Health Consultation

Newtown Creek Area Health Outcomes Review:

Birth Outcomes and Cancer

Kings and Queens Counties, New York City, New York

NEWTOWN CREEK

BROOKLYN, NEW YORK

EPA FACILITY ID: NYN000206282

Prepared by the
New York State Department of Health
Center for Environmental Health
Bureau of Environmental & Occupational Epidemiology

December 3, 2019

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

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SUMMARY

Introduction

The New York State Department of Health (NYS DOH) conducted a health outcomes review, reported in this Public Health Consultation, for a study area surrounding Newtown Creek, a federal Superfund site, in Brooklyn and Queens, New York City (Kings and Queens Counties). This review was conducted in response to community concerns about health effects from potential exposures related to the area's urban and industrial setting.

A previous report, the Public Health Assessment released in 2014 for the site, concluded based on the available data, that swimming in the Creek, or other types of full-body immersion in the Creek, as well as eating fish and crabs taken from the Creek, could harm people's health (ATSDR, 2014). Based on the available data, the 2014 assessment concluded there were no other specific types of unusual exposures for the community residing near the Creek. Residents of the area remained concerned, however, about potential exposures that could have resulted from the history of industrial activity, contaminated sites and spills in the area surrounding Newtown Creek.

In response to these ongoing concerns, NYS DOH worked with community members to develop a study plan to review the levels of adverse birth outcomes and cancer among the population living near the creek. The plan specified that health outcomes would be evaluated for the area up to ¼ mile from the Creek, from ¼ to ½ mile from the Creek, and for these two areas combined. The area up to ¼ mile from the Creek is relatively sparsely populated, as it is primarily industrial, with total population in 2010 of approximately 14,000. The area from ¼ to ½ mile from the Creek had a population in 2010 of nearly 49,000.

A health outcomes review uses information from existing sources, such as birth certificates, to compare levels of health outcomes among residents of a specific area to levels in one or more comparison populations. The comparison population is selected to be as similar to the study group as possible, except for the difference in potential risk factors or exposures of concern. In this study, specific risks or types of exposure have not been identified. Instead, the study population is defined by residential location near Newtown Creek. For the birth outcome review, the comparison area is the remainder of the ZIP codes that contain the Creek. For the cancer review, the comparison area is Brooklyn and Queens as a whole. A study of this type cannot prove that a specific environmental exposure caused elevated levels of health problems in a community, nor does it provide information about causes of health problems in individual people.

This health outcomes review used existing data and statistical methods to take account of important factors that can affect the risk for health problems, such as age, gender, and race category or ethnicity. Specific statistical tests were used to draw conclusions about whether the study showed that specific health outcomes were unusually elevated in the study areas. Some differences can be due to chance fluctuations in numbers of health outcomes. If a statistical test shows there is a difference that is not likely due to chance, we say the difference is statistically significant.

This health outcomes review was provided as a Public Comment Draft via website posting and paper copies upon request. NYS DOH staff presented the report's methods and findings at a public meeting. Comments were accepted at the meeting, via postal mail and email. This Final document includes in Appendix I a summary of the public comments received and responses to those comments.

Conclusions

As stated above, this type of review of health outcome data cannot prove whether or not a specific environmental exposure has occurred and has caused elevated levels of health problems in a community, nor can it provide information about causes of health problems in individual people. This review conducted analyses to evaluate the incidence of 15 groupings of adverse birth outcomes, 19 types of cancer in males, and 21 types of cancer in females. Statistical test results are presented for the analyses of these adverse health outcomes in the area up to ¼ mile from the Creek and the area from ¼ to ½ mile from the Creek, as well as for these two areas combined, in comparison to the surrounding local area. The geographic area evaluations multiply the number of analyses presented in this report: 45 adverse birth outcome analyses and 120 cancer analyses are presented. The two conclusions provided below are overall summary conclusions from these multiple analyses. These summary conclusions were reached based on interpretation of all the available information described in this report as well as consideration of the limitations of this type of health outcome review.

Conclusion 1: Adverse birth outcomes do not show a pattern of elevations that suggests unusual environmental exposures associated with these outcomes occurred among the population residing in the area up to ¼ mile from the Creek or from ¼ to ½ mile from the Creek.

Basis for the Conclusion: For the study period 1988-2010, the following birth outcomes were assessed: three birth weight categories (low birth weight, low birth weight but not preterm, and small for gestational age), preterm births, and birth defects. The study showed no statistically significant elevations for the birth weight categories or birth defects. The study showed statistically significant elevations for total preterm births and moderately preterm births (32 to 37 weeks gestation), in the area closer to the Creek and the total study area.

Severely preterm births (fewer than 32 weeks gestation) were not elevated in any of the study areas.

Considering the adverse birth outcomes findings as a whole, the statistically significant elevation of total preterm births and moderately preterm births does not suggest a consistent pattern of highly elevated adverse birth outcomes. The statistically significant elevation of preterm births is not accompanied by a statistically significant elevation of any type of low birth weight births, and moderately preterm, but not severely preterm births, showed an elevation.

Well-known risk factors for preterm birth include low socioeconomic status and associated psychosocial factors, including stress and lack of social support; behavioral risk factors such as tobacco and alcohol use; and medical factors such as having inadequate prenatal care and high blood pressure during pregnancy. Risk for pre-term birth is higher for African-American and Hispanic infants than for non-Hispanic white infants.

In this study, the most likely explanations for the preterm birth elevations are factors associated with lower socioeconomic status and Hispanic ethnicity. While there do not appear to be large differences in income and poverty levels between the study and comparison areas used for the birth outcome analyses, more infants in the study than the comparison area were identified as Hispanic.

The study attempted to adjust for known risk factors using information on education, race, ethnicity, and prenatal care from birth certificates, but statistical adjustments using available data may not have been able to completely account for additional risks associated with lower income levels and Hispanic ethnicity. The most important limitation associated with the adverse birth findings is that the existing data do not have comprehensive information about all known risk factors for adverse birth outcomes. Of particular importance for the preterm birth finding from this study is that the birth certificate data do not contain a direct measure of socioeconomic status, and also may not have provided accurate and complete information about each individual's race and/or ethnicity category. A study of this type cannot prove or disprove that specific environmental exposures or other types of risk factors caused elevated levels of health problems in a community, and this type of study does not provide information about causes of health problems in individual people.

Conclusion 2: This study's patterns of elevations and deficits of cancer do not suggest that unusual environmental exposures associated with cancer risk occurred among the population residing in the area up to ¼ mile from the Creek or from ¼ to ½ mile from the Creek.

Basis for the Conclusion: Total cancers as well as 19 separate categories/types of cancer for males and 21 types for females were reviewed for 1990-2008. For males, two types of cancer, lung and liver, showed statistically significant elevations for the total study area. Lung cancer was statistically significantly elevated in both sub-areas while liver cancer was statistically

significantly elevated in the area farther from the Creek, but not in the area closer to the Creek. Two cancer categories were statistically significantly low for males. For females, one cancer type, cervical cancer, showed statistically significant elevations in both sub-areas and the total area. Total cancers and four types of cancer were statistically significantly low for females. The cancer analyses adjusted for age, gender, and race/ethnicity.

The types of cancer showing statistically significant elevations in this study are known to occur more frequently among populations with lower incomes and higher poverty levels, and U.S. Census data show lower median income and higher poverty in the Newtown study area than the comparison area used for the cancer analyses.

In the general population, smoking is the most important risk factor for lung cancer. Liver disease, alcohol use and infections that cause liver disease (hepatitis B and hepatitis C), obesity, diabetes, and smoking are the most important causes of liver cancer. Nearly all cervical cancer is caused by the human papilloma virus (HPV), and most cervical cancer can be prevented by regular screening. The recently introduced HPV vaccine will prevent cervical cancers in future years.

Interpretation of the cancer incidence findings is limited due to two major limitations associated with this type of study. First, the existing data do not include information about important risk factors for cancer, including each individual's medical history, dietary and lifestyle choices, including smoking and alcohol consumption, physical activity, barriers to preventive healthcare, occupational and residential exposure histories, and socioeconomic status. Most important for this study's findings is the lack of information about socioeconomic status, which would be needed to account for differences in cancer incidence by income category. This type of study is not able to link cause and effect and provide certainty about the reasons for elevated cancer rates in a community. In addition, this type of study does not provide information about what caused an individual's cancer.

Another important limitation is that the cancer diagnoses included in the study occurred when the individual lived in the study area, but the person may not have lived in the study area for a long period of time. This is an important limitation because most types of cancer begin to develop long before they are diagnosed, with a latency period of from 5 to 40 years between the potential first exposure or biological change and the later diagnosis of cancer.

General Recommendations

The health outcome review findings do not provide evidence pointing to health outcome patterns or elevations that are likely associated with unusual environmental exposures in the vicinity of Newtown Creek. Therefore, no additional health outcome data review or study is recommended to be conducted in response to concerns raised to date.

Based on what was currently known about the Creek itself, the Public Health Assessment released in February 2014 concluded that swimming in the Creek, or other types of full-body immersion in the Creek, as well as eating fish and crabs taken from the Creek could harm people's health (ATSDR, 2014). People who are considering eating fish or crabs from the Creek need to follow the fish consumption advice for the East River and Newtown Creek. Women under 50 years old and children under 15 years old should not eat any fish or crabs from these waters.

Next Steps

NYS DOH staff will continue to be available to respond to new information, additional concerns, and questions regarding the Newtown Creek site.

FOR MORE INFORMATION

The fish advisory information can be found at http://www.health.ny.gov/publications/6532.pdf.

PURPOSE

This health outcomes review was conducted by the New York State Department of Health (NYS DOH) in response to community concerns about the health of residents living near Newtown Creek, a body of water that creates the boundary between Kings (Brooklyn) and Queens Counties in New York City. Residents expressed a variety of concerns about potential past and ongoing exposures related to urban and industrial land use near and along the creek.

Health outcomes of concern included cancer, neurological conditions, autoimmune diseases, adverse birth outcomes, and asthma and other respiratory disorders. NYS DOH developed the study plan in consultation with concerned community members and based on feasibility and data quality issues, in particular, the availability of high quality and comprehensive health data for specific types of outcomes. This review examined levels of adverse birth outcomes and cancer among people living within ½ mile of Newtown Creek. These levels were compared to levels among residents living more than ½ mile away from the Creek, in nearby ZIP codes and Brooklyn and Queens Counties.

> A **health outcomes review** uses information from existing sources, such as birth certificates, to compare levels of health outcomes among residents of a specific area to levels in one or more comparison populations.

This type of review cannot prove whether there is a causal relationship between specific exposures and health outcomes in a community nor can it determine the cause of any one individual's health problem. The findings of this type of review may be used, together with findings from other similar investigations, to suggest hypotheses for more in-depth research studies. The study may also be useful to residents because it provides information about levels of health outcomes in their area.

BACKGROUND AND STATEMENT OF ISSUES

Environmental concerns

Waterfront properties on Newtown Creek have been the site of commercial and industrial operations for over a century. In the mid-1800s, the area adjacent to Newtown Creek was one of the busiest hubs of industrial activity in New York City. More than 50 industrial facilities were located along its banks, including oil refineries, petrochemical plants, fertilizer and glue factories, sawmills, and lumber and coal yards. In addition to the industrial pollution that resulted from all this activity, the city began dumping raw sewage directly into the water in

1856. During World War II, the creek was one of the busiest ports in the nation. Currently, factories and commercial facilities still operate along the creek. Various contaminated sites along the creek have contributed to the contamination of Newtown Creek. Today, as a result of its industrial history, including numerous spills, Newtown Creek is reported by the U.S. Environmental Protection Agency (EPA) to be one of the nation's most polluted waterways (EPA 2011).

The Greenpoint Petroleum Remediation Project lies on land adjacent to the middle of Newtown Creek. In the past, multiple oil refineries operated along Newtown Creek. A series of spills on what is currently Exxon/Mobil property on the eastern end of Greenpoint, Brooklyn, resulted in a large plume of petroleum-based hydrocarbons floating on the groundwater. In 1978, the US Coast Guard found evidence of an oil spill entering Newtown Creek. Subsequent investigations found petroleum product from the spill encompassing more than 52 acres under Greenpoint. The volume of petroleum that was leaked and spilled onto land in the area is estimated at 17 million gallons, but could be as much as 30 million gallons. Residents of the neighborhoods surrounding Newtown Creek have voiced concerns about a variety of environmental health concerns, including the oil spill, hazardous waste sites, brownfield properties, ongoing industrial emissions, waste transfer stations, truck traffic, and the Newtown Creek Water Pollution Control Plant. In other words, the concerns include a variety of issues that go beyond the Newtown Creek itself.

The neighborhoods surrounding Newtown Creek include a number of State Superfund sites, brownfields properties, and facilities reporting releases via the EPAs Toxic Release Inventory (TRI) program. While there are no data to suggest that any of these sites is individually responsible for causing environmental exposure for all study area residents to a specific contaminant, the underlying concern expressed by community members was that the commercial, industrial, and urban land use in the area resulted in residents being subjected to a pattern of unusual exposures. A list of hazardous waste sites that are located within the study area can be found in Appendix A. For more information, each of these sites can be looked up on the DEC website (http://www.dec.ny.gov/) or EPA website (http://www.epa.gov/) by its "Site Number" given in Appendix A.

Health outcomes reviewed

This review includes birth outcome and cancer data. This type of review is feasible because NYS DOH and the New York City Department of Health and Mental Hygiene (NYC DHMH) collect comprehensive data on birth outcomes and cancer for the population of New York City. While community members expressed concerns about other health outcomes (e.g., immune system and respiratory outcomes), those health outcomes were not included in this review because similarly complete data are not available. (In response to requests from the community, Appendix H provides information about asthma hospitalization rates at the ZIP code level.)

More specifically, this review includes the following birth outcome categories: growth restriction births, low birth weight births, premature births, and birth defects. Growth restriction births are births that are small given their gestational age (small for gestational age - SGA) or are small despite being full-term (term low birth weight - TLBW). (More complete descriptions of these categories are provided in Appendix B.) This review includes many, but not all, types of birth defects. The list of birth defects included comes from the National Birth Defects Prevention Network (NBDPN). This list includes birth defects that are relatively consistently and reliably reported. (See Appendix C for more information on the defects and categories of defects included in this review.)

Total cancers, as well as 23 separate categories of cancer, 19 specific categories of cancer for males and 21 specific categories for females, are included in this review. One of the categories of cancer is labeled "other sites." This category includes several types of very rare cancers. The entire list of types and categories is provided in Appendix D.

DISCUSSION

Methods

This study examined the levels of adverse birth outcomes and newly diagnosed cancer cases among residents living within ¼ mile of Newtown Creek, from ¼ to ½ mile from the Creek, and both areas combined, and compared them to the levels among residents living farther away in Brooklyn and Queens. These comparisons show us whether the levels of these health outcomes are higher, lower, or about the same as would be expected taking into account the community's specific sex, race, ethnicity, and age group populations during the years of the investigation. Because birth certificates contain additional information about the mother and infant, the analyses of birth outcomes are also able to take into account mother's education, previous live births, and prenatal care. The cancer incidence analyses are able to take account of gender, age, and race/ethnicity only.

While statistical analyses can take account of some differences between study populations and comparison populations, there may be no data available about some other important differences that affect the health outcomes. For this reason, comparison populations are as similar to the study population as possible, and local comparison populations, if large enough for statistical purposes, are preferable to more distant comparison populations. For these reasons, the comparison group for the birth outcomes review includes live births occurring to mothers living in the large portion of the Newtown Creek area ZIP codes that is outside of the Newtown Creek area up to ½ mile from the Creek. The comparison group for the cancer review is the combined population of Brooklyn and Queens (Kings and Queens Counties).

BOUNDARIES

Community members assisted with the selection of the study area and requested that analyses be conducted for three areas: within ¼ mile of the Creek, from ¼ to ½ mile from the Creek, and for these two areas combined for a total area within ½ mile of the Creek. U.S. Census blocks were used to form the study areas. Figure 1 provides a map showing the study area boundaries and the boundaries of the eight ZIP codes that contain the study areas.

The total population in 2010 for the area within ¼ mile of the Creek was 13,965 people; for the area ¼ to ½ mile from the Creek, 48,758; and for the entire area, 62,723. In 2000, the mid-year of this project's timeframe, almost all of the Census blocks adjacent to the Creek contained no population, as these areas include industrial and commercial properties only. Only one Census block adjacent to the Creek, in Brooklyn, where the Creek meets the East River, contained residential housing in 2000.

TIMEFRAMES

The most recent data available at the time of the data request for each health outcome vary slightly, with birth weight, prematurity, and growth restriction outcomes available for births from 1988 through 2010, birth defect outcomes available for births occurring from 1988 through 2007, and cancer data available from 1990 through 2008. The birth defects are available only for births occurring through 2007 because complete ascertainment of birth defects includes identifying defects occurring within the first two to three years of life, and this creates a lag between birth year and the time data are considered complete.

IDENTIFYING AND DEFINING HEALTH OUTCOMES

In order to acquire data for individual births within New York City, NYS DOH submitted a data request and the protocol for this study to the NYC Department of Health and Mental Hygiene (NYC DHMH). This study was approved by both the NYC DHMH and NYS DOH Institutional Review Boards for the Protection of Human Subjects. Once approvals had been received, staff was able to obtain records of all births and birth defects with mothers' home addresses in ZIP codes 11101, 11109, 11206, 11211, 11222, 11237, 11378, and 11385. (11109 is a ZIP code that was newly created after 2000. The area within 11109 was previously within 11101.) Using a variety of geographic information system (GIS) data sources and methods, project staff assigned each birth, based on mother's address, as being either in or out of the study area. These birth records were then evaluated to find out which births met criteria for growth restriction, low birth weight, prematurity, or having a birth defect.

For cancer, staff obtained records from the NYS Cancer Registry for all cancer cases diagnosed among residents of the eight ZIP codes. These cancer records had already been geocoded to residential address location at date of diagnosis by Cancer Registry staff. GIS methods were

used to select the specific cancer cases occurring to residents of the area up to ½ mile from Newtown Creek.

Additional details about selecting records and analyzing adverse birth outcome and cancer data are available in Appendix B. For purposes of protecting confidentiality, no maps of individual case locations are provided.

DEMOGRAPHIC CHARACTERISTICS

For the analyses of birth outcomes and birth defects, the comparison population included all live births to mothers living in the ZIP codes adjacent to Newtown Creek but outside of the study area. Eighty-five percent of the population in the eight study area ZIP codes reside outside of the Newtown Creek study areas. According to 2010 U.S. Census data, the population of the area up to ¼ mile from the Creek was 13,965, the population of the area ¼ to ½ mile from the Creek was 48,758, and the population of the entire eight ZIP code area was 422,598 (Table 1a).

From the information about race/ethnicity, income and poverty for 1990 – 2010, shown in Table 1a, the Newtown Creek study area appears to have shifted from having a slightly higher percentage of population identified as minority (59%) and/or Hispanic (47%) in 1990 to having a lower percentage identified as minority (50%) and/or Hispanic (35%) in 2010 compared to the comparison area. The comparison area percentages remained relatively unchanged over the same time period, with estimates of 55% minority and 38% Hispanic in 2010. Income and poverty levels appear to be quite similar for the study areas and the comparison area from 1990 through 2000.

For the analyses of cancer rates, the comparison population included all individuals who lived in Kings and Queens Counties. Using County-level cancer data provides a relatively local population for comparison that is also large enough to provide stable estimates for cancer incidence rates per population. Data in Table 1b show that in 2010, in contrast to the study area population of 62,723, the comparison area populations for both counties total to 4,735,421. The study area population comprises 1.3% of the population in the two counties.

The U.S. Census data in Table 1b show differences between the overall Newtown Creek study area and the County comparison areas for race/ethnicity, income and poverty levels. According to the U.S. Census, the Newtown Creek study area was 50% minority and 35% Hispanic in 2010, compared to 68% minority and 23% Hispanic in Brooklyn and Queens combined. In the earlier census years, the difference for the Hispanic population was even greater. In 1990, the Newtown Creek study area was 47% Hispanic compared to 20% Hispanic for Kings and Queens Counties combined. The Newtown Creek study area's median household income and poverty level were $29,498 and 26% compared to $37,336 and 20% in Kings and Queens Counties

combined. This indicates 21% lower median income and a 30% higher poverty level in the study area compared to the comparison area for the cancer analyses.

