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# THE MEMPHIS DEPOT
# TENNESSEE

## ADMINISTRATIVE RECORD
## COVER SHEET

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# UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010-5422

WATER QUALITY BIOLOGICAL STUDY NO. 32-24-0733-86
INVESTIGATION OF FIRE RESERVOIR
DEFENSE DEPOT MEMPHIS
MEMPHIS, TENNESSEE
10-14 MARCH 1986

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO ATTENTION OF

HSHB-ME-WS

30 July 1986

SUBJECT: Water Quality Biological Study No. 32-24-0733-86, Investigation of Fire Reservoir, Defense Depot Memphis, Memphis, Tennessee, 10-14 March 1986

Director
Defense Logistics Agency
ATTN: DLA-WS
Alexandria, VA 22304-6100

EXECUTIVE SUMMARY

The purpose and a summary of the recommendations of the enclosed report follow:

a. Purpose. To investigate possible metal, pesticide, and other organic and inorganic contamination of Fire Reservoir waters, sediment, and associated fish species on Defense Depot Memphis, Memphis, Tennessee.

b. Recommendations. The following recommendations are based on good environmental practices: Keep the Fire Reservoir off limits to fishing, and find the source of the pesticides and polychlorinated biphenyls.

FOR THE COMMANDER:

Encl

KARL J. DAUBEL
Colonel, MS
Director, Environmental Quality

CF:
HQDA(DASG-PSP) (wo/encl)
Comdt, AHS (HSHA-IPM) (w/encl)
Cdr, MEDDAC, Ft Campbell (PVNTMED Svc) (2 cy) (w/encl)
Cdr, DDEAMC (PVNTMED Svc) (w/encl)
Cdr, USAEHA Fld Spt Actv, Ft McPherson (w/encl)

Water Quality Biological Study No. 32-24-0733-86, DDMT, 10-14 Mar 86

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WATER QUALITY BIOLOGICAL STUDY NO. 32-24-0733-86
INVESTIGATION OF FIRE RESERVOIR
DEFENSE DEPOT MEMPHIS
MEMPHIS, TENNESSEE
10-14 MARCH 1986

1. AUTHORITY. Letter, DLA, DLA-WS, 4 October 1985, subject: USAEHA Mission Services, FY 86.

2. REFERENCES. See Appendix A.

3. PURPOSE. To investigate possible metal, pesticide, and other organic and inorganic contamination of Fire Reservoir waters, sediment, and associated fish species on DDMT.

4. GENERAL.

a. Abbreviations and Definitions. See Appendix B.

b. Personnel Contacted.

(1) Mr. Ulysses Truitt, Deputy Director, Installation Services, DDMT.

(2) MAJ Douglas R. Lamothe, US Army, Chief, DEH, DDMT.

(3) Mr. Bill Lovejoy, Environmental Coordinator, DEH, DDMT.

(4) Mr. Thomas Bumpas, Chief, Operations and Maintenance Branch, DEH, DDMT.

(5) Mr. Charles Dunaway, Chief, Roads, Railroads, Grounds, Entomology, and Refuse Sections, DEH, DDMT.

(6) Mr. Jewel Edwards, Entomology Supervisor, DEH, DDMT.

Use of trademarked names does not imply endorsement by the US Army but is intended only to assist in identification of a specific product.

c. Study Personnel.

(1) CPT Richard W. Whiteside, Environmental Science Officer, who has since departed USAEHA.

(2) Mr. Carl A. Bouwkamp, Aquatic Biologist, WQED, USAEHA.

d. Background. The DDMT encompasses 642 acres and is located within the city limits of Memphis, Tennessee. The major mission of DDMT is storage and distribution of supplies common to all American military services and some civilian agencies located in the south central United States. Stock items include food, clothing, electronics, petroleum products, and general construction, industrial, and medical supplies (reference 4). The DDMT surface waters include the Fire Reservoir (3.95 acres) and a small pond (0.1 acre) on the golf course. Influent to the Fire Reservoir includes golf course runoff and effluent from a storm sewer system that collects discharge from approximately one-third of the installation storage facilities and adjacent areas. The small pond on the golf course primarily receives runoff from part of the golf course, open area, and two nearby parking lots. Overflows from these impoundments discharge to separate storm drains that eventually empty into the Mississippi River via Nonconnah Creek (reference 4).

e. Sample Site Locations. See Appendix C.

f. Methods. See Appendix D for analytical methods used and Appendix E for characteristics studied at each sample site. Water and sediment grab samples were collected at each sample location. Additional water grab samples were collected at each sample site following a period of heavy rainfall. Precipitation during the study caused the flow into the Fire Reservoir and small pond (totally stormwater) to bring the water level up several inches and overflow significantly. Water and sediment samples were preserved and returned to USAEHA for analysis. Fish were collected in the Fire Reservoir and the small pond using experimental gill and dip nets. Fish samples were prepared (filleted), preserved (frozen), and returned to USAEHA for analysis.

