Lake Ralph Hall Appendix F

#### Appendix F

#### **Biological and Habitat Studies**

F-1: Lake Ralph Hall Preliminary Habitat Assessment

F-2: Summary of SWAMPIM and WHAP Memorandum

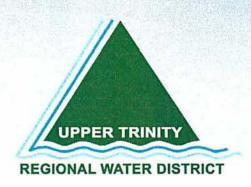
F-3: Biological Assessment of the North Sulphur River

Lake Ralph Hall	Appendix F
F-1: Lake Ralph Hall Prelimin	nary Habitat Assessment

# ATTACHMENT 4 LAKE RALPH HALL PRELIMINARY HABITAT ASSESSMENT

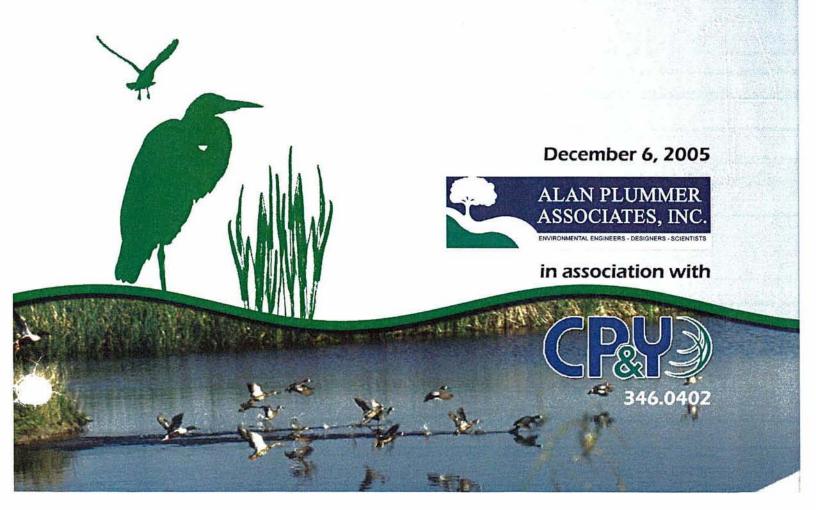
PREPARED BY
ALAN PLUMMER ASSOCIATES, INC.





# REPORT

# Lake Ralph Hall Preliminary Habitat Assessment



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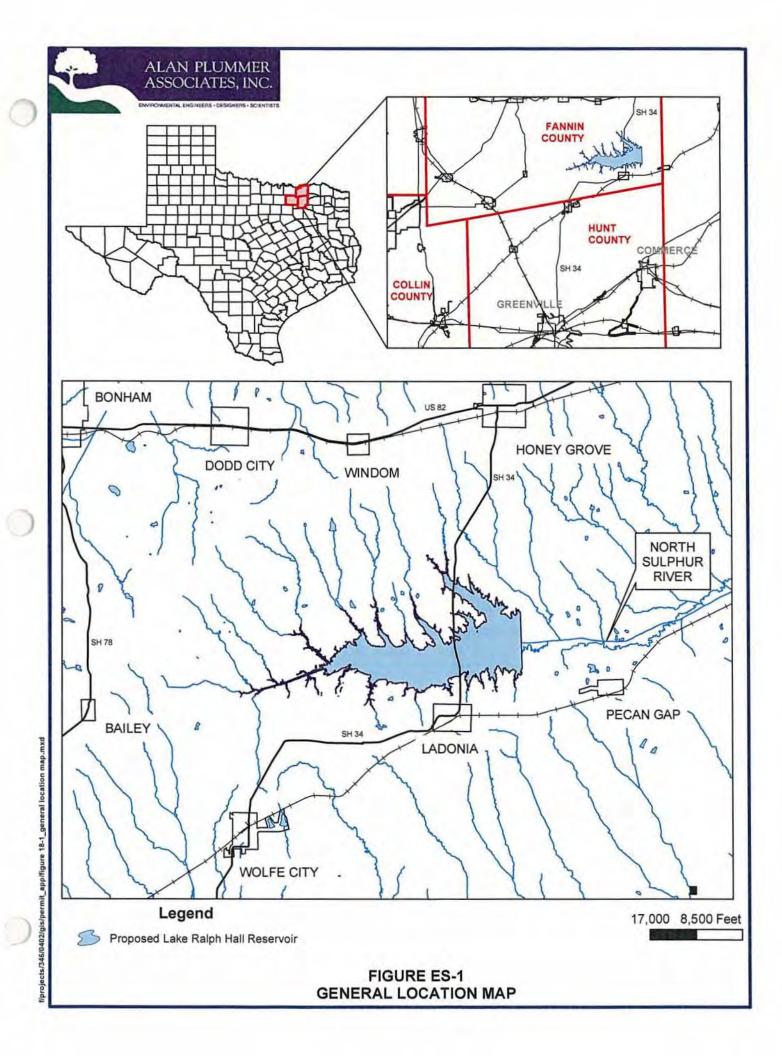
#### **EXECUTIVE SUMMARY**

#### **Background and History of Area**

The proposed Lake Ralph Hall reservoir would impound a portion of the North Sulphur River, inundating the river channel and portions of its named and unnamed tributaries as well as the immediate river valley. The proposed reservoir site is located in northeast Texas, in the southern portion of Fannin County, north of the City of Ladonia. (Figure ES-1). The surface area at conservation pool, based on preliminary engineering studies, is approximately 7,560 acres. This report presents the documentation of the initial environmental survey efforts to assess the habitat existing within the proposed reservoir project area.

Fannin County lies within the Blackland Prairie Ecoregion. Pre-settlement conditions of the region were representative of true prairie grassland community dominated by a diverse assortment of perennial and annual grasses and forbs with forested or wooded areas restricted to bottomlands along the river and tributary streams. Early settlers used the prairie lands for grazing livestock. Farming became a major use in the 1870s at which time the prairies were plowed and converted to cropland, primarily for the production of cotton through the first half of the 1900s. Agriculture is still considered the main business of Fannin County with nearly half of the agricultural income in the county derived from the sale of livestock, primarily beef cattle, on improved pastures of Bermudagrass and fescue. (4) Crops currently under production within the general project area include wheat and soybeans. (18)

Significant portions of the North Sulphur River, including the reach within the proposed reservoir project area and continuing for several miles downstream, were channelized beginning in the 1920s to increase drainage of floodwaters from agricultural cropland. The original channelization project created a straight channel approximately 40 feet wide and 10 feet deep. Severe erosion within the main river channel, the tributary channels, and the watershed has occurred over the past several decades and continues to date resulting in loss of soil, riparian vegetation, and stream properties and functions. After several decades of erosion, the main channel of the North Sulphur River is currently 200-300 feet wide and over 60 feet deep.



Aquatic resources within the project area outside the river and tributary channels are limited to scattered upland stock ponds constructed to provide water for livestock or for erosion control. Approximately 147 ponds, varying in size from less than 1 acre to approximately 4 acres, were identified within the project area. Total acreage within the identified ponds is approximately 87 acres.

The Caddo Lyndon B. Johnson National Grasslands (Ladonia Unit) administered by the U.S. Forest Service (USFS) located at the southwest edge of the proposed reservoir is managed under a cooperative agreement with the Texas Parks and Wildlife Department. The Ladonia Unit is comprised of twelve individual, non-contiguous tracts totaling 2,780 acres owned by the federal government but surrounded by privately owned land. Primary management emphasis on the Caddo-LBJ National Grasslands concerns restoration of the land and conservation of soil and watershed resource values. Since the twelve tracts are not contiguous, management for habitat restoration and public hunting is difficult. Also, soil erosion continues to be a problem on the tracts and approximately 93 acres of gullies are reported across seven of the twelve tracts and are targeted for management plans. The proposed reservoir conservation pool will inundate approximately 220 acres or 7.9 percent of the federally owned land. There are two Texas Natural Heritage Areas identified within the Ladonia Units. Neither lies within the proposed conservation pool footprint of Lake Ralph Hall.

#### **TPWD** Natural Diversity Database Review

Review of records within the TPWD database for information regarding rare, threatened, and endangered plants and animals, exemplary natural communities, and other significant ecological features within an expanded project area was requested by Alan Plummer Associates, Inc. Response from TPWD included a list of rare, threatened, and endangered species reported for the county, special features and natural communities including colonial waterbird rookeries and Little Bluestem-Indiangrass Series communities within and in the area of the Caddo National Grasslands – Ladonia Tract and Caddo Wildlife Management Area. Concerns were expressed regarding the resulting inundation of portions of the federally owned grassland tracts based on the proposed footprint of the reservoir, but potential mitigation options for this impact were

suggested. Also some potentially positive impacts for the managed grassland area resulting from the proposed reservoir were presented. Further baseline surveys for determining and quantifying the impacts of the proposed projects conducted in conjunction with the TPWD, the U.S. Forest Service, and the U.S. Fish and Wildlife Service were recommended by the TPWD.

#### Habitat Assessment

Review of historical and current aerial photographs and maps followed by groundtruthing of identified tracts of representative land cover types was conducted from early spring through summer of 2005. Groundtruthing investigations were conducted on over 3,300 acres of the 8,060 acres within the project area including conservation pool, embankment, and spillway areas. The methodology used for the assessment was the TPWD's Wildlife Habitat Appraisal Procedure (WHAP), since this is the methodology that has been primarily used by the state and U.S. Fish and Wildlife Service to evaluate impacts of proposed reservoir sites across the state of Texas. The WHAP measures key components of each identified cover type, which contribute to ecological condition of the cover type and resulting overall suitability for wildlife. An average Habitat Quality (HQ) score was derived from the evaluation of multiple sites for each identified cover type.

The majority (about 65 percent) of the land use within the project area is in agricultural production including cropland and pasture (both improved and native grasses). Due to the ongoing severe erosion of soil from cropland within the area, cropland is actively being converted to forage production with plantings of improved forage grasses including bermudagrass and fescue. Although there are wooded riparian areas still present along the North Sulphur River and its major tributaries, these areas are limited and are isolated, discontinuous tracts, which decreases their value for wildlife habitat. Hydrologic and hydraulic studies of the river channel indicated that at the proposed dam site, the existing channel has the capacity to fully contain and convey the 100-year flood. Based on the elevations of the tributaries relative to the river channel and extrapolation of river channel flow depth under 100-year flood conditions where the flow in the main channel creates a backwater condition for the tributaries, the flow in the tributary channels for the north side of the river is also contained within the banks

of the creek channels for about a mile upstream of the river channel.<sup>(17)</sup> Therefore, none of the riparian forest tracts were considered as bottomland hardwood forest. The six land cover types evaluated included cropland, pasture, grassland, parks, young forest, and forest. The WHAP methodology does not provide means for evaluating aquatic resources such as ponds and stream channels. As to stream channels, the North Sulphur River, because of the on-going erosion, appears to be unable to sustain viable populations of aquatic life. The bottom and sidewalls of the channel are essentially devoid of vegetation. The river is intermittent and pools remaining after rainfall events were devoid of visible life.

Overall, the quality of habitat along the North Sulphur River within the proposed project area is mostly degraded by agricultural usage and the significant continuing erosion problems experienced as a result of historical channelization projects. The remaining wooded areas provide moderate quality habitat, but these areas are isolated and fragmented reducing the overall ability to support wildlife populations. None of the riparian forested areas has current hydrology to support classification of bottomland hardwood forest. Native grassland areas that are being managed to preserve and enhance native prairie habitat also provide some moderate quality habitat, but these areas are likewise fragmented reducing the effectiveness of management plans and utilization by wildlife and public. Invasion by species including eastern red cedar, honey locust, cedar elm, and other common woody invaders is also prevalent throughout the grassland areas.

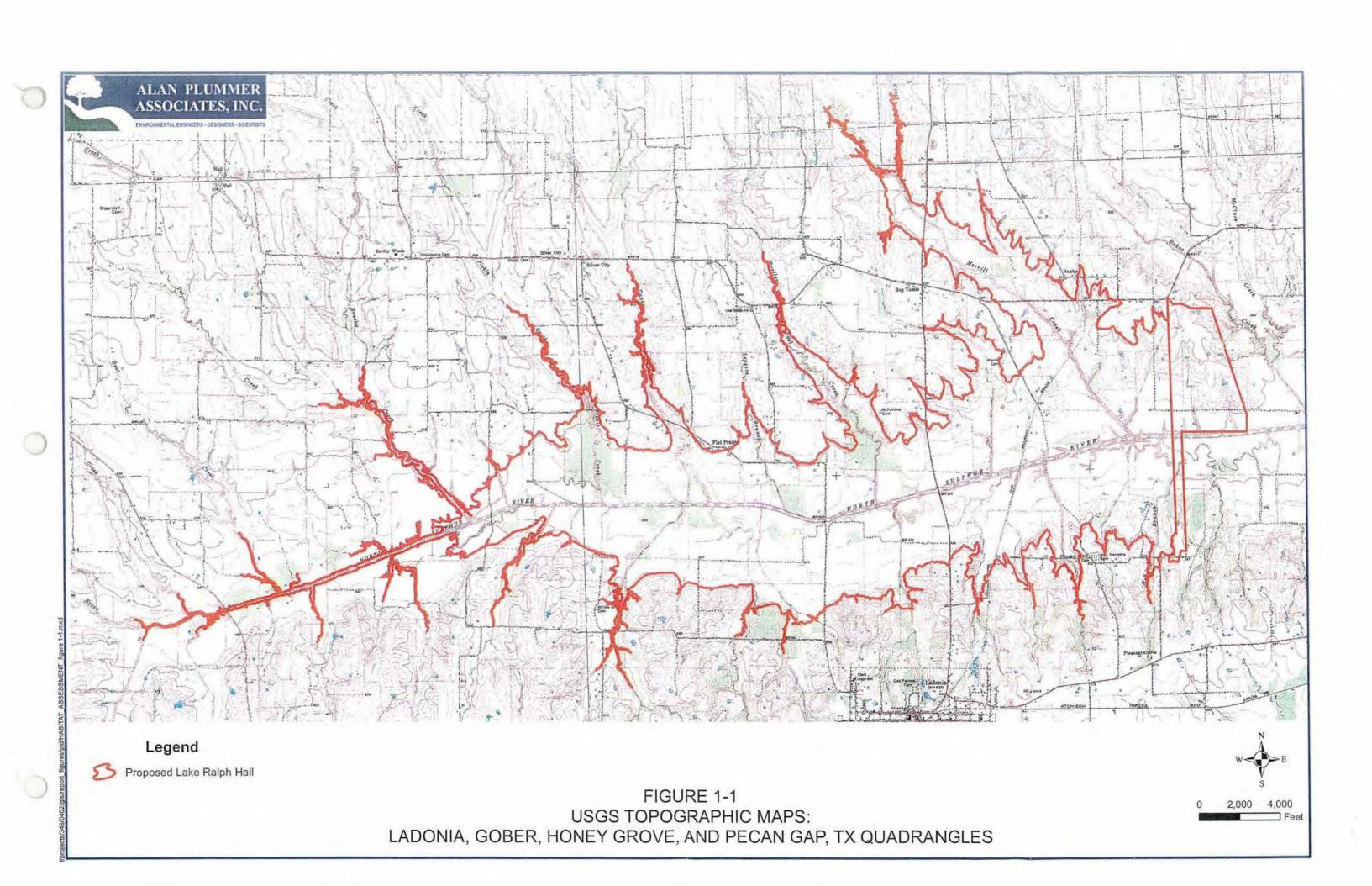
Multiple opportunities exist for providing benefits to help stabilize the North Sulphur River watershed in association with the development of the proposed Lake Ralph Hall reservoir project. Proposed coordination with federal, state, and local government agencies as well as local citizens could result in reduction of impacts from currently on-going severe erosion as well as maintain water quality within the proposed water supply reservoir. These efforts would also serve to enhance habitat for local and migratory wildlife and provide a diverse, healthy environment for future generations.

#### BACKGROUND

The proposed Lake Ralph Hall project involves the impoundment of a portion of the North Sulphur River in Fannin County, north of the City of Ladonia, resulting in the creation of an approximately 7,560 acre (based on conservation pool) reservoir. This reservoir would inundate the river and portions of its named and unnamed tributaries as well as the immediate river valley. Figure 1-1 shows the location of the proposed reservoir site and the approximate footprint of the conservation pool for the proposed reservoir based on the preliminary engineering studies.

Fannin County is located in northeast Texas. The North Sulphur River drains the southern portion of Fannin County, which lies within the Blackland Prairie Ecoregion. Annual rainfall ranges from 41 inches in the western part of the county to 44 inches in the eastern part. Nearly 25 inches or about 56 percent of the annual rainfall usually falls from April through September. In winter, the average temperature is 44 degrees F and the average daily minimum temperature is 33 degrees F. In summer, the average temperature is 81 degrees F.<sup>(4)</sup>

Beginning in the 1920s, significant portions of the North Sulphur River, including the reach within the proposed reservoir project area, were channelized to increase drainage of floodwaters from agricultural cropland, primarily in cotton cultivation at the time. The original channelization project created a straight channel that was approximately 40 feet wide and 10 feet deep. After several decades of erosion, the main channel of the North Sulphur River is currently 200-300 feet wide and over 60 feet deep. Some tributaries were also channelized some distance upstream of their confluence with the river. Substantial erosion is also exhibited in the majority of the major tributaries to the North Sulphur River as a result of the channelization and also the increasing gradient produced as the river channel deepens. Head cutting and bank widening as a result of gully erosion exacerbated by both sheet and rill erosion are actively occurring along both the North Sulphur River channel and its major tributaries resulting in continued loss of soil, riparian vegetation, and stream properties and functions. The North Sulphur River itself appears to be unable to sustain viable populations of aquatic life



throughout the proposed project reach due to the constant slaking of the eroding shale within the current channel bottom and lack of cover for protection from high velocity flows.

