FIRE MANAGEMENT PLAN

MARAIS DES CYGNES NATIONAL WILDLIFE REFUGE

LINN COUNTY, TRADING POST, KANSAS

U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

September 18, 1998

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TRADING POST, KANSAS

1998

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Fire Management Plan

Fire Management Program
Marais des Cygnes National Wildlife Refuge
Linn County, Trading Post, Kansas

US Fish and Wildlife Service
Region 6
Department of the Interior
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I. INTRODUCTION

Marais des Cygnes National Wildlife Refuge (NWR) was established in 1992 to protect bottomland hardwood habitats along the Marais des Cygnes River in Linn County (Decision Document Marais des Cygnes National Wildlife Refuge 1992). Additionally, the Refuge will serve as an area for wildlife-dependent environmental education, interpretation, and compatible recreational day use.

The Refuge was purchased with Land and Water Conservation Fund money. The initial purchase was made from Pittsburg and Midway Coal Company, a subsidiary of Chevron U.S.A., Inc., by the Fish and Wildlife Service and The Nature Conservancy (whose land was later bought by the Service). Land was also purchased from the Midland Cattle Company. The remainder of the acquisitions have been from individual landowners (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998).

The Refuge was established under the Fish and Wildlife Act of 1956 and the Emergency Wetland Resources Act of 1986:

> **Emergency Wetland Resources Act:** The purpose of the Act is: "To promote the conservation of migratory waterfowl and to offset or prevent the serious loss of wetlands by the acquisition of wetlands and other essential habitat, and for other purposes." "... the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions..."
>
> **Fish and Wildlife Act:** "... for the development, advancement, management, conservation, and protection of fish and wildlife resources..."

Before the 20th century, the area now known as Marais des Cygnes NWR was primarily bottomland hardwood forest along the Marais des Cygnes River channel. At the periphery of the hardwood forest was oak savannah. The remaining areas were native tallgrass prairie. Fire played a major role in continued restoration of these communities by restoring vigor to plant growth, releasing nutrients, reducing accumulated litter, increasing seed production, and eliminating woody invasions.

By the time the Refuge was established, most of the land the Refuge is located upon had been disturbed by agricultural practices and mining. The Refuge plans to reduce farming and re-seed former croplands and introduced grass areas to native grasses, convert to moist soil management areas, or allow to succeed to Oak-Hickory forests. Due to amount of rainfall and long growing season, all Refuge habitats have a propensity to be invaded by woody vegetation. The use of prescribed fire, especially in areas where trees are not desirable, would increase the health and vigor of vegetation. Proper management of the

Refuge's habitats is essential to meeting refuge objectives and Service bio-diversity mandates. The use of fire to manipulate habitat will increase management flexibility to meet management goals.

A. This Fire Management Plan is written to help achieve resource management objectives of Marais des Cygnes National Wildlife Refuge as defined in the Comprehensive Conservation Plan (CCP) (1998).

B. This plan meets NEPA/NHPA compliance. An environmental assessment (EA) (Appendix B) for the Marais des Cygnes NWR Comprehensive Conservation Plan was completed in 1992 and is on file. The EA for the CCP addresses fire management. A separate EA for prescribed fire will not be completed due to new regulations published in the Federal Register (62 FR 2375) on January 16, 1997. The new regulation categorically excludes prescribed fire (when used for habitat improvement purposes and conducted in accordance with local and State ordinances and laws). Wildfire suppression actions and prescribed fire are both now categorically excluded, as outlined in 516 DM 2 Appendix 1.

C. The Department of Interior Manual (Part 620 DM-1) requires that all refuges with burnable vegetation must have a written Fire Management Plan. This plan provides fire management guidelines for Marais des Cygnes NWR.

D. Authority and guidance for implementing this plan are found in:

1. Protection Act of September 20, 1922 (42 Stat. 857; 16 U.S.C. 594).

2. Economy Act of June 30, 1932 (47 Stat. 417; 31 U.S.C. 315).

3. Reciprocal Fire Protection Act of May 27, 1955 (69 Stat. 66, 67; 42 U.S.C. 1856, 1845a and b).

4. National Wildlife Refuge System Administrative Act of 1966 as amended (80 Stat. 927; 16 U.S.C. 1601).

5. Disaster Relief Act of May 22, 1974 (88 Stat. 143; U.S.C 5121).

6. Federal Fire Prevention and Control Act of October 29, 1974 (88 Stat. 1535; 15 U.S.C. 2201).

7. Federal Grants and Cooperative Act of 1977 (Pub. L. 95-244, as amended by Pub. L. 97-258, September 13, 1982. 96 Stat. 1003 31 U.S.C. 6301-6308).

8. Wildfire Suppression Assistance Act of 1989 (Pub. L. 100-428, as amended by Pub. L. 101-11, April, 1989).

9. Department of the Interior Manual, Part 620 DM-1, Wildland Fire Management (April 10, 2000).

10. United States Fish and Wildlife Service Wildland Fire Management Handbook (December 2, 2000).

11. United States Fish and Wildlife Service Refuge Manual, 621 FW1-3, Fire Management (February 7, 2000).

II. COMPLIANCE WITH FWS POLICY

A. Purpose

The Marais des Cygnes NWR was established on August 8, 1992 with the purchase of 5,836 acres in Linn County, eastern Kansas. The land purchased lies within a 9,300 acre boundary and is adjacent to the State managed Marais des Cygnes Wildlife Area. Currently, about 7,300 acres of the 9,300 have been acquired. The stated purpose is (Refuge Mgmt Information System 1997):

> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources..." 16 U.S.C. § 742 f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance my be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742 f (b) (1) (Fish and Wildlife Act of 1956).
>
> "... the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. § 3901 (b) (Emergency Wetlands Resources Act of 1986).

The mission of the Refuge is to protect bottomland hardwood habitats along the Marais des Cygnes River (Refuge Mgmt Information System 1997).

Cultural listings for National Register of Historic Places on or near Marais des Cygnes Refuge include: 1. Historic Ft. Leavenworth - Ft. Scott Military Road which crosses the Marais des Cygnes River between Sections 8 and 9, T21S, R25E; and 2. Marais des Cygnes Massacre Site (1858) located two (2) miles north of the Refuge.

Limited archeological work has been completed for Marais des Cygnes NWR. Preliminary reconnaissance work completed by Kansas State Historical Society in conjunction with development on Marais des Cygnes Waterfowl Management Area did not yield sites of archeological significance. However, the area does have potential for the presence of archeological sites (Decision Document Marais des Cygnes National Wildlife Refuge 1992).

Threatened and Endangered Species (T & E) known to occur or have the potential to occur on or near the Refuge include; four (4) federally listed birds; one (1) federally listed plant; eight (8) state listed reptiles and amphibians; one (1) state listed invertebrate; one (1) state listed fish; and one (1) state listed bird. Unless Section 7 consultation is approved, endangered species habitats must be protected from fire.

Marais des Cygnes NWR improvements must also be protected from fire. These include buildings as well as public use improvements proposed throughout the refuge.

B. Objectives

U.S. Fish and Wildlife Service policy requires that an approved Fire Management Plan must be in place for all of Service lands with burnable vegetation. Service Fire Management Plans must be consistent with firefighter and public safety, protection values, and land, natural, and cultural resource management plans, and must address public health issues. Fire Management Plans must also address all potential wildland fire occurrences and may include the full range of appropriate management responses. The responsible agency administrator must coordinate, review, and approve Fire Management Plans to ensure consistency with approved land management plans.

Service policy allows for a wildland fire management program that offers a full range of activities and functions necessary for planning, preparedness, emergency suppression operations, emergency rehabilitation, and prescribed fire operations, including non-activity fuels management to reduce risks to public safety and to restore and sustain ecosystem health. The Fire Management Plan is a detailed program of action to implement the fire management program at Marais des Cygnes National Wildlife Refuge.

Marais des Cygnes NWR goals and objectives include managing; endangered species, habitat, migratory birds, public use and recreation, and optimizing abundance and diversity of wildlife and plant species. A complete list of Refuge goals and objectives (Refuge Mgmt Information System 1997) can be

found in Appendix A.

C. Effect of Fire Upon Complex Objectives

Marais des Cygnes NWR is operating under a Comprehensive Conservation Plan (CCP) approved in 1998. Objectives within the "Landscape Goal" of the CCP have reference to the use of prescribed fire as a management tool. Listed below are objectives of the "Landscape Goal".

> **Oak-Hickory Forest Objectives:** 1) Restore and maintain a core block of bottomland hardwoods, on all adaptable sites, totaling approximately 3,300 acres along the Marais des Cygnes River and associated floodplain: to reduce fragmentation effects on breeding forest interior birds and to provide habitat for migrating interior forest songbirds and water birds, as well as other native wildlife species. 2) Reestablish approximately 125 acres of bottomland hardwood forest in the Trading Post slough area to provide habitat for resident and migratory songbirds, water birds, and other native wildlife species.

The Fire Management Plan will assist in achieving Oak-Hickory Forest Objectives by allowing the use of fire to: 1) reduce undesirable vegetation invasions; 2) clearing of understory to reduce fuel loadings; 3) enhancing native fire dependent vegetative species; and 4) reducing competition (ie thinning within planted timber areas).

> **Savannah Objective:** Restore and maintain approximately 750 acres of savannah/grove habitat consisting predominantly of post oak, blackjack oak, and pin oak with native grass understory.

The oak savannah is a fire dependent ecosystem. The Fire Management Plan will assist in achieving the Savannah Objective by allowing the use of fire to: 1) reduce undesirable vegetation invasions; 2) invigorate native fire dependent and/or fire resistant grasses, forbs and trees; and 3) reduce understory (shrub) growth.

> **Upland Shrub Objective:** Maintain approximately 450 acres of upland shrub outside of the core bottomland forest to provide habitat for migrating and nesting migratory bird and other native wildlife species.

The Fire Management Plan will assist in achieving the Upland Shrub Objective by allowing the use of fire to: 1) reduce undesirable vegetation invasions; and 2) invigorate native fire dependent and/or resistant grasses, forbs, and shrubs.

Native Prairie Objectives: 1) Restore and maintain approximately 1,300 acres of native upland prairie containing big bluestem, little bluestem, switchgrass, indiangrass, sideoats grama, and native forbs. 2) Restore and maintain 300 acres of native lowland prairie dominated by prairie cordgrass.

The native prairie is a fire dependent ecosystem. The Fire Management Plan will assist in achieving the Native Prairie Objectives by allowing the use of fire to: 1) reduce undesirable vegetation invasions; and 2) invigorate native fire dependent grasses and forbs.

Wetlands Objectives: 1) Maintain 93 acres of riparian woodland habitat along Marais des Cygnes River. 2) Maintain 104 acres of ponds and oxbows. 3) Develop and maintain about 500 acres of moist-soil cells to enhance the production of natural foods for migratory birds and other wildlife. 4) Provide up to 300 acres of seasonal wetlands to enhance wildlife diversity in the area. 5) Maintain and enhance 94 acres of water-filled mines.

The Fire Management Plan will assist in achieving some of the Wetlands Objectives by allowing the use of fire to: 1) reduce undesirable vegetation invasions especially within the moist soil areas; and 2) allow migratory birds easier access to food especially within moist soil cells.

Croplands Objective: Reduce the amount of farmed land to 1,500 acres or less.

The Fire Management Plan will not assist in reducing the amount of farmed land. However, on land that remains farmed, The Fire Management Plan will allow these areas to be burned for: 1) allowing migratory birds easier access to seeds; and 2) reducing the amount of agricultural chemicals applied to farmland by burning post-harvest residues in the event of double cropping.

This Fire Management Plan is one of the first operational plans to be written for Marais des Cygnes NWR. Other operational plans (such as Safety Plan), which will have reference to fire management, have yet to be completed.

III. DESCRIPTION OF AREA AND FIRE EFFECTS

A. General Description

The Marais des Cygnes National Wildlife Refuge is located in Linn County in southeastern Kansas. The Refuge consists of 9,300 acres between U.S. Highway 69 and the Missouri state line on either side of the Marais des Cygnes River (Map 1, page 8). The Refuge lies within the Platte/Kansas Rivers ecosystem (as delineated by the Service) (Map 2, page 9). Immediately west of the Refuge is the 7,500 acre Marais des Cygnes Wildlife Management Area, administered by the Kansas Department of Wildlife and Parks. The Marais des Cygnes Wildlife Management Area includes; bottomland hardwoods habitat, managed waterfowl impoundments, and moist soil agricultural units. Upstream and to the northwest of the state-owned area are a number of private and corporate ownerships. These lands are primarily dedicated to agriculture and are composed of a mixture of drained and diked bottomland farmed fields, remnant hardwood areas, and wetlands. The upland areas fringing the river corridor are a mixture of hardwoods, agricultural lands, and areas in which oil, gas, and coal development occurred in the past. Currently, the nearest development of gas fields is occurring two (2) miles north and west of the Refuge near Sugar Creek.

Currently, dominant areas within the Refuge include introduced grasses, croplands, bottomland hardwoods, and upland hardwoods. Figure 2 (page 17) shows current and proposed habitat areas for Marais des Cygnes NWR. Agricultural areas dominate the surrounding landscape. These areas include cropland, hayland, grassland, and shelter belts.

B. Topography and Soils

Soils on the Refuge are productive Class I, II, and III lands of silty loam and silty clay loam. Two (2) soil associations are located on the Refuge. The first is the Verdigris-Osage-Lanton Association. This association consists of soils on flood plains along major streams, in this case the Marais des Cygnes River. This association composes about 12 percent of the soils in Linn and Miami Counties but dominates the soil types on the Refuge. The second association is the Dennis-Parsons association. This association consists of soils located on uplands that have a silty and clayey subsoil (Soil Survey of Linn and Miami Counties 1981).

The most common soils of this association are Osage silty clay loam (Ot-IIw), Osage silty clay (Ov-IIIw), and Verdigris silt loam (Vb-IIw). All of these soils occur on the floodplain of the Marais des Cygnes River and are frequently flooded if not protected by dikes and levees. Most of the bottomland hardwood vegetation occurs within these soil types. Approximately 60 percent of the Refuge is in these soil types. (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998).

An additional soil type, the Dennis silt loam (De-IIe), occurs on the periphery of the floodplain and is an easily erodible soil. Special care must be exercised if this soil type is used for cultivated crops. It is best suited for permanent cover and pasture. Numerous severely eroded spots occur in this soil throughout the Refuge. Approximately 20 percent of the Refuge is in this soil type.

The remaining 20 percent of the soils on the Refuge do not have site-specific limitations of wetness or erodibility. Most land practices can be exercised without consideration of these two limiting factors (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Elevation on the refuge ranges from 750 to 960 feet M.S.L. with an average of 800 feet M.S.L.

Soil erosion resulting from prescribed fire or suppression is generally not a problem on the Refuge.

C. Climate

Linn County has a continental climate typical of the interior of a large land mass in the middle latitudes. Such a climate is characterized by large daily and annual variations in temperature. Winters are cold because of the frequent outbreaks of air from the polar regions. Winter lasts only from December through February. Warm summer temperatures last for about six (6) months every year, and the transition seasons, spring and fall, are fairly short. The warm temperatures

provide a long growing season for crops.

Linn County is in the path of a fairly dependable current of moisture laden air from the Gulf of Mexico. Precipitation is heaviest late in spring and early in summer. Much of it occurs as late-evening or nighttime thunderstorms. Although the total precipitation is generally adequate for any crop, its distribution may cause problems in some years. Prolonged dry periods of several weeks duration are not uncommon during the growing season.

In winter the average temperature is 34.4 degrees F, and average daily minimum temperature is 23.5 degrees. The lowest temperature on record, which occurred at Pleasanton on February 13, 1905, is -23 degrees. In summer the average temperature is 77.4 degrees, and the average daily maximum temperature is 89.7 degrees. The highest recorded temperature, which occurred at Mound City on July 14, 1954, is 117 degrees.

