Per the Federal Facility Agreement for Iowa Army Ammunition Plant, Article X.B.1, the attached document is the final version of the submitted document.

US Army Corps
of Engineers
Omaha District

IOWA ARMY AMMUNITION PLANT

CONSTRUCTION PROGRESS PHOTOGRAPHS

SEPTEMBER 1997

Line 800 Lagoon

Line 1 Impoundment

Wetlands Borrow

Stump Lake

Inert Landfill

CAMU

Trench 6

Explosive Sumps

Burning Grounds

Blue Sludge

CAMU Sediment Dam

Trench 6 Sediment Dam

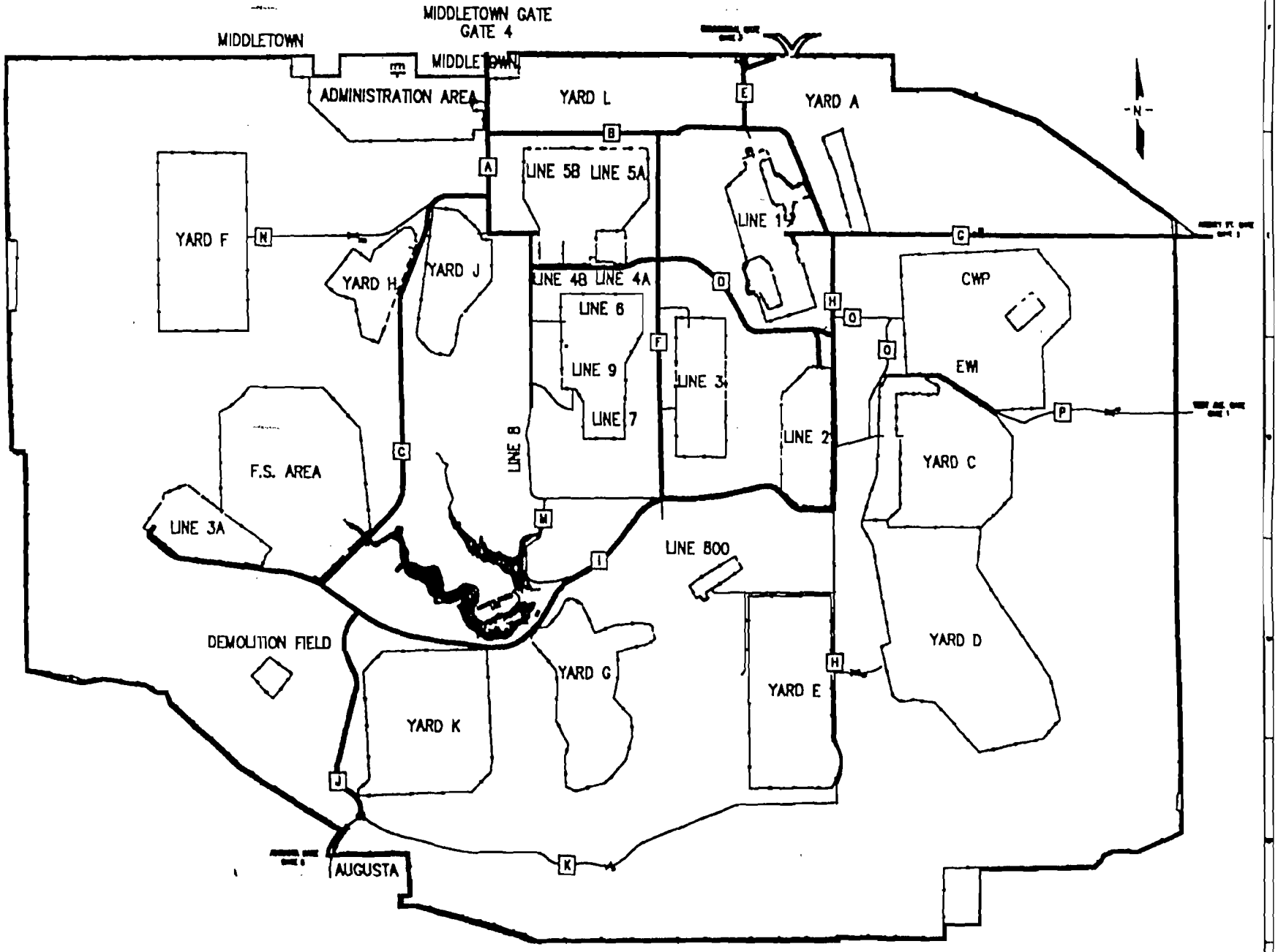
PCDR \ PCDR3 \ IOWA AAP \
041708 \ IWA080118

Cleaning Up the Iowa Army Ammunition Plant

Iowa AAP
USACE, Omaha District
Army Environmental Center
USEPA, Region 7

Cleaning Up the IAAAP

- General Information
- Past Efforts
- Current Efforts
- Future Efforts
- Summary


MIDDLETOWN GATE
GATE 4
MIDDLETOWN
MIDDLETOWN
ADMINISTRATION AREA
YARD L
YARD A
N
LINE 5B LINE 5A
LINE 1
YARD F
YARD H
YARD J
LINE 4B LINE 4A
CWP
LINE 6
LINE 9
LINE 7
LINE 3
EWI
LINE 2
F.S. AREA
LINE 8
YARD C
LINE 3A
LINE 800
DEMOLITION FIELD
YARD G
YARD D
YARD E
YARD K
AUGUSTA
SCALE
ONE INCH EQUALS 1000 FEET
IOWA ARMY AMMUNITION PLANT
GENERAL AREA ORIENTATION MAP FOR VISITORS

Iowa AAP Background

- Load, Assemble, & Pack (LAP) Munitions Production Facility
  - Government-Owned, Contractor-Operated (GOCO)
    - Mason & Hanger - Silas Mason Company, Inc.
  - Army Industrial Operations Command (IOC)
  - Conventional Munitions Production
- Operational Period - 1941 to Present

Iowa AAP Background

- Location - Southeast Iowa
  - 5-10 miles west of Burlington, Iowa and the Mississippi River
  - Between Middletown, Iowa (on north border) and Augusta, Iowa (on south border)
  - South Border Adjacent to the Skunk River
- Facility Size
  - 19,127 acres (30 sqr. miles)
  - 1,148 buildings
  - >1,000 current employees

Iowa AAP Background

- Primary Contaminants
  - Explosives (TNT, RDX, HMX)
  - Metals
  - Volatile Organic Compounds (VOCs)
- Secondary Contaminants
  - Semi-Volatile Organic Compounds (SVOCs)
  - Pesticides / Herbicides
  - PCBs
  - Radionuclides

Iowa AAP Background

- Contaminated Media
  - Soil
    - >170 Sites & Sub-sites
    - >150,000 cubic yards
  - Surface Water
    - Streams and Impoundments
    - Low-level Contamination beyond IAAAP's Boundaries
  - Groundwater
    - Localized Plumes near "Source" Areas
    - Impacted Private Wells South of IAAAP

Iowa AAP Background

- Origin of Contamination
  - Primarily Due to the Historical Discharge of Explosives-Contaminated Wastewater to Surface Soils and to Streams & Impoundments
    - "Pinkwater" = term commonly used to describe wastewater contaminated with explosives due to the pink/red color resulting from the photo-chemical reaction of certain explosive compounds in solution
    - Best Disposal Practice of the Time

Iowa AAP Background

- Origin of Contamination (cont.)
  - Direct Disposal of Explosives and Explosives-Contaminated Materials
    - Open Burning
    - Surface and Sub-Surface Land Disposal
    - Detonation
  - Fuel and Solvent Uses, Spills, and Disposal
  - Pesticide and Herbicide Applications, Spills, and Disposal
  - Lead-Based Paint

