ORNL/TM-9936

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Characteristics of the 3513 Impoundment

R. G. Stansfield
C. W. Francis

Environmental Sciences Division
Publication No. 2651

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NUCLEAR AND CHEMICAL WASTE PROGRAMS
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ABSTRACT

STANSFIELD, R. G. and C. W. FRANCIS. 1986. Characteristics of the 3513 impoundment. ORNL/TM-9936. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 136 pp.

A characterization study was conducted on a waste settling impoundment (3513 Basin) at the Oak Ridge National Laboratory, to provide information necessary for its proper disposition. The impoundment received laboratory low-level radioactive-waste waters from 1944, the year of its construction, through 1976. The pond is square-shaped and measures approximately 67 m (220 ft) on a side at normal water level. Water in the impoundment overlies 0.6 m (2 ft) of sediment waste.

The pond sediment was sampled and analyzed to determine if it would classify as a hazardous waste under regulatory definitions promulgated in accordance with the Resource Conservation and Recovery Act (RCRA). Total inventories of chemical elements in the waste were also determined. The impoundment is not regulated under RCRA because it was a land disposal unit and ceased receiving waste before November 19, 1980. However, it appears that the sediment would be classified as hazardous under those regulations, because mercury concentrations in the RCRA Extraction Procedure toxicity test were about ten times higher than is permitted. The sediment waste has previously been determined to be contaminated by radioactivity. An earlier study found the sediment to contain a radioactivity inventory of approximately 6000 GBq, consisting primarily of ^{137}Cs [(5000 GBq (130 Ci)], ^{60}Co [50 GBq (1 Ci)], ^{90}Sr [770 GBq or (20 Ci)] and ^{239}Pu [100 GBq (3 Ci)].

The impoundment was constructed in clay soil overlying Chickamauga Limestone. In some places, the bottom of the impoundment is as close as 0.3 m (1 ft) or so to the top of the limestone bedrock. Five wells for monitoring the groundwater were constructed around the perimeter of the impoundment at depths ranging from 2.7 to 7.6 m (9 to 25 ft). All of the wells, except one of the two upgradient wells, extend at least 0.3 m (1 ft) into bedrock. Sampling and analyses of the groundwater have been completed for the winter and spring seasons (1985) and will be continued for at least two more quarters, to account for possible natural seasonal variation in groundwater quality. At that time, a determination as to the effect of the impoundment on groundwater quality will be made. Analyses from the first two quarters indicate that radioactivity (gross beta resulting from predominately ^{90}Sr) of the groundwater exceeds limits allowed by RCRA regulations. Low levels (0.0001 mg/L) of PCB were also detected in the groundwater.

The current conceptual plan for impoundment closure will need to be revised to consider the following: (1) if the waste is solidified in place, remedial actions will have to be taken to isolate the solidified material from the groundwater in both the surrounding clay overburden and underlying limestone bedrock, and (2) the proposal to separate the pond into smaller workable segments by driving sheet piling into the clay may need to be modified for some parts of the pond because of an insufficiently thick clay layer in which to found the piling.

1. INTRODUCTION

This characterization study of the 3513 impoundment at Oak Ridge National Laboratory (ORNL) has been conducted under the Surplus Facilities Management Program (SFMP) to provide information necessary for proper disposition of the facility. Work has been performed towards obtaining information that would be useful in assisting ORNL in fulfilling any obligation that may develop under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

1.1 ORNL SURPLUS FACILITIES MANAGEMENT PROGRAM (SFMP)

The SFMP at ORNL is part of the Department of Energy's (DOE) National SFMP, administered by the Richland Operations Office. This program provides for the management of radioactively contaminated DOE facilities from the end of their operating life until final disposition is completed.

1.2 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT

Impoundments that contain hazardous wastes but which stopped receiving such wastes prior to November 19, 1980 are regulated under CERCLA rather than the Resource Conservation and Recovery Act (RCRA). Basin 3513 has not been an active part of the ORNL's waste management system since 1976. This ORNL basin has been listed as a possible hazardous waste facility with the Environmental Protection Agency (EPA) and the Tennessee Division of Solid Waste Management (TDSWM). Under CERCLA regulations, this original listing of the site did not require sampling and analysis of the waste, but could be based on "the respondent's belief, recollection and examination of available records" (FR vol. 46, No. 77, April 15, 1981, EPA Notices, p. 22144). Primarily, CERCLA hazardous waste sites are regulated by EPA under the National Oil and Contingency Plan of 40 CFR Part 300 (USEPA 1983). Unlike RCRA regulations, the National Oil and Contingency Plan does not provide specific procedures for determining whether a waste is hazardous, or for determining any potential effect on the groundwater at a site. Therefore, RCRA procedures and requirements generally have been employed as guidelines for this current characterization study.

1.3 SCOPE OF THE CHARACTERIZATION

Previous studies (Tamura et al. 1977 and an unpublished study by S. F. Huang, W. F. Ohnesorge, B. F. Kelly, R. K. Owenby, J. S. Eldridge, K. L. Daniels, and T. W. Oakes, Environmental and Occupational Safety Division, ORNL) have sampled, analyzed, and calculated inventories of radionuclides and certain heavy metals in the impoundment's sediment. The Huang et al. study will be referenced as Huang et al. (personal communication) throughout this report. The current study commenced in November, 1984, and extended through July, 1985. The sediment waste in the bottom of the pond was sampled and analyzed to determine if it would classify as a hazardous waste as defined by RCRA regulations, and to determine the chemical elements that comprise the major portion of the sediment. The groundwater hydrology at the site was investigated by a review of its geology, and the construction and sampling of five groundwater-monitoring wells.

2. DESCRIPTION OF THE FACILITY

The 3513 impoundment at ORNL is located in Bethel Valley as shown in Fig. 1. The facility is situated on the north side of westward-flowing White Oak Creek between Building 3544 on the west and two smaller impoundments, 3539 and 3540, on the east. On the north side lies Basin 3524 which, like the two smaller impoundments on the east side, is a part of the ORNL process waste system. Figure 2 is a photograph looking northward from south of White Oak Creek with the 3513 impoundment in the center, the 3539-40 basins on the right, and the 3524 basin in the upper-left portion of the figure. Groundwater monitoring systems are scheduled to be completed in the fall of 1985 for the other three impoundments. Impoundment 3513 is positioned so that groundwater at this facility might well be influenced by the other three impoundments.

2.1 IMPOUNDMENT CONSTRUCTION

The unlined impoundment was constructed in the year 1944 to serve as a settling basin for wastewaters prior to their discharge into adjacent White Oak Creek. The impoundment basically was constructed by excavating into the clay soil overlying the limestone bedrock at the site. No lining was added to the facility. Dimensions of the impoundment at water level elevation 778 ft (237 m) are approximately 220 by 220 ft (67 m), sloping to 200 by 200 ft (61 m) at the bottom. The bottom elevation of the north end of the impoundment, at approximately 772 feet (235 m), is approximately 1 ft lower than the south end. (These elevations are based on probings made at nine evenly

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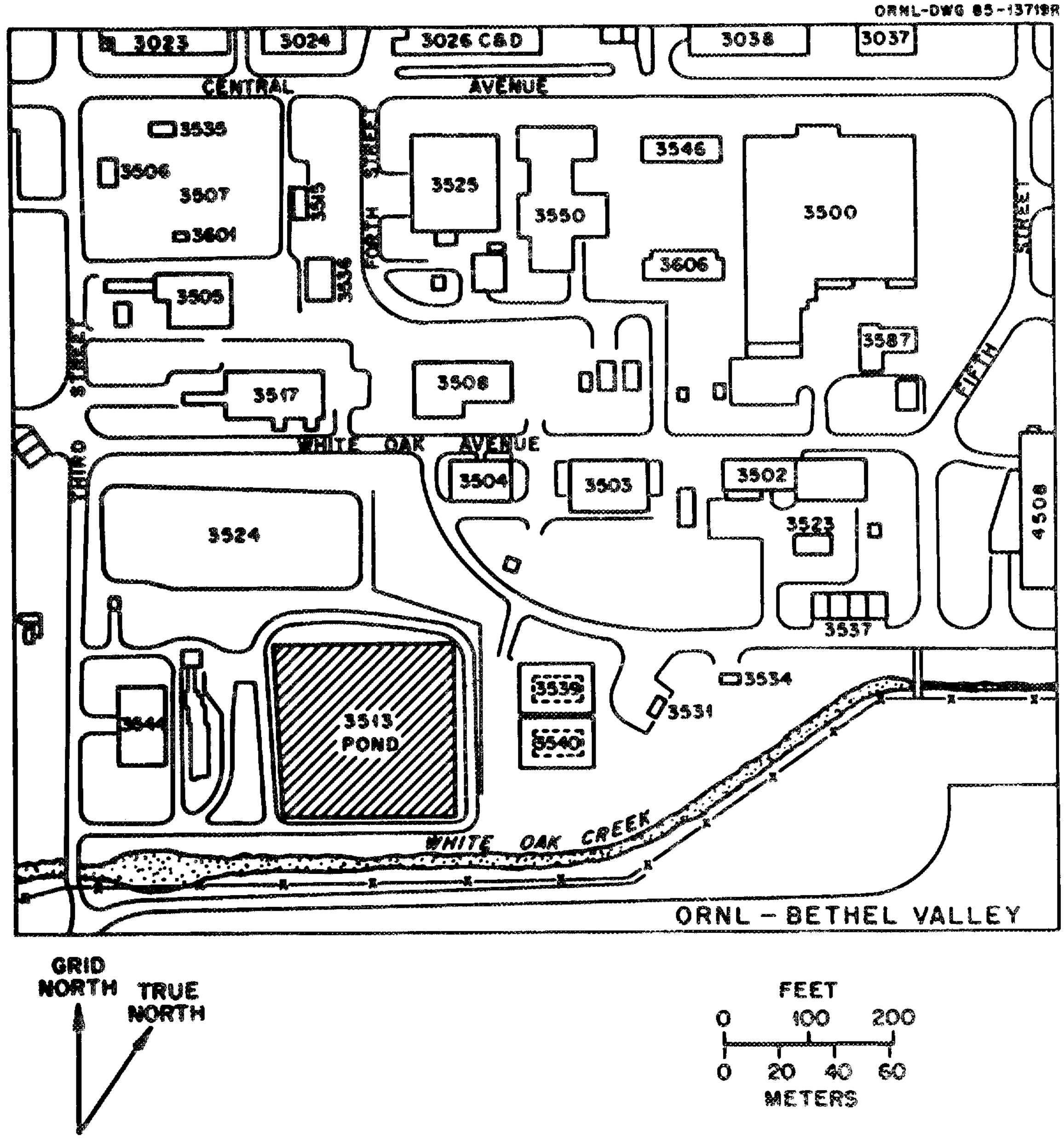

Figure 1. Location of 3513 impoundment within ORNL.

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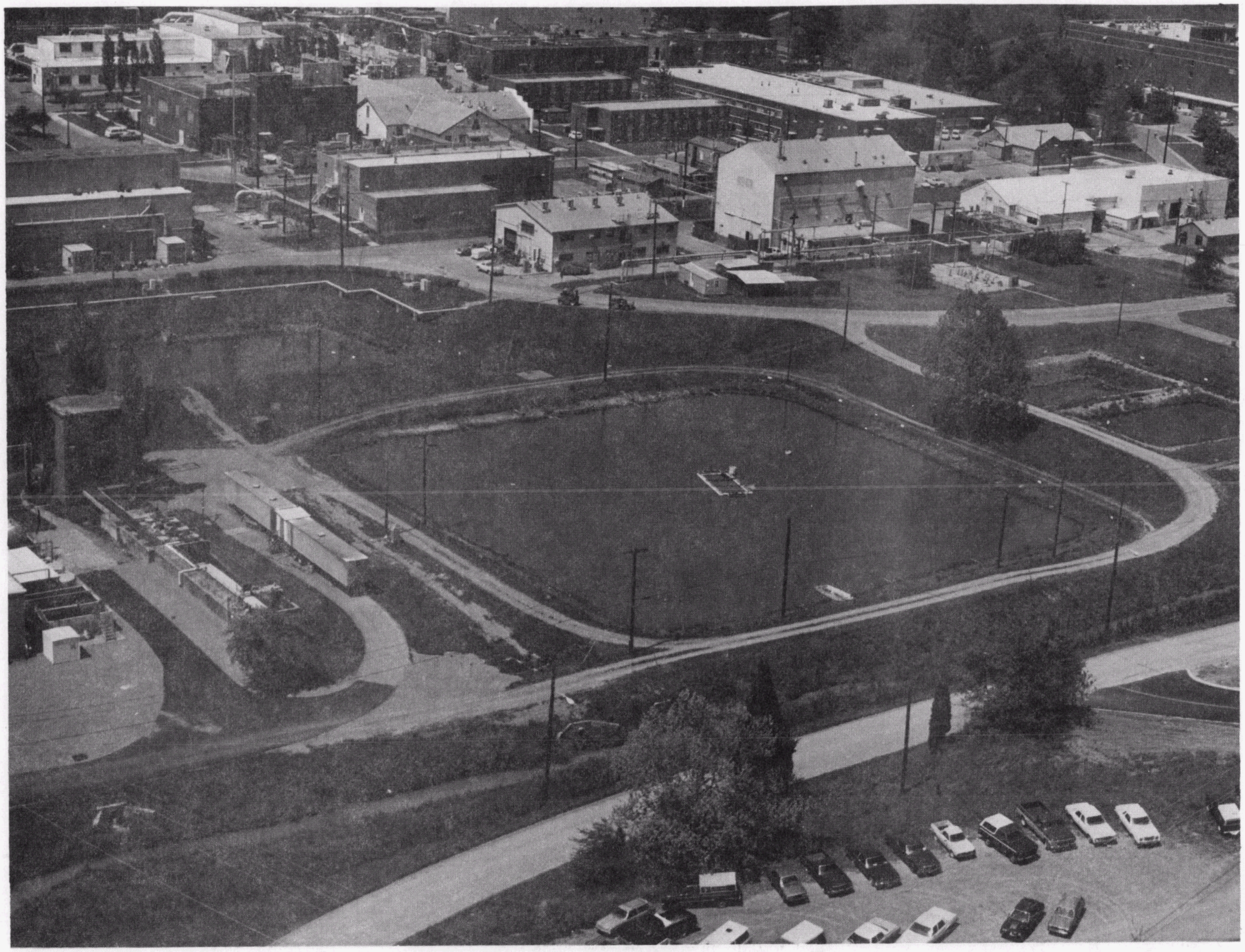

Figure 2. Photograph taken looking northward with 3513 impoundment in the center and White Oak Creek visible in lower left.

spaced locations during this study.) Inflow to the impoundment was by five waste lines emptying into the north side, while outflow was through the same number of opposing lines on the south side. Employing the above dimensions and water level, a normal storage capacity of approximately 1,880,000 gal (7,120,000 L) of water and sediment is calculated for the impoundment.

2.2 IMPOUNDMENT OPERATION

Operation of the facility ceased in 1976 when a new process waste treatment plant came into operation. From 1944 until 1949, the impoundment received supernatant from the gunite tanks which collected most of the radioactive chemical waste at ORNL. Fly ash and soda lime were added to the impoundment waters to precipitate the major portion of radionuclides prior to releasing the water to White Oak Creek. Other waste streams routed to the impoundment during its service years consisted of wastes from laboratory floor and sink drains, chemical process cells, and shield and cooling water from the graphite reactor.

In 1977, the depth of waste sediment at the south end of the impoundment averaged 2.5 ft (0.76 m) and 3.8 ft (1.16 m) at the north end (Horton unpublished). It appears that the sludge may have consolidated somewhat during the eight years since 1977 as the average depths measured by probings and soundings during this study were 1.6 ft (0.43 m) and 2.8 ft (0.85 m), respectively.

3. IMPOUNDMENT SEDIMENT WASTE

3.1 SEDIMENT AND POND WATER SAMPLING PROCEDURES

To determine the constituents of the waste sediment, samples were secured from the center of each quadrant of the impoundment as well as in the pond's center as shown in Fig. 3. Two sets of samples were obtained: the first in November, 1984, and the second in February, 1985.

The procedure for sampling the first set consisted of pushing a 3.0-in. (7.62-cm) diam aluminum tube through the sediment into the underlying clay bottom to a depth of 1 to 3 in. (2.54 to 7.62 cm). The clay, which was sampled to a depth of from 1 to 3 inches, acted as a plug at the bottom of the sampling tube to retain the loose, low-density sediment. The top of the tube protruded above the water level and was plugged with a rubber stopper prior to retrieving the sample tube from the sediment.

The second set of samples was collected with a 1.5-in.(3.81-cm) diam aluminum tube. This sampler had a wood plugging device that was pulled into place at the bottom of the sample tube by an attached line which extended through the bottom and out the top of the tube. Sampling in this manner allowed the sediment to be retained in the sampler without a clay plug as in the earlier sampling technique.

For ease of handling, sediment samples were emptied from the sampling devices into a wide-mouth plastic container from which they were transferred to 0.5-gal (1.9 L) glass containers at the sampling site. More than one core was taken at each site for both sets

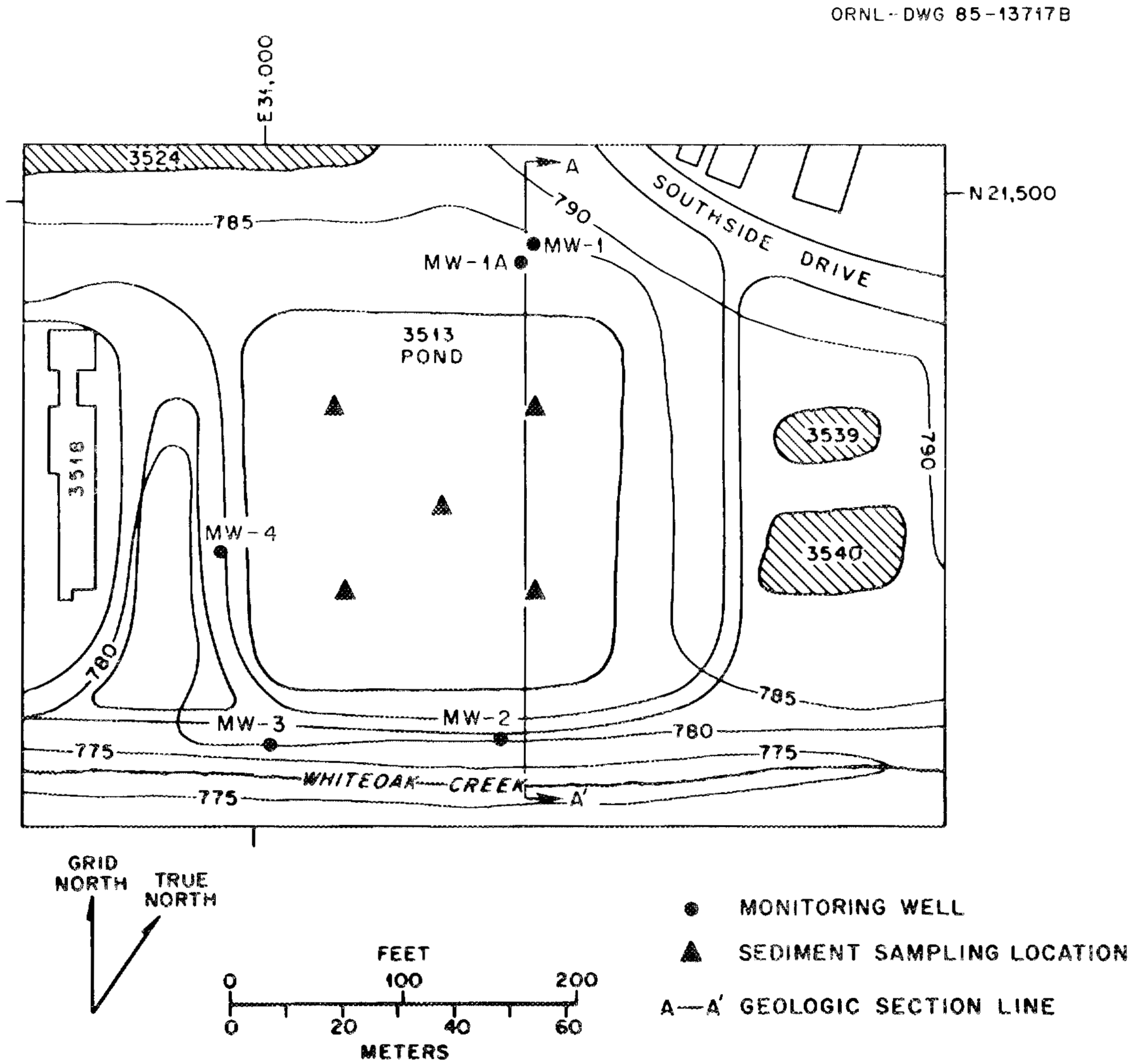

Figure 3. Location of sediment sampling sites and groundwater monitoring wells.

of samples. During the first set, two containers of sediment were collected at each sampling site. For the second set only one container was collected at each site.