As described in more detail in Appendix B, for all the health outcomes, births, birth defects, and cancer, individuals were assigned to one of four race/ethnicity groups: Hispanic ethnicity, non-Hispanic white, non-Hispanic black, or non-Hispanic other, which includes people identifying as multi-racial or Asian as the primary groups. Information about race/ethnicity that was available for this study is provided on birth certificates, cancer records, and Census estimates. These four somewhat heterogeneous race/ethnicity groupings were used for this review because dividing the population into smaller groups would have made many of the birth outcome and cancer analyses inconclusive because summary numbers for the analyses of many individual types of birth defects or cancer would have been very small or zero.

STATISTICAL ANALYSES

A health outcomes review compares the level of specific health outcomes that actually occurred among residents of the study area (observed), and the level we would expect to see (expected) based on the levels experienced among the residents of the comparison area. Rate ratios (for birth outcomes) or standardized incidence ratios (for cancer) measure the difference between the observed and expected levels of health outcomes. To determine whether any differences between the observed and expected numbers are statistically significant (unlikely due to chance alone), 95% confidence intervals are calculated. Additional information about the statistical analyses for each type of health outcome is available in Appendix B.

Rate ratios (RRs) and **standardized incidence ratios (SIRs)** are measures of the association between an exposure or risk factor and a health outcome. A ratio of 1.0 means the study population and comparison levels are the same. A ratio greater than 1.0 means the study population had a higher level of the health outcome than the comparison group, while a ratio of less than 1.0 means the study population had a lower level than the comparison group.

The **95% confidence interval (95% CI)** helps us decide whether the difference between the study and comparison levels is likely due to chance. If the 95% CI excludes 1.0, the SIR or RR is considered to be statistically significant. If the 95% CI includes 1.0, the SIR or RR is not statistically significant. **Statistically significant** means that the difference between the measure in the study population and comparison population is unlikely to have occurred by chance alone, given the statistical assumptions of the test.

Results

BIRTH OUTCOMES

As stated above, the researchers identified all birth records from 1988-2010 from ZIP codes 11101, 11109, 11206, 11211, 11222, 11237, 11378, and 11385 and mapped them to find out if the mothers lived within the study area at the time of the birth. Almost all (98%) of these addresses were successfully mapped. This process resulted in 4,050 births to mothers residing in the area within ¼ mile of the Creek, 15,413 births in the area from ¼ to ½ mile from the Creek, and 142,425 births in the comparison area, the remainder of the surrounding ZIP Codes (Table 1c).

From U.S. Census data, as described above (Table 1a), the study area population appeared to change over time but be fairly similar to the ZIP code comparison population in terms of percent minority, percent Hispanic, and income and poverty levels. The birth outcome analyses, however, do not use the population in general, but rather the live births among the population, for comparison. Table 1c shows the race/ethnicity distribution, as well as mother's age, mothers' education and prenatal care level for the live births in each study area and the comparison area. This information comes from individual-level information on birth certificates.

A slightly lower percentage of births in the Newtown Creek study area were identified as non-Hispanic black (8.2%) or non-Hispanic white (29%) than in the comparison area (10% and 35% respectively). About 54% of births in the Newtown study area were to Hispanic mothers, while in the remainder of the ZIP codes, the comparison area, 44% of births were to Hispanic mothers. Information about mother's education and prenatal care do not show substantial differences among the study and comparison area births.

As described previously, the births occurring in the study area were evaluated by comparing the births for residents living near Newtown Creek to births in the remainder of the eight surrounding ZIP Codes. As described in more detail in Appendix B, regression analyses were used to adjust for factors such as mother's race, ethnicity, education, and prenatal care in the analyses.

Growth restriction, low birth weight, and prematurity: Table 2a shows the growth restriction, birth weight, and prematurity results for births occurring among residents from 1988 through 2010 who lived at the time of the birth (1) within ¼ mile of the Creek, (2) from ¼ to ½ mile from the Creek, and (3) both areas combined (within ½ mile of the Creek). For these outcomes, only infants that were not multiples (not twins, triplets, etc.), were included in the analyses as multiple births are more likely to be born preterm and/or have low birth weights (see Appendix B). Births for which there was insufficient or obviously incorrect information about gestational age or weight were also excluded. These exclusions led to 3,862 births in the study area closer to the Creek, 14,690 in the study area farther from the Creek, 18,552 in the total study area, and 136,153 in the comparison area (Table 1c).

Table 2a provides the results for these outcomes. The rate ratio for births in the closer study area that were small for their gestational age is slightly elevated, with a rate ratio of 1.05, but this slight elevation is not statistically significant. In the ¼ to ½ mile study area, farther from the Creek, small-for-gestational age births are not elevated. The next category in Table 2a, term low birth weight, includes births that are not preterm, but that are low birth weight. This category is a subset of the small for gestational age category, and the results for the two categories are very similar, with no statistically significant elevations. Low birth weight births also show some slightly elevated ratios but no statistically significant elevations.

One type of outcome, preterm birth, shows statistically significant elevations. For the study area closer to the Creek and the total study area, the analyses produced statistically significantly elevated rate ratios for preterm births. The rate ratio for all births occurring at fewer than 37 weeks gestation (all preterm) is 1.14, indicating a 14% elevation, in the closer study area compared to the comparison area. In the study area further from the Creek, the rate is not statistically significantly elevated, but is at the borderline of statistical significance, suggesting a 5% elevation of preterm births in this area. For the entire study area (up to ½ mile from the Creek), there is a 6% elevation that is statistically significant.

Preterm births were divided into two subsets for analysis. The subset analyses show that only moderately preterm (from 32 to 37 weeks) are elevated, showing statistically significant elevations (17%) in the closer study area and in the entire study area (8%). The statistically significant elevation of moderately preterm births is based on observing 294 moderately preterm births in the area closer to the Creek, compared to 257 births expected. The subset

including more severely preterm births (very preterm), births occurring with fewer than 32 weeks' gestation, was not statistically significantly elevated in either study area.

The models (Poisson regression models) that evaluated whether preterm births show elevations in the areas near the Creek also provide estimates of how much the known risk factors affect risk for preterm birth in the study and comparison populations. These modeling results, for moderately preterm births (32-37 weeks), are shown in Table 2b. As stated previously, the analyses estimated that moderately preterm births were elevated by 17% in the area within ¼ mile of Newtown Creek and by eight percent in the total study area within ½ mile of the Creek. The well-established risk factors, evaluated simultaneously in the models, also had statistically significant effects on the risk for preterm birth, and these effects were similar in the study and comparison populations (data not shown). From Table 2b, for the area within ¼ mile of the Creek, these statistically significant elevated risks were estimated to be: mother being over age 35, 29% elevated risk; having less than a high school education, 18% elevated risk; less than a college education, 28% elevated risk; being non-Hispanic black, more than a doubling of risk; being Hispanic, 49% elevation of risk; and having had inadequate prenatal care, 41% elevation of risk.

Birth defects: Fewer births were included in the birth defect analyses than in the birth weight analyses because the birth defects were available only for births occurring through 2007. Another difference is that multiple births (twins, triplets, etc.) are not excluded from analyses of birth defects. Table 3 shows 3,426 births were identified for the birth defect analyses for the area closer to the Creek, 13,441 births for the area farther from the Creek, and 16,867 total births for the combined area. The comparison area included 120,773 births (data not shown).

Using data from the NYS Congenital Malformations (birth defects) Registry for 1988 through 2007, staff identified 239 infants with one or more birth defects from the total of 16,867 births in the overall study area. Table 3 shows the birth defects grouped by category, as developed by the National Birth Defects Prevention Network (NBDPN), and provides observed versus expected cases, which are adjusted only for mother's age and year of birth. The adjusted rate ratios are estimated from multiple regression analyses that compare the Newtown Creek study area births to the comparison area births while taking account of additional factors such as mother's education, race/ethnicity, and level of prenatal care.

For all the birth defects combined, the rate ratios show no elevation in any of the specific study areas. For defects by specific NBDPN categories, there were no statistically significant findings. One category, central nervous system defects, showed a relatively high rate ratio for the study area closer to the creek, (RR: 1.97, CI: 0.61-6.31), but this was based on just three cases, a relatively small number in statistical terms, and was not statistically significant.

Research staff also reviewed the listing of specific defects and saw no unusual patterns or elevations of specific defects. Overall, these results show no consistent patterns suggesting

differences between the observed and expected numbers of birth defects for the Newtown Creek study areas. It is evident that the types of birth defects included in this review occur quite rarely. The 239 infants identified with birth defects (compared to 258 expected based on comparison area rates), comprise 1.4% of the total 16,867 births for the study area.

CANCER

As described previously, the number of cancer cases observed in the study area was compared to the number expected based on cancer rates in the comparison area for 1990 through 2008. Total cancers and 19 individual types of cancer for males and 21 types for females were reviewed (see Appendix D for a listing of cancer types evaluated). A total of 3,608 cancer cases were diagnosed among study area residents from 1990 through 2008. Individual-level information about each cancer case's gender, age, race, and ethnicity were taken into account when estimating the standardized incidence ratios (i.e., observed versus expected numbers provided in the results tables).

Table 4a shows the observed and expected numbers of cancer cases among male residents from 1990 through 2008 who lived at the time of diagnosis (1) within ¼ mile of the Creek, (2) from ¼ to ½ mile from the Creek, and (3) both areas combined (within ½ mile of the Creek).

A total of 1,799 cancer cases were diagnosed among males in the study area during the study period, somewhat lower than the expected number of 1,885. Reviewing the 19 cancer categories for males, the observed numbers are very similar to the expected numbers for most of the cancer types evaluated. Two types of cancer, lung and liver, show statistically significant elevations while two other types, bladder and cancers of "other sites," show statistically significant deficits. (See Appendix D for a listing of cancer types included in "other sites" category.) Liver cancer is elevated among males in the area farther from the Creek, but not in the area closer to the Creek. For lung cancer, both areas show elevations.

Table 4b shows the observed and expected numbers of cancer cases among female residents from 1990 through 2008 who lived in the study area at the time of diagnosis. A total of 1,809 cancer cases were diagnosed among women in the study area during the study period compared to 1,939 expected. Only one cancer type, cervical cancer, shows a statistically significant elevation among women. Statistically significant deficits are seen for several cancer types: total cancers, breast cancer, thyroid cancer, and leukemia. Cervical cancer is elevated in both of the study sub-areas.

The cancer results were also evaluated for males and females combined (data not shown). These results do not show any statistically significant elevations in the areas near the Creek for specific types of cancer in addition to those already shown in either males or females in the sex-specific analyses. For males and females combined, liver and bile duct cancer as well as lung and bronchus cancer are statistically significantly elevated for males and females combined in

the area up to ½ mile from the Creek, as they were for males considered separately. For males and females combined, some additional types of cancer show deficits compared to expected numbers. For males and females combined, the number of total cancers observed is statistically significantly lower than expected in the area ¼ to ½ mile from the Creek and in the area up to ½ mile from the Creek. Hodgkin's lymphoma, leukemia, kidney cancer, renal pelvis cancer, thyroid cancer, and urinary bladder cancer show deficits in one or more of the areas within ½ mile of the Creek. (data not shown).

The results shown in Tables 4a and 4b adjust for differences in proportions of race/ethnicity groups in the study versus comparison population and differences in specific cancer rates for different race/ethnicity groups. Results combined together in this way do not show whether there are unusual cancer patterns within specific race/ethnicity groups. In order to address this issue, observed and expected cancer cases were also produced for each race/ethnicity category separately. These results can be seen in Appendix F.

The race/ethnicity specific results from the Appendix F tables may be useful for seeing if the statistically significant elevations for the combined study area population (shown in table 4a and 4b) arise from specific race/ethnicity categories. For males, the statistically significant elevations of liver and intrahepatic bile duct cancer appear to come primarily from Hispanic males (Appendix F, Table F1). Liver cancer for Hispanic males is statistically significantly elevated in the area farther from the Creek and the total area. Liver cancer diagnosed among non-Hispanic white males and non-Hispanic black males also contribute to the statistically significant elevation for all groups combined, with each sub-group showing slight, non-statistically significant elevations. The statistically significant lung cancer elevation among males is from cases diagnosed among non-Hispanic white males and non-Hispanic black males. Both groups show statistically significantly elevated incidence ratios for lung cancer (Appendix F, Tables F3 and F5).

The statistically significant cervical cancer elevation is primarily associated with non-Hispanic white females, with almost a tripling of observed compared to expected cases (SIR 2.83, CI: 1.55-4.75) in the area closer to the Creek, and a 58% elevation (SIR 1.58, CI: 1.07-2.24) for the area farther from the Creek. The SIRs are also elevated for Hispanic females and non-Hispanic black females, but the elevations are not statistically significant. (Appendix F, Tables F2, F4, F6.)

The race/ethnicity specific findings (Appendix F) showed a few more statistically significant cancer elevations and deficits in addition to those for the combined study population. Reviewing the Appendix F tables in order, for Hispanic males, there were no statistically significant elevations in addition to the liver cancer elevation. One type of cancer showed a statistically significant deficit: bladder cancer. For Hispanic females, total cancers and the grouping of rare cancers labeled "other sites" were both statistically significantly elevated in the area up to ¼ mile from the Creek. (A listing of the other sites is in Appendix D.) Review of the specific "other" cancers diagnosed among Hispanic females did not show an unusual

pattern, such as young ages of diagnosis, or higher than expected numbers of a specific type of cancer within the category. For Hispanic females, the observed number of breast cancer cases was statistically significantly lower than expected in the area from ¼ to ½ mile from the Creek.

For non-Hispanic white males, in addition to the lung cancer elevation described previously, oral cavity and pharynx cancer were statistically significantly elevated in the area closer to the Creek and the study area as a whole. In addition, there were statistically significant deficits of total cancers, kidney and renal pelvis cancer, leukemia, bladder cancer, and "other sites" for Non-Hispanic white males.

The results for non-Hispanic white females showed a statistically significant elevation of stomach cancer in the area closer to the Creek, in addition to cervical cancer, described above. There were several statistically significant cancer deficits in one or both of the study areas: total cancers, breast, uterine, kidney and renal pelvis, thyroid, Hodgkin's lymphoma, and leukemia.

The findings for non-Hispanic black males show no statistically significant elevations of cancer in addition to the elevation of lung and bronchus described above. The results show a large deficit (SIR 0.59, CI: 0.40-0.82) for total cancers in the area closer to the Creek, and this deficit is primarily due to a deficit in prostate cancer. For non-Hispanic black females, total cancers, lung and bronchus, and other sites show statistically significant elevations in the area farther from the Creek and the study area as a whole. For the group labeled as non-Hispanic other, which includes a variety of ethnicities, no statistically significant elevations for specific cancer types were detected for males or females.

Interpretation

BIRTH OUTCOMES

Birth outcome analyses showed no statistically significant elevations for the small for gestational age, term low birth weight, or low birth weight categories. For birth defects, the rate ratios show a mixed pattern of elevations and deficits, with no statistically significant findings. For moderately preterm births, the results showed a statistically significant 17% elevation for the area closer to the Creek. The total study area up to ½ mile from the Creek showed a statistically significant eight percent elevation. There were no elevations for the more severe category, very preterm births. (Moderately preterm births range from 32 to less than 37 weeks gestation, compared to very preterm births at less than 32 weeks gestation.)

While the precise causes and specific biological pathways leading to preterm birth are not completely understood, there is agreement that socioeconomic status and psychosocial factors, including stress and lack of social support, are important and likely interact with lifestyle factors such as tobacco and alcohol use, medical factors such as high blood pressure during pregnancy, and having less than adequate prenatal care, which is also closely tied to socio-economic status

and education (Committee on understanding premature birth, 2007, Reece et al., 2007, Leveno et al., 2009). The potential importance of psychosocial stress has been increasingly explored in response to studies showing that African Americans are at greater risk for preterm birth even when socioeconomic status is taken into account (Committee on understanding premature birth, 2007). Hispanic ethnicity has also been associated with increased risk for preterm birth (McCabe, et al., 2014).

In this study, the most likely explanations for the preterm birth elevation in the study area include the well-known risk factors associated with lower socioeconomic status as well as Hispanic ethnicity. While the study areas near the Creek do not appear to have more poverty or lower median income as a whole than the ZIP code comparison area for the birth analyses, birth certificates do not provide data specifically on income level for each individual mother. As a result, the analyses may not have adequately controlled for income differences for mothers giving birth while residing in the study versus the comparison area.

Regarding Hispanic ethnicity, the demographic data (Table 1a) show that in the earlier years of the study, the study areas near the Creek had higher proportions of Hispanic population than the comparison area. Over the timeframe of the study, the proportion of the population identified as Hispanic and African American in the study areas near the Creek has declined. The birth demographics shown in Table 1c for the entire study period show that a greater proportion of study area than comparison area births were identified as Hispanic. The study attempted to adjust for risk associated with being Hispanic, but birth certificates do not always provide complete and accurate information about ethnicity. The statistical adjustments using available data may not have adequately accounted for differences in risk factor profiles between the study area and comparison area births.

The importance of the role of the known risk factors for preterm birth is shown by the regression model results. The study estimated that moderately preterm births were statistically significantly elevated by 17% in the area within ¼ mile of Newtown Creek and by eight percent in the entire study area up to ½ mile from the Creek. In contrast, the model results showed higher elevations of risk for preterm birth from the following risk factors, all statistically significant: mother being over age 35 (29% elevated risk), mother having less than a high school education (18% elevated risk), mother having less than a college education (28% elevated risk), infant identified as non-Hispanic black (122% - more than a doubling of risk), infant identified as Hispanic (49% elevation of risk), and mother and infant having had inadequate prenatal care (41% elevation of risk).

Infants with preterm births, whether in the moderate or more severe category, are at higher risk for lifelong chronic health problems, and the reduction of preterm birth rates is an important public health goal. Preterm birth is associated with low birth weight, but in this study, the low birth weight categories did not show statistically significant elevations. The lack of low birth weight findings suggests that the statistically significant elevation of moderately

preterm births may be based on preterm births that were very near term, and thus not low birth weight. Alternatively, the moderately preterm birth elevation might be an isolated finding due to chance given the large number of statistical tests in this review.

Regarding the potential role of environmental pollutants for preterm births, there are no strong findings to date for any specific type of environmental exposure (Committee on understanding premature birth, 2007). Because lower income, more highly stressed populations often live in areas with more pollution, it has been difficult for studies to adequately account for the potentially complex interactions among various risk factors in order to support strong conclusions about the role of environmental chemical exposures. There is currently no strong consensus that any particular type of environmental pollutant increases the risk for preterm birth. One possible exception is lead. A variety of studies have shown that mothers with higher exposures to lead appear to be at greater risk for preterm birth (Committee on understanding premature birth, 2007).

CANCER

Almost all of the 19 categories of cancer types evaluated for males, as well as total cancers for males, showed no statistically significant elevations. A few types showed statistically significant deficits (urinary bladder and "other" sites). Two types of cancer were statistically significantly elevated among males in the study area, liver and lung cancer. While both of these types of cancer have been associated with some specific occupational and environmental exposures, both are known to be strongly associated with lifestyle factors such as tobacco and alcohol consumption. Strong risk factors for liver cancer include liver disease, alcohol use, infections that cause liver disease (hepatitis B and hepatitis C), obesity, diabetes, and smoking. Smoking is known to be the strongest risk factor for lung cancer. NYS DOH staff checked the listing of liver and lung cancers for the study area and saw no unusual pattern in addition to the excess, such as a pattern of younger ages at diagnosis than expected.

For females, almost all of the 21 categories evaluated, as well as total cancers for females, showed no statistically significant elevations. A few types of cancer (breast, kidney, leukemia, and thyroid) and total cancers for females showed statistically significant deficits. Research staff checked the breast cancers diagnosed in the study area for stage at diagnosis to see if the cases showed a pattern of increased late stage at diagnosis, which might be associated with lack of access to screening or delayed screening. The proportion of cases at early versus late stages at diagnosis was not different than for the rest of NYS.

One type of cancer was statistically significantly elevated for females, cervical cancer. Cervical cancer is known to be associated with infection with the human papilloma virus (HPV) and there is now a vaccine that can prevent most types of HPV infection. Appropriate screening and follow-up care are able to prevent cervical cancer from occurring, so this elevation may indicate lack of screening and preventive care in this population. Lower socioeconomic status is

associated with lack of access to health care, particularly preventive health care. See Appendix E for more information about cervical cancer and the HPV vaccine.

