June 29, 2009

RTI Project No. 0211670.002

Delaware Cancer Consortium Phase III Final Report

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This document was prepared as the final deliverable on P.O. 01010000777 issued by the State of Delaware. A briefing on the contents of this report was made by RTI to the Delaware Cancer Consortium Environmental Committee on May 18, 2009 at the Delaware Technical and Community College in Dover. This report was prepared by Charles Rodes (Senior RTI Fellow), James Raymer (Senior Research Chemist), Linda Brown (Senior Research Epidemiologist), Richard Kwok (Research Epidemiologist), and James Shannon (Senior Program Development Specialist).

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Executive Summary

In 2008, RTI worked with the state of Delaware's Department of Natural Resources and Environmental Conservation, Delaware Health and Social Services, and the Delaware Cancer Consortium to develop a plan to characterize Delaware residents' exposure to environmental pollutants. The plan proposed that two study designs be performed in two phases:

- Phase I (Design I)—a 12-month pilot effort to test proposed study methods and provide initial exposure data for three areas within the state, including the Millsboro Census County Division (CCD), home of the Indian River Power Plant
- Phase II (Design II)—a longitudinal, multi-year, probability-based Multimedia Exposure Study that would be representative of exposures throughout Delaware.

In August 2008, the Environmental Advisory Board requested that a Phase III report be funded to describe how the health and environmental data collected by Designs I and II could be used to inform stakeholders (e.g., the public, policy makers, and healthcare providers) about measures that could be taken to

- Strengthen estimates of risk for target contaminants and adverse health outcomes
- Allow policy and technology enhancements to lessen risk of adverse health outcomes such as cancer and cardiopulmonary disease
- Facilitate programs to communicate results to stakeholders
- Facilitate discussions that better position the funding of Designs I and II in context with other potential uses of the funds.

To address these issues, this Phase III report describes the benefits and limitations of the environmental and health data to (1) make epidemiological inferences about specific populations and sources of pollution; (2) change public knowledge, attitudes, and behaviors; and (3) use existing toxicological data to improve risk estimates. In addition, this report suggests how to communicate study findings to various stakeholders and discusses the value of spending limited resources to fund both the proposed scientifically rigorous environmental/health study as well as proven smoking cessation/prevention programs.

Although the excess health risks associated with environmental pollutants are less than active cigarette smoking, the contributions of these exposures across Delaware may have significant public health implications that must be addressed. At a minimum, an emphasis to reduce the "hot spot" levels of carcinogens in Delaware during the next 10 years should eliminate the ability to statistically detect differences in cancer rates between counties and between CCDs and will complement smoking cessation/prevention programs in terms of providing an effective, long-term cancer prevention strategy for Delaware. Thus, some level of balanced support by Delaware for both environmental/health assessment and smoking control programs is essential to effectively address cancer and other health concerns over the next decade. Without a substantive focus on identifying likely adverse environmental exposures, and without taking appropriate and timely corrective actions, Delaware will likely have the same or greater spatial gradients in cancer rates in a decade as they do today.

1. Scope of Work

A select team of RTI senior epidemiologists will initially collaborate with the current RTI Delaware Team to review and understand the structure and intent of the proposed Design I and Design II programs.

A trip to Wilmington by two of the senior epidemiologists and two program professionals will be arranged to meet with Delaware officials to discuss the specific objectives desired, primarily as they relate to the medical community.

Upon return to RTI, the team of epidemiologists will prepare a concise summary report on the potential use of the data obtained from the designs and present their professional opinion on how these data could be used by Delaware to infer patterns related to the health of the state's population. See the enclosed "Phase III Plan" for additional details.

Finally, the report will be encapsulated into a PowerPoint presentation and presented by the RTI Team, led by two senior epidemiologists and two program professionals, at a future meeting of the Delaware Cancer Consortium (DCC).

The delivery of the summary report and the presentation would conclude this proposed portion of any Phase III effort.