Pond water was sampled from a location in the center of the impoundment with a stainless steel, bottom loading bailer. Water was taken from both the lower and upper depths.

3.2 SELECTION OF CONSTITUENTS FOR ANALYSIS IN SEDIMENT AND POND WATER

The primary purpose of the sampling was to determine if the sediment waste in the bottom of the 3513 pond would be classified as a hazardous waste under CERCLA or RCRA regulations. Federal regulation 40 CFR 261, promulgated under RCRA, specifies that a solid waste is a hazardous waste if it exhibits any of the defined characteristics of ignitability, corrosivity, reactivity, or extraction procedure (EP) toxicity. The EP toxicity is of primary concern as the inherent physical and chemical characteristics of the sediment rule out classification as a hazardous waste based on ignitability or reactivity. The EP toxicity characteristic is based on measured concentrations of eight elements of the National Interim Primary Drinking Water Standard (NIPDWS) and six herbicides and pesticides in the filtrate of a 24-h solid waste extraction test (USEPA 1980). If levels of these constituents exceed established maximum permissible concentrations, as shown in Table 1, then that waste is considered a hazardous waste.

Table 1. Contaminants that determine EP toxicity
(From FR vol. 45, No. 98, May 19, 1980, p. 33122)

Note: Waste is classified as hazardous if concentration of any listed constituent equals or exceeds these maximum concentrations.

EPA hazardous waste number	Contaminant	Maximum concentration (milligrams per liter)
D004	Arsenic	5.0
D005	Barium	100.0
D006	Cadmium	1.0
D007	Chromium	5.0
D008	Lead	5.0
D009	Mercury	0.2
D010	Selenium	1.0
D011	Silver	5.0
D012	Endrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-endo-5,8-dimethano naphthalene	0.02
D013	Lindane (1,2,3,4,5,6-hexachlorocyclohexane gamma isomer	0.4
D014	Methoxychlor (1,1,1-trichloro-2,2-bis [*p*-methoxyphenyl]ethane)	10.0
D015	Toxaphene ($C_{10}H_{10}Cl_8$, technical chlorinated camphene, 67-69% chlorine)	0.5
D016	2,4-D,(2,4-dichlorophenoxyacetic acid)	10.0
D017	2,4,5-TP Silvex (2,4,5-trichlorophenoxy)-propionic acid	1.0

To evaluate the potential of the sediments to leach organic compounds other than the above herbicides and pesticides, the EP extracts were analyzed for total toxic organics (TTO). The general definition of TTO is meant to be a summation of all quantifiable concentrations greater than 0.01 mg/L of a large selection of volatile and semivolatile organic compounds as listed in the July 15, 1983, Federal Register vol. 48 (No. 137).

As supplementary information, concentrations of nonregulatory elements were also reported for EP extracts. These concentrations resulted from analysis of the EP extracts by the multielemental analysis technique, Inductively Coupled Plasma (ICP) spectroscopy. These nonregulatory elements, such as iron, calcium, sodium, phosphorus, copper, and nickel, although not regulated by CERLA or RCRA, are significant in determining the overall leaching characteristic of the sediment.

An estimate of total elemental analyses of the sediment was conducted and the total concentration of PCB in the sediment was also determined. Analyses of this nature are useful in evaluating remedial action alternatives and are necessary to determine inventories of chemical constituents in the sediment waste.

The pond water in the 3513 impoundment was analyzed for the parameters defined by the NIPDWS as well as those established to determine groundwater quality and as indicators of groundwater contamination. Radiological analyses of the pond water were also determined. These analyses included gross alpha and beta determinations, as required by the NIPDWS regulations, in addition to separate analyses of specific alpha, beta, and gamma emitting isotopes. data of this type have been previously reported for both pond water and sediment samples. (Tamura 1977, Huang et al. unpublished).

3.3 CHEMICAL METHODS USED FOR ANALYSIS OF SEDIMENT AND POND WATER

Chemical analyses used to characterize the sediment and pond water were performed by the ORNL Analytical Chemistry Division. The methods used are predominately those described in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, second edition, published July 1982 by the USEPA Office of Solid Waste and Emergency Response, Washington, D.C. (USEPA 1982) and Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, revised March 1983, published by USEPA Environmental Monitoring and Support Laboratory, Office of Research and Development, Cincinnati, Ohio (USEPA 1983).

For the sediment, the EP toxicity test was conducted as outlined by EPA method 1310 (USEPA 1982). The concentrations of metals in the EP extract were determined by EPA methods 7061, 7081, 7131, 7191, 7421, 7470, 7741, and 7761 in USEPA (1982) and inductively coupled plasma (ICP) spectroscopy, method 200.7 in USEPA (1983). The concentrations of pesticides and herbicides in the EP extracts were determined by method 8080 (USEPA 1982) except that the analyses were by liquid chromatography instead of gas chromatography. The total toxic organics (TTO) in the EP extracts were determined using method 624 (USEPA 1983) or pentane extraction for the volatile organic compounds and method 1625 (USEPA 1982) for the semivolatile compounds.

Total elemental concentrations in the sediment from the 3513 impoundment were determined by digesting a 1-g sample (dry weight at 110°C overnight) with a 1:1 mixture of concentrated nitric acid and concentrated hydrofluoric acid. After bringing to dryness the residue was taken up in 12% nitric acid, and elemental concentrations were determined by ICP spectroscopy. Thus, this digestion procedure precludes the analysis of mercury because the element is lost on volatilization. The total concentrations of PCB in sediment were determined using method 8080 (USEPA 1982).

Elemental concentrations in pond water at the 3513 site were determined by ICP (method 200.7 in USEPA 1983). Methods used to determine concentrations of pesticides and herbicides as well as PCB were the same as those used to determine their concentrations in the EP extracts. Coliform bacteria were determined by method 405.1 (USEPA 1983). Concentrations of fluoride, chloride, nitrate, and sulfate were determined in pond water using methods 340.2 and 300.0 as described in USEPA (1983). Phenol concentration was determined by method 420.1 (USEPA 1983). Total organic carbon (TOC) and total organic halides (TOX) were determined in the pond water using methods 9060 and 9020, respectively (USEPA 1982).

Concentrations of radionuclides in pond water at the 3513 impoundment were determined using solid state alpha and beta detectors. Gross alpha and gross beta measurements were performed by counting on Tennelec LB5100 Series II equipment. This automated system is programmed to convert raw data to activity units as well as utilizing material weights or volume to produce activity per unit (weight or volume). Analyses of gamma-emitting radionuclides were conducted using high-resolution germanium detectors. The detectors were shielded from extraneous background and were calibrated for the respective sample geometries using certified mixtures of gamma-emitting radionuclide standard solutions from the National Bureau of Standards (NBS). Calibration procedures and assessment have been described elsewhere (Larsen and Cutshall 1981).

3.4 RESULTS AND DISCUSSION OF CHEMICAL ANALYSES OF SEDIMENT AND POND WATER

As stated earlier, the primary interest in the chemical characterization of sediment and pond water at 3513 is the classification of the sediment as a hazardous or nonhazardous waste. The pH of the sediment slurry was found to be 7.2, thus the waste does not have the characteristic of corrosivity as defined by EPA. The controlling test for classification is the EP toxicity characteristic. Concentrations of RCRA regulatory constituents in EP extracts from sediment taken at various locations within the 3513 impoundment are presented in Table 1A of Appendix C. The concentrations prefixed by a minus sign are the detection limit for the element or compound for that analysis. Table 1A reveals that concentrations of all regulatory constituents except mercury, which is on the order of ten times higher than the permissible limit, are below the maximum permissible concentrations. These data are summarized in Table 2. The concentration of selenium in the EP extract was below ICP detection; however, the detection level by ICP for these extracts was 1 to 2 mg/L greater than the RCRA limit. It is because of the mercury

Table 2. Concentrations of RCRA-regulated constituents in EP extracts from 3513 impoundment sediments

		Measured concentration				
Constituent	Permissible concentration	Mean	No. obs.	Min	Max	%CV
Arsenic, mg/L	5.0	1.8000[a]	5	1.2000	4.2000	74.5
Barium, mg/L	100	0.7640	5	0.5600	0.9700	22.7
Cadmium, mg/L	1.0	0.0860[a]	5	0.0200	0.1900	77.7
Chromium, mg/L	5.0	0.2160[a]	5	0.1400	0.4200	53.7
Lead, mg/L	5.0	1.1224[a]	5	0.0030	4.2000	160
Mercury, mg/L	0.2	2.9900	5	0.1500	4.8000	58.7
Selenium, mg/L	1.0	3.6000[a]	5	2.4000	8.4000	74.5
Silver, mg/L	5.0	0.6360[a]	5	0.4200	1.5000	75.9
Endrin, mg/L	0.02	0.0001	1	0.0001	0.0001	.
Lindane, mg/L	0.4	0.0003	1	0.0003	0.0003	.
Methoxychlor, mg/L	10.	0.0002	1	0.0002	0.0002	.
Toxaphene, mg/L	0.5	0.0020	1	0.0020	0.0020	.
2,4-D, mg/L	10.	0.0050	1	0.0050	0.0050	.
2,4,5-TP SILVEX, mg/L	1.0	0.0050	1	0.0050	0.0050	.

[a]Measurements include analytical detection levels (see Table 1A).

concentrations in EP extracts of sediment from the 3513 impoundment that the sediment would be considered a hazardous waste. Concentrations of organic compounds in the EP extract, as measured by the TTO (a screening summation for 113 of the 115 organics listed by EPA as priority pollutants) are low (<0.01 mg/L, see Table 2A of Appendix C). Concentrations of copper, nickel, and zinc in EP extracts are significantly below the 100 times the maximum limit for water in the recently issued "Hazardous Substance Guidelines" (see Table 3) by the State of Tennessee (Gregory 1985). The concentrations listed in Table 3 are not regulation, but rather are guideline limits currently used by the State of Tennessee. As such, they are subject to modification. Activities of radioisotopes were not determined in the EP extracts.

Results of total elemental analyses of the sediment are provided in Table 3A of Appendix C. These analyses also indicate elevated concentrations of PCB (concentrations ranged from 3 to a maximum of 22 mg/kg, Table 3A). Regulatory levels do not presently exist governing total concentrations of inorganic or organic constituents in sediments. Relative to the previously mentioned Tennessee "Hazardous Substance Guidelines" the sediment exceeds maximum soil limits for copper, zinc, nickel, cadmium, chromium, silver, lead, and PCB.

An inventory of metals and other constituents in the sediments of the 3513 impoundment, derived from the total elemental analyses, is presented in Table 4A of Appendix C. The inventory was calculated based on 2,350,000 L of sediment having a bulk wet density of 1.2 g/cm^3, and 83% water as determined in this study. As discussed earlier, the total

Table 3. Hazardous substance guidelines
Tennessee Division of Solid Waste Management - Superfund

Compound	Maximum limit, water (ppm or mg/L)	Maximum limit, soil (ppm or mg/kg)	Water reference
Benzene	0.025	2.5	6
Ethylbenzene	1.4	140	1
Toluene	14.3	1430	1
Carbon tetrachloride	0.025	2.5	6
Chloroform	0.002	0.2	1
1,2-Dichloroethane	0.26	26	6
1,1-Dichloroethylene	0.35	35	6
Methylene chloride	0.15	15	2
Tetrachloroethylene	0.085	8.5	6
Trichloroethylene	0.26	26.0	6
1,1,1-Trichlorethane	1.0	100	6
Acetone	20	2,000	7
Ethylacetate	400	40,000	4
Xylenes	0.62	62	2
Methyl-ethyl ketone	0.75	75	5
Methyl-isobutyl ketone	100	10,000	4
Vinyl chloride	0.06	6.0	6
Naphthalene	0.025	2.0	1
Di-N-butyl phthalate	0.034	3.4	1
Pentachloro phenol	1.01	101	1
Cyanide	0.2	10	3,8
Phenol	0.3	30	1,8
Copper	1	100	3
Zinc	5	500	3,8
Nickel	0.2	20	3,8
Mercury	0.002	0.2	3,8
Arsenic	0.05	5	3,8
Cadmium	0.01	1.0	3,8
Chromium	0.05	5	3,8
Silver	0.05	5	3,8
Lead	0.05	5	3,8
PAHs	0.000028	0.0028	1
PCBs	0.00000079	0.000079	

Water limits, clarified by MED 8/28/84:
- Nitrates(N) - 10 ppm
- Sulfates - 250 ppm
- Phosphate - should be set below 50 ppm in water (gives renal damage in rats, is ten times dietary, adequate nutritional level for rats)

References:
1. Federal Register 45:231, November 1980
2. Long-term SNARL
3. Interim Drinking Water Standard
4. Dangerous Properties of Industrial Materials, N. Irving Sax
5. Ten-day SNARL
6. Federal Register, 49:114, 24338, June 1984
7. Flash point concentration
8. E.P. toxicity limit or suggested level (phenol, cyanide, nickel)

elemental concentration of mercury was not determined in analyses for this report (mercury in this study was determined by EP toxicity test only). However, Huang et al. (personal communication) reported a mercury inventory for the sediment of 25 kg.

For pond water analysis, the detection limit by ICP for some of the metals generally exceeded the NIPDWS (see Table 5A of Appendix C). For example, the detection limits for silver was in excess of the maximum allowable NIPDWS. Measurements of chromium, lead, and selenium in pond water were observed to be in excess of NIPDWS. However, levels of arsenic, barium, cadmium, fluoride, mercury, and nitrate, as well as the pesticides and herbicides were below the maximum allowable NIPDWS. The concentration of total organic halides (TOX) was relatively high (0.670 mg/L). Detectable concentrations of PCB were observed in the pond water (0.0006 mg/L) and counts of coliform bacteria (12) were in excess of the NIPDWS. The total organic carbon content (TOC), however, was relatively low (12 mg/L). The major contaminant, as expected, is the radionuclide concentrations (Table 6A of Appendix C). The bulk of the activity is from ^{137}Cs and ^{90}Sr, measuring 290 and 420 Bq/L (7.8 and 11 pCi/mL), respectively. Gross beta activity appears to be predominately from ^{90}Sr and Y-90 decay [i.e., gross beta (910 Bq/L or 25 pCi/mL)] is slightly more than twice the ^{90}Sr activity. Alpha activity in the pond water is less than 2% of the gross beta and ^{137}Cs activity combined.

3.5 RADIONUCLIDES IN THE SEDIMENTS DETERMINED BY PREVIOUS REPORTS

Radionuclides present in the sediment waste have been determined by Tamura 1977 and Huang et al. (personal communication) Table 4 is from

Table 4. Radionuclide concentration and inventories in 3513 impoundment (from Tables 7 and 8 of Huang et al. personal communication)

Results of quantitative analyses for samples from 3513 impoundment

Sample[a]	^{137}Cs	^{60}Co	^{154}Eu	^{239}Pu	^{238}Pu	^{241}Am	^{244}Cm	^{90}Sr
	(Bq/g wet wt)[b]							
6E	4,000	20	ND	50	1.7	5.0	2.2	540
13E	800	10	4	80	2.8	8.0	1.1	300
8G	1,200	16	4	20	1.0	7.0	2.4	320
5L	4,000	40	4	60	1.0	12.0	2.4	200
10L	1,800	16	4	30	1.7	14.0	3.6	280

[a]Sample locations refer to locations described in Huang et al. (personal communication)

[b]1 Bq = 27 pCi

Estimated inventories of radionuclides in the 3513 impoundment

Pond content	Average depth and volume	Major radionuclide	Average activity (Bq/mL or Bq/g)[a]	Inventory GBq	Inventory Ci
Water	1 m	^{137}Cs	0.4	2	0.05
	4×10^6L	^{90}Sr	0.3	1	0.03
Sediment	0.5 m	^{137}Cs	2400	5000	130
	2×10^6L	^{60}Co	21	50	1
		^{90}Sr	330	700	20
		^{238}Pu	1.7	4	0.1
		^{239}Pu	47	100	3
		^{241}Am	9.2	20	0.5
		^{244}Cm	2.3	5	0.1
		^{154}Eu	3.8	8	0.2

[a]Activity in sediment is on wet weight basis

the study by Huang and shows the concentrations and inventories of radionuclides in the sediment. No adjustments have been made in the figures for decay of radioactivity due to the recent date of that report.

4. SUBSURFACE EXPLORATION AND MONITORING WELLS

All work was performed with ORNL equipment and personnel.

4.1 DRILLING AND SAMPLING

A total of five borings ranging in depth from 12 to 25 ft (3.65 to 7.62 m) were drilled with a mobile, model B-33 drilling machine using 4- and 6-in. (10.16- and 15.24-cm) diam, continuous-flight augers with the exception of monitoring well No. 1 (MW-1) which was drilled with an 8-in. (20.32-cm) diam, hollow-stem auger.

The augers were washed between the drilling of each hole and the sampling tools were washed and rinsed with acid and distilled water between each sampling event.

Continuous soil samples were taken by driving a 2-in. diam x 24-in. long (5.08 x 60.96-cm) split-tube sampler. All soil samples and drill cuttings were monitored with a Geiger-Mueller (G/M) meter, and no radioactivity above background was detected. Descriptive records of all borings are provided in the boring logs in Appendix A. Locations of the borings (as monitoring wells) are shown on Fig. 3.

4.2 MONITORING WELL CONSTRUCTION

A groundwater monitoring well was constructed in each of the borings using 2-in. (5.08-cm) diam stainless steel well screen and casing. Prior to installation of the well screen, drill cuttings from the limestone encountered in the bottom portion of each boring (except for boring MW-1) were flushed from the bottom of the hole by pressure washing with potable water. To ensure that the potable wash water did not interfere with sampling of the groundwater, a volume of water was removed from each of these wells equal to or greater than five times the drilled diameter volume of the well.

The well screens had a continuous slot, 0.01-in. (0.25 mm) wide opening. They ranged in length from 2 to 7 ft (0.61 to 2.13 m), and were surrounded by a sand pack of medium-grained quartz sand which extended a minimum height of 1 ft (0.3 m) above the elevation of the top of the well screen. A bentonite (clay) seal of at least 1 ft (0.3 m) minimum thickness was placed at the top of the sand pack. The remainder of the boring was backfilled with portland cement concrete from the top of the seal to the top of the boring. A 4-in. (10.16-cm) diam protective casing, 5 ft (1.52 m) in length, was installed around the well-riser pipe with both the pipe and casing extending approximately 3 ft (0.91 m) above the ground surface. The top of the riser pipe is closed by a removable, stainless steel cap. Construction details of each of the wells are provided in Appendix B. A summary of construction details and measured groundwater elevations, as well as surveyed locations and elevations, are provided in Table 5.