5. FINDINGS AND DISCUSSION. The results are presented in Appendix F through M.

a. Water Analysis. Results from water analysis indicated that the Fire Reservoir and the small pond were relatively free of tested pollutants (Appendix F, I, J, and K). Base neutral and acid extractable organics, and metals were not detected in waters from the Fire Reservoir or small pond during either sampling period (Appendix G and J). Pesticides were not detected in the Fire Reservoir or pond water during the initial sampling period (Appendix K). However, in the second sample period during the heavy rainfall, DDT was detected in the Fire Reservoir at sample site 1 (0.85 µg/L) along with trace amounts of DDE and DDD. The level of DDT detected at this site approached the mean acute aquatic life toxicity level of 1.1 µg/L (reference 2). However, the acute toxicity level for catfish (the

species in the Fire Reservoir) and goldfish (the species in the small pond) was 17.4 and 180 µg/L, respectively. Sample site 1 was the stormwater influent site to the reservoir. Detection of DDT at this site following rainfall indicated an active source of this pesticide entering the reservoir since DDT exposed to the environment for a period of time changes form to a combination of DDE and DDD. Inorganic and physical parameters were within the acceptable range for aquatic life (Appendix E). However, detection limits for cyanide (0.01 mg/L) were above aquatic life criteria levels (0.0052 mg/L, reference 1). Therefore, cyanide may be present in waters above the criteria level, but there was no reason to suspect any contamination.

b. Sediment Analysis. Results from sediment analysis indicated that several metals (cadmium, chromium, copper, lead, and zinc) and pesticides (chlordane and DDT) were at higher concentrations in the sediments of the fire reservoir than the sediments of the small pond (Appendix H and L). The levels found in the small pond were extremely similar to that found in the sediment of several previous Agency studies indicating that indeed the concentrations in the Fire Reservoir were somewhat elevated over the norm. However, the metals analyzed for in the water were all below detection limits at the time of this study indicating the metals were accumulating in the sediments without being a water quality problem. The low concentrations in the supernatant indicated that the metals were effectively bound up in the sediments. The pesticide residues found in the sediment of the Fire Reservoir were both persistent (chlordane and DDT).

c. Fish Tissue Analysis. Results of fish tissue analysis for metals indicated the catfish in the Fire Reservoir showed no bioaccumulation of metals over that of the goldfish in the small pond at the stated detection limits (Appendix I). The pesticide residues were higher in the catfish of the Fire Reservoir than the goldfish of the small pond (Appendix M). The worst-case fish sample added up to 23.64 mg/kg DDT + breakdown products, and the FDA action level is 5 mg/kg. The worst-case fish sample for chlordane was 2.13 mg/kg in the Fire Reservoir and 0.6 mg/kg in the small pond and the FDA action level was 0.3 mg/kg (reference 3). The action level for dieldrin was 0.3 mg/kg, and one of the catfish from the Fire Reservoir contained 0.31 mg/kg. The PCBs were questionably high in both the Fire Reservoir and small pond. The action level is not given for fish, but being a carcinogen, any exposure to PCB is a risk. Chlorpyrifos (Dursban®) was detected in the catfish from the Fire Reservoir. While reference 3 specifies no action level for chloropyrifos, the Food and Drug Administration can take action at any concentration detectable for this pesticide. The fish should not be eaten from either water body. There must be an active source (other than pest spraying) for DDT since DDT changes to DDD and DDE (breakdown products) when exposed to the environment for any length of time. High percentages of DDT were found in the runoff going into the Fire Reservoir, sediment, and in the fish tissue. Since DDT is no longer used, the source must be other than normal environmental residuals. Chlordane, dieldrin, and chlorpyrifos are often used because of their persistence making them good for termites, ants, and household pests.

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® Dursban is a registered trademark of Dow Chemical Company, Midland, Michigan.

6. CONCLUSIONS. The physical and chemical water quality in the Fire Reservoir and the small pond were generally within acceptable ranges for the support of aquatic life. However, the persistent pesticides (chlordane and DDT) far exceeded the action level for the safe consumption of fish. The normalized bioconcentration factor for DDT is 17,870 and chlordane is 4,444 (reference 2). Also, concentrations of dieldrin, chlorpyrifos and PCBs detected in the fish approach or slightly exceed safe levels for human consumption.

7. RECOMMENDATIONS. To ensure good environmental practices, the following recommendations are made:

a. Keep the Fire Reservoir off limits to fishing (paragraph 5c).

b. Locate the source of pesticides and PCBs (paragraph 5c).

8. TECHNICAL ASSISTANCE. Requests for services should be directed through appropriate command channels of the requesting activity to the Commander, US Army Environmental Hygiene Agency, ATTN: HSHB-ME, Aberdeen Proving Ground, MD 21010-5422, with an information copy furnished the Commander, US Army Health Services Command, ATTN: HSCL-P, Fort Sam Houston, TX 78234-6000. Informal technical advice and/or assistance regarding this report may be obtained from the Chief, WQED, AUTOVON 584-3816/3554.

Carl A. Bouwkamp

CARL A. BOUWKAMP
Aquatic Biologist
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APPROVED:

for Stephen L. Kistner

ROY D. MILLER
LTC, MS
Chief, Water Quality Engineering Division

## APPENDIX A

## REFERENCES

1. Water Quality Criteria; Availability of Documents; 50 Federal Register (FR) 30784-30796, 29 July 1985.

2. Ambient Water Quality Criteria, October 1980, Environmental Criteria and Assessment Office, Washington, DC.

3. Food and Drug Administration, January 1985, Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed.

4. Letter, US Army Toxic and Hazardous Materials Agency, DRXTH-AS, 16 July 1982, subject: Installation Assessment of Defense Depot Memphis, Memphis, Tennessee, Report No. 191.

5. Letter, USAEHA, HSHB-EA-A, 25 November 1985, subject: Environmental Audit No. 43-21-1387-86, Defense Depot Memphis, Memphis, Tennessee, 8-18 July 1985.