The types of cancer generally considered to have environmental and occupational exposures as contributors to increased risk are leukemia, non-Hodgkin lymphoma, melanoma, and bladder, brain, breast, esophageal, kidney, larynx, liver, and lung cancers (CDC, EPHT, 2015). As described above, liver and lung cancer are known to be caused primarily by factors such as specific medical conditions and smoking.

As described previously, the population in the study areas near the Creek has lower median income and higher poverty levels than the comparison areas (Table 1b). While the cancer analyses attempted to adjust for differences in race/ethnicity between the study and comparison area, socioeconomic differences are not able to be similarly controlled for using readily available data.

Appendix E provides more detailed information about all the cancer types that were elevated in this study and provides detailed information about cervical cancer and cervical cancer screening.

Study strengths and limitations

There are several strengths and limitations associated with this health outcomes review. All human epidemiology studies have limitations associated with incomplete or inaccurate information about the varied exposures and behaviors that make up a person's history and that could affect health status. The particular strengths and limitations of this type of health outcomes review are described below.

One strength of this study is its use of existing data that are accurately and comprehensively collected for all of New York City and all of New York State. On the other hand, the existing datasets do not include important personal risk factor information such as medical history, dietary and lifestyle choices, and occupational exposures. For both the birth outcomes and cancer analyses, the study lacked individual-level risk factor information for behaviors such as smoking and alcohol consumption, as well as for individual socioeconomic status. Lower socioeconomic status is associated with low birth weight and preterm births and with elevations for some types of cancer such as liver, lung, and cervical cancer, and with deficits for other types of cancer such as Hodgkin and non-Hodgkin lymphoma, leukemia, and thyroid, bladder, brain, breast, prostate, and testicular cancers (Boscoe et al., 2014).

Cancer types with lower incidence rates in populations with higher poverty levels also tend to show higher mortality despite the lower incidence because incidence for these types of cancer is artificially reduced in lower SES populations due to lack of screening and diagnosis. For these types of cancer with suppressed incidence, it would be difficult to detect relatively small cancer

elevations, such as might be associated with environmental exposures, even if such elevations existed. This current study showed cancer elevations and deficits consistent with the study areas having higher poverty levels than the comparison area, Kings and Queens Counties. While the cancer incidence results show no patterns of unusual, significant or non-significant elevations suggesting borderline but undetected elevations, the possibility remains that lower SES artificially reduced the cancer incidence rates.

Another potentially important limitation associated with the use of existing data is that the data sources do not contain complete and accurate information about each individual's race and/or ethnicity category. In addition, the study's use of the general categories of "Non-Hispanic white, Non-Hispanic black, Hispanic, and Other", could have resulted in inappropriately grouping people together who may have very different risk profiles. To conduct statistical tests, it is necessary to maintain sub-groups of sufficient size for the analyses, and this is an additional reason for not creating more specific, smaller sub-categories of race or ethnicity for the study.

Another important limitation of this type of review is the issue of residential mobility. People may move out of the study area before being diagnosed with cancer or move in just prior to a diagnosis. The locations of the birth outcomes are assigned as the mother's residence at time of birth and the locations of cancer outcomes are determined by residence at time of diagnosis only. The length of residence and/or residential addresses prior to the birth or cancer diagnosis are not available for study. Mothers who moved into the study area just before their child's birth would therefore be included in the review although most of the pregnancy occurred outside of the study area. Most cancers begin to develop long before they are diagnosed (latency) and this review could not take into account how long each person lived in the study area before being diagnosed with cancer. Residential mobility is less of an issue for the birth outcomes because the nine-month period before birth is much shorter than the latency period for cancer, from 5 to 40 years, between the potential first exposure or biological change that leads to cancer and diagnosis of the cancer.

There are also limitations associated with the statistical tests. For very small populations, it is unlikely that any statistically significant findings will be observed, because the numbers of outcomes are too small. On the other hand, for outcomes with sufficient numbers of cases, it is possible to observe statistically significant findings that are truly just due to chance. In an investigation such as this one, with many statistical tests, some significant results are expected to occur just by chance.

Regarding the numbers needed for statistical tests to be meaningful, the probability of observing a statistically significant doubling of incidence, if it truly exists, is about 80% when the expected number of outcomes is 12 or more. Using this benchmark, in the area up to ½ mile from the Creek and both sub-areas, up to ¼ mile and from ¼ to ½ mile from the Creek, there was sufficient statistical power to detect a doubling of all of the birth weight and prematurity outcomes. In the area up to ¼ mile from the Creek, there was sufficient statistical power to

detect a doubling only of cardiovascular defects and total defects. In the area from ¼ to ½ mile from the Creek and the area up to ½ mile from the Creek, a doubling of birth defects could have been detected for all but three of the defect types (central nervous system, ear and eye).

For males, there was sufficient power to detect a doubling of incidence for most types of cancer in the area up to ¼ mile from the Creek, and all types of cancer in the area from ¼ to ½ mile from the Creek. For females, there was sufficient power to detect a doubling only for eight of the 21 cancer types in the area up to ¼ mile from the Creek, and for 19 of the 21 types in the area from ¼ to ½ mile from the Creek. For the race/ethnicity specific analyses, particularly for non-Hispanic blacks and non-Hispanic others, there were many types of cancer with insufficient power for detecting a doubling of cancer incidence.

Another study limitation applies only to the cancer incidence analysis: the use of Census estimates for small subsets of the population. Accurate estimates of the population of small areas by sex, age, and race/ethnicity categories are required in order to accurately estimate expected numbers for all the types of cancer reviewed. Rates for each type of cancer vary by sex and age, and some also vary by race and/or ethnicity. The study area boundaries were smaller than whole census tracts or ZIP codes, and these irregular boundaries create a challenge for estimating race or ethnicity-specific population numbers. Particularly in areas with recent immigrants or with relatively high poverty rates, the Census may underestimate numbers of people, and this could affect the calculation of cancer rates per population. If study area population numbers were underestimated, this would lead to lower expected numbers of cancer, so the incidence rates would be artificially higher than expected.

A strength of this study design for the cancer analyses is the use of the local boroughs of NYC (the two counties) for the comparison area. Using this local comparison area is expected to help minimize regional differences in cancer screening and diagnostic patterns. However, the study and comparison areas have a potentially important difference in race category and income/poverty levels. The study area had a lower percentage of non-Hispanic blacks than the comparison area (7% versus 29%) while also having a higher percentage of population living below poverty (26% versus 21%). Because it is possible that the attempt to adjust for race and ethnicity distorted the overall findings in some way due to differences in race and ethnicity and socioeconomic status of the study and comparison areas, the cancer results were also evaluated for the population as a whole, with no adjustment for race or ethnicity. These results are provided in Appendix G. Review of these results shows no substantial differences in the findings compared to the race/ethnicity adjusted results.

CONCLUSIONS

This type of review of health outcome data cannot prove whether or not a specific environmental exposure has occurred and has caused elevated levels of health problems in a

community, nor can it provide information about causes of health problems in individual people. This review conducted analyses to evaluate the incidence of 15 groupings of adverse birth outcomes, 19 types of cancer in males, and 21 types of cancer in females. Statistical test results are presented for the analyses of these adverse health outcomes in the area up to ¼ mile from the Creek and the area from ¼ to ½ mile from the Creek, as well as for these two areas combined, in comparison to the surrounding local area. The geographic area evaluations multiply the number of analyses presented in this report: 45 adverse birth outcome analyses and 120 cancer analyses are presented. The two conclusions provided below are overall summary conclusions from these multiple analyses. These summary conclusions were reached based on interpretation of all the available information described in this report as well as consideration of the limitations of this type of health outcome review.

Conclusion 1: Adverse birth outcomes do not show a pattern of elevations that suggests unusual environmental exposures associated with these outcomes occurred among the population residing in the area up to ¼ mile from the Creek or from ¼ to ½ mile from the Creek.

Basis for the Conclusion: For the study period 1988-2010, the following birth outcomes were assessed: three birth weight categories (low birth weight, low birth weight but not preterm, and small for gestational age), preterm births, and birth defects. The study showed no statistically significant elevations for the birth weight categories or birth defects. The study showed statistically significant elevations for total preterm births and one of two subsets, moderately preterm births (32 to 37 weeks gestation), in the area closer to the Creek and the total study area. The other subset, severely preterm births (fewer than 32 weeks gestation), was not elevated in any of the study areas.

Considering the adverse birth outcomes findings as a whole, the statistically significant elevation of total preterm births and moderately preterm births does not suggest a consistent pattern of highly elevated adverse birth outcomes. The statistically significant elevation of preterm births is not accompanied by a statistically significant elevation of any type of low birth weight births, and moderately preterm, but not severely preterm births, showed an elevation.

Well known risk factors for preterm birth include low socioeconomic status and associated psychosocial factors, including stress and lack of social support; behavioral risk factors such as tobacco and alcohol use; and medical factors such as having inadequate prenatal care and high blood pressure during pregnancy. Risk for preterm birth is higher for African-American and for Hispanic infants than for non-Hispanic white infants.

In this study, the most likely explanations for the preterm birth elevations are factors associated with lower socioeconomic status and Hispanic ethnicity. While there do not appear to be large differences in income and poverty levels between the study and comparison areas used for the birth outcome analyses, more infants in the study than the comparison area were identified as Hispanic.

The study attempted to adjust for known risk factors using information on education, race, ethnicity, and prenatal care from birth certificates, but statistical adjustments using available data may not have been able to completely account for additional risks associated with lower income levels and Hispanic ethnicity. The most important limitation associated with the adverse birth findings is that the existing data do not have comprehensive information about all known risk factors for adverse birth outcomes. Of particular importance for the preterm birth finding from this study is that the birth certificate data do not contain a direct measure of socioeconomic status, and also may not have provided accurate and complete information about each individual's race and/or ethnicity category. A study of this type cannot prove or disprove that specific environmental exposures or other types of risk factors caused elevated levels of health problems in a community, and this type of study does not provide information about causes of health problems in individual people.

Conclusion 2: This study's patterns of elevations and deficits of cancer do not suggest that unusual environmental exposures associated with cancer risk occurred among the population residing in the area up to ¼ mile from the Creek or from ¼ to ½ mile from the Creek.

Basis for the Conclusion: Total cancers as well as 19 separate categories/types of cancer for males and 21 types for females were reviewed for 1990-2008. For males, two types of cancer, lung and liver, showed statistically significant elevations for the total study area. Lung cancer was statistically significantly elevated in both sub-areas while liver cancer was statistically significantly elevated in the area farther from the Creek, but not in the area closer to the Creek. Two cancer categories were statistically significantly low for males. For females, one cancer type, cervical cancer, showed statistically significant elevations in both sub-areas and the total area. Total cancers and four types of cancer were statistically significantly low for females.

The types of cancer showing statistically significant elevations in this study are known to occur more frequently among populations with lower incomes and higher poverty levels, and U.S. Census data show lower median income and higher poverty in the Newtown study area than the comparison area used for the cancer analyses.

In the general population, smoking is the most important risk factor for lung cancer. Liver disease, alcohol use and infections that cause liver disease (hepatitis B and hepatitis C), obesity, diabetes, and smoking are the most important causes of liver cancer. Nearly all cervical cancer is caused by the human papilloma virus (HPV). Most cases of cervical cancer can be prevented by use of the HPV vaccine and by regular screening. The vaccine protects against the types of HPV that most often cause cervical cancer. For more information about the HPV vaccine, visit

CDC's websites[1]. (Please see Appendix E for more information about cervical cancer, the HPV vaccine, and other types of cancer and birth outcomes.)

Interpretation of the cancer incidence findings is limited due to two major limitations associated with this type of study. First, the existing data does not include information about important risk factors for cancer, including each individual's medical history, dietary and lifestyle choices, including smoking and alcohol consumption, physical activity, barriers to preventive healthcare, occupational and residential exposure histories, and socioeconomic status, for example. Most important for this study's findings is the lack of information about socioeconomic status, which would be needed to account for differences in cancer incidence by income category. This type of study is not able to link cause and effect and provide certainty about the reasons for elevated cancer rates in a community. In addition, this type of study does not provide information about what caused an individual's cancer.

Another important limitation is that the cancer diagnoses included in the study occurred when the individual lived in the study area, but the person may not have lived in the study area for a long period of time. This is an important limitation because most types of cancer begin to develop long before they are diagnosed, with a latency period of from 5 to 40 years between the potential first exposure or biological change and the later diagnosis of cancer.

General Recommendations

The health outcome review findings do not provide evidence pointing to health outcome patterns or elevations that are likely associated with unusual environmental exposures in the vicinity of Newtown Creek. Therefore, no additional health outcome data review or study is recommended to be conducted in response to community concerns raised to date.

Based on what was currently known about the Creek itself, the Public Health Assessment released in February 2014 concluded that swimming in the Creek, or other types of full-body immersion in the Creek, as well as eating fish and crabs taken from the Creek could harm people's health (ATSDR, 2014). People who are considering eating fish or crabs from the Creek need to follow the fish consumption advice for the East River and Newtown Creek. Women under 50 years old and children under 15 years old should not eat any fish or crabs from these waters. The fish advisory information can be found at http://www.health.ny.gov/publications/6532.pdf.

[1] http://www.cdc.gov/hpv/parents/vaccine.html or http://www.cdc.gov/hpv/parents/questions-answers.html

Next Steps

NYS DOH staff will continue to be available to respond to new information, additional concerns, and questions regarding the Newtown Creek site.

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REPORT PREPARATION

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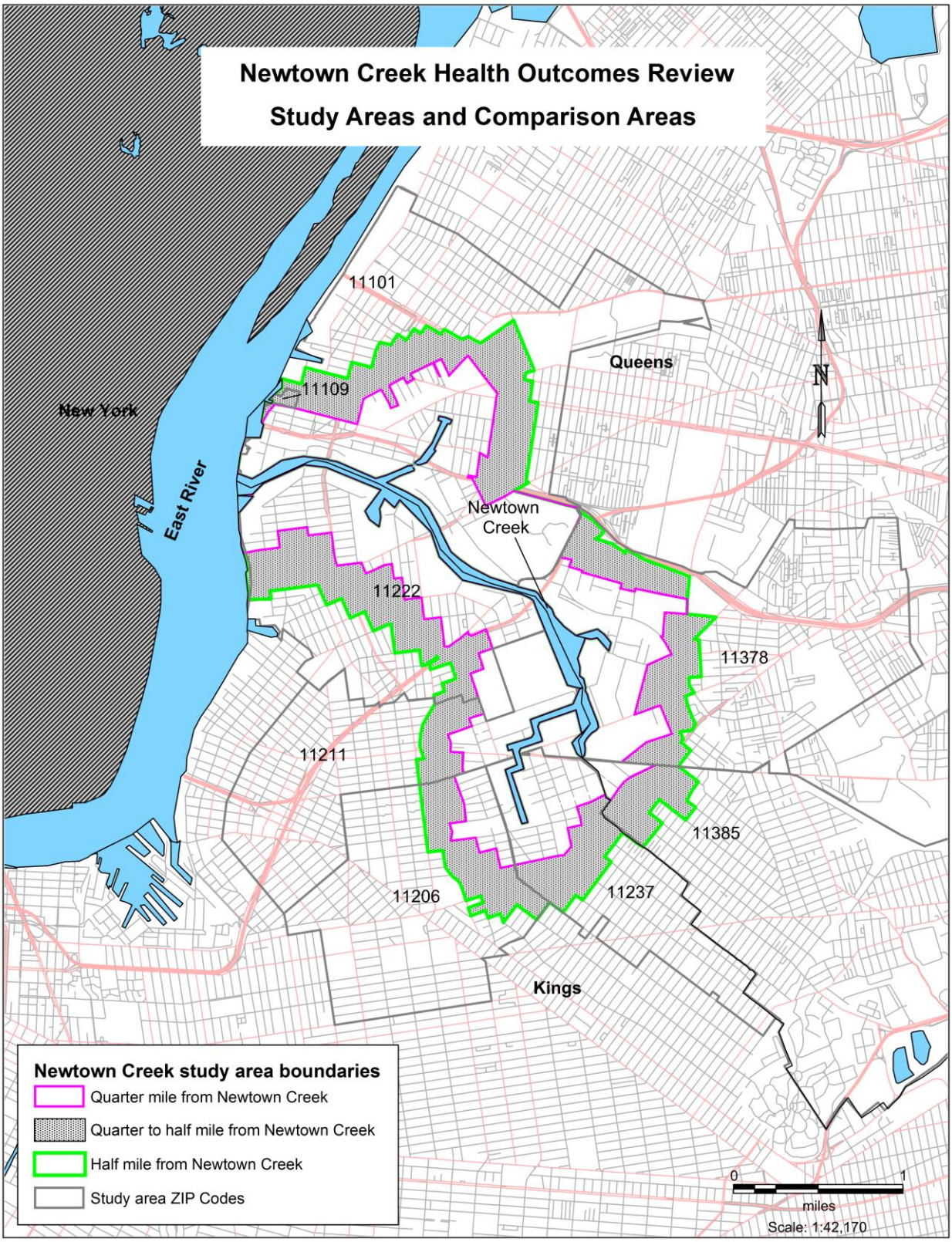
Division of Community Health Investigations

STUDY AREA MAP



REPORT TABLES

Table 1a. Demographic information for Newtown study areas and ZIP code comparison area

Demographics	Within ¼ mile 1990[1,2]	Within ¼ mile 2000[3,4]	Within ¼ mile 2010[5]	¼ to ½ mile 1990[1,2]	¼ to ½ mile 2000[3,4]	¼ to ½ mile 2010[5]	Within ½ mile 1990[1,2]	Within ½ mile 2000[3,4]	Within ½ mile 2010[5]	Comparison area 1990[1,2]	Comparison area 2000[3,4]	Comparison area 2010[5]
Total Population	11,191	13,785	13,965	43,866	44,655	48,758	54,137	58,803	62,723	377,946	397,801	422,598
% Males	57.6	54.3	55.7	49.7	50.1	51	51.3	51.3	52.1	47.8	48.7	49.4
% by Age group												
<6 (years)	7.4	7.2	4.3	9.3	8.2	5.7	8.9	8.0	5.4	10.0	9.7	8.6
6-19	15.2	15.7	9.3	19.3	18.1	11.6	18.5	17.8	11.1	20.8	21.3	17.4
20-64	69.2	68.9	78.9	61.4	64.8	74.7	62.9	65.5	75.6	57.7	59.2	65.0
>64	8.2	8.2	7.5	10.1	8.8	8.0	9.7	8.7	7.9	11.4	9.7	9.0
% by Race/ethnicity												
White	60.2	57.7	64.0	54.9	58.6	64.4	56.3	57.2	64.3	58.5	54.5	60.5
Black	13.8	8.0	8.2	9.6	6.4	7.2	10.3	7.5	7.4	14.6	10.6	10.5
Native American	0.7	0.9	0.6	0.5	0.8	0.7	0.6	0.8	0.7	0.4	0.6	0.7
Asian*	3.5	6.2	9.8	4.2	4.7	7.1	4.2	4.8	7.7	4.7	5.1	6.6
Pacific Islander*	-	0.1	0.0	-	0.1	0.1	-	0.1	0.1	-	0.1	0.1
Other	21.8	20.9	13.7	30.7	24.1	16.3	28.6	24.1	15.7	21.9	23.8	17.8
Multi-Racial**	-	6.3	3.7	-	5.4	4.3	-	5.7	4.1	-	5.4	3.8
Minority***	58.0	59.1	48.5	58.9	58.0	50.9	58.6	59.7	50.4	53.9	59.5	55.0
Hispanic	43.8	41.8	28.8	48.5	46.0	36.2	47.4	46.2	34.6	38.1	41.7	38.5
Income & Poverty												
Median household income	$22,799	$31,614	-	$22,030	$28,758	-	$22,180	$29,498	-	$21,976	$29,443	-
% of households below poverty level	27.5	24.9	-	28.2	27.0	-	28.0	26.5	-	28.8	28.9	-

ZIP codes included are 11101, 11109, 11206, 11211, 11222, 11237, 11378, and 11385.

* Asian and Pacific Islander categories are combined for 1990 Census.

** Multi-Racial category not available in 1990 Census.

***Percent minority includes the non-white categories.

1 U.S. Bureau of the Census. 1990 Census of population and housing summary tape file 1 (STF1). U.S. Department of Commerce. 1991.

