DEPARTMENT OF THE NAVY
CRANE DIVISION
NAVAL SURFACE WARFARE CENTER
300 HIGHWAY 361
CRANE, INDIANA 47522-5001

IN REPLY REFER TO
5090
Ser 095/U5298

13 OCT 1995

U.S. Environmental Protection Agency, Region V
Waste, Pesticides, and Toxics Division
Waste Management Branch
Illinois, Indiana, and Michigan Section
Attn: Ms. Carol Witt-Smith (HRP-8J)
77 West Jackson Blvd.
Chicago, IL 60604

Dear Ms. Witt-Smith:

In accordance with the requirements of the Federal Resource Conservation Recovery Act permit renewal, Crane Division, Naval Surface Warfare Center (NAVSURFWARCENDIV Crane) submits enclosure (1). This enclosure is a report of the interim measures revegetation activities recently completed at the Ammunition Burning Grounds.

NAVSURFWARCENDIV Crane point of contact is Mr. Thomas J. Brent, Code 09510, telephone 812-854-6160.

Sincerely,

G. K. HILL
Deputy Director, Public Works Directorate
By direction of the Commander

Encl:

(1) Revegetation for Erosion Control at the Ammunition Burning Grounds

Copy to:
SOUTHNAVFACENGCOM, (Code 1864)
COMNAVSEASYSCOM (SEA 07E)
USAE-WES (Richard Price)

REVEGETATION FOR EROSION CONTROL
AT THE
AMMUNITION BURNING GROUNDS

CRANE DIVISION, NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

OCTOBER 11, 1995

Enclosure (1)

1. INTRODUCTION

This report documents the activities leading to the reestablishment of vegetation at Ammunition Burning Grounds (ABG) at the Crane Division, Naval Surface Warfare Center (NSWC Crane). The United States Environmental Protection Agency (U.S. EPA) became concerned about the potential of contaminated soils migrating from the site via erosion of banks cleared of vegetation as a routine maintenance practice. NSWC Crane agreed to pursue an agreeable solution which should provide for long-term stabilization of the soils within the ABG.

2. SITE BACKGROUND

a. Location

NSWC Crane is located in southwestern Indiana, approximately 75 miles southwest of Indianapolis, and 71 miles northwest of Louisville, Kentucky. NSWC Crane occupies 62,463 acres (approximately 100 square miles) of the northern portion of Martin County and small portions of neighboring Greene, Daviess, and Lawrence Counties. The base is located in a rural agricultural and wooded area, and is situated on a topographic plateau known as the Crawford Upland, dissected by well-defined stream valleys, causing elevation differences of over 300 feet in some areas. Surficial geology consists of Pennsylvanian and Mississippian age sandstones, shales, and limestones.

