CANCER INCIDENCE DATA ANALYSIS
WINGATE ROAD MUNICIPAL INCINERATOR AND LANDFILL
FT. LAUDERDALE, FLORIDA

Florida Department of Health
Division of Environmental Health

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TABLE OF CONTENTS

INTRODUCTION

The Wingate Road Municipal Incinerator and Landfill (Wingate) site is in Ft. Lauderdale, Broward County, Florida. From 1954 to 1978, the City of Ft. Lauderdale incinerated municipal solid waste at this site. In 1990, the US Environmental Protection Agency (EPA) added this site to their Superfund National Priorities List. In 2001, the City of Ft. Lauderdale and the other potentially responsible parties finished their EPA-directed demolition of the incinerator buildings and capping of the landfill.

Residents near the Wingate site were concerned that their health may have been adversely affected by exposure to chemicals from the site (Benedick 1996 and McCoy, personal communication, 1998). In response to these concerns, the Florida Department of Health (DOH) performed a cancer incidence data analysis for the community adjacent to the Wingate road municipal incinerator and landfill.

Site Background and History

The 60-acre Wingate site is at 1300 NW 31st Avenue, Ft. Lauderdale, Broward County, Florida. It is bordered on the west by NW 31st Avenue (formerly known as Wingate Road), on the north by a privately owned junkyard, to the northeast by privately owned, 25-acre Rock Pit Lake, and to the east and south by residential properties.

The population within two miles of the Wingate site is predominantly: African American. The average age was between 30 and 35, the average educational level was high school, and the median household income was about $33,360 during 1999 (Census 2000).

The City of Ft. Lauderdale owned and operated a municipal solid waste incinerator and landfill at this site from 1954 to 1978 receiving municipal solid waste materials from many entities during its operations. The incinerator, storage buildings, maintenance building, administration buildings, and cooling ponds were on 20 southern acres. The City disposed of ash and other solid waste in a landfill on 40 northern acres (TASK 1994).

Combustion of municipal solid waste generates two types of ash. Fly ash is the fine-grained ash that is carried to the smoke stack or emission control facility. Bottom ash is the coarser-grained bulk ash that remains in the furnace. Fly ash consists of 70 to 95% inorganic matter, primarily silicon, iron, aluminum, calcium, magnesium, and sodium. The remaining 5 to 30% of fly ash contains dioxins, furans, polynuclear aromatic hydrocarbons (PAHs); and metals such as arsenic, cadmium, chromium, nickel, and lead (Chrostowski and Sager 1991)

Nearby residents reported fly ash from the incinerator smoke stacks frequently fell in their neighborhoods (Benedick 1996, Samuels, 1998). Air quality measurements were insufficient, however, on which to predict health effects. Reilly (1975) conducted one stack test but only measured the weight of emitted particulates.

In 1990, the US Environmental Protection Agency (EPA) added this site to their Superfund National Priorities List. In 2001, the City of Ft. Lauderdale and other responsible parties completed a site cleanup (landfill cap) under EPA supervision (EPA 2001). In 2002, the Florida Department of Environmental Protection (DEP) completed a cleanup of dioxin-contaminated soil in 17 nearby residential yards (IT Corp. 2002). Although Florida DEP cleaned up dioxin-contaminated soil in 17 nearby residential properties (IT 2002), the levels before cleanup were well below EPA residential soil standards for dioxin.

In six reports since 1990, the Florida DOH, in cooperation with ATSDR, has assessed the potential public health threat at this site. They found the levels of various chemicals in off-site residential soil (ATSDR 1996b) and ground water (ATSDR 1990) were not a public health threat. Because of the lack of air monitoring data, however, they found it was not possible to assess the public health threat due to incinerator emissions between 1954 and 1978 when the incinerator was in operation (ATSDR 1990). In 1997, the City of Ft. Lauderdale, in cooperation with Florida DOH, posted fish consumption advisories at adjacent Rock Pit Lake (Florida DOH 1997).