2 U.S. Bureau of the Census. 1990 Census of population and housing summary tape file 3 (STF3). U.S. Department of Commerce. 1992.

3 U.S. Bureau of the Census. 2000 Census of population and housing summary file 1 (SF1). U.S. Department of Commerce. 2001.

4 U.S. Bureau of the Census. 2000 Census of population and housing summary file 3 (SF3). U.S. Department of Commerce. 2002.

5 U.S. Bureau of the Census. 2010 Census of population and housing summary file 1 (SF1). U.S. Department of Commerce. 2011.

Table 1b. Demographic information for Newtown study areas and Kings (Brooklyn) and Queens County comparison area

Demographics	Within ¼ mile 1990[1,2]	Within ¼ mile 2000[3,4]	Within ¼ mile 2010[5]	¼ to ½ mile 1990[1,2]	¼ to ½ mile 2000[3,4]	¼ to ½ mile 2010[5]	Within ½ mile 1990[1,2]	Within ½ mile 2000[3,4]	Within ½ mile 2010[5]	Comparison area 1990[1,2]	Comparison area 2000[3,4]	Comparison area 2010[5]
Total Population	11,191	13,785	13,965	43,866	44,655	48,758	54,137	58,803	62,723	4,251,609	4,690,648	4,735,421
% Males	57.6	54.3	55.7	49.7	50.1	51	51.3	51.3	52.1	47.0	47.5	47.8
% by Age group												
<6 (years)	7.4	7.2	4.3	9.3	8.2	5.7	8.9	8.0	5.4	8.4	8.3	7.8
6-19	15.2	15.7	9.3	19.3	18.1	11.6	18.5	17.8	11.1	18.2	19.3	17.2
20-64	69.2	68.9	78.9	61.4	64.8	74.7	62.9	65.5	75.6	59.8	60.3	62.9
>64	8.2	8.2	7.5	10.1	8.8	8.0	9.7	8.7	7.9	13.5	12.1	12.1
% by Race/ethnicity												
White	60.2	57.7	64.0	54.9	58.6	64.4	56.3	57.2	64.3	51.9	42.6	41.3
Black	13.8	8.0	8.2	9.6	6.4	7.2	10.3	7.5	7.4	30.4	28.6	27.1
Native American	0.7	0.9	0.6	0.5	0.8	0.7	0.6	0.8	0.7	0.35	0.45	0.59
Asian*	3.5	6.2	9.8	4.2	4.7	7.1	4.2	4.8	7.7	8.24	12.3	16.3
Pacific Islander*	-	0.1	0.0	-	0.1	0.1	-	0.1	0.1	-	0.1	0.05
Other	21.8	20.9	13.7	30.7	24.1	16.3	28.6	24.1	15.7	9.04	10.9	10.7
Multi-Racial**	-	6.3	3.7	-	5.4	4.3	-	5.7	4.1	-	5.1	3.7
Minority***	58.0	59.1	48.5	58.9	58.0	50.9	58.6	59.7	50.4	56.3	66.1	68.1
Hispanic	43.8	41.8	28.8	48.5	46.0	36.2	47.4	46.2	34.6	19.8	22.3	23.4
Income & Poverty												
Median household income	$22,799	$31,614	-	$22,030	$28,758	-	$22,180	$29,498	-	$29,539	$37,336	$51,228
% of households below poverty level	27.5	24.9	-	28.2	27.0	-	28.0	26.5	-	17.3	20.1	19.3

* Asian and Pacific Islander categories are combined for 1990 Census.

** Multi-Racial category not available in 1990 Census.

*** Percent minority includes the non-white categories.

1 U.S. Bureau of the Census. 1990 Census of population and housing summary tape file 1 (STF1). U.S. Department of Commerce. 1991.

2 U.S. Bureau of the Census. 1990 Census of population and housing summary tape file 3 (STF3). U.S. Department of Commerce. 1992.

3 U.S. Bureau of the Census. 2000 Census of population and housing summary file 1 (SF1). U.S. Department of Commerce. 2001.

4 U.S. Bureau of the Census. 2000 Census of population and housing summary file 3 (SF3). U.S. Department of Commerce. 2002.

5 U.S. Bureau of the Census. 2010 Census of population and housing summary file 1 (SF1). U.S. Department of Commerce. 2011.

Table 1c. Birth demographics in Newtown study areas and comparison area (remainder of ZIP codes*): 1988 - 2010

Demographics	Within ¼ mile	¼ to ½ mile	Within ½ mile	Comparison area
Live births	4,050	15,413	19,463	142,425
Singleton live births	3,942	15,051	18,993	138,950
Singleton live births with plausible gestational age/weight	3,862	14,690	18,552	136,153
Mother's age (% age distribution)				
<19 years	7.1	7.3	7.2	6.1
19-34 years	80.2	80.9	80.7	80.7
>35 years	12.7	11.8	12.0	13.2
Mother's education (% age distribution)				
< high school	34.4	36.9	36.4	32.1
High school graduate to some college	51.4	52.7	52.4	58.1
College graduate	14.2	10.4	11.2	9.7
Infant's ethnicity/race category				
Hispanic	51.8	54.3	53.8	44.3
Non-Hispanic Black	6.8	8.6	8.2	10.4
Non-Hispanic White	30.4	28.3	28.7	34.7
Other/Unknown	11.1	8.8	9.3	10.6
Infant's Hispanic category				
Hispanic	51.8	54.3	53.8	44.3
Non-Hispanic	43.9	41.5	42.0	49.9
Unknown	4.3	4.2	4.2	5.7
Prenatal care category				
Adequate	40.9	39.6	39.9	42.7
Intermediate	37.9	39.8	39.4	38.2
Inadequate	21.2	20.6	20.7	19.1

*Comparison area is the remainder of the ZIP code, i.e., the ZIP code not including the area up to ½ mile from the Creek.
Source: NYSDOH Vital Records, birth certificate data, 1988-2010.

Table 2a. Growth restriction, prematurity, and low birth weight among births in the Newtown study areas compared to births in the comparison area (remainder of ZIP codes): 1988-2010

	Within ¼ mile Cases Obs[a]	**Within ¼ mile** Cases Exp[a]	**Within ¼ mile** Adjusted Rate Ratio (CI)[b, c]	**¼ to ½ mile** Cases Obs[a]	**¼ to ½ mile** Cases Exp[a]	**¼ to ½ mile** Adjusted Rate Ratio (CI)[b, c]	**Within ½ mile** Cases Obs[a]	**Within ½ mile** Cases Exp[a]	**Within ½ mile** Adjusted Rate Ratio (CI)[b, c]
Number of births (N)	3,862			14,690			18,552		
Small for gestational age[d]	401	379	1.05 (0.95-1.16)	1,409	1,441	0.97 (0.92-1.03)	1,810	1,820	0.99 (0.94-1.04)
Term low birth weight[e]	96	92	1.03 (0.84-1.28)	345	351	0.98 (0.87-1.10)	441	443	0.99 (0.89-1.10)
Low birth weight (LBW) < 2500 grams	242	234	1.04 (0.91-1.19)	910	889	1.02 (0.95-1.09)	1,152	1,123	1.02 (0.96-1.09)
Moderately LBW 1500 - <2500 grams	201	195	1.03 (0.89-1.19)	769	742	1.03 (0.96-1.11)	970	937	1.03 (0.96-1.11)
Very LBW < 1500 grams	41	39	1.08 (0.78-1.49)	141	148	0.95 (0.79-1.13)	182	186	0.97 (0.83-1.14)
Preterm birth < 37 weeks	339*	305*	1.14 (1.02-1.27)*	1,214	1,165	1.05 (0.99-1.11)	1,553*	1,471*	1.06 (1.01-1.12)*
Moderately preterm 32 – < 37 weeks	294*	257*	1.17 (1.04-1.31)*	1,037	983	1.06 (0.99-1.13)	1,331*	1,240*	1.08 (1.02-1.15)*
Very preterm < 32 weeks	45	48	0.96 (0.71-1.32)	177	183	0.96 (0.82-1.13)	222	231	0.96 (0.83-1.12)

*Statistically significant elevations.

[a] Obs = observed cases; Exp = expected cases based on rates in the remainder of the study area ZIP Codes.

[b] CI = 95% confidence interval.

[c] Adjusted analysis - Poisson regression models produced rate ratios that are adjusted for sex of baby, mother's age (<19, 19-34, 35+ years), education (<high school, high school +), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other/unknown), total previous live births (0,1,2+), and adequate prenatal care (modified Kessner index: adequate, intermediate, inadequate). Adjustment can result in a rate ratio that differs from the less fully adjusted rate ratio which adjusts only for mother's age and baby's year of birth (not shown).

[d] Small for gestational age in this review is defined as a birth weight below the 10th percentile of the comparison study area birth weight distribution for an infant's gestational week, gender, and year of birth (Alexander, et al., 1996).

[e] Term low birth weight means not preterm, but low birth weight, i.e., >= 37 weeks gestation and <2500 grams (low birth weight).

Table 2b. Moderately preterm births (32 - <37 weeks) among births in the Newtown study areas compared to births in the comparison area (remainder of ZIP codes), 1988-2010: Poisson regression model results

	Within ¼ mile N = 3,862 births	**¼ to ½ mile N = 14,690 births**	**Within ½ mile N = 18,552 births**
Risk factor variables:	**Adjusted Rate Ratio (CI)[a, b]**	**Adjusted Rate Ratio (CI)[a, b]**	**Adjusted Rate Ratio (CI)[a, b]**
In versus out of study area	1.17 (1.04-1.31)*	1.06 (0.99-1.13)	1.08 (1.02-1.15)*
Male vs female infant	1.04 (1.00-1.09)	1.05 (1.01-1.09)*	1.05 (1.01-1.09)*
Age 10-18 yrs vs 19-34 yrs	1.07 (0.99-1.15)	1.06 (0.98-1.15)	1.07 (0.99-1.15)
Age 35-70 yrs vs 19-34 yrs	1.29 (1.21-1.37)*	1.29 (1.22-1.37)*	1.29 (1.22-1.37)*
Education 0-11 yrs vs 16+ yrs	1.18 (1.09-1.28)*	1.18 (1.09-1.28)*	1.19 (1.10-1.28)*
Education 12-16 yrs vs 16+ yrs	1.28 (1.17-1.40)*	1.27 (1.16-1.38)*	1.27 (1.17-1.39)*
Non-Hispanic black vs non-Hispanic white	2.22 (2.08-2.38)*	2.22 (2.08-2.37)*	2.20 (2.06-2.35)*
Hispanic versus non-Hispanic white	1.49 (1.41-1.57)*	1.53 (1.45-1.61)*	1.51 (1.44-1.59)*
Other/Unknown versus Non-Hispanic white	1.03 (0.94-1.12)	1.03 (0.95-1.12)	1.02 (0.94-1.11)
1 vs 0 previous live births	0.97 (0.92-1.03)	0.97 (0.92-1.03)	0.98 (0.92-1.03)
>1 vs 0 previous live births	1.16 (1.10-1.22)*	1.16 (1.10-1.22)*	1.16 (1.11-1.22)*
Intermediate vs adequate prenatal care	1.02 (0.97-1.07)	1.01 (0.97-1.06)	1.02 (0.98-1.07)
Inadequate versus adequate prenatal care	1.41 (1.33-1.49)*	1.40 (1.33-1.48)*	1.41 (1.34-1.49)*

*Statistically significant elevations.

[a] Adjusted Rate Ratios are from Poisson regression models that adjust simultaneously for all the risk factor variables listed in the table.

[b] CI = 95% confidence interval.

Table 3. Surveillance birth defects by body system: prevalence rate ratios, Newtown Creek study areas compared to comparison area (remainder of ZIP codes): 1988-2007

Defects by Body System[d]	Within ¼ mile Cases Obs[a]	Within ¼ mile Cases Exp[a]	Within ¼ mile Adjusted Rate Ratio (CI)[b, c]	¼ to ½ mile Cases Obs[a]	¼ to ½ mile Cases Exp[a]	¼ to ½ mile Adjusted Rate Ratio (CI)[b, c]	Within ½ mile Cases Obs[a]	Within ½ mile Cases Exp[a]	Within ½ mile Adjusted Rate Ratio (CI)[b, c]
Number of births (N)	3,426			13,441			16,867		
Cardiovascular	25	27.4	0.90 (0.60-1.35)	98	107.6	0.93 (0.75-1.14)	123	135.1	0.92 (0.76-1.11)
Central Nervous System	3	1.8	1.97 (0.61-6.31)	7	6.8	1.15 (0.52-2.53)	10	8.6	1.31 (0.67-2.58)
Chromosomal	5	5.2	1.01 (0.41-2.46)	17	20.2	0.87 (0.53-1.44)	22	25.5	0.90 (0.58-1.40)
Ear	0	0.4	0.00	1	1.5	0.60 (0.08-4.56)	1	1.9	0.47 (0.06-3.62)
Eye	1	1.0	1.04 (0.14-7.64)	5	3.9	1.34 (0.52-3.45)	6	5.0	1.28 (0.53-3.06)
Gastrointestinal	2	3.4	0.60 (0.15-2.45)	15	13.3	1.17 (0.68-2.01)	17	16.7	1.06 (0.64-1.76)
Genitourinary	9	9.1	1.06 (0.54-2.05)	28	35.6	0.86 (0.58-1.27)	37	44.7	0.90 (0.64-1.27)
Musculoskeletal	5	6.3	0.82 (0.34-2.00)	25	24.3	0.97 (0.63-1.49)	30	30.6	0.94 (0.64-1.40)
Orofacial	3	4.2	0.74 (0.24-2.32)	21	16.5	1.26 (0.79-2.02)	24	20.7	1.15 (0.74-1.79)
Total infants with any surveillance defects	49	52.6	0.95 (0.71-1.26)	190	205.5	0.94 (0.81-1.10)	239	258.2	0.94 (0.82-1.08)

No statistically significant elevations or deficits were found.

[a] Obs = observed cases; Exp = expected cases based on rates in the remainder of the study area ZIP Codes.

[b] CI = 95% confidence interval.

[c] Adjusted analysis - = Poisson regression models produced rate ratios that take into account mother's age (<19, 19-34, 35+ years), sex of baby, mother's education (<high school, high school-some college, 4+ years college), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic other/unknown), total previous live births (0, 1, 2+), and prenatal care (adequate, intermediate, inadequate). This adjustment can result in a rate ratio estimate that differs from the less fully adjusted rate ratio estimate calculated as observed divided by expected, which adjusts only for mother's age and baby's year of birth (not shown).

[d] The list of specific birth defects and their ICD 9 Codes are provided in Appendix C.

Table 4a. Newtown Creek study area cancer incidence among males, adjusted for ethnicity/race and age: 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	407	435.2	0.94	0.85	1.03	1392	1449.7	0.96	0.91	1.01	1799	1885.2	0.95	0.91	1.00
Brain and Other Nervous System	8	8.2	0.98	0.42	1.93	23	27.3	0.84	0.53	1.27	31	35.4	0.87	0.59	1.24
Colon and Rectum	49	51.1	0.96	0.71	1.27	171	177.5	0.96	0.82	1.12	220	228.6	0.96	0.84	1.10
Esophagus	6	5.7	1.06	0.39	2.30	21	18.1	1.16	0.72	1.77	27	23.8	1.14	0.75	1.65
Hodgkin Lymphoma	*	--	0.96	0.31	2.25	**	--	0.63	0.30	1.15	15	21.1	0.71	0.40	1.17
Kidney and Renal Pelvis	8	15.8	0.51	0.22	1.00	48	52.6	0.91	0.67	1.21	56	68.4	0.82	0.62	1.06
Larynx	*	--	0.54	0.15	1.37	**	--	1.11	0.73	1.61	31	31.9	0.97	0.66	1.38
Leukemia	11	12.9	0.86	0.43	1.53	34	44.8	0.76	0.53	1.06	45	57.6	0.78	0.57	1.04
Liver and Intrahepatic Bile Duct	8	11.1	0.72	0.31	1.42	**56**	**34.4**	**1.63**	**1.23**	**2.11**	**64**	**45.5**	**1.41**	**1.08**	**1.80**
Lung and Bronchus	**74**	**57.1**	**1.30**	**1.02**	**1.63**	**230**	**192.5**	**1.19**	**1.05**	**1.36**	**304**	**249.6**	**1.22**	**1.08**	**1.36**
Myeloma	*	--	0.71	0.19	1.82	**	--	0.78	0.43	1.31	18	23.5	0.76	0.45	1.21
Non-Hodgkin Lymphoma	20	24.4	0.82	0.50	1.26	67	77.0	0.87	0.67	1.11	87	101.5	0.86	0.69	1.06
Oral Cavity and Pharynx	16	14.1	1.13	0.65	1.84	54	43.3	1.25	0.94	1.63	70	57.4	1.22	0.95	1.54
Other sites	45	47.6	0.95	0.69	1.27	**117**	**152.5**	**0.77**	**0.63**	**0.92**	**162**	**200.1**	**0.81**	**0.69**	**0.94**
Pancreas	9	10.5	0.86	0.39	1.63	32	35.9	0.89	0.61	1.26	41	46.4	0.88	0.63	1.20
Prostate	98	106.3	0.92	0.75	1.12	347	353.8	0.98	0.88	1.09	445	460.2	0.97	0.88	1.06
Stomach	17	14.4	1.18	0.69	1.88	44	49.1	0.90	0.65	1.20	61	63.5	0.96	0.73	1.23
Testis	*	--	0.42	0.09	1.23	**	--	0.79	0.47	1.25	21	29.9	0.70	0.43	1.07
Thyroid	*	--	0.57	0.12	1.68	**	--	0.84	0.46	1.41	17	21.9	0.78	0.45	1.24
Urinary Bladder	17	24.6	0.69	0.40	1.11	**60**	**90.0**	**0.67**	**0.51**	**0.86**	**77**	**114.6**	**0.67**	**0.53**	**0.84**

Statistically significant elevations, if any, are shown in **bold type** and are **underlined**.
Statistically significant deficits, if any, are shown in **bold type**.
* For protection of confidentiality, numbers smaller than 6 are not provided.
** Some numbers larger than 6 are withheld when providing the number larger than 6 would reveal numbers smaller than 6, from subtraction from the total area. Numbers smaller than 6 are not provided in order to protect confidentiality.
--Expected numbers are not shown in order to prevent revealing observed numbers by using the SIR.
OBS – observed; EXP – expected; SIR - standardized incidence ratio; LCI – lower confidence interval (95%); UCI – upper confidence interval (95%)

Table 4b. Newtown Creek study area cancer incidence among females, adjusted for ethnicity/race and age: 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	356	373.1	0.95	0.86	1.06	**1453**	**1566.5**	**0.93**	**0.88**	**0.98**	**1809**	**1939.5**	**0.93**	**0.89**	**0.98**
Brain and Other Nervous System	7	5.8	1.22	0.49	2.51	23	23.9	0.96	0.61	1.45	30	29.6	1.01	0.68	1.45
Breast	**70**	**107.8**	**0.65**	**0.51**	**0.82**	**363**	**454.9**	**0.80**	**0.72**	**0.88**	**433**	**562.8**	**0.77**	**0.70**	**0.85**
Cervix Uteri	**23**	**11.6**	**1.97**	**1.25**	**2.96**	**65**	**49.6**	**1.31**	**1.01**	**1.67**	**88**	**61.2**	**1.44**	**1.15**	**1.77**
Colon and Rectum	43	44.0	0.98	0.71	1.32	190	185.6	1.02	0.88	1.18	233	229.6	1.01	0.89	1.15
Corpus and Uterus, NOS	24	24.4	0.99	0.63	1.47	86	104.2	0.83	0.66	1.02	110	128.6	0.86	0.70	1.03
Esophagus	*	--	1.09	0.13	3.94	**	--	1.00	0.43	1.97	10	9.8	1.02	0.49	1.87
Hodgkin's Lymphoma	*	--	1.23	0.34	3.15	**	--	0.62	0.27	1.21	12	16.2	0.74	0.38	1.29
Kidney and Renal Pelvis	*	--	0.52	0.14	1.33	**	--	0.68	0.43	1.03	**26**	**39.9**	**0.65**	**0.43**	**0.95**
Larynx	*	--	0.71	0.02	3.93	**	--	1.30	0.56	2.56	9	7.6	1.19	0.54	2.26
Leukemia	7	9.1	0.77	0.31	1.59	**25**	**37.7**	**0.66**	**0.43**	**0.98**	**32**	**46.7**	**0.68**	**0.47**	**0.97**
Liver and Intrahepatic Bile Duct	*	--	1.01	0.27	2.58	**	--	1.16	0.70	1.81	23	20.4	1.13	0.72	1.70
Lung and Bronchus	39	36.7	1.06	0.76	1.45	172	153.8	1.12	0.96	1.30	211	190.4	1.11	0.96	1.27
Myeloma	*	--	1.21	0.39	2.82	**	--	1.03	0.62	1.61	24	22.5	1.07	0.68	1.59
Non-Hodgkin's Lymphoma	17	15.1	1.13	0.66	1.80	50	63.1	0.79	0.59	1.05	67	78.2	0.86	0.66	1.09
Oral Cavity and Pharynx	*	--	0.57	0.12	1.68	**	--	0.91	0.56	1.41	23	27.2	0.85	0.54	1.27
Other sites	41	35.7	1.15	0.82	1.56	157	148.5	1.06	0.90	1.24	198	184.2	1.08	0.93	1.24
Ovary	15	14.1	1.07	0.60	1.76	56	59.1	0.95	0.72	1.23	71	73.2	0.97	0.76	1.22
Pancreas	*	--	0.50	0.16	1.17	**	--	1.19	0.88	1.56	55	52.2	1.05	0.79	1.37
Stomach	15	8.7	1.72	0.96	2.84	39	36.8	1.06	0.75	1.45	54	45.5	1.19	0.89	1.55
Thyroid	16	13.8	1.16	0.66	1.88	**38**	**54.5**	**0.70**	**0.49**	**0.96**	54	68.4	0.79	0.59	1.03
Urinary Bladder	11	8.8	1.25	0.63	2.24	35	36.5	0.96	0.67	1.33	46	45.3	1.01	0.74	1.35

Statistically significant elevations, if any are shown in bold type and are underlined.
Statistically significant deficits, if any, are shown in bold type.
* For protection of confidentiality, numbers smaller than 6 are not provided.
** Some numbers larger than 6 are withheld when providing the number larger than 6 would reveal numbers smaller than 6, from subtraction from the total area. Numbers smaller than 6 are not provided in order to protect confidentiality.
--Expected numbers are not shown in order to prevent revealing observed numbers by using the SIR.
OBS – observed; EXP – expected; SIR – standardized incidence ratio; LCI – lower confidence interval (95%); UCI – upper confidence interval (95%).\

APPENDICES

Appendix A. List of hazardous waste sites located within ½ mile of the Newtown Creek:
(sites are listed by County)

More information for each of these sites is available on the NYS DEC website (http://www.dec.ny.gov/) or US EPA website (http://www.epa.gov/).