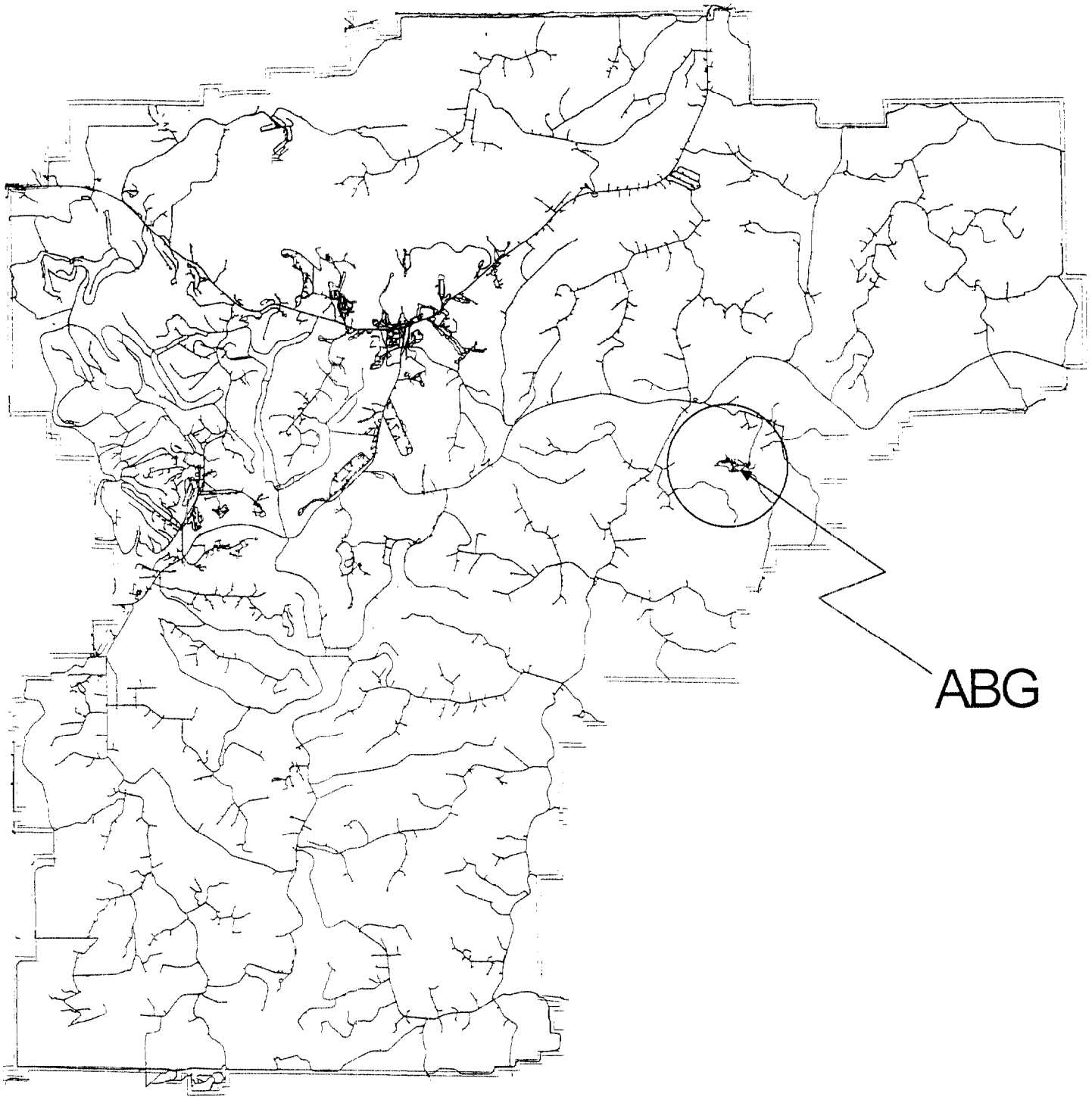
The mission of NSWC Crane is to provide material, technical, and logistics support to the Navy for weapons systems and ordnance items. The responsibility for production, renovation, and storage of conventional ammunition belongs to the Crane Army Ammunition Activity (CAAA). The Army utilizes Navy-owned facilities at NSWC Crane through a license agreement initiated in 1977. All environmental permits and compliance at the base are the responsibility of the Navy.

b. Corrective Action Under RCRA

On December 23, 1989, the U.S. EPA issued a Resource Conservation Recovery Act (RCRA) Part B Permit for NSWC Crane's hazardous waste storage facility. The permit also established the HSWA Corrective Action Requirements and Compliance Schedules for 30 Solid Waste Management Units (SWMUs). This included conducting RCRA Facility Investigations (RFIs) at the SWMUs, and if contamination were found, to conduct Corrective Measures Studies and implement Corrective Measures if needed.

c. Description of ABG

The ABG is located at the east-central portion of the facility (see Figure 1) in the northwest corner of Section 28 and the southwest corner of Section 21, Township 5N, Range 3W. The ABG was identified as a SWMU in the facility's Part B Permit. Covering approximately 50



0.85 0 0.85 1.7 Miles

Location of the Ammunition Burning Grounds

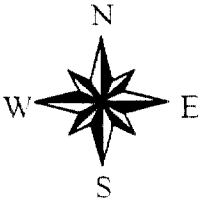


Figure 1

acres, the ABG is located in a valley at the headwaters of Little Sulphur Creek (Figures 2 and 3). The eastern boundary of the operating unit is the beginning of a pseudo-karst zone characterized by springs and a sinking stream.

