Chapter 22: Public Health

A. INTRODUCTION

This chapter assesses the Proposed Actions' potential public health impacts, including those related to air quality, noise, and hazardous materials during construction and operation of the Proposed Project. Construction equipment and vehicles could cause potential public health impacts related to noise and air pollutant emissions, while potential impacts from hazardous materials could occur from construction-related ground disturbance. Potential health effects during operation of the Proposed Actions would be related to noise and pollutant emissions from traffic, and pollutant emissions from central energy plants, smaller package boiler systems, and heating, ventilation, and air conditioning (HVAC) systems. Of particular concern is the potential for diesel emissions to impact public health, such as by increasing asthma rates. Therefore, this chapter also provides an overview of health concerns related to traffic, diesel equipment, and particulate matter (PM) emissions, and a discussion of asthma, its prevalence in New York City, and the area most likely affected by the Proposed Actions. In addition, institutional oversight, regulations, use, storage, transportation, and disposal of laboratory materials are described. Finally, Columbia University's commitment to sustainable development, an initiative that supports regional public health considerations, is also discussed.

PRINCIPAL CONCLUSIONS

The analysis (summarized below by technical area) concludes that the Proposed Actions would not cause any significant adverse impacts on public health.

AIR QUALITY

In considering the public health significance of predicted air quality increments summarized in Chapter 19, "Air Quality," and Chapter 21, "Construction," it is important to recognize that ambient air quality emission standards are set to limit the public health risks within large populations. The determination of whether an identified increment in PM has a public health impact necessarily takes into account a number of factors: (1) the extent of the increment, taking into account environmental epidemiological studies which demonstrate a variety of concentration-response functions; (2) duration and frequency of the added exposure; and (3) the geographic extent of the exposure in its setting.

The air quality analyses in the Draft Environmental Impact Statement (DEIS) for Columbia University construction and operation of the Proposed Actions show 24-hour average $PM_{2.5}$ concentration increments greater than 2 $\mu g/m^3$ (but not at any nearby residences or schools with respect to construction). These increments, which are also shown in the air quality analyses for the FEIS, reflect only slight elevations in PM for a very small number of days and within highly localized areas. For these reasons, no significant adverse public health impacts from $PM_{2.5}$ are expected from project operations and from Columbia University construction.

With respect to construction and operations at non-Columbia sites, as noted above, the only sites which may still be expected to be developed as a result of this rezoning action are Sites 24 and 25 (see Chapter 29). An emission reduction program would be instituted for any construction on those sites, implemented through E-designations. E-designations on those sites would ensure that concentrations from emissions of fossil fuel-fired equipment do not result in a violation of ambient air quality standards or with respect to the City's $PM_{2.5}$ interim guidance criteria. With these measures in place, no significant adverse $PM_{2.5}$ impacts would occur from these non-Columbia sites. For these reasons, no significant adverse public health impacts from $PM_{2.5}$ are expected from project operations and from non-Columbia University construction.

NOISE

As described in Chapter 20, "Noise," and Chapter 21, "Construction," the Proposed Actions would result in significant adverse noise impacts both during project operation and construction. Based upon the magnitude of and location of the noise impact during project operations, however, a significant adverse impact on public health is not expected. Maximum predicted noise levels at discrete locations during construction would be of limited duration, and the predicted overall changes in noise levels would not be large enough to significantly affect public health. While construction activities would produce noise levels of a magnitude that at times are annoying and intrusive, and would be considered undesirable, construction activities would only occur for a limited number of hours per day, and for a limited time period. Based upon the limited durations of these noise levels, the noise produced by construction activities would not result in a significant adverse public health impact.

Therefore, no significant adverse health impacts from noise are expected from construction and operation of the Proposed Actions.

HAZARDOUS MATERIALS

All sites that would undergo construction as part of the Proposed Actions would be remediated for their potential hazardous materials pursuant to Restrictive Declarations on sites owned or controlled by Columbia at the time of the proposed rezoning, and E-designations on all other sites. Potential impacts during construction and development activities would be avoided by implementing a Construction Health and Safety Plan (CHASP), and any contamination encountered would be addressed under a Remedial Action Plan (RAP). (Both plans have been approved by the New York City Department of Environmental Protection [DEP] and would be approved by the New York State Department of Environmental Conservation [DEC], if necessary, in response to a reported petroleum spill.)

With these measures in place, no significant public health adverse impacts related to hazardous materials are expected to occur as a result of the Proposed Actions.

RODENT CONTROL

As discussed in Chapter 21, construction contracts would include provisions for a rodent (mouse and rat) control program. Before the start of construction, the contractor would survey and bait the appropriate areas and provide for proper site sanitation. During the construction phase, as necessary, the contractor would carry out an ongoing prevention, inspection, and response program. Coordination would be maintained with appropriate public agencies. Only registered rodenticides would be permitted, and the contractor would be required to perform rodent control programs in a manner that avoids hazards to persons, domestic animals, and non-target wildlife.

B. METHODOLOGY

For determining whether a public health assessment is appropriate, the 2001 *City Environmental Quality Review (CEQR) Technical Manual* lists the following as public health concerns for which a public health assessment may be warranted:

- Increased vehicular traffic or emissions from stationary sources resulting in significant adverse air quality impacts;
- Increased exposure to heavy metals (e.g., lead) and other contaminants in soil/dust resulting in significant adverse impacts;
- The presence of contamination from historic spills or releases of substances that might have affected or might affect groundwater to be used as a source of drinking water;
- Solid waste management practices that could attract vermin and result in an increase in pest populations (e.g., rats, mice, cockroaches, and mosquitoes);
- Potentially significant adverse impacts to sensitive receptors from noise or odors;
- Vapor infiltration from contaminants within a building or underlying soil (e.g., contamination originating from gasoline stations or dry cleaners) that may result in significant adverse hazardous materials or air quality impacts;
- Actions for which the potential impact(s) result in an exceedance of accepted federal, State, or local standards; or
- Other actions that might not exceed the preceding thresholds but might, nonetheless, result in significant public health concerns.

Based on this guidance, this chapter assesses the potential health concerns during the construction and operation of the Proposed Actions, including assessments of air quality, noise, and hazardous materials. In addition, a description of the institutional oversight, regulations, use, storage, transportation, and disposal practices of laboratory materials is provided.

The public health assessment first identifies the pollutants of concern relating to air quality, then outlines the applicable standards and thresholds to which potential emissions from construction and operational activities associated with the Proposed Actions will be compared. A description of the sources of air and noise pollutants during construction and operation are then presented, followed by a literature review of the health effects associated with diesel engine exhaust and emissions of PM in particular.

Given public concern about asthma in New York City, and that exposure to PM emissions could aggravate or induce asthma attacks, this chapter also provides a review of relevant asthma-related studies, provides an overview of the prevalence of asthma in New York City, and presents current asthma hospitalization data for neighborhoods representing the potentially affected population surrounding the Project Area.

A summary of the air quality and noise impact assessments during the construction and operational periods of the Proposed Actions is then presented, and the potential for public health impacts due to the Proposed Actions is determined. Summaries of potential impacts from hazardous materials and rodent control measures during construction are also presented. Following these discussions, the institutional oversight, regulations, use, storage, transportation,

and disposal practices of laboratory materials is described, along with a discussion of Columbia University's comprehensive commitment to incorporating "green building" elements.

C. SUMMARY OF AIR AND NOISE POLLUTION SOURCES FROM THE PROPOSED ACTIONS

CONSTRUCTION

AIR QUALITY

Construction activities have the potential to impact public health as a consequence of emissions from on-site construction engines, and emissions from on-road construction-related vehicles and their impact on traffic conditions. Historically, most construction engines have been diesel-powered and have produced relatively uncontrolled emissions of PM. Construction activities also emit fugitive dust. Impacts on traffic could also increase mobile source-related emissions.

In recognition of the potential construction-related air quality and public health effects of emissions from diesel engines, an emissions reduction program would be required during construction for the Proposed Actions, as detailed in Chapter 21.

In addition, to address health and safety procedures that minimize exposure to workers and the public to contaminated materials during construction, an RAP and a CHASP would be required for all lots in the Project Area (see Chapter 12, "Hazardous Materials").

Additional measures would be taken to reduce pollutant emissions during construction in accordance with all applicable laws, regulations, and building codes. These include dust suppression measures and the restriction of on-road vehicle idle time to three minutes for all vehicles that are not using the engine to operate a loading, unloading, or processing device (e.g., concrete mixing trucks).

NOISE

Community noise levels during construction of the Proposed Actions could result from noise and vibration from construction equipment operation and from construction vehicles and delivery vehicles traveling to and from a building site. Noise levels caused by construction activities would vary widely, depending on the phase of construction and the location of the construction relative to receptor locations. The most significant construction noise sources related to the Proposed Actions are expected to be impact equipment, such as jackhammers, impact wrenches, and paving breakers, as well as the movements of trucks and cranes.

PROJECT OPERATIONS

AIR QUALITY

The primary source of mobile source pollutant emissions during project operations would be from project-generated vehicles using nearby intersections in the study area. The Proposed Actions would increase traffic in the vicinity of the Project Area and along feeder streets to and from the Project Area, potentially increasing pollutant emissions.

Potential stationary source emissions associated with operation of the Proposed Actions would primarily be from fuel burned on-site for HVAC systems, central energy plants, and smaller package boiler systems.

NOISE

The primary source of noise during project operations would be attributable to increased traffic in the area generated by the Proposed Actions.

D. POLLUTANTS OF CONCERN

As mentioned above, the primary source of air quality pollutant emissions from the Proposed Actions would be from diesel engines during construction, and emissions from project-generated vehicles and fuel-burning heating systems during project operations. Increases in airborne PM emitted by such sources may account for potential impacts on public health. Also, given the higher than national asthma prevalence in New York City and the potential effects of PM emissions on asthma, PM has been identified as the primary pollutant of concern as it relates to potential public health impacts from the Proposed Actions. The potential air quality impacts of $PM_{2.5}$ and other pollutants of concern from the Proposed Actions are analyzed in Chapters 19 and 21.

PARTICULATE MATTER

PM is a broad class of air pollutants that exist as liquid droplets or solids, with a wide range of sizes and chemical composition. PM_{10} refers to suspended particles with diameters less than 10 micrometers (μm), and $PM_{2.5}$ to suspended particles with diameters less than 2.5 μm. Generally, airborne concentrations of PM are expressed as the total mass of all material (often smaller than a specified aerodynamic diameter) per volume of air (in micrograms per cubic meter, $\mu g/m^3$).

PM is emitted by a variety of natural and man-made sources. Natural sources include the condensed and reacted forms of natural organic vapors; salt particles resulting from the evaporation of sea spray; wind-borne pollen, fungi, molds, algae, yeasts, rusts, and bacteria; debris from live and decaying plant and animal life; particles eroded from beaches, desert, soil and rock; and particles from volcanic and geothermal eruptions, and forest fires.

Major man-made sources of PM include the combustion of fossil fuels, such as vehicular exhaust, power generation and home heating, chemical and manufacturing processes; all types of construction; agricultural activities; and wood-burning fireplaces. Since the chemical and physical properties of PM vary widely, the assessment of the public health effects of airborne pollutants in ambient air is extremely complicated.

$PM_{2.5}$

As mentioned above, PM is a byproduct of fossil fuel combustion. It is also derived from mechanical breakdown of coarse PM such as pollen fragments. $PM_{2.5}$ does not refer to a single pollutant, but to an array of fine inhalable materials. For example, there are thousands of forms of natural ambient $PM_{2.5}$ and perhaps as many forms of man-made $PM_{2.5}$, which include the products of fossil fuel combustion (such as diesel fuel), chemical/industrial processing, and burning of vegetation. Some PM is emitted directly to the atmosphere (i.e., primary PM), while other types of PM are formed in the atmosphere through various chemical reactions and physical

transformations (i.e., secondary PM). The formation of secondary $PM_{2.5}$ is one determinant of ambient air quality and is, thus far, extremely difficult to model.