Kings County

Voluntary Cleanup Sites

Site Name	Site Number
101-105 West Street	V00231
Greenpoint	V00631
Popular Hand Laundry	V00170
Cornish Knit Goods/Cornish Mini-Malls	V00409

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) sites (Federal Superfund) US Environmental Protection Agency (EPA)

Site Name	Site Number
Brooklyn Term/Mobil Oil	0201304
Brooklyn Union Gas/Varick Ga	0202000
Jones Motor Site	0201577
Lombardy St	0202009
Brooklyn Union Gas/Greenpoint	0201977
Brooklyn Union Gas/Maspeth	0201996
BCF Oil Refining Inc	0204261
Brooklyn Union Gas/Equity W	0201980

NYS Superfund Program Sites

Site Name	Site Number
Former Spic and Span Cleaners and Dryers Inc	224129
ACME Steel Metal Works	224131
ACME Steel Brass Foundry	224132
K-Greenpoint MGP-Energy Center	224052
Former Klink Cosmo Cleaners	224130
B.C.F. Oil Refining Inc	224034
K-Equity Works	224050
K-Scholes St Station	224067
Technical Metal Finishers	224008

Brownfields Sites

Site Name	Site Number
Frito Lay	C224133
353 McKibbin St	C224102

Queens County

Voluntary Cleanup Sites

Site Name	Site Number
Maspeth Substation	V00326
Formerly ACCO Brands Inc	V00331
Outlet City, Queens Blvd & Jac	V00081
21-16 44th Rd, LIC	V00366
Queens West (Hunter's Point) Center Blvd	V00194A
Queens West (Hunter's Point) Parcel 11	V00194B

Resource Conservation and Recovery Act (RCRA) sites (NYS DEC)

Site Name	Site Number
Kosan Industrial Corp	NYD061949228
Review Ave Development II	NYD980592562
Active Steel Drum Co Inc	NYD003933355

CERCLIS (Federal Superfund sites) (US EPA)

Site Name	Site Number
Roehr Chemicals	0203512
Peerless Property	0202134
Hudson Oil Refinery	0202040

NYS Superfund Program Sites

Site Name	Site Number
Roehr Chemicals	241014
Quanta Resources	241005
Phelps Dodge Refining Corp	241002
Former WLK Corp	241097

Brownfields Sites

Site Name	Site Number
Quanta Resources AKA Review Ave Development II	C241005
Review Ave Development I	C241089
Queens Plaza Residential Development	C241105
OCA LIC Fifth St Mixed Use Housing	C241098
Queens West (Hunter's Point) Parcel 9	C241049
Queens West (Hunter's Point) Parcel 8	C241087

Appendix B. Health outcome data acquisition, evaluation and analysis

Birth outcomes

Growth restriction, birth weight, and prematurity: NYS DOH used birth certificate data for 1988-2010 to determine if the study area had an unusual number or pattern of adverse birth outcomes. Only singleton births (one baby) were included in this part of study because multiple births (e.g., twins, triplets) have a much higher risk of some adverse birth outcomes. The birth certificate data include the infant's birth weight, gestational age, and gender; mother's age, race, ethnicity, years of education, the number of previous births (parity), and the week of pregnancy when she had her first prenatal visit.

Birth outcomes are divided into three groups: growth restriction, birth weight, and prematurity. Two measures of growth restriction were studied; small for gestational age (SGA) births and term LBW. SGA is defined as a birth weight below the 10th percentile of the comparison area birth weight distribution of singleton births by gestational week, gender, and five-year time period (Alexander et al., 1996). Term LBW was defined as ≥ 37 weeks gestation and birth weights < 2500 g. The birth weight outcomes are low birth weight (LBW) (<2500 g), divided into two subsets: moderately LBW (≥1500g and <2500g), and very LBW (<1500g). (2500 grams = 5 lbs. 8 oz., 1500 grams = 3 lbs. 5 oz.) Birth records with missing birth weight or birth weight outside a reasonable range (<100g or >8000g) were excluded from the analysis. The prematurity outcomes are pre-term births (<37 weeks gestation), divided into two subsets; moderately pre-term births (≥32 and <37 weeks gestation); and very pre-term births (<32 weeks gestation). Birth records missing gestational age or with gestational ages outside the reasonable range for a live birth (<20 weeks or >44 weeks) were excluded from the analysis.

Birth records for the comparison areas were used to calculate expected number of births with each type of birth outcome. Using all singleton births during the study period, comparison area annual age-group rates for each outcome were calculated. Three maternal age groups were used: 10-18, 19-34, 35, and older. The annual expected number of births having each specific birth outcome is the annual comparison area age-specific rate for that health outcome multiplied by the number of singleton births in the study area for that age group and year. The annual expected numbers are then summed across age groups and study years to get the total expected number. Observed and expected numbers for each birth outcome are presented in the report's outcome tables. When the observed number is greater (or less) than the expected number, this is called an excess (or deficit). This process adjusts for the distribution of mother's age and infant's year of birth in the study area versus the comparison population.

Several outcomes being studied, including LBW and pre-term birth, have been linked to lower socioeconomic status. Study areas are often somewhat different from comparison areas in measures of socioeconomic status, race, and ethnicity. Therefore, the birth outcome analyses used information about the mother and the pregnancy to take some of these differences into account. Poisson

regression analysis was used to analyze the risk of each birth outcome for infants of mothers living either in or out of the Newtown Creek study areas.

The following information from the birth certificate was included in the Poisson regression models as potential confounders: baby's gender, mother's age (less than 19, 19-34, 35+ years), education (less than high school, high school to some college, 4+ years college), race-ethnicity (Hispanic, non-Hispanic black, non-Hispanic other and non-Hispanic white), number of previous live births (0, 1, 2+), and prenatal care. The modified Kessner Index, which combines the month the mother first got prenatal care and the number of prenatal visits she had, was used to classify her prenatal care into one of three categories: adequate, intermediate, and inadequate (Kessner et al., 1973).

For each outcome, the rate ratio (RR) and its 95% confidence interval (95% CI) are presented. The RR represents the rate of the health outcome in study area births divided by the rate of the health outcome in the comparison area births. A RR above (or below) 1.0 with a 95% CI that does not include 1.0 is considered a statistically significant excess (or deficit). This rate ratio may differ from the observed versus expected ratio which did not take account of the demographic and risk factors listed above.

Birth defects: Records of birth defects diagnosed from 1988 through 2007 for all births (including multiple births) occurring to mothers living in the study areas were obtained from the NYS DOH Congenital Malformations Registry (CMR). These were merged with geocoded births for the same time frame. Individual defects appropriate for surveillance studies were assigned to categories based on the NBDPN (National Birth Defects Prevention Network) main categories ("Major Birth Defects," 2014).

The expected numbers of total birth defects, NBDPN categories of birth defects, and individual birth defects (Appendix B) for the study area were calculated adjusting for year of birth and maternal age (less than 19, 19-34, 35+ years). These expected numbers are presented in the birth defects result table (Table 3). Then, using Poisson regression to account for the variables listed above for the other birth outcome analyses, more fully adjusted rate ratios and 95% confidence interval (95% CI) were also calculated. These are also presented in Table 3 of the main report.

Cancer

Cancer incidence was evaluated for total cancers and 21 individual types of cancer in females, and total cancers and 19 individual types of cancer in males, for the time period 1990-2008. Cancer incidence was also evaluated for both sexes combined. To compute the expected numbers of cancer cases, race, ethnicity, age (18 categories) and sex-specific population (for study area) and cancer incidence rates (for comparison area) for each year were used.

The yearly population counts for the study area were derived from Census data in order to estimate population numbers for each sex, age, and race/ethnicity group (Hispanic, non-Hispanic white, non-Hispanic black and non-Hispanic other), for each year of the study. The yearly incidence rates for each type of cancer, for each of the sex, age, and race/ethnicity sub-groups for the comparison area were

provided by the NYS Cancer Registry. These comparison area incidence rates were applied to the population numbers for the study area to calculate expected numbers of cancer cases for each sub-group for each type of cancer.

These estimates were then summed to calculate an overall estimate of the number of expected cases for each type of cancer for the study area. Standardized incidence rations (SIRs) were calculated by dividing the observed number of cancer cases in the study area by the total expected number of cancer cases for the study area, a number estimated from the study area sub-group populations and the comparison area sub-group rates. An SIR greater than 1.0 (or SIR less than 1.0) with a 95% CI that does not include 1.0 is considered a statistically significant excess (or deficit).

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Appendix C. Birth defect groups evaluated in the Newtown Creek study area

Body System	Birth Defect	ICD-9 Code
CENTRAL NERVOUS SYSTEM	Anencephalus	740.0-740.1
	Encephalocele	742.0
	Holoprosencephaly	742.2
	Spina bifida without hydrocephalus	741.0, 741.9; w/o 740.0 - 740.10
EYE	Aniridia	743.45
	Anophthalmia/microphthalmia	743.0, 743.1
	Congenital cataract	743.30 - 743.34
EAR	Anotia/microtia	744.01, 744.23
CARDIOVASCULAR	Aortic valve stenosis	746.3
	Atrial septal defect	745.5
	Atrioventricular septal defect (Endocardia cushion defect)	745.60, .61, .69
	Coarctation of the aorta	747.10
	Common truncus (truncus arteriosus or TA)	745.0
	Double outlet right ventricle (DORV)	745.11
	Ebstein anomaly	746.2
	Hypoplastic left heart syndrome	746.7
	Interrupted aortic arch (IAA)	747.11
	Pulmonary valve atresia and stenosis	746.01, 746.02
	Single ventricle	745.3
	Tetralogy of Fallot (TOF)	745.2
	Total anomalous pulmonary venous return (TAPVR)	747.41
	Transposition of the great arteries (TGA)	745.10, 745.12, 745.19
	Tricuspid valve atresia and stenosis	746.1
	Ventricular septal defect	745.4
OROFACIAL	Choanal atresia	748.0
	Cleft lip with cleft palate	749.2
	Cleft lip without cleft palate	749.1
	Cleft palate without cleft lip	749.0
GASTROINTESTINAL	Biliary atresia	751.61
	Esophageal atresia/tracheoesophageal fistula	750.3
	Rectal and large intestinal atresia/stenosis	751.2
	Small intestinal atresia/stenosis	751.1
GENITOURINARY	Bladder exstrophy	753.5
	Cloacal exstrophy	751.5
	Congenital posterior urethral valves	753.6
	Hypospadias	752.61
	Renal agenesis/hypoplasia	753.0
MUSCULOSKELETAL	Clubfoot	754.51, 754.70
	Craniosynostosis	No specific code
	Diaphragmatic hernia	756.6
	Gastroschisis	756.73
	Limb deficiencies (reduction defects)	755.2 - 755.4
	Omphalocele	756.72
CHROMOSOMAL	Deletion 22 q11	758.32
	Down syndrome (trisomy 21)	758.0
	Trisomy 13	758.1
	Trisomy 18	758.2
	Turner syndrome (gonadal dysgenesis)	758.6

Categories and defects are from: “Major birth defects data from population-based birth defects surveillance programs in the U.S., 2007-2011. Updated August 2014.” **Birth Defects Research** (Part A) 100:S1-S170 (2014).

Appendix D. SEER* Recodes for cancer types included in the Newtown Creek study area

Table D1. Major cancer types evaluated and SEER Site Recodes

SEER Site Recode	Cancer Type
20010 to 20100	Oral Cavity and Pharynx
21010	Esophagus
21020	Stomach
21041 to 21052	Colon and Rectum
21071 to 21072	Liver and Intrahepatic Bile Duct
21100	Pancreas
22020	Larynx
22030	Lung and Bronchus
26000	Breast
27010	Cervix Uteri
27020 to 27030	Corpus and Uterus, NOS
27040	Ovary
28010	Prostate
28020	Testis
29010	Urinary Bladder
29020	Kidney and Renal Pelvis
31010 to 31040	Brain and Other Nervous System
32010	Thyroid
33011 to 33012	Hodgkin Lymphoma
33041 to 33042	Non-Hodgkin Lymphoma
34000	Myeloma
35011 to 35043	Leukemia
Other**	Rare sites combined into one group

Source of recodes: http://seer.cancer.gov/siterecode/icdo3_dwhoheme/index.html
*SEER stands for “Surveillance, Epidemiology, and End Results”. The SEER program is part of the National Cancer Institute.
** These “other” sites are listed in Table D2.

Table D2. Other types of cancer included in the "Other" category in Table D1 and associated SEER Site Recodes.

SEER Site Recode	Cancer Type
21030	Small Intestine
21060	Anus, Anal Canal and Rectum
21080	Gallbladder
21090	Other Biliary
21110	Retroperitoneum
21120	Peritoneum, Mesentry Omentum
21130	Other Digestive Organs
22010	Nose Nasal Cavity Middle Ear
22060	Trachea Mediastinum and Other Respiratory Organs
23000	Bones and Joints
24000	Soft Tissue including Heart
25010	Melanoma of Skin
25020	Other NonEpithelial Skin
27050	Vagina
27060	Vulva
27070	Other Female Genital Organs
28030	Penis
29030	Ureter
29040	Other Urinary Organs
30000	Eye and Orbit
32020	Other Endocrine including Thymus (excludes Thyroid)
36010	Mesothelioma
36020	Kaposi Sarcoma
37000	Miscellaneous

Source of recodes: http://seer.cancer.gov/siterecode/icdo3_dwhoheme/index.html

Appendix E: Risk factors associated with the health outcomes examined in this report

ADVERSE BIRTH OUTCOMES

Small for gestational age:

There are various risk factors for babies being born underweight for their gestational age (small for gestational age), including restricted fetal growth during pregnancy or smaller than average size parents. Small for gestational age babies can have low birth weight because something slowed or halted their growth in the uterus (Robinson et al., 2000). Small for gestational age births are an important health outcome because babies who are small for gestational age are more likely to have health problems as newborns and children.

Maternal cigarette smoking is a major risk factor for having a small for gestational age baby. A U.S. Surgeon General report links maternal smoking to fetal growth restriction and low birth weight (USDHHS, 2004). When expectant mothers have poor nutrition, smoke, or use alcohol or illegal drugs, their babies have an increased chance of being small for gestational age (Resnick, 2002).

Other factors also influence the risk of having a small for gestational age baby. If a baby has birth defects, is a twin or triplet, has fetal infections, or has an abnormality of the placenta, the baby's chances of being small for gestational age increase. Maternal diseases or medical conditions that reduce the blood flow to the fetus account for 25 – 30 percent of small for gestational age births (Resnick, 2002). Health care provider visits before becoming pregnant and during pregnancy are helpful for identifying and controlling these medical conditions (NYS DOH, 2006a). Prenatal care is also essential for determining whether a baby is growing normally. In some cases, fetal growth can be improved by treating medical condition in the mother (such as high blood pressure) that may be a contributing factor (March of Dimes, 2005).

Low birth weight:

Cigarette smoking is the single largest risk factor for fetal growth restriction and low birth weight in non-premature infants (Kramer, 1987). Studies have also found a persistent association between low birth weight and measures of socioeconomic status, including occupation, income, and education (Hughes and Simpson, 1995). Poverty is associated with reduced access to health care, poor nutrition, and increased behavioral risk factors such as smoking. Poor nutritional status of the mother at conception and inadequate nutritional intake during pregnancy can result in term low birth weight births (Kramer, 1987). Although mother's education is not a direct measure of socioeconomic status, birth certificates contain information about mother's education that is often used as an indicator for a variety of low socio-economic status risk factors.

Preterm birth:

Preterm birth babies are born before 37 weeks gestation. Preterm birth is an important health outcome because it increases the risk for infant mortality (death before one year of age) as well as lifelong illness and disability (Muller et al., 2014, Sipola-Leppanen et al., 2014). Significant differences exist among groups, with African-American women having a greater risk than white women for preterm delivery, even in studies that control for socio-economic differences (Cardwell 2013, Burris and Collins, 2010). Visits to a healthcare provider before pregnancy and seeking

early and regular prenatal care help reduce the risk of delivering a baby preterm (March of Dimes, 2004, Reece et al., 2002; Leveno et al., 2009).

Birth defects: While scientists have been able to identify some causes of specific birth defects, the cause of most birth defects is unknown. About 40 – 60 percent of birth defects are of unknown origin (Kalter and Walkany, 1983). Genetic and environmental factors can cause birth defects. Twenty percent of birth defects may be due to a combination of heredity and other factors, eight percent to single gene mutations, six percent to chromosomal abnormalities, and five percent to maternal illnesses, such as diabetes, infections, or anticonvulsant drugs (Kalter and Walkany, 1983; Nelson and Holmes, 1989). Radiation exposure and the use of certain drugs, such as thalidomide or Accutane, are associated with birth defects. Women who smoke, use alcohol or illegal drugs while pregnant have a higher risk of having a baby with a birth defect. No consistent pattern has been observed for associations between race, ethnicity, or socioeconomic status, and the risk of birth defects.

There are ways to reduce a baby's risk for birth defects and to ensure early treatment if a birth defect is found. Pre-pregnancy visits with health care providers may identify genetic or other maternal health conditions which can be treated. A woman's daily use of a multivitamin with 400 micrograms of the B vitamin, folic acid, before and during pregnancy, also helps prevent some types of birth defects (Eichholzer et al., 2006). Women are advised to talk to their health care providers about any medications they take and refrain from smoking, drinking alcohol, or taking illegal drugs while trying to become pregnant or during pregnancy (NYS DOH, 2006a). Despite all of these efforts, birth defects may still occur. To improve health outcomes, certain medical screenings during pregnancy may assist early identification of any birth defects and lead to early infant treatment.

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CANCER

A review of cancer risk factors for all types of cancer is beyond the scope of this report because cancer is not a single disease, but more than 100 different diseases. Cancer is characterized by the abnormal growth of cells in the body. Cancer types are usually labeled based on the type of cell that has grown abnormally to form a tumor. A tumor is malignant, or cancerous, if it is able to spread to other tissues or organs in the body.

