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Award Number: DAMD17-99-2-9006

TITLE: Prescribed Burn at Pine Bluff Arsenal

PRINCIPAL INVESTIGATORS: Lance Peacock
Douglas Zollner
Scott Simon

CONTRACTING ORGANIZATION: The Nature Conservancy

Little Rock, Arkansas 72205

REPORT DATE: March 2000

TYPE OF REPORT: Final

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

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FOREWORD

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N/A In conducting research using animals, the investigator(s) adhered to the "Guide for the Care and Use of Laboratory Animals," prepared by the Committee on Care and use of Laboratory Animals of the Institute of Laboratory Resources, national Research Council (NIH Publication No. 86-23, Revised 1985).

N/A For the protection of human subjects, the investigator(s) adhered to policies of applicable Federal Law 45 CFR 46.

N/A In conducting research utilizing recombinant DNA technology, the investigator(s) adhered to current guidelines promulgated by the National Institutes of Health.

N/A In the conduct of research utilizing recombinant DNA, the investigator(s) adhered to the NIH Guidelines for Research Involving Recombinant DNA Molecules.

N/A In the conduct of research involving hazardous organisms, the investigator(s) adhered to the CDC-NIH Guide for Biosafety in Microbiological and Biomedical Laboratories.

Lance Peacock
Douglas Zollner
Scott Simon

PI - Signature

Date

RATIONALE FOR FIRE MANAGEMENT

Site: Pine Bluff Arsenal.

Location: Sections 18, 22, and 24, R10W T5S; Sections 13 and 14, R10W T5S; Jefferson County, Arkansas.

Ownership: Department of Defense.

Update: August 1998; Douglas Zollner and Scott Simon.

Site Description:

The 15,000 acre Pine Bluff Arsenal landscape is a mix of second growth forest (11,000 acres), old fields and right-of-ways maintained by mowing and fire, ponds, and urbanized areas. The arsenal is located on the West Gulf Coastal Plain along the Arkansas River. The geologic formations are deep alluvial deposits composed of sand and silt with embedded clay and gravel layers and wind deposited loess. The landscape is generally flat with little relief except where small creeks and streams have formed deeply incised ravines as they penetrate steep (to 100% slopes) Arkansas River bluffs. The elevation ranges from 195 feet above msl at the Arkansas River to 240 feet above msl at the top of the Arkansas River bluff and to 340 feet above msl at the northwest corner of the base.

The arsenal contains most of the forest communities found on the West Gulf Coastal Plain except the most xeric. Hydric bald cypress strands, mesic riparian forests, mesic to dry pine-oak forests, seeps, grasslands, and dry oak woodlands are extant. Quality ranges from low to high with the bulk of the forested area of medium quality. Many sensitive plants and animals, as well as a wide diversity of common species find suitable habitat on the arsenal. PBA has an active wildlife and timber management program. Five sites on the arsenal have been delineated due to their ecological quality and representativeness and three of these areas have a designated old growth forest components. Additional sites on PBA may be identified for biodiversity management due to continuing ecological assessment and biological inventory.

Refuge Woods: The Refuge woods comprise a spectrum of forest communities ranging from poorly drained hardwood bottoms to moderately well-drained pine-oak uplands. The bottoms are relatively open oak, hickory, sweetgum forests with scattered loblolly pine, and bald cypress in depressions. The trees are tall (70'-80') with 2' dbh common. The understory is mostly deep duff and leaf litter. Small patches of cane, seeps with dense ferns, and vine tangles are extant. The soil is usually moist with standing water in the late winter and spring. In the better drained upland areas the pine component increases with more grasses and areas of thick vine tangles. The litter and duff layers contain pine needles, and are more volatile. Large standing snags are extant. Two small draws that are brush hogged annually contain rattlesnake master (*Eryngium yuccafolium*) and its dependent rattlesnake master borer moth (*Papipema erygium*).

Eastwood Bayou: Eastwood Bayou comprises rich riparian forests and slopes along a stream that flows year round and adjacent dry upland oak-pine forests. Although the trees are not as tall or large as refuge woods the herbaceous layer is better developed with more grasses and forbs. The riparian understory contains scattered cane and seeps with ferns. The duff and litter (mostly oak leaves) layer is deep. The uplands are drier with a higher component of pine needles in the litter layer. Vine tangles and woody debris are extant. Several rare plants are known from Eastwood bayou. Much of this site contains munitions storage bunkers.

Triplets Bluff-Phillips Creek: This site contains the driest uplands on the base, as well as a deep ravine with a rich bottomland and slope forests of cherrybark oak and bald cypress. Philips Creek is a perennial stream with a elm-ash-sugarberry canopy over a rich plant community. The riparian area is often dense with cane and vines. The trees are large and the soils moist. The uplands are mesic to dry oak and oak-pine forests and woodlands. The trees in the uplands are relatively short (50' or less) and small (dbh 18"). Scattered grasses form the herbaceous layer with a mostly oak leaf litter. The duff layer is moderately deep. Several rare plants and the highest quality plant communities are located at this site. Much of this site is in a designated duded area.

Yellow Lake: (see TNC 1997) Not a fire maintained site.

Railroad Grassland: The railroad grassland comprises a long strip of grass dominated vegetation along the railroad right-of-way. The grassland is dominated by little bluestem, velvet pain grass, and a wide diversity of the forbs and grasses. Several rare plants are known from the railroad grassland. In places the site has become shrubby with small tress

Elements of Conservation Concern:

The following list is composed of plant communities and plant and animal species of conservation concern known from the Pine Bluff Arsenal. Not all plant communities and plant and animal species are known from the old growth areas. Recent biological inventories uncovered many species of insects that had not been recorded from Arkansas. Several are considered rare but have not been ranked and are not included in the following table.

Scientific name	Common name	Rank
Plant communities		
mixed overstory- <i>Arundinaria gigantea</i> Riparian Forest	forested canebrake	G2 S1
mixed overstory- <i>Acer rubrum</i> var. <i>trilobum</i> -fern Forest	coastal plain seeps	G4 S2S3
<i>Pinus echinata</i> - <i>Quercus (stellata-falcata)</i> Woodland	dry shortleaf pine-oak woodland	G4 S4
<i>Pinus (taeda-ecinata)</i> - <i>Quercus (velutina-falcata-alba)</i> Forest	submesic pine-oak forest	G3 S1
<i>Pinus taeda</i> - <i>Quercus (nigra-alba)</i> Forest	lowland pine-oak forest	G2 S1
<i>Quercus lyrata</i> Forest	overcup oak forest	G4 S3
<i>Quercus phellos</i> Forest	willow oak forest	G3 S2
<i>Quercus (nigra-alba)</i> - <i>Carya cordiformis</i> Forest	mesic oak forest	G4 S4
<i>Quercus stellata</i> - <i>Quercus (velutina-mariandica)</i> Woodland	dry oak woodland	G3 S2
<i>Quercus (pagoda-alba)</i> - <i>Liquidambar styraciflua</i> Forest	lowland oak-sweetgum forest	G3G4 S1
<i>Schizachyrium scoparium</i> - <i>Panicum anceps</i> Grassland	tallgrass prairie	G4 S4
<i>Taxodium distichum</i> Forest	bald cypress forested channel	G4 S3

<i>Ulmus americana</i> - <i>Fraxinus pensylvancia</i> - <i>Celtis laevigata</i> Forest	elm-ash-sugarberry forest	G5 S5
Plants		
<i>Carex atlantica</i> subsp. <i>capillacea</i>	prickly bog sedge	G5T5 S2S3
<i>Chamaelirium luteum</i>	devil's bit	G5 S3
<i>Cypripedium</i> sp.	unknown species of orchid	
<i>Eleocharis flavescens</i>	pale spikesedge	G5 SU
<i>Eleocharis microcarpa</i>	small seeded spikesedge	G5 S2
<i>Eupatorium hyssopifolium</i> var. <i>hyssopifolium</i>	boneset	G5 S3
<i>Lycopodium appressum</i>	southern clubmoss	G5 S3
<i>Sceria pauciflora</i>	few flowered nutrush	G5 S3
Animals		
<i>Alligator mississippiensis</i>	American alligator	G5 S3
<i>Buteo lineatus</i>	red-shouldered hawk	G5 S3
<i>Haliaeetus leucocephalus</i>	bald eagle	G4 S2
<i>Ixobrychus exilis</i>	least bittern	G5 S2
<i>Lophodytes cucullatus</i>	hooded merganser	G5 S2
<i>Macroclermys temmincki</i>	alligator snapping turtle	G3G4 SU
<i>Papaipema eryngii</i>	rattlesnake master borer moth	G1 S1
<i>Regina grahamii</i>	Graham's crayfish snake	G5 S2
<i>Speyeria diana</i>	diana fritillary	G3 S3
<i>Tachycineta bicolor</i>	tree swallow	G5 S4

Role and History of Fire:

Fire in the pine, pine-oak, and oak dominated forests of the southeastern United States has been well documented by Pyne (1982) and others. An examination of Arkansas Forestry Commission records indicates a prevalence of naturally (lightening) ignited fires occurring from mid-July through October in the Interior Highlands and Gulf Coastal Plain with a shorter fire season in March and April. Anthropogenic fire could occur in any season but early records of aboriginal burning reference September through December. Periodic fire is essential to maintaining open forest structure and composition, as well as the herbaceous vegetation in pine, oak-pine, and oak forests and woodlands and associated grassland ecosystems of the Gulf Coastal Plain uplands. Fire also plays a role in maintaining open wetland and oak-dominated bottomland forest communities

Examination of GLO records of the site indicate a forest composition similar to today's but with a more open forest structure. Fire history reconstruction in the Ouachita Mountains show a wide range in frequencies, spatial coverage, and seasonally depending on location, community type, and aspect. Pine, oak, and pine-oak communities on ridges and south slopes with grassy herbaceous layers burned in the range of 1 - 7 year intervals. While north slope and ravine forests burned at less frequent intervals. No fire reconstruction work has been done for Arkansas' Gulf Coastal Plain.

Past Management:

Previous to the establishment of the arsenal in 1941 the area was a mix of farms and forest. The area was cutover for timber before 1920. The flat areas were cultivated and steeper area used as woodlots and grazing for cattle and hogs. Abandoned fields grew up in pine or in some cases were planted in pine during the 1930's. The burning of farm stubble and woodlands was a common practice in Arkansas throughout this time period.

The establishment of the arsenal began a long history of timber and wildlife management under various management philosophies ranging from neglect to active manipulation. Fires were suppressed during much of this time period.

For the last 15-20 years prescribed fire has been used to prevent wildfires along the railroad right-of-way and under pine forests to control the understory and to improve wildfire habitat. Some prescribed burning is carried out every year at PBA. Prescribed forest fires have been relatively cool winter burns and are not usually used in hardwood stands to protect timber value. With the more recent emphasis on biodiversity and ecosystem management attempts are being made to more closely imitate fires that maintain and enhance forest structure and composition.

Goals of Fire Management:

1. The restoration and maintenance of a diverse herbaceous layer in all plant communities represented at PBA.
2. The restoration of a more open, large tree-grass structure in the designated old growth areas across forest types.
3. The maintenance and enhancement of fire-dependent rare species populations.

Constraints:

Possible logistical constraints include restricted access to some burn units, nearby munitions storage, duded areas, smoke management, and base operations.

Damage from Fire:

Several rare plants, reptiles, birds, and insects are known from PBA. The species of concern are grassland remnant-dependent, fire-dependent, or fire-independent and are expected to increase or not be affected as fire is reintroduced.

Burn Units: No permanent burn units are in place. For the 1998-1999 season three units have been developed.

Refuge Woods: pond unit 185 acres.

Eastwood Bayou (CLA): munitions unit 98 acres.

Phillips Creek-Triplets Bluff (bombing mat): dud unit 103 acres.

Burn Timing and Frequency:

Fire could burn in this landscape in any season. Most prescribed burning in Arkansas is carried out from September through April. Burning in any of these months is appropriate. Growing season (April - September) and pre/post drought burns have very beneficial effects in restoring ecosystem composition and structure.

Restoration burns are used to remove the heavy build up of litter and duff and reduce the density of woody stems in the smaller size classes. During the restoration phase short time intervals (annual to every 2 years) are desired, dependent on fuel conditions. During the maintenance phase longer time intervals (4-7 years) are desired.

Monitoring:

Post fire estimates of fire intensity (scorch height and class, char, understory burn severity, and litter consumption) will be taken. Permanent transects with photo points will be established to monitor and measure tree densities and plant composition. Observations of rare species reaction to fire management will be noted. The reaction of the rattlesnake borer moth to the timing, frequency, and intensity of burns will be noted.

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THE NATURE CONSERVANCY CONTROLLED BURN PRESCRIPTION

1. LOCATION

Site: Refuge Woods; Pine Bluff Arsenal.
Location: T5S, R10W, sections 13 and 14; Jefferson County, Arkansas.
Unit: Pond unit - 185 acres.
Ownership: Department of Defense; TNC - burn contract.
Update: August 1998; Douglas Zollner and Scott Simon.

2. SOURCES OF EMERGENCY ASSISTANCE (location and phone)

Jefferson County uses 911 for all emergency responses.
A Mobile phone is staged with the vehicles.

Law: Base Security (870) 540-3505.
Fire: Base Fire Department (870) 540-3507/08.
Medical: Base Health Clinic (870) 540-3409.
Attorney: Lisa Mattimoe (SERO); (919) 967-5493 ext. 115.
Other: Arkansas Forestry Commission; (870) 879-1333.

3. PERMITS AND OFFICIAL NOTIFICATIONS

Burn permit required? No
Other notification required? Yes

Verbal notification:

Charles Becker; (870) 540-2834.
Base Security; (870) 540-3499.
Base Fire Department; contact Fred Culelger (Chief) or Darrell McGee (Asst. Chief)
(870) 540-3507/08.
Jefferson County Sheriff; (870) 541-5351.
White Hall Police Department; (870) 247-1414.
Arkansas Forestry Commission; (870) 879-1333.
Mayor of White Hall; (870) 247-2399.

4. NEIGHBOR NOTIFICATION:

Morning of burn notify factory-warehouse complex directly south of the refuge ponds.

5. UNIT DESCRIPTION

Vegetation types	Fuel models	% of unit & area	Aspect & % slope	exposure
hardwood-pine forest	9	75% 140 ac.	slightly south 1%	sheltered
bottomland	8	25% 45 ac.	flat	sheltered

Fire Unit Narrative Description:

This unit comprises the west end of the Refuge Woods, north of the ponds, and includes all of the designated old growth area. The unit gently slopes to the south. A small ephemeral creek bisects the unit from north to south. The south end of the unit is wet and often has standing water. A shrubby, 20'-wide right-of-way runs through the north end of the unit parallel to the north fireline. The south fireline is a 20'-wide gravel road adjacent to a ponded area with dry grass on the levees. The west fireline is a 20'-wide gravel road through FM9. The north fireline is a 25'-wide paved road with 10'-wide mown rights-of-way on each side adjacent to an old field that has grown up in shrubs and small trees (FM 3). The east fireline is a 16'-wide mown and raked handline through FM9 and FM8. All firelines are accessible to the pumper. Under wet conditions the pumper could get bogged down along the east fireline.

Hardwood-pine/litter: Most of the unit is covered by hardwood-pine/leaf litter (FM9). Where pine needles predominate this area will burn on the hot side of FM9. The ground cover is mostly oak leaves, pine needles, and non-continuous grass 20" tall. Pine needle draped vine tangles and large snags are extant. At the edges shrubs and herbaceous vegetation is thicker and often draped with pine needles.

Hardwood bottoms: The hardwood bottoms have a thick, moist duff layer (FM8). Seep vegetation (ferns, carex, shrubs, and vines) and oak flats are present. Much of the bottoms will burn slowly and incompletely, or not at all, except under drought conditions.

Maps Attached:

Site Location
Topographic
Route to Hospital
Aerial Photo
Smoke Screening

6. PRESCRIBED BURN RATIONALE

Type of burn: Ecological Stewardship

Site Fire Management Goals: The restoration and maintenance of a diverse herbaceous layer in all plant communities represented at PBA. The restoration of a more open, large tree-grass structure in the designated old growth areas across forest types. The maintenance and enhancement of fire-dependent rare species populations.

Specific Burn Unit Objectives:

60%-80% unit coverage.

substrate burn severity class = 1.0 - 2.5.

understory burn severity class = 1.0 - 2.5.

overstory char height class = 1 - 2.

overstory char degree = 1 - 2.

overstory scorch percent class = 1 - 3.

overstory scorch height class = 1 - 2.