The ABG has been used extensively since the 1940's for the thermal treatment of military pyrotechnics, propellants, and explosives (PEP), and materials potentially PEP contaminated. CAAA has operated the ABG since 1978. Thermal treatment is via open burning, conducted under an interim status permit. NSWC Crane has applied to the U.S. EPA, Region V, for a subpart X permit for the open burning operations.

Solid explosives residues not in containers or bombs were formerly spread out on burning pads or in flash pits and ignited. Burning today is done in clay-lined steel pans. There are 29 pans currently in operation at the ABG. Specific operations at the ABG include (refer to Figure 4):

i. RDX and phosphorus sludges are dewatered by gravity into an under-drain system, air dried, and ignited in steel pans. These units have secondary containments and underground storage tanks (area 1). The dewatering units replace the surface impoundments, which are currently undergoing closure (area 6);

ii. Bulk propellant and high explosives are open burned in clay-lined steel pans (areas 2 and 3). Bulk propellants typically are poured into the burning pans to a depth of a few inches, primed, and remotely initiated;

iii. Waste red phosphorous is burned in unlined steel pans (area 4);

iv. The primer pit (area 5), and incinerator cage (area 8) are used to thermally treat ammunition components and pyrotechnic munitions;

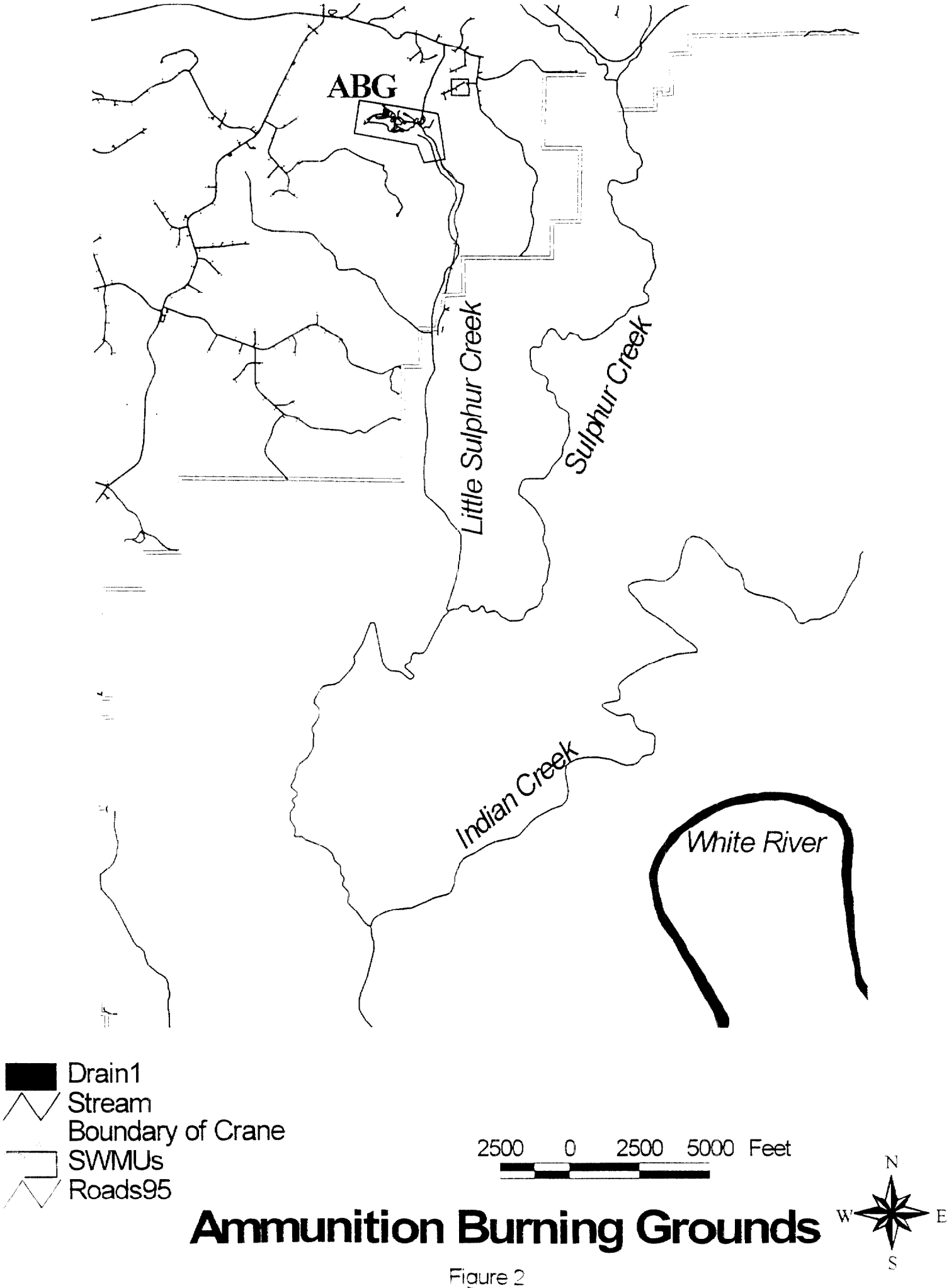
v. Ash from various burning operations is inspected in a steel pan (area 7);

