

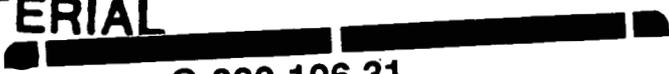
**FEED MATERIALS PRODUCTION CENTER  
ENVIRONMENTAL MONITORING ANNUAL  
REPORT FOR 1973**

**04/01/74**

**NLCO-1109  
NLO/AEC  
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REPORT**

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FEEB MATERIALS PRODUCTION CENTER  
ENVIRONMENTAL MONITORING ANNUAL REPORT  
FOR 1973

Prepared by  
HEALTH AND SAFETY DIVISION

NATIONAL LEAD COMPANY OF OHIO  
P. O. Box 39158  
Cincinnati, Ohio 45239

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UNITED STATES ATOMIC ENERGY COMMISSION  
CINCINNATI AREA

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'73

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### INTRODUCTION

This report summarizes environmental monitoring data collected at the Feed Materials Production Center (FMPC) during 1973. Data are presented for both radioactive and non-radioactive contaminants in environmental samples. These data show that the average offsite concentrations of radioactive contaminants from FMPC operations were no greater than 0.6% of the guide levels published in AEC Manual Chapter 0524. The resulting offsite radiation exposures would, therefore, be a small fraction of the standards for uncontrolled areas.

The FMPC is an industrial facility owned by the Atomic Energy Commission and operated by the National Lead Company of Ohio. It is located on a 1050-acre site about 20 miles northwest of Cincinnati, Ohio. Several rural communities are 1-3 miles away. See Figure 1 for a map of the area.

### AREA FEATURES

Glacial action gave the area its basic geological features. Outwash from retreating glaciers filled in the former course of a large ancient river. Through this fill, the Miami River has cut its present course and the river bed is now located about 60 feet below the original level of the glacial deposits. The area east of the FMPC, in the Miami River flood plain, has fertile soil and is reported to contain some of the best farm land in the state. In



the gently rolling uplands west of the flood plain, the thin soil mantle over the glacial drift is less fertile.

Although there are several small industries near the FMPC, the major economic activities in this rural area are farming, dairying, and the raising of beef cattle. Farm crops include sweet corn, field corn, soybeans and wheat. Truck crops are widely grown and sold at local produce stands and in nearby urban markets.

The glacial fill and the Miami River have provided two other important area products--ground water and gravel. A company located about one mile from the FMPC pumps out about 20 million gallons of ground water per day, chiefly for industries in and near Cincinnati. Pumping began just before the FMPC was built. The permeable glacial deposits, called valley-train, house the bountiful deep aquifer from which the water company and the FMPC draw supplies. The Miami River continuously provides part of the aquifer recharge.

Gravel pit operations are a familiar sight in the Miami Valley. Some operations are located along the river, with a sand dike separating gravel washwater from the river. Other operations are within the flood plain, but are several hundred feet from the river.

The river receives substantial amounts of industrial and municipal wastes upstream from the FMPC. The cities of Dayton, Middletown, Hamilton, and Fairfield are major contributors. Little recreational

use is made of the river. Downstream from the FMPC, the population is sparse and industries are small and scattered. About 18 miles away, the Miami meets the Ohio River.

#### FMPC OPERATIONS

The primary work at the FMPC is the production of purified uranium metal and compounds for use at other AEC sites. A small amount of thorium is also processed.

Uranium production may begin with ore concentrates, recycled uranium from spent reactor fuel, or with various compounds from other AEC sites. Impure starting material is dissolved in nitric acid and the uranium is extracted into an organic liquid and then back-extracted into dilute nitric acid to yield a solution of uranyl nitrate.

Evaporation and heating convert the nitrate solution to uranium trioxide ( $UO_3$ ) powder. This compound is reduced to uranium dioxide ( $UO_2$ ) with hydrogen and then converted to uranium tetrafluoride ( $UF_4$ ) by reaction with anhydrous hydrogen fluoride. Uranium metal is produced by reacting  $UF_4$  and magnesium metal in a refractory-lined reduction vessel. This primary uranium metal is then remelted with scrap uranium metal to yield a purified uranium ingot which is extruded to form rods or tubes. Sections are then cut and machined to final dimensions. These machined cores are shipped to other AEC sites for canning and final assembly into reactor fuel elements.

Thorium production steps, in general, are similar to those followed in uranium production. Final products may be purified thorium nitrate solution, solid thorium compounds, or metal.

#### STANDARDS

There are several sets of standards which can be applied to environmental samples collected in connection with FMPC operations. These standards have been set by the AEC and the State of Ohio Environmental Protection Agency (OEPA).

AIR. The AEC specifies limits for radionuclides in air and water which must be followed by contract operators such as the National Lead Company of Ohio.<sup>(1)</sup> These criteria, published in AEC Manual Chapter 0524, specify maximum concentrations in work areas and in offsite areas which are beyond AEC control.

For environmental monitoring purposes, the criteria for air and water in uncontrolled areas are used as standards. At the FMPC, criteria for offsite or ambient air are applied to samples collected at the plant boundary.

Criteria used for non-radioactive contaminants in ambient air are those established by the Ohio EPA.<sup>(2)</sup> Current production operations exhaust particulates and oxides of nitrogen in sufficient quantity to warrant occasional boundary sampling for these contaminants.

WATER. As previously noted, standards for radionuclides in water have been specified by the AEC for use by the Commission's contract operators. Criteria for offsite water are applied to river samples collected downstream from the point where the plant effluent reaches the river, but upstream from any known use of the water as a drinking water supply.

Water quality criteria adopted by the Ohio EPA are mainly concerned with non-radioactive contaminants, but several radioactivity limits are included.<sup>(3)</sup> State water quality standards apply to the river, beyond a mixing zone permitted for industrial and municipal effluents.

On July 27, 1974, the Ohio EPA adopted that agency's initial set of water quality standards.<sup>(3)</sup> Prior to this date, the state standards in effect were those issued by the Ohio Department of Health (ODH).<sup>(4)</sup> In this Environmental Monitoring Report, data comparisons are made with the OEPA standards except for dissolved alpha radioactivity listed in Table 3. The ODH standard for dissolved alpha was not continued by OEPA.