7. ACCEPTABLE FIRE BEHAVIOR

Fuel Model (% area)

FM9 (75%) FM8 (25%)

Maximum behavior

headfire flame length (ft)	6	2
backfire flame length (ft)	1	0.3
hf rate of spread (ch/hr)	38	7
bf rate of spread (ch/hr)	1	0

Minimum behavior

headfire flame length (ft)	1	0.7
backfire flame length (ft)	0.6	0.2
hf rate of spread (ch/hr)	3	1
bf rate of spread (ch/hr)	0	0

8. FUEL AND WEATHER PRESCRIPTION

Source of weather: National Weather Service (501) 834-9102 x 441 (Mike Thompson) or Arkansas Forestry Commission; (501) 664-2531 after 8:00 am ask for John Burton.

Weather parameters

air temperature: 35 - 85F°.

relative humidity: 25% - 60%.

wind direction: south through northwest (180° - 305°).

20' windspeed: 8 - 20 mph.

midflame windspeed: 3 - 12 mph.

Atmospheric Mixing Height: Category 3, 4, or 5 (Arkansas Forestry Commission); ventilation rate 4000-16,000+ = mixing height x transport windspeed.

9. SMOKE MANAGEMENT PLAN

Smoke screening procedure completed? Yes

Map of smoke sensitive areas attached? Yes

List smoke sensitive areas:

2 mile screen:

Missouri-Pacific railroad 0.25 miles west.

Industrial Park 0.25 miles south.

Town of White Hall 1.0 miles west.

Highway 365 1.5 miles west.

City of Pine Bluff 2.0 miles south.

Highway 270 2.0 miles south

5 mile screen:

Highway 65 (interstate quality) 3 miles south and west.

Built-up area of Pine Bluff 3.5 miles southeast.

Residential areas 4.0 miles.

Highway 104 5 miles west.

Describe desirable smoke behavior and smoke management actions:

Arkansas Forestry Commission categories 3 - 5 allow for good lift and dispersal of smoke during daylight hours. This unit has a deep litter and duff layer that will produce a lot of smoke under dry conditions. Under good lift and dispersal conditions winds from the south through the northwest are acceptable. Under category 3 - 5 days 180° - 305° winds will disperse smoke over the base and Arkansas River. A factory complex directly south of the unit is the only off-base area within one mile that could be impacted by smoke. Built-up areas to the south and west, including major highways, could be impacted during days with poor dispersal conditions

10. CREW ORGANIZATION

Qualified fire leader: Yes

Crew number: 6

11. EQUIPMENT

Required items:

pumper onsite: Yes

First aid kit: Yes

Two-way radios: 4

Weather kit: Yes

Protective clothing: Yes

Other equipment	Number	Source
waterpacks	6	TNC
5 gallon waterjugs	10	TNC
fire rakes	8	TNC
leaf blower	1	TNC
drip torches	4	TNC
fuel cans	3	TNC
pulaski	2	TNC
chainsaw	2	TNC
ATV w/water	1	TNC

12. BURN DURATION

Baseline preparation: 60 minutes

Interior ignition: 90 minutes

Spreading fire: 90 minutes

Total duration: 4 hours

13. MANAGING THE FIRE (describe the following)

Firebreak preparation:

The north fireline is a 25'-wide paved road with 10'-wide mown rights-of-way. Ignition will be directly off the road to create a blackline in the mown right-of-way. The west fireline is a 20'-wide gravel road. The south fireline is a 20'-wide gravel road. The east fireline is a 16'-wide mown and raked handline along an old forest road. All culverts need to be checked for continuous fuels and woody debris deposited by beaver. All lines are ATV and pumper accessible. Snags near the firelines will be removed or raked around.

Firing techniques:

Onsite weather will be taken and a test fire set to check fire and smoke behavior. If conditions are satisfactory, ignition will continue along the downwind fireline. The backfire will be allowed to burn in to form a secure black line. In FM9 and FM 8 extensive stripping will likely be needed for form a secure blackline. Ignition will then continue around the flanks in opposite directions. When the flanks are secure a headfire will be ignited to ring the unit. The south line often has standing water in several small sloughs, the ignitor will have to travel into the unit and strip in places to secure the blackline. Interior ignition will be used to speed burnout.

Crew communication: via two-way radios

Holding:

The pumper with a radio will be staged along the downwind road. Crew will patrol backfire lines and flanks with backpack pumps and rakes. An ATV with water will be available for patrol.

Fire sensitive areas or hazards:

Pine needle draped vines and shrubs along the firelines could cause jackpotting. Vines often grow into the crowns of large pine trees. Crew should be ready for sharp flare-ups. The drainages have vine tangles in places and seepage areas that are mucky. Large snags, downed trees, and cottonmouths are extant in the unit.

Contingencies:

Minor escapes and spot fires will be treated by direct attack by the appropriate crew. Spot fires and escapes in FM8 and 9 are controllable by raking and blowing in narrow firelines. Rates of spread are slow. A major escape to the north will require assistance from the base fire department and backfiring from the roads; a security fence will inhibit control measures. A major escape to the west can be controlled by backfiring off the road along the railroad tracks. An escape to the south can be controlled by direct attack and backfiring from roads surrounding the ponds. An escape into the forested area to the west can be controlled by backfiring from surrounding roads and skid trails.

Mop-up:

Mop-up smoldering material within 50' of the firelines. Extinguish any burning snags that threaten the fire lines. The pumper can be used to reduce burning snags or downed woody debris if necessary. Plenty of water is available nearby.

Public relations:

Public relations are being handled by Mr. Charles Becker, Base Environmental Officer, per action plan.

Follow-up assignments:

A fire summary report will be completed by the fire leader. ARFO stewardship staff will remain with the unit through the following morning. ARFO stewardship staff will carry out monitoring tasks.


14. APPROVALS

Fire Planners:

Douglas Zollner/Dir. Cons. Sci.

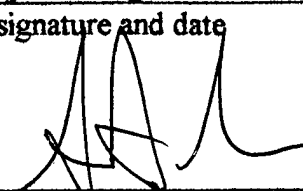
 27 August 98
signature and date

Scott Simon/Land Steward

 8 Oct 98
signature and date

Fire Leader:

Scott Simon/Land Steward

 8 Oct 98
signature and date

Fire Manager:

Doug Ladd/Dir. Sci. Stew.-MOFO

 30 Oct 98
signature and date

PINE BLUFF ARSENAL-PONDS UNIT

DIRECT

1-TWO FUEL MODEL CONCEPT - 75% 9 - HARDWOOD LITTER
25% 8 - CLOSED TIMBER LITTER

2-1-HR FUEL MOISTURE, % - 4.0 6.0 8.0 10.0 12.0

3-10-HR FUEL MOISTURE, % - 5.0

4-100-HR FUEL MOISTURE, % 8.0

7-MIDFLAME WINDSPEED, MI/H 3.0 5.0 7.0 9.0 11.0

8-TERRAIN SLOPE, % — 1.0

9-DIRECTION OF WIND VECTOR 0.0

DEGREES CLOCKWISE

FROM UPHILL

10-DIRECTION OF SPREAD — 0.0 (DIRECTION OF MAX SPREAD)

CALCULATIONS

DEGREES CLOCKWISE

FROM UPHILL

HEADFIRE

FUEL MODEL 9 (75%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 5. 11. 18. 27. 38.

I

6.0 I 4. 9. 15. 23. 32.

I

8.0 I 4. 8. 13. 20. 27.

I

10.0 I 3. 7. 12. 18. 25.

I

12.0 I 3. 6. 11. 16. 23.

FUEL MODEL 9 (75%)

FIRELINE INTENSITY, BTU/FT/S							(V4.1)
1-HR I	MIDFLAME WIND, MI/H						
MOIS I							
I	3.0	5.0	7.0	9.0	11.0		
(%) I							
4.0 I	38.	81.	138.	209.	291.		
6.0 I	28.	59.	102.	153.	214.		
8.0 I	23.	48.	82.	124.	173.		
10.0 I	20.	41.	71.	107.	149.		
12.0 I	18.	37.	64.	97.	135.		

FUEL MODEL 8 (25%)

FIRELINE INTENSITY, BTU/FT/S							(V4.1)
1-HR I	MIDFLAME WIND, MI/H						
MOIS I							
I	3.0	5.0	7.0	9.0	11.0		
(%) I							
4.0 I	5.	9.	15.	21.	26.*		
6.0 I	4.	7.	11.	16.	17.*		
8.0 I	3.	6.	9.	12.*	12.*		
10.0 I	3.	5.	7.	10.*	10.*		
12.0 I	2.	4.	7.	8.*	8.*		

* MEANS YOU HIT THE WIND LIMIT.

BACKFIRE

DIRECT

1-TWO FUEL MODEL CONCEPT - 75% 9 - HARDWOOD LITTER

25% 8 - CLOSED TIMBER LITTER

2-1-HR FUEL MOISTURE, % - 4.0 6.0 8.0 10.0 12.0

3-10-HR FUEL MOISTURE, % - 5.0

4-100-HR FUEL MOISTURE, % 8.0

7-MIDFLAME WINDSPEED, MI/H 3.0 5.0 7.0 9.0 11.0

8-TERRAIN SLOPE, % — 1.0

9-DIRECTION OF WIND VECTOR 0.0

DEGREES CLOCKWISE

FROM UPHILL

10-DIRECTION OF SPREAD — 180.0

CALCULATIONS

DEGREES CLOCKWISE

FROM UPHILL

FUEL MODEL 9 (75%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I —————

I

4.0 I 0. 1. 1. 1. 1.

I

6.0 I 0. 0. 1. 1. 1.

I

8.0 I 0. 0. 0. 0. 1.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 9 (75%)

FIRELINE INTENSITY, BTU/FT/S (V4.1)

1-HR I MIDFLAME WIND, MI/H
MOIS I

I 3.0 5.0 7.0 9.0 11.0
(%) I-----

I
4.0 I 4. 4. 5. 5. 5.

I
6.0 I 3. 3. 4. 4. 4.

I
8.0 I 2. 3. 3. 3. 3.

I
10.0 I 2. 2. 3. 3. 3.

I
12.0 I 2. 2. 2. 2. 2.

FUEL MODEL 8 (25%)

FIRELINE INTENSITY, BTU/FT/S (V4.1)

1-HR I MIDFLAME WIND, MI/H
MOIS I

I 3.0 5.0 7.0 9.0 11.0
(%) I-----

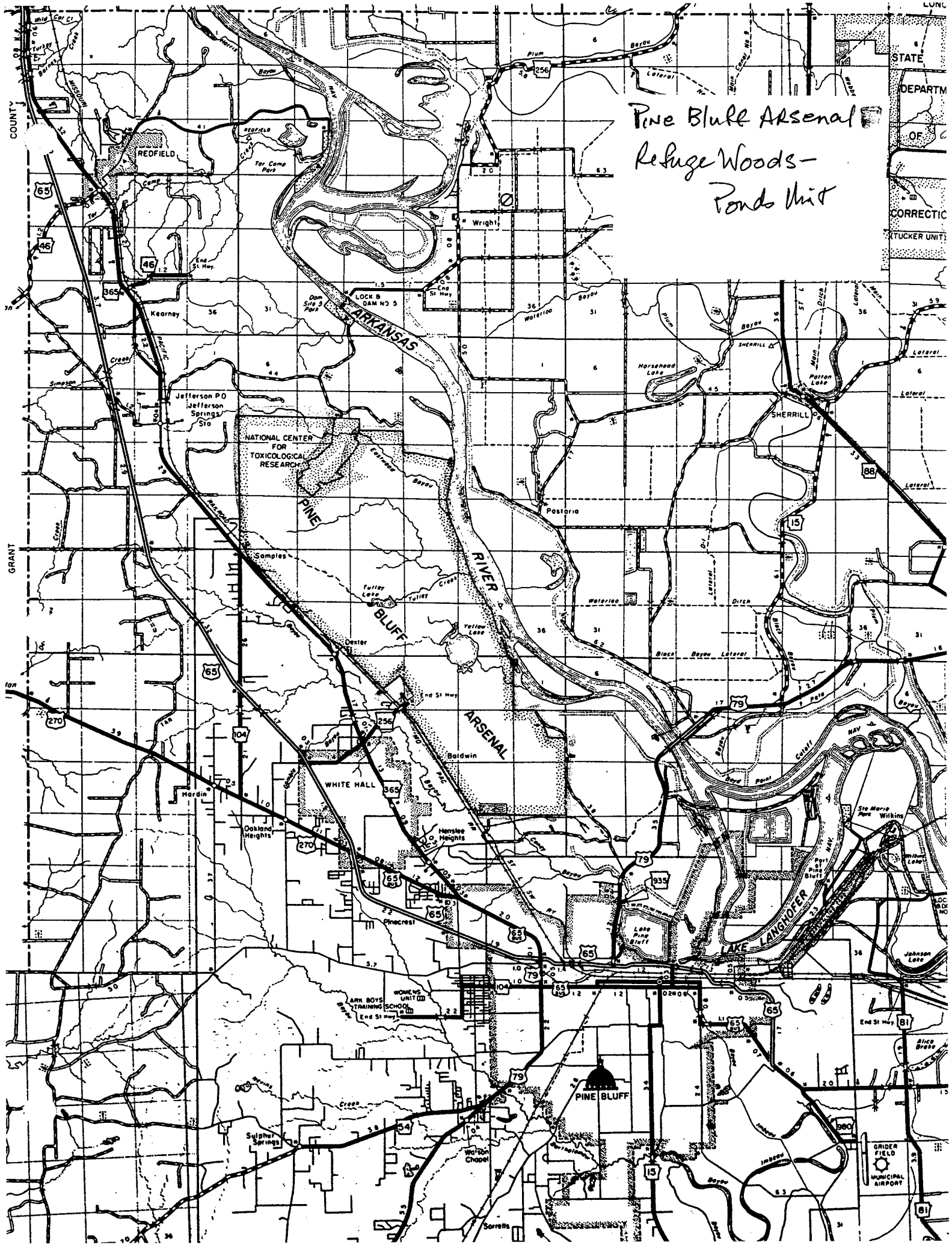
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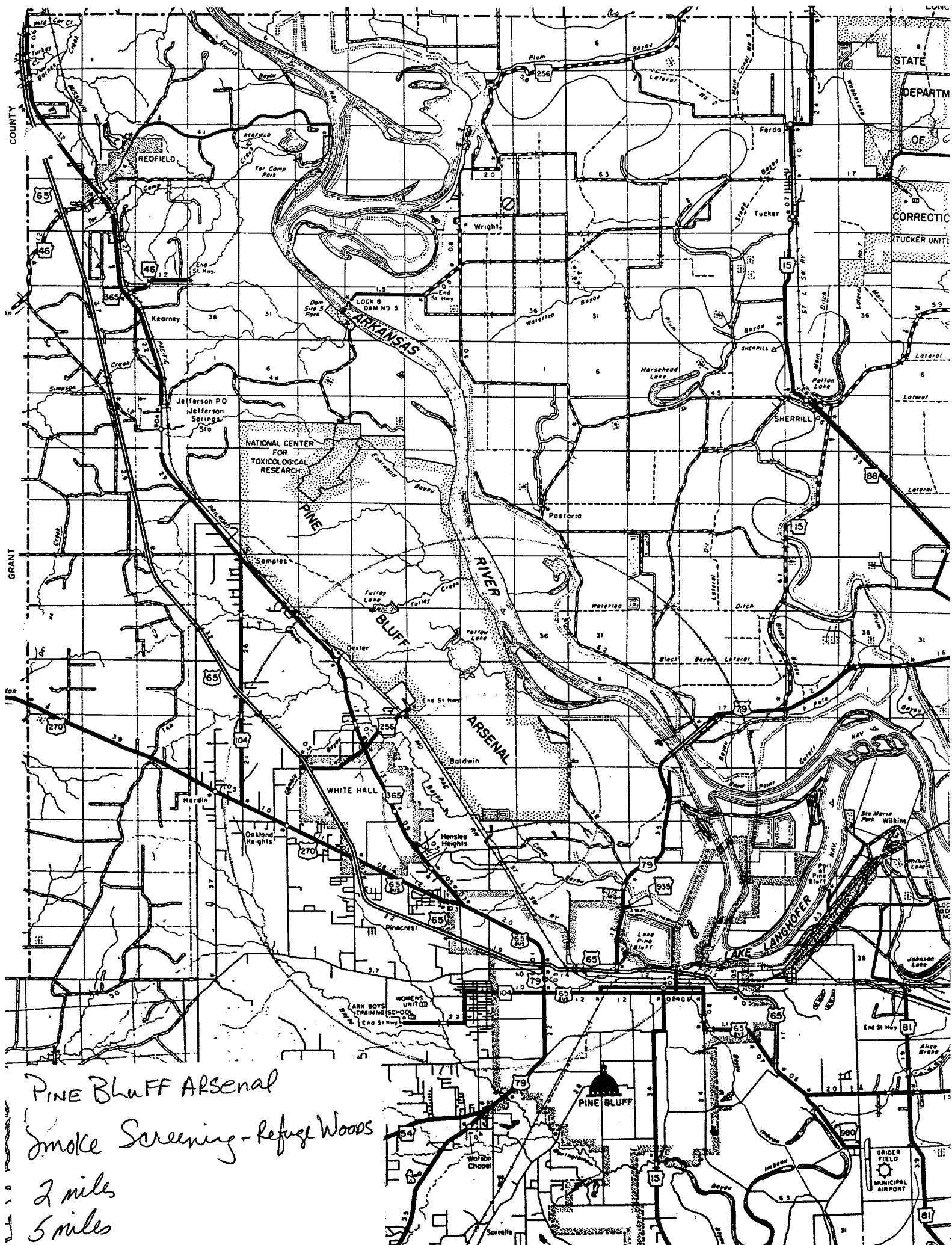
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Pine Bluff Arsenal
Refuge Woods -
Ponds Unit