vi. PEP contaminated solvents are burned in unlined steel pans (area 9);

vii. Suspect contaminated materials, such as cardboard and wood, are burned on clay-lined concrete pads with leachate collection (area 10);

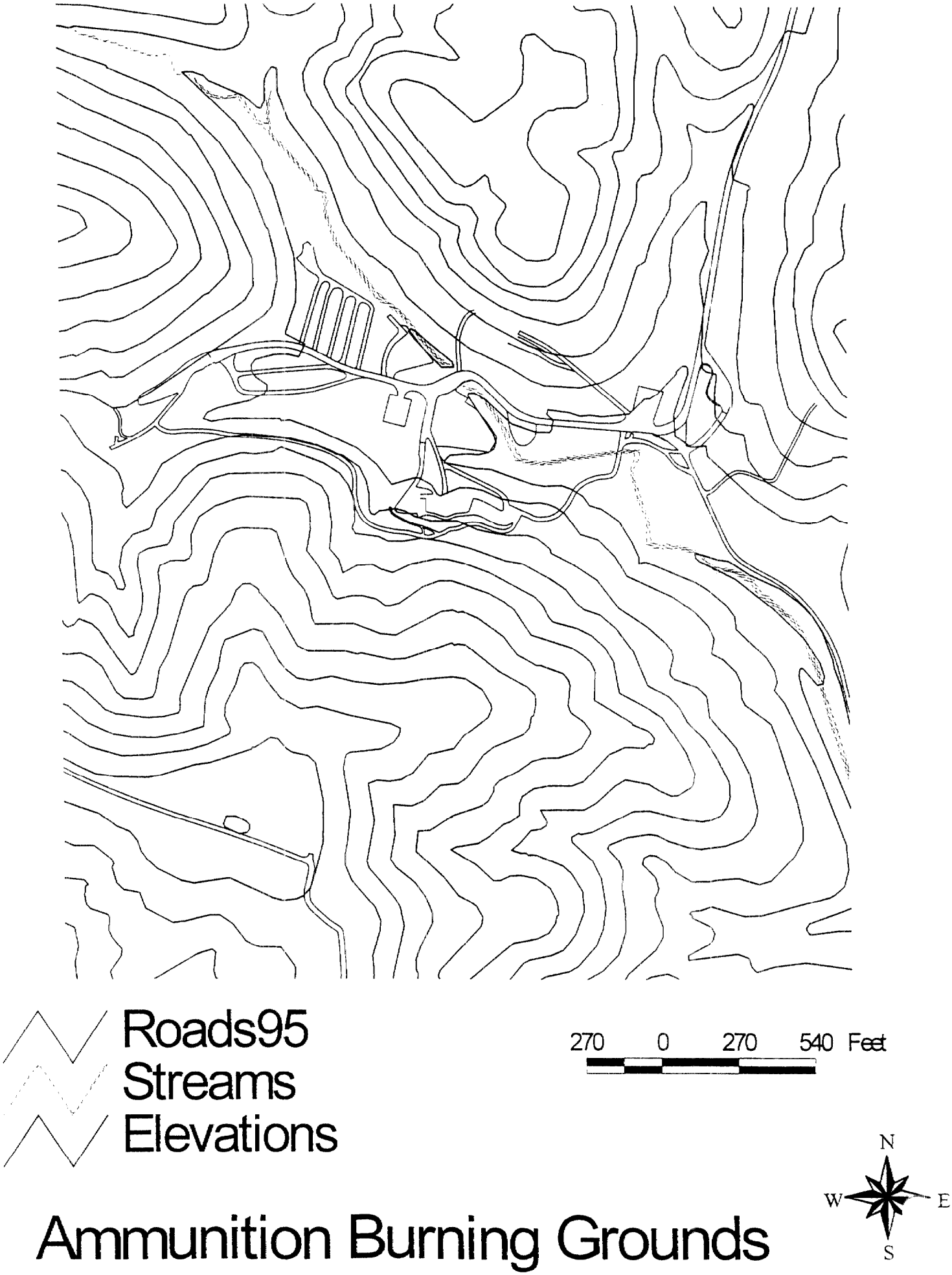
viii. The burn box (area 11) has been decommissioned; and