The total annual precipitation is 38.53 inches. Of this, 26.38 inches, or 68 percent, usually falls in April through September. In two (2) years out of 10, the rainfall in April through September is less than 17.67 inches.

Average seasonal snowfall is 17.5 inches. The greatest snowfall, 36.5 inches, occurred during the winter of 1958-1959. On an average of 20 days, at least one (1) inch of snow is on the ground.

The sun shines 72 percent of the time possible in summer and 56 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in March (Soil Survey Linn and Miami Counties 1981). Growing season will exceed 200 days in most years.

Figure 1 (page 12) shows temperature and precipitation as recorded in Mound City in the period 1951 to 1976.

FIGURE 1. Temperature and Precipitation

(All data except average snowfall data were recorded at Mound City, Kansas, in the period 1951-76. The average snowfall data were recorded at Garnett, Kansas, in the period 1947-70.)

Month	Temperature					Precipitation				
	Average Daily Maximum ^{0}F	Average Daily Minimum ^{0}F	Average Daily ^{0}F	2 years in 10 will have--		Average In	2 years in 10 will have--		Average number of days with 0.10" or more	Average Snowfall In
				Maximum temperature higher than-- ^{0}F	Minimum temperature lower than-- ^{0}F		Less than-- In	More than-- In		
January	42.1	20.2	31.2	71	-9	1.25	0.48	1.88	3	5.3

February	48.2	25.4	36.8	75	-1	1.32	0.41	2.27	3	3.4
March	56.8	32.4	44.6	85	5	2.82	1.37	4.10	5	3.6
April	69.6	44.4	57.0	90	21	3.69	2.05	5.59	6	0.2
May	78.3	53.8	66.1	94	32	4.64	2.93	6.18	7	0.0
June	86.6	62.8	74.7	98	46	4.77	1.63	7.37	7	0.0
July	91.7	67.1	79.4	106	48	3.85	1.48	6.57	6	0.0

August	90.9	65.2	78.1	104	50	4.12	1.62	7.42	5	0.0
September	82.6	56.7	69.7	99	35	5.31	2.12	8.80	7	0.0
October	72.4	46.2	59.3	92	23	3.33	0.91	5.93	5	0.0
November	56.8	33.8	45.3	79	7	1.91	0.19	3.65	4	0.7
December	45.4	25.0	35.2	70	-5	1.52	0.67	2.56	4	4.3

Year	68.5	44.4	56.5	106	-9	38.53	27.47	46.41	62	17.5

D. Vegetation

The vegetation adjacent to the Marais des Cygnes River channel is primarily bottomland hardwood. These stands of hardwoods are present in other states east and south of Kansas but are unique to Kansas. The ecosystem is a Lowland Oak-Hickory-Bluestem Parkland association that reaches its westernmost extension in the 13 counties of eastern Kansas. Due to the extensive clearing and draining of bottomland hardwood area, no other such areas exist in the eight-state

Mountain-Prairie Region of the Fish and Wildlife Service.

Uplands surrounding the drainage systems within the Refuge were historically prairie grasslands with very little woody vegetation. These grass dominated lands were broken by woody vegetation only along the bottomland and the tops of some of the higher hills in the area until the time of permanent settlement in the mid-1800's.

Figure 2 (page 18) shows habitat types, description, and current and planned acres. Figures 3 and 4 (page 19) indicate relative abundance of habitat type on the Refuge (both current and proposed). Map 3 (page 20) shows the current location of the six (6) different habitat types within the Refuge boundaries (including both Service-owned land and inholdings). Map 4 (page 21) shows Service and private ownership within the Refuge boundary through fiscal year 1995.

An 1851 Government Land Survey showed the limits of timber adjoining the river at that time. Comparisons with current photography and mapping show that of the original 3,300 acres of bottomland timber, almost 55 percent or 1,800 acres, have been converted to cropland or pasture. Much of the remaining timber has been cut at least once. On areas where regrowth has been allowed to occur, several excellent mature or near-mature stands now occur along the river (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Map 5 (page 22) indicates the amount of wooded and wet areas within the Refuge in 1869 (pre-settlement). The remaining areas on the map which are not colored were historically tallgrass prairie and savannah. Fire's effect on vegetation depends on plant species, timing of burn, type of burn, and burn intensity.

1. Oak-Hickory Forest

Stands of hardwood include pecan, oak, mulberry, osage orange, hickory and maple. The range of naturally occurring pecan (*Carya illinoensis*) is most common along river floodplains in the southeastern eighth of the state including the Refuge. Native hardwood stands are important to wildlife due to their permanent nature and high level of plant diversity. Floodplain hardwoods, being the most diverse in this group in plant

species, are also the most diverse in animal species. All species of cavity dwelling birds and mammals are dependent on woodlands. The State of Kansas is considering the bottomlands area for the reintroduction of ruffed grouse.

Prescribed fire would be utilized in the hardwoods to reduce fuel loadings, thin tree species, rejuvenate fire dependent species, or to meet other resource management objectives. Generally, these fires would be of low intensity with low scorch heights.

The oak-hickory habitat type is divided into three (3) groups on the Refuge: 1) bottomland hardwood; 2) upland hardwood; and 3) upland shrubs. Figure 5 (page 23) indicates the abundance of these three Oak-Hickory habitat types (both current and proposed). The following is a listing of the most common vegetative species in each of these three hardwood types.

Bottomland Hardwood - Shumard oak, pin oak, mulberry, cottonwood, black willow, peachleaf willow, sandbar willow, green ash, silver maple, pecan, hickory, and osage orange.

Upland Hardwood - Maple, hickory, black walnut, red-osier dogwood, sumac, Ohio buckeye, bladderpod, spicebush, rose spp., and raspberries.

Upland Shrubs - Rose spp., raspberries.

2. Wetlands

Wetlands on the Refuge are, for the most part, the flooded timbered areas along the river. The original wetland sites were predominantly covered by hardwoods with a few open marsh sites along old oxbows where water depths discouraged woody growth. The wooded areas extended into the major lateral drainages associated with the Marais des Cygnes River into the prairie. Most of these former seasonal wetland areas have been eliminated by conversion of bottomland hardwood wetlands to agriculture. These former wetlands can be re-created by use of existing levees and building of dikes to control water levels.

The wetlands habitat type is divided into five (5) separate habitat types on the Refuge. The types are: 1) riparian woodland; 2) ponds and oxbows; 3) moist soil cells; 4) seasonal wetlands (low prairie); and 5) water-filled mines. Figure 6 (page 23) indicates the abundance of these five (5) Wetland habitat types on the Refuge. Following is a listing of dominant

vegetation for each (where applicable) of the habitat types.

Riparian Woodland - Cottonwood, sycamore, hackberry, maple, grapes, moonseed, Dutchman's pipe, ash, and pin oak.

Moist Soil Cells - Wild millet, beggar ticks, nut sedges, and smartweed.

Seasonal Wetlands (low prairie) - Prairie cordgrass, *Carex* spp., spikerush, and Eastern gamma grass.

Prescribed fire's use in the wetlands depends upon each wetland type. Depending upon resource management objectives, fire may be utilized in the riparian woodland to reduce fuel loadings, thin vegetative species, and/or encourage specific vegetative species.

Ponds and oxbows are generally a water driven system. Therefore, fire use in this system will be minimal. Fire may be utilized to reduce fuel loadings and/or encourage vegetative species within the ponds and oxbows habitat type.

Moist soil cells are intended to be dominated by annual vegetation. Prescribed fire will be utilized within this habitat type to keep vegetation in an annual state and reduce/retard invasions of cottonwoods, willows, and other undesirable species.

Seasonal wetlands (low prairie) is a fire dependent habitat type. Fire will be utilized to control undesirable vegetation invasions (ie trees and shrubs) and rejuvenate fire dependent species.

Prescribed fire use in water-filled mines is extremely limited. The ground surrounding these areas is generally bare. However, these areas have been utilized by T&E species (Piping plover and least tern) adjacent to the Refuge. These two T&E species prefer bare sand and/or gravel areas. If these bare ground areas re-vegetate, fire may be utilized to reduce/retard amount of succession occurring.

3. Native Prairie

Currently, native prairie on the Refuge is very limited and is typically small (less than 20 acres in size). Dominant vegetation within the native prairie consists of big bluestem, little bluestem, indiangrass, sideouts grama, switchgrass, and numerous forb species. These areas do, however, provide prime habitat for wildlife feeding and nesting cover. Diverse

plants in native prairie provide a variety of seeds and fruits for wildlife utilization. The majority of native prairie located on the Refuge has been utilized for grazing. Over-grazing and the introduction and/or invasion by exotic plants has impacted the health of this habitat type.

Native prairie is a fire dependent ecosystem. If fire is not utilized this habitat will eventually become forest. Prescribed fire will be utilized in native prairie to reduce/retard undesirable vegetative species invasions and invigorate native fire dependent vegetation.

4. Savannah

Savannah habitats are one of the most endangered habitat types throughout the United States. Traditionally, these areas have either been converted to agriculture, or do to the lack of fire, have succeeded to forests. An oak savannah is the dominant savannah type at Marais des Cygnes NWR. Dominant tree species consists of post oak, blackjack oak, pin oak, and Osage orange with a grass understory. This understory is dominated by native warm season grasses and forbs including big bluestem, little bluestem, switchgrass, indiangrass, and side-outs grama.

Savannah is a fire dependent ecosystem. Prescribed fire will be utilized in the savannah habitat type to reduce/retard undesirable vegetative species invasions and invigorate native fire dependent and fire resistant vegetation.

5. Introduced Grasses

This habitat type is common on the Refuge. These areas are Conservation Reserve Program (CRP) fields and old mine sites that have been reclaimed and re-seeded into cool season grasses such as fescue and smooth brome. These areas have generally been grazed and/or hayed.

The proposal within the CCP for this habitat is that introduced grasses are to be converted into one of the above habitats depending on each area's location. Prescribed fire will be utilized in this habitat to eliminate dead fuel to allow easier reseeding to native vegetation and to reduce/retard undesirable vegetative species invasions.

6. Croplands

Crops grown in the area include soybeans, millet, wheat, and other row crops that thrive on the bottomland type soils. More than 40 percent of the croplands on the Refuge at the time of establishment, will be converted to native vegetation.

Fire use in the cropland program is usually to remove wheat stubble in preparation for late planting of soybeans. The purpose of the burn is two fold; reduction of herbicide use for weed control and to remove moisture absorbing straw. Fire may also be used in croplands to eliminate crop residues for reseeding to native vegetation and to reduce/retard undesirable vegetative species invasions.

FIGURE 2: Summarized below are the major habitats of the Refuge, both current and planned.

HABITAT TYPE	DESCRIPTION	CURRENT ACRES	PROPOSED ACRES
OAK - HICKORY FOREST			
Bottomland Hardwood	Shumard oak; pin oak; burr oak; mulberry; cottonwood; black willow; peachleaf willow; sandbar willow; green ash; silver maple; pecan; hickory; Osage orange	1,854	3,300
Upland Hardwood	Maple; hickory; walnut; dogwood; sumac; Ohio buckeye; bladderpod; spicebush; rose spp.; raspberries	1,449	1,250
Upland Shrub	Rose spp.; raspberries	887	450
WETLANDS			
Riparian Woodland	Riverbanks: cottonwood; sycamore; hackberry; maple; grapes; moonseed; Dutchman's pipe; ash; pin oak	93	93
Ponds and Oxbows		104	104
Moist Soil Cells	Wild millet; beggar ticks; nut sedges; smartweed	0	500
Seasonal Wetlands (low prairie)	Herbaceous: prairie cordgrass; Carex; spikerush; Eastern grama grass	0	300
Water-filled Mines		94	94

HABITAT TYPE	DESCRIPTION	CURRENT ACRES	PROPOSED ACRES
NATIVE PRAIRIE - SAVANNAH			
Native Prairie	Big and little bluestem; switchgrass; Indiangrass; sideoats grama; forbs	8	1,300
Savannah Groves	Savannah: Post oak; blackjack oak; pin oak; pecan; Osage orange; native grass understory	273	750
INTRODUCED GRASSES - CROPLAND			
Introduced Grasses	including hay meadows, pastureland, and CRP: Fescue; brome; Virginia bluestem	2,129	0
Cropland	Soybeans; milo; corn; winter wheat; sunflowers; oats; clover; alfalfa	2,250	1,500 or less

Introduced Grasses
Cropland

Introduced Grasses
Cropland

E. Noxious Weeds and Other Problem Species

Several, legally designated, noxious weeds are known or believed to occur on the Refuge: Johnson grass, field bindweed, and musk thistle. Other pest species that may cause problems are: Sericea lespedeza, marijuana, multiflora rose, and purple loosestrife. Purple loosestrife is currently a problem on the Marais des Cygnes Wildlife Management Area. State law dictates control efforts for noxious weeds and the Refuge voluntarily participates in control programs, including the use of prescribed fire. Prescribed fire or wildfire can increase the spread and density of some noxious weeds depending on environmental and phenological conditions.

Other problem vegetative species which may invade different habitat types on the Refuge include smooth brome, fescue, cottonwoods, willows, and eastern red cedar.

F. Threatened, Endangered, and Special Concern Species

Marais des Cygnes NWR contains or has the potential to contain a number of threatened, endangered, and special concern species. The Refuge will implement its fire management program within the restraints of the Endangered Species Act (1973), as amended, and will take appropriate action to identify and protect from adverse impacts any rare, threatened, or endangered species and its habitats located within the Refuge.

Fish and Wildlife Service policy requires that State T&E species and species of concern will be incorporated into all planning activities. In addition to the federally-listed species, a number of species that are listed as threatened or endangered by the States of Kansas and Missouri occur or potentially occur in the area (Appendix C). At least eight (8) species of amphibians and reptiles currently on the Kansas Endangered or Threatened List are found within or very near to the boundaries of the Refuge. These species have special habitat requirements which include standing water, organically rich oxbow ponds, and subirrigated fields with stable water levels. State of Kansas listed species include:

Flat-floater mussel - State Endangered. The flat-floater mussel is a large, thin shelled mussel that is shiny straw-yellow to dark brown in color. The mussel is found in shallow areas of relatively permanent oxbow lakes having organically rich mud bottoms. The current range of the mussel in Kansas is the lower reaches of the Neosho and Marais des Cygnes Rivers. Currently, critical habitat for the Flat-floater mussel has been designated in Allen County (Collins et al 1995).

Horneyhead chub - State threatened. This fish has been found in Big Sugar Creek adjacent to the Refuge (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). At one time, the horneyhead chub occurred over most of Kansas; however, now it is restricted to the Marais des Cygnes River basin. Currently, critical habitat for this species has been designated in Allen and Miami counties near the Refuge (Collins et al 1995).

Eastern newt - State Threatened. This salamander was once abundant at Pigeon Lake in Miami County near the Linn County border. It may now be extirpated from this area and, if so, is an excellent candidate for re-introduction (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Critical habitat for the Eastern newt includes all wetlands, waters, moist wooded bottomlands in Linn County that are in and adjoin the Marais des Cygnes Wildlife Area (Collins et al 1995) (Map - Appendix C, page 5).

Northern spring peeper - State Threatened. This frog was once abundant at Pigeon Lake in Miami County near the Linn County border. It may now be extirpated from this area and, if so, is an excellent candidate for re-introduction. Critical habitat for the Northern spring peeper has been identified in Kansas; however, it does not include Linn or Miami Counties.

Northern crawfish frog - State Threatened. This threatened frog was recently discovered on land now within the Refuge. Critical habitat has not yet been identified for this species.

Northern green frog - State Threatened. This frog was once abundant at Pigeon Lake in Miami County near the Linn County border. It may now be extirpated from this area and, if so, is an excellent candidate for re-introduction (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Critical habitat has been identified in Cherokee County (very southeast county) in Kansas (Collins et al 1995).