#### SAMPLE COLLECTION AND ANALYSIS

AIR. Conversion of impure uranium and thorium compounds to reactor-grade feed materials involves operations which generate radioactive dust, nuisance dusts, and corrosive mists or reaction products. Ventilation and air cleaning systems are used to confine this air and remove airborne contaminants, including valuable material which

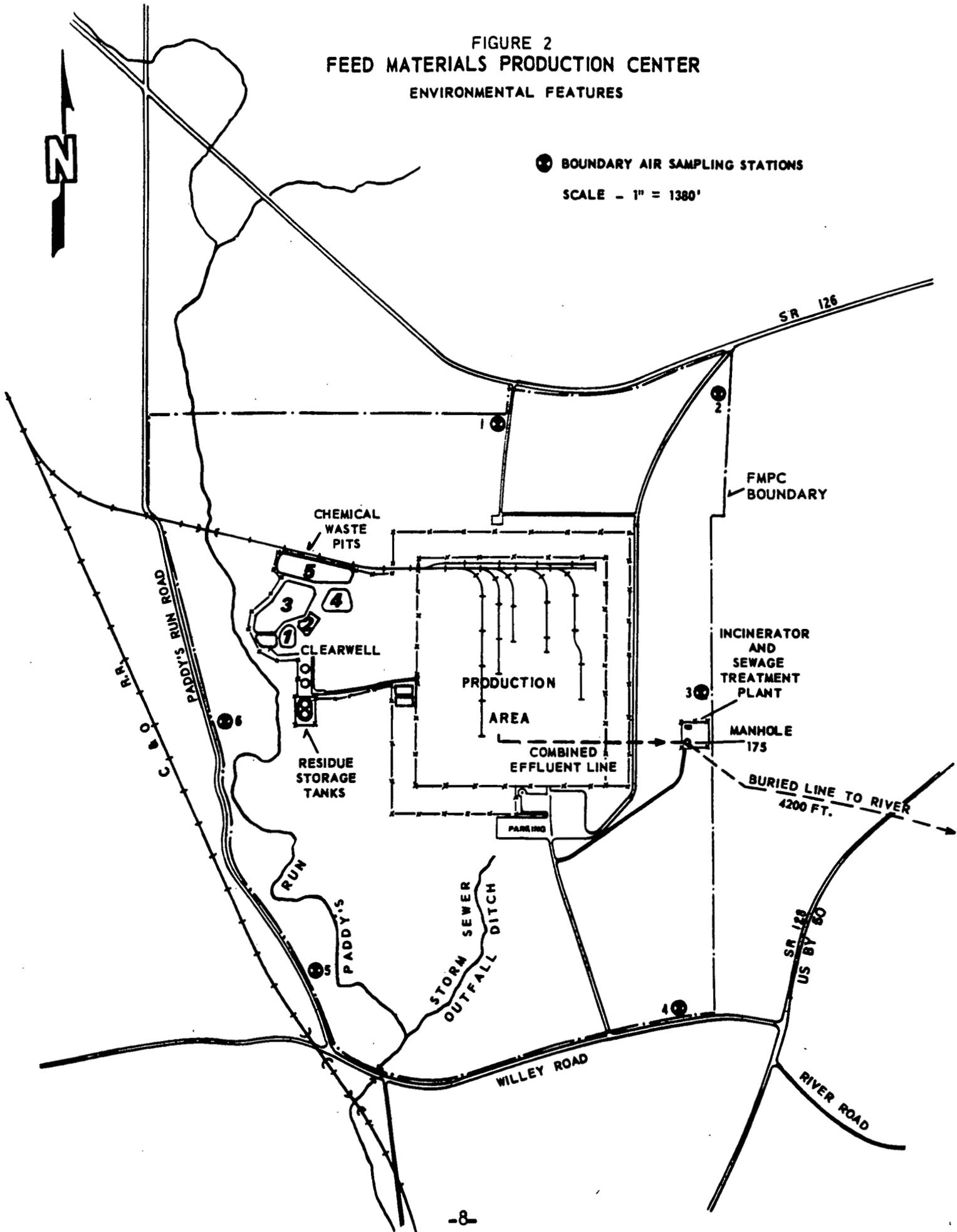
is returned to the production processes. The filtered or scrubbed air is exhausted to the atmosphere. Sampling of these stack exhausts is maintained on a continuous schedule to determine the operating condition of the air cleaning systems.

During 1973, samples of particulate matter in air were continuously collected at six permanent sampling stations located on the project's outer boundary (see Figure 2). At each Boundary Station, a metered quantity of air is drawn through a filter which is changed weekly. Filters are weighed before use and then reweighed after changing to obtain the weight of collected dust. After reweighing, the filter and its collection of dust is dissolved in acid and the solutions are analyzed for uranium and alpha and beta radioactivity. After these analyses are completed the remaining solution is held to provide a long-term composite for thorium analyses. Frequent thorium analyses are not considered necessary because of the small amount of thorium processed and the low concentration of thorium found in the boundary samples. Because of the low concentrations, routine analyses for thorium were discontinued in January, 1974.

During the past year, a four-bubbler air sampler belonging to the Southwestern Ohio Air Pollution Control Division operated at Boundary Station 2. Division personnel supplied and analyzed sampling solutions for nitrogen dioxide, sulfur dioxide, total oxidants, and aldehydes. The sampler operated for a 24-hour period every six days.