Iowa AAP Background

- Cleanup Funding
  - Primarily via Congressionally-appropriated Environmental Restoration Account (ERA)
    - Formerly Dept. of Defense ERA (DERA)
    - Currently Army ERA (ERA-Army)
  - Secondary Funding from Facility Operating Budget (and other misc. sources)

Iowa AAP Background

- Primary Executors of IAAAP Cleanup
  - U.S. Army Corps of Engineers (USACE)
    - Omaha District
    - Waterways Experiment Station (WES)
  - U.S. Army Environmental Center (AEC)
  - Iowa AAP
    - Mason & Hanger - Silas Mason Company (GOCO Contractor)

Iowa AAP Background

- Regulatory Oversight of IAAAP Cleanup
  - Primary - USEPA, Region VII (Kansas City)
  - Secondary - Iowa Department of Natural Resources (IA-DNR)
- IAAAP added to EPA's National Priorities List (NPL) in 1990
  - HRS Score = 29.73
- EPA/Army Interagency Agreement - 1990

Iowa AAP Background

- Army-EPA Relationship
  - Historically Somewhat Adversarial
    - Informal Dispute Initiated by EPA in May 1994
  - Currently Very Positive
    - Relationship Improved thru Partnering and Teamwork Approach
    - Recognition of Mutual Agency Goals
    - Recognition of Conflicting Agency Constraints
    - Focus is on Agreement
    - Focus is on Remediation

Iowa AAP Background

- Current Inter-Agency Teamwork Approach
  - Frequent On-Site Team Meetings
  - Joint Scoping of Project Requirements
  - Joint Document Preparation
  - Continual Review during Project Execution
  - Real-Time Adjustments during Project Execution

Iowa AAP Background

- Current Inter-Agency Participation
  - Iowa AAP
  - U.S. EPA and Iowa DNR
  - U.S. Army Corps of Engineers
    - Omaha District
    - Waterways Experiment Station
  - Army Environmental Center
  - U.S. Fish & Wildlife Service
  - University of Iowa
  - Numerous Private Sector Firms
  - Local Community (RAB recently established)

Prior Cleanup-Related Activities

- More than 17 Major Studies/Investigations between 1975 and 1997
- Closure of North Section of Trench 5 at the Inert Landfill - 1989
- Line 6 Sumps and Contaminated Soil Removal - 1993 (Cost = $1.2M)
- Connection of Local Residences (Affected by Off-Site Groundwater Contamination) to Public Water Supply - 1994

Prior Cleanup-Related Activities

- Explosives-Sumps Removal Action - 1994/1995
  - Removal/Disposal of 60 Wastewater Sumps
  - On-Site Disposal (i.e., Stockpile) of 1,000 cubic yards of Soil Contaminated with Explosives and/or Metals
  - Off-Site Disposal of 10 cubic yards of Mercury-Contaminated Soil
  - Project Cost = $1M

Prior Cleanup-Related Activities

- Pesticide Pit Removal Action - 1995/1996
  - Off-Site Disposal of 160 cubic yards of Contaminated Soils
  - Dioxins/Furans Contaminants in the Soil
    - Army Requested "Contained-Out" Ruling from EPA regarding Lightly-Contaminated Soil
    - Innovative Solution Resulted in $750K Savings in Disposal Costs
  - Project Cost = $750K

LINE 800 LAGOON

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Line 800 Pinkwater Lagoon

- Former Lagoon Located Adjacent to Line 800 Production Facilities and Adjacent to an Intermittent Tributary to Brush Creek
  - Received Pinkwater Discharges from Line 800, plus Sludges Trucked in from Other Lines
  - Unlined 5-acre Lagoon, 4-feet Deep, Surrounded by an Earthen Berm
  - Originally Contained Leaching Fields and Evaporation Furrows (in 1943)
  - Eventually Converted to Settling Pond Prior to Discharge to Brush Creek Tributary

Line 800 Pinkwater Lagoon

- 74,736 cubic yards of Explosives-Contaminated Soil Excavated from Area in 1997
  - Excavated Soil Contained >80,000 lbs of explosives
  - Excavated Soil Segregated by Level of Contamination
  - Excavated Soil Relocated to Inert Landfill Site

Line 800 Pinkwater Lagoon

- Excavated Area will be Converted to a Wetlands
  - Provides Large Cost Savings due to Avoidance of Backfill for Excavation Site
  - Provides Local Ecological Enhancement
  - Wetlands Design Incorporates Plant Species to "Phytoremediate" Residual Contaminants

IAAAP Soil Disposition

Explosives-Contaminated Soil Disposition Matrix (by **VOLUME**, by Source Areas)					
		Temporary Stockpile in **Trench #7** "CAMU" (pending treatment)	Permanent Landfill in **Trench #6** RCRA Subtitle C "Soil Repository"	Permanent Landfill as **"Random Fill"** under Inert Landfill Cap	Totals
Line 1 Impoundment	Volume (yd^3)	618	1,234	6,418	**8,270**
	Ratio	7%	15%	78%	100%
Line 800 Lagoon	Volume (yd^3)	6,803	12,133	55,800	**74,736**
	Ratio	9%	16%	75%	100%
Totals	Volume (yd^3)	7,421	13,367	62,218	**83,006**
	Ratio	**9%**	**16%**	**75%**	100%

IAAAP Soil Disposition

Explosives-Contaminated Soil Disposition Matrix (by **CONTAMINANT MASS**, by Source Areas)									
		Temporary Stockpile in **Trench #7** "CAMU" (pending treatment)		Permanent Landfill in **Trench #6** RCRA Subtitle C "Soil Repository"		Permanent Landfill as **"Random Fill"** under Inert Landfill Cap		Totals	
Line 1 Impoundment	Mass of Explosives	1,040 kg	2,293 lb	570 kg	1,257 lb	176 kg	388 lb	**1,786 kg**	**3,937 lb**
	Ratio	58%		32%		10%		100%	
Line 800 Lagoon	Mass of Explosives	28,497 kg	62,824 lb	5,938 kg	13,091 lb	1,971 kg	4,345 lb	**36,406 kg**	**80,261 lb**
	Ratio	78%		16%		5%		100%	
Totals	Mass of Explosives	**29,537 kg**	**65,117 lb**	**6,508 kg**	**14,348 lb**	**2,147 kg**	**4,733 lb**	**38,192 kg**	**84,198 lb**
	Ratio	**77%**		**17%**		**6%**		100%	

Photo No. 1: (12-16 March 1996) Preconstruction aerial view of the Line 800 Pinkwater Lagoon looking northwest.

Photo No. 2: (12-16 March 1996) Preconstruction view of the Line 800 Pinkwater Lagoon looking north.

Photo No. 3: (15-16 July 1996) Aerial view of the Line 800 Pinkwater Lagoon looking southeast. Note the granular activated carbon units on the embankment crest. The lagoon is being dewatered.

Photo No. 4: (17-18 September 1996) Soil sampling operations.

Photo No. 5: (19 November 1996) The Line 800 Lagoon has been essentially dewatered.

Photo No. 6: (1 May 1997) Aerial of the excavation of contaminated materials as viewed looking easterly.

Photo No. 7: (30 April 1997) Excavation of contaminated materials as viewed looking northwest.

Photo No. 8: (24 June 1997) Aerial of the excavation of contaminated materials as viewed looking southeast.

Photo No. 9: (26 June 1997) Placement of seedbank material on the bottom of the excavated area.

Photo No. 10: (7 August 1997) Placement of seedbank material on the bottom of the excavated area has been completed. The GAC units have been removed.