Broadhead skink - State Threatened. This threatened lizard prefers dead, standing trees along water, a particular habitat abundant on the Refuge (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Critical habitat for the Broadhead skink in Kansas includes all stands of mature oak woodland within the Marais des Cygnes and Marmaton river basins in Bourbon, Crawford, Linn, and Miami counties (Collins et al 1995) (Map Appendix C, page 6).

Eastern hognose snake - State Threatened. This nonpoisonous, showy snake reaches its greatest abundance along the eastern border of Kansas, where there is plenty of water for toads. The Eastern Hognose Snake feeds exclusively on toads. Critical habitat has not yet been identified for this species.

Western earth snake - State Threatened. This snake was recently discovered in Linn County. The most recent discovery was in the La Cygne Lake area, just north of the Refuge.

Northern redbelly snake - State Threatened. This small harmless snake prefers mature forests, and is dependent on this forest habitat (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Critical habitat has been designated in Cherokee county (Collins et al 1995)

Also occurring or potentially occurring on the area are the federally listed Mead's milkweed, bald eagle, peregrine falcon, piping plover, and interior least tern.

Mead's milkweed - Threatened. This federally-listed threatened plant is found in prairie hay meadow habitats in the Refuge. A draft recovery plan is being prepared for this species. Two small populations of Mead's milkweed are known to occur on prairie hay meadows south of the Marais des Cygnes River. One of these lies within the Refuge; the other is roughly one mile southwest of the boundary. The plant is a perennial that usually occurs in virgin prairie as a solitary plant or a few closely associated individuals (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Mead's milkweed typically grows in dry bluestem (tallgrass) prairie, primarily in the eastern two tiers of counties in the Osage Cuestas and the southern Glaciated Region. The middle and upper slopes of ridges and hills with shallow, well-drained limestone or (infrequently) sandstone soils are ideal habitat for this milkweed (Collins et al 1995). The habitat needed by this species is gradually being lost to agricultural expansion, detrimental agricultural practices such as overgrazing and spraying, and the general elimination of tallgrass prairie (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Critical habitat for Mead's milkweed in Kansas has not been designated. Potential habitat for this plant may exist from the southern Glaciated Region south to Crawford County along the Missouri border, and west as far as Coffey County. Mead's milkweed has been documented to live as long as 26 years, and may reach a century in age (Collins et al 1995).

Peregrine falcon - Endangered. Peregrine falcons are migrants through the area. They have been recorded several times at the wildlife management area. Peregrine falcons utilize wetlands and open areas, including water bodies, crop fields, and grasslands, preying primarily upon other birds. They were observed in the immediate vicinity of the Refuge in 1990-1991 (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Currently, critical habitat has not been designated for the peregrine falcon within Kansas (Collins et al 1995)

Bald eagle - Threatened. Bald eagles winter at the Marais des Cygnes Wildlife Management Area and adjacent private lands, using the large concentrations of waterfowl. Peak counts during waterfowl censuses at the Wetland Management Area averaged 30 eagles in the middle of the 1970's. This was followed by a sharp decline which then increased to ten (10) in 1988. These counts probably represent minimum bald eagle numbers because they are not actively being searched out during the waterfowl censuses (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). Critical habitat designated in Kansas for the bald eagle includes all lands and waters that lie within five (5) air miles of current refuge lands in the Marais des Cygnes Wildlife Area and Marais des Cygnes National Wildlife Refuge (Collins et al 1995) (Map - Appendix C, page 4).

Piping plover - Threatened. The piping plover is a small shorebird which is an uncommon seasonal spring and fall migrant in or near the Refuge. Piping plovers are associated with unvegetated shorelines, sandbars, and mudflats of wetlands and streams, utilizing aquatic invertebrates for food. They have been observed in the immediate vicinity of the Refuge in 1990-1991(Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998). No critical habitat has been designated for the piping plover in Kansas (Collins et al 1995).

Interior least tern - Threatened. Interior least terns use similar, unvegetated wetland, habitat to piping plovers, feeding on aquatic invertebrates and small forage fish. They occur as uncommon spring and fall migrants. They have been observed in the immediate vicinity of the Refuge in 1990-1991. Critical habitat for Interior least terns has not been designated near the Refuge.

Threatened and Endangered species listed for Bates County, Missouri include; the sharp-shinned hawk, Swainson's hawk, *Carex bicknellii* var *opaca* (sedge), northern harrier, codaea penstomen, buffalo clover, barn owl, and greater prairie-chicken leks (Natural Heritage Database 1995). Critical habitat has not been designated for these species by the State of Missouri. *C. bicknellii* is also listed Federal Category 2.

G. Birds

A comprehensive survey and bird list have yet to be developed for Marais des Cygnes NWR. However a list of birds that use the area has been compiled by Stephanie L. Jones and Beth Dickerson. The information for this list was supplied by W. Busby (KSBBA), M. Cooksley, C. Ely, G.H. Farley, B. Fisher, C. Hobbs, J. Jefferson, P.A. Johnsgard, L. Moore, M. McHugh, M. Schwilling, M.C. Thompson, and J.L. Zimmerman. This list of bird species which probably utilize Marais des Cygnes NWR is found in Appendix D.

Many bird species occur in the area including neotropical migrants. A total of 317 bird species have been observed in the area of the Refuge , including 109 species which are probably nesters on the Refuge. January and February are good months to observe Bald Eagles. April and May are the best months for observing passerines, as the Refuge is an outstanding migration corridor for warblers. These months are also good for marsh birds, including egrets, herons, and shorebirds. March, October, and November are good times to observe peak concentrations of waterfowl. During the winter, clouds of wintering sparrows can be observed in the upland areas.

Bird species evolving with fire may show fire adapted behavior and responses, whereas other species exposed infrequently to fire in their evolutionary history may be severely inhibited by it (Best 1979). Hawks and purple martins are attracted to fire and use the fire front to locate prey (Lehman and Allendorf 1989). Edwards and Ellis (1969) observed four bobwhite quail flying directly to a burn and landing within a few meters of the flames. However, Tester and Marshall (1961) indicate that bobolinks, savannah sparrows, and LeConte's sparrows all avoided recently burned grassland. Fire's direct and indirect effect to bird species's depends upon each individual species of bird.

H. Mammals

Comprehensive inventories of mammal species have not been completed for Marais des Cygnes NWR. However, the Kansas Natural Heritage Inventory has compiled a list of 'Vertebrates (other than birds) of Linn County, Kansas' (Appendix E - *Mammalia*, page 1). The Refuge's habitats support healthy populations of game mammals such as white-tailed deer, cottontail rabbit, and fox squirrels. Significant numbers of beaver, coyote, fox, opossum, raccoons, and skunks are also present. Several species of small mammals are also common, including; deer mice, voles, and shrews. For further information on mammals which may occur on Marais des Cygnes NWR see Mammals in Kansas (Bee et al 1981).

Fire tends to have little direct effect on large mammals mainly due to their ability to move. The major indirect effect to large mammals is an increase in available forage. Fire removes standing dead vegetation making new growth more accessible to grazers. In addition to bison, elk, pronghorn, and "rabbits" concentrate on burned areas in North American grasslands (Lewis 1973, Evans and Probasco 1977). Burning up to 70% of a home range did not cause deer to change their range (Ivey and Causey 1984).

Small mammals are generally unable to run from a fire and thus must otherwise be adapted to survive in a fire frequented environment. The abundance of small mammals in prairies is evidence of their behavioral, physical, or reproductive capacity to survive in a fire environment (Bragg 1994). Searches following burning rarely find many dead small mammals. The effect of fire on small mammals is generally indirect. Populations of small mammal herbivores tend to be reduced following a burn; whereas, granivores and omnivores tend to increase (Algren 1966; Stout et al 1971; and Kaufman et al 1983). Further information concerning the effects of fire on wildlife can be reviewed in The Effects of Fire in the Northern Great Plains, prepared by Higgins, Kruse, and Piehl; and "The Physical Environment of Great Plains Grasslands", by Bragg.

I. Fish

The Marais des Cygnes River and tributaries provide habitat for species of fish that include minnow (family *Cyprinidae*), catfish (family *Ictaluridae*), and sunfish (family *Centrachidae*). These species make up the biggest part of the fish population found in the river. These fish populations provide a sport fishery for large channel catfish, bass, bluegill, carp and buffalo fish. Comprehensive inventories of fish species have not been completed for Marais des Cygnes NWR. However, the Kansas Natural Heritage Inventory has compiled a list of 'Vertebrates (other than birds) of Linn County, Kansas' (Appendix E - *Osteichthyes*, page 2). For further information on fish that may be found on Marais des Cygnes NWR see Fishes in Kansas (Cross and Collins 1975).

Fire's effect on fish should be minimal except for potential of increased erosion from recently burned areas.

J. Reptiles and Amphibians

These groups on the Refuge include turtles, frogs, toads, lizards, snakes and salamanders. Approximately 39 species of reptiles and amphibians have been reported in Linn County. Most of the species are restricted to certain habitat types and can probably be found where favorable conditions exist.

The Refuge provides habitat for a diversity of reptiles and amphibians. A total of 58 herpetological species (16 amphibians and 42 reptiles) have been recorded from either Linn or Miami Counties. Even though detailed site inventories have not been completed, all of these species probably inhabit the Refuge or the land adjacent to it. The Kansas herpetofauna consists of 92 species of which 58 (63 percent) have been recorded in Linn or Miami Counties (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998).

The Kansas Natural Heritage Inventory has compiled a list of 'Vertebrates (other than birds) of Linn County, Kansas' (Appendix E - *Reptilia* and *Amphibia*, pages 1 and 4). For further information on reptiles and amphibians see Amphibians and Reptiles in Kansas (Collins 1982).

Reference on the effects of fire on reptiles and amphibians in grasslands is limited (Mushinsky 1985). These animals try to escape fire by going below ground when possible. However, caught above ground, the physiological and morphological status of herpetofauna makes these animals particularly susceptible to being killed in a fire, perhaps because their body temperature rapidly reaches a lethal level (Bragg 1994). Bullsnakes and "blue racers" tended to survive prescribed fire in Nebraska Sandhills Prairie while ornate box turtles were far more susceptible (personal observation).

K. Invertebrates

A number of mussel species are present in the wetlands and flowages within the Refuge. These species are good indicators of the general health of the wetlands of the area. Populations of mussels are vulnerable to pollutants such as agricultural pesticides and industrial discharges. An additional threat to populations in Kansas, Missouri, and Oklahoma is now present from a small industry that has developed to provide mussel shell export to the Orient. People collecting mussel shell will dredge out ponds, pits, and stream channels to remove all the mussels from an area. This practice, whether by legal or illegal means, can critically affect populations of mussels such as the flat-floater which is a State-listed species.

Fire's effect on mussels has not been documented. The only potential threat is an increase in soil erosion from recently burned areas.

L. Insects

Insect life and range of occurrence all not well documented at Marais des Cygnes NWR. Effects of burning on insects is quite variable. As a group, insects do not appear to experience a severe decline following fire, suggesting that they have adaptations that allow at least some individuals to survive periodic burning (Bragg 1994). Inappropriately timed fires, however, can result in the extirpation of butterflies and other prairie insects in isolated areas (Panzer 1988).

Grasshoppers and leafhoppers have been shown to increase with burning in tallgrass prairie in Kansas, Illinois, and Minnesota (Knutson and Campbell 1976). Varying fire conditions effected the response of these organisms. Early-spring burns in tallgrass prairie resulted in more grasshoppers than late-spring burns (Evans 1984).

Ants have also been found to increase with burning. Ants spend much of their time below ground, thus, at least some of the colony survives. In addition, their scavenging behavior and general adaptation to hot, dry conditions make them one of the animals that most rapidly increases in population size in burned areas (Bragg 1994).

Spiders, centipedes, and millipedes are species that are drastically reduced by fire (Bragg 1994).

M. Cultural Resources

Fire management activities at Marais des Cygnes NWR will be implemented in accordance with the regulations and directions governing the protection of cultural resources as outlined in Departmental Manual Part 519 (519M), Code of Federal Regulations (36 CFR 800), the Archeological Resources Protection Act of 1979, and the Archeological and Historic Preservation Act of 1974. National Historic Preservation Act of 1966 section 106 clearance will be followed for any fire management activity that may affect historic structures or archeological resources.

Limited archeological work has been done on the Refuge. Preliminary reconnaissance work done by the Kansas State Historical Society in conjunction with development on the Marais des Cygnes Waterfowl Management Area did not yield sites of archeological significance. However, investigators did report that studies of contour maps of the region and reports of sites located in adjacent drainages indicate the area's potential for the presence of archeological sites. Currently, the most notable historical resource in the Refuge area would be the old Fort Leavenworth-Fort Scott Military Road. This historic road site crosses the Marais des Cygnes River between Sections 8 and 9, T21S, R25E, just south of the town of Trading Post. It is not known whether the actual crossing site or roadbed

are still evident on the ground.

Discussions with Ft. Scott National Historic Site staff and information from the Kansas State Historical Society indicate the Refuge may have been centrally involved in the Battle of Mine Creek. This Civil War battle, the largest in Kansas, began in October 1864 near Trading Post, Kansas. Union forces attacked the retreating forces of Major General Sterling Price along the Old Military Road. The opposing forces constituted about 24,000 troops and calvary and the battle rolled south through the Refuge to Mine Creek. There, Price's troops were routed, abandoning their wagons as they fled south.

Evidence of human use of the Refuge for the past two thousand years has been documented, and the potential for finding evidence of older occupations exist. Resources include a prehistoric campsite, a segment of the original Military Post Road between Forts Leavenworth and Scott, historic farmsteads and coal mines, as well as fossilized plant remains.

The 1987 Kansas Prehistoric Archeological Preservation Plan divides the state into ten (10) physiographic units and six (6) temporal periods. The Refuge is located within the Osage Cuestas physiographic subprovince. Sites dating to the Archaic, circa 3500 B.C., have been identified in the Osage Cuestas. Based on the information provided in the Preservation Plan, settlement patterns for both the Archaic and Ceramic Periods were in sheltered lowlands along major and minor drainages. However, seasonal upland camps have been identified dating to the Archaic and Early Ceramic Periods.

Site 14LN342, a prehistoric camp site assigned to the Early Ceramic Temporal Period (A.D. 1 to A.D.1000), is located with the Refuge boundaries. The site, which covers approximately seven acres, is located within the floodplain on the north side of the river. The potential for similar sites along both sides of the river is high. The subsistence economy was based on hunting and gathering with limited agriculture. Although evidence of earlier sites in Kansas is scarce, projectile points dating to the Clovis Period, circa 10,000 B.C. have been recorded. Researchers have postulated that this paucity of remains does not reflect lack of use of the area. Rather, they believe that these earlier sites have likely been buried by geological processes.

Although the first European exploration of Kansas dates to the mid 1500's with the Spanish expeditions from Mexico, the first European settlement was by French fur traders in the mid 1700's. The American Fur Company moved into eastern Kansas in the early 1800's. In 1839, Michael Gireau established a trading post on the river. Gabriel Choutea bought the post in 1842. This site became known as Trading Post.

Until Congress passed the Kansas-Nebraska Act in 1854, Kansas had fewer that 800 European settlers, most of whom were traders, missionaries, or associated with military posts. The areas along the Missouri-Kansas border, including the river area were the earliest areas settled after Indian Country was opened in 1854. In the mid 1850's the border between Kansas and Missouri became the scene of violence between the free-state and pro-slavery factions with the region being dubbed "Bleeding Kansas". The last major incident of this guerilla warfare was the Marais des Cygnes Massacre of 1858. Missourians captured eleven free-state men, lined them up in a ravine before a firing squad and killed five of them. The site, just north of Trading Post, is on the National Register of Historic Places.