This report documents the efforts to date to assess the habitat existing within the proposed reservoir project area. These efforts include initial review of available information including maps, aerial photographs, historical data, soil survey data, field investigation, and analysis of gathered data using the Texas Parks and Wildlife Department's Wildlife Habitat Appraisal Procedure (WHAP) to evaluate the current habitat conditions within identified land cover types occurring in the project area. The following sections discuss the efforts conducted and present the findings of this preliminary assessment.

#### METHODOLOGY

#### 2.1 Literature Review

The North Sulphur River flows across the southern portion of Fannin County. The proposed reservoir site lies entirely within Fannin County; however, some downstream habitats in Lamar and Delta Counties may potentially be impacted by changes in hydrology resulting from the proposed project. Therefore, preliminary evaluation of potential impacts to downstream habitat areas is included in this study.

The southern portion of Fannin County and the proposed reservoir project area lie within the Blackland Prairie Ecoregion where the soils formed under prairie vegetation. A historical perspective of this ecoregion presented by the Texas Parks and Wildlife Department (TPWD)<sup>(9)</sup> indicates that pre-settlement conditions of this region were that of a true prairie grassland community dominated by a diverse assortment of perennial and annual grasses and forbs. Early settlers into the area described it as a vast endless sea of grasses and wildflowers with sparsely scattered trees or mottes of oaks on uplands. Forested or wooded areas were restricted to bottomlands along major rivers and streams, ravines, protected areas, or on certain soil types. Recurrent prairie fires, either ignited by lightning or humans (American Indian), were the major force that molded the prairie landscape. These fires were typically very large in scale and would traverse the countryside until they reached landforms or conditions that would contain them (rivers, creek bottoms, soil change, topographical change, climatic change, or fuel charge). Fire maintained these plant communities by suppressing invading woody species and stimulating growth of prairie grasses and forbs.

One of the earliest uses of the Blackland Prairies by early settlers was grazing livestock, primarily cattle and horses. Farming was also common but did not become a major use until the 1870's. During this time, the prairies were plowed under and cotton replaced ranching as the principle land use. The rich soils of the Blackland Prairie were ideal for growing cotton and in a relatively short time, a majority of the desirable land was cultivated, leaving only small remnants

of the original prairie intact. Farming is still a major land use in the Blackland Prairies region today, but a large portion of the previously farmed land has been converted to pastureland (mostly "improved" grasses) for grazing livestock. (9)

Agriculture is still considered the main business of Fannin County, according to the Soil Survey of Fannin County, Texas (United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Texas Agriculture Experiment Station, the U.S. Forest Service, and the Texas State Soil and Water Conservation Board). (4) Nearly half of the agricultural income in the county is derived from the sale of livestock, primarily beef cattle. (4) Bermudagrass and fescue are the main improved pasture grasses. (4) Other important cash crops for the county include wheat, grain sorghum, soybeans, corn, and peanuts. (4) Cotton, once the main cash crop, is now grown on less than 2,000 acres in the county. (4) Crops currently under production within the general project area include wheat and soybeans. (18)

Of the approximately 575,916 acres within Fannin County<sup>(4)</sup>, 3,749 acres were dedicated to irrigated cropland in 2000 (as reported to the Texas Water Development Board in its annual irrigation survey in 2000<sup>(8)</sup>). Countywide, the number of acres enrolled in the Conservation Reserve Program from 1987-2003 was 3,672.4, and 471 acres were enrolled in the Environmental Quality Incentives Program in 2002. Another 770 acres of private land was enrolled in the Wetlands Reserve Program in 2002. However, no acres of private lands were reported as enrolled in the Wildlife Habitat Incentives Program in 2002.<sup>(8)</sup>

The Soil Survey of Fannin County, Texas states that soil is the most important natural resource in the county. Food, fiber, and timber for marketing and for home consumption as well as forage for livestock are products of the soils in the county. These products represent the major source of livelihood for many people of the area. Water is also considered an important natural resource with several lakes in the northern part of the county (in the Red River drainage basin) providing water for towns as well as for recreation and fishing. Wells provide water for household use and a few wells provide water for irrigation. Many floodwater-retarding structures have been built in the northwest and southwest parts of the county. However, the

proposed reservoir project area does not encompass any floodwater-retarding structures other than scattered upland stock ponds.

Wildlife provides both recreational opportunities and income for landowners in the county. Quail and dove are throughout the county. Deer and turkey are more prevalent in the northeast part of the county.<sup>(4)</sup>

There are two Federally listed species under the Endangered Species Act for Fannin County in addition to a number of species listed by the state of Texas as endangered, threatened, rare, or species of concern. The listed animal and plant species of concern, typical habitat for each species, and classification by the Federal and State governments for Fannin, Lamar, and Delta Counties are shown in Table A-1 included in Appendix A. Potential impacts to Federally and State listed species were evaluated based on the preliminary assessment of typical habitat for the list species or available reports of occurrence within the region of the proposed project area. Table A-2, Appendix A, identifies the potential for impacts based upon this preliminary assessment. Information regarding the designated critical habitat for the listed species of special concern for the study area is presented in Table A-3, Appendix A. No designated critical habitat for any of the listed species is found within the proposed project study area.

The Caddo Lyndon B. Johnson National Grasslands (Ladonia Unit) administered by the U.S. Forest Service (USFS) is managed under a cooperative agreement with Texas Parks and Wildlife Department as the Caddo Wildlife Management Area – Ladonia Unit and is located at the southwest edge of the proposed reservoir footprint. The twelve tracts that make up the Ladonia Unit were purchased by the federal government in the mid- to late 1930's as part of a national program to restore eroded and sub-marginal lands. Most of the land purchased was abandoned farms and ranches suffering severe soil erosion from poor agricultural practices. Primary management emphasis on the Caddo-LBJ National Grasslands concerns restoration of the land and conservation of soil and watershed resource values. These grasslands tracts are managed to provide public hunting and appreciative uses in a manner compatible with the resource. Since the twelve tracts of the Ladonia Unit are not contiguous and boundaries are sometimes hard to find, hunting is limited. The habitat attracts mostly doves and quail. However, the once

abundant northern bobwhite population have reached a non-viable level for hunting and appear to be approaching extirpation based on recent whistle count and brood survey data. Densities of white-tailed deer, another primary game species present, range from moderate to low depending on habitat diversity and range conditions. Based on communication with Jack Jernigan, TPWD, occasionally a few white-tailed deer are harvested from the Ladonia Unit. One of the stated objectives of the management plan for the Caddo Wildlife Management Area is to enhance wildlife habitat and diversity on the Ladonia Unit since this Unit receives light public use due to low game and nongame species populations.

Ephemeral streams bisect some of the tracts of the Ladonia Unit, but there are no permanently flowing streams on this Unit. Although the management plan for the Caddo Wildlife Management Area mentions numerous small water impoundments of less than one acre scattered throughout the Unit, only one pond was identified during the review of aerial photographs of the grasslands area. Alfredo Sanchez, TPWD field technician, indicated that there are several small ponds within the Ladonia Unit that have bream and catfish, but that no regular stocking program is practiced. Jack Jernigan, TPWD manager for the Ladonia Unit, also indicated that he was not aware of any stocking programs being undertaken for any ponds by the TPWD at the Ladonia Unit.

All tracts within the Ladonia Unit are noted as being subject to soil erosion due to run off. Approximately 93 acres of gullies that need treatment are reported across seven of the twelve tracts that make up the Ladonia Unit. (13)

Two Texas Natural Heritage Areas (TNHAs) exist in the Ladonia Units. These include the Center Point Prairie in Unite 44 and Gober Prairie in Unit 47. The Environmental Assessment for the Ladonia Watershed Landscape Analysis (13) indicates that the goal for these areas is to maintain the areas for the botanical character and successional stage for which the area was designated (little bluestem-Indian grass). Neither of the TNHAs lies within the proposed footprint based on the conservation pool of Lake Ralph Hall.

#### 2.2 TPWD Natural Diversity Database Review

The TPWD maintains a database called the Natural Diversity Database (NDD) (formerly called the Texas Biological and Conservation Data System) that stores information on rare, threatened, and endangered plants and animals, exemplary natural communities, and other significant ecological features. A request for review of the proposed project area including the reservoir footprint for the 100-year flood elevation plus a potential impact zone downstream of the proposed dam site and an additional 1-mile buffer zone around this footprint for potential impacts to rare, threatened, and endangered species, natural communities, or other recorded significant features recorded for this area was submitted to TPWD on November 10, 2004. Base maps indicating proposed reservoir 100-year floodplain footprint on 7.5 minute USGS quadrangle sheets (Dodd City, Texas; Gober, Texas; Honey Grove, Texas; and Ladonia, Texas), 2002 aerial photograph, and GIS maps showing 911 residences for Fannin County, 2003 rural addresses, and roadways from the Texas Department of Transportation Electronic Files, as well as on-site photographs were included with the review request. The response received from TPWD, dated May 12, 2005, is included in Appendix B. A statement was included in the letter to the effect that although the database represents the best data available to the TPWD regarding rare species, it does not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in the project area.

In addition to a list of rare, threatened, and endangered species reported for the proposed project area, special features and natural communities listed included colonial waterbird rookeries and Little Bluestem-Indiangrass Series communities. The Caddo National Grasslands — Ladonia Tract and Caddo Wildlife Management Area — Ladonia Unit were also listed. The TPWD manages the Caddo National Grasslands — Ladonia Tract as the Caddo Wildlife Management Area — Ladonia Unit, so these actually represent the same land area. Concerns regarding proposed inundation of portions of the managed grassland areas were expressed. The reported acreage for the national grasslands is not all owned by the government, and the area perceived as potentially being inundated by the proposed reservoir represents a larger percentage of the government owned land (9 percent versus 1 percent). The project area submitted to the TPWD with the review request was based on approximately 1-mile buffer around the probable

maximum flood (pmf) boundary for the proposed reservoir. Based on the conservation pool footprint for the proposed reservoir, about 220 acres or 7.9 percent of the government owned land would be inundated.

The correspondence from TPWD also presents some of the potentially positive impacts for the managed grassland area resulting from the proposed reservoir. These included the potential development of wetland and open water habitats beneficial to migratory species such as waterfowl and possibly the bald eagle, and that the potential for inundation of private lands providing source of wildlife migration to the managed grassland areas resulting in increased wildlife populations and diversity of habitats. It was suggested that purchase of private properties bordering currently managed units to develop larger contiguous tracts for grassland species management would be potential compensatory mitigation for loss of grassland and shrubland habitats inundated by the proposed reservoir. These possibilities need to be explored further including baseline surveys for determining and quantifying the impacts of the proposed project in conjunction with the TPWD, the USFS, and the U.S. Fish and Wildlife Service.

#### 2.3 Maps and Aerial Photograph Reconnaissance

Recent and historical aerial photographs, USGS topographic quadrangles (Gober, Ladonia, Honey Grove, and Pecan Gap), and U.S. Department of Interior - National Wetlands Inventory (NWI) Maps for the identified quadrangles, and the Soil Survey of Fannin County, Texas maps and aerial photographs were reviewed for the proposed project area to develop an inventory of aquatic and terrestrial resources and land cover types. Maps and aerial photographs reviewed are included in Appendix C. As indicated on the maps and aerial photographs reviewed, the majority of the land use within the proposed reservoir project area is in agricultural production, either as improved pasture or as cropland. Although there are wooded riparian areas still present along the North Sulphur River and its major tributaries, these areas are isolated, discontinuous tracts. Some isolated areas were identified including abandoned meanders of the original river channel that still exist and reclaimed native prairie areas such as the managed national grassland tracts that potentially could have higher habitat quality, but have reduced functionality for habitat due to their small size and discontinuity.

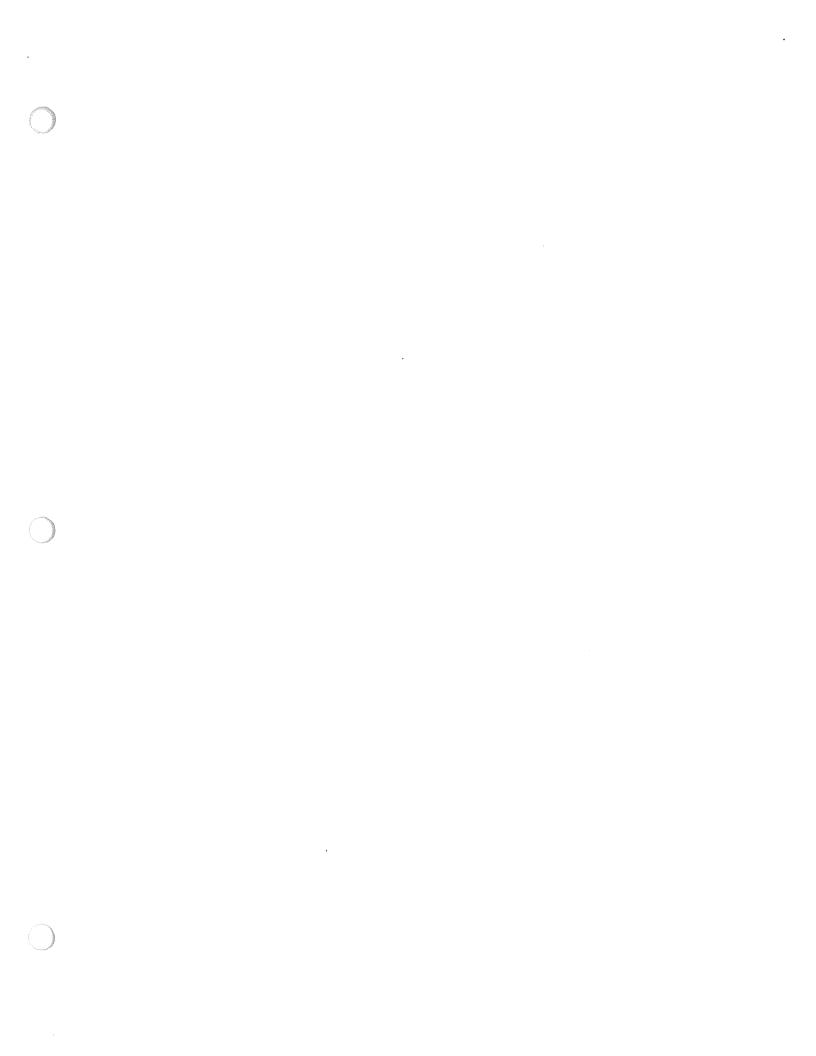
Preliminary analysis of recent aerial photographs (2002) identified the following potential land use cover types:

- Mixed Upland Forest forest along stream channels that does not stay inundated for sufficient duration to be considered bottomland hardwood forest
- Mixed Upland Forest forest in upland areas not associated with river or tributary channels
- Grassland (Native) grassland dominated by native prairie grasses
- Grassland (Tame) grassland dominated by "improved" pasture grasses; maybe utilized as pasture or as hay meadow
- Crops includes land actively being cropped and fallow fields
- Scrub-Shrub wetland areas dominated by small trees and shrubs
- Emergent Marsh wetland areas dominated by herbaceous vegetation
- Bottomland Hardwood Forest forest along stream channels that have soil characteristics indicating sustained periods of inundation or saturation and dominated by hardwood species
- Open Water diked or excavated impoundments with sufficient water depths to maintain open water (>6.6 feet)
- Other areas occupied by homesteads, farm buildings, cemeteries, etc.

Representative tracts containing the identified cover types were identified from the 2002 aerial photograph and county tax maps, and rights-of-entry were obtained from the individual private landowners so that the representative sites could be inspected or groundtruthed to confirm cover type characteristics.

#### 2.4 Groundtruthing Field Assessment

Of the approximately 7,560 acres within the conservation pool of the proposed reservoir project plus the approximately 500 acres at the embankment and emergency spillway channel, field investigation was conducted by two biologist from Alan Plummer Associates, Inc. for over 3,300



acres represented in 67 privately owned tracts. This field investigation was conducted to develop data for evaluating the cover types identified during the preliminary assessment of the 2002 aerial photograph. Since the methodology selected for the evaluation was the TPWD's Wildlife Habitat Appraisal Procedure (WHAP), the originally identified cover types were correlated with the major physiognomic classes of vegetation listed for Texas as used for the WHAP. The following vegetation cover types were used during the field investigation for the WHAP evaluation:

- Grasses Herbs (grasses, forbs, and grasslike plants) dominant; woody vegetation lacking or nearly so (generally 10 percent or less woody canopy coverage).
- Pasture Similar to grasses, but grazing limits the density of vegetation to sparse ground cover.
- Parks Woody plants mostly equal to or greater than nine feet tall generally dominant
  and growing as small clusters, or as randomly scattered individuals within continuous
  grass or forbs (11 to 70 percent woody canopy cover). (This category is defined based on
  vegetation characteristics and should not be confused with parks as public use facilities.)
- Young Forest Immature deciduous or evergreen trees generally equally to or less than 30 feet tall (greater than 20 percent canopy cover); mid-story usually absent; potential to form mature forest; usually encountered in association under silvicultural treatments.
- Forest Deciduous or evergreen trees dominant; mostly greater than 20 feet tall with closed crowns or nearly so (71 to 100 percent canopy cover); midstory generally apparent except in managed monoculture.
- Cropland Includes cultivated cover crops or row crops used for the purpose of producing food and/or fiber for either man or domestic animals. For the purpose of this assessment, fallow fields or areas recently cropped with characteristics more closely matching active cropland rather than pasture or grassland were counted as crop cover type.