Generally, each type of cancer has its own spectrum of risk factors, symptoms, outlook for cure, and methods of treatment. A family history of cancer is a strong risk factor. There are some known carcinogens that increase risk for more than one type of cancer, such as X-rays and tobacco. Other carcinogens include sunlight and certain chemicals that may be found in the air, water, food, drugs, and workplace. Personal habits, lifestyle, and diet may contribute to many cancers. It is estimated that about 30 percent of cancer deaths are due to tobacco. Most types of cancer develop slowly in people. They may appear from 5 to 40 years after exposure to a carcinogen. For example, cancer of the lung may not occur until 30 years after a person starts smoking. This long latency period is one of the reasons it is difficult to determine what causes cancer in humans (NYS DOH 2006b). For more information about the cancers described below, see http://www.health.ny.gov/statistics/cancer/registry/abouts/.

(The following information is from the fact sheets on the website provided above.)

Liver and intrahepatic bile duct cancer

The liver is one of the most important organs of the body. It stores nutrients, produces bile that is needed for digestion, and helps the body process the foods we eat. The liver also breaks down many drugs and chemicals that would be dangerous if they built up in the body.

Cancer of the liver is more common in older people. About half of people newly diagnosed with liver cancer in New York State are age 65 and over. Liver cancer is more common in men than in women. Liver cancer rates are highest among Asians and Pacific Islanders, most likely because of the higher prevalence of viral hepatitis infection in these populations. Liver cancer rates are lower among Whites than Blacks or Asians and Pacific Islanders.

At this time, the causes of liver cancer are not well understood. However, scientists agree that certain factors increase a person's risk of developing this disease. These risk factors are:

- Infections. The most common risk factor for liver cancer is long-term infection with hepatitis B virus (HBV) or hepatitis C virus (HCV). These infections lead to cirrhosis of the liver, a condition in which liver cells become damaged and are replaced by scar tissue. People with cirrhosis have an increased risk of liver cancer.
- Alcohol use. Long-term excessive alcohol use leads to scarring of the liver, a condition known as alcoholic cirrhosis. People who have alcoholic cirrhosis are at greater risk for developing liver cancer.
- Aflatoxins. Aflatoxins are substances made by a fungus that grows on some foods (e.g., peanuts, wheat, soybeans) that have been improperly stored. Eating foods contaminated with aflatoxins increases the risk of liver cancer. In the United States, foods and products that may develop aflatoxins are monitored for safety and quality by the Food and Drug Administration.
- Arsenic. Exposure to arsenic at work or through medical treatment (Fowler's solution, arsenic trioxide) increases the risk of liver cancer. High levels of arsenic in drinking water may also increase the risk for liver cancer. In the United States, safety standards limit the amount of arsenic that is in public water supplies.
- Workplace exposures. Workers exposed to vinyl chloride have an increased risk of liver cancer.
- Hereditary conditions. People with certain hereditary metabolic conditions that can lead to cirrhosis are at increased risk for liver cancer. These disorders include hemochromatosis, alpha1-antitrypsin deficiency, and porphyria cutanea tarda.
- Personal health history. People with diabetes and certain medical conditions that affect the bile ducts, such as primary sclerosing cholangitis or primary biliary cirrhosis, have an increased risk of liver cancer. Obesity may also increase the risk of developing liver cancer.
- Steroid use. Anabolic steroids are male hormones used by some athletes to increase their strength and muscle mass. Long-term use of anabolic steroids increases the risk of getting liver cancer.
- Diet. Diets low in vegetables increase risk for liver cancer.

Scientists are still working to fully understand the role some risk factors (hormones, diabetes) play in the development of liver cancer. Researchers are especially interested in determining if these factors affect liver cancer risk differently among people with chronic hepatitis infection compared to those without the infection. In addition, some studies suggest that tobacco use and exposure to various chemicals including some chlorinated solvents may increase risk of getting liver cancer. Additional research is needed to determine the role, if any, these factors may have in the development of liver cancer.

Lung and bronchus cancer

The lungs are the organs we use to breathe. The bronchus is one of the two tubes that lead from the windpipe (trachea) to the lung. Lung cancer is one of the most common cancers among New Yorkers. In New York it is the leading cause of cancer deaths. Each year almost 6,900 men and about 6,700 women are diagnosed with lung cancer and over 4,700 men and over 4,300 women die from this disease. In New York State, lung cancer death rates among men and women have been declining since 1995, but the decline among women has been slower.

More men than women still get lung cancer because more men than women are current or former smokers. As women started smoking in numbers similar to men, more women began to get lung cancer. In men, lung cancer rates are higher among White and Black men, compared to men who are Asian, Pacific Islander or Hispanic. Non-Hispanic White women have higher lung cancer rates than other racial or ethnic groups. Again, this reflects the smoking patterns of these groups.

At this time, all of the causes of lung cancer are not well understood. However, scientists agree that certain factors increase a person's risk of developing this disease. These risk factors include:

- Smoking. Smoking is the most important cause of lung cancer and one that a person can control. Research studies show that exposure to other people's cigarettes (second-hand smoke) also increases a person's risk of getting lung cancer. Scientists believe that smoking is responsible for about 85% of lung cancers.
- Radon gas. Exposure to radon gas has been estimated to be the second leading cause of lung cancer in the United States. The risk of lung cancer from radon exposure is higher in people who smoke.
- Asbestos in the workplace. People exposed to high levels of asbestos on the job, such as shipbuilders and pipefitters, have an increased risk of lung cancer. This risk is increased even more in workers who smoke.
- Ionizing Radiation. Exposure to high levels of ionizing radiation, such as radiation treatments for other cancers, increases risk for getting lung cancer.
- Personal history. People who have had lung cancer are at increased risk of developing lung cancer again.
- Family history. People with a close relative who had lung cancer may have an increased risk for the disease, even if they do not smoke.
- Other lung diseases. People with a history of certain other diseases of the lung, such as tuberculosis (TB), are at increased risk of developing lung cancer.
- Other workplace exposures. Other chemicals or substances that may be found at high levels in certain workplaces have been identified as risk factors for lung cancer. These include arsenic, beryllium, cadmium, vinyl chloride, nickel compounds, chromium compounds, coal products, tars and soot, chloromethyl ethers and diesel exhaust.

Some studies have shown that living in an area with urban air pollution may increase lung cancer risk slightly, but much less than smoking. Studies also suggest that eating a diet low in fruits and vegetables might increase the risk of lung cancer among people who smoke. Additional research is needed to determine the role, if any, these factors may have in the development of lung cancer.

The following may help reduce the risk of developing lung cancer:

- Do not smoke. If you currently smoke, quit. Avoid exposure to second hand smoke. For more information on quitting smoking, visit the NYS Smoker's Quitline at www.nyssmokefree.com or call 1-866-NY-QUITS.
- Have your home tested for radon, especially if you live in a high radon area. If radon levels in your home are high, make the necessary modifications. For more information on radon visit www.health.ny.gov/environmental/radiological/radon/radon.htm or call 1-800-458-1158.
- Be aware of workplace health and safety rules and follow them.
- Discuss the risks and benefits of medical imaging, such as CT scans, with your health care provider to avoid unnecessary exposure to ionizing radiation. This is particularly important for children.
- Be aware of your family history and discuss any concerns with your health care provider.

Cervical cancer

Cervical cancer is cancer that starts in a woman's cervix. The cervix is the lower, thin opening of the uterus that connects the vagina (or birth canal) to the uterus. Cervical cancer grows slowly over time and usually starts with abnormal changes to the cells on the cervix, known as dysplasia. For more information about the cervix and cervical cancer, visit http://www.cdc.gov/cancer/cervical.

Any woman can get cervical cancer. It occurs most often in women over 30 years old. Women who are not screened or have not been screened in a long time could have cervical cancer and not know it. Cervical cancer is most often found in women who have not had a Pap test in more than five years or have never had a Pap test. The Pap test is the main screening test for cervical cancer; Pap tests can identify cells on the cervix that may become cancerous.

Nearly all cervical cancer is caused by the human papilloma virus (HPV). HPV is one of the most common sexually transmitted infections in the United States; it is estimated that more than half of adults will get HPV. There are 120 different types of HPV, over 30 of which can infect the genitals. Genital types of HPV are either low-risk or high-risk based on how likely it is that they may cause cervical or other gynecological cancers; HPV types 16 and 18 cause 70% of cervical cancer cases.

Most often HPV will go away on its own, but if it does not, it could cause cervical cancer. Many women will have an HPV infection at some point in their lives, but few will get cervical cancer. In addition to HPV infection, there are other factors that can increase the chances of getting cervical cancer. These include:

- Not having regular Pap tests
- Not following up with your health care provider if you have had a Pap test result that is not normal
- Having HIV, the virus that causes AIDS, or another condition that makes it hard for your body to fight off health problems

- Smoking

For more information about HPV and the HPV vaccine visit
http://www.cdc.gov/hpv/parents/vaccine.html.

Symptoms of cervical cancer

Early on, there are usually no symptoms. The longer a person has cervical cancer without treatment, the more likely they will have symptoms. Some of the symptoms of advanced cervical cancer can include:

- Abnormal vaginal bleeding
- Unusually heavy vaginal discharge
- Painful intercourse
- Painful urination
- Bleeding after intercourse, between periods or after a pelvic exam

If you have any of these symptoms, you should talk to your health care provider. These symptoms may be caused by something else; the only way to know for sure is to see your health care provider.

Screening tests can prevent cervical cancer or find it early, when it is easily treated. In the United States, the Pap test has reduced cervical cancer rates by more than 70%.
There are two tests that screen for cervical cancer:

- Papanicolaou test (known as a Pap test or Pap Smear)

  A Pap test looks at cells on the cervix and is often done during a routine pelvic exam. It looks for changes on the cervix that could become cervical cancer if not treated. If your Pap test results show cells that are not normal and may become cancer, your health care provider will contact you for follow-up. There are many reasons why Pap test results might not be normal. It usually does not mean you have cancer.

- HPV test

  The HPV test looks for the types of the virus that cause most cases of cervical cancer, the high-risk types. The HPV test can be done at the same time as the Pap test using either the same sample of cells or a second sample taken right after the Pap test. A positive result for high-risk HPV means that you should be followed closely to make sure that abnormal cells do not develop.

Women should start getting screened for cervical cancer at age 21. Talk with your health care provider about how often you should be screened for cervical cancer. Women who may no longer be having sex or who may feel too old to have a child should still have regular Pap tests. Cervical cancer is most often found in women who have not been screened with the Pap test in more than five years or have never been screened at all. Women who are not screened or have not been screened in a long time could have cervical cancer and not know it.

To prevent cervical cancer:

- Get the HPV vaccine. The vaccine protects against the types of HPV that most often cause cervical cancer. For more information about the HPV vaccine, visit: http://www.cdc.gov/hpv/parents/vaccine.html or http://www.cdc.gov/hpv/parents/questions-answers.html
- See your health care provider regularly for a Pap test.
- Follow-up with your health care provider if your Pap test results are not normal.
- Limit your number of sexual partners.
- Use condoms. For more information about condoms, visit: http://www.health.ny.gov/diseases/aids/facts/condoms/
- Don't smoke or, if you do, quit. For more information about how to quit, visit the New York State Department of Health Tobacco Control Program Quitline at http://www.nysmokefree.com/

Free cervical cancer screening is available for eligible, uninsured and underinsured New York residents through New York State Cancer Services Program. To get more information or to be connected to a Cancer Services Program near you, please call 1-866-442-CANCER or visit the Cancer Services Program website.
Information adapted from CDC Cervical Cancer Fact Sheet (2009) Centers for Disease Control and Prevention Publication #99-9123 available online
http://www.cdc.gov/cancer/cervical/pdf/cervical_facts.pdf

Oral cavity cancer

The oral cavity is made up of the mouth, pharynx and salivary glands. Almost four percent of cancers occur in the oral cavity. Most oral cavity cancers occur on the tongue, floor of the mouth, gums, lip, tonsils and the oropharynx (the part of the throat just behind the mouth). Cancer of the salivary glands is relatively rare. However, when it does occur, it most frequently starts in the parotid gland.

The nasopharynx is the upper part of the back of the throat. Cancer of the nasopharynx has different risk factors than cancers of the rest of the oral cavity and pharynx. This fact sheet does not include cancer of the nasopharynx.

Cancer of the oral cavity is two to three times more common among men than among women. Black men are more likely to get oral cavity cancer than White men, and are almost twice as likely to die from the disease. Most oral cavity cancers occur among people over the age of 60, but they can occur in young people. Cancer of the oral cavity is rare in children.

At this time, the causes of cancer of the oral cavity are not well understood. However, scientists agree that certain factors increase a person's risk of developing this disease. These risk factors include:

- Tobacco use. Using tobacco of any kind, including cigarettes, cigars, pipes and smokeless tobacco is the most important cause of cancer of the oral cavity.

- Alcohol use. Drinking alcoholic beverages in excess can also cause cancer of the oral cavity.
- People who use tobacco and drink alcoholic beverages in excess have a much greater risk of getting oral cavity cancer than people who do either one alone (or people who do neither). It is estimated that as many as 80% of all oral cavity cancers may be due to these two practices.
- Diet. People who eat a diet low in vegetables and fruits are at increased risk for cancer of the oral cavity.
- Personal history of cancer. People who have had one cancer of the oral cavity have a greater risk of developing another oral cavity cancer. People who have had other smoking-related cancers, such as lung cancer, are also at increased risk of developing oral cavity cancer.
- Family history. People with close relatives (parents, brothers/sisters, children) who have had oral cavity cancer are at increased risk of getting cancer of the oral cavity.
- In addition, certain parts of the oral cavity have their own risk factors:
- Lip. Cancer of the lip is associated with outdoor occupations, such as farming and fishing. This may be due to excess exposure to sunlight.
- Salivary gland. Cancer of the salivary gland has been associated with exposure to ionizing radiation, such as X rays. It is also associated with working in the rubber-making industry.
- Oropharynx. Cancer of the oropharynx, particularly in young people, has been associated with exposure to the human papilloma virus (HPV). HPV is the virus that causes cervical cancer in women.

Some studies have suggested that various sources of irritation to the mouth, such as broken or poorly fitting dentures, may increase the risk of oral cavity cancer. Some studies have also shown an increased risk of oral cavity cancer in people who use mouthwashes containing alcohol. Other studies have not confirmed this association. Scientists are also studying the risk of other viruses, including the Epstein-Barr virus (a very common virus that causes infectious mononucleosis, also called "mono") and herpes simplex virus. Additional research is needed to determine the role, if any, these factors may have in the development of cancer of the oral cavity.

To help reduce the risk of getting cancer of the oral cavity:

- Do not smoke. If you currently smoke or use smokeless tobacco, quit. Avoid exposure to second hand smoke. For more information on quitting smoking, visit the NYS Smoker's Quitline at www.nysmokefree.com or call 1-866-NY-QUITS.
- Limit alcohol use.
- Choose a healthy diet to achieve and maintain a healthy weight. Eat more vegetables, fruits and whole grains and eat less red and processed (e.g., bacon, sausage, luncheon meat, hot dogs) meats. These actions may reduce the risk of developing many types of cancer as well as other diseases.
- Be aware of your family history and discuss any concerns with your health care provider.
- If you work outdoors, avoid too much sunlight and use sunscreen.
- Be aware of workplace health and safety rules and follow them.
- Discuss the risks and benefits of medical imaging, such as CT scans, with your health care provider to avoid unnecessary exposure to ionizing radiation. This is particularly important for children.

Stomach cancer

The stomach is a J-shaped organ that is part of the digestive system. It processes foods that are eaten and helps pass waste material out of the body. In the past, stomach cancer was one of the most common cancers among New Yorkers, but this is no longer the case. Stomach cancer rates have been declining over the past 40 years.

Stomach cancer (also called gastric cancer) occurs most often in older people and is rare in people under the age of 50. Men are about twice as likely to get stomach cancer as women. In New York State, stomach cancer occurs twice as often among Blacks as among Whites. Some groups, particularly immigrants from countries with high rates of stomach cancer, such as Japan and China, and their American children, have much higher rates of stomach cancer than other New Yorkers.

At this time, the causes of stomach cancer are not well understood. However, scientists agree that certain factors increase a person's risk of developing this disease. These risk factors include:

- *H. pylori* (*Helicobacter pylori*). Individuals who are infected with the bacterium *H. pylori* are at higher risk for stomach cancer than people who are not infected. However, most people with *H. pylori* do not develop stomach cancer.
- Family history. People with close relatives (parents, brothers/sisters, children) who have had stomach cancer are at greater risk for the disease. Current research indicates that about 30% of stomach cancers may be inherited.
- Smoking. Smoking increases the risk for getting stomach cancer. A current smoker's risk for stomach cancer may be about double that of a non-smoker.
- Ionizing radiation. Individuals exposed to high levels of ionizing radiation, such as radiation treatment for other diseases, are at higher risk for developing stomach cancer.
- Workplace exposures. Individuals who work in industries that are dusty, such as foundries, steel-making and mining, are at increased risk of developing stomach cancer. Workers in the rubber industry, oil refineries, and workers exposed to diesel exhaust are also at increased risk for the disease.
- Diet. Diets low in vegetables, fruit and high fiber foods may increase risk for stomach cancer.

Scientists are continuing to look at various foods and specific vitamins and nutrients to better understand how they affect the risk for developing stomach cancer. High salt intake appears to increase the risk for stomach cancer. In addition, studies suggest that eating smoked, pickled and salty preserved, or poorly preserved, foods increases the risk of getting stomach cancer. Drinking green tea appears to reduce the risk for stomach cancer.

Scientists also continue to focus on the specific ways that *H. pylori* affects the stomach and leads to stomach cancer in some people. H. pylori infection also increases a person's chances of getting ulcers, but having an ulcer does not necessarily lead to an increased risk for stomach cancer. Increased risk appears to depend on the type of ulcer and ulcer treatment.

The information provided above for specific cancer types is from the NYS DOH website: http://www.health.ny.gov/statistics/cancer/registry/abouts/.

References for cancer

[NYS DOH] New York State Department of Health. 2006b. Cancer fact sheet. [accessed January 2015]. Available from: http://www.health.state.ny.us/statistics/cancer/registry/abouts/cancer.htm

Appendix F: Newtown Creek study area cancer incidence results for specific ethnicity/race categories, 1990-2008.