FIGURE 2  
FEED MATERIALS PRODUCTION CENTER  
ENVIRONMENTAL FEATURES

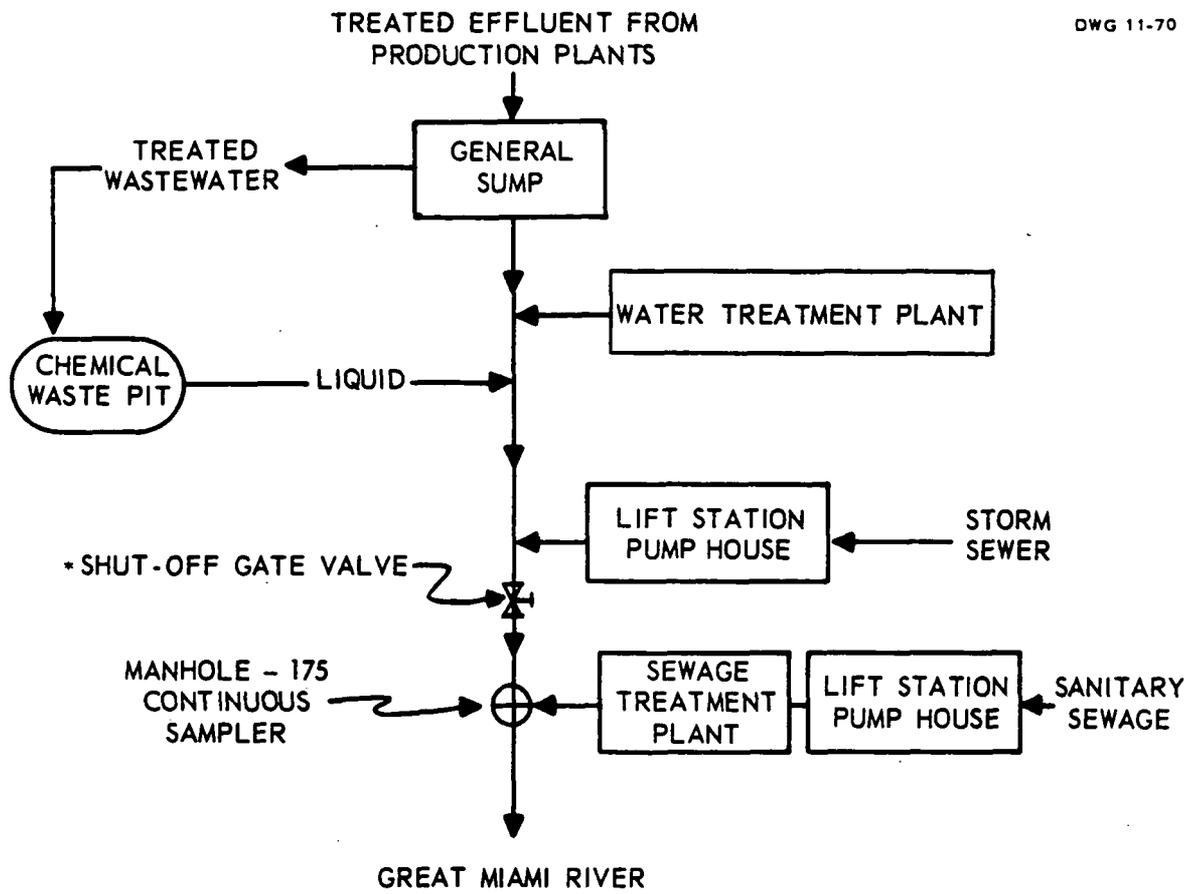
● BOUNDARY AIR SAMPLING STATIONS  
SCALE - 1" = 1380'



WATER. Each of the individual production plants on the project has sumps and equipment for the collection and initial treatment of process waste water. Uranium and thorium may be recovered as part of the treatment. Effluents from the plants are collected at a central facility, called the General Sump, for additional treatment. The treated wastes are then discharged into a large pit where the solids settle to the bottom. Clear effluent from the pit is combined with the other water streams and discharged to the Great Miami River. See Figure 3 for a diagram of the process.

Water samples are collected at several points to determine the effect of the effluent upon the river. Locations are shown in Figure 4. At point W1, upstream from the effluent discharge, a daily grab sample is collected. At the final access point on the waste line, a Parshal Flume type water sampler collects continuously a sample which is proportional to the total flow. This sample is collected and analyzed on a daily basis. Results of these analyses, combined with river flow measurements, are used to calculate contaminant concentrations added to the river at point W2. At point W3, downstream on the river from the discharge point, 24-hour samples are collected by a continuous sampler.

Daily samples from the final access point are analyzed for uranium, alpha and beta radioactivity, chloride, fluoride, nitrate, non-filterable solids, and pH. The same analyses are made on at least one sample per week from each of the river sampling points



DWG 11-70

\* Storm sewer water can be diverted to the Chemical Waste Pit or the General Sump by first halting the pumping from both locations and then closing the shut-off gate valve in the process waste line.