2. Background and Introduction

In 1996, the State of Delaware's Department of Natural Resources and Environmental Conservation (DNREC) and RTI International (RTI) jointly prepared a proposal that was designed to characterize Delaware residents' exposures to pollutants in the environment. This proposal was subsequently revised to become the exposure component of Senate–House Joint Resolution No. 11 (SJR-11). Since 1996, advances in science have changed which pollutants are considered important, how samples are collected, and how the collected samples are analyzed. Some of the most significant changes have occurred in the characterization and knowledge of particulate matter toxicology. Chemical usage patterns have changed, with production and usage increasing or decreasing for many chemicals, and concurrent concerns for new impacts on human health have emerged. Methods for environmental sample collection have improved, resulting in fewer burdens on study participants. Analytical chemistry methods have also improved to permit the expanded characterization of a wider array of pollutants, often with great improvements in sensitivity and selectivity. This report provides an update on the state of the science and folds this new information into an overarching study design.

During 2008, RTI worked with DNREC and Delaware Health and Social Services (DHSS) to create a plan to execute robust study designs that reflect clear relevance to Delaware's environmental and health requirements, as well as apply defensible methodologies and defined data quality objectives that produce databases that are scientifically credible and stand up to rigorous peer review. Study results will be used to achieve the following:

- **Characterize human exposure representative of the people of Delaware.** A probability-based human exposure study conducted within Delaware will provide a statistically defensible representation of the exposures experienced by the people of Delaware. A combination of indoor, outdoor, and personal environmental samples (e.g., air, drinking water, food, dust) will be used, along with biological samples, to help characterize human exposure.

- **Serve as a baseline for future trends monitoring.** Trends data are critical to understanding the environmental factors associated with changes in disease incidence and to help assess the effectiveness of the policy/regulatory changes designed to reduce human exposure to pollutants. Key uses of study data are risk assessments and source identifications.
- **Validate models that have been developed to predict human exposures.** One of the logical applications of data from area monitors is the prediction of local pollutant concentrations that can then be used to inform about risk estimations. An exposure study that includes outdoor, indoor, and personal measurements will provide data that can be used to validate the transport models in use (outdoor measurements) and to estimate the extent to which personal exposure can be predicted, given additional information of housing characteristics, personal and household behaviors, and individual mobility. Exposure models under development at the U.S. Environmental Protection Agency incorporate media other than air to provide a multimedia estimation.

Discussions held among DNREC, DHSS's Division of Public Health, RTI, and the DCC suggested that two study designs would best serve the program. Design I will address three objectives over a 12-month period, ahead of the probability-based Multimedia Exposure Study (MMES) proposed in Design II. The design of the National Human Exposure Assessment Survey MMES (Pellizzari et al., 2001; Whitmore et al., 1999) provides an underlying framework for the current updated designs.

Design I is a pilot effort, with three objectives to complete the study design for the MMES and provide initial exposure data for targeted areas within the state.

- First, the pilot study will determine the range of contaminant concentrations across Delaware that are expected in all media planned to be investigated during the MMES of Design II. Three areas with presumed low, medium, and high pollutant concentration will be targeted.
- Second, a study of experimental and analytical methods will be simultaneously implemented for specific metrics to identify the best methods for Design II. Methods for survey selection, recruitment/enrollment, sample collection, analysis, archival, and database management will be evaluated and refined, as needed. Although many accepted and proven methods are proposed, the testing of new or Delaware-specific collection and analysis methods or survey instruments is anticipated to provide information to show that either (1) the method or instrument performed acceptably, or (2) the method or instrument requires modification or should not be used in the implementation of Design II.
- Third, an intensive exposure characterization study will be conducted in the Millsboro Census County Division (CCD), as one of the three locations for statewide range finding, to provide additional data relevant to the concerns related to emissions from the Indian River Power Plant.

In August 2008, RTI attended a meeting of the Environmental Advisory Board to present an overview of the study designs and to address any questions from the members. At that meeting, it was decided that an evaluation of the uses of the data should be performed so that stakeholders were clear on what would be obtained from the implementation of Designs I and II. An additional discussion focused on whether the "values" of the study and the resultant data could be better placed into a context that would allow more reasonable comparisons between competing uses for the same funding resources (e.g., additional smoking cessation or prevention programs). As a result, this Phase III report was funded to primarily address an evaluation of the uses of the data. Some effort was also made to define the values of these proposed studies and to include them here in a limited description.

3. Purpose

The purpose of a Phase III plan is to describe how multimedia exposure and body-burden data collected by Designs I and II can be used to inform the public, policy makers, healthcare providers, and other stakeholders about measures that can be taken at different levels to accomplish the following:

- Strengthen estimates of (comparative) risk for each target contaminant and adverse health outcome
- Allow policy and technology enhancements within public and private programs to lessen cancer, cardiovascular, and pulmonary risk levels and associated morbidity, mortality, and severity impacts
- Facilitate robust outreach/risk communication programs to provide the results to the public and other stakeholders in the most appropriate forms
- Facilitate value judgment discussions that better position the funding of Designs I and II in context with other potential uses of the funds.

