total Hospital Admissions for Emphysema by zip code, Bronx County



Source: Mapped using www.infoshare.org.

Table 11 shows the total hospital admissions per 10,000 people for emphysema ranked in descending order by area. In the case of emphysema the zip codes with the highest asthma hospitalization rates are City Island and Woodlawn/Wakefield. City Island has a hospitalization rate for emphysema that is over 8 times higher than the corresponding figure for New York City.

Table 11. Hospital Admissions for emphysema per 10,000 People by Zip Code, Bronx County

Area Name	Hospital Admissions per 10,000 People
10464 - City Island	4.32
10470 - Woodlawn/Wakefield	2.52
10455 - The Hub/Longwood	1.07
10475 - Co-op City/Eastchester	1.05
10451 - Melrose	0.98
10465 - Throgs Neck/Country Club	0.94
10463 - Kingsbridge (Bronx only)	0.87
10454 - Mott Haven/Port Morris	0.86
10469 - Williamsbridge/Baychester	0.78
10460 - West Farms/Crotona	0.75
10462 - Parkchester/Van Nest	0.69
10453 - Morris Heights	0.65
10458 - Belmont/Fordham/Bedford Park	0.64
Bronx	**0.61**
10473 - Clasons Point	0.53
10456 - Morrisania	0.52
10459 - Longwood/Morrisania	0.51
New York City	**0.50**
10472 - Soundview	0.47
10466 - Wakefield	0.44
10457 - Tremont/East Tremont	0.43
10467 - Norwood/Williamsbridge	0.42
10452 - Highbridge	0.42
10461 - Westchester/Morris Park	0.20
10468 - University Heights	0.13
10471 - Riverdale/Fieldston	0.00
10474 - Hunts Point	0.00
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

F. Asthma

Asthma is a major concern to many communities in Bronx County and, in particular, in the South Bronx which is the study area that this project focuses on. Information on asthma was presented in the Phase I report and is revisited in this section as part of this broad discussion of hospital admissions due to respiratory diseases. The data on hospital admissions for asthma per 10,000 people by zip code in Bronx County are shown in Tables 12 and 13 and in Figure 7.

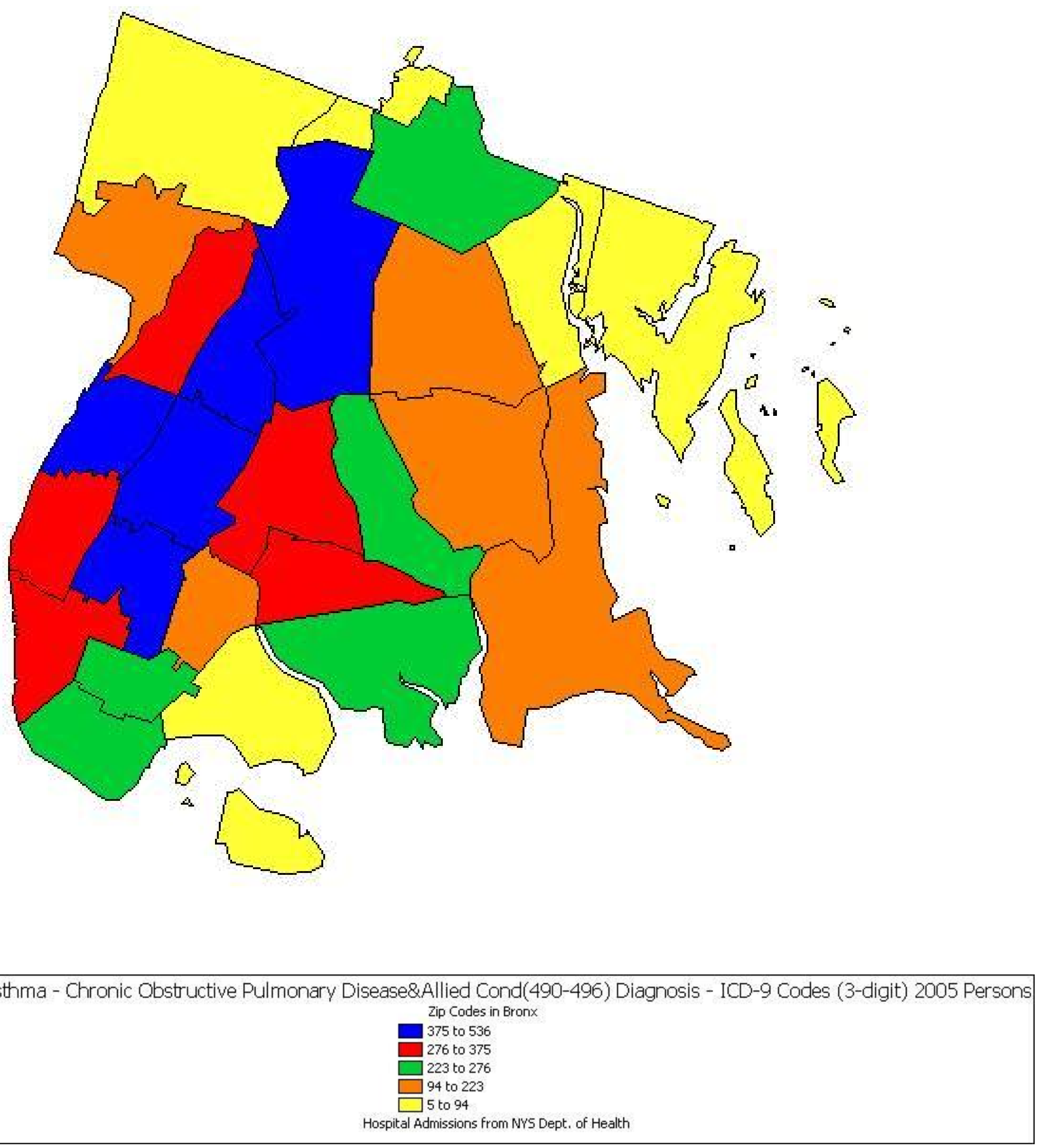
Table 12. Hospital Admissions for Asthma per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	493 - Asthma	Population	Hospital Admissions for Emphysema per 10,000 People
New York City	100	19217	8008278	24.00
Bronx	100	6078	1332650	45.61
10451 - Melrose	100	280	41021	68.26
10452 - Highbridge	100	362	71802	50.42
10453 - Morris Heights	100	422	76928	54.86
10454 - Mott Haven/Port Morris	100	272	35012	77.69
10455 - The Hub/Longwood	100	265	37482	70.70
10456 - Morrisania	100	536	76868	69.73
10457 - Tremont/East Tremont	100	459	69259	66.27
10458 - Belmont/Fordham/Bedford Park	100	387	77699	49.81
10459 - Longwood/Morrisania	100	214	39174	54.63
10460 - West Farms/Crotona	100	301	53505	56.26
10461 - Westchester/Morris Park	100	119	49916	23.84
10462 - Parkchester/Van Nest	100	231	72159	32.01
10463 - Kingsbridge (Bronx only)	88.5	197	57283	34.39
10464 - City Island	100	5	4625	10.81
10465 - Throgs Neck/Country Club	100	107	42466	25.20
10466 - Wakefield	100	268	68638	39.05
10467 - Norwood/Williamsbridge	100	399	94473	42.23
10468 - University Heights	100	285	78717	36.21
10469 - Williamsbridge/Baychester	100	198	63700	31.08
10470 - Woodlawn/Wakefield	100	43	15867	27.10
10471 -	100	32	23415	13.67

Riverdale/Fieldston				
10472 - Soundview	100	307	64296	47.75
10473 - Clasons Point	100	252	56139	44.89
10474 - Hunts Point	100	53	11361	46.65
10475 - Co-op City/Eastchester	100	81	38065	21.28
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 7. Total Hospital Admissions for Asthma by zip code, Bronx County



Source: Mapped using www.infoshare.org.

Table 13 ranks the hospital admissions rates for asthma by area. The zip codes with the highest asthma hospitalization rates are Mott Haven/Port Morris and The Hub/Longwood. These zip codes have asthma hospitalization rates that are three times higher than the New York City figure. Bronx County's asthma hospitalization rate is nearly twice as high as the New York City rate.

Table 13. Hospital Admissions for asthma per 10,000 People by Zip Code, Bronx County

Area Name	**Hospital Admissions per 10,000 People**
10454 - Mott Haven/Port Morris	77.69
10455 - The Hub/Longwood	70.70
10456 - Morrisania	69.73
10451 - Melrose	68.26
10457 - Tremont/East Tremont	66.27
10460 - West Farms/Crotona	56.26
10453 - Morris Heights	54.86
10459 - Longwood/Morrisania	54.63
10452 - Highbridge	50.42
10458 - Belmont/Fordham/Bedford Park	49.81
10472 - Soundview	47.75
10474 - Hunts Point	46.65
Bronx	**45.61**
10473 - Clasons Point	44.89
10467 - Norwood/Williamsbridge	42.23
10466 - Wakefield	39.05
10468 - University Heights	36.21
10463 - Kingsbridge (Bronx only)	34.39
10462 - Parkchester/Van Nest	32.01
10469 - Williamsbridge/Baychester	31.08
10470 - Woodlawn/Wakefield	27.10
10465 - Throgs Neck/Country Club	25.20
New York City	**24.00**
10461 - Westchester/Morris Park	23.84
10475 - Co-op City/Eastchester	21.28
10471 - Riverdale/Fieldston	13.67
10464 - City Island	10.81
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

G. Chronic Airway Obstruction

The last respiratory disease considered in this section is chronic airway obstruction. Tables 14 and 15 and Figure 8 include data on hospital admissions for this condition.