Photographs, GPS locations, and vegetative species lists for each representative site were compiled during field investigations conducted from March 15 through September 2, 2005. Representative photographs of the identified land cover types surveyed are included in

Appendix D. Selection of representative site locations was influenced by stratification of vegetative land cover within the proposed reservoir project area, availability of access, and special emphasis on special features that represent a small percentage of the overall project area but potentially higher quality habitat (e.g., remaining former rive channel oxbows).

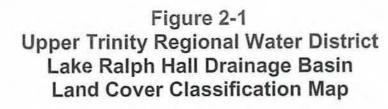
#### 2.5 Wildlife Habitat Appraisal Procedure Analysis

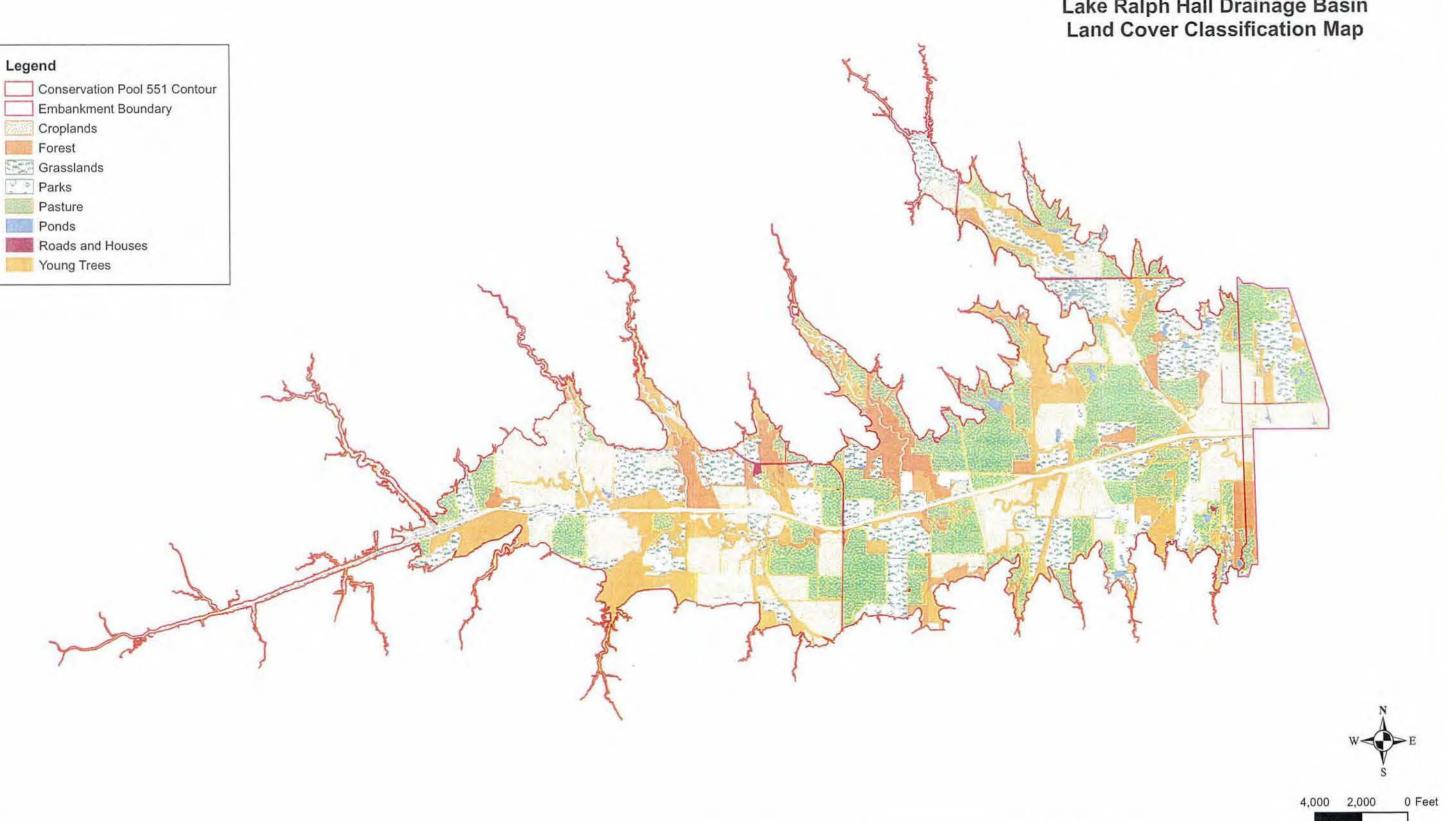
The method used to evaluate the proposed Lake Ralph Hall project site was the Wildlife Habitat Appraisal Procedure (WHAP) developed by TPWD. (2) The WHAP methodology was used by the TPWD and U.S. Fish and Wildlife Service (USFWS) to evaluate direct impacts to wildlife resources for 30 of 44 proposed reservoir sites throughout the state of Texas during the 1980s. (3) The WHAP measures key components of each cover type, which contribute to ecological condition of the cover type and resulting overall suitability for wildlife. The WHAP was designed to obtain a direct measure of the habitat suitability for wildlife using an assessment of ecological productivity and diversity rather than an evaluation based on the selection of individual wildlife species. Key habitat components which are evaluated include: site potential for woody and herbaceous plant production; age of existing vegetation; relative abundance of the habitat type and its value to wildlife; diversity of occurring woody species; vertical stratification of vegetation canopy cover; relative abundance or the scarcity of dens and refuge sites; and availability of browse and herbaceous material. The biological habitat components evaluation key for the WHAP is included in Appendix E. A habitat quality (HQ) score was derived from this evaluation for each cover type. Habitat Units (HU's) are derived by multiplying the average habitat quality score (HQ) of the cover type by the number of acres for each cover type as determined by the photo-interpretation of the 2002 aerial and subsequent confirmation by groundtruthing.

Classification of land cover within the proposed reservoir project area was performed by conventional analysis of digital aerial photographs from 2002 with 2 feet per pixel resolution. This analysis was used to produce two principal products:

1. A classification map portraying major vegetation cover types and associations (Figure 2-1); and







#### RESULTS

Lists of the plant species identified within the proposed reservoir project area for each land use cover type for the WHAP analysis are included in Appendix F. These lists along with Biological Components Field Evaluation Forms for each cover type, also included in Appendix F, provide a characterization of the habitat suitability for wildlife as determined by WHAP analysis of the data gathered during the groundtruthing field investigations.

Table F-1 displays the scores for the seven crop WHAP sites. Crops include cultivated cover or row crops for food or fiber production (Frye 1995). Based on personal communication with the Fannin County NRCS field office staff (Randy Moore), crops currently under cultivation in the general project area include wheat and soybeans. No cotton is currently being produced. Former cropland in the project area is also actively being converted and utilized for production of forage (bermuda and fescue grass) as part of land management programs developed with the National Resources Conservation Service (NRCS) to control loss of soil due to the extreme erosion in the area. These forage grasses are used for hay production. Cropland areas identified from the 2002 aerial photograph that were determined to be planted to forage grasses based on the groundtruthing investigations conducted in 2005 was considered to be more representative of pasture cover type and acreage for these areas transferred accordingly. The representative cropland sites scored very consistently with the exception of Component 7, Criteria C which relates to condition of existing vegetation. The average WHAP score for all crop sites was 0.09 out of a possible maximum of 0.65. Plants, other than the crops, commonly occurring in cultivated fields included Japanese brome grass (Bromus japonicus), Bermudagrass (Cynodon dactylon), perennial ryegrass (Lolium perenne), peppergrass (Lepidium spp.), giant ragweed (Ambrosia trifida), Johnsongrass (Sorghum halepense), and crabgrass (Digitaria ciliaris). Vegetation observed on the crop sites is listed in Table F-2 included in Appendix F.

Table F-3 shows the scores for the seven pasture WHAP sites. These sites were dominated by improved grasses but had been over-seeded with cool-season grasses and/or legumes in some cases. A variety of wildflowers and forbs were also observed at some sites in addition to pasture

grasses. The representative pasture sites scored very consistently with the exception of Component 7, Criteria B (Condition of Existing Vegetation, Herbaceous). The average HQ score for pasture cover type was 0.20 out of a possible maximum of 0.92. The improved grasses dominating these sites included Bermudagrass and Johnsongrass. Legumes and cool-season grasses observed included white clover, vetch (*Vicia sp.*), spurred butterfly pea (*Centrosema virginianum*), and Texas wintergrass (*Stipa leucotricha*). Other forbs observed included yellow thistle (*Cirsium horridulum*), Texas toadflax (*Nuttallanthus texanus*), primrose (*Oenothera speciosa*), prairie phlox (*Phlox pilosa*), Texas prairie parsley (*Polytaenia texana*), dotted blue-eyed grass (*Sisyrinchium langloisii*), buttercup (*Ranunculus sp.*), dewberry (*Rubus trivialis*), trumpet creeper (*Campsis radicans*), wild onion (*Allium ascalonicum*), wood sorrel (*Oxalis spp.*), curly dock (*Rumex crispus*), fiddle dock (*Rumex pulcher*), violet (*Viola sp.*), and cocklebur (*Xanthium sp.*). Table F-4 lists the vegetative species observed in the pasture cover type sites surveyed.

The scores for the seven representative grasses WHAP sites are listed in Table F-5. These sites were vegetated by both native and introduced grasses and a diversity of legumes and forbs. Variation in the scores for uniqueness and relative abundance for two of the sites was due to a higher ranking score given for larger contiguous tracts with dominance of native grass species. The average HQ score for the grasses was 0.25 out of a possible 0.92. The dominant grasses observed included little bluestem (Schizachyrium scoparium), big bluestem (Andropogon gerardii), Bermudagrass (Cynodon dactylon), purple threeawn (Aristida purpurea), and Virginia wildrye (Elymus virginicus). Legumes included Illinois bundleflower (Desmanthus illinoensis), spurred butterfly pea (Centrosema virginianum), and sensitive briar (Schrankia spp.). A variety of forbs were observed including annual ragweed (Ambrosia artemisiifolia), giant ragweed (Ambrosia trifida), common yarrow (Achillea millefolium), wild onion (Allium ascalonicum), milkweed (Asclepia sp.), Indian paintbrush (Castilleja indivisa), prairie parsley (Polytaenia nuttalli), yellow thistle (Cirsium horridulum), prairie plantain (Plantago elongata), common selfheal (Prunella vulgaris), fiddle dock (Rumex pulcher), nightshade (Solanum sp.), and Texas vervain (Verbena halei). Vegetative species observed across the grasses sites are listed in Table F-6 included in Appendix F.

Table F-7 lists the scores for the seven representative forest WHAP sites. Forest areas within the proposed project area consist of isolated tracts mostly along the major tributaries draining to the north side of the North Sulphur River with some tracts south of the river, associated with tributaries or segments of the former river channel. Due to historical clearing of riparian forest within the proposed project area for agricultural purposes, the forests observed mostly represent regrowth that is less than 50 years old. Those tracts that were somewhat larger or provided a more contiguous corridor with a diversity of mature hard mast producing species were scored higher for Criteria 3 - Uniqueness and Relative Abundance. The average HQ score for forest sites was 0.59 out of a maximum possible 1.0. Canopy species observed in the isolated tracts of riparian forest are pecan (Carya illinoensis), American elm (Ulmus americana), bur oak (Quercus macrocarpa), shumard red oak (Quercus shumardii), post oak (Quercus stellata), blackjack oak (Quercus marilandica), southern red oak (Quercus falcata), bois d'arc (Maclura pomifera), sassafras (Sassafras albidum), gum bumelia (Bumelia lanuginosa), eastern red cedar (Juniperus virginiana), American elm (Ulmus americana), cedar elm (Ulmus crassifolia), and green ash (Fraxinus pennsylanica). Species observed in the understory included young specimens of the canopy species listed above as well as chinkapin oak (Quercus muhlenbergii), coralberry (Symphoricarpos orbiculatus), deciduous holly (Ilex decidua), roughleaf dogwood (Cornuus drummondii), sugar hackberry (Celtis laevigata), Eve's necklace (Sophora affinis), honey locust (Gleditsia triacanthos), box elder (Acer negundo), with woody vines represented by common trumpet creeper (Campis radicans), poison ivy (Toxicodendron radicans), rattanvine (Berchemia scandens), saw greenbriar (Smilax bona-nox), and Virginia creeper (Parthenocissus quinquefolia). Herbaceous species commonly observed in the wooded areas included inland seaoats (Chasmanthium latifolium), knotroot bristlegrass (Setaria geniculata), Virginia wildrye, Missouri violet (Viola missouriensis), sedge (Carex spp.), and Japanese honeysuckle (Lonicera japonica). Table F-8 provides a list of the species recorded in the surveyed areas for forest cover type.

Young forest, with trees less than 30 feet tall making up more than 20 percent of the canopy, were scored separately from forested areas. This category scored 0.44 out of a maximum possible 1.0. Table F-9 lists the scores for the seven representative young forest WHAP sites. Tree species recorded as canopy included eastern red cedar, cottonwood (*Populus deltoides*),

gum bumelia, American elm, cedar elm, bois d'arc, green ash., box elder, sugar hackberry, toothache tree (Zanthoxylum clava-herculis), and mesquite (Prosopis glandulosa). Young hard mast producing tree species including bur oak, red oak (*Quercus shumardii*), pecan, and post oak were also observed on some tracts. Black willow (Salix nigra) was observed around ponds and along stream channels. Understory species noted included young specimens of the canopy tree species as well as Chinese privet (Ligustrum sinese), rattlebush (Sesbania drummondii), Chickasaw plum (*Prunus angustifolia*), Mexican plum (*Prunus mexicana*), wild rose (*Rosa sp.*), hawthorn (Crataegus sp.), Eve's necklace (Sophora affinis), and soapberry (Sapindus drummondii). Poison ivy and greenbriar (Smilax spp.) were commonly observed vines. A variety of herbaceous species was observed within the young forest cover type including residual plants from former land use and colonization from available sources. Common herbaceous plant species included Johnsongrass, Bermuda grass, inland sea oats, Virginia wildrye, bushy bluestem (Andropogon glomeratus), sedge (Carex sp.), perennial ryegrass (Lolium perenne), false garlic, catchweed bedstraw (Galium aparine), Japanese honeysuckle, buttercup (Ranunculus sp.), giant ragweed, henbit (Lamium amplexicaule), poison hemlock (Conium maculatum), American pokeweed (Phytolacca americana), Texas prairie parsley (Polytaenia texana), curly dock (Rumex crispus), and prickly pear cactus (Opuntia sp.). Table F-10 lists the species observed within the forest areas.

Land use areas including pasture and grassland with scattered large trees or isolated wooded mottes were characterized as parks. This cover type scored a 0.41 out of a maximum possible 1.0. Scores for the seven representative park WHAP sites are listed in Table F-11. Species observed within this cover type varied considerably depending on the overall land use. Occasional large trees including pecan, post oak, red oak, American elm, cedar elm, and catalpa (Catalpa speciosa) were observed as shade trees within some pastures. Clumps of trees and shrubs were also observed as invaders within grassland or as more mature stands along ponds and small drainages. Canopy species observed in these areas included green ash, bois d'arc, American elm, cedar elm, sugar hackberry, pecan, and red oak. Understory species observed in these areas included sugar hackberry, black willow, Eve's necklace, cedar elm, green ash, eastern red cedar, Chickasaw plum, soapberry, Chinese privet, roughleaf dogwood, hawthorn, honey locust, deciduous holly, bois d'arc, Mexican plum, and post oak. A large variety of grasses and

forbs were observed across the various tracts representing this land cover as listed in Table F-12. Commonly observed grasses included Johnsongrass, Bermuda grass, little bluestem, Japanese brome, bushy bluestem, and purple three awn. Commonly observed forbs included poison ivy, greenbriar, coralberry, dotted blue-eyed grass, giant ragweed, annual ragweed, false garlic, buttercup, Indian paintbrush (*Castilleja sp.*), and prairie peppergrass (*Lepidium densiflorum*).

#### Aquatic Resources

During the Environmental Characteristics study performed in 2002-2003, which was primarily a literature review and study of available maps and aerial photographs, several types of aquatic resources including streams and rivers, wetlands, and ponds (open water) were identified within the proposed reservoir project area. Approximately 615,000 linear feet of stream channels including the North Sulphur River, its major tributaries, and headwater tributaries to the tributaries were identified within the proposed reservoir footprint based on evaluation of 2002 aerial photographs. Revised calculation of impacts to jurisdictional stream channels following the groundtruthing conducted with the habitat assessment and preliminary jurisdictional determination field investigations indicates that 600,573 linear feet of stream channel will be impacted by inundation within the proposed conservation pool of Lake Ralph Hall.