4.3 MONITORING WELL LOCATION RATIONALE

Locations available for the construction of monitoring wells at the 3513 site are restricted by topography, roads, three adjacent impoundments, and underground lines. At the time of this report, monitoring wells were in the process of being constructed around the

Table 5. Summary of monitoring well location, construction data, and water levels at 3513 impoundment

	Well No.				
	MW-1	MW-1A	MW-2	MW-3	MW-4
North Grid coordinate, (ft)	21463.30	21462.19	21180.43	21180.33	21281.89
East grid coordinate, (ft)	31157.39	31155.27	31141.45	31009.21	30970.03
Top of well casing el., (ft)	786.61	786.37	785.96	785.24	783.25
Height of casing above ground, (ft)	3.0	2.9	3.0	3.0	2.5
Ground surface el., (ft)	783.6	783.5	783.0	782.2	780.8
Top of well screen el., (ft)	777.8	769.2	776.2	766.1	774.2
Bottom of well screem el., (ft)	775.8	762.2	769.2	769.1	767.2
Top of sand pack el., (ft)	778.6	769.6	778.0	777.2	775.8
Bottom of well hole el., (ft)	775.6	758.5	769.2	769.0	767.1
Diameter of well pipe/screen, (in)	2.0	2.0	2.0	2.0	2.0
Type material of pipe/screen	S.S.[a]	S.S.[a]	S.S.[a]	S.S.[a]	S.S.[a]
Width of screen opening, (in)	0.01	0.01	0.01	0.01	0.01
Water level el., (ft) (2-6-85)	779.56	780.05	776.68	773.81	776.79
Water level eL., (ft) (4-8-85)	779.10	779.22	776.45	773.30	776.39
Water level el., (ft) (4-16-85)	778.21	779.22	776.25	773.13	776.56
Water level el., (ft) (6-16-85)	778.87	779.12	776.77	773.43	775.93
Water level el., (ft) (7-1-85)	778.97	779.15	776.45	773.20	776.18

[a]Stainless steel

other impoundments that exist to the north and east, and these were scheduled for completion in September 1985.

Locations for monitoring wells MW-1 and MW-1A were selected in an attempt to provide groundwater samples that are upgradient of the impoundment and that are not affected by potential contamination from that source. Monitoring/well MW-1 is completed in the clay soil overlying the limestone bedrock, while MW-1A is completed within a 3 ft (1 m) horizontal distance at a lower elevation in the bedrock.

The locations of the other three monitoring wells were selected to determine if contaminants from the impoundment are migrating into the groundwater. As CERCLA does not provide specific requirements for monitoring well locations, these wells comply with regulations promulgated by the EPA in accordance with RCRA which specifies that there be three "downgradient wells." Downgradient wells are required to be at the boundary of the impoundment facility. As described in RCRA Permit Writer's Manual Groundwater Protection 40 CFR, Part 264, Subpart E, Draft (USEPA 1983), EPA interprets this boundary to be no more distant than the outside toe of any containment dike that may exist, plus 30 ft (9.14 m) for physically selecting an appropriate drill site.

Monitoring well MW-2 is at the downgradient end of the impoundment and is adjacent to an underground line which exits from the embankment above White Oak Creek. This particular location was chosen because the backfill around the line could possibly provide a preferred pathway for migration of impoundment contaminants.

Monitoring well MW-3 is at the extreme downgradient point of the impoundment and also at the west end of striking strata so that it has the opportunity of intercepting pollution movement downgradient and to a lesser degree along strike of the bedrock strata.

Monitoring well MW-4 is located along the west side of the impoundment and is geometrically in the most advantageous position of all the wells to intercept contaminants moving along geologic strike of the limestone bedrock. Although to a lesser degree than MW-3, it also is in a downgradient position relative to the northern portion of the impoundment.

4.4 SURFACE GEOPHYSICAL SURVEY

An electromagnetic conductivity survey, using a model EM-34 instrument manufactured by Geonics Ltd., was conducted around the perimeter of impoundment 3513. This geophysical method provides a rapid site reconnaissance that can detect contaminant plumes of high ionic strength. The technique measured the apparent electrical conductivity of the subsurface using self-contained dipole transmitter and receiver coils held in the horizontal dipole configuration and separated by a horizontal distance of 20 ft (6.1 m). In this configuration the instrument senses to approximately 0.75 of the intercoil spacing (Geonics 1983). Therefore, the apparent conductivity was measured in units of millimhos per meter to an approximate depth of 15 ft (4.6 m) at each station. Readings in millimhos per meter at each measurement station around the 3513 impoundment are shown in Fig. 4. The magnitude of variations do not indicate major conductivity anomalies that would seem to be attributable to contamination plumes from the impoundment. These variations may likely be due to interferences caused by surrounding overhead and underground power lines and pipelines.

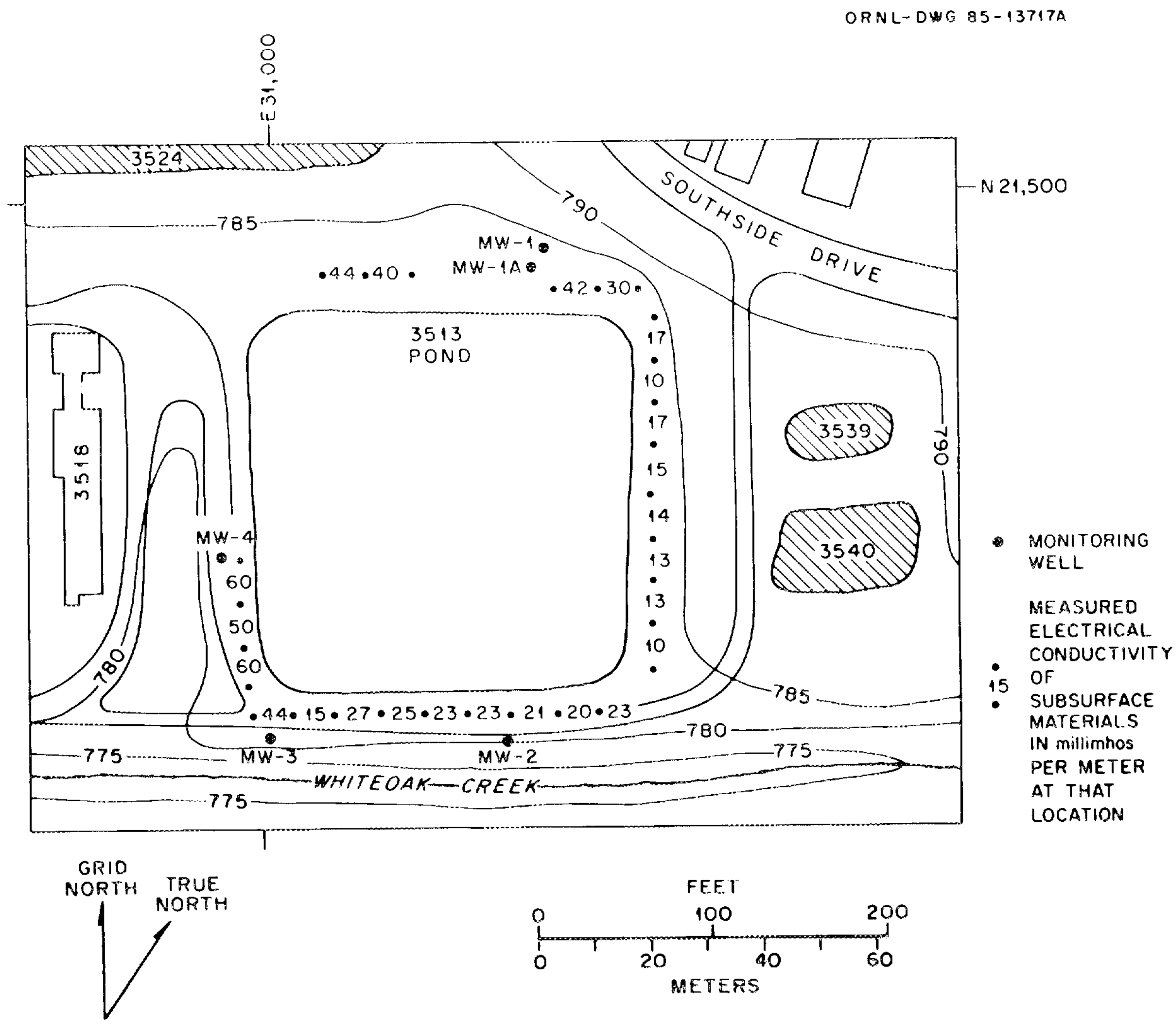

Figure 4. Locations and measurements of electromagnetic conductivity survey.

5. GEOLOGY

5. 1. REGIONAL GEOLOGY

Oak Ridge National Laboratory lies in the Ridge and Valley Physiographic Province. In Tennessee, the province consists of northeast-southwest striking rock strata of limestone, sandstone, and shale extending from the Georgia-Alabama border on the south to the Virginia border on the north. The strata is tilted to angles of 30 degrees and greater throughout its length resulting in the erosion-resistant beds forming parallel ridges, and those less-resistant beds becoming intervening valley floors.

5.2 SITE GEOLOGY

5.2.1 Bedrock

Impoundment 3513 lies in Bethel Valley approximately 700 ft (213 m) northwest of the Copper Creek fault. As shown on the geologic map of Fig. 5, the site is underlain by unit "G" of the Chickamauga Group: a hard, mostly thin-bedded limestone with shaly partings (Stockdale 1951). Locations of several core holes conducted for that study in the vicinity of the 3513 impoundment upon which the description of the limestone was based are shown in Fig. 6. Thin-bedded limestone crops out in the bottom of White Oak Creek immediately adjacent to the south side of the impoundment.

The limestone strata beneath the impoundment dips to the southeast at an angle of approximately 35° from the horizontal; and the beds strike approximately 58° to the northeast. This bedding plane strike

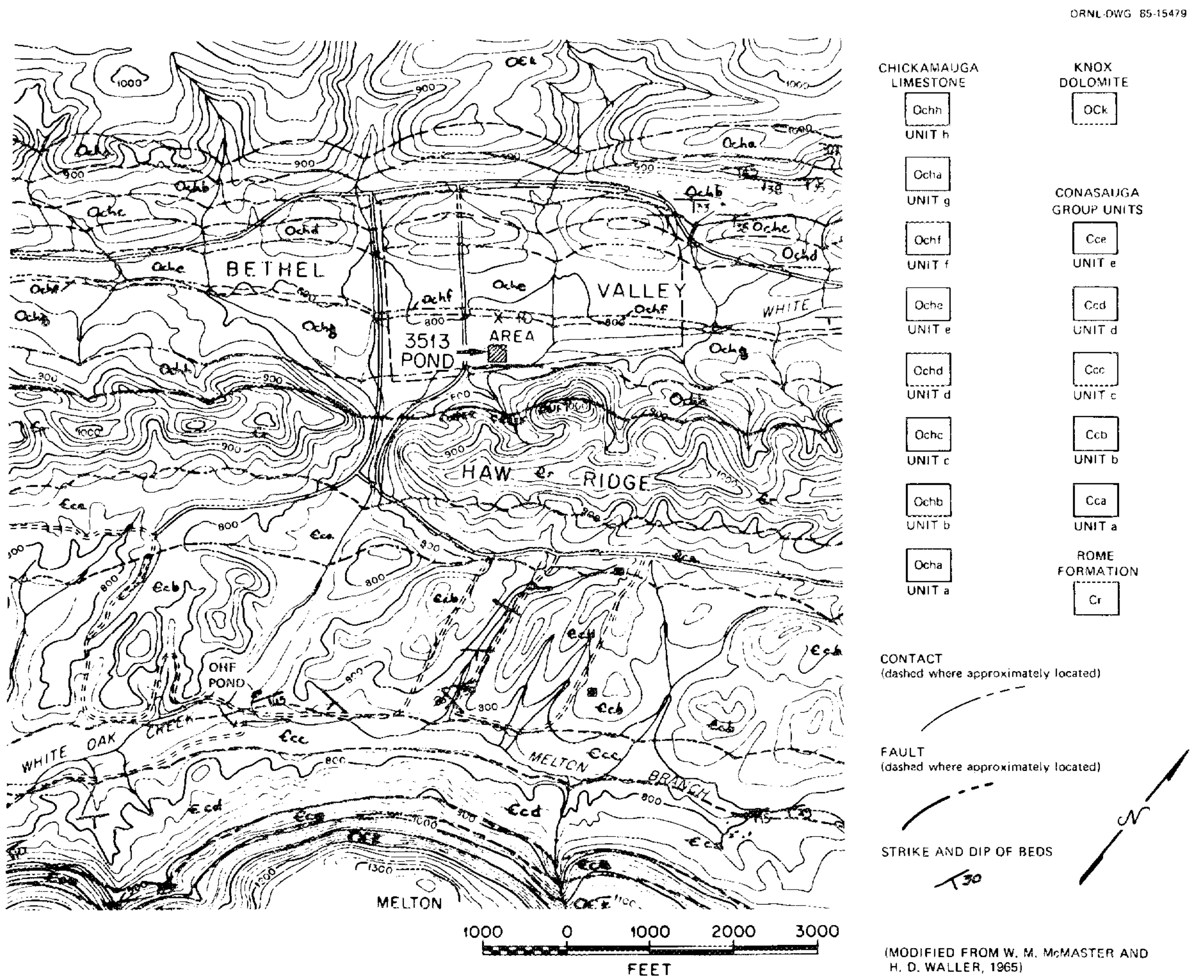

Figure 5. Geologic map of the ORNL area including the 3513 impoundment.

ORNL-DWG 85-14646R

MODIFIED FROM WATER TABLE MAP OF ORNL
BY GEORGE D. DeBUCHANANNE FROM STOCKDALE, 1951

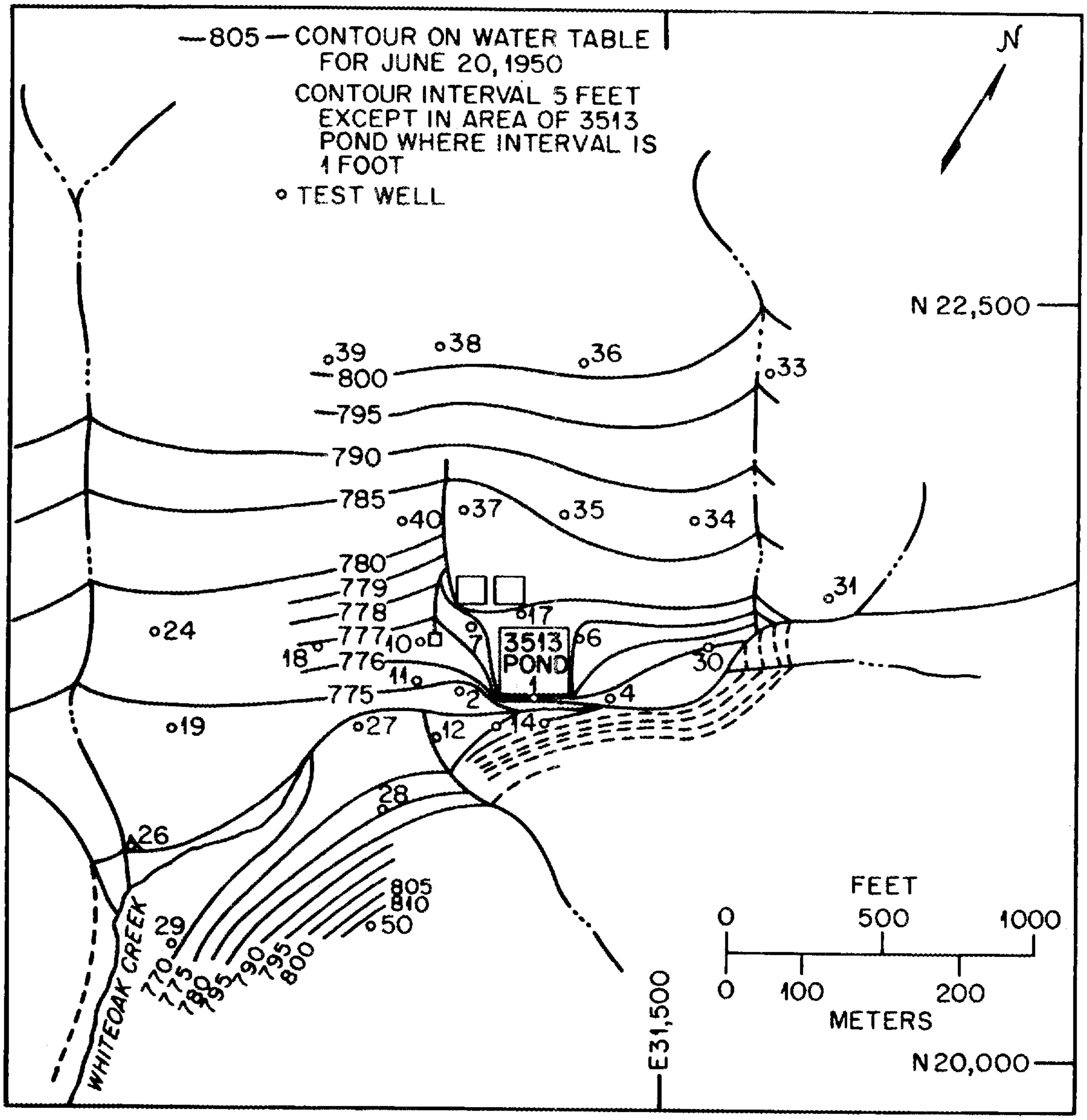

Figure 6. General water table map of a portion of ORNL.

direction is approximately parallel with the section of White Oak Creek adjacent to the impoundment. In regards to bedrock units "G" and "H", Stockdale (1951) reports "small secondary openings in the rock brought about by solution through ground waters exist in minor amounts as revealed by core drilling." The boring log of core hole No. 1 of that study, drilled from the south side and directed beneath the impoundment at a 55° angle from the horizontal, shows two solution openings of 0.5 in. (1.27 cm) each at the inclined depth of between 212 to 216 ft (64.62 to 65.83 m). A geologic section through the impoundment is shown in Fig. 7. The elevation of the sediment, as shown in Fig. 7, is based on probings obtained for this study at nine evenly spaced locations in the impoundment.

5.2.2 Soil

The soil depth around the impoundment is approximately 12 ft (3.66 m) and, as indicated by the boring records in Appendix A, consists mostly of material which would classify as clays under the Unified Soil Classification System. For the most part, these soils are likely to consist of colluvium overlying residuum derived from the underlying bedrock; however, the area adjacent to White Oak Creek appears to be of alluvial and fill origin. Boring MW-2 encountered a clayey sand with some gravel at a depth of 7.4 to 8.8 ft (2.3 to 2.6 m). From field observation, it appears that this clayey sand is part of the backfill material placed for an 8 in (20.52 cm) discharge line that exits into White Oak Creek at this location. No flow has been observed from this line during the course of this study.