ix. Ash residue from the burning operations is stored in roll-off boxes until sent to an off-site landfill (area 12).



Ammunition Burning Grounds

Figure 2


Roads95
Streams
Elevations
270 0 270 540 Feet
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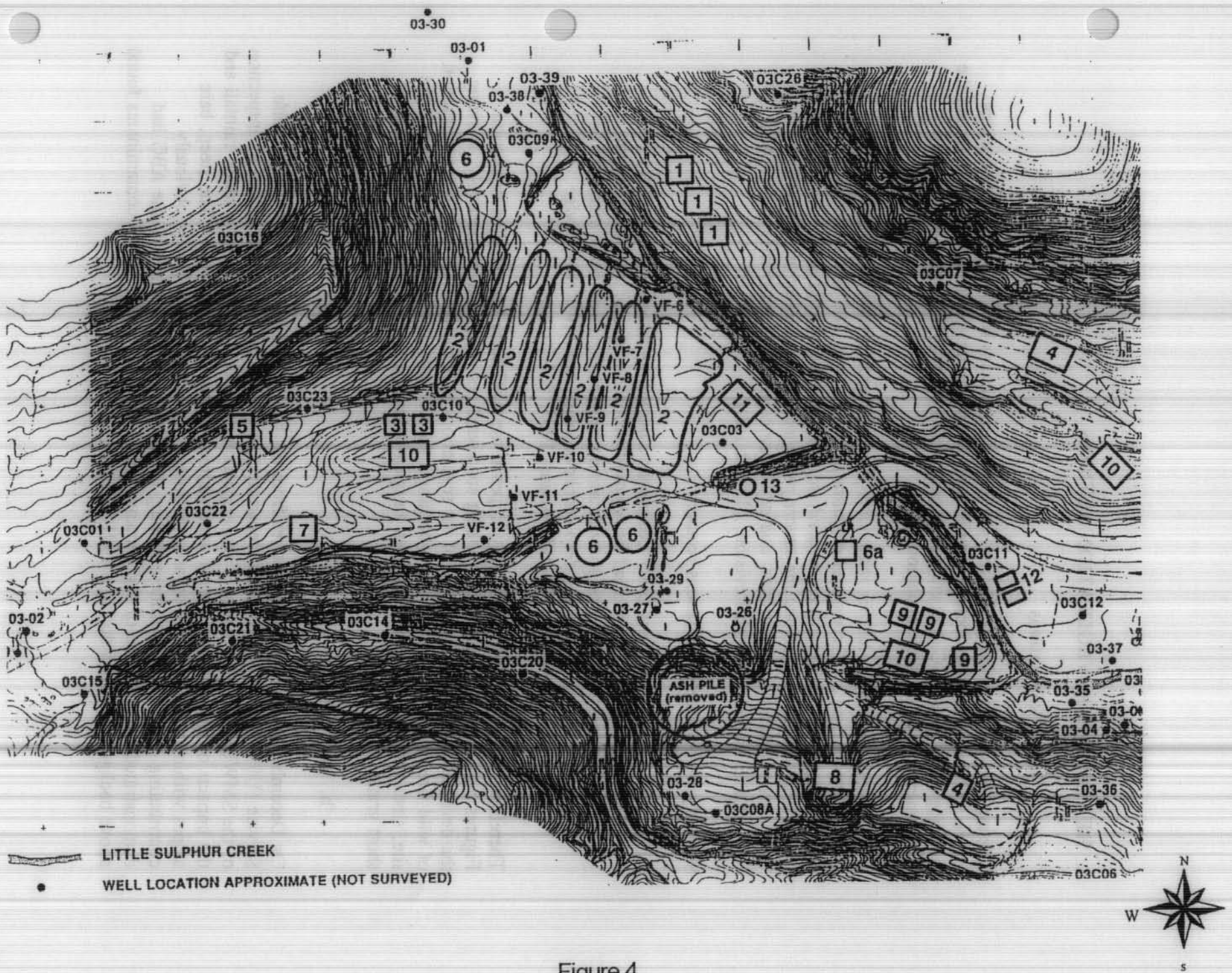
Ammunition Burning Grounds