LINE 1 IMPOUNDMENT

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Line 1 Pinkwater Impoundment

- Former Impoundment Located Adjacent to Line 1 Production Facilities Along Upper Reaches of Brush Creek
  - Received Large Volumes of Line 1 Pinkwater Discharges from 1948 to 1975
  - 1,300 to 2,400 feet long
  - 3.6 to 7.5 acres
  - Embankment Breached after 1975
    - Brush Creek Flowed thru Area after Breach
    - Area Re-Vegetated after Breach

Line 1 Pinkwater Impoundment

- 8,270 cubic yards of Explosives-Contaminated Soil Excavated from Area in early 1997
  - Excavated Soil Contained >3,900 lbs of explosives
  - Excavated Soil Segregated by Level of Contamination
  - Excavated Soil Relocated to Inert Landfill Site

Line 1 Pinkwater Impoundment

- Excavated Area will be Converted to a Wetlands
  - Provides Cost Savings due to Avoidance of Backfill for Excavation Site
  - Provides Local Ecological Enhancement
  - Wetlands Design Incorporates Plant Species to "Phytoremediate" Residual Contaminants

IAAAP Soil Disposition

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Photo No. 1: (12-16 March 1996) Preconstruction aerial photograph of the Line 1 Impoundment as viewed looking northwest.

Photo No. 2: (15-16 July 1996) Aerial photograph of the Line 1 Impoundment as viewed looking northwest. Brush Creek has been relocated around the area of contamination. Material is being mined from the Wetlands Borrow Area.

Photo No. 3: (24 June 1997) Aerial photograph of the Line 1 Impoundment as viewed looking northwest. 8,270 cubic yards of contaminated soil containing 3,937 pounds of explosives has been excavated and relocated to the Inert Disposal Area.

Photo No. 4: (7 August 1997) Aerial photograph of the Line 1 Impoundment as viewed looking northwest. Construction is in progress of the upstream wetland hydraulic control structure. Material is still being mined from the Wetlands Borrow Area.

Photo No. 5: (12-16 March 1996) Preconstruction view of Brush Creek flowing southeast (downstream) through the Line 1 Impoundment.

Photo No. 6: (15-16 July 1996) View of the Line 1 Impoundment looking north (upstream) at the area of contamination.

Photo No. 7: (15-16 July 1996) View of the relocated Brush Creek flowing southeast (downstream) around the Line 1 Impoundment. The culvert is a temporary construction crossing that will be removed in the fall of 1997.

Photo No. 8: (15-16 July 1996) View of the relocated Brush Creek flowing southeast (downstream) around the Line 1 Impoundment as viewed from the temporary construction crossing.

Photo No. 9: (11-12 February 1997) Excavation of contaminated soils from the Line 1 Impoundment as viewed looking northwest.

Photo No. 10: (28 February 1997) Excavation area of the Line 1 Impoundment as viewed looking northwest (upstream). Surface runoff from heavy rainfall several days earlier ponded water in the excavation area. The trapped water became contaminated with RDX at levels of approximately 800 ppb. Granular activated carbon absorption units had to be used to treated the water before it could be discharged into Brush Creek.

Photo No. 11: (15-16 July 1996) Looking northeast at the cutoff trench and outlet works foundation for the upstream wetlands hydraulic control structure.

Photo No. 12: (6 August 1997) Looking northeast at the gatewell and outlet works for the upstream wetlands hydraulic control structure.

Additional Current Efforts

- Wetlands Borrow Area
  - Used as a Borrow Source for Clean Soil Requirements in Line 1/800 and Inert Landfill Project
  - 150,000 cubic yards Excavated
  - Excavation Site Converted to Lake and Wetlands
    - Significant Local Ecological Enhancement
    - Coordinated with U.S. Fish & Wildlife Service

Photo No. 1: (March 1996) Aerial view of the future Wetland Borrow Area.

Photo No. 2: (21 March 1995) The Wetland Borrow Area Dam will cross this unnamed tributary to Brush Creek. The reservoir area will be excavated to provide fill material for the landfill cap at the Inert Disposal Area.

Photo No. 3: (8 August 1996) Construction of the outlet works conduit in progress.

Photo No. 4: (11 September 1996) The intake structure, low level intake, and outlet works conduit are complete. The stilling basin is currently under construction.

Photo No. 5: (17-18 September 1996) View of the low level intake and intake structure from the reservoir area, prior to final grading.

Photo No. 6: (17-18 September 1996) Aerial view of the Wetland Borrow Area. The stilling basin is being constructed and excavation of borrow material is underway.

Photo No. 7: (19 November 1996) The stilling basin, and the remainder of the outlet works, is completed.

Photo No. 8: (19 November 1996) The Wetland Borrow Area embankment is complete.

Photo No. 9: (29 April 1997) View of the completed intake structure. Note the excavation of borrow material in the background.

Photo No. 10: (7 August 1997) Aerial view of the complete Wetland Borrow Area Dam. Borrow excavation is continuing in the upstream reaches of the ` reservoir.

STUMP LAKE

Additional Current Efforts

- Stump Lake
  - Silted-In Lake Near Inert Landfill Site
  - Breached Dam to Dry Out Lake Bed
  - Sediment Mined for Use as Topsoil
  - Sediment also Used for Wetlands "Seed-Bank" at the Lines 1 & 800 "Phtyo" Wetlands
  - Avoids Need to Obtain Topsoil from Productive Farmland

Additional Current Efforts

- Stump Lake (cont.)
  - Dam Re-Constructed and Lake Re-Established After Sediment Mining Complete
    - Significant Improvement to Quality of Lake
    - Significant Local Ecological Enhancement
    - Coordinated with U.S. Fish & Wildlife Service

Photo No. 1: (12-13 March 1996) Aerial view of the original Stump Lake and Dam prior to breaching of the dam. Note the Inert Disposal Area in the background.

Photo No. 2: (12-16 March 1996) View of Stump Lake from the embankment.

Photo No. 3: (17-18 September 1996) Aerial view of Stump Lake and Dam after clearing and breaching of the embankment.

Photo No. 4: (March 1996) View of Stump Lake, looking north from the embankment, shortly after the dam was breached.

Photo No. 5: (March 1996) The lake bottom where topsoil and seedbank material will be obtained for other Lines 1 and 800, and the Inert Landfill cap.

Photo No. 6: (March 1996) A close-up view of decaying organic matter found on the lake bottom.

Photo No. 7: (March 1996) A granular sediment filter was constructed downstream of Stump Lake Dam, and immediately upstream of the railroad embankment conduit. This filter, constructed of graded granular material with a geotextile filter facing, prevented sediment from the lake from deteriorating water quality downstream.

Photo No. 8: (March 1996) Close-up of the relatively clear water exiting the granular sediment filter shown in Photo No. 7.

Photo No. 9: (26 June 1997) The new intake structure is under construction. Also visible is the 14 foot diameter conduit through the railroad embankment, and the right abutment inspection trench, located to the right of the intake structure.

Photo No. 10: (6 August 1997) View of the completed intake structure, newly constructed portion of the outlet works conduit, the plug wall, and the existing railroad embankment conduit.

Photo No. 11: (6 August 1997) View of the inlet to the intake structure-low level intake pipe.

Photo No. 12: (17-18 September 1996) View of the vegetation which grew in the fertile soil in the Stump Lake reservoir within three months after dewatering.

Photo No. 13: (17-18 September 1996) Close-up of the arrowhead plant which grew in the Stump Lake reservoir after dewatering. This native plant will serve as an integral part of the phyto remediation process at the Line 1 Impoundment and Line 800 Lagoon.

Photo No. 14: (6 August 1996) Aerial view of the Stump Lake reservoir area, looking south. The seedbank excavation has begun at the upper end of the reservoir, shown at the bottom of the photo. Construction of the new Stump Lake Dam is proceeding at the top of the photo.

INERT LANDFILL

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Inert Landfill Area

- Trench 7 Temporary Stockpile (CAMU)
- Trench 6 Soil Repository
- Trenches 1-5 Municipal Landfill and Random Fill Area
- Soil Disposition
- Burning Grounds
- Sedimentation Control Dams

Inert Landfill, Trenches 1-5

- Previously Filled, Primarily with Sanitary Landfill Materials
  - residential and cafeteria refuse/garbage
  - wood/lumber
  - plastic
  - metal
  - paper
  - asbestos insulation (in double plastic bags)

Inert Landfill, Trenches 1-5

- Sanitary Landfill Areas Require "Closure" with Installation of Low-Permeability Cap and Long-Term Groundwater Monitoring
- North End of Trench 5 Contains "Special Wastes"
  - Ash from Contaminated Waste Processor
  - Ash from Explosive Waste Incinerator
  - Ash from Open Burning of Explosives and Explosives-Contaminated Wastes

Inert Landfill, Trenches 1-5

- North End of Trench 5 Previously Capped and RCRA Closure Completed
- Entire Area To Receive Synthetic Cap (17 acres Capped by Fall 1997)
  - 6" Topsoil (with shallow-rooted vegetation)
  - 24" Select Fill (cover soil)
  - Geonet Drainage Layer
  - 40 mil Geomembrane (low permeability layer)
  - "Random Fill"

Inert Landfill, Trenches 1-5

- Cap Design
  - Isolates Waste Materials
  - Eliminates Direct Human & Animal Contact
  - Contains Waste Materials in a Controlled Environment
    - Drastically Reduces Surface Water Infiltration
    - Minimizes Potential Transport of Contaminants from Landfill to Groundwater
  - Allows Management and Safe Release of Gases Generated by Decaying Organic Matter

Inert Landfill, Trenches 1-5

- Random Fill Required to Bring Landfill Surfaces to Proper Slopes for Adequate Drainage
  - Large Volumes of Soil Required (approx. 100,000 cubic yards)
  - Lightly-Contaminated Soil Can Be Used (since it is placed under a cap)
    - Lightly-Contaminated Soil from Lines 1& 800 Excavations Available for Use
    - Large Cost Savings Results from "Dual Use"

IAAAP Soil Disposition

Explosives-Contaminated Soil Disposition Matrix (General)					
		Temporary Stockpile in **Trench #7** "CAMU" (pending treatment)	Permanent Landfill in **Trench #6** RCRA Subtitle C "Soil Repository"	Permanent Landfill as **"Random Fill"** under Inert Landfill Cap	Leave In-Place
Level of Soil Contamination		High	Moderate	Low	Very Low
Level of "Cumulative Exposure Risk"	**Soil** Exposure Pathway	greater than 10^{-5}	less than 10^{-5} but greater than 10^{-6}	less than 10^{-6}	-NA-
	Groundwater Exposure Pathway	-NA-	-NA-	greater than 10^{-6}	less than 10^{-6}

NOTES:

1. "Level of risk" refers to the projected rate of incidence of a severe reaction to a contaminant at a particular concentration, in a particular media (e.g., soil, water, air, etc.), and via a particular exposure scenario (as defined by EPA). For example, a 10^{-6} risk represents a contaminant level which is expected to produce one severe reaction among every 1,000,000 people exposed to the defined scenario.

2. "Cumulative Exposure Risk " refers to the sum of the risks contributed by each of the several individual contaminants of concern.

IAAAP Soil Disposition

Explosives-Contaminated Soil Disposition Matrix (Compound-Specific Examples)					
		Temporary Stockpile in **Trench #7** "CAMU" (pending treatment)	Permanent Landfill in **Trench #6** RCRA Subtitle C "Soil Repository"	Permanent Landfill as **"Random Fill"** under Inert Landfill Cap	Leave In-Place
"Compound-Specific" Soil Contaminant Levels	TNT	greater than 1,960 mg/kg	less than 1,960 mg/kg but greater than 196 mg/kg	less than 196 mg/kg but greater than 47.5 mg/kg	less than 47.5 mg/kg
	RDX	greater than 530 mg/kg	less than 530 mg/kg but greater than 53 mg/kg	less than 53 mg/kg but greater than 1.3 mg/kg	less than 1.3 mg/kg

NOTES:

1. "Leave-In-Place" soil concentrations were calculated using the "Summers Model", which models the relationship between soil and groundwater contaminant concentrations.

2. TNT and RDX concentrations of 2 ug/l (or 2 ppb) in groundwater represent 10^{-6} levels of groundwater exposure risk.

3. Soil containing 47.5 mg/kg of TNT is expected to produce groundwater containing 2 ug/l of TNT. Similarly, soil containing 1.3 mg/kg of RDX is expected to produce groundwater containing 2 ug/l of RDX.

IAAAP Soil Disposition

- EPA/CERCLA "Preference for Treatment"
  - Army/EPA Agreement that Final Soil Disposition Would Include At Least 50% Treatment (as measured by contaminant mass)
- Treatment Costs Based Upon VOLUME of Soil, Not Contaminant Mass
- EPA & Army BOTH "Win" if High Percentage of Contaminant Mass is Concentrated in Low Percentage of Excavated Soil Volume

IAAAP Soil Disposition

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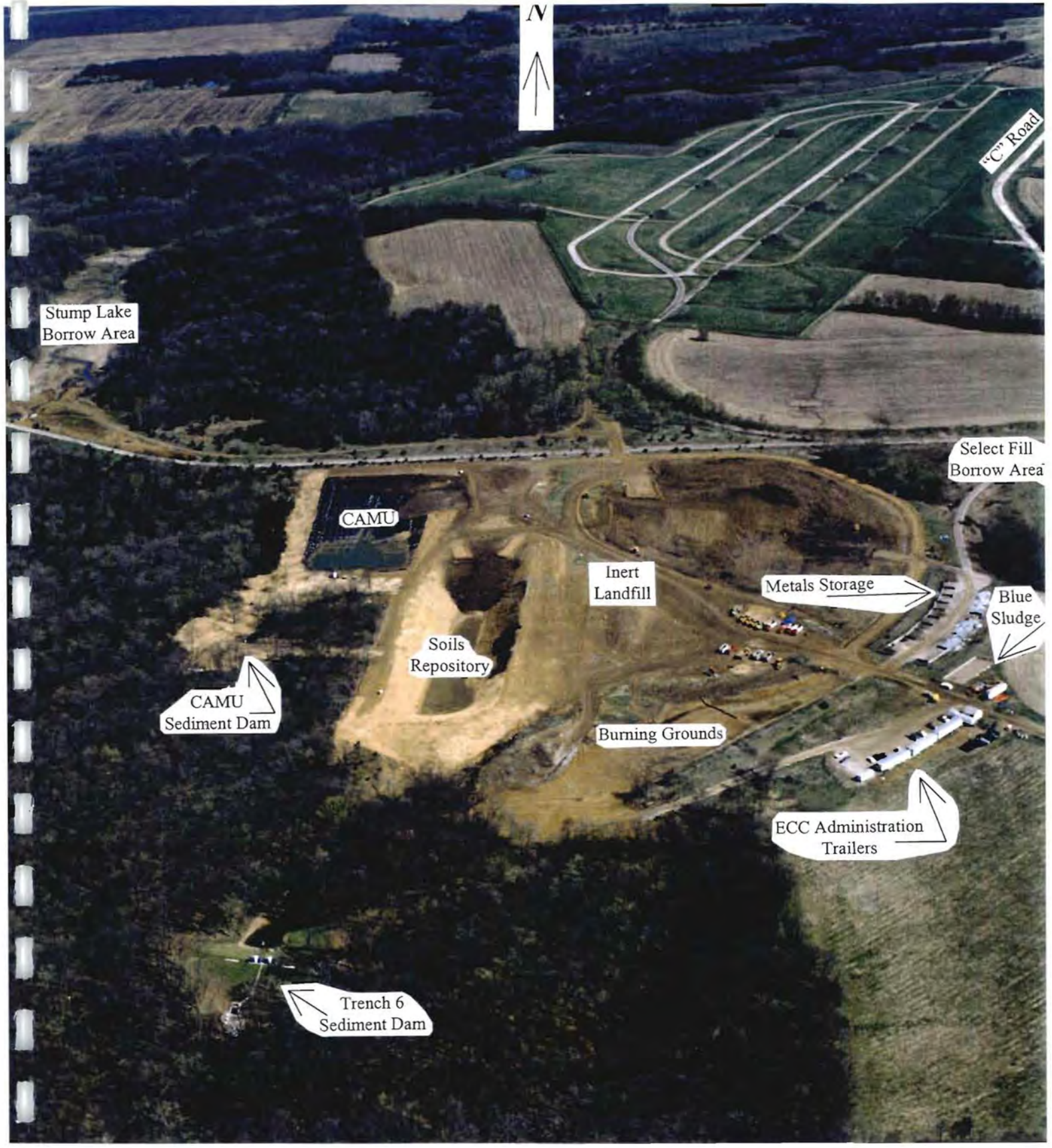

Photo No. 1: (30 April 1997) Aerial view of the Inert Disposal Area (IDA) looking north. The following features of the IDA can be viewed on this photograph: Inert Landfill, CAMU, Trench 6 Soils Repository, Sediment Dams, Stump Lake and Select Fill Borrow Sources, Burning Grounds, Metals Storage Area, Blue Sludge Drying Bin and ECC's administration trailers.

Photo No. 2: (12-16 March 1996) Preconstruction aerial view of Inert Landfill Area (IDA) looking northwest. Stump Lake (before breaching) can also be viewed in this photograph.

Photo No. 3: (15-16 July 1996) Aerial view of Inert Landfill Area (IDA) looking northwest. Stump Lake (after breaching) can also be viewed in this photograph. On this date, the CAMU foundation is prepared. The Trench 6 Soil Repository has been graded and the seep collection layer has also been placed.

Photo No. 4: (17-18 Sept 1996) Looking southeast at the CAMU foundation preparation and the Trench 6 Soils Repository under construction at the IDA.

Photo No. 5: (17-18 Sept 1996) Looking north at the Trench 6 Soils Repository under construction at the IDA. The Inert Landfill is in the right of the photograph.

Photo No. 6: (12 June 1997) Aerial view of IDA looking northwest. Contaminated soils are being relocated from both the Line 1 Impoundment and the Line 800 Lagoon.

Photo No. 7: (7 August 1997) Aerial view of the IDA looking west. On this date, the contaminated soils from both the Line 1 Impoundment and the Line 800 Lagoon had been relocated to the IDA. 7,421 cubic yards went to the CAMU, 13,367 cubic yards went to the Trench 6 Soil Repository, and 62,218 cubic yards was used as random fill for the Inert Landfill cover.

Trench 7 Soil Stockpile

- Designed for Temporary Storage of "Highly Contaminated" Soil ... Pending Treatment
- Designed per RCRA Stockpile Requirements ... similar to "Subtitle C" (Hazardous Waste) Landfill Cell
  - Double Bottom Liner (60 mil Geomembrane)
    - Leachate Collection & Treatment Systems
    - Leak Detection System
  - Synthetic Cap

Trench 7 Soil Stockpile

- Permitted by EPA as a RCRA "Corrective Action Management Unit" (CAMU)
- Utilizes Pre-Existing Borrow Trench/Pit
  - Minimizes Construction Cost
  - Minimizes Land Use
  - Minimizes Environmental Impacts
- Flexible Design Capacity
  - 13,000 cubic yards, "level"
  - 30,000 cubic yards, "mounded"

Photo No. 1: (March 1996) Preconstruction conditions at the CAMU site, looking south.

Photo No. 2: (15 August 1996) Initial grading of the CAMU, looking south.

Photo No. 3: (17-18 September 1996) Aerial view of the CAMU and Trench 6.

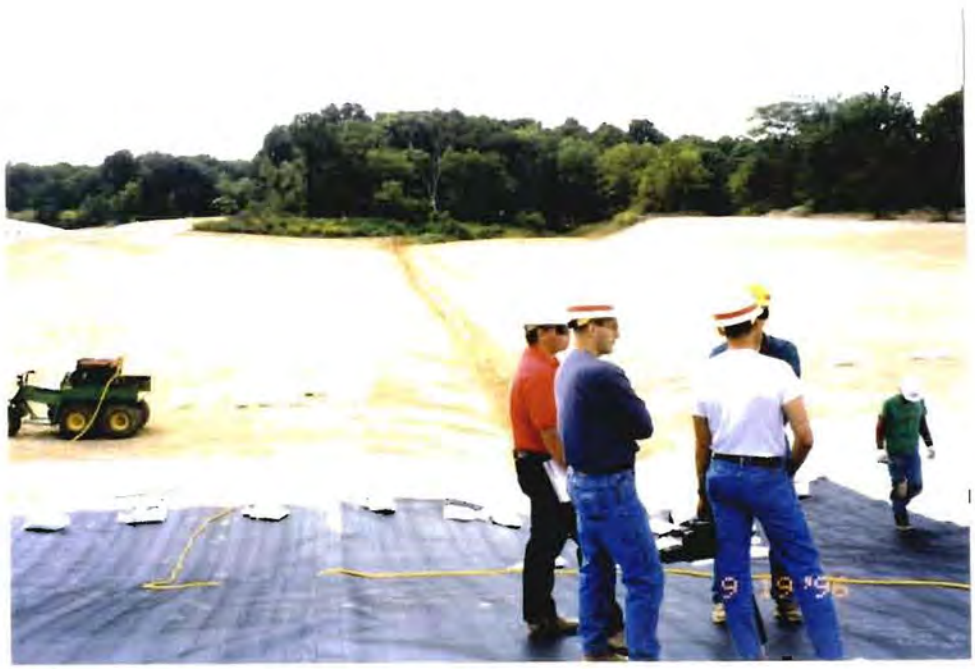

Photo No. 4: (19 September 1996) Initial grading is complete. On this date the placement of the geosynthetic clay liner (GCL) and the secondary geomembrane was taking place.

Photo No. 5: (6 November 1996) View of the progression of the CAMU leachate collection system construction, looking north. Visible layers include the primary geomembrane in the area of the leachate collection sump, the geonet for leachate collection, a filtration geotextile, and the granular leachate collection trench.

Photo No. 6: (19 November 1996) The bottom liner system is nearly complete. Following the installation of a filtration geotextile, the CAMU will be able ready to receive contaminated soils.

Photo No. 7: (30 April 1997) At the south end of the CAMU, granular activated carbon (GAC) units treat leachate and contaminated storm water prior to releasing the effluent downstream.

Photo No. 8: (24 June 1997) Highly contaminated material being placed in the CAMU after excavation from the Line 1 Impoundment and the Line 800 Lagoon.

Photo No 9: (7 August 1997) Aerial view of the of the CAMU (left), Trench 6 (right), and the landfill cap (top). On this date the CAMU contains approximately 7,400 cubic yards of soil contaminated with approximately 65,000 pounds of explosives.

Photo No. 10: (6 August 1997) Closeup view of the contaminated leachate and stormwater runoff within the CAMU.

Trench 6 Soil Repository

- Designed for Permanent Storage of "Moderately Contaminated" Soil ... Without Treatment
- Designed per RCRA "Subtitle C" (Hazardous Waste) Landfill Requirements
  - Double Bottom Liner (60 mil Geomembrane)
    - Leachate Collection & Treatment Systems
    - Leak Detection System
  - Synthetic Cap

Trench 6 Soil Repository

- Utilizes Pre-Existing Landfill Trench
  - Minimizes Construction Cost
  - Minimizes Land Use
  - Minimizes Environmental Impacts
- Flexible Design Capacity
  - 65,000 cubic yards, "level"
  - 100,000 cubic yards, "mounded"

Photo No. 1: (12-16 March 1996) Preconstruction conditions along Trench 6, looking south.

Photo No. 2: (March 1996) Initial grading of Trench 6, looking south.

Photo No. 3: (8 August 1996) Initial grading is complete. The geocomposite and pea gravel seepage collection layers are complete at the bottom of the trench.

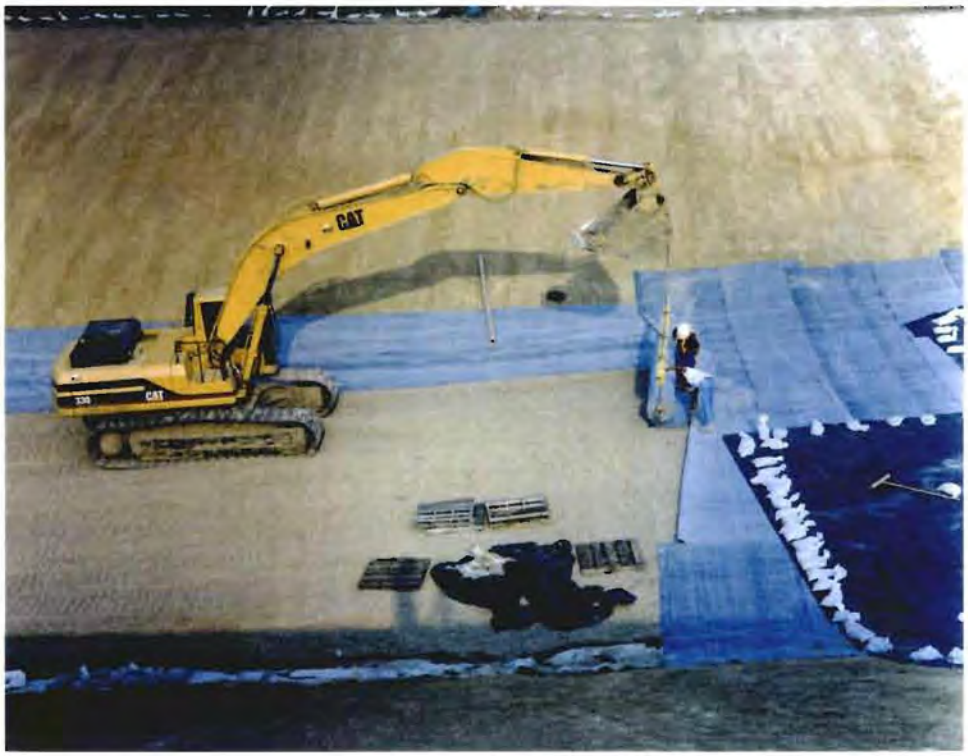

Photo No. 4: (14-15 August 1996) Placement of the geosynthetic clay liner (GCL) on the trench bottom.

Photo No. 5: (14-15 August 1996) Placement of the secondary geomembrane liner on the west sideslope of the trench.

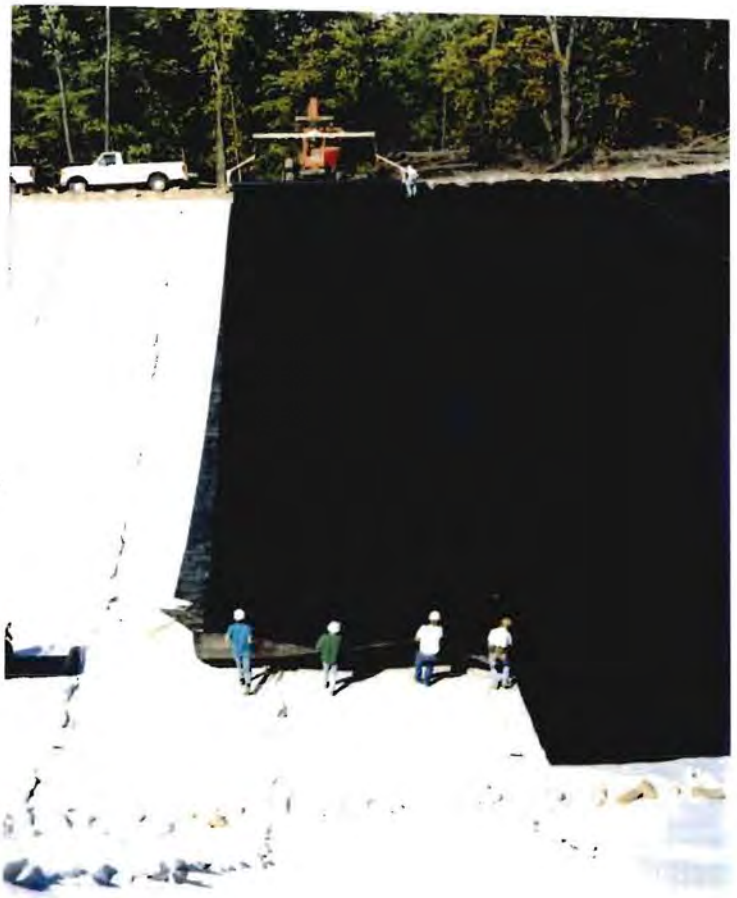

Photo No. 6: (17-18 September 1996) Placement of the primary geomembrane over the geocomposite leak detection layer.

Photo No. 7: (17-18 September 1996) View of the progression of geosynthetic placement. Visible layers include the secondary geomembrane, the geocomposite leak detection layer, and the primary geomembrane.

Photo No. 8: (September 1996) View of the geosynthetic anchor trench along the east side of Trench 6, looking north.

Photo No. 9: (17-18 September 1996) Aerial view of Trench 6, looking southwest.

Photo No. 10: (19 November 1996) View of the geogrid anchor trench along the west side of Trench 6. Note the smaller geosynthetic anchor trench in the background.

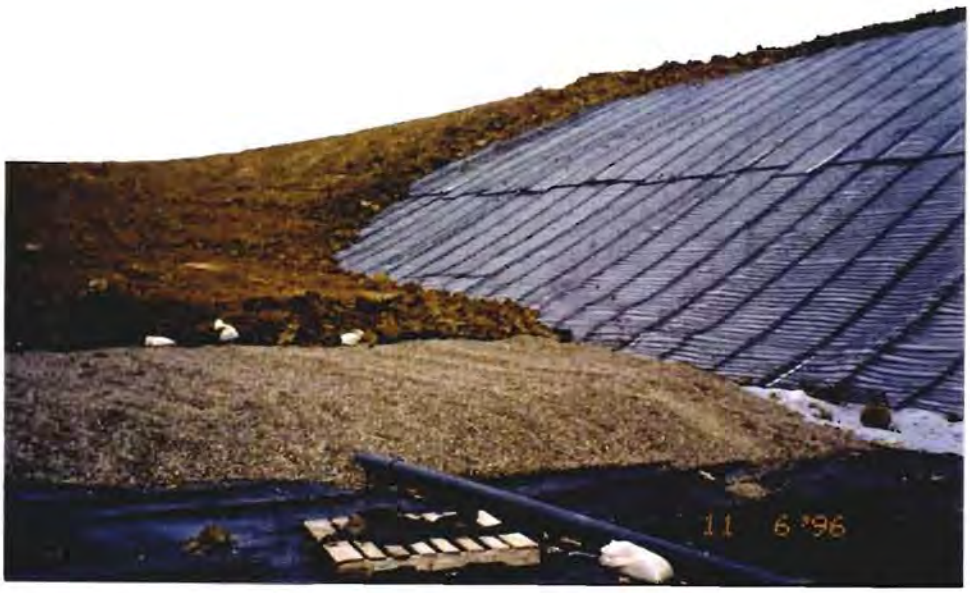

Photo No. 11: (6 November 1996) The various component layers along the bottom of the trench identified in this photo are the primary geomembrane liner, the perforated leachate collection pipe, the gravel leachate drainage layer, a geotextile separator, and a protective cover soil layer being placed across the trench bottom and on top of the geogrid on the trench sideslopes.

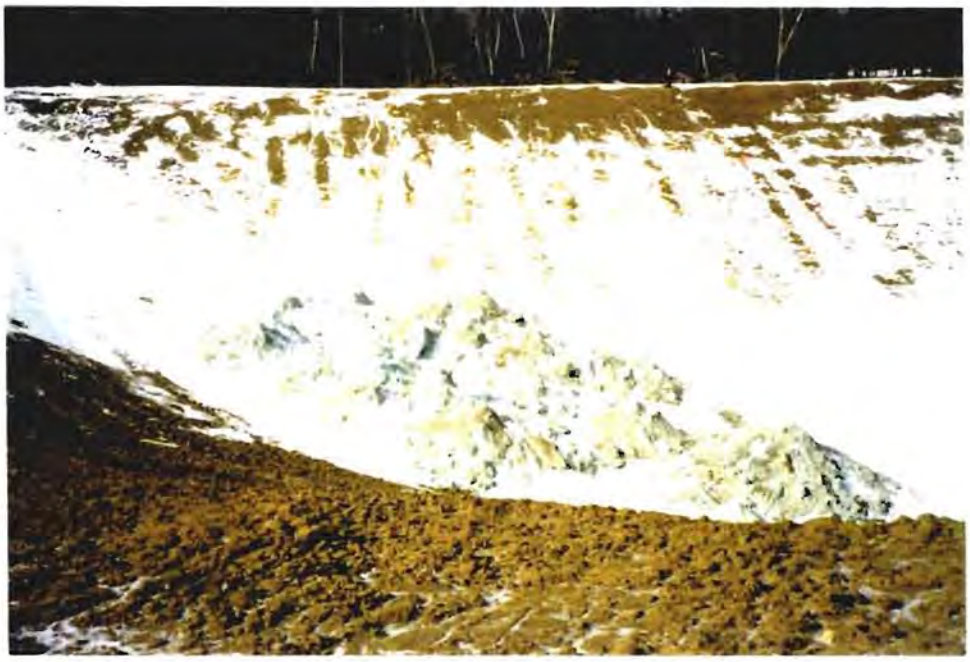

Photo No. 12: (February 1997) Material from the Blue Sludge Lagoon after excavation and placement into Trench 6.

Photo No. 13: (March 1997) View of Trench 6 after the protective soil cover had been placed. The soil repository had just begun to receive contaminated materials. A slide of the cover soil had occurred on the east sideslope of the trench at the geogrid/soil interface. There was no damage to any of the geosynthetic layers.

Photo No. 14: (1 May 1997) View of the north end of Trench 6 where contaminated soil from the Line 1 Impoundment and the Line 800 Lagoon has been placed.

Photo No. 15: (6 August 1997) View of Trench 6, looking north. On this date, approximately 13,300 cubic yards of contaminated soil had been placed into the cell. The soil contains approximately 14,300 pounds of explosives.

Photo No. 16: (7 August 1997) Aerial view of the completed Trench 6 cell. Note the red water in the cell that was generated from the TNT and RDX leaching out of the contaminated soil placed in the trench. This water is pumped out of the cell and treated with granular activated carbon absorption units.

EXPLOSIVE SUMPS

Additional Current Efforts

- Inert Landfill Burning Grounds
  - 14,200 cubic yards of Metals-Contaminated Soil Excavated & Relocated as Random Fill under the Inert Landfill Cap (without treatment)
- Explosives-Sumps Stockpile
  - 1,700 cubic yards of Previously-Excavated Soil Relocated To Trench 6 Soil Repository
- Blue Sludge
  - 300 cubic yards of Metals-Contaminated Soil Relocated from Former Lagoon to Trench 6

Photo No. 1: (12-16 March 1996) Preconstruction view of the Explosives Sumps Stockpile and the Burning Grounds as viewed looking southwest. The Explosives Sump Stockpile contained explosive contaminated soils.

Photo No. 2: (1 May 1997) View of the remediated Explosives Sumps Stockpile and the Burning Grounds looking southwest. The Explosives Sumps Stockpile was placed into the Trench 6 Soils Repository.

BURNING GROUNDS

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Additional Current Efforts

- Inert Landfill Burning Grounds
  - 14,200 cubic yards of Metals-Contaminated Soil Excavated & Relocated as Random Fill under the Inert Landfill Cap (without treatment)
- Explosives-Sumps Stockpile
  - 1,700 cubic yards of Previously-Excavated Soil Relocated To Trench 6 Soil Repository
- Blue Sludge
  - 300 cubic yards of Metals-Contaminated Soil Relocated from Former Lagoon to Trench 6

Photo No. 1: (12-16 March 1996) Preconstruction aerial view of Inert Landfill Area (IDA) looking northwest. The Burning Grounds and the Explosive Sumps Stockpile is located at the southern portion (left in photo) of the IDA.

Photo No. 2: (12-16 March 1996) View of the Burning Grounds looking northeast. The Burning Grounds consisted of lead contaminated soils and ash and debris fill.

Photo No. 3: (15-16 July 1996) Chemist taking samples in the Burning Grounds Area. The contaminant of concern at the burning grounds was lead.

Photo No. 4: (19 November 1996) The Burning Grounds was trenched and sampled to determine the nature and extent of contamination. The ash material generally extended to a depth of three feet and extended over a three acre area.

Photo No. 5: (19 November 1996) The Burning Grounds has been delineated to extend into the ravine located south of Trench 6. Ash and other debris was pushed into the ravine.

Photo No. 6: (19 November 1996) Close up view of the debris extending from the east bank of the ravine located south of Trench 6.

Photo No. 7: (24 June 1997) Aerial view of the IDA looking north. On this date, the Burning Grounds had been relocated in the random fill zone of the IDA cover. The Explosive Sumps Stockpile was relocated into Trench 6.

Additional Current Efforts

- Inert Landfill Burning Grounds
  - 14,200 cubic yards of Metals-Contaminated Soil Excavated & Relocated as Random Fill under the Inert Landfill Cap (without treatment)
- Explosives-Sumps Stockpile
  - 1,700 cubic yards of Previously-Excavated Soil Relocated To Trench 6 Soil Repository
- Blue Sludge
  - 300 cubic yards of Metals-Contaminated Soil Relocated from Former Lagoon to Trench 6

Photo No. 1: (March 1996) Blue Sludge Storage Area located at the Inert Disposal Area. This material was a by-product of metal plating operations.

Photo No. 2: (March 1997) View of the Blue Sludge Storage Area after the contaminated material was removed and placed in Trench 6.

Additional Current Efforts

- Trench 6 Sediment Control Dam
  - Built to Control Sediment-Laden Run-Off from Precipitation Events
  - Captures Run-Off from Most of Inert Landfill Area (>20 acres)
  - Due to Unexpected Mobility of RDX, Captured Water Has Required Treatment with Granular Activated Carbon Prior to Discharge

Additional Current Efforts

- Trench 7 Sediment Control Dam
  - Functions Similar to Trench 6 Sed Dam, but Captures Run-Off from Much Smaller Area (<6 acres)
  - As with Trench 6 Sed Dam, Captured Water Has Required Treatment with Granular Activated Carbon Prior to Discharge

Photo No. 1: (15-16 July 1996) Excavation of the outlet works foundation for the CAMU Sediment Dam. Perpendicular to the excavation is the foundation inspection trench, located along the centerline of the dam alignment.

Photo No. 2: (17-18 September 1996) Aerial view of the future location of the CAMU Sediment Dam. The outlet works foundation is visible at the bottom-center of this photo. The CAMU site and Trench 6 are shown above.

Photo No. 3: (6 November 1996) View of the completed intake structure and outlet works conduit, prior to construction of the embankment.

Photo No. 4: (19 November 1996) Construction of the CAMU Sediment Dam embankment.

Photo No. 5: (March 1997) View of the completed Sediment Dam. Note that the water elevation behind the dam is near the invert of the uncontrolled intake structure.

Photo No. 6: (1 May 1997) View of the completed Sediment Dam. Note the riser which was added to the intake structure to prevent the uncontrolled release of contaminated water from the CAMU site.

Photo No. 7: (24 June 1997) View of the completed Sediment Dam.

Photo No. 8: (24 June 1997) Aerial view of the CAMU Sediment Dam. Also visible is the CAMU site and Trench 6.

TRENCH 6 SEDIMENT DAM

Additional Current Efforts

- Trench 6 Sediment Control Dam
  - Built to Control Sediment-Laden Run-Off from Precipitation Events
  - Captures Run-Off from Most of Inert Landfill Area (>20 acres)
  - Due to Unexpected Mobility of RDX, Captured Water Has Required Treatment with Granular Activated Carbon Prior to Discharge

Additional Current Efforts

- Trench 7 Sediment Control Dam
  - Functions Similar to Trench 6 Sed Dam, but Captures Run-Off from Much Smaller Area (<6 acres)
  - As with Trench 6 Sed Dam, Captured Water Has Required Treatment with Granular Activated Carbon Prior to Discharge

Photo No. 1: (12-16 March 1996) An unnamed tributary of Long Creek located approximately 1/4 mile south of the Inert Disposal Area. Contaminated water would flow into this stream if the Trench 6 Sediment Dam was not constructed.

Photo No. 2: (12-16 March 1996) Close-up view of leachate in a drainage channel immediately downstream of Trench 6, flowing towards the creek shown in Photo No. 1.

Photo No. 3: (12-16 March 1996) Future location of the Trench 6 Sediment Dam.

Photo No. 4: (March 1996) Clearing is complete and excavation of the outlet works foundation is in progress. The excavation for the inspection trench in the west abutment can be seen in the center of the photo.

Photo No. 5: (15-16 July 1996) Forms for the reinforced concrete stilling basin are being constructed. The truck is parked at the approximate location of the embankment centerline.

Photo No. 6: (14-15 August 1996) Construction of the stilling basin and outlet works conduit is complete. Compaction of the soil immediately adjacent to the structures is in progress.

Photo No. 7: (17-18 September 1996) Aerial view of the Trench 6 Sediment Dam after final grading of the embankment. Also visible is the intake structure and the stilling basin, shown at the top and bottom of the photo respectively.

Photo No 8: (17-18 September 1996) View of the intake structure and upstream side of the embankment.

Photo No. 9: (19 September 1996) Placement of erosion control fabric on the embankment.

Photo No. 10: (1 May 1997) View of the granular activated carbon (GAC) units located on top of the embankment. The GAC units are used to treat the contaminated storm water and leachate from the Inert Disposal Area prior to releasing to the downstream channel. When construction of the landfill cap is completed, and the subsequent inflow of contaminated water into the Sediment Dam ceases, the GAC units will be disassembled and inflows will be released through the uncontrolled outlet works.

Additional Current Efforts

- Surface Water Treatment
  - >12,000,000 Gallons Treated with Granular Activated Carbon Prior to Discharge
    - Line 1 Impoundment
    - Line 800 Lagoon
    - Trench 6
    - Trench 7
    - Trench 6 and Trench 7 Sed Dams
  - Required Primarily Due to Explosives Contamination
    - 2 ppb max. allowable discharge for RDX and TNT

Additional Current Efforts

- Fire Training Pit
  - On-Site Treatment of 1,000 cubic yards of Soil Contaminated with Fuels & Solvents
    - Original Treatment Plan = Ex-situ Soil Vapor Extraction (SVE)
    - Current Treatment Plan = Low Temperature Thermal Desorption (LTTD)
  - Placement of Treated Soil in Trench 6

Additional Current Efforts

- Phytoremediation of Explosives Residuals
  - Wetlands
    - Line 1 Pinkwater Impoundment
    - Line 800 Pinkwater Lagoon
    - Innovative Technology Implementation
    - Technical Assistance from USACE-WES and the University of Iowa
  - Uplands
    - Poplar Trees
    - Technical Assistance from the University of Iowa

Additional Current Efforts

- Evaluation of Bioremediation Technologies Suitable for Treatment of Explosives-Contaminated Soil in Trench 7 Stockpile
  - Bioslurry - AEC/Argonne Pilot Study
  - Composting - USACE-WES Pilot Study
  - BTS - ECC/USACE-Omaha Pilot Study
  - Daramend - Potential W.R. Grace Pilot Study Funded by DOD "Foreign Technology Evaluation Program"

Additional Current Efforts

- RI Data Gaps Closure Effort
  - Required to Close Critical Data Gaps in the Remedial Investigation Report, Especially as Related to Groundwater Fate & Transport
    - Intended to Answer Question About How Contamination is Getting Off-Site
  - Required to Close Data Gaps in the Ecological Risk Assessment Portion of the RI Report
  - Will Lead into Next Step of Process - Development of Groundwater FS thru ROD

Future Efforts

- Focused FS Soil Removal Project
  - >120 Sites
  - 60,000 cubic yards Additional Contaminated Soil Removal
  - Wastes Compatible with Line 1/800 and Inert Landfill Project
  - Soil to be Managed Similar to Line 1/800 Soil

Future Efforts

- Focused FS Soil Removal Project (cont.)
  - $6.5M Contract Ready for Award Upon Receipt of Funds
  - $6M-$8M Additional Being Prepared for Contract Award
  - EPA/Army Expected to Sign Interim Record of Decision (ROD) by Fall 1997

Future Efforts

- Line 800 Lagoon Groundwater Remediation
  - Design Project Programmed for FY98
  - EPA Priority to Remediate Highly-Contaminated Local Groundwater Plume
- Treatment of Contaminated Soil in Trench ~~X~~ 7 Stockpile
  - After Completion of Focused FS Soil Removals
  - After Completion of ROD Regarding Treatment Methodology

Summary

- Enormous Cleanup Efforts are Currently Underway at Iowa AAP
- Success has Largely been Due to the Partnering and Team Approach Currently In Place Between Army and EPA
  - Focus has been on Remediation ... Often Before an Official ROD has been Signed
  - Focus has been on Treatment of Principal Threats and Containment of Lesser Threats
  - Cooperative Spirit Fosters Innovation and Accelerated Progress