INTEGRATED NATURAL RESOURCE MANAGEMENT PLAN

LONGHORN ARMY AMMUNITION PLANT

2002 - 2006

Longhorn Army Ammunition Plant
Karnack, Texas
June 2002

SIKES ACT COOPERATIVE AGREEMENT ON THE INTEGRATED NATURAL RESOURCE MANAGEMENT PLAN FOR THE LONGHORN ARMY AMMUNITION PLANT

APPROVAL BY: DATE

FOR THE DEPARTMENT OF DEFENSE

David Tolbert 7/15/02

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Louisiana/Longhorn Army Ammunition Plants,
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FOR THE STATE OF TEXAS

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PREFACE

Responsible stewardship requires a proactive management philosophy that recognizes the underlying complexities of functioning ecosystems. Projects of this size and scope require major commitments from all participants. The Louisiana/Longhorn Army Ammunition Plant Commander's Representative expresses his appreciation to all those who assisted with preparing and reviewing this plan.

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EXECUTIVE SUMMARY

Purpose: This Integrated Natural Resource Management Plan (INRMP) was developed to provide interdisciplinary strategic guidance for natural resource management on Longhorn Army Ammunition Plant (LHAAP) consistent with federal stewardship requirements.

Environmental Compliance: This INRMP supercedes previous forest, land and wildlife management plans for Longhorn Army Ammunition Plant. The INRMP design concurs with and supports existing plans and regulatory documents, including the 1996 LHAAP Cultural Resources Management Plan.

The INRMP strives to satisfy various legal requirements and mandates requiring inventory and protection of critical environmental areas as stated in one or more of the following pieces of legislation or Executive Orders:

- American Indian Religious Freedom Act of 1978 [PL 95-341] [92 Stat. 469] [42 USC 1996]
- Americans with Disabilities Act of 1992 [PL 101-336] [104 Stat. 328] [42 USC 12101 et seq]
- Archaeological Resources Protection Act of 1979 [PL 96-95] [93 Stat. 721] [16 USC 470]
- Clean Water Act (Federal Water Pollution Control Act) [PL 80-845] [62 Stat. 1155] [33 USC 1251 et seq]
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) [PL 96-510, 94 Stat. 2767] [42 USC 9601, 9603, 9607, 9620]
- Endangered Species Act of 1973 (ESA) [PL 93-205] [87 Stat. 884] [16 USC 1531-11536, 1538-1540]
- Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended [PL 80-104] [61 Stat. 63] [7 USC 136(note), 136, 136b, 136i-m, 136p]
- National Environmental Policy Act of 1969 (NEPA)[PL 91-190] [83 Stat. 852] [42 USC 4321(note), 4321, 4331-4335,4341-4346, 4346a-b, 4347]
- National Historic Preservation Act (NHPA) of 1966, as amended through 1992 [PL 89-665] [80 Stat. 915] [16 USC 470 et seq and Public Laws 91-243, 93-54, 94-422, 96-199, 96-244, 96-515, 98-483, 99-514, 100-127, and 102-575]
- Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 [PL 101-601] [104 Stat. 3048] [25 USC 3001-3013]
- Protection of Wetlands - Executive Order 11990 (May 24, 1977)

Requirements to provide public access to natural resource values are stated in one or more of the following:

- Conservation Programs on Military Reservations (Sikes Act) [PL 86-797] [74 Stat. 1052] [16 USC 670g-670l, 670o]
- Off-road Vehicles on Public Lands [EO 11989]

Natural resource management planning requirements are specified in the following Army regulations:

- Memorandum on Ecosystem Management Information for U.S. Army Materiel

Command (AMC), 1995

- Army Regulation 200-3 Natural Resources - Land, Forest, & Wildlife Management, 1995

Written comments will be solicited during the public review phase and made a part of the public record available for review upon request from Louisiana Army Ammunition Plant.

Scope: LHAAP is located in the Gulf coastal Plain Physiographic in northeast Texas. Upland hardwood forest interspersed with agricultural crops and pastures occupy most of the land not utilized for industrial facilities. Bottomland hardwood forest and wetlands occupy the remaining land.

Relationship to the Military Mission:
Partnerships: INRMP implementation requires partnerships to accomplish the scope of this plan. Those partners required for implementation are:

- U.S. Army Corps of Engineers
- U.S.D.I. Fish and Wildlife Service
- U.S.D.A. Forest Service
- U.S.D.A. Natural Resources Conservation Service
- Texas Parks and Wildlife Department
- Texas Natural Resources Conservation Commission
- Texas State Historic Preservation Officer
- The Nature Conservancy
- Universities

Planned Major Initiatives: (in order of priority)

Since LHAAP is closed and the lands are proposed for transfer to another Federal agency, natural resources management at LHAAP will mainly be at the custodial or caretaker level. LHAAP will continue to be good forest stewards and all activities will be looked at with the larger landscape and ecosystem functions in mind. LHAAP will manage the resources sustainably and will not preclude the options of the next manager.

Upon resumption of normal threat assessments, the hunting and recreation programs will continue as before. Preventive measures for pest management, such as the southern pine beetle, will keep trees growing vigorously through timed thinnings. Current inventories and monitoring will continue.

1.0 GOALS AND POLICIES

The Department of Defense (DOD) has directed that natural resources on DOD lands be managed using the principles of ecosystem management. The U.S. Army, following DOD's initiative, provided installation guidance for preparation of Integrated Natural Resource Management Plans (INRMP). The Longhorn Army Ammunition Plant's (LHAAP) INRMP embraces the principles of ecosystem management and DOD directives in selecting goals and setting policies for the management of LHAAP's natural resources. Due to the excess status of LHAAP and the absence of a natural resources staff, natural resource efforts will be limited in scope. Although, LHAAP has set attainable management goals and objectives to ensure the long term health of the resources and compliance with all applicable environmental laws.

1.1 Goals

LHAAP's general goals for this INRMP are:

· The protection of cultural and natural resource assets
· To provide multiple use accommodation of lands
· To provide for recreational opportunities compatible with the current mission

1.2 Policies

LHAAP policies established to attain each goal in paragraph 1.1 are:

· Compliance of all natural resource programs with applicable environmental regulations
· Compliance of all installation activities with the LHAAP Cultural Resources Management Plan
· Compliance with Army Materiel Command (AMC) requirements and existing cooperative agreements for maximizing recreational opportunities
· Multiple use of all lands unless the uses are in conflict. Established priorities will determine use when multiple uses are incompatible

2.0 LOCATION AND ACREAGE

2.1 Location

LHAAP is located in east Texas in the northeast corner of Harrison County, Texas, with approximately 8,493 acres of land. The eastern boundary of LHAAP is only three and one-half miles from the Louisiana border (See Exhibit 4 – Regional Location Map).

LHAAP is bordered on the west by Karnack, Texas. Karnack is a small community (population 600)[1] approximately 16 miles northeast of Marshall, Texas, via Texas Highway 43. Marshall is at the crossroads of Interstate Highway 20, U.S. Highway 80 and U.S. Highway 59. The population of Marshall is approximately 23,682 people. LHAAP is served by the Kansas City Southern Railway Company and can also be reached via Texas Farm to Market Road 2198.

Shreveport, Louisiana, on Interstate Highway 20, is approximately 35 miles to the southeast. Shreveport is separated by the Red River from Bossier City, and the two cities have a combined population of approximately 251,246 people, representing the largest metropolitan area between Dallas and New Orleans. The airport servicing this metropolitan area provides LHAAP with excellent travel facilities.

The area of east Texas in which LHAAP is located is commonly known as the "Piney Woods," due to the predominance of southern pine forests. The Piney Woods include 43 counties and an area of 11,773,800 acres. Most of the timberland is in loblolly-shortleaf pine forest type, 4.1 million acres. There are 2.5 and 3.2 million acres, respectively, in the oak-pine and oak-hickory

[1] Population data cited throughout the INRMP is from the 1990 census or the latest estimates available.

types. The remaining timberland is in bottomland hardwood types (1.8 million acres) and the longleaf-slash pine type. (See Rosson, James F., Jr., 1993. *The Woody Biomass Resource of East Texas, 1992*, Resource Bull. SO-183. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 87 p.) *

Caddo Lake, the largest natural ly-formed freshwater lake in Texas, borders LHAAP for several miles on the north and east. It has an area of 35,000 to 40,000 acres, with an average depth of less than ten feet.

The average altitude of Harrison county is 375 feet above sea level. The annual rainfall averages 45 inches; the average temperature in the summer is 83 degrees and the average winter temperature is 48 degrees.

2.2 Acreage and Acquisition

U.S. government and Monsanto Chemical Corporation officials selected the present LHAAP site on December 15, 1941, and a contract for its construction and operation was signed on December 22, 1941. Purchase of the land followed shortly afterwards from private parties who had used the property for farming and forestry. According to the *Longhorn Army Ammunition Plant Annual Historical Review, October 1, 1990 to September 30, 1991,* the current acreage of LHAAP is 8,493 acres.

2.3 Installation History

Construction of the plant, designated as a U.S. TNT "six line special," was completed in July, 1943, by Ford, Bacon, & Davis, Inc. Monsanto Chemical Company was the contractor-operator until August 1945.

LHAAP was classified as a standby installation in August, 1945, and changed to government-owned, government-operated status in November, 1945. The installation remained in a standby status until February, 1952.

Universal Match Corporation was the contractor-operator of Plant 2 facilities from February, 1952, until April, 1956. Their primary function was the loading, assembly, and packaging of pyrotechnic ammunition.

Thiokol Corporation was the last contractor-operator of LHAAP. Thiokol assumed responsibility on January 1, 1953, for the purpose of producing polysulfied polymer solid propellants. In May, 1963, Thiokol reopened Plant 2 facilities to load, assemble, and package pyrotechnic ammunition. A Pershing requalification program during FY78 resulted in production of Pershing P1A motors during FY79-80. LHAAP completed the design task in 1978 for an expansion project to produce Surface Launched Unit/Fuel Air Explosive rocket motors, and project funding was received in 1982. LHAAP has become the leading producer of infrared (aircraft countermeasures) flares for both the Army and Air Force.

The 1980s saw a gradual buildup of workload in pyrotechnic type devices. However, in January, 1990, the Secretary of Defense announced that LHAAP was included on a list of plants to be closed (laid away). The Army is attempting to negotiate transfer of the property to the U.S. Fish and Wildlife Service (FWS) for establishing a wildlife refuge. A footprint of the refuge has been developed and the proposed acceptance/transfer of LHAAP to FWS to establish the Caddo Lake National Wildlife Refuge has been subjected to NEPA review in September 2000. The details of such transfer are still in process. The Army will still be responsible for the restoration program on the site.

2.4 Neighbors

Most of the LHAAP's boundary neighbors are private citizens in a rural setting. The town of Karnack is on the western boundary, and Caddo Lake State Park is on the northwestern boundary. Groundwater contamination from past land uses and operations may affect LHAAP's neighbors.

3.0 MILITARY MISSIONS

3.1 Overview

LHAAP is a government-owned-contractor-operated (GOCO) military industrial installation under the jurisdiction of the Operations Support Command. The Commander's Representative of the Louisiana Army Ammunition Plant (LAAAP) oversees the operations at LHAAP with the assistance of a civil service staff of employees at LAAAP and additional civil service employees at LHAAP. There is no current military industrial mission at LHAAP, but there is a mission to operate and maintain active facilities in support of the Installation's Restoration Program.

3.2 Natural Resources Needed to Support the Military Mission

With no active military mission, natural resources management is simply a base operation that is required by a number of DoD and Army regulations and Federal laws. When there was an active military mission at LHAAP, the large acreages of land served as buffer areas to meet Quantity distance requirements were the primary natural resources required to meet the military mission (See Exhibit 5 – LHAAP Site Map). Ammunition storage; road shoulders and railroad beds and appurtenant land acres; security clear zones and other open areas related to production facilities removed 626 acres from multiple use status. Other semi-improved areas included utility rights-of-way, product test areas, waste product burning areas; a small arms range, and other grounds production areas that removed 210 acres from multiple use management.

3.3 Effects of the Military Mission on Natural Resources

The current mission impacts on natural resources are:

- Limited access to some areas for recreational activities such as hunting and fishing.
- Removal of forested areas from managed forest acreage.
- Limited use of some management techniques such as controlled burning.

The past military mission resulted in two major impacts on natural resources:

- Groundwater contamination originating at the burning ground, landfill, and production areas. Contamination remains in the groundwater but has not spread beyond the installation boundaries. A Remedial Investigation Feasibility Study of the groundwater contamination is presently being studied in compliance with CERCLA.
- Soil contamination at the burning ground, landfill, and production areas. The extent of the contamination has not been characterized.

3.4 Effects of Natural Resources or Their Management on the Mission

During the active period of the installation, the management of LHAAP natural resources directly impacted the military mission. Timber management techniques supported the mission through noise attenuation. New construction sites in potential historic areas must be surveyed prior to construction. No federally listed Rare, Threatened or Endangered (RTE) species and no state RTE species presently occur within the boundary of the installation. (See para. 6.10) - check this!

3.5 Future Military Mission Impacts on Natural Resources

The military mission at LHAAP has ended, and the Dept. Of the Army is in the process of finalizing the transfer of the installation to the FWS for a refuge overlay. In the meantime, remedial actions taken to correct contaminated groundwater may affect natural resources. Future well drilling to monitor groundwater contamination or construction of treatment facilities will affect natural resources by removing areas from forest management.

4.0 FACILITIES

4.1 Overview

LHAAP encompasses 8,491.5 acres. During it's active period, LHAAP was an industrial installation and storage facility with an ammunition storage area with 57 Richmond Type Magazines and three earth covered concrete magazines; a TNT area; a burning ground~~s~~; an igniter area; a static test are; a shops area; a construction waste landfill; a pistol range; the Plant 2 test area; a ground signal test area; two cemeteries, and an administration area (see Exhibit 6).

4.2 Transportation System

LHAAP is serviced directly by road and railroad. Air transportation is available regionally from the Shreveport Regional Airport, approximately 35 miles to the southeast of LHAAP.

- **Roads:** Road access to LHAAP is via State Hwy. 43 from the west, FM 134 from the south, and FM 2198 from the north. Interstate 20 is approximately miles to the southwest via State Highway 43 or miles to the southeast via FM 134. The installation is serviced by paved roads in all areas except for portions of the commercial forest land, which is serviced by gravel roads or roads with no surfacing materials. Road maintenance is performed by contractors (primarily those involved in hauling materials for environmental remediation) whenever needed.

- **Railroads:** LHAAP is serviced by the Kansas City Southern Railroad (KCS).

- **Air:** Shreveport Regional Airport is approximately 35 miles southeast of LHAAP and is available for most aviation needs of LHAAP. This facility has commercial air passenger service provided by American Eagle Airlines, Continental Express, Delta Air Lines/Atlantic Southeast Airlines, Northwest Airlink, and US Airways Express. Cargo carriers servicing Shreveport Regional Airport include Airborne Express, Emery Worldwide, Federal Express, and United Parcel Service. Barksdale Air Force Base in Bossier City, LA, approximately 45 miles southeast of LHAAP, provides military air service.

4.3 Water Supply

LHAAP receives an average of 45 to 50 inches of precipitation per year. Permanent streams include, from east to west, Saunders Branch, Harrison Bayou, Martins Bayou, and an unnamed drainage in the northern portion of the plant (hereinafter referred to as Goose Prairie Bayou) that flows into Goose Prairie, a small embayment of Caddo Lake. The northeastern portion of the LHAAP borders Caddo Lake, a natural impoundment of Big Cypress Bayou. Several ponds have been constructed to maintain a year-round water source. Sources of water on LHAAP are:

- Ponds, swamps, and streams: LHAAP wildlife depends on ponds, swamps, intermittent and permanent streams for water.
- Drainage ditches: A system of drainage ditches was constructed on LHAAP to direct runoff into three main arteries that discharge into Caddo Lake.
- Industrial potable water: Water for LHAAP was originally supplied by Big Cypress Bayou, but that use was discontinued and water is now supplied by two wells.
- Groundwater: Most groundwater on LHAAP comes from the sands of the Carrizo-Wilcox aquifer. Groundwater contamination is a result of past releases of contaminants from the burning ground, landfill, and production areas.

4.4 Projected Changes in Facilities

The Department of the Army declared LHAAP as excess to its needs. Therefore, there has been no active military mission on the installation other then clean-up of environmental contamination. Army is currently in the process of negotiating the transfer of primary administrative jurisdiction for LHAAP to the FWS. Should these negotiations prove unsuccessful, attempts will be made to seek other interested parties.

Can't do this, a large amount on the 7772 ac. already in NWR System.

5.0 RESPONSIBLE AND INTERESTED PARTIES

5.1 Installation Organizations

The following individuals and installation organizations play roles in implementation of the LHAAP INRMP:

- **Commander's Representative:** The Commander's Representative of the LAAAP oversees LHAAP as well, and is the primary signatory for the INRMP.

- **Environmental Protection Specialist:**
- **Environmental Engineer:**
- **Contract Administrator:**
- **Safety Manager:**
- **Forest Technician:**
- **Administrative Assistant:**

5.2 Other Defense Organizations

The following Defense organizations play roles in implementation of the LHAAP INRMP:

- **Army Materiel Command:** Major command that reviews and approves natural resource plans and budgets.
- **Operations Support Command:** Subordinate command that reviews and recommends natural resource plans and budgets.
- **Fort Worth District Army Corps of Engineers:** Administers timber sales, construction projects and other contracts.
- **Army Environmental Center:** Provides technical expertise on natural resource and pest control issues.