Figure 3


03-30
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13
6a
03C11
12
03C12
03-29
03-27
03-26
03-02
03C21
03C14
03C20
03-37
03C15
ASH PILE
(removed)
03-35
03-04
03-28
03C08A
03-36
03C06
LITTLE SULPHUR CREEK
WELL LOCATION APPROXIMATE (NOT SURVEYED)
N
W
S

Figure 4

3. HISTORY OF REVEGETATION ACTIONS

a. Safety Regulations

Defense Department safety regulations set forth requirements for operating open-burning ranges. These regulations include requirements for maintaining vegetation in and around the operating unit. The ABG is operated to comply with specific Navy and Army safety requirements. Navy safety regulations state:

> *Burning grounds shall be reasonably free from undergrowth or shrubbery. The burning area shall consist of a square pad, measuring 300 feet by 300 feet. The pad should be entirely cleared, so that a flatbed of sand or dirt remains. A 20-foot border beyond the square pad should be cleared of all vegetation, grass, glass, glass particles, and any other combustible materials.* (NAVSEA OP 5 Volume 1, Fifth Revision, §13-2.2.1.d.).

Similarly, Army safety regulations require:

> *Dry grass, leaves, and other extraneous combustible material in amounts sufficient to spread fire shall be removed within a radius of 200 feet from the point of destruction. The grounds should be of well packed earth and shall be free from large stones and deep cracks in which explosives might lodge.* (AMC Regulation No. 385-100, August 1995, §27-10.c.).

Therefore, the valley floor and nearby slopes at the ABG were kept void of vegetation. Figures 5 and 6 are aerial photos, looking southward and westward, respectively, showing the devegetated slopes. The intent of the regulations is primarily to prevent the propagation of wild fires resulting from the open-burning. Bare ground also aids in the policing of the site, since ordnance items ejected from an open-burning unit are difficult to locate even in short grass.

b. EPA Visit

On December 18, 1990, representatives from the U.S. EPA, the U.S. Fish and Wildlife Service (USFWS), and the Indiana Department of Natural Resources performed an inspection of the SMWUs at NSWC Crane. The inspection took place shortly after a major rainfall and the impacts of surface water runoff were visible in Little Sulphur Creek. The steep, bare slopes within the ABG operating area (as shown in Figures 5 and 6) were obviously contributing considerable sediment loading to the creek. RFI activities at the ABG had demonstrated the existence of soil contamination. Table 1 is a list of soil contaminants found above background levels during a 1991 RFI.