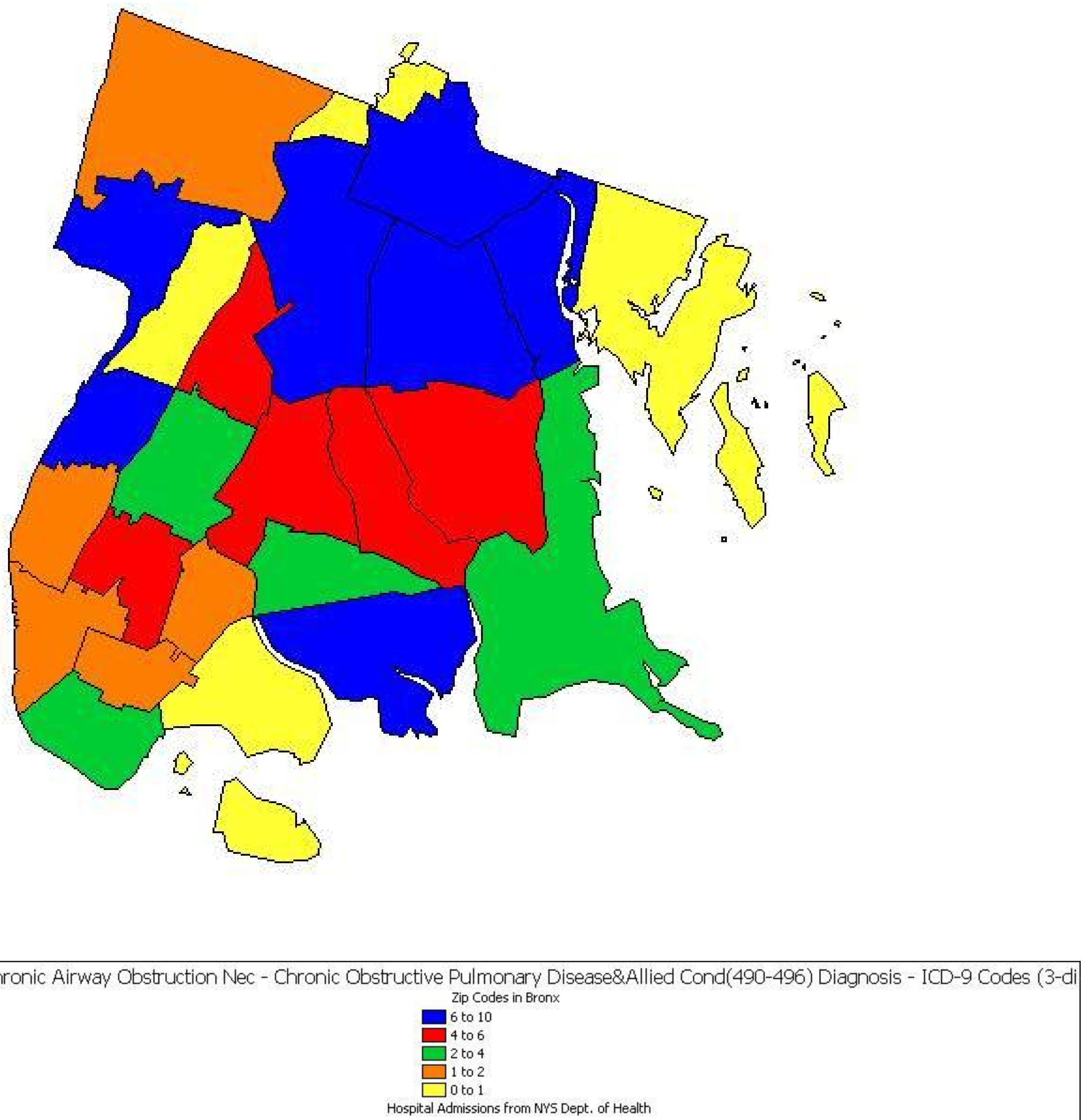
Table 14. Hospital Admissions for Chronic Airway Obstruction per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	496 - Chronic Airway Obstruction	Population	Hospital Admissions for Emphysema per 10,000 People
New York City	100	452	8008278	0.56
Bronx	100	86	1332650	0.65
10451 - Melrose	100	1	41021	0.24
10452 - Highbridge	100	1	71802	0.14
10453 - Morris Heights	100	6	76928	0.78
10454 - Mott Haven/Port Morris	100	2	35012	0.57
10455 - The Hub/Longwood	100	1	37482	0.27
10456 - Morrisania	100	4	76868	0.52
10457 - Tremont/East Tremont	100	2	69259	0.29
10458 - Belmont/Fordham/Bedford Park	100	5	77699	0.64
10459 - Longwood/Morrisania	100	1	39174	0.26
10460 - West Farms/Crotona	100	4	53505	0.75
10461 - Westchester/Morris Park	100	4	49916	0.80
10462 - Parkchester/Van Nest	100	5	72159	0.69
10463 - Kingsbridge (Bronx only)	88.5	10	57283	1.75
10464 - City Island	100	0	4625	0.00
10465 - Throgs Neck/Country Club	100	3	42466	0.71
10466 - Wakefield	100	6	68638	0.87
10467 - Norwood/Williamsbridge	100	9	94473	0.95
10468 - University Heights	100	0	78717	0.00
10469 - Williamsbridge/Baychester	100	6	63700	0.94
10470 - Woodlawn/Wakefield	100	0	15867	0.00
10471 - Riverdale/Fieldston	100	1	23415	0.43
10472 - Soundview	100	2	64296	0.31
10473 - Clasons Point	100	7	56139	1.25
10474 - Hunts Point	100	0	11361	0.00

10475 - Co-op City/Eastchester	100	6	38065	1.58
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 8. Total Hospital Admissions for Chronic Airway Obstruction by zip code, Bronx County



Source: Mapped using www.infoshare.org.

Table 15 ranks the data on hospital admissions per 10,000 people for chronic airway obstruction in descending order by area. The zip codes with the highest hospital admissions rates for this disease are Kingsbridge (Bronx only), Co-op City/Eastchester and Clasons Point. The hospitalization rates for chronic obstructive pulmonary disease in these counties are at least twice as high as the New York City rate. Bronx County has a significantly higher rate than New York City.

Table 15. Hospital Admissions for Chronic Airway Obstruction per 10,000 People by Zip Code, Bronx County

Area Name	**Hospital Admissions per 10,000 People**
10463 - Kingsbridge (Bronx only)	1.75
10475 - Co-op City/Eastchester	1.58
10473 - Clasons Point	1.25
10467 - Norwood/Williamsbridge	0.95
10469 - Williamsbridge/Baychester	0.94
10466 - Wakefield	0.87
10461 - Westchester/Morris Park	0.80
10453 - Morris Heights	0.78
10460 - West Farms/Crotona	0.75
10465 - Throgs Neck/Country Club	0.71
10462 - Parkchester/Van Nest	0.69
Bronx	**0.65**
10458 - Belmont/Fordham/Bedford Park	0.64
10454 - Mott Haven/Port Morris	0.57
New York City	**0.56**
10456 - Morrisania	0.52
10471 - Riverdale/Fieldston	0.43
10472 - Soundview	0.31
10457 - Tremont/East Tremont	0.29
10455 - The Hub/Longwood	0.27
10459 - Longwood/Morrisania	0.26
10451 - Melrose	0.24
10452 - Highbridge	0.14
10464 - City Island	0.00
10468 - University Heights	0.00
10470 - Woodlawn/Wakefield	0.00
10474 - Hunts Point	0.00
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

Part II. Hospital Admissions for Cardiovascular Diseases

H. Acute Myocardial Infarction

The first cardiovascular disease included is acute myocardial infarction. Tables 16 and 17 and Figure 9 include the data on hospital admissions for this condition.

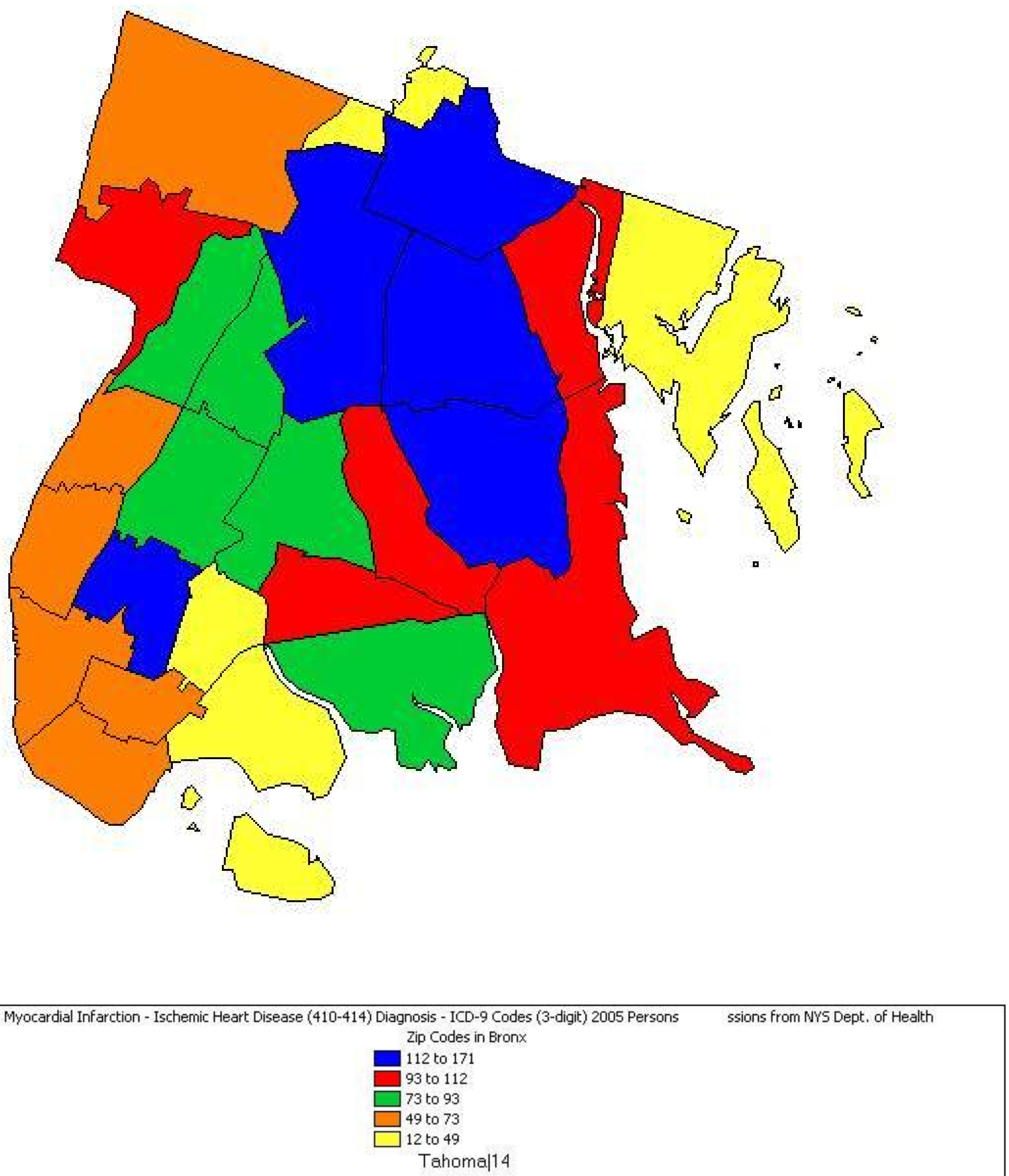
Table 16. Hospital Admissions for Acute Myocardial Infarction per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	410 - Acute Myocardial Infarction	Population	Hospital Admissions per 10,000 People
New York City	100	12265	8008278	15.32
Bronx	100	2060	1332650	15.46
10451 - Melrose	100	49	41021	11.95
10452 - Highbridge	100	70	71802	9.75
10453 - Morris Heights	100	69	76928	8.97
10454 - Mott Haven/Port Morris	100	56	35012	15.99
10455 - The Hub/Longwood	100	49	37482	13.07
10456 - Morrisania	100	113	76868	14.70
10457 - Tremont/East Tremont	100	92	69259	13.28
10458 - Belmont/Fordham/Bedford Park	100	89	77699	11.45
10459 - Longwood/Morrisania	100	48	39174	12.25
10460 - West Farms/Crotona	100	76	53505	14.20
10461 - Westchester/Morris Park	100	113	49916	22.64
10462 - Parkchester/Van Nest	100	99	72159	13.72
10463 - Kingsbridge (Bronx only)	88.5	107	57283	18.68
10464 - City Island	100	12	4625	25.95
10465 - Throgs Neck/Country Club	100	111	42466	26.14
10466 - Wakefield	100	116	68638	16.90
10467 - Norwood/Williamsbridge	100	171	94473	18.10
10468 - University Heights	100	90	78717	11.43
10469 - Williamsbridge/Baychester	100	137	63700	21.51
10470 - Woodlawn/Wakefield	100	32	15867	20.17
10471 - Riverdale/Fieldston	100	49	23415	20.93
10472 - Soundview	100	111	64296	17.26
10473 - Clasons Point	100	92	56139	16.39

10474 - Hunts Point	100	14	11361	12.32
10475 - Co-op City/Eastchester	100	94	38065	24.69
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 9. Total Hospital Admissions for Acute Myocardial Infarction by zip code, Bronx County



Source: Mapped using www.infoshare.org.