The major constituents of $PM_{2.5}$ are typically sulfates, nitrates, organic carbon, elemental carbon (soot), ammonium, and metallic elements (not including sulfur). Secondary sulfates and nitrates are formed from their precursor gaseous pollutants, sulfur dioxide (SO_2), and nitrogen oxides ($NO_{x,}$) at some distance from the source due to the time needed for the chemical conversion within the atmosphere. Elemental carbon and metallic elements are components of primary PM, while organic carbon can be either emitted directly from a source or formed as a secondary pollutant in the atmosphere. Due to the influence of these "secondary" pollutants from distant or regional sources, regional ambient levels of $PM_{2.5}$ are typically more evenly distributed than their related class of pollutants, PM_{10}, which is more highly influenced by local sources.[1,2]

Data from the Botanical Gardens in the Bronx and Queens College in Queens indicate that the greatest contributors to ambient $PM_{2.5}$ concentrations in New York City are sulfates and organic carbon (approximately two-thirds of the total $PM_{2.5}$ mass). Studies confirming the contribution of long-range transport to ambient $PM_{2.5}$ levels compared the data from New York City monitors with monitors from a remote site within the State, downwind from other states. These data show that high levels of sulfate and other pollutants come into New York State from areas to the west and south of New York. The data also indicate that urban sites are more likely to experience increased nitrate and carbon levels than rural sites.[3]

E. AIR QUALITY AND NOISE REGULATIONS AND STANDARDS

AIR QUALITY

THE NATIONAL AMBIENT AIR QUALITY STANDARD FOR $PM_{2.5}$

Section 108 of the Clean Air Act (CAA) directs the U.S. Environmental Protection Agency (EPA) to identify criteria pollutants that may reasonably be anticipated to endanger public health and welfare. Section 109 of the CAA requires EPA to establish National Ambient Air Quality Standards (NAAQS) and periodically revise them for such criteria pollutants. Primary NAAQS are mandated to protect public health with an adequate margin of safety. In setting the NAAQS, EPA must account for uncertainties associated with inconclusive scientific and technical information, and potential hazards not yet identified. The standard must also be adequate to protect the health of any sensitive group of the population. Secondary NAAQS are defined as standards that are necessary to prevent adverse impacts on public welfare, such as impacts to crops, soil, water, vegetation, wildlife, weather, visibility, and climate.

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[1] Ito K., Christensen W.F., Eatough D.J., Henry R.C., Kim E., Laden F., Lall R., Larson T.V., Neas L., Hopke P.K., Thurston G.D. PM source apportionment and health effects: 2. An investigation of intermethod variability in associations between source-apportioned fine particle mass and daily mortality in Washington, DC. J Expo Sci Environ Epidemiol. 2006 Jul;16(4):300-10. Epub 2005 Nov 23.

[2] Lena T.S., Ochieng V., Carter M., Holguin-Veras J., Kinney P.L. Elemental carbon and $PM_{2.5}$ levels in an urban community heavily impacted by truck traffic. Environ Health Perspect. 2002 Oct; 110(10):1009-15

[3] New York State Department of Environmental Conservation (DEC), Report to the Examiners on Consolidated Edison's East River Article X Project, Case No. 99-F-1314, February 2002.

Beginning in 1994, EPA conducted a five-year review of the NAAQS for PM, which included an in-depth examination of epidemiologic and toxicological studies. The studies are summarized in EPA's Criteria Document for Particulates, Chapters 10–13 (1996); EPA's Staff Papers on Particulates, in particular Chapter V[1]; and EPA's proposed NAAQS for particulates, found in the December 13, 1996, Federal Register on page 65638. Based on this extensive analysis, in June 1997, EPA revised the NAAQS for PM and proposed a new standard for $PM_{2.5}$ consisting of both a long-term (annual) limit of 15 $\mu g/m^3$ and a short-term (24-hour) limit of 65 $\mu g/m^3$.[2]

In establishing the NAAQS for $PM_{2.5}$ in 1997, EPA conservatively assumed that moderate levels of airborne PM of any chemical, physical, or biological form might harm health. In setting the value of the annual average NAAQS for $PM_{2.5}$, EPA found that an annual average $PM_{2.5}$ concentration of 15$\mu g/m^3$ is below the range of data most strongly associated with both short- and long-term exposure effects. The EPA Administrator concluded that an annual NAAQS of 15$\mu g/m^3$ "would provide an adequate margin of safety against the effects observed in the epidemiological studies."[3]

EPA has revised the NAAQS for PM, effective December 18, 2006. The revision included lowering the level of the 24-hour $PM_{2.5}$ standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$, and retaining the level of the annual $PM_{2.5}$ standard at 15 $\mu g/m^3$.

NOISE

As discussed in Chapter 20, "Noise," noise levels associated with the construction and operation of the Proposed Actions would be subject to the emission source provisions of the New York City Noise Control Code and to Noise Standards set for the CEQR process. Construction equipment is regulated by the Noise Control Act of 1972 and the New York City Noise Control Code.

F. DETERMINING THE SIGNIFICANCE OF PUBLIC HEALTH IMPACTS

The State Environmental Quality Review Act (SEQRA) regulations and the *CEQR Technical Manual* state that the significance of a likely consequence (i.e., whether it is material, substantial, large, or important) should be assessed in connection with:

1) Its setting (e.g., urban or rural);
2) Its probability of occurrence;
3) Its duration;
4) Its irreversibility;
5) Its geographic scope;
6) Its magnitude; and
7) The number of people affected.

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[1] Many of the studies are found on EPA's Web site at http://www.epa.gov/ttn/oarpg/t1sp.html.

[2] 62 Federal Register 38652 (July 18, 1997).

[3] 62 Federal Register 28652, 38676 (July 18, 1997).

The potential public health impacts of PM emissions and noise levels due to the Proposed Actions are based on the results of the air quality and noise impact assessments in Chapters 19, 20, and 21. The following section presents the applicable standards and thresholds with which the results of the air quality and noise modeling are compared in determining the significance of public health impacts.

AIR QUALITY

To maintain concentrations lower than the NAAQS in attainment areas, or to ensure that concentrations will not be significantly increased in non-attainment areas, threshold levels have been defined for certain pollutants. Any action predicted to increase the concentrations of these pollutants above the thresholds requires a detailed analysis of air quality impacts for that pollutant. New York County has been designated a non-attainment area for $PM_{2.5}$. To determine the potential significance of impacts from individual projects, DEC and DEP have provided interim guidance criteria as described below.

INTERIM GUIDANCE CRITERIA (THRESHOLD LEVELS) REGARDING $PM_{2.5}$ IMPACTS

As mentioned above, DEP is currently recommending an interim guidance for $PM_{2.5}$, a threshold value that is used for comparison when determining potential significance of air quality impacts. A neighborhood analysis is warranted, given that $PM_{2.5}$ is a regional pollutant, with monitored annual background concentrations that are near or above the applicable annual average standard in the New York City metropolitan area. In the neighborhood analysis, an area of 1 km^2, centered at the maximum predicted ground-level concentration, is considered. According to the interim guidance, actions should not exceed an average annual $PM_{2.5}$ concentration increment of 0.1 $\mu g/m^3$ within the 1 km^2 area considered. To put this value in perspective: 0.1 $\mu g/m^3$ constitutes less than 1 percent of the annual NAAQS for $PM_{2.5}$. A concentration increment that is lower than the incremental neighborhood guidance concentration would not be registered by the ambient air monitors.

In addition, DEP is currently recommending interim guidance criteria for evaluating the potential $PM_{2.5}$ impacts for projects subject to CEQR. The updated interim guidance criteria currently employed by DEP for determination of potential significant adverse $PM_{2.5}$ impacts under CEQR are as follows:

- 24-hour average $PM_{2.5}$ concentration increments which are predicted to be greater than 5 $\mu g/m^3$ at a discrete receptor location would be considered a significant adverse impact on air quality under operational conditions (i.e., a permanent condition predicted to exist for many years regardless of the frequency of occurrence);
- 24-hour average $PM_{2.5}$ concentration increments which are predicted to be greater than 2 $\mu g/m^3$ but no greater than 5 $\mu g/m^3$ would be considered a significant adverse impact on air quality based on the magnitude, frequency, duration, location, and size of the area of the predicted concentrations;
- Predicted annual average $PM_{2.5}$ concentration increments greater than 0.1 $\mu g/m^3$ at ground-level on a neighborhood scale (i.e., the annual increase in concentration representing the average over an area of approximately 1 square kilometer, centered on the location where the maximum ground-level impact is predicted for stationary sources; or at a distance from a roadway corridor similar to the minimum distance defined for locating neighborhood scale monitoring stations); or

- Predicted annual average $PM_{2.5}$ concentration increments greater than 0.3 $\mu g/m^3$ at a discrete or ground level receptor location.

DEC has also published a policy to provide interim direction for evaluating $PM_{2.5}$ impacts. This policy would apply only to facilities applying for permits or major permit modification under SEQRA that emit 15 tons of PM_{10} or more annually. The policy states that such a project will be deemed to have a potentially significant adverse impact if the project's maximum impacts are predicted to increase $PM_{2.5}$ concentrations by more than 0.3 $\mu g/m^3$ averaged annually or more than 5 $\mu g/m^3$ on a 24-hour basis. (These thresholds have also been referenced by DEP in its interim guidance policy.) The Proposed Actions' annual emissions of PM_{10} are estimated to be well below the 15-ton-per-year threshold under the DEC's $PM_{2.5}$ guidance. The DEP community-based annual threshold of 0.1 $\mu g/m^3$ is considered more relevant and appropriate when determining potential public health impacts than the above-mentioned DEC thresholds, since it represents maximum ground-level concentrations averaged over a wider "neighborhood-scale" area.

As presented in Chapter 19, both the DEC and DEP interim guidance criteria have been used to evaluate the potential significance of predicted air quality impacts of the Proposed Actions on $PM_{2.5}$ concentrations, and to determine the need to minimize PM emissions from the Proposed Actions. Therefore, the public health analysis considers both the DEC and DEP thresholds in the determination of the public health impacts from the Proposed Actions.

Actions under CEQR that would increase $PM_{2.5}$ concentrations by more than the DEP or DEC interim guidance criteria above will be considered to have potential significant adverse impacts. DEP recommends that its actions subject to CEQR that fail the interim guidance criteria prepare an EIS and examine potential measures to reduce or eliminate such potential significant adverse impacts.

NOISE

As described in Chapter 20, in terms of CEQR, a significant noise impacts occurs when there is an increase in the one hour equivalent noise level ($L_{eq(1)}$) of between 3 and 5 dBA, depending upon the noise level without the proposed action. In terms of public health, significance is not determined based upon the incremental change in noise level, but is based principally upon the magnitude of the noise level and time frame of exposure.

G. AIR QUALITY-RELATED HEALTH EFFECTS

Scientists have been studying possible links between various health effects, particularly respiratory diseases or symptoms such as cough, asthma, and bronchitis, and traffic sources of air pollution. The toxic effects of diesel engine exhaust, in particular, have been evaluated in numerous studies. Increases in airborne PM emitted by such sources may account for potential impacts on public health. The following section provides a general discussion of the health effects from traffic and construction equipment sources of air pollution, such as engine exhaust, then focuses specifically on the characteristics of PM, especially $PM_{2.5}$ (suspended particles with diameters less than 2.5 μm) and the public health effects related to human exposure to airborne concentrations of $PM_{2.5}$. Because New York City, and the Project Area in particular, are considered high-density areas with asthma rates that are generally higher than in less urban areas, a detailed discussion of asthma is presented, including its prevalence in New York City and the area most likely to be affected by the Proposed Actions.