Figure 5

Table 1. Possible ABG Soil Contaminants	
Metals	
Magnesium	Lead
Barium	Copper
Nickel	Zinc
Aluminum	Manganese
Cadmium	Phosphorus
Antimony	Chromium
Mercury	Silver
Tin	Sodium
Explosives	
TNT	HMX
RDX	Tetryl
1,2,5 TNB	1,3 DNB
2,4,6 TNT	2,4 DNT
2,6 DNT	
Volatile Organics	
Trichloroethane	Tetrachloroethane
Semivolatile Organics	
Polycyclic Aromatic Hydrocarbons	
Pesticides and Herbicides	
Methoxychlor	

The inspectors were concerned that contaminated soils may be eroding into Little Sulphur Creek and potentially impacting ecological habitats downstream. The ABG does not have any sediment retention structures (e.g., ponds) to prevent sediments from leaving the facility below the ABG. In an April 1991 letter to NSWC Crane, the U.S. EPA stated:

> *The ABG is devoid of vegetative cover and is located at the bottom of a valley that contains the headwaters of Little Sulfur Creek. The creek empties into the east fork of the White River. During a U.S. EPA and Fish and Wildlife site visit, sediment runoff into the creek was quite evident, due to the rainfall in the area at the time. Our major concern is that even when relatively clear feeder streams entered the creek, there was no visual abatement of the sediment from the ABG as the Little Sulfur Creek left the facility. This is a very serious run-off issue that must be addressed and mitigated in some manner.*
>
> *Contaminants from the burning of explosives could be of concern in the soil particles being washed out of the valley. Soil sampling data has not been evaluated yet, and the toxicological effects of any contamination still need to be addressed. There are no sediment ponds or other structures to contain the sediment run-off, or limit potential explosive contaminants from entering Little Sulfur Creek. A method of controlling run-on and run-off must be addressed.*
>
> *The Indiana Department of Natural Resources, Division of Fish and Wildlife is concerned about the ABG. The State endangered Lake Sturgeon is documented to occur below Shoals, Indiana, which is located on the east fork of the White River. The Lake Sturgeon population has been decreasing due to water quality problems. By monitoring and decreasing sediment loading that may extend into this area, and which does effect the Little Sulfur Creek environment, the Navy can improve surface water quality in the area.*

NSWC Crane is also a breeding area for the Bald Eagle. Furthermore, a young eagle was seen at the time of the inspection downstream of the ABG. Nesting is also known to occur along the east fork of the White River.

The U.S. EPA requested that NSWC Crane evaluate a regulatory change to allow the establishment of short grass cover in order to stabilize the erosion and reduce contaminant transport.

4. REVEGETATION ACTIVITIES

a. Problem Evaluation

NSWC Crane had previously investigated the feasibility of constructing a sediment pond near the boundary south of the ABG. The study showed that damming the valley in a manner sufficient to allow for sediment settlement, would flood the entire Little Sulphur Creek

Valley on base. Therefore, NSWC Crane began to look at the possibility of designing a revegetation scheme which would meet all involved interests. The solution would have to take into account fire protection and safety for the personnel operating the site. Furthermore, the solution would prevent the further spread of contamination and reduce total suspended solids (TSS) in the creek while RFI investigations continue to define the rate and extent of contamination.

NSWC Crane and the U.S. EPA intended to make use of the U.S. EPA's Stabilization, or Interim Measures initiatives. This meant that NSWC Crane and the U.S. EPA would agree on a remedial solution ahead of the investigative schedules set forth in the facility's permit. The U.S. EPA, in the proposed Subpart S rule (57 FR 30798) recognized the importance of allowing willing and responsible facilities to begin corrective action promptly without unnecessary procedural delays. As such, the U.S. EPA intended to remove regulatory disincentives and encourage voluntary cleanups. The goal of the stabilization effort whose goal is to control or minimize threats to human health and/or the environment from releases at SWMUs and/or to prevent or reduce the further spread of contamination while pursuing long-term remedies. Thus, enacting these measures more expeditiously than what is called for in the facility's operating permit should significantly reduce the rate and extent of environmental degradation from existing releases. Clearly, it was the U.S. EPA's intent that obvious remedial solutions should not be impeded by the investigative process.

NSWC Crane contacted the U.S. Army Corps of Engineers Waterways Experiment Station (WES) for assistance and arranged for discussions between NSWC Crane, the U.S. EPA and WES.

b. Procedures and Recommendations

WES personnel visited the ABG to begin developing a revegetation strategy. Numerous soil samples were collected for agricultural analyses to determine nutrient levels and organic matter content of the soils. The objective was to develop a vegetation scheme which would stabilize the soils and not present a fire hazard.