Table 17 ranks the hospital admission rates for by area. Bronx County and New York City have very similar hospitalization rates for this disease. Several zip codes (Throgs Neck/Country Club, City Island, Co-op City/Eastchester, Westchester/Morris Park, Williamsbridge/Baychester, Riverdale/Fieldston and Woodlawn/Wakefield) have hospitalization rates above 20.

Table 17. Hospital Admissions for Acute Myocardial Infarction per 10,000 People by Zip Code, Bronx County

Area Name	Hospital Admissions per 10,000 People
10465 - Throgs Neck/Country Club	26.14
10464 - City Island	25.95
10475 - Co-op City/Eastchester	24.69
10461 - Westchester/Morris Park	22.64
10469 - Williamsbridge/Baychester	21.51
10471 - Riverdale/Fieldston	20.93
10470 - Woodlawn/Wakefield	20.17
10463 - Kingsbridge (Bronx only)	18.68
10467 - Norwood/Williamsbridge	18.10
10472 - Soundview	17.26
10466 - Wakefield	16.90
10473 - Clasons Point	16.39
10454 - Mott Haven/Port Morris	15.99
Bronx	**15.46**
New York City	**15.32**
10456 - Morrisania	14.70
10460 - West Farms/Crotona	14.20
10462 - Parkchester/Van Nest	13.72
10457 - Tremont/East Tremont	13.28
10455 - The Hub/Longwood	13.07
10474 - Hunts Point	12.32
10459 - Longwood/Morrisania	12.25
10451 - Melrose	11.95
10458 - Belmont/Fordham/Bedford Park	11.45
10468 - University Heights	11.43
10452 - Highbridge	9.75
10453 - Morris Heights	8.97
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

I. Ischemic Heart Disease

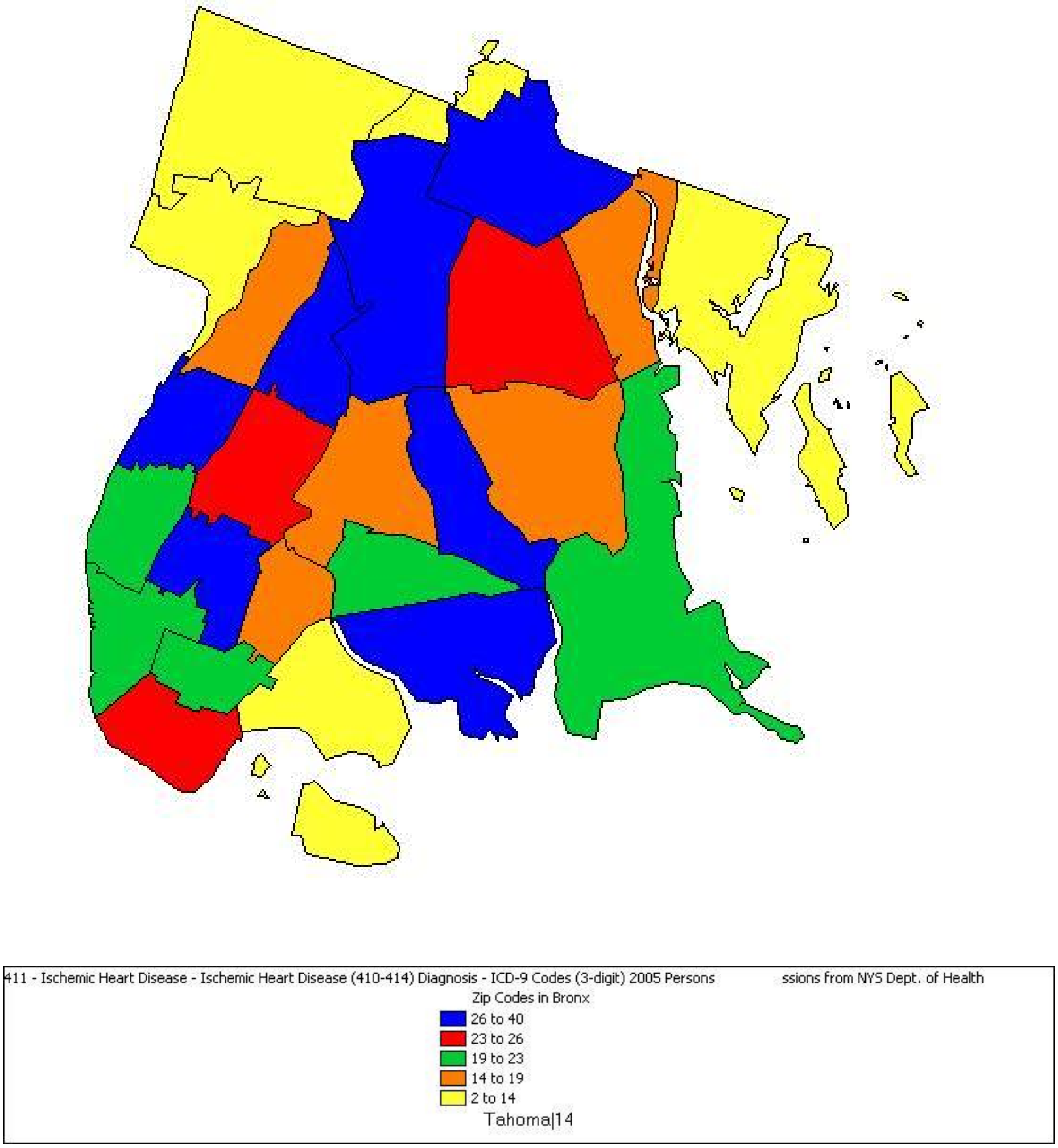
Tables 18 and 19 and Figure 10 include the data on hospital admissions for Ischemic Heart Disease.

Table 18. Hospital Admissions for Ischemic Heart Disease per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	411 - Ischemic Heart Disease	Population	Hospital Admissions per 10,000 People
New York City	100	2775	8008278	3.47
Bronx	100	507	1332650	3.80
10451 - Melrose	100	20	41021	4.88
10452 - Highbridge	100	22	71802	3.06
10453 - Morris Heights	100	35	76928	4.55
10454 - Mott Haven/Port Morris	100	25	35012	7.14
10455 - The Hub/Longwood	100	22	37482	5.87
10456 - Morrisania	100	40	76868	5.20
10457 - Tremont/East Tremont	100	24	69259	3.47
10458 - Belmont/Fordham/Bedford Park	100	27	77699	3.47
10459 - Longwood/Morrisania	100	18	39174	4.59
10460 - West Farms/Crotona	100	18	53505	3.36
10461 - Westchester/Morris Park	100	17	49916	3.41
10462 - Parkchester/Van Nest	100	31	72159	4.30
10463 - Kingsbridge (Bronx only)	88.5	13	57283	2.27
10464 - City Island	100	2	4625	4.32
10465 - Throgs Neck/Country Club	100	20	42466	4.71
10466 - Wakefield	100	27	68638	3.93
10467 - Norwood/Williamsbridge	100	27	94473	2.86
10468 - University Heights	100	15	78717	1.91
10469 - Williamsbridge/Baychester	100	24	63700	3.77
10470 - Woodlawn/Wakefield	100	5	15867	3.15
10471 - Riverdale/Fieldston	100	4	23415	1.71
10472 - Soundview	100	22	64296	3.42
10473 - Clasons Point	100	29	56139	5.17
10474 - Hunts Point	100	6	11361	5.28
10475 - Co-op City/Eastchester	100	14	38065	3.68
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 10. Total Hospital Admissions for Ischemic Heart Disease by zip code, Bronx County



Source: Mapped using www.infoshare.org.

Table 19 ranks hospital admission rates for Ischemic Heart Disease by area. The rate for Bronx County is higher than the rate for New York City. The following zip codes have a hospitalization rate for Ischemic Heart Disease above 5: Mott Haven/Port Morris, The Hub/Longwood, Hunts Point, Morrisania and Clasons Point. These rates are significantly higher than the figure for New York City (3.47).

Table 19. Hospital Admissions for Ischemic Heart Disease per 10,000 People by Zip Code, Bronx County

Area Name	Hospital
10454 - Mott Haven/Port Morris	7.14
10455 - The Hub/Longwood	5.87
10474 - Hunts Point	5.28
10456 - Morrisania	5.20
10473 - Clasons Point	5.17
10451 - Melrose	4.88
10465 - Throgs Neck/Country Club	4.71
10459 - Longwood/Morrisania	4.59
10453 - Morris Heights	4.55
10464 - City Island	4.32
10462 - Parkchester/Van Nest	4.30
10466 - Wakefield	3.93
Bronx	**3.80**
10469 - Williamsbridge/Baychester	3.77
10475 - Co-op City/Eastchester	3.68
10458 - Belmont/Fordham/Bedford Park	3.47
10457 - Tremont/East Tremont	3.47
New York City	**3.47**
10472 - Soundview	3.42
10461 - Westchester/Morris Park	3.41
10460 - West Farms/Crotona	3.36
10470 - Woodlawn/Wakefield	3.15
10452 - Highbridge	3.06
10467 - Norwood/Williamsbridge	2.86
10463 - Kingsbridge (Bronx only)	2.27
10468 - University Heights	1.91
10471 - Riverdale/Fieldston	1.71
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