The border wars continued during the Civil War. In 1964 Confederate forces retreated south along the military road after a battle with Union forces at Westport. The Confederate army had a wagon train of plundered items and a herd of sheep and cattle. The Union forces caught up with Price's troops at Trading Post. During their crossing of the river, the retreating Confederates lost part of their cattle and wagons and 100 men were taken captive.

The retreat ended with a Union victory at the Battle of Mine Creek, approximately six (6) miles to the south. This was the last significant Civil War battle in the west. One of the most significant remains of European settlement on the Refuge is the Military Road and southern retreat route of Price's troops from Trading Post.

The Refuge also encompasses the remains of abandoned farmsteads and two (2) community cemeteries. In addition to the community cemeteries, other burial sites are located on the Refuge. Appendix F (from 100 Cemeteries and Burial Sites in Linn County, Kansas 1987) consists of maps indicating burial sites located on or near the Refuge.

Agriculture and coal mining have been important economic activities for Linn County since the mid 1800's. The Refuge lies within the Pleasanton Coal Mining District. The earliest record of coal production in the district is in 1872. Several abandoned coal mines are present on the Refuge. These include shaft and open pit mines; both large commercial operations and small family mines (Marais des Cygnes National Wildlife Refuge Comprehensive Conservation Plan 1998).

Heat from grassland fires rarely penetrates more than a centimeter into the soil. Impacts of grassland fires on artifacts and other materials in subsurface settings will be negligible even if they are buried only a centimeter or less below the ground surface (Wright and Bailey 1982, Vogl 1974). Research conducted by Sayler, Seablom, and Ahler in North Dakota indicate that fire related impacts to surface exposed artifacts will be significant, depending on fire conditions and artifact type and size. Damage includes scorching, fracturing, charring, and spalling. Secondary impacts are created by erosion and vandalism. The severity of fire effects can be controlled and diminished to some degree by controlling the

fireline intensity at the time of the burn.

Files and records of cultural resources should be consulted by the fire management team when planning prescribed burns, pre-attack, and preparedness actions. The potential for adverse impacts to cultural resources will be evaluated prior to prescribed burning and in the selection of fire suppression strategies during wildfires. Protective blackline may be used around sensitive sites. The use of earth moving equipment for wildfire suppression and prescribed fire operations must be approved by the Project Leader (or designee), and these resources will be considered in the approval process.

Fire suppression and prescribed fire actions involve construction of blackline and scratchline, use of swatters, and direct attack with engines, all primarily in fine fuels. Ground disturbance is minimal and not likely to adversely effect cultural resources. At Marais des Cygnes NWR many potential archeological sites have previously been farmed or inundated by flooding from the Marais des Cygnes River.

N. Improvements

Wildfire damage to improvements on and off the Refuge is a primary concern. While developments can generally be protected from fire damage, dispersed improvements, particularly fences, public use facilities, and gates, are likely to be damaged by severe or large fires. Since the Refuge is just "getting off the ground", little has been completed in the area of facilities. An old house which has been refinished and is currently the office/housing is located in the northwest corner of the Refuge (replacement value $150,000).

Wildfire damage to non FWS public property can occur to wooden utility poles and utility junction boxes located on or near the Refuge. Adjacent land ownership to the Refuge is either private or Kansas Wildlife and Parks. Wildfires or escaped prescribed fires could damage adjacent private structures, equipment, and grazing/hay/cropland. Private landowners in this area of Kansas are very tolerant of fire. Many private landowners annually burn winter wheat fields and grassland.

The community of Trading Post is also located adjacent to the Refuge. In order to reduce the risk of wildfire in this area, the Refuge is considering planting a cool season grass break adjacent to the town.

O. Wilderness

The Refuge does not conform to the definition of a wilderness, as described in the Wilderness Act of 1964. The area has been noticeably affected by humans (i.e.

mining, human habitation). In addition, due to existing inholding and rights-of-way, there are no significant areas that provide for outstanding solitude and primitive type recreation opportunities.

P. Smoke Management / Air Quality

The management of smoke is incorporated into the planning of prescribed fires, and to extent possible, in suppression of wildfires. Sensitive areas are identified and precautions are taken to safeguard local neighbors and visitors. Smoke dispersal is a consideration in determining whether or not a prescribed fire is within prescription. Generally, the fine grass fuels and small burn size (1 - 500 acres) generate low volumes of smoke for a short duration (4-5 hours).

Fire management activities at Marais des Cygnes NWR which result in the discharge of pollutants (smoke, carbon monoxide, particulate, and other pollutants from fire) are subject to and must comply with all applicable Federal, State, and local air pollution control requirements as stated in Section 118 of the Clean Air Act, as amended 1990.

The Kansas Department of Health and Environment implements the requirements of the Clean Air Act for the State of Kansas. Open burning for agricultural purposes (including wildlife) are exempted from K.A.R. 28-19-648 (Open Burning Prohibited) providing conditions are met (Appendix G, page 1). Burning of timber is an exception to the exemption. According to Lynn Ranabarger (Kansas Department of Health and Environment), understory burns in standing timber do not need to have a permit; however, piles of slash or flood debris must have a permit before the burn is initiated. Individual counties can impose more restrictive controls. Currently, Linn County does not require a permit for prescribed fires unless a burn ban has been instituted by either Linn County or the State of Kansas. Appendix G, page 5 is an open burning permit for Linn County.

The Missouri Department of Natural Resources, Air Conservation Commission, implements the Clean Air Act for the State of Missouri. Appendix G , page 3, is laws and regulations concerning open burning for the State of Missouri. Nothing is stated regarding burning for wildlife habitat within these statutes. However, in conversation with Rorke Hozschuh (MO DNR), he stated that permits *may* be required for prescribed burning in Missouri. However, he also stated that “we” have pretty much left State and Federal Agencies alone in their prescribed fire operations. Currently, the Refuge does not cross into Missouri. However, the boundary is the State Line and smoke management would be a concern.

Q. Fire Environment and History

1. Fuel Types

Fuel Model 1/3 - Grass. Acreage in these two fuel models is highly variable depending on time of year. Fuel model 1 consists of short grasses which have generally been recently grazed heavily, mowed, or harvested. Grass areas that have not been manipulated and unharvested crops fall into Fuel model 3 (tall grass). Habitat types on the Refuge which constitute fuel model 1 and 3 include moist soil cells, seasonal wetlands (low prairie), native prairie, introduced grasses, and cropland. Current acreage of these fuel models is 4,387 acres. Current proposed acreage is 3,600 acres.

Fuel Model 2 - Grass and timber overstory. The major habitat type for fuel model 2 that occurs on the Refuge is savannah. Current acreage for fuel model 2 is 273 acres. The proposed acreage for savannah is 750 acres.

Fuel Model 5/6 - Short to mid-height shrubs. The habitat type on Marais des Cygnes NWR that is characteristic of this fuel type is the upland shrub which is dominated by Rose sp., and raspberries. Some grassland areas may currently fall into this fuel model due to the absence of fire leading to large increases in shrubs and young tree growth. Currently, 887 acres are involved in these two fuel models. The proposed acreage is 450 acres.

Fuel Model 8/9 - Timber. Hardwoods growing in riparian areas with an understory which may be any combination of brush, grass, or litter. Habitat types associated with these fuel models include bottomland hardwoods, upland hardwoods, and riparian woodland forest. The Refuge currently has 3,396 acres in these fuel models. The proposed acreage for these fuel model is 4,643 acres.

2. Fire Behavior

Data and descriptions for the following fuel models obtained from Aids To Determining Fuel Models For Estimating Fire Behavior (Anderson 1982), "Behave: Fire Behavior Prediction and Fuel Modeling System" (Version 4.1), and "Fireline Handbook - NWCG Handbook 3 (1989).

Fuel Model 1 - shortgrass. Fire spread is governed by the fine, very porous, and continuous herbaceous fuels that have cured or nearly cured. Fires are surface fires that move rapidly through the cured grass and associated material. Fuel loads average 0.74 tons/acre with a fuel bed depth of one foot.

Fire behavior in this fuel model is directly related to fine fuel moisture and windspeed. Rates of spread can reach 446 chains/hour and flame lengths of 10' with a fine dead fuel moisture of 3% and midflame windspeed of 10 mph. Spot fires are generally not produced because fuels are consumed rapidly.

Fire fronts tend to become irregular as topography, fuel loads, wind, or natural barriers speed up or slow movements. Depending on windspeed, resistance to control is low to moderate.

Fuel Model 2 - timber (grass and understory). Fire spread is primarily through the fine herbaceous fuels, either curing or dead. These are surface fires where the herbaceous materials, in addition to litter and dead-down stemwood from the open shrubland or timber overstory, contribute to the fire intensity. Total fuel load (<3") averages 4.0 tons/acre with about 2.0 tons/acre of dead fuel load (0.25"). The live fuel load (foliage) averages 0.5 tons/acre. The fuel bed depth is about 1.0 foot.

Rates of spread can reach 152 chains/hr with flame lengths of 11' with a fine dead fuel moisture of 3%, live fuel moisture of 90%, midflame windspeed of 10 mph and 0% slope. Resistance to control can be moderate to very high.

Fuel Model 3 - tallgrass. Fire in this model is the most intense of grass fuel models and displays high rates of spread under the influence of wind. Wind may drive fire into the upper heights of the grass and across standing water. Fuel loads consist of fine and course dead fuels that average 3.0 tons/acre with a fuel bed depth of 2.5 feet.

Rates of spread can reach 387 chains/hour and flame lengths of 25’ with a fine dead fuel moisture of 3% and midflame windspeed of 10 mph. Short range spotting (500') is common. Resistance to control is very high to extreme.

Fuel Model 5 - shrub. Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs and grasses or forbs in understory. The fires are low intensity because surface fuel loads are light, the shrubs are young with very little dead material, and the foliage contains little volatile substances. Total fuel load (<3") averages 3.5 tons/acre with only

1 ton/acre dead (0.25"). The fuel bed depth is 2 feet. Rates of spread are generally slow, approximately 10 chains/hour with flame lengths from 1 to 3 feet.

Fuel Model 6 - shrub. Fires carry through the shrub layer where the foliage is more flammable than fuel model 5, but this requires moderate winds, greater than 8 mph at mid-flame height. Generally, fire will drop to ground in openings or when wind speed diminishes. Total fuel loadings (<3") average 6.0 tons/acre with about 1.5 tons/acre dead (0.25"). Fuel bed depth is 2.5 feet.

Rates of spread can reach 109 chains/hr with flame lengths near 11 feet with a dead fuel moisture of 3%, midflame windspeed of 10 mph, and 0% slope. Resistance to control can be high to extreme.

Fuel Model 8 - timber. Slow burning ground fires with low flame lengths are generally the case, although the fire may encounter an occasional jackpot of fuels. Only under severe weather conditions involving high temperatures, low humidities, and high winds do the fuels pose fire hazards. Total fuel loadings (<3") are about 5.0 tons/acre with about 1.5 tons/acre dead (0.25"). The fuel bed depth for this fuel model is approximately 0.2 feet.

Rates of spread are about 7 chains/hr with flame lengths of 2 feet with a fine dead fuel moisture of 3%, midflame windspeed of 10 mph, and 0% slope. Resistance to control is low except during drought conditions.

Fuel Model 9 - timber. This model displays moderate to low fire intensity. Fires are carried by dead loosely compacted leaves. Flame lengths in this fuel model are higher than fuel model 8. Concentrations of dead downed woody material will contribute to more intense burning and spotting. Total fuel loadings (<3") are about 3.5 tons/acre with a dead fuel load (0.25") at 2.9 tons/acre. The fuel bed depth is 0.2 feet.

Rates of spread are about 36 chains/hr and a flame length of 6 feet with a dead fuel moisture of 3%, midflame windpeed of 10 mph, and a slope of 0%. Resistance to control is low except during drought conditions.

3. Fire Occurrence/History

Wildfire is one of the primary natural forces which created native prairie and savannah. Historic records describe huge prairie fires started by lightning or humans. Fires consumed millions of acres of prairie vegetation as there were few natural firebreaks and no suppression. Wright and Baily (1982) estimate fire frequency in pre-settlement tallgrass prairie ranged from every 5 - 10 years; however, Hulbert (1973) estimated fire frequency to be two to five times every 10 years.

Historical reviews indicate the July-August period, to varying degrees, as a seasonal fire peak (Hamilton 1996). Moore (1972) reports for the southern plains region that October and then July-August as the peak fire seasons with a smaller season in April-May.

The primary lightning season for Marais des Cygnes NWR is July-August - a pattern which holds for most of the continental United States. Orville (1991) reported 13.4 million lightning ground flashes in 1989 in the contiguous U.S., of which 50% occurred in the July-August period. In 1989, the Flint Hills region of Kansas and Oklahoma had the highest density of lightning strikes (6-8/km^2) in the United States west of the Mississippi River (Hamilton 1996).

Obviously, lightning was an important source of fire in the central grasslands. However, fires during July and August are generally small due to tallgrass prairie being lush and green, thereby reducing fire spread and intensity.

Conversely, fires during the dormant season of spring and fall (while of lower frequency) had a larger spacial influence on the pre-settlement landscape. Rates of fire spread and intensity have been measured as high as 15 to 20 times the July-August period (Steuter 1986). Most fires occurring in the fall were started by aboriginal people for a variety of reasons. Some of the reasons aboriginal people burned vegetation include; burned areas provided safe camping areas from their enemies, driving big game animals; luring big game animals to green vegetation for hunting purposes; and even destroying enemy camps.

Between the tallgrass prairie and forested areas along rivers, a continuous battle line existed. This area became known as the oak savannah. Higher intensity fires would burn into these areas killing young oak trees but leaving the older fire resistant trees in tact. A compendium of historical accounts leads Ladd (1991) to portray the land in Missouri being vegetated much differently than it is today. Historical accounts (Mudd 1888, Dockery 1855, Wilhelm 1835, Saur 1920) all document that timbered regions of Missouri were restricted to steep slopes and

waterways. Savannah and tallgrass prairie were the dominant habitat types in Missouri prior to settlement. Foster (1869) summarized the general character of the vegetation, occurring as an "almost continuous" belt from Green Bay, Wisconsin, to western Arkansas:

> *"... the trees stand as in an artificial park, shading a green-sward devoid of underbrush, so that a traveler may ride or drive in any direction."*

Houck (1908) described Ozark woodlands:

> *"... open woods and a growth of wild prairie grasses and flowers filling the broad spaces between the trees...All the forests were free from undergrowth, and open and park like in appearance."*

Historically, these savannahs and prairies within Missouri were fall burned almost annually by aboriginal people. Numerous accounts (Stoddard 1812, Brackenridge 1816, Duden 1829) described the use of fire by aboriginal people. Stevens Publishing Co (1888) documented fire use by aboriginal people in Shuyer County in northern Missouri:

> *"For many years prior to the settlement of the country, it had been the custom of the Indians, after the frost had killed the rank growth of vegetation, especially the wild grasses, and it had become dry, to set fire to it, and thus burn over the entire surface of the ground. This annual burning destroyed the young germs of forest trees and prevented a dense growth of timber; so, when the early settlers came, they found no undergrowth of timber. The forest trees, nearly all of which had a short, scrubby growth, stood far apart, and, there being no underbrush, the forests were so open that the deer could be seen for hundreds of yards, and the pioneer could ride and drive through the timber without any difficulty. It is not so now, a gradual but distinct change having been brought about. Soon after the settlement began the annual fires ceased to occur, and as a consequence the young timber began to grow."*

Marbut (1914) in a description of the Ozark region of Missouri, noted:

> *"The greater part of the Ozark Dome and large area of the rest of the region discussed in this report was up to the middle of the nineteenth century a region of open woods, large areas being almost treeless. Except on the roughest land...the timber growth was not dense enough to hinder in any way the growth of grass. The native "bluestem" wild grass covered the region with a heavy growth and its burning every fall served to kill every seedling tree that had reared its head during the preceding summer. It was only on the main area of Clarksville soil that the original timber growth was heavy, and there is abundant evidence that at least forty per cent of that area consisted of grass covered, sparsely timbered rolling uplands. The region was treeless or nearly so, not because the soil and climate were unfavorable to tree growth, but because the annual fires which burned the dry grass every autumn or winter killed the tree seedlings."*

An initial reaction to these accounts of frequent aboriginal fires, especially in light of the intense behavior of prairie fires, is to assume fires would destroy the original timbers, resulting in the rapid replacement by prairie or other non-absorbent vegetation types. This impression undoubtedly is augmented by spectacular reports of forest conflagrations in the popular media. Fire, however, is not a single force, but manifests a nearly infinite range of behaviors determined by weather parameters, fuel loads, topography, and other variables. Thus it is possible to envision woodland fires as totally different processes than the whirling, violent, catastrophic images often evoked (Ladd 1991).