FIGURE 3 Flow Diagram of Chemical Waste and Disposal Process

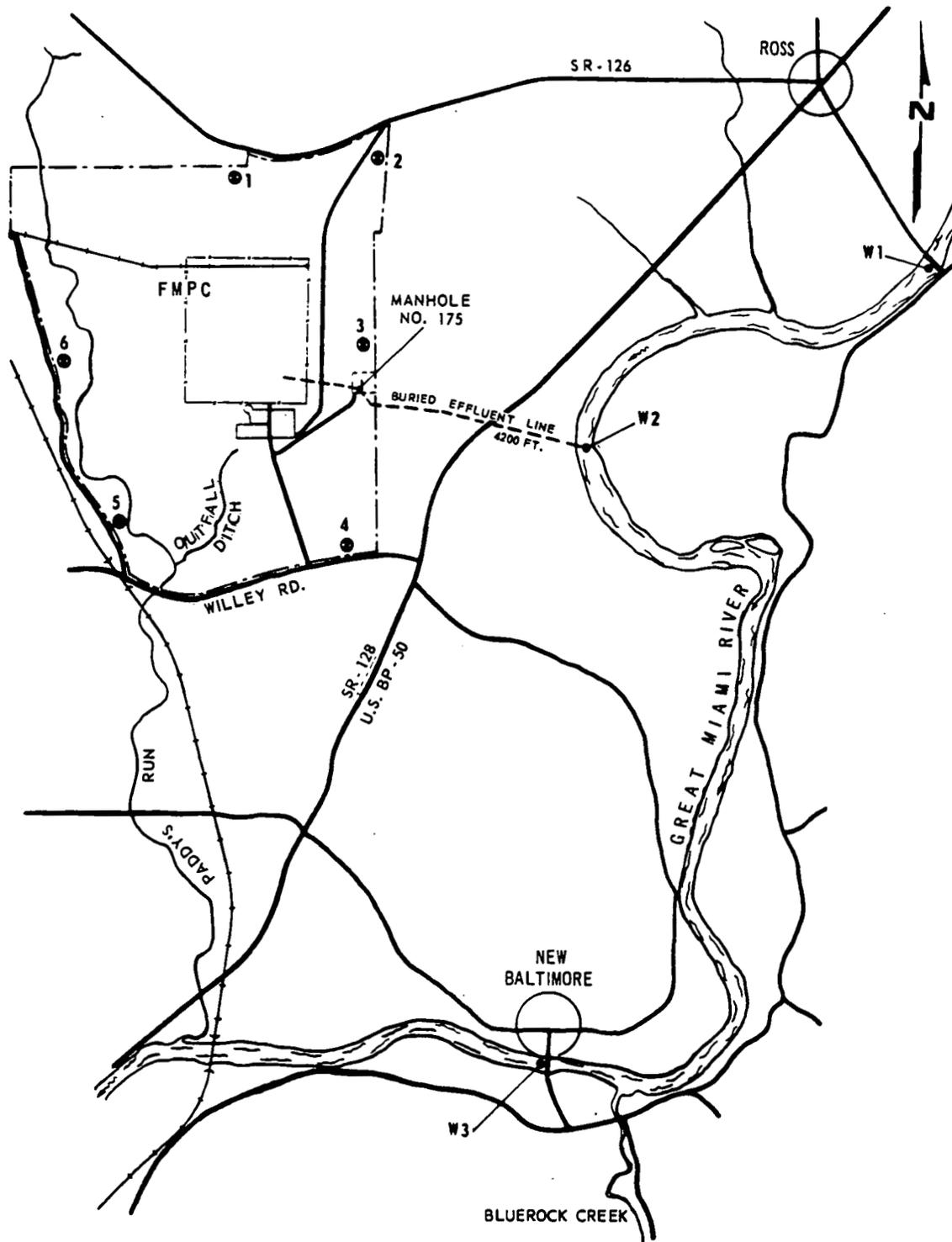


FIGURE 4 FMPC and Surrounding Area

● BOUNDARY AIR SAMPLING STATIONS.  
 W1 & W3 - WATER SAMPLING LOCATIONS.  
 W2 - POINT OF PLANT DISCHARGE  
 SCALE: 1" = 3055'

(W1 and W3). Results of this monitoring have been reported to the State of Ohio on a monthly basis since 1954.

Each month, single upstream and downstream river samples collected at points W1 and W3 are analyzed for radium<sup>226</sup> and radium<sup>228</sup>. Two-week composites from the waste-line final access point are analyzed for radium and three-month composites are analyzed for thorium.

SOIL. Once each year, soil samples are collected near the six Boundary Sampling Stations. Each sample consists of six cores, 2 cm diameter and 10 cm deep. The cores are taken about 1.5 meters apart. These samples are analyzed for uranium to observe the possible contribution from stack effluents.

#### MONITORING DATA

Environmental data collected during 1973 are given in Tables 1-5. Comparisons are made with the applicable standard for each contaminant.

Data in Table 1 show that average airborne uranium concentrations at the boundary sampling stations were no greater than 0.6% of the standard for offsite areas. It is concluded from these data that any offsite radiation exposure resulting from FMPC airborne contaminants would be a small fraction of the standards given in reference (1).

The concentrations of particulate matter found at the boundary are given in Table 2. At all locations the average concentration of

TABLE 1 Radioactive Contaminants in Air

Contaminant	Sampling Point (1)	Number of Samples	Maximum Conc. Found		Minimum Conc. Found		Average Concentration					Detection Level	Standard (2)
			$\mu\text{Ci/ml}$	$\mu\text{g/m}^3$	$\mu\text{Ci/ml}$	$\mu\text{g/m}^3$	$\mu\text{Ci/ml}$	$\mu\text{g/m}^3$	% of Standard	95% Confidence Limit			
Uranium(3)	BS1	52	$3.67 \times 10^{-14}$	0.110	$0.06 \times 10^{-14}$	0.002	$1.07 \times 10^{-14}$	0.032	0.5	$\pm 0.14 \times 10^{-14}$	$0.03 \times 10^{-14}$	$2 \times 10^{-12}$	
	BS2	52	$2.79 \times 10^{-14}$	0.084	$0.05 \times 10^{-14}$	0.002	$0.85 \times 10^{-14}$	0.026	0.4				
	BS3	49	$3.35 \times 10^{-14}$	0.100	$0.01 \times 10^{-14}$	<0.001	$1.19 \times 10^{-14}$	0.036	0.6				
	BS4	51	$1.78 \times 10^{-14}$	0.053	$0.03 \times 10^{-14}$	<0.001	$0.32 \times 10^{-14}$	0.010	0.2				
	BS5	47	$1.30 \times 10^{-14}$	0.039	$0.02 \times 10^{-14}$	<0.001	$0.34 \times 10^{-14}$	0.010	0.2				
	BS6	50	$4.58 \times 10^{-14}$	0.137	$0.02 \times 10^{-14}$	<0.001	$0.87 \times 10^{-14}$	0.026	0.4				
Thorium(3)	BS1	4(4)	$0.03 \times 10^{-15}$	0.0003	$<0.01 \times 10^{-15}$	<0.0001	$0.02 \times 10^{-15}$	0.0002	<0.001				
	BS2	4	$0.03 \times 10^{-15}$	0.0003	$0.01 \times 10^{-15}$	0.0001	$0.02 \times 10^{-15}$	0.0002	<0.001				
	BS3	4	$0.04 \times 10^{-15}$	0.0004	$0.01 \times 10^{-15}$	0.0001	$0.02 \times 10^{-15}$	0.0002	<0.001	$\pm 0.1 \times 10^{-15}$	$0.1 \times 10^{-15}$	$1 \times 10^{-12}$	
	BS4	4	$0.02 \times 10^{-15}$	0.0002	$0.01 \times 10^{-15}$	0.0001	$0.02 \times 10^{-15}$	0.0002	<0.001				
	BS5	4	$0.02 \times 10^{-15}$	0.0002	$0.01 \times 10^{-15}$	0.0001	$0.02 \times 10^{-15}$	0.0002	<0.001				
	BS6	4	$0.03 \times 10^{-15}$	0.0003	$0.01 \times 10^{-15}$	0.0001	$0.02 \times 10^{-15}$	0.0002	<0.001				
Gross Alpha Radioactivity	BS1	52	$5.31 \times 10^{-14}$	NA(5)	$0.10 \times 10^{-14}$	NA	$1.13 \times 10^{-14}$	NA	0.6				
	BS2	52	$3.62 \times 10^{-14}$	NA(5)	$0.15 \times 10^{-14}$	NA	$0.94 \times 10^{-14}$	NA	0.5				
	BS3	49	$4.02 \times 10^{-14}$	NA(5)	$0.10 \times 10^{-14}$	NA	$2.37 \times 10^{-14}$	NA	1.2	$\pm 0.14 \times 10^{-14}$	$0.01 \times 10^{-14}$	$2 \times 10^{-12}$	
	BS4	51	$1.96 \times 10^{-14}$	NA(5)	$0.05 \times 10^{-14}$	NA	$0.35 \times 10^{-14}$	NA	0.2				
	BS5	47	$1.45 \times 10^{-14}$	NA(5)	$0.04 \times 10^{-14}$	NA	$0.38 \times 10^{-14}$	NA	0.2				
	BS6	50	$4.22 \times 10^{-14}$	NA(5)	$0.08 \times 10^{-14}$	NA	$0.94 \times 10^{-14}$	NA	0.5				
Gross Beta Radioactivity	BS1	52	$5.77 \times 10^{-14}$	NA	$1.09 \times 10^{-14}$	NA	$2.70 \times 10^{-14}$	NA	0.003				
	BS2	52	$5.98 \times 10^{-14}$	NA	$1.11 \times 10^{-14}$	NA	$2.65 \times 10^{-14}$	NA	0.003				
	BS3	49	$8.73 \times 10^{-14}$	NA	$1.66 \times 10^{-14}$	NA	$3.54 \times 10^{-14}$	NA	0.004	$\pm 0.6 \times 10^{-14}$	$0.5 \times 10^{-14}$	$1 \times 10^{-9}$	
	BS4	51	$5.97 \times 10^{-14}$	NA	$1.00 \times 10^{-14}$	NA	$2.35 \times 10^{-14}$	NA	0.002				
	BS5	47	$4.65 \times 10^{-14}$	NA	$<0.10 \times 10^{-14}$	NA	$2.32 \times 10^{-14}$	NA	0.002				
	BS6	50	$6.01 \times 10^{-14}$	NA	$1.07 \times 10^{-14}$	NA	$3.35 \times 10^{-14}$	NA	0.003				

