RESULTS OF THE RISK ASSESSMENT AND DIRECT-PUSH INVESTIGATION OF RED WATER POND AREAS AT THE FORMER PLUM BROOK ORDNANCE WORKS

AS REPORTED IN THE DRAFT RISK ASSESSMENT AND DIRECT-PUSH INVESTIGATION OF RED WATER POND AREAS

Presented to the Restoration Advisory Board

May 12, 1999

Location of Red Water Ponds

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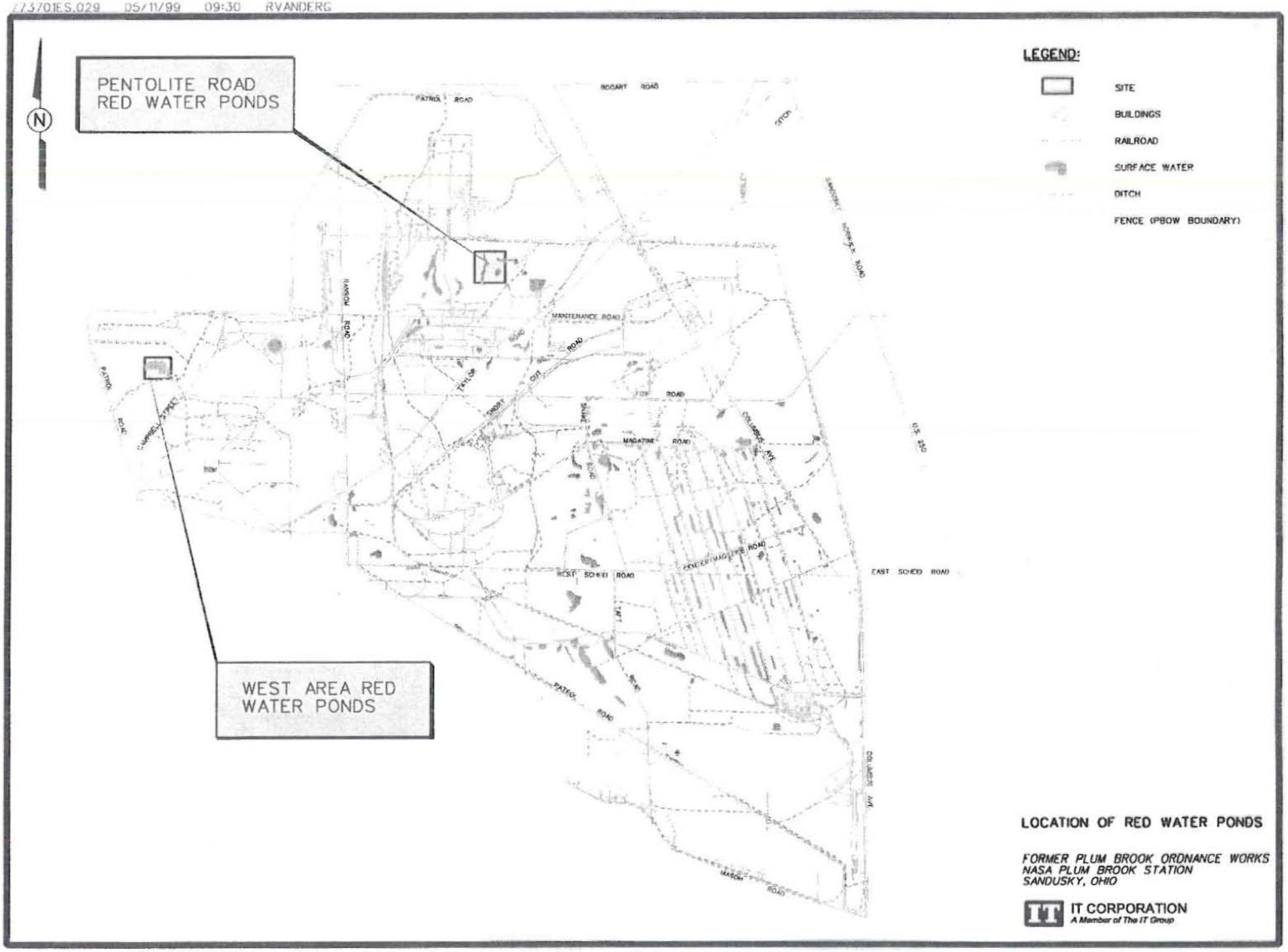

LOCATION OF RED WATER PONDS

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
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Purpose and Objectives

- Delineate the vertical and lateral extent of contamination in the overburden water-bearing zone to support potential future remedial action
- Collect data for use in fate and transport modeling
- Perform human health and ecological risk assessments

NOTE: Draft Risk Assessment and Direct Push Investigation of the Red Water Ponds Areas Report Issued in March 1999. Therefore, findings, recommendations, and conclusions presented herein are draft and are subject to revision.