J. Angina Pectoris

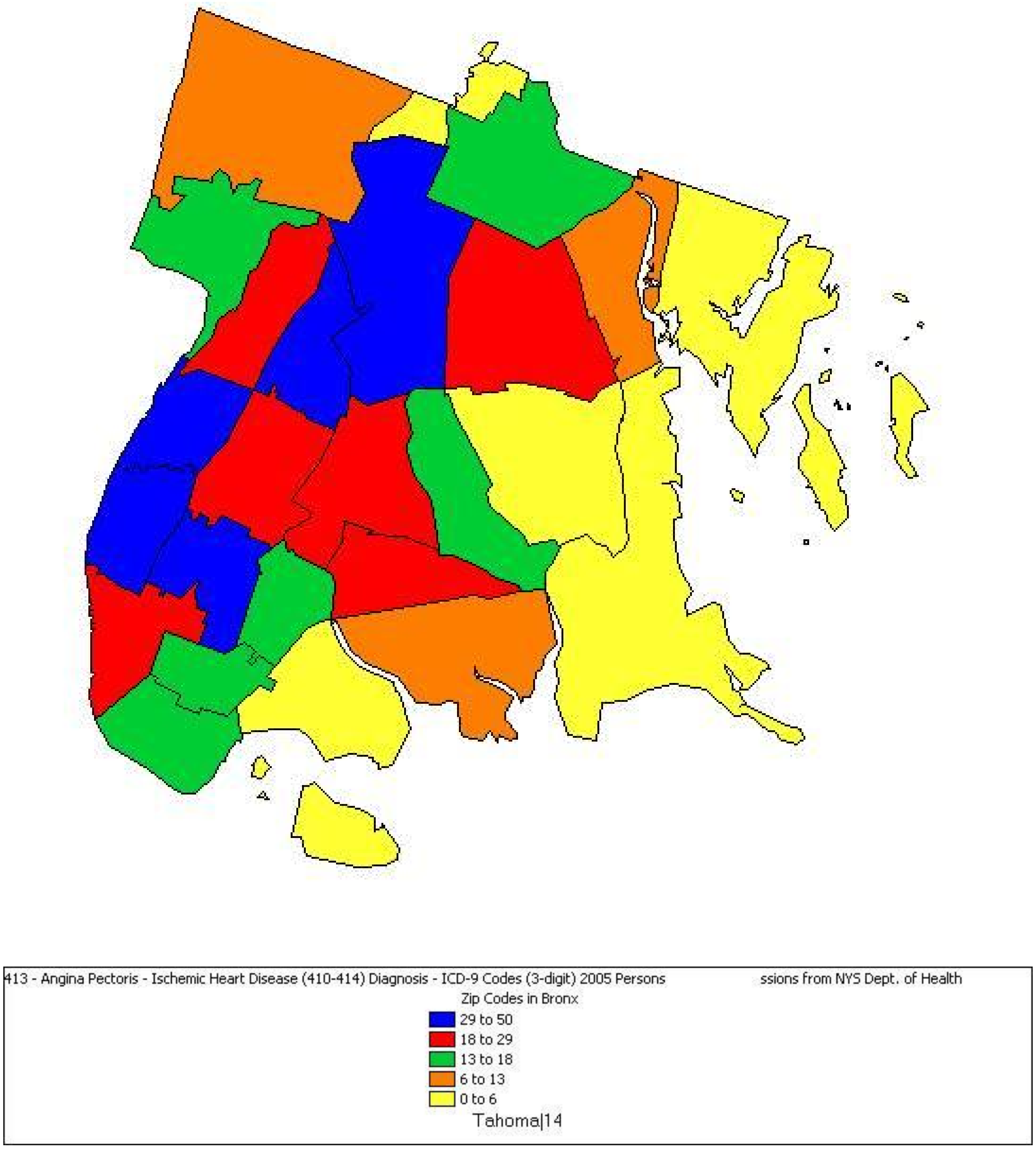
Tables 20 and 21 and Figure 11 include data on hospital admissions for Angina Pectoris.

Table 20. Hospital Admissions for Angina Pectoris per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	413 - Angina Pectoris	Population	Hospital Admissions per 10,000 People
New York City	100	1044	8008278	1.30
Bronx	100	439	1332650	3.29
10451 - Melrose	100	19	41021	4.63
10452 - Highbridge	100	39	71802	5.43
10453 - Morris Heights	100	37	76928	4.81
10454 - Mott Haven/Port Morris	100	17	35012	4.86
10455 - The Hub/Longwood	100	13	37482	3.47
10456 - Morrisania	100	50	76868	6.50
10457 - Tremont/East Tremont	100	23	69259	3.32
10458 - Belmont/Fordham/Bedford Park	100	32	77699	4.12
10459 - Longwood/Morrisania	100	13	39174	3.32
10460 - West Farms/Crotona	100	20	53505	3.74
10461 - Westchester/Morris Park	100	5	49916	1.00
10462 - Parkchester/Van Nest	100	13	72159	1.80
10463 - Kingsbridge (Bronx only)	88.5	15	57283	2.62
10464 - City Island	100	0	4625	0.00
10465 - Throgs Neck/Country Club	100	5	42466	1.18
10466 - Wakefield	100	15	68638	2.19
10467 - Norwood/Williamsbridge	100	32	94473	3.39
10468 - University Heights	100	25	78717	3.18
10469 - Williamsbridge/Baychester	100	18	63700	2.83
10470 - Woodlawn/Wakefield	100	2	15867	1.26
10471 - Riverdale/Fieldston	100	6	23415	2.56
10472 - Soundview	100	18	64296	2.80
10473 - Clasons Point	100	12	56139	2.14
10474 - Hunts Point	100	2	11361	1.76
10475 - Co-op City/Eastchester	100	7	38065	1.84
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 11. Total Hospital Admissions for Angina Pectoris by zip code, Bronx County



Source: Mapped using www.infoshare.org.

Table 21 ranks the areas by hospital admissions rates for Angina Pectoris. The zip codes with the highest hospital admissions rates for this disease are Morrisania, Highbridge and Mott Haven/Port Morris. The figure for Bronx County (3.29) is over twice as high as the rate for New York City (1.30).

Table 21. Hospital Admissions for Angina Pectoris per 10,000 People by Zip Code, Bronx County

Area Name	Hospital Admissions per 10,000 People
10456 - Morrisania	6.50
10452 - Highbridge	5.43
10454 - Mott Haven/Port Morris	4.86
10453 - Morris Heights	4.81
10451 - Melrose	4.63
10458 - Belmont/Fordham/Bedford Park	4.12
10460 - West Farms/Crotona	3.74
10455 - The Hub/Longwood	3.47
10467 - Norwood/Williamsbridge	3.39
10457 - Tremont/East Tremont	3.32
10459 - Longwood/Morrisania	3.32
Bronx	**3.29**
10468 - University Heights	3.18
10469 - Williamsbridge/Baychester	2.83
10472 - Soundview	2.80
10463 - Kingsbridge (Bronx only)	2.62
10471 - Riverdale/Fieldston	2.56
10466 - Wakefield	2.19
10473 - Clasons Point	2.14
10475 - Co-op City/Eastchester	1.84
10462 - Parkchester/Van Nest	1.80
10474 - Hunts Point	1.76
New York City	**1.30**
10470 - Woodlawn/Wakefield	1.26
10465 - Throgs Neck/Country Club	1.18
10461 - Westchester/Morris Park	1.00
10464 - City Island	0.00
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

K. Chronic Ischemic Heart Disease

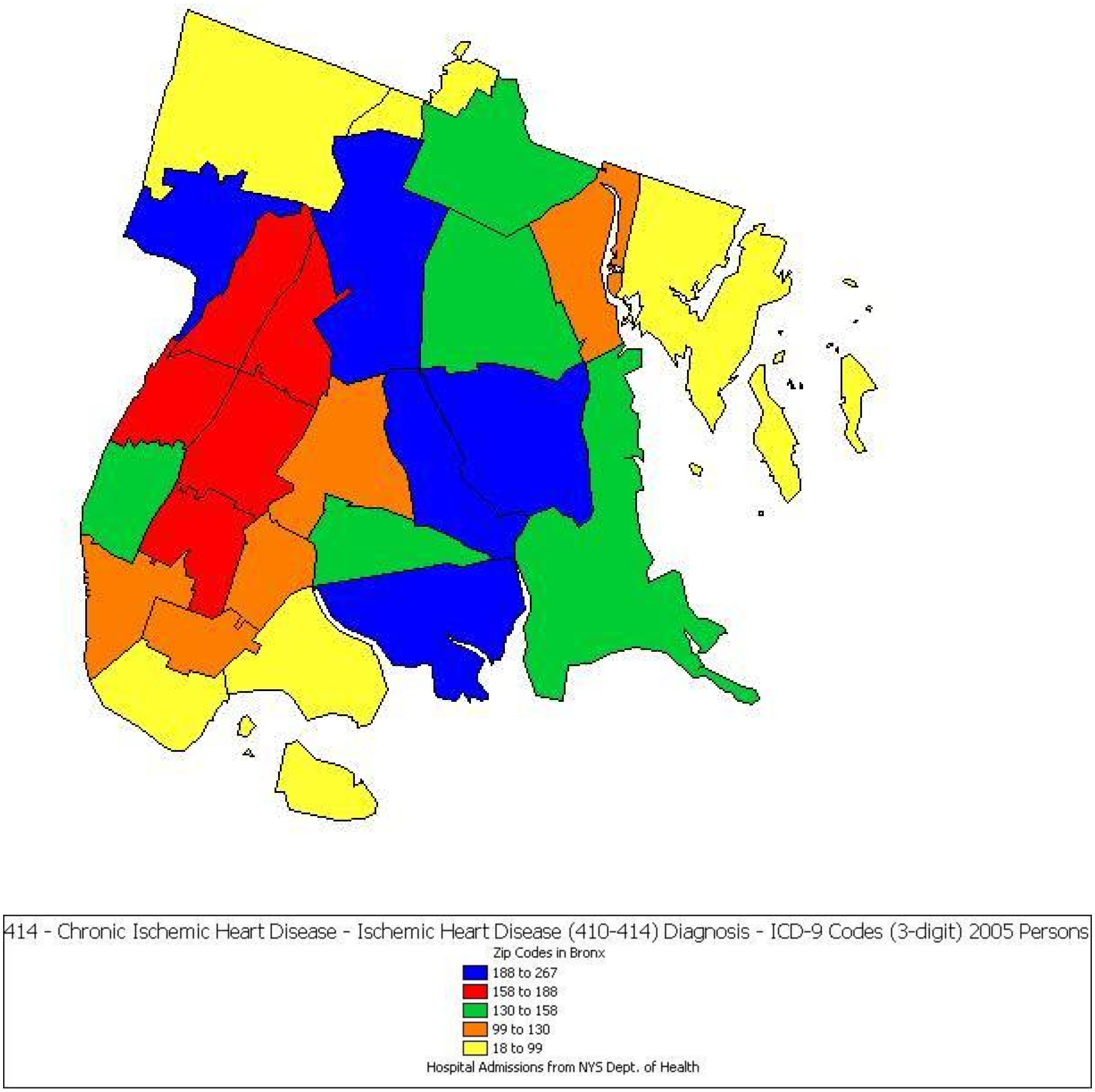
Tables 22 and 23 and Figure 12 include data on hospital admissions for Chronic Ischemic Heart Disease.