4. Stakeholder Questions

In February 2009, RTI attended another meeting of the Environmental Advisory Board to begin the Phase III process by clarifying stakeholder expectations. The following questions, which express the concerns of three different Delaware stakeholder groups (the general public, policy makers, and healthcare providers), were expressed by the Environmental Advisory Board at either their February 2009 meeting or during previous board meetings attended by RTI.

General Public

- How does this study help me know if I should be concerned and what I should do?
- Will exposures to contaminants where I live cause specific future health problems if I continue to live here and conduct my daily activities in the same way?
- Have past contaminant exposures caused the (specific) health problems I am currently experiencing?

Policy Makers

- Are we spending funds on the most important issues and prioritizing them in the right way?
- What environmental concerns (risks) need to be addressed from the public's perspective, juxtaposed against the best available scientific information and/or expert opinions, current regulatory policies, and the availability of the resources needed to adequately address these concerns?
- What approaches should be used to review data on adverse exposures and the expected or potential adverse health outcomes that would lead to needed policies in the form of new or revised legislation?
- How will this study impact the overall number of cancer deaths in Delaware?
- Are there potential cost savings related to a potential reduction in cancer deaths in Delaware?

Healthcare Providers

- Will this study help me treat or educate my patients better?

- Will I be able to suggest specific environmental factors that might have been causal in the observed specific disease outcomes diagnosed?
- Will the study data provide additional information to consider ways in which patients can reduce their exposures and risk levels to avoid future adverse health outcomes or minimize current symptoms?
- Would supporting multi-media pollutant studies targeted specifically to Delaware be better than or comparable to other uses of existing resources (e.g. Cancer Consortium) to enable the most positive and/or broadest impacts on the health of residents over the next decade?

5. Benefits/Limitations

There are a number of benefits associated with conducting exposure monitoring in Delaware. However, there are also limitations on the statistical inferences that we can make from these data and about the individual health consequences associated with these levels. The following section describes what we mean by statistical inference and the number of study participants needed to validly compare exposure levels in different geographic areas.

5.1 The Role of Statistical Inference in Environmental Exposure Assessment

1. What do we mean by statistical inferences?

In this study, statistical inferences will take the following form:

- Estimate of the distribution of concentrations of an analyte in an environmental or biological medium
- Confidence interval estimates of population parameters like the mean or median concentration of an analyte in an environmental or biological medium (e.g., the mean is estimated to be x ppm ± y ppm)
- Hypothesis tests regarding the differences in mean concentrations of an analyte in different geographic areas (e.g., between counties).

2. What's needed to make statistical inferences regarding a geographic area?

The ability to make inferences regarding a geographic area (i.e., state, county, CCD, group of CCDs) depends largely on the number of randomly selected study participants in that area. The sample will not be distributed across the state totally at random. Instead, the sample will be clustered within primary sampling units (PSUs) to reduce travel costs for field data collection. Numerous options exist for clustering. Two examples of potential PSUs are Census block groups and 5-digit postal zip code areas. Making inferences to an area requires sufficient numbers of both PSUs (or clusters) and participants. Minimally, statistical inferences should be supported by at least 10–20 PSUs and 50–75 participants (e.g., 10 PSUs with five participants per PSU, or 20 PSUs with four participants per PSU). Strong inferences, which are desirable for state-level inferences, require at least 50 PSUs and 400 participants.

3. What sample size tradeoffs are possible depending on the relative importance of inferences for various geographical areas?

The best precision for state-level inferences (most precise, or narrowest, confidence intervals) requires that the sample be allocated to sub-state geographic regions proportional to their populations. If a proportional allocation does not result in a sample size sufficient to make statistical inferences regarding some important geographic areas, the sample can be allocated differently, increasing the precision for the areas of special interest while reducing the precision for state-level inferences. For example, one might identify the CCD containing Dover and a set of two to five CCDs in the vicinity of the Indian River Power Plant as important enough that they should have a larger than proportional allocation so that inferences are supported for those areas. At the extreme, one could decide that all CCDs are equally important and give the same sample size to every CCD. One could select four PSUs in every CCD and get five participants in every PSU, for about 540 participants across the entire state (27 CCDs). The precision for the state as a whole would be comparable to a proportionally allocated sample of about 326 participants, but statistical inferences would be possible for any area defined by three or more contiguous CCDs (12 PSUs and 60 participants). The sample size needed to detect differences between two areas of interest is dependent on the percentage of the population exposed, the difference in exposure percentage between the two populations, and the probability that the statistical test will be able to detect these differences. For example, with 300 participants in each area, there is an 81% probability of detecting a difference of 10% (25% in Area 1 versus 15% in Area 2) in the concentration of some pollutant.