5.3 Other Federal Agencies

Federal agencies assisting with plan development or assisting with natural resources programs on a regular basis are:

- **U.S.D.I. Fish and Wildlife Service:** Serves as a consultant and signatory agency on the INRMP.
- **U.S.D.A. Natural Resources Conservation Service**
- **U.S.D.A. Farm Services Agency:**
- **U.S.D.I. National Biological Service:** Has produced satellite imagery maps of the Caddo Lake area.

5.4 State Agencies

State agencies participating in the preparation of the INRMP or providing services to the natural resources program on a regualr basis are:

- **Texas Parks and Wildlife Department:** Serves as a consultant on LHAAP wildlife management. The TPWD is also a signatory agency of the INRMP and has conducted research on the LHAAP.
- **Texas Natural Resources and Conservation Commission:** Serves as a consultant.
- **Texas State Historic Preservation Office:** Serves as a consultant and concurring agency on actions that may have an effect on important historic properties.
- **Texas Forest Service:** Provides aerial reconnaissance for detection of southern pine beetle infestations and assistance, when requested, in wildfire suppression.

5.5 Universities

Universities participating in preparation of the INRMP, in research projects or contracts are:

- **Stephen F. Austin State University:** Serves as a consultant and contractor. Recent research projects included a wetland identification and functional assessment of plant communities in Harrison Bayou (which included the development of a Geographic Information System database); an LHAAP soil survey; a vertebrate survey on the LHAAP; an investigation of forest insects and diseases on the LHAAP; a study of attitudes and perceptions of residents in the Cypress Valley watershed and Caddo Lake area; and a study of the home range, activity and spatial distribution of a secretive snake, the western mud snake *(Farancia abacura reinwardtii),* on the LHAAP.

5.6 Contractors

No private contractors are assisting with development of the LHAAP INRMP.

5.7 Other Interested Parties

Private organizations and interested parties participating with INRMP preparation:

- **Caddo Lake Institute:**
- **Texas Regional Institute for Environmental Studies (TRIES):** Has provided funding to SFASU for environmental research at LHAAP.
- **The Nature Conservancy**

5.8 Signatory Agencies

A tripartite cooperative agreement exists between LHAAP, the U.S. Fish and Wildlife Service, and the Texas Parks and Wildlife Department for the conservation and development of fish and wildlife resources on the LHAAP. That agreement will be superseded by signatures on Page (I) of this document and technical assistance provided by the cooperative agencies outlined below:

- **U.S. Fish and Wildlife Service:**
  - ➢ Provide technical wildlife and fisheries assistance within funding personnel limitations, including participation in resource management planning meetings.
- **Texas Parks and Wildlife Department:**
  - ➢ Provide technical assistance in fish and wildlife management including deer population status assessment, hunting season recommendations and habitat development expertise.
  - ➢ Provide technical assistance in joint fish and wildlife research activities with LHAAP and universities.
  - ➢ Provide wildlife law enforcement.
- **LHAAP:**
  - ➢ Will manage the LHAAP deer herd in cooperation with the TPWD. Selected population size will not cause excessive damage to reforestation sites or an unacceptable number of deer-vehicle collisions. TPWD deer biologists follow guidelines in AR200-3 and applicable Army Materiel Command or Operations Support Command supplements and make recommendations to the Commander, who approves and institutes them through his

Security Officer.

- All Rare, Threatened, and Endangered (RTE) species on LHAAP will be subject to applicable state and federal regulations. There are no known populations of any threatened or endangered species on LHAAP. – I don't think this is true
- The Commanding Officer will extend public participation in the LHAAP hunting and fishing program to the maximum extent allowed. There has been no use by the general public of fish or wildlife resources at LHAAP except as guests of employees at the recreational facility at Starr Ranch or as guests of the deer hunters during deer season.
- No attempt is made to provide fishing opportunities except at the recreational facility of Starr Ranch on Caddo Lake.

6.0 NATURAL RESOURCES AND CLIMATE

6.1 Setting

LHAAP is located in northeastern Harrison County in eastern Texas. The eastern boundary of Harrison County is Caddo Parish, Louisiana, making the eastern boundary of LHAAP approximately 3.3 miles from the Louisiana border. The town of Karnack is immediately adjacent to the western boundary of LHAAP; the city of Jefferson lies 11 miles northwest of LHAAP; the city of Marshall lies 16 miles southwest, and Shreveport, LA, lies 35 miles southeast. LHAAP encompasses 8491.5 acres and is bordered on the west by the town of Karnack, on the northwest by Caddo Lake State Park, on the northeast by Caddo Lake, on the east by Farm to Market (FM) Road 9, on the southwest by the Kansas City Southern Railway, and on the north and south by private property.

6.2 Topography

LHAAP is located within the South Central Arkansas Subsection, Middle Coastal Plains Western Section, Southeastern Mixed Forest Province, Subtropical Division of the Humid Temperate Domain as described in *Ecological Units of the Eastern United State - First Approximation,* by James E. Keys, Jr., W. Henry McNab and Constance A. Carpenter, Atlanta, GA: U.S.D.A. Forest Service, 1995. The Subsection is generally located in southern Arkansas, northwestern Louisiana and extreme east central Texas. The geomorphology of this subsection is characterized by irregular plains, with an elevation of 100 to 300 feet. Temperature and moisture regimes are classified as thermic and udic. Perennial streams are common, but there are few lakes and wetlands.

According to the *Soil Survey of Harrison County, Texas*, published by the Soil Conservation Service (now the Natural Resource Conservation Service) in 1994, the topography of the county is generally gently sloping but ranges from nearly level to steep. The county has a well defined drainage pattern and is dissected by many streams. The extreme northwest part of the county drains into Big Cypress Bayou and Lake O' The Pines. The north-central and western parts drain into Little Cypress Bayou and Caddo Lake. The northeastern part drains into Big Cypress Bayou and Caddo Lake. The southern part drains into the Red River.

Examination of the U.S.D.I. Geological Survey 7.5 Minute Series Topographical Quadrangles that encompass the LHAAP (the Karnack, Texas, and Potters Point, Texas-Louisiana, quadrangles) reveals that most of the LHAAP has nearly level to gently sloping topography. The steepest slopes are found in the northwest corner of LHAAP adjacent to Big Cypress Bayou, where 25% slopes occur for short distances (less than 200 feet). The perennial streams, Saunders Branch, Harrison Bayou, Martins Bayou, and Goose Prairie Bayou, as well as two intermittent streams, all drain directly into Caddo Lake. The extreme northwestern corner of LHAAP (on the northwest side of FM 2198, representing less than 25 acres) drains directly into Big Cypress Bayou.

6.3 Geology

Extreme east central Texas (including LHAAP) lies in the western portion of the South Central Arkansas Subsection; this subsection is dissected by the Red River Alluvial Plain Subsection. Elevations at LHAAP range from a low of 170 feet along the edge of Caddo Lake to a high of 335 feet near Hayner Cemetary in the northwestern corner of the plant. Underlying sediments consist primarily of Quartenary, Tertiary Limonitic sandy claystic, clayey, fine to medium sands and fine sandy clays. Soil taxa at the great group level are Hapludults, Glassaqualfs, and Fragiudults. (See *Ecological Units of the Eastern United State - First Approximation, page 49.)* Harrison County is in the West Gulf Coastal Plain Physiographic Province. Wide lowlands along the Sabine River, Big Cypress Bayou, and Little Cypress Bayou extend easterly along the major drainage-ways. The main sources of fresh ground water are the Carizzo-Wilcox and Queen City-Reklaw aquifers, which are probably hydraulically interconnected. They receive most of their groundwater recharge from rainwater infiltrating the formations in their respective outcrop areas. The lower aquifers also receive some recharge from the overlying formations and from streams crossing the outcrops.

The Carrizo-Wilcox aquifer is stratigraphically the lowest, largest, and most productive of the two aquifers. The quality of the water is generally very good, although the content of dissolved solids increases with increasing depth and the content of iron is moderate. Yields of groundwater from the Queen city-Reklaw aquifer are limited. The aquifer is recharged from its outcrop area in the central and western parts of the county. Both aquifers feed numerous springs and creeks throughout the county.

The Sabine Uplift is a prominent feature in the county. It is a relatively flat-topped structural high centering near the Sabine River, at the Texas-Louisiana border. It partly separates the East Texas Embayment from the larger Mississippi Embayment to the east. The surface of the Sabine Uplift consists of an inlier of Wilcox rocks surrounded by younger Claiborne rocks. The dip of the rock units is generally radial, away from the central part of the uplift.

The surface geologic formations in the county range in age from Eocene to Holocene. They crop out in northeasterly trending belts (see *Geologic Atlas of Texas*, Tyler sheet, University of Texas Bureau of Economic Geology, 1975). The rocks dip in a southeast direction toward the axis of the East Texas basin, which extends northeasterly and lies on the edge of the county. This trough-like depression is part of an extensive downwarp or embayment. The Sabine Uplift has significantly influenced soil formation in the county. The coastal plain sediments in the uplands were deposited when the Gulf of Mexico covered the area in successive periods. Meanwhile, riverine sediments were intermittently deposited on top of deltaic deposits.

The oldest geologic materials on the surface in the county are those of the Wilcox Group of Eocene age. This group is the dominant surface exposure, and is as much as 1,000 feet thick. It consists of fine and medium, crossbedded sand, shale, clay, lignite, and some minor or locally significant amounts of siderite, pyrite, and glauconite. The soils commonly in the Scottsville and Eastwood general soil map units formed in deposits of the Wilcox Group.

The rest of the geologic materials on the surface of Harrison County are also from the Eocene age except for limited Pleistocene and Recent materials, and are from the Claiborne Group. They are described from older to younger in the paragraphs following.

Carrizo Sand overlies the Wilcox Group, and is found in the north-central and southwestern parts of the county. It crops out in small, sinuous, narrow bands on the outer edge of the Sabine uplift, and can be as much as 100 feet thick. It is made up of fine and medium sand, small amounts of silt and clay, and interbeds of indurated ironstone.

The Reklaw Formation overlies Carrizo Sand, and occurs in the north-central and southwestern parts of the county. It crops out in large areas, and has a maximum thickness of approximately 100 feet. It is made up of micaceous clay and minor amounts of sand and silt. Ironstone seams and ironstone pebbles occur at or near the surface.

Queen City Sand overlies the Reklaw foundation, and it outcrops in large areas in the western and northwestern parts of the county. It is about 100 to 200 feet thick, and consists of fine and medium quartz sand, minor amounts of shale, silt, clay and impure lignite, and some interbeds of indurated ironstone.

The Weches Formation overlies Queen City Sand, but it is of very limited extent in the county. It occurs as scattered erosional remnants of relatively sharp escarpments, ridges, and isolated hills in the western and northwestern parts of the county, and can be up to 70 feet thick. It consists of highly weathered, interbedded clay and some sand.

Sparta Sand overlies the Weches Formation, but it also is of very limited extent in the county. It occurs on gently undulating top and rolling side slopes of the Weches escarpments. It consists primarily of fine grained quartz sand and interbeds of sandy clay.

The next to youngest geologic material in the county are Pleistocene-aged Quartenary fluviatile terrace deposits, which consist of sand, silt and clay. They are six to 30 feet thick, and are about two to 25 feet higher than the present-day floodplains. Remnants of the older terraces are on upland stream divides and side slopes that are as high as 25 to 200 feet above the present-day floodplains.

The youngest geologic materials in the county are recent alluvial sediments of Holocene age, which were deposited by modern streams. The soils in the Iuka-Socagee-Sardis general soil map unit are mainly along the smaller streams, in areas where the sediments are a mixture of loamy material.

6.4 Climate

The climate is mild and temperate with an occasional frost and/or freezing in winter. The summers are relatively hot. The growing season averages 245 days. Summer and fall seasons frequently experience drought conditions. The average rainfall is 46.90 inches. Other climate data is as follows:

Table 6-1: CLIMATE TABLE

Month	Average Rainfall (Inches)	Average Daily Temperature (°F) Min.	Max.	Average No. of Growing Degree Days*	Average Snowfall (Inches)
January	3.95	33.0	54.7	61	0.8
February	3.86	36.8	59.6	109	0.3
March	3.91	43.4	67.2	218	0.2
April	4.87	52.9	76.2	438	.0
May	5.15	60.5	83.0	676	.0
June	3.82	67.8	89.8	864	.0
July	3.23	71.5	93.8	1,014	.0
August	2.47	70.4	93.7	995	.0
September	3.96	64.3	88.0	786	.0
October	3.37	52.0	78.7	477	.0
November	3.86	42.3	66.7	173	.0
December	4.45	35.3	58.1	76	0.2
Yearly:					
Average	-----	52.5	75.8	------	----
Total	46.90	-----	-----	5,887	1.5

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by two, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

The extreme high temperature was 110° in August 1909, and the extreme low temperature was -5° in February 1899. The extreme maximum precipitation was 25.44 inches in July 1933, and the extreme minimum precipitation was 0.00 inches in October 1963. This information was provided by the *Soil Survey of Harrison County, Texas*, the U.S. Weather Bureau in Shreveport, Louisiana, and the local recording station at the LHAAP fire station.

6.5 Petroleum and Minerals

Oil and gas production is significant in Harrison County, which lies within the East Texas Oil Field. The numerous oil and gas wells in the county are sources of income for many landowners. Oil and gas exploration, drilling, and servicing provide opportunities for employment.

Sandy material suitable for a number of industrial and specialty purposes is deposited in the county. Quartz sand is mined on stream terraces along the Sabine river and in deep deposits of the Carizzo Sand and Queen City Sand Formations. Gravel is mined on gravelly ridges in areas of the Reklaw and Weches Formations. These materials are used primarliy in construction projects.

Clay is mined in areas of the Wilcox and Reklaw Formations. Fired clay is used in the production of brick, pottery, tile, and fillers.

Lignite coal mining has become increasingly important in the county. Lignite has been mined in the county for many years, both in underground shaft mines and in open pits. Lignite is used in the production of activated carbon and is burned to generate electricity. (See *Soil Survey of Harrison County, Texas*, page 3.)

The Department of the Army owns the mineral rights on the LHAAP. Petroleum resources have been leased to SMK, Inc., which currently has one well in gas production and plans to drill two to three additional wells. The lease is administered by the Bureau of Land Management.

6.6 Soils

Soils on the LHAAP were investigated by the U.S.D.A. Soil Conservation Service (now the Natural Resource Conservation Service), in cooperation with the Texas Agricultural Experiment Station and the Texas State Soil and Water Conservation Board, in conjunction with the Harrison County soil survey. The major field work for this survey was done in 1988, and the survey was published as the *Soil Survey of Harrison County, Texas,* by the Soil Conservation Service, in October, 1994.

The latest soil information was gathered in a customized survey of the LHAAP conducted by Stephen F. Austin State University investigators. The results were compiled in a report entitled, *Longhorn Army Ammunition Plant Soil Survey, Summary Report,* in October, 1997. The soils on this installation belong to the Forested Coastal-Plains Problem Area and can be described as deep, acid, moundy, low in fertility, and mostly moderately drained.

The following table illustrates the map symbol, map unit name, drainage classification and other key features of the soils described in the *Longhorn Army Ammunition Plant Soil Survey, Summary Report* and illustrated on the Soil Map (Exhibit 7).

Table 6-2: SOIL FEATURES

Map Symbol	Map Unit Name	Slope Character	Woodland Suitability Group**
17	Aquents, clayey	submerged	---
75	Evadale-Cart complex	0-1%	2w9
107	Sardis-Mathiston complex	frequently flooded	lw9
109	Thage-Cart complex	0-2%	2w8
115	Guyton-Cart complex	0-1%	2w9
120	Iuka fel	frequently flooded	lw8
130	Wolfpen, lfs	2-5%	2s2

131	Larue lsf	2-5%	3s2
150	Bernaldo fel	1-3%	2o7
172	Wolfpen lfs	6-15%	2s2
192	Socagee sicl	frequently flooded	2w6
194	Meth fsl	1-3%	3o1
195B	Eastwood vfsl	1-5%	2c2
195E	Eastwood vfsl	5-20%	2c2
195G	Eastwood vfsl	20-45%	4r3
196	Latex fsl	1-3%	1o7
198	Scottsville vfsl	0-3%	lw8
203	Metcalf-Cart complex	0-2%	2w8

Table 6-3: SOIL MAP UNIT GUIDE

Map Symbol	Map Unit Name	Drainage	Hydric Soil	Capability Class	Wood Site Index
Cy	Cypress cl, submerged	very poorly	yes	8w	cypress
EaC	Eastwood vfsl, 1-5% slopes	moderately well	no	4e	93' loblolly
EaE	Eastwood vfsl, 5-20% slopes	moderately well	no	6e	86' loblolly
EcA	Erno-Cart cmpx, 0-2% slopes Cart part	well well	no no	2e 2e	100' loblolly 102' loblolly
GcA	Guyton-Cart cmpx, 0-1% slp Cart part	poorly well	yes no	4w 2s	hardwood 102' loblolly
Iu	Iuka fsl, freq. flooded	moderately well	no	5w	110' loblolly
LeB	Latex fsl, 1-3% slopes	well	no	2e	96' loblolly
McA	Metcalf-Cart cmpx, 0-2% slp Cart part	somewhat poorly well	no no	2w 2e	92' loblolly 102' loblolly
MeB	Meth fsl, 1-3% slopes	well	no	2e	85' loblolly
Sm	Sardis-Mathiston complex, freq. flooded Marthiston part	somewhat poorly somewhat poorly	no yes	5w 5w	107' loblolly 95' loblolly

that is either very cold or very dry.