DIESEL ENGINE EXHAUST

EPA's *Health Assessment Document for Diesel Engine Exhaust, 2002*, evaluates available evidence of the health hazards associated with exposure to diesel engine exhaust (DE).[1] The assessment categorizes the possible health hazards as either acute (short-term exposure) effects, chronic (long-term exposure) non-cancer respiratory effects, or chronic (long-term exposure) carcinogenic effects.

EPA's assessment notes that there is available, but limited, human and animal evidence to suggest that exposure to diesel exhaust can cause acute irritation (e.g., eye, throat, and bronchial), neurophysiological symptoms (e.g., lightheadedness and nausea), and respiratory symptoms (e.g., cough and phlegm). There is also evidence of the exacerbation of allergenic responses to known allergens and asthma-like symptoms.

Toxicological information from human studies does not provide a definitive evaluation of possible non-cancer health effects; however, there is extensive animal evidence. Based on the available animal evidence, EPA has concluded that diesel exhaust exposure may pose a chronic respiratory hazard to humans. In several animal species, including rats, mice, hamsters, and monkeys, chronic-exposure animal inhalation studies show a range of dose-dependent inflammation and histopathological changes in the lungs.

Based on the evaluation of evidence from human, animal, and other supporting studies, EPA has concluded that diesel engine exhaust is "likely to be carcinogenic to humans by inhalation," and that this hazard applies to environmental exposures. EPA's assessment states that:

> *Although the available human evidence shows a lung cancer hazard to be present at occupational exposures that are generally higher than environmental levels, it is reasonable to presume that the hazard extends to environmental exposure levels.*
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> *Given a carcinogenicity hazard, EPA typically performs a dose-response assessment of the human or animal data to develop a cancer unit risk estimate that can be used with exposure information to characterize the potential cancer disease impact on an exposed population. The DE human exposure-response data are considered too uncertain to derive a confident quantitative estimate of cancer unit risk, and with the chronic rat inhalation studies not being predictive for environmental levels of exposure, EPA has not developed a quantitative estimate of cancer unit risk.*

Although there is convincing evidence for potential human health hazards related to diesel engine exhaust, EPA's assessment acknowledges that uncertainties exist because of the use of assumptions to bridge data and knowledge gaps about human exposures to DE and the underlying mechanisms by which DE may cause the observed toxicities in humans and animals:

> *A notable uncertainty of this assessment is how the physical and chemical nature of DE emissions has changed over the years because the toxicological and epidemiologic observations are based on older engines and their emissions, yet the desire is to focus on the potential health hazards related to exposure from present-day or future emissions.*
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> *Other uncertainties include the assumptions that health effects observed at high doses may be applicable to low doses, and that toxicologic findings in laboratory animals are*

[1] EPA National Center for Environmental Assessment, 2002, *Health Assessment Document for Diesel Engine Exhaust*, EPA/600/8-90/057F.

predictive of human responses. Also, the available data are not sufficient to demonstrate the absence or presence of an exposure/dose-response threshold in humans from DE toxicity at environmental exposures.

As mentioned above, the results of the EPA study are based on data for older engines. As part of the Proposed Actions, Columbia has committed to implementing a state-of-the-art emissions reduction program for all of its construction activities (Subdistrict A), which include: minimizing the use of diesel engines to the extent practicable by using electric engines operating on grid power; exclusively using ultra-low-sulfur diesel (ULSD) for all diesel engines; utilizing best available tailpipe reduction technologies[1] for all nonroad diesel engines with a power rating of 50 horsepower (hp) or greater and for controlled truck fleets (i.e., truck fleets under long-term contract with Columbia University, such as concrete mixing and pumping trucks); and mandating the use of "newer" (i.e., Tier 1[2] or later) construction equipment for nonroad diesel engines greater than 50 hp. These measures would significantly reduce diesel PM emissions related to Columbia University's construction activities in Subdistrict A, which would reduce the potential for public health impacts. In addition, the DEIS conservatively predicted that there would be non-Columbia construction in Subdistrict B. Since the issuance of the DEIS, CPC has proposed a modification of the rezoning which would result in no new construction in Subdistrict B[3] (see Chapter 29, "Modifications to the Proposed Actions"). The analysis in Chapter 21 addresses construction emission reduction measures for $PM_{2.5}$ that would be implemented by means of an E designation for construction on the non-Columbia construction sites, Sites 24 and 25 in the Other Area east of Broadway. Those would be the only two sites with non-Columbia construction under the proposed modification presented in Chapter 29.

The PM emitted from combusting ULSD consists primarily of organic products of incomplete combustion and is very low in metal content.[4] Further, this PM contains no biological material. Small amounts of nitrates and sulfates may be present in this PM, and NO_x, SO_2, and ammonia emissions may lead to further (but much more diffuse) formation of secondary PM in the region, although chemical reactions that result in secondary PM are typically too slow to cause an

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[1] Columbia University has identified diesel particle filters (DPFs) as being the tailpipe technology currently proven to have the highest reduction capability (Columbia University's construction contracts would specify that all diesel nonroad engines rated at 50 hp or greater would utilize DPFs, either original equipment manufacturer (OEM) or retrofit technology that would result in emission reductions of DPM of at least 90 percent (when compared with normal private construction practices).

[2] The first federal regulations for new nonroad diesel engines were adopted in 1994, and signed by EPA into regulation in a 1998 Final Rulemaking. The 1998 regulation introduces Tier 1 emissions standards for all equipment 50 hp and greater and phases in the increasingly stringent Tier 2 and Tier 3 standards for equipment manufactured in 2000 through 2008. The Tier 1 through 3 standards regulate the EPA criteria pollutants, including particulate matter (PM), hydrocarbons (HC), oxides of nitrogen (NO_x) and carbon monoxide (CO). Prior to 1998, emissions from nonroad diesel engines were unregulated. These engines are typically referred to as Tier 0.

[3] The proposed modifications would rezone Subdistrict B to a modified M1-2 light manufacturing district to support light manufacturing and retail uses. It is anticipated that this modification would not result in any projected development sites in Subdistrict B. The proposed modifications are more fully described in Chapter 29, "Modifications to the Proposed Actions." Chapter 29 also analyzes the potential environmental impacts that could result from the proposed modifications.

[4] *AP42*, Section 1.3, September, 1998 and Section 3.1, April, 2000.

increase in secondary PM near the source. Many toxicological studies have shown that concentrations of hundreds of micrograms of sulfate or nitrate per cubic meter of air are required before even minimal changes in respiratory or other functions can be observed, even in asthmatic subjects or in sensitive laboratory rodents.[1]

$PM_{2.5}$

An important issue associated with $PM_{2.5}$ is that it has a direct causal effect on human health. Since PM in the ambient air is composed of a combination of discrete compounds or elements, its possible public health effects could vary depending on the specific components of PM in a region. For example, acid aerosols, such as sulfuric acid, may trigger reactions in pulmonary lung function, while bioaerosols, such as mold spores, may result in allergic reactions related to increased incidences of asthma. The EPA 2004 Criteria Document acknowledges the uncertainty regarding the shapes of PM exposure-response relationships; the magnitude and variability of risk assessments for PM; the ability to attribute observed health effects to specific PM constituents; the time intervals over which PM health effects are manifested; the extent to which findings in one location can be generalized to other locations; and the nature and magnitude of the overall public health risk imposed by ambient PM exposure.

Studies have shown the importance of separating total personal exposure to $PM_{2.5}$ into its two major components.[2] Ambient (or outdoor) exposure includes the ambient PM concentrations while outdoors, usually estimated by measurements at local air monitoring stations. Non-ambient exposure is the result of indoor sources (e.g., cooking and cleaning) and personal sources (e.g., smoking and materials used for hobbies). Non-ambient exposure levels are independent of outdoor ambient PM concentrations. Among subjects of a large study of three cities, personal exposures to $PM_{2.5}$ were significantly higher than outdoor $PM_{2.5}$ concentrations.[3] The fact that personal PM exposures were higher than outdoor concentrations indicates that indoor sources of $PM_{2.5}$ contribute to, and in some cases dominate, personal exposures.

The potential for $PM_{2.5}$ to affect public health is dependent on the composition and the amount of PM in the atmosphere (i.e., the higher the ambient $PM_{2.5}$ concentration, the more likely that it would have an effect). The evidence cited by EPA in establishing the NAAQS for $PM_{2.5}$ is derived from epidemiologic studies that found, at typical ambient levels, a statistical correlation of PM and increased levels of morbidity and mortality.[4] It is unclear what forms of PM and what physiological mechanisms are responsible for the observed health effects. However, the extent of any adverse public health effect related to an increase in PM concentrations is anticipated to be

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[1] Concentrations of at least 100 micrograms of sulfate or nitrate per cubic meter of air are required before even minimal changes in respiratory function can be observed, even in asthmatic subjects or in sensitive laboratory rodents. See EPA's 2004 PM Criteria Document for extended discussion and references.

[2] Wilson, W.E., Brauer M., 2006. Estimation of ambient and non-ambient components of particulate matter exposure from a personal monitoring panel study. J Exp Sci Env Epid 16:264-74.

[3] Weisel, C.P., Zhang., J., Turpin, B.J., et al. 2005. Relationships of indoor, outdoor, and personal air (RIOPA), Part I. Collection methods and descriptive analyses. Health Effects Institute No. 130 Part I. Available at: http://www.healtheffects.org/Pubs/RIOPA-I.pdf (Accessed July 5, 2006).

[4] Krewski et al (2000); Dockery et al. N. Engl. J. Med. 329, 1753-1759 (1995); Pope et al Am. J. Respir. Crit. Care Med., 151:669-674 (1995), Burnett et al, JAMA 287(9), 1132-41 (2002); Dominici et al, Am. J. Epidemiol. 157 (12), 1055-1065 (2003).

proportional in some way to the concentration increase. A small increase in PM concentrations can, at most, lead to a small increase in the risk of PM-related public health effects.

The principal health effects of airborne PM are on the respiratory system, although recent research investigated the possible link between PM pollution and cardiovascular disease.[1]

Respiratory

General Respiratory Effects of $PM_{2.5}$. Numerous studies have correlated increased rates of hospital admissions for respiratory conditions, small decreases in lung function in children with or without asthma, and absences from school with changes in PM concentrations.[2] As a result, EPA stated that these statistical associations reflect cause and effect and established the NAAQS for PM primarily on the basis of the associations.[3] The $PM_{2.5}$ standard was established to protect public health.

Asthma

Urban populations in general, and New York City residents, specifically in the greater Harlem area, have a higher prevalence of asthma and higher rates of hospitalization for asthma than non-urban populations.[4] Given the concern that exposure to PM emissions, especially $PM_{2.5}$, from activities associated with the Proposed Actions could either aggravate pre-existing asthma or induce asthma in an individual with no prior history of the disease, the potential for emissions of $PM_{2.5}$ to precipitate the onset or exacerbation of asthma is examined below. The discussion includes a review of the risk factors for asthma development and exacerbation; current prevalence, morbidity, and mortality estimates of asthma; and a survey of the scientific literature that discusses the relationship between truck traffic and the occurrence of asthma.

Background. Asthma is a complex disease with multiple causes and substantial inter-individual variation in the severity of symptoms. It is a chronic inflammatory disorder of the airways characterized by variable airflow obstruction and airway hyper-responsiveness in which prominent clinical manifestations include wheezing and shortness of breath.[5] During an asthma attack, an individual experiences difficulty breathing, which, if severe enough and treatment is not rendered, may be fatal in rare instances.[6] Asthmatic episodes may be triggered by specific substances, environmental conditions, and stress, as discussed below.

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[1] Künzli, N., Tager I.B. 2005. Air pollution: from lung to heart. Swiss Med Wkly 135:697-702. Available at http://www.smw.ch/docs/pdf200x/2005/47/smw-11025.pdf (accessed July 2006).