Additional aquatic areas identified visually during the 2002-2003 Environmental Characteristics study from 2002 aerial photographs included 209 ponds totaling approximately 119 acres; 74 wetland areas, as identified by the National Wetland Inventory Maps produced by the U.S. Department of the Interior, totaling approximately 351 acres; and approximately 11,200 linear feet of remnant stream channels or meander scars totaling approximately 6.5 acres that may potentially be jurisdictional waters. Further investigation of these resources was conducted during the 2005 field investigation. Within the 8,060 acres of the conservation pool footprint of the proposed reservoir and the embankment and spillway area, the total number of ponds impacted is only 147 totaling 87 acres. This acreage is included within the total acreages for each of the cover types depending on the locations of the individual ponds.

The numerous small ponds (less than 1 acre in size) scattered throughout the proposed project area serve primarily as water supply for livestock within the pasture and grassland areas. These small ponds also provide habitat functions for local and migratory wildlife. The ponds typically have characteristic aquatic flora around the fringes including spikerushes (*Eleocharis spp.*), soft rush (*Juncus effusus*), water primrose (*Ludwigia peploides*), arrowhead (*Sagittaria spp.*) and cattails (*Typha spp.*). Other aquatic species observed in some locations included toothcup (*Ammannia coccinea*), fragrant waterlily (*Nymphaea odorata*), flatsedges (*Cyperus spp.*), and sedges (*Carex spp.*). During this preliminary survey due to the limitations of the WHAP methodology, these small ponds were not evaluated separately from the cover type in which they were located. The vegetation observed around the pond areas was included in the assessment of vegetative diversity for the representative cover type being assessed. However, due to the paucity of aquatic habitat within the project area, the small farm ponds increase the overall habitat quality of the land cover in which they are located.

The majority (335 acres) of the wetland acreage originally identified from the NWI maps during the Environmental Characteristic study performed in 2002-2003 was characterized as palustrine forested, describing areas of potential bottomland hardwood forests along the North Sulphur River and its major tributaries. However, current hydrologic and hydraulic studies of the river channel indicated that at the proposed dam site, the existing channel has the capacity to fully contain and convey the 100-year flood. Based on the elevations of the tributaries relative to the river channel and extrapolation of river channel flow depth under 100-year flood conditions where the flow in the main channel creates a backwater condition for the tributaries, the flow in the tributary channels for the north side of the river is also contained within the banks of the creek channels for about a mile upstream of the river channel. Based on the hydraulic analyses and observations during field investigations, the forested areas identified as potential wetland areas on the NWI maps do not appear to have sufficient hydrology to be characterized as bottomland hardwood forest. These areas were considered to function as riparian forest and were assessed within the forest land use cover type. As observed during the field investigations, these forested areas continue to be cleared for agricultural and other development.

#### DISCUSSION

The preliminary habitat assessment included review of aerial photographs and field investigation to provide groundtruthing of identified cover types. Based on analysis of the preliminary surveys using the WHAP protocol, approximately 7,764 acres in six identified cover types out of the 8,060 acres within the total project area impacted based on the conservation pool of the proposed reservoir and the embankment/spillway area were assessed. A map of the identified cover types superimposed on the 2002 aerial photograph is included in Appendix G. The acreage assessed does not include the approximately 252 acres within stream channels. However, the acreage of the 147 identified ponds was included within the surrounding cover type and the assessment incorporates the vegetative diversity identified around small ponds within each identified cover types. Further evaluation will be needed to determine a habitat quality separately for the aquatic resources. Table 4-1 presents the wildlife habitat appraisal summary based upon the preliminary investigations.

TABLE 4-1 WILDLIFE HABITAT APPRAISAL SUMMARY

Cover Type Category	Average Habitat Quality Score (HQ)	Total Acres	Habitat Units HQ X Acres
Cropland	0.09	1,720	154.80
Grasses	0.25	1,435	358.75
Pasture	0.20	2,192	438.40
Parks	0.41	516	211.56
Forest	0.59	602	355.18
Young Forest	0.44	1,299	571.56
TO	TAL	7,764	2,090.25

The conservation pool of the proposed reservoir site is approximately 7,560 acres as defined in the preliminary engineering studies. The additional acreage assessed in the habitat assessment survey includes the areas of the embankment footprint and emergency spillway area downstream of the embankment. As engineering studies and design progress, further refinements to adjust the area of potential impacts may be conducted.

Based on the preliminary habitat assessment, approximately 69 percent of the potential vegetated impact area for the proposed reservoir is currently under agricultural production (crop, grasses and pasture). The cover type identified as parks, representing another 6.6 percent, is also used for grazing livestock. Acreage with woody vegetation (forest, young forest, and parks) represents approximately 31 percent of the proposed project area. Over half of this acreage (1,299 acres) is in young regrowth forest. Parks (516 acres) represent about one-quarter of the wooded vegetation areas. The remaining wooded vegetation areas are identified as forest (602 acres). In the project area, this classification represents more mature regrowth that has occurred following historical clearing of the area for cotton growing in the late 1800s and early 1900s. Based on current hydrologic and hydraulic analysis of the North Sulphur River watershed, none of the forested areas should be considered bottomland hardwood forest since flood flows up through the 100-year event are completely contained within the river and tributary channels up to a mile upstream of the river for the tributaries on the north side of the river.

Severe erosion throughout the watershed is a significant ongoing problem as demonstrated by the eroded drainage channels, creek channels, and the main channel of the North Sulphur River observed during the field investigations. As a result of historical erosion, cropland within the proposed project area is continuing to be converted to pasture with the planting of forage grasses such as Bermuda and fescue as part of land management programs attempting to address soil loss from the area. The historical and ongoing erosion has significantly reduced areas formerly considered prime farmland within the North Sulphur River watershed.

#### CONCLUSIONS

Overall, the quality of habitat along the North Sulphur River within the proposed project area is mostly degraded by agricultural usage and the significant continuing erosion problems experienced as a result of historical channelization projects along the river. The few existing wooded areas provide some moderate quality habitat, but these areas are fragmented reducing the overall ability to support wildlife populations. Since the channels have eroded to the extent that the 100-year flood flows are contained within the channel, none of the existing riparian forest areas has current hydrology to be classified as bottomland hardwood forest. Native grassland areas that are being managed to preserve and enhance native prairie habitat also provide some moderate quality habitat, but these areas are likewise fragmented (the Ladonia unit of the Caddo National Grassland WMA has twelve separate land tracts) reducing the effectiveness of management plans and wildlife as well as public utilization. Substantial areas being managed as native grassland are currently dominated by woody invaders such as eastern red cedar, honey locust, cedar elm.

Multiple opportunities exist for providing benefits to the North Sulphur River watershed in association with the development of the proposed Lake Ralph Hall reservoir project. Proposed coordination with federal, state, and local government agencies as well as local citizens could result in the following benefits: stabilize the watershed and reduce impacts from currently ongoing severe erosion, maintain water quality within the proposed reservoir, enhance habitat for local and migratory wildlife, and provide a diverse, healthy environment for future generations.

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# FEDERALLY AND STATE LISTED THREATENED OR ENDANGERED SPECIES

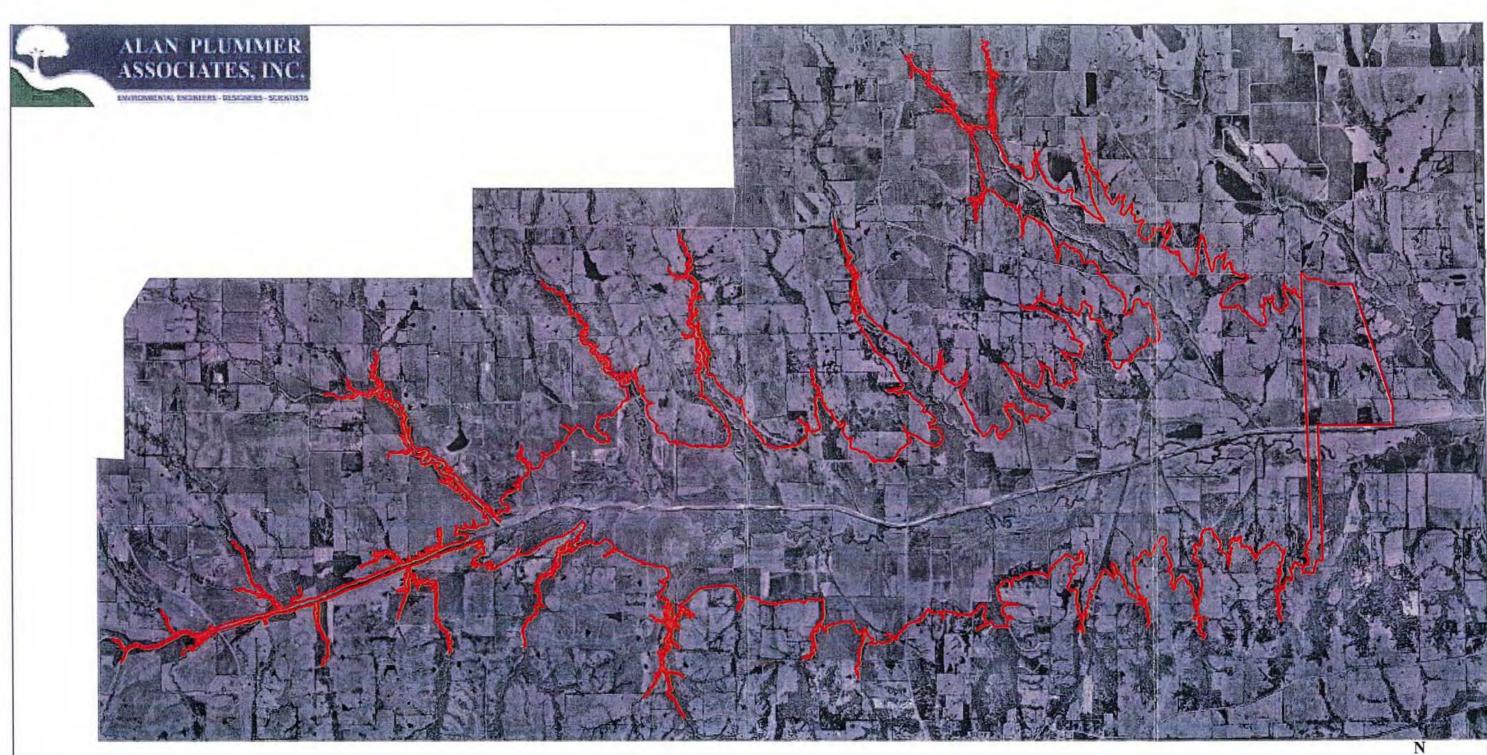
TABLE A-1
Federally and State Listed Species in Fannin, Lamar and Delta Counties

				Sta	atus Within Cou	inty
	Common Name	Scientific Name	Habitat	Fannin	Lamar	Delta
	American Peregrine Falcon	Falco peregrinus anatum	areas with high, massive cliffs with expansive views near water where prey are numerous and diverse	State listed as endangered	State listed as endangered	State listed as endangered
	Arctic Peregrine Falcon	Falco peregrinus tundrius	areas with high, massive cliffs with expansive views near water where prey are numerous and diverse	State listed as threatened	State listed as threatened	State listed as threatened
	Bachman's Sparrow	Aimophila aestivalis	open pine woods with understory, brushy slopes, old fields	State listed as threatened	N/A	State listed as threatened
	Baird's Sparrow	Ammodramus bairdii	shortgrass prairie with scattered low bushes and matted vegetation	State listed as rare	N/A	N/A
Birds	Bald Eagle	Haliaeetus leucocephalus	large lakes, nesting in tall trees; feeds in areas of open water where food is available	Federally and State listed as threatened	Federally and State listed as threatened	Federally and State listed as threatened
	Cerulean Warbler	Dendroica cerulea	mature deciduous forests	State listed as rare	N/A	N/A
	Eskimo Curlew	Numenius borealis	coastal prairies and open tundra	State listed as endangered	N/A	N/A
	Henslow's Sparrow	Ammodramus henslowii	weedy fields or cut-over areas with some bare ground where bunch grasses and vines occur	State listed as rare	N/A	State listed as rare
	Interior Least Tern	Sterna antillarum athalassos	nests along sand and gravel bars within braided streams and rivers	Federally and State listed as endangered	Federally and State listed as endangered	Federally listed as endangered
	Piping Plover	Charadrius melodus	found along sandy areas associated with rivers, lakes, or oceans that are bare to sparsely vegetated	N/A	N/A	Federally listed as threatened

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# Federally and State Listed Species (Continued)

				Sta	atus Within Cou	nty
	Common Name	Scientific Name	Habitat	Fannin	Lamar	Delta
(par	Western Burrowing Owl	Athene cunicularia hypugaea	open grasslands, especially prairie, plains, and savannas, nest and roosts in abandoned burrows	N/A	N/A	State listed as rare
Birds (Continued)	Whooping Crane	Grus americana	marshes, river bottoms, potholes, prairies, and cropland (migratory)	N/A	Federally listed as endangered	N/A
Bird	Wood Stork	Mycteria americana	prairie ponds, flooded pastures or fields, ditches, and other shallow standing water	State listed as threatened	N/A	State listed as threatened
	Blackside Darter	Percina maculata	clear, gravelly streams; prefers pools with some current, or quiet pools to swift riffles	N/A	N/A	State listed as threatened
	Blue Sucker	Cycleptus elongatus	large, deep rivers and deeper zones of reservoirs with moderate to swift currents; bottom type is bedrock, gravel, or rubble	State listed as threatened	State listed as threatened	N/A
sh	Creek Chubsucker	Erimyzon oblongus	small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs	State listed as threatened	State listed as threatened	State listed as threatened
Fish	Paddlefish	Polyodon spathula	slow moving waters of large rivers and reservoirs	State listed as threatened	State listed as threatened	State listed as threatened
	Shovelnose Sturgeon	Scaphirhynchus platorynchus	bottom of pools with sand, rock, or gravel substrate	State listed as threatened	N/A	N/A
	Western Sand Darter	Ammocrypta clara	large streams; most common in slight to moderate current over a sandy bottom	State listed as rare	N/A	N/A