While it is likely that a sampling scheme can be incorporated that will allow the Design II study to make statistical inferences regarding environmental exposure, a sample size at least a magnitude larger than the proposed 400–600 participants would be required to collect information on rare health outcomes like cancer. In the following section, we discuss some of the benefits and limitations of using the proposed environmental and health data to (1) make epidemiologic inferences; (2) change knowledge, attitudes, and behaviors; and (3) improve risk estimates by using existing toxicological and susceptibility data.

5.2 Benefits and Limitations of the Environmental and Health Data Derived from a Sample of the Delaware Population

1. Make epidemiologic inferences at target geographic levels (e.g., statewide, country-wide, CCD-wide) as well as about individual point, area, and line contaminant sources.

- Benefits
  - Measurement data are valuable in estimating exposures of the population and categorizing potential risks
  - Number of study participants in Designs I and II should be sufficient to make statistical inferences regarding environmental exposures across the state as a whole
  - Definitive exposure estimation does not require any data extrapolation to the study population
  - Proposed population selection schemes can be designed to allow statistical inference regarding important geographic areas and point sources of exposure such as the Indian River Power Plant and the Wilmington/I-95 corridor
  - Better control of environmental pollutants, especially from point sources, has the potential to lower the number of acute respiratory events and cardiac events reported in Delaware
  - Better control of environmental pollutants, especially from point sources, has the potential to lower Delaware’s incidence and mortality from lung cancer and other chronic respiratory diseases in the future

- Potential exists for generating hypotheses for follow-up in analytical studies. For example, concurrent longitudinal changes in environmental exposures and lung cancer incidence obtained from the Delaware cancer registry might suggest a possible etiologic link that would require a more systematic follow-up in a lung cancer case-control study or large cohort study of adults.

- Limitations
  - Number of study participants in Designs I and II, while population-based, may be insufficient for study of rare outcomes like cancer and other chronic diseases

2. Change public knowledge, attitudes, and behaviors.

- Benefits
  - Clarifies for policy makers how involuntary environmental exposure to natural or man-made contaminants can negatively affect the health of Delaware residents
  - Defines risks to human health rather than just emphasizing avoidance of environmental exposures such as tobacco smoke and pesticides
  - Provides physicians and other health and public health professionals with reference levels of exposures so that they can recognize unusually high levels of exposure in Delaware patients and assess the effectiveness of efforts to reduce these exposures
  - Provides information on the relationship between the source and toxic emissions as well as between cancer and non-cancer health outcomes
  - Stresses the role of tobacco as a human carcinogen and its ability to magnify the carcinogenic effects of other exposures
  - Provide physicians and community and state educators with valuable information to share with patients/residents about ways to limit or reduce the risk of adverse health outcomes from exposure to environmental and personal (e.g., tobacco smoke) contaminants
  - Potential reductions in environmentally related adverse health outcomes including cancer incidence and mortality would result in substantial cost savings associated with medical care, lost wages, and quality of life.
- Limitations
  - Potential cost of developing an effective communication plan
  - Will not address individual concerns about contaminant exposures and current or future health problems
  - Delaware residents who are not part of the study may feel that the study results do not apply to them.

3. Improve risk estimates by combining the collected exposure and dose data with existing toxicological (e.g., National Cancer Institute definitions of known carcinogens and their potencies for specific types of cancer) and susceptibility data. For example, ambient air, particularly in urban areas, contains a number of known human lung carcinogens, including benzo [a] pyrene, benzene, arsenic, and chromium.