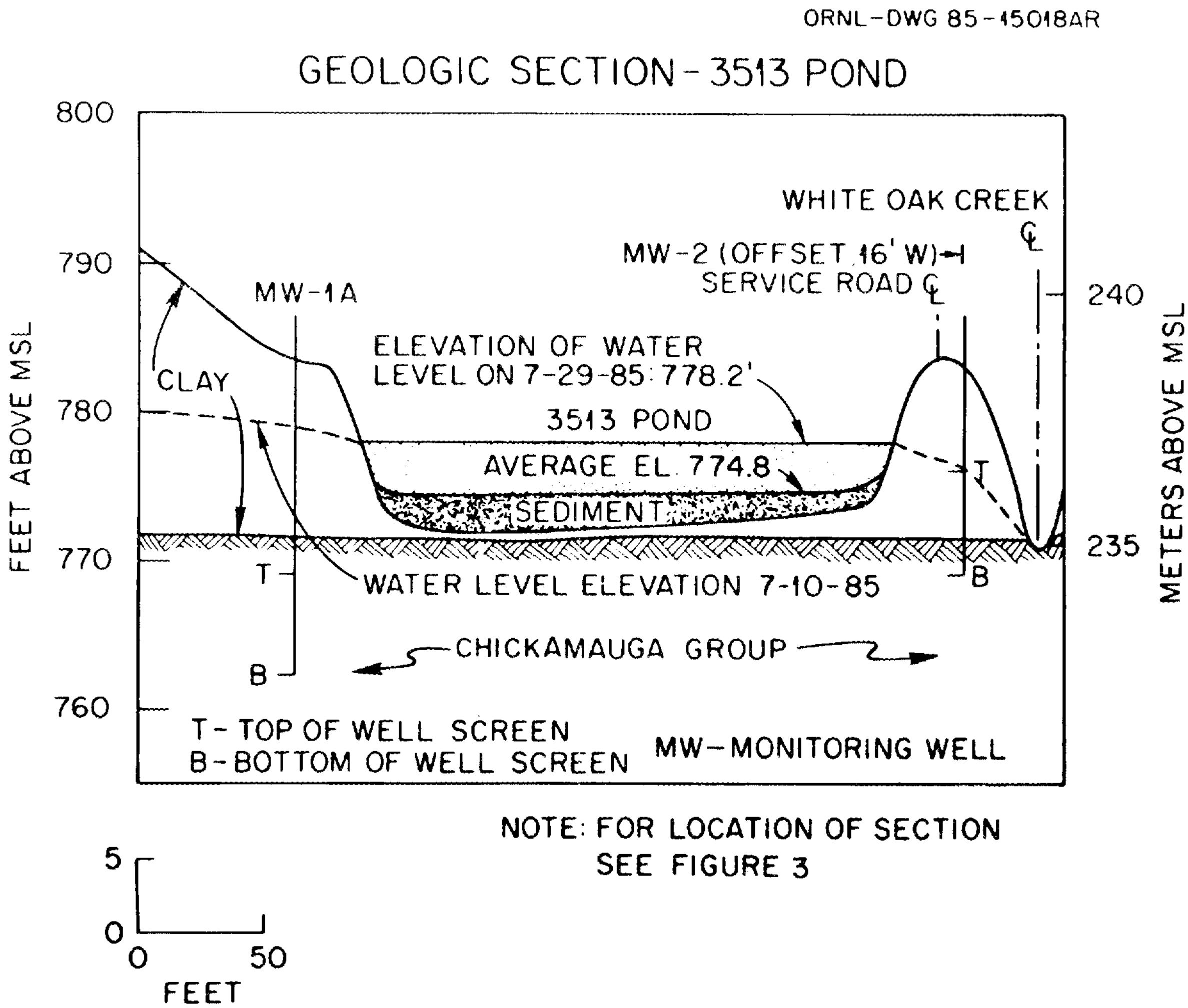

Figure 7. Geologic section through 3513 impoundment.

6. HYDROLOGY

From 1948 through 1983, the mean annual precipitation at Oak Ridge was 54.61 in. (138.71 cm). In this region, the heaviest precipitation normally occurs during winter and early spring with the monthly maximum normally occurring during the period January to March. However during some years, the monthly maximum has occurred in July because of thunderstorms. September and October are usually the driest months. According to the Climatic Atlas of the United States (U.S Department of Commerce, 1979), mean annual lake evaporation in the Oak Ridge area is 33 in. (89 cm).

From the above data, it can be estimated that the net annual precipitation input to the 3513 pond is 22 in. (56 cm). Multiplying this amount by the surface area of the impoundment yields an average yearly retained precipitation contribution of approximately 664,000 gal (2,510,000 L) . This is approximately one-third the value of the pond's normal capacity as earlier described.

The level of the pond is generally held at an elevation of 778 ft (237 m), which is the approximate elevation of the effluent drain lines on the south side of the impoundment. Outflow from these lines goes to a sump from which it is pumped to the 3524 impoundment and processed. In the fall and winter of 1984, the water level in the impoundment was allowed to rise to a maximum elevation of approximately 780.5 ft (237.9 m). The quantity of water pumped from the 3513 impoundment is not measured.

6.1 GROUNDWATER MOVEMENT

Water table maps, including the area containing the 3513 impoundment, are shown in Figs. 6 and 8. The map in Fig. 6 is from a report by Stockdale (1951) and depicts the water table for a large portion of ORNL based on well data available at the time the two impoundments now located just east of 3513 impoundment did not exist. Figure 8 is based on water level observations from the five monitoring wells constructed during this study and is limited to the immediate site of the 3513 impoundment. Water level observations upon which Fig. 8 is based are provided in Table 4. Both Figs. 6 and 8 show the hydraulic gradient to be generally towards White Oak Creek with a lesser component to the west, which is the downstream direction of White Oak Creek.

As previously described in Sect. 5.2.1, White Oak Creek flows in the direction of geologic strike on top of the limestone along the south boundary of the impoundment. In a homogeneous material, groundwater movement is in a direction normal to the water table contours. However, studies on the ORNL reservation (Webster 1976; Davis et al. 1984) support the fact that in the bedrock, the direction of groundwater movement is greatly affected by the directional permeability of the strata. Therefore, the overall groundwater movement through the bedrock is often in a direction at some acute angle to the groundwater contours. Such movement would not normally be expected to be in a straight line of flow, but rather would follow irregular pathways as along joints and bedding planes because the underlying bedrock strata has insignificant primary permeability. Therefore, a particular groundwater pathway could extend a distance westward in the form of a

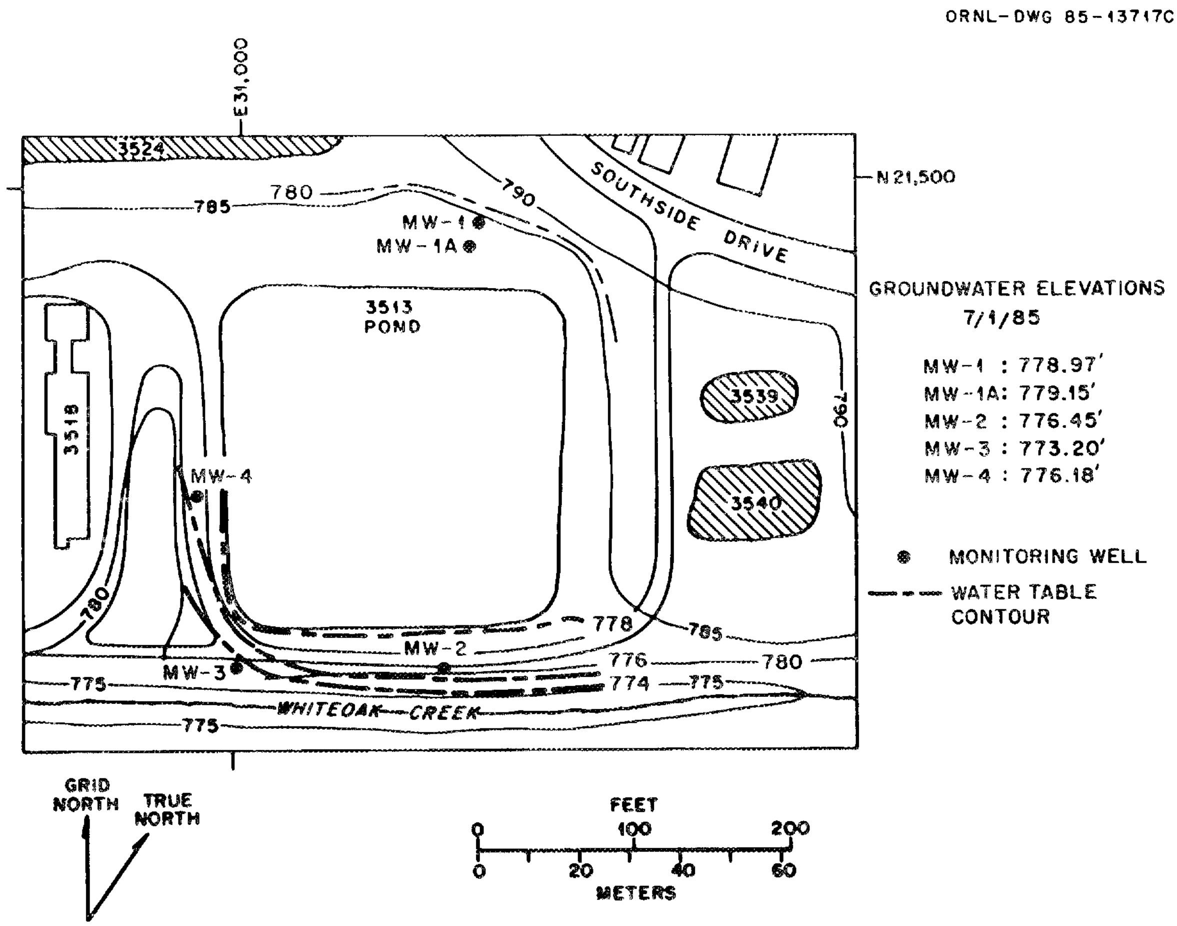

Figure 8. Water table map of 3513 impoundment.

bedding plane joint (direction of geologic strike) before intersecting another fracture leading in a steeper downgradient direction towards the creek.

In addition to the horizontal movement of groundwater at the 3513 site, there also existed during the period of this study a slight upward vertical gradient from the underlying bedrock to the overlying soil. As shown in the boring and well construction logs in Appendixes A and B, adjacent monitoring wells MW-1 and MW-1A have their intake screens positioned in the overburden clay soil and limestone bedrock, respectively. As shown in Table 4, the piezometric head in MW-1A (bedrock well) exceeded the head in MW-1 (clay overburden well) by as much as 1.0 ft (30.4 cm) in March to 0.2 ft (6.1 cm) in July.

6.2 UPPERMOST AQUIFER

The soil overlying the limestone bedrock consists of material that has been visually classified as clay (according to the Unified Soils Classification System), which categorically has low hydraulic conductivities. As shown in the boring and well construction logs provided in Appendixes A and B, monitoring well MW-1 is constructed entirely in clay soil and, to date, produces adequate quantities of water for sampling purposes. However, for most water uses, the clay would provide an insufficient quantity and would not be considered an aquifer. The two units are hydraulically connected as the clay immediately overlies the limestone bedrock.

6.3 GROUNDWATER SAMPLING METHODS

Water levels were measured with an electric tape prior to purging and sampling each well, and the immersed portion of the tape was rinsed with distilled water between wells. The wells were purged and sampled with bottom-loading, stainless steel bailers that were disassembled for thorough cleaning before use. The bailers were washed with hot water and detergent, and during the first round of sampling were rinsed with dilute nitric acid followed by distilled water. During the second round, to avoid rusting of the steel, the acid was replaced with alcohol followed by distilled water rinses. A new nylon line was attached to the bailer for each well.

Prior to taking a sample, the well was purged by removing a volume of water equal to five times the volume contained within the well screen and casing. This amounted to a volume of 0.82 gal/ft (3.10 L per 30.48 cm) of water depth in the well. The water removed for purging purposes was measured in 5 gal (18.9 L) containers and discarded into the impoundment.

On the first round of samples, which were collected in February 1985, the pH and specific conductivity were measured at an Environmental Sciences Division (ESD) laboratory located adjacent to the 3513 site. On the second round of sampling in May, these two parameters were measured at the well site.

6.4. SAMPLE COLLECTION AND PRESERVATION

Groundwater samples to be analyzed by the Analytical Chemistry Division (ACD) were poured directly from the stainless-steel bailer into

1 qt (0.95 L) new glass containers (previously rinsed with distilled water) having caps with Teflon liners. Four such samples were collected from each well during February and April, and two of the samples from each were acidified with nitric acid to a pH of 2. These samples were either delivered to the Analytical Chemistry Division within an hour or so after collection where they were refrigerated or stored overnight in an ESD refrigerator for next day delivery to ACD. In June, two additional, 1 qt (0.95 L) samples were collected from each well for additional total organic carbon (TOC) and polychlorinated biphenols (PCB) analyses.

In the February and April sampling operations, one-liter samples in plastic containers were collected from each well for gamma radiation analysis by ESD's Low-Level Gamma-Ray Spectrometry Laboratory using a high-resolution, lithium-drifted germanium [Ge(Li)] detector. These samples required no preservation.

6.5 CHAIN OF CUSTODY

A record was completed for all samples collected which contains the following information: name of collector, identifying list of samples, date and location where collected, inclusive dates that samples were in collector's custody, and the date that samples were transferred to the laboratory for analyses. A copy of this record accompanied the samples to the laboratory.

6.6 SELECTION OF CONSTITUENTS FOR ANALYSIS IN GROUNDWATER

The principal goal in analyzing groundwater was to determine if the groundwater had been contaminated. To do this the groundwater was analyzed for those 30 constituents promulgated under RCRA regulations as shown in Table 6. For active hazardous waste facilities (those that receive wastes after November 19, 1980), RCRA regulations require that each groundwater monitoring well be sampled and analyzed for these constituents at least four times during the first year to ascertain any seasonal variations in groundwater quality. Sampling for this report was conducted in February and April of 1985.

In addition to those 30 constituents listed in Table 5, groundwater samples were analyzed by ICP spectroscopy. This technique provides general information on concentrations of nearly 30 elements in one analysis. Many of these are not RCRA regulatory elements, but their concentrations in groundwater are useful in evaluating general groundwater quality. For instance, the concentrations of copper, nickel, and zinc were determined in groundwater samples using this technique. These elements are included in the list of compounds and elements listed in the recently issued "Hazardous Substance Guidelines" by the State of Tennessee (Gregory 1985). Groundwater samples were also analyzed for PCB and the radioisotopes ^{90}Sr, ^{137}Cs, and tritium.

6.7 CHEMICAL METHODS USED FOR ANALYSIS OF GROUNDWATER

The methods used to analyze groundwater are those described in USEPA (1982 and 1983). For elemental concentrations of the NIPDWS, it

Table 6. RCRA - 40 CFR 265.92 - Groundwater monitoring parameters

EPA Interim Primary Drinking Water Standards

Parameter	Maximum level (mg/L)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Fluoride	1.4-2.4
Lead	0.05
Mercury	0.002
Nitrate (as N)	10.
Selenium	0.01
Silver	0.05
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP Silvex	0.01
Radium	0.2 Bq/L
Gross alpha	0.56 Bq/L
Gross beta	4 mrem/y
Coliform bacteria	1/count/100 mL

Parameters establishing groundwater quality

- Chloride
- Iron
- Manganese
- Phenols
- Sodium
- Sulfate

Parameters used as indicators of groundwater contamination

- pH
- Specific conductance
- Total organic carbon
- Total organic halogen

was necessary to use atomic absorption methods to reach the required detection levels. The recommended USEPA methods are 7061, 7081, 7131, 7191, 7421, 7470, 7741, and 7761 for arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, respectively. As mentioned above, ICP spectroscopy (method 200.7 in USEPA 1983) was also used to determine concentrations of nonregulatory elements. The concentrations of pesticides and herbicides, as well as the PCB in the groundwater, were determined by method 8080 (USEPA 1982) except that the analyses were by liquid chromatography instead of gas chromatography. The total toxic organics (TTO) were determined using method 624 (USEPA 1983) or pentane extraction for the volatile organic compounds and method 1625 (USEPA 1982) for the semivolatile compounds. Coliform bacteria were determined by method 405.1 (USEPA 1983). Concentrations of fluoride, chloride, nitrate, and sulfate were determined in pond water using methods 340.2 and 300.0 as described in USEPA (1983). Phenol concentration was determined by method 420.1 (USEPA 1983). Total organic carbon (TOC) and total organic halides (TOX) were determined in the pond water using methods 9060 and 9020, respectively (USEPA 1982). The radionuclide concentrations were determined as described for the radionuclide analyses of the pond water.

6.8 RESULTS AND DISCUSSION OF CHEMICAL ANALYSES OF GROUNDWATER

Groundwater concentrations measured in the five monitoring wells in February and April are presented in Tables 7A and 8A of Appendix C. Those constituents presented in Table 7A are those regulated by RCRA (principally those listed in the NIPDWS) as well as those constituents that have been determined to be parameters establishing groundwater quality (chloride, iron, manganese, phenols, sodium, and sulfate), and those which USEPA has determined to be indicators of groundwater contamination (pH, specific conductance, total organic carbon, and total organic halogens). Also included in Table 7A are the concentrations of PCB, the beta-emitting radionuclides tritium and ^{90}Sr, and the gamma-emitters ^{137}Cs and ^{214}Pb. Listed in Table 8A are the concentrations of elements in groundwater samples determined by ICP spectroscopy.

Table 7 is a summary of measured constituent concentrations of all analyses listed in Table 7A for the three downgradient monitoring wells. As seen in Tables 7 and 7A, the maximum level for beta emitting radionuclides is presented as a dose rate of 4 millirems/year. However, the gross beta concentrations in Tables 7 and 7A are presented in the commonly accepted manner as activity units (Bq). EPA specifies that the dose rate for drinking water be calculated as the total body or organ dose that a person would receive by drinking 1 L of water daily for one year (USEPA 1976). According to EPA (1976), the activity in water of the beta emittors tritium and ^{90}Sr, which result in a dose rate of 4 millirems/year, are 20,000 pCi/L (740 Bq/L) and 8 pCi/L 0.3 Bq/L), respectively.

Major contaminants in groundwater at the 3513 impoundment appear to be radionuclides; for example, gross-alpha and gross-beta concentrations exceed NIPDWS concentrations in upgradient as well as downgradient wells. There are sampling dates when concentrations of chromium and

Table 7. Concentration of selected groundwater parameters from down-gradient wells at the 3513 impoundment (summary across all sampling dates)

Constituent	Unit	Maximum allowable concentration	Measured concentration				
			Mean	N	Minimum	Maximum	%CV
Arsenic	mg/L	0.05	0.0018	6	0.001	0.004	64
Barium	mg/L	1	0.247	6	0.059	0.52	76
Cadmium	mg/L	0.01	0.0018	6	0.001	0.002	22
Chloride	mg/L	not defined	17.7	6	6	35	73
Chromium	mg/L	0.05	0.339	6	0.016	1.2	147
Coliform	counts/100 mL	1	0.5	6	0	2	167
Endrin	mg/L	0.002	0.0001	6	0.0001	0.0001	0
Fluoride	mg/L	1.4 to 2.4	1	6	1	1	0
Gross alpha	Bq/L	0.56	1.47	6	0.03	3.9	110
Gross beta	Bq/L	4 mrem/y	19.9	6	1.4	54	117
Iron	mg/L	not defined	19.78	6	5.6	72	130
Lead	mg/L	0.05	0.24	6	0.003	1.4	232
Lindane	mg/L	0.004	0.0002	6	0.0001	0.001	147
Manganese	mg/L	not defined	3.73	6	2.7	5	25
Mercury	mg/L	0.002	0.0002	6	0.0001	0.0005	84
Methoxychlor	mg/L	0.1	0.0002	6	0.0002	0.0002	0
Nitrate (as N)	mg/L	10	3.5	6	2	5	47
PCBs	mg/L	not defined	0.0001	3	0.0001	0.0001	6
Phenol	mg/L	not defined	0.0025	6	0.001	0.007	90
Selenium	mg/L	0.01	0.005	6	0.005	0.005	0
Silver	mg/L	0.05	0.07	6	0.07	0.07	0
Sodium	mg/L*	not defined	30.2	6	25	37	17
Sp. cond.	umhos/cm	not defined	592	6	442	803	25
Sulfate	mg/L	not defined	12.8	6	5	22	58
TOC	mg/L	not defined	5.98	6	1.46	10	44
TOX	mg/L	not defined	0.0485	6	0.022	0.08	43
Toxaphene	mg/L	not defined	0.002	6	0.002	0.002	0
Tritium	Bq/L	not defined	2700	3	2200	3600	29
pH	pH	not defined	6.5	6	6.2	7.1	5
2,4,5-TP Silvex	mg/L	0.01	0.0058	6	0.005	0.01	35
2,4-D	mg/L	0.1	0.0057	6	0.005	0.009	29
^{137}Cesium	Bq/L	not defined	0.39	10	0.0001	1.04	106
^{214}Lead	Bq/L	not defined	6.55	5	3.51	10.6	47
^{226}Radium	Bq/L	0.19	0.046	6	0.008	0.14	110
^{90}Strontium	Bq/L	not defined	10.6	3	0.4	26	128

lead for the five wells exceed NIPDWS (note concentrations of chromium in wells 2 and 4 in April, also lead in well 3 during April). These concentrations may simply represent sample and analytical variations, since no general trend is indicated for concentrations of either of these elements in the downgradient wells. Further sampling over time will verify possible contamination. The EP extracts from the 3513 sediment indicated concentrations of mercury in excess of RCRA permissible levels; however, concentrations of mercury in groundwater sampled to date are not in excess of the NIPDWS. Counts of coliform bacteria in groundwater upgradient, as well as downgradient, were in excess of the NIPDWS. These counts may result from wildlife habitat, such as waterfowl and terrestrial animals, known to be in the area. They also may represent sampling and analytical variations. Again, additional monitoring will indicate a trend over time.