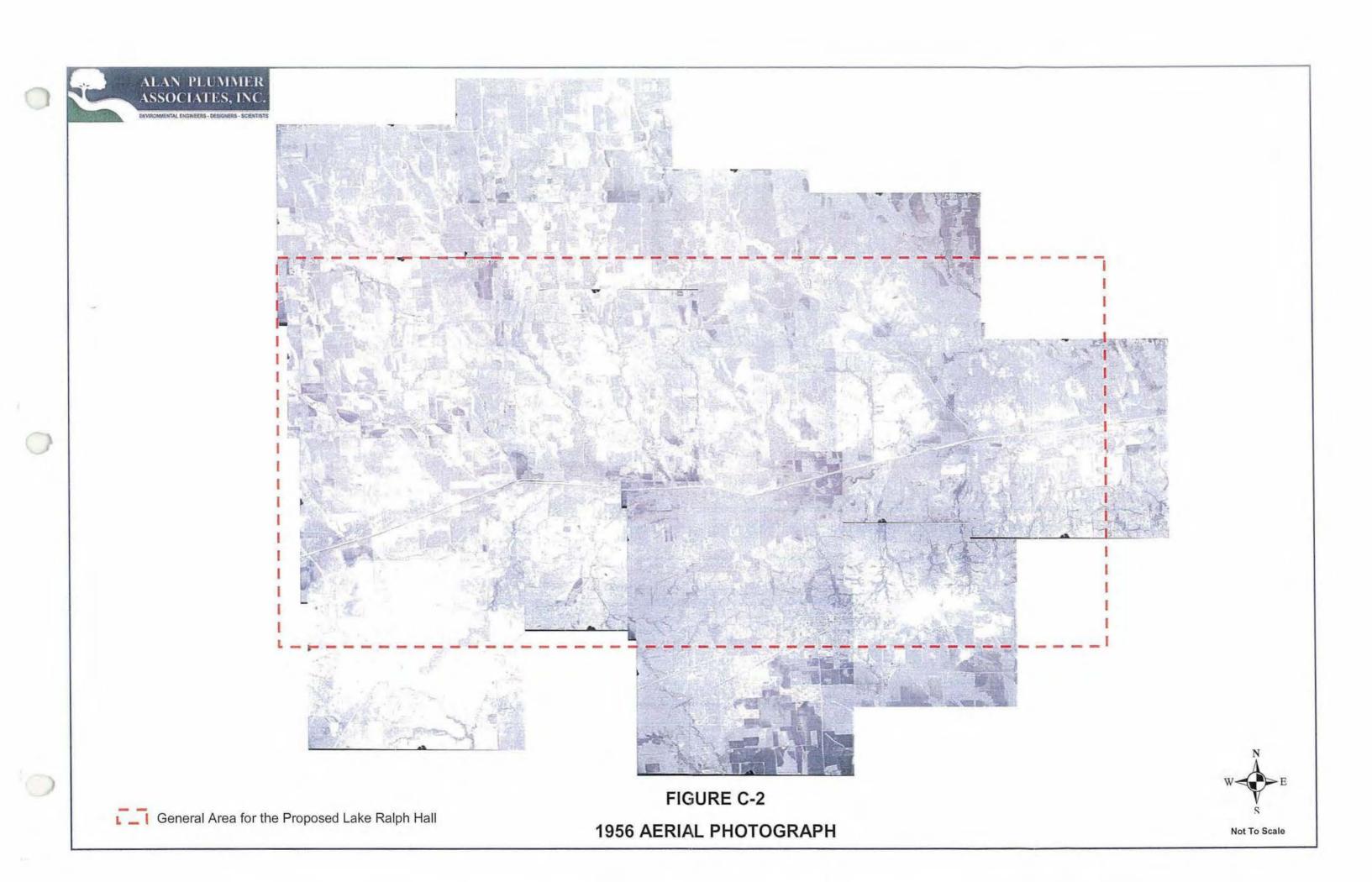


Legend

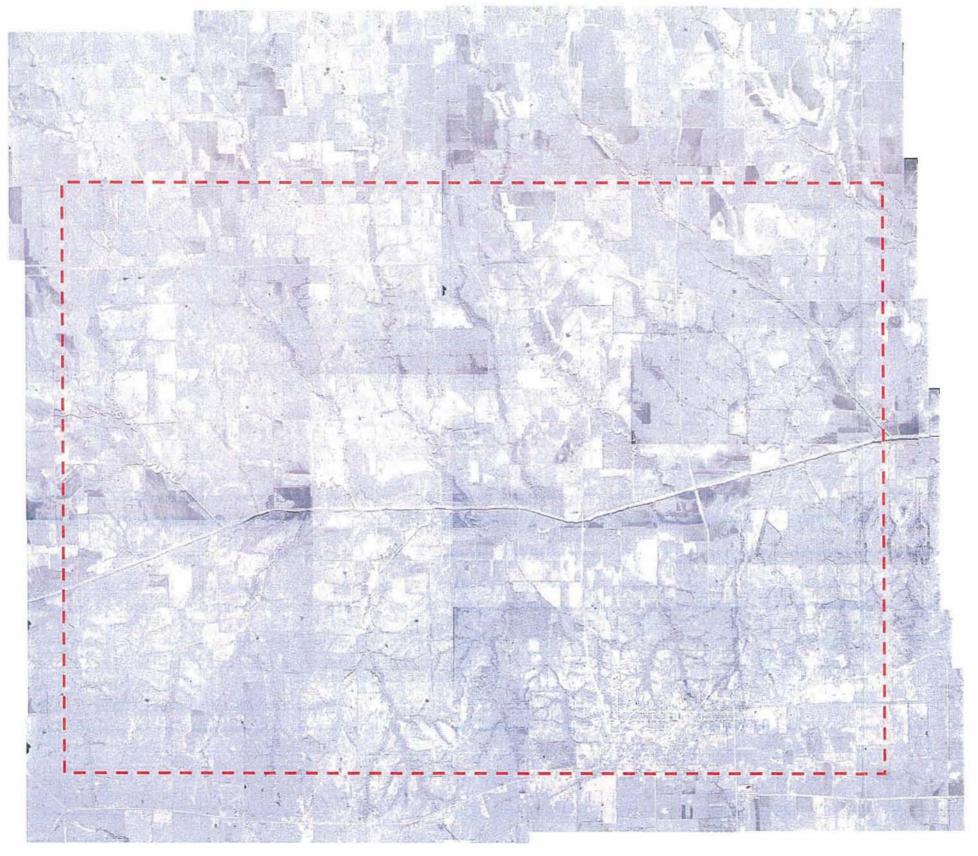
Proposed Lake Ralph Hall Reservoir









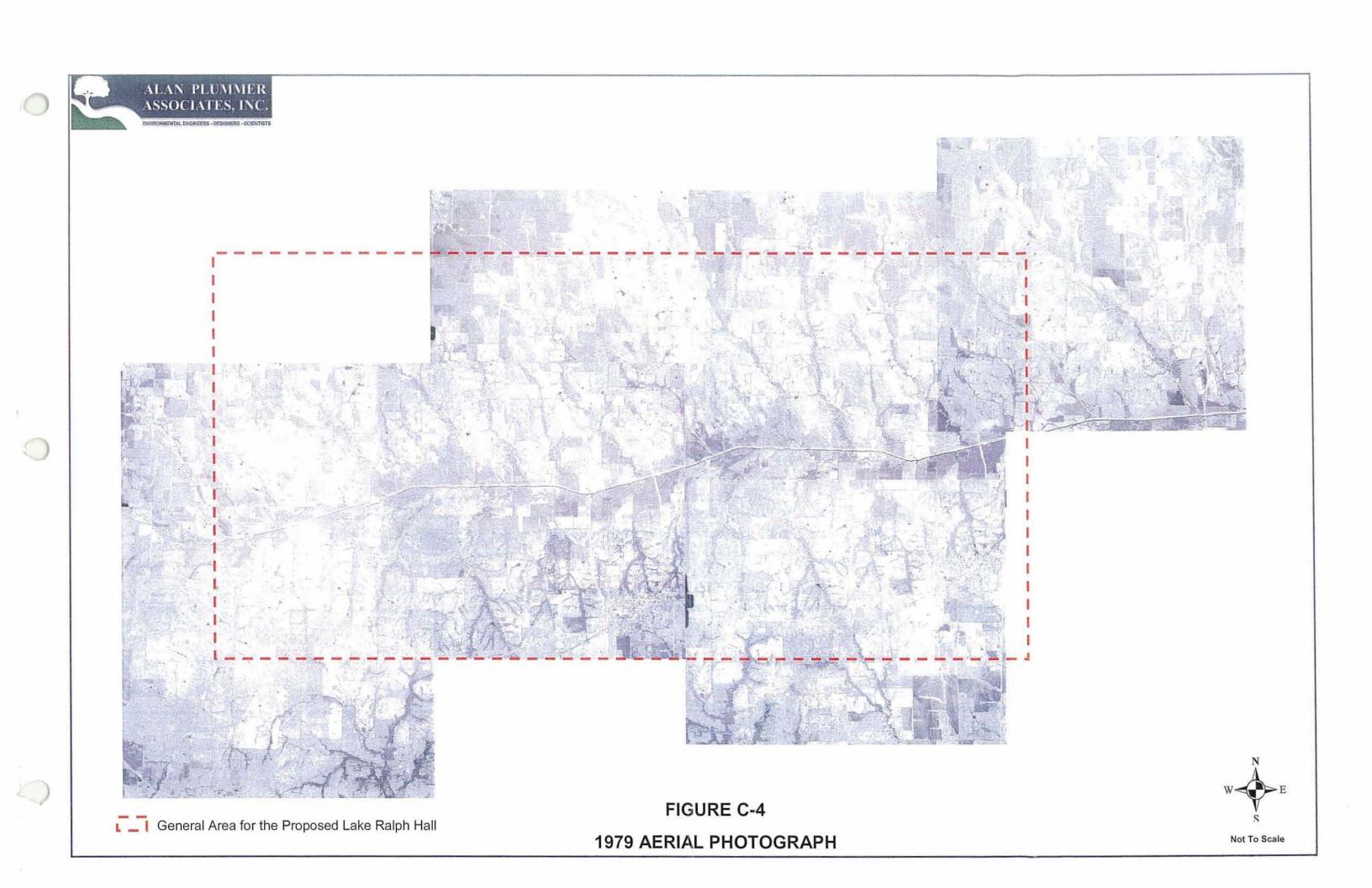




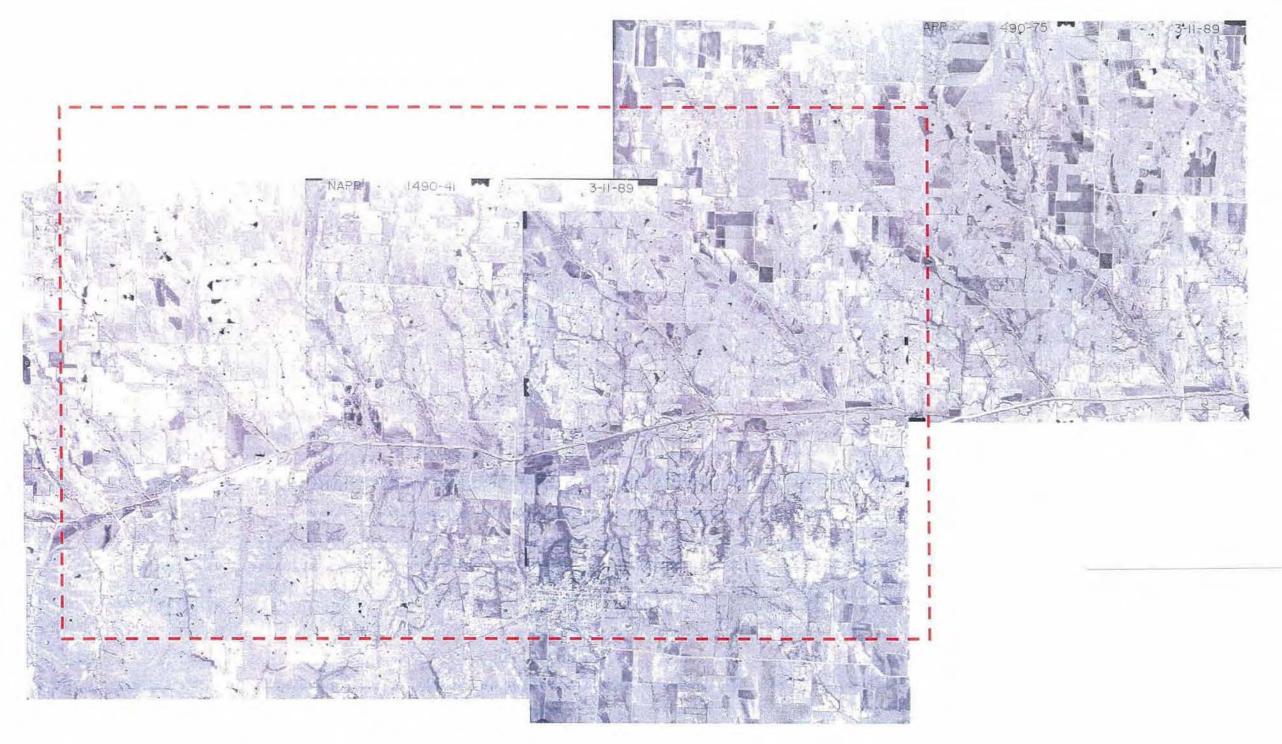


General Area for the Proposed Lake Ralph Hall

FIGURE C-3 1969 AERIAL PHOTOGRAPH







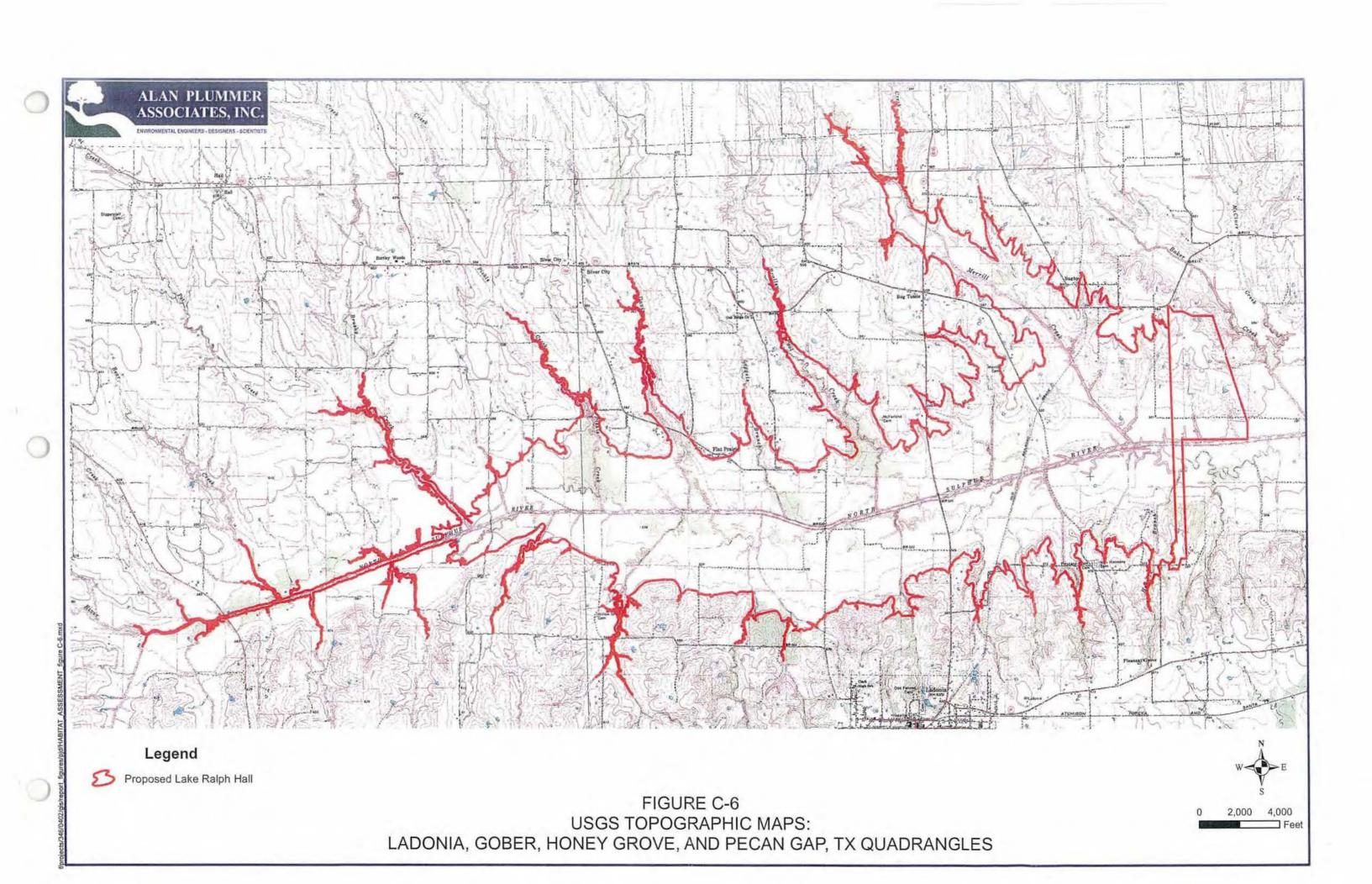


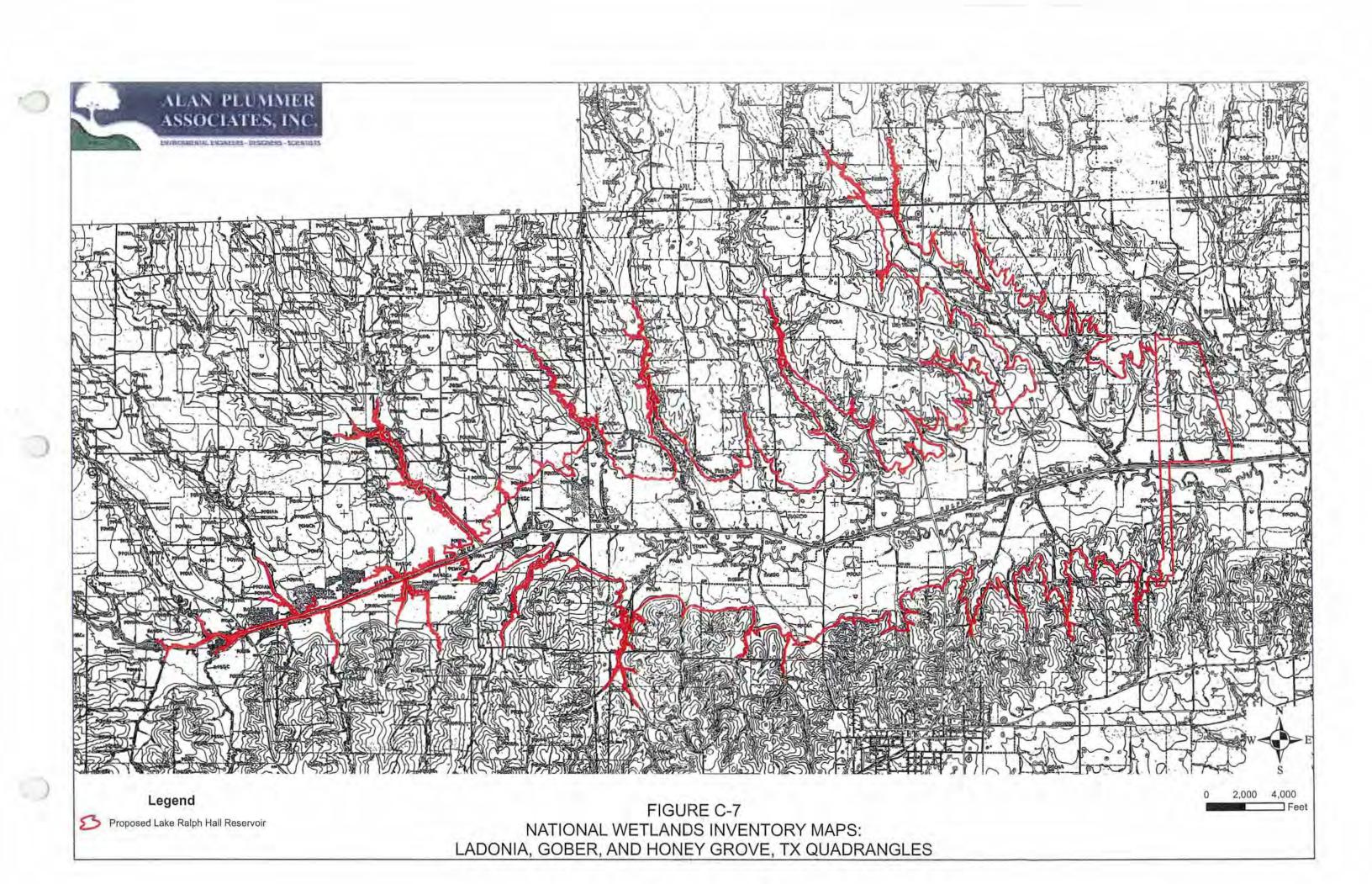
General Area for the Proposed Lake Ralph Hall