## APPENDIX B

## ABBREVIATIONS AND DEFINITIONS

| | |
|---|---|
| AOAC | Association of Official Analytical Chemists |
| BHC | benzene hexachloride |
| $CaCO_3$ | calcium carbonate |
| DDD | dichloro-diphenyl-dichloro-ethane, breakdown product of DDT |
| DDE | dichloro-diphenyl-dichloro-ethene, breakdown product of DDT |
| DDMT | Defense Depot Memphis Tennessee |
| DDT | dichloro-diphenyl-trichloro-ethane, banned persistent pesticide |
| DEH | Directorate of Engineering and Housing |
| DLA | Defense Logistics Agency |
| EDTA | ethylenediaminetetraacetic acid |
| EPA | US Environmental Protection Agency |
| FDA | Food and Drug Administration |
| FY | fiscal year |
| HCB | hexachlorobenzene |
| mg/kg | milligram per kilogram |
| mg/L | milligram per liter |
| PCB | polychlorinate biphenyl, a common industrial pollutant |
| pH | the negative logarithm of the effective hydrogen ion concentration used in expressing both acidity and alkalinity |
| USAEHA | United States Army Environmental Hygiene Agency |
| WQED | Water Quality Engineering Division |

# APPENDIX C

## SAMPLE SITE LOCATIONS

DEFENSE DEPOT MEMPHIS

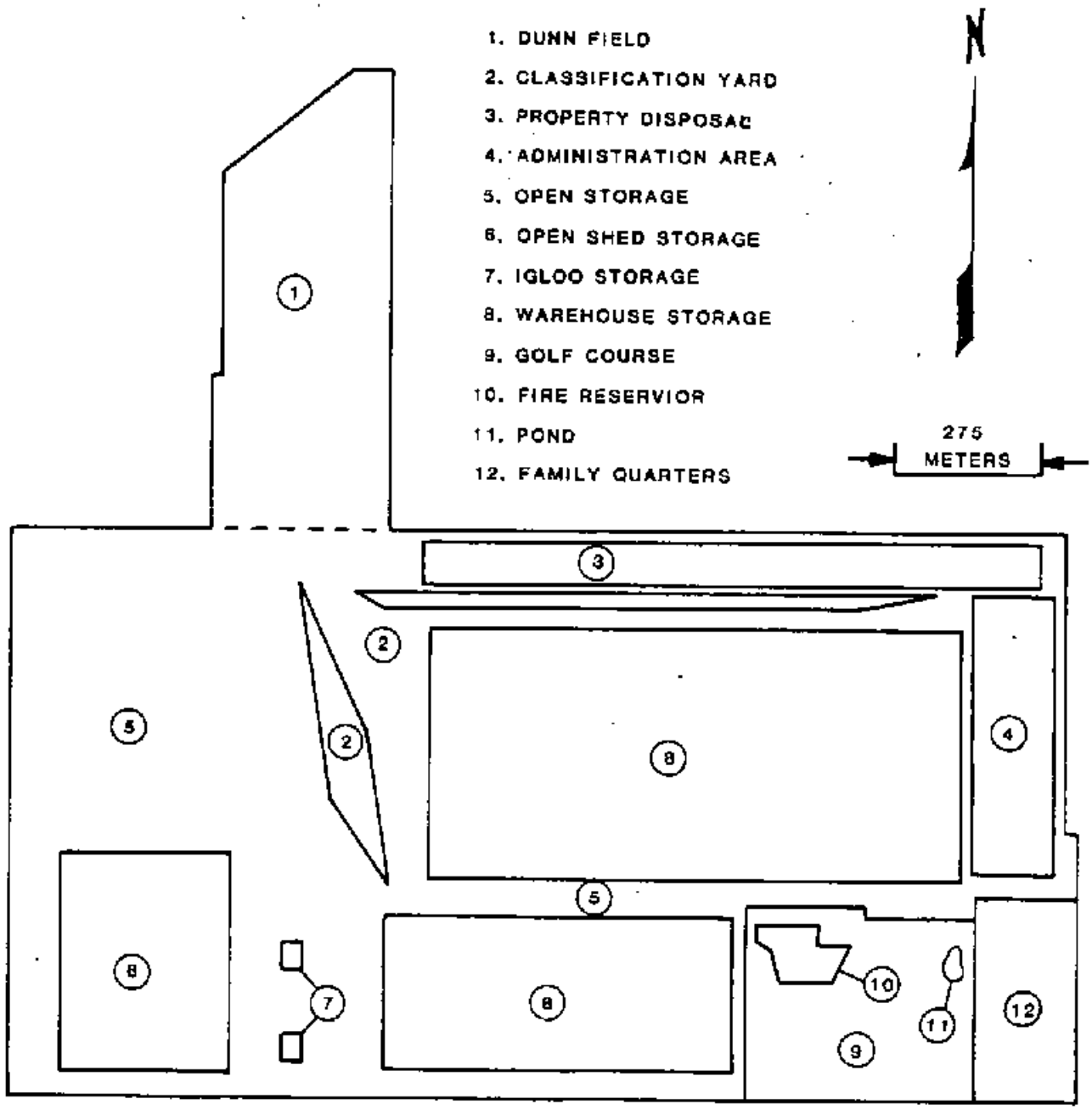


FIGURE C-1 LOCATIONS ON DEFENSE DEPOT MEMPHIS

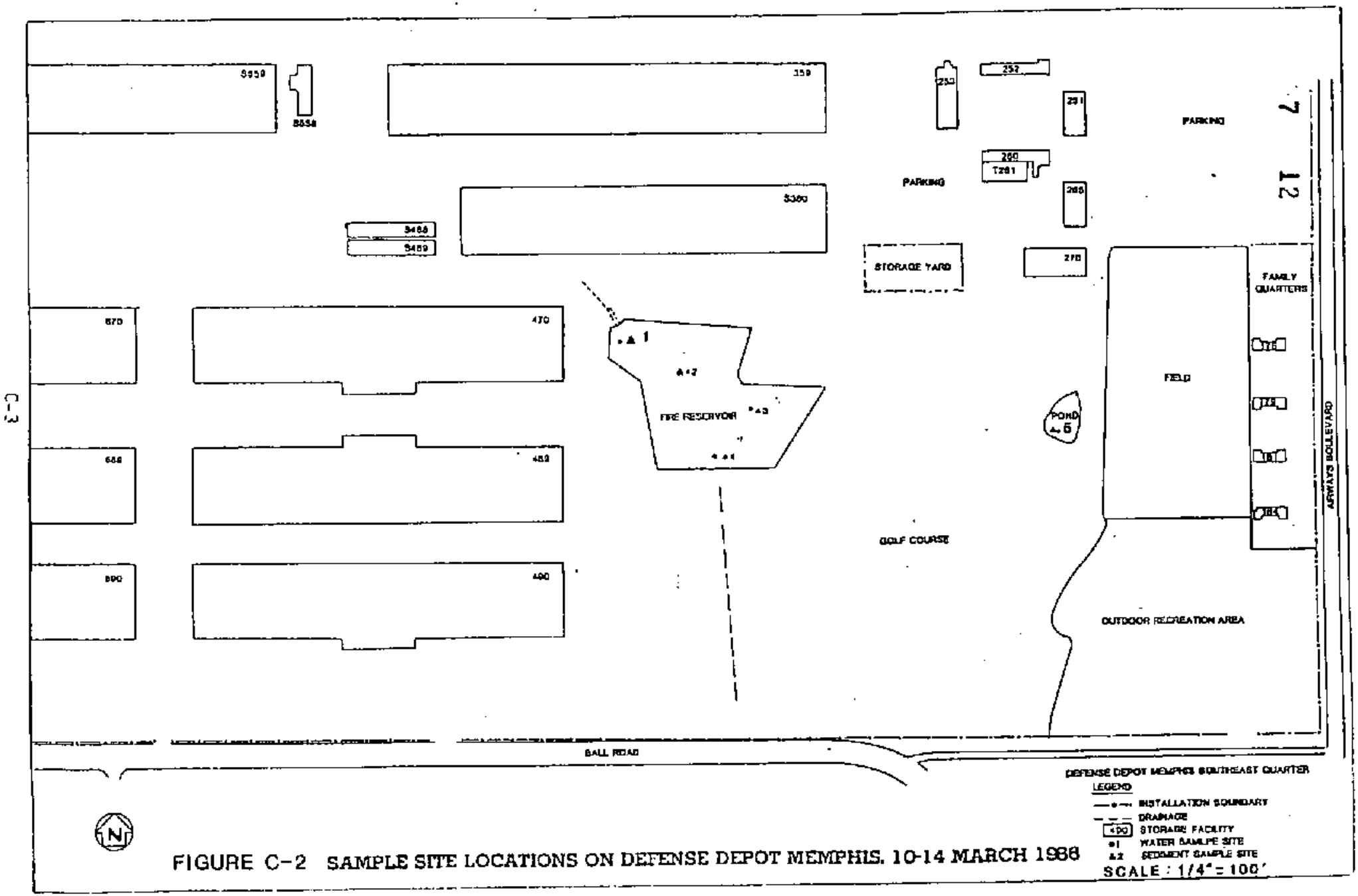


FIGURE C-2 SAMPLE SITE LOCATIONS ON DEFENSE DEPOT MEMPHIS, 10-14 MARCH 1986

APPENDIX D

ANALYTICAL METHODS

| Characteristic | Reference Method | Method |
|---|---|---|
| Dissolved Oxygen | EPA 360.1* | Electrochemical membrane |