Concentrations of total organic carbon (TOC), total organic halides (TOX), and PCB in groundwater samples appear to be relatively constant regardless of the monitoring well sampled, either upgradient or downgradient from the 3513 impoundment. To date, it appears that the groundwater is contaminated by radionuclides and PCB, both of which appear in upgradient and downgradient wells. The upgradient wells may be affected by contaminants from other sources, such as the previously mentioned impoundments or underground waste lines.

7. IMPOUNDMENT CLOSURE

7.1 CURRENT CONCEPT FOR POND CLOSURE

The current technical plan as summarized from Myrick (1984) is as follows: "Based on the concept of in-situ stabilization of the pond sediment, the objective of site decommissioning is to solidify all radioactive and hazardous waste into a stable waste form on-site, and isolate the disposal site from long-term interactions with surface and groundwater. According to the conceptual plan for this site, the pond would be segmented into smaller areas to provide a better controlled and more thorough fixation of the pond contents. The majority of the clear water above the pond sediment would be transferred to the process waste treatment system for processing prior to release. Truck-mounted equipment would then move along the accessible side of each pond segment, extracting the sediment/sludge, mixing it with grout, and returning it back into the basin. A closed-loop suction, mixing, and discharge system has been specified to eliminate the concerns with airborne particulates. After the grout had sufficiently hardened, the remaining free liquids would be transferred to the process system while an additional concrete cap is applied. Compacted fill, graded aggregate, and appropriate capping (soil or asphalt) would follow, resulting in a site grade that would alleviate surface runoff and infiltration concerns. Groundwater control would be provided through installation of a slurry wall or grout curtain surrounding the site."

7.2 CHARACTERIZATION RESULTS TO BE CONSIDERED

As previously discussed, analyses of the sediment have determined that the waste can be classified as both a hazardous and radioactive substance. As such, closure concepts may be required to comply with regulations of both the EPA and Nuclear Regulatory Commission (10 CFR 20 or 10 CFR 61). Also, EPA requirements for the final disposition of PCBs (which are a constituent of the waste) during the time frame that closure is planned (1987-1991) may be adverse to in-situ solidification.

Two physical characteristics of the site, as revealed by this study, need to be considered in the current conceptual plan: (1) the relative thinness of the clay layer overlying the bedrock beneath the waste sediment, and (2) the fact that the elevation of the water table at the site is several feet above the elevation of the limestone bedrock.

As presently conceived in the site stabilization plan, division of the pond into smaller sections would be accomplished by driving sheetpiling. However, the clay in the pond bottom is probably not sufficiently thick in all parts of the impoundment [approximately 0.5 ft (15 cm) on the north side to 3.0 ft (30.5 cm) on the south side] to support the sheetpiling, nor will the piling be able to penetrate the underlying hard, limestone bedrock. Therefore, if the impoundment is to be divided into segments, a method other than driving sheetpiling may be needed in a major portion of the facility.

The elevation of the groundwater at the site is above the elevation of the impoundment's sediment and even further above the limestone bedrock (see Fig. 7). When solidification is completed, the groundwater elevation would be above at least part of that mass. The current concept is to provide either a slurry wall or grout curtain to isolate the solidified mass from the groundwater. A slurry wall is not feasible in the limestone bedrock, and grout is not feasible in the clay overburden; at a minimum, either a slurry trench or passive French drain and a grout curtain would probably be necessary. The slurry wall would be a barrier to lateral groundwater movement from outside the site, but because of its depth limitation to the top of bedrock, it would not protect the solidified mass against upward movement from the underlying bedrock. As the area will be approximately 210 ft (64 m) square, there will be the possibility of significant upward groundwater flow from the limestone, and then lateral movement along the base of the mass. Although a grout curtain around the perimeter of the site would not prevent upward pressure of the groundwater to the base of the mass, it would be expected to restrict groundwater circulation within the grouted perimeter. The degree of restriction would depend in large measure on the depth and effectiveness of the grout curtain. The substitution of a passive French drain in place of the slurry trench would have the advantage of actually lowering the groundwater table around the perimeter of the site to the elevation of the bottom of the trench (top of bedrock).

8. ADDITIONAL DATA NEEDS

8.1 GROUNDWATER SAMPLING AND HYDRAULIC TESTING AT EXISTING WELLS

Monitoring wells at the 3513 impoundment will be sampled at least twice more so that four quarters of data on RCRA regulated constituents (see Table 5) will be available. For impoundments active after November 19, 1980, RCRA regulations require that, at the end of the first year of sampling, statistical analyses be performed on the data from the four quarters to determine whether the groundwater is polluted by the impoundment. Pollution is assumed if the analysis (Cochran's Approximation to the Behrens-Fisher Student's t test) indicates a significant increase (decrease in the case of pH) in the water quality parameters (listed in Table 5) between the upgradient and downgradient wells. This procedure for determining pollution will be considered for the 3513 impoundment after four quarters of sampling and analyses have been completed.

Tests will be conducted in the existing monitoring wells to estimate the hydraulic conductivity of the clay and bedrock in the vicinity of the wells.

8.2 PLANNED AND POTENTIAL WELLS

As stated earlier in this report, an extensive groundwater-monitoring system will be in place by October 1985 at three active impoundments (3524, 3539, and 3540; see Fig. 1) that bound the 3513 impoundment on the north and east, respectively. This system will have two downgradient wells that are open only to groundwater moving through the bedrock. The test results from the bedrock wells will be evaluated to determine whether an additional bedrock monitoring well should be constructed at the 3513 impoundment.

If it is decided that an additional well is necessary, it is proposed that it be constructed within 10 ft (3 m) of the existing MW-3 or MW-4, depending on future sampling results. This well would be constructed in limestone bedrock so that the hydraulic head would be measured at a depth approximately 30 ft deeper than that measured in MW-3, and the groundwater would be sampled for contaminants at a depth between approximately 40 and 50 ft below the ground surface. As previously discussed, the limestone beds dip at an angle of approximately 35° from the horizontal below the pond almost parallel with the south side of the impoundment. Therefore, at a depth of 50 ft (13 m) at either location, the well would be expected to intersect a stratum that subcrops beneath the clay bottom of the pond 70 ft (21 m) north of its position at the ground surface. Thus, this well would have the opportunity to intercept possible contamination if it is moving downward along the dip of the bedding planes from the pond.

If the results of continued sampling confirm that the 3513 impoundment has significantly contaminated the groundwater, additional monitoring wells will be considered for construction in the appropriate areas to determine the extent and concentration of the plume.

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APPENDIX A

DRILLING LOGS OF BORINGS, MW-1 THROUGH MW-4

DRILLING LOG | DIVISION: Environmental Sciences | INSTALLATION: Oak Ridge National Laboratory | Hole No. MW-1 | SHEET 1 OF 2 SHEETS

1. PROJECT: SEMP - 3513 Pond	10. SIZE AND TYPE OF BIT: 8" auger
2. LOCATION (Coordinates or Station): N21463.30; E31157.39	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: Plant & Equipment Division	12. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B-33
4. HOLE NO. (As shown on drawing title and file number): MW-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5 jars; UNDISTURBED
5. NAME OF DRILLER: P. E. Moore	14. TOTAL NUMBER CORE BOXES: -
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 11.9'	16. DATE HOLE: STARTED 1/7/85; COMPLETED 1/7/85
8. DEPTH DRILLED INTO ROCK: -	17. ELEVATION TOP OF HOLE: 783.6'
9. TOTAL DEPTH OF HOLE: 11.9'	18. TOTAL CORE RECOVERY FOR BORING: %
	19. SIGNATURE OF INSPECTOR: R. G. Stansfield

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) (Visual classification only) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
783.6	0		CLAY (CL) stiff, moist, brown,			Boring was sampled by driving 1 1/2" x 24" split-tube sampler to full depth of hole in 2.0' drives prior to drilling with auger.
	1		1.0'		Jar 1	Sampler was washed between each drive.
			CLAY (CL) stiff, moist, brownish red, contains mudstone fragments to 1/2" size			
	2				2.0	Augers were washed at completion of boring.
	3				Jar 2	
	4				4.0	
	5		5.0'		Jar 3	
			CLAY (CL) stiff, moist, medium grey			
	6				6.0	
	7				Jar 4	
	8				7.9'	
			8.5'			
	9		CLAY (CL) stiff, moist, mottled yellow-grey with subangular mudstone fragments to 1.0" size		Jar 5	
773.6	10					

PROJECT | HOLE NO. MW-1

Hole No. MW-1

DRILLING LOG	DIVISION Environmental Sciences	INSTALLATION Oak Ridge National Laboratory	SHEET 2 of 2 SHEETS

1. PROJECT SFMP - 3513 Pond	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED — COMPLETED
	17. ELEVATION TOP OF HOLE
7. THICKNESS OF OVERBURDEN	18. TOTAL CORE RECOVERY FOR BORING %
8. DEPTH DRILLED INTO ROCK	19. SIGNATURE OF INSPECTOR
9. TOTAL DEPTH OF HOLE	

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) (Visual classification only) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
773.6	10		CLAY (CL)(continued) stiff, moist, mottled yellow-grey, with subangular mudstone fragments to 1.0" size		Jar 6	At completion of drilling only approximately 0.1-0.2' of water in hole.
	11					
			11.9'	11.9'	11.9'	
771.7	12		Bottom of hole on firm bedrock			Samples checked with G/M meter and no count was measured above background.

PROJECT | HOLE NO. MW-1

Hole No. MW-1A

DRILLING LOG

DIVISION	Environmental Sciences
INSTALLATION	Oak Ridge National Laboratory
SHEET	1 OF 1 SHEETS
1. PROJECT	SFMP- 3513 Pond
2. LOCATION (Coordinates or Station)	N21462.19; E31155.27
3. DRILLING AGENCY	Plant & Equipment Division
4. HOLE NO. (As shown on drawing title and file number)	MW-1A
5. NAME OF DRILLER	P. E. Moore
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	11.9'
8. DEPTH DRILLED INTO ROCK	13.1'
9. TOTAL DEPTH OF HOLE	25.0'
10. SIZE AND TYPE OF BIT	4" auger
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Mobile B-33
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED - ; UNDISTURBED -
14. TOTAL NUMBER CORE BOXES	-
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 1/8/85; COMPLETED 1/8/85
17. ELEVATION TOP OF HOLE	783.5 '
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	R. G. Stansfield

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) (Visual classification only) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
783.5	0		CLAY (see log of boring MW-1)		NO SAMPLES TAKEN	Boring MW-1A is located 2.3' south-westerly of boring MW-1. Drilled with 4" auger equipped with rock bit. Water in hole at completion of drilling. Augers were washed at completion of boring. Drill cuttings were washed from bottom of boring with clear water at completion of drilling.
771.6	11.9		11.9' Chickamauga Limestone			
758.5	25		25.0' Bottom of hole			Cuttings checked with G/M meter and no count was measured above background

PROJECT | HOLE NO. MW-1A

Hole No. MW-2

DRILLING LOG	DIVISION Environmental Sciences	INSTALLATION Oak-Ridge National Laboratory	SHEET 1 OF 2 SHEETS

1. PROJECT SFMP - 3513 Pond	10. SIZE AND TYPE OF BIT 6" auger
2. LOCATION (Coordinates or Station) N21180.43; E31141.45	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY Plant and Equipment Division	12. MANUFACTURER'S DESIGNATION OF DRILL Mobile B-33
4. HOLE NO. (As shown on drawing title and file number) MW-2	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6 Jars; UNDISTURBED
5. NAME OF DRILLER P. E. Moore	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN 11.7'	16. DATE HOLE: STARTED 1/9/85; COMPLETED 1/9/85
8. DEPTH DRILLED INTO ROCK 2.1'	17. ELEVATION TOP OF HOLE 783.0'
9. TOTAL DEPTH OF HOLE 13.8'	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR R. G. Stansfield

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) (Visual classification only) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
783.0	0		CLAY (CL) stiff, damp, medium brown with red, subangular sandstone fragments to 1.0" in size	50%	Jar 1	Boring was sampled by driving 1 1/2" x 24" split-tube sampler to refusal in 2.0' drives prior to drilling with auger. Sampler was washed between drives. Augers were washed at completion of boring. Drill cuttings were washed from bottom of boring with clear water at completion of drilling.
	2				2.0'	
	3		1" chert fragment at 3.0'	35%	Jar 2	
	4				4.0'	
	5		5.5'	65%	Jar 3	
	6		CLAY (CL) med, moist, grey		6.0'	
775.6	7		7.4' CLAYEY Sand (SC) poorly graded with some gravel, material contains chert, sandstone and limestone, wet, brown and red	75%	Jar 4	Note: SC material may be backfill as boring is located within 3' of drain pipe.
	8				8.0'	
774.2	9		8.8' CLAY (CL) medium moist brownish grey with chert fragments	80%	Jar 5	
773.0	10				10.0'	

PROJECT | HOLE NO. MW-2

Hole No. MW-2

DRILLING LOG	DIVISION Environmental Sciences	INSTALLATION Oak Ridge National Laboratory	SHEET 2 OF 2 SHEETS

1. PROJECT: SFMP - 3513 Pond
2. LOCATION (Coordinates or Station): 3513 Pond
3. DRILLING AGENCY
4. HOLE NO. (As shown on drawing title and file number): MW-2
5. NAME OF DRILLER
6. DIRECTION OF HOLE: ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER
16. DATE HOLE: STARTED / COMPLETED
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING %
19. SIGNATURE OF INSPECTOR

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d Visual classification only	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
773.0	10		CLAY (CL) (continued) medium, moist, brownish grey, with chert fragments	25%	Jar 6	Water present in hole at completion of drilling.
	11					
771.3			11.7'		11.9'	
	12		Chickamauga Limestone			Samples and drill cuttings were checked with G/M meter and no count was measured above background.
	13					
769.2			13.8'			
	14		Bottom of hole			

PROJECT | HOLE NO. MW-2

Hole No. MW-3

DRILLING LOG	DIVISION Environmental Sciences	INSTALLATION Oak Ridge National Laboratory	SHEET 1 OF 2 SHEETS

1. PROJECT: SFMP - 3515 Pond	10. SIZE AND TYPE OF BIT: 6" auger
2. LOCATION (Coordinates or Station): N21180.33; E31009.21	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: Plant and Equipment Division	12. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B-33
4. HOLE NO. (As shown on drawing title and file number): MW-3	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6 jars; UNDISTURBED
5. NAME OF DRILLER: P. E. Moore	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 11.4'	16. DATE HOLE: STARTED 1/9/85; COMPLETED 1/9/85
8. DEPTH DRILLED INTO ROCK: 1.8'	17. ELEVATION TOP OF HOLE: 782.2'
9. TOTAL DEPTH OF HOLE: 13.2'	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR: R. G. Stansfield

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) (Visual classification only) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
782.2	0		CLAY (CL) stiff, moist, brown with organic matter in top 0.5', chert and sandstone fragments to 1/2" size, with dark brown streaks (organic?)	75%	Jar 1	Boring was sampled by driving 1 1/2" x 24" split-tube sampler to refusal in 2.0' drives prior to drilling with auger. Sampler was washed between drives.
	2				2.0'	Samples and drill cuttings were checked with G/M meter and no count was measured above background.
	3			65%	Jar 2	Augers were washed at completion of boring. Water in hole at completion of drilling.
	4				4.0'	Drill cuttings were washed from hole with clear water at completion of drilling.
	5			60%	Jar 3	
	6		Consistency changes to medium at approximately 6.0'		6.0'	
	7			50%	Jar 4	
	8				8.0'	
	9		9.0 CLAY (CL) medium, moist, grey	50%	Jar 5	
772.2	10				10.0'	

PROJECT | HOLE NO MW-3

Hole No. MW-3

DRILLING LOG	DIVISION Environmental Sciences	INSTALLATION Oak Ridge National Laboratory	SHEET 2 OF 2 SHEETS
1. PROJECT SMFP - 3515 Pond		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number)	MW-3	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED / COMPLETED
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING %	
9. TOTAL DEPTH OF HOLE		19. SIGNATURE OF INSPECTOR	

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) (Visual classification only) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
772.2	10		CLAY (CL)(continued)			
			10.9'	25%	Jar 6	
	11		Clayey Gravel (CG) Angular to subround fragments of lime-stone, chert and sandstone to 1.0" size			
770.8			11.4'		11.4'	
	12					
			Chickamauga Limestone			
	13		13.2'			
769.0			Bottom of hole			
	14					

PROJECT | HOLE NO. MW-3

Hole No. MW-4

DRILLING LOG	DIVISION: ENvironmental Sciences	INSTALLATION: Oak Ridge National Laboratory	SHEET 1 OF 2 SHEETS

1. PROJECT: SFMP - 3515 Pond	10. SIZE AND TYPE OF BIT: 6" auger
2. LOCATION (Coordinates or Station): N21281.89; E30970.03	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: Plant & Equipment Division	12. MANUFACTURER'S DESIGNATION OF DRILL: MObile B-33
4. HOLE NO. (As shown on drawing title and file number): MW-4	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6 jars; UNDISTURBED -
5. NAME OF DRILLER: P. E. Moore	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 11.7'	16. DATE HOLE: STARTED 1/8/85; COMPLETED 1/8/85
8. DEPTH DRILLED INTO ROCK: 2.0'	17. ELEVATION TOP OF HOLE: 780.8'
9. TOTAL DEPTH OF HOLE: 13.7'	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR: R. G. Stansfield

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d (Visual classification only)	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
780.8	0		CLAY (CL) stiff, damp, brown, with chert fragments and sandstone fragments to 1/2" size	65%	Jar 1 (2.0')	Boring was sampled by driving 1 1/2" x 24" split-tube sampler to refusal in 2.0' drives prior to drilling with auger. Sampler was washed between drives. Samples and drill cuttings were checked with a G/M meter and no count was measured above background.
	1					
	2		3.0'	65%	Jar 2 (4.0')	Augers were washed at completion of boring. Water in hole at completion of drilling. Drill cuttings were washed from hole at end of drilling by clear water.
	3		CLAY (CL) stiff, moist, mottled medium grey and yellow, with occasional white chert in sand sizes			
	4					
	5			90%	Jar 3 (6.0')	
	6					
	7			90%	Jar 4 (3.0')	
	8					
	9			75%	Jar 5 (10.0')	
770.8	10					

PROJECT | HOLE NO. MW-4

Hole No. MW-4

DRILLING LOG	DIVISION Environmental Sciences	INSTALLATION Oak Ridge National Laboratory	SHEET 2 OF 2 SHEETS

1. PROJECT SFMP - 3513 Pond	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station) 3513 Pond	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number) MW-4	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) (Visual classification only) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
770.8	10		CLAY (CL)(continued)			
	11		11.0'	20%	Jar 6	
			CLAY (CL) stiff, moist, mottled grey and yellow, with sandstone and chert fragments to 1.0" size			
769.01					11.7'	
	12		11.7'			
			Chickamauga Limestone			
	13					
767.01			13.7'			
	14		Bottom of hole			

PROJECT | HOLE NO. MW-4

APPENDIX B

GROUNDWATER MONITORING WELL REPORTS, MW-1 THROUGH MW-4

GROUND WATER OBSERVATION WELL REPORT

PROJECT SEMP PONDS

LOCATION 3513 Pond N21463.30; E31157.39

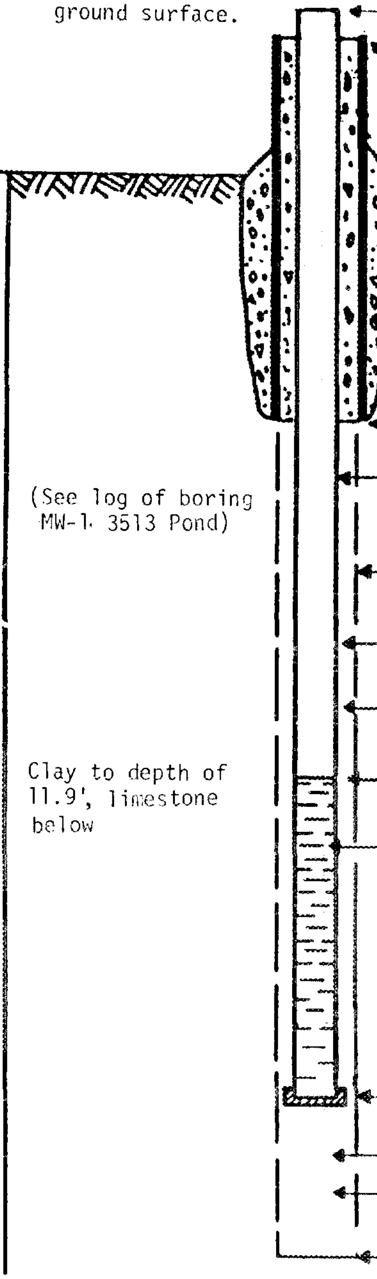
Date Completed 1/8/85 **Original Depth** 7.8' below ground surface

Elevation of top of well riser pipe = 786.61 ft

Well No. MW-1

Aquifer Uppermost (Water Table)

Note: All depths and heights are referenced to ground surface.