## Footnotes:

(1) See sampling locations shown in Figure 2.

(2) See Reference 1.

(3) In accordance with AECM-0524 a Curie of natural uranium means a total of  $7.49 \times 10^{10}$  dis/sec and a Curie of natural thorium means a total of  $7.4 \times 10^{10}$  dis/sec.

(4) Composite samples consisting of 13 continuous samples per calendar quarter.

(5) Not applicable

TABLE 2 Non-Radioactive Contaminants in Air

Contaminant	Sampling Point (1)	Number of Samples	Conc. Found		Average Concentration			Detection Level	Standard (2)
			Maximum $\mu\text{g}/\text{m}^3$	Minimum $\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	% of Standard	95% Confidence Limit		
Particulates	BS1	52	117	28	48	80	$\pm 5\%$	$1\mu\text{g}/\text{m}^3$	$60\mu\text{g}/\text{m}^3$
	BS2	52	108	25	52	87			
	BS3	49	94	27	52	87			
	BS4	51	111	31	58	97			
	BS5	47	107	31	54	90			
	BS6	50	113	24	52	87			
Nitrogen Dioxide	BS2	61	157	13	63	63	(3)	(3)	$100\mu\text{g}/\text{m}^3$
Sulfur Dioxide	BS2	58	117	0	20	33	(3)	(3)	$60\mu\text{g}/\text{m}^3$
Total Oxidants	BS2	59	104	3	25	60	(3)	(3)	$40\mu\text{g}/\text{m}^3$
Aldehydes, as Formaldehyde	BS2	58	42	0	11	7	(3)	(3)	$331\mu\text{g}/\text{m}^3$

- (1) See sampling locations shown in Figure 2.
- (2) See reference 2.
- (3) Not known.

particulate matter was less than the OEPA limit for the annual arithmetic mean.

During the year a total of 61 24-hour samples were collected with the sampler operated by the Southwestern Ohio Air Pollution Control Division. Results are given in Table 2. All monthly averages were within the applicable limits for nitrogen dioxide, sulfur dioxide, total oxidants, and aldehydes.

Table 3 contains information on radionuclides in water. As shown, the average concentration of uranium, thorium, and radium added to the river was no greater than 0.02% of the AEC Radiation Protection Standards for uncontrolled areas. By comparison, the average upstream concentrations of radium<sup>226</sup> and radium<sup>228</sup> were 7.2% and 1.5% of the standard.

State criteria for gross beta and dissolved alpha radioactivity were not exceeded in the river. The calculated addition of gross alpha and dissolved alpha radioactivity did average 7.8% and 5.4%, respectively, of the State criteria. However, this alpha activity was due principally to uranium, for which the AEC standard is substantially higher. The more limiting State standard is intended to provide control over all alpha emitters, including radium<sup>226</sup> which must be kept at a concentration much lower than other less important radionuclides.