STATE
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OF
CORRECTIO
TUCKER UNIT

COUNTY
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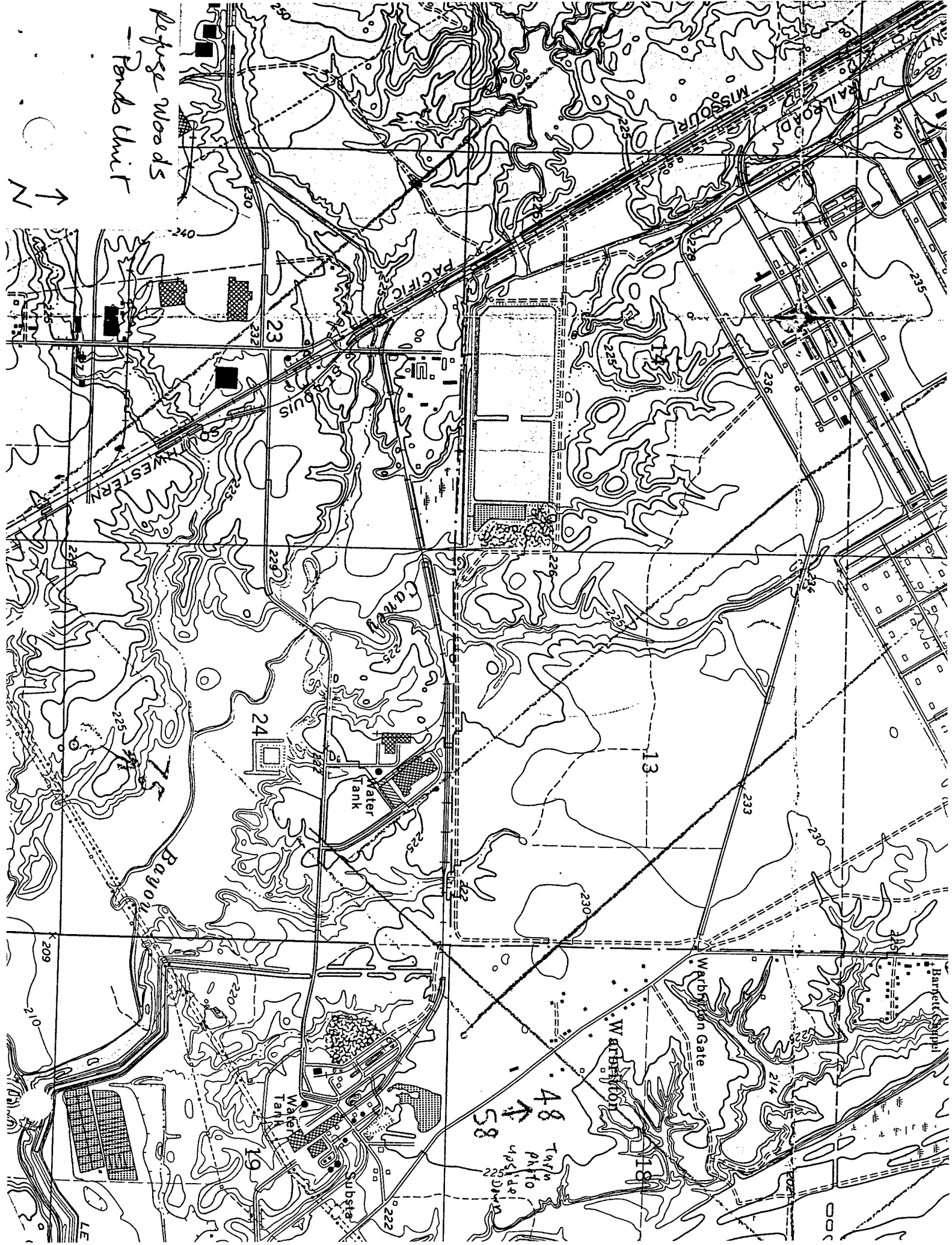
PINE BLUFF Arsenal

Smoke Screening - Refuge Woods

2 miles

5 miles

Refuge Woods
- Pond Unit



**Pine Bluff Arsenal
Refuge woods - Ponds unit**

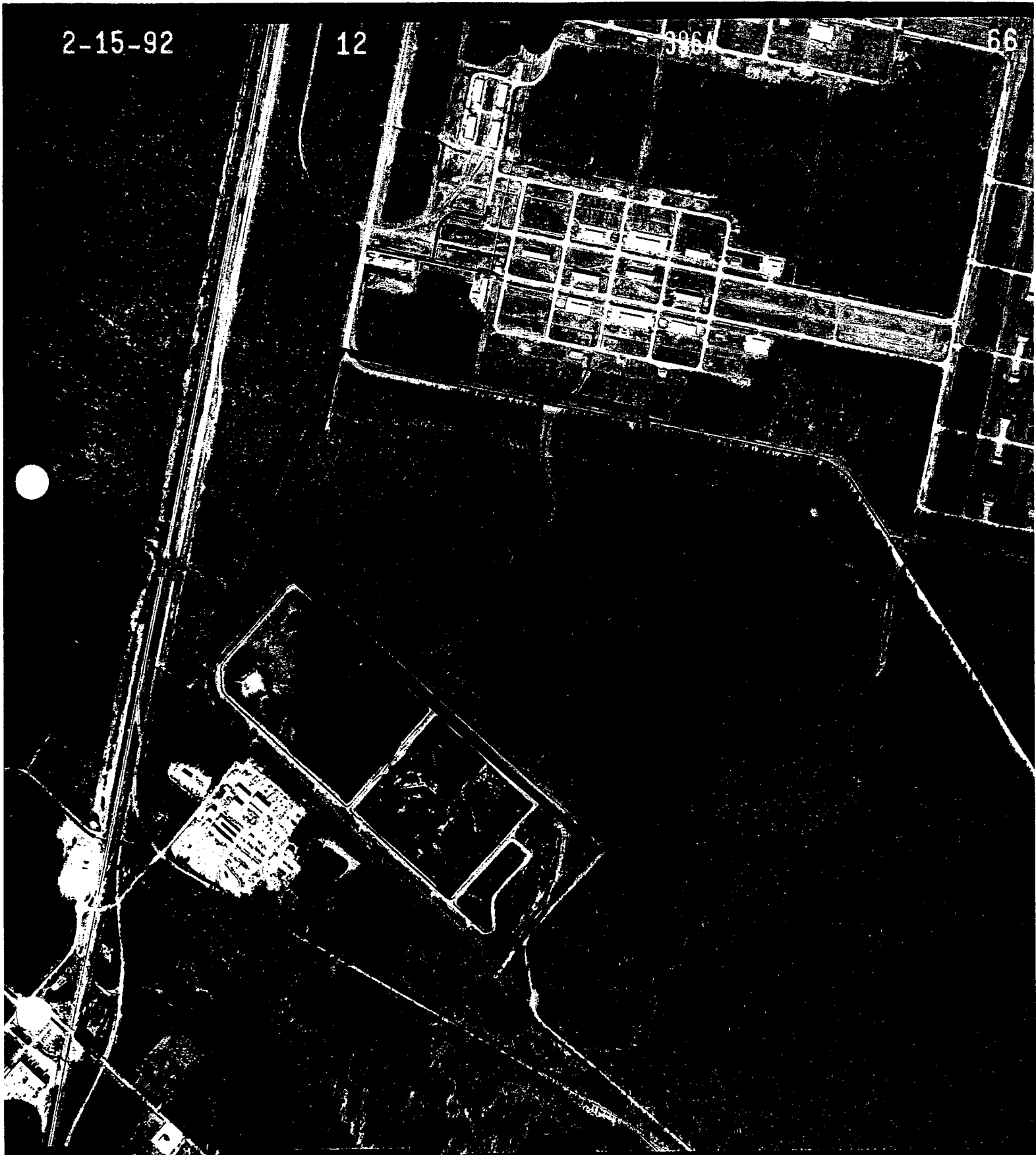


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THE NATURE CONSERVANCY
FIRE SUMMARY REPORT AND POST BURN EVALUATION

Site: Pine Bluff Arsenal

Unit: Refuge Woods (including old growth area) – Pond Unit; 185 acres.

Date Burned: 17 March 1999.

Date Evaluated: 22 March 1999.

Report Date: 23 March 1999.

Reported By: Scott Simon and Douglas Zollner

FIRE WEATHER FORECAST

Date: 17 March 1999

Time: 0700

Humidity (low): 43%

Temperature (high): 70°F

Wind speed: 10 - 15 mph

Wind direction: 220° (southwest)

Mixing height 3000 feet

Sky: partly cloudy

Comments: Becoming mostly sunny. Winds shifting north during the evening. Heavy rain fell two days previous to the burn followed by two days of good drying weather.

ON-SITE WEATHER

Time:	1030	1115	1200	1230
Location:	north corner	north corner	north corner	north corner
By:	Douglas Zollner	DZ	DZ	DZ
Dry bulb:	67°	69°	68°	70°
Wet bulb:	59°	60°	59°	60°
Humidity:	62%	59%	58%	55%
Dew point:	54°	54°	53°	53°
Windspeed:	7 (9) mph	5-8 (10) mph	7-8 (9) mph	6-8 (10) mph
Wind direction:	250° (westerly)	240° (southwest)	245° (southwest)	245°
Sky:	prtly cloudy	prtly cloudy	prtly. Cloudy	prtly. cloudy
Comments:	The duff layer was moist.			

CREW

Fire leader: Scott Simon (rake and water) with Douglas Sprouse (torch and water), Jeff Barger (rake and water), and Danielle Brown (ATV).

Crew boss: Douglas Zollner (rake and water) with Matthew Scott (torch and water) and Kathryn Wilson (ATV).

IGNITION BEGUN: 1250; North corner.
PERIMETER RUNG: 1355; Southeast and southwest corners.
INTERIOR IGNITION COMPLETE: 1615.
INTERIOR BURNOUT: ~1900.

FIRE NARRATIVE

The firelines were prepared two weeks before and the morning of the burn. The northwest fireline was a 25 foot wide road bordering grass and pine saplings (FM 2) separated by a fence. The northeast fireline was a 16 foot wide cut, raked, and blown logging road through pine woodland fuels (FM 9). The east line was a 16 foot wide cut, mowed, raked, and blown logging road adjacent to grass and pine timber (FM 2). The south line was a 16 foot wide road adjacent to ponds with fine fuel (FM2) along the edge. The west line was a 16 foot wide blown road through pine-oak woodland (FM 9). Vine ladders and pine reproduction were present on all lines. Scattered brush and brushpiles were located along the north lines. Eight hours of crew time were spent preparing the firelines. All lines were accessible by the ATV and pumper.

Zollner and Simon obtained water from the water tender near the Whitehall entrance gate. Simon completed official notifications. Charlie Becker (PBA environmental coordinator) completed base notifications. Zollner and Wilson took weather. Barger and Brown raked around snags along the line. Sprouse scouted his interior ignition route. The 1-ton pumper (with fire rake, flapper, blower, torch, pulaski, and extra waterpacks) was staged at the north corner. The blue ATV (with a 15 gallon pumper, fire rake, flapper, pulaski, blower, torch, and waterpack) was used by Brown for patrol on the northeast and east lines. The gray ATV (with a 15 gallon pumper, fire rake, flapper, pulaski, blower, torch, and waterpack) was used by Wilson for patrol on the northwest and west lines. Four reserve drip torch fuel containers were staged (southwest corner, west corner, northeast corner, and southeast corner). Ten reserve water jugs were staged (3 on the east line, 4 on the northeast line, 2 on the northwest line, and 1 on the west line). Two flappers were staged at the northeast corner. Two fire rakes were staged at the west corner. A crew briefing with Charlie Becker (PBA environmental contact) was conducted at 1230. The base Assistant Fire Chief and one firefighter arrived at 1240 and were briefed by Simon.

A test fire was lit at 1245. After 2 minutes of test fire smoke was lofting well to the east. Firing proceeded in opposite directions by the ignitors. The off-crew stripped out the north corner. Ignition moved at a moderate pace along the northeast line by the on-crew ignitor. The backfire moved slowly and some stripping was required in the beginning through discontinuous fuels. After several hundred feet, stripping was not required and the ignitor moved rapidly to the north east corner across from the pine-grass (FM2) fuels. Simon had Barger move to the east line and had Brown patrol the southern portion of the northeast line more regularly. Sprouse continued ignition of the east line while Simon and Barger patrolled looking for spots in the adjacent fine fuels. Sprouse ignited and patrolled the remainder of the east line until the corner, when he re-tanked his torch. Simon bumped to the southeast corner while Sprouse rounded the corner and rapidly ignited the south line. After completing ignition several hundred feet to the swamp along the south line, Sprouse dropped his pack and entered the unit to begin interior ignition. The off-crew moved west from the north corner at a moderate pace stripping out the grassy road edge

and igniting the edge of the woods. Wilson patrolled the road on the ATV looking for spots in the productions area. The ignitor re-tanked and stripped out the northwest corner and moved down the west line to the swamp at a rapid pace. Zollner then began interior ignition of the west portion of the unit. The off-crew then patrolled while the on-crew completed ignition. The unit was considered rung in one hour, five minutes (once both Zollner and Sprouse completed their line ignition and entered the unit).

Once the unit was rung, Barger patrolled the east line, Simon patrolled the northeast line, Brown patrolled both lines on the ATV, Scott patrolled the west line and Wilson patrolled the northwest line on the ATV.

Interior ignition on the along the west line pulled the fire and smoke into the unit at a good pace through pine needle litter and duff. Zollner and Sprouse each re-tanked their torches 5 times and completed igniting the unit in 2 hours 20 minutes.

Mop-up assignments were given by Simon at 1520 (50 foot cold mop of all lines). Barger and Brown used the ATV, mopping north from the southeast corner. Simon mopped south from the north corner. Scott and Wilson mopped north from the southwest corner using the ATV. At 1540 a PBA police officer asked Simon to place "Smoke Ahead" signs on the road. Simon and Wilson placed the signs east and west of the unit.

At 1630 the crew assembled at the north corner and held a debriefing. Simon and Zollner left the unit with Sprouse in charge. Simon phoned the PBA fire department and Charlie Becker and briefed them on the status of the unit. The crew continued mopping until 1830. Sprouse conducted an additional patrol at 2030. Dozens of 1000 hour fuels (mostly stump holes) were still burning in the interior of the unit. The crew camped on site. At 0530 the following day Sprouse conducted a final patrol (approximately ten 1000 hour fuels were burning in the interior of the unit), the crew broke camp and left the site.

No spots occurred. Backfire flame lengths were 0.2-3 feet through pine needles and grass. Flanking fire flame lengths were 2-4 feet through dry pine needles torching to 6 feet in honeysuckle and 15 feet in a brushpile at the northwest corner. Headfire flame lengths were all interior due to unit configuration and ranged from 4-7 feet, flaring to 20 feet through pine reproduction and vines. The fire moved well through the pine-oak woodland litter, backfiring into the drainages throughout the evening. There was no smoke accumulation along the road.