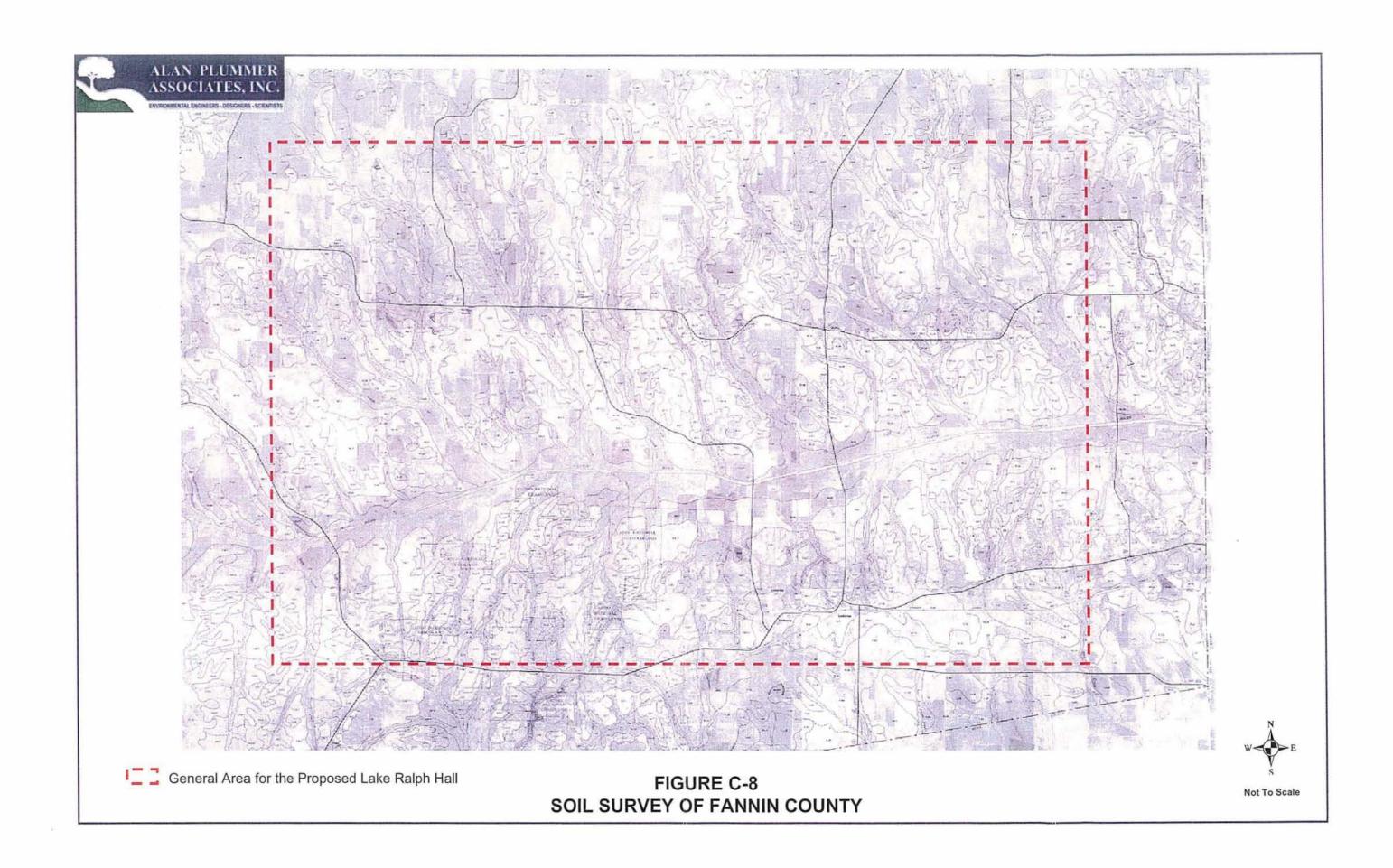


Not To Scale

FIGURE C-5 1989 AERIAL PHOTOGRAPH







# Federally and State Listed Species (Continued)

				Status Within County		nty
	Common Name	Scientific Name	Habitat	Fannin	Lamar	Delta
	Black Bear	Ursus americanus	bottomland hardwoods and large tracts of inaccessible forested areas	State listed as threatened	N/A	State listed as threatened
Mammals	Louisiana Black Bear	Ursus americanus luteolus	woodlands and forests near water especially bottomland hardwoods and floodplain forests; occasionally upland hardwood forests, mixed pine/hardwood forests, wetlands, and ag fields	Federally listed as threatened	Federally listed as threatened	Federally and state listed as threatened
M	Plains Spotted Skunk	Spilogale putorius interrupta	open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands	State listed as rare	N/A	State listed as rare
	Red Wolf	Canis rufus	extirpated - formerly throughout eastern half of Texas in brushy and forested areas and coastal prairies	State listed as endangered	N/A	N/A
Mollusks	Ouachita Rock-pocketbook Mussel	Arkansia wheeleri	muddy or rocky substrate of slow-flowing streams, side channels and backwaters, as well as in pools of small, slow-moving rivers	N/A	State listed as endangered	N/A
	Alligator Snapping Turtle	Macrcolemys temminckii	deepwater rivers, lakes, oxbows, sloughs; occasionally enters brackish water	State listed as threatened	N/A	State listed as threatened
tiles	Texas Garter Snake	Thamnophis sirtalis annectens	wet or moist microhabitats	State listed as rare	N/A	State listed as rare
Reptiles	Texas Horned Lizard	Phrynosoma cornutum	open, arid and semi-arid regions with sparse vegetation	State listed as threatened	State listed as threatened	State listed as threatened
	Timber/Canebrake Rattlesnake	Crotalus horridus	swamps, floodplains, upland pine and deciduous forests, riparian zones, abandoned farmland, prefers dense brush	State listed as threatened	State listed as threatened	State listed as threatened

# Federally and State Listed Species (Continued)

				Sta	atus Within Cou	nty
	Common Name	Scientific Name	Habitat	Fannin	Lamar	Delta
Vascular Plants	Arkansas Meadow-Rue	Thalictrum arkansanum	low lying rich woods, edges of swamps, and along stream banks	N/A	State listed as rare	State listed as rare

TABLE A-2
Preliminary Assessment of Potential Project Impacts to Listed Species

			,	Potential for Impact
	Common Name	Scientific Name	Habitat	(Low, Medium, High)
	American Peregrine Falcon	Falco peregrinus anatum	areas with high, massive cliffs with expansive views near water where prey are numerous and diverse	low; potential migrant around wetland complexes
	Arctic Peregrine Falcon	Falco peregrinus tundrius	areas with high, massive cliffs with expansive views near water where prey are numerous and diverse	low; potential migrant around wetland complexes
	Bachman's Sparrow	Aimophila aestivalis	open pine woods with understory, brushy slopes, old fields	low; lack of pine forest in project area
	Baird's Sparrow	Ammodramus bairdii	shortgrass prairie with scattered low bushes and matted vegetation	low; overgrazed pastures may temporally simulate shortgrass prairie conditions
Birds	Bald Eagle	Haliaeetus leucocephalus	large lakes, nesting in tall trees; feeds in areas of open water where food is available	low; potential migrant around wetland complexes
Bi	Cerulean Warbler	Dendroica cerulea	mature deciduous forests	low; limited areas of mature forests within project area
	Eskimo Curlew	Numenius borealis	coastal prairies and open tundra	low; migrant, last accepted record in Texas in 1962
	Henslow's Sparrow	Ammodramus henslowii -	weedy fields or cut-over areas with some bare ground where bunch grasses and vines occur	medium; within weedy fields, pastures, or grasslands
	Interior Least Tern	Sterna antillarum athalassos	nests along sand and gravel bars within braided streams and rivers	medium to high; along sand/gravel bars within North Sulphur River
	Piping Plover	Charadrius melodus	found along sandy areas associated with rivers, lakes, or oceans that are bare to sparsely vegetated	medium to high; along sand/gravel bars/shoreline within North Sulphur River and tributaries

A-5 8/11/2005

# **Preliminary Assessment of Potential Project Impacts (Continued)**

	Common Name	Scientific Name	Habitat	Potential for Impact
ued)	Western Burrowing Owl	Athene cunicularia hypugaea	open grasslands, especially prairie, plains, and savannas, nest and roosts in abandoned prairie dog burrows	low; overgrazed pastures may temporally create favorable habitat
Birds (Continued)	Whooping Crane	Grus americana	marshes, river bottoms, potholes, prairies, and cropland (migratory)	low; migrant around wetland complexes
Bird	Wood Stork	Mycteria americana	prairie ponds, flooded pastures or fields, ditches, and other shallow standing water	low; migrant around wetland complexes
	Blackside Darter	Percina maculata	clear, gravelly streams; prefers pools with some current, or quiet pools to swift riffles	low; no records in North Sulphur River basin but possible in its tributaries; present in tributaries to Red, Sabine, and Neches Rivers
	Blue Sucker	Cycleptus elongatus	large, deep rivers and deeper zones of reservoirs with moderate to swift currents; bottom type is bedrock, gravel, or rubble	low; due to lack of depth in North Sulphur River; however, may impact downstream populations
Fish	Creek Chubsucker	Erimyzon oblongus	small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs	low; possible in tributaries to North Sulphur River; reported from tributaries of Red, Sabine, Neches, Trinity and San Jacinto rivers
	Paddlefish	Polyodon spathula	slow moving waters of large rivers and reservoirs	low; unlikely in project area unless areas remain that are at least one meter deep; may impede migration of downstream populations, if any
	Shovelnose Sturgeon	Scaphirhynchus platorynchus	bottom of pools with sand, rock, or gravel substrate	low; no records in North Sulphur River. If present, dam could block access to spawning areas.
	Western Sand Darter	Ammocrypta clara	large streams; most common in slight to moderate current over a sandy bottom	low; only known records in Texas are in Red, Sabine, and Neches River Basins

A-6 8/11/2005

# **Preliminary Assessment of Potential Project Impacts (Continued)**

	Common Name	Scientific Name	Habitat	Potential for Impact
	Black Bear	Ursus americanus	bottomland hardwoods and large tracts of inaccessible forested areas	low due to lack of large tracts of bottomland hardwoods contiguous to other habitat areas
Wammals	Louisiana Black Bear	Ursus americanus luteolus	woodlands and forests near water especially bottomland hardwoods and floodplain forests; occasionally upland hardwood forests, mixed pine/hardwood forests, wetlands, and ag fields	low due to lack of large tracts of bottomland hardwoods contiguous to other habitat areas
M	Plains Spotted Skunk	Spilogale putorius interrupta	open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands	medium due to similarity of habitat, but not reported from this area
	Red Wolf	Canis rufus	extirpated - formerly throughout eastern half of Texas in brushy and forested areas and coastal prairies	low; extirpated from state
Mollusks	Ouachita Rock-pocketbook Mussel	Arkansia wheeleri	muddy or rocky substrate of slow-flowing streamside channels and backwaters, as well as in pools of small, slow-moving rivers	low; due to highly disturbed habitat; however, recently collected in North Central Texas
esi.	Alligator Snapping Turtle	Macrcolemys temminckii	deepwater rivers, lakes, oxbows, sloughs; occasionally enters brackish water	low; potential impact to downstream populations, but presence unlikely within project area due to lack of deep water habitat
Reptiles	Texas Garter Snake	Thamnophis sirtalis annectens	wet or moist microhabitats	low; potential habitat in North Sulphur River floodplain
Rep	Texas Horned Lizard	Phrynosoma cornutum	open, arid and semi-arid regions with sparse vegetation	medium; known records of species in Fannin County
	Timber/Canebrake Rattlesnake	Crotalus horridus	swamps, floodplains, upland pine and deciduous forests, riparian zones, abandoned farmland, prefers dense brush	low; lack of suitable habitat, no records in Fannin County

A-7 8/11/2005

# Preliminary Assessment of Potential Project Impacts (Continued)

	Common Name	Scientific Name	Habitat	Potential for Impact
Vascular Plants	Arkansas Meadow-Rue	Thalictrum arkansanum	low lying rich woods, edges of swamps, and along streambanks	low; unless bottomland hardwood/wetland complexes remain within the project area that are not already impacted as a result of the substantial, on-going channel erosion and subsequent drainage of riparian areas

TABLE A-3
Designated Critical Habitat for Listed Species in Fannin, Lamar and Delta Counties

	Common Name	Scientific Name	Designated Critical Habitat
	American Peregrine Falcon	Falco peregrinus anatum	Critical habitat designated in California
	Arctic Peregrine Falcon	Falco peregrinus tundrius	N/A
	Bachman's Sparrow	Aimophila aestivalis	N/A
	Baird's Sparrow	Ammodramus bairdii	N/A
	Bald Eagle ,	Haliaeetus leucocephalus	No critical habitat
	Cerulean Warbler	Dendroica cerulean	N/A
	Eskimo Curlew	Numenius borealis	No critical habitat
şp	Henslow's Sparrow	Ammodramus henslowii	N/A
Birds	Interior Least Tern	Sterna antillarum athalassos	No critical habitat
	Piping Plover	Charadrius melodus	Great Lakes Shoreline and areas along the Texas  Coast
	Western Burrowing Owl	Athene cunicularia hypugaea	N/A
	Whooping Crane	Grus Americana	Aransas National Wildlife Refuge (Calhoun, and Refugio Counties, Texas)
	Wood Stork	Mycteria Americana	No critical habitat
	Blackside Darter	Percina maculate	N/A
	Blue Sucker	Cycleptus elongates	N/A
	Creek Chubsucker	Erimyzon oblongus	N/A
Fish	Paddlefish	Polyodon spathula	N/A
•	Shovelnose Sturgeon	Scaphirhynchus platorynchus	N/A
	Western Sand Darter	Ammocrypta clara	N/A
	Black Bear	Ursus americanus	N/A
als	Louisiana Black Bear	Ursus americanus luteolus	Proposed critical habitat (not specified)
Mammals	Plains Spotted Skunk	Spilogale putorius interrupta	N/A
	Red Wolf	Canis rufus	No critical habitat
Mollusks	Ouachita Rock-pocketbook Mussel	Arkansia wheeleri	No critical habitat
	Alligator Snapping Turtle	Macrcolemys temminckii	N/A
iles	Texas Garter Snake	Thamnophis sirtalis annectens	N/A
Reptiles	Texas Horned Lizard	Phrynosoma cornutum	N/A
7	Timber/Canebrake Rattlesnake	Crotalus horridus	N/A
Vascular Plants	Arkansas Meadow-Rue	Thalictrum arkansanum	N/A

A-9

12/8/2005

# TEXAS PARKS AND WILDLIFE DEPARTMENT RESPONSE LETTER



May 12, 2005

COMMISSIONERS

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ROBERT L COOK EXECUTIVE DIRECTOR Ms. Loretta Mokry Alan Plummer Associates, Inc. 7524 Mosier View Court, Suite 200 Fort Worth, Texas 76118

Dear Ms. Mokry:

This letter is in response to your preliminary review request, dated November 10, 2004, for potential impacts to rare, threatened, and endangered species from the proposed development of Ralph Hall Lake consisting of a 7,500-acre reservoir on the North Sulfur River northwest of Ladonia in Fannin County (#346-0402).

Given the small proportion of public versus private land in Texas, the TPWD Natural Diversity Database (NDD) (formerly Biological and Conservation Data System) does not include a representative inventory of rare resources in the state. Although it is based on the best data available to TPWD regarding rare species, the data from the BCD do not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in your project area. These data cannot substitute for an on-site evaluation by your qualified biologists. The BCD information is intended to assist you in avoiding harm to species that may occur on your site.

Based on the project description, the following species and special features could be impacted by potential development activities:

# Federal and State Listed Endangered

Interior Least Tern (Sterna antillarum athalassos)

# Federal Listed Endangered

American Burying Beetle (Nicrophorus americanus)

#### State Listed Threatened

Blackside Dater (Percina maculata)

Blue Sucker (Cycleptus elongatus)
Creek Chubsucker (Erimyzon oblongus)

Paddlefish (Polyodon spathula)

Alligator Snapping Turtle (Macrochelys temiminckii)

Timber/Canebrake Rattlesnake (Crotalus horridus)

# Species of Concern

Fawnsfoot (Truncilla donaformis)



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To manage and conserve the natural and cultural resources of Texas and to provide bunting, fishing and outdoor recreation opportunities for the use and enjoyment of presentational and anti-conserved the conserved to the conserv

Ms. Loretta Mokry Ralph Hall Lake near Ladonia, Fannin County Page 2

Little Spectaclecase (Villosa lienosa)
Rock-pocketbook (Arcidens confragosus)
Wabash Pigtoe (Fusconaia flava)
White Heelsplitter (Lasmigona complanata)
Arkansas meadow-rue (Thalictrum arkansanum)

#### Special Features and Natural Communities

Colonial Waterbird Rookeries Little Bluestem-Indiangrass (Schizachyrium scoparium-Sorghastrum nutans) Series

#### Managed Areas

Caddo National Grasslands – Ladonia Tract Caddo Wildlife Management Area (WMA) – Ladonia Unit

Occurrences of a Little Bluestem-Indiangrass Series natural plant community and portions of the Caddo National Grasslands/Caddo WMA – Ladonia Unit would be directly inundated by the reservoir. Printouts for these occurrence records are included for your planning reference.