TABLE 3 Radioactive Contaminants in Water

Contaminant	Sampling Point (1)	Number of Samples	Maximum Conc. Found		Minimum Conc. Found		Average Concentration					Detection Level $\mu\text{Ci/ml}$	Standard
			$\mu\text{Ci/ml}$	mg/l	$\mu\text{Ci/ml}$	mg/l	$\mu\text{Ci/ml}$	mg/l	% of Standard	95% Confidence Limit $\mu\text{Ci/ml}$			
Uranium (2)	W1	52	$0.42 \times 10^{-7}$	0.125	$< 0.01 \times 10^{-7}$	0.001	$0.04 \times 10^{-7}$	0.012	0.02	$\pm 1.7 \times 10^{-10}$	$3.4 \times 10^{-10}$	$2 \times 10^{-6}$	
	W2	365	$0.29 \times 10^{-9}$	0.001	$0.03 \times 10^{-9}$	$< 0.001$	$0.13 \times 10^{-9}$	$< 0.001$	$< 0.001$	NA(4)	NA	$\mu\text{Ci/ml}$	
	W3	52	$0.47 \times 10^{-7}$	0.140	$< 0.01 \times 10^{-7}$	0.001	$0.03 \times 10^{-7}$	0.010	0.02	$\pm 1.7 \times 10^{-10}$	$3.4 \times 10^{-10}$	(5)	
Thorium (2)	W2	12(3)	$9.03 \times 10^{-19}$	$8.02 \times 10^{-6}$	$1.18 \times 10^{-19}$	$1.05 \times 10^{-6}$	$4.11 \times 10^{-19}$	$3.65 \times 10^{-6}$	$< 0.001$	NA	NA	$1 \times 10^{-6}$	
Radium-226	W1	12	$20.43 \times 10^{-9}$	NA	$< 4.54 \times 10^{-10}$	NA	$22.70 \times 10^{-10}$	NA	7.2	$\pm 4.5 \times 10^{-10}$	$4.5 \times 10^{-10}$	$3 \times 10^{-8}$	
	W2	24	$0.19 \times 10^{-10}$	NA	$0.07 \times 10^{-11}$	NA	$0.06 \times 10^{-10}$	NA	0.02	NA	NA	$\mu\text{Ci/ml}$	
	W3	12	$36.32 \times 10^{-10}$	NA	$< 4.54 \times 10^{-10}$	NA	$9.08 \times 10^{-10}$	NA	3.0	$\pm 4.5 \times 10^{-10}$	$4.5 \times 10^{-10}$	(5)	
Radium-228	W1	12	$9.08 \times 10^{-10}$	NA	$< 4.54 \times 10^{-10}$	NA	$4.54 \times 10^{-10}$	NA	1.5	$\pm 4.5 \times 10^{-10}$	$4.5 \times 10^{-10}$	$3 \times 10^{-8}$	
	W2	24	$0.07 \times 10^{-10}$	NA	$0.05 \times 10^{-11}$	NA	$0.02 \times 10^{-10}$	NA	0.007	NA	NA	$\mu\text{Ci/ml}$	
	W3	12	$13.62 \times 10^{-10}$	NA	$< 4.54 \times 10^{-10}$	NA	$4.54 \times 10^{-10}$	NA	1.5	$\pm 4.5 \times 10^{-10}$	$4.5 \times 10^{-10}$	(5)	
Dissolved Alpha	W2	69	$4.26 \times 10^{-10}$	NA	$0.50 \times 10^{-10}$	NA	$1.62 \times 10^{-10}$	NA	5.4	NA	NA	$3 \times 10^{-9}$	
Gross Alpha	W2	365	$4.61 \times 10^{-10}$	NA	$0.73 \times 10^{-10}$	NA	$2.33 \times 10^{-10}$	NA	7.8	NA	NA	$3 \times 10^{-9}$	
Gross Beta	W1	52	$1.00 \times 10^{-7}$	NA	$0.04 \times 10^{-7}$	NA	$0.24 \times 10^{-7}$	NA	24	$\pm 5 \times 10^{-9}$	$4 \times 10^{-9}$	$1 \times 10^{-7}$	
	W2	365	$18.81 \times 10^{-10}$	NA	$2.69 \times 10^{-10}$	NA	$6.77 \times 10^{-10}$	NA	0.7	NA	NA	$\mu\text{Ci/ml}$	
	W3	52	$0.50 \times 10^{-7}$	NA	$0.04 \times 10^{-7}$	NA	$0.18 \times 10^{-7}$	NA	18	$\pm 5 \times 10^{-9}$	$4 \times 10^{-9}$	(7)	

Footnotes:

- (1) See sampling locations shown in Figure 4. W1 - Miami River, upstream at Ross, Ohio. W2 - Calculated addition to the river based on effluent analyses and river flow. W3 - Miami River, downstream at New Baltimore, Ohio.
- (2) In accordance with Manual Chapter 0524 a Curie of natural uranium means a total of  $7.45 \times 10^{10}$  dis/sec and a Curie of natural thorium means a total of  $7.4 \times 10^{10}$  dis/sec.
- (3) Each sample is a one-month composite of daily 24-hour samples.
- (4) Not applicable.
- (5) See reference 1.
- (6) See reference 4.
- (7) See reference 3.

Until the adoption of OEPA regulations in mid-1973 there was no state standard for gross alpha radioactivity. At the FMPC, gross alpha is considered only as an estimate of the uranium concentration because uranium is the major alpha-emitting radionuclide handled. Alpha results are not used independently but are used as an adjunct to uranium data. As a consequence, no special efforts are made to avoid low level contamination during the alpha determination. Laboratory quality control tests indicate a detection level slightly above the state standard of  $3 \times 10^{-9}$   $\mu\text{Ci}/\text{m}\ell$ . Therefore, gross alpha radioactivity in river samples is not reported. However, as noted in the preceding paragraph, the calculated average addition of gross alpha amounts to only 7.8% of the state standard.

A recent OEPA report contains information on Miami River radioactivity for 1969 through 1972.<sup>(5)</sup> On an annual basis, the average radioactivity found at New Baltimore (W3, Figure 4) did not exceed  $3 \times 10^{-9}$   $\mu\text{Ci}/\text{m}\ell$ , alpha, and  $26 \times 10^{-9}$   $\mu\text{Ci}/\text{m}\ell$ , beta. State limits for gross radioactivity are  $3 \times 10^{-9}$   $\mu\text{Ci}/\text{m}\ell$ , alpha, and  $100 \times 10^{-9}$   $\mu\text{Ci}/\ell$ , beta.

Operations at the FMPC did not cause any State standard for non-radioactive contaminants to be exceeded in the river. The contaminants listed in Table 4 were selected for analysis and reporting because of the possibility of adding to the river contaminant concentrations which were >1% of the applicable State standards.

TABLE 4 Non-Radioactive Contaminants in Water

Contaminant	Sampling Point (1)	Number of Samples	Maximum Conc. Found mg/l	Minimum Conc. Found mg/l	Average Concentration			Detection Limit	Standard
					mg/l	% of Standard	95% Confidence Limit		
Chloride	W1	52	60	16.	35	14	±10%	1mg/l	250 mg/l (2)
	W2	365	0.1	0.01	0.05	0.02			
	W3	52	60	16	34	14			
Non-Filterable Solids	W1	52	1300	16	140	NA(3)	±20%	4mg/l	100 mg/l (4)
	W2	365	49	20	31	31			
	W3	52	1800	7	160	NA			
Fluoride	W1	52	2.1	0.2	0.6	46	±15%	0.2mg/l	1.3 mg/l (2)
	W2	365	0.002	<0.001	<0.001	0.08			
	W3	52	1.2	0.2	0.6	46			
Nitrate	W1	52	29	6	16	46	±10%	0.3mg/l	35 mg/l (2)
	W2	365	4.0	0.6	1.5	4.3			
	W3	52	32	9	19	54			

## Footnotes:

- (1) See sampling locations shown in Figure 4.
- (2) See reference 3.
- (3) Not applicable.
- (4) National Lead Company of Ohio Concentration Guide for non-filterable solids in the effluent.