IMMEDIATE POST BURN EFFECTS

Overall unit	pine-oak forest; oak bottomland (riparian)
Unit coverage	79%
Burn severity organic substrate	1.9 (lightly burned)
Burn severity understory	1.6 (lightly burned)
Char height	1.1 (10' - 20')
Char degree	1.3 (medium)
Scorch percent	0.3 (less than 25% of live crowns)
Scorch height	0.2 (less than 25')

By natural community	pine-oak forest	oak bottomland (riparian)
Fuel models	9	8
Coverage	98%	29%
Organic substrate	2.0 (light)	1.1 (light)
Understory	1.6 (light)	1.0 (light)
Char height	1.2 (10' – 20')	0.3 (less than 10')
Char degree	1.5 (medium)	0.3 (light)
Scorch percent	0.3 (less than 25%)	0.0
Scorch height	0.2 (less than 25')	0.0

ECOLOGICAL OBJECTIVES

1. 60% - 80% unit coverage. The unit was 79% burned. Unburned areas included the beaver impounded bottoms, cypress swamp, lower riparian zones, and oak flats. The burn coverage in the upland pine and pine-oak forest was virtually complete with small skips in the disturbed right-of-way, edges with debris piles, and moist depressions some with standing water. Surprisingly, 29% of the flat, oak-dominated riparian and bottomland portions of the unit burned with both creeping backfires and small (flame lengths ~ 1') headfires.
2. Organic substrate burn severity class = 1.0 – 2.5. Overall substrate burn severity = 1.9 (lightly burned) and ranged from 1.1 to 2.0. Pine needle litter was much reduced throughout the unit. The duff layer was minimally reduced, in rare instances to bare soil. The top layer of oak leaf litter was removed without affecting the duff. Large woody debris and old stumps burned to ash over a five day period. The fire burned much hotter through the pine needle litter.
3. Understory burn severity class = 1.0 – 2.5. Overall understory burn severity = 1.6 (lightly burned) and ranged from 1.1 to 2.0. Small stems and vines were partially consumed with foliage scorched to the 6' – 10' level throughout the unit. Woody stems smaller than 1" diameter at the base were top-killed in areas dominated by pine needle litter. In oak dominated areas smaller understory plant were top-killed. The shorter pine saplings in the right-of-way were 80% - 90% scorched in many places, these trees will show mortality. Over the next year a thermal thinning will occur in the dense reproduction area. The riparian grassland with the rare rattlesnake borer moth were 75% burned. The fire along the drainage was cool and discontinuous through moist, green grass but hotter in drier areas.
4. Overstory char height class = 1.0 – 2.0. Overall overstory char = 1.1 (10' – 20') and ranged from 0.3 to 1.2 (less than 10' to 20'). Overstory pine trees in the uplands were commonly charred to the 7' level and sporadically to 20'. Overstory hardwoods were commonly charred to the 3' level or less. Char was minimal in the riparian and bottomland portions of the unit. This height of char will not effect overstory trees except where suppressed. Small fire-sensitive species may experience delayed mortality.

5. Overstory char degree = 1.0 – 2.0. Overall overstory char degree = 1.3 (medium) and ranged from 0.3 to 1.5 (light to medium). Minor reductions in bark thickness were noted on overstory pine and scattered hardwoods. This level of char will not affect overstory pine and the oak trees generally experienced significantly less char. Smaller fire-sensitive species will show limited delayed mortality. Scattered trees near brush-piles were also impacted by char and may show limited mortality.
6. Overstory scorch percent class = 1.0 – 3.0. Overall overstory scorch percent = 0.3 (less than 25% of live crowns) and ranged from 0.0 to 0.3. The pine-oak forest is quite tall and the scorch line seldom exceeded 20', most of the lower branches are well above this level. Few pine were scorched enough to cause mortality although in sporadic instances the lower limbs may die. Overstory hardwood trees were still dormant, experienced little scorch, and will not be affected by this level of scorch.
7. Overstory scorch height class = 1.0 – 2.0. Overall overstory height class = 0.2 (less than 25') and ranged from 0.0 to 0.2 (less than 25'). The scorch line in the upland forest ranged from 10' – 20'. Few overstory trees will be affected by this level of scorch. Shorter suppressed and fire-sensitive species may show delayed mortality.

Most ecological goals were met by this burn. The fire burned into the bottoms better than expected. The moist duff layer prevented the exposure of bare soil except in rare instances. Litter reduction and the clearing of underbrush and small woody vines was excellent. The overstory was little impacted by the burn and little increase in light penetration is predicted. The burn was a light to moderate first burn for the old growth restoration unit. Further evaluation of vegetative response may indicate the need for greater fire intensity for the next burn to accomplish ecological objectives.

NOTES

1. The heavy smoke production set off fire alarms inside the production unit. Pre-burn notification by Becker and Simon prevented the alarm from spreading.

**THE NATURE CONSERVANCY
FIRE SUMMARY REPORT AND POST BURN EVALUATION**

Site: Triplets Bluff-Phillips Creek; Pine Bluff Arsenal.

Unit: Dud Unit; 103 acres.

Date Burned: 27 March 1999.

Date Evaluated: 28 March 1999.

Report Date: 5 April 1999.

Reported By: Doug Sprouse and Douglas Zollner

Fire Weather Forecast

Date: 27 March 1999
Time: 0700
Humidity (low): 35%
Temperature (high): 68°
Windspeed: 5 mph
Wind direction: southeast
Sky: mostly sunny

On-site Weather

Time:	1015	1100	1145
Location:	north Line	north line	north line
By:	Douglas Zollner	DZ	DZ
Dry Bulb:	54°	55°	57°
Wet Bulb:	45°	46°	47°
Humidity:	48%	49%	45%
Dew point	35°	36°	36°
Wind speed:	calm	0-4 mph	0-4 mph
Wind direction:	90°-135° (e-se)	90°-135°(e-se)	90°-135° (e-se)
Sky:	sunny	sunny	sunny
Comments:	Rain fell two days before the burn followed by good drying weather.		

Crew

Fire leader: Doug Sprouse (rake and water) with Douglas Zollner (torch and water), and Dani Brown (ATV).

Crew boss: Jeff Barger (rake and water) with Kathy Wilson (torch and water), and Matt Scott (ATV).

Ignition begun:	1208
Perimeter rung:	1320
Interior ignition complete:	1400
Interior burnout	1430

Fire Narrative

The firelines were cut, mowed, raked, and blown the week before the burn and re-blown the morning of the burn. Eight hours of crew time were spent preparing the unit. The northwest line was a 20-foot wide gravel road through FM9. The northeast line was a 10-15 foot wide mowed and blown line through FM2 (pine-grass). The east line was a three to four foot wide blown walking line through FM9 adjacent to the bombing mat. The south line was an eight foot wide road through broomsedge (FM3) with a small section along Phillips creek (FM8). Vine tangles and pine reproduction was located sporadically along all lines. There were duds from the bombing mat and various pieces of shrapnel throughout the unit. The south and northwest lines were pumper accessible. The northeast line was ATV accessible. The east line was accessible by the base fire department from the bombing mat.

Zollner took on-site weather. Sprouse completed the official notifications. Wilson obtained weather forecasts from the National Weather Service. Wilson and Sprouse got water for the 1-ton pumper, ATV pumps, waterpacks, and staging jugs from the Base Water Dispensary. The 1-ton pumper with blower, flapper, rake, pulaski, waterpack, and drip-torch was staged at the creek along the northwest line (ignition point). Both ATV's with water, pulaski, flapper, rake, drip-torch or drip-torch fuel, pulaski, and one with a blower, were staged at the ignition point during the test fire and the initial ignition. After the initial ignition the ATV's were used by appropriate drag personnel for patrol. On the northwest line, five reserve water jugs and two drip-torch fuel canisters were staged. On the south line, three reserve water jugs and flappers for patrol were staged. On the northeast line, two reserve water jugs and one drip-torch fuel canister were staged. Two smoke ahead signs were placed appropriately along the northwest line. The pre-burn crew briefing was held at the ignition point (bridge on northwest line) at 1145.

A test fire was lit at the bridge on the northwest line at 1208. After five minutes of test fire, wind direction was consistent and smoke was lofting well. Firing proceeded in opposite directions along the northwest line. The on-crew proceeded northeast occasionally needing one strip on top of the road-cut alongside the road. The off-crew stripped both sides of the creek and proceeded southwest along the northwest line. The on-crew proceeded to the north corner and used several parallel strips to secure a good blackline around the corner. When the north corner was secure, Zollner proceeded with ignition southeast along the northeast line. After one 50 foot strip, Zollner held while Sprouse dropped back to the northwest line to check the blackline. The north corner burned completely out within five minutes and Zollner proceeded with ignition. Sprouse and Brown patrolled the northwest line. The off-crew proceeded at a moderate rate to the creek at southeast corner. The off-crew ran two strips through the grassy field and another along the forest-old field interface. The off-crew reached the east side of the creek at 1320, the on-crew igniter reached the west side of the creek at 1324. The unit was considered rung at 1325 in one hour seventeen minutes.

Both crews began interior ignition immediately. The on-crew started with interior ignition of the west side of the unit at 1325 which took 15 minutes and ½ a drip torch. The west side burned through without the aid of interior ignition. The off-crew started with interior ignition of the east side of the creek at 1320 and Zollner assisted after completing the west side. The torches were re-tanked twice on the east side during interior ignition. The east portion of the unit was essentially re-rung with interior ignition complete by 1400. All surface fire was out at 1430.

The crew began a 25-foot mop of the northeast, northwest, and south lines at 1435. Sprouse and Brown started at the north corner with Barger and Wilson starting at the southeast corner. Scott and Zollner patrolled the lines. Zollner remained at the unit overnight while the crew left the unit following the de-briefing at 1545 with all lines secure to 25 feet.

There were no problems holding and no duds exploded during the burn. Backfire flamelengths were 0.5-2 feet. Flanking fire flamelengths were 2-5 feet flaring to 8. Headfire flamelengths were 4-7 occasionally flaring to 15 feet. Large amounts of woody debris along the east line burned and smoldered into the night with heavy smoke production settling into the valley to the east and draining toward the Arkansas River. 1000 hour fuels burned for the following week. A live loblolly pine continued burning ~15 feet up in old woodpecker holes for five days. Zollner periodically checked the unit in the week following the burn. A heavy rain on the sixth day following the burn extinguished the fire.

IMMEDIATE POST BURN EFFECTS

Overall unit	pine-oak woodland; oak bottomland (riparian)	
Unit coverage	89%	
Burn severity organic substrate	2.0 (lightly burned)	
Burn severity understory	1.4 (lightly burned)	
Char height	1.1 (10' - 20')	
Char degree	1.2 (medium)	
Scorch percent overstory	0.1 (less than 25% of live crowns)	
Scorch height overstory	0.0 (less than 25')	

By natural community	pine-oak woodland	oak bottomland (riparian)
Fuel models	9	8
Coverage	96%	73%
Organic substrate	2.1 (moderate)	1.7 (light)
Understory	1.5 (light)	1.2 (light)
Char height	1.2 (10' - 20')	1.1 (10' - 20')
Char degree	1.3 (medium)	1.0 (light)
Scorch percent	0.1 (less than 25%)	0.0
Scorch height	0.0 (less than 25')	0.0

ECOLOGICAL OBJECTIVES

1. 60% - 80% unit coverage. The unit was 89% burned. Unburned areas included small water-filled depression in the upland forest and riparian and bottomland areas. The burn coverage in the upland pine-oak woodland was virtually complete (96%) with small skips in moist depressions. The burn moved well into the riparian and bottomland areas along Phillips Creek, including one cane stand, with 73% coverage.
2. Organic substrate burn severity class = 1.5 – 2.5. Overall substrate burn severity = 2.0 (lightly burned) and ranged from 1.7 to 2.1 (lightly to moderately burned). Pine needle litter was much reduced throughout the unit. The duff layer was reduced on ridge-tops, in some places to bare soil. Large woody debris and old stumps burned to ash over a two day period. A disturbed area of bulldozed debris burned for the next two days. The fire crept through the extensive riparian and bottomland area with relatively small flames (1.0' or less'). The top layer of oak leaf litter was removed mostly without affecting the duff.
3. Understory burn severity class = 1.5 – 2.5. Overall understory burn severity = 1.4 (lightly burned) and ranged from 1.2 to 1.5. Small stems and vines were partially consumed. Larger understory plants (mostly horse sugar and red buckeye) had their foliage scorched to the 4' (oak riparian) to 12' (pine woodlands) level throughout the unit. Woody stems smaller than 1.5" diameter at the base were top-killed in areas dominated by pine. In oak dominated bottoms smaller understory plant were top-killed. Cane stands along Phillips Creeks were burned through and in one instance mostly consumed.
4. Overstory char height class = 1.0 – 2.0. Overall overstory char = 1.1 (10' – 20') and ranged from 1.1 to 1.2 (10' to 20'). Overstory pine trees in the uplands were commonly charred to the 8' level and in hot spots to 20'. Overstory hardwoods were commonly charred to the 5' level but frequently less. Char was minimal in the riparian and bottomland portions of the unit. This height of char will not effect overstory trees except where suppressed. Small fire-sensitive species will experience delayed mortality.
5. Overstory char degree = 1.0 – 2.0. Overall overstory char degree = 1.2 (medium) and ranged from 1.0 to 1.3 (light to medium). Minor reductions in bark thickness were noted on overstory pine and scattered hardwoods. This level of char will not affect overstory pine and the oak trees generally experienced significantly less char. Smaller fire-sensitive species will show delayed mortality. Scattered hardwood trees near downed woody debris experienced medium char and may show delayed mortality.
6. Overstory scorch percent class = 1.0 – 3.0. Overall overstory scorch percent = 0.1 (less than 25% of live crowns) and ranged from 0.0 to 0.1. The pine-oak woodland is quite tall and the scorch line seldom exceeded 12', most of the lower branches are well above this level. Few pine were scorched enough to cause mortality although in sporadic instances the lower limbs may die. Overstory hardwood trees experienced little scorch even on new succulent leaves and will not be affected.

7. Overstory scorch height class = 1.0 - 2.0. Overall overstory height class = 0.0 (less than 25'. The scorch line in the upland forest ranged from 4' - 12'. Few overstory trees will be affected by this level of scorch. Shorter suppressed and fire-sensitive species may show delayed mortality.

Most ecological goals were met by this burn. The fire burned into the bottoms much better than expected giving a high unit coverage. The cool fire that burned through the bottoms lowered the average fire intensity for the unit. The reduction in litter, underbrush, and small woody vines in the upland woodland was excellent. The burn was a light to moderate first burn for this old growth restoration unit. The overstory was little impacted by the burn and little increase in light penetration is predicted. Further evaluation of vegetative response may indicate the need for greater fire intensity for the next burn.

Notes:

1. The light winds predicted from the southeast became easterly onsite due to the differential heating of the open bombing mat. This made it impossible to headfire the area east of Phillips creek without interior ignition and raised the possibility of smoke impacting base facilities. As it was, smoke traveled straight up until evening. Most of the facilities were closed on this Saturday and no complaints were received.

THE NATURE CONSERVANCY CONTROLLED BURN PRESCRIPTION

1. LOCATION

Site: Triplets Bluff-Phillips Creek; Pine Bluff Arsenal.
Location: T4S, R10W, sections 22 and 27; Jefferson County, Arkansas.
Unit: Dud Unit - 103 acres.
Ownership: Department of Defense; TNC - burn contract.
Update: August 1998; Douglas Zollner and Scott Simon.

2. SOURCES OF EMERGENCY ASSISTANCE (location and phone)

Jefferson County uses 911 for all emergency responses.
A Mobile phone is staged with the vehicles.

Law: Base Security; (870) 540-3505.
Fire: Base Fire Department; (870) 540-3507/08.
Medical: Base Health Clinic; (870) 540-3409.
Attorney: Lisa Mattimoe (SERO); (919) 967-5493 ext. 115.
Other: Arkansas Forestry Commission; (870) 879-1333.

3. PERMITS AND OFFICIAL NOTIFICATIONS

Burn permit required? No
Other notification required? Yes

Verbal notification:

Charles Becker; (870) 540-2834.
Base Security; (870) 540-3499.
Base Fire Department; contact Fred Culclager (Chief) or Darrell McGee (Asst. Chief);
(870) 540-3507/08.
Jefferson County Sheriff; (870) 541-5351.
White Hall Police Department; (870) 247-1414.
Arkansas Forestry Commission; (870) 879-1333.
Mayor of White Hall; (870) 247-2399.
Mayor's Office Pine Bluff (870) 543-1860.

4. NEIGHBOR NOTIFICATION:

National Center for Toxicological Research (870) 543-7000.

5. UNIT DESCRIPTION

Vegetation types	Fuel models	% of unit & area	Aspect & % slope	exposure
hardwood-pine woodland	9	75% 77 acres	flat*	sheltered
bottomland-riparian forest	8	25% 26 acres	flat*	sheltered

*A 30'-40' escarpment separates the upland (FM9) forest from the riparian-bottoms (FM8) along Phillips Creek.