A preliminary review of the Florida Cancer Data System in 1996 by Florida DOH found that area rates of some cancers might be elevated but reported that a more detailed study was needed to confirm the findings. The study concluded that if rates were elevated, exposure to site chemicals was not necessarily the cause (ATSDR 1996a). Florida DOH sponsored a public meeting in 1996 to summarize its findings for the surrounding community. Florida DOH met April 16, June 6, and July 15, 2002 with federal, county, city, and community representatives in Ft. Lauderdale to discuss health study plans. For this purpose during later part of 2003, the Florida DOH consulted with experts representing the Wingate community: Dr. Richard Clapp from Boston University and Dr. Jeffrey Roseman from University of Alabama at Birmingham. Along with community representatives, experts representing the city of Fort Lauderdale, Dr. Christopher Teaf and his associates were also kept informed and consulted for the development of a protocol for this cancer incidence data analysis.

Potential Exposure Pathways

The major potential exposure pathway for nearby populations was inhalation of particulates (fly ash) from the smoke stacks when the incinerator was in operation (1954-1978). This potential exposure pathway also assumes direct skin contact with particulates and accidentally eating (incidental ingestion) small amounts of particulates (ash). Nearby residents reported that fly ash from the incinerator stacks frequently fell in their neighborhoods (Benedick 1996, Samuels 1998).

For this analysis, consumption of fish from Rock Pit Lake was a minor potential pathway (ATSDR 1993). Until the late 1990s, houses on private property had limited access to 25-acre Rock Pit Lake, which received runoff from the site. Although there have been anecdotal reports of fishing and swimming in Rock Pit Lake, these occurrences have not been widespread (Florida DEP 1984, ATSDR 1993). The low levels of dioxin in fish from Rock Pit Lake were not considered a public health threat (ATSDR 1993 and ICF Kaiser 1994). Nonetheless, in 1997 the City, in cooperation with Florida DOH, posted a fish consumption advisory for Rock Pit Lake based on dioxin. This advisory cautioned people not to eat more than one meal of fish a week from Rock Pit Lake and children under six and pregnant women not to eat any fish from this lake (Florida DOH 1997).

Sampling of fish tissues from Rock Pit Lake in 2002 and 2003, conducted as part of the activities pursuant to the Record of Decision, confirm the low concentrations found in previous studies and do not indicate health risks associated with fish consumption.

Other possible exposure pathways such as contact with residential soil, use of ground water, eating vegetables and fruits from home gardens, and swimming in Rock Pit Lake were not considered significant for this analysis. There were no off-site residential soil analyses before the early 1980s from which to assess potential exposure. Possible exposure to off-site soils after the early 1980s were not considered significant because contaminant levels were not likely to cause illness (ATSDR 1996b). Although Florida DEP cleaned up dioxin-contaminated soil in 17 nearby residential properties (IT 2002), the levels before cleanup were well below EPA residential soil standards for dioxin.

The City of Ft. Lauderdale supplies potable water to the area around this site. Ground water around this site was not a source of drinking water. A few shallow wells near the site were used for lawn irrigation. Although there was some ground water contamination of the superficial aquifer under the site, off-site ground water contamination was minimal (TASK 1994 and EPA 1998). Vegetables and fruit grown in nearby soil were not likely to cause illness (ATSDR 1999). Skin contact with, and incidental ingestion of, water from Rock Pit Lake was not likely to cause illness (ICF Kaiser 1994).

Florida DOH in consultation with the residents' representatives selected arsenic and dioxins as chemicals of concern. Both arsenic and dioxins are typical components of municipal solid waste combustion fly ash (Chrostowski 1991). Both have been found in the fly ash from the Wingate incinerator (TASK 1994).

Possible Health Effects

Arsenic and dioxin levels in the fly ash likely varied depending on incinerator operating conditions. Since there was no air monitoring between 1954 and 1978, determination of individuals' exposure to arsenic or dioxin was not possible.