Featherstonhaugh (1844) witnessed a woodland fire in southeast Missouri, providing this anecdotal account of variable and less catastrophic behavior:

> *"... we could see a fiery horizon through the forest in every direction, and hear the crackling of the advancing conflagration... We were upon an elevated table-land, covered with dry autumnal leaves, grass, and sticks, upon which stood numerous dead and dry trees killed by previous fires. Not a quarter mile from the house was a narrow edging of bright crackling fire, sometimes not more that two inches broad, but much wider when it met with large quantities of combustible matter. On it came in a waving line, consuming everything before it... I measured the progress of the fire, and found it advanced at the rate of about one foot a minute".*

Forest closure and understory development rapidly followed initial settlement or disruption of aboriginal populations. Pyne (1982) states:

"The dominant vegetation type in North America may well have been grassland or open forest savanna. The role of fire in sustaining these landscapes is incontestable; when broadcast burning was suppressed as a result of European settlement, the land spontaneously reverted to forest... The transformation of grasslands, prairies, and savannas into forests is one of the most fundamental and widespread outcomes of European colonization."

Indications of frequent aboriginal burning are supported by data from several sources. Recent dendrochronological work in Missouri, using fire scars on old growth trees, has established frequent burn intervals for the presettlement period (Guyette and McGinnes 1982, Guyette and Cutter 1991). In a 1982 study, conducted on a glade in southwestern Missouri, a presettlement fire frequency of 3.2 years was established. This is especially impressive because dendrochronological fire frequency studies can only establish a minimum fire frequency, and will not reflect low intensity fires that do not result in scar formation. Similarly, areas with sparse timber in presettlement times would have few trees available for analysis in studies such as this. In the study cited, old growth cedars were used as sample trees. As pointed out by Arend (1950), cedars are highly fire sensitive. In the presettlement landscape, it seems likely that cedars were confined to sites with lower or more sporadically distributed fuel loads, and hence perhaps lower fire frequencies than on ambient lands (Ladd 1991).

Very limited fire records exist for Marais des Cygnes NWR since the Refuge was established in 1992. Prior to the fall of 1997, the Refuge was unstaffed and signs of wildfire occurrence quickly disappeared due to rapid regrowth. During this time (1992 through 1997), only one (1) wildfire (lightning) was reported for the Refuge. This wildfire was a pecan tree that had been struck by lightning and was extinguished by Linn County Fire Department at 2.0 acres. Since the Refuge has been staffed, a total of seven (7) man-caused wildfires were documented in the spring of 1998. Six (6) of these fires were suspected arson fires set by "kids" in CRP fields on the Refuge. One (1) fire was ignited by an adjacent landowner while burning his CRP; and, he allowed his fire to burn CRP on the Refuge. The agricultural field burning season occurs in the spring and again in late June to early July. Private landowners are not subject to the same burning regulations as government agencies; and thus, many fields are often ignited and left unattended.

The largest wildfire on record (March 1998) consumed 115 acres (75 acres on Refuge). This fire was ignited by an adjacent landowner who allowed fire to cross onto Refuge. To date, all but one wildfire have been natural outs.

As per Service policy, a Fire Management Plan must be completed before prescribed fires can be attempted. Therefore, no prescribed fires have occurred during the Refuge's short history.

FIGURE 7. WILDFIRE FREQUENCY AND SIZE ON MARAIS DES CYGNES NWR

Year	Number of Fires	Acres Burned	Range of Acres Burned
1992	0	0.0	0.0 - 0.0
1993	0	0.0	0.0 - 0.0
1994	0	0.0	0.0 - 0.0
1995	0	0.0	0.0 - 0.0
1996	1	2.0	2.0 - 2.0
1997	0	0.0	0.0 - 0.0
* 1998	7	* 330.7	20.0 - 115.0
Total	8	** 332.7	0.0 - 115.0

7 Year Average: 1.1 fires / year
34.5 acres / fire
241.6 acres burned / year

* Refuge was staffed in fall 1997. Note dramatic increase in reported fires in 1998.

** Includes Refuge and private land.

IV. MARAIS DES CYGNES NWR FIRE MANAGEMENT POLICY AND OBJECTIVES

A. General

The goal of wildland fire management is to plan and make decisions that help accomplish the mission of the National Wildlife Refuge System. That mission is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. Fire management objectives (standards) are used in the planning process to guide management to determine what fire management responses and activities are necessary to achieve land management goals and objectives.

The primary goal is to provide for firefighter and public safety, property, and natural resource values. Service policy and the Wildland Fire Policy and Program Review direct an agency administrator to use the appropriate management response concept when selecting specific actions to implement protection and fire use objectives. The resulting Appropriate Management Response are specific actions taken in response to a wildland fire to implement protection and fire use objectives. With an approved Fire Management Plan, the Refuge staff may use wildland fire in accordance with local and State ordinances and laws to achieve resource management objectives (habitat improvement) outlined below.

The following considerations influenced the development of the Refuge's fire management goals and objectives. The previous sections of this plan have established that:

1. Fire is an essential natural part of the native biotic communities.

2. Uncontrolled wildfire has the potential for negative impacts on and off the Refuge.

3. Positive or negative effects of prescribed fire on vegetation, wildlife, and cultural resources depend on burning conditions and species involved.

4. Use of "minimum tool" concept to minimize environmental and cultural damage.

5. Rapid rates of spread and fire suppression response time pose significant suppression problems and increase the likelihood of escape onto adjacent lands.

B. Refuge Fire Management Goals

1. Protect life, public and private property, and cultural and natural resources from wildfire.

2. Utilize prescribed fire as a tool to accomplish Marais des Cygnes NWR habitat management objectives.

C. Refuge Fire Management Objectives

1. Safely suppress all wildfires using strategies and tactics appropriate to safety considerations, values at risk, and in accordance with Service policy.

2. Minimize the cost and impact of suppression activities.

3. Prevent human-caused wildfires.

4. Use prescribed fire to the fullest extent possible within or near Refuge development zones, wildfire sensitive resources, and boundary areas to reduce the risk from wildfire damage.

5. Use prescribed fire to restore and perpetuate native wildlife species, by maintaining a diversity of plant communities.

6. Maintain prairie and savannah by retarding the invasion of woody species and noxious weeds.

7. Educate the public regarding the role of prescribed fire within the Refuge.

V. FIRE MANAGEMENT STRATEGIES

The following will be employed to meet fire management objectives:

A. Fish and Wildlife Service policy mandates that wildland fire be managed using the appropriate management response concept. The Refuge will utilize an appropriate management response to manage all wildland fires and will incorporate minimum impact suppression tactics whenever appropriate.

B. Conduct all fire management programs in a cost effective manner consistent with applicable laws, policies, and regulations.

C. Utilize prescribed fire as a tool for hazard fuel reduction and meeting resource management objectives. As much as possible, hazard fuel reduction prescribed fires will be used only when they compliment resource management objectives. Resource management prescribed fire will be used to accomplish specific objectives established for individual units.

D. Initiate cost effective fire monitoring which will inform managers if objectives are being met. Monitoring information will also be used to refine prescribed fire plans to better meet objectives.

E. Due to low numbers of personnel, low amounts of equipment, and the Refuge's proximity to town, local fire agencies (volunteer fire departments) will be utilized for initial attack on wildfires. Memorandums of Understanding (MOU) with local fire agencies will be completed and maintained to provide for cooperative suppression actions.

F. Limits to Strategies

1. Heavy equipment (bulldozers, discs, plows, and graders) will only be used in fire suppression with approval of the Project Leader (or designee).

1. Aerial Retardants and foams will not be used within 300 feet of any waterway as described in the Guidelines for Aerial Delivery of Retardant or Foam near Waterways.

2. Prescribed burning in areas where threatened, endangered, and candidate species exist will not be conducted if the prescribed fire is detrimental to the species or if any adverse impacts cannot be mitigated. Section 7 clearance will be secured, as appropriate.

3. Prescribed burns will not be conducted during periods of high fire danger when county or State-wide burning bans are in effect.

4. Generally, no more than one prescribed burn will be active at one time although multiple burns may be conducted consecutively in one day. Only in circumstances where additional burns are closely situated and can be safely managed by the Refuge staff and local back-up forces are available, will multiple fires be conducted simultaneously.

VI. FIRE MANAGEMENT UNITS

Marais Des Cygne NWR has been divided into two Fire Management Units (FMU), which are the same for both wildland fire and prescribed fire. The decision to divide the Refuge into two FMUs was based on: (1) differences in fuel types, fuel loading, and access; and (2) differences in values at risk (ie. endangered species habitat, cultural and archeological resources, and urban interface). Once more fire data is obtained, these FMU's may be changed in the future to better meet Refuge goals and objectives. A map of FMUs on Marais des Cygnes NWR can be found in Appendix H, page 5.

Specific actions taken in response to a wildland fire to implement protection and fire use objectives is known as Appropriate Management Response. Due to: Refuge's small size; private land inholdings; smoke management concerns; T & E species habitats; urban interface, and potential for rapid rates of spread, the Appropriate Management Response for the Refuge during a wildfire will be suppression. Tactics available to the Incident Commander to carry out the suppression will vary depending upon safety concerns, values at risk, and access.

Table 1: Appropriate Management Response

SITUATION	STRATEGY	TACTIC
1. Wildland fire on Refuge lands which does not threaten life, natural or cultural resources or property values.	Restrict the fire within defined boundaries established either prior to the fire or during the fire.	1. Holding at natural and man-made barriers. 2. Burning out. 3. Observe and patrol.
1. Wildland fire on Service property with low values to be protected. 2. Wildfire burning on to Service lands. 3. Escaped prescribed fire entering another unit to be burned.	Take suppression action, as needed, which can reasonably be expected to check the spread of the fire under prevailing conditions.	1. Direct and indirect line construction. 2. Use of natural and man-made barriers. 3. Burning out 4. Patrol and mop-up of fire perimeter.
1. Wildland fire that threaten life, property or sensitive resources. 2. Wildland fire on Service property with high values to be protected. 3. Observed and/or forecasted extreme fire behavior.	Aggressively suppress the fire using direct or indirect attack methods, holding the fire to the fewest acres burned as possible.	1. Direct and indirect line construction 2. Engine and water use. 3. Aerial retardant 4. Burn out and back fire. 5. Mop-up all or part of the fire area.

A. Oak-Hickory Forest FMU

The Oak-Hickory FMU (Map - Appendix H, page 6) includes all refuge lands that are or are proposed to be hardwood forests. The Oak-Hickory unit is dominated by Fuel Models 8 and 9 with some Fuel model 5 and 6 present as well. This area is characterized by bottomland hardwood, upland hardwood forests, and oxbows. The Oak-Hickory FMU is split into three (3) parts. One part is north of the Marais des Cygnes River; a second part is south of the river; and a third piece is located near the southeast corner of the Refuge. The FMU is considered critical habitat for the state-listed (threatened) central newt, northern spring peeper, broadhead skink, and the federally-listed (threatened) bald eagle (see Appendix C for Critical Habitat Maps). Other T & E species (State and/or Federally-listed) which associate or have the potential to associate with this FMU include the

peregrine falcon, eastern spotted skunk, common map turtle, Flat-floater mussel, horneyhead chub, and western earth snake. The Oak-Hickory Forest Unit has the largest amount of 100 hour, 1000 hour, and 10,000 hour fuels on the Refuge.

The Appropriate Management Response (suppression) will be used in this unit to meet refuge fire management goals. Low impact suppression should be given high priority when fire intensity and spread is minimal. However, fires occurring during drought conditions pose high resistance to control due to fuel types, and lack of access. The entire Oak-Hickory FMU is a wildfire suppression area as well as a prescribed fire area. Maps dictating these areas are shown in Appendix H, pages 7 and 8. More detailed maps will be produced showing roads, fuels, archeological and cultural resources, and values at risk.

Keetch-Byram Indexes (KBI) greater than 400 (or Palmer Drought Index (PDI) of greater than -2.5) for an extended length of time would allow downed 100 and 1000 hour fuels to burn. Another consideration is a KBI that has been above 400 for an extended length of time, then falls rapidly due to a precipitation event. The downed 100, 1000, and 10,000 hour fuels are still dry internally and a fire occurring during this time could generate enough heat to dry the outside of these fuels causing them to ignite.

1. Unit Fire Objectives

a. Provide for firefighter safety first.

b. Minimize damage to Refuge resources.

c. Utilize the Appropriate Management Response (suppression) to control the fire in the most cost effective manner consistent with values at risk and safety.

d. Prevent fire from burning off Refuge lands.

e. Protect critical habitat for T & E species.

f. Protect structures in urban interface. Service policy restricts wildland firefighters from engaging in structural firefighting activities while employed by the Service. Policy does allow use of wildland firefighters for structural (exposure) protection.

g. Use of prescribed fire to meet unit resource management objectives.

h. Protection of archeological and cultural resources.

2. Suppression Strategies and Techniques

a. Utilize existing roads and natural barriers as primary control lines, safety zones, escape routes, and anchor points whenever possible.

b. When possible, use backfires from existing roads and natural breaks to halt fire spread.

c. All constructed fireline will be rehabilitated prior to departure from the fire.

d. Use burnouts to strengthen fire control lines.

B. Grass FMU

The Grass FMU (Map - Appendix H, page 9) is all Refuge land that is not included in the Oak-Hickory FMU; and do to the lay-out of the Oak-Hickory FMU, the Grass FMU is split into three (3) parts. The first part lies north of the Oak-Hickory FMU; the second part lies south of the Oak-Hickory FMU; and the third part is located in the very southeast corner of the Refuge. These units include grasslands, savannahs, croplands, introduced grasses, moist soil cells, and upland shrubs. The Grass FMU is dominated by Fuel Models 1, 2, and 3 with some Fuel Models 5 and 6 present. This FMU has the majority of in-holdings occurring within Refuge boundaries. The Grass FMU has been designated as critical habitat for the Federally-listed Bald eagle. Other T & E species associated or potentially associated with this FMU include: Federally-listed (Threatened) Mead's milkweed, peregrine falcon, piping plover, least tern; and State-listed (Threatened) eastern spotted skunk and green frog.

The Appropriate Management Response (suppression) will be utilized in this unit to meet refuge fire management goals. Low impact suppression should be given high priority when fire intensity and spread is minimal. Fires occurring in this area have a high potential to cross onto private land due to large amounts of private in-holdings and rapid rates of spread. The road system in this unit also provides good access to most fires. The entire Grass FMU is a wildland fire suppression area as well as a prescribed fire area. Maps of these areas are located in Appendix H, pages 10 and 11). More detailed maps will be produced showing roads, fuels, archeological and cultural resources, and values at risk.