Please do not include NDD occurrence printouts in your draft or final documents. Because some species are especially sensitive to collection or harassment, these records are for your reference only.

Please note: the review request lists the amount of acreage for the Ladonia Unit at 17,874, however it is actually 2,780 acres. With the 17,874 amount, the approximately 257 acres of the unit directly impacted by inundation would comprise only 1%, when actually it will encompass 9% of the Ladonia Unit. Plus, additional acreage could be indirectly impacted by water that will back up into two of the drainages. This could create some low level flooding and marsh habitat at flood elevation. Some of the impacts could be comprised of a rise in creek depth while other impacts could be more substantial with the creation of approximately 30 to 50 acres of marsh and flooded shrub lands.

While the loss of grassland and shrub land habitat through inundation would impact upland species such as bobwhite quail and/or eastern turkey, it would create wetland and open water habitats beneficial to migratory species such as waterfowl and possibly the bald eagle. If mitigation can replace the loss of grassland and shrubland habitats with comparable property bordering current units to the south of the project, it would create larger contiguous tracts that would be more beneficial for grassland species management in the Ladonia Unit of the wildlife management area.

Secondly, the impacts due to the loss of wildlife habitat on private lands could provide source populations for immigration onto the Ladonia Unit. That immigration could be determined by the condition of the habitat on those lands. Therefore, research to include baseline surveys for inventorying the flora and fauna would need to be conducted to help quantify and determine those impacts.

Over all, the project could provide increased wildlife populations and diverse habitats on the Ladonia Unit, as well as increased hunter opportunity. Both of which are goals for the Department. However, these gains should not be gained at the expense of endemic grassland

habitats, which is a problem that must be addressed on a landscape scale. Conservation and preservation of endemic habitats are also Department goals.

The US Fish and Wildlife Service (FWS) should be contacted for additional species occurrence data, guidance, permitting, survey protocols, and mitigation for federally listed species. TPWD recommends the enclosed updated lists for Fannin, Delta, and Lamar counties of rare species be reviewed as species, in addition to those listed above, could occur depending upon habitat availability.

This letter does not include a complete review of habitat impacts for general fish and wildlife from this project. Once additional information on the project plans is developed please provide the environmental documentation for review to the office of Kathy Boydston, TPWD Wildlife Habitat Assessment Program, Wildlife Division (512) 389-4571.

Thank you for the opportunity to provide preliminary comment on this project. Please contact me if you have any questions or need additional assistance (512) 912-7021.

Sincerely,

Celeste Brancel, Environmental Review Coordinator

Wildlife Habitat Assessment Program Threatened and Endangered Species

Cal A (B)

Enclosures (3)

# **FANNIN COUNTY**

Last Revision: 14 Mar 2005

Page 1 of 3

PAINTIN COUNTY		
	Federal Status	State Status
*** BIRDS ***	Status	Otatus
American Peregrine Falcon (Falco peregrinus anatum) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (Falco peregrinus tundrius) - potential migrant Baird's Sparrow (Ammodramus bairdii) - shortgrass prairie with scattered low bushes and matted vegetation	DL	T
Bald Eagle (Haliaeetus leucocephalus) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds  Cerulean Warbler (Dendroica cerulea) - treetops of riverbank woodlands, swamps, and bottomlands; mainly insectivorous	LT- PDL	T
Eskimo Curlew (Numenius borealis) - nonbreeding: grasslands, pastures, plowed fields, and less frequently, marshes and mudflats  Henslow's Sparrow (Ammodramus benslowii) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along	LE	E
with vines and brambles; a key component is bare ground for running/walking Interior Least Tern (Sterna antillarum athalassos) - this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony	LE	E
<ul> <li>Mountain Plover (Charadrius montanus) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous</li> <li>Wood Stork (Mycteria americana) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly</li> </ul>		Т
nested in Texas, but no breeding records since 1960		
***FISHES***  Blackside Darter ( <i>Percina maculata</i> ) - clear, gravelly streams; prefers pools with some		Т
current, or even quiet pools, to swift riffles  Blue Sucker (Cycleptus elongatus) - usually inhabits channels and flowing pools with a		Т
moderate current; bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		•
Creek Chubsucker (Erimyzon oblongus) - small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks  Goldeneye (Hiodon alosoides) - spawns spring to July in shallow firm-bottomed backwaters or gravel shoals in tributaries, eggs semibuoyant drift downstream or to quiet water; adults in quiet turbid water of medium to large lowland rivers, small lakes, marshes and muddy shallows connected to them; young feed on microcrustaceans and other inverts; adults on surface water insects, also frogs, fishes, and small mammals		<b>T</b>

Texas Parks & Wildlife Annotated County Lists of Rare Species FANNIN COUNTY, cont'd Last Revision: 14 Mar 2005

Page 2 of 3

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Status	Status

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Orangebelly Darter (*Etheoostoma radiosum*) - spawns February to mid-April, eggs buried in gravel riffles and raceways; post-larvae in quiet water, move to faster water during maturation; adults range from high gradient streams to sluggish lowland streams; headwaters only, gravel and rubble riffles with moderate to high current preferred; young feed mainly on copepods and cladocerans, adults on mayfly and fly larvae

Paddlefish (*Polyodon s pathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir

Shovelnose Sturgeon (Scaphirhynchus platorynchus) -open, flowing channels with bottoms of sand or gravel; spawns over gravel or rocks in an area with a fast current; never more than a rare occurrence in Rio Grande

Western Sand Darter (Ammocrypta clara) - clear to slightly turbid water of medium to large rivers that have moderate to swift currents, primarily over extensive areas of sandy substrate

## \*\*\*INSECTS\*\*\*

American Burying Beetle (Nicrophorus americanus) - varies widely from oak-hickory and coniferous forest ridges tops or hillsides to riparian corridors and valley floor pastures; extremely xeric, saturated, or loose sandy soils unsuitable; adults primarily above ground, eggs in soil adjacent to buried carcass, teneral adults overwinter in soil

# \*\*\* MAMMALS \*\*\*

Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles

Plains Spotted Skunk (Spilogale putorius interrupta) - catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

Red Wolf (Canis rufus) (extirpated) – formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

## \*\*\*MOLLUSKS\*\*\*

Fawnsfoot (Common) (Truncilla donaciformis) - small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Pimpleback (Common) (Quadrula pustulos a) - small streams to larger rivers, and associated with nearly every bottom type except deep shifting sands; Red River downstream of Lake Texoma and possibly Big Cypress Bayou and lower Sulphur river basins

Texas Parks & Wildlife Annotated County Lists of Rare Species FANNIN COUNTY, cont'd

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> Federal State Status Status

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- Pistolgrip (*Tritogonia verrucosa*) stable substrate, rock, hard mud, silt, and soft bottoms, often buried deeply; east and central Texas, Red through San Antonio River basins
- Rock-pocketbook (*Arcidens confragosus*) mud, sand, and gravel substrates of medium to large rivers in standing or slow flowing water, may tolerate moderate currents and some reservoirs, east Texas, Red through Guadalupe River basins
- Wabash Pigtoe (Fusconaia flava) creeks to large rivers on mud, sand, and gravel from all habitats except deep shifting sands; found in moderate to swift current velocities; east Texas River basins, Red through San Jacinto River basins; elsewhere occurs in reservoirs and lakes with no flow
- White heelsplitter (Lasmigona complanata) typically large rivers and streams with sluggish, turbid waters, on mud or mud-gravel bottoms; also smaller streams and reservoirs usually deep in soft mud or occasionally among rocks; quiet areas of otherwise swift streams; Red River with unsuccessful introductions into the upper Trinity River System

#### \*\*\* REPTILES \*\*\*

- Alligator Snapping Turtle (Macrochelys temminckii) deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October
- Texas Garter Snake (*Thamnophis sirtalis annectens*) wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August
- Texas Horned Lizard (*Phrynosoma cornutum*) open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September
- Timber/Canebrake Rattlesnake (Crotalus horridus) swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

#### Status Key:

- LE, LT Federally Listed Endangered/Threatened
  PE, PT Federally Proposed Endangered/Threatened
- E/SA, T/SA Federally Listed Endangered/Threatened by Similarity of Appearance
  - C1 Federal Candidate for Listing, Category 1; information supports proposing to list as Endangered/Threatened
  - DL, PDL Federally Delisted/Proposed for Delisting
    - NL Not Federally Listed
    - E, T State Listed Endangered/Threatened
    - "blank" Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

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# **DELTA COUNTY**

	Federal Status	
*** BIRDS ***	Status	Status
American Peregrine Falcon (Falco peregrinus anatum) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (Falco peregrinus tundrius) - potential migrant Bachman's Sparrow (Aimophila aestivalis) - open pine woods with scattered bushes or understory, brushy or overgrown hillsides, overgrown fields with thickets and brambles, grassy orchards; nests on ground against grass tuft or under low shrub	DL	T T
Bald Eagle (Haliaeetus leucocephalus) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds Henslow's Sparrow (Ammodramus benslowii) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking	LT- PDL	Т
Interior Least Tern (Sterna antillarum athalassos) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony  Mountain Plover (Charadrius montanus) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous  Western Burrowing Owl (Athene cunicularia hypugaea) - open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows and manmade structures, such as culverts	LE	E
Wood Stork ( <i>Mycteria americana</i> ) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		Т
***FISHES*** Blackside Darter ( <i>Percina maculata</i> ) - clear, gravelly streams; prefers pools with some		Т
current, or even quiet pools, to swift riffles  Creek Chubsucker (Erimyzon oblongus) - small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks		T
Orangebelly Darter (Etheoostoma radiosum) - spawns February to mid-April, eggs buried in gravel riffles and raceways; post-larvae in quiet water, move to faster water during maturation; adults range from high gradient streams to sluggish lowland streams; headwaters only, gravel and rubble riffles with moderate to high current preferred; young feed mainly on copepods and cladocerans, adults on mayfly and fly larvae		

Texas Parks & Wildlife Annotated County Lists of Rare Species DELTA COUNTY, cont'd

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> Federal State Status Status

Paddlefish (Polyodon spathula) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir

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# \*\*\* MAMMALS \*\*\*

Black Bear (Ursus americanus) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles

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Louisiana Black Bear (Ursus americanus luteolus) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas

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Plains Spotted Skunk (Spilogale putorius interrupta) - catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

# \*\*\*MOLLUSKS\*\*\*

Fawnsfoot (Common) (Truncilla donaciformis) - small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Little Spectaclecase (Villosa lienosa) - creeks, rivers, and reservoirs, sandy substrates in slight to moderate current, usually along the banks in slower currents; east Texas,

Cypress through San Jacinto River basins

Pimpleback (Common) (Quadrula pustulosa) - small streams to larger rivers, and associated with nearly every bottom type except deep shifting sands; Red River downstream of Lake Texoma and possibly Big Cypress Bayou and lower Sulphur river basins

Pistolgrip (Tritogonia verrucosa) - stable substrate, rock, hard mud, silt, and soft bottoms, often buried deeply, east and central Texas, Red through San Antonio River basins

Rock-pocketbook (Arcidens confragosus) - mud, sand, and gravel substrates of medium to large rivers in standing or slow flowing water, may tolerate moderate currents and some reservoirs, east Texas, Red through Guadalupe River basins

Wabash Pigtoe (Fusconaia flava) - creeks to large rivers on mud, sand, and gravel from all habitats except deep shifting sands; found in moderate to swift current velocities; east Texas River basins, Red through San Jacinto River basins; elsewhere occurs in reservoirs and lakes with no flow

## \*\*\* REPTILES \*\*\*

Alligator Snapping Turtle (Macrochelys temminckii) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October

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Texas Parks & Wildlife
Annotated County Lists of Rare Species
DELTA COUNTY, cont'd

Last Revision: 14 Mar 2005 Page 3 of 3

> Federal State Status Status

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Texas Garter Snake (*Thamnophis sirtalis annectens*) - wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August

Texas Horned Lizard (*Phrynosoma cornutum*) – open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

Timber/Canebrake Rattlesnake (Crotalus horridus) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

# \*\*\* VASCULAR PLANTS \*\*\*

Arkansas meadow-rue (*Thalictrum arkansanum*) - mesic mostly deciduous woodlands or forests, often on alluvial terraces; flowering March - April

#### Status Key:

LE,LT - Federally Listed Endangered/Threatened PE,PT - Federally Proposed Endangered/Threatened

E/SA,T/SA - Federally Endangered/Threatened by Similarity of Appearance

C1 - Federal Candidate, Category 1; information supports proposing to list as endangered/threatened

DL,PDL - Federally Delisted/Proposed for Delisting

NL - Not Federally Listed

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Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

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# LAMAR COUNTY

Federal State Status Status \*\*\*\* DRAFT \*\*\*\* DRAFT \*\*\*\* DRAFT\*\*\*\* DRAFT \*\*\*\* DRAFT \*\*\*\* UNDER CONSTRUCTION \*\*\*\* SPECIES MIGHT BE ADDED/DELETED DURING QUALITY CONTROL \*\*\* BIRDS \*\*\* American Peregrine Falcon (Falco peregrinus anatum) - potential migrant; nests in DL E west Texas Arctic Peregrine Falcon (Falco peregrinus tundrius) - potential migrant DLT T Bachman's Sparrow (Aimophila aestivalis) - inhabits mature open pine forests with grassy understory, regenerating pine clear-cuts (1-7 years post re-planting), or open habitats with a dense ground cover of grasses and forbs, or palmetto scrub; in Texas, known to occur only in the far eastern portion of the state; most abundant in forests south of Angelina National Forest Bald Eagle (Haliaeetus leucocephalus) - found primarily near seacoasts, rivers, and T LTlarge lakes; nests in tall trees or on cliffs near water; communally roosts, especially PDL in winter; hunts live prey, scavenges, and pirates food from other birds Cerulean Warbler (Dendroica cerulea) - treetops of riverbank woodlands, swamps, and bottomlands; mainly insectivorous Henslow's Sparrow (Ammodramus henslowii) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking Interior Least Tern (Sterna antillarum athalassos) - this subspecies is listed only when LE E inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony Mountain Plover (Charadrius montanus) - breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous Wood Stork (Mycteria americana) - forages in prairie ponds, flooded pastures or fields, T ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960 \*\*\*FISHES\*\*\* Τ Blackside Darter (Percina maculata) - clear, gravelly streams; prefers pools with some current, or even quiet pools, to swift riffles Blue Sucker (Cycleptus elongatus) - usually inhabits channels and flowing pools with a Τ moderate current; bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles Τ Creek Chubsucker (Erimyzon oblongus) - small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks

Texas Parks & Wildlife Annotated County Lists of Rare Species LAMAR COUNTY, cont'd Last Revision: 14 Mar 2005 Page 2 of 4

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- Goldeneye (*Hiodon alosoides*) spawns spring to July in shallow firm-bottomed backwaters or gravel shoals in tributaries, eggs semibuoyant drift downstream or to quiet water; adults in quiet turbid water of medium to large lowland rivers, small lakes, marshes and muddy shallows connected to them; young feed on microcrustaceans and other inverts; adults on surface water insects, also frogs, fishes, and small mammals
- Orangebelly Darter (Etheoostoma radiosum) spawns February to mid-April, eggs buried in gravel riffles and raceways; post-larvae in quiet water, move to faster water during maturation; adults range from high gradient streams to sluggish lowland streams; headwaters only, gravel and rubble riffles with moderate to high current preferred; young feed mainly on copepods and cladocerans, adults on mayfly and fly larvae
- Paddlefish (*Polyodon s pathula*) prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir
- Shovelnose Sturgeon (Scaphirhynchus platorynchus) -open, flowing channels with bottoms of sand or gravel; spawns over gravel or rocks in an area with a fast current; never more than a rare occurrence in Rio Grande
- Western Sand Darter (Ammocrypta clara) clear to slightly turbid water of medium to large rivers that have moderate to swift currents, primarily over extensive areas of sandy substrate

#### \*\*\*INSECTS\*\*\*

American Burying Beetle (Nicrophorus americanus) - varies widely from oak-hickory and coniferous forest ridges tops or hillsides to riparian corridors and valley floor pastures; extremely xeric, saturated, or loose sandy soils unsuitable; adults primarily above ground, eggs in soil adjacent to buried carcass, teneral adults overwinter in soil

#### \*\*\* MAMMALS \*\*\*

- Black Bear (*Ursus americanus*) within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles
- Plains Spotted Skunk (*Spilogale putorius interrupta*) catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie
- Red Wolf (Canis rufus) (extirpated) formerly known throughout eastern half of Texas LE in brushy and forested areas, as well as coastal prairies

# \*\*\*MOLLUSKS\*\*\*

Fawnsfoot (Common) (Truncilla donaciformis) - small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Texas Parks & Wildlife Annotated County Lists of Rare Species LAMAR COUNTY, cont'd