Previous studies in other exposure situations have shown an associated increased risk of skin, liver, kidney, bladder, lung and other respiratory tract cancers among persons exposed to arsenic depending on the route and level of exposure. (ATSDR- 2000). Epidemiological evidence for cancer in human populations from exposure to dioxin is not as strong as it is for arsenic.

Purpose of the cancer data analysis

Florida DOH held public meetings on April 16, June 6, and July 15 of 2002 with federal, county, city, and community representatives in Ft. Lauderdale to discuss health study plans. At those meetings, it was suggested by the community representatives and their experts: Richard Clapp, PhD. from Boston University and Jeffrey Roseman, MD, PhD. from the University of Alabama at Birmingham, to conduct a cancer incidence data analysis for the area because of concerns about potential past exposure to incinerator emissions. The community wanted to see if there was an increase in the cancers related to the chemical exposures in the area and if there were any trends in the incidence of those cancers during the five-year periods.

METHODS

Population

At the request of Florida DOH, the Florida Department of Environmental Protection (DEP) modeled the pattern of dry particulate deposition (ash) from the incinerator stacks. Florida DEP estimated that most particulate deposition was to the west-northwest due to prevailing southeast winds. Florida DEP estimated some particulate deposition to the southeast due to transient winter and spring low-pressure systems (DEP 2002). Florida DOH used this model to estimate a general pattern of ash deposition, not to estimate the absolute amount or quality of the deposition.

Because Census tracts were the smallest area unit for which population counts exist since the 1980 Census, Florida DOH selected those census tracts that best represent the “ash deposition zone”.

Area and Time Period of Study

According to the DEP’s air model that considers wind direction, the dispersion of fly ash containing chemical contaminants had the potential to expose local residents to different levels of airborne chemicals in the adjacent community. In discussion with the residents’ representatives, the Florida DOH decided to consider geographical area for cancer incidence study as close as possible to the area considered for the Wingate Disease and Symptoms Prevalence Survey. The 1990 census tracts: 0410, 0411, 0412, 0503.04 and 0604 corresponding to 2000 census tracts 0410, 0411, 0412, 0503.07, 0503.08, 0604.01, 0604.02 and 0604.03 in Fort Lauderdale, Broward County, Florida combined together and referred to as study area (area of concern). Please see the attached map on page # 14.

The incidence data on selected cancers for the study area were analyzed for 1986 to 2000 with the fifteen years combined. In addition, for the cancers selected, cancer cases diagnosed in residents of the study area were grouped into three diagnosis periods (1986 to 1990, 1991 to 1995, and 1996 to 2000) and were analyzed to identify possible trends.

Study Population

We obtained data on incidence cancer cases from 1986 through 2000 from the state's cancer registry, the Florida Cancer Data System (FCDS). Population information for Broward County and the state of Florida was collected from the official state estimates provided annually to FCDS. For the census tracts that form the study area, population for inter-census years were estimated from the values for the 1990 census and 2000 census using linear interpolation. In addition, for the trend study, linear interpolation using 1980 and 1990 census population data by census tracts yield the estimated population of the area for inter-census years from 1986 to 1989.

Selection of Cancers for Analysis

Florida DOH in consultation with the community's representatives and city's representatives selected arsenic and dioxins as chemicals of concern. ATSDR's toxicological profiles indicated the following cancers that may be associated with long-term exposure to dioxins: soft tissue sarcoma, non-Hodgkin's lymphoma and cancers of the respiratory system. ATSDR's toxicological profiles indicated the following cancers that may be associated with long-term exposure to arsenic: cancers of lung, liver, bladder, kidneys and skin. Finally, all cancers combined were reviewed as a category by itself.