Keetch-Byram Indexes (KBI) greater than 400 (or Palmer Drought Index (PDI) of

greater than -2.5) for an extended length of time would allow scattered drift piles and other downed 100 and 1000 hour that may be present in the unit to burn. Another consideration is a KBI that has been above 400 for an extended length of time, then falls rapidly due to a precipitation event. The downed 100 and 1000 hour fuels are still dry internally and a fire occurring during this time could generate enough heat to dry the outside of these fuels causing them to ignite. This is especially pertinent for prescribed fire operations. Generally, timbered areas are utilized as firebreaks because they are green and wet when spring burning of grasslands occurs. However, these timbered areas may not be adequate fire breaks when above conditions are occurring.

1. Unit Fire Objectives

a. Provide for firefighter safety first.

b. Minimize damage to Refuge resources.

c. Utilize the Appropriate Management Response (suppression) to control the fire in the most cost effective manner consistent with values at risk and safety.

d. Prevent fire from burning off Refuge lands.

e. Use of prescribed fire to meet unit resource management objectives.

f. Protect structures in urban interface. Service policy restricts wildland firefighters from engaging in structural firefighting activities while employed by the Service. Policy does allow use of wildland firefighters for structural (exposure) protection.

g. Protection of archeological and cultural resources.

2. Suppression Strategies and Techniques

a. Utilize existing roads and natural barriers as primary control lines, safety zones, escape routes, and anchor points whenever possible.

b. When possible, use backfires from existing roads and natural breaks to halt fire spread.

c. All constructed fireline will be rehabilitated prior to departure from the fire.

d. Use burnouts to strengthen fire control lines.

VII. FIRE MANAGEMENT ORGANIZATION AND RESPONSIBILITIES

The Project Leader at Flint Hills/Marais des Cygnes NWRC is responsible for planning and implementing an effective fire management program at Marais des Cygnes NWR. The Project Leader is also the official ultimately responsible for all fire management decisions concerning both wildfire and prescribed fire. At this time, the two Refuges (Flint Hills and Marais des Cygnes) are managed as a Complex. Eventually, Marais des Cygnes NWR will be a separate Refuge.

All wildfires must receive some type of initial attack response. Currently, two (2) staff at Marais des Cygnes NWR are fire qualified. However, do to lack of storage facilities, all equipment (including engines) is currently located at Flint Hills NWR headquarters near Hartford which is over two (2) hours away. The most fire qualified individual available will be in charge of suppression efforts.

Currently, the Complex's fire management team consists of the following staff: Project Leader, who is ultimately responsible for all fire management decisions; one Refuge Manager, who is responsible for day to day operations of Marais des Cygnes NWR; one Refuge Operations Specialist, who is responsible for the day to day operations of Flint Hills NWR; one Range Technician; who is responsible for the day to day operations of the fire programs at both Refuges; two Biological Technicians, who are responsible for the biological programs at each individual Refuge. In total, five (5) permanent staff employees and two (2) seasonal firefighters are red-carded for arduous duty, and one (1) permanent employee is classified as moderate duty.

The Normal Unit Strength (NUS) for Marais des Cygnes NWR has yet to be determined due to a lack of fire data, facilities, staffing, etc. NUS is estimated to be determined by year 2000. The NUS of the Refuge is defined as "the amount of non-capitalized fire fighting equipment needed by a refuge to meet 70 percent of suppression needs".

A. Project Leader

1. Responsible for the overall management of the Complex, including the fire program.
2. Insure that Department, Service, and Refuge policies are followed and maintained.
3. Insure sufficient collateral duty firefighters meeting Service standards are available for initial attack.
4. Supervise the writing of prescribed burn plans for the Complex.
5. As available, serve as prescribed fire burn boss.
6. Approves prescribed fire burn plans.

B. Refuge Manager

1. Responsible for the management of Marais des Cygnes NWR, including the fire program.
2. Insure that Department, Service, and Refuge policies are followed and maintained.
3. Insure sufficient collateral duty firefighters meeting Service standards are available for initial attack.
4. Supervise the writing of prescribed burn plans for Marais des Cygnes NWR.
5. As available, serve as prescribed fire burn boss.

C. Refuge Operations Specialist

1. Supervise the maintenance, biological, and fire staff at Flint Hills NWR.
2. Supervise the resource management activities including the selection of objectives and tools to be used in achieving objectives (including prescribed fire).
3. Supervise the writing of prescribed fire plans.
4. As available, serve as prescribed fire burn boss.
5. Prepares annual FireBase budget request, approves and tracks use of FireBase accounts.

D. Range Technician

1. Delegated the responsibility for coordination and supervision of the fire management programs by the Refuge Manager.
2. Responsible for planning, coordinating, and directing preparedness activities including:
    a. Fire training.
    b. Physical fitness testing and Interagency Fire Qualification System (IFQS) data entry.
    c. Fire cache and equipment inventory accountability, maintenance, and operation.
    d. Cooperation with cooperative agencies. Revises cooperative agreements as necessary.
    e. Insures step-up plan is followed.
3. Insures fire management policies are observed.
4. Has lead responsibility for managing the prescribed fire program including:

a. When available, serve as prescribed fire burn boss.

b. Propose prescribed fire projects.

c. Write prescribed fire plans.

5. Assist Refuge Biological Technician with fire effects monitoring.
6. Coordinates fire prevention with other employees, and prepares a Fire Prevention Plan if necessary.
7. Maintains liaison with Regional Fire Management Coordinator and Zone Fire Management Officer.
8. Updates the Fire Management Plans, maintains fire records, reviews fire reports (DI-1202) for accuracy, and enters fire reports into FMIS.
9. Maintains engines in state of readiness.
10. Qualify annually (prior to March 1) on the standardized fitness test for arduous positions approved by the National Wildfire Coordinating Group for wildland fire agencies.

E. Biological Technicians

1. Coordinates fire monitoring program to determine if resource management prescribed fires accomplish objectives.
2. Provide technical/biological support to managers in selecting appropriate resource objective, and the best tool to use in accomplishing resource objectives, including the use of prescribed fire.
3. Reviews all proposed units to be burned to ensure sound biological principles are being followed, management objectives are valid, and sensitive resources are not being impacted.

F. Seasonal and Collateral Duty Firefighters

1. Maintain assigned fire equipment in ready state and use required safety gear.
2. Responsible for their personal protective equipment and physical conditioning.
3. Qualify annually (prior to March 1 or within two weeks of EOD date) on the standardized fitness test for arduous positions approved by the National Wildfire Coordinating Group for wildland fire agencies.
4. Assist Range Technician with maintaining accurate records.

G. Wildfire Incident Commander (as assigned)

1. The Incident Commander (IC) will be responsible for the safe and efficient suppression of the assigned fire.
2. Fulfill the duties described for the IC in the Field Operations Guidelines (IC-420-1).
3. Notify dispatch and/or Zone FMO of all resource needs and situation updates, including the need for an extended attack.
4. Ensure that personnel are qualified for the job their performing.
5. Ensure that fire behavior and weather are monitored; data collected and recorded; firefighters are briefed on expected weather, fire behavior, communications, escape routes, and safety zones; and fire lookouts posted.
6. Identify and protect sensitive areas.
7. Utilize minimum impact strategies whenever possible.
8. Ensure that the fire site is fully rehabilitated or that the management of rehabilitation has been assigned.
9. Submit completed DI-1202 wildfire report, crew time sheets, and a listing of any other fire related expenditures or losses to Range Technician within 7 days of fire being declared out.

H. Prescribed Burn Boss (as assigned)

1. Implement approved prescribed burn plans within prescriptions.
2. Assist with the administration, monitoring, and evaluation of prescribed burns.
3. Document weather and fire behavior (including rates of spread and flame length) and submit to Range Technician.
4. Document necessary information to complete DI-1202 (fire report) and submit to Range Technician.

I. Fire Cooperators

Along with other land management agencies, the Service has adopted the National Interagency Incident Management System (NIIMS) Wildland and Prescribed Fire Qualification Subsystem Guide, PMS 310-1 to identify minimum qualification standards for interagency wildland and prescribed fire operations. PMS 310-1 recognizes the ability of cooperating agencies at the local level to jointly define certification and qualification standards for wildland fire suppression. Under that authority, local wildland fire suppression forces will meet the standards established for their agency or department. All personnel participating in prescribed fire management activities must meet Service fitness and training standards.

Cooperators will provide assistance in the suppression of wildfires and assist as needed, in the investigation of suspicious fires as defined in cooperative agreements and memorandums of understanding. Appendix H, page 3 is a copy of a Memorandum dealing with Fire Agreement between Marais des Cygnes NWR and Linn County Fire Department. Interagency cooperators can be found in the Dispatch Plan (Appendix J). Cooperators will also assist, as needed, in the investigation of suspicious fires.

VIII. WILDFIRE PROGRAM

A. Fire Prevention

Due to a lack of fire history for the Refuge, it is unknown at this time if a fire prevention plan needs to be developed. Human caused ignitions have the potential to be the most damaging because they can occur at a time of year when fewer initial attack forces are available and fuels are cured. Agricultural field burning occurs in the spring (which is predominantly pastures and CRP) and summer (which is predominantly wheat fields).

As a reminder to the public and visitors, the Refuge will do the following:

Signing.
Public contacts via press releases and verbal contacts.
Contacts with adjoining private landowners.
Closures of the Refuge when necessary.
Implementation and following of State regulations and restrictions.
Enforcement of regulations and prosecution of violators.
Employee training and awareness.

One other fire prevention measure is the mowing of public use roads.

B. Fire Behavior

See Section III Part Q.

C. Fire Preparedness Planning

1. General

The Project Leader, Refuge Manager, Refuge Operations Specialist, and Supervisory Range Technician are responsible for coordinating preparedness planning. The Step-up Plan (Appendix G) which is currently based on the Rangeland Fire Index lists specific duties. Due to a lack of fire history, a fire season can not be evaluated by FireBase. However, prescribed burning for Refuge habitat objectives can begin in mid-February and extend through the end of April. A second prescribed burning season would coincide with winter wheat harvest (mid-June to mid-July) when the Refuge may be burning stubble fields for double cropping. A third prescribed burning season would occur in the fall (October - November) and would coincide with curing of grasses. Historically, this was the season that aboriginal people burned grasses for tree control (see Section III, Part Q, Number 3). The dates listed above are approximate.

As part of the planning process, Refuge planners will review the affects of fire management activities and incorporate contingency planning elements into each fire management operation.

a. Impacts of Fire Management Activities

Marais des Cygnes NWR is located within a highly fragmented landscape that is dominated by agricultural interests. These agricultural interests include mainly row crop production and livestock production; therefore, adjoining lands are dominated by cropfields, pastures, and hay land. Many of the pastures and hay meadows have been converted to Fescue which is a cool season non-endemic vegetative species. Many of these areas are burned on nearly an annual basis in the spring (early February to mid April) for grass production. In addition, many cropfields are also burned especially those planned for double cropping with winter wheat followed by soybeans.

A secondary land use in the area is strip mining for coal. These areas create deep pits with spoil piles along the edges. These areas many times contain water with the edges being allowed to go to timber.

Refuges lands are very similar to the surrounding area. Prior to Refuge establishment, most of the area was either cultivated or mined. Some Refuge lands continue to be cultivated; however, cultivation has been reduced to less than 1500 acres and it is anticipated that this amount will decrease even more over time.

The affect of Refuge fire management activities on adjacent agricultural land could have an adverse impact on adjacent landowners, especially escaped prescribed fires in the fall. An

escaped prescribed fire during the fall would reduce the amount of vegetation available for livestock grazing or could burn unharvested row crops. A Refuge escaped prescribed fire in the spring would most likely have far less impact to adjoining landowners as Refuge tends to burn areas a little later than surrounding neighbors, especially fescue areas as Refuge wants to reduce this plant species while neighboring farmers/ranchers encourage it.

The effects of adjacent landowner burns crossing onto the Refuge have both positive and negative Impacts. Private landowners burning fescue pastures and hay meadows tend to burn early in the burning season (February-March). Fires crossing onto the Refuge during this time of year would lead to an increase in fescue which is a detriment for the Refuge. However, these same fires would generally not adversely impact areas of virgin tallgrass prairie located on the Refuge as these fires are generally early enough to not adversely effect native forbs (including T & E Mead's milkweed). Native prairie plants evolved with fire occurring at almost any time of year. These species tolerate occasional burns that may occur during their active growing season. However, successive burns occurring during the active growing season would begin to adversely effect most native prairie species. In addition, trespass fires occurring in grasslands would most likely top kill invasive woody vegetation.

Effects of trespass fires on other areas of the refuge would be highly variable based on time of year and Refuge lands effected. The Refuge has areas that were previously croplands near the Marais des Cygnes River that have been planted with deciduous trees (oak, hickory, etc) or are succeeding to deciduous trees to improve bottomland hardwood forest. Fires entering these areas would top kill most of these young trees. The effect of trespass fires into mature stands of bottomland hardwood forest is not well known. Tree species within these areas tend to be thin barked and can be adversely effected by even low intensity fires. Fire tends to scar the bark, and combined with high humidity, leads to fungal infections occurring in the trees. However, these areas did historically burn especially during the fall after leaf drop or during drought conditions. How often burns occurred and the effects of these fires on bottomland hardwood areas is a subject that is still being debated.

Marais des Cygnes NWR also has areas of wildland urban interface located adjacent to the Refuge. These areas consist of small communities as well as scattered farmsteads. Fire management activities conducted by the Refuge could have serious impacts on these wildland urban interface areas. A wildfire on

Refuge land could threaten an entire community and/or isolated farmsteads.

Currently, the Refuge has yet to develop a Memorandum of Understanding (MOU) with Linn County Fire Department. An MOU is anticipated on being completed in late 2001 or early 2002.

Another impact in the wildland urban interface is smoke generated from both prescribed fires and wildfires. This smoke could cause adverse health effects to the local population as well as damaging private property (home furnishings etc). Smoke management is going to become an increasing issue for fire management at Marais des Cygnes NWR. Currently, Linn County is located within an attainment area; however, Miami County, which is just north of the Refuge, is within a non-attainment area.

b. Contingency Planning Elements

Due to fragmented habitats on the Refuge, the possibility of fires requiring contingency forces is fairly low. Numerous barriers (both man-made and natural) and changes in fuels exist on the Refuge. These barriers are utilized extensively in both wildfire suppression and prescribed fire operations.

If contingency forces are needed, they include additional refuge personnel and local Volunteer Fire Departments. If additional resources are needed to contain the escape, other refuge personnel should be called upon first for assistance. If needed, outside Coop resources can be ordered directly through Linn County Sheriff Department as follows:

By calling either 911 or 913-795-2666 or 2665 directly or;

1. Contacting refuge office by radio and having refuge staff call Linn Co Sheriff Office.
2. The Sheriff Office will then contact Linn County VFD or other emergency service for response.
3. In the event Linn County VFD is contacted, radio frequency will switch to Linn County VFD (154.190 R/T) (Channel 5 on refuge radios).

The Sheriff's Office is notified prior to conducting a prescribed fire. Information relating to location of prescribed fire, size of prescribed fire, and estimated start time are provided to the offices. In addition, the offices are contacted when the prescribed fire is completed. The notification of contingency forces will follow the Contingency Section of the approved prescribed fire plan.

Personnel and equipment required to be on-site within an approved prescribed fire plan will be on-site prior to initiation of the burn; unless an amendment to the prescribed fire plan has been approved by Project Leader (or person designated by Project Leader).

2. Personnel

The safety of firefighters and the public is the first priority. Persons engaged in fire suppression activities are exposed to a high element of risk. The Refuge Manager and fireline supervisors must make every effort to reduce the exposure to risk and enhance performance. One way is through formal and on-the-job training and improved physical fitness. The Service has adopted the training and fitness standards established in 310-1, and all firefighters must meet these and other standards established by the Service to participate in fire management activities.