Fire Unit Narrative Description:

This triangular unit comprises the Phillips Creek section of the Phillips Creek-Triplets Bluff old growth area west of the Bombing Mat. Phillips Creek is a perennial stream with a wide, flat bottom and a 30'-40' escarpment running west to east through the unit separating the upland woodland into two sections. The northwest fireline is a 20'-wide gravel road through FM9. The east fireline is a 12'-wide mown and raked handline adjacent to the bombing mat through old field and scattered pine forest vegetation. The south fireline is a 12'-wide handline that includes an 8'-wide vehicle track. A portion of the south fireline runs along Phillips Creek. The surface of the unit has been checked for unexploded ordnance and is open to hunting. Buried ordinance is likely to be present. Caution is warranted when encountering any pieces of metal.

Hardwood-pine/litter: Most of the unit is covered by hardwood-pine/leaf litter (FM9). Where pine needles predominate this area will burn on the hot side of FM9. The ground cover is mostly oak leaves, pine needles, and non-continuous grass 20" tall. Pine needle draped vine tangles and large snags are extant. At the edges small pines, shrubs, and herbaceous vegetation is thicker and often draped with pine needles.

Hardwood bottoms: The hardwood bottoms have a thick, moist duff layer (FM8). Seep vegetation (ferns, carex, shrubs, cane, and vines) is present. Much of the bottoms will burn slowly and incompletely, or not at all, except under drought conditions.

Maps Attached:

Site Location

Topographic

Route to Hospital

Aerial Photo

Smoke Screening

6. PRESCRIBED BURN RATIONALE

Type of burn: Ecological Stewardship

Site Fire Management Goals: The restoration and maintenance of a diverse herbaceous layer in all plant communities represented at PBA. The restoration of a more open, large tree-grass structure in the designated old growth areas across forest types. The maintenance and enhancement of fire-dependent rare species populations.

Specific Burn Unit Objectives:

60%-80% unit coverage.

substrate burn severity class = 1.5 - 2.5.

understory burn severity class = 1.5 - 2.5.

overstory char height class = 1 - 2.

overstory char degree = 1 - 2.

overstory scorch percent class = 1.5 - 3.

overstory scorch height class = 1 - 2.

7. ACCEPTABLE FIRE BEHAVIOR

Fuel Model (% area)

FM9 (75%) FM8 (25%)

Maximum behavior

headfire flame length (ft)	6	2
backfire flame length (ft)	1	0.3
hf rate of spread (ch/hr)	38	7
bf rate of spread (ch/hr)	1	0

Minimum behavior

headfire flame length (ft)	1	0.7
backfire flame length (ft)	0.6	0.2
hf rate of spread (ch/hr)	3	1
bf rate of spread (ch/hr)	0	0

8. FUEL AND WEATHER PRESCRIPTION

Source of weather: National Weather Service (501) 834-9102 x 441 (Mike Thompson) or Arkansas Forestry Commission; (501) 664-2531 after 8:00 am ask for John Burton.

Weather parameters

air temperature: 35 - 85F°.
relative humidity: 25% - 60%.
wind direction: generally south 135° - 215°.
20' windspeed: 8 - 20 mph.
midflame windspeed: 3 - 12 mph.

Atmospheric Mixing Height: Category 3 or 4 (Arkansas Forestry Commission); ventilation rate 4000-16,000 = mixing height x transport windspeed.

9. SMOKE MANAGEMENT PLAN

Smoke screening procedure completed? Yes
Map of smoke sensitive areas attached? Yes

List smoke sensitive areas:

2 mile screen:
Arsenal facilities are 1.5 miles south and west.
Rifle range directly south.

5 mile screen:

NCTR; 3.0 miles northwest.
Highway 365; 3.0 miles west and south.
Missouri Pacific railroad; 3.0 miles west and south.
Town of White Hall; 4.0 miles southwest.
Highway 104; 4.0 miles west.
Highway 65; 4.5 miles southwest.
Lock and Dam Number 3; 5.0 miles north.

Describe desirable smoke behavior and smoke management actions:

Arkansas Forestry Commission categories 3 and 4 allow for good lift and dispersal of smoke during daylight hours. This unit has a deep litter and duff layer that will produce a lot of smoke under dry conditions. Under good lift and dispersal conditions winds with a southerly component (135° - 215°) are required. Under category 3 and 4 days winds from the south will disperse smoke over the Arkansas River and agricultural lands to the north and avoid putting smoke over the bombing mat storage area.

Due to possible public concern with having smoke plumes rise over the Arsenal a public relation plan has been developed with the PBA public relations office.

10. CREW ORGANIZATION

Qualified fire leader: Yes

Crew number: 6

11. EQUIPMENT

Required items:

Pumper onsite: Yes

First aid kit: Yes

Two-way radios: 4

Weather kit: Yes

Protective clothing: Yes

Other equipment	Number	Source
waterpacks	6	TNC
5 gallon waterjugs	10	TNC
fire rakes	8	TNC
leaf blower	1	TNC
drip torches	4	TNC
fuel cans	3	TNC
pulaski	2	TNC
chainsaw	2	TNC
ATV w/water	1	TNC

12. BURN DURATION

Baseline preparation: 60 minutes.

Interior ignition: none.

Spreading fire: 180 minutes.

Total duration: 4 hours

13. MANAGING THE FIRE (describe the following)

Firebreak preparation:

The northwest fireline is a 20'-wide gravel road. The east fireline is a 12'-wide dirt road adjacent to an old field and scattered pine forest and a 12'-wide mown and raked handline around the bombing mat. The south fireline is a 12'-wide mown and raked handline along an 8'-wide vehicle track adjacent to an old field and a 6'-wide blown line along Phillips Creek. All culverts need to be checked for continuous fuels and woody debris deposited by beaver. All lines are ATV accessible. The pumper cannot access the fireline along Phillips Creek. Snags near the firelines will be removed or raked around.

Firing techniques:

Onsite weather will be taken and a test fire set to check fire and smoke behavior. If conditions are satisfactory, ignition will continue along the downwind fireline. The backfire will be allowed to burn in to form a secure black line. In FM9 and FM 8 extensive stripping will likely be needed to form a secure blackline. Ignition will then continue around the flanks in opposite directions. When the flanks are secure a headfire will be ignited to ring the unit. Interior ignition can be used in this unit. If interior ignition is deemed necessary by the Fire Leader the Crew Boss can enter the unit and ignite along the three ridges in the unit.

Crew communication: via two-way radios

Holding:

The pumper with a radio will be staged along the downwind road. Crew will patrol backfire lines and flanks with backpack pumps and rakes. An ATV with water will be available for patrol.

Fire sensitive areas or hazards:

It is possible that unexploded, buried ordinance is extant in the unit. Crew will not enter the unit during the burn. Although the area has been swept and is open to hunting caution is advised. An intense ground fire could set off small explosions. Move away from anything that looks like an explosive. Pine needle draped vines and shrubs along the firelines could cause jackpotting. Vines often grow into the crowns of pine trees. Crew should be ready for sharp flare-ups. The drainages have vine tangles in places and seepage areas that are mucky. Large snags, downed trees, and cottonmouths are extant in the unit.

A large stock of wooden pallets and containers holding environmental wastes are stored on the northeast corner of the cement bombing mat approximately 0.25 miles from the closest fireline. If wind direction changes and smoke moves over the storage area the base fire department will monitor the pallets.

Contingencies:

Minor escapes and spot fires will be treated by direct attack by the appropriate crew. Spot fires and escapes in FM8 and FM9 are controllable by raking and blowing in narrow firelines. Rates of spread are slow. A major escape to the north will require backfiring from the roads that surround the area or blowing in firelines and backfiring. A major escape to the west will be allowed to burnout along the Arkansas River. An escape to the south into the large field of Johnson grass will cannot be controlled by direct attack. Backfire from roads that surround the fields or recently burned areas. A flare up in the bombing mat storage area will be handled by the base fire department.

Mop-up:

Mop-up smoldering material within 50' of the firelines. Do not disturb any extraneous pieces of metal on the surface or embedded in the ground exposed by the fire. Extinguish any burning snags that threaten the firelines. The pumper can be used to reduce burning snags or downed woody debris if necessary. Plenty of water is available nearby.

Public relations:

Public relations are being handled by Mr. Charles Becker, Base Environmental officer, per action plan.

Follow-up assignments:

A fire summary report will be completed by the fire leader. ARFO stewardship staff will remain with the unit through the following morning. ARFO stewardship staff will carry out monitoring tasks.

14. APPROVALS

Fire Planners:

Douglas Zollner/Dir. Cons. Sci.

Douglas Zollner 23 Aug. 98
signature and date

Scott Simon/Land Steward

SS 80498
signature and date

Fire Leader:

Scott Simon/Land Steward

SS 80498
signature and date

Fire Manager:

Doug Ladd/Dir. Sci. Stew.-MOFO

Doug Ladd 2 NOV 98
signature and date

PINE BLUFF ARSENAL-PONDS UNIT

DIRECT

1-TWO FUEL MODEL CONCEPT - 75% 9 - HARDWOOD LITTER

25% 8 - CLOSED TIMBER LITTER

2-1-HR FUEL MOISTURE, %- 4.0 6.0 8.0 10.0 12.0

3-10-HR FUEL MOISTURE, %- 5.0

4-100-HR FUEL MOISTURE, % 8.0

7-MIDFLAME WINDSPEED, MI/H 3.0 5.0 7.0 9.0 11.0

8-TERRAIN SLOPE, % — 1.0

9-DIRECTION OF WIND VECTOR 0.0

DEGREES CLOCKWISE

FROM UPHILL

10-DIRECTION OF SPREAD — 0.0 (DIRECTION OF MAX SPREAD)

CALCULATIONS

DEGREES CLOCKWISE

FROM UPHILL

HEADFIRE

FUEL MODEL 9 (75%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 5. 11. 18. 27. 38.

I

6.0 I 4. 9. 15. 23. 32.

I

8.0 I 4. 8. 13. 20. 27.

I

10.0 I 3. 7. 12. 18. 25.

I

12.0 I 3. 6. 11. 16. 23.

FUEL MODEL 8 (25%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 1. 2. 4. 5. 7.*

I

6.0 I 1. 2. 3. 5. 5.*

I

8.0 I 1. 2. 3. 4.* 4.*

I

10.0 I 1. 2. 2. 3.* 3.*

I

12.0 I 1. 1. 2. 3.* 3.*

* MEANS YOU HIT THE WIND LIMIT.

FUEL MODEL 9 (75%)

FUEL MODEL 8 (25%)

WEIGHTED RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 4. 9. 15. 22. 30.*

I

6.0 I 3. 7. 12. 18. 25.*

I

8.0 I 3. 6. 10. 16.* 22.*

I

10.0 I 3. 6. 9. 14.* 19.*

I

12.0 I 2. 5. 9. 13.* 18.*

* MEANS YOU HIT THE WIND LIMIT.

FUEL MODEL 9 (75%)

FIRELINE INTENSITY, BTU/FT/S

(V4.1)

1-HR I MIDFLAME WIND, MI/H
MOIS I

I 3.0 5.0 7.0 9.0 11.0
(%) I

4.0 I 38. 81. 138. 209. 291.

6.0 I 28. 59. 102. 153. 214.

8.0 I 23. 48. 82. 124. 173.

10.0 I 20. 41. 71. 107. 149.

12.0 I 18. 37. 64. 97. 135.

FUEL MODEL 8 (25%)

FIRELINE INTENSITY, BTU/FT/S

(V4.1)

1-HR I MIDFLAME WIND, MI/H
MOIS I

I 3.0 5.0 7.0 9.0 11.0
(%) I

4.0 I 5. 9. 15. 21. 26.*

6.0 I 4. 7. 11. 16. 17.*

8.0 I 3. 6. 9. 12.* 12.*

10.0 I 3. 5. 7. 10.* 10.*

12.0 I 2. 4. 7. 8.* 8.*

* MEANS YOU HIT THE WIND LIMIT.

FUEL MODEL 9 (75%)

FLAME LENGTH, FT (V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I _____

I

4.0 I 2.4 3.4 4.3 5.2 6.1

I

6.0 I 2.1 2.9 3.8 4.6 5.3

I

8.0 I 1.9 2.7 3.4 4.1 4.8

I

10.0 I 1.8 2.5 3.2 3.9 4.5

I

12.0 I 1.7 2.4 3.0 3.7 4.3

FUEL MODEL 8 (25%)

FLAME LENGTH, FT (V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I _____

I

4.0 I 0.9 1.3 1.6 1.8 2.0*

I

6.0 I 0.8 1.1 1.4 1.6 1.7*

I

8.0 I 0.7 1.0 1.2 1.4* 1.4*

I

10.0 I 0.7 0.9 1.1 1.3* 1.3*

I

12.0 I 0.7 0.9 1.1 1.2* 1.2*

* MEANS YOU HIT THE WIND LIMIT.

BACKFIRE

DIRECT

1-TWO FUEL MODEL CONCEPT - 75% 9 - HARDWOOD LITTER

25% 8 - CLOSED TIMBER LITTER

2-1-HR FUEL MOISTURE, %- 4.0 6.0 8.0 10.0 12.0

3-10-HR FUEL MOISTURE, %- 5.0

4-100-HR FUEL MOISTURE, % 8.0

7-MIDFLAME WINDSPEED, MI/H 3.0 5.0 7.0 9.0 11.0

8-TERRAIN SLOPE, % — 1.0

9-DIRECTION OF WIND VECTOR 0.0

DEGREES CLOCKWISE

FROM UPHILL

10-DIRECTION OF SPREAD — 180.0

CALCULATIONS

DEGREES CLOCKWISE

FROM UPHILL

FUEL MODEL 9 (75%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 0. 1. 1. 1. 1.

I

6.0 I 0. 0. 1. 1. 1.

I

8.0 I 0. 0. 0. 0. 1.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 8 (25%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 0. 0. 0. 0. 0.

I

6.0 I 0. 0. 0. 0. 0.

I

8.0 I 0. 0. 0. 0. 0.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 9 (75%)

FUEL MODEL 8 (25%)

WEIGHTED RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 0. 0. 1. 1. 1.

I

6.0 I 0. 0. 0. 0. 0.

I

8.0 I 0. 0. 0. 0. 0.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 9 (75%)

FIRELINE INTENSITY, BTU/FT/S

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 4. 4. 5. 5. 5.

I

6.0 I 3. 3. 4. 4. 4.

I

8.0 I 2. 3. 3. 3. 3.

I

10.0 I 2. 2. 3. 3. 3.

I

12.0 I 2. 2. 2. 2. 2.

FUEL MODEL 8 (25%)

FIRELINE INTENSITY, BTU/FT/S

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 0. 1. 1. 1. 1.

