EP-R-D 31Mar99 B

Actual Presentation Handout

RESULTS OF 1997-1998 SITE-WIDE GROUNDWATER MONITORING AT THE FORMER PLUM BROOK ORDNANCE WORKS

AS REPORTED IN THE DRAFT SUMMARY REPORT SITE-WIDE GROUNDWATER INVESTIGATION

Team Meeting

Ohio EPA, Nashville COE, NASA and IT Corporation

March 31, 1999

Purpose and Objectives

- Determine if hazardous substances are present in groundwater at concentrations that may constitute unacceptable risk to human health and the environment
- Refine Site Conceptual Model
- Determine current and future routes of exposure as part of a site conceptual exposure model

NOTE: Summary Report Site-Wide Groundwater Monitoring (1997-1998) issued as Draft in February 1999. Therefore, findings, recommendations, and conclusions presented herein are subject to revision.

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Scope of the Site-Wide GW Investigation

- Monitoring Well Installation
  - → Install 3 overburden and 8 bedrock monitoring wells
  - → One proposed overburden well was dry
- Groundwater Level Measurements
  - → Quarterly measurements of 58 overburden wells and 19 bedrock wells
- Groundwater Sampling
  - → Semi-annual sampling of 38 overburden and 17 bedrock monitoring wells (November 1997 & May 1998)

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Groundwater Level Measurements

- Four Quarterly Measurement Events Completed
  - August & November 1997
  - February & May 1998
  - → Two Water-Bearing Zones Monitored
    - Overburden Water-Bearing Zone
    - Bedrock Water-Bearing Zone
      - Ohio Shale
      - Olentangy Shale
      - Delaware Limestone

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Groundwater Level Measurements

- Bedrock Water Level Measurements
  - → Groundwater flow is generally to the north-northeast with flow on the west side of the site toward a groundwater trough trending west to northeast
  - → Groundwater fluctuations between wells completed in the Ohio Shale and Olentangy Shale are very similar; greater water level fluctuations were observed in wells completed in the Delaware Limestone
    - Fluctuations in the Delaware Limestone possibly attributed to groundwater extraction from sump wells in the Reactor Building and formation heterogeneity
  - → Hydraulic conductivity ranges from 0.03 ft/day to 22.2 ft/day with a geometric mean of 0.35 ft/day in eight bedrock wells

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Groundwater Level Measurements

- Overburden Water-Bearing Zone
  - → Groundwater flow in the overburden generally mirrors surface topography with the predominant flow direction to the north-northeast
  - → Groundwater fluctuations in the overburden wells are very similar possibly implying a certain degree of connectivity between site wells.

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Groundwater Level Measurements

- Overburden Water-Bearing Zone (continued)
  - → Hydraulic conductivity ranges from 0.74 ft/day to 212 ft/day with a geometric mean of 8.75 ft/day.
  - → Similar groundwater elevations in the overburden and bedrock water bearing zones were observed in the eastern and southern portions PBOW indicating a higher degree of connectivity between overburden and bedrock water bearing zones.

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Risk-Based Screening Concentrations (RBC)

- RBCs are a screening tool
  - → Determine need for additional investigation/assessment
  - → Identify Chemicals of Potential Concern for Risk Assessment
- PBOW RBCs adapted from published EPA Region 3 RBCs using lifetime excess cancer risk of 10^{-6} and hazard index (HI) of 0.1 (published RBCs use cancer risk of 10^{-6} and HI of 1.0)
- RBCs do not replace human health or ecological risk assessments
- Risk Based Screening Criteria derived from EPA Region IX Preliminary Remediation Goals currently proposed to replace RBCs.

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Groundwater Sampling Results

- Sampled Areas
  - West Area Red Water Ponds Area (5 overburden / 1 bedrock)
  - Pentolite Road Red Water Ponds Area (4 / 1)
  - TNT Area A (5 / 2), TNT Area B (2 / 2), TNT Area C (6 / 1)
  - Acid Area 1 (2 / 2), Acid Area 2 (3 / 2), Acid Area 3 (1 / 1)
  - Burning Grounds (5 / 2)
  - Upper Toluene Tank Area (1 / 1)
  - Lower Toluene Tank Area (2/0)
  - Reactor Facility (1 / 1)
  - PB-BED-GW020 (0 / 1)
  - IT-MW01 (1/0)