Only qualified employees meeting the fitness and training requirements (red carded) of assigned positions will be dispatched to fires. Other personnel not meeting requirements may be used in support activities but will not be permitted on the fire line. The FWS Fire Management Handbook and Wildland Qualification Subsystem Guides (Wildfire and Prescribed Fire) should be referenced for specific policies and qualifications. The Fire Directory (Appendix J, pages 9 and 10) indicates qualification levels (wildfire and prescribed fire) for staff stationed at Flint Hills/Marais des Cygnes NWRC. All attempts will be made to maintain the following minimum fire qualification levels.

FIGURE 8. PERSONNEL QUALIFICATIONS

ICS Position	# Have *	# Needed
Incident Commander Type 4 (ICT4)	0 (1)	1
Incident Commander Type 5 (ICT5)	0 (0)	2
Engine Boss (ENGB)	0 (1)	2
Engine Operator (ENOP)	2 (4)	3
Firefighter Type 2 (FFT2)	2 (4)	3

* Number in ( ) are personnel stationed at Flint Hills NWR.

In keeping with Service Policy, a physical examination is required for all new permanent employees and all seasonal employees assigned to arduous duty as fire fighters prior to reporting for duty. A physical examination may be requested for a permanent employee by the supervisor if there is a question about the ability of an employee to safely complete one of the work capacity tests. All permanent employees over 40 years of age who take the Pack or Field Work Capacity Test to qualify for a wildland or prescribed fire position are required to have an annual physical examination before taking the test.

3. Training

Service policy sets training, qualification, and fitness requirements for all firefighters and prescribed fire positions (collateral and fire). All firefighters will be provided with the training required to meet Service job qualification standards for the jobs they are expected to perform. Interagency training opportunities will be utilized whenever possible.

All firefighters will be required to participate in an annual firefighter refresher to remain qualified. Refreshers will concentrate on local needs as well as Standards for Survival or Look Up, Look Down, & Look Around, and fire shelter training.

4. Equipment

Engines are the primary initial attack resource on the Refuge because of the predominance of fine fuels and access roads. Earth moving equipment is available and can be used in areas that have been disturbed in the past (i.e. croplands, reseeded grasslands, etc) provided that permission is granted by Project Leader (or designee), and that cultural artifacts will not be effected.

Table 9 (Appendix K, page 1) lists equipment currently available and/or needed (NUS) at Marais des Cygnes NWR. Table 10 (Appendix K, page 2) lists equipment stationed at Flint Hills NWR.

D. Impacts of Drought and Preparedness Levels

As indicated previously, periods of drought can greatly impact fire behavior and resistance to suppression. For that reason the Rangeland Fire Index, Palmer Drought Index and the Keetch-Byram Drought Index will be monitored at a minimum on a weekly bases throughout the year. All are available on the Internet

at http://www.boi.noaa.gov/fwxweb/fwoutlook.htm. The Refuge fire staff can also contact the Pueblo Interagency Dispatch Center (719-545-1454) during periods of high fire danger to track indices and anticipate possible fire activity. Preparedness actions have been identified in the Step-Up Plan to respond to unusual conditions associated with drought and other factors.

Large scale fire suppression activities occurring in various parts of the country can have an impact on local fire management activities. For example, resources may be limited to implement prescribed fire activities because the closest available resources may be assigned to fire suppression duties or Refuge personnel may be involved as well. Regional drought conditions may also tie-up local resources that would normally be able to assist with Refuge fire management activities. It may be necessary to go out of Region to get the resources needed to staff Refuge engines during periods of extreme drought or high fire danger.

The Refuge is in the Rocky Mountain Area. During National and Regional Planning Levels IV and V, it is necessary to receive approval from the Rocky Mountain Area Coordination Group to conduct prescribed burns.

E. Emergency Preparedness

The Step-up Plan is currently based on the Rangeland Fire Danger Index. The Rangeland Fire Index is calculated daily during fire season by the National Weather Service. Greenness factors of fuels are calculated by an Advanced Very High Resolution Radiometer (AVHRR) onboard NOAA weather satellites. Satellite calculated greenness factors are combined with forecasted winds and relative humidities to obtain the index. The data is accurate enough to calculate greenness on a county by county basis. The Rangeland Fire Index is broadcast daily on NOAA weather radio through July 15 as well as anytime the index is in the high, very high, or extreme categories.

The Refuge Team Managers will monitor current and predicted fire weather reports and take appropriate actions as listed in the Step-up Plan (Appendix I).

F. Emergency Presuppression and Severity Funding

Severity funding is different from Emergency Presuppression funding. Emergency Presuppression funds are used to fund activities during short-term weather events and increased human activity that increase the fire danger beyond what is normal. Severity funding is requested to prepare for abnormally extreme fire potential caused by unusual climate or weather event such as extended drought. Severity funds and emergency presuppression funds may be used to rent or preposition additional initial attack equipment, augment existing fire suppression personnel, and meet other requirements of the Step-up Plan.

Emergency Presuppression and Severity funds will be requested in accordance with the guidance provided in the Service's Fire Management Planning Handbook. As a general guide, Severity funding will be requested if a severe drought is indicated by a Palmer Drought Index reading of -4.0 or less or a Keetch-Byram Drought Index of 600 or greater and a long-range forecasts calling for below average precipitation and/or above average temperatures. Drought Indices can be located at: http://www.boi.noaa.gov/fwxweb/fwoutlook.htm

G. Detection

The Refuge relies on neighbors, visitors, cooperators, and staff to detect and report fires. In addition, the step-up plan provides for increased patrols by refuge personnel during periods of very high and extreme fire danger.

There may be occasions when unqualified personnel discover a wildland fire. When this occurs the employee should report the fire and request assistance before taking action to suppress or slow the spread of the fire. If the fire poses an imminent threat to human life, the employee may take appropriate action to protect that life before requesting assistance. The unqualified personnel will be relieved from direct on-line suppression duty or reassigned to non-fireline duty when qualified initial attack forces arrive.

H. Pre-Attack Plan

Pre-attack planning continues to be compiled by the Range Technician and seasonal fire staff. Parts of the pre-attack plan have been completed and are found in Appendix H. Once finished, pre-attack plans will be included in Appendix H and copies placed in each engine. Final pre-attack plans will include:

1. Response Maps
   - Roads, gates, and fences
   - Fire stations/caches
   - Airports
   - Helispots
   - Water sources (type and flow)
   - Mutual aid zones/fire cooperator districts
   - Land ownership maps

2. Hazard/Risk Map
   - High potential fire occurrence zones
   - Potential values at risk zones (high, medium, low)
   - Hazard potential zones (high, medium, low)

3. Natural and Cultural Resources Map

4. Structure Assessments

5. Closure/Evacuation Procedures

I. Fire Suppression

1. General

Service policy requires the Refuge to utilize the ICS system and firefighters meeting NWCG qualifications for fires occurring on Refuge property. All suppression efforts will be directed towards safeguarding life and property while protecting the Refuge's resources from harm.

Mutual aid resources will report to the IC (in person or by radio) and receive their duty assignment. Mutual aid forces will be first priority for release from the fire. Occasionally, individuals that are not members of a fire department and are not qualified to fight fires will arrive at a fire scene. These individuals are not to be used as firefighters. If additional firefighters are needed, appropriate procedures will be used to acquire them.

2. Initial Reporting and Dispatching

All fires occurring within the Refuge will be reported to Marais des Cygnes NWR headquarters. The person receiving the report will be responsible for implementing the Fire Dispatch Plan (Appendix J) and assume duties of Fire Dispatcher.

Requests for assistance by cooperators on fires not threatening the Refuge must be made to the Project Leader or designee. Only qualified and properly equipped resources will be dispatched off of the Refuge.

For local fires, the Fire Dispatcher will stay on duty until: (1) all Refuge resources return; (2) relieved by another dispatcher; or (3) advised by IC that he/she can leave. The Fire Dispatcher will not be required to stay on duty if the fire occurs outside Refuge radio coverage. However, the dispatcher must notify Linn County Fire Department when he/she leaves and leave a telephone number.

The Fire Dispatcher will be responsible for coordinating the filling and delivery of any resource orders made by the IC including engines, aircraft, tools, supplies, and meals. The IC will place all resource orders through the Dispatcher, and specify what is needed, when it is needed, and where it is needed. The Dispatcher will promptly determine if the resource orders can be filled or procured locally and notify the IC. If a resource order can not be filled locally, the Dispatcher will place the order with the Pueblo

Dispatch Center Dispatcher. The Zone FMO at Ft. Niobrara - Valentine NWRC or District FMO at Quivira NWR will generally be able to assist with ordering resources from outside the area.

3. Initial Attack

All fires occurring on the Refuge and staffed with Service employees will be supervised by a qualified incident commander (IC). The IC will be responsible for all management aspects of the fire. If a qualified IC is not available, one will be ordered through Pueblo Dispatch Center. All resources will report to the IC (either in person or by radio) prior to deploying to the fire and upon arrival to the fire. The IC will be responsible for: (1) providing a size-up of the fire to dispatch as soon as possible; (2) determine the resources needed for the fire; and (3) advising dispatch of resource needs on the fire. (See Section VII-G for a more complete listing of duties)

The IC will receive general suppression strategy from the Fire Management Plan, but appropriate tactics used to suppress the fire will be up to the IC to implement. Minimum impact tactics should be used whenever possible. The use of earth moving equipment (dozers, graders, plows) for suppression activities on the Refuge will not be permitted without the approval of the Project Leader (or designee).

4. Escaped Fires/Extended Attack

The IC will notify the Zone FMO whenever it appears a fire will escape initial attack efforts, escape Service lands, or when fire complexity will exceed the capabilities of command or operations. The Zone FMO will be responsible for coordinating extended attack operations including:

Completion of WFSA (wildland fire situation analysis) (Appendix H, pages 4 - 20) for Project Leader.

Completion of Delegation of Authority (Appendix H, page 1) if needed.

Assignment or ordering of appropriate resources.

J. Mop up Standards and Emergency Stabilization and Rehabilitation

The IC will be responsible for mop-up and mitigation of suppression actions taken on Refuge fires. The mop-up standards established in the Fireline Handbook will be followed. Refuge fires will be patrolled or monitored until declared out.

Prior to releasing all firefighters from a wildland fire the following actions will be

taken:

- All trash will be removed.
- Firelines will be refilled and waterbars added if needed.
- Hazardous trees and snags cut and the stumps cut flush.
- Disked firelines should be compacted as soon as possible to preserve the living root stock of natives grasses.
- Overturned sod resulting from plowing must be rolled back with a grader or by hand and compacted to preserve native grass root stock.

Other emergency stabilization and emergency rehabilitation measures may be taken in accordance with Chapter 5 of the Fire Management Handbook. Briefly:

- **Emergency stabilization** is the use of appropriate emergency stabilization techniques in order to protect public safety and stabilize and prevent further degradation of cultural and natural resources in the perimeter of the burned area and downstream impact areas from erosion and invasion of undesirable species. The Incident Commander may initiate Emergency Stabilization actions before the fire is demobilized, as delegated by the Agency Administrator, but completing emergency stabilization activities may be completed after the fire is declared out.

- **Rehabilitation** is the use of appropriate rehabilitation techniques to improve natural resources as stipulated in approved refuge management plans and the repair or replacement of minor facilities damaged by the fire. Total "rehabilitation" of a burned area is not within the scope of the Emergency Rehabilitation funding. Emergency Rehabilitation funding can be use to begin the rehabilitation process if other funding is committed to continue the rehabilitation throughout the life of the project (beyond the initial 3 years of Emergency Rehabilitation funding). Major facilities are repaired or replaced through supplemental appropriations of other funding.

- Because of the emergency nature of the fire event, the emergency stabilization section of the Emergency Stabilization and Rehabilitation Plan (ESR Plan) must be developed expeditiously and is frequently developed by a local unit or designated burned area ESR team. The rehabilitation section of the ESR Plan is not considered an emergency, and is developed as other refuge land use plans. The refuge manager is responsible for preparing all ESR Plans. In order to be funded, ESR Plans must meet resource management objectives and be approved by the Project Leader and the Regional Director.

K. Records and Reports

The IC will complete a DI-1202 Fire Report as well as Crew Time Reports for all personnel assigned to the fire, and return those documents to the Range Technician. The IC should include a list of all expenses and/or items lost on the fire and a list of personnel assignments on the DI-1202. The Range Technician will enter all data into the FMIS computer database within 10 days from when the fire is declared out. The Range Technician will also inform the timekeeper of all time and premium pay to be charged to the fire and ensure expended supplies are replaced.

IX. PRESCRIBED FIRE PROGRAM

Since the Refuge is relatively new and a Fire Management Plan had not been completed, the use of prescribed fire has not occurred (to date) at Marais des Cygnes NWR. Once the FMP is approved, the Refuge will utilize prescribed fire as a tool in two management areas - resource management and hazard fuel reduction. All acreage on the Refuge will be subject to prescribed fires. However, timing of prescribed fires will depend upon values at risk as well as resource management objectives.

A. Resource Management Prescribed Fire

Resource management prescribed burning is used to restore, create, and/or maintain a diversity of plant communities in order to restore and perpetuate native plant and wildlife species. The goals of resource management prescribed fire are:

1. Restoration of native plant and animal species in grasslands, savannahs, hardwood forests, and wetlands.
2. Maintenance of native plant and animal species in grasslands, savannahs, hardwood forests, and wetlands.
3. Reduction /control of non-native species (smooth brome, fescue, etc) and noxious weeds.
4. Assist the Refuge farming program by burning small grain stubble and burning for site preparation of grass seeding projects.
5. Preserve and/or stimulate endangered species habitat.

Achieving many of the goals will require repeated burn cycles for an indefinite length of time. Burn frequency will vary from annually to 15 years dependent on management objectives, historic fire frequency, and funding.

B. Hazard Fuel Reduction Prescribed Fire

Marais des Cygnes NWR may use hazard fuel reduction prescribed burns within or near Refuge development zones, sensitive resources, and boundary area to

reduce the risk from wildfire damage. To the greatest extent possible, hazard reduction prescribed fires will only be used when they compliment resource management objectives.

C. Planning

The Refuge Manager is responsible for supervising the development of resource management objectives for individual units. The Refuge staff will provide assistance in selection of the appropriate management tool needed to meet objectives. Prescribed fire is just one of a combination of tools available. If needed, the Zone FMO, Quivira NWR FMO, or regional prescribed fire specialist will be consulted for assistance in accomplishing the desired objectives.

A burn plan will be written that will document objectives and the plan of action for achieving them. The burn plan will follow the format in the FWS Fire Management Handbook. The plan must also meet all training, personnel, equipment, and other requirements as specified in the FWS Fire Management Handbook. All burn plans will be reviewed by Refuge Manager, Project Leader, Zone ZMO, and regional office (if necessary) prior to implementation. Burn plans can be written by any qualified burn boss and approved by Project Leader. Each burn plan will include or address the appropriate contingency elements discussed in Section IX - G.

The Range Technician and fire crew will be responsible for preparing all fire equipment used for prescribed burning prior to February 15. Prescribed burn units may require preparation including; mow lines, disclines, blacklines, and public relations. Preparation of prescribed burn units will be handled on an individual basis with site preparation identified in the burn plan for that unit.

Prescribed burns can be conducted at any time of year depending on resource objectives and prescription; however, the normal prescribed fire season begins approximately February 15 and ends by May 7 due to bird nesting.