| Temperature | EPA 170.1* | Thermometric |
| pH | EPA 150.1* | Electrochemical |
| Conductivity | SM 250† | Wheatstone Bridge conductivity |
| Alkalinity (as $CaCO_3$) | EPA 310.1* | Titrimetric to pH of 4.5 |
| Hardness (as $CaCO_3$) | EPA 130.2* | Titrimetric EDTA |
| Chlorides | SM 408B† | Titrimetric-mercuric nitrate |
| Sulfate | EPA 375.4* | Turbidimetric |
| Cyanide, total | EPA 335.2* | Spectrophotometric, Manual Distillation |
| Grease and Oil | EPA 413.1* | Liquid-liquid extraction, gravimetric |
| Ammonia Nitrogen | EPA 350.1* | Automated, phenate following distillation |
| Total Kjeldahl Nitrogen | EPA 351.3* | Spectrophotometric |
| Nitrate-Nitrite Nitrogen | EPA 353.2* | Automated, cadmium reduction |
| Total Phosphate Phosphorus | EPA 365.2* | Spectrophotometric ascorbic acid |
| Biochemical Oxygen Demand | EPA 405.1* | 5-day 20°C, membrane |
| Total Organic Carbon | EPA 415.1* | Combustion, infrared |
| Metals Elements Analysis | EPA* | Atomic Absorption, direct aspiration or furnace |
| Mercury | EPA 245.1* | Manual cold vapor technique |
| Organics, Acid Extractable | EPA 625‡ | Gas Chromatography/Mass Spectrography |
| Organics, Base/Neutral Extractable | EPA 625‡ | Gas Chromatography/Mass Spectrography |
| Pesticides | EPA 608§ | Gas Chromatography |
| Water | EPA// | |
| Sediment | USAEHA** | |
| Fish | AOAC†† | |

* EPA 600/4-79-020, Methods for Chemical Analysis of Water and Wastes, revised March 1983.