I

6.0 I 0. 0. 0. 0. 0.

I

8.0 I 0. 0. 0. 0. 0.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 9 (75%)

FLAME LENGTH, FT

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 0.8 0.9 0.9 1.0 1.0

I

6.0 I 0.7 0.8 0.8 0.8 0.8

I

8.0 I 0.6 0.7 0.7 0.8 0.8

I

10.0 I 0.6 0.7 0.7 0.7 0.7

I

12.0 I 0.6 0.6 0.7 0.7 0.7

FUEL MODEL 8 (25%)

FLAME LENGTH, FT

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I

I

4.0 I 0.3 0.3 0.3 0.3 0.3

I

6.0 I 0.3 0.3 0.3 0.3 0.3

I

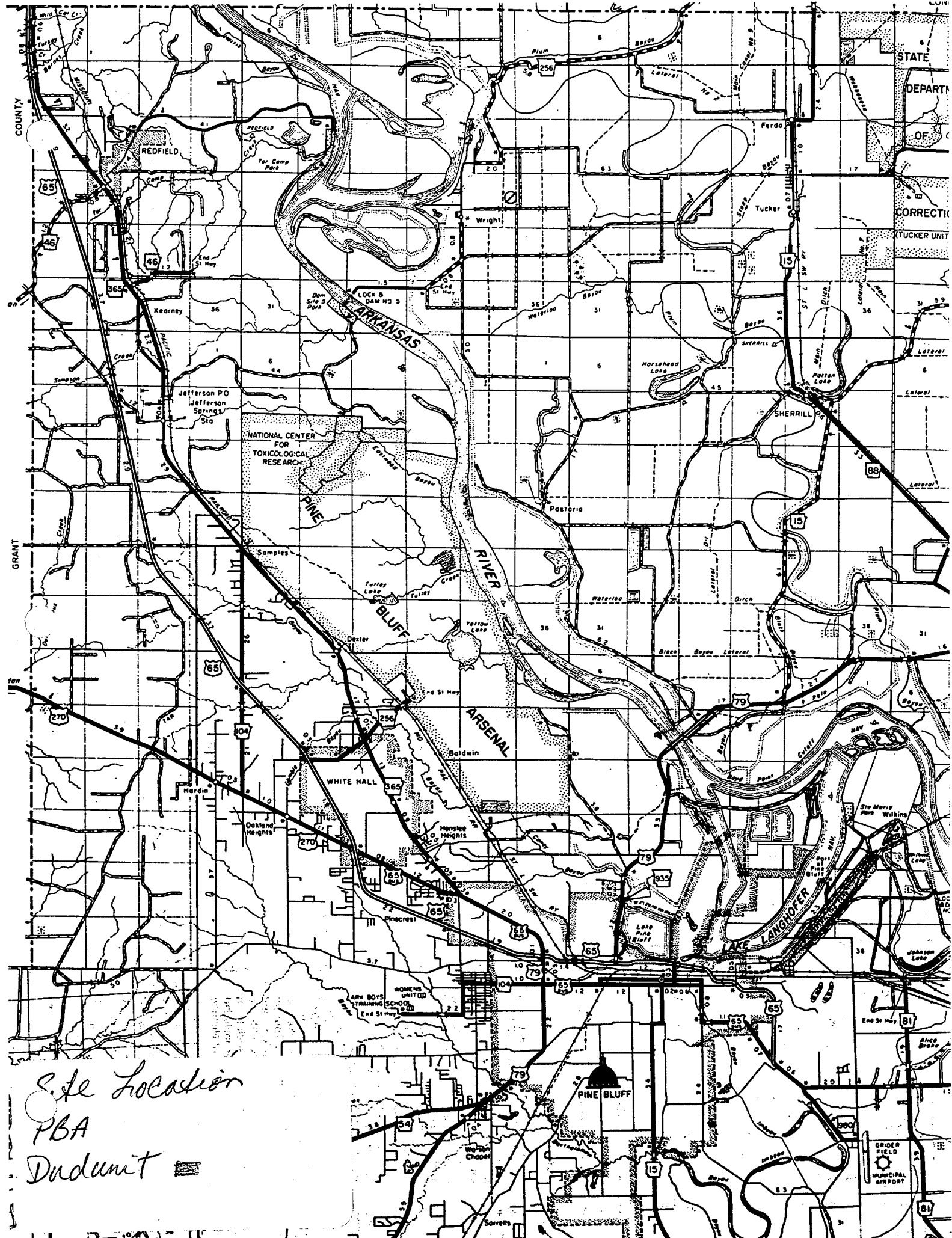
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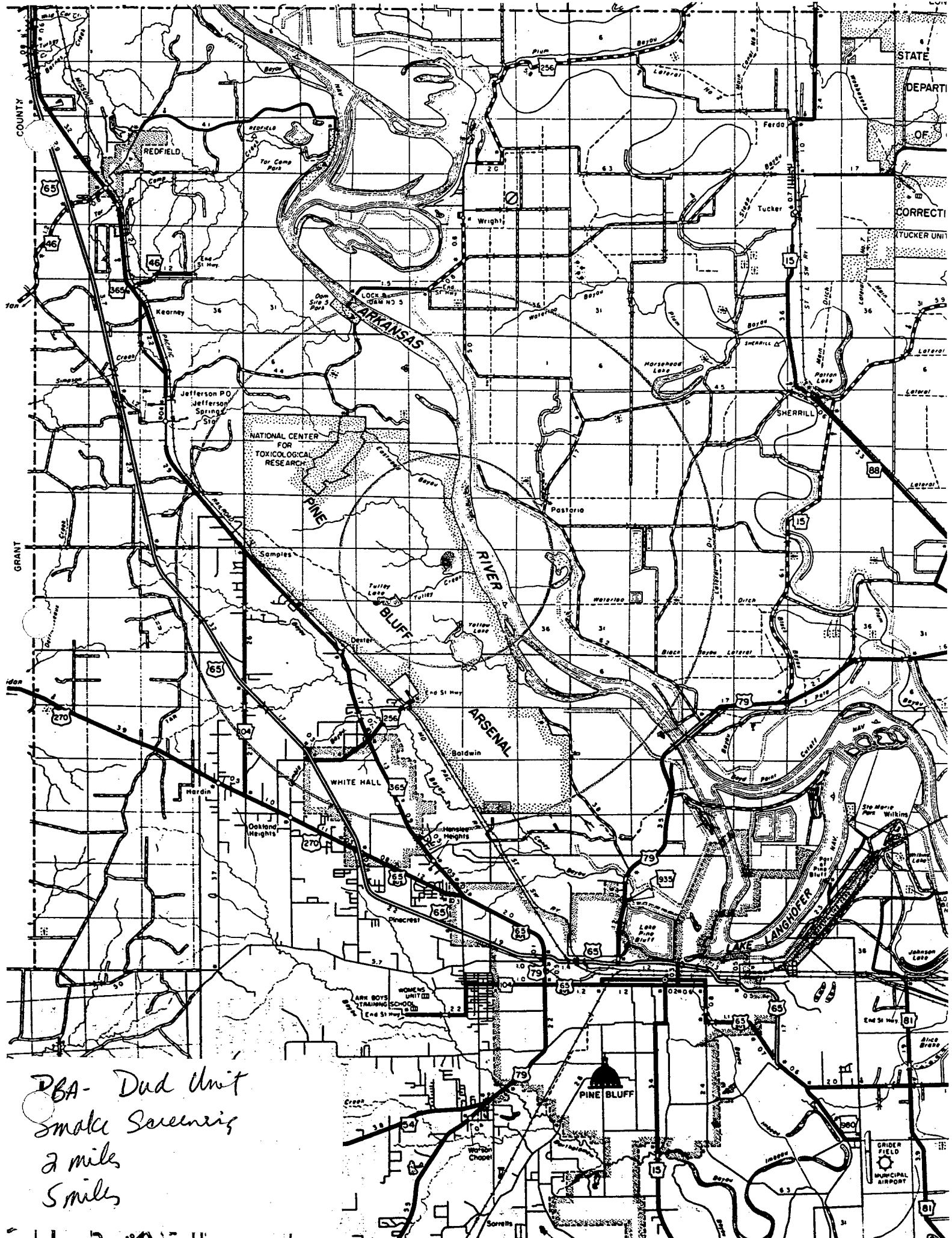
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10.0 I 0.2 0.2 0.2 0.2 0.2

I

12.0 I 0.2 0.2 0.2 0.2 0.2





PBA- Dad Unit
Smaller Screening
2 mile
Smiles

2-15-92

12

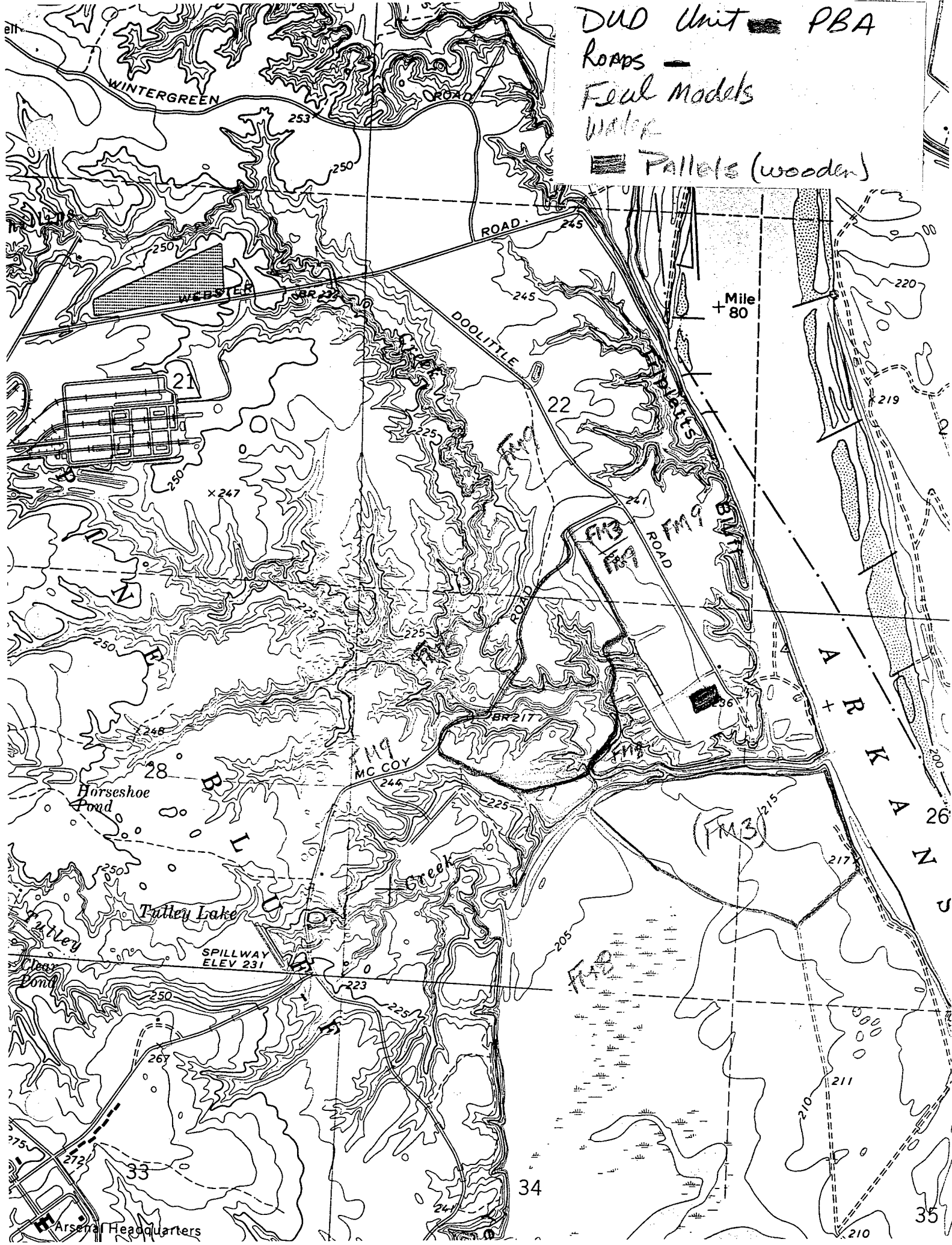
396A

32

Dud Unit —



DUD Unit PBA
Roads —
Fuel Models
Water
Pallets (wooden)



**THE NATURE CONSERVANCY
FIRE SUMMARY REPORT AND POST BURN EVALUATION**

Site: Triplets Bluff-Phillips Creek; Pine Bluff Arsenal.
Unit: Dud Unit; 103 acres.

Date Burned: 27 March 1999.
Date Evaluated: 28 March 1999.
Report Date: 5 April 1999.
Reported By: Doug Sprouse and Douglas Zollner

Fire Weather Forecast

Date: 27 March 1999
Time: 0700
Humidity (low): 35%
Temperature (high): 68°
Windspeed: 5 mph
Wind direction: southeast
Sky: mostly sunny

On-site Weather

Time:	1015	1100	1145
Location:	north Line	north line	north line
By:	Douglas Zollner	DZ	DZ
Dry Bulb:	54°	55°	57°
Wet Bulb:	45°	46°	47°
Humidity:	48%	49%	45%
Dew point	35°	36°	36°
Wind speed:	calm	0-4 mph	0-4 mph
Wind direction:	90°-135° (e-se)	90°-135°(e-se)	90°-135° (e-se)
Sky:	sunny	sunny	sunny
Comments:	Rain fell two days before the burn followed by good drying weather.		

Crew

Fire leader: Doug Sprouse (rake and water) with Douglas Zollner (torch and water), and Dani Brown (ATV).

Crew boss: Jeff Barger (rake and water) with Kathy Wilson (torch and water), and Matt Scott (ATV).

Ignition begun:	1208
Perimeter rung:	1320
Interior ignition complete:	1400
Interior burnout	1430

Fire Narrative

The firelines were cut, mowed, raked, and blown the week before the burn and re-blown the morning of the burn. Eight hours of crew time were spent preparing the unit. The northwest line was a 20-foot wide gravel road through FM9. The northeast line was a 10-15 foot wide mowed and blown line through FM2 (pine-grass). The east line was a three to four foot wide blown walking line through FM9 adjacent to the bombing mat. The south line was an eight foot wide road through broomsedge (FM3) with a small section along Phillips creek (FM8). Vine tangles and pine reproduction was located sporadically along all lines. There were duds from the bombing mat and various pieces of shrapnel throughout the unit. The south and northwest lines were pumper accessible. The northeast line was ATV accessible. The east line was accessible by the base fire department from the bombing mat.

Zollner took on-site weather. Sprouse completed the official notifications. Wilson obtained weather forecasts from the National Weather Service. Wilson and Sprouse got water for the 1-ton pumper, ATV pumps, waterpacks, and staging jugs from the Base Water Dispensary. The 1-ton pumper with blower, flapper, rake, pulaski, waterpack, and drip-torch was staged at the creek along the northwest line (ignition point). Both ATV's with water, pulaski, flapper, rake, drip-torch or drip-torch fuel, pulaski, and one with a blower, were staged at the ignition point during the test fire and the initial ignition. After the initial ignition the ATV's were used by appropriate drag personnel for patrol. On the northwest line, five reserve water jugs and two drip-torch fuel canisters were staged. On the south line, three reserve water jugs and flappers for patrol were staged. On the northeast line, two reserve water jugs and one drip-torch fuel canister were staged. Two smoke ahead signs were placed appropriately along the northwest line. The pre-burn crew briefing was held at the ignition point (bridge on northwest line) at 1145.

A test fire was lit at the bridge on the northwest line at 1208. After five minutes of test fire, wind direction was consistent and smoke was lofting well. Firing proceeded in opposite directions along the northwest line. The on-crew proceeded northeast occasionally needing one strip on top of the road-cut alongside the road. The off-crew stripped both sides of the creek and proceeded southwest along the northwest line. The on-crew proceeded to the north corner and used several parallel strips to secure a good blackline around the corner. When the north corner was secure, Zollner proceeded with ignition southeast along the northeast line. After one 50 foot strip, Zollner held while Sprouse dropped back to the northwest line to check the blackline. The north corner burned completely out within five minutes and Zollner proceeded with ignition. Sprouse and Brown patrolled the northwest line. The off-crew proceeded at a moderate rate to the creek at southeast corner. The off-crew ran two strips through the grassy field and another along the forest-old field interface. The off-crew reached the east side of the creek at 1320, the on-crew igniter reached the west side of the creek at 1324. The unit was considered rung at 1325 in one hour seventeen minutes.

Both crews began interior ignition immediately. The on-crew started with interior ignition of the west side of the unit at 1325 which took 15 minutes and ½ a drip torch. The west side burned through without the aid of interior ignition. The off-crew started with interior ignition of the east side of the creek at 1320 and Zollner assisted after completing the west side. The torches were re-tanked twice on the east side during interior ignition. The east portion of the unit was essentially re-rung with interior ignition complete by 1400. All surface fire was out at 1430.

The crew began a 25-foot mop of the northeast, northwest, and south lines at 1435. Sprouse and Brown started at the north corner with Barger and Wilson starting at the southeast corner. Scott and Zollner patrolled the lines. Zollner remained at the unit overnight while the crew left the unit following the de-briefing at 1545 with all lines secure to 25 feet.

There were no problems holding and no duds exploded during the burn. Backfire flamelengths were 0.5-2 feet. Flanking fire flamelengths were 2-5 feet flaring to 8. Headfire flamelengths were 4-7 occasionally flaring to 15 feet. Large amounts of woody debris along the east line burned and smoldered into the night with heavy smoke production settling into the valley to the east and draining toward the Arkansas River. 1000 hour fuels burned for the following week. A live loblolly pine continued burning ~15 feet up in old woodpecker holes for five days. Zollner periodically checked the unit in the week following the burn. A heavy rain on the sixth day following the burn extinguished the fire.