(See log of boring MW-1, 3513 Pond)

Clay to depth of 11.9', limestone below

Generalized Stratigraphy

Height of riser pipe above ground surface	3.0'
Height of top of surface casing pipe above ground surface	1.7'
Depth of surface seal below ground surface	2.31'
Type of surface seal: concrete	
I.D. of surface casing.	4.0"
Type of surface casing: steel	
Depth of surface casing below ground	2.3'
I.D. of riser pipe.	2.0"
Type of riser pipe: stainless steel	
Diameter of borehole	8.0"
Depth of borehole	11.9'
Type of backfill: concrete	
depth top of seal.	4.0'
Type of seal: bentonite clay	
depth bottom of seal.	5.0'
Type of sand pack. medium-grained silica sand	
Depth of top of sand pack.	5.0'
depth top of screened section.	5.8'
Type of screened section: stainless steel	
Discribe openings continuous slot, 0.010" opening	
I.D. of screened section.	1.9"
depth bottom of screened section	7.8'
depth bottom of sand column.	8.0'
Type of backfill below observation pipe. native clay capped with 2.0' bentonite	
depth of hole.	11.9'

GROUND WATER OBSERVATION WELL REPORT

PROJECT SFMP PONDS

LOCATION 3515 Pond N21462.19; E31155.27

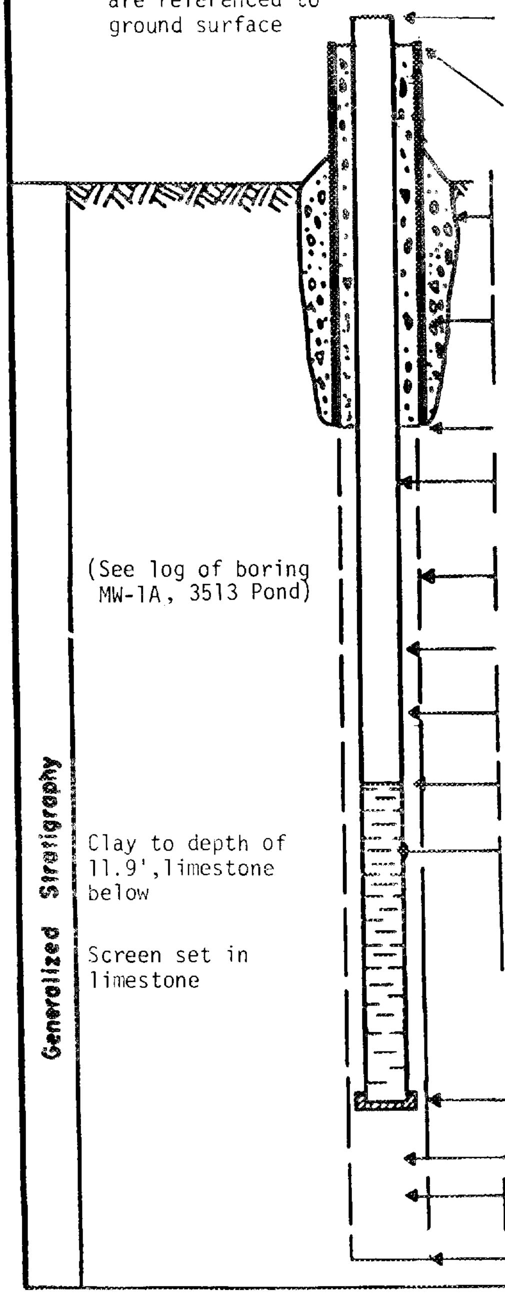
Date Completed 1/8/85 **Original Depth** 21.3 below ground surface

Elevation of top of well riser pipe = 786.37 ft

Well No. MW-1A

Aquifer Chickamauga Limestone

Note: All depths and heights are referenced to ground surface



(See log of boring MW-1A, 3513 Pond)

Generalized Stratigraphy

Clay to depth of 11.9', limestone below

Screen set in limestone

Height of riser pipe above ground surface	2.9'
Height of top of surface casing pipe above ground surface	1.9'
Depth of surface seal below ground surface	2.1'
Type of surface seal: concrete	
I.D. of surface casing	4.0"
Type of surface casing: steel	
Depth of surface casing below ground	2.1'
I. D. of riser pipe:	2.0"
Type of riser pipe: stainless steel	
Diameter of borehole	4.0"
Depth of borehole	25.0'
Type of backfill: concrete	
depth top of seal	11.0'
Type of seal: bentonite	
depth bottom of seal	13.9'
Type of sand pack medium-grained silica sand	
Depth of top of sand pack	13.9'
depth top of screened section	14.3'
Type of screened section: stainless steel	
Discribe openings continuous slot, 0.010" opening	
I.D. of screened section	1.9"
depth bottom of screened section	21.3'
depth bottom of sand column	23.5'
Type of backfill below observation pipe. in-place limestone drill cuttings	
depth of hole	25.0'

GROUND WATER OBSERVATION WELL REPORT

PROJECT SFMP PONDS

LOCATION 3513 Pond N21180.43; E31141.45

Date Completed 1/11/85 **Original Depth** 13.8' below ground surface

Elevation of top of well riser pipe - 785.96 ft

Well No. MW-2

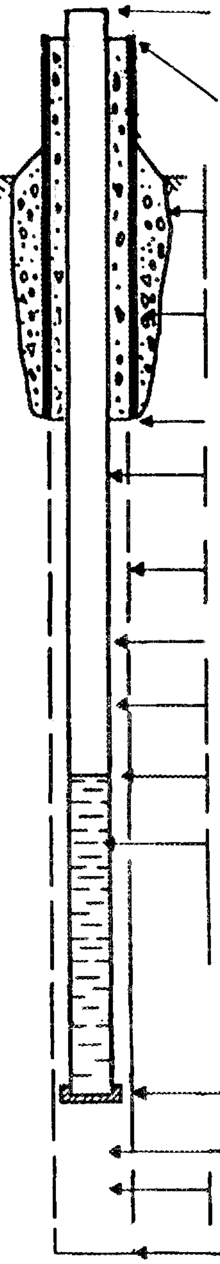
Aquifer Uppermost (Water Table)

Note: All depths and heights are referenced to ground surface.

(See log of boring MW-2, 3513 Pond)

Clay to depth of 11.7', limestone below

Generalized Stratigraphy



Height of riser pipe above ground surface	3.0
Height of top of surface casing pipe above ground surface	2.1'
Depth of surface seal below ground surface	1.9'
Type of surface seal: concrete	
I.D. of surface casing.	4.0"
Type of surface casing: steel	
Depth of surface casing below ground	1.9
I.D. of riser pipe:	4.0"
Type of riser pipe: stainless steel	
Diameter of borehole	6.0"
Depth of borehole	13.8'
Type of backfill: concrete	
depth top of seal.	4.0'
Type of seal: bentonite	
depth bottom of seal.	5.0'
Type of sand pack. medium-grained silica sand	
Depth of top of sand pack.	5.0
depth top of screened section.	6.8'
Type of screened section: stainless steel	
Discribe openings continuous slot, 0.010" opening	
I.D. of screened section.	1.9"
depth bottom of screened section	13.8'
depth bottom of sand column.	13.8'
Type of backfill below observation pipe.	
depth of hole.	13.8'

GROUND WATER OBSERVATION WELL REPORT

PROJECT: SFMP PONDS

LOCATION: 3513 Pond N21180.33; E31009.21

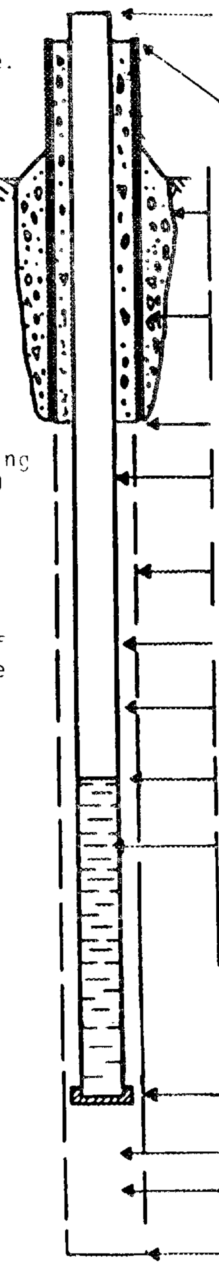
Date Completed: 1/11/85 Original Depth: 13.1' below ground surface

Elevation of top of well riser pipe = 785.24 ft.

Well No. MW-3

Aquifer: Uppermost (Water Table)

Note: All depths and heights are referenced to ground surface.



(See log of boring MW-3, 3513 Pond)

Clay to depth of 11/4', limestone below

Generalized Stratigraphy

Height of riser pipe above ground surface	3.0
Height of top of surface casing pipe above ground surface	1.8'
Depth of surface seal below ground surface	2.2'
Type of surface seal: concrete	
I.D. of surface casing.	4.0"
Type of surface casing: steel	
Depth of surface casing below ground	2.2'
I.D. of riser pipe:	2.0"
Type of riser pipe: stainless steel	
Diameter of borehole	6.0"
Depth of borehole	13.2'
Type of backfill: concrete	
depth top of seal.	4.0'
Type of seal: bentonite	
depth bottom of seal.	5.0'
Type of sand pack. medium-grained silica sand	
Depth of top of sand pack.	5.0'
depth top of screened section.	6.1'
Type of screened section: stainless steel	
Discribe openings continuous slot, 0.010" opening	
I.D. of screened section.	1.9"
depth bottom of screened section	13.1'
depth bottom of sand column.	13.2'
Type of backfill below observation pipe. sand	
depth of hole.	13.2'

GROUND WATER OBSERVATION WELL REPORT

PROJECT SFMP PONDS

LOCATION 3515 Pond N21281.89; E30970.03

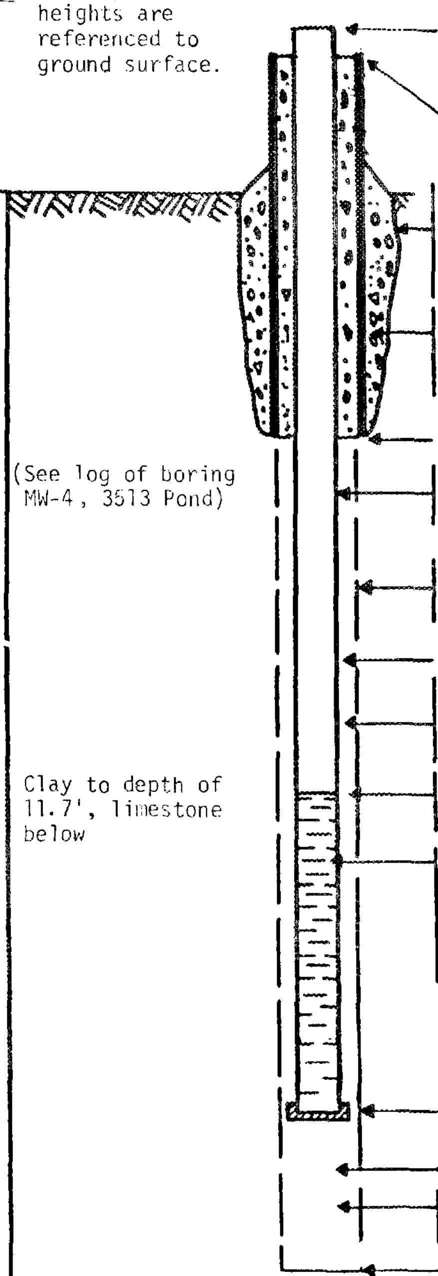
Date Completed 1/11/85 **Original Depth** 13.6' below ground surface

Elevation of top of well riser pipe = 783.25 ft.

Well No. MW-4

Aquifer Uppermost (Water Table)

Note: All depths and heights are referenced to ground surface.



Generalized Stratigraphy

(See log of boring MW-4, 3513 Pond)

Clay to depth of 11.7', limestone below

Height of riser pipe above ground surface	2.5'
Height of top of surface casing pipe above ground surface	1.8'
Depth of surface seal below ground surface	2.2'
Type of surface seal: concrete	
I.D. of surface casing.	4.0"
Type of surface casing: steel	
Depth of surface casing below ground	2.2'
I.D. of riser pipe:	2.0"
Type of riser pipe: stainless steel	
Diameter of borehole	6.0"
Depth of borehole	13.7'
Type of backfill: concrete	
depth top of seal.	4.0'
Type of seal: bentonite	
depth bottom of seal.	5.0'
Type of sand pack. medium-grained silica sand	
Depth of top of sand pack.	5.0'
depth top of screened section.	6.6'
Type of screened section: stainless steel	
Discribe openings continuous slot, 0.010" opening	
I.D. of screened section.	1.9"
depth bottom of screened section	13.6'
depth bottom of sand column.	13.7'
Type of backfill below observation pipe. sand	
depth of hole.	13.7'

APPENDIX C

ANALYTICAL TABLES, 1A THROUGH 8A

Notes for all tables:

1. The "-" (minus) symbol is used to represent the detection level.

2. Detection limit for the same constituent varied among the analyses because of sample dilution and matrix effects.

TABLE 1A. CONCENTRATIONS OF RCRA REGULATED CONSTITUENTS
IN EP EXTRACTS FROM 3513 POND SEDIMENTS.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
AS	MG/L	5.0	C QUAD	11/15/84	-1.2000
			COMPOSITE	02/19/85	-4.2000
			NEQUAD	11/14/84	-1.2000
			NWQUAD	11/14/84	-1.2000
			SWQUAD	11/14/84	-1.2000
BA	MG/L	100.0	C QUAD	11/15/84	0.5600
			COMPOSITE	02/19/85	0.9700
			NEQUAD	11/14/84	0.9000
			NWQUAD	11/14/84	0.6300
			SWQUAD	11/14/84	0.7600
CD	MG/L	1.0	C QUAD	11/15/84	0.0200
			COMPOSITE	02/19/85	-0.1900
			NEQUAD	11/14/84	0.0900
			NWQUAD	11/14/84	0.0350
			SWQUAD	11/14/84	0.0950
CR	MG/L	5.0	C QUAD	11/15/84	0.1800
			COMPOSITE	02/19/85	-0.4200
			NEQUAD	11/14/84	0.1500
			NWQUAD	11/14/84	0.1900
			SWQUAD	11/14/84	0.1400
PB	MG/L	5.0	COMPOSITE	02/19/85	-4.2000

(CONTINUED)

TABLE 1A. CONCENTRATIONS OF RCRA REGULATED CONSTITUENTS IN EP EXTRACTS FROM 3513 POND SEDIMENTS.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
PB	MG/L	5.0	NEQUAD	11/14/84	1.2000
			NWQUAD	11/14/84	0.2000
			SWQUAD	11/14/84	0.0090
			C-QUAD	11/15/84	-0.0030
HG	MG/L	0.2	COMPOSITE	02/19/85	4.8000
			NEQUAD	11/15/84	3.6000
			NWQUAD	11/15/84	3.7000
			SWQUAD	11/15/84	0.1500
			C-QUAD	11/15/84	2.7000
SE	MG/L	1.0	C QUAD	11/15/84	-2.4000
			COMPOSITE	02/19/85	-8.4000
			NEQUAD	11/14/84	-2.4000
			NWQUAD	11/14/84	-2.4000
			SWQUAD	11/14/84	-2.4000
AG	MG/L	5.0	C QUAD	11/15/84	-0.4200
			COMPOSITE	02/19/85	-1.5000
			NEQUAD	11/14/84	-0.4200
			NWQUAD	11/14/84	-0.4200
			SWQUAD	11/14/84	-0.4200
ENDRIN	MG/L	0.02	COMPOSITE	02/19/85	-0.0001
LINDANE	MG/L	0.04	COMPOSITE	02/19/85	0.0003

(CONTINUED)

TABLE 1A. CONCENTRATIONS OF RCRA REGULATED CONSTITUENTS IN EP EXTRACTS FROM 3513 POND SEDIMENTS.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
METHOXYCHLOR	MG/L	10.0	COMPOSITE	02/19/85	-0.0002
TOXAPHENE	MG/L	0.5	COMPOSITE	02/19/85	-0.0020
2,4-D	MG/L	10.0	COMPOSITE	02/19/85	-0.0050
2,4,5-TP	MG/L	1.0	COMPOSITE	02/19/85	-0.0050

TABLE 2A. CONCENTRATIONS OF RCRA NONREGULATED CONSTITUENTS IN EP EXTRACTS FROM 3513 POND SEDIMENTS

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
AL	MG/L	C QUAD	11/15/84	1.5000
		COMPOSITE	02/19/85	-4.2000
		NEQUAD	11/14/84	-1.2000
		NWQUAD	11/14/84	-1.2000
		SWQUAD	11/14/84	-1.2000
B	MG/L	C QUAD	11/15/84	-0.6000
		COMPOSITE	02/19/85	-2.1000
		NEQUAD	11/14/84	-0.6000
		NWQUAD	11/14/84	-0.6000
		SWQUAD	11/14/84	-0.6000
BE	MG/L	C QUAD	11/15/84	-0.0060
		COMPOSITE	02/19/85	-0.0210
		NEQUAD	11/14/84	-0.0060
		NWQUAD	11/14/84	-0.0060
		SWQUAD	11/14/84	-0.0060
CA	MG/L	C QUAD	11/15/84	1600.0000
		COMPOSITE	02/19/85	3200.0000
		NEQUAD	11/14/84	1900.0000
		NWQUAD	11/14/84	1600.0000
		SWQUAD	11/14/84	1800.0000
CO	MG/L	C QUAD	11/15/84	-0.1200
		COMPOSITE	02/19/85	-0.4200
		NEQUAD	11/14/84	-0.1200

(CONTINUED)

TABLE 2A. CONCENTRATIONS OF RCRA NONREGULATED CONSTITUENTS IN EP EXTRACTS FROM 3513 POND SEDIMENTS

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
CO	MG/L	NWQUAD	11/14/84	-0.1200
		SWQUAD	11/14/84	-0.1200
CU	MG/L	C QUAD	11/15/84	-0.1200
		COMPOSITE	02/19/85	-0.4200
		NEQUAD	11/14/84	-0.1200
		NWQUAD	11/14/84	-0.1200
		SWQUAD	11/14/84	-0.1200
FE	MG/L	C QUAD	11/15/84	1.4000
		COMPOSITE	02/19/85	-0.6300
		NEQUAD	11/14/84	0.5600
		NWQUAD	11/14/84	0.2000
		SWQUAD	11/14/84	0.8200
GA	MG/L	C QUAD	11/15/84	-3.0000
		COMPOSITE	02/19/85	-11.0000
		NEQUAD	11/14/84	-3.0000
		NWQUAD	11/14/84	-3.0000
		SWQUAD	11/14/84	-3.0000
HF	MG/L	C QUAD	11/15/84	0.4100
		COMPOSITE	02/19/85	-1.3000
		NEQUAD	11/14/84	-0.3600
		NWQUAD	11/14/84	-0.3600
		SWQUAD	11/14/84	-0.3600
K	MG/L	C QUAD	11/15/84	1.8000

(CONTINUED)