† American Public Health Association, Standard Methods for the Examination of Water and Wastewater, 16th ed. 1985.

‡ EPA 600/4-82-057, Test Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, July 1982.

§ EPA 608, developed from Pressley, T. A. and J. E. Longbottom, The Determination of Carbonate and Urea Pesticides in Industrial and Municipal Wastewater, Method 632, January 1982.

// EPA, Methods for Organochlorine Pesticides and Chlorophenoxy Acid Herbicles in Drinking Water and Raw Source Water, July 1978.

** Letter, USAEHA, HSE-RE/WP, 16 February 1977, subject: Pesticide Monitoring Special Study No. 44-0131-77, Pesticide Recovery Studies for Evaluation of Department of the Army Pesticide Monitoring Program - Soil and Sediment Analysis Methodology, Part I. Determination of Pesticide and Polychlorinated Biphenyl Recoveries from Soil Extracted Immediately Following Fortification, October - December 1976, developed from Wiersman, G. B., H. Tai, and P. F. Sand, "Pesticide Residue Levels in Soils in FY 69 - National Soils Monitoring Program," Pesticide Monitoring Journal, 6(3): 194-228 (1972).

†† Official Method of Analysis, Sections 29.012 (E, 29.014 and 29.015), Association of Official Analytical Chemists, 1975.

# APPENDIX E

## CHARACTERISTICS STUDIED

## DDMT, 10-14 MAR 86

| Characteristic | Sample Site 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Dissolved Oxygen | w | w | w | w | w |
| Temperature | w | w | w | w | w |
| pH | w | w | w | w | w |
| Conductivity | w | w | w | w | w |
| Chlorides | w | w | w | w | w |
| Cyanides | w | w | w | w | w |
| Sulfates | w | w | w | w | w |
| Biochemical Oxygen Demand | w | w | w | w | w |
| Total Organic Carbon | w | w | w | w | w |
| Ammonia Nitrogen | w | w | w | w | w |
| Total Kjeldahl Nitrogen | w | w | w | w | w |
| Nitrate Nitrite Nitrogen | w | w | w | w | w |
| Total Phosphate Phosphorous | w | w | w | w | w |
| Grease and Oil | w | w | w | w | w |
| Alkalinity | w | w | w | w | w |
| Hardness | w | w | w | w | w |
| Metals* | ws | ws | ws | ws | ws |
| Organic Priority Pollutants* | w | w | w | w | w |
| Pesticides* | ws | ws | ws | ws | ws |

* The metals and pesticides were analyzed on fish tissue from the Fire Reservoir and small pond. The list of metals, organic priority pollutants and pesticides are presented in Appendix G, J, and K.
w - Water grab samples taken 11 and 12 March 1986, before and after a rain.
s - Sediment sample collected 11 March 1986.

APPENDIX F

GENERAL CHEMICAL AND PHYSICAL WATER QUALITY DATA FROM FIRE RESERVOIR AND SMALL POND, DDMT, 10-14 MARCH 1986

| Characteristic Unit | Sample Date (March) | Sample Site* 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Dissolved Oxygen | 11 | 10.4 | 10.9 | 11.0 | 11.5 | 15.6 |
| mg/L | 12 | 9.8 | 10.1 | 10.3 | 10.0 | 7.6 |
| Temperature | 11 | 14.0 | 14.2 | 13.7 | 13.9 | 17.1 |
| °C | 12 | 14.0 | 13.7 | 13.7 | 13.7 | 14.9 |
| pH | 11 | 6.8 | 7.6 | 8.2 | 8.2 | 9.6 |
| Standard Units | 12 | 8.0 | 8.6 | 8.5 | 8.6 | 8.5 |
| Conductivity | 11 | 77 | 77 | 77 | 77 | 97 |
| µmhos/cm | 12 | 83 | 74 | 75 | 74 | 60 |
| Chlorides | 11 | 1.3 | 1.5 | 1.6 | 1.3 | 2.0 |
| mg/L | 12 | 1.5 | 1.2 | 1.9 | 1.1 | 1.5 |
| Cyanide | 11 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| mg/L | 12 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Sulfates | 11 | 11.5 | 11.2 | 11.6 | 11.0 | 7.7 |
| mg/L | 12 | 11.1 | 11.0 | 12.1 | 11.2 | 6.4 |
| Biochemical Oxygen Demand | 11 | 3.6 | 3.9 | 3.5 | 3.6 | 10.3 |
| mg/L | 12 | 3.1 | 3.6 | 4.2 | 3.9 | 16.0 |
| Total Organic Carbon | 11 | 19.4 | 16.8 | 17.1 | 17.3 | 16.8 |
| mg/L | 12 | 18.9 | 17.0 | 15.8 | 17.3 | 23.4 |
| Ammonia Nitrogen | 11 | 0.023 | 0.22 | 0.23 | 0.26 | 0.32 |
| mg/L | 12 | 0.33 | 0.63 | 0.51 | 0.58 | 0.11 |
| Total Kjeldahl-Nitrogen | 11 | 0.51 | 0.89 | 0.81 | 1.6 | 0.90 |
| mg/L | 12 | 1.6 | 0.51 | 0.50 | 0.54 | 4.2 |
| Nitrate Nitrite Nitrogen | 11 | 0.16 | 0.16 | 0.19 | 0.15 | 0.08 |
| mg/L | 12 | 0.97 | 0.26 | 0.25 | 0.25 | 0.30 |
| Total Phosphate Phosphorus | 11 | 0.047 | 0.035 | 0.045 | 0.067 | 0.61 |
| mg/L | 12 | 0.12 | 0.086 | 0.096 | 0.085 | 0.46 |
| Grease and Oil | 11 | <5.0 | <5.0 | 33 | 10.9 | <5.0 |
| mg/L | 12 | <5.0 | 48 | 23.2 | 13.9 | <5.0 |
| Alkalinity (as $CaCO_3$) | 11 | 26.0 | 25.1 | 28.0 | 27.0 | 23.1 |
| mg/L | 12 | 24.1 | 23.1 | 25.1 | 23.1 | 23.1 |
| Hardness (as $CaCO_3$) | 11 | 31.3 | 29.3 | 31.3 | 29.3 | 21.2 |
| mg/L | 12 | 39.4 | 32.3 | 27.3 | 29.3 | 24.3 |