- Benefits
  - Provides population-specific data on exposure toxicants in a cost-effective manner
  - Helps to define risks to human health rather than just emphasizing avoidance of environmental exposures such as tobacco smoke and pesticides. Helps to understand and prioritize these issues for consideration for funding opportunities

  - Enhances the ability to quantify the magnitude of the risks associated with exposure to environmental contaminants by providing a more accurate measurement of air pollution and other risk factors such as cigarette smoking and environmental tobacco smoke. These risk estimates can be used to inform health policy and to stimulate legislative changes to protect the health of the people of Delaware.
  - Biologic and molecular markers of exposure will provide improved characterization and accuracy of exposure estimation at the individual level on participating subjects
  - Risk assessment should include the evaluation of all available evidence.
- Limitations
  - May not be able to extrapolate risk to all segments of the population
  - Cannot be used to generate individual estimates of risk on subjects not studied.

6. Communication Strategy

We realize that DNREC, DHSS, healthcare providers, the DCC, and other Delaware government agencies, community groups, and health-based consortiums have substantial experience in designing and carrying out effective health communication and implementation strategies with the people of Delaware (e.g., DNREC's "Air Quality Education Program," DHSS's "Tobacco Prevention Program," and DCC's "Screening for Life" Cancer Program). The recommended steps outlined below are based on ideas obtained from "A Field Guide to Designing a Health Communication Strategy" (O'Sullivan et al., 2003). While these steps are generic, they provide a basis for generating a highly effective communication plan that would address the needs and concerns of the three major stakeholders: the general public, policy makers, and healthcare professionals.

6.1 Communication Plan Outline

- Identify and understand the specific health problems (e.g., cancer, respiratory disease, cardiovascular disease) that will be the focus of the proposed communication effort
  - Have a clear understanding of the extent of the health problems (prevalence, incidence, attributable risk, attributable fraction)
  - Understand the severity of the health problems in terms of morbidity, mortality, and monetary costs to the individual, family, and society as a whole
- Identify the target audience for communication efforts
  - Determine whether or not the audience needs to be divided into smaller groups with similar communication-related needs, preferences, and characteristics or if the general public, policy makers, and healthcare professionals can be effectively reached through the same set of channels and receive the same set of messages. The costs involved in developing and executing separate communication efforts for these three groups may outweigh the benefits
  - Another option is to use a phased approach. For example, the communication strategy may start by addressing healthcare professionals since they may be easiest to reach and most receptive to hearing the message
- Develop specific and measurable program objectives for the general public, policy makers, and healthcare professionals
  - Determine the program goals (e.g., making policy makers aware of the health implications of the combustion of fossil fuels for power generation)

  - Link objectives to outcome or specific evaluation measures (e.g., reducing the incidence of lung cancer)
  - Be sensitive to audience need and preferences (e.g., programs that promote "going green")
  - Consider the impact of social, economic, and political factors (e.g., the use of cigarette taxes to fund tobacco prevention or cancer screening programs)
- Review potential strategic approaches and select the one best suited to achieving the plan objectives
  - Identify a central theme for the overall communication strategy
  - Determine how the objectives will be achieved
  - Determine the best approaches to, for example, (1) motivate the general public to stop smoking indoors, (2) present data to policy makers on pollutant levels near point sources, (3) educate healthcare providers on how to recognize high levels of environmental contaminants in their patients
  - Use various strategic approaches such as community-based participation and geographically focused programs
- Identify the most appropriate combination of channels and tactics for communicating with stakeholders, including community-based media and activities
- Create a management plan that coordinates and maximizes the capabilities of each partner (e.g., DNREC, DHSS, DCC).

An effective communication plan would provide recommended steps for analyzing and reporting the multimedia exposure and body-burden data collected by Designs I and II to provide the greatest value to the general public, policy makers, and healthcare professionals and to promote the most robust decision making. It would also influence the attitude and behavioral changes needed to reduce the public's risk of excess morbidity and mortality, thereby improving overall health and social well being, and ultimately reducing the resources required to diagnose and treat undesirable health outcomes.

7. Defining Values

Designs I and II are inherently robust, and while the proposed plans exhibit cost-effective strategies to minimize the overall cost burdens, they will still be commensurately expensive to fund. Defining the best uses of available funding falls under the purviews of both DNREC and DHSS, but some supporting scientific arguments can and should be proposed that help guide the decision process. The value of the data produced by both designs can only be described if the utility of the data are fully understood.

The prior sections of this report have attempted to directly address the latter elements—how best to describe and communicate the potential findings for various users. This section attempts to place the value of the potential findings into a context that can be better compared with another potential use of the funding: supporting environmental tobacco smoking cessation/prevention programs.