TABLE 5 Uranium in Soil

Sampling Point (2)	Uranium Concentration (1)			Detection Level
	μCi/g	μg/g	95% Confidence Limit	
BS1	$7.0 \times 10^{-6}$	21	± 25%	0.5 μg/g
BS2	$9.0 \times 10^{-6}$	27		
BS3	$45.8 \times 10^{-6}$	137		
BS4	$5.0 \times 10^{-6}$	15		
BS5	$4.7 \times 10^{-6}$	14		
BS6	$5.0 \times 10^{-6}$	15		

## Footnotes:

- (1) Results on dry basis.
- (2) See sampling locations shown in Figure 2.

There are no standards for comparison with the results for uranium in soil listed in Table 5. Although the normal value for uranium in local soil is 1-4  $\mu\text{g/g}$ , there are no hazards associated with the elevated soil uranium produced by FMPC operations. External radiation from uranium is slight and the exposure contribution from these onsite concentrations would be considerably less than 1% of the Radiation Protection Standard for people in uncontrolled areas.

#### RADIATION EXPOSURE ESTIMATIONS

Based on the reasoning outlined below, it is concluded that radiation exposure to the public from activities at the FMPC during 1973 did not exceed one percent of AEC radiation protection standards.<sup>(1)</sup> Intakes of uranium from water, food, and air are considered as the only potential sources of exposure.

Water. Permissible intake for natural uranium in water, for persons living at the plant boundary, is  $2 \times 10^{-5} \mu\text{Ci/ml}$ .<sup>(1)</sup> This limit applies to soluble or insoluble uranium.

The daily water intake for the ICRP standard man is 2200 ml/day.<sup>(6)</sup> Therefore, the total daily uranium intake permitted is 44,000 picocuries per day:

$$\begin{aligned} (2200 \text{ ml/day}) (2 \times 10^{-5} \mu\text{Ci/ml}) &= 4400 \times 10^{-5} \mu\text{Ci/day} \\ &= 44,000 \text{ pCi/day} \end{aligned}$$

Using the AECM-0524 definition of a curie of uranium, an intake of 44,000 pCi/day corresponds to 0.13 grams of uranium:

$$\frac{(44,000 \text{ pCi/day}) (4.49 \text{ dpm/p Ci})}{1.5 \text{ dpm}/\mu\text{g}} = 1.3 \times 10^5 \mu\text{g U}$$

$$= 0.13 \text{ grams U}$$

As shown in Table 3 of this report, the average concentration of uranium downstream from the FMPC was ten micrograms per liter (0.010 mg/l). If a boundary resident used water from the Miami River he would have a daily intake of 22 micrograms:

$$(0.010 \text{ mg/l}) (2.2\text{l}) = 0.022 \text{ mg U}$$

$$= 22 \mu\text{g U}$$

This quantity of uranium is 0.02% of the permissible daily intake:

$$\frac{22 \mu\text{g U (intake)}}{1.3 \times 10^5 \mu\text{g U (permitted)}} (100\%) = 0.02\%$$

Food. If a local resident raises his own vegetables it is possible for those crops to contain some uranium from FMPC operations. The average concentration of uranium found in vegetables grown near the FMPC is 0.016 micrograms per gram wet weight. If we assume that a boundary resident consumes two pounds of such vegetables per day, his uranium intake would be 14 micrograms per day:

$$(0.016 \mu\text{g U/g}) (453.6 \mu\text{g/lb}) (2 \text{ lb/day}) = 14 \mu\text{g U/day}$$

This amount of uranium is 0.01% of the intake permitted in drinking water:

$$\frac{14 \mu\text{g}}{1.3 \times 10^5 \mu\text{g}} (100\%) = 0.01\%$$

A less conservative estimate is obtained by considering the average daily intake of uranium. Based on analyses of basic foods, it has been estimated that the average person has a daily intake of <2  $\mu\text{g}$

of uranium from all sources.<sup>(7)</sup> If we assume that FMPC activities have caused a 100-fold increase due to soil contamination, our boundary resident would have a daily intake of 200 µg U from his home-grown vegetables. This amounts to 0.15% of the intake permitted from drinking water:

$$\frac{200 \text{ } \mu\text{g}}{1.3 \times 10^5 \text{ } \mu\text{g}} (100\%) = 0.15\%$$

Air. As shown in Table 1 of this Environmental Monitoring Report, the highest average concentration of uranium in air was at Boundary Sampling Station No. 3. The average was 0.6% of the standard given in AECM-0524.

Maximum Potential Exposure. The total estimated maximum potential exposure to a local resident living just within the plant boundary is less than one percent of the AECM-0524 standards:

<u>Source</u>	<u>% of Standard</u>
Water	0.02
Food	0.15
Air	<u>0.6</u>
	0.77

Maximum Dose To An Individual. Since the nearest resident to Boundary Station No. 3 lives about 1000 feet away, it is reasonable to expect that the resident's actual intake of uranium was less than the amount indicated by air samples from that station. If he drank

water from the river and ate the same vegetables described above, his exposure would be less than 0.77% of the relevant AECM-0524 dose standards.

Maximum Dose To A Population Group. In addition to providing limits for boundary residents, AECM-0524 also stipulates that the limits must be reduced by a factor of three when applied to a suitable sample of the exposed population. The community of Ross, Ohio, is located about 2.5 miles from the center of the FMPC production area. If these residents qualify as a suitable sample of the exposed population, their airborne uranium exposure limit should be one-third of the limit used in Table 1 of this report, or  $0.7 \times 10^{-12}$   $\mu\text{Ci}/\text{m}\ell$ . Boundary Station No. 2 is the nearest station to Ross. During 1973, the average airborne uranium concentration at this station was  $0.85 \times 10^{-14}$   $\mu\text{Ci}/\text{m}\ell$ . This is 1.2% of  $0.7 \times 10^{-12}$   $\mu\text{Ci}/\text{m}\ell$ . The actual concentration in Ross would have been much lower since the 2.5 miles between FMPC and Ross is about six times the distance from the production area center to the Boundary Sampling Station. At this distance we conservatively assume a reduction to one-fourth of the boundary concentration, or 0.3% of the applicable limit.

Exposure due to uranium in home-grown foods would be less for these urban residents than for farm residents along the plant boundary. If we assume that a Ross resident buys about one-half of his produce from the boundary resident, then we can assume an intake of 100  $\mu\text{g}$  U per day. Since this group has a lower permissible intake, this quantity of uranium amounts to 0.26% of the standard:

$$\frac{100 \text{ } \mu\text{g/day}}{(1/3)(1.3 \times 10^5 \text{ } \mu\text{g/day})} (100\%) = 0.26\%$$

This community is upstream on the Miami River from the FMPC outfall and FMPC activities would not contribute to their uranium intake from drinking water. Therefore, this groups' exposure would also be less than one percent of the applicable standard.