* See Appendix C for sample site locations.

APPENDIX G

METAL ANALYSIS OF WATER FROM FIRE RESERVOIR AND SMALL POND, DDMT, 10-14 MARCH 1986

| Metal | Detection Limit (mg/L) | Sample Date (March) | Sample Site* 1 | 2 | 3 | 4 | 5. |
|---|---|---|---|---|---|---|---|
| Antimony | 1.0 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Arsenic | 0.01 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Beryllium | 0.05 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Cadmium | 0.025 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Chromium | 0.05 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Copper | 0.05 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Lead | 0.05 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Mercury | 0.002 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Nickel | 0.05 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Selenium | 0.01 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Thallium | 0.01 | 11&12 | BDL | BDL | BDL | BDL | BDL |
| Zinc | 0.05 | 11&12 | BDL | BDL | BDL | BDL | BDL |

* See Appendix C for sample site locations.
BDL - Below detectable limit

## APPENDIX H

### METALS IN SEDIMENT AND SEDIMENT SUPERNATANT FROM FIRE RESERVOIR AND SMALL POND, DDMT, 10-14 MARCH 1986

| Metal | Units | Sample Type | Sample Site* 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| Antimony | mg/L | S | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | mg/Kg | D | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| Arsenic | mg/L | S | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | mg/Kg | D | 16.9 | 17.7 | 13.5 | 20.8 | 23.1 |
| Beryllium | mg/L | S | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/Kg | D | <1.3 | <1.3 | <1.3 | <1.3 | <1.3 |
| Cadmium | mg/L | S | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 |
| | mg/Kg | D | 4.3 | 4.9 | 6.2 | 4.9 | 1.8 |
| Chromium | mg/L | S | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/Kg | D | 166 | 50.0 | 74.0 | 52.0 | 11.0 |
| Copper | mg/L | S | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/Kg | D | 68.6 | 84.4 | 70.5 | 81.0 | 39.8 |
| Lead | mg/L | S | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/Kg | D | 560 | 280 | 240 | 250 | 79 |
| Mercury | mg/L | S | 0.02 | 0.15 | 0.04 | 0.04 | 0.04 |
| | mg/Kg | D | 0.24 | 0.40 | 0.42 | 0.27 | 0.36 |
| Nickel | mg/L | S | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/Kg | D | 21.7 | 21.7 | 22.5 | 21.7 | 16.3 |
| Selenium | mg/L | S | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | mg/Kg | D | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Thallium | mg/L | S | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | mg/Kg | D | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Zinc | mg/L | S | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/Kg | D | 801 | 768 | 643 | 768 | 195 |

* See Appendix C for sample site locations.
S - Supernatant
D - Dry Weight of sediment

APPENDIX I

METALS IN FISH TISSUE (FILLETS) FROM FIRE RESERVOIR AND SMALL POND, DDMT, 10-14 MARCH 1986

| Metal (mg/kg) | Sample: Catfish from Fire Reservoir A | B | C | D | Goldfish from Pond A | B |
|---|---|---|---|---|---|---|
| Antimony | <0.992 | <0.954 | <1.05 | <1.00 | <0.992 | <0.978 |
| Arsenic | <0.992 | <0.954 | <1.05 | <1.00 | <0.992 | <0.978 |
| Beryllium | <0.198 | <0.191 | <0.209 | <0.200 | <0.198 | <0.196 |
| Cadmium | <0.099 | <0.095 | <0.105 | <0.100 | <0.099 | <0.098 |
| Chromium | <2.98 | <2.86 | <3.14 | <3.00 | <2.98 | <2.94 |
| Copper | <3.97 | 50.8 | <4.18 | <4.00 | <3.97 | <3.91 |
| Lead | 0.794 | 1.15 | 0.628 | <0.200 | 0.397 | <0.196 |
| Mercury | <0.039 | <0.038 | <0.042 | <0.040 | 0.238 | 0.333 |
| Nickel | <9.92 | <9.54 | <10.5 | <10.0 | <9.92 | <9.78 |
| Selenium | <0.198 | <0.191 | <0.209 | <0.200 | <0.198 | <0.196 |
| Thallium | <0.198 | <0.191 | <0.209 | <0.200 | <0.198 | <0.196 |
| Zinc | 3.57 | 19.8 | 3.97 | 3.80 | 15.9 | 10.8 |