Table F1. Newtown Creek study area cancer incidence results for Hispanic males, 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	98	104.15	0.94	0.76	1.15	389	387.98	1.00	0.91	1.11	487	492.13	0.99	0.90	1.08
Brain and Other Nervous System	*	--	0.84	0.10	3.03	**	--	0.78	0.32	1.62	9	11.30	0.80	0.36	1.51
Colon and Rectum	16	11.24	1.42	0.81	2.31	45	42.30	1.06	0.78	1.42	61	53.54	1.14	0.87	1.46
Esophagus	*	--	0.67	0.02	3.72	**	--	1.42	0.61	2.81	9	7.12	1.26	0.58	2.40
Hodgkin Lymphoma	*	--	0.63	0.02	3.51	*	--	0.53	0.11	1.54	*	--	0.55	0.15	1.41
Kidney and Renal Pelvis	*	--	0.64	0.08	2.32	**	--	1.41	0.81	2.29	18	14.46	1.24	0.74	1.97
Larynx	*	--	1.59	0.33	4.65	*	--	0.73	0.24	1.71	8	8.73	0.92	0.40	1.81
Leukemia	*	--	1.45	0.47	3.38	**	--	0.96	0.51	1.64	18	17.01	1.06	0.63	1.67
Liver and Intrahepatic Bile Duct	*	--	0.84	0.17	2.45	**	--	**2.25**	**1.51**	**3.24**	**32**	**16.44**	**1.95**	**1.33**	**2.75**
Lung and Bronchus	13	10.33	1.26	0.67	2.15	37	38.51	0.96	0.68	1.32	50	48.84	1.02	0.76	1.35
Myeloma	*	--	0.60	0.02	3.32	**	--	0.95	0.35	2.07	7	7.99	0.88	0.35	1.80
Non-Hodgkin Lymphoma	*	--	0.69	0.22	1.60	**	--	1.05	0.69	1.53	32	32.89	0.97	0.67	1.37
Oral Cavity and Pharynx	*	--	0.25	0.01	1.40	**	--	1.06	0.59	1.74	16	18.16	0.88	0.50	1.43
Other sites	10	12.44	0.80	0.39	1.48	37	44.07	0.84	0.59	1.16	47	56.51	0.83	0.61	1.11
Pancreas	*	--	0.94	0.11	3.39	**	--	0.75	0.28	1.63	8	10.13	0.79	0.34	1.56
Prostate	25	27.07	0.92	0.60	1.36	112	105.16	1.07	0.88	1.28	137	132.23	1.04	0.87	1.22
Stomach	*	--	1.17	0.38	2.73	**	--	0.69	0.35	1.24	16	20.13	0.79	0.45	1.29
Testis	0	1.77	---	---	---	*	--	0.65	0.18	1.67	*	--	0.51	0.14	1.30
Thyroid	*	--	2.14	0.26	7.72	*	--	0.30	0.01	1.68	*	--	0.70	0.15	2.06
Urinary Bladder	*	--	0.29	0.01	1.63	**	--	0.53	0.21	1.08	**8**	**16.74**	**0.48**	**0.21**	**0.94**

Table F2. Newtown Creek study area cancer incidence results for Hispanic females, 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	**110**	**85.32**	**1.29**	**1.06**	**1.55**	387	376.39	1.03	0.93	1.14	497	461.71	1.08	0.98	1.18
Brain and Other Nervous System	*	--	1.87	0.39	5.47	*	--	0.56	0.15	1.44	7	8.71	0.80	0.32	1.66
Breast	25	25.05	1.00	0.65	1.47	**88**	**109.57**	**0.80**	**0.64**	**0.99**	113	134.62	0.84	0.69	1.01
Cervix Uteri	9	5.53	1.63	0.74	3.09	27	23.83	1.13	0.75	1.65	36	29.36	1.23	0.86	1.70
Colon and Rectum	6	8.41	0.71	0.26	1.55	45	37.35	1.20	0.88	1.61	51	45.76	1.11	0.83	1.47
Corpus and Uterus, NOS	9	5.73	1.57	0.72	2.98	30	25.43	1.18	0.80	1.68	39	31.15	1.25	0.89	1.71
Esophagus	0	0.48	---	---	---	*	--	1.89	0.51	4.83	*	--	1.54	0.42	3.94
Hodgkin Lymphoma	*	--	1.25	0.03	6.97	**	--	1.68	0.62	3.67	7	4.36	1.60	0.65	3.31
Kidney and Renal Pelvis	*	--	1.22	0.15	4.40	**	--	1.22	0.56	2.32	11	9.02	1.22	0.61	2.18
Larynx	*	--	3.07	0.08	17.11	*	--	0.70	0.02	3.88	*	--	1.13	0.14	4.10
Leukemia	*	--	1.77	0.48	4.52	**		0.89	0.41	1.69	13	12.36	1.05	0.56	1.80
Liver and Intrahepatic Bile Duct	*	--	1.54	0.19	5.56	**	--	1.04	0.38	2.26	8	7.07	1.13	0.49	2.23
Lung and Bronchus	7	5.11	1.37	0.55	2.82	29	22.63	1.28	0.86	1.84	36	27.74	1.30	0.91	1.80
Myeloma	*	--	2.23	0.46	6.53	*	--	0.50	0.10	1.47	6	7.32	0.82	0.30	1.78
Non-Hodgkin Lymphoma	6	3.97	1.51	0.55	3.29	12	17.55	0.68	0.35	1.19	18	21.52	0.84	0.50	1.32
Oral Cavity and Pharynx	*	--	0.76	0.02	4.21	*	--	0.68	0.19	1.75	*	--	0.70	0.23	1.62
Other sites	**16**	**8.07**	**1.98**	**1.13**	**3.22**	41	35.90	1.14	0.82	1.55	57	43.97	1.30	0.98	1.68
Ovary	*	--	1.30	0.35	3.33	**	--	1.18	0.68	1.92	20	16.62	1.20	0.74	1.86
Pancreas	*	--	1.52	0.31	4.44	**	--	1.36	0.71	2.38	15	10.77	1.39	0.78	2.30
Stomach	*	--	0.76	0.09	2.75	**	--	1.55	0.92	2.46	20	14.20	1.41	0.86	2.17
Thyroid	*	--	1.15	0.31	2.95	**	--	0.91	0.50	1.53	18	18.86	0.95	0.57	1.51
Urinary Bladder	*	--	1.64	0.20	5.91	**	--	1.63	0.75	3.10	11	6.74	1.63	0.81	2.92

Statistically significant elevations, if any, are shown in bold type and are underlined. Statistically significant deficits, if any, are shown in bold type.

* For protection of confidentiality, numbers smaller than 6 are not provided.

**Numbers larger than 6 are withheld when providing that number would reveal the number smaller than 6, from subtraction from the total area, or from subtraction from other ethnic/race categories, in other tables.

--Expected numbers are not shown in order to prevent revealing observed numbers, by using the SIR.

--- When there are no observed cases, an SIR is not calculated.

OBS – observed; EXP – expected; SIR – standardized incidence ratio; LCI – lower confidence interval (95%); UCI – upper confidence interval (95%).

Table F3. Newtown Creek study area cancer incidence results for Non-Hispanic white males, 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	253	254.90	0.99	0.87	1.12	**868**	**951.40**	**0.91**	**0.85**	**0.98**	**1121**	**1206.99**	**0.93**	**0.88**	**0.98**
Brain and Other Nervous System	*	--	1.07	0.35	2.49	**	--	0.96	0.55	1.57	21	21.29	0.99	0.61	1.51
Colon and Rectum	32	32.22	0.99	0.68	1.40	114	123.53	0.92	0.76	1.11	146	155.83	0.94	0.79	1.10
Esophagus	*	--	1.04	0.21	3.04	**	--	0.94	0.45	1.72	13	13.59	0.96	0.51	1.64
Hodgkin Lymphoma	*	--	1.10	0.23	3.21	**	--	0.76	0.30	1.56	10	12.00	0.83	0.40	1.53
Kidney and Renal Pelvis	*	--	**0.38**	**0.10**	**0.98**	**	--	0.76	0.51	1.09	**33**	**48.72**	**0.68**	**0.47**	**0.95**
Larynx	*	--	0.23	0.01	1.29	**	--	1.37	0.86	2.07	23	20.40	1.13	0.71	1.69
Leukemia	*	--	0.52	0.14	1.34	**	--	0.64	0.38	1.00	**22**	**35.98**	**0.61**	**0.38**	**0.93**
Liver and Intrahepatic Bile Duct	*	--	0.91	0.25	2.33	**	--	1.25	0.76	1.93	24	20.40	1.18	0.75	1.75
Lung and Bronchus	46	36.86	1.25	0.91	1.66	**173**	**139.27**	**1.24**	**1.06**	**1.44**	**219**	**176.24**	**1.24**	**1.08**	**1.42**
Myeloma	*	--	1.11	0.23	3.25	**	--	0.60	0.22	1.31	9	12.71	0.71	0.32	1.34
Non-Hodgkin Lymphoma	11	12.97	0.85	0.42	1.52	35	46.65	0.75	0.52	1.04	46	59.67	0.77	0.56	1.03
Oral Cavity and Pharynx	**14**	**6.68**	**2.10**	**1.15**	**3.52**	31	24.14	1.28	0.87	1.82	**45**	**30.84**	**1.46**	**1.06**	**1.95**
Other sites	29	27.47	1.06	0.71	1.52	**68**	**98.92**	**0.69**	**0.53**	**0.87**	**97**	**126.49**	**0.77**	**0.62**	**0.94**
Pancreas	7	6.76	1.03	0.42	2.13	22	25.47	0.86	0.54	1.31	29	32.25	0.90	0.60	1.29
Prostate	59	56.42	1.05	0.80	1.35	194	216.35	0.90	0.77	1.03	253	272.89	0.93	0.82	1.05
Stomach	8	7.27	1.10	0.47	2.17	28	27.91	1.00	0.67	1.45	36	35.20	1.02	0.72	1.42
Testis	*	--	0.62	0.13	1.81	**	--	0.82	0.44	1.40	16	20.77	0.77	0.44	1.25
Thyroid	0	3.53	---	---	---	10	12.08	0.83	0.40	1.52	10	15.62	0.64	0.31	1.18
Urinary Bladder	15	19.34	0.78	0.43	1.28	**50**	**73.44**	**0.68**	**0.51**	**0.90**	**65**	**92.82**	**0.70**	**0.54**	**0.89**

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Table F4. Newtown Creek study area cancer incidence results for Non-Hispanic white females, 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	**225**	**262.27**	**0.86**	**0.75**	**0.98**	**887**	**1061.81**	**0.84**	**0.78**	**0.89**	**1112**	**1324.01**	**0.84**	**0.79**	**0.89**
Brain and Other Nervous System	*	--	0.79	0.16	2.32	**	--	1.00	0.56	1.64	18	18.84	0.96	0.57	1.51
Breast	**41**	**75.70**	**0.54**	**0.39**	**0.73**	**227**	**308.43**	**0.74**	**0.64**	**0.84**	**268**	**384.13**	**0.70**	**0.62**	**0.79**
Cervix Uteri	**14**	**4.95**	**2.83**	**1.55**	**4.75**	**31**	**19.60**	**1.58**	**1.07**	**2.24**	**45**	**24.55**	**1.83**	**1.34**	**2.45**
Colon and Rectum	36	32.66	1.10	0.77	1.53	129	133.10	0.97	0.81	1.15	165	165.74	1.00	0.85	1.16
Corpus and Uterus, NOS	14	17.16	0.82	0.45	1.37	**49**	**70.42**	**0.70**	**0.51**	**0.92**	**63**	**87.58**	**0.72**	**0.55**	**0.92**
Esophagus	*	--	0.83	0.02	4.65	*	--	0.20	0.01	1.14	*	--	0.33	0.04	1.19
Hodgkin Lymphoma	*	--	1.29	0.27	3.76	*	--	**0.23**	**0.03**	**0.83**	*	--	0.45	0.15	1.05
Kidney and Renal Pelvis	*	--	0.35	0.04	1.27	**	--	**0.48**	**0.24**	**0.86**	**13**	**28.65**	**0.45**	**0.24**	**0.78**
Larynx	0	1.03	---	---	---	*	--	1.17	0.38	2.74	*	--	0.94	0.31	2.20
Leukemia	*	--	0.32	0.04	1.17	**	--	**0.57**	**0.31**	**0.95**	**16**	**30.96**	**0.52**	**0.30**	**0.84**
Liver and Intrahepatic Bile Duct	*	--	0.96	0.12	3.45	**	--	1.07	0.49	2.03	11	10.53	1.04	0.52	1.87
Lung and Bronchus	30	29.34	1.02	0.69	1.46	116	119.74	0.97	0.80	1.16	146	149.09	0.98	0.83	1.15
Myeloma	*	--	0.82	0.10	2.96	**	--	1.01	0.48	1.85	12	12.38	0.97	0.50	1.69
Non-Hodgkin Lymphoma	10	10.30	0.97	0.47	1.78	31	41.45	0.87	0.61	1.20	46	51.75	0.89	0.65	1.19
Oral Cavity and Pharynx	*	--	0.30	0.01	1.69	**	--	0.82	0.41	1.47	12	16.68	0.72	0.37	1.26
Other sites	25	15.54	0.98	0.63	1.45	95	102.09	0.93	0.75	1.14	120	127.62	0.94	0.78	1.12
Ovary	9	10.03	0.90	0.41	1.70	33	40.86	0.81	0.56	1.13	42	50.89	0.83	0.59	1.12
Pancreas	*	--	0.27	0.03	0.98	**	--	1.03	0.70	1.47	33	37.41	0.88	0.61	1.24
Stomach	**12**	**5.16**	**2.32**	**1.20**	**4.06**	18	20.93	0.86	0.51	1.36	30	26.09	1.15	0.78	1.64
Thyroid	9	8.74	1.03	0.47	1.95	**19**	**33.41**	**0.57**	**0.34**	**0.89**	**28**	**42.14**	**0.66**	**0.44**	**0.96**
Urinary Bladder	7	7.22	0.97	0.39	2.00	25	29.33	0.85	0.55	1.26	32	36.55	0.88	0.60	1.24

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Table F5. Newtown Creek study area cancer incidence results for Non-Hispanic black males, 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	**33**	**56.24**	**0.59**	**0.40**	**0.82**	84	63.14	1.33	1.06	1.65	117	119.34	0.98	0.81	1.17
Brain and Other Nervous System	0	0.73	---	---	---	0	0.80	---	---	---	0	1.53	---	---	---
Colon and Rectum	0	4.98	---	---	---	6	5.84	1.03	0.38	2.24	6	10.81	0.55	0.20	1.21
Esophagus	*	--	1.91	0.23	6.89	*	--	1.64	0.20	5.93	*	--	1.76	0.48	4.52
Hodgkin Lymphoma	0	0.71	---	---	---	0	0.63	---	---	---	0	1.35	---	---	---
Kidney and Renal Pelvis	0	1.58	---	---	---	*	--	1.31	0.16	4.72	*	-	0.64	0.08	2.32
Larynx	0	1.06	---	---	---	0	1.05	---	---	---	0	2.11	---	---	---
Leukemia	*	--	0.87	0.02	4.83	0	1.34	---	---	---	*	--	0.40	0.01	2.24
Liver and Intrahepatic Bile Duct	0	1.49	---	---	---	*	--	2.27	0.47	6.63	*	--	1.07	0.22	3.12
Lung and Bronchus	12	6.91	1.74	0.90	3.03	12	8.05	1.49	0.77	2.60	**24**	**14.96**	**1.60**	**1.03**	**2.39**
Myeloma	0	1.06	---	---	---	*	--	1.72	0.21	6.22	*	--	0.90	0.11	3.25
Non-Hodgkin Lymphoma	*	--	0.89	0.18	2.60	*	--	0.74	0.09	2.66	*	--	0.82	0.27	1.92
Oral Cavity and Pharynx	*	--	0.41	0.01	2.30	*	2.09	2.39	0.78	5.59	6	4.51	1.33	0.49	2.90
Other sites	*	--	0.51	0.11	1.49	8	5.42	1.47	0.64	2.91	11	11.31	0.97	0.49	1.74
Pancreas	0	1.05	---	---	---	*	--	2.40	0.49	7.01	*	--	1.30	0.27	3.81
Prostate	**10**	**19.57**	**0.51**	**0.25**	**0.94**	34	24.75	1.37	0.95	1.92	44	44.31	0.99	0.72	1.33
Stomach	*	--	0.69	0.02	3.86	*	--	0.52	0.01	2.91	*	--	0.60	0.07	2.15
Testis	0	0.34	---	---	---	0	0.26	---	---	---	0	0.60	---	---	---
Thyroid	0	0.39	---	---	---	*	--	3.28	0.08	18.29	*	--	1.44	0.04	8.05
Urinary Bladder	0	0.93	---	---	---	*	--	1.48	0.18	5.34	*	--	0.88	0.11	3.17

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Table F6. Newtown Creek study area cancer incidence results for Non-Hispanic black females, 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	11	7.53	1.46	0.73	2.61	**127**	**76.84**	**1.65**	**1.38**	**1.97**	**138**	**84.41**	**1.63**	**1.37**	**1.93**
Brain and Other Nervous System	*	--	11.37	0.29	63.34	*	--	2.17	0.26	7.82	*	1.01	2.96	0.61	8.66
Breast	*	--	1.82	0.49	4.65	**	--	1.36	0.92	1.94	34	24.24	1.40	0.97	1.96
Cervix Uteri	0	0.39	---	---	---	*	--	1.32	0.43	3.08	*	4.19	1.19	0.39	2.79
Colon and Rectum	*	--	1.08	0.03	6.00	**	--	1.12	0.56	2.01	12	10.75	1.12	0.58	1.95
Corpus and Uterus, NOS	0	0.49	---	---	---	**	--	1.30	0.52	2.67	7	5.89	1.19	0.48	2.45
Esophagus	*	--	14.23	0.36	79.26	*	--	2.52	0.30	9.09	*	0.86	3.47	0.72	10.14
Hodgkin Lymphoma	0	0.05	---	---	---	0	0.46	---	---	---	0	0.52	---	---	---
Kidney and Renal Pelvis	0	0.13	---	---	---	*	--	0.80	0.02	4.46	*	1.38	0.72	0.02	4.03
Larynx	0	0.04	---	---	---	*	--	5.11	0.62	18.46	*	0.43	4.69	0.57	16.93
Leukemia	*	--	6.53	0.17	36.39	*	--	1.32	0.16	4.76	*	1.67	1.79	0.37	5.24
Liver and Intrahepatic Bile Duct	0	0.08	---	---	---	*	--	2.45	0.30	8.85	*	0.90	2.23	0.27	8.06
Lung and Bronchus	*	--	2.85	0.34	10.29	**	--	**2.78**	**1.72**	**4.25**	**23**	**8.26**	**2.78**	**1.77**	**4.18**
Myeloma	0	0.20	---	---	---	*	--	2.46	0.80	5.74	*	2.23	2.24	0.73	5.23
Non-Hodgkin Lymphoma	0	0.26	---	---	---	*	--	0.81	0.10	2.93	*	2.73	0.73	0.09	2.64
Oral Cavity and Pharynx	0	0.12	---	---	---	*	--	3.13	0.85	8.01	*	1.40	2.86	0.78	7.33
Other sites	0	0.67	---	---	---	**	--	**2.73**	**1.62**	**4.32**	**18**	**7.26**	**2.48**	**1.47**	**3.92**
Ovary	0	0.23	---	---	---	*	--	1.21	0.25	3.55	*	2.70	1.11	0.23	3.25
Pancreas	0	0.22	---	---	---	**	--	2.57	0.94	5.60	6	2.55	2.36	0.86	5.13
Stomach	0	0.23	---	---	---	*	--	0.88	0.11	3.17	*	2.51	0.80	0.10	2.88
Thyroid	0	0.17	---	---	---	*	--	1.29	0.16	4.67	*	1.72	1.16	0.14	4.20
Urinary Bladder	*	--	8.98	0.23	50.04	0	1.10	---	---	---	*	1.21	0.83	0.02	4.60

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Table F7. Newtown Creek study area cancer incidence results for Non-Hispanic other males, 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	23	19.94	1.15	0.73	1.73	51	47.13	1.08	0.81	1.42	74	66.76	1.11	0.87	1.39
Brain and Other Nervous System	*	--	2.70	0.07	15.02	0	0.96	---	---	---	*	--	0.76	0.02	4.22
Colon and Rectum	*	--	0.38	0.01	2.13	**	5.86	1.02	0.38	2.23	7	8.43	0.83	0.33	1.71
Esophagus	0	0.24	---	---	---	*	0.56	1.78	0.05	9.92	*	--	1.25	0.03	6.95
Hodgkin Lymphoma	*	--	6.79	0.17	37.81	0	0.38	---	---	---	*	--	1.91	0.05	10.62
Kidney and Renal Pelvis	*	--	3.26	0.39	11.76	*	1.51	0.66	0.02	3.68	*	--	1.42	0.29	4.14
Larynx	0	0.19	---	---	---	0	0.48	---	---	---	0	0.66	---	---	---
Leukemia	*	--	1.61	0.04	8.96	*	1.53	1.96	0.40	5.72	*	--	1.86	0.51	4.77
Liver and Intrahepatic Bile Duct	*	--	0.61	0.02	3.39	*	4.23	0.95	0.26	2.42	*	--	0.86	0.28	2.00
Lung and Bronchus	*	--	1.01	0.21	2.95	**	6.66	1.20	0.52	2.37	11	9.58	1.15	0.57	2.05
Myeloma	0	0.19	---	---	---	0	0.44	---	---	---	0	0.62	---	---	---
Non-Hodgkin Lymphoma	*	--	1.22	0.03	6.82	*	2.01	1.49	0.31	4.35	*	--	1.42	0.39	3.64
Oral Cavity and Pharynx	0	1.06	---	---	---	*	2.89	1.04	0.21	3.04	*	--	0.77	0.16	2.24
Other sites	*	--	1.70	0.35	4.97	*	4.09	0.98	0.27	2.50	7	5.83	1.20	0.48	2.47
Pancreas	0	0.54	---	---	---	*	1.17	0.86	0.02	4.77	*	--	0.59	0.01	3.27
Prostate	*	--	1.23	0.34	3.16	**	7.52	0.93	0.37	1.92	11	10.73	1.03	0.51	1.83
Stomach	*	--	2.06	0.43	6.03	*	3.38	1.18	0.32	3.03	7	4.81	1.46	0.59	3.00
Testis	0	0.18	---	---	---	*	0.47	2.12	0.05	11.83	*	--	1.55	0.04	8.62
Thyroid	*	--	2.75	0.07	15.30	*	0.97	2.05	0.25	7.41	*	--	2.25	0.46	6.58
Urinary Bladder	*	--	1.15	0.03	6.40	*	1.92	0.52	0.01	2.91	*	--	0.72	0.09	2.60