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Site-Wide Monitoring Well Locations

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Site-Wide RBC Exceedances

Site	Water Bearing Zone	Number of Wells Exceeding RBCs/Total Number of Wells					
		VOCs	SVOCs	Nitroaromatic	Dissolved Metals	Cyanide	Nitrate
West Area Redwater Ponds	Overburden	0/5	3/5	2/5	5/5	1/5	1/5
	Bedrock	1/1	1/1	0/1	0/1	1/1	1/1
Pentolite Road Red Water Ponds	Overburden	2/4	3/4	3/4	4/4	3/4	3/4
	Bedrock	1/1	1/1	0/1	1/1	0/1	0/1
TNT Area A	Overburden	0/5	1/5	1/5	5/5	0/5	0/5
	Bedrock	2/2	0/2	1/2	2/2	0/2	0/2
TNT Area B	Overburden	0/2	0/2	1/2	2/2	0/2	0/2
	Bedrock	1/2	0/2	0/2	2/2	0/2	0/2
TNT Area C	Overburden	0/6	2/6	0/6	6/6	0/6	2/6
	Bedrock	1/1	1/1	0/1	1/1	0/1	0/1
Acid Areas	Overburden	2/6	1/6	0/6	2/6	0/6	0/6
	Bedrock	3/5	3/5	3/5	5/5	0/5	0/5
Burning Grounds Areas	Overburden	1/5	1/5	0/5	5/5	0/5	0/5
	Bedrock	0/2	0/2	0/2	2/2	0/2	1/2
Lower Toluene Tank Area	Overburden	0/2	1/2	0/2	2/2	0/1	0/1
Upper Toluene Tank Area	Overburden	1/1	1/1	0/1	1/1	0/1	0/1
	Bedrock	1/1	1/1	0/1	1/1	0/1	0/1
Reactor Facility	Overburden	0/1	0/1	0/1	0/1	0/1	0/1
	Bedrock	1/1	1/1	0/1	1/1	0/1	0/1
IT-MW01	Overburden	0/1	0/1	0/1	1/1	0/1	0/1
Southeast Bedrock Well	Bedrock	1/1	0/1	0/1	1/1	0/1	0/1

RBC exceedances indicated by **bold/red**

Conclusions

- **Overburden Water Bearing Zone**
  - → **Organic Contaminants (VOCs, SVOCs)**
    - Acid Area 1, Acid Area 3, and the Reactor Building do not exhibit impacts of organic compounds from past site activities
    - TNT B, TNT C, Burning Grounds Areas, and Lower Toluene Area exhibited sporadic exceedances of organics; however, these detections are not necessarily site related.
    - TNT A exhibited one SVOC that warrants further evaluation to determine if it is site related.
    - The Maintenance Area and Upper Toluene Area have been impacted by VOCs from past site activities.

Conclusions

- **Overburden Water-Bearing Zone (continued)**
  - → **Nitroaromatic Contaminants**
    - TNT A and TNT B have been impacted by low levels of nitroaromatics
    - Pentolite Road and Red Water Ponds Areas exhibited the highest concentrations of nitroaromatics from previous site activities.

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Conclusions

- **Overburden Water Bearing Zone (continued)**
  - → **Metals**
    - Acid Area 2, the Maintenance Area, and the Reactor Facility did not exhibit dissolved metals at concentrations above RBCs.
    - TNT C, Acid Area 3, the Additional Burning Ground, the Snake Road Burning Ground and the Upper Toluene Area exhibited dissolved iron, manganese, and/or nickel at concentrations exceeding RBCs.
    - Acid Area 1 and the Lower Toluene Area exhibited dissolved iron and manganese at concentrations exceeding RBCs
    - TNT A, TNT B, the West Area Red Water Ponds and Pentolite Road Red Water Ponds exhibited larger suites of metals than other sites
    - Detected metals concentrations are believed to be naturally occurring but require additional study to confirm