[2] CEPA/FPAC Working Group on Air Quality Objectives and Guidelines. National Ambient Air Quality Objectives for Particulate Matter. Part 1: Science Assessment Document.

[3] EPA (2004) Air Quality Criteria for Particulate Matter (Vols. I and II); EPA/600/P-99/002af.Washington, DC: Office of Research and Development (1997); National Ambient Air Quality Standards for Particulate Matter, Final Rule, Federal Registry: July 18, EPA 2003.

[4] Aligne C.A., Auinger P., Byrd R.S. 2000. Risk factors for pediatric asthma: contributions of poverty, race, and urban residence. Am J Resp Crit Care Med 162:873-877.

[5] Sheffer, A.L., and V.S. Taggart. 1993. The National Asthma Education Program: expert panel report guidelines for the diagnosis and management of asthma. Med Care 1993:31 (suppl):MS20-MS28.

[6] McFadden, Jr. E.R. 2004. Asthma. In Harrison's Principles of Internal Medicine. (Eds: D.L. Kasper, E. Braunwald, A. Fauci, S. Hauser, D. Longo, J.L. Jameson), McGraw-Hill, New York, pp. 1508-1516.

Although somewhat of a simplification, asthma can be categorized as having either an allergic or a non-allergic basis.[1,2,3] Allergic asthma is usually associated with a family history of allergic disease, increased levels of certain immune system proteins, and/or positive responses to specific diagnostic tests. Although exercise, cold air, and respiratory infections may also exacerbate asthma for allergic asthmatics, allergen exposure may be most important for eliciting airway inflammation and hyper-responsiveness. About 75 percent of people suffering from asthma have allergic asthma.[4] In contrast, people suffering from non-allergic asthma experience symptoms in their airways when exercising, breathing cold air, or suffering from respiratory infections.[5]

Prevalence of Asthma. In the United States, approximately 6.4 million children (8.8 percent of children under age 18) have asthma. Asthma prevalence in New York State is estimated at approximately 9.9 percent.[6] According to the Centers for Disease Control (CDC), over the last two decades, the self-reported prevalence of asthma increased 75 percent in all age groups, and 160 percent in children between 0 and 4 years of age. The rate of asthma is increasing most rapidly in children under age 5. Additionally, it is estimated that asthma prevalence in Western countries doubled between 1977 and 1997.[7] Other parts of the world have also reported an increase in asthma prevalence in urban areas. Though changes in infectious disease patterns,[8] decreased physical activity, increasing prevalence of obesity,[9] and increased time spent indoors are hypothesized to be contributing factors to the increase in the prevalence of asthma, the subject is one of continuing research.

Asthma Morbidity and Mortality. Asthma morbidity and mortality rates have been rising throughout the U.S. over the last few decades,[10] with New York City experiencing a disproportionate increase in the early 1990s[11]. However, hospitalization rates in New York City have been gradually declining since the peak rates in the mid-1990s. Between 1997 and 2004,

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[1] Scadding, J.G. 1993. "Chapter 1: Definition and clinical categorization." In *Bronchial Asthma: Mechanisms and Therapeutics*. Second Edition (Eds: Weiss, E.B, M.S. Segal, and M. Stein), Little, Brown, and Company, Boston, MA, pp. 3-13.

[2] McFadden, 2004.

[3] Sears, M.R. 1997. "Epidemiology of childhood asthma." *Lancet* 350:1015-1020.

[4] Centers for Disease Control (CDC). 2002. "Surveillance for Asthma – United States, 1980-1999." *Morbidity and Mortality Weekly Report* 51(SS01): 1-13. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5101a1.htm (accessed July 2006).

[5] McFadden, 2004.

[6] American Lung Association, May 2005. "Trends in Asthma Morbidity and Mortality."

[7] Cookson, W.O.C.M., and M.F. Moffatt. 1997. "Asthma: an epidemic in the absence of infection?" *Science* 275:41-42.

[8] Ibid.

[9] Platts-Mills, T.A.E., R.B. Sporik, M.D. Chapman, and P.W. Heymann. 1997. "The role of domestic allergens." In: *The Rising Trends in Asthma.* Ciba Foundation Symposium 206. John Wiley and Sons, New York, NY, pp. 173-189.

[10] CDC, 2002.

[11] Garg, R., Karpati, A., Leighton, J., Perrin, M., Shah, M., 2003. *Asthma Facts, Second Edition*. New York City Department of Health and Mental Hygiene.

asthma hospitalization rates among children aged 0 to 14 years decreased in most New York City boroughs.[1] Asthma mortality rates between 1990 and 2000 also declined for all age groups.[2]

Asthma is the leading cause of hospitalization in New York City for children aged 0 to 14 years and ranks among the leading causes of hospitalization for all age groups.[3] In 2000, the hospitalization rate for asthma among children aged 0 to 4 years was 10.2 per 1,000 children in New York City, compared with 6.4 per 1,000 in the United States.[4] Asthma exacerbations resulting in hospitalizations appear to be particularly frequent and severe among minority inner-city children. A recent study by investigators at the Mount Sinai School of Medicine found an enormous difference in the rate at which children living in poor New York City neighborhoods were hospitalized for asthma, compared with children in wealthy neighborhoods. Another recent study conducted in New York City found that children living in neighborhoods of low socioeconomic status had more than 70 percent increased risk of current asthma (a diagnosis with symptoms during the previous 12 months), when compared with children of their same ethnicity and income level living in communities of greater economic affluence.[5] These findings suggest that characteristics of the urban environment, apart from the ethnicity and income level of the residents, contribute to high asthma prevalence. The study noted that areas with high asthma hospitalization rates are geographically clustered in low socioeconomic status areas. These areas tend to contain a number of potential pollution sources that could affect respiratory health, including designated truck routes and high traffic roads, waste transfer stations, and nearby power plants.

As such, there are striking differences in the number of hospitalizations among New York City boroughs and specific neighborhoods within each borough. On a borough level, hospitalization and death rates that are associated with asthma are highest in the Bronx. On a neighborhood level, in 2004, the East Harlem area of Manhattan reported the highest rate of asthma hospitalizations among children aged 0 to 14 years (approximately 13.1 hospitalizations per 1,000 children[6]), followed by Central Harlem, which includes the Project Area. Among adults 35 years and older, Hunts Point/Mott Haven had the highest rate, at 12.6 per 1,000.

The borough of Manhattan as a whole has experienced a 50 percent decrease in child hospitalization rates between 1997 and 2004.[7] A comparison of asthma hospitalization rates in 1997 and 2004

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[1] New York City Department of Health and Mental Hygiene. *Updated Asthma Hospitalization Data by NYC Neighborhood* from website http://www.nyc.gov/html/doh/downloads/pdf/asthma/asthma-hosprates-children.pdf. Site accessed June, 2006.

[2] Garg et al., 2003.

[3] Ibid.

[4] Ibid.

[5] Claudio L, Stingone JA, Godbold J. Prevelence of Childhood Asthma in Urban Communities: The Impact of Ethnicity and Income. Ann Epidemiol 2006; 16: 332-340.

[6] New York City Department of Health and Mental hygiene. *Updated Asthma Hospitalization Data by NYC Neighborhood* from website http://www.nyc.gov/html/doh/downloads/pdf/asthma/asthma-hosprates-children.pdf. Site accessed June, 2006.

[7] Under the direction of the New York City Department of Health and Mental Hygiene (DOHMH), an aggressive Asthma Initiative was begun in 1997, with goals of reducing illness and death from childhood asthma. Since its inception, major childhood asthma initiatives have been implemented in several low income neighborhoods with high hospitalization rates. Between 1997 and 2004, many of these

among children aged 0 to 14 years is presented in Table 22-1 for zip codes surrounding the Project Area (see Figure 22-1), and for East Harlem, Manhattan, and New York City as a whole.

The reasons for the borough and local disparities in asthma are not known, but they may be due to differences in economic status and ethnicity, exposure to different asthma triggers, or access to medical care.[1,2]

Table 22-1
1997 and 2004 Hospitalization Rates per 1,000 Persons (Aged 0 to 14 Years)*

Location	1997	2004
Central Harlem** (includes zip codes 10026, 10027, 10030, 10037 and 10039)	20.9	12.5
Washington Heights—Inwood** (includes zip codes 10031, 10032, 10033, 10034 and 10040)	9.2	4.0
East Harlem (includes zip codes 10029 and 10035)	29.2	13.1
Borough of Manhattan	12.3	6.1
New York City	9.5	6.0

* New York City Department of Health and Mental Hygiene. *Updated Asthma Hospitalization Data by NYC Neighborhood* from website http://www.nyc.gov/html/doh/downloads/pdf/asthma/asthma-hosprates-children.pdf. Site accessed August, 2006.
** The Project Area is included in these two neighborhoods as defined by New York City Department of Health and Mental Hygiene

Causes and Triggers. The increase in asthma among children has spurred scientists and clinicians to search for causes and risk factors for the disease. The rapidity of the increase points away from a significant change in population genetics, which would evolve over a much longer time scale, and toward some characteristic(s) of modern life. Factors that have been investigated epidemiologically (and sometimes experimentally) include indoor air pollution, outdoor air pollution, behaviors, food and food additives, medical practices, and illness in infancy. The reasons for the dramatic increase in asthma prevalence are currently unknown, although a number of hypotheses have been developed and investigated. Current hypotheses tend to focus on three areas: (1) increases in individual sensitivity (possibly due to reduced respiratory infections); (2) increases in exposures to allergens and other environmental triggers; and (3) increases in airway inflammation of sensitized individuals (due to factors such as viral infections). No single factor is likely to explain the increased rates of asthma, however, and different factors are likely to dominate in different areas, homes, and individuals.

In theory, one can distinguish between "causes" and "triggers" of asthma. Causes are those factors that make a person susceptible to asthmatic attacks in the first place, while triggers are those factors that elicit asthmatic symptoms at a particular time. Immunologists are increasingly