Table 22. Hospital Admissions for Chronic Ischemic Heart Disease per 10,000 People by Zip Code, Bronx County

Area Name	Percent in Area	414 - Chronic Ischemic Heart Disease	Population	Hospital Admissions per 10,000 People
New York City	100	25333	8008278	31.63
Bronx	100	3476	1332650	26.08
10451 - Melrose	100	111	41021	27.06
10452 - Highbridge	100	148	71802	20.61
10453 - Morris Heights	100	164	76928	21.32
10454 - Mott Haven/Port Morris	100	98	35012	27.99
10455 - The Hub/Longwood	100	100	37482	26.68
10456 - Morrisania	100	166	76868	21.60
10457 - Tremont/East Tremont	100	183	69259	26.42
10458 - Belmont/Fordham/Bedford Park	100	158	77699	20.33
10459 - Longwood/Morrisania	100	111	39174	28.34
10460 - West Farms/Crotona	100	119	53505	22.24
10461 - Westchester/Morris Park	100	200	49916	40.07
10462 - Parkchester/Van Nest	100	220	72159	30.49
10463 - Kingsbridge (Bronx only)	88.5	193	57283	33.69
10464 - City Island	100	18	4625	38.92
10465 - Throgs Neck/Country Club	100	154	42466	36.26
10466 - Wakefield	100	141	68638	20.54
10467 - Norwood/Williamsbridge	100	267	94473	28.26
10468 - University Heights	100	163	78717	20.71
10469 - Williamsbridge/Baychester	100	156	63700	24.49
10470 - Woodlawn/Wakefield	100	45	15867	28.36
10471 - Riverdale/Fieldston	100	73	23415	31.18
10472 - Soundview	100	157	64296	24.42
10473 - Clasons Point	100	194	56139	34.56
10474 - Hunts Point	100	21	11361	18.48
10475 - Co-op City/Eastchester	100	114	38065	29.95
11370 - Jackson Heights-Rikers Island (Bronx only)	100	0	12780	0.00

Source: Data obtained from www.infoshare.org.

Figure 11. Total Hospital Admissions for Chronic Ischemic Heart Disease by zip code, Bronx County



Source: Mapped using www.infoshare.org.

Table 22 ranks areas by hospital admissions rates for Chronic Ischemic Heart Disease. In the case of this disease the figure for hospital admissions rate is significantly higher for New York City (31.63) than for Bronx County (26.08). Within Bronx County the zip codes with the highest hospitalization rates are Westchester/Morris Park, City Island and Throgs Neck/Country Club.

Table 22. Hospital Admissions for Chronic Ischemic Heart Disease per 10,000 People by Zip Code, Bronx County

Area Name	Hospital Admissions per 10,000 People
10461 - Westchester/Morris Park	40.07
10464 - City Island	38.92
10465 - Throgs Neck/Country Club	36.26
10473 - Clasons Point	34.56
10463 - Kingsbridge (Bronx only)	33.69
New York City	**31.63**
10471 - Riverdale/Fieldston	31.18
10462 - Parkchester/Van Nest	30.49
10475 - Co-op City/Eastchester	29.95
10470 - Woodlawn/Wakefield	28.36
10459 - Longwood/Morrisania	28.34
10467 - Norwood/Williamsbridge	28.26
10454 - Mott Haven/Port Morris	27.99
10451 - Melrose	27.06
10455 - The Hub/Longwood	26.68
10457 - Tremont/East Tremont	26.42
Bronx	**26.08**
10469 - Williamsbridge/Baychester	24.49
10472 - Soundview	24.42
10460 - West Farms/Crotona	22.24
10456 - Morrisania	21.60
10453 - Morris Heights	21.32
10468 - University Heights	20.71
10452 - Highbridge	20.61
10466 - Wakefield	20.54
10458 - Belmont/Fordham/Bedford Park	20.33
10474 - Hunts Point	18.48
11370 - Jackson Heights-Rikers Island (Bronx only)	0.00

Source: Estimated using data obtained from www.infoshare.org.

L. Conclusions

The data on hospital admissions and the estimates for hospital admissions rates (hospital admissions per 10,000 people in this case) show there are wide variations at the zip code level which was the geographical are chosen for comparison. In general Bronx County has significantly higher hospitalization rates for the diseases considered in this analysis than New York City as a whole. However, there are some exceptions such as bronchitis nos and chronic ischemic heart disease. For two diseases the rates are very similar for Bronx County and New York City: chronic bronchitis and acute myocardial infarction. In the case of asthma, a public health issue of major concern to the communities in the South Bronx, the hospitalization rate figure is much higher for Bronx County than for

New York City. Among the zip codes within the project study area there are some that stand out as having some of the highest hospital admission rates for several of diseases considered in the analysis. These include Morrisania, Mott Haven and Melrose.

A limitation of using hospital admission data as proxies for understanding how environmental health risk factors such as air pollution affect public health is that for some of these diseases the high figures reflect lack of access to preventive health care by poor people. Because some areas in the South Bronx have high percentages of people living below the poverty line, these figures may reflect inadequacies in the public health arena. The information presented in this section will be used in Phases V and VI of the project in other analyses and in future sections on public policy.

Chapter 6. Proximity Analysis to Sensitive Receptors using Geographic Information Systems (GIS)

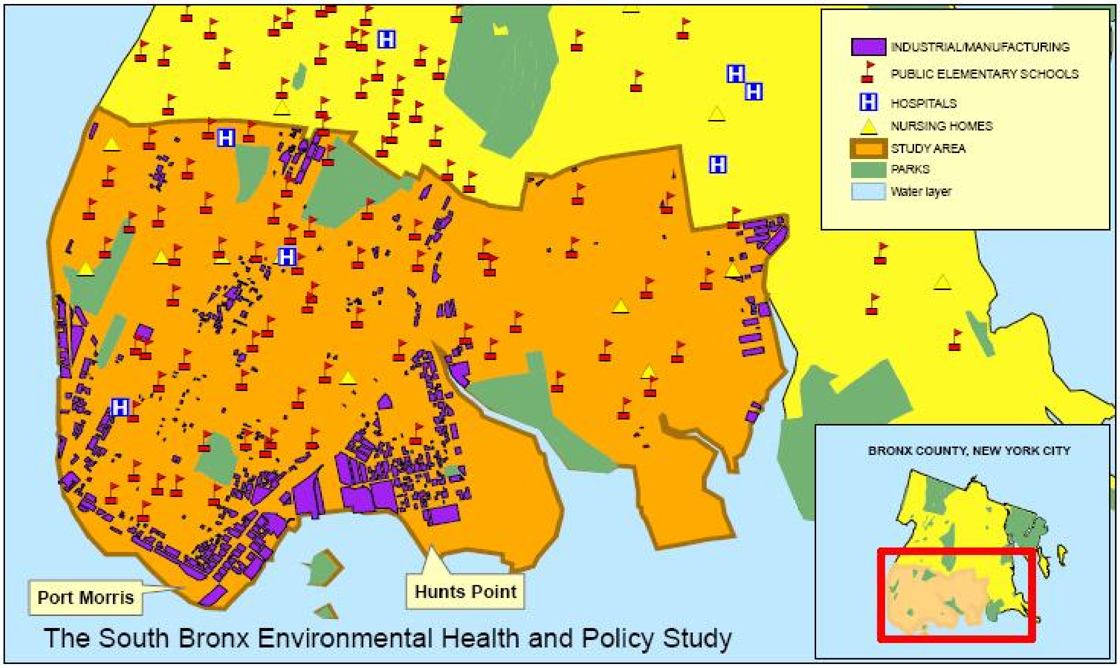
Carlos E. Restrepo, Zvia Segal Naphtali and Rae Zimmerman

In this part of the research GIS is used as a tool to better understand how environmental risk factors may affect sensitive populations (Naphtali et al 2006). The environmental risk factors in this case are waste transfer stations, polluting facilities, areas associated with high traffic densities, high traffic road intersections, and areas with a manufacturing or industrial land use zoning designation. Figure 1 shows the study area and some of these environmental risk factors.

Figure 1. Bronx County, New York City, the project's Study Area, Major Highways, Waste Transfer Stations and Toxic Release Inventory (TRI) Site

The first analysis presented here refers to proximity of sensitive receptors to areas that are currently zoned for industrial and manufacturing land uses. Figure 2 shows the location of the industrial land use areas and the location of schools, nursing homes and hospitals in the study area.

Figure 2. South Bronx, Proximity of Schools, Nursing Homes and Hospitals to Areas Zoned for Manufacturing Land Uses



To examine the proximity of the manufacturing land use areas to sensitive receptors buffers of different radii were drawn around the industrial land use areas. Figures 3 and 4 show that when buffers of 1/8 and 1/4 of a mile are drawn around industrial land use areas many of the schools and hospitals fall within the buffers. A very large percentage of study area is actually within the 1/4 of a mile buffers.

Figure 3. South Bronx, Proximity of Schools, Nursing Homes and Hospitals to Areas Zoned for Manufacturing Land Uses – Using a 1/8 Mile Buffer

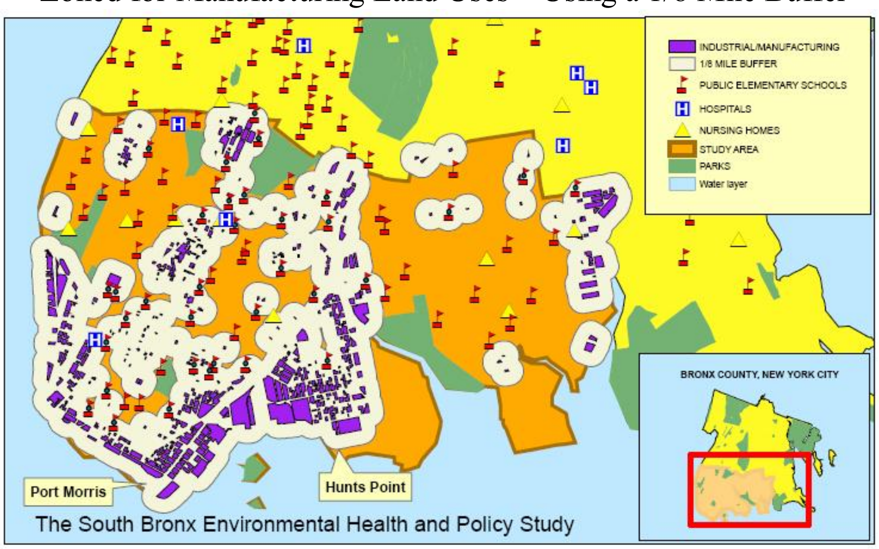
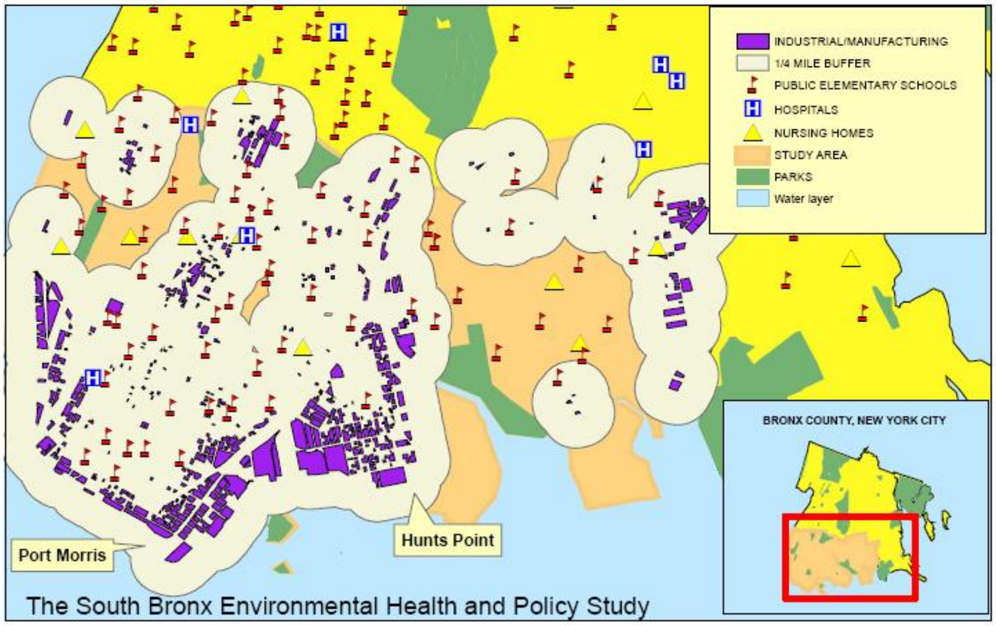