Analysis of Cancer Rates

Because the race composition of the study area and that of other parts of the state may differ considerably, the data were analyzed separately for whites and non-whites.
For the cancers of concern, the observed number of cases occurring in the study area during the specified period, were compared with the expected number of cases for the area for the same time frame assuming that the incidence rate was the same as for the rest of the state. For each race, the expected numbers of cases were calculated for each type of cancer. For each cancer type, the age-specific rates were calculated for the State of Florida minus the area of concern, for the period of fifteen years (1986 to 2000). Next, the population of each group of race in the area of concern for the same time period was multiplied by the age-specific rates of appropriate race calculated earlier. Then the addition of the generated numbers for each specific race separately provided the age-adjusted expected numbers of cases for a particular type of cancer for a specific race.
Standardized Incidence Ratios (SIR) were calculated by dividing observed number of cases by the expected number of cases for that particular cancer type and race group for the area of concern as calculated above. To assess the statistical significance, 95% confidence intervals (CI) were calculated for each standardized incidence ratio (SIR). Similarly, for the trend analysis, SIRs were calculated for each of the three five year period aggregates (1986-1990, 1991-1995, 1996-2000). The three periods were compared for each race and type of cancer.

Table A:

Wingate Area(1) Number of Cancers Observed and Expected by Cancer Site and Race, 1986-2000.

Cancer Sites	White					Non-White				
				95% Confidence Interval					95% Confidence Interval	
	Observed	expected	SIR	Lower Lim	Upper Lim	Observed	Expected	SIR	Lower Lim	Upper Lim
Bladder	77	90.0	0.9	0.7	1.1	12	29.5	0.4	0.2	0.7
Kidney	38	32.0	**1.2**	0.8	1.6	21	30.9	0.7	0.4	1.0
Liver	8	9.3	0.9	0.4	1.7	7	16.4	0.4	0.2	0.9
Lung	191	238.3	0.8	0.7	0.9	143	224.1	0.6	0.5	0.8
Melanoma	29	40.1	0.7	0.5	1.0	2	5.1	0.4	0.0	1.4
non Hodgkin's	61	51.8	**1.2**	0.9	1.5	37	42.7	0.9	0.6	1.2
Other Respiratory	7	17.5	0.4	0.2	0.8	20	25.2	0.8	0.5	1.2
Soft Tissue	8	6.6	**1.2**	0.5	2.4	3	10.9	0.3	0.1	0.8
All Cancers	1394	1516.1	0.9	0.9	1.0	1165	1550.0	0.8	0.7	0.8

Notes:
1. Wingate Area comprises the 2000 Census tracts 410, 411, 412, 503.07, 503.08 and 604 of Broward County.
2. Standardized Incidence Ratio (SIR) equals Observed divided by Expected

Source:
Office of Environmental Public Health Medicine
Department of Health
Florida Cancer Data System

Conclusion (Table A):

Reviewing all different types of cancers of concern for the area during the time interval of 1986 to 2000; among non-Whites, none of the cancer types had elevated SIR (Standardized Incidence Ratio). Among the white population, kidney, non-Hodgkin's lymphoma and soft tissue sarcomas had increased SIRs, which were not statistically significant.