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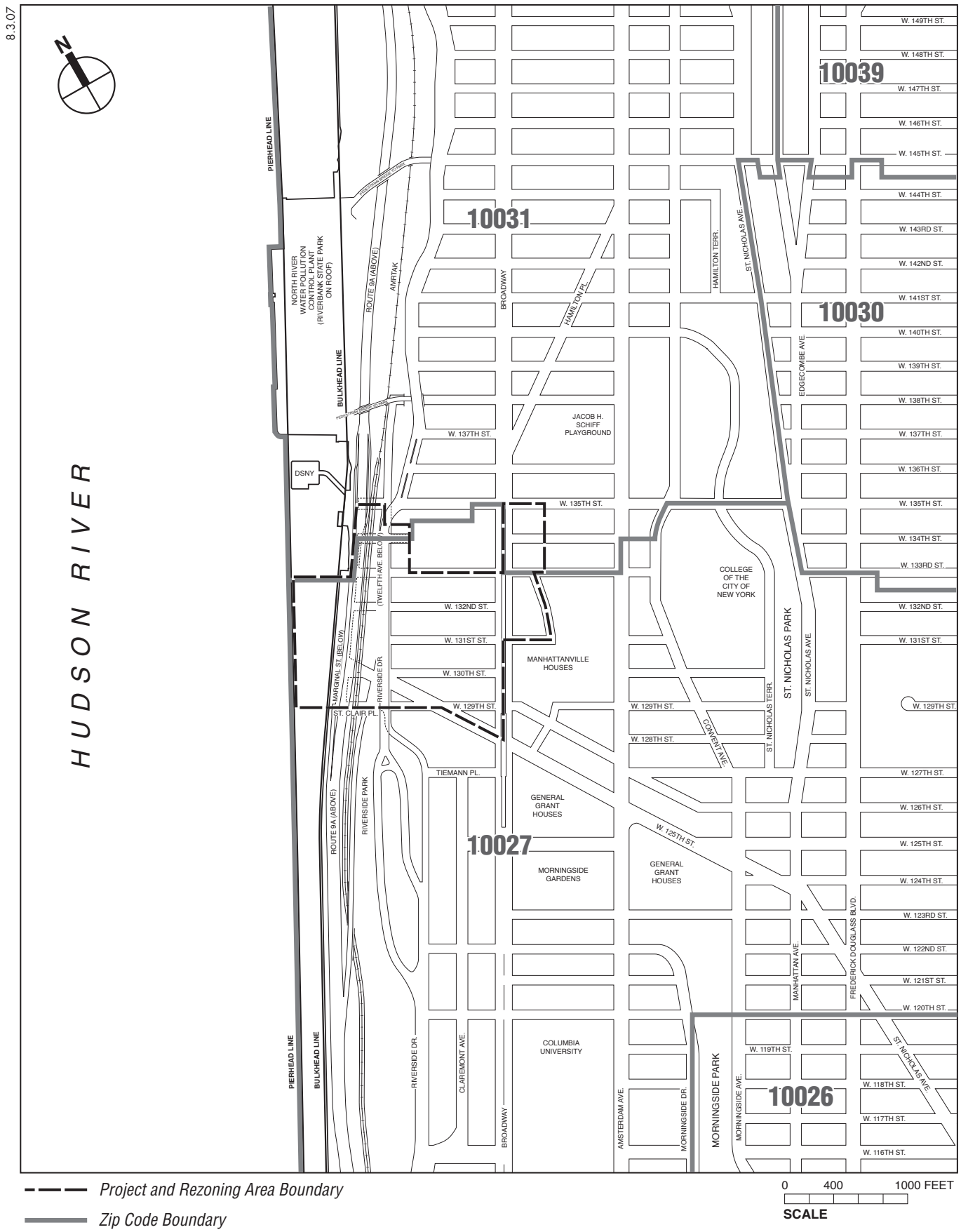
neighborhoods have experienced substantial decreases in hospitalization rates, which may be an indication of success from extensive efforts by medical providers and community organizations participating in such initiatives.

[1] Weiss, K.B., P.J. Gergen, and E.F. Crain. 1992. Inner-city asthma: the epidemiology of an emerging U.S. public health concern. *Chest* 101:362S-367S.

[2] Platts-Mills, 1997.



MANHATTANVILLE IN WEST HARLEM REZONING AND ACADEMIC MIXED-USE DEVELOPMENT

Figure 22-1

Zip Codes Surrounding Project Area

coming to understand asthma as a genetic disorder. While genetic predisposition seems to be necessary for the onset of asthma, it is not sufficient. Asthma attacks typically occur when a genetically predisposed person encounters one or more environmental triggers.[1]

Triggers are more easily studied but may not be the underlying causes of the disease. For example, although a genetic predisposition to allergy is an important risk factor for developing asthma, there may have been no real increase in the number of genetically susceptible children, but rather a growth in the prevalence of factors that promote asthma development or trigger an attack. For a person suffering from asthma, however, the identification and elimination of triggering factors is of greatest practical importance.

Allergens in the indoor environment are important triggers of asthma in the U.S. Organic materials that cause the immune system to overreact, such as cockroach antigens, dust mite antigens, molds, and pet and rodent dander and urine, are the principal indoor air quality triggers of asthma attacks in children. Some of these antigens are probably more common in poor quality housing, which could explain, in part, why poor children suffer high rates of asthma. Other indoor pollutants, such as tobacco smoke and natural gas combustion from household appliances, can also exacerbate asthma symptoms. "Improvements" in housing, such as increased insulation and reduced ventilation to save on energy costs, and increased amounts of wall-to-wall carpeting and stuffed furniture, may have the unintended effects of promoting growth of dust mites and molds, and concentrating antigens, irritants, and PM indoors. In addition, the effect of indoor pollutants may be increased by the growing amount of time that children spend indoors, which increases a child's exposure to antigens. Reduced physical activity may increase the respiratory system's sensitivity to allergens.

Some natural aspects of outdoor air, such as pollens, are capable of triggering asthma attacks. On a local scale, air pollution may be important, and on a larger scale it is possible that specific pollutants, such as ozone or diesel exhaust, enhance the effects of other factors, such as allergens, even if the pollutants themselves are not triggers of asthma. In addition, weather conditions, and cold air in particular, can elicit asthmatic symptoms independent of air pollution.

Asthma and Traffic and Construction Equipment Sources of Air Pollution. Most of the particles emitted by diesel engines are small enough to be counted as $PM_{2.5}$. Their small size makes them highly respirable and able to reach deep within the lung.

Certain experimental studies have evaluated the respiratory and systemic effect of diesel particles on laboratory animals.[2] These studies revealed that chronic and/or prolonged continuous exposures of the animals to large concentrations cause inflammation, fibrosis, and functional changes in the respiratory system, and that very large concentrations cause premature death. The lowest observed adverse effect levels, as well as no observed adverse effect levels, occurred at concentrations that were considerably in excess of ambient concentrations. Specifically, the levels at which these effects were not observed ranged from 100 to 500 μg of diesel particulates per cubic meter, concentrations that are above allowable average daily values.

Epidemiologically, a few studies have addressed childhood asthma in relation to distance from roads and, hence, from vehicle exhaust. For example, young children in Birmingham, England, admitted to hospitals with a diagnosis of asthma were more likely to live close to busy roads than

[1] Gentile, D. A. J. Immunology, 65, 4, 347-351 (2004).

[2] EPA (2002, 2003a) IRIS record for diesel engine exhaust, available at www.epa.gov/iris/subst/0642.htm.

children admitted for other reasons. The apparent risk of admission for asthma was increased by almost two-fold for children who live close to busy roads. Undercutting the significance of these findings was the lack of information about their socioeconomic status, family history of asthma, and the indoor environment. Other epidemiological studies have demonstrated an increase in daily mortality, hospitalizations, and emergency department utilization attributable to air quality diminution from increased levels of sulfur dioxide, ozone, and PM. [1,2,3]

In a study conducted in the Netherlands, researchers found that living near busy streets was associated, in children, but not adults, with a one-and-a-half-fold increase in wheezing symptoms in the past, with a 4.8-fold higher use of asthma medications among children after controlling for various socioeconomic and indoor environmental exposures.[4] Other studies have not found an association between asthma symptoms or hospitalizations and residence near heavy traffic.[5]

Most studies found associations between some indicator of traffic (distance to roads, traffic volumes, or truck traffic volumes) near a residence or school and some indicator of respiratory disease (allergic rhinitis, wheezing, or cough), while a few found no evidence of an association.[6] Experiments in which non-asthmatic adults were exposed for an hour to diesel engine exhaust containing particles and gases found increased airways resistance[7] and some cellular indicators of inflammatory response;[8] however, these subjects did not experience asthma. Diesel particulates and ozone have been shown to increase the synthesis of the allergic antibody IgE in animals and humans, which would increase sensitization to common allergens. By interacting together and with other environmental factors, particulates and gaseous air pollutants can have an effect on allergic individuals.[9]

Other Health Effects, Including Cardiovascular, Lung Cancer, and Premature Mortality

People with heart disease, such as coronary artery disease and congestive heart failure, are at risk of serious cardiac effects.[10] In people with heart disease, very short-term exposures of one hour to elevated fine PM concentrations have been linked to irregular heartbeats and heart attacks.[1]

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[1] Kunzli, et al., Public health impact of outdoor and traffic-related air pollution: a European assessment, Lancet 2000 2:356 (9232); 795-801

[2] Schwela, D. Air Pollution and Health in Urban Areas. Rev Environ Health. 2000 Jan-Jun; 15(1-2): 13-42

[3] Edwards et al., (1994). Hospital Admissions for Asthma in Preschool Children; Relationshiop to Major Roads in Birmingham, United Kingdom. Arch. Environ. Health 49 (4); 223-227

[4] Oosterlee, A. et al., (1996). Chronic Respiratory Symptoms in Children and Adults Living Along Streets with High Traffic Density. Occup. Environ. Med. 53:241-247.

[5] Wilkinson, P. et al., (1999). Case-control Study of Hospital Admission with Asthma in Children Aged 5-14 Years: Relations with Road Traffic in North West London. Thorax. 54(12); 1070-1074.

[6] Brunekreef et al 1997, English et al (1999), Livingstone et al (1996).

[7] Rudell et al, Occup. Environ. Med. 53, 6480652, 1996.

[8] Slavi et al, Am. J. Respir. Crit. Care. Med. 159: 702-709, 1999.

[9] Fujieda et al Am J. Respir Cell Mol Biol, 19, 507-12, 1998; Nel et al.

[10] Goldberg MS, Bailar JC 3rd, Burnett RT, Brook JR, Tamblyn R, Bonvalot Y, Ernst P, Flegel KM, Singh RK, Valois MF. Identifying subgroups of the general population that may be susceptible to short-

New epidemiological re-analyses of studies of long-term ambient PM exposure also show substantial evidence for increased lung cancer risk being associated with such PM exposures, especially exposure to fine PM or specific fine particles subcomponents.[2]

The elderly are at increased risk from fine PM air pollution. Numerous community health studies have shown that when particle levels are high, senior citizens are more likely to be hospitalized for heart and lung problems, and some may die prematurely.[3]

Inhaling fine PM has been attributed to increased hospital admissions, emergency room visits, and premature death among sensitive populations with pre-existing heart or lung disease. Studies estimate that tens of thousands of elderly people die prematurely each year from exposure to ambient levels of fine particles.

In summary, studies conducted in individual cities and using data pooled from multiple cities have demonstrated that increases in PM, SO_2, and ozone exposures are associated with increases in daily mortality, and hospitalizations and emergency department utilization for asthma with increases in PM. While the epidemiologic literature demonstrates that variation in air quality is associated with these morbidity and mortality events, it does not, in general, demonstrate that air quality differences account for the large increases seen in the prevalence of asthma through the 1980s and 1990s, or the wide variability in the prevalence of asthma and heart disease across and within cities.

H. FUTURE WITH THE PROPOSED ACTIONS

The following section summarizes the potential public health impacts related to air quality and noise during construction and operation of the Proposed Actions, hazardous materials and rodent control during construction, and laboratory practices from the operation of the Proposed Actions.

AIR QUALITY

DURING PROJECT OPERATIONS

As presented in Chapter 19, on an annual basis, the projected $PM_{2.5}$ impacts would be less than the applicable interim guidance criterion of 0.3 $\mu g/m^3$, and the DEP interim guidance criterion of 0.1$\mu g/m^3$ for neighborhood scale impacts.

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term increases in particulate air pollution: a time-series study in Montreal, Quebec. Res Rep Health Eff Inst 2000 Oct;(97): 7-113; discussion 115-20; and Zanobetti A, Schwartz J. Cardiovascular damage by airborne particles: are diabetics more susceptible? Epidemiology 2002 Sep; 13(5):588-92.

[1] Peters A, Liu E, Verrier RL, Schwartz J, Gold DR, Mittleman M, Baliff J, Oh JA, Allen G, Monahan K, and Dockery DW. Air pollution and incidence of cardiac arrhythmia. Epidemiology 2000 Jan; 11(1):11-7; and Peters A, Dockery DW, Muller JE, and Mittleman MA. Increased particulate air pollution and the triggering of myocardial infarction. Circulation 2001 Jun 12; 103(23):2810-5.

[2] EPA Air Quality Criteria for Particulate Matter (Vols II); October 2004, EPA/600/P-99/002bf.

[3] Pope CA 3rd. Epidemiology of fine particulate air pollution and human health: biologic mechanisms and who's at risk? Environ Health Perspect 2000 Aug; 108 Suppl 4:713-23; and Samet JM, Zeger SL, Dominici F, Curriero F, Coursac I, Dockery DW, Schwartz J, and Zanobetti A. The National Morbidity, Mortality, and Air Pollution Study. Part II: Morbidity, Mortality and Air Pollution in the United States. Health Effects Institute Research Report 94, Part II, June 2000.