7.1 Potential Value of Addressing All Pollution-Related Cancer Causes

Available 1981 and 1998 data from the National Cancer Institute Web site on the proportion of cancer deaths attributable to environmental and behavioral risk factors are listed in Table 7-1.

Table 7-1. Proportion of US and UK Cancer Deaths by Cause[a]

Causes	Percentage, 1981 (US)*	Percentage, 1998 (UK)**
Tobacco	25–40	29–31
Diet	10–70	20–50
Medicines	0.3–1.5	<1
Infection: parasites, bacteria, viruses	10 (best estimate)	10–20
Ionizing and ultraviolet light	2–4	5–7
Occupation	2–8	2–4
Pollution: air, water, food	<1-5	1–5
Physical inactivity	—	1–2

[a] http://www.cancer.gov/templates/doc_bench.aspx?viewid=5d17e03e-b39f-4b40-a214-e9e9099c4220&docid=4ed11bf0-c7eb-4797-95f3-049be19a8fa2&print=1 (Accessed June 2009)

* Data from Doll and Peto, 1981.

** Data from Doll, 1998.

Although these data are more than 10 years old, they are likely to still be reasonably relevant to cancers occurring now, given the long latency period for most cancers. However, they do not take into account carcinogens that have been identified in the past decade and their most likely offending sources (e.g., diesel particulate matter, fossil-fuel combustion, pesticides) or changes in smoking rates. Thus, the proportion of cancer deaths (1%–5%) attributed to *pollution* may be greater than previously thought. An estimation of 5%–10%—roughly double the older range—may be reasonable based on recent estimates that pollution might explain 10% or more of lung cancer incidence and mortality (Pope et al., 2002; Boffetta, 2006; Vineis, et al., 2007).

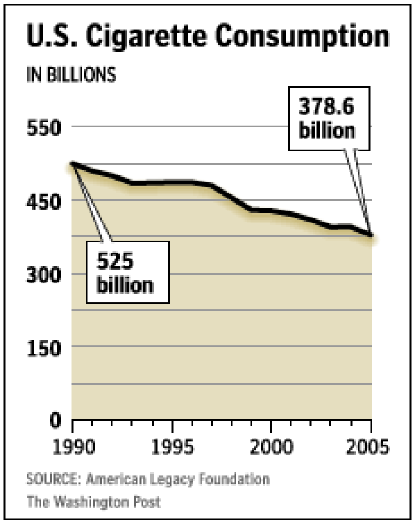

Figure 7-1. Decline in U.S. smoking rate as reflected by cigarette sales data

Alternatively, the previous estimates of 25%–40% for tobacco do not reflect the 28% decline in cigarette consumption in the United States over the 15-year period from 1990 to 2005 (Figure 7-1). It is difficult to gauge how much this estimate would change, but it would clearly be lower now than it was a decade ago. Undoubtedly, much of the decrease over the past decade can be attributed to the effectiveness of programs advocating reductions in active and passive exposure to tobacco smoke. It is not clear whether cessation/prevention programs will be as cost-effective in the future, but there is certainly no question that these programs can have dramatic impacts.

7.2 Delaware-Specific Cancer Data

Given the magnitude of the differences in incidence rates between Delaware and the United States and between counties or CCDs within Delaware that prompted further evaluation and the preparation of Delaware-specific Designs I and II, it is likely that the amount of cancer cases attributable to pollution and possibly smoking will vary by geographic areas. For example, Delaware has significantly higher lung cancer incidence rates (77.7/100,000) than the 17 U.S. SEER areas (63.1/100,000), and Sussex County (83.9/100,000) has significantly higher rates than New Castle County (74.7/100,000) (Table 7-2).

Table 7-2. Average Age-Adjusted Lung Cancer Incidence Rates for the 17 U.S. SEER Areas, Delaware, and New Castle, Kent, and Sussex Counties for 2002–2006

Area	Incidence Rate per 100,000 (95% CI)
United States (17 SEER areas)	63.1
Delaware	77.7 (75.1–80.2)
New Castle County	74.7 (71.4–78.1)*
Kent County	78.6 (72.0–85.2)
Sussex County	83.9 (78.9–88.9)*

Note: *Indicated values are statistically significantly different from one another.