Wingate Area[1] Number of Cancers Observed and Expected by Cancer Site, Race and Time Period,												
		WHITE					NON-WHITE					
					95% Confidence Interval					95% Confidence Interval		
Cancer Site	Time Period	Observe	Expected	SIR	Lower	Upper	Observed	Expected	SIR	Lower	Upper	
Bladder	1986 to 1990	28	35.4	0.8	0.5	1.1	3	8.5	0.4	0.1	1.0	
	1991 to 1995	27	30.3	0.9	0.6	1.3	4	10.7	0.4	0.1	1.0	
	1996 to 2000	22	23.3	0.9	0.6	1.4	5	10.3	0.5	0.2	1.1	
Kidneys	1986 to 1990	15	11.8	**1.3**	0.7	2.1	7	8.9	0.8	0.3	1.6	
	1991 to 1995	13	11.0	**1.2**	0.6	2.0	5	10.9	0.5	0.1	1.1	
	1996 to 2000	10	8.4	**1.2**	0.6	2.2	10	11.0	0.9	0.4	1.7	
Liver	1986 to 1990	2	2.5	0.8	0.1	2.9	1	4.0	0.2	0.0	1.4	
	1991 to 1995	4	3.3	**1.2**	0.3	3.1	3	5.9	0.5	0.1	1.5	
	1996 to 2000	2	2.8	0.7	0.1	2.6	3	6.1	0.5	0.1	1.4	
Lung and	1986 to 1990	66	86.8	0.8	0.6	1.0	31	73.6	0.4	0.3	0.6	
Bronchus	1991 to 1995	70	84.0	0.8	0.7	1.1	65	84.9	0.8	0.6	1.0	
	1996 to 2000	55	61.4	0.9	0.7	1.2	47	70.3	0.7	0.5	0.9	
Melanoma	1986 to 1990	8	12.2	0.7	0.3	1.3	0	1.1	0.0	- - -	4.0	
	1991 to 1995	15	12.2	**1.2**	0.7	2.0	1	1.8	0.6	0.0	3.1	
	1996 to 2000	6	12.7	0.5	0.2	1.0	1	2.1	0.5	0.0	2.7	
Non-Hodgkins	1986 to 1990	23	17.8	**1.3**	0.8	1.9	8	10.3	0.8	0.3	1.5	
Lymphoma	1991 to 1995	20	18.0	**1.1**	0.7	1.7	14	15.4	0.9	0.5	1.5	
	1996 to 2000	18	14.2	**1.3**	0.8	2.0	15	16.0	0.9	0.5	1.5	
Other Res-	1986 to 1990	2	7.5	0.3	0.0	1.0	4	7.9	0.5	0.1	1.3	
piratory	1991 to 1995	3	5.9	0.5	0.1	1.5	4	10.4	0.4	0.1	1.0	
	1996 to 2000	2	4.1	0.5	0.1	1.8	12	7.6	**1.6**	0.8	2.8	
Soft Tissue	1986 to 1990	1	2.4	0.4	0.0	2.4	0	2.9	0.0	- - -	7.0	
	1991 to 1995	4	2.2	**1.8**	0.5	4.7	2	4.5	0.4	0.1	1.6	
	1996 to 2000	3	1.8	**1.7**	0.3	4.9	1	3.4	0.3	0.0	1.6	
All Cancers	1986 to 1990	530	576.9	0.9	0.84	1.00	257	453.4	0.6	0.50	0.64	
	1991 to 1995	482	538.7	0.9	0.82	0.98	423	595.9	0.7	0.64	0.78	
	1996 to 2000	382	380.2	**1.005**	0.91	1.11	485	514.4	0.9	0.86	1.03	

Notes:

1. Wingate Area comprises the 2000 Census tracts 410, 411, 412, 503.07, 503.08 and 604 of Broward County.
2. Standardized Incidence Ratio (SIR) equals Observed divided by Expected
3. Other Respiratory Cancers include Nasal Cavities, Larynx, Pleura, Trachea, Middle Ear and Accessory Sinus, Mediastinum and Other Respiratory organs.

Source:

Office of Environmental Public Health Medicine
Department of Health
Florida Cancer Data System

Table B:

Conclusion (Table B):

In summary, there were no statistically significant increases in the SIRs (Standardized Incidence Ratios) of cancers.

Bladder cancer:
Among both Whites and non-Whites, the SIRs were not increased during any of the three five-year periods (i.e. 1986 to 1990, 1991 to 1995 and 1996 to 2000).

Cancer of the kidney:
Among the whites, the SIRs were increased (1.3, 1.2 and 1.2 for the three five-year periods), but statistically not significant.
Among non-Whites, the SIRs were not increased during any of the three five-year periods.