Maximum $PM_{2.5}$ concentrations from the Proposed Actions' central energy plants and package boilers were predicted to exceed the City's 24-hour interim guidance criterion of 2 $\mu g/m^3$; however, based on the magnitude, and the limited frequency and extent of these occurrences, no significant adverse air quality impact is predicted due to emissions of $PM_{2.5}$. To ensure the avoidance of impacts, limitations on annual fuel usage and minimum stack heights would be included in the Restrictive Declaration for the Academic Mixed-Use Area. For Site 15, the Restrictive Declaration would include a provision limiting the package boilers to natural gas.

Other projected development sites within the Project Area (at Site 5, Subdistrict B, and the Other Areas) were analyzed using a conservative screening procedure to determine whether fossil fuel-fired equipment would result in any potential significant adverse air quality impacts on nearby buildings. The results demonstrated that for Sites 20, 24 and 25, an air quality E-designation is necessary to ensure that concentrations from emissions of fossil fuel-fired equipment do not result in a violation of ambient air quality standards or with respect to the City's $PM_{2.5}$ interim guidance criteria. The E-designations would require the use of certain types of fossil fuels and/or place restrictions on where exhaust stacks for fossil fuel-fired equipment could be located. The other projected developments would also not result in any violation of ambient air quality standards when firing natural gas or fuel oil. Therefore, operation of the Proposed Actions would not result in significant adverse air quality impacts from project operations.

DURING CONSTRUCTION

Under both SEQRA and CEQR, the determination of the significance of impacts is based on an assessment of the predicted intensity, duration, geographic extent, and the number of people who would be affected by the predicted impacts. In most cases, the predicted increments from construction of both Columbia University and non-Columbia University construction would be limited in extent, duration, and severity.

As presented in Chapter 21, Columbia University construction under the Proposed Actions would not result in predicted significant adverse impacts on air quality. Columbia University would implement an emissions reduction program that would exceed that of any large-scale private project constructed in New York City to date, and substantially reduce $PM_{2.5}$ emissions due to Columbia University construction. E-designations on non-Columbia University projected development sites would be implemented as necessary to reduce $PM_{2.5}$ concentrations resulting from construction at these locations. With these measures in place, no significant adverse air quality impacts would occur from the projected development sites.

For both Columbia University construction (in Subdistrict A) and construction at non-Columbia University projected development sites, concentrations of particulate matter, CO, and NO_2 could increase at locations near the areas of construction, but would not result in significant adverse impacts.

Columbia University Construction

$PM_{2.5}$ concentrations would increase the greatest in areas immediately adjacent to the construction; for the most part, these elevated concentrations would occur on sidewalks and covered walkways along the construction fences and in some cases across the street and would not be significant. In no instances were $PM_{2.5}$ annual increments greater than 0.3 $\mu g/m^3$ and 24-hour increments greater than 2 $\mu g/m^3$ at nearby residences or schools.

Non-Columbia University Construction

For construction in Phase 1 on the non-Columbia University projected development sites in Subdistrict B and the Other Areas, elevated $PM_{2.5}$ concentrations were predicted to occur during construction in the near vicinity of the projected development sites in Subdistrict B and Other Area east of Broadway both with respect to annual average and 24-hour average $PM_{2.5}$ levels. However, since the publication of the DEIS, project modifications have been identified, which would result in no new development taking place in Subdistrict B (see Chapter 29, "Modifications to the Proposed Actions"); the only non-Columbia University sites which may still be expected to be developed as a result of this rezoning action are Sites 24 and 25. An emission reduction program would be instituted for any construction on those sites, implemented through E-designations. The program would include early electrification to ensure that large generators are not used on the sites, the use of ULSD for all diesel engines, and the use of Tier 2 certified engines or cleaner equipped with DPF tailpipe controls. With these measures in place, no significant adverse $PM_{2.5}$ impact would occur as a result of construction on Sites 24 and 25.

RELATIONSHIP OF AIR QUALITY EFFECTS TO PUBLIC HEALTH

In considering the public health significance of the predicted increments greater than applicable thresholds discussed above, it is important to recognize that ambient air quality emission standards are set to limit the public health risks within large populations. Thus, for example, increases in fine particulate matter measured by a rooftop air sampler reflect exposures over a large geographic area, which, especially in urban areas, includes large numbers of persons. By contrast, the determination of whether an identified increment in particulate matter has a public health impact necessarily takes into account a number of factors: (1) the extent of the increment, taking into account environmental epidemiological studies which demonstrate a variety of concentration-response functions; (2) duration and frequency of the added exposure; and (3) the geographic extent of the exposure in its setting.

The air quality analyses in the Draft Environmental Impact Statement (DEIS) for Columbia University construction and operation of the Proposed Actions show 24-hour average $PM_{2.5}$ concentration increments greater than 2 $\mu g/m^3$ (but not at any nearby residences or schools with respect to construction). These increments, which are also shown in the air quality analyses for the FEIS, reflect only slight elevations in PM for a very small number of days and within highly localized areas. For these reasons, no significant adverse public health impacts from $PM_{2.5}$ are expected from project operations and from Columbia University construction.

With respect to construction and operations at non-Columbia sites, as noted above, the only sites which may still be expected to be developed as a result of this rezoning action are Sites 24 and 25 (see Chapter 29). An emission reduction program would be instituted for any construction on those sites, implemented through E-designations. E-designations on those sites would ensure that concentrations from emissions of fossil fuel-fired equipment do not result in a violation of ambient air quality standards or with respect to the City's $PM_{2.5}$ interim guidance criteria. With these measures in place, no significant adverse $PM_{2.5}$ impacts would occur from these non-Columbia sites. For these reasons, no significant adverse public health impacts from $PM_{2.5}$ are expected from project operations and from non-Columbia University construction.

NOISE

As described in Chapter 20, in 2015 (when construction of Phase 1 of the project is completed) and in 2030 (when full build-out of the project would be completed), the Proposed Actions

would result in a significant noise impact at one location— Receptor Site 10 on West 125th Street at St. Clair Place and West 129th Street. The impact would be due to a combination of project-generated traffic and assumes the installation of a traffic signal midblock on West 125th Street (between Twelfth Avenue and Broadway) to improve the flow of pedestrian traffic at this currently difficult to regulate, unsignalized intersection. There are no non-Columbia buildings immediately adjacent to this location that would be impacted. Development Sites 4 and 5 of the Proposed Project are immediately adjacent to this location. Site 4 is proposed for academic use (or for University housing), and Site 5 is proposed for retail use. These buildings would be designed with double-glazed windows and air conditioning to avoid significant adverse noise impacts on their users. Therefore, the noise impact at Receptor Site 10 would impact pedestrians at ground level. The magnitude of noise levels at Receptor Site 10 would be comparable to noise levels at other locations within the Project Area and elsewhere in New York City. While the magnitude of the noise levels would be above the levels that are desirable from a public health perspective, they are not of a magnitude that would result in significant adverse health effects, and they would not constitute a significant public health impact.

As noted in the noise analysis section of Chapter 21, there would be potential significant noise impacts (based on CEQR criteria) during construction (at sensitive receptors adjacent to locations under construction) in both Phase 1 and Phase 2 based on maximum predicted values. However, these maximum predicted noise levels at discrete locations would be of limited duration, and the predicted overall changes in noise levels from the Proposed Project would not be large enough to significantly affect public health. While construction activities would produce noise levels of a magnitude that at times are annoying and intrusive, and would be considered undesirable, construction activities would only occur for a limited number of hours per day, and for a limited time period. Based upon the limited durations of these noise levels, the noise produced by construction activities would not result in a significant adverse public health impact.

Therefore, no significant adverse health impacts from noise are expected from construction and operation of the Proposed Actions.

HAZARDOUS MATERIALS

As described in detail below, potential contaminants identified in the Academic Mixed-Use Area on lots owned or controlled by Columbia University at the time of construction would be remediated (cleaned up) as part of the development of this area by Columbia University. Contaminated soil, historic fill, and demolition debris would be either disposed of off-site in accordance with all applicable regulations or capped (i.e., covered by a building, paving, or other impervious material). Potential impacts during construction and development activities would be avoided by implementing a CHASP. The CHASP would ensure that there would be no significant adverse impacts on public health, workers' safety, or the environment as a result of potential hazardous materials exposed by or encountered during construction. Following construction, any remaining contamination would be isolated from the environment, and it is expected that there would be no further potential for exposure. In addition, to address the remediation of known or potential environmental conditions that may be encountered during proposed construction and development activities, an RAP will be prepared. (Both the RAP and CHASP have been approved by DEP and would be approved by DEC, if necessary, in response to a reported petroleum spill.) To ensure the implementation of these measures, Restrictive Declarations will be placed against these Columbia-owned properties, as required by DEP.

An E-designation would be placed on lots comprising development sites in the Academic Mixed-Use Area not owned by Columbia University at the time the proposed zoning is approved and for the remainder of the Project Area, pursuant to Section 11-15 of the New York City Zoning Resolution. An E-designation is a mechanism to ensure that properties that are subject to an area-wide rezoning, but cannot be investigated as part of the CEQR process in connection with a rezoning because they are not owned or controlled by the applicant, are properly investigated and remediated, if necessary, before redevelopment. The owner and developer of a lot with an E-designation must prepare a Phase I Environmental Site Assessment (Phase I ESA) and, if necessary, implement a testing and sampling protocol and Health and Safety Plan (HASP) to the satisfaction of DEP before the New York City Department of Buildings (DOB) issues a building permit. Based on the results of the sampling protocol, if remediation is necessary, an RAP and CHASP must be submitted and approved by DEP.

With these measures in place (i.e., where necessary, DEP-approved RAPs and CHASPs for all lots to be developed in the Project Area), no significant adverse impacts related to hazardous materials are expected to occur as a result of the Proposed Actions.

RODENT CONTROL

As discussed in Chapter 21, construction contracts would include provisions for a rodent (mouse and rat) control program. Before the start of construction, the contractor would survey and bait the appropriate areas and provide for proper site sanitation. During the construction phase, as necessary, the contractor would carry out an ongoing prevention, inspection, and response program. Coordination would be maintained with appropriate public agencies. Only EPA- and DEC-registered rodenticides would be permitted, and the contractor would be required to perform rodent control programs in a manner that avoids hazards to persons, domestic animals, and non-target wildlife.

LABORATORY PRACTICES

INTRODUCTION

Columbia University is one of the leading scientific research institutions in the United States. The University attracts researchers from around the world to work in their laboratories and engage in state-of-the-art experiments in all disciplines of science. The Manhattanville university area is expected to include a focus on medical research, but the university area would not be limited to just this one discipline. Science has become increasingly multi-disciplined, and researchers in many fields could be expected to work at the Manhattanville university area.

As such, advanced laboratories would be part of the building program. These laboratories may use a number of chemical and biological materials that, if released into the surrounding environment, could potentially lead to a public health concern. Therefore, the following section discusses the materials that could be used in the proposed laboratories as well as methods to minimize and control the use of these materials, and then analyzes the potential for public health impacts from the likely laboratory practices that would be employed. First, the institutional controls that set and monitor laboratory practices are discussed. Then, specific measures for chemical, biological, radiological, and emerging technologies are presented. Security and emergency procedures that would likely be employed are also described.

INSTITUTIONAL CONTROLS

The Executive Vice President for Research oversees research administration on all Columbia campuses. The head of Environmental Health and Radiation Safety/Environmental Health and Safety, described below, is a member of their staff. This reporting relationship is intended to ensure that public health concerns related to laboratory safety are integrated at the highest level into the University's research operations.