Source: U.S. data based on 2008 SEER data submission for the 17 SEER geographic areas, posted to the SEER Web site, 2009, http://seer.cancer.gov/csr/1975_2006. State- and county-level rates based on Delaware Cancer Registry data, retrieved November 2007.

In addition, examination of Delaware cancer data on a CCD level (Figure 7-2) shows that strong spatial gradients exist and must be taken into account in explaining cancer incidence statistics. If more detailed review of Delaware-specific co-factor data show that levels of smoking, obesity, alcohol consumption, and dietary habits are relatively uniform across CCDs, then air and other pollutants become a likely causal factor to explain the within-Delaware cancer mortality gradients between CCDs. It also becomes reasonable to suggest that the proportion of cancer deaths attributable to adverse environmental exposures is more likely to reflect a contemporary 5%–10% contribution than the outdated 1%–5% estimate.

7.3 Delaware-Specific Passive Smoke Exposures

Smokers produce environmental tobacco smoke that results in both active and passive exposures. The active, self-induced exposure patterns are reasonably predictable from cigarette consumption data, but the impacts for those who are passively exposed are not as obvious (Paoletti et al., 2006). Toxicity data in the literature for both active and passive smoke strongly suggests that both routes provide excessive and undesirable exposure scenarios. Passive smoke exposure scenarios in the general population have been poorly characterized and understood, especially within smoking households. It is likely that smoking households have fewer adults smoking now (e.g. only one smoker between a husband and wife), and also that smokers more often retreat outside - at least during warmer months - rather than smoke within the residence. It is also likely that such lifestyle changes differ substantially by socioeconomic status, and those in the lower strata are more likely to smoke inside the residence and inside vehicles during commuting. These latter scenarios can produce by far the greatest levels of passive exposures for both adult and children passengers.

As noted previously, it is likely that a significant proportion of the smoking population either can't or won't give up smoking during the next decade unless laws and/or regulations prompt stronger actions. Thus, there could be expected to be continued, significant levels of passive ETS exposure occurring in Delaware well into the next decade with only societal pressures prompting changes in patterns and locations that might reduce the exposure levels for those nearby. Designs I and II will collect for the first time, robust data on passive ETS exposures for a cross-section of Delaware residents, in parallel with questionnaire data on the smoking habits of active smokers in each residence. This would allow decision making that is guided by a clear understanding of the passive exposure levels actually occurring in Delaware, and help better define the trends in both active and passive exposures to guide more effective communication strategies on the health impacts of smoking. While some data exists in the literature based on questionnaire summaries (e.g. Kaufman et al., 2002), it has also been suggested that survey-based data on smoking habits are often not accurate, i.e., the questionnaires are not completed truthfully by the respondents. Collecting actual household and personal exposure samples analyzed for ETS levels, as proposed in Designs I and II, provide an unbiased metric to characterize passive exposure levels in a representative selection of Delaware residences. These data would fill a current data gap by not only defining trends in passive ETS exposures, but also by tracking of the effectiveness of anti-smoking campaigns in reducing the amount of active smoking, as well as the true impacts of active smokers on non-smokers passively exposed.