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- Ouachita Rock-pocketbook (Arkansia wheeleri) large, dense, diverse beds of other unionids; stable mud, sand, and gravel substrates of medium-sized rivers, backwater or slackwater areas adjacent to the main channel; also reported from cobble-gravel bottoms in pools of small, slow-flowing rivers; Red River Basin
- Pimpleback (Common) (Quadrula pustulos a) small streams to larger rivers, and associated with nearly every bottom type except deep shifting sands; Red River downstream of Lake Texoma and possibly Big Cypress Bayou and lower Sulphur river basins
- Pistolgrip (*Tritogonia verrucosa*) stable substrate, rock, hard mud, silt, and soft bottoms, often buried deeply; east and central Texas, Red through San Antonio River basins
- Plain pocketbook (Lampsilis cardium) -small creeks and large rivers, flowing waters, occasionally oxbows or slackwater areas of sandy-bottomed rivers and reservoirs on sand, sand-gravel, or sand-mud but not typically in dense beds; Red and Cypress River basins
- Rock-pocketbook (Arcidens confragosus) mud, sand, and gravel substrates of medium to large rivers in standing or slow flowing water, may tolerate moderate currents and some reservoirs, east Texas, Red through Guadalupe River basins
- Wabash Pigtoe (Fusconaia flava) creeks to large rivers on mud, sand, and gravel from all habitats except deep shifting sands; found in moderate to swift current velocities; east Texas River basins, Red through San Jacinto River basins; elsewhere occurs in reservoirs and lakes with no flow
- Wartyback (Quadrula nodulata) gravel and sand-gravel bottoms in medium to large rivers and on mud; Red, Sabine, Neches River basins
- White heelsplitter (Lasmigona complanata) typically large rivers and streams with sluggish, turbid waters, on mud or mud-gravel bottoms; also smaller streams and reservoirs usually deep in soft mud or occasionally among rocks; quiet areas of otherwise swift streams; Red River with unsuccessful introductions into the upper Trinity River System

## \*\*\* REPTILES \*\*\*

- Alligator Snapping Turtle (Macrochelys temminckii) deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October
- Texas Horned Lizard (*Phrynosoma cornutum*) open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September
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Texas Parks & Wildlife Annotated County Lists of Rare Species LAMAR COUNTY, cont'd

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# REPRESENTATIVE FIGURES



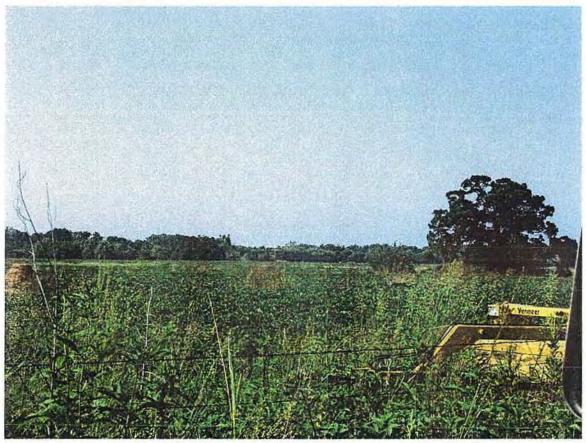
# REPRESENTATIVE PHOTOGRAPHS OF CROPLAND

# REPRESENTATIVE PHOTOGRAPHS OF CROPLAND









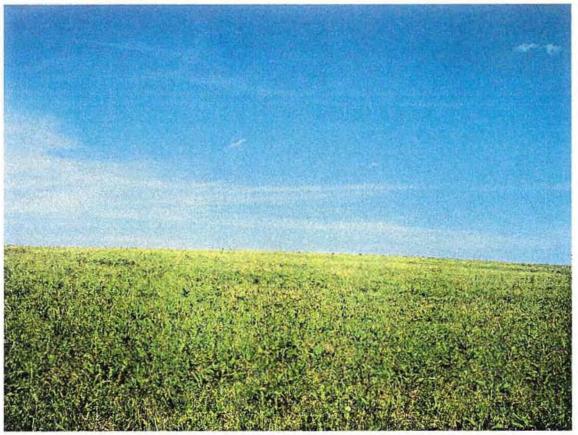
# REPRESENTATIVE PHOTOGRAPHS OF PASTURE

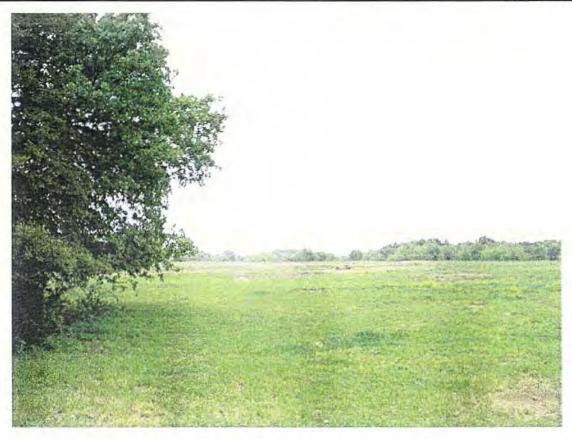
#### REPRESENTATIVE PHOTOGRAPHS OF PASTURE





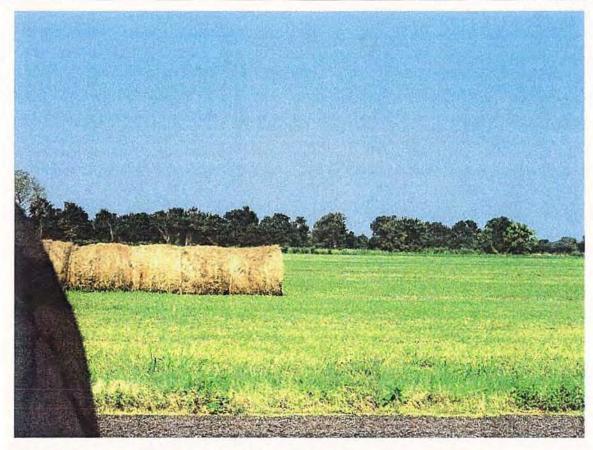


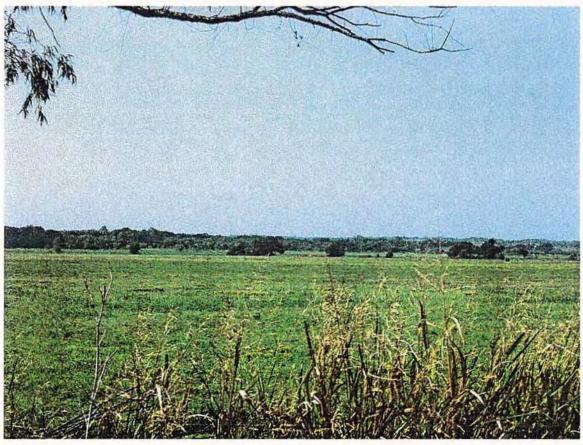






Cropland recently converted to forage grasses









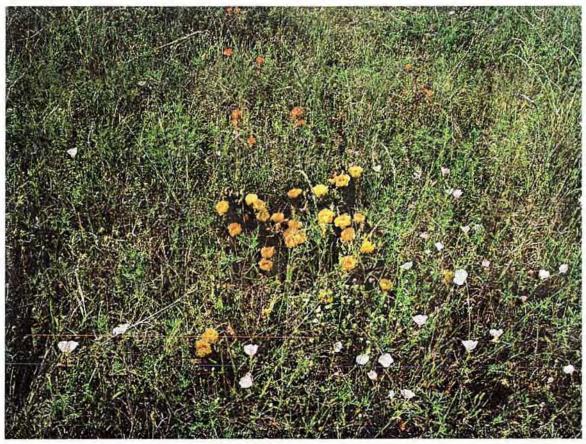
## REPRESENTATIVE PHOTOGRAPHS OF GRASSLAND

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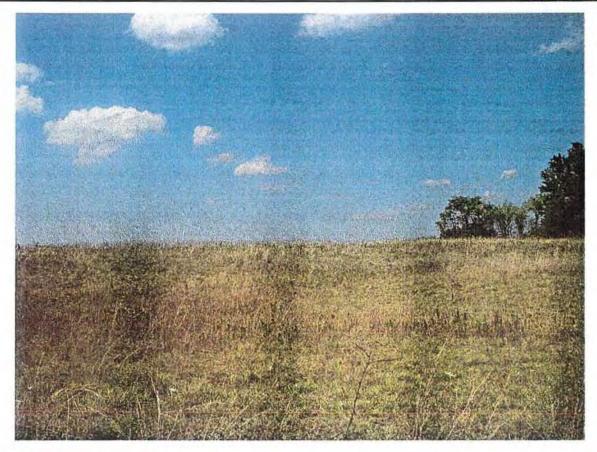






Boundary signage for Caddo National Grasslands - Ladonia Unit Tract

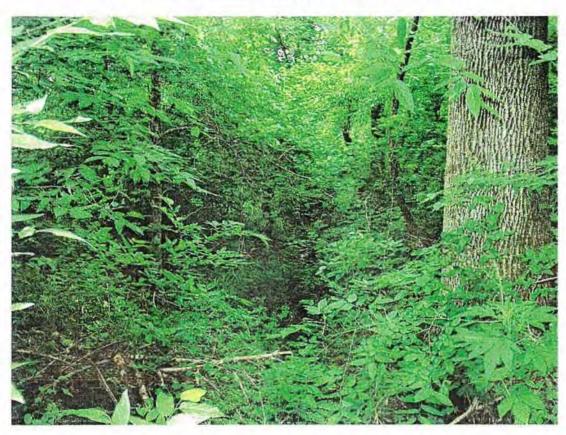




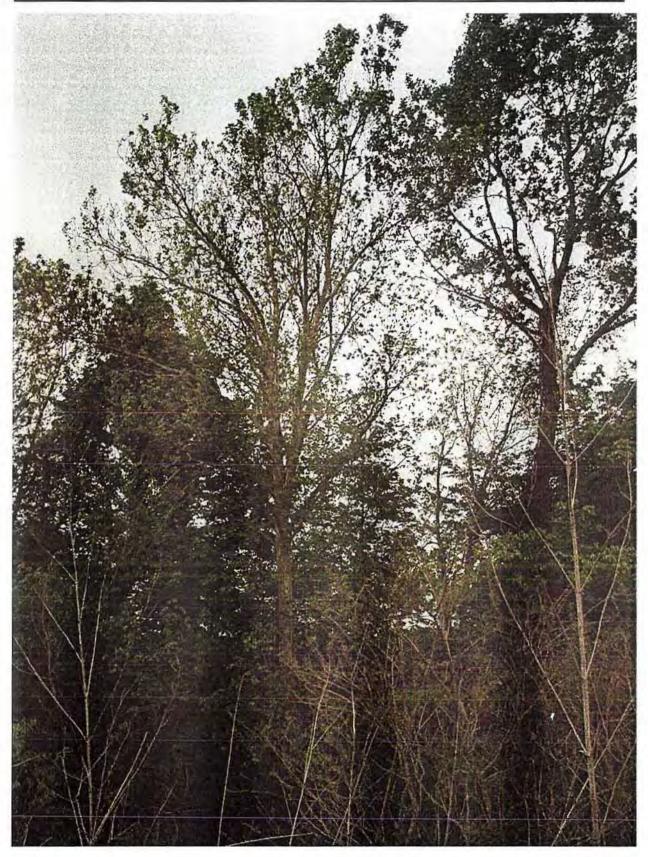


## REPRESENTATIVE PHOTOGRAPHS OF FOREST

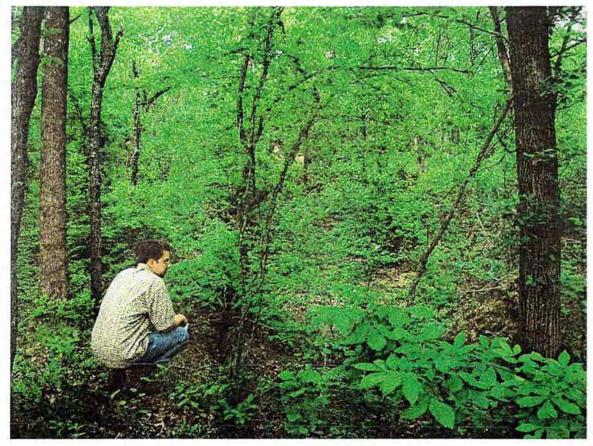
### REPRESENTATIVE PHOTOGRAPHS OF FOREST















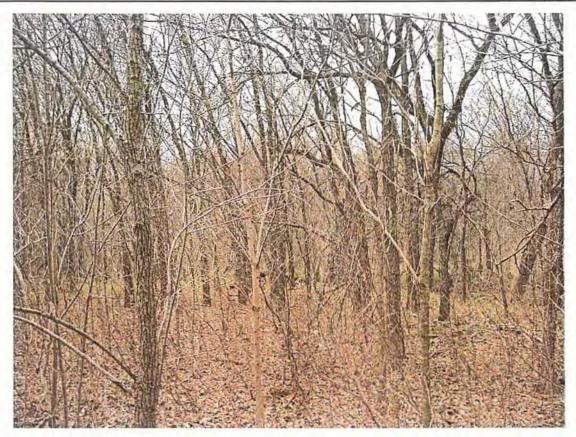
Forested area identified from 2004 aerial photograph where clearing activity had recently been conducted. Classification changed to Parks.

# REPRESENTATIVE PHOTOGRAPHS OF YOUNG FOREST

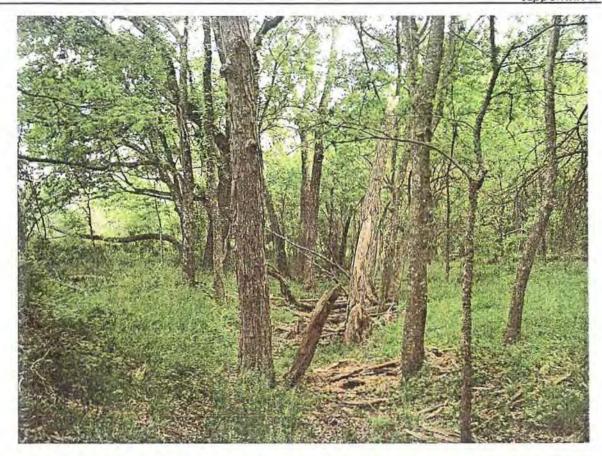
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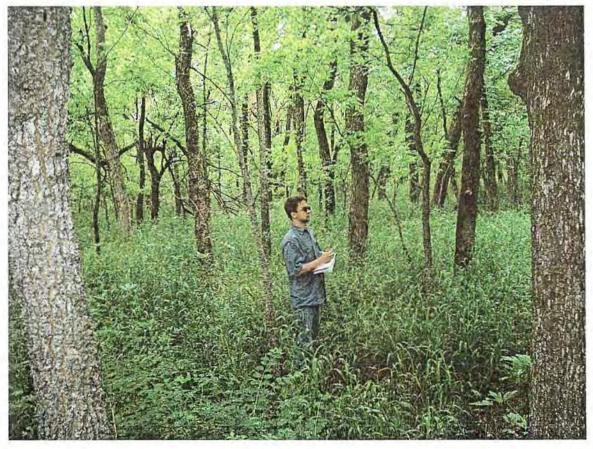




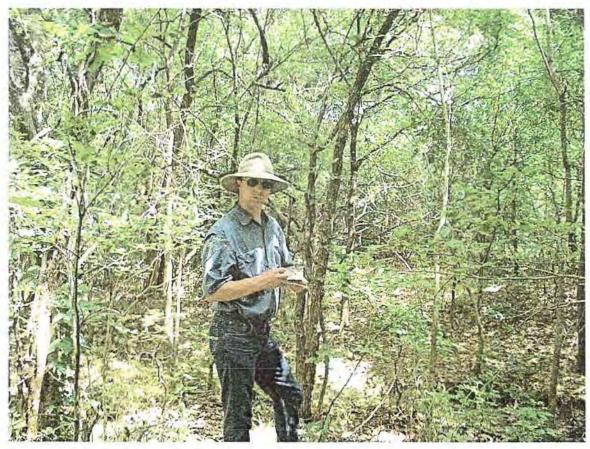


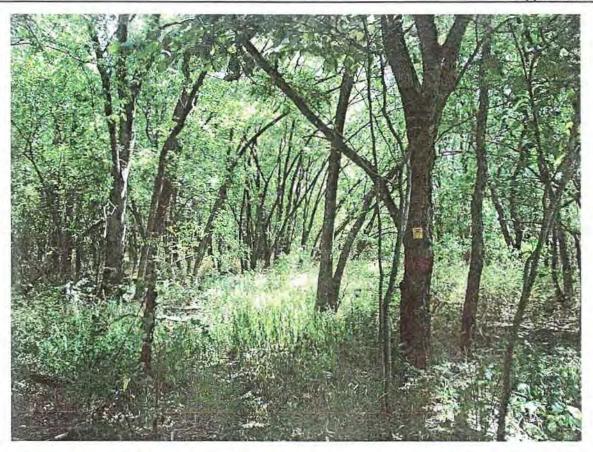


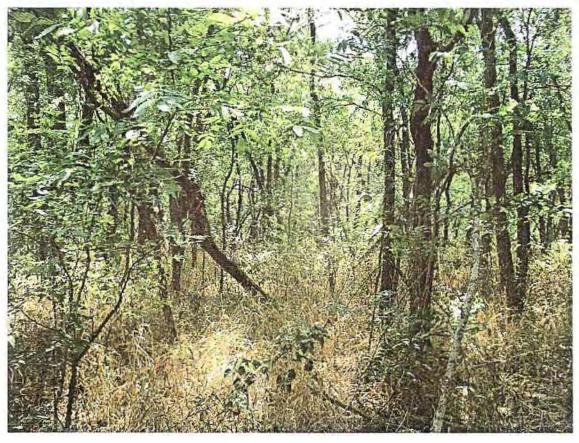