Institutional Health and Safety Council

To support its continued commitment to protecting the health and safety of its employees, faculty, and students, as well as the environment, the Institutional Health and Safety Council (IHSC) provides "executive level" commitment necessary to ensure that each of Columbia University's health and safety programs receives the appropriate support necessary for its success, as well as delineate responsibility for meeting program goals. IHSC is composed of senior members of Columbia University's faculty, administrators, chairpersons of separate safety committees, and technical personnel, and is the executive level body that oversees the development, adoption, implementation, and monitoring of all health and safety programs within the University. IHSC is chaired by the Senior Associate Dean for Health Affairs. IHSC meets quarterly to review the environmental health and safety programs, and monitors their success in achieving goals and compliance with regulatory requirements. IHSC:

- Evaluates and approves changes in health and safety policies;
- Reviews reports from the University's health and safety subcommittees (e.g., Institutional Biological Safety Committee, Laboratory Safety Committee, and Joint Radiation Safety Committee) on the status of new and ongoing programs;
- Offers critical evaluations of the programs to ensure compliance with laws and regulations, and to advocate for continued improvements;
- Assesses expected changes to existing regulations and new regulations to determine their impact on current and future practices on each campus, and develops specific actions and policies needed to address the changes; and
- Oversees the Office of Environmental Health and Radiation Safety/Environmental Health and Safety (EH&RS/EH&S), and facilitates obtaining resources and personnel to address new and existing health and safety issues.

All existing policies for research facilities, which are reviewed by IHSC, would be implemented at the proposed Manhattanville university area. Columbia University advises that once the proposed Manhattanville laboratories are operational, as part of an ongoing review, IHSC would determine if new policies are required. IHSC would also oversee the Environmental Health and Radiation Safety Department for any workload accommodation that would be generated by the new facilities as they became available. In addition, IHSC would oversee the activities at the Manhattanville university area, and would monitor programs and policy effectiveness in maintaining a safe workplace in the laboratories and university area (see "Compliance and Enforcement," below).

Office of Environmental Health and Radiation Safety/Environmental Health & Safety

The Office of Environmental Health and Radiation Safety has day-to-day responsibility for implementing all health and safety services and programs on all campuses; and for developing,

maintaining, and promoting policies, procedures, and programs for environmental stewardship to ensure a healthy and safe workplace in compliance with local, State, and federal environmental health and safety codes, standards and regulations. The Associate Vice President for EH&RS/EH&S, who is a clinician by training and holds a masters degree in public health, leads a present team of 28, who are responsible for the health and safety operations of all University operations. EH&RS/EH&S is organized into program teams consisting of biological safety, environmental safety, laboratory safety, occupational safety, radiation safety, and information technology. Each program is managed by a Director, who works in collaboration with his/her colleagues to ensure consistent delivery of program information and services to the University community.

As new technologies emerge and new regulations are promulgated, the Office is organized to address these changes. Also, as workload increases, staffing is adjusted to meet the new requirements. Columbia advises that staffing in EH&RS/EH&S would expand as new facilities are placed in use in Manhattanville.

Compliance and Enforcement

Currently, in all of its programmatic areas—biological, chemical, and radiological safety—EH&RS/EH&S strives to achieve compliance through a variety of mechanisms. All the required personnel trainings in these areas are offered regularly, usually monthly, to the community at large. In some cases, individualized training programs are provided to laboratories or departments. EH&RS/EH&S staff adhere to their own mandatory training requirements for their respective subject areas and actively strive to remain up-to-date on regulatory changes and new areas of concern. EH&RS/EH&S actively seeks to identify its target audiences for training through a variety of mechanisms, including newsletters, its Web site, and administrative outreach. Operational compliance is monitored through regularly scheduled and unscheduled laboratory surveys. The University's electronic data tracking system has "stops" built into it so that institutional approval, and hence funding, cannot be granted for certain activities until laboratories demonstrate adequate knowledge of procedures and regulations related to their use of hazardous materials. These established mechanisms would extend to the proposed Manhattanville university area.

LABORATORY CHEMICALS

Chemicals of many types are currently used at Columbia University laboratories and would be used in the laboratories at the proposed Manhattanville university area. Currently, many chemicals are used in the laboratories, and if they were to be released into the environment, some could adversely affect human health. However, these chemicals have long been used in laboratories, and proven safeguards have been developed to prevent harmful consequences from the transport, handling, use, and disposal of chemicals.

Regulations and Oversight

The responsibility for regulation of chemicals is spread among a number regulatory agencies The U. S. Occupational Health and Safety Administration (OSHA) defines employers' requirements in minimizing hazardous exposures to their personnel. The primary function of EPA in the laboratory environment is to issue rules for managing hazardous chemicals from generation through disposal. DEC enforces EPA regulations and in some cases has made them more restrictive. The U. S. Department of Transportation (USDOT) regulates the transport of hazardous materials. New York City Local Law 26 (Community Right to Know) requires all

institutions using hazardous (flammable, corrosive, reactive, or toxic) chemicals to submit an annual inventory.

The New York City Fire Department (FDNY) regulates the storage and handling of flammable and explosive materials, including a number of the chemicals that would be used in the laboratories. In addition, FDNY issues Certificates of Fitness (COF) to individuals who achieve certification in the proper handling of laboratory chemicals and knowledge of safety protocols. FDNY requires that when a laboratory is in operation, a COF holder be present on the laboratory floor. To obtain a COF, an individual must pass a written test. FDNY has authorized EH&RS/EH&S to perform onsite training to obtain a COF.

Transport of Chemicals

All transport of chemicals must meet the requirements of the USDOT for the particular type and quantity of that chemical.

Use and Handling of Chemicals

At Columbia University, a number of organizations and individuals have the responsibility to ensure the safe use, handling, and disposal of chemicals. Overall, EH&RS/EH&S oversees the use of chemicals, and:

- Provides technical support and assistance to all University chemical users;
- Develops and implements the Laboratory Safety and Chemical Hygiene Plans;
- Reviews the Plans for regulatory compliance with all applicable EPA, OSHA, DEC, and FDNY regulations;
- Represents the University to these agencies;
- Develops educational and training programs to ensure individuals know how to comply with the regulations;
- Conducts regular surveys of the laboratories to ensure compliance with the Plans;
- Implements the policies of the University;
- Oversees the storage, use, and handling of chemicals;
- Oversees the storage and disposal of waste chemicals; and
- Provides training on the safe use of chemicals.

Within each laboratory, the Principal Investigator is responsible for the conduct of the research and the use of chemicals. A Principal Investigator is usually a senior faculty member with a doctorate degree and a number of years of laboratory experience. The Principal Investigator is asked to develop, keep current, and submit an Individual Laboratory Chemical Hygiene Plan. The Individual Laboratory Chemical Hygiene Plan includes a listing of all laboratory personnel, the identification of all hazards (both chemicals and physical devices) and the Material Safety Data Sheets (MSDS [produced by manufacturers as required by OSHA to ensure the safe handling of materials]) for these hazards. The physical devices include such items as compressed gas cylinders and lasers. In addition, the Principal Investigator must ensure that all laboratory personnel have received proper training and are familiar with the contents of the Individual Laboratory Chemical Hygiene Plan, and that a COF holder is present on the laboratory floor when personnel are working in the laboratory.

The Principal Investigator may designate another staff member as the Laboratory Safety Manager to be responsible for safety aspects of the laboratory. Responsibilities of the Laboratory Safety Manager may include:

- Holding a FDNY COF;
- Ensuring laboratory workers are familiar with and adhere to the practices in the Individual Laboratory Chemical Hygiene Plan;
- Ensuring that the appropriate personal protective equipment and spill control equipment are in good condition and available;
- Ensuring that the MSDS are current and available;
- Ensuring that the chemicals are properly labeled and stored;
- Keeping the chemical inventory current; and
- Advising the Principal Investigator of any potential hazards or if the practices could be made safer.

Storage and Disposal of Hazardous Chemical Wastes

Columbia follows all EPA and DEC rules and regulations regarding hazardous waste management. EH&RS/EH&S coordinates and performs the collection and movement of the waste from the individual laboratories to a central storage area that is under the control of EH&RS/EH&S. Hazardous waste is transported and disposed of by licensed/permitted hazardous waste transporters at permitted disposal facilities and is not handled or disposed of by the New York City Department of Sanitation (DSNY).

Storage and Disposal of Liquid Chemical Wastes

Columbia University has a policy of prohibiting the disposal of chemicals into the City's sewer system. The same policy would be instituted and enforced at the proposed Manhattanville university area. The laboratories in the proposed academic research buildings and, to a lesser degree, the academic buildings would generate wastes that would not be disposed of in the City sewer system. DEP and the New York City Department of Health and Mental Hygiene (DOHMH) have established standards for chemical wastes that can be discharged into the sewer system. However, Columbia University has instituted a "no drain disposal policy." Columbia University has a system for classifying, collecting, storing, and disposing chemical, biological, and radiological wastes. This system would be implemented in the University buildings in the Manhattanville university area. These policies follow all applicable State and federal regulations.

Columbia currently stores hazardous waste (as per OSHA and EPA requirements) in a designated area of the laboratory (satellite accumulation area) inside specially labeled containers. Containers are selected to ensure that corrosion or leakage does not occur and are regularly inspected to ensure they are in sound condition. EH&RS/EH&S arranges for the collection and transport of the waste to a main accumulation area. Private vendors pick up, transport, and dispose of the waste in accordance with all applicable State and federal regulations.

Potential Impacts from the Transport, Use, and Disposal of Chemicals

Columbia University's programs and practices as described in the preceding sections for the transport, use, and disposal of chemicals have proven successful in preventing uncontrolled releases of chemicals and protecting public health. These same programs and practices would be

extended to the proposed Manhattanville university area. No significant adverse impacts from transporting, handling, using, and destroying of chemicals are expected.

BIOLOGICAL MATERIALS

As a research institution, Columbia currently operates many laboratories that handle biological materials, and the Manhattanville university area would also have laboratories devoted to biomedical research. Biomedical research has long been practiced worldwide, in the United States and in New York City. During this long history, proven safeguards have been developed to prevent harmful consequences from the transport, handling, use, and disposal of medical and biological materials.

Regulations and Oversight

The main federal agency that oversees biomedical research is the NIH (National Institutes of Health), which is part of the U. S. Department of Health and Human Services. A number of other federal agencies regulate certain activities associated with biological and medical research. OSHA has standards for persons handling blood-borne pathogens. The U. S. Department of Agriculture (USDA) oversees research and the handling of organisms that affect plants and animals. USDOT sets and enforces standards for the road transport of biomedical materials (USDOT, Title 49 Code of Federal Regulations). The International Air Transport Association (IATA), an international trade organization of airlines, sets standards for the transport of biological materials by airplane through rules published in their "Dangerous Goods Regulations."

Since September 11, 2001, when terrorists attacked the United States, security to prevent other terrorist attacks has been increased. In recognition of these threats, Congress enacted the USA Patriot Act, which strengthened the provisions of the Anti-Terrorism Act of 1996. Certain of the provisions apply to access to Select Agents. Columbia University has identified additional microorganisms and toxins to the federal list for enhanced oversight by the University. Columbia University has instituted policies to meet the requirements of the USA Patriot Act and subsequent bioterrorism legislation as they apply to their laboratories and the materials found in the laboratories. Background checks are required of people who have access to Select Agents. The location and quantities of these materials are frequently checked and inventoried. These measures would be implemented in the proposed Manhattanville university area.

In addition to the non-structural measures discussed above, robust structural features would be incorporated into the new buildings. These features would result in structures that are stronger than existing buildings, because they could be designed into the buildings and laboratories from the start. The structural measures would include security check points, visual and audio surveillance, double-locking doors, intruder alarms, and locked and extra-strength storage cabinets. The non-structural and structural measures would be implemented in consultation with NYPD and other recognized security agencies. On the New York State level, the New York State Department of Health oversees the operation of clinical laboratories and licenses laboratories as applicable, to perform certain tests. In addition, FDNY oversees safety, especially as related to flammable and explosive materials, and certifies certain laboratory personnel.