Figure 4. South Bronx, Proximity of Schools, Nursing Homes and Hospitals to Areas Zoned for Manufacturing Land Uses – Using a ¼ Mile Buffer



The buffers were also used to estimate the number of pre Kindergarten to 8^{th} grade students enrolled in public elementary schools who attend schools within the specified buffers. The results are shown in Table 1. About 43.5% of the students in this category for Bronx County attend schools in the study area. About half of all students in this category in the study area are within a 1/8 mile buffer of industrial land use areas and about 90% of the students in the study area are within a 1/4 mile buffer of industrial land use areas.

Table 1. Proximity of Public Elementary Schools to Industrial/Manufacturing Zoned Areas in the Study Area: Some Comparative Statistics

	Public Elementary Schools		Pre Kindergarten to 8th grade Student Enrollment		
Region	Number in Region	Percent of Bronx	No. of Students In Region	Percent of Bronx	Percent of Study Area
BRONX County	153	100%	114,514	100%	
Study Area	68	44.4%	49,791	43.5%	100%
1/8 Mile buffer Around industrial and Manufacturing zoned areas	34	22.2%	25,084	21.9%	50.4%
1/4 Mile buffer Around industrial and Manufacturing zoned areas	59	38.5%	44,248	38.6%	88.9%

A similar analysis was done for hospitals. In this case the variable examined was number of hospital of beds. About 16.7% of hospital beds available in Bronx County are within the study area. Also, about 56% of hospital beds are in hospitals located within a 1/8 and 1/4 mile buffers of industrial land use areas. The figures are shown in Table 2.

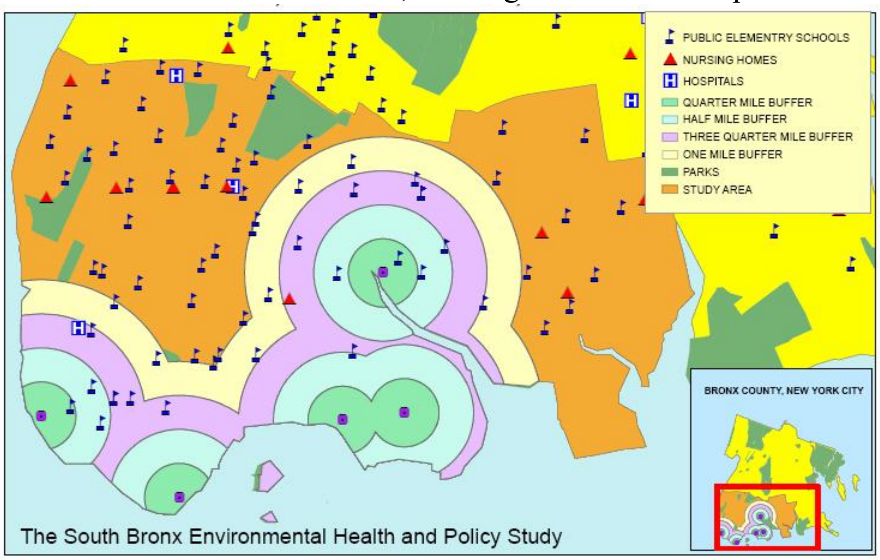
Table 2. Proximity of Hospitals to Industrial/Manufacturing Zoned Areas in the Study Area: Some Comparative Statistics

	Hospitals		Number of Beds		
Region	Number in Region	Percent of Bronx	No. of Beds in Region	Percent of Bronx	Percent of Study Area
Bronx County	13	100%	4,622	100%	
Study Area	3	23.1%	912	16.7%	100%
1/8 Mile buffer Around industrial and Manufacturing zoned areas	2	15.4%	511	11.1%	56.0%

1/4 Mile buffer Around industrial and Manufacturing zoned areas	2	15.4%	511	11.1%	56%

The kind of analysis described above for industrial land use areas was also done for waste transfer stations. Figure 5 shows concentric buffers drawn around putrescible waste transfer stations in the study area.

Figure 5. South Bronx, Proximity of Sensitive Receptors to Five Putrescible Waste Tranfer Stations: Schools, Nursing Homes and Hospitals



As Table 3 shows, about 10% of the pre Kindergarten to 8th grade students are within ½ a mile of a putrescible waste transfer station and about 37% are within a mile of these facilities. Waste transfer stations are considered an environmental health risk factor because they are associated with high volumes of diesel truck traffic.

Table 3. Proximity of Public Elementary Schools To Five Putrescible Waste Transfer Stations
Buffer Sizes: ¼ Mile, ½ Mile. ¾ Mile and 1 Mile: Some Comparative Statistics

	Public Elementary Schools		Pre Kindergarten to 8th grade Student Enrollment		
Region	Number in Region	Percent of Bronx	No. of Students in Region	Percent of Bronx	Percent of Study Area
Bronx County	153	100%	114,514	100%	
Study Area	68	44.4%	49,791	43.5%	100%
1/4 Mile buffer	2	1.3%	1,208	1.1%	2.4%
1/2 Mile Buffer	7	4.6%	5,051	4.4%	10.1%
¾ Mile Buffer	19	12.4%	12,192	10.6%	24.5%
1 Mile Buffer	28	18.3%	18,220	15.9%	36.6%

V.c Proximity of sensitive receptors to major highways and truck routes

Land use planning decisions made over the last few decades in the South Bronx have placed a sensitive population of asthmatic children in close proximity to highways, truck routes, industrial land use areas and other environmental hazards. According to the transportation and air pollution modeling studies described in the Wagner/ICIS South Bronx Environmental Health and Policy Study Phase II and III Report traffic associated with these facilities creates pollution hotspots that could potentially exacerbate asthma symptoms.[31] The modeled concentrations of traffic-related particulate matter and nitrogen oxides presented in the Phase II and III report are two to five times higher around South Bronx highways than in other parts of the South Bronx. It should also be noted that the Bronx is currently a “non-attainment area” for particulate matter ($PM_{2.5}$), which means that the U.S. Environmental Protection Agency’s current annual standard for this pollutant is exceeded. In this part of the paper we examine the proximity of sensitive receptors to major highways and truck routes.[32]

[31] See Wagner/ICIS South Bronx Environmental Health and Policy Study Phase II and III Report – Chapters 3 and 4. The report is available online: http://www.icisnyu.org/south_bronx/admin/files/ICISPhaseIIandIIIreport.pdf.
[32] For a discussion of ambient particulate matter concentrations in Bronx County see chapter 4 of the Wagner/ICIS South Bronx Environmental Health and Policy Study Phase I Report. The report is available online: http://www.icisnyu.org/south_bronx/admin/files/PhaseIWagner930.pdf.

As figure 6 shows, some of the zip codes with the highest asthma hospitalization rates are in close proximity to major highways.

Figure 6. Pediatric Asthma Hospitalizations per 1,000 Children by Zip Code (2004) and Major Highways, South Bronx

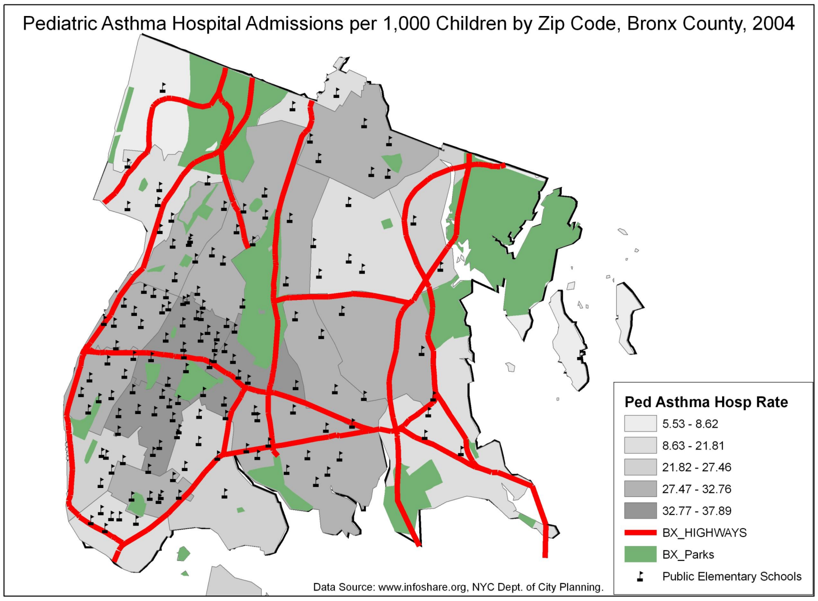


Figure 7 shows the number of schools that are located within 150 meters of a major highway. Figure 8 does the same analysis using a 300 meter buffer. These are the distances referred to in the air pollution studies that suggest that air pollution concentrations are significantly higher than background levels within 300 meters of a highway, and especially within 150 meters of a highway. The results show that about a fifth of all pre Kindergarten to 8th grade students in the South Bronx attend schools within 150 meters (500 feet or less than two city blocks) of major highways.