There are no subclasses in class 1 because the soils of this class have few limitations. The soils in class 5 are subject to little or no erosion, but they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

In the Soil Map Unit Guide table the last column, entitled "Wood Site Index," provides information about the productivity of a soil series. Loblolly pine is the indicator species for soils that can be used for pine management. Sweetgum is the indicator species for soils that can be used only for hardwood management. The numbers in this column indicate the site index for the species given in feet at base age 50; therefore, the greater the number, the more productive is the soil.

**WOODLAND SUITABILITY GROUP SYMBOLS

1st Character - Site Index

1 - Loblolly pine & sweetgum 96+
2 - Loblolly pine & sweetgum 86-95
3 - Loblolly pine & sweetgum 76-85
4 - Loblolly pine & sweetgum 66-75

2nd Character

w - wetness
s - sandy
c - clayey
r - rocky or gravely
o - no restriction

3rd Character - Physical Limitation

1 - Slight limitation for pine
2 - Slight limitations for pine & hardwood
3 - Slight limitations for hardwood
4 - Moderate limitations for pine
5 - Moderate limitations for pine & hardwood
6 - Moderate limitations for hardwood
7 - Severe limitations for pine
8 - Severe limitations for pine and hardwood
9 - Severe limitations for hardwood

The *Soil Survey of Harrison County, Texas,* contains a general soil map and detailed soil maps. The general soil map shows the survey area divided into groups of associated soils called general soil map units, and is useful in planning the use and management of large areas. The primary general soils on the LHAAP are Scottsville and Iuka-Socagee-Sardis.

Scottsville soils are found on uplands, and are described as nearly level, moderately well-drained, loamy soils. They have a thin veneer of loamy sediments over clayey material. The underlying material is weakly consolidated siltstone and shale of the Wilcox Group. Slopes are zero to two percent.

Iuka-Socagee-Sardis soils are found on bottomlands, and are described as nearly level, moderately well-drained to poorly drained, loamy soils. They are subject to flooding and are wet for extended periods. They formed in recent loamy sediments derived from nearby sources, mostly of the Wilcox or Claiborne Groups. Slopes are zero to one percent.

6.7 Water Resources

LHAAP does not have a public water supply. Drinking water is obtained from two drilled wells; water is treated with chlorine at the pump. No water is provided for off-site users, and there are no non-potable wells with exception of shallow groundwater monitoring wells. Depth to groundwater ranges from zero to greater than six feet below the land surface, depending on topography and hydraulic location. The primary sources of fresh ground water in Harrison County are the Carrizo-Wilcox and Queen City-Reklaw aquifers. At LHAAP, the Carrizo-Wilcox aquifer is the major aquifer. The Wilcox Group is composed of fine and medium, crossbedded sand, shale, clay, lignite, and some minor or locally significant amounts of siderite, pyrite, and glauconite.

LHAAP is drained by numerous perennial and ephemeral streams that generally flow to the northeast. The perennial streams, Saunders Branch, Harrison Bayou, Central Creek, and Goose Prairie Bayou, as well as two intermittent streams, all drain directly into Caddo Lake. The extreme northwestern corner of LHAAP (on the northwest side of FM 2198, representing less than 25 acres) drains directly into Big Cypress Bayou.

Harrison Bayou, the largest interior drainage body, originates approximately ten miles to the southwest of LHAAP and three miles southeast of the town of Scottsville, in Harrison County. It drains the east central portion of the installation, including the area from 70th Street south to the plant boundary, the area south and west of the Signal Test Area, the area south and east of Landfill 16, and the area south and east of the HMX Area, and empties into Caddo Lake. The extreme eastern portion of LHAAP drains into Saunders Branch, which also empties into Caddo Lake. Caddo Lake empties into 12 Mile Bayou, which flows into the Red River in Louisiana.

The drainage system throughout the installation is a network of small drainage ditches emptying into three main arteries that discharge the run off water into Caddo Lake. These major channels are adequate to carry rains that will occur throughout the lifetime of this installation.

Location of drainage, contour elevations, and boundaries of principal on-post watersheds is found in the Appendix, Exhibit 8.

The LHAAP has been divided into drainage areas and flood zones (see Appendix Exhibit 8). Flood zones 1B, 2B, and 1C were flooded in May 1958. A number of roads and utility service lines were inundated. No buildings were flooded. Most damage was to bridge headwalls, roadbeds, pavements, steam line insulations, and sewers. In 1966 the same areas were flooded but the water level was not as high. Due to the Lake of the Pines Dam flood damage was less than in 1958. In June, 1986, a 6 inch rainfall occurred in a 3 hour time period, causing extensive damage to roads, bridges, fences, railroads, and fire lanes.

Flood zones 2C, and ID are subject to flooding when heavy upstream rainfall occurs. No other major damage or traffic problems have ever resulted.

The principal channels crossing the installation vary in width from 10 to 100 feet. The banks of the channels vary from 2 to 15 feet from water level.

The average percent slope of the drainage area on the northern portion of the installation is 3%. The drainage ditch that passes through Compartment II and flows in front of Plant Force 13 has a drainage area that averages 2% slope. The average slope of the Harrison Bayou drainage area is approximately 3%. The average slope of the existing channels is 0.5%. The vegetation cover on the channels is a grass cover. At the present time there are no storm drainage structures or tile drainage used on the installation.

The only tile used is as culverts, with a maximum length of 75 feet.

Wetland areas are indicated on the map in the Appendix Exhibit 9. Wetland areas are to be preserved in their present condition subject only to utilization under the Natural Resources Management portion of this plan.

6.8 Flora

Both upland and bottom land forest types are found on the installation and cover about equal areas. The upland forests are composed of pine (80%) and hardwood (approximately 20%). Common associates include gums, oaks, and hickories. The bottom land forests contain black gums, sweetgum, oak and bald cypress (50% or more) with southern pines (less than 25%). Common associated species include willow, ash, elm, hackberry and maple. The open fields are used for administrative purposes such as buildings, roads, and parking lots.

Principal trees, vines and shrubs in the woodland are listed in following table.

Table 6-4: TREES OF LHAAP

Common Name	Scientific Name	Common Name	Scientific Name
Shortleaf pine	Pinus echinata	Winged elm	Ulmus alata
Loblolly pine	Pinus taeda	Cedar elm	Ulmus crassifolia
Longleaf pine	Pinus palustria	Slippery elm	Ulmus rubra
Slash pine	Pinus elliottii	Water elm	Planera aquatica
Bald cypress	Taxodium distichum	Red mulberry	Morus rubra

Common Name	Scientific Name	Common Name	Scientific Name
Eastern red cedar	Juniperus virginiana	Bois d'arc	Maclura pomifera
Eastern cottonwood	Populus deltoides	Sassafras	Sassafras albidum
Black willow	Salix nigra	Sweet gum	Liquidambar styraciflua
Palmetto	Sabal minor	Sycamore	Platanus occidentalis
Black walnut	Juglans nigra	Mayhaw	Crataegus opaca
Sweet pecan	Carya illinoenses	Blueberry hawthorn	Crataegus brachyacantha
Bitter pecan	Carya aquatica	Mexican plum	Prunus mexicana
Mockernut hickory	Carya tomentosa	Redbud	Cercis canadensis
Pignut hickory	Carya glabra	Honey locust	Gleditsia triacanthos
Black hickory	Carya texana	Water locust	Gleditsia acquatica
Bitternut hickory	Carya cordiformis	Black locust	Robinia pseudoacacia
River birch	Betula nigra	American holly	Ilex americana
Blue beech	Carpinus caroliniana	Red maple	Acer rubrum
American hophornbeam	Ostrya virginiana	Sugar maple	Acer saccharum
Overcup oak	Quercus lyrata	Box elder	Acer negundo
White oak	Quercus alba	Basswood	Tilia americana
Cow oak	Quercus michauxii	Flowering dogwood	Cornus florida
Post oak	Quercus stellata	Blackgum	Nyssa sylvatica
Willow oak	Quercus phellos	Gum bumelia	Bumelia languinosa
Water oak	Quercus niger	Persimmon	Diospyros virginiana
Blackjack oak	Quercus marilandica	Sweetleaf	Symplocos tinctoria
Southern red oak	Quercus falcata	Silver-bell	Halesia diptera
Cherry bark oak	Quercus pagodaefolia	Green ash	Fraxinus pennsylvanica
Shumard oak	Quercus shumardii	Catalpa	Catalpa bignonioides

Common Name	Scientific Name	Common Name	Scientific Name
Black oak	Quercus velutina	Chinaberry	Melia azedarach
Sugar hackberry	Celtis laevigata	Toothache tree	Zanthoxylum clavaherculis
American elm	Ulmus americana		

The following table provides a listing of the common shrubs found on the LHAAP, showing both the common and scientific names.

Table 6-5: SHRUBS OF LHAAP

Common Name	Scientific Name	Common Name	Scientific Name
Wax myrtle	Myrica cerifera	Pawpaw	Asimina triloba
Parsely hawthorn	Crateagus marshallii	St. Andrews Cross	Ascyrum hypericoides
Green hawthorn	Crateagus viridis	French mulberry	Callicarpa americana
Chicasaw plum	Prunus augustifolia	Elderberry	Sambucus canadensis
Crab apple	Malus augustifolia	Eastern bacharis	Baccharis hamimifolia
Winged sumac	Rhus copallina	Winter huckleberry	Vaccinium arboreum
Smooth sumac	Rhus glabra	Summer huckleberry	Vaccinium elliottii
Deciduous holly	Ilex decidua	Swamp privet	Forestiera acuminate
Yaupon	Ilex vomitoria	Common privet	Lequstrum japonicum
Carolina buckthorn	Rhamnus caroliniana	Strawberry bush	Euonymus americana
Rusty blackhaw	Viburnum rifidulum	Fringe tree	Chionanthus virginicus
Red buckeye	Aesculus pavia	Trifoliate orange	Poncirus trifoliata
Devil's walkingstick	Arlalia spinosa		

The following table provides a listing of the common vines found on the LHAAP, showing both the common and scientific names.

Table 6-6: VINES OF LHAAP

Common Name	Scientific Name	Common Name	Scientific Name
Poison ivy	Toxicodendyon radicans	Trumpet creeper	Bigonia radicans
Pepper vine	Ampelopsis arborea	Cross vine	Bianonia capreolata
Grape	Vitis sp.	Yellow jasmine	Gelsemium sempervirens
Virginia creeper	Parthenocissus quinquefolia	MaCartney rose	Rosa bracteata
Green briar	Smilax sp.	Cherookee rose	Rosa laevigata
Rattan	Berchemia scandens	Poison oak	Toxicodendron quercifolia
Honeysuckle	Lonicera japonica		

The following table provides the common and scientific names of the principal grasses and herbs on the LHAAP.

Table 6-7: GRASSES AND HERBS OF LHAAP

Common Name	Scientific Name	Common Name	Scientific Name
Broom sedge	Andropogon virgincus	Pokeberry	Phytacca americana
Bermuda	Cynodon dactylon	Whiteheath aster	Aster pilosus
Switch cane	Arundinaria tacta	Bitterweed	Helenium amarum
Crab grass	Digitaria sanninalis	Dandelion	Taraxacum officinale
Dallis grass	Paspalus dialatatinum	Goldenrod	Solidago sp.
Vasey grass	Paspalum urvillei	Lambs quarters	Chenopodium album
Signal grass	Brachiaria sp.	Horseweed	Erigeron canadensis
Johnson grass	Sorghum halepense	Nutsedge	Cyperus sp.
Crimson clover	Trifolium incarnatum	Maypop	Passiflora incarnata
Ball clover	Trifolium nigresens	Mayflower	Podophyllum peltatum
White clover	Trifolium repens	Yellow woodsorrel	Oxalis stricata

Common Name	Scientific Name	Common Name	Scientific Name
Partridge pea	Cassia faciculata	Dockweed	Rumex sp.
Beggar weed	Desmodium tortuosum	Poorjoe	Diodia teres
Hemp sasbania	Sesbania exaltata	Horse nettle	Solanum carolinense
Rattle box	Sesbania vesicaria	Jimson weed	Datura stramonium
Common ragweed	Ambrosia artemisifolia	Giant ragweed	Ambrosia trifida

Successional vegetation trends on LHAAP are evident in all woodlands. When land was purchased for construction in 1942, the predominant land uses were cotton farming and private woodlots. Just prior to acquisition, the timber stands were heavily cut, removing most of the merchantable trees. Most open areas were initially grazed by cattle, but have been reforested by either natural regeneration or tree planting. The first commercial planting of pine occurred in 1946, when 55 acres were planted. In the early 1960s, an extensive reforestation project accomplished 1200 acres of planting loblolly pine in old pastures. In 1974 and 1975, approximately 166 acres of previously mowed areas, primarily in the production areas, were planted.

Jurisdictional wetlands were identified and a functional assessment performed on Harrison Bayou within the confines of LHAAP in a research study conducted by the Stephen F. Austin State University College of Forestry. The study was published in October, 1997, and titled "The Wetland Identification and Functional Assessment of Plant Communities in Harrison Bayou." Wetland communities were identified adjacent to Harrison Bayou and Caddo Lake. Wetland (hydrophytic) vegetation was found on over 95% of Harrison Bayou. Plant communities that were observed to have indicators of wetland hydrology also had indicators of hydric soil. Anthropogenic alterations in hydrology within the Caddo Lake/Big Cypress Bayou watershed give cause to question whether the Harrison Bayou watershed currently has the timing, frequency and duration of flooding required to meet the jurisdictional wetland hydrology criteria.

A study done by William J. Sheffield, Ph.D., of the Texas Parks and Wildlife Department in cooperation with the U.S. Army Corps of Engineers, identified the major land and cover types within the Big Cypress Bayou watershed. This study, published in 1995 and entitled "A Summer-Fall Ecological Reconnaissance of the Big Cypress Bayou Watershed, Texas and Louisiana," identified ten natural plant communities that require special attention within the watershed, a number of which may occur on the LHAAP. The following table provides the common name and federal and state status of these communities.

Table 6-8: Natural Plant Communities that Require Special Attention

Big Cypress Bayou Watershed, Texas

Common Name		Status Federal	State
Shortleaf Pine-Oak Series		G4	S4
Water Oak-Willow Oak Series		G2	S3
Sporobolus Silveus Dropseed Series		G2	S2
American Beech-White Oak Series		G3	S2
Sweetbay-Magnolia Series		G4	S4
Longleaf Pine-Little Bluestem Series		G3	S2
Swamp Chestnut Oak-Willow Oak Series		G3	S3
Post Oak-Black-Hickory Series		G4	S3
Baldcypress-Water Tupelo Series		G4	S3
Sugarberry-Elm Series		G4	S4

Following is an explanation of the status codes used in the above table:

G2 - Imperiled globally, very rare, six to 20 occurrences. (Endangered throughout range.)
G3 - Very rare and local throughout range or found locally in restricted range, 21 to 100 occurrences. (Threatened throughout range.)
G4 - Apparently secure globally.
S2 - Imperiled in state, very rare, vulnerable to extirpation, 6 to 20 occurrences.
S3 - Rare or uncommon in state, 21 to 100 occurrences.
S4 - apparently secure in state.

LHAAP is located within the Southeastern Mixed Forest Province. Within LHAAP's boundary, bottomland hardwood, upland hardwood, upland pine and open fields occur and require different management strategies. The "ecosystem" to be managed is difficult to define and depends upon the scale considered. Management strategies are discussed in the appropriate section of this plan.

6.9 Fauna

In previous years, most of the wildlife management effort has been directed toward improving the habitat for white-tailed deer. Some small game species management has occurred, including squirrel and wood duck nest box installations and grain plantings for quail. The Texas Parks and Wildlife Department cooperates in evaluating the wildlife populations on the LHAAP.

A vertebrate survey was conducted on the LHAAP in 1996 and 1997 by Robert R. Fleet and R. Montague Whiting, principal investigators for the Stephen F. Austin State University as part of the Texas Regional Institute of Environmental Studies in support of military installations. Vertebrates surveyed included herptiles, birds, and mammals. The surveys found 45 species of herptiles, including 19 species of snakes, 11 species of anurans, six species of salamanders, five species of turtles, and four species of lizards. The bird censuses, conducted in the winter and spring of 1996 and 1997, found 70 species. The most common species observed in the winter were the pine warblers *(Dendroica pinus)*, but in the spring the red-eyed vireo *(Vireo olivaceous)*, a neotropical migrant, was the most observed bird species. Resident birds that were frequently recorded in both seasons included Carolina wrens *(Thyrothorus ludovicianus)*, Carolina chickadees *(Parus carolinensis)*, northern cardinals *(Cardinalis cardinalis)*, and the tufted titmouse *(Parus bicolor)*. The survey also found ten species of small mammals in 1996 and 1997. Of over 900 specimens captured, 85% of them were of four species: three mice species (the white-footed mouse, *Peromyscus leucopus,* the cotton mouse, *Peromyscus gossypinus,* and the golden mouse, *Ochrotomys nuttali),* and the short-tailed shrew, *Blarina brevicauda.*

Livestock grazing has occurred in the past on LHAAP, but it is no longer permitted. The only known exotic animals found on LHAAP thus far are the nutria, *Myocastor coypus*, and ubiquitous rock dove, *Columba livia*, European starling, *Sturnus vulgaris*, and house sparrow, *Passer domesticus*.