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Conclusions

- **Bedrock Water-Bearing Zone**
  - → **Organic Contaminants (VOCs, SVOCs)**
    - Natural petroleum and corresponding low levels of BTEX constituents are prevalent in bedrock across much of the site
    - The Additional Burning Ground and G-8 Burning Grounds do not exhibit organics at levels exceeding RBCs
    - The Pentolite Road Red Water Pond, TNTA, TNTC, Acid Area 2 and the Upper Toluene Tanks Area exhibited benzene and/or toluene at concentrations exceeding RBCs
    - West Area Red Water Pond and the Upper Toluene Tank Area exhibited two or more SVOCs at concentrations exceeding RBCs.
    - Sporadic detections of bis(2-ethylhexyl)phthalate require additional study to determine if it is site related or a sampling artifact

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Conclusions

- **Bedrock Water-Bearing Zone**
  - → **Nitroaromatic Contaminants**
    - TNT A, Acid Areas 1 and 2, the Maintenance Area, and the West Area Red Water Ponds exceeded RBCs
  - → **Metals**
    - Dissolved barium and manganese exceeded RBCs in most areas of PBOW.
    - Arsenic, iron, thallium, and vanadium were detected at concentrations exceeding RBCs
  - → **Cyanide**
    - Cyanide exceeded RBCs at the West Area Red Water Ponds

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Conclusions & Recommendations

- Recommendations
  - → Investigate bedrock groundwater at the Middle Toluene Tank Area
  - → Conduct human health risk assessment for site-wide groundwater in the bedrock water-bearing zone
  - → Complete a residential/agricultural well survey to determine potential off-site receptors

Direct question concerning our intent to proceed considering OVB water non-potable! OEPA Risk Assessor is not sure on that approach thinks may need input from groundwater group. Steve says groundwater supporting our approach. OEPA people have to chk w/ some others.

So OVB GW issue is not settled.

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Conclusions & Recommendations

- Recommendations (continued)
  - → Establish site-specific background for metals and BTEX constituents in groundwater
  - → Completion of a three-dimensional groundwater fate and transport model to aid in bedrock groundwater monitoring
  - → Evaluate need to sample downgradient off-site wells within proximity of the site

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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

Team Meeting

Ohio EPA, Nashville COE, NASA and IT Corporation

March 31, 1999

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.

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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)

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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

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WARWP Sampling Locations

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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

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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

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West Area Red Water Ponds Area Results

- **Groundwater**
  - **Volatile Organic Contaminants**
    - 2-Butanone, benzene, carbon disulfide, ethyl benzene, and/or tetrachloroethene detected in seven samples
    - Concentrations of VOCs detected range from 0.13 ug/L to 1.8 ug/L.
  - **Semivolatile Organic Contaminants**
    - Five nitroaromatics were detected under the SVOC analyses
    - Concentrations of SVOCs detected ranged from 1.8 ug/L to 660 ug/L

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West Area Red Water Ponds Area Results

- Groundwater
  - → Nitroaromatics
    - Five nitroaromatics (1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, and 2,6-DNT) were detected in ten samples
    - Maximum detected concentrations of nitroaromatics in groundwater was 950 ug/L (2,4-DNT)
  - → PCBs
    - PCBs were not detected in any of the groundwater samples
  - → Inorganics
    - Nine dissolved metals were detected in groundwater samples, excluding nutritionally essential elements
  - → Cyanide
    - Cyanide was not detected in any of the groundwater samples

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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

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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

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PRRWP Sampling Locations

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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

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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

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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

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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

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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

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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

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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

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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

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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

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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

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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.

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Conclusions

- Extent of Contamination
  - → West Area Red Water Ponds
    - Contamination is generally limited to subsurface soils and groundwater
    - Extent of groundwater contamination is adequately defined except downgradient (north-northeast) of the ponds
  - → Pentolite Road Red Water Ponds
    - Contamination is generally limited to subsurface soils and groundwater
    - Extent of groundwater contamination is only adequately defined east, north and northwest of the ponds.

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Conclusions

- Human Health Risk
  - → Human health risk for potential chemical carcinogens and potential noncarcinogenic chemical hazards are at or below OEPA limits for residential, groundskeeper, and construction worker exposure scenarios
  - → Site related cancer risk values for residential exposure to soil, surface water and sediment at the WARWP are precipitously close to the OEPA acceptance limit.
  - → It is probable that cancer risk from groundwater in the Red Water Ponds areas, when calculated in future risk assessment may push the residential exposure to soil, surface water and sediment into the unacceptable range.

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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.

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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

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