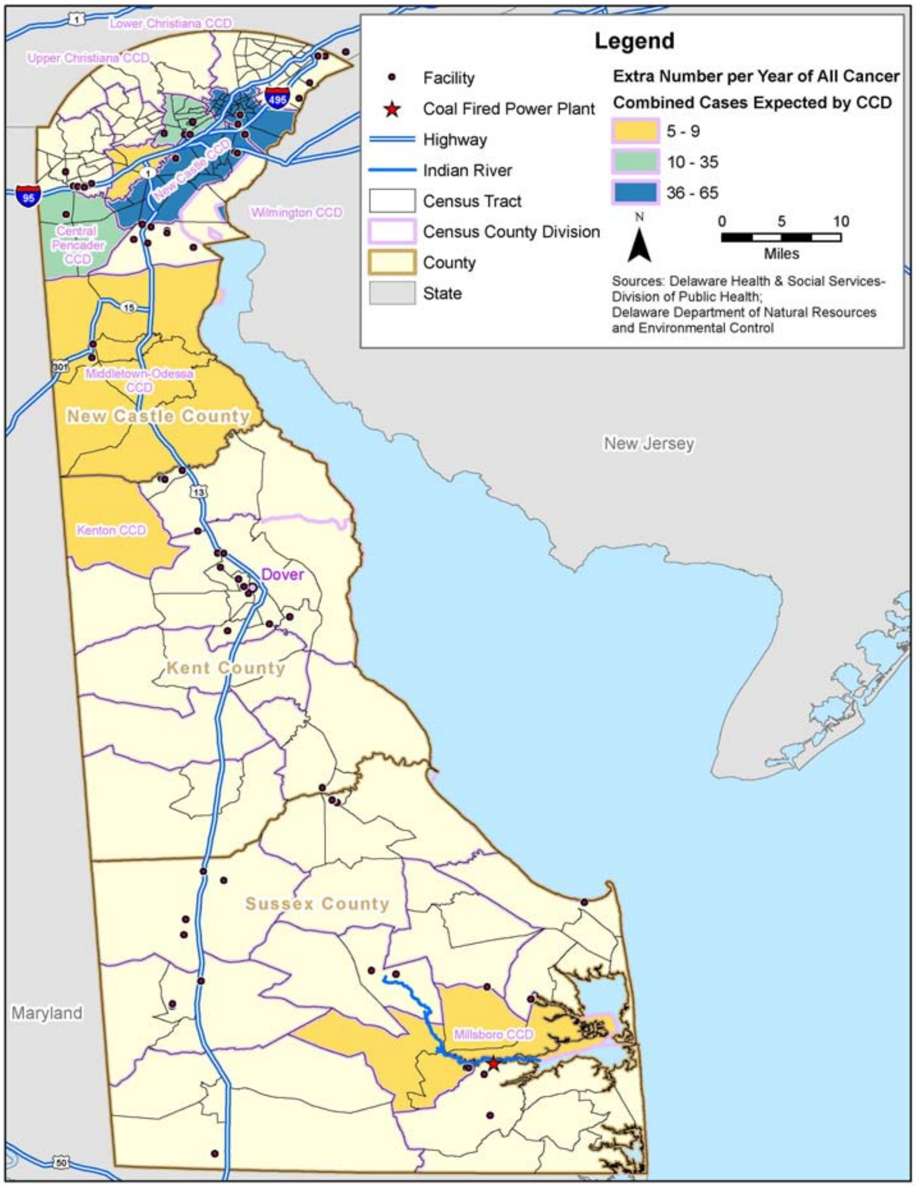

Figure 7-2. DNREC/DHSS map showing excess cancer cases by CCD

8. Conclusions

Smoking remains the largest single "environmental" cause of cancer in Delaware. Emphasis on increasing rates of smoking cessation and decreasing rates of smoking initiation is a worthwhile objective. The rates of smoking in the general population are declining from levels a decade ago, but it is not clear whether a continued emphasis on smoking cessation/prevention programs would continue to provide the same "bang for the buck" over the next 5 to 10 years. The true levels of passive ETS exposure are not characterized in any state, which is a significant impairment to both understanding adverse exposure scenarios and determining the true effectiveness of anti-smoking campaigns. Design I, and especially Design II, include indoor and personal level characterizations that would provide valuable exposure data that truly represent passive exposure levels in Delaware.

In addition, errors in the measurement in other studies of air and other pollutants and of other risk factors, including exposure to active and passive cigarette smoking, have limited the ability to quantify the magnitude of the excess health risks associated with environmental pollutants. The comprehensive approach proposed for Design II will address these concerns by providing better estimates of exposure and more sophisticated analytic tools. Since Design II cannot begin without Design I, a critical-path plan toward initiating the latter program is strongly urged to best protect the health of Delaware residents. The relative proportion of support demands further DNREC/DHSS evaluation and scrutiny of existing Delaware-specific data, as well as the collection of additional information where gaps exist.

The bottom line: Although the excess health risks associated with environmental pollutants are less than active cigarette smoking, the contributions of these exposures across Delaware may have significant public health implications that must be addressed. At a minimum, an emphasis to reduce the "hot spot" levels of carcinogens in Delaware during the next 10 years should eliminate the ability to statistically detect differences in cancer rates between counties and between CCDs and will complement smoking cessation/prevention programs in terms of providing an effective, long-term cancer prevention strategy for Delaware. Thus, some level of balanced support by Delaware for both environmental/health assessment and smoking control programs is essential to effectively address cancer and other health concerns over the next decade. Without a substantive focus on identifying likely adverse environmental exposures and taking appropriate and timely corrective actions, Delaware will likely have the same or greater spatial gradients in cancer rates a decade from now as they do today.

9. References

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