<u>Source</u>	<u>% of Standard</u>
Food	0.26
Air	<u>0.3</u>
	0.56

50-Mile Man-Rem Value. An estimated 2.5 million people live within a 50-mile radius of the FMPC. Airborne uranium is the only exposure source which might be of any importance for this group.

The whole body exposure dose limit given for this group in AECM-0524 is 0.17 rem per year. If airborne uranium is to be the source of this exposure, the limit for soluble uranium must be considered. According to AECM-0524, the limit for soluble uranium related to an exposure of 0.17 rem per year is  $1 \times 10^{-12}$   $\mu\text{Ci/ml}$ . The average concentration of total uranium found at the FMPC boundary, calculated from data in Table 1 of this report, was  $0.77 \times 10^{-14}$   $\mu\text{Ci/ml}$ . It appears reasonable, and conservative, to assume that the average concentration throughout the entire 50-mile radius would be no more than 1% of the boundary line concentration, or  $0.77 \times 10^{-16}$   $\mu\text{Ci/ml}$ . On this basis, the exposure within this 50-mile radius caused by

airborne uranium from the FMPC would be 32 man-rem:

$$\frac{0.77 \times 10^{-16} \mu\text{Ci/ml}}{1 \times 10^{-12} \mu\text{Ci/ml}} (0.17 \text{ rem})(2.5 \times 10^6 \text{ people}) = 32 \text{ man-rem}$$

#### TOTAL RADIONUCLIDES RELEASED

During 1973, the amount of airborne uranium released through the plant stacks was 0.13 curies. The total released in liquid effluent was 0.58 curies. Other liquid effluent release totals were: Thorium, 0.001 curies; Radium-226, 0.024 curies; Radium-228, 0.006 curies.

#### OTHER ENVIRONMENTAL CONTROLS

Sewage Plant Effluent. Effluent from the FMPC Sewage Treatment Plant is combined with other effluents at MH 175 (see Figure 3). Prior to discharge from the Sewage Treatment Plant, however, the effluent is carefully monitored and sampled to determine efficiency of operation and compliance with all applicable standards. The comparison below shows that FMPC sewage treatment effluent far surpasses the requirements, in all parameters, of the federal EPA secondary treatment regulations (40 CFR 133.102).

<u>Parameter</u>		<u>EPA Standards</u>	<u>Typical FMPC Monthly Results</u>
B.O.D.	30 days (mg/ℓ)	30	7.4 avg.
	7 days (mg/ℓ)	45	10.7 max.
	Reduction (%)	85	89.0
Suspended Solids	30 days (mg/ℓ)	30	4.0 avg.
	7 days (mg/ℓ)	45	7.0 max.
	Reduction (%)	85	95.3
Fecal Coliform	30 days (/100 ml)	200	3.0 avg. (MH 175)
	7 days (/100 ml)	400	5.0 max. (MH 175)
pH	(range)	6.0-9.0	7.0-8.0

Steam Plant Emissions. The steam generation plant at FMPC consists of four boilers with a total design capacity of 300,000 lbs. of steam per hour. State of Ohio EPA Regulation EP-11-10 "Restriction on emission of particulate matter from fuel burning equipment" establishes 0.13 pounds of particulates per million BTU input as the maximum limit on emissions of particulates from a steam generation plant with such capacity. Repeated stack sampling tests have shown that the range of particulate emissions from the steam generation plant stacks is 0.25 - 0.40 lbs. per million BTU input.

Plans have been made for the installation of electrostatic precipitation equipment on the steam generation plant. With the completion of this installation it is anticipated that FMPC will be in compliance with the particulate emission limit set by EP-11-10.

State of Ohio EPA Regulation EP-11-13, "Restrictions on emission of sulfur dioxide from use of fuel" sets a sulfur dioxide emission limit for facilities such as the FMPC steam generation plant located in Hamilton and Butler Counties at 1.6 pounds of SO<sub>2</sub> per million BTU heat input. Continued compliance with this regulation will depend on the availability of coal with less than 1.0% sulfur content.

Particulates from Industrial Processes: Maximum rates of emissions of particulates from industrial processes are prescribed in State of Ohio EPA Regulation EP-11-11, "Restriction of emission of particulate matter from industrial processes." Through the use of many dust collectors, scrubbers, electrostatic precipitators, and other types of air cleaning equipment, particulate emissions from FMPC process operations are far below the established limits. No problems are anticipated in remaining in compliance with EP-11-11.

Incinerator Operations. The FMPC incinerator is used for the destruction of combustible trash, paper, wood, etc. It is equipped with a gas-fired afterburner to aid in attaining a goal of +1850°F temperature in the stack gases. The particulate emission limit prescribed by State of Ohio EPA Regulation EP-11-09, "Restriction on emissions from incinerators" is 0.10 pounds of particulate matter per 100 pounds of combustible refuse charged. Inaccessibility of the stack and the high temperature of the stack gas combine to make sampling difficult and data as to compliance with EP-11-09 has not

been obtained. However, during steady state operations with the 1850°F temperature developed, it is believed the incinerator operation is in compliance. Plans have been made to obtain a suitable sampling platform and the equipment necessary for compliance testing. Open burning is prohibited at FMPC in compliance with State of Ohio EPA Regulation AP3-08.

#### REFERENCES

- (1) U. S. Atomic Energy Commission, AEC Manual Chapter 0524, Standards For Radiation Protection. February 4, 1969.
- (2) Ohio Environmental Protection Agency, Ambient Air Quality Standards.
- (3) Ohio Environmental Protection Agency, Regulation EP-1, Water Quality Standards, effective July 27, 1973.
- (4) Ohio Department of Health, Water Pollution Control Board, Regulations adopted January 28, 1972; effective February 15, 1972.
- (5) Ohio Environmental Protection Agency, Radiological Monitoring Report, Surface and Ground Waters of Ohio, 1969, 1970, 1971, 1972. Undated.
- (6) ICRP Publication 6, Recommendations of the International Commission on Radiological Protection, 1964.
- (7) G. A. Welford and R. Baird, Uranium Levels in Human Diet and Biological Materials, Health Physics 13: 1321 (1967).

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