3

Scope of the Direct Push Investigation

- Direct Push Surface and Subsurface Soil Sampling
  - → Thirty-nine borings completed for chemical analysis
  - → Nine borings completed for geotechnical analysis
- Direct Push Groundwater Sampling
  - → Fourteen groundwater samples (Overburden Water-Bearing Zone) collected from the West Area Red Water Ponds (WARWP)
  - → Twenty groundwater samples (Overburden Water-Bearing Zone) collected from the Pentolite Road Red Water Ponds (PRRWP)

4

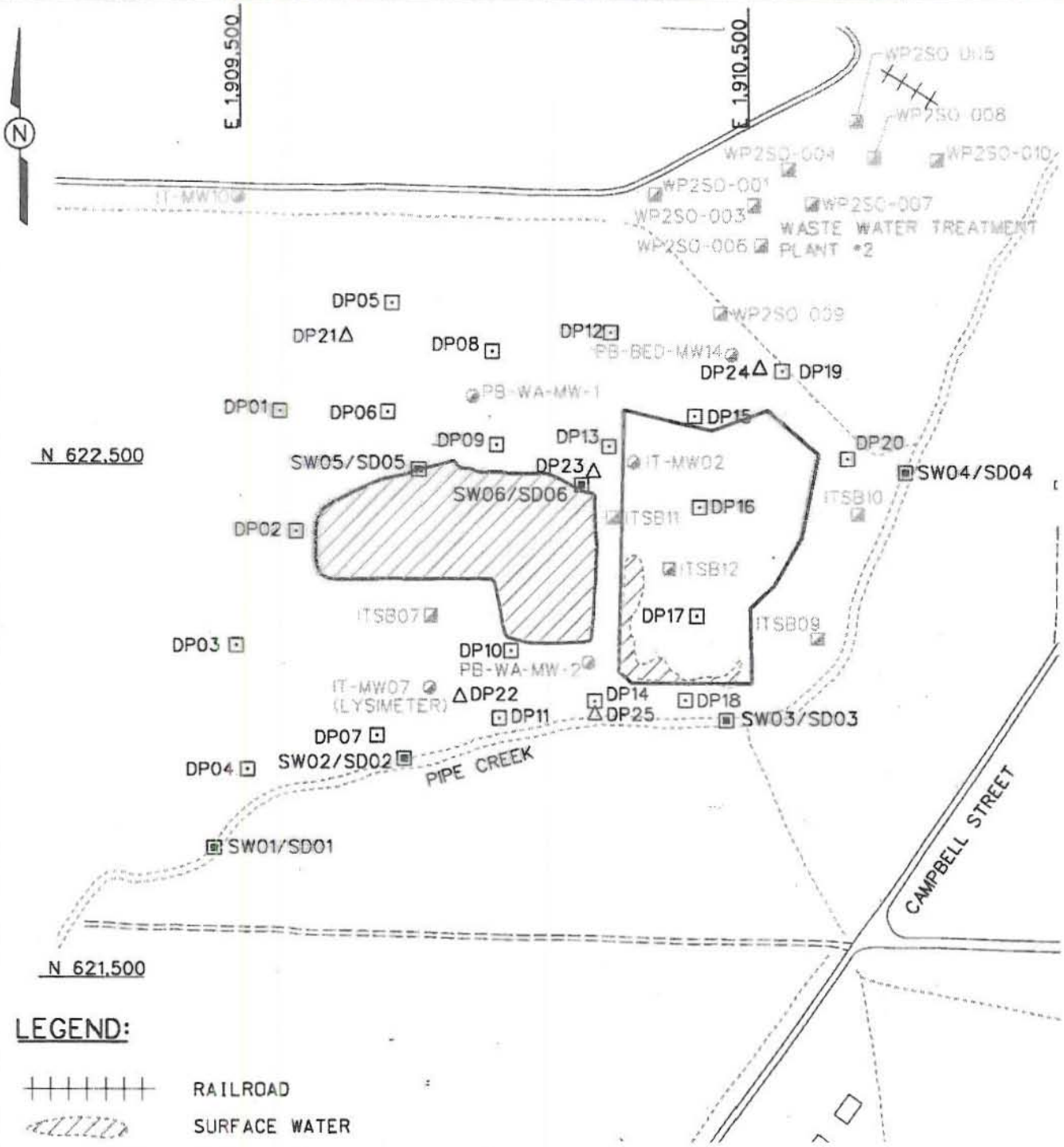
Scope of the Direct Push Investigation

- Surface Water and Sediment Sampling
  - → Six collocated surface water and sediment samples collected from the WARWP
  - → Four collocated surface water and sediment samples collected from the PRRWP