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Table F8. Newtown Creek study area cancer incidence results for Non-Hispanic other females, 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	10	17.96	0.56	0.27	1.02	52	51.41	1.01	0.76	1.33	62	69.41	0.89	0.68	1.15
Brain and Other Nervous System	0	0.28	---	---	---	*	--	2.55	0.31	9.21	*	--	1.88	0.23	6.80
Breast	0	4.87	---	---	---	18	14.90	1.21	0.72	1.91	18	19.77	0.91	0.54	1.44
Cervix Uteri	0	0.78	---	---	---	*	--	0.84	0.10	3.04	*	--	0.63	0.08	2.29
Colon and Rectum	0	2.02	---	---	---	*	--	0.93	0.30	2.18	*	--	0.68	0.22	1.58
Corpus and Uterus, NOS	*	--	1.02	0.03	5.71	0	2.98	---	---	---	*	--	0.25	0.01	1.41
Esophagus	0	0.09	---	---	---	*	--	4.56	0.12	25.39	*	--	3.26	0.08	18.17
Hodgkin Lymphoma	0	0.07	---	---	---	0	0.21	---	---	---	0	0.29	---	---	---
Kidney and Renal Pelvis	0	0.23	---	---	---	*	--	1.51	0.04	8.39	*	--	1.12	0.03	6.23
Larynx	0	0.02	---	---	---	0	0.06	---	---	---	0	0.08	---	---	---
Leukemia	0	0.44	---	---	---	0	1.28	---	---	---	0	1.73	---	---	---
Liver and Intrahepatic Bile Duct	0	0.50	---	---	---	*	--	1.47	0.18	5.30	*	--	1.07	0.13	3.88
Lung and Bronchus	0	1.50	---	---	---	6	3.83	1.57	0.58	3.41	6	5.33	1.13	0.41	2.45
Myeloma	0	0.16	---	---	---	*	--	2.27	0.06	12.66	*	--	1.67	0.04	9.32
Non-Hodgkin Lymphoma	*	--	1.77	0.04	9.86	0	1.60	---	---	---	*	--	0.46	0.01	2.57
Oral Cavity and Pharynx	*	--	2.07	0.05	11.53	*	--	0.70	0.02	3.91	*	--	1.05	0.13	3.79
Other sites	0	1.43	---	---	---	*	--	0.77	0.16	2.25	*	--	0.56	0.12	1.65
Ovary	*	--	2.65	0.32	9.58	*	--	1.78	0.48	4.56	6	3.00	2.00	0.73	4.35
Pancreas	0	0.42	---	---	---	*	--	0.97	0.02	5.39	*	--	0.69	0.02	3.84
Stomach	*	--	1.43	0.04	7.98	*	--	0.51	0.01	2.83	*	--	0.75	0.09	2.71
Thyroid	*	--	2.06	0.42	6.02	*	--	0.72	0.15	2.09	6	5.65	1.06	0.39	2.31
Urinary Bladder	*	--	4.45	0.11	24.81	*	--	1.67	0.04	9.29	*	--	2.42	0.29	8.75

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--Expected numbers are not shown in order to prevent revealing observed numbers, by using the SIR.

--- When there are no observed cases, an SIR is not calculated.

OBS – observed; EXP – expected; SIR – standardized incidence ratio; LCI – lower confidence interval (95%); UCI – upper confidence interval (95%).

Appendix G. Newtown Creek study area cancer incidence results with no ethnicity/race adjustment, 1990-2008

Table G1. Newtown Creek study area cancer incidence results for males with no ethnicity/race adjustment (adjusted only for age), 1990-2008

	Within ¼ mile OBS	Within ¼ mile EXP	Within ¼ mile SIR	Within ¼ mile LCI	Within ¼ mile UCI	¼ to ½ mile OBS	¼ to ½ mile EXP	¼ to ½ mile SIR	¼ to ½ mile LCI	¼ to ½ mile UCI	Within ½ mile OBS	Within ½ mile EXP	Within ½ mile SIR	Within ½ mile LCI	Within ½ mile UCI
All Cancers	411	442.1	0.93	0.84	1.02	**1399**	**1490.6**	**0.94**	**0.89**	**0.99**	**1810**	**1932.6**	**0.94**	**0.89**	**0.98**
Brain and Other Nervous System	8	7.8	1.03	0.45	2.03	23	25.1	0.92	0.58	1.38	31	32.8	0.94	0.64	1.34
Colon and Rectum	49	51.1	0.96	0.71	1.27	171	176.7	0.97	0.83	1.12	220	227.9	0.97	0.84	1.10
Esophagus	6	6.1	0.98	0.36	2.13	21	20.7	1.02	0.63	1.55	27	26.8	1.01	0.66	1.47
Hodgkin Lymphoma	*	--	1.04	0.34	2.42	**	--	0.68	0.33	1.25	15	19.5	0.77	0.43	1.27
Kidney and Renal Pelvis	8	15.4	0.52	0.22	1.03	48	50.2	0.96	0.70	1.27	56	65.6	0.85	0.64	1.11
Larynx	*	--	0.54	0.15	1.37	**	--	1.10	0.72	1.60	31	32.1	0.97	0.66	1.37
Leukemia	11	12.4	0.89	0.44	1.59	34	42.2	0.81	0.56	1.13	45	54.6	0.82	0.60	1.10
Liver and Intrahepatic Bile Duct	8	11.7	0.68	0.29	1.34	**57**	**37.1**	**1.54**	**1.16**	**1.99**	**65**	**48.8**	**1.33**	**1.03**	**1.70**
Lung and Bronchus	**75**	**59.0**	**1.27**	**1.00**	**1.59**	**230**	**202.5**	**1.14**	**0.99**	**1.29**	**305**	**261.5**	**1.17**	**1.04**	**1.30**
Myeloma	*	--	0.68	0.19	1.74	**	--	0.71	0.39	1.19	18	25.6	0.70	0.42	1.11
Non-Hodgkin Lymphoma	20	23.0	0.87	0.53	1.34	68	72.1	0.94	0.73	1.19	88	95.1	0.93	0.74	1.14
Oral Cavity and Pharynx	16	14.9	1.08	0.61	1.75	54	47.0	1.15	0.86	1.50	70	61.9	1.13	0.88	1.43
Other sites	45	45.4	0.99	0.72	1.33	**118**	**145.7**	**0.81**	**0.67**	**0.97**	**163**	**191.0**	**0.85**	**0.73**	**0.99**
Pancreas	9	10.6	0.85	0.39	1.62	32	36.3	0.88	0.60	1.24	41	46.9	0.87	0.63	1.19
Prostate	99	116.0	0.85	0.69	1.04	**350**	**405.7**	**0.86**	**0.77**	**0.96**	**449**	**521.7**	**0.86**	**0.78**	**0.94**
Stomach	17	14.9	1.14	0.66	1.83	45	50.9	0.88	0.64	1.18	62	65.8	0.94	0.72	1.21
Testis	*	--	0.65	0.18	1.67	**	--	1.01	0.60	1.59	22	24.0	0.92	0.58	1.39
Thyroid	*	--	0.60	0.12	1.75	**	--	0.93	0.51	1.56	17	20.0	0.85	0.49	1.36
Urinary Bladder	18	23.6	0.76	0.45	1.21	**60**	**83.0**	**0.72**	**0.55**	**0.93**	**78**	**106.5**	**0.73**	**0.58**	**0.91**

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OBS – observed; EXP – expected; SIR – standardized incidence ratio; LCI – lower confidence interval (95%); UCI – upper confidence interval (95%).

Table G2. Newtown Creek study area cancer incidence results for females with no ethnicity/race adjustment (adjusted only for age), 1990-2008

	Within ¼ mile OBS	**Within ¼ mile** EXP	**Within ¼ mile** SIR	**Within ¼ mile** LCI	**Within ¼ mile** UCI	**¼ to ½ mile** OBS	**¼ to ½ mile** EXP	**¼ to ½ mile** SIR	**¼ to ½ mile** LCI	**¼ to ½ mile** UCI	**Within ½ mile** OBS	**Within ½ mile** EXP	**Within ½ mile** SIR	**Within ½ mile** LCI	**Within ½ mile** UCI
All Cancers	363	369.2	0.98	0.88	1.09	**1463**	**1554.4**	**0.94**	**0.89**	**0.99**	**1826**	**1923.6**	**0.95**	**0.91**	**0.99**
Brain and Other Nervous System	7	5.3	1.32	0.53	2.71	23	22.4	1.03	0.65	1.54	30	27.7	1.08	0.73	1.55
Breast	**72**	**106.6**	**0.68**	**0.53**	**0.85**	**365**	**450.4**	**0.81**	**0.73**	**0.90**	**437**	**557.0**	**0.78**	**0.71**	**0.86**
Cervix Uteri	**23**	**12.4**	**1.85**	**1.17**	**2.78**	**66**	**51.8**	**1.28**	**0.99**	**1.62**	**89**	**64.2**	**1.39**	**1.11**	**1.71**
Colon and Rectum	46	45.0	1.02	0.75	1.36	190	190.3	1.00	0.86	1.15	236	235.3	1.00	0.88	1.14
Corpus and Uterus, NOS	24	24.1	1.00	0.64	1.48	88	102.4	0.86	0.69	1.06	112	126.5	0.89	0.73	1.07
Esophagus	*	--	0.89	0.11	3.22	**	--	0.84	0.36	1.66	10	11.7	0.85	0.41	1.57
Hodgkin Lymphoma	*	--	1.40	0.38	3.58	**	--	0.69	0.30	1.35	12	14.5	0.83	0.43	1.44
Kidney and Renal Pelvis	*	--	0.55	0.15	1.41	**	--	0.72	0.45	1.09	26	37.9	0.69	0.45	1.00
Larynx	*	--	0.67	0.02	3.75	**	--	1.26	0.55	2.49	9	7.8	1.15	0.53	2.19
Leukemia	7	8.6	0.81	0.33	1.67	25	36.2	0.69	0.45	1.02	32	44.9	0.71	0.49	1.01
Liver and Intrahepatic Bile Duct	*	--	1.02	0.28	2.61	**	--	1.15	0.69	1.80	23	20.4	1.13	0.71	1.69
Lung and Bronchus	39	37.1	1.05	0.75	1.44	173	156.7	1.10	0.95	1.28	212	193.7	1.09	0.95	1.25
Myeloma	*	--	0.97	0.32	2.27	**	--	0.87	0.53	1.36	24	26.9	0.89	0.57	1.33
Non-Hodgkin Lymphoma	17	14.2	1.19	0.70	1.91	50	59.6	0.84	0.62	1.11	67	73.8	0.91	0.70	1.15
Oral Cavity and Pharynx	*	--	0.54	0.11	1.58	**	--	0.86	0.52	1.32	23	28.9	0.80	0.50	1.19
Other sites	42	34.4	1.22	0.88	1.65	161	143.5	1.12	0.96	1.31	203	177.8	1.14	0.99	1.31
Ovary	15	13.5	1.11	0.62	1.83	56	57.1	0.98	0.74	1.27	71	70.6	1.01	0.79	1.27
Pancreas	*	--	0.49	0.16	1.14	**	--	1.16	0.86	1.53	55	53.2	1.03	0.78	1.35
Stomach	15	9.0	1.67	0.93	2.75	39	37.9	1.03	0.73	1.41	54	46.9	1.15	0.86	1.50
Thyroid	17	12.1	1.40	0.82	2.25	38	49.3	0.77	0.55	1.06	55	61.4	0.90	0.67	1.17
Urinary Bladder	11	8.2	1.35	0.67	2.41	35	34.3	1.02	0.71	1.42	46	42.4	1.08	0.79	1.45

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Appendix H: Summary of asthma data available from public websites for the Newtown Creek study area ZIP codes

Table H1. Asthma hospital discharges and emergency department (ED) visits, total numbers and rates per 10,000 population, based on 2010-2012 SPARCS data available as of November 2013

ZIP Code/County	Discharges 2010-2012	Discharge Rate	ED Visits 2010-2012	ED visit Rate
11101	253	30.5	1427	172.2
11109	s	s	9*	11.5
11206	1098	45.7	7467	311.1
11211	435	15.4	2415	85.3
11222	83	6.9	419	34.7
11237	872	57.4	3325	219.0
11378	140	13.4	502	48.1
11385	729	24.4	2611	87.3
Queens	11918	18.1	54217	86.3
Brooklyn (Kings)	22330	30.0	105570	141.0
Bronx	24085	58.3	99960	236.0

http://www.health.ny.gov/statistics/ny_asthma/index.htm Main page with data links

s - Data are suppressed for confidentiality purposes when there are fewer than 6 ED visits per ZIP code

* - When there are fewer than or equal to 10 ED visits, the rate may not be stable.

This table provides information about asthma numbers and rates for the ZIP Codes included in the Newtown Creek study area. It also provides the same information for three boroughs of NYC: Queens, Kings, and the Bronx. Queens and Kings County data are provided because the study area is in these two counties. Bronx data are provided as well for comparison. The Bronx tends to shows relatively high rates for asthma hospitalizations compared to NYC's other two boroughs, Manhattan (New York County) and Staten Island (Richmond County) (data not shown).

The data in the table above show that there are wide variations in the rates (per 10,000 population) of hospitalizations and emergency department visits for asthma in the study area ZIP Codes. The three ZIP codes with the highest hospitalization and ED visit rates are 11206 and 11237 in Brooklyn, and 11101 in Queens. For the counties as a whole, asthma hospitalization and ED visits rates are higher in Brooklyn than in Queens.

(Appendix H continues on next page)

There are important limitations associated with using hospital data for assessing the burden of asthma in a population. By definition, the hospital data capture information about individuals who are experiencing more extreme asthma events. People who are less likely to receive preventive care and medications to assist with management of asthma are more likely to be seen in the hospital for asthma. High hospitalization rates for asthma are therefore often associated with lower incomes and other factors that increase barriers to receiving preventive health care.

Appendix I: Response to Comments

This health outcome review was provided to the public as a Public Comment Draft. Members of the public had the opportunity to provide questions and comments about the draft during a 60-day period. This appendix is a summary of the comments we received and responses to those comments.

Comment: Why doesn't the report discuss the large number of environmental health concerns present within the study boundaries? The report should discuss these sources of pollution and their possible impact on local disease incidence.

A full assessment of all possible exposure scenarios is outside the scope of this document. We developed the study boundaries used in the current report through cooperation with community stakeholders to capture the areas of highest concern with respect to possible environmental health issues, including these sites.

Appendix A includes a list of all NYS voluntary cleanup, Resource Conservation and Recovery Act (RCRA), Brownfields, federal, and state superfund sites located within the study area. Information about these sites is available through the NYS DEC and US EPA websites. This information includes the contaminants of concern, location of the contamination, possible exposure pathways, and steps being taken to protect public health.

Comment: Why doesn't the report discuss the possibility of epigenetic effects of exposure to contaminants of concern present in Newtown Creek?

The possibility of epigenetic effects, generally defined as changes in gene activity or expression due to external or environmental factors, is a relatively new and interesting area of scientific research. The topic was not brought up during the discussions with community stakeholders about the scope of this report, and it was therefore not discussed in the report. Even if it had been suggested as a possible outcome to be studied, the type of group-level study conducted for the Newtown Creek area was limited to health outcomes for which NYS DOH has complete and accurate data. Data such as genetic profiles or indicators of epigenetic interactions are not comprehensively available for epidemiological study of individuals or populations, so that type of evaluation could not be accounted for in a study such as the one conducted for the Newtown Creek community.

Comment: Why does the report focus almost exclusively on socio-economic risk factors for disease?

The study methodology used for this group-level study cannot take into consideration many risk factors that affect individuals' health status, including family history, lifestyle, or occupation, or actual exposures over a person's lifetime. The reason for this is a lack of information about those potential risk factors. We do have information about socio-economic status for groups within the study population, and socio-economic status is known to affect health status for many adverse health outcomes. Socio-economic status is discussed in this report because the health outcomes that showed elevations in the study population are outcomes known to be elevated in populations with lower socio-economic status.

Comment: How can the report conclude that elevated incidence of health outcomes cannot be attributed to environmental exposures, if no evaluation or measurement of exposures was done?

The study boundaries developed in conjunction with community stakeholders were designed to serve as a proxy for potential exposure to a variety of environmental health concerns in the area. While this does not allow for specific evaluations of exposure for each individual in the area being studied, it defines a population made up of individuals who may be more likely to experience environmental exposures than individuals in the comparison population. The patterns of illness identified by the study, specifically the elevations of adverse health outcomes known to be strongly associated with low socioeconomic status, do not point to environmental exposures as a likely explanation for the health outcomes identified as being elevated. However, the study is not able to rule out a role for environmental exposures as potentially related to some adverse health outcomes among area residents. This type of health outcomes review is not able to draw definitive conclusions about cause and effect relationships between exposure and disease.

Comment: It is important that NYS DOH improve education and local signage about fish consumption advisories. NYS DOH should also evaluate fish data from the Newtown Creek remedial investigations and update the fish consumption advisory accordingly.

We will continue to be involved with stakeholders and other agencies regarding the need to improve local outreach about the fish and crab consumption advisories for the East River and Newtown Creek. The advisories will continue to be updated as the annual NYS DEC fish samples are collected and analyzed for various contaminants. Specific information about the fish consumption advisories is available at: https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/.

Comment: What criteria are used to determine whether connected bodies of water will have individual fish consumption advisories?

Fish consumption advisories apply to tributaries and connected waters if there are no dams, falls, or barriers to stop the fish from moving away from the defined water body.

Comment: NYS DOH should work with other agencies to evaluate the health risks faced by past and current workers who may have been exposed to pollutants from Newtown Creek.

Thank you for that suggestion. This suggestion was discussed in meetings with the community prior to the conduct of the health outcomes review described in this report, which was identified as the priority study to conduct. An occupational study would involve a completely different approach. A major barrier to conducting a study of past and current employees is the lack of complete and accurate information for identifying past and current employees along with information about their exposures and health status over time.

Comment: NYS DOH should work with other agencies to develop strategies to prevent exposure to pollutants in Newtown Creek.

Thank you for this suggestion. We work with numerous agencies and stakeholders to provide information about our fish consumption advice. We advise women under 50 and children under 15 to eat no fish or crabs caught in the East River to Throgs Neck Bridge, including Newtown Creek. For fish caught in the same area, men over 15 and women over 50 are advised to not eat crab, lobster tomalley, cooking liquid, channel catfish, gizzard shad, or white catfish. These individuals are also advised to restrict their consumption of the following locally caught seafood: (1) blue crabs to four meals per month; (2) Atlantic needlefish, bluefish, carp, goldfish, rainbow smelt, striped bass, and white perch to one meal per month; (3) all other fish to one meal per month.

Comment: Why did NYS DOH conduct this type of study instead of doing a door-to-door survey?

An in-person interview study of all individuals residing in the study area is often suggested and was discussed at meetings with the community. While such an approach appears to be valid, in practice it is very difficult to gain cooperation from individuals to be part of a health study, whether their input is sought via telephone interviews, mailings, or in-person via a door to door effort. Such an approach that relies on each person or household's active cooperation results in incomplete participation. The incomplete information gathered would not be considered to be representative of the entire community. One criticism would be that people with illnesses may be more likely to participate than people who are healthy. A health outcomes review such as the one conducted for the Newtown Creek area uses data that are complete and accurate, and this type of study leads to results that represent the entire community being studied, and are thus considered to be valid results.

Comment: This study did not capture the health of people who lived in the area for years, and then moved away.

This is correct. We do not have information about the residential history of the individuals residing in the study area. People who lived in the study area for a long time and were diagnosed with an illness after moving away would not be captured in this study. Similarly, people who lived outside of the study area and were diagnosed with an illness after moving in were included in this study. This is a known limitation of this type of study. However, this methodology remains scientifically rigorous due to the completeness and accuracy of the health outcome data being reviewed and statistically sound because of sufficient population size for most outcomes studied.