TABLE 2A. CONCENTRATIONS OF RCRA NONREGULATED CONSTITUENTS

IN EP EXTRACTS FROM 3513 POND SEDIMENTS

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
K	MG/L	NEQUAD	11/14/84	2.0000
		NWQUAD	11/14/84	2.8000
		SWQUAD	11/14/84	1.7000
LA	MG/L	COMPOSITE	02/19/85	-2.1000
LI	MG/L	C QUAD	11/15/84	-1.2000
		COMPOSITE	02/19/85	-4.2000
		NEQUAD	11/14/84	-1.2000
		NWQUAD	11/14/84	-1.2000
		SWQUAD	11/14/84	-1.2000
MG	MG/L	C QUAD	11/15/84	88.0000
		COMPOSITE	02/19/85	120.0000
		NEQUAD	11/14/84	100.0000
		NWQUAD	11/14/84	140.0000
		SWQUAD	11/14/84	80.0000
MN	MG/L	C QUAD	11/15/84	21.0000
		COMPOSITE	02/19/85	6.4000
		NEQUAD	11/14/84	5.3000
		NWQUAD	11/14/84	7.8000
		SWQUAD	11/14/84	4.1000
MO	MG/L	C QUAD	11/15/84	-0.1200
		COMPOSITE	02/19/85	-0.4200
		NEQUAD	11/14/84	-0.1200
		NWQUAD	11/14/84	-0.1200

(CONTINUED)

TABLE 2A. CONCENTRATIONS OF RCRA NONREGULATED CONSTITUENTS
IN EP EXTRACTS FROM 3513 POND SEDIMENTS

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
MO	MG/L	SWQUAD	11/14/84	-0.1200
NA	MG/L	C QUAD	11/15/84	9.9000
		COMPOSITE	02/19/85	-11.0000
		NEQUAD	11/14/84	13.0000
		NWQUAD	11/14/84	19.0000
		SWQUAD	11/14/84	13.0000
NI	MG/L	C QUAD	11/15/84	-0.3600
		COMPOSITE	02/19/85	-1.3000
		NEQUAD	11/14/84	0.3800
		NWQUAD	11/14/84	0.3800
		SWQUAD	11/14/84	-0.3600
P	MG/L	C QUAD	11/15/84	-1.8000
		COMPOSITE	02/19/85	-6.3000
		NEQUAD	11/14/84	-1.8000
		NWQUAD	11/14/84	-1.8000
		SWQUAD	11/14/84	-1.8000
SB	MG/L	C QUAD	11/15/84	-1.8000
		COMPOSITE	02/19/85	-6.3000
		NEQUAD	11/14/84	-1.8000
		NWQUAD	11/14/84	-1.8000
		SWQUAD	11/14/84	-1.8000
SC	MG/L	COMPOSITE	02/19/85	-0.6300
SI	MG/L	C QUAD	11/15/84	13.0000

(CONTINUED)

TABLE 2A. CONCENTRATIONS OF RCRA NONREGULATED CONSTITUENTS IN EP EXTRACTS FROM 3513 POND SEDIMENTS

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
SI	MG/L	COMPOSITE	02/19/85	9.3000
		NEQUAD	11/14/84	8.1000
		NWQUAD	11/14/84	15.0000
		SWQUAD	11/14/84	8.0000
SN	MG/L	COMPOSITE	02/19/85	-0.8400
SR	MG/L	C QUAD	11/15/84	1.5000
		COMPOSITE	02/19/85	1.7000
		NEQUAD	11/14/84	2.7000
		NWQUAD	11/14/84	2.3000
		SWQUAD	11/14/84	2.5000
TI	MG/L	C QUAD	11/15/84	-0.1200
		COMPOSITE	02/19/85	-0.4200
		NEQUAD	11/14/84	-0.1200
		NWQUAD	11/14/84	-0.1200
		SWQUAD	11/14/84	-0.1200
TTO	MG/L	NE	02/19/85	-0.0100
		NEQUAD	02/19/85	-0.0100
		NW	02/19/85	-0.0100
		NWQUAD	02/19/85	-0.0100
		SE	02/19/85	-0.0100
		SEQUAD	02/19/85	-0.0100
		SW	02/19/85	-0.0100
		SWQUAD	02/19/85	-0.0100

(CONTINUED)

TABLE 2A. CONCENTRATIONS OF RCRA NONREGULATED CONSTITUENTS
IN EP EXTRACTS FROM 3513 POND SEDIMENTS

				MEASURED CONCENTRATION
				MEAN
CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	
TTO	MG/L	WATER	02/19/85	-0.0100
V	MG/L	C QUAD	11/15/84	-0.1800
		COMPOSITE	02/19/85	-0.6300
		NEQUAD	11/14/84	-0.1800
		NWQUAD	11/14/84	-0.1800
		SWQUAD	11/14/84	-0.1800
ZN	MG/L	C QUAD	11/15/84	1.1000
		COMPOSITE	02/19/85	1.6000
		NEQUAD	11/14/84	1.4000
		NWQUAD	11/14/84	0.7100
		SWQUAD	11/14/84	0.6200
ZR	MG/L	C QUAD	11/15/84	-0.3600
		COMPOSITE	02/19/85	-1.3000
		NEQUAD	11/14/84	-0.3600
		NWQUAD	11/14/84	-0.3600
		SWQUAD	11/14/84	-0.3600

TABLE 3A. TOTAL ANALYSIS OF 3513 POND SEDIMENT.

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
AG	MG/KG	CENTER	11/15/84	64.0000
		NEQUAD	02/19/85	43.0000
		NWQUAD	02/19/85	45.0000
		SEQUAD	02/19/85	44.0000
		SWQUAD	02/19/85	44.0000
AL	MG/KG	CENTER	11/15/84	41000.0000
		NEQUAD	02/19/85	39000.0000
		NWQUAD	02/19/85	32000.0000
		SEQUAD	02/19/85	30000.0000
		SWQUAD	02/19/85	31000.0000
AS	MG/KG	CENTER	11/15/84	-80.0000
		NEQUAD	02/19/85	-80.0000
		NWQUAD	02/19/85	-79.0000
		SEQUAD	02/19/85	-79.0000
		SWQUAD	02/19/85	-80.0000
BA	MG/KG	CENTER	11/15/84	450.0000
		NEQUAD	02/19/85	380.0000
		NWQUAD	02/19/85	360.0000
		SEQUAD	02/19/85	310.0000
		SWQUAD	02/19/85	390.0000
BE	MG/KG	CENTER	11/15/84	48.0000
		NEQUAD	02/19/85	23.0000
		NWQUAD	02/19/85	26.0000

(CONTINUED)

TABLE 3A. TOTAL ANALYSIS OF 3513 POND SEDIMENT.

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
BE	MG/KG	SEQUAD	02/19/85	25.0000
		SWQUAD	02/19/85	29.0000
CA	MG/KG	CENTER	11/15/84	100000.0000
		NEQUAD	02/19/85	130000.0000
		NWQUAD	02/19/85	180000.0000
		SEQUAD	02/19/85	170000.0000
		SWQUAD	02/19/85	170000.0000
CD	MG/KG	CENTER	11/15/84	19.0000
		NEQUAD	02/19/85	9.4000
		NWQUAD	02/19/85	11.0000
		SEQUAD	02/19/85	11.0000
		SWQUAD	02/19/85	15.0000
CO	MG/KG	CENTER	11/15/84	17.0000
		NEQUAD	02/19/85	13.0000
		NWQUAD	02/19/85	12.0000
		SEQUAD	02/19/85	9.2000
		SWQUAD	02/19/85	10.0000
CR	MG/KG	CENTER	11/15/84	1600.0000
		NEQUAD	02/19/85	960.0000
		NWQUAD	02/19/85	850.0000
		SEQUAD	02/19/85	910.0000
		SWQUAD	02/19/85	960.0000
CU	MG/KG	CENTER	11/15/84	300.0000

(CONTINUED)

TABLE 3A. TOTAL ANALYSIS OF 3513 POND SEDIMENT.

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
CU	MG/KG	NEQUAD	02/19/85	430.0000
		NWQUAD	02/19/85	1900.0000
		SEQUAD	02/19/85	750.0000
		SWQUAD	02/19/85	750.0000
FE	MG/KG	CENTER	11/15/84	20000.0000
		NEQUAD	02/19/85	2000.0000
		NWQUAD	02/19/85	14000.0000
		SEQUAD	02/19/85	13000.0000
		SWQUAD	02/19/85	15000.0000
GA	MG/KG	CENTER	11/15/84	-200.0000
		NEQUAD	02/19/85	-200.0000
		NWQUAD	02/19/85	-200.0000
		SEQUAD	02/19/85	-200.0000
		SWQUAD	02/19/85	-200.0000
HF	MG/KG	CENTER	11/15/84	170.0000
		NEQUAD	02/19/85	120.0000
		NWQUAD	02/19/85	160.0000
		SEQUAD	02/19/85	100.0000
		SWQUAD	02/19/85	120.0000
K	MG/KG	CENTER	11/15/84	11000.0000
		NEQUAD	02/19/85	12000.0000
		NWQUAD	02/19/85	10000.0000
		SEQUAD	02/19/85	10000.0000

(CONTINUED)

TABLE 3A. TOTAL ANALYSIS OF 3513 POND SEDIMENT.

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
K	MG/KG	SWQUAD	02/19/85	11000.0000
LI	MG/KG	CENTER	11/15/84	92.0000
		NEQUAD	02/19/85	94.0000
		NWQUAD	02/19/85	98.0000
		SEQUAD	02/19/85	93.0000
		SWQUAD	02/19/85	99.0000
MG	MG/KG	CENTER	11/15/84	11000.0000
		NEQUAD	02/19/85	12000.0000
		NWQUAD	02/19/85	12000.0000
		SEQUAD	02/19/85	11000.0000
		SWQUAD	02/19/85	11000.0000
MN	MG/KG	CENTER	11/15/84	830.0000
		NEQUAD	02/19/85	610.0000
		NWQUAD	02/19/85	470.0000
		SEQUAD	02/19/85	550.0000
		SWQUAD	02/19/85	570.0000
MO	MG/KG	CENTER	11/15/84	20.0000
		NEQUAD	02/19/85	18.0000
		NWQUAD	02/19/85	22.0000
		SEQUAD	02/19/85	21.0000
		SWQUAD	02/19/85	16.0000
NA	MG/KG	CENTER	11/15/84	1600.0000
		NEQUAD	02/19/85	1400.0000

(CONTINUED)

TABLE 3A. TOTAL ANALYSIS OF 3513 POND SEDIMENT.

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
NA	MG/KG	NWQUAD	02/19/85	970.0000
		SEQUAD	02/19/85	890.0000
		SWQUAD	02/19/85	970.0000
NI	MG/KG	CENTER	11/15/84	66.0000
		NEQUAD	02/19/85	68.0000
		NWQUAD	02/19/85	65.0000
		SEQUAD	02/19/85	57.0000
		SWQUAD	02/19/85	63.0000
P	MG/KG	CENTER	11/15/84	24000.0000
		NEQUAD	02/19/85	16000.0000
		NWQUAD	02/19/85	8700.0000
		SEQUAD	02/19/85	7800.0000
		SWQUAD	02/19/85	6400.0000
PB	MG/KG	CENTER	11/15/84	4600.0000
		NEQUAD	02/19/85	2600.0000
		NWQUAD	02/19/85	2300.0000
		SEQUAD	02/19/85	2600.0000
		SWQUAD	02/19/85	2500.0000
PCB	MG/KG	C-QUAD	11/15/85	3.1000
		NEQUAD	02/19/85	4.5000
			11/15/85	13.0000
		NWQUAD	02/19/85	3.8000
			11/15/85	22.0000

(CONTINUED)

TABLE 3A. TOTAL ANALYSIS OF 3513 POND SEDIMENT.

CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	MEASURED CONCENTRATION MEAN
PCB	MG/KG	SEQUAD	02/19/85	2.9000
		SWQUAD	02/19/85	3.0000
			11/15/85	3.6000
SB	MG/KG	CENTER	11/15/84	-120.0000
		NEQUAD	02/19/85	-120.0000
		NWQUAD	02/19/85	-120.0000
		SWQUAD	02/19/85	-120.0000
SE	MG/KG	CENTER	11/15/84	-160.0000
		NEQUAD	02/19/85	-160.0000
		NWQUAD	02/19/85	-160.0000
		SEQUAD	02/19/85	-140.0000
		SWQUAD	02/19/85	-160.0000
SI	MG/KG	CENTER	11/15/84	169400.0000
		NEQUAD	02/19/85	157300.0000
		NWQUAD	02/19/85	107100.0000
		SEQUAD	02/19/85	123600.0000
		SWQUAD	02/19/85	133900.0000
SR	MG/KG	CENTER	11/15/84	150.0000
		NEQUAD	02/19/85	180.0000
		NWQUAD	02/19/85	240.0000
		SEQUAD	02/19/85	220.0000
		SWQUAD	02/19/85	210.0000
TI	MG/KG	CENTER	11/15/84	2500.0000

(CONTINUED)

TABLE 3A. TOTAL ANALYSIS OF 3513 POND SEDIMENT.

				MEASURED CONCENTRATION
				MEAN
CONSTITUENT	UNIT	LOCATION	SAMPLE DATE	
TI	MG/KG	NEQUAD	02/19/85	2400.0000
		NWQUAD	02/19/85	1800.0000
		SEQUAD	02/19/85	1800.0000
		SWQUAD	02/19/85	1900.0000
V	MG/KG	CENTER	11/15/84	85.0000
		NEQUAD	02/19/85	120.0000
		NWQUAD	02/19/85	180.0000
		SEQUAD	02/19/85	150.0000
		SWQUAD	02/19/85	150.0000
ZN	MG/KG	CENTER	11/15/84	750.0000
		NEQUAD	02/19/85	550.0000
		NWQUAD	02/19/85	620.0000
		SEQUAD	02/19/85	570.0000
		SWQUAD	02/19/85	670.0000
ZR	MG/KG	CENTER	11/15/84	140.0000
		NEQUAD	02/19/85	110.0000
		NWQUAD	02/19/85	81.0000
		SEQUAD	02/19/85	79.0000
		SWQUAD	02/19/85	95.0000

TABLE 4A. INVENTORY OF CONSTITUENTS IN 3513 SEDIMENT.

CONSTITUENT	UNIT	TOTAL INVENTORY MEAN
AG	KG	23.01
AL	KG	16587.24
AS	KG	38.16
BA	KG	181.21
BE	KG	14.48
CA	KG	71910.00
CD	KG	6.27
CO	KG	5.87
CR	KG	506.25
CU	KG	395.98
FE	KG	6136.32
GA	KG	95.88
HF	KG	64.24
K	KG	5177.52
LI	KG	45.64
MG	KG	5465.16
MN	KG	290.52
MO	KG	9.30
NA	KG	558.98
NI	KG	30.59
P	KG	6030.85
PB	KG	1342.32
PCB	KG	3.35
SB	KG	57.53

(CONTINUED)

TABLE 4A. INVENTORY OF CONSTITUENTS IN 3513 SEDIMENT.

CONSTITUENT	UNIT	TOTAL INVENTORY MEAN
SC	KG	73.51
SI	KG	66281.84
SR	KG	95.98
TI	KG	997.15
V	KG	65.68
ZN	KG	302.98
ZR	KG	48.42

TABLE 5A. CHEMICAL CONSTITUENTS MEASURED IN 3513 POND WATER.

CONSTITUENT	UNIT	SAMPLE DATE	MEASURED CONCENTRATION MEAN
AG	MG/L	05/08/85	-0.0700
AS	MG/L	05/08/85	-0.0010
B	MG/L	05/08/85	-0.1000
BA	MG/L	05/08/85	0.0636
BE	MG/L	05/08/85	0.0029
CA	MG/L	05/08/85	75.3000
CD	MG/L	05/08/85	-0.0010
CL	MG/L	05/08/85	9.0000
CO	MG/L	05/08/85	-0.0200
COLIFORM	CO/100ML	05/08/85	12.0000
CR	MG/L	05/08/85	0.0702
CU	MG/L	05/08/85	0.3520
ENDRIN	MG/L	05/08/85	-0.0001
F	MG/L	05/08/85	1.0000
FE	MG/L	05/08/85	1.3800
GA	MG/L	05/08/85	-0.5000
HF	MG/L	05/08/85	-0.0600
HG	MG/L	05/08/85	0.0003
K	MG/L	05/08/85	2.4000
LI	MG/L	05/08/85	-0.2000
LINDANE	MG/L	05/08/85	-0.0001
METHOXYCHLOR	MG/L	05/08/85	-0.0002
MG	MG/L	05/08/85	14.3000

(CONTINUED)

TABLE 5A. CHEMICAL CONSTITUENTS MEASURED IN 3513 POND WATER.

CONSTITUENT	UNIT	SAMPLE DATE	MEASURED CONCENTRATION MEAN
MN	MG/L	05/08/85	0.4600
MO	MG/L	05/08/85	-0.0200
NITRATE-N	MG/L	05/08/85	-1.0000
NA	MG/L	05/08/85	-0.5000
NI	MG/L	05/08/85	-0.0600
P	MG/L	05/08/85	0.5360
PB	MG/L	05/08/85	0.1500
PCB	MG/L	06/27/85	0.0006
PH	PH	01/26/85	8.0250
PHENOL	MG/L	05/08/85	-0.0010
SB	MG/L	05/08/85	-0.3000
SE	MG/L	05/08/85	0.0160
SI	MG/L	05/08/85	2.3500
SULFATE	MG/L	05/08/85	27.0000
SP.COND.	UMHOS/CC	01/26/85	159.7500
SR	MG/L	05/08/85	0.0994
TI	MG/L	05/08/85	-0.0200
TOC	MG/L	05/08/85	14.6667
TOX	MG/L	05/08/85	0.6700
TOXAPHENE	MG/L	05/08/85	-0.0020
V	MG/L	05/08/85	-0.0300
ZN	MG/L	05/08/85	0.1180
ZR	MG/L	05/08/85	-0.0600

TABLE 6A. RADIOISOTOPES MEASURED IN 3513 POND WATER.