5

WARWP Sampling Locations

6



LEGEND:

+++++++	RAILROAD
	SURFACE WATER
- - - - - - - -	SURFACE DRAINAGE
▭	APPROXIMATE HISTORICAL LOCATION OF PONDS
IT-MW02	EXISTING MONITORING WELL LOCATION
WP2SO-010	EXISTING SOIL BORING LOCATION
DP01	DIRECT PUSH SAMPLE LOCATIONS
DP21	DIRECT PUSH GEOTECHNICAL LOCATIONS
SW01/SD01	SURFACE WATER/SEDIMENT SAMPLES
- - - - - - - -	UNPAVED ROADS/DRIVES
═══	PAVED ROADS

SCALE

0 300 600 FEET

WEST AREA RED WATER PONDS SAMPLE LOCATIONS

PLUM BROOK ORDNANCE WORKS
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West Area Red Water Ponds Area Results

- Soils
  - → Volatile Organic Contaminants
    - Low levels of acetone, methylene chloride, and/or toluene detected in eleven borings
  - → Semivolatile Organic Contaminants
    - SVOCs detected in two surface soil samples and two subsurface soil samples
    - Fluoranthene and pyrene were the most frequently detected (3 samples each)
    - Two samples had ten SVOCs detected

7

West Area Red Water Ponds Area Results

- Soils (continued)
  - → Nitroaromatics
    - Nitroaromatics were not detected in any surface soil samples
    - Four nitroaromatics (1,3,5-TNB, 2,4,6-TNT, 2,4-DNT, and 2,6-DNT) were detected in six subsurface soil samples
    - Maximum detected concentrations of nitroaromatics in soils was 6.3 mg/kg
  - → PCBs
    - PCBs were not detected in any of the soil samples
  - → Inorganics
    - Twenty-one metals detected in at least one soil sample
  - → Cyanide
    - Cyanide was not detected in any of the soil samples

8

West Area Red Water Ponds Area Results

- Sediments
  - → VOCs
    - Acetone and 2-butanone were detected in 3 samples at concentrations below 0.11 mg/kg.
  - → SVOCs
    - Seven SVOCs were detected in sediment sample SD-01
    - One SVOC (fluoranthene) was detected in SD-04
  - → PCBs
    - PCBs were not detected in any of the sediment samples
  - → Inorganics
    - Fifteen metals were detected in at least one of the six sediment samples

13

West Area Red Water Ponds Area Results

- Surface Water
  - → VOCs
    - Bromomethane was detected in five of six samples at concentrations ranging from 0.16 to 0.22 ug/L.
  - → SVOCs
    - Di-n-octyl phthalate (7.8 ug/L) was detected in one sample from the west pond
  - → PCBs
    - PCBs were not detected in any of the surface water samples
  - → Inorganics
    - Eleven dissolved metals were detected in at least one of the six surface water samples