Figure7. Proximity of Public Elementary Schools to Major Highways (150 meter buffer), South Bronx

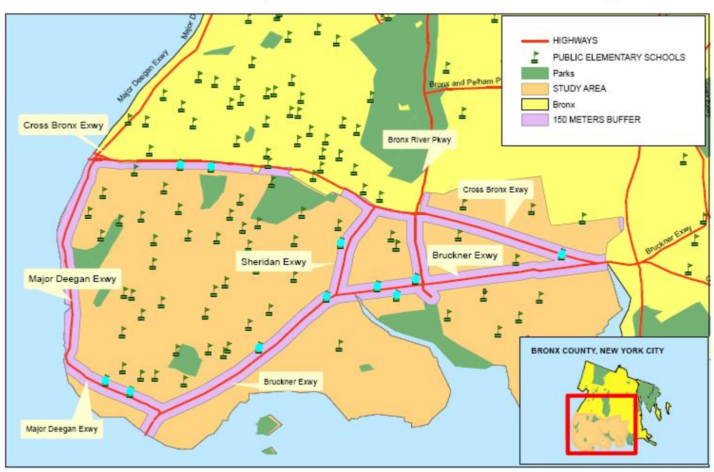
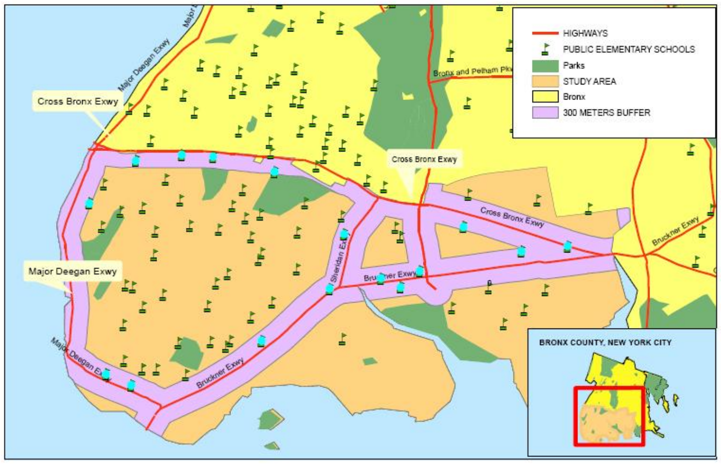


Figure 8. Proximity of Public Elementary Schools to Major Highways (300 meter buffer), South Bronx



As mentioned above, about a fifth of pre Kindergarten to 8th grade students attend schools within 150 meters (500 feet or less than two city blocks) of a highway in the South Bronx. This figure is significantly higher than the figure for New York City as a whole, which is about half of that. Figures 9 and 10 show a similar analysis for New York City using 150 and 300 meter buffers respectively. The overall results for the proximity of schools to major highways in the South Bronx and in New York City are summarized in Table 4.

Figure 9. Proximity of Public Elementary Schools to Major Highways (150 meter buffer), New York City

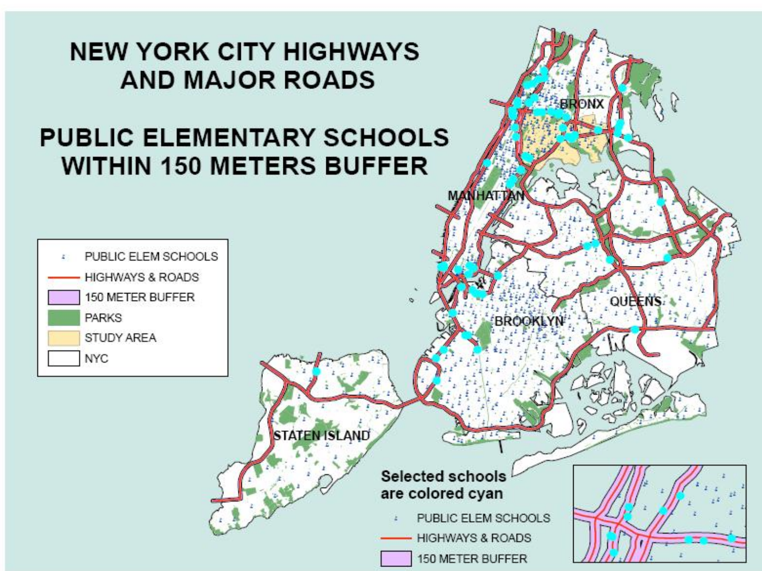


Figure 10. Proximity of Public Elementary Schools to Major Highways (300 meter buffer), New York City

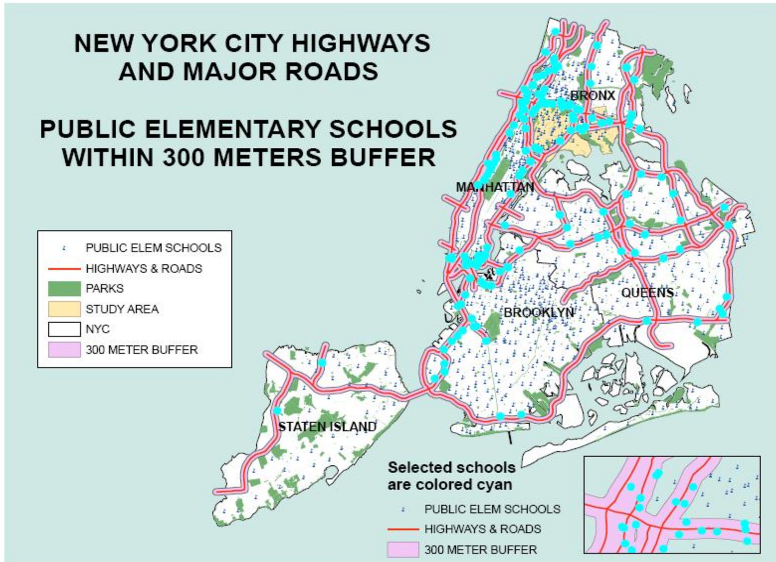


Table 4. Proximity of Public Elementary Schools to Major Highways

Region	New York City		Bronx		Bronx Study Area	
	Schools No. %	Students No. %	Schools No. %	Students No. %	Schools No. %	Students No. %
Entire region	712 (100%)	514,961 (100%)	153 (100%)	114,514 (100%)	68 (100%)	49,791 (100%)
150 Meter Buffer	65 (9.1%)	43,499 (8.4%)	23 (15.0%)	15,709 (13.7%)	11 (16.2%)	8,752 (17.6%)
300 Meter Buffer	146 (20.5%)	102,465 (19.9%)	44 (28.8%)	32,451 (28.3%)	16 (23.5%)	13,211 (26.5%)

The same type of analysis was done for truck routes. Although major highways carry the highest number of vehicles in the South Bronx, truck routes other than major highways also carry large numbers of vehicles due to the land uses in the area. Figures 11 and 12 show the location of public schools and truck routes with 150 meters and 300 meters around them respectively in the South Bronx. About half (47%) of the pre Kindergarten to 8^{th} grade students in the South Bronx attend schools located within 150 meters (500 feet or less than two city blocks) of a truck route, and about 86% of the students are within 300 meters of truck route. Figures 13 and 14 do the same analysis for New York City. Table 5 summarizes the results. In the case of truck routes the figures are similar between the South Bronx and New York City, but the truck traffic densities of these routes in different parts of the city are not included in the analysis. It could be that some truck routes have much higher traffic densities than others.

Figure 11. Proximity of Public Elementary Schools to Truck Routes (150 meter buffer), South Bronx

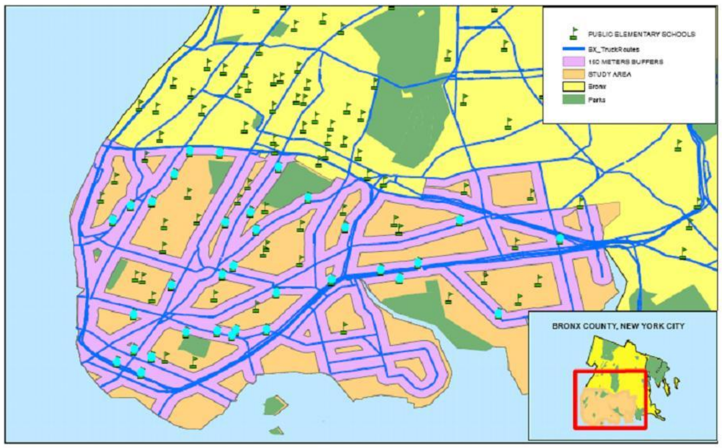


Figure 12. Proximity of Public Elementary Schools to Truck Routes (300 meter buffer), South Bronx

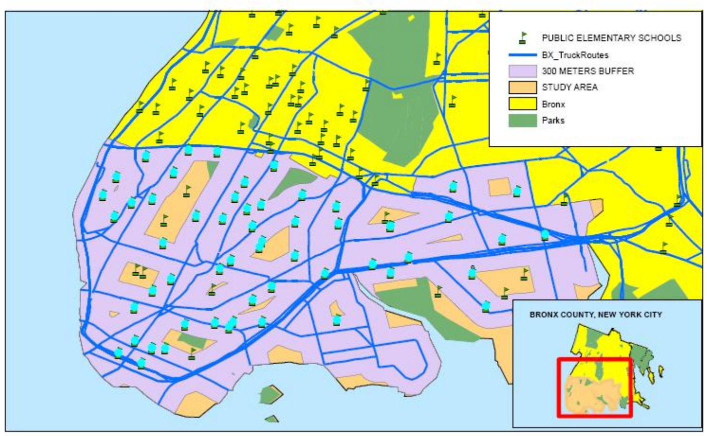


Figure 13. Proximity of Public Elementary Schools to Truck Routes (150 meter buffer), New York City

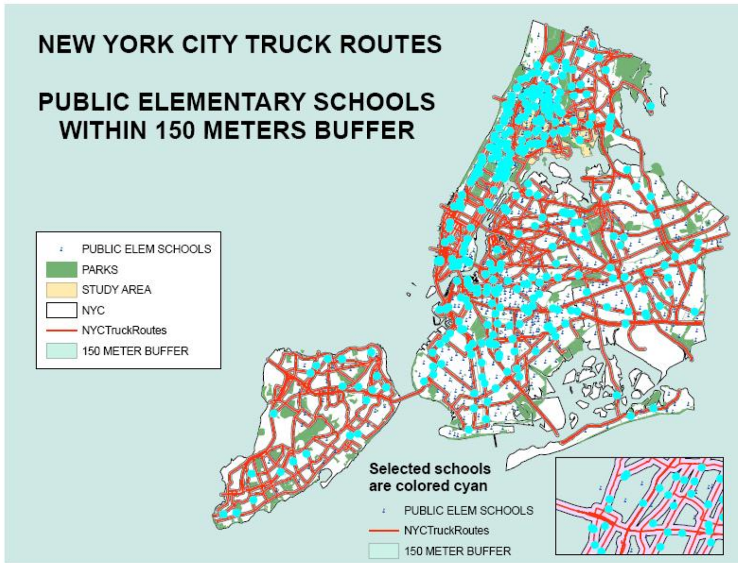


Figure 14. Proximity of Public Elementary Schools to Truck Routes (300 meter buffer), New York City