			MEASURED CONCENTRATION
			MEAN
CONSTITUENT	UNIT	SAMPLE DATE	
GROSS-A	BQ/L	05/08/85	16.0000
GROSS-B	BQ/L	05/08/85	910.0000
137CS	BQ/L	05/08/85	290.0000
226RA	BQ/L	05/08/85	0.1200
234U	BQ/L	05/08/85	1.6000
235U	BQ/L	05/08/85	0.1600
238PU	BQ/L	05/08/85	0.1500
238U	BQ/L	05/08/85	0.6100
239PU	BQ/L	05/08/85	4.1000
241AM	BQ/L	05/08/85	3.4000
244CM	BQ/L	05/08/85	2.6000
60CO	BQ/L	05/08/85	5.2000
90SR	BQ/L	05/08/85	420.0000

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

					MEASURED CONCENTRATION
					MEAN
CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	
AG	MG/L	0.05	1	02/06/85	-0.0700
				04/15/85	-0.0700
			1A	02/06/85	-0.0700
				04/15/85	-0.0700
			2	02/07/85	-0.0700
				04/15/85	-0.0700
			3	02/07/85	-0.0700
				04/15/85	-0.0700
			4	02/07/85	-0.0700
				04/15/85	-0.0700
AS	MG/L	0.05	1	02/06/85	-0.0020
				04/15/85	-0.0010
			1A	02/06/85	-0.0020
				04/15/85	-0.0010
			2	02/07/85	-0.0020
				04/15/85	-0.0010
			3	02/07/85	0.0040
				04/15/85	-0.0010
			4	02/07/85	-0.0020
				04/15/85	0.0010
BA	MG/L	1.0	1	02/06/85	-0.0880
				04/15/85	0.1100

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
BA	MG/L	1.0	1A	02/06/85	0.0830
				04/15/85	0.1400
			2	02/07/85	0.2400
				04/15/85	0.4300
			3	02/07/85	0.1400
				04/15/85	0.5200
			4	02/07/85	0.0590
				04/15/85	0.0940
CD	MG/L	0.01	1	02/06/85	0.0020
				04/15/85	-0.0020
			1A	02/06/85	0.0010
				04/15/85	-0.0020
			2	02/07/85	0.0020
				04/15/85	-0.0020
			3	02/07/85	0.0010
				04/15/85	-0.0020
			4	02/07/85	0.0020
				04/15/85	-0.0020
CHLORIDE	MG/L	NOT DEF	1	02/06/85	6.0000
				04/15/85	6.8000
			1A	02/06/85	7.0000
				04/15/85	7.0000

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
CHLORIDE	MG/L	NOT DEF	2	02/07/85	33.0000
				04/15/85	35.0000
			3	02/07/85	10.0000
				04/15/85	13.0000
			4	02/07/85	9.0000
				04/15/85	6.0000
COLIFORM	CO/100ML	1/100ML	1	02/06/85	8.0000
				04/15/85	0.0000
			1A	02/06/85	2.0000
				04/15/85	0.0000
			2	02/07/85	1.0000
				04/15/85	0.0000
			3	02/07/85	2.0000
				04/15/85	0.0000
			4	02/07/85	0.0000
				04/15/85	0.0000
CR	MG/L	0.05	1	02/06/85	0.0210
				04/15/85	-0.0080
			1A	02/06/85	0.1400
				04/15/85	0.0290
			2	02/07/85	1.2000
				04/15/85	0.0160

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
CR	MG/L	0.05	3	02/07/85	0.0730
				04/15/85	0.0340
			4	02/07/85	0.6900
				04/15/85	0.0200
ENDRIN	MG/L	0.0002	1	02/06/85	-0.0001
				04/15/85	-0.0001
			1A	02/06/85	-0.0001
				04/15/85	-0.0001
			2	02/07/85	-0.0001
				04/15/85	-0.0001
			3	02/07/85	-0.0001
				04/15/85	-0.0001
			4	02/07/85	-0.0001
				04/15/85	-0.0001
F	MG/L	1.4-2.4	1	02/06/85	-1.0000
				04/15/85	-1.0000
			1A	02/06/85	-1.0000
				04/15/85	-1.0000
			2	02/07/85	-1.0000
				04/15/85	-1.0000
			3	02/07/85	-1.0000
				04/15/85	-1.0000

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
F	MG/L	1.4-2.4	4	02/07/85	-1.0000
				04/15/85	-1.0000
FE	MG/L	NOT DEF	1	02/06/85	0.4200
				04/15/85	1.4000
			1A	02/06/85	1.2000
				04/15/85	3.5000
			2	02/07/85	7.2000
				04/15/85	9.3000
			3	02/07/85	15.0000
				04/15/85	72.0000
			4	02/07/85	5.6000
				04/15/85	9.6000
GROSS-A	BQ/L	0.556	1	02/06/85	2.2000
				04/15/85	0.7900
			1A	02/06/85	1.0000
				04/15/85	1.1000
			2	02/07/85	3.9000
				04/15/85	1.4000
			3	02/07/85	0.2000
				04/15/85	0.3000
			4	02/07/85	-3.0000
				04/15/85	0.0300

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
GROSS-B	BQ/L	4MREM/YR	1	02/06/85	4.7000
				04/15/85	1.8000
			1A	02/06/85	6.6000
				04/15/85	4.8000
			2	02/07/85	54.0000
				04/15/85	45.0000
			3	02/07/85	3.6000
				04/15/85	1.4000
			4	02/07/85	8.5000
				04/15/85	7.0000
HG	MG/L	0.002	1	02/06/85	0.0004
				04/15/85	0.0002
			1A	02/06/85	0.0003
				04/15/85	0.0001
			2	02/07/85	0.0003
				04/15/85	-0.0001
			3	02/07/85	0.0001
				04/15/85	-0.0001
			4	02/07/85	0.0005
				04/15/85	-0.0001
LINDANE	MG/L	0.004	1	04/15/85	-0.0010
				06/06/85	-0.0001

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
LINDANE	MG/L	0.004	1A	04/15/85	0.0001
				06/06/85	-0.0001
			2	04/15/85	-0.0010
				06/06/85	-0.0001
			3	04/15/85	0.0001
				06/06/85	-0.0001
			4	04/15/85	0.0001
				06/06/85	-0.0001
METHOXYCHLOR	MG/L	0.1	1	02/06/85	-0.0002
				04/15/85	-0.0002
			1A	02/06/85	-0.0002
				04/15/85	-0.0002
			2	02/07/85	-0.0002
				04/15/85	-0.0002
			3	02/07/85	-0.0002
				04/15/85	-0.0002
			4	02/07/85	-0.0002
				04/15/85	-0.0002
MN	MG/L	NOT DEF	1	02/06/85	1.4000
				04/15/85	2.7000
			1A	02/06/85	0.2500
				04/15/85	0.5400

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
MN	MG/L	NOT DEF	2	02/07/85	4.5000
				04/15/85	5.0000
			3	02/07/85	3.1000
				04/15/85	4.1000
			4	02/07/85	3.0000
				04/15/85	2.7000

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
NA	MG/L	NOT DEF	1	02/06/85	18.0000
				04/15/85	25.0000
			1A	02/06/85	13.0000
				04/15/85	13.0000
			2	02/07/85	37.0000
				04/15/85	35.0000
			3	02/07/85	25.0000
				04/15/85	27.0000
			4	02/07/85	31.0000
				04/15/85	26.0000
PB	MG/L	0.05	1	02/06/85	0.0110
				04/15/85	0.0150
			1A	02/06/85	-0.0010
				04/15/85	0.0070
			2	02/07/85	0.0040
				04/15/85	0.0220
			3	02/07/85	0.0110
				04/15/85	1.4000
			4	02/07/85	0.0030
				04/15/85	0.0240
PCB	MG/L	NOT DEF	1	06/06/85	0.0001
			1A	06/06/85	0.0001

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
PCB	MG/L	NOT DEF	2	06/06/85	0.0001
			3	06/06/85	0.0001
			4	06/06/85	0.0001
PH	PH	NOT DEF	1	02/06/85	6.7000
				04/15/85	6.5000
			1A	02/06/85	6.4000
				04/15/85	6.6000
			2	02/07/85	6.2000
				04/15/85	7.1000
			3	02/07/85	6.4000
				04/16/85	6.6000
			4	02/07/85	6.4000
				04/16/85	6.3000
PHENOL	MG/L	NOT DEF	1	04/15/85	-0.0010
			1A	04/15/85	-0.0010
			2	02/06/85	-0.0020
				04/15/85	-0.0010
			3	02/07/85	-0.0020
				04/15/85	-0.0010
			4	02/07/85	-0.0020
				04/15/85	0.0070
226RA	BQ/L	0.19	1	02/06/85	-0.0100

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

					MEASURED CONCENTRATION
					MEAN
CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	
226RA	BQ/L	0.19	1	04/15/85	-0.0100
			1A	02/06/85	-0.0020
				04/15/85	-0.1000
			2	02/07/85	-0.0200
				04/15/85	-0.0700
			3	02/07/85	-0.0200
				04/15/85	0.1400
			4	02/07/85	0.0080
				04/15/85	-0.0200
SE	MG/L	0.01	1	02/06/85	-0.0050
				04/15/85	-0.0050
			1A	02/06/85	-0.0050
				04/15/85	-0.0050
			2	02/07/85	-0.0050
				04/15/85	-0.0050
			3	02/07/85	-0.0050
				04/15/85	-0.0050
			4	02/07/85	-0.0050
				04/15/85	-0.0050
SULFATE	MG/L	NOT DEF	1	02/06/85	97.0000
				04/15/85	135.0000
			1A	02/06/85	35.0000

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
SULFATE	MG/L	NOT DEF	1A	04/15/85	36.0000
			2	02/07/85	21.0000
				04/15/85	22.0000
			3	02/07/85	-5.0000
				04/15/85	-5.0000
			4	02/07/85	11.0000
				04/15/85	13.0000
SP.COND.	UMHOS/CC	NOT DEF	1	02/06/85	570.0000
				04/15/85	941.0000
			1A	02/06/85	590.0000
				04/15/85	805.0000
			2	02/07/85	442.0000
				04/15/85	678.0000
			3	02/07/85	460.0000
				04/16/85	671.0000
			4	02/07/85	500.0000
				04/16/85	803.0000
TOC	MG/L	NOT DEF	1	02/06/85	2.7000
				04/15/85	8.1000
				06/06/85	3.6250
			1A	02/06/85	2.2500
				04/15/85	8.4000

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
TOC	MG/L	NOT DEF	1A	06/06/85	4.0500
			2	02/07/85	1.4600
				04/15/85	5.7250
				06/06/85	2.9500
			3	02/07/85	3.7100
				04/15/85	9.4250
				06/06/85	5.0750
			4	02/07/85	2.8500
				04/15/85	9.6500
				06/06/85	5.5750
TOX	MG/L	NOT DEF	1	02/06/85	0.0620
				04/15/85	0.0039
			1A	02/06/85	0.0720
				04/15/85	0.0220
			2	02/07/85	0.0550
				04/15/85	0.0220
			3	02/07/85	0.0600
				04/15/85	0.0320
			4	02/07/85	0.0800
				04/15/85	0.0420
TOXAPHENE	MG/L	NOT DEF	1	02/06/85	-0.0020
				04/15/85	-0.0020

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
TOXAPHENE	MG/L	NOT DEF	1A	02/06/85	-0.0020
				04/15/85	-0.0020
			2	02/07/85	-0.0020
				04/15/85	-0.0020
			3	02/07/85	-0.0020
				04/15/85	-0.0020
			4	02/07/85	-0.0020
				04/15/85	-0.0020
TRITIUM	BQ/L	NOT DEF	1	04/15/85	9.0000
			1A	04/15/85	200.0000
			2	04/15/85	3600.0000
			3	04/15/85	2300.0000
			4	04/15/85	2200.0000
137CS	BQ/FILTER	NOT DEF	1	02/06/85	0.4330
			1A	02/06/85	0.0296
			2	02/07/85	0.0000
			3	02/07/85	0.0000
			4	02/07/85	0.4256
				04/09/85	0.6699
	BQ/L	NOT DEF	1	02/06/85	4.8853
				06/06/85	0.1850
			1A	02/06/85	0.3257

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
137CS	BQ/L	NOT DEF	1A	06/06/85	0.0000
			2	02/07/85	0.2517
				06/06/85	0.0000
			3	02/07/85	0.5089
				06/06/85	0.0000
			4	02/07/85	0.5218
				04/09/85	0.7920
				06/06/85	0.0000
2,4-D	MG/L	0.1	1	02/06/85	-0.0050
				04/15/85	-0.0050
			1A	02/06/85	-0.0050
				04/15/85	-0.0050
			2	02/07/85	-0.0050
				04/15/85	-0.0050
			3	02/07/85	-0.0050
				04/15/85	-0.0050
			4	02/07/85	-0.0090
				04/15/85	-0.0050
2,4,5-TP	MG/L	0.01	1	02/06/85	-0.0050
				04/15/85	-0.0050
			1A	02/06/85	-0.0050
				04/15/85	-0.0050

(CONTINUED)

TABLE 7A. INDEX OF GROUNDWATER QUALITY FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATI-ON	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRAT-ION MEAN
2,4,5-TP	MG/L	0.01	2	02/07/85	-0.0050
				04/15/85	-0.0050
			3	02/07/85	-0.0050
				04/15/85	-0.0050
			4	02/07/85	-0.0100
				04/15/85	-0.0050
214PB	BQ/L	NOT DEF	1	02/06/85	1.8135
			1A	02/06/85	0.5922
			2	02/07/85	9.0674
			3	02/07/85	3.5159
			4	02/07/85	10.6218
				04/09/85	4.7742
90SR	BQ/L	NOT DEF	1	04/15/85	1.3000
			1A	04/15/85	2.6000
			2	04/15/85	26.0000
			3	04/15/85	0.4000
			4	04/15/85	5.4000

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
AL	MG/L	NOT DEF	1	02/06/85	0.7000
				04/15/85	1.6000
			1A	02/06/85	0.3300
				04/15/85	1.9000
			2	02/07/85	0.4100
				04/15/85	6.9000
			3	02/07/85	1.3000
				04/15/85	16.0000
			4	02/07/85	0.4900
				04/15/85	5.4000
B	MG/L	NOT DEF	1	02/06/85	-0.1000
				04/15/85	-0.1000
			1A	02/06/85	0.1000
				04/15/85	-0.1000
			2	02/07/85	0.1400
				04/15/85	-0.1000
			3	02/07/85	0.1100
				04/15/85	-0.1000
			4	02/07/85	-0.1000
				04/15/85	-0.1000
BE	MG/L	NOT DEF	1	02/06/85	-0.0010

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
BE	MG/L	NOT DEF	1	04/15/85	0.0028
			1A	02/06/85	-0.0010
				04/15/85	0.0072
			2	02/07/85	-0.0010
				04/15/85	0.0032
			3	02/07/85	-0.0010
				04/15/85	0.0120
			4	02/07/85	-0.0010
				04/15/85	0.0048
CA	MG/L	NOT DEF	1	02/06/85	130.0000
				04/15/85	140.0000
			1A	02/06/85	140.0000
				04/15/85	700.0000
			2	02/07/85	72.0000
				04/15/85	100.0000
			3	02/07/85	140.0000
				04/15/85	520.0000
			4	02/07/85	140.0000
				04/15/85	370.0000
CO	MG/L	NOT DEF	1	02/06/85	-0.0200
				04/15/85	-0.0200

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
CO	MG/L	NOT DEF	1A	02/06/85	-0.0200
				04/15/85	-0.0200
			2	02/07/85	0.0270
				04/15/85	-0.0200
			3	02/07/85	-0.0200
				04/15/85	0.0700
			4	02/07/85	0.0230
				04/15/85	-0.0200
CU	MG/L	NOT DEF	1	02/06/85	0.0390
				04/15/85	-0.0200
			1A	02/06/85	-0.0200
				04/15/85	-0.0200
			2	02/07/85	0.0250
				04/15/85	-0.0200
			3	02/07/85	0.0220
				04/15/85	0.0590
			4	02/07/85	-0.0200
				04/15/85	-0.0200
GA	MG/L	NOT DEF	1	02/06/85	-0.5000
				04/15/85	-0.5000
			1A	02/06/85	-0.5000

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS
FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
GA	MG/L	NOT DEF	1A	04/15/85	-0.5000
			2	02/07/85	-0.5000
				04/15/85	-0.5000
			3	02/07/85	-0.5000
				04/15/85	-0.5000
			4	02/07/85	-0.5000
				04/15/85	-0.5000
HF	MG/L	NOT DEF	1	02/06/85	-0.0600
				04/15/85	0.1500
			1A	02/06/85	-0.0600
				04/15/85	0.1600
			2	02/07/85	0.1100
				04/15/85	0.2000
			3	02/07/85	0.0720
				04/15/85	0.2300
			4	02/07/85	0.0730
				04/15/85	0.1600
K	MG/L	NOT DEF	1	02/06/85	2.2000
				04/15/85	1.5000
			1A	02/06/85	1.6000
				04/15/85	1.8000

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
K	MG/L	NOT DEF	2	02/07/85	1.9000
				04/15/85	2.3000
			3	02/07/85	1.8000
				04/15/85	3.3000
			4	02/07/85	1.8000
				04/15/85	1.7000
LI	MG/L	NOT DEF	1	02/06/85	-0.2000
				04/15/85	-0.2000
			1A	02/06/85	-0.2000
				04/15/85	0.2900
			2	02/07/85	-0.2000
				04/15/85	-0.2000
			3	02/07/85	-0.2000
				04/15/85	0.2700
			4	02/07/85	-0.2000
				04/15/85	0.2000
MG	MG/L	NOT DEF	1	02/06/85	25.0000
				04/15/85	20.0000
			1A	02/06/85	29.0000
				04/15/85	48.0000
			2	02/07/85	22.0000

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
MG	MG/L	NOT DEF	2	04/15/85	27.0000
			3	02/07/85	11.0000
				04/15/85	38.0000
			4	02/07/85	14.0000
				04/15/85	22.0000
MO	MG/L	NOT DEF	1	02/06/85	-0.0200
				04/15/85	-0.0200
			1A	02/06/85	-0.0200
				04/15/85	-0.0200
			2	02/07/85	0.0210
				04/15/85	-0.0200
			3	02/07/85	0.0210
				04/15/85	0.0320
			4	02/07/85	-0.0200
				04/15/85	-0.0200
NI	MG/L	NOT DEF	1	02/06/85	-0.0600
				04/15/85	-0.0600
			1A	02/06/85	-0.0600
				04/15/85	-0.0600
			2	02/07/85	1.0000
				04/15/85	-0.0600

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
NI	MG/L	NOT DEF	3	02/07/85	0.2700
				04/15/85	-0.0600
			4	02/07/85	0.6900
				04/15/85	-0.0600
P	MG/L	NOT DEF	1	02/06/85	-0.3000
				04/15/85	-0.3000
			1A	02/06/85	-0.3000
				04/15/85	-0.3000
			2	02/07/85	-0.3000
				04/15/85	-0.3000
			3	02/07/85	-0.3000
				04/15/85	0.9700
			4	02/07/85	-0.3000
				04/15/85	-0.3000
SB	MG/L	NOT DEF	1	02/06/85	-0.3000
				04/15/85	-0.3000
			1A	02/06/85	-0.3000
				04/15/85	-0.3000
			2	02/07/85	-0.3000
				04/15/85	-0.3000
			3	02/07/85	-0.3000

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
SB	MG/L	NOT DEF	3	04/15/85	-0.3000
			4	04/15/85	-0.3000
SI	MG/L	NOT DEF	1	02/06/85	4.4000
				04/15/85	3.3000
			1A	02/06/85	6.9000
				04/15/85	-0.0800
			2	02/07/85	4.4000
				04/15/85	8.4000
			3	02/07/85	5.3000
				04/15/85	7.9000
			4	02/07/85	6.2000
				04/15/85	4.8000
SR	MG/L	NOT DEF	1	02/06/85	0.3200
				04/15/85	0.2300
			1A	02/06/85	0.4100
				04/15/85	0.6500
			2	02/07/85	0.9600
				04/15/85	1.0000
			3	02/07/85	0.2800
				04/15/85	0.4000
			4	02/07/85	0.3300

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
SR	MG/L	NOT DEF	4	04/15/85	0.3800
TI	MG/L	NOT DEF	1	02/06/85	-0.0200
				04/15/85	0.0330
			1A	02/06/85	-0.0200
				04/15/85	0.0550
			2	02/07/85	-0.0200
				04/15/85	0.0270
			3	02/07/85	-0.0200
				04/15/85	0.0490
			4	02/07/85	-0.0200
				04/15/85	0.0380
V	MG/L	NOT DEF	1	02/06/85	-0.0300
				04/15/85	-0.0300
			1A	02/06/85	-0.0300
				04/15/85	-0.0300
			2	02/07/85	-0.0300
				04/15/85	-0.0300
			3	02/07/85	-0.0300
				04/15/85	0.0650
			4	02/07/85	-0.0300
				04/15/85	-0.0300

(CONTINUED)

TABLE 8A. SUPPLEMENTARY GROUNDWATER QUALITY MEASUREMENTS FOR THE 3513 SITE.

CONSTITUENT	UNIT	MAXIMUM ALLOWABLE CONCENTRATION	WELL NUMBER	SAMPLE DATE	MEASURED CONCENTRATION MEAN
ZN	MG/L	NOT DEF	1	02/06/85	0.1100
				04/15/85	-0.0200
			1A	02/06/85	0.0960
				04/15/85	-0.0200
			2	02/07/85	0.1100
				04/15/85	0.0370
			3	02/07/85	0.1600
				04/15/85	0.4300
			4	02/07/85	0.1500
				04/15/85	0.0370
ZR	MG/L	NOT DEF	1	02/06/85	-0.0600
				04/15/85	-0.0600
			1A	02/06/85	-0.0600
				04/15/85	-0.0600
			2	02/07/85	-0.0600
				04/15/85	-0.0600
			3	02/07/85	-0.0600
				04/15/85	-0.0600
			4	02/07/85	-0.0600
				04/15/85	-0.0600

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