14

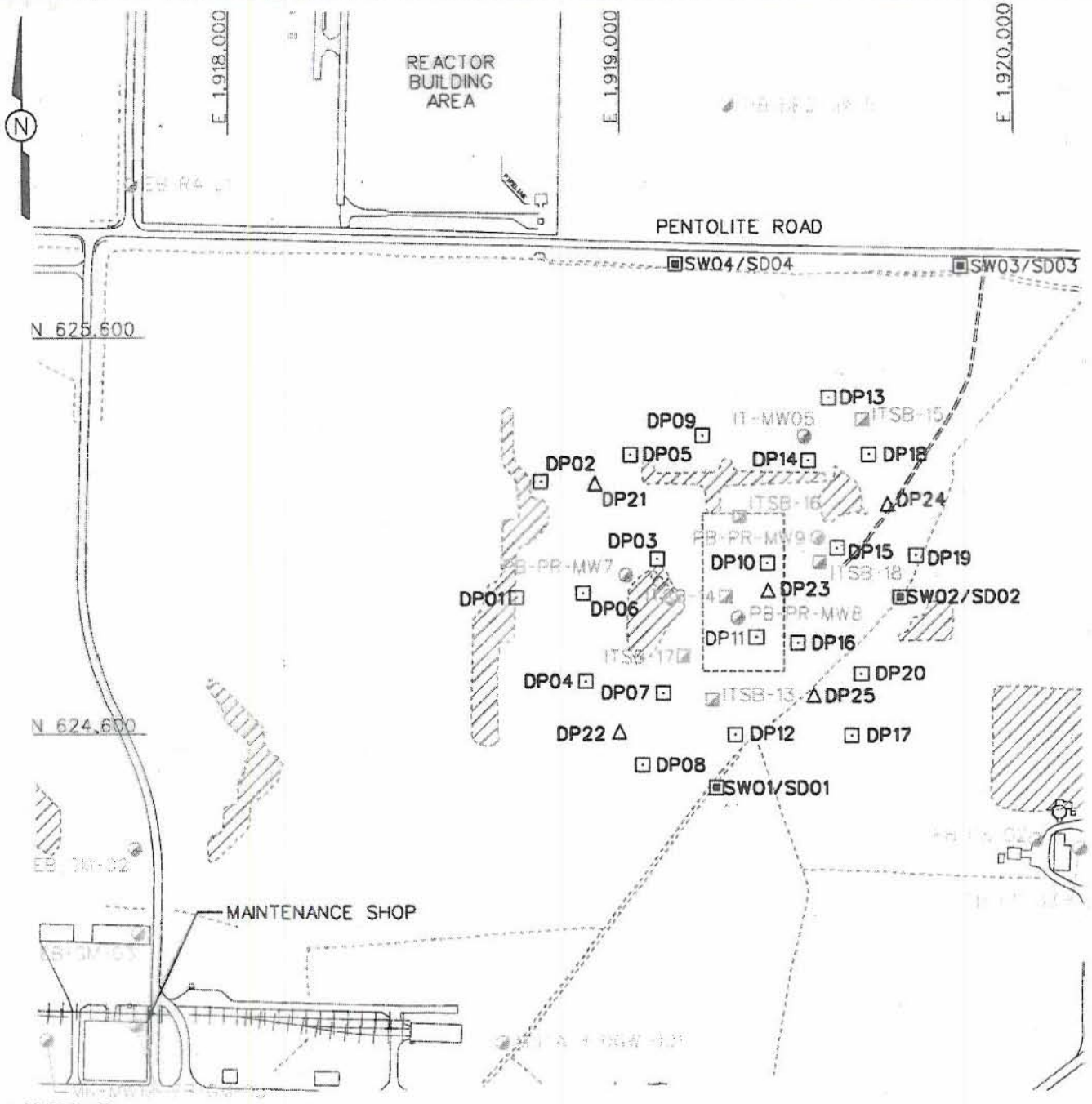
PRRWP Sampling Locations

15

Pentolite Road Red Water Ponds Area Results

- Soils
  - → Volatile Organic Contaminants
    - Low levels of acetone, methylene chloride, and/or toluene detected in four samples at concentrations below 0.09 mg/kg
  - → Semivolatile Organic Contaminants
    - Three nitroaromatic compounds were detected under the SVOC analysis in one surface soil sample and five subsurface soil samples
    - Nitroaromatics detected were 2,4-DNT, 2,6-DNT and nitroaniline

16



LEGEND:

	BUILDINGS
	RAILROAD
	SURFACE WATER
	SURFACE DRAINAGE
	APPROXIMATE HISTORICAL LOCATION OF PONDS
	FENCE (PBOW BOUNDARY)
IT-MW02	EXISTING MONITORING WELL LOCATION
ITSB-13	EXISTING SOIL BORING LOCAITON
DP01	DIRECT PUSH SAMPLE LOCATIONS
DP21	DIRECT PUSH GEOTECHNICAL LOCATIONS
SW01/SD01	SURFACE WATER/SEDIMENT SAMPLES

SCALE

0 400 800 FEET

PENTOLITE ROAD RED WATER PONDS SAMPLE LOCATIONS

PLUM BROOK ORDNANCE WORKS
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Pentolite Road Red Water Ponds Area Results

- Soils (continued)
  - → Nitroaromatics
    - Nitroaromatics were not detected in any surface soil samples
    - Six nitroaromatics (1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT and 4-amino-2,6-DNT) were detected in eleven subsurface soil samples
    - Maximum detected concentrations of nitroaromatics in soils was 43 mg/kg
  - → PCBs
    - PCBs were not detected in any of the soil samples
  - → Inorganics
    - Twenty-one metals detected in at least one soil sample
  - → Cyanide
    - Cyanide was not detected in any of the soil samples

17

Soil Montage of Red Water Ponds Analytical Results

18

Pentolite Road Red Water Ponds Area Results

- Groundwater
  - → Volatile Organic Contaminants
    - 2-Butanone, 2-hexanone, acetone, benzene, carbon disulfide, ethyl benzene, tetrachloroethene, total xylenes, and trichloroethene were detected at low concentrations
    - Concentrations of VOCs detected range from 0.13 ug/L to 24 ug/L.
  - → Semivolatile Organic Contaminants
    - Ten SVOCs, including eight nitroaromatics were detected under the SVOC analyses
    - Concentrations of SVOCs detected ranged from 1.5 ug/L to 9,200 ug/L