IMMEDIATE POST BURN EFFECTS

Overall unit	pine-oak woodland; oak bottomland (riparian)	
Unit coverage	89%	
Burn severity organic substrate	2.0 (lightly burned)	
Burn severity understory	1.4 (lightly burned)	
Char height	1.1 (10' - 20')	
Char degree	1.2 (medium)	
Scorch percent overstory	0.1 (less than 25% of live crowns)	
Scorch height overstory	0.0 (less than 25')	

By natural community	pine-oak woodland	oak bottomland (riparian)
Fuel models	9	8
Coverage	96%	73%
Organic substrate	2.1 (moderate)	1.7 (light)
Understory	1.5 (light)	1.2 (light)
Char height	1.2 (10' - 20')	1.1 (10' - 20')
Char degree	1.3 (medium)	1.0 (light)
Scorch percent	0.1 (less than 25%)	0.0
Scorch height	0.0 (less than 25')	0.0

ECOLOGICAL OBJECTIVES

1. 60% - 80% unit coverage. The unit was 89% burned. Unburned areas included small water-filled depression in the upland forest and riparian and bottomland areas. The burn coverage in the upland pine-oak woodland was virtually complete (96%) with small skips in moist depressions. The burn moved well into the riparian and bottomland areas along Phillips Creek, including one cane stand, with 73% coverage.
2. Organic substrate burn severity class = 1.5 - 2.5. Overall substrate burn severity = 2.0 (lightly burned) and ranged from 1.7 to 2.1 (lightly to moderately burned). Pine needle litter was much reduced throughout the unit. The duff layer was reduced on ridge-tops, in some places to bare soil. Large woody debris and old stumps burned to ash over a two day period. A disturbed area of bulldozed debris burned for the next two days. The fire crept through the extensive riparian and bottomland area with relatively small flames (1.0' or less'). The top layer of oak leaf litter was removed mostly without affecting the duff.
3. Understory burn severity class = 1.5 - 2.5. Overall understory burn severity = 1.4 (lightly burned) and ranged from 1.2 to 1.5. Small stems and vines were partially consumed. Larger understory plants (mostly horse sugar and red buckeye) had their foliage scorched to the 4' (oak riparian) to 12' (pine woodlands) level throughout the unit. Woody stems smaller than 1.5" diameter at the base were top-killed in areas dominated by pine. In oak dominated bottoms smaller understory plant were top-killed. Cane stands along Phillips Creeks were burned through and in one instance mostly consumed.
4. Overstory char height class = 1.0 - 2.0. Overall overstory char = 1.1 (10' - 20') and ranged from 1.1 to 1.2 (10' to 20'). Overstory pine trees in the uplands were commonly charred to the 8' level and in hot spots to 20'. Overstory hardwoods were commonly charred to the 5' level but frequently less. Char was minimal in the riparian and bottomland portions of the unit. This height of char will not effect overstory trees except where suppressed. Small fire-sensitive species will experience delayed mortality.
5. Overstory char degree = 1.0 - 2.0. Overall overstory char degree = 1.2 (medium) and ranged from 1.0 to 1.3 (light to medium). Minor reductions in bark thickness were noted on overstory pine and scattered hardwoods. This level of char will not affect overstory pine and the oak trees generally experienced significantly less char. Smaller fire-sensitive species will show delayed mortality. Scattered hardwood trees near downed woody debris experienced medium char and may show delayed mortality.
6. Overstory scorch percent class = 1.0 - 3.0. Overall overstory scorch percent = 0.1 (less than 25% of live crowns) and ranged from 0.0 to 0.1. The pine-oak woodland is quite tall and the scorch line seldom exceeded 12', most of the lower branches are well above this level. Few pine were scorched enough to cause mortality although in sporadic instances the lower limbs may die. Overstory hardwood trees experienced little scorch even on new succulent leaves and will not be affected.

7. Overstory scorch height class = 1.0 – 2.0. Overall overstory height class = 0.0 (less than 25'. The scorch line in the upland forest ranged from 4' - 12'. Few overstory trees will be affected by this level of scorch. Shorter suppressed and fire-sensitive species may show delayed mortality.

Most ecological goals were met by this burn. The fire burned into the bottoms much better than expected giving a high unit coverage. The cool fire that burned through the bottoms lowered the average fire intensity for the unit. The reduction in litter, underbrush, and small woody vines in the upland woodland was excellent. The burn was a light to moderate first burn for this old growth restoration unit. The overstory was little impacted by the burn and little increase in light penetration is predicted. Further evaluation of vegetative response may indicate the need for greater fire intensity for the next burn.

Notes:

1. The light winds predicted from the southeast became easterly onsite due to the differential heating of the open bombing mat. This made it impossible to headfire the area east of Phillips creek without interior ignition and raised the possibility of smoke impacting base facilities. As it was, smoke traveled straight up until evening. Most of the facilities were closed on this Saturday and no complaints were received.

THE NATURE CONSERVANCY CONTROLLED BURN PRESCRIPTION

1. LOCATION

Site: Eastwood Bayou; Pine Bluff Arsenal.

Location: T4S, R10W, section 18; Jefferson County, Arkansas.

Unit: Bunker Unit - 98 acres.

Ownership: Department of Defense; TNC - burn contract.

Update: July 1999; Doug Sprouse, Douglas Zollner, and Scott Simon.

2. SOURCES OF EMERGENCY ASSISTANCE (location and phone)

Jefferson County uses 911 for all emergency responses. A mobile phone is staged with the vehicles.

Law: Base Security; (870) 540-3505.

Fire: Base Fire Department; (870) 540-3507/08.

Medical: Base Health Clinic; (870) 540-3409.

Attorney: Lisa Mattimoe (SERO); (919) 967-5493 ext. 115.

Other: Arkansas Forestry Commission; (870) 367-6767.

3. PERMITS AND OFFICIAL NOTIFICATIONS

Burn permit required? No

Other notification required? Yes

Verbal notification:

Charles Becker; (870) 540-2834.

Base Security; (870) 540-3499.

Base Fire Department; contact Fred Culelger (Chief) or Darrell McGee (Asst. Chief);
(870) 540-3507/08.

Jefferson County Dispatch; (870) 541-5351 (*Ask if they will inform both of following*)

Jefferson County Sheriff; (870) 541-5351.

White Hall Police Department; (870) 247-1414.

Arkansas Forestry Commission; (870) 367-6767.

Arkansas Forestry Commission, Central Dispatch; (501) 332-2000.

Mayor of White Hall; (870) 247-2399,

Pine Bluff Fire Department; (870) 541-5300

Contractor for PBA (Greg Marks); (870) 540-3738

4. NEIGHBOR NOTIFICATION:

National Center for Toxicological Research; (870) 543-7000; (870) 845-4084.

5. UNIT DESCRIPTION

Vegetation types	Fuel models	% of unit & area	Aspect & % slope	exposure
hardwood-pine woodland	9	75% 74 acres	flat*	sheltered
bottomland-riparian forest	8	25% 24 acres	flat*	sheltered

*A 20' escarpment separates the upland (FM9) forest from the riparian-bottoms (FM8) along Phillips Creek.

Fire Unit Narrative Description:

This squarish unit sits within a munitions storage area (Conventional Limited Area - CLA) and is composed of upland oak forest north and south of west to east flowing Eastwood Bayou. A mesic riparian forest parallels the Bayou. The north fireline is a 16'-wide paved road through FM9 south of a row of munitions bunkers, except for one bunker within the unit. The west fireline is a 16'-wide paved road through FM 8 and FM9. The south fireline is a 16'-wide paved road through FM9 north of a row of munitions bunkers. The east fireline is a 16'-wide mown and raked handline through FM9 and FM8 that crosses Eastwood Bayou. All firelines are ATV accessible. The firelines are pumper accessible except where the fireline crosses Eastwood Bayou. The bunkers are concrete with metal doors and earth covered roofs. The bunkers are surrounded by short, dry grass and have grass growing over the tops. PBA policy requires personnel to carry gas masks at all times when in the CLA.

Hardwood-pine/litter: Most of the unit is covered by hardwood-pine/leaf litter (FM9). Where pine needles predominate this area will burn on the hot side of FM9. The ground cover is mostly oak leaves, pine needles, and non-continuous grass 20" tall. Pine needle draped vine tangles and large snags are extant. At the edges small pines, shrubs, and herbaceous vegetation is thicker and often draped with pine needles.

Hardwood bottoms: The hardwood bottoms have a thick, usually moist duff layer (FM8). Seep vegetation (ferns, carex, shrubs, cane, and vines) is present. Much of the bottoms will burn slowly and incompletely, or not at all, except under dry conditions.

Maps Attached:

Site Location
Topographic
Route to Hospital
Aerial Photo
Smoke Screening

6. PRESCRIBED BURN RATIONALE

Type of burn: Ecological Stewardship

Site Fire Management Goals: The restoration and maintenance of a diverse herbaceous layer in all plant communities represented at PBA. The restoration of a more open, large tree-grass structure in the designated old growth areas across forest types. The maintenance and enhancement of fire-dependent rare species populations. A reduction in the amount of litter and the thickness of the duff layer.

Specific Burn Unit Objectives:

60%-80% unit coverage.

substrate burn severity class = 1.5 - 2.8.

understory burn severity class = 1.5 - 2.8.

overstory char height class = 1 - 2.

overstory char degree = 1 - 2.

overstory scorch percent class = 1.5 - 3.

overstory scorch height class = 1 - 2.

7. ACCEPTABLE FIRE BEHAVIOR

Fuel Model (% area)
FM9 (75%) FM8 (25%)

Maximum behavior

headfire flame length (ft)	6	2
backfire flame length (ft)	1	0.3
hf rate of spread (ch/hr)	38	7
bf rate of spread (ch/hr)	1	0

Minimum behavior

headfire flame length (ft)	1	0.7
backfire flame length (ft)	0.6	0.2
hf rate of spread (ch/hr)	3	1
bf rate of spread (ch/hr)	0	0

8. FUEL AND WEATHER PRESCRIPTION

Source of weather: National Weather Service (501) 834-9102 x 441 (Mike Thompson) or Arkansas Forestry Commission; (501) 664-2531 after 8:00 am ask for John Burton.

Weather parameters

air temperature: 35 - 85F°.
relative humidity: 25% - 65%.
wind direction: south through northwest (180° - 305°).
20' windspeed: 8 - 20 mph.
midflame windspeed: 3 - 12 mph.

Atmospheric Mixing Height: Category 3 or 4 (Arkansas Forestry Commission); ventilation rate
4000-16,000 = mixing height x transport windspeed.

9. SMOKE MANAGEMENT PLAN

Smoke screening procedure completed? Yes
Map of smoke sensitive areas attached? Yes

List smoke sensitive areas:

2 mile screen:

Arsenal facilities; south.
NCTR; 0.75 miles east.
Highway 365 (residential housing along highway); 1.0 miles west and south.
Missouri - Pacific railroad; 1.0 miles west and south.

5 mile screen:

Highway 104; 1.5 miles south.
Highway 65; 2.5 miles west and south.
Lock and Dam number 3; 3.0 miles northeast.

Describe desirable smoke behavior and smoke management actions:

Arkansas Forestry Commission categories 3 and 4 allow for good lift and dispersal of smoke during daylight hours. This unit has a deep litter and duff layer that will produce a lot of smoke under dry conditions. Under good lift and dispersal conditions winds from the south through the northwest are acceptable. Under category 3 or 4 days winds from 180° - 305° degrees will disperse smoke over forest lands to the north and east.

10. CREW ORGANIZATION

Qualified fire leader: Yes
Crew number: 6

11. EQUIPMENT

Required items:

Pumper onsite: Yes

First aid kit: Yes

Two-way radios: 4

Weather kit: Yes

Protective clothing: Yes

Other equipment	Number	Source
waterpacks	6	TNC
5 gallon waterjugs	10	TNC
fire rakes	8	TNC
leaf blower	1	TNC
drip torches	4	TNC
fuel cans	3	TNC
pulaski	2	TNC
chainsaw	2	TNC
ATV w/water	1	TNC

12. BURN DURATION

Baseline preparation: 60 minutes.

Interior ignition: 60 minutes.

Spreading fire: 60 minutes.

Total duration: 3 hours

13. MANAGING THE FIRE (describe the following)

Firebreak preparation:

The north fireline is a 16'-wide paved road through FM9 with dry grass along the sides and around bunkers north of the fireline. One bunker is situated within the unit and will have a 16'-wide mown and raked handline around it. The west fireline is a 16'-wide paved road through FM8 and FM9. The south fireline is a 16'-wide paved road through FM9 with dry grass along the sides and around bunkers to the south. The east fireline is a 16'-wide mown and raked handline through FM9 and FM8 that crosses Eastwood Bayou. All culverts need to be checked for continuous fuels and woody debris deposited by beaver. All firelines are ATV accessible. All firelines except the east are pumper accessible. Snags near the firelines will be removed or raked around.

Firing techniques:

Onsite weather will be taken and a test fire set to check fire and smoke behavior. If conditions are satisfactory, ignition will continue along the downwind fireline. The backfire will be allowed to burn in to form a secure blackline. In FM9 and FM 8 extensive stripping will likely be needed to form a secure blackline. Ignition will then continue around the flanks in opposite directions. When the flanks are secure a headfire will be ignited to ring the unit. Interior ignition will be used to speed burnout.

Crew communication: via two-way radios

Holding:

The pumper with a radio will be staged along the downwind road. Crew will patrol backfire lines and flanks with backpack pumps and rakes. An ATV with water will be available for patrol.

Fire sensitive areas or hazards:

The short dry fuels along the roads and around and on top of the bunkers can ignite easily. Pine needle draped vines and shrubs along the firelines could cause jackpotting. Vines often grow into the crowns of pine trees. Crew should be ready for sharp flare-ups. The drainages have vine tangles in places and seepage areas that are mucky. Large snags, downed trees, and cottonmouths are extant in the unit.

Contingencies:

Minor escapes and spot fires will be treated by direct attack by the appropriate crew. Spot fires and escapes in FM8 and FM9 are controllable by raking and blowing in narrow firelines. Rates of spread are slow. A major escape in any direction will require backfiring from the roads that surround the conventional limited area or blowing in firelines and backfiring. An escape outside the conventional limited area can be controlled within the arsenal perimeter security road. An escape into NCTR (National Center for Toxicological Research) will require assistance from the base fire department due to security fences and difficult access.

Mop-up:

Mop-up smoldering material within 100' of firelines and bunkers. Extinguish any burning snags that threaten firelines or bunkers. The pumper can be used to reduce burning snags or downed woody debris if necessary. Plenty of water is available nearby.

Public relations:

Public relations are being handled by Mr. Charles Becker Base Environmental Coordinator, per action plan.

Follow-up assignments:

A fire summary report will be completed by the fire leader. ARFO stewardship staff will remain with the unit through the following morning. ARFO stewardship staff will carry out monitoring tasks.

14. APPROVALS

Fire Planners:

Douglas Zollner/Dir. Cons. Sci.

Douglas Zollner 24 August 98
signature and date

Scott Simon/Land Steward

SS 8 Oct 98
signature and date

Fire Leader:

Scott Simon/Land Steward

SS 8 Oct 98
signature and date

Fire Manager:

Doug Ladd/Dir. Sci. Stew.-MOFO

D/L 2 Nov 98
signature and date

PINE BLUFF ARSENAL- BUNKER UNIT

DIRECT

1--TWO FUEL MODEL CONCEPT - 75% 9 -- HARDWOOD LITTER
25% 8 -- CLOSED TIMBER LITTER

2--1-HR FUEL MOISTURE, % -- 4.0 6.0 8.0 10.0 12.0

3--10-HR FUEL MOISTURE, % - 5.0

4--100-HR FUEL MOISTURE, % 8.0

7--MIDFLAME WINDSPEED, MI/H 3.0 5.0 7.0 9.0 11.0

8--TERRAIN SLOPE, % ----- 1.0

9--DIRECTION OF WIND VECTOR 0.0

DEGREES CLOCKWISE

FROM UPHILL

10--DIRECTION OF SPREAD --- 0.0 (DIRECTION OF MAX SPREAD)

CALCULATIONS

DEGREES CLOCKWISE

FROM UPHILL

HEADFIRE

FUEL MODEL 9 (75%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 5. 11. 18. 27. 38.

I

6.0 I 4. 9. 15. 23. 32.

I

8.0 I 4. 8. 13. 20. 27.

I

10.0 I 3. 7. 12. 18. 25.

I

12.0 I 3. 6. 11. 16. 23.

FUEL MODEL 8 (25%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 1. 2. 4. 5. 7.*

I

6.0 I 1. 2. 3. 5. 5.*

I

8.0 I 1. 2. 3. 4.* 4.*

I

10.0 I 1. 2. 2. 3.* 3.*

I

12.0 I 1. 1. 2. 3.* 3.*

* MEANS YOU HIT THE WIND LIMIT.

FUEL MODEL 9 (75%)

FUEL MODEL 8 (25%)

WEIGHTED RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 4. 9. 15. 22. 30.*

I

6.0 I 3. 7. 12. 18. 25.*

I

8.0 I 3. 6. 10. 16.* 22.*

I

10.0 I 3. 6. 9. 14.* 19.*

I

12.0 I 2. 5. 9. 13.* 18.*

* MEANS YOU HIT THE WIND LIMIT.