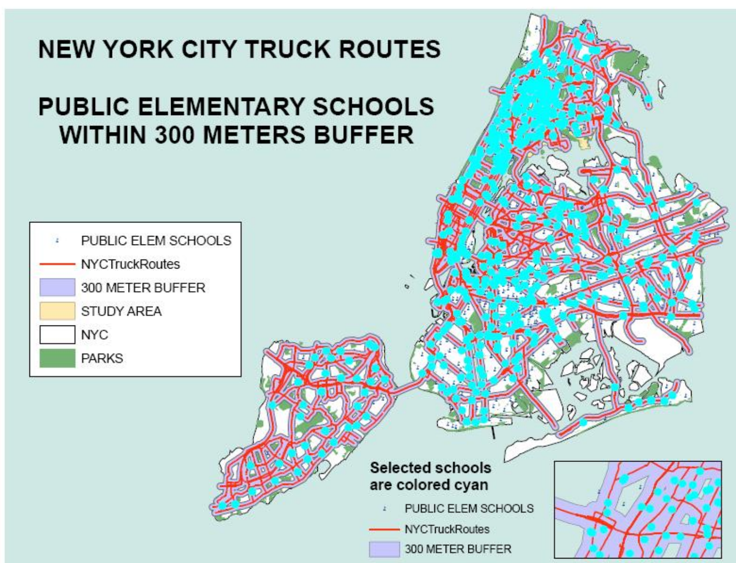


Table 5. Proximity of Public Elementary Schools to Major Highways

Region	New York City		Bronx County		Bronx Study Area	
	Schools No. %	Students No. %	Schools No. %	Students No. %	Schools No. %	Students No. %
Entire region	712 (100%)	514,961 (100%)	153 (100%)	114,514 (100%)	68 (100%)	49,791 (100%)
150 Meter Buffer	330 (46.3%)	233,093 (45.2%)	84 (54.9%)	61,843 (54.0%)	34 (50%)	23,410 (47%)
300 Meter Buffer	500 (70.2%)	363,167 (70.5%)	130 (85.0%)	98,103 (85.7%)	58 (85.3%)	42,678 (85.7%)

VI. Conclusions and Policy Recommendations

The South Bronx Environmental Health and Policy Study provides numerous important insights into the association between transportation, waste transfer activities, air quality and public health. The research carried out by the NYU School of Medicine as part of the South Bronx Environmental Health and Policy Study indicates that elemental carbon (EC) concentrations in the South Bronx are higher than in other areas in the New York City metropolitan area, where measurements were also taken.[33] Moreover, the NYU School of Medicine's asthma "back-pack" study found important associations between this pollutant and asthma symptoms among children. The main source of this pollutant in South Bronx is diesel exhaust emanating from the high number of diesel trucks traveling through the area every day. These trucks are mostly used to transport waste to and from waste transfer stations and to transport goods to a number of industrial, manufacturing and commercial facilities located in the area. Bronx County also connects other parts of New York City to important transportation routes in the northeastern part of the United States and is thus heavily used by commercial trucks.

The transportation and air quality computer modeling carried out as part of this project and presented in the Wagner/ICIS South Bronx Environmental Health and Policy Phase II and III Report used available traffic data to estimate AM and PM peak hour traffic concentrations along the network of streets and highways in the South Bronx. The results show extremely high vehicle numbers along the main highways and other streets. This information was used as inputs into a computer model that used traffic emission rates and weather data to estimate particulate matter (PM) and nitrogen oxide (NOx)

[33] For a description of the research and outreach work done by the NYU School of Medicine as part of the South Bronx Environmental Health and Policy study visit their web page: http://www.med.nyu.edu/SBEHPS/

concentrations in the study area. The results, which were presented visually as maps, show that air pollution “hotspots” are present around the highway and street intersections with the highest estimated traffic densities.

This kind of information is critical to making important land use planning decisions in the South Bronx. The area has one of the highest asthma rates in the country, especially among children. This sensitive population is in close proximity to environmental health risk factors such as waste transfer stations, highways and truck routes. The GIS analyses done as part of this research project found that about 20% of pre-Kindergarten to 8^{th} grade children attend schools located within two blocks of a major highway. This figure is almost twice as high as the average for New York City. In addition, about half of the students in this age group attend schools located within 2.5 blocks of land zoned for manufacturing activities.

These findings provide additional arguments to support current efforts to introduce policies to reduce traffic in the study area, with particular emphasis on diesel truck traffic. Examples of these policies include using marine transfer stations and freight to move waste around the city instead of relying so heavily on diesel trucks. Reducing the number of trucks traveling through the South Bronx should be a high priority to improve air quality and ultimately benefit this sensitive population.

Additional policies and programs could also be implemented to reduce the impact of current and future traffic patterns in the South Bronx. New York City could adopt measures to limit the distance between the location of a school and major highways. For example, California has implemented a policy that new schools cannot be located within 500 feet of the edge of the closest traffic lane of a freeway or other busy traffic corridors (California State Senate 2003).

For schools that are currently located in close proximity to a highway or busy traffic intersection the New York City Department of Education could work with the U.S. Environmental Protection Agency to promote the adoption of measures to improve indoor air quality such as the existing *Indoor Air Quality Tools for Schools Action Kit* program (USEPA 2007). Indoor air quality is strongly affected by outdoor air quality and these programs can have a significant impact over indoor air quality. There is evidence that the adoption of indoor air quality programs by schools leads to fewer asthma attacks, fewer visits to the school nurse, and lower student absenteeism (Moglia et al 2006).

In addition to these school-specific measures, urban planning tools such as greenways and green buffers can be used to reduce the impact of air pollution on the residents of the South Bronx. Trees have been shown to reduce air pollutant concentrations (Nowak 2007). If tree species are adequately chosen they can also benefit other efforts such as reducing temperature and improving microclimate and providing habitat for urban species. In addition to targeting specific areas such as buffering schools from highways and truck routes, tools such as the New York City 2005-2006 Tree Census can be used with GIS to understand where trees could have a significant impact (New York City Department of Parks and Recreation 2007). The experience of Morrisania with the development of a Community Forestry Management Plan could be used in other neighborhoods in the South Bronx (New York City Department of Parks and Recreation 2006).

Bibliography

California State Senate. 2003. California Senate Bill 352: California Statutes Chapter 668. Sacramento, California. See: http://info.sen.ca.gov/pub/03-04/bill/sen/sb_0351-0400/sb_352_bill_20031003_chaptered.html

Kling, Alison. 2006. "Zoning, Land Use, and Environmental Justice on the Bronx River." Unpublished report. NYU Wagner-ICIS.

Moglia, Dena, Alisa Smith, David L. MacIntosh and Jennifer L. Somers. 2006. "Prevalence and Implementation of IAQ Programs in U.S. Schools." Environmental Health Perspectives. Volume 114, Number 1. January 2006. Pages 141-146.

Naphtali, Zvia, Carlos Restrepo and Rae Zimmerman. 2006. *Land Use, Demographics and Industrial Facilities: Using GIS to Support Improved Land Use Initiatives and Policies in South Bronx, New York City*. Presentation made at the 2006 Meeting of The Association of American Geographers (AAG), March 10 2006, Chicago, IL.

New York City Department of Parks and Recreation. 2006. *Greening Morrisania A Coomunity Forestry Management Plan*. Available at: http://www.nycgovparks.org/sub_your_park/trees_greenstreets/morrisania_forest_plan/Morrisania_Plan.pdf. Access date: January 10, 2007.

New York City Department of Parks and Recreation. 2007. *Trees Count! 2005 - 2006 Street Tree Census*. Web page available at: http://www.nycgovparks.org/sub_your_park/trees_greenstreets/treescount/index.php. Access date: January 10, 2007.

Nowak, David. 2007. The Effects Of Urban Trees On Air Quality. Available at: http://www.fs.fed.us/ne/syracuse/gif/trees.pdf. Access date: January 10, 2007.

Restrepo, Carlos, Rae Zimmerman, George Thurston, Jessica Clemente, John Gorczynski, Mianhua Zhong, Martin Blaustein, Lung Chi Chen. 2004. "A comparison of ground-level air quality data with New York State Department of Environmental Conservation monitoring stations data in South Bronx, New York." *Atmospheric Environment*. 38: 5295-5304.

Restrepo, Carlos and Rae Zimmerman (eds). 2004. South Bronx Environmental Health and Policy Study: Transportation and Traffic Modeling, Air Quality, Waste Transfer

Stations, and Environmental Justice Analyses in the South Bronx. Final Report for Phase II & III. < http://www.icisnyu.org/admin/files/ICISPhaseIIandIIIreport.pdf>

USEPA (Environmental Protection Agency). 2007. *Indoor Air Quality Tools for Schools Kit*. http://www.epa.gov/iaq/schools/toolkit.html. Access date: January 10, 2007.

Zimmerman, Rae, Carlos Restrepo, Cary Hirschstein, José Holguín-Veras, Jennifer Lara, David Klebenov. 2002. South Bronx Environmental Studies: Public Health and Environmental Policy Analysis: Final Report for Phase I. < http://www.icisnyu.org/admin/files/PhaseIWagner930.pdf>

Appendix A: Publications and Conference Presentations Featuring Wagner/ICIS South Bronx Environmental Health and Policy Phase IV Work

Publications:

Zvia Segal Naphtali, Carlos E. Restrepo and Rae Zimmerman. Forthcoming. “Maps Expand Asthma Hazards Awareness.” *Healthy GIS*. ESRI.

Carlos E. Restrepo and Rae Zimmerman. Forthcoming 2008. “Environmental Justice.” In Edward Melnick and Brian Everitt (editors). *Encyclopedia of Quantitative Risk Analysis and Assessment*. John Wiley & Sons: London.

Zvia Segal Naphtali, Carlos E. Restrepo and Rae Zimmerman. 2007. “Using GIS to Examine Environmental Injustice in the South Bronx: The Case of Waste Transfer Stations.” *Connect* 17 (2): 23-28.

Conferences:

The Society for Risk Analysis (SRA) Annual Meeting. December 3-6, 2006. Baltimore, Maryland. Carlos E. Restrepo, Zvia S. Naphtali and Rae Zimmerman. Paper presentation titled: “Traffic hotspots, highways and proximity to sensitive receptors as inputs to environmental health risk management in the South Bronx, New York.”

November 9-12, 2006. *Association of Collegiate Schools of Planning (ACSP) 2006 Annual Conference*. R. Zimmerman and C. Restrepo, “Connectivity and Consistency of Environmental Decision Tools for Community Planning,” Fort Worth, TX.

May 23, 2006. *2006 Metropolitan Waterfront Conference.* Zoning Compatibility With Open Space Planning Along The Bronx River, Bronx River, New York.

2006 Meeting of the Association of American Geographers (AAG). March 7-11 2006. Zvia Segal Naphtali, Carlos E. Restrepo and Rae Zimmerman. Paper presentation titled: “Land Use, Demographics and Industrial Facilities: Using GIS to Support Improved Land Use Initiatives and Policies in South Bronx, New York City.”

The International Society for Urban Health’s Third International Conference on Urban Health: “The Global Urban Health Agenda: Setting Priorities and Building Infrastructure”. October 20-22, 2004. Carlos E. Restrepo, Zvia Segal Naphtali and Rae Zimmerman. Poster presentation titled: “Asthma hospitalization rates, poverty, demographics and industrial land use in Bronx County, New York.”

Association of American Geographers Conference on Race/Ethnicity and Place. September 16-18, 2004. Zvia Segal Naphtali, Carlos E. Restrepo and Rae Zimmerman. Poster presentation titled: “Demographics and Waste Transfer Stations in South Bronx, New York.”