Transport of Biological Materials

USDOT and IATA rules apply to the transport of biological materials. There are two classifications of biological materials with differing requirements. The lower risk category

includes materials deemed unlikely to pose an infection risk in the event of an accident during transport. The higher risk category includes high risk infectious materials. Irrespective of the category, the personnel sending and receiving these materials must receive training on the packing and handling of the biological materials, with the training and testing repeated every three years.

For transport between campuses or off campus in University vehicles, Columbia University requires the same types of rules and requirements as USDOT and IATA. The packaging must meet IATA standards for the particular class of materials being transported. The person transporting must have been trained, and the training levels must be current. The materials are transported directly without detours or stops. The outside of the package has a contact telephone number so that the contents of the package can be ascertained, if anything should happen to the transporter. Allowable transport is limited to either materials that are "unregulated" (based on a low risk) or regulated materials in the lower risk category. The latter would only be allowed to be transported off campus by University personnel upon receipt of permission from EH&RS/EH&S.

Handling of Biological Materials and Biosafety Levels

In the United States, CDC has established four levels of biosafety for the handling of medical and biological materials, with 1 being the lowest level and 4 the highest level, reserved for the most dangerous microorganisms. Columbia University currently operates almost all of its laboratories at Biosafety Level 1 and 2, and has two Biosafety Level 3 laboratories. The proposed Manhattanville area may include a Biosafety Level 3 laboratory. Columbia University does not operate a laboratory at Biosafety Level 4 and would not operate a Biosafety Level 4 laboratory at the proposed Manhattanville university area. A brief description of the biological materials handled and the required laboratory practices and equipment are given below.

Biosafety Level 1 practices, safety equipment, facility design, and construction are appropriate for undergraduate and high school teaching laboratories. This level does not require special primary or secondary barriers to prevent the spreading of microorganisms beyond sinks for hand washing. Biosafety Level 2 is applicable for laboratories using a broad spectrum of moderate risk microorganisms associated with human diseases. The equipment includes enclosed biological safety cabinets and splash shields. The personal safety equipment includes laboratory aprons, gloves, and face protection; and hand washing facilities are required at this level. Biosafety Level 3 is applicable for laboratories using microorganisms that have a potential for respiratory transmission (through the air) and that may cause infections. Biosafety Level 3 laboratories have controlled access, and are separated from corridors and common areas. They have self-closing, double doors, and are under negative air pressure so that the air flow is always into the laboratory. All windows are sealed. The exhaust air is not recirculated and is filtered. All waste and all laboratory clothing are decontaminated.

Disposal of Regulated Medical Waste

Research in many of the laboratories would generate Regulated Medical Waste (RMW)—materials that cannot be treated as regular trash because they may contain infectious microorganisms. RMW is not handled or disposed of by DSNY, but is collected, transported, and treated by specially licensed contractors. These contractors handle and dispose of regulated medical waste outside the normal solid waste systems. Columbia University would continue its current practice in the future, and RMW would be securely packaged prior to the transport and destruction off-site. RMW receives special packaging and handling controlled by State

regulations. These contractors have the ability and the incentive to expand their operations in response to any increased demand.

Potential Impacts from the Transport, Handling, and Disposal of Regulated Medical Waste

Government regulations addressing the transport, and disposal of RMW have succeeded in preventing releases of the materials and protecting public health. Columbia University adheres to the applicable State regulation in this area. The compliance programs in this area would be extended to the proposed Manhattanville university area. No significant adverse impacts from transporting, handling, and destroying of RMW are expected.

RADIOACTIVE MATERIALS

Radioactive materials are currently used in the Columbia University laboratories and would likely be used in the proposed Manhattanville university area. Radiation is produced by certain devices, such as x-ray machines and electron microscopes, and by radioactive materials used as tracers for certain medical and experimental procedures. Proven safeguards have been developed for radioactive material transport, handling, and disposal. Nevertheless, radiation can be dangerous and is a public health concern.

Regulation and Oversight

Under the Atomic Energy Act, EPA is the primary authority for setting exposure limits for the public to radiation. The Atomic Energy Act also gives certain responsibilities to the Nuclear Regulatory Agency and to the Department of Energy.

New York City Bureau of Radiological Health, part of the DOHMH, regulates (through frequent inspections) the use of radioactive materials in New York. Columbia University is broad-use licensed by DOHMH for the use of radioactive materials on the campuses in the City. Both the Joint Radiation Safety Committee at Columbia University Medical Center (CUMC) and the Radiation Safety Committee at Morningside Heights report to the IHSC, and, following DOHMH guidelines, implement the rules governing use of radioactive materials at Columbia University. All proposed uses of radioactive materials at Columbia University must be reviewed and approved by the respective Radiation Safety Committee.

Columbia University's existing security measures regarding radioactive materials would be extended to the Manhattanville university area. These include:

- All purchased and acquired radioactive materials must be pre-approved by the Radiation Safety Office.
- All radioactive materials are received in a secure location by the Radiation Safety Office before distribution to the research laboratories.
- Inventory is checked periodically as to amount received, used, and disposed.
- Laboratories using radioactive materials, if not attended, must be locked.
- Unescorted access to large radioactive sources will be limited to pre-approved personnel.
- Any suspicious activity or personnel will be reported immediately to the authorities.
- All radioactive waste transport will be performed by licensed vendors.

Transport of Radioactive Materials

The Radiation Safety Offices arrange for the transport of all radioactive materials. All packages and handling procedures meet the requirements of the USDOT as per 10 CFR Part 71 and 49 CFR Part 171 et seq.

Use of Radioactive Materials

An individual must be approved by the respective Radiation Safety Committee to be a Responsible Investigator before he or she can use radioactive materials in a laboratory. A Responsible Investigator must meet all qualifications to use radioactive material. The Radiation Safety Office must approve the acquisition of any quantity of radioactive materials, no matter how small. The Radiation Safety Office monitors the use of radioactive materials and enforces the safe laboratory practices. A violation or infraction is met with enforcement measures, including withdrawing the privilege to use radioactive materials.

The Responsible Investigator is also required to assure that safe laboratory practices are being followed. He or she must take periodic measurements of exposure rates and check for contamination within the laboratory. In addition, the Radiation Safety Officer monitors the exposure of workers and reviews all badge reports.

Prior to radioactive materials being used in a laboratory, the Radiation Safety Office surveys the laboratory to confirm the absence of any prior radiological contamination. When the laboratory is vacated, the survey is repeated to ensure that the laboratory is not contaminated.

Disposal of Radioactive Wastes

Specific areas are set aside for the storage of radioactive wastes (as per DOHMH requirements) The wastes are divided into solid waste, liquid waste, and liquid scintillation vials, and these wastes cannot be mixed. The unshielded exposure rate from the surface of any disposal container cannot exceed 2 millirems per hour. A waste log is attached to each container with the principal contents and the estimated amount.

The current approved practice of allowing radioactive waste to decay to background levels prior to disposal would continue in the Manhattanville university area. When radioactive materials decay to background levels, the material is no longer considered to be radioactive. In accordance with federal, State, and New York City regulations, the materials can be disposed of as non-radioactive waste. If a radioactive waste has a long half-life, it would be disposed of by licensed contractors.

Potential Impacts from the Transport, Handling, Use, and Disposal of Radioactive Materials

Columbia University's programs and practices as described in the preceding sections for the transport, use, and disposal of these materials have proven successful in preventing releases of the materials and protecting public health. These programs and practices would be extended to the proposed Manhattanville university area. No significant adverse impacts from transporting, handling, using, and disposing of radioactive materials are expected.

EMERGING TECHNOLOGIES

The proposed build-out of the Manhattanville university area would take place over a 25-year period, and it is not possible to determine what technologies could be used that far into the future. In the past 25 years, computer technology has burgeoned, lasers have been introduced

into medical treatments, and organ transplants have become common. Currently, nanotechnology and genomics are new technologies for which laboratory practices are being developed. Nanotechnology deals with materials and devices with one dimension between 1 to 100 nanometers. As a point of comparison, the human hair is about 80,000 nanometers in diameter. Genomics deals with the mapping and understanding of the human chromosomes.

In fields such as these, long established laboratory practices do not exist. In the absence of regulatory mandates, Columbia University/EH&RS/EH&S would continue to avail itself of "best practices" developed at similar institutions and any existing government guidance, typically gravitating toward a more conservative approach. The scientific community is aware of the potential danger associated with these technologies, and working groups have been formed to develop the best laboratory practices. These working groups include members of government agencies, universities, private industry, and individuals. Agencies such as OSHA, EPA, DOH, and DEC, which are actively involved in the regulation of laboratories, participate in these working groups. Faculty members of Columbia University also belong to and participate in these working groups.

Columbia University is committed to using safe laboratory practices, and has the institutional framework to develop and implement additional policies for emerging technologies. As recommendations are developed by the working groups and new regulations promulgated by government agencies, IHSC would evaluate these recommendations to ensure that they provide the best and safest laboratory procedures. Policies best suited to Columbia University in an urban environment would be developed and implemented. Through these policies and practices, Columbia would comply with governmental regulations.

EMERGENCY PROCEDURES

Even with the best laboratory practices, accidents and emergencies can occur. Because of the chemicals and other materials in use, these emergencies are of particular concern. Security of the chemicals, biologicals, and other materials that could be used in the laboratory is a vital concern, especially with the threat of terrorism. While specifics of emergency and security procedures cannot be given, the general approaches are discussed below.

Emergency Procedures

An integral part of every Individual Laboratory Chemical Hygiene Plan is the location and use of emergency equipment. The emergency equipment encompasses fire-fighting equipment, spill remediation materials, or biological agents. The type and amount of equipment in each laboratory is matched to the hazards posed by the materials used in the laboratory. The types of fire extinguishers are matched to the materials at a particular location and are readily available within 50 feet of any given point. All buildings are equipped with fire alarms that sound automatically based on smoke and/or heat detectors. In areas of chemical storage, standpipes are installed so that extra water can be sent to the area if needed. For the proposed Manhattanville university area, Columbia University would install similar systems and would comply with any improvements in the Fire Code at that time. As discussed above, the Laboratory Safety Officer is responsible for ensuring that this equipment is in place and is in good operating condition. In addition, the COF has been trained in emergency procedures and the use of emergency equipment. Columbia University has a cadre of personnel trained as first responders who would take emergency actions prior to the arrival of FDNY or the New York City Police Department (NYPD). When those agencies arrived, the COF and other personnel would brief them on the location and type of emergency.

Columbia University has stringent policies on the storage of chemicals and what chemicals can and cannot be stored in proximity to one another. The Health and Safety Office regularly inspects laboratories to ensure compliance with these policies. FDNY regulations govern the storage of chemicals and flammable materials, and FDNY regularly inspects laboratories to ensure compliance with the regulations. These policies would be implemented and the FDNY inspections conducted in the proposed Manhattanville university area.

New York City has some of the most advanced and sophisticated emergency response agencies in the world. For example, NYPD employs a number of specialists in terrorism and has them deployed in many countries. FDNY and DEP have prepared and practiced responses to a variety of emergency scenarios, and possess modern equipment and people highly trained to respond to chemical and hazardous materials fires and spills. Columbia University, as described above, has a comprehensive system for safely and securely using, transporting, and disposing of many materials that are dangerous if released in an uncontrolled manner. This system is continually reviewed and audited by the highest level of the University's administration. Columbia University currently works very closely with New York City's emergency response agencies to ensure safety and would continue to do so at the Manhattanville university area. These measures would minimize the potential for significant adverse impacts. ✷