FUEL MODEL 9 (75%)

FIRELINE INTENSITY, BTU/FT/S

(V4.1)

1-HR I	MIDFLAME WIND, MI/H				
MOIS I					
I	3.0	5.0	7.0	9.0	11.0
(%) I	-----				
I					
4.0 I	38.	81.	138.	209.	291.
I					
6.0 I	28.	59.	102.	153.	214.
I					
8.0 I	23.	48.	82.	124.	173.
I					
10.0 I	20.	41.	71.	107.	149.
I					
12.0 I	18.	37.	64.	97.	135.

FUEL MODEL 8 (25%)

FIRELINE INTENSITY, BTU/FT/S

(V4.1)

1-HR I	MIDFLAME WIND, MI/H				
MOIS I					
I	3.0	5.0	7.0	9.0	11.0
(%) I	-----				
I					
4.0 I	5.	9.	15.	21.	26.*
I					
6.0 I	4.	7.	11.	16.	17.*
I					
8.0 I	3.	6.	9.	12.*	12.*
I					
10.0 I	3.	5.	7.	10.*	10.*
I					
12.0 I	2.	4.	7.	8.*	8.*

* MEANS YOU HIT THE WIND LIMIT.

FUEL MODEL 9 (75%)

FLAME LENGTH, FT

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 2.4 3.4 4.3 5.2 6.1

I

6.0 I 2.1 2.9 3.8 4.6 5.3

I

8.0 I 1.9 2.7 3.4 4.1 4.8

I

10.0 I 1.8 2.5 3.2 3.9 4.5

I

12.0 I 1.7 2.4 3.0 3.7 4.3

FUEL MODEL 8 (25%)

FLAME LENGTH, FT

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 0.9 1.3 1.6 1.8 2.0*

I

6.0 I 0.8 1.1 1.4 1.6 1.7*

I

8.0 I 0.7 1.0 1.2 1.4* 1.4*

I

10.0 I 0.7 0.9 1.1 1.3* 1.3*

I

12.0 I 0.7 0.9 1.1 1.2* 1.2*

* MEANS YOU HIT THE WIND LIMIT.

BACKFIRE

DIRECT

1-TWO FUEL MODEL CONCEPT - 75% 9 -- HARDWOOD LITTER
25% 8 -- CLOSED TIMBER LITTER

2-1-HR FUEL MOISTURE, % -- 4.0 6.0 8.0 10.0 12.0

3-10-HR FUEL MOISTURE, % - 5.0

4-100-HR FUEL MOISTURE, % 8.0

7-MIDFLAME WINDSPEED, MI/H 3.0 5.0 7.0 9.0 11.0

8-TERRAIN SLOPE, % ---- 1.0

9-DIRECTION OF WIND VECTOR 0.0

DEGREES CLOCKWISE

FROM UPHILL

10-DIRECTION OF SPREAD --- 180.0

CALCULATIONS

DEGREES CLOCKWISE

FROM UPHILL

FUEL MODEL 9 (75%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H
MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 0. 1. 1. 1. 1.

I

6.0 I 0. 0. 1. 1. 1.

I

8.0 I 0. 0. 0. 0. 1.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 8 (25%)

RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 0. 0. 0. 0. 0.

I

6.0 I 0. 0. 0. 0. 0.

I

8.0 I 0. 0. 0. 0. 0.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 9 (75%) FUEL MODEL 8 (25%)

WEIGHTED RATE OF SPREAD, CH/H

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 0. 0. 1. 1. 1.

I

6.0 I 0. 0. 0. 0. 0.

I

8.0 I 0. 0. 0. 0. 0.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 9 (75%)

FIRELINE INTENSITY, BTU/FT/S

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 4. 4. 5. 5. 5.

I

6.0 I 3. 3. 4. 4. 4.

I

8.0 I 2. 3. 3. 3. 3.

I

10.0 I 2. 2. 3. 3. 3.

I

12.0 I 2. 2. 2. 2. 2.

FUEL MODEL 8 (25%)

FIRELINE INTENSITY, BTU/FT/S

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 0. 1. 1. 1. 1.

I

6.0 I 0. 0. 0. 0. 0.

I

8.0 I 0. 0. 0. 0. 0.

I

10.0 I 0. 0. 0. 0. 0.

I

12.0 I 0. 0. 0. 0. 0.

FUEL MODEL 9 (75%)

FLAME LENGTH, FT

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 0.8 0.9 0.9 1.0 1.0

I

6.0 I 0.7 0.8 0.8 0.8 0.8

I

8.0 I 0.6 0.7 0.7 0.8 0.8

I

10.0 I 0.6 0.7 0.7 0.7 0.7

I

12.0 I 0.6 0.6 0.7 0.7 0.7

FUEL MODEL 8 (25%)

FLAME LENGTH, FT

(V4.1)

1-HR I MIDFLAME WIND, MI/H

MOIS I

I 3.0 5.0 7.0 9.0 11.0

(%) I-----

I

4.0 I 0.3 0.3 0.3 0.3 0.3

I

6.0 I 0.3 0.3 0.3 0.3 0.3

I

8.0 I 0.3 0.3 0.3 0.3 0.3

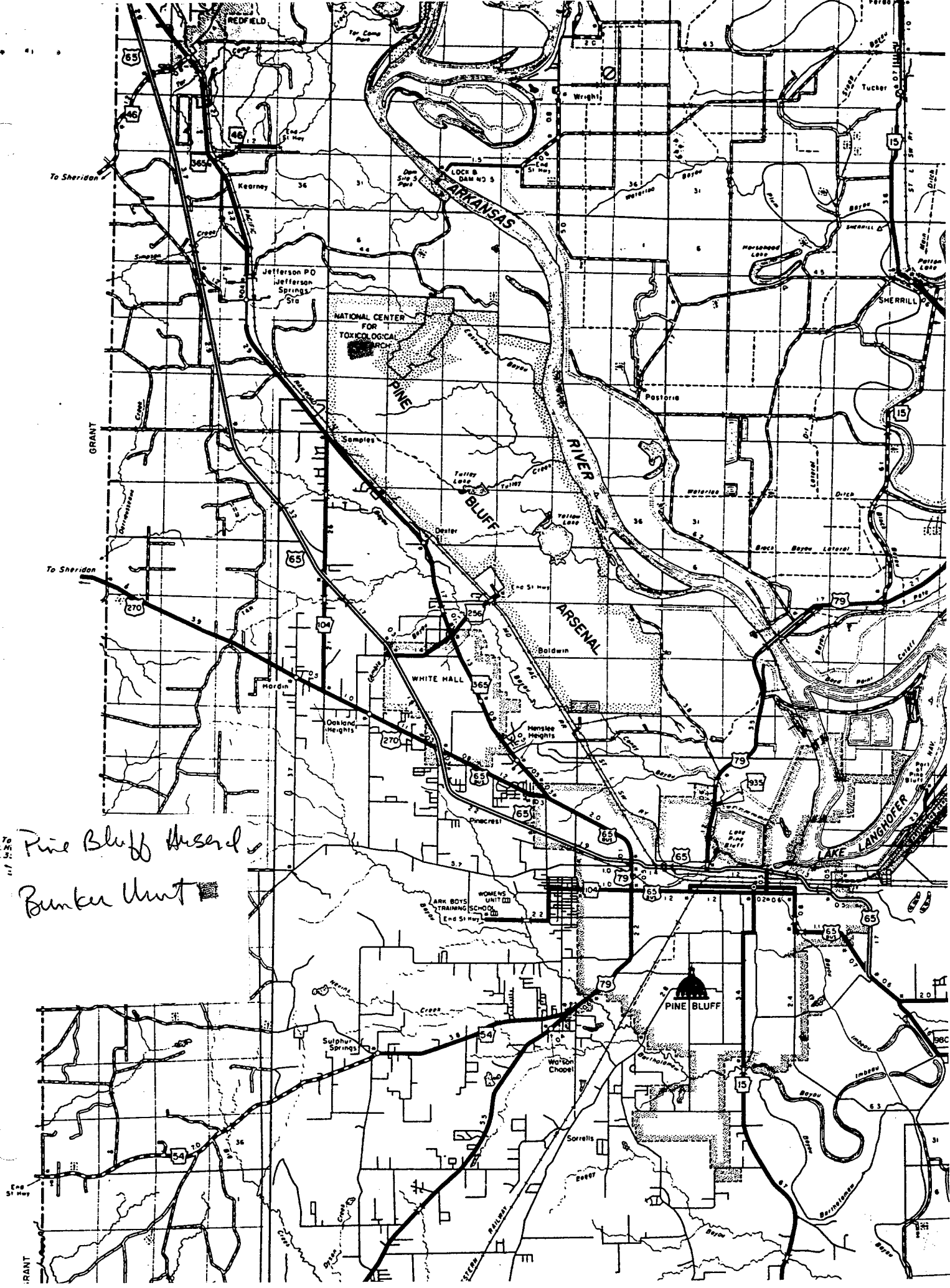
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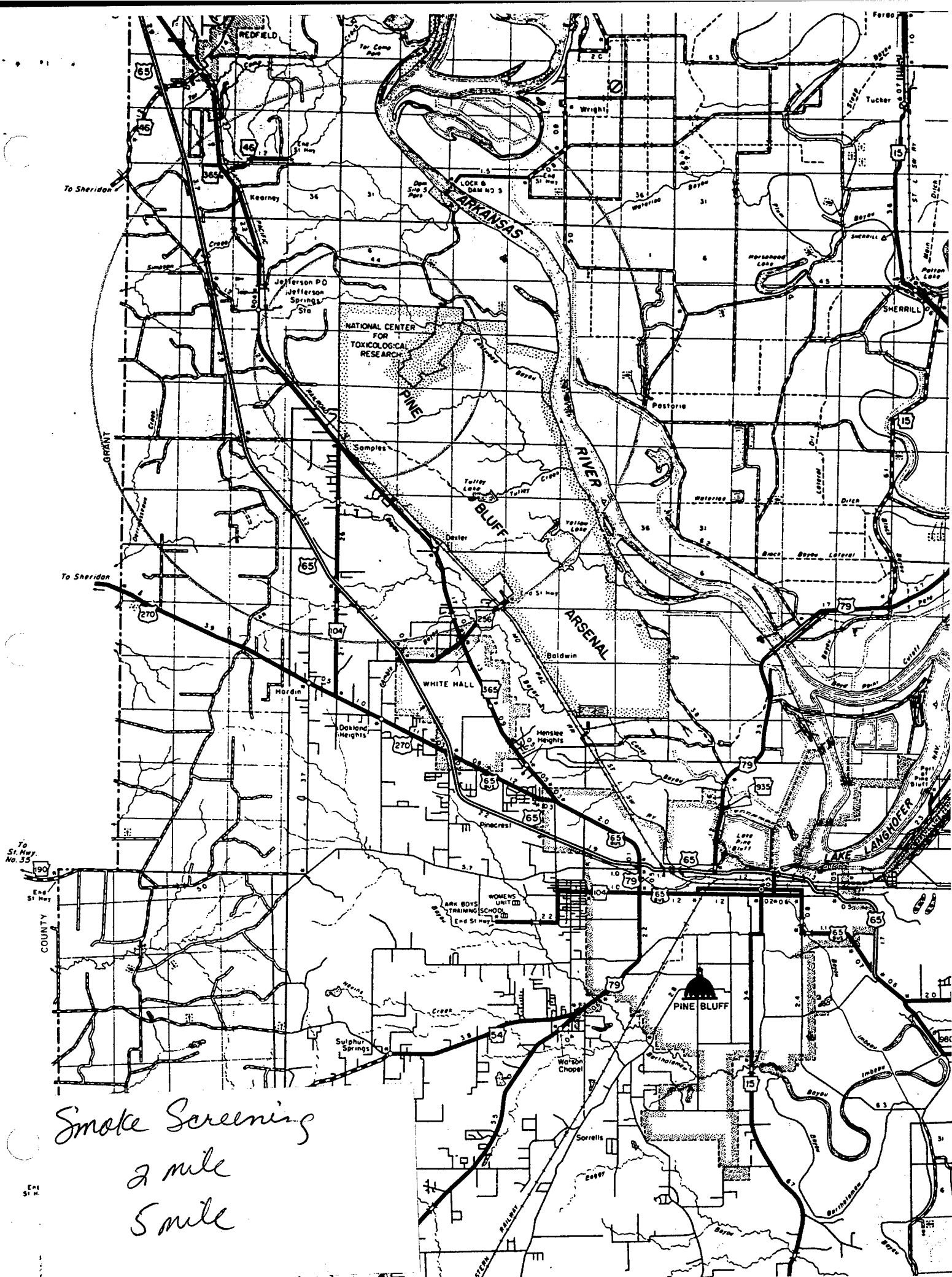
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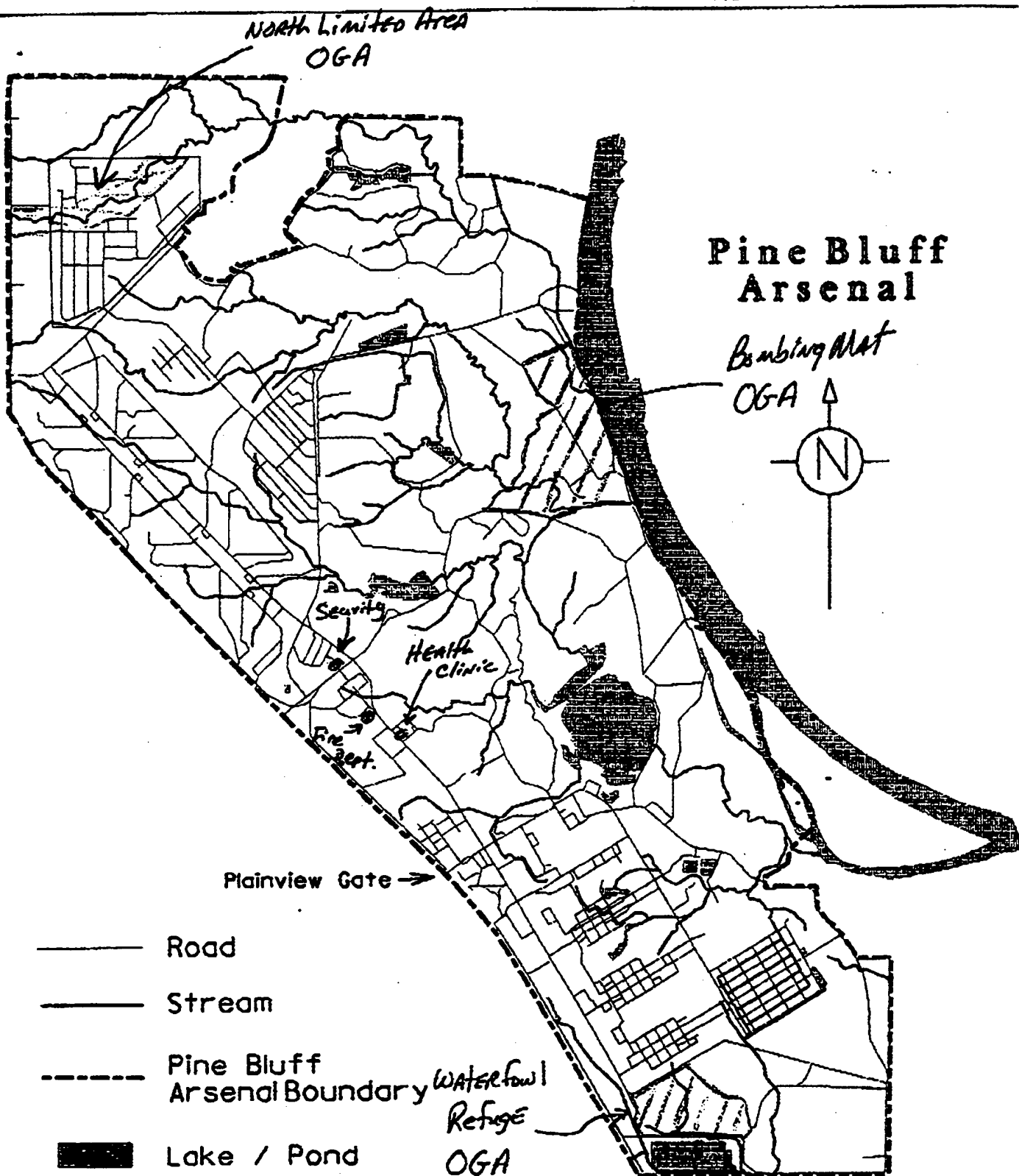
I

12.0 I 0.2 0.2 0.2 0.2 0.2

To
St. M.
No. 3:
Pine Bluff Arsenal
Bunker Unit



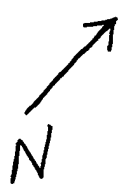




Route to Hospital



Bunker Unit



46

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