Water Quality Biological Study No. 32-24-0733-86, ODMT, 10-14 Mar 86

APPENDIX J

ORGANIC PRIORITY POLLUTANTS AND DETECTION LIMITS IN WATER FROM FIRE RESERVOIR AND SMALL POND, ODMT, 10-14 MARCH 1986

1. BASE NEUTRAL EXTRACTABLES.

a. 10 ppb

Benzidine
3,3'-Dichlorobenzidine
Bis(2-chloroethyl) ether
Bis(2-chloroethoxy) methane
Bis(2-chloroisopropyl) ether
4-Bromophenyl phenyl ether
4-Chlorophenyl phenyl ether
Isophorone
Nitrobenzene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
N-nitrosodimethylamine
N-nitrosodiphenylamine
N-nitrosodi-n-propylamine
Benzyl butyl phthalate
Bis(2-ethylhexyl) phthalate
Di-n-butyl phthalate
Di-n-octyl phthalate
Diethyl phthalate
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoroanthene
Benzo(k)fluoroanthene
Chrysene
Fluoranthene
Naphthalene
Phenanthrene
Pyrene
Hexachlorocyclopentadiene
Hexachlorobenzene
Hexachlorobutadiene
Hexachloroethane
1,2-Dichlorobenzene
1,2,4-Trichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Chloronaphthalene

b. 25 ppb

Benzo(g,h,i)pyrene
Dibenzo(a,h)anthracene
Indeno(1,2,3-c,d)pyrene

2. ACID EXTRACTABLES.

a. 25 ppb

2-Chlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2-Nitrophenol
4-Nitrophenol
Pentachlorophenol
Phenol
2,4,6-Trichlorophenol

b. 250 ppb

2,4-Dinitrophenol
2-Methyl-4,6-Dinitrophenol

Base neutral and acid extractable organics were below detection limits at sample sites 1 through 5 both 11 and 12 March 1986, except for 21 µg/L of Bis(2-ethythexyl) phthalate and 9 µg/L of Di-n-octyl phthalate on 12 March 1986 at Sample Site 5. The volatile organics were not analyzed because of a large backlog, and equipment problems caused holding times to be exceeded.

APPENDIX K

DETECTION LIMITS FOR PESTICIDE RESIDUES* ANALYZED IN WATER FROM FIRE RESERVOIR AND SMALL POND, DDMT, 10-14 MARCH 1986

| Pesticide | Detection Limit µg/L |
|---|---|
| Aldrin | 0.16 |
| Alpha BHC | 0.20 |
| Beta BHC | 0.20 |
| Chlordane (tech) | 1.20 |
| Chlordane - Cis | 0.16 |
| Chlordane - Trans | 0.16 |
| Chlorpyrifos | 0.24 |
| 2,4-D (acid equiv.) | 3.80 |
| O,P'-DDD | 0.40 |
| P,P'-DDD | 0.40 |
| O,P'-DDE | 0.40 |
| P,P'-DDE | 0.40 |
| O,P'-DDT | 0.60 |
| P,P'-DDT | 0.60 |
| Diazinon | 1.00 |
| Dieldrin | 0.24 |
| Endrin | 0.04 |
| HCB | 0.80 |
| Heptachlor | 0.06 |
| Heptachlor Epoxide | 0.16 |
| Lindane | 0.08 |
| Malathion | 1.60 |
| Methoxychlor | 1.60 |
| Methyl Parathion | 0.60 |
| Mirex® | 0.04 |
| Oxychlordane | 0.16 |
| Parathion | 0.40 |
| PCB (Aroclor® 1242, 1248, 1254 and 1260) | 0.80 |
| Ronnel | 0.20 |
| Silvex (acid equiv.) | 0.50 |
| 2,4,5-T (acid equiv.) | 0.50 |
| Toxaphene | 1.60 |

® Mirex a registered trademark of Allied Chemical Corp., Morristown, New Jersey.
® Aroclor is a registered trademark of Monsanto Co., St Louis, Missouri.
* Water samples from both 11 and 12 March 1986 were below detection limits stated, except at Sample Site 1 on 12 March 1986 where 0.85 µg/L of P,P'-DDT was detected with trace amounts of DDD's and DDE's that were below detection limits.