19

Pentolite Road Red Water Ponds Area Results

- Groundwater (continued)
  - → Nitroaromatics
    - Five nitroaromatics (1,3,5-TNB, 1,3-DNB, 2,4-DNT, 2,6-DNT, and tetryl) were detected in twelve samples
    - Maximum detected concentrations of nitroaromatics in groundwater was 6,800 ug/L (2,4-DNT)
  - → PCBs
    - PCBs were not detected in any of the groundwater samples

20

Pentolite Road Red Water Ponds Area Results

- Groundwater (continued)
  - → Inorganics
    - Nine dissolved metals were detected in groundwater samples, excluding nutritionally essential elements
  - → Cyanide
    - Cyanide was detected in three groundwater samples ranging in concentration from 23 to 780 ug/L

21

Groundwater Montage of Red Water Ponds Analytical Results

22

Pentolite Road Red Water Ponds Area Results

- Sediments
  - → VOCs
    - Acetone and 2-butanone were detected in two samples at concentrations below 0.06 mg/kg.
  - → SVOCs
    - Fifteen SVOCs, primarily PAHs were detected in sediment samples SD-02 and/or SD-04
  - → PCBs
    - PCBs were not detected in any of the sediment samples
  - → Inorganics
    - Fifteen metals were detected in at least one of the four sediment samples

23

Pentolite Road Red Water Ponds Area Results

- Surface Water
  - → VOCs
    - Acetone, chloroform, bromomethane, bromodichloromethane, and dibromochloromethane were detected in at least one surface water sample at low concentrations
  - → SVOCs
    - Phenol was detected in three samples and bis(2-ethylhexyl)phthalate was detected in one sample at concentrations below 3 ug/L.
  - → Nitroaromatics
    - Nitroaromatics were not detected in any of the surface water samples

24

Pentolite Road Red Water Ponds Area Results

- Surface Water (continued)
  - → PCBs
    - PCBs were not detected in any of the surface water samples
  - → Inorganics
    - Twelve dissolved metals were detected in at least one of the six surface water samples

25

Red Water Ponds Area Summary

Site	Media Sampled	Number of Detections/Total Number of Samples			
		VOCs	SVOCs	Nitroaromatic	Metals
West Area Redwater Ponds	Surface Soil	5/5	2/5	1/5	5/5
	Subsurface Soil	6/11	2/11	4/11	11/11
	Groundwater	7/12	6/12	9/12	16/16
	Surface Water	5/6	0/6	0/6	6/6
	Sediment	3/6	2/6	0/6	6/6
Pentolite Road Red Water Ponds	Surface Soil	1/3	1/3	2/3	3/3
	Subsurface Soil	3/13	5/13	10/13	13/13
	Groundwater	7/17	12/17	12/17	17/17
	Surface Water	4/4	3/4	0/4	4/4
	Sediment	2/4	2/4	0/4	4/4

26

Human Health Risk Assessment Results

- Human Health Risk Assessment
  - → PRRWP: Incremental Lifetime Cancer Risk (ILCR) and Hazard Index (HI) do not exceed OEPA limits
  - → WARWP: Site related ILCR and HI's are near the OEPA limit for residential exposure to soil, surface water, and sediment, with the driver for this scenario being metals in surface water. Data are insufficient to determine whether the metals are site related

27

Ecological Risk Assessment Results

- Ecological Risk Assessment
  - → High Hazard Quotients are predicted for certain receptors due to potential 4-amino-2,6-DNT uptake by invertebrates from surface soil and sediment, aluminum ingestion by the racoon at the WARWP, and iron uptake by fish from surface water.

28

Conclusions

- Ecological Risk Assessment
  - → High Hazard Quotients are predicted for certain receptors
    - Because of conservative estimates used to account for uncertainties in estimating ecological risk, Hazard Quotients may be overestimated.

31

Recommendations

- Determine site-specific background concentrations of metals in surface water and sediment
- Evaluate human health risk from bedrock groundwater following completion of the characterization of bedrock water quality at the two Red Water Pond Areas
- Conduct earthworm bioassay to estimate uptake and bioavailability of organics from surface soil
- Conduct fish uptake study to estimate bioaccumulation and bioavailability of metals from surface water
- Conduct literature search to obtain more accurate avian NOAEL for 4-amino-2,6-DNT

32