6.10 Threatened and Endangered Species

LHAAP has no state- or federally-listed endangered, threatened, or candidate species.

7.0 LAND USES AND MANAGEMENT UNITS

7.1 Land Uses

Multiple uses of land within the boundary of LHAAP often overlap. Land includes the unused munitions production areas, munitions storage areas, ammunition destruction areas and test areas, which is where restoration and remediation efforts are concentrated. The buffer areas at LHAAP were and still are managed forest areas. Upon closure of the installation, there are now more areas that can be subjected to natural resources management. There are no agricultural leases on LHAAP.

7.1.1 Munitions production areas

The Army's initial plans for LHAAP were to construct a six-line special TNT plant, but only five were constructed and operated. Construction for a three-line JB-2 propellant fuel facility known as Plant 2 was begun in November, 1944, but construction was halted in August, 1945, when the facility was 90% completed. Plant 2 was reactivated and rehabilitated for Korean War pyrotechnics production, and produced a wide variety of munitions before production was discontinued in April, 1956.

Construction on a facility to produce solid-fuel rocket motors for tactical missiles, known as Plant 3, began in July, 1953, and was completed in December, 1953. The first live propellant was produced in December, 1954, and production continued until early 1971. Pershing P1A motors were produced during fiscal years 1979-80. An expansion project to produce Surface Launched Unit/Fuel Air Explosive rocket motors was funded in 1982. LHAAP was the leading producer of Infrared (aircraft counter-measures) Flares for both the Army and the Air Force in the 1980s. All munitions production ceased in 1995, and LHAAP is inactive, excess installation. The production facilities and their associated open areas total 242 acres.

7.1.2 Munitions storage areas

The munitions storage area occupies 160 acres. As munitions storage no longer occurs, active forest management is conducted within the area.

7.1.3 Munitions destruction area and test areas:

There is one burning grounds area and three test areas on LHAAP: the Ground Signal Test Area, the Static Test Area, and the Plant 2 Test Area. These areas occupy 53 acres, and since they are no longer used for their intended purposes they are available for forest management..

7.1.4 Industrial support facilities

Industrial support facilities on the LHAAP include a railroad classification yard, a shops area, a power area, a gas metering station, and a warehouse. Additional facilities that indirectly supported the production operations are the administration area, a pistol range, two sanitary landfills, and a construction waste landfill.

7.1.5 Managed forest land

Total managed forest land occupies 5,930 acres. Managed forest types include bottomland and upland hardwood (1,653 acres), mixed hardwood-pine (517 acres), mixed pine-hardwood (1,752 acres), and upland pine (3,430 acres). Forested areas are subdivided into 40 woodland management units for planning purposes (see Exhibit 10).

7.1.6 Hunting areas

Managed forest areas provide approximately 5,930 acres for hunting throughout the installation. There is no use by the general public of fish or wildlife resources at LHAAP except as deer hunters during deer season. Other than these occasions, hunting and fishing is not permitted for safety reasons.

7.2 Management Units

The management units utilized for natural resource management on LHAAP are the woodland management units, as there are no agricultural leases or hunting zones.

The managed forest land on LHAAP is divided into 40 woodland management units (cutting units). Unit boundaries utilize natural features such as streams and man-made features such as roads, fences, fire lanes and utility rights-of-way (see Exhibit 10). Individual cutting unit folders are maintained in the Natural Resource Manager's office.

8.0 NATURAL RESOURCES MANAGEMENT

8.1 Objectives

The objective of the natural resources management program is to support the military mission. As LHAAP is an excess installation with no active military mission, management needs are minimal and focused on maintaining the facility at an acceptable level, environmental restoration and excessing the property at the earliest possible time. Therefore, the scope of the natural resources effort will be concentrated on supporting current installation needs, health of the resources and compliance with applicable environmental laws. The major objective of this chapter is to specifically identify major decisions used to manage LHAAP's natural resources during the next five years. Data gaps are evident in some areas, but where data gaps exist, corrective actions are specified. The secondary objective of this chapter is to assure all management actions of each subchapter are integrated with management actions of the other subchapters. This plan attempts to integrate all natural resource programs toward the accomplishment of stated goals and policies in Chapter 1.

8.2 Forest Management

8.2.1 Overview

Natural resource management has come under increased public scrutiny in recent years with increased public awareness of natural resource values. Timber production is no longer the primary forest management objective. Biodiversity of forest lands, and planning for non-commercial forest lands are recognized as important forest management goals. Potential historic sites, natural communities containing rare plant or animal species, and wetlands all influence management strategies for forest lands. LHAAP's forest management planning does not delete timber production from the range of desired results, but attempts to integrate management planning to compliment objectives of other sections of the INRMP. Specific forest management activities are planned to meet objectives of other natural resource needs (ie., wetlands management).

8.2.2 History

The land the government acquired for the installation in 1942 was made up of cotton farms and private woodlots. Just prior to acquisition the timber stands were heavily cut, removing most of the merchantable trees. Since that time, the growing stock has been increasing. Most open areas were initially grazed by cattle, but have been reforested by either natural or artificial (tree planting) regeneration methods so that sawtimber stands now exist in most of these areas.

LHAAP forest management activities began with the first tree planting of loblolly and shortleaf pines in 1946. Early forest management activities included periodic improvement thinnings and harvest cuts, reforestation on old field sites, and periodic controlled burning. Additional management activities that have occurred to a lesser extent include timber stand improvement treatments and pine release treatments.

8.2.3 Forest Description

LHAAP's forest land is predominately upland pine (47 %), but significant acreages of pine-hardwood, hardwood, and hardwood-pine also occur. The table below illustrates the acreage for each forest type along with the percentage each type represents of the total acreage under management.

Table 8-1: FOREST TYPES AND SIZE

Forest Type	Acres	% of Total
Pine	3430	47
Pine-Hardwood	1752	24
Hardwood	1653	22
Hardwood-Pine	517	7
Total	7352	100

The primary commercial tree species are loblolly pine, shortleaf pine, sweetgum, black gum, various oak species, ash and baldcypress. Pine stands have been managed on an even-aged basis, although different age groups and size classes occur within stands. This type of management has been termed group even-aged management, and it relies upon natural regeneration methods, principally shelterwood and seed-tree methods.

8.2.4 Inventories

LHAAP's last complete forest inventory was performed in 1992 by a forester employed by Thiokol Corporation, which at that time was the contractor-operator of the facility. Ongoing inventory cruises are being conducted by the forestry technician, and include information on sawtimber volumes, species stocking tables, regeneration, basal area and forest type. Since the last Natural Resources Management Plan was completed in 1993, changes in Dept. of Defense land management policy make new planning necessary. A Cultural Resources Management Plan was completed for LHAAP in December, 1996.

8.2.5 Management Strategies

General: Management strategies for LHAAP forest land include all forest uses and desired objectives of the INRMP, including timber production, timber sale planning, timber stand improvement (TSI), and stocking levels. Forest stand types and desired age classes will be considered when selecting harvest and reforestation methods. The major timber crops to be grown are pine and hardwood sawtimber, but substantial volumes of pine and hardwood small roundwood will be harvested through intermediate thinnings. Speciality products such as pine, baldcypress and cedar poles and sawtimber may occasionally be sold as well when market prices treatments and pine release treatments.

8.2.3 Forest Description

LHAAP's forest land is predominately upland pine (47 %), but significant acreages of pine-hardwood, hardwood, and hardwood-pine also occur. The table below illustrates the acreage for each forest type along with the percentage each type represents of the total acreage under management.

Table 8-1: FOREST TYPES AND SIZE

Forest Type	Acres	% of Total
Pine	3430	47
Pine-Hardwood	1752	24
Hardwood	1653	22
Hardwood-Pine	517	7
Total	7352	100

The primary commercial tree species are loblolly pine, shortleaf pine, sweetgum, black gum, various oak species, ash and baldcypress. Pine stands have been managed on an even-aged basis, although different age groups and size classes occur within stands. This type of management has been termed group even-aged management, and it relies upon natural regeneration methods, principally shelterwood and seed-tree methods.

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Species to be grown: The major species managed and the reason for selection are as follows:
- Loblolly pine *(Pinus taeda)* - Loblolly pine is the most common tree species on LHAAP, and it is marketable for both small roundwood (pulpwood) and sawtimber. It grows well on the LHAAP's upland sites and is also found in riparian, and to a lesser extent, in bottomland areas.
- Shortleaf pine (*Pinus echinata)* - Shortleaf pine is one of the principal tree species on LHAAP and is marketable for both small roundwood and sawtimber. It does well on the facility's upland sites, where it competes primarily with loblolly pine.
- Oaks *(Quercus sp.)* - While there are ten or more species of oaks that grow on the LHAAP, the principal commercial species are white oak *(Q. Alba),* cherrybark oak *(Q. pagodaefolia),* Shumard oak *(Q. shumardii),* black oak *(Q. velutina),* water oak *(Q. niger)*, willow oak *(Q. phellos),* and southern red oak *(Q. falcata).* The value of oak species, and hardwoods in general, is highly dependent upon log grade; high grade logs bring a premium price, but low grade logs are difficult to sell at all. The oaks can be high value species, especially on the better sites, and they are also an excellent source of hard mast.

Minor pine species: Two additional pine species occur on LHAAP in small numbers: longleaf pine *(Pinus palustrus)* and slash pine *(Pinus elliottii).* Slash pine is not native to the east Texas area; it was planted years ago when seedlings of native pine species were scarce or unavailable. It is also unlikely that longleaf pine is native to the LHAAP, although it does occur naturally in east Texas. These species have similar wood properties to loblolly and shortleaf pine, and can be sold with these species in intermediate or regeneration harvests.

Miscellaneous species - These species occur naturally, primarily in hardwood-pine or hardwood stands. Lower value species are removed from stands during harvests as soon as they reach merchantability unless they are needed for mast production or to maintain biological diversity.

Sweetgum - *Liquidambar styraciflua*
Baldcypress - *Taxodium distichum*
Eastern redcedar - *Juniperus virginiana*
Eastern cottonwood - *Populus deltoides*
Black willow - *Salix nigra*
Black walnut - *Juglans nigra*
Mockernut hickory - *Carya tomentosa*
Pignut hickory - *Carya glabra*
Bitternut hickory - *Carya cordiformis*
Black hickory - *Carya texana*
Overcup oak - *Quercus lyrata*
Cow oak - *Quercus michauxii*
Post oak - *Quercus stellata*
Blackjack oak - *Quercus marilandica*
American elm - *Ulmus americana*
Slippery elm - *Ulmus rubra*
Black gum - *Nyssa sylvatica*
Green ash - *Fraxinus pennsylvanica*

River birch - *Betula nigra*

- **Rotation ages:** Listed rotation ages are for species' age at final harvest. Commercial thinnings and improvement cuttings during the rotation may be conducted if economic factors warrant harvesting. Stands with low merchantability may remain up to 50 years before final harvest. Rotation ages represent an average stand age at final harvest.

Table 8-2: HARVEST ROTATION AGES

Loblolly pine	50 years
Shortleaf pine	60 years
Baldcypress	150 years
All other hardwoods	80 years

- **Cutting Cycle:** Pine stands have a seven year cutting cycle in order to optimize growth and produce quality products. Hardwood stands have a fifteen year cutting cycle due to their slower growth rates.

- **Silvicultural System:** An all-aged forest management system utilizing both even-aged and uneven-aged harvesting methods will be employed. Determination of harvesting method will be based upon stand condition prior to harvest, species composition desired for regeneration, and other considerations such as wildlife habitat needs.

    Pine - Pine is a native species on LHAAP and is found in both natural stands and plantations. Pine stands are managed as even-aged stands even though trees of different age groups, size classes, and product utility are found in many of them. This is termed group even-aged management and is used in the management of natural pine stands. These stands are regenerated with either the shelterwood or seed-tree harvesting methods. Competing hardwoods are reduced through cutting, TSI, and prescribed burning to facilitate successful pine regeneration.

    Pine stands that were established through planting or seeding are managed with an even-aged system. These stands are grown to sawtimber maturity and then artificially regenerated after the final harvest.

    Hardwood - Hardwood stands are managed to produce sawtimber of predominant species on the site unless other management requirements have priority. All hardwood stands are managed as all-aged, multi-species stands. Dominant species and advanced reproduction present on each site will determine the necessity, frequency, and type of intermediate harvests.

    Intermediate cuttings will be used very sparingly, since damage by logging equipment and tree-length skidding is a significant risk in hardwood stands. These harvests will be made to remove poor quality dominants and intermediate and suppressed trees of merchantable size. Some intermediate trees may be retained if they have good form and may be needed for future crop trees.

Hardwood stands with high percentages of oaks are desirable since they are beneficial for wildlife and have high value as wood products. However, harvesting practices prior to government acquisition generally removed all the merchantable oak species without providing for their regeneration, so that current oak stocking is likely much less now than 60 years ago.

Hardwood stands with desirable oaks as dominants will be managed for advanced oak reproduction in the understory before final harvest. A preparatory cut to remove 20-40% of the overstory will allow establishment of advanced oak regeneration. An insufficient cut will allow shade tolerant species such as hickory and maple to dominate the understory. A proper preparatory cut will allow oak regeneration to develop necessary root systems to compete successfully with faster growing, less desirable species.

Hardwood stands that are not predominantly oak are managed for the most valuable species on the site. Environmental, silvicultural, and economic factors for each site will determine when and how these stands are harvested.

8.2.6 Years in Cutting Cycle

Pine timber sales are conducted annually. Harvesting is in different management units each year and scheduled so that each stand is entered every seven years. Sufficient volumes of hardwood sawtimber and pulpwood are not available in every management unit; therefore, hardwood sales often involve several management units. Sales of speciality products are made when markets are available. The present cutting cycle is based upon the 1992 inventory.

8.2.7 Harvest Schedule

Annual timber sales of pine sawtimber and pulpwood are conducted. Periodic sales of hardwood sawtimber and pulpwood are made when sufficient volumes of merchantable material are available. The approximate volume for harvest in the next five years is as follows:

- **Pine sawtimber – 800 mbf**
- **Hardwood sawtimber – 40 mbf**
- **Pine pulpwood – 800 cds.**
- **Hardwood pulpwood – 400 cds.**
- **Specialty products** - Merchantable quantities whenever markets are available.

All timber sales will have sufficient total volume and per acre volume to attract the highest possible bid for the products offered. Pine sawtimber sales will have a minimum sale volume of 75 MBF and a minimum average per acre volume of one MBF. Hardwood sawtimber sales will have a minimum total volume of 100 MBF and a minimum average per acre volume of 1.2 MBF. Pine pulpwood sales will have a minimum total volume of 100 cords and a minimum average per acre volume of five cords. Hardwood pulpwood sales will have a minimum total volume of

150 cords and a minimum average per acre volume of five cords.

Salvage sales are occasionally necessitated by southern pine beetle outbreaks, fire mortality or storm events that damage and blow down portions of the forest. While salvage sales may not fit the merchantability specifications above, they are made when necessary to recover a portion of the lost value of the dead, damaged or dying trees.

Efforts will be made to harvest timber during times of year and conditions that will minimize impacts on non-game species, such as migratory birds and herptiles, and limit unintentional take of migratory birds per Executive Order 13186 -- Responsibilities of Federal Agencies To Protect Migratory Birds.

8.3 Agricultural/Grazing Outleases

No agricultural outleasing has been done on LHAAP, and none is planned.

8.4 Habitat Management

Habitat management in some form is practiced on most areas of the installation. Those forms of habitat management specific to land use are as follows:

- **Road shoulder mowing:** to reduce deer-vehicle collision hazard.
- **Prescribed burning:** as a silvicultural tool to favor fire-dependent species such as pine on upland sites, with an additional benefit of stimulating quality forage and browse for wildlife; to reduce the fire hazard by consuming fuels that accumulate over time. Due to funding and staff constraints, prescribed burns will only be conducted if LHAAP obtains assistance from the FWS and/or State forestry/wildlife agency.

No discing, mowing, or brush cutting has been done for habitat improvement. Past TSI treatments involving injecting brush and small hardwood trees with herbicides favors grass and herbaceous vegetation, in turn benefiting several wildlife species. No fish management work has ever been done on LHAAP.

8.5 Game Harvest Management

All public access is denied during the current period of increased security. Public access will be strictly controlled thereafter, due to safety concerns. The Texas Parks and Wildlife Department (TPWD) conducts surveys of game species and makes recommendations on harvest quotas to the Commander's Representative, who approves and institutes them through his Security Officer. Law enforcement is the responsibility of the state and federal game warden. Policing the harvest is the job of the Contractor Security personnel and the Army Security Officer. Hunting seasons for game species are established by the TPWD.

Population trends for game species on the LHAAP are as follows:

Table 8-3: GAME SPECIES POPULATION TRENDS

Species	Population Trend

Species	Population Trend
White-tailed deer	Stable
Squirrel	Decreasing
Quail	Decreasing
Waterfowl	Stable
Turkey	Decreasing

8.6 Rare, Threatened, or Endangered Species Management

LHAAP has no RTE species which require an Endangered Species Management Plan (ESMP). The vertebrate survey conducted on the LHAAP in 1996 and 1997 (see subchapter 6.8), which included surveys for herptiles, birds, and mammals, found no state or federal RTE species. Surveys for endangered plant or animal species have been conducted jointly by the TPWD, the USFWS, and SFASU personnel.

8.7 Furbearer Management

No species-specific management actions are taken for furbearers on LHAAP. All furbearers occurring on LHAAP are subject to TPWD game regulations.

8.8 Other Nongame Species Management

Wildlife habitat management on LHAAP has focused on game species, principally white-tailed deer, and no management practices have been undertaken to enhance habitat for nongame species. Although, many habitat management activities on LHAAP have benefited the many non-game species found on the installation.

8.9 Relocation and Re-introductions

LHAAP has not participated in any species relocation or re-introduction efforts with any state or federal agencies.

8.10 Wetlands Management

No waterfowl impoundments have been constructed at LHAAP due to lack of funding. There are numerous areas on and around LHAAP where wood duck nest, and it appears that there are sufficient nesting sites available for them so that installation of nest boxes is not necessary. No marshland improvement work has ever been done on LHAAP.

A project to identify wetlands and assess plant communities within Harrison Bayou within the confines of LHAAP was conducted in 1997 by researchers with the Stephen F. Austin State University Arthur Temple College of Forestry. Wetland vegetation communities were identified according to the U.S. Army Engineers 1987 Wetland Identification and Delineation Manual. Six plant communities were identified as wetlands, comprising approximately 51% of the Harrison Bayou study area. Marsh areas that have good potential to meet wetland criteria but have not been assessed are shown on the map in Appendix Exhibit 9. Other potential wetlands have not been identified or assessed on LHAAP.

The state of Texas has a voluntary Best Management Practices (BMPs) program for forestry. These BMPs include guidelines and recommended specifications for the practices outlined in the Guidelines. Due to the importance of forested wetlands in providing wildlife habitat, filtering silt, recharging groundwater, and reducing flooding downstream, extreme care is needed when working in these areas. In all forestry operations Texas BMPs (both the guidelines and recommended specifications) for Streamside Management Zones will be utilized for wetlands, since there are no BMPs specifically for wetlands.

8.11 Harrison Bayou Special Management Area

Harrison Bayou is the largest perennial stream flowing through LHAAP. LHAAP borders Caddo Lake and Big Cypress Bayou, which are much larger water bodies, but has no jurisdiction over their management. Harrison Bayou originates approximately ten miles to the southwest of LHAAP and three miles southeast of the town of Scottsville, in Harrison County. It drains the east central portion of the installation, including the area from 70th Street south to the plant boundary, the area south and west of the Signal Test Area, the area south and east of Landfill 16, and the area south and east of the HMX Area, and empties into Caddo Lake.

Harrison Bayou is a bottomland hardwood area that has been minimally impacted by man as compared to the rest of east Texas. When logging companies first began operating in the Caddo Lake area, there were many bottomland hardwood sites that were not harvested due to their inaccessibility and the primitive logging equipment used at the time. By the time logging methods had developed to enable harvesting of these bottomland sites, much of Harrison Bayou had been incorporated into LHAAP and was not harvested. Most of Harrison Bayou within the confines of LHAAP has been set aside in a reserve to preserve its relatively pristine character, as it is probably the best example in east Texas of how bottomland hardwood forests may have appeared at the time of European settlement. The reserve encompasses approximately 1,113 acres within all or portions of ten Management Units (Management Units 11-13, 15, 32, 33, 35, 36, 38 and 40).

8.12 Water Quality Management

LHAAP does not own or operate any industrial wastewater treatment plants or sewage treatment plants. Groundwater contamination at the burning ground, landfill, and production areas is currently under Remedial Investigation Feasibility Study, a CERCLA action.

8.13 Land Rehabilitation and Maintenance

LHAAP does not have military training, so land rehabilitation and maintenance needs are minimal. Any timber harvesting ground disturbing activities such as road reconstruction and log landings will be restored by the timber purchasers.

Mathiston soils occur in a complex with Sardis soils and are frequently flooded, somewhat poorly drained and moderately permeable. Metcalf soils occur in a complex with Cart soils on nearly level (0-2% slope) uplands. Metcalf soils are silt loams that are somewhat poorly drained and very slowly permeable. Scottsville soils are very fine sandy loams on uplands, are moderately well drained and very slowly permeable. All other soils on the LHAAP have slight equipment limitations.

The areas that are vulnerable to erosion are newly constructed earthen barricades with slopes of 2 to 1. Other areas, ordinarily less extensive but requiring attention, are road and ditch embankments. All of the erosion on these areas are caused by water run-off. One area in Management Unit 3 is currently being restored and revegetated; no other active soil erosion areas have been identified.

The following methods are used to correct erosion: smooth and level surface with equipment or by hand; fertilize with a complete fertilizer such as 10-20-10 in sufficient quantities to place 2 pounds of nitrogen per 1000 square feet; seed with 1 pound of bermuda and 1 pound of Kobe lespedeza seed per 1000 square feet in the spring or early summer. If in fall or late winter, use rye grass in place of bermuda. On-site construction projects by contractors and in-house work require implementation of BMPs such as mulching, reseeding, sediment fences and silt basins.

8.15 Cantonment Area Management

Due to the current status of LHAAP, there is no grounds maintenance.

8.16 Pest Management

8.16.1 Overview

Insect and disease problems on the LHAAP have historically been very minor. Past corrective actions have been taken only to control aphid infestations on oak shade trees in the Administrative Area and to control pine bark beetle infestations in forested areas. For the next 5 years, pest control will be limited to maintaining forest health and complying with Federal and State statutes regarding noxious weeds. Efforts will be made to identify any forest pests that are impacting the resources and implementing control measures.

8.16.2 Integrated Pest Control Strategies

8.16.2.1 General

An investigation of forest insects and diseases, primarliy of the pine resource, on LHAAP was conducted by researchers from the Arthur Temple College of Forestry at Stephen F. Austin State University and completed in 1997. This study developed a pest management hazard rating system for southern pine beetle *(SPB), Dendroctonus frontalis* Zimmermann, Nantucket pine tip moth (NPTM), *Rhyacionia frustrana* (Comstock), fusiform rust, *Cronartium quercuum* (Berk.) Miy. ex Shirai f. Sp. *fusiforme,* and annosus root rot, *Heterobasidion annosum* (syn. *Fomes annosus* (Fries) Karst.) (Aphyllophorales, Polyporaceae). A synopsis of the study for each of the

The 1997 SFA study conducted aerial videography to use in hazard rating stands for SPB. A stand mosaic of the aerial video was constructed, but due to time constraints was not completed through ground checking. Preliminary data showed that high hazard stands were present on the LHAAP.

Historical information on SPB infestations on LHAAP is not available. The Texas Forest Service Pest Control unit in Lufkin, Texas, provided a listing of SPB infestations reported in Harrison County from 1967 through 1998 (see Exhibit 12). The data shows that there have been many years in which no SPB infestations were reported, and a few fews when large numbers of infestations were reported. There were only seven years in which any infestations were reported; these years, with the number of reported infestations in parentheses, were 1993 (10), 1987 (118), 1986 (944), 1985 (12), 1977 (118), 1976 (241), and 1975 (9). While this data is for Harrison County, it is likely that some infestations occurred on LHAAP in 1986, and perhaps in some of the other years as well.

8.16.2.3 Nantucket Pine Tip Moth

The Nantucket pine tip moth (NPTM), *Rhyacionia frustrana* (Comstock), is an important insect pest of pines in the eastern U.S. Both loblolly and shortleaf pines are susceptible to its attack, but when loblolly and shortleaf grow adjacent to one another shortleaf is more seriously injured. Longleaf pine is resistant to attack, and slash pine is somewhat resistant as well.

Pine plantations and natural seedlings in open areas are susceptible to NPTM during early growth, generally up to five years of age. Populations of tip moths and numbers of damaged tips vary according to site and stand factors and tree species. Adult moths lay eggs in the succulent shoots at the branch tips; the eggs hatch, and the larvae feed on the shoots, usually killing them. Indications of tip moth damage are browning, curling and dieback of infested tips. Damage can be classified four categories as follows:

1. Deformation of host tree
2. Loss or retardation of host growth
3. Reduction of cone crops
4. Mortality of infested trees under severe instances

Rate of tip moth infestation is directly related to the degree of intensity of site preparation, with greatest infestation occurring on sites most intensively prepared. Open-grown stands have higher infestation rates compared to those grown under some type of cover, such as a seed-tree or shelterwood cut. Those tree species that are most susceptible to NPTM should be planted only on sites for which they are well adapted. Marginal sites with poor moisture and nutrient conditions leading to low productivity should be regenerated to a more suitable species. Encouraging rapid growth enables host trees to reach a threshold height, approximately 4.5 meters, sooner, beyond which trees become less susceptible to attack. On sites where nutrients are limiting, fertilization may increase pine growth as well as lower tip moth density. Highly productive sites also promote rapid host recovery from damage and reduced time spent in susceptible stages.

Several insecticides are registered for tip moth control, although their use is generally not economically feasible except for high value trees such as ornamentals or Christmas trees. LHAAP has few large areas of pine regeneration where NPTM could make a noticeable impact. Preventative management through the use of proper cultural practices such as matching species to the site and using natural regeneration, is probably the best control method.

8.16.2.4 Fusiform Rust

Fusiform rust, *Cronartium quercuum* (Berk.) Miy. ex Shirai f. sp. *fusiforme,* is a destructive forest disease throughout the southern U.S. Disease incidence and hazard varies geographically. Longleaf pine is relatively resistant to the disease, and shortleaf pine is practically immune. However, loblolly and slash pine are very susceptible to fusiform rust, and in some high-hazard areas it can be economically impossible to manage these species.

Fusiform rust has a complex life cycle, often requiring two or more years to complete. Pines are the initial host, oaks are an intermediate host, and then pines are re-infected. The intermediate hosts of the disease are within the black oak group, commonly water oak (*Quercus nigra* L.), willow oak *(Quercus phellos* L.*),* and laurel oak *(Quercus laurifolia* Michx.*)*. Infection of the pines takes place through the needles of succulent stems in the spring. Research suggests that disease incidence varies in proportion to the intensity of forest management and is greatest where pine and oak distributions maximally coincide.

Fusiform rust is the most common disease affecting survival of loblolly pine plantations. The degree of impact on future yields depends upon site index, tree age, stand density, incidence of stem galls, age of the tree at initial infection, growth rate of surviving galled trees, and response of adjacent healthy trees to space provided by rust-associated mortality or reduced growth rate. Disease incidence has increased in proportion with the increase in pine plantation acreage, which creates large areas of young, succulent tissue in the presence of abundant inoculum on oak and favorable environmental conditions.

Fusiform rust is named for the spindle, or fusiform, shaped swellings it causes on the main stem and branches of pine trees. It first becomes noticeable as abnormal swellings on the stems of seedlings; while it can occur throughout the life of a stand, the most serious infections occur within the first five years. Stem galls and branch galls near the stem are especially serious at this stage of development, since they often cause death. Later infections are less frequently fatal, but can cause significant degrade loss.

Although disease incidence is widespread and localized areas of high incidence occur occasionally, the disease is most prevalent in a band extending from southeastern Louisiana through southern and central Mississippi, Alabama, Georgia, and South Carolina. Hazard rating for fusiform rust is difficult; a rating system designed by Robert L.Anderson, Robert A. Schmidt, and Glen A. Snow in 1984 is described below:
High HazardTwenty-five percent or more of trees in current or adjacent stands infected in each of at least two years during five consecutive years. Trees frequently have multiple galls from a single year's infections. Oaks are abundant on or within 400 meters of the planting site. Telia are very numerous during April-June in most years.

Medium HazardTwenty-five percent or more of trees in adjacent stands infected in one year during five consecutive years. Trees with multiple galls at more than one level are infrequent. Oaks are sparse within 400 meters, but may be abundant within 1600 meters. Telia occur, but are not numerous in most years.
Low HazardLess than 25% of trees in adjacent stnads infected in any one year during five consecutive years. Trees with multiple galls are rare. Oaks are rarely found within 1600 meters.

Some loblolly and slash pine families are genetically resistant to fusiform rust. Unfortunately, numbers of resistant families are severely limited. Judicious selection of species for planting, alterations in site preparation, and salvage removal of infected stems can help to reduce losses. The most promising way to minimize losses while growing the most desirable species is by planting resistant growing stock in areas of high rust hazard.

The following is a summary of key management considerations to minimize fusiform rust damage developed by Anderson, et al.:

1. Avoid movement of rust-infected stock from the nursery (all sites).
2. Use resistant seeds or seedlings, if available (high, medium hazard sites). Avoid planting rust-susceptible seed sources on high-hazard sites.
3. Reduce oak population when practical and not in conflict with other management practices (all sites).
4. Alter fertilization schedule (high hazard sites). If fertilization is planned, and more than 25% of the trees in the stand or adjacent stands is rust infected, delay application until age eight to ten.
5. Use seed-tree or shelterwood regeneration (high hazard sites). When heavily-infested plantations are harvested and an adequate number of residual, rust-free trees are available, consider using a seed-tree or shelterwood system to regenerate the stand. The seed from rust-free trees will confer some genetic resistance to the future stand, and these regeneration methods may provide an unfavorable microclimate for infection.
6. Consider planting density (high hazard sites). Decisions on planting density are best made using growth and yield equations which include fusiform rust as one of the components. Use of these equations is described by Kuhlman, Froelich, and Blakeslee (1984). Increasing density to compensate for rust mortality may result in an increase in the number of infected trees and a significant increase in the quantity of inoculum in the early years.
7. Heavily-infected stands: regenerate or manage to rotation (all sites). Each planting should be evaluated at age three to five to determine whether enough rust-free trees are present to maintain the stand to rotation age. Growth and yield models that include fusiform rust as a component are available for unthinned slash pine plantations and will help to make this determination.
8. Delay prescribed burning (high, medium hazard sites). In merchantable stands, prescribed burning should occur after stem-cankered trees are removed in thinnings. Since rust galls are easily ignited and tree death or excessive charring may result, prescribed burning in young infected stands should be avoided until the trees are at least nine to ten years old.

The 1997 SFA study found a high incidence of fusiform rust throughout the stands where it established basal area plots. Some attention should be given to the areas of high hazard and high infection rate. While mortality is low, severe degrade and wood loss may occur in infected trees. Objectives of intermediate thinnings and improvement cuttings should include removing as many of the infected trees as possible while maintaining sufficient growing stock.

8.16.2.5 Annosus Root Rot

Another important forest disease is annosus root rot, *Heterobasidion annosum* (syn. *Fomes annosus* (Fries) Karst.). It causes damage in forests after thinning and harvesting in most regions where conifers grow, including most of the United States. It has been reported on about 200 species of plants, but is only an important pathogen on gymnosperms. The southeastern U.S. has experienced the most severe damage, probably due to the length of time that intensive forestry has been practiced there. Surveys indicate that the disease is present in a majority of the loblolly and slash pine plantations in this area. However, only a minority of these plantations occur on sites conducive to severe damage. After thinning in some high hazard sites, mortality rates of slash pine in excess of 40% due to root rot have occurred, and living infested trees have sustained losses of 20-32% in diameter growth and 40% in height growth during the first six years after harvest. The ability of the fungus to exist either as a parasite in living trees or as a saprophyte in stumps gives it the ability to remain in an active condition for decades, ready to attack a new crop of trees.

The disease is spread through airborne basidiospores that germinate on freshly-cut stumps or other wounds that expose sapwood. The fungus colonizes the stump and grows out into the roots, where it can infect roots of healthy trees through root grafts. Plantations heavily infected with the fungus may be recognized by the presence of infection centers surrounded by dead and dying trees. Living, infected trees surrounding the infection centers may have thin, yellowed crowns. Since pines can generally tolerate the loss of half their roots before growth suppression becomes noticeable, many more trees are usually infected than can be detected on the basis of symptoms and signs. Symptoms usually do not appear until six to ten years after the initial infection. Potential symptoms of the disease include root rot, windthrow due to rotted roots, butt rot, suppressed growth, and tree mortality.

All current management techniques for the disease are aimed at prevention. The most widely recommended method is treatment of stump surfaces with such chemicals as borax (sodium tetraborate), urea, or creosote. These treatments must be applied immediately to freshly-cut stump surfaces following cutting to prevent spore germination and may be effective for up to six months. Another treatment is the application of *Peniophora gigantea* (Fries).

The 1997 SFA study found that hazard rating for annosus root rot based on soil and site characteristics indicated potential areas for infestation, but ground checking of field plots failed to detect direct evidence of the disease. Careful monitoring of stands after thinning should occur on sites with high hazard. Other means of prevention include planting less susceptible species on high hazard sites, maintaining wide spacing to prevent root contact, using more care in planting, and reducing the frequency of thinning.

8.17 Fire Management

The USFWS has primary responsibility for non-structural firefighting on the installation.

USFWS will provide non-structural firefighting during periods of heightened fire threat via. Cooperative agreement with Little River National Wildlife Refuge. During severe fire threat conditions, temporary fire fighters will be detailed to LHAAP.

Fire protection, including the use of prescribed fire and fire breaks, has successfully minimized the risk of wildfires occurring on LHAAP. Major forest fires that occurred in the past were a result of the testing of pyrotechnic devices being produced on LHAAP. These fires burned approximately 450 acres of government lands and 80 acres of private lands in 1965 and 1979. Since production and testing of these devices ceased on LHAAP there have been no major wildfires.

Prescribed burning is done primarily as a silvicultural tool to control undesirable vegetation, prepare seedbeds, and stimulate growth by release of nutrients. Controlled burns are normally conducted during the dormant season (from November through March) to minimize stress on residual trees and animals. A cooperative agreement between the TFS and LHAAP provides that they be notified prior to conducting any controlled burns on the LHAAP.

Wildfire detection is done by aerial surveillance by the TFS and by ground surveillance by LHAAP personnel. The only fire breaks are those which are used for forest fire protection. There are several miles of security clear zones, primarily around the perimeter fence, which are grass covered but afford some fire protection. Several miles of forest access roads are maintained and serve as fire breaks. Fire break locations are noted on the map in Appendix Exhibit 13.

8.18 Special Interest Area Protection

Provisions for the protection of special interest areas are described in the appropriate chapters and subchapters. These areas include wetlands (8.10) and Harrison Bayou (8.11). Otherwise, land is managed for multiple uses in accordance with accepted BMPs and with an interest toward economic profitability, since income from forest harvest sales provide funding for ecosystem management activities on LHAAP.

9.0 <u>INVENTORYING AND MONITORING</u>

9.1 Objectives

Objectives are critical for achieving LHAAP mission to use responsible stewardship and conservation leadership for managing LHAAP's natural resources. Specific research and special projects objectives are:

- Assess, recommend, and design research projects that will provide information and guidance to meet management goals.
- Evaluate completed research conducted at LHAAP and monitor implementation of future work.
- Involve LHAAP and LAAAP personnel, as appropriate, in developing strategies to bring needed research projects to LHAAP, including identifying qualified investigators and potential funding sources.

9.2 General

Established intervals for evaluating and monitoring ecosystem integrity should initially be seasonal. Once seasonal relationships are established, it may be possible to shift to annual intervals to detect trends or responses to management activities. Management activities that are evaluated for environmental effects will be experimentally controlled. Research programs and special projects will be designed to allow for scientifically acceptable methods. Based on the current status of LHAAP and the absence of a natural resources staff on-site, ecosystem evaluation and monitoring will be dependent upon the cooperation and input from the FWS, the State and/or other agency(s), government or NGO.

9.3 Water Quality

LHAAP has installed monitoring wells to detect any spread of groundwater contamination. LHAAP's potable water and supply wells are monitored according to provisions of the Safe Drinking Water Act.

9.4 Soil Resources Inventory and Monitoring

Existing soil inventories are current, complete, and provide an excellent source of information for making natural resource management decisions. Copies of the *Soil Survey of Harrision County, Texas,* published in 1994, and the *LHAAP Soil Survey,* a customized version of the soil survey of Harrison County completed in 1997, are on file in the Operations Review Division office at LAAAP. Maps generated from the 1997 soil survey are available on 8mm tape.

9.5 Wetland Inventory and Monitoring

A portion of wetlands on LHAAP have been inventoried to date. A study entitled *The Wetland Identification and Functional Assessment of Plant Communities in Harrison Bayou* was completed in 1997 by researchers from the Arthur Temple College of Forestry at Stephen F. Austin State University. This study examined Harrison Bayou within the confines of LHAAP and compared it with study sites outside the LHAAP. Jurisdictional wetlands were identified and a functional assessment performed, and the results were entered into a Geographic Information System (GIS) database. Other potential wetlands on the LHAAP have not been studied.

10.0 RESEARCH AND SPECIAL REPORTS

10.1 Objectives

- Review research proposals for effectiveness in supporting ecosystem management and the LHAAP mission.
- Identify research and special projects needed for managment purposes at LHAAP in the short and long term.
- Recommend research and special project priorities.

- Identify keystone indicators and develop plans for monitoring such species, as necessary.
- Develop means for measuring success of the management program.
- Develop an overall research plan to meet long-term LHAAP management needs.

10.2 Research Mechanisms

Projects planned or needed for implementation of the LHAAP INRMP are accomplished with a variety of methods. The method chosen depends upon the expertise level required to successfully complete the project, available funding sources, organizations, institutions, or associations willing to assist with the project, and installation natural resource program funding levels. Sources of funds and available expertise to the installation are:

Universities: Universities have recently conducted research beneficial to the scientific community and the installation. Funding is available for projects from the university, sponsoring state agencies, and the installation for portions of research projects.

Agencies: Contracts through cooperative agreements with other government agencies such as the U.S.D.I. Fish and Wildlife Service, U.S.D.A. Forest Service, or the Corps of Engineers to perform project work where installations lack manpower, expertise, or time.
Conservation Organizations: Organizations such as The Nature Conservancy and Quail Unlimited provide technical expertise, manpower, or materials to help conduct projects within their area of interest. Funding is usually through the installation.

Natural Resource Program Annual Work Plans: Funding for projects directly related to natural resource programs is secured from natural resource income and funded through installaiton natural resource Annual Work Plans (AWPs).

10.3 Planned Research/Special Projects

11.0 <u>ENFORCEMENT</u>

11.1 Objectives

To identify wildlife enforcement needs on the LHAAP.
To provide effective mechanisms for wildlife law enforcement.

11.2 History and Authority

LHAAP hunting and fishing activities have been restricted due to security considerations. Law enforcement is the responsibility of the state and federal game warden. The TPWD evaluates LHAAP wildlife populations and sets game seasons.

11.3 Jurisdiction

Exclusive, concurrent, and proprietary jurisdiction all exist on LHAAP. U.S.D.I. Fish and

Wildlife Service officers have exclusive federal jurisdiction on LHAAP but have always limited their on-installation activities to endangered species assessments. The TPWD game warden has jurisdiction to enforce state and federal game laws.

11.4 Enforcement Activities

A reduced installation security force and limited time available from the TPWD wildlife officer results in very little time expended on wildlife law enforcement. Presence of wildlife officers during deer hunts and at check stations gives the impression to most hunters that there is more enforcement effort than actually exists. The limited time available requires the most efficient use of enforcement officers during peak periods of activity. Most enforcement effort is expended during deer seasons, usually on weekends. Checking for road hunting and trespass are the most common officer activities.

The installation security force assists in a limited manner with spot checks for prohibited items and road hunting. Security forces grant access for hunting and fishing at the Guard Headquarters during all hunting seasons.

11.5 Training

TPWD wildlife officer training is handled internally by the TPWD. LHAAP security force personnel receive annual training based upon security requirements for the installation. Training topics include but are not limited to proper search techniques, firearms use, accident investigation and riot control.

12.0 ENVIRONMENTAL AWARENESS

12.1 Objectives

To insure all installation organizations are aware of and understand environmental regulations. To provide avenues for information exchange between installation environmental and natural resource sections and resource users, both recreational and work related.

12.2 Military Personnel Awareness

There are no military personnel residing on LHAAP, and military use of the installation has been limited to occasional inspections and visits by higher command personnel; therefore, environmental awareness training for military personnel has not been conducted.

12.3 Public Awareness

Videos and professional presentations are the primary methods of environmental awareness education. Major environmental awareness efforts center around:

Installation Restoration video:

LHAAP video
Hunter orientation
Professional presentations

13.0 OUTDOOR RECREATION

13.1 Objectives

- To identify areas of outdoor recreation available on LHAAP.
- To identify types of outdoor recreation available on LHAAP.
- To identify and qualify access policies for outdoor recreation on LHAAP.
- To describe the relationship between outdoor recreation policies and ecosystem management on LHAAP.

13.2 Military Mission Considerations

Munitions production on LHAAP ceased in 1995, and all munitions storage functions have been transferred to other facilities. The installation is on inactive status, and the Department of the Army is currently negotiating with the U.S.D.I. Fish and Wildlife Service to transfer ownership of the installation.

13.3 Public Access

Historically, access to LHAAP for natural resource based recreational opportunities was severely restricted based on security and safety requirements. The general public was and is not allowed access except as guests of employees at the recreational facility at Starr Ranch or during deer season.

13.4 Hunting, Fishing, and Trapping Programs

No recreational trapping is allowed on LHAAP. Hunting is governed by the wildlife laws of the state of Texas. Seasons and bag limits are recommended by the TPWD and approved by the Commander's Representative. The security contractor administers access and collection of data during deer seasons.

13.5 Other Natural Resource Oriented Outdoor Recreation

No access to LHAAP for purposes of outdoor recreation is permitted.

13.6 Recreation and Ecosystem Management

During periods of reduced threat, the only recreational activity on LHAAP with direct effects on management of LHAAP natural resources is the hunting program. Hunters comprise the vast majority of all visitors to the installation; due to limited law enforcement resources, hunters are largely governed by their own ethics to abide by game laws, seasons and bag limits, to avoid making ruts that lead to soil erosion, etc.

13.7 Safety and Security

Safety and security issues center on security of facilities and property. Recreational activity is restricted. When a hunting program is permitted, hunter safety is the primary concern. Security issues are handled by the security contractor. All participants on LHAAP are subject to search for prohibited items. Security patrols occasionally work with TPWD wildlife officers in hunting violations and security checks.

14.0 <u>CULTURAL RESOURCES PROTECTION</u>

14.1 Objectives

To assure the INRMP meets existing regulatory requirements
To identify short and long term future cultural resource protection needs
To identify funding sources for survey of remaining identified sites (by priority)
To identify archaeological resources available

14.2 Cultural and Historical Resources

LHAAP has a Cultural Resources Management Plan (CRMP), which was completed in December, 1996. Copies are located in the Operation Review Division office at LAAAP. The CRMP was prepared by Geo-Marine, Inc., for LHAAP under contract with the Fort Worth District, U.S. Army Corps of Engineers. The CRMP has four sections; Section I is an overview that explains the Department of the Army policy toward historic properties as well as briefly describing the body of legal requirements necessary for compliance. The overview provides a set of goals to integrate the LHAAP mission with appropriate management of historic properties. This section also offers a brief review of the local prehistoric and preinstallation historic cultural chronology and an evaluation of the archaeological data and architectural information accumulated at the facility to date.

Section II of the CRMP has a review of known and potential prehistoric and preinstallation historic site locations, outlines the appropriate procedures for inventory and evaluation, and provides a list of the recorded sites that includes their eligibility recommendations for inclusion in the National Register of Historic Places (NRHP), as well as information on the military-related architectural resources on the installation.

Section III of the CRMP presents the management plan requirements established by federal regulations and the treatment plans for those cultural resources that are considered to be significant enough to be identified as historic properties. Section IV details compliance procedures for mission-related ground-disturbing activities that may damage historic properties.

A full cultural resources survey of the LHAAP area has not been completed. The following is a summary of the cultural resources work that had been completed through 1996 (see the CRMP, pages III-10 and III-11):
- Out of a total 8,493 acres, 2,135 acres have been excluded from intensive survey because of ground surface disturbance.

- Approximately 3,553 acres have been surveyed for cultural resources.
- Approximately 2,805 acres remain to be intensively surveyed.
- Thirty-two archeological sites have been recorded; of these two are considered eligible for NRHP inclusion (41HS407 and HS484) nine are of unknown/potential eligibility, and twenty-one archival sites have been identified but not yet field verified and are considered of unknown/potential eligibility.

Since the CRMP was completed and additional archeological survey has been conducted at LHAAP. An *Archeological Survey of 319 Hectares (789 acres) at the Longhorn Army Ammunition Plant, Harrison County, Texas,* was conducted by Prewitt and Associates, Inc., under contract with the Fort Worth District, U.S. Army Corps of Engineers, and published in June, 1998. This survey entailed a 100% pedestrian survey of 319 hectares (789 acres) within six areas, along with historic archival research. Ten previously unrecorded sites (seven historic and three prehistoric) were documented, as were one prehistoric site and one historic site recorded during earlier work at LHAAP. Three prehistoric sites and one historic site were recommended as being potentially eligible for listing in the NRHP.

Coordination for all projects that will involve ground-disturbing activities and that may affect historic properties is the ultimate responsibility of the Installation Commander. This responsibility may be assumed by the Commander's Representative or the informally appointed point-of-contact for the installation cultural resources. The individual who fulfills this coordination role is referred to as the CRPOC.

The CRMP recommended the following treatment options for cultural resources:
- sites of unknown eligibilty must be treated as potentially eligible;
- impacts to any cultural resource judged to be either eligible for inclusion in the NRHP or requiring further evaluation prior to a final determination of eligibility should be avoided; and
- NRHP-ineligible resources have been judged to contain little or no significant data and thus are not of archeological or historical importance; therefore, avoidance of ineligible properties is not necessary.

Four treatment measures for archeological histroic properties are defined in AR 420-40:
Avoidance - In most cases, projects propsed in areas containing an archeological historic property (NRHP-listed or NRHP-eligible/potentially eligible) can be adjusted to avoid impact to that resource.
Physical Protection - If it is necessary to disturb or construct in an area containing archeological historic properties, it is usually possible to protect these resources from inadvertent impact by temporarily fencing, berming, burial, or marking off the area with flourescent flagging tape and notifying military commanders, security personnel, and contractors of the presence of these resources.
Monitoring - Archeological historic properties that have been avoided or physically protected need periodic monitoring to assess the effectiveness of the protection measures.
Protection of a Valid Sample - Within a defined area, several occupation episodes and site types may be represented, both for the historic and prehistoric periods. In addition, there may also be several archeological historic properties for each represented occupation. Each property should be evaluated for the possibility of intact deposits and for its chronological, functional, and

cultural importance in relation to what is already known for the region.

The standard mitigation treatment for archeological historic properties (NRHP-listed or NRHP-eligible) is data recovery of the historic property, generally in the form of archeological excavation and/or documentation. Mitigation will be undertaken when the resource cannot be avoided or physically protected and will be destroyed through construction or other activities.

In addition to the two known cemeteries (sites HS270 and HS485), it is likely that additional unmarked family plots or unmarked isolated burials are present on LHAAP. In the event that human remains are encountered during construction or archeological investigations, work should be stopped in the vicinity of the find and the supervisor should immediately inform the CRPOC. Cemeteries should be avoided, protected, and evaluated as per NPS Bulletin 41, *Guidelines for Evaluating and Registering Cemetaries and Burial Places.* It should be assumed that unmarked graves are of Native American affiliation, in which case NAGPRA must be applied. Measures to comply with NAGPRA are outlined in the CRMP on pages III-15 through II-17.

14.3 Natural Resource Management Implications

14.3.1 General Actions

The CRMP identifies the following standard operating procedures to review and monitor field activities, construction, and other undertakings to ensure compliance with the CRMP:

- It should be the responsibility of the manager(s) of installation activities and security to coordinate with the CRPOC.
- These managers should submit to the CRPOC for review all work orders or design plans that have the potential to affect either historic properties or previously undisturbed and unsurveyed land.
- The managers should not proceed with the project until the CRPOC provides clearance for such action.
- Coordination of any undertaking with the SHPO and/or the Advisory Council on Historic Preservation (ACHP) is the responsibility of the CRPOC.
- When a site visit is made to determine what work is required, it may be beneficial to include the SHPO in the visit.
- Upon receipt of SHPO and/or ACHP comments, the CRPOC takes comments into consideration and forwards the applicable comments to the appropriate managers.
- The CRPOC works with the respective managers to provide correspondence regarding changes and/or modifications resulting from comments of the review agencies.
- Copies of all correspondence concerning coordination efforts should be retained in the project file.

Monitoring of any activity that may directly or indirectly impact a historic property involves two phases. First, the CRPOC should be responsible for monitoring the project. To alleviate the monitoring responsibility, however, an individual who is involved with the undertaking may be appointed by the CRPOC to serve as a monitor designee. Thus, the monitoring responsibility will not fall upon a single individual who may not always be available.

The CRPOC, the monitor, and a field supervisor of the third-party subcontractor visit the project area, evaluate the site context in relation to planned activities, and decide how the historic property may be best protected or mitigated. Advice from the outside archeologists/historic preservationists may be sought.

The CRPOC should place a brief descriptive summary of the protection plan within the project file.
Second, the CRPOC and the monitor decide on a schedule of regular site visits in order to supervise properly the protection of the historic property.
Any damage to the historic property as a result of the undertaking should be documented through photographs and a written assessment of the damage. The facility may seek advice from outside archeologists/historic preservationists to accomplish this task.
Steps taken to ensure that no further damage occurs should also be documented.

The CRMP outlines the following steps for general actions compliance with Section 106 of the NHPA:

Step 1: The CRPOC and Project Manager will determine impact of project on historic properties. Assessment of impact may require professional assistance from archeologists/historic preservation specialists.

- If architectural historic properties are within the area of potential affect and there is no potential for these/this property to be affected by the project, then make a note of this determination and proceed with the project.
- If it is determined that the action will have no effects on historic properties, then the CRPOC will have to provides appropriate documentation to the SHPO for review and concurrence.
- If architectural historic properties are affected, CRPOC and Project Manager will determine the direct or indirect impacts.
- If impacts to architectural historic properties are involved, the CRPOC will consult with the SHPO to develop a mitigative treatment.
- If the area has been surveyed and no archeological historic properties are present, provide the appropriate documentation to the SHPO for review and concurrence, then proceed with the project .
- If sufficient information is not available for decision-making, consult with the SHPO to determine if archeological survey is required.
- If historic properties are present, CRPOC and Project Manager will determine if historic properties can be avoided and protected from direct or indirect impacts.
- If historic properties are present within the area of potential effect (APE) and those properties cannot be avoided, the CRPOC will consult with the SHPO to develop a mitigative treatment. If cultural resource of potential NRHP eligibility exist within the project area, the CRPOC can develop a testing program to complete the NRHP eligibility evaluation of those resources and will report the findings to the SHPO.
- If historic properties exist within the APE and the CRPOC, Project Manager, and Design Engineers can develop a plan to facilitate avoidance of and protection for those resources, the project may proceed following concurrence by the SHPO.
- If archivally identified archeological sites of potential/unknown NRHP eligibility exist within the project area, one of the following actions may be implemented:

- monitor any ground-disturbing activities and treat any discovery as an unexpected cultural resource discovery;
- the CRPOC can develop a testing program to complete the NRHP eligibility evaluation of those resources and will report the findings to the SHPO; or
- the CRPOC, Project Manager, and Design Engineers can develop a plan to facilitate avoidance of and protection for those resources, and the project may proceed following concurrence by the SHPO.

Step 2: CRPOC will inform contracting officer of specification that must be included within subcontracts or work orders to maintenance staff.

Step 3: Implement protection measures. These measures may include:

- marking and avoidance of site boundaries,
- fencing and avoidance of site, or
- sealing site with sterile fill dirt.

Step 4: Familiarize any subcontractor with historic property locations and protection measures.

Step 5: The CRPOC and/or Project Manager will monitor contracted activities to ensure the protection of historic properties.

14.3.2 Forestry

The CRMP outlines the following steps for forest management activity compliance with Section 106 of the NHPA:

Step 1: The Forester will determine if planned operations are ground-disturbing and whether the area has been surveyed for cultural resources.

- If ongoing timber management programs do not recontour land nor disturb the ground surface and are conducted under dry ground conditions, the logging may proceed in areas not surveyed once the SHPO concurs with the assessment of "no adverse effect" or "no historic properties affected".
- If the logging activities will cause ground disturbance within an area that is unsurveyed and is on undisturbed ground, the CRPOC will require a survey. If no historic properties are present, and the SHPO concurs, the harvesting may proceed.
- If the area has been surveyed and historic properties are present, the CRPOC will determine locations of historic properties. If such resources are present, then proceed to Step 2.

Step 2: CRPOC will determine treatment options applicable to each site.

- Direct impacts to the properties - as well as to a 50-foot buffer extending out from marked site edges - from tree-planting areas or harvesting skid trails and loading and logistical staging areas will be avoided.
- In the event that emergency situations - such as uncontrolled wildfire or insect infestation - should arise, the appropriate actions to control the emergency should be taken, with the impact to historic properties affected by the actions assessed after the fact.

Step 3: The CRPOC and the Forester will mark locations of historic properties.
Boundaries will be conspicuously marked with fluorescent paint and/or fluorescent flagging tape.

Step 4: Inform the contracting officer of special requirements related to historic properties.

Step 5: Familiarize subcontractor with locations of historic properties and their treatment options.

Step 6: The CRPOC and/or the Forester will monitor any such tree removal in order to ensure the protection of the historic properties.

The CRMP also provides guidelines for the following types of activities for compliance with Section 106 of the NHPA:

- Agricultural leases
- Unexpected cultural resources discoveries made during implementation of an undertaking
- Recovery of human remains
- Unintended partial damage to an eligible archeological site or site of unknown eligibility
- New construction: building/facility and utility
- Hazardous waste/materials assessment
- Hazardous waste/materials remediation
- Borrow pit excavation
- Maintenance and repair of architectural historic properties
- Renovation/rehabilitation of architectural historic properties
- Unintentional partial damage to architectural historic properties

15.0 NATIONAL ENVIRONMENTAL POLICY ACT

15.1 Objectives

- Implementation of the Environmental Impact Analysis Process at LHAAP.
- Ensure all actions at LHAAP are in compliance with the NEPA program.

15.2 NEPA Responsibilities and Implementation

Army Regulation 200-2, *Environmental Effects of Army Actions* (23 December 1988), defines the responsibilities and process for implementing the National Environmental Policy Act (NEPA) on Army installations. The Environmental Protection Specialist (EPS) at LHAAP has primary responsibility for ensuring implementation of the NEPA process at LHAAP. The proponent advises the EPS of a proposed activity or project. The EPS uses a comprehensive checklist to review the proposal to determine the level of NEPA review [Record of Environmental Consideration (REC), Environmental Assessment (EA), or Environmental Impact Statement (EIS)] required. If the activity/project is simple in nature, with little potential for environmental impact or a categorical exemption is applicable, the proponent will be asked to prepare the documentaiton with guidance from the EPS. If more extensive NEPA review is required, the proponent provides the EPS with full details of the proposed activity/project and the EPS prepares the appropriate NEPA documentation. Once NEPA documentation is completed, it is reviewed and signed by the Proponent, the EPS and the Commander's Representative. The NEPA documentation also receives OPSEC review by the ACO Safety and Security Officer in accordance with Army Regulation AR 530-1.

15.3 NEPA and Natural Resources Management

The Forester updates the LHAAP's Integrated Natural Resource Management Plan (INRMP) every five years. Proposed natural resource management actions are evaluated for potential environmental impact in accordance with NEPA.

For actions such as timber sales, the Forester prepares a Record of Environmental Consideration (REC). For proposed actions affecting natural resources outside the scope of the INRMP, the Forester seeks guidance from the EPS or outside agencies such as The Nature Conservancy, the Natural Resources Conservation Service, the State Historical Preservation Officer, and the Texas Parks and Wildlife Department.

16.0 IMPLEMENTATION

16.1 Organization, Roles, and Responsibilities

Implementation of an INRMP is complex; established roles and responsibilities and new organizational relationships to meet this plans's stated goals are defined in the two tables below. Many internal and external organizational responsibilities were defined and established during the previous fifty years of natural resource management at LHAAP. Multi-disciplinary relationships necessary for management, monitoring, and research were developed during the preparation of the INRMP and will continue to be refined as the INRMP is implemented.

Table 16-1: INTERNAL ORGANIZATION & INRMP IMPLEMENTATION

Organization/Section	Responsibility
Forester Technician – Lanis Rieger	Coordination of INRMP implementation; preparation of all natural resource AWPs and contracts; provide recommendations on pest control needs
Environmental Protection Specialist	Assist with writing and documentation of all required environmental documents
Security (Contractor)	Assist with access for participants in the hunting program; process security passes and access for research and natural resource contractors
Purchasing	Execute contracts for natural resource work according to SOWs provided by the Forester

INTERNAL ORGANIZATION & INRMP IMPLEMENTATION

LHAAP	Coordinate implementation of the INRMP
U.S.D.I. Fish and Wildlife Service	Formal agreement to this INRMP IAW Sikes Act; provide technical assistance when requested

Texas Parks and Wildlife Department	Formal agreement to this INRMP IAW Sikes Act; provide technical assistance when requested
Universities	Conduct by contract or cooperative agreement research or technical assistance with natural resource programs
Natural Resource Conservation Service	Provide technical assistance when requested
U.S. Army Corps of Engineers (Fort Worth District)	Administer construction contracts and timber sales
Texas State Historic Preservation Officer (SHPO)	Review projects implementing the INRMP that may impact cultural resources and concur with actions when protection of cultural resources is assured; provide technical assistance in cultural and historical affairs
US Army Materiel Command and MSC Operations Support Command	Provide guidance, funding, and technical assistance with the execution of the INRMP
Army Environmental Center	Provide technical expertise and assistance with the pest control programs, technical reviews and contract assistance upon request

16.2 Staffing Requirements

Staff members required to implement the INRMP and their sources are listed in the table below. Day to day natural resource activities are directed through the Commander's Representative office. Personnel training is budgeted annually for natural resource areas related to implementation of the INRMP. Training for other individuals is handled internally within the department or organization and not controlled nor funded with natural resource funds.

Table 16-2: SOURCE OF STAFFING

Staff	Source
Forester	Internal (Army)
Forestry Technician	Internal (Army)
Environmental Protection Specialist	Internal (Army)
Security personnel	Internal (Contractor)
Purchasing Agent	Internal (Army)
Wildlife Officer	External (TPWD)
Historic Preservation Specialist	External (SHPO)
Soil Scientist	External (NRCS)
Natural Resource Professionals	External (OSC, AMC, & AEC)

16.3 Project/Program Priorities

Those projects identified within the INRMP proposed for accomplishment within the next five years are listed in the table below:

- Thin approximately 500 acres of upland pine and pine-hardwood forest annually to reduce potential of pest infestation;
- Prescribe burn approximately 1,000 acres annually to reduce fuel load hazard, prepare seedbeds, improve wildlife habitat and stimulate growth;
- Use natural and artifical regeneration to restore forest areas affected by the excessing of buildlings/structures or areas affected by other disturbances such as wind/ice storms;
- Conduct ground surveys to determine forest pest problems;
- Continue the hunting and outdoor recreation programs;
- Continue current inventory and monitoring programs and;
- Reduce or eliminate kudzu.

These projects are considered necessary to meet requirements for ecosystem management. These projects monitor or acquire data needed to manage LHAAP's natural resources.

16.4 Implementation funding Options

Completion and implementation of an Integrated Natural resources Management Plan (INRMP) is required by AR 200-3 and the Sikes Act. Future funding for INRMP implementation is sought from a variety of sources, but traditionally, most funding has been received from forestry and wildlife annual work plans. Limited funding was available from the Department of Defense forestry reserve account. Identification of Class 1, 2, and 3 environmental funding needs on EPR documents will identify additional funding sources.

Possible funding sources for implementation are as follows:

- Forestry and wildlife annual work plans: the only reliable source of funds generated through installation natural resource programs with a portion of the receipts returned for natural resources management.
- Department of Defense Reserve Account: projects are submitted supon requests from higher headquarters, but this is not a reliable source of funds since most submitted projects are never funded.
- Universitites and state agencies: limited funds occasionally are made available for mutually beneficial projects. Upon availability of such funds, excess AWP funds would be returned or redirected into any approved additional natural resource work.
- Private organizations: organizations such as Quail Unlimited perform work or provide materials in areas of interest to their organization under oversight of the Commanding Officers Representative.

High priority projects are funded within the annual work plan process because it is the most reliable source of funding. Projects which have a low priority or would be nice to accomplish but are not really necessary to the implementation of the INRMP are proposed through other funding channels.

16.5 Command Support

Without command support, the INRMP cannot be successfully implemented on LHAAP. Specific command support actions needed for successful implementation are:

- Funding of natural resource annual work plans at identified funding levels
- Assistance securing funding from alternate sources
- Providing technical assistance in areas where technical expertise is lacking at the local level
- Providing support for environmental initiatives
- Providing contracting services through cooperative agreements between the Army and the U.S.D.A. Forest Service for forest planning

Appendix 1

INRMP PREPARERS – REVIEWERS

The following people were involved in the development of this INRMP.

Name	Organization
Thomas F. Vorac C.F.	US Army Materiel Command, Forester
Jay M. Rubinoff	US Army Operations Support Command, Fish & Wildlife Biologist
George F. Weick, Jr.	National Forests and Grasslands in Texas

PERSONS CONTACTED

The following people were contacted during INRMP development:

Name	Organization
Michael F. Jordan	US Army Corps of Engineers, Fort Worth District, Project Manager
Steve Hartley	US Geological Survey, National Wetlands Research Center, Geographer
Gene Rice	US Army Corps of Engineers, Fort Worth District, Project Manager
Jim Neal	USDI Fish and Wildlife Service, Ascertainment Biologist
Joe Pase	Texas Forest Service, Entomologist III
Lanis Rieger	Longhorn Army Ammunition Plant, Forest Technician
R. Scott Beasley	Stephen F. Austin State University, Dean of Arthur Temple College of Forestry

Appendix 2

ABBREVIATIONS USED

ACHP	Advisory Council on Historic Preservation
AEC	Army Environmental Center
AMC	Army Materiel Command
AR	Army Regulation
ARPA	Archeological resources Protection Act of 1978
BMPs	Best Management Practices
CRPOC	Cultural Resources Point of Contact
DOD	Department of Defense
GOCO	Government-Owned Contractor-Operated
OSC	Operations Support Command
LHAAP	Longhorn Army Ammunition Plant
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NEPA	National Environmental Policy Act of 1969, as amended
NHPA	National Historic Preservation Act, as amended through 1992
NRHP	National Register of Historic Places
PA	Programmatic Agreement
PL	Public Law
SHPO	State Historic Preservation Officer
TFS	
TPWD	Texas Parks and Wildlife Department
USC	United States Code

Appendix 3

GLOSSARY

ADVISORY COUNCIL ON HISTORIC PRESERVATION
The independent agency set up under the National Historic Preservation Act (Title II) to advise the President and the Congress on cultural resources preservation; to advise on the dissemination of information on such activities; and to encourage public interest in cultural resources preservation. Under the National Historic Preservation Act (Section 106), the Advisory Council on Historic Preservation will be afforded an opportunity to comment on federal, federally assisted, or federally licensed undertakings that may have an effect on cultural resource properties.

BEST MANAGEMENT PRACTICES
Actions taken to prevent or reduce nonpoint source pollution and to protect and improve water quality. The governor of each state prepares and submits these measures, after a public comment period, to the Administrator of the Environmental Protection Agency for approval. These actions are authorized by the Clean Water Act of 1948 as amended by the Federal Water Pollution Control Act Amendments of 1972 and the Water Quality Act of 1987.

CULTURAL RESOURCES
Buildings, districts, structures, objects, and sites as defined in 36 CFR 60.3, cultural items as defined in the Native American Graves Protection and Repatriation Act; American Indian, Eskimo, Aleut, or native Hawaiian sacred sites for which access is protected under the American Indian religious freedom Act; archeological resources defined by the Archeological resources Protection Act; archeological artifact collections and associated records defined under 36 CFR Part 79.

CULTURAL RESOURCES MANAGEMENT PLAN (CRMP)
The installation's cultural resources protection and compliance document, formerly known as a Historic Preservation Plan.

HISTORIC PROPERTY
Any prehistoric or historic building, district, site, structure, or object included in or eligible for inclusion in, the National Register. The term includes artifacts, records, and remains that are related to and located within such properties. [See 36 CFR 800.2(e)]
a. DISTRICT - A geographically definable area, urban or rural, with a concentration, linkage, or continuity of cultural resources properties that are united by past events, or aesthetically by plan or physical development. A district may also be composed of areas that are separated by space but are linked by history or style.
b. SITE - The location of a prehistoric or historic
1. Event, occupation, or activity; or
2. Structure, whether represented by standing ruins or by other surface or subsurface evidence, when the location, regardless of the value of existing structures, contains the historical or archeological value.
c. BUILDING - A structure created to shelter any form of activity, such as a house, stable, church, barracks, hospital, or similar structure. Buildings may refer to a functionally related complex, such as a courthouse and jail, a house and barn, or a barracks, a mess hall, and a chapel.
d. STRUCTURE - An edifice, often an engineering project, designed to aid human activities, such as bridges, canals, or aqueducts.
e. OBJECT - An artifact of functional, aesthetic, cultural, historical, or scientific value that may be, by nature or design, movable yet related to a specific historical activity, event, district, site, setting, or environment.

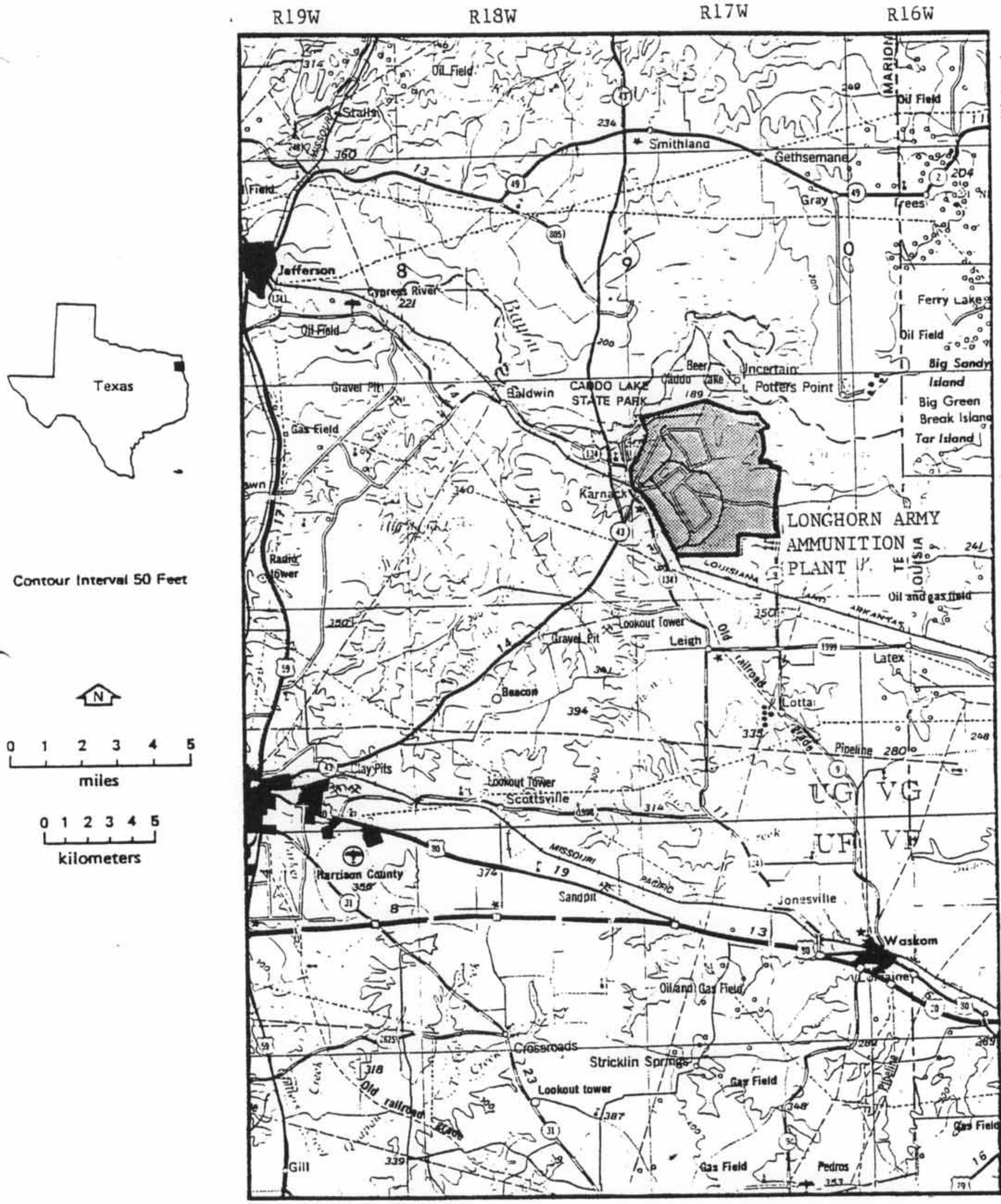
MEMORANDUM OF AGREEMENT
a. A document signed by the State Historic Preservation Officer, Advisory Council on Historic Preservation, and the Army, listing what the installation will do to meet the requirements of the National Historic Preservation Act, as amended through 1992, Section 106.
b. It is prepared -
1. In coordination with the preparation of an installation CRMP.

2. When a specific undertaking will have an adverse effect on a historic property listed on or eligible for listing in the National Register of Historic Places.
c. It contains -
1. Items or stipulations to be addressed in a CRMP.
2. Ways to avoid or reduce adverse effects.
3. Calendar for meeting the stipulations.

NATIONAL REGISTER OF HISTORIC PLACES (NRHP)
A listing of districts, sites, buildings, structures, and objects significant on the national, regional, or local level in United States history, architecture, archeology, engineering, and culture. It is maintained by the Secretary of the Interior per the Historic Sites Act and the National Historic Preservation Act, as amended through 1992. The term "eligible for inclusion on the National Register" includes both properties formally determined as such and all other properties that meet the National Register of Historic Places criteria as defined by 36 CFR Part 60.4.

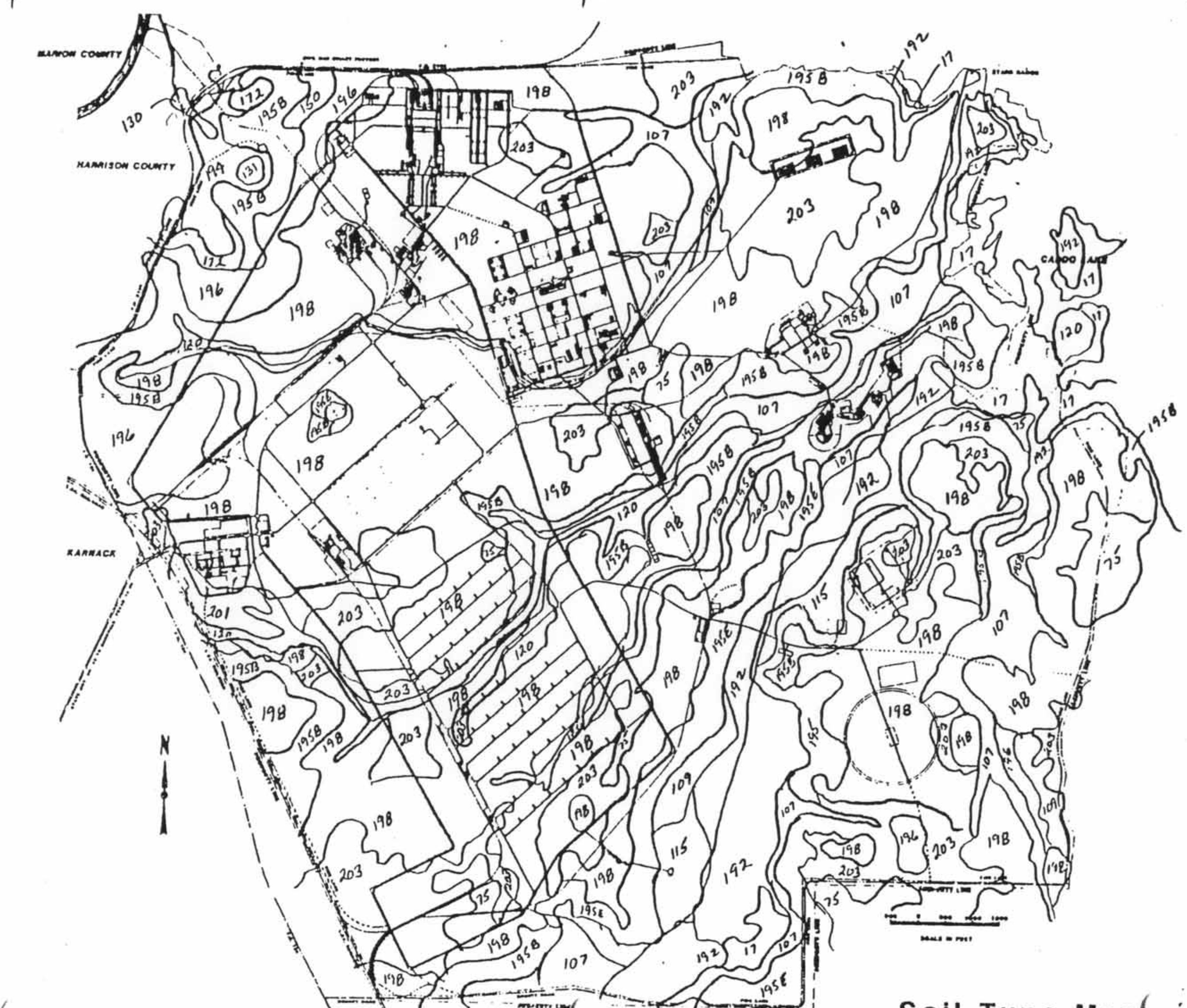
PROGRAMMATIC AGREEMENT
A documented executed between a facility and advisory agencies, which may take the place of multiple Memoranda of Agreement when actions are programmed, repetitive, or are perceived to have similar impacts on cultural resources.

STATE HISTORIC PRESERVATION OFFICER
The official within each state who has been designated and appointed by the state governor to administer the state historic preservation program, pursuant to Section 101(b)(1) of the NHPA.



Note: Base map is the Tyler, Texas (1955, photorevised 1963) 1:250,00 topographic sheet

Figure 1-1. MAP OF THE GENERAL VICINITY OF THE LONGHORN AAP



Soil Type Map

3. **Soils:** The soils on this installation belong to the Forested-Coastal-Plains Problem Area and can be described as deep, acid, moundy, low in fertility, and mostly moderately drained.

Soil Types and Descriptions: The soils type map of the installation (Appendix 5) shows the location of various types of soils. The map symbol shows first the soil unit, then the soil type.

Map Symbol	* Soil	Slope Character	** Woodland Suitability Group
17	Aquents, clayey	submerged	----
75	Evadale-Cart complex	0-1%	2w9
107	Sardis-Mathiston complex	frequently flooded	1w9
109	Thage-Cart complex	0-2%	2w8
115	Guyton-Cart complex	0-1%	2w9
120	Iuka fsl	frequently flooded	1w8
130	Wolfpen, lfs	2-5%	2s2
131	Larue lsf	2-5%	3s2
150	Bernaldo fsl	1-3%	2o7
172	Wolfpen lfs	6-15%	2s2
192	Socagee sicl	frequently flooded	2w6
194	Meth fsl	1-3%	3o1
195B	Eastwood vfsl	1-5%	2c2
1[illegible]	Eastwood vfsl	5-20%	2c2
195G	Eastwood vfsl	20-45%	4r3
196	Latex fsl	1-3%	1o7
198	Scottsville vfsl	0-3%	1w8
203	Metcalf-Cart complex	0-2%	2w8

* Soil descriptions on file in Maintenance Office.

****WOODLAND SUITABILITY GROUP SYMBOLS**

1st Character - Site Index

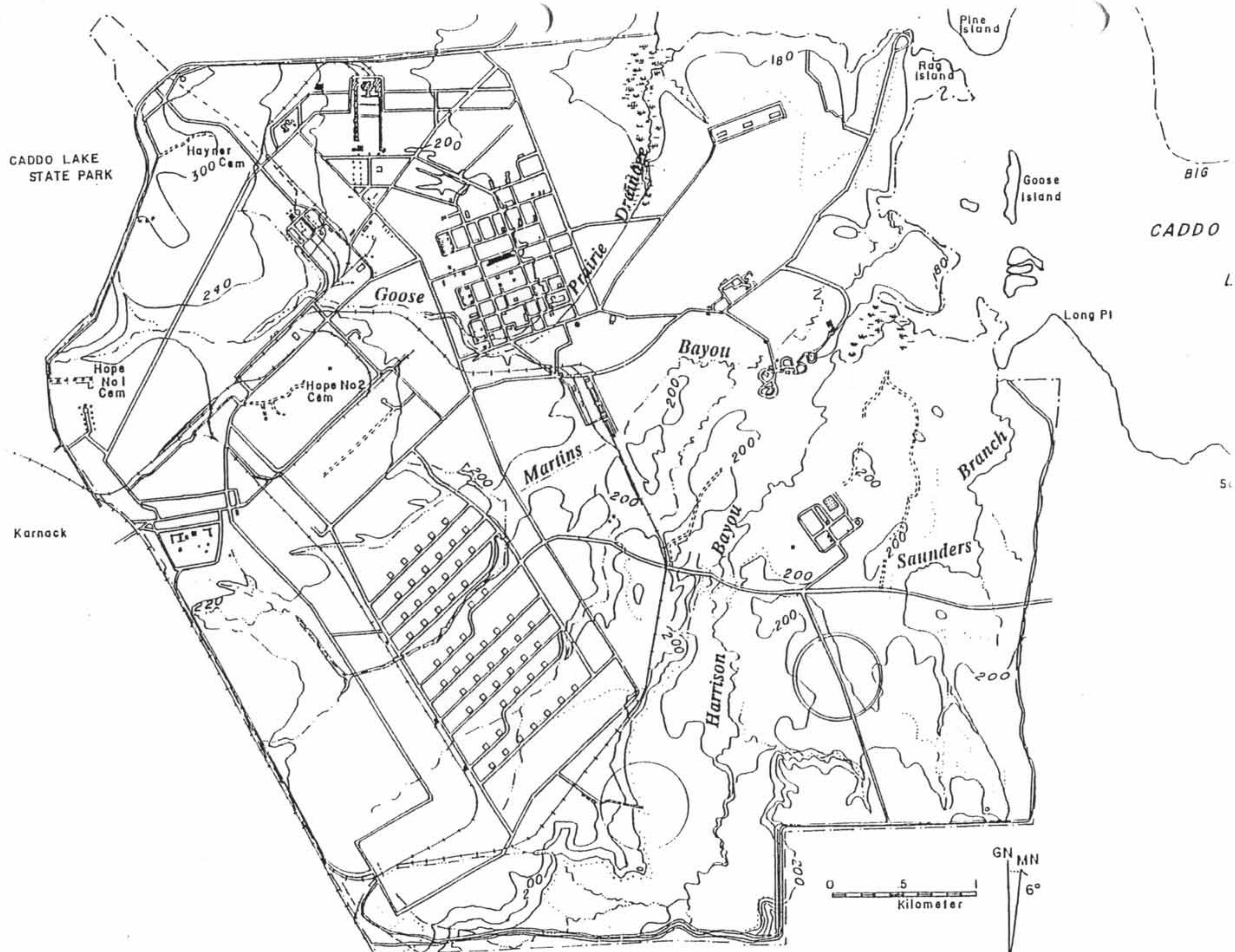
1 - Loblolly pine & sweetgum 96+
2 - Loblolly pine & sweetgum 86-95
3 - Loblolly pine & sweetgum 76-85
4 - Loblolly pine & sweetgum 66-75

2nd Character

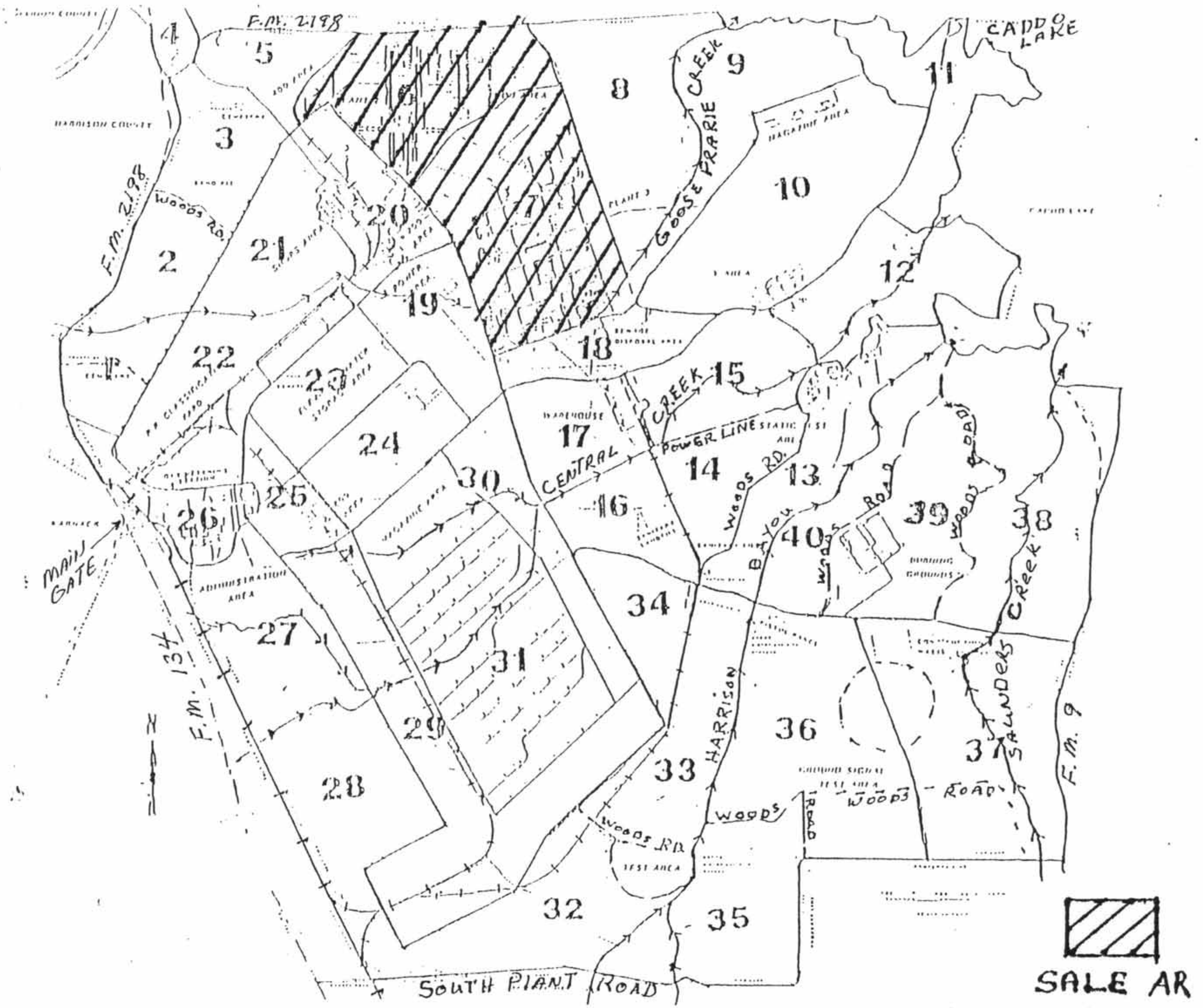
w - wetness
s - sandy
c - clayey
r - rocky or gravely
o - no restriction

3rd Character - Physical Limitation

1 - Slight limitation for pine
2 - Slight limitations for pine & hardwood
3 - Slight limitations for hardwood
Moderate limitations for pine
Moderate limitations for pine & hardwood
6 - Moderate limitations for hardwood
7 - Severe limitations for pine
8 - Severe limitations for pine and hardwood
9 - Severe limitations for hardwood



Topographic map of Longhorn Army Ammunition Plant, Harrison County, Texas, showing four major drainages within the plant area.



SALE AR

Longhorn Army Ammunition Plant