APPENDIX L

PESTICIDE RESIDUES IN SEDIMENT FROM
FIRE RESERVOIR AND SMALL POND, ODMT, 10-14 MARCH 1986

| Pesticide | Detection Limit mg/kg | Sample Site* 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Aldrin | 0.050 | BDL | BDL | BDL | BDL | BDL |
| BHC (Alpha) | 0.020 | BDL | BDL | BDL | BDL | BDL |
| BHC (Beta) | 0.060 | BDL | BDL | BDL | BDL | BDL |
| BHC (Delta) | 0.060 | BDL | BDL | BDL | BDL | BDL |
| Chlordane | 0.400 | BDL | BDL | BDL | BDL | BDL |
| Chlordane (Metab)† | 0.400 | 1.11 | 2.52 | 1.64 | 2.09 | BDL |
| O,P'-DDD | 0.120 | 0.95 | 1.34 | 0.77 | 0.97 | BDL |
| P,P'-DDD | 0.100 | 3.45 | 3.75 | 2.32 | 3.93 | 0.21 |
| O,P'-DDE | 0.120 | BDL | BDL | BDL | BDL | BDL |
| P,P'-DDE | 0.100 | 2.71 | 5.31 | 4.22 | 4.75 | 0.22 |
| O,P'-DDT | 0.120 | 0.18 | 0.24 | 0.18 | 0.21 | BDL |
| P,P'-DDT | 0.150 | 0.77 | 0.81 | 0.59 | 0.75 | 0.15 |
| Diazinon | 0.052 | BDL | BDL | BDL | BDL | BDL |
| Dieldrin | 0.070 | BDL | BDL | BDL | BDL | BDL |
| Endrin | 0.130 | BDL | BDL | BDL | BDL | BDL |
| HCB | 0.020 | BDL | BDL | BDL | BDL | BDL |
| Heptachlor Epoxide | 0.050 | BDL | BDL | BDL | BDL | BDL |
| Lindane | 0.024 | BDL | BDL | BDL | BDL | BDL |
| Malathion | 0.010 | BDL | BDL | BDL | BDL | BDL |
| Methoxychlor | 0.500 | BDL | BDL | BDL | BDL | BDL |
| Methyl Parathion | 0.030 | BDL | BDL | BDL | BDL | BDL |
| Mirex | 0.120 | BDL | BDL | BDL | BDL | BDL |
| Oxychlordane | 0.050 | BDL | BDL | BDL | BDL | BDL |
| Parathion | 0.020 | BDL | BDL | BDL | BDL | BDL |
| PCB (Aroclor 1242, 1248, 1254 & 1260) | 0.100 | BDL | BDL | BDL | BDL | BDL |
| Toxaphene | 4.00 | BDL | BDL | BDL | BDL | BDL |

* See Appendix C for sample site locations.
† Metabolized/total constituents chlordane that includes cis and trans chlordane.
BDL - Below detectable limit

APPENDIX M

PESTICIDE RESIDUES IN FISH TISSUE (FILLETS) FROM FIRE RESERVOIR AND SMALL POND, ODMT, 10-14 MARCH 1986

| Pesticide | Detection Limit mg/kg | Catfish from Fire Reservoir A | B | C | D | Goldfish From Pond A | B |
|---|---|---|---|---|---|---|---|
| Aldrin | 0.004 | BDL* | BDL | BDL | BDL | BDL | BDL |
| BHC (Alpha) | 0.003 | BDL* | BDL | BDL | BDL | BDL | BDL |
| BHC (Beta) | 0.005 | BDL* | BDL | BDL | BDL | BDL | BDL |
| BHC (Delta) | 0.005 | BDL* | BDL | BDL | BDL | BDL | BDL |
| Chlordane | 0.030 | BDL* | BDL | BDL | BDL | BDL | BDL |
| Chlordane (Metab)† | 0.030 | 2.13 | 2.13 | 2.01 | 1.82 | 0.14 | 0.60 |
| Chlorpyrifos | 0.004 | 0.012 | 0.008 | 0.023 | 0.006 | BDL | BDL |
| O,P'-DDD | 0.010 | 0.51 | 0.57 | 0.55 | 0.43 | 0.02 | 0.07 |
| P,P'-DDD | 0.010 | 4.06 | 4.76 | 3.66 | 3.68 | 0.18 | 1.02 |
| O,P'-DDE | 0.010 | ‡ | ‡ | ‡ | ‡ | ‡ | ‡ |
| P,P'-DDE | 0.010 | 15.55 | 15.65 | 8.44 | 11.82 | 1.25 | 3.61 |
| O,P'-DDT | 0.015 | 0.59 | 0.63 | 0.29 | 0.47 | BDL | BDL |
| P,P'-DDT | 0.020 | 2.16 | 2.03 | 1.38 | 1.66 | BDL | BDL |
| Diazinon | 0.003 | BDL | BDL | BDL | BDL | BDL | BDL |
| Dieldrin | 0.008 | 0.31 | 0.19 | 0.16 | 0.16 | 0.03 | 0.17 |
| Endrin | 0.012 | BDL | BDL | BDL | BDL | BDL | BDL |
| HCB | 0.003 | BDL | BDL | BDL | BDL | BDL | BDL |
| Heptachlor | 0.003 | BDL | BDL | BDL | BDL | BDL | BDL |
| Heptachlor Epoxide | 0.005 | ‡ | ‡ | ‡ | ‡ | ‡ | ‡ |
| Lindane | 0.003 | BDL | BDL | BDL | BDL | BDL | BDL |
| Malathion | 0.005 | BDL | BDL | BDL | BDL | BDL | BDL |
| Methoxychlor | 0.040 | BDL | BDL | BDL | BDL | BDL | BDL |
| Methyl Parathion | 0.004 | BDL | BDL | BDL | BDL | BDL | BDL |
| Mirex | 0.020 | BDL | BDL | BDL | BDL | BDL | BDL |
| Oxychlordane | 0.005 | ‡ | ‡ | ‡ | ‡ | ‡ | ‡ |
| Parathion | 0.004 | BDL | BDL | BDL | BDL | BDL | BDL |
| PCB (Aroclor 1242 | 0.200 | BDL | BDL | BDL | BDL | BDL | BDL |
| PCB (Aroclor 1248 & 1254) | 1.00 | BDL | BDL | BDL | BDL | BDL | BDL |
| PCB (Aroclor 1260) | 0.200 | 0.45 | 0.48 | 0.34 | 0.44 | 1.13 | 2.84 |
| Ronnel | 0.004 | BDL | BDL | BDL | BDL | BDL | BDL |
| Toxaphene | 0.400 | BDL | BDL | BDL | BDL | BDL | BDL |

* BDL Below Detection Limit
† Metabolized/total constituents chlordane that includes cis and trans chlordane
‡ Unable to separate

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## ADMINISTRATIVE RECORD

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