Cancer of the liver:
Among the whites, the SIR was increased (1.2) only during 1991 to 1995, but was not significant statistically.
Among non-Whites, the SIRs were not increased during any of the three five-year periods.

Cancer of lung and bronchus:
Neither among the whites nor the non-Whites, SIRs were found increased.

Melanoma (Skin cancer):
Among the whites, the SIR was increased (1.2) only during the 1991 to 1995 period, but was not statistically significant.
Among non-Whites, the SIRs were not increased during any of the three five-year periods.

Non-Hodgkin's Lymphoma:
Among the whites, the SIRs were increased (1.3, 1.1 and 1.3 for the three five-year periods), but not statistically significant.
Among non-Whites, the SIRs were not increased during any of the three five-year periods.

Cancers of the other respiratory system:
Among whites, the SIRs were not increased during any of the three five-year periods.
Among the non-whites, the SIR was increased (1.6) only during the 1996 to 2000 period, but was not statistically significant.

Soft tissue sarcomas:
Among the whites, the SIR was increased (1.8 during the 1991 to 1995 period and 1.7 during 1996 to 2000 period), but was not statistically significant.
Among non-Whites, the SIRs were not increased during any of the three five-year periods.

All cancers:

Among the whites, the SIR was increased (1.005) only during the 1996 to 2000 period, but was not statistically significant.
Among non-Whites, the SIRs were not increased during any of the three five-year periods.

DISCUSSION

Strengths of the methodology

By using modeled ash deposition, the potentially affected population in this cancer analysis could be better estimated than by merely considering a circle around the incinerator. Defining the ash deposition area as the aggregate of census tracts allowed for a better estimation of population at risk for 1986 to 2000. The use of linear interpolation for this task minimized errors in the estimation of the expected value for each cancer type and race.
By analyzing separately the cancer cases for white and non-whites we took into account the existing difference in racial make-up of the population of the area and the state minus the area.
Multiplying the area population in certain age groups with the age specific rates of the cancers for the same age groups provided the age-adjusted numbers for expected cases. This age adjustment helps control the age related confounding.

Limitations of the methodology

There were limitations and confounders in this analysis. There was an absence of documented individual exposure history. Because of this and other limitations, this analysis by itself can not establish causation. Other risks factors are often present for cancer. An important confounder in many cancer studies is the use of tobacco in different forms. A high percentage of cancers of lung, bladder and kidneys, for instance, are attributed to smoking or other tobacco use. Similarly, there are other risk factors like occupation, diet, lifestyle, etc. that can play a role in the development of cancers, but specific information on individuals is not available in the cancer registry.

Studies show that people with limited income visit doctors less often. For this reason they may not have been diagnosed with cancer, and therefore not be part of the registry, simply because they never saw a doctor for the condition while living in the area. If access to care is a problem for residents of this area, an underestimation of cancer cases may result. Similarly, since FCDS collects only the residence at time of diagnosis and considering the long latency period of most cancers, we do not know how long a person diagnosed with cancer actually lived in the area before being diagnosed nor how many cancers were missed on people who spent a good part of their lives in the area and moved away in recent years. In addition, socio-economic status may be a confounder in this study, not captured by the data available.

SUMMARY:

For all of the cancer types individually evaluated from 1986 to 2000 in the study area, there was no statistically significant difference between the study area and the state. All cancer types combined were reviewed for the same time interval for the area and there was no increase observed compared to the state. Similarly all categories were reviewed for three separate five-year intervals (1986-1990, 1991-1995 and 1996-2000) to identify the trends if any existed. There were no statistically significant elevations of cancer rates during those three five-year intervals in comparision with the rest of the state.

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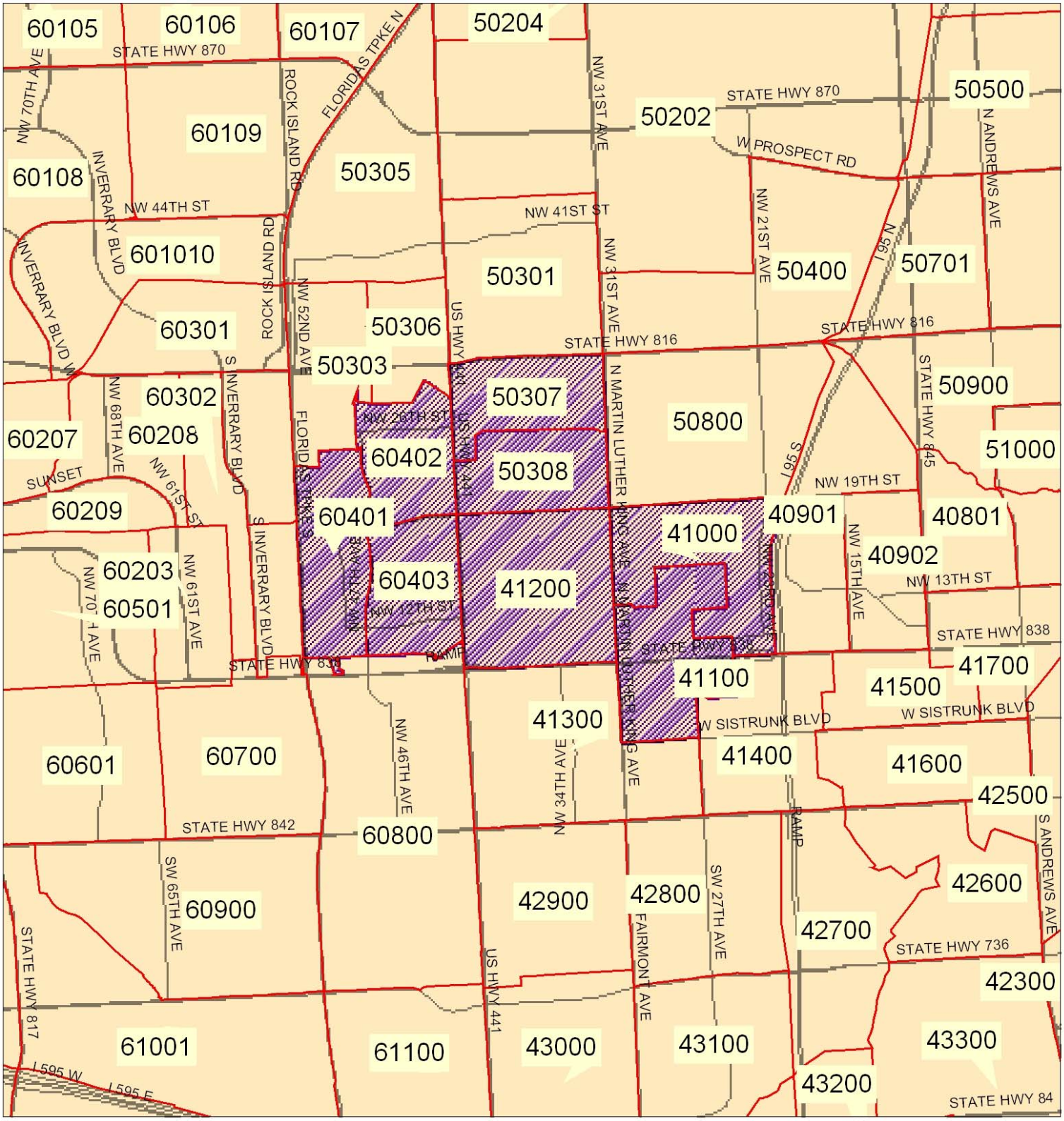

Wingate Study Area

2000 Census Tracts

Major Highway

County Boundary

Wingate Study Area

FLORIDA DEPARTMENT OF HEALTH

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