At Marais des Cygnes NWR, most agricultural and resource management prescribed fires use timbered areas for fuel breaks because they are green/wet. However, the burn boss must be aware of cumulative effects of drought on these fuel models. The burn plan will state that if precipitation is significantly below normal, Palmer Drought Index indicates the area is in “moderate drought” (-2 to -3 on scale), and/or Keetch-Byram Drought Index is greater than 400 that additional mitigation measures such as wider mow lines or disc lines will be installed before the burn commences. The Refuge is located in the Rocky Mountain Coordination Center area. Prescribed fires cannot be ignited when the Rocky Mountain Coordination Center is in a fire danger preparedness level V and/or the National Preparedness level is V. In addition, the Refuge will not ignite prescribed fires when: (1) either Linn County or the State of Kansas has instituted burning bans (unless permission has been granted by Fire Coordinator for Linn County); or (2) Palmer Drought Index is in the “extreme drought”

(greater than -4) category and/or Keetch-Byram Drought Index is greater than 600.

Most agricultural burns (including wildlife habitat) are exempted from obtaining open burning permits in the State of Kansas. Regulations regarding open burning can be found in Appendix G, page 1. Currently, a permit for open burning is required in Linn County only when the County or State have instituted burning bans. Procedures to follow for obtaining permits are located in Appendix G, page 5.

Since the Refuge borders the State of Missouri, regulations dealing with open burning in Missouri are located in Appendix G, pages 3. Very little information is listed which deals with open burning for agricultural or resource management. In conversation with Rorke Hozschuh (MO DNR), he stated that permits *may* be required for prescribed burning in Missouri. However, he also stated that "we" have pretty much left State and Federal Agencies alone in their prescribed fire operations.

Multiple prescribed fires may be initiated at the same time within the Refuge. A qualified Prescribed Fire Manager will coordinate multiple burns. The maximum number of simultaneous burns will depend upon the cumulative impacts of smoke on sensitive targets and the availability of the prescribed equipment and personnel. The Refuge may also assist private landowners with prescribed burning to improve the value of their land as wildlife habitat. A Wildlife Extension Agreement with a written provision for the use of prescribed fire must be approved prior to implementing burns on private lands. Such assistance is subject to guidance provided within the Fire Management Handbook, private lands program policies, and funding and staffing restraints.

D. Training

The Refuge will at minimum meet policy requirements of the FWS prescribed fire qualification system. The Range Technician will be responsible for ensuring Refuge personnel maintain the qualifications necessary to implement the prescribed fire program. The Refuge will develop and maintain a minimum of two employees qualified at the burn boss III (RXB3) level. Additional training will be obtained for Refuge resource managers in fire effects and monitoring for prairie and woodland ecosystems in order to implement emerging Service ecosystem management strategies.

E. Complexity

Prescribed fires on Marais des Cygnes NWR can range from low to high complexity as determined by the Region Complexity Analysis Guide. The complexity of a prescribed fire is dependent upon fuels/vegetation, objectives,

smoke management, values at risk, burn boundaries, size, and number of personnel involved. All prescribed fires currently are of low complexity. Moderate and high complexity burns will only be undertaken if a burn boss II (RXB2) or burn boss I (RXB1) and adequate resources are available.

F. Monitoring and Evaluation

Since prescribed burning has not yet taken place at the Refuge, no past history of monitoring and evaluation exists. Burn prescriptions and timing are based on past research (Bragg, Hulbert, and others) as well as staff and local knowledge.

Prior to initiating a burn, photographs, species composition, and percent cover data will attempt to be recorded at least one growing season prior to burn. Burn day data will document weather on site, fire behavior, and fuel consumption. Post burn data will attempt to follow-up on photographs, species composition, and percent cover to document prescribed fire's effects.

Fire monitoring protocols for the Region or Service will be adopted by the Refuge when they are finalized. If the fire management program proposed by this Fire Management Plan is fully funded, a quantitative monitoring program will be implemented. The FTE increase proposed in this plan will be used to establish vegetative monitoring in each of the habitat types being prescribed burned. Species composition and percent cover will be the primary information used to determine if burn objectives are being met and to monitor long term vegetation responses.

G. Prescribed Fire Impacts

1. Environmental Impacts

Environmental impacts of the prescribed fire program have been discussed in previous sections of this Fire Management Plan.

2. Social and Economic Impacts

Social and economic impacts are as follows. Marais des Cygnes NWR lies in the northeastern corner Linn County which has a population of nearly 8,300. Pleasanton is the largest community (2 miles southwest of the Refuge) in Linn County with a population of about 1,200. However, the Refuge also lies about 50 miles south of Kansas City (population around three million).

The main industry in the area is agriculture and most other industry is agricultural related. A secondary industry located near the Refuge is coal

mining.

The Refuge has a cooperative farming program. Land is planted to row crops; and when harvested, some is left for waterfowl which reduces depredation on private land. In addition, some haying occurs on the Refuge. Both of these programs are viewed positively both socially and economically.

The majority of neighbors accept the fact that Marais des Cygnes NWR's first priority is management of bottomland hardwoods and associated wildlife; and most neighbors have a general appreciation for the value of wildlife. However, these neighbors expect the land to be managed for wildlife and not ignored. If the Refuge land is ignored, non-endemic vegetation will invade, habitat conditions will decline, and wildlife species and diversity will also decline. This will lead to negative public opinions about the Refuge. However, if Refuge land is managed for the best interest of wildlife and habitat conditions are maintained or improved, these opinions become positive and wildlife benefits both on and off the Refuge. Prescribed fire is one of the tools necessary to manage Refuge lands.

Marais des Cygnes NWR will not be open to public use until the Fall of 1998. However, once opened, the majority of recreational use will center toward river recreation or waterfowl and upland game hunting. Prior to acquisition by Pittsburg and Midway Coal Company, several duck clubs were present in the area. Some clubs continue to lease land from other private owners for hunting.

A variety of clubs, whose theme is outdoor-oriented recreation, visit the nearby State area, and the area that is now the Refuge each year for opportunities to observe waterfowl, general birding, hiking in natural places, or viewing wildflowers and other plant species. These clubs travel from throughout the State of Kansas and the Midwest region to enjoy the naturalness and diversity of the area.

Annual visitation is projected at 100,000 per year. Negative impact to the local economy could result if habitat conditions decline resulting in decreases in wildlife populations. The number of hunters and bird watchers traveling to the area could decrease; thus, reducing income for the local economy.

Escaped prescribed fires pose a threat to adjacent life and property. However, proper planning, prescriptions, use of qualified personnel, and contingency planning will mitigate this threat. Temporary air quality impacts from smoke may occur, but are mitigated by small burn unit size, consultation with State and County air quality personnel, and generally

fine fuels.

Public opinion to prescribed burning on Marais des Cygnes NWR is generally positive. Many private landowners burn grassland and cropland; thus, burning on the Refuge is not viewed negatively.

H. Reporting and Documentation

Individual prescribed burn plans will be the primary document used to record prescribed fire information. Burn plans document personnel, costs, fire behavior, weather, and burn critique information. Prescribed burns will also be recorded on Individual Fire Report (DI-1202) and entered into Fire Management Information System (FMIS) within 10 business days of fire being declared out.

X. WILDLAND FIRE USE FOR RESOURCE BENEFIT (WFURB)

Marais des Cygnes NWR has chosen not to utilize WFURB for the following reasons:

Rapid rates of spread in fine fuels would create high probability of escape to private land.

Smoke management concerns in timbered areas.

Large amounts of private in-holdings within Refuge boundary.

Conflicting land uses within Refuge boundaries (ie. haying and farming)

Small numbers of wildfires being started by natural means (1 lightning fire since 1992).

XI. AIR QUALITY

Previously discussed in Section III. P. of this Fire Management Plan.

XII. FIRE RESEARCH AND MONITORING

The effects of fire on the Refuge's plants and animals needs to be better understood. Through applied research and careful application of fire, data collected can provide managers with a better understanding of the natural ecological effects of fire, and the information needed to refine prescriptions to meet resource objectives.

Fire behavior data will be collected on all fires occurring on Marais des Cygnes NWR.

Monitoring will comply with accepted scientific methods. This data, along with information gathered through research studies, will be used to improve the effectiveness of the fire management program. The Refuge will continue to encourage fire related research on FWS lands where research operations will not conflict with resource management objectives.

Fire research that is needed at the Refuge includes:

Comprehensive assessment of the Refuge's hazard fuel, and the identification and prioritization of hazard fuel units.

Assessment of hazard fuel management options, and their effects upon Refuge resource objectives.

Assessment of long and short term fire effects in the Refuge's different habitats with recommendations for using prescribed fire in conjunction with other management tools to meet resource objectives.

Assessment of fire effect monitoring needs and preparation of fire effect monitoring plan.

XIII. PUBLIC SAFETY

Firefighter and public safety will always take precedence over property and resource protection during any fire management activity. Firefighter safety is covered in Section VIII. C. This section will deal with public safety.

Fire fronts in grass fuel models move rapidly and are dangerous. However, most of the grass units on the Refuge are small; therefore, entrapment by public users is not a big threat. A larger threat is neighbors who initiate their own suppression without proper training, equipment, or communication. The Refuge staff will attempt to keep the fire scene clear of people except for Service firefighters and cooperating volunteer fire departments.

Smoke from a Refuge fire could impair visibility on roads and become a hazard. During wildfires, the IC is responsible for managing traffic hazards from smoke. Smoke from prescribed fires is included in the prescribed burn plan and is the responsibility of the burn boss. Actions to manage smoke include: use of road guards and pilot car, signing, alternative ignition techniques and sequence, halting ignition, suppressing the fire, and use of local law enforcement as traffic control.

Wildfires which might escape FWS land and spread to inhabited private property are also a concern. The IC is responsible for contacting local law enforcement officials to warn or evacuate the public from potentially dangerous situations. Additionally, the Refuge will use prescribed fire and other management techniques to manage hazard fuels in high risk

areas.

XIV. PUBLIC INFORMATION AND EDUCATION

Informing the public is an important part of fire suppression, fire prevention, prescribed fire, and the FWS mission. Information and education are critical to gaining public support for the Refuge's fire management programs. There are several different aspects to this task.

A. Wildfire Suppression

During wildfire suppression, the IC is in charge of dispersal of information to the press and or public. The IC may delegate this responsibility if needed.

B. Prescribed Fire

Informing the public is a vital component of the prescribed fire program. Areas that have been burned will present opportunities for the public to actually see the effects of fires, and offer staff members an opportunity to explain the purpose of the burns to the public. The following will be used to promote the prescribed fire program to the public:

Talks in local schools.

Attendance at local volunteer fire department meetings.

Including the prescribed fire message in Refuge interpretive publications and materials.

Personal contacts with bystanders during prescribed burns.

Follow prescriptions in burn plans to prevent escapes.

Developing a quantitative fire effects monitoring program and sharing the results with the public.

C. Fire Prevention

Due to a lack of fire history for the Refuge, it is currently unknown if a Fire Prevention Plan will need to be written. However, a list of fire prevention measures can be found in part VIII. A. of this Fire Management Plan.

XV. ARCHEOLOGICAL/CULTURAL/HISTORIC RESOURCES

Fire Management activities at the Refuge will be implemented in accordance with the regulations and directions governing the protection of cultural resources as outline in Departmental Manual Part 519, Code of Federal Regulations (36 CFR 800), the Archeological Resources Protection Act of 1979, as amended, and the Archeological and Historic Preservation Act of 1974. All fire management activities will be in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

Currently wildfires are suppressed. However, historical evidence demonstrates that natural and artificial fires were regular events in the mixed grass prairie. In recent years, fire suppression has resulted in a steady buildup of grassland and riparian fuel loads, colonization of disturbed soils by invading plant species, and natural vegetative growth, increasing the chances of an uncontrolled wildfire that could potentially endanger the Refuge's cultural resources as well as surrounding lands. Although over 20 years of fire ecology research allows ecologists to predict impacts on biotic communities, the possible impacts of prescribed burning (and wildfires) on archeological resources are not well known. Research conducted in North Dakota indicated that fire-related impacts to buried artifacts are negligible, but effects on surface-exposed artifacts will be significant, depending on artifact type and size (Seabloom et al 1991).

Impacts to archeological resources by fire resources vary. The four basic sources of damage are (1) fire intensity, (2) duration of heat, (3) heat penetration into soil, and (4) suppression actions. Of the four, the most significant threat is from equipment during line construction for prescribed fires or wildfire holding actions (Anderson 1983).

The following actions will be taken to protect archeological and cultural resources:

- Files and records of cultural resources should be consulted by the staff when planning prescribed burns, developing pre-attack plans, and performing other preparedness actions. The potential for adverse impacts to cultural resources will be evaluated prior to prescribed burning and in the selection of fire suppression strategies during wildfires.

- The Regional Archeologist will be contacted during the development phase of the burn plan writing process when cultural resources are suspected or known to exist in the project area.

- The Kansas State Historic Preservation Officer (SHPO) will be contacted by the Regional Archeologist when it is known a planned management action may impact archeological or cultural resources. The SHPO has 30-days to respond. The Refuge will follow any programmatic archeological/cultural resources management plan that may be implemented in the future.

- Low impact wildfire suppression tactics (cold-trailing, use of foam/wet-water/water, use

of natural and manmade barriers, change in vegetation, mowing, etc.) will be used to the fullest extent possible. Line construction for prescribed fire activities will follow the same principle. Maps indicating the known location of significant cultural resources will be consulted prior to laying out burn units, and whenever possible, before constructing fireline to halt the spread of a wildfire.

- Prescriptions for management ignited prescribed fires will take into account the presence of known cultural sites. Cooler fires with short residence time will be used in areas containing known cultural sites, whenever possible.

- Known surface sites will be marked, protected, and excluded from the burn, if possible. Foam will not be used in areas known to harbor surface artifacts.

- The use of mechanize equipment within the refuge must be approved by the Refuge Manager on a fire by fire basis, and the use these resources will be considered in the approval process for any planned management actions. When the use of heavy equipment is authorized, its use will be monitored.

- The location of sites discovered as the result of fire management activities will be reported by the ROS to the Regional Archeologist.

- Rehabilitation plans will address cultural resources and will be reviewed by the Regional Archeologist.

XVI. FIRE CRITIQUE AND PLAN REVIEW

The Fire Management Plan will be reviewed annually to ensure the fire program advances and evolves with the FWS and the Refuge's mission.

A. Wildfire

Wildfires will be critiqued by the IC. The Zone FMO and/or Regional Office will conduct formal critiques in the event of:

Significant injury, accident or fatality.

Significant property or resource damage.

Significant safety concerns are raised.

An extended attack is necessary.

B. Prescribed Fire

Prescribed fires will be critiqued by the burn boss and documented in the prescribed burn plan. The Zone FMO and/or Regional Office will conduct formal critiques in the event of:

Significant injury, accident, or fatality.

An escaped prescribed fire occurs.

Significant safety concerns are raised.

Smoke management problems occur.

XVII. CONSULTATION AND COORDINATION

All fire management program activities will be implemented in cooperation and coordination with the State of Kansas Department of Health and Environment, and Linn County Fire District. Other agencies and organizations will be consulted as needed.

General program consultation and coordination will be sought from Quivira NWR FMO, Zone FMO, the Regional Fire Management Coordinator, Regional Prescribed Fire Specialist, and National Interagency Fire Center (NIFC).

Copies of this Fire Management Plan will be sent to the following parties for comment:

Volunteer Rural Fire Protection District(s)
- Linn County Fire District

State of Kansas
- Department of Health and Environment
- Department of Wildlife and Parks

US Fish & Wildlife Service
- Regional Office - Region 6
  - Regional Fire Management Coordinator
  - Prescribed Fire Specialist
- Ecological Service - Manhatten

The following were consulted in the development of this plan.

Phil Street, Region 6 Fire Management Coordinator
Carl Douhan, Prescribed Fire Specialist
Jim Kelton, Zone FMO Nebraska and Kansas
Morgan Beveridge - FMO Quivira NWR
Rorke Hozschuh - Missouri Department of Natural Resources
Fire Management Plan - Ft. Niobrara - Valentine NWRC
Fire Management Plan - Charles M. Russell NWR
Fire Management Plan - Arrowwood NWR
Fire Management Plan - Flint Hills NWR