After reviewing the physical characteristics (slopes, burn unit locations, stream location, etc.) and the agronomic characteristics of the site, the WES personnel presented an erosion control plan to NSWC Crane for the ABG. A copy of this plan is provided as Attachment 1. The plan divided the ABG into seven areas based on proposed vegetation type (a factor of soil conditions, slope, and relation to burn units), necessary amendments (e.g., fertilizer, lime, etc.), and site preparation (e.g., tillage, mulching, and seed application methods). Seed types and mixes were chosen for complimentary growth characteristics with regards to the requirements of the conditions at ABG. For example, Reliant Hard Fescue is slow growing whereas Creeping Red Fescue provides faster cover. Thus, the seed mixtures take into consideration such aspects as growth rate, growth height, winter color, mat densities, heat tolerance, etc. Table 2 shows the seed types selected, and the consideration for seed selection.

Table 2. Seed Recommendations and Considerations	
Selected Seed Types	
Reliant Hard Fescue (*Festuca longifolia*) Empire Birdsfoot Trefoil (*Lotus corniculatus*) Derby Perennial Ryegrass (*Lolium perenne*) Weeping Lovegrass (*Eragrostis curvula*)	Common Creeping Red Fescue (*Festuca rubra*) Rebel II or Clemfine Tall Fescue (*Festuca arundinacea*)
Considerations	
Ease of establishment - Because the vegetating will be performed by contract, want a plant that will take off without much management.	
Height - for fire purposes, plants should be low growing. Mowing is unreliable.	
Perennial.	
Competitive - Invasion of weeds and other grasses is undesirable.	
Suitable to poor soils (low nutrients, clay, etc.).	
Erosion control - the plants must be able to hold soils in steep slope situations.	
High heat tolerant - some will be south slope, others will be close to open burning operations.	
Growth season - vegetation should not be a winter or late summer fire hazard.	

In order to satisfy fire and safety concerns, the WES plan included recommendations for additional graveled areas around the operating units and upgrading of existing fire lanes. Gravel and rip-rap were used to extend the devegetated zone immediately around the burn operations and to control erosion on adjacent slopes. A fire road on the south side of the ABG was upgraded through grading, application of stone, and installation of drain culverts.

NSWC Crane contracted with P.B. Avery Construction for the actual field implementation of the project. Field activities began in August 1994 and were completed April 1995. Figures 7 through 11 show various slopes at the ABG after the project was completed. Note the extent of grasses growing on the once barren slopes, and the additional graveled areas around the units.

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

5. CONCLUSION

NSWC Crane worked with the U.S. EPA, USFWS, and the Army Corps of Engineers to design and implement a program to reduce the amount of potentially contaminated and uncontaminated TSS entering Little Sulphur Creek. Reducing TSS loads should thereby improve habitat quality for endangered species downstream of the ABG. Vegetation has been reestablished on the slopes of the valley walls at the ABG. However, the grasses have been present for only one growing season. Determination of success of this project is ultimately a measure of the following factors:

a. Vegetation remains established. The steep slopes and poor soils could combine with an unfavorable growing season to lead to natural erosion and loss of rooted plants;

b. Low growth plants remain dominant. An unfavorable condition would develop if the selected long-term plants do not dominate and are succeeded by native weeds and grasses. Such plants may have tall growth and/or dry-out in winter thus presenting a fire hazard;

c. Vegetation reduces contaminant mobility. Additional studies are necessary to demonstrate that the revegetation has reduced the contaminant transport in Little Sulphur Creek. Unfortunately, a base line has not been adequately established. The Phase II RFI surface water study (March 1994) is the primary pre-erosion control study on ABG surface water quality. Storm water run-off sampling is ongoing as required by the facility's NPDES permit, and should be completed by July 1996. These samples along with a Phase III RFI should give some measure as to the success of the project; and

d. Vegetation does not create a fire hazard. If excessive grass fires occur, explosive and personnel safety issues will require reevaluation of the revegetation strategy.

Erosion control measures are a simple, effective, and economical means of site stabilization. In addition to the benefits of reducing contaminant migration, other benefits may include improved aesthetic qualities and possible biotransformation of the contaminants in the root zone and through plant uptake.