Fish

HEALTH CONSULTATION

WINGATE ROAD MUNICIPAL INCINERATOR AND LANDFILL

FORT LAUDERDALE, BROWARD COUNTY, FLORIDA

CERCLIS NO. FLD981021470

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Prepared by

The Florida Department of Health and Rehabilitative Services
Under Cooperative Agreement With the
Agency for Toxic Substances and Disease Registry

Background and Statement of Issues

The purpose of this health consultation is to evaluate the public health threat from eating fish from Rock Pit Lake, adjacent to the Wingate Road Municipal Incinerator and Landfill Superfund site in Fort Lauderdale, Broward County, Florida (Figure 1).

The Wingate Road Municipal Incinerator and Landfill operated from 1954 to 1978. A chain-linked fence divides this 60-acre site into two portions (Figure 2). The northern portion is a 40-acre landfill, 25 feet above the surrounding grade, and densely covered by vegetation. Although the landfill contains mostly bottom ash, the City of Fort Lauderdale also disposed of sludges containing a variety of substances in the landfill. The 20-acre southern portion is a process area including two inactive incinerator buildings, cooling water treatment structures, a vehicle maintenance area, various other buildings, and an old percolation pond. Because of fine ash buildup, this percolation pond lost its permeability and became known as Lake Stupid. The City periodically removed the ash from the bottom of Lake Stupid and deposited it in the landfill and along the banks of the pond. Eventually, the City connected Lake Stupid to Rock Pit Lake (Figure 2), an old borrow pit adjacent to the northeast corner of the site, by an overflow ditch running along the eastern edge of the site. A film production company currently leases the site from the City (1, 2). The site is in a well-populated area (Figure 3). There is a commercial area immediately west of the site, a junk yard north of the site, and residential areas east and south of the site (1, 3).

In 1990, the Florida Department of Health and Rehabilitative Services (FHRS), under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), published a public health assessment for the Wingate Road Municipal Incinerator and Landfill Superfund Site. This assessment evaluated available ground water, soil, sediment, and surface water data. Based on this information, the public health assessment found the site was not of public health concern from current exposure conditions (4).

In 1991, the City of Fort Lauderdale entered into an Administrative Order on Consent with the U.S. Environmental Protection Agency (EPA) to conduct a Remedial Investigation/Feasibility Study (RI/FS). Four phases of field investigations detected heavy metals, polynuclear aromatic hydrocarbons, pesticides, dioxins, and furans in ash residue, soil and sediment; heavy metals and pesticides in surface waters; heavy metals, volatile organic compounds, and phthalates in groundwater; and dioxins in fish (1, 2). Under EPA's cleanup proposal, most of the current site area will be covered by a landfill cap and the accompanying storm water retention pond (1).

EPA's 1994 Baseline Risk Assessment (BRA) estimated the present-day increased cancer risk to workers and child trespassers to be within the limits EPA considers protective (1). EPA estimated that the present-day increased risk of noncancer illnesses is negligible. For hypothetical residents living on-site in the future, EPA estimated the increased cancer risk to be within the protective range; however, they estimated there could be an increased risk of noncancer illnesses to children and, in some circumstances, to adults (1, 3).

Throughout the site investigation and cleanup proposal process, there has been concern about whether or not residents should continue to eat fish from Rock Pit Lake (5, 6). Past studies have focused on dioxin and mercury levels in lake fish. In May 1993, ATSDR completed a health consultation on the public health risk from exposure to dioxin in Rock Pit Lake fish. ATSDR based their dose estimates on a 70 kilogram adult eating 18 grams of fish per day. ATSDR concluded people occasionally eating fillets of fish from the lake were unlikely to have adverse health effects. ATSDR also pointed out that no one knew how much fish were being eaten from the lake, and recommended EPA consider performing a fish consumption survey (6). The BRA estimated the increased risk of illness from either dioxin or mercury to be negligible, basing the dose estimates on a 70 kilogram adult eating 54 grams of fish per day (3). Although EPA attempted to collect fish consumption information through a mailed-out survey, they received no responses from area residents (Zimmerman, pers. comm.).

On February 24, 1994, FHRS staff attended an EPA-held public meeting concerning the results of the RI. During this meeting, a resident asked if it was safe to eat fish from Rock Pit Lake. Referring to dioxin levels found in lake fish, an ATSDR representative said eating fish from the lake would not be harmful if only one meal per week were eaten. The ATSDR representative informed residents they should eat only fillets of lake fish (5). After this meeting, FHRS staff talked to several residents about their health concerns and possible exposure pathways. FHRS staff performed windshield surveys of the site and the surrounding neighborhood on February 25 and June 22, 1994. During both visits, the site was open to visitors in the daytime (5, 7). Although FHRS staff did not observe anyone fishing the Rock Pit Lake during either site visit, one resident with lake-front property has reported some residents eat fish from the lake (8).

In April 1995, the Florida Department of Environmental Protection (FDEP) asked FHRS for an assessment of lead in the fish in Rock Pit Lake. During the RI, EPA found high concentrations of lead in on-site surface soil samples, on and off-site sediments, and surface water from the Rock Pit Lake drainage. (The Rock Pit Lake drainage area sampled during the RI no longer exists because of reconfiguration activities in the area.) The BRA found copper, lead, iron and zinc from the Rock Pit Lake drainage could adversely affect the lake's water quality. Furthermore, the BRA's ecological risk assessment found the average concentration of chemicals in Rock Pit Lake sediment and surface water could adversely affect aquatic receptors (3). Since Rock Pit Lake fish had not been analyzed for heavy metals, their potential health effects on residents eating lake fish were unknown. In addition, the median family income for the 1990 census tract containing the site was $18,750 (9), raising the concern that fish from the lake might be a dietary staple for some residents.

An FHRS toxicologist performed a preliminary estimate of lead in non-sediment feeding fish, using worst-case surface water quality data. The results suggested the amount of lead that might be found in fish tissue could significantly contribute to lead poisoning in a young child eating fish and exposed to lead from other sources (10). Since many Wingate area homes were built before 1978, the most likely additional source of lead is lead-based paint (11). There were no models available for estimating the amount of lead in sediment-feeding fish

from the lake (10). To resolve the metals in fish issue, FHRS asked EPA to collect fish from Rock Pit Lake and analyze them for lead. Because EPA could not perform this sampling quickly, FHRS used ATSDR grant funds to collect and analyze fish in Rock Pit Lake for heavy metals, including lead.

At FHRS's request, Florida Game and Fresh Water Fish Commission staff collected fish from Rock Pit Lake on July 11, 1995 using an electroshock method (12). Game and Fish staff collected and sent 1 warmouth, 4 bluegill, and 7 bass to the FHRS laboratory for heavy metal analysis.

Methodology

The FHRS laboratory analyzed 12 discrete fish fillet samples for the following metals: lead, chromium, copper, cadmium, zinc, arsenic, and selenium (13). We chose fillet samples for analysis because most people, especially children, eat fillets rather than whole fish. When initially examining the fish sample data, we noticed the data set from one bass seemed atypical. This fish sample had an unusually low moisture content of 50%; the normal moisture content of a fish is about 80%. The low moisture content made the wet weight detection limits unusually high (14), and likely affected the wet weight results for the detected metals. Therefore, we did not include data from this fish specimen in any of our analyses.

We performed four separate analyses on the data from 11 fish:

- an assessment of chronic (long-term) exposure from eating Rock Pit Lake fish only,
- an assessment of chronic exposure from eating both Rock Pit Lake fish and incidentally eating soil from the site,
- an assessment of acute (short-term) exposure from eating one fish meal, and
- an evaluation of the detection limits for undetected metals.

In each analysis, we used the maximum wet weight metal concentration of the 11 fish samples. We used the computer software Risk*Assistant™ (15), along with standard assumptions (Table 1), to estimate ingestion doses for the following hypothetical residents: an adult, an older child (7-16 years old), and a young child (0-6 years old). We then compared our estimated doses with ATSDR and EPA health values for each contaminant. We describe our methods for evaluating each of these four exposure scenarios in more detail below.

In the chronic fish consumption analysis, we used the traditional approach of estimating an ingestion dose based on the average daily amount of fish eaten by an adult over a year. For our analysis, we used EPA's average daily consumption rate of 54 grams of fish per day for a 70 kilogram adult. This is a 90th percentile consumption rate for recreational fishers of a bay in Takoma, WA (16). More recent studies suggest 54 grams per day is a 90th-100th percentile

consumption rate for recreational fresh water fishers in various parts of the United States (17). However, preliminary results of a fish consumption study in Florida indicate 54 grams per day is close to a 50th percentile consumption rate for men and women eating fresh water bottom-feeders, and is between a 50th and 90th percentile consumption rate for both sexes eating fresh water pan or predatory fish (Sekerke, et al., unpublished). To estimate the amount of fish eaten by children, we calculated proportionately smaller consumption values based on ATSDR data for the two age groups (18) (Table 2). We compared our estimated doses for each age group with ATSDR and EPA chronic exposure health values for each detected contaminant.

For the analysis of exposure to metals both in fish and in on-site surface soils, we planned to add EPA soil ingestion estimates, found in the BRA, to our dose estimates from the fish consumption analysis. After evaluating the soil exposure scenarios in the BRA, we decided the only likely soil exposure pathway was that of EPA's hypothetical present-day trespasser (i.e., an older child occasionally visiting the site). Because the assumptions we used to estimate fish ingestion doses for an older child were similar to the assumptions EPA used to estimate soil ingestion doses for a trespasser (compare Tables 1 and 3), we added the two dose estimates together for this age group. We compared our estimated total doses for older children with ATSDR and EPA chronic exposure health values for each detected contaminant. Given current EPA plans for cleaning up the site, it seemed very unlikely residents would live on the site in the future. Therefore, we did not evaluate combined ingestion doses for the BRA's future child and future adult soil ingestion scenarios.

Although people incidentally ingest a little bit of soil every day, people do not eat fish in the same manner. Instead of eating 1.9 ounces (54 grams) of fish per day, an adult eats about 7-9 ounces (about 198-255 grams) of fish in one dinnertime serving (19). Consequently, for our third analysis, we examined the possible health effects from ingesting the relatively large amounts of metals contained in one fish meal. Based on the value of 1.9 ounces per day, we estimated an adult eats about 13 ounces of fish per week. At 9 ounces per meal, this was the equivalent of about 1½ fish meals per week. By using our daily fish consumption estimates to calculate a weekly consumption estimate and then dividing the weekly estimate into 1½ meals, we estimated the amount of fish children eat in one meal (Table 2). We compared our estimated doses for each age group with ATSDR acute exposure health values for each detected contaminant.

In our detection limit analysis, we estimated potential exposure doses by assuming each undetected metal was present at a concentration equal to the largest detection concentration for that metal (Table 4). We then compared the estimated doses for each age group to acute and chronic health values published by ATSDR and EPA.

Because we used the maximum wet weight value in the first, second, and fourth analyses, we introduced a bias into our analysis that could lead us to overestimate exposure doses. At the same time, this method helped prevent underestimation of risks that are present. We maintain using the maximum value is desirable because it is protective of public health, and it is necessary because of the small sample size of fish in our analysis.

Discussion

Rock Pit Lake fish have detectable levels of zinc and copper (Table 4). Both of these metals occur naturally in food, and people need to eat small amounts of these nutrients for good health. The chronic ingestion doses we estimated for copper and zinc in all age groups are much smaller than the doses associated with illness in human studies (20, 21). This indicates residents eating an average amount of filleted fish from Rock Pit Lake are unlikely to become ill from chronic ingestion of zinc or copper found in lake fish. Similarly, the chronic ingestion doses we estimated for copper and zinc in older children who eat an average amount of fish and trespass on the site are much smaller than the doses associated with illness in human studies (20, 21). This indicates older children are unlikely to become ill from the combined eating of lake fish and incidental eating of on-site soils. In our analysis, we considered an average amount of fish eaten by an adult to be about 13 ounces per week (54 grams per day), by an older child to be about 8 ounces per week (34 grams per day), and by a young child to be about 5 ounces per week (20 grams per day). We estimated the average amount of fish consumed is approximately equivalent to 1½ fish servings per week for each age group. Our analysis was limited by not knowing what the fish eating habits of the Wingate Road residents actually are.

Because people tend to eat fish in single large meals rather than in small daily amounts, we evaluated the possible health effects from eating relatively large amounts of zinc and copper in one dinnertime serving each week. We based our consumption estimates on an adult's eating 9 ounces of fish in one dinnertime serving. (A 4 x 3 x 1 inch piece of fish typically weighs about 3½-4 ounces) (19). The acute ingestion doses we estimated for zinc in adults and older children are much smaller than the doses associated with illness in human studies (20). This indicates adults and older children are unlikely to become ill from eating the zinc found in a single serving of Rock Pit Lake fish. The acute ingestion dose we estimated for zinc in young children is slightly below the dose associated with temporary decreases in blood cortisol levels in one human study (20). Although ATSDR's toxicological profile reports this study may indicate an association between adrenal cortical damage and zinc at the study dose (20), we find the study's sample size to be too small (22) to give scientifically reliable results. Furthermore, the average amount of zinc found in Rock Pit Lake fish (Table 4) is less than the average amount of zinc found in the meat, poultry, and fish food group of the American diet. In addition, the amount of zinc in lake fish seems to be within the range of zinc normally found in fresh water fish in the United States (20). These latter findings suggest young children are unlikely to become ill from eating the amount of zinc found in a single fish serving.

The amount of copper found in Rock Pit Lake fish is slightly higher than the average amount of copper normally found in fresh water fish but similar to the average daily intake of copper from all foods. The acute ingestion doses we estimated for copper in all age groups are slightly below the lowest dose associated with upset stomach and diarrhea in human studies. However, dietary information in ATSDR's toxicological profile for copper suggests the equivalent daily intake of copper is safe for all age groups. Furthermore, zinc interferes with copper absorption and metabolism in the body, suggesting the zinc in found in Rock Pit Lake fish may decrease

the amount of copper absorbed. Similarly, high dietary amounts of vitamin C and fiber decrease the absorption of copper (21). This information seems to indicate residents are unlikely to become ill from copper found in a single serving of Rock Pit Lake fish. Our interpretations are limited because of our lack of knowledge of the fish eating and other dietary habits of the nearby community.

It is noteworthy that the highest levels of zinc and copper were both found in the same bluegill fish. Overall, the four bluegill tended to have above average quantities of zinc and a wide range of copper values. The bass collected tended to have average or below average quantities of zinc and below average quantities of copper. The one warmouth collected had an average amount of copper and a below average amount of zinc (Table 4). Zinc has a moderate potential to bioconcentrate in fish (20), and the differences we noted may represent species' differences in zinc bioconcentration. Copper has a low potential to bioconcentrate in fish (21), and the widely varying copper concentrations among the bluegill collected may represent individual differences in copper metabolism. On the other hand, finding the highest concentrations of both detected metals in one bluegill may mean that particular fish was unusually polluted. In this case, our dose estimates would be further biased towards overestimation as a result of a sampling artifact. Nevertheless, the maximum detected values are within two standard deviations of the mean (Table 4), suggesting these values are not unusually large if the data are normally distributed.

The laboratory analyses did not detect lead, chromium, cadmium, arsenic, or selenium in Rock Pit Lake fish. Still, we examined the detection limits of these metals to determine if they were protective of human health. Our detection limit analysis suggested if lead or selenium were present in lake fish at levels just below the highest detection limit, eating an average amount of fish might affect the health of residents (23-27). This could be especially true for young children who eat fish and ingest lead-based paint chips or dust. Although our arsenic dose estimate for each age group was similar to doses associated with health effects in human studies, it is unlikely health problems would occur because most arsenic found in fish is in a stable, nontoxic form (23, 28). Although we do not know if any of these metals were present in the fish at levels below the detection limits, our findings point to the need for more fish sampling for heavy metals in the future, employing the lowest detection limits possible.

In evaluating and interpreting the data, it is important to remember the laboratory performed analyses on fish fillets rather than whole fish. Lead, in particular, tends to accumulate in the bones of animals (24, 29). Residents who eat fish bones may ingest much higher amounts of lead than residents who eat only fish fillets. Because young children and unborn babies are particularly sensitive to lead exposure (24, 30), it is important young children and pregnant women avoid incidentally eating lead whenever possible. By eating filleted fish, residents can avoid a possible source of lead in their food. Previously, ATSDR recommended residents eat only fillets of fish from this lake (5, 6), and our fish data interpretations assume residents eat only fillets.

ATSDR had also previously recommended residents eat only one meal of lake fish per week to limit the risk of illness from dioxin exposure. Although the daily fish consumption rate ATSDR

used in their dose estimate for adults was 1/3 of the rate we used, the BRA used the same daily consumption rate for adults that we used and estimated the increased risk of illness from dioxin or mercury to be negligible. Since we based our evaluations on 1 (acute) to 1½ (chronic) meals of lake fish per week, we concur that residents should limit their consumption of lake fish to one meal per week.

Because we do not know the community's fish eating habits, we could not address the issue of subsistence fishing from the lake. Studies of Native Americans indicate adult subsistence fishers consume more than 54 grams of fish per day (17). However, there is a question about how many fish are in Rock Pit Lake, since Florida Game and Fresh Water Fish Commission staff have been able to catch only a small number of fish in each of two collection efforts (for the RI and for this health consultation). Based on our catch information, it is not clear if Rock Pit Lake can support subsistence fishers in the surrounding community. As we noted earlier, EPA attempted to collect fish consumption data from the community through a mailed survey and received no responses. It is possible that a written survey format is not appropriate for this community, and other survey techniques (e.g., phone, personal interviews of fishers) may be more effective if EPA attempts another survey in the future.

Conclusions

Based on the information we reviewed and cited in this health consultation, FHRS concludes the following:

1 Rock Pit Lake fish have detectable levels of zinc and copper. Based on the fish analyzed, residents eating an average amount of filleted fish from Rock Pit Lake are unlikely to become ill from ingesting zinc or copper found in the fish. We consider an average amount of fish to be about 13 ounces per week or 9 ounces per meal for an adult, with children consuming proportionately smaller amounts. ATSDR previously recommended residents limit the amount of fish they eat from the lake to one meal per week to avoid the increased risk of illness from dioxin ingestion. We concur with ATSDR's recommendation.

2. We based our dose estimates and analyses on the results from filleted fish, rather than whole fish. Because lead may accumulate in fish bones, people eating whole fish may ingest more lead than we predicted. Young children and unborn babies are particularly sensitive to lead exposure.

3 We do not know if any of the undetected metals were present in fish at levels just below the highest detection limit. Nevertheless, eating an average amount of lake fish containing lead or selenium at levels just below the highest detection limit might affect the health of residents, especially young children who are exposed to lead from another source such as lead-based paint.

4. Our analysis is limited because we do not know what the fish eating habits of Wingate area residents actually are.

Recommendations

The recommendations and advice in this health consultation are based upon the referenced data and information, and are specific to FHRS' review of the data from 11 fish collected on July 11, 1995 from Rock Pit Lake. This lake is adjacent to the Wingate Road Municipal Incinerator and Landfill Superfund Site. Additional data could alter these recommendations.

1. To avoid the possible risk of illness from heavy metal or dioxin ingestion, residents should limit their diet to no more than one serving of fish from Rock Pit Lake per week. FHRS should inform nearby residents of this recommendation.

2. Residents eating fish from Rock Pit Lake should eat only fillets of fish. Residents, especially young children and pregnant women, should not eat the bones of fish taken from the lake. FHRS should inform nearby residents of this recommendation.

3. EPA should analyze future fish samples for heavy metals, including lead and selenium. The lowest feasible detection limits should be used in these analyses. Because of the possibility young children may be exposed to lead-based paint, parents may want to avoid feeding young children fish from Rock Pit Lake.

4. EPA should consider conducting another fish consumption survey of the residents living around the Wingate Road site, perhaps using a nonwritten technique such as a telephone survey or personal interviews.

If clarification is necessary, please call Carolyn Voyles in FHRS' Environmental Toxicology Section at (904) 488-3385. If information becomes available indicating additional exposures at levels of concern, FHRS will evaluate that information to determine what additional actions, if any, are necessary.

CERTIFICATION

This Wingate Road Municipal Incinerator and Landfill Health Consultation was prepared by the Florida Department of Health and Rehabilitative Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation, and concurs with its findings.

for Sharon Williams-Fleetwood, Ph.D.
Chief, SSAB, DHAC, ATSDR

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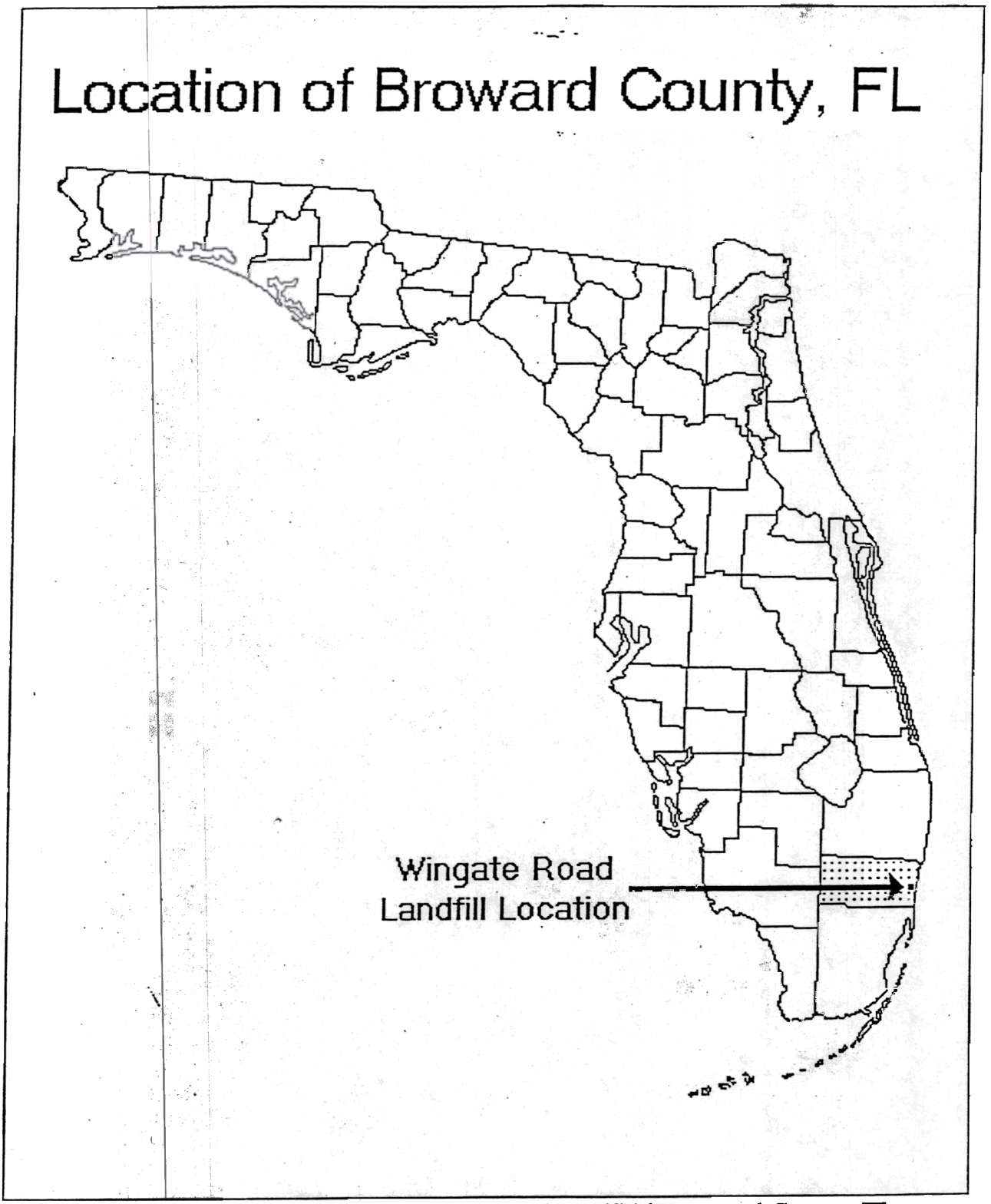

Figure 1 Location of Wingate Road Incinerator and Landfill in Broward County, FL.

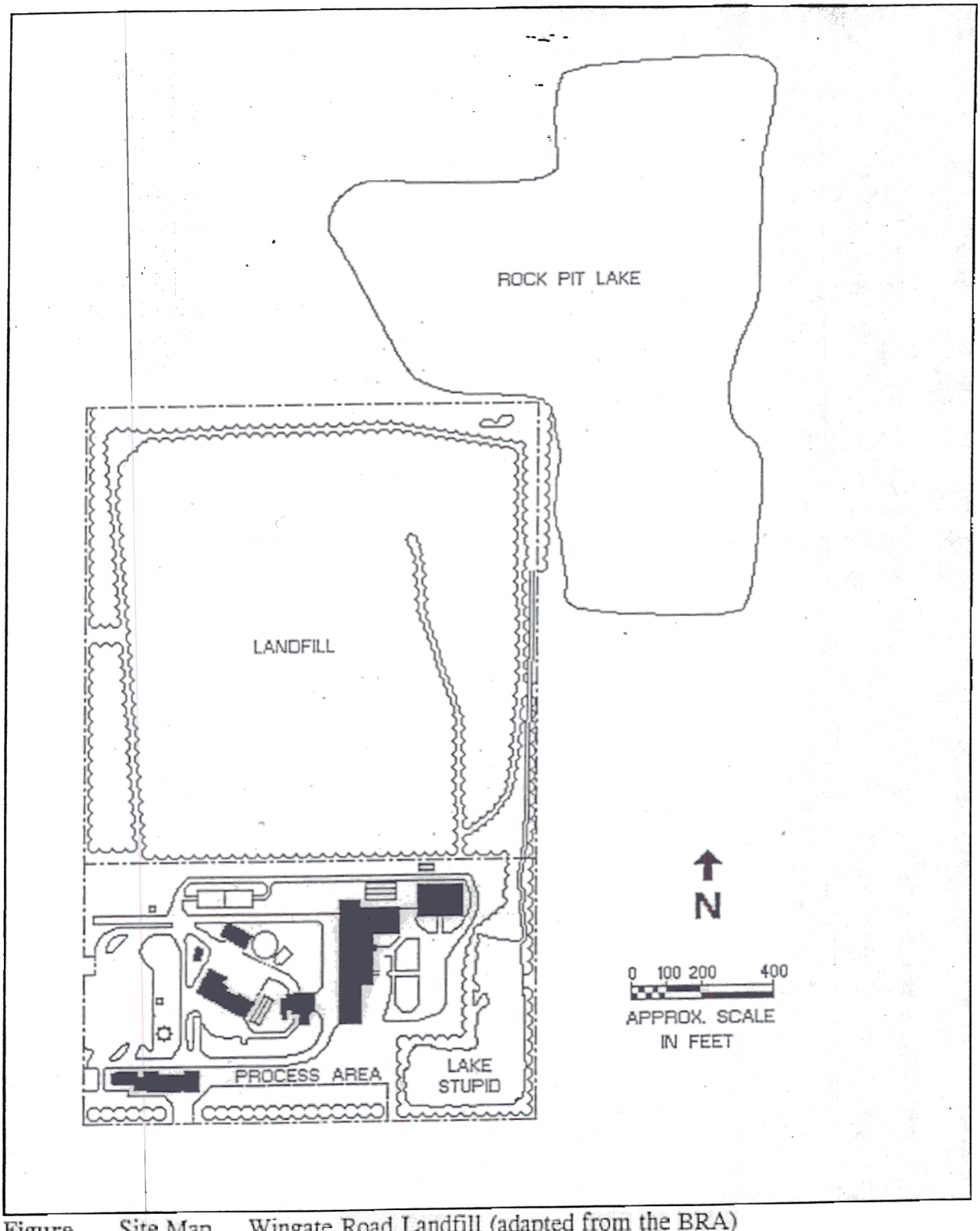

Figure Site Map Wingate Road Landfill (adapted from the BRA)

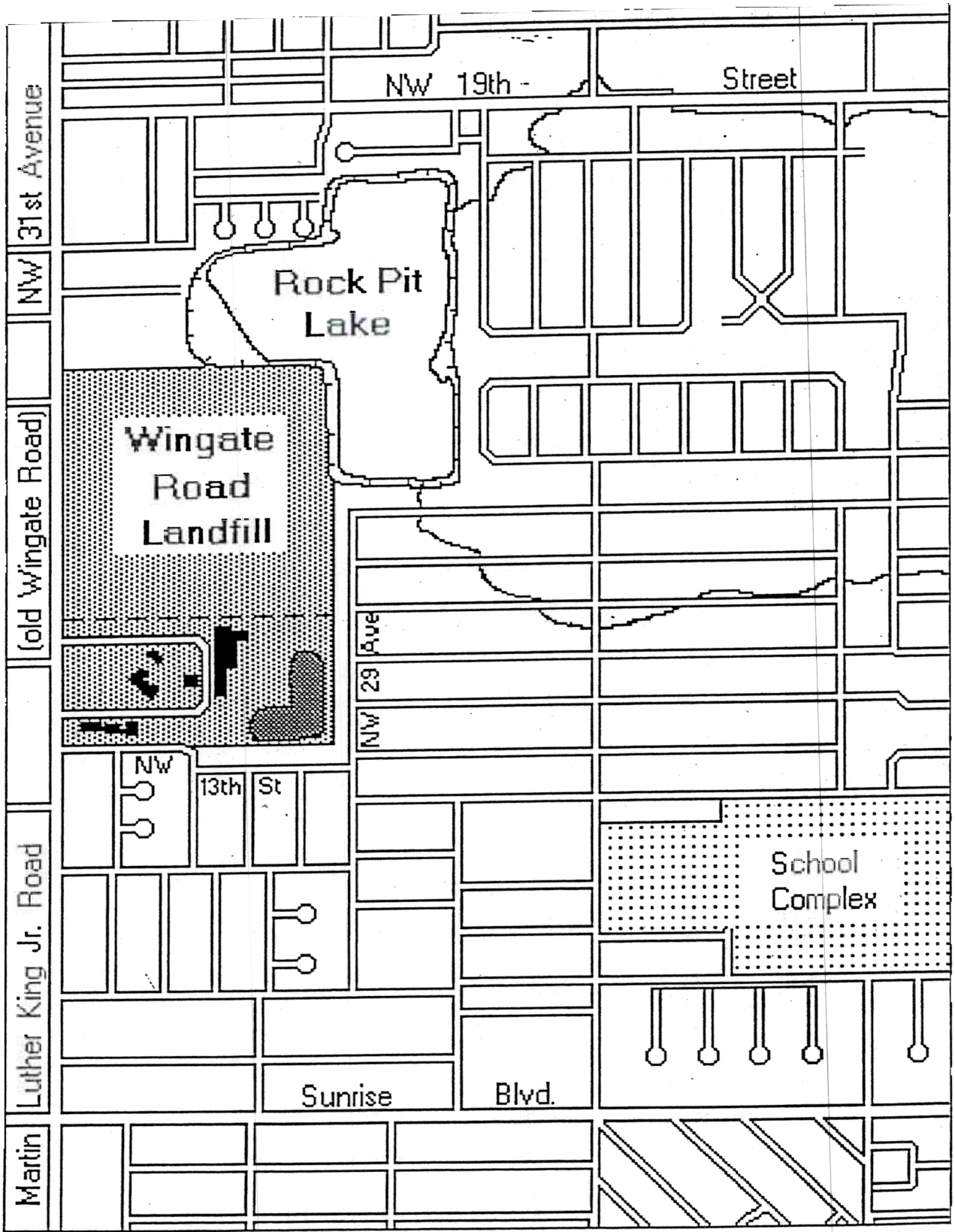

Figure 3 Neighborhood Surrounding the Wingate Road Landfill (adapted from the BRA

Table 1. Standard Assumptions Used in the FHRS Fish Ingestion Dose Estimates

Parameter	Adult	Older Child	Young Child
Body Weight (kilograms)	70	36	13
Event Frequency (per year)	365	365	365
Chronic Exposure Period (years)	30	10	6
Lifetime (years)	70	70	70
Fish Consumption Rate (kilograms/event)	0.054	0.034	0.020
Fraction of Fish Contaminated	1.0	1.0	1.0

Table 2. Fish Weights Used to Calculate Ingestion Doses

Parameter	Adult	Older Child	Young Child
Average Amount Per Day (grams)†	54	33	20
Average Amount Per Week (ounces)	13	8	5
Average Amount Per Meal (ounces)	9	5.5	3.5
Average Amount Per Meal (grams)†	255	157	98

† - Values used in dose calculations; ounce equivalents are given because of their customary use by the general public.

Table 3. Values Used in the BRA Surface Soil Ingestion Dose Estimates

Parameter	Present-day Trespasser
Body Weight (kilograms)	37
Event Frequency (per year)	150
Exposure Period (years)	6
Lifetime (years)	70
Soil Ingestion Rate (milligrams/kilogram)	100

Table 4. Heavy Metal Analytical Results for Rock Pit Lake Fish and Data Distribution Information*

Metal	Total # Detected/ Total # Sampled	Range of Detected Results (mg/kg)	Detection Limit Ranges for Undetected Metals (mg/kg)	Distribution of Sample Results or Detection Limits	
				Mean	Std. Deviation
Copper	7/11	0.86-5.1	--	2.56	1.54
Zinc	11/11	6-17	--	10.06	3.54
Arsenic	0/11	--	16-22	18.55	1.88
Cadmium	0/11	--	0.81-1.1	0.93	0.10
Chromium	0/11	--	1.6-2.2	1.85	0.19
Lead	0/11	--	8.1-11	9.34	0.96
Selenium	0/11	--	16-22	18.55	1.88

* - Data do not include the analytical results for one fish sample which was unusable.
mg/kg - milligrams per kilogram; wet weight results are presented
mean - the average of the sample points
std. deviation - standard deviation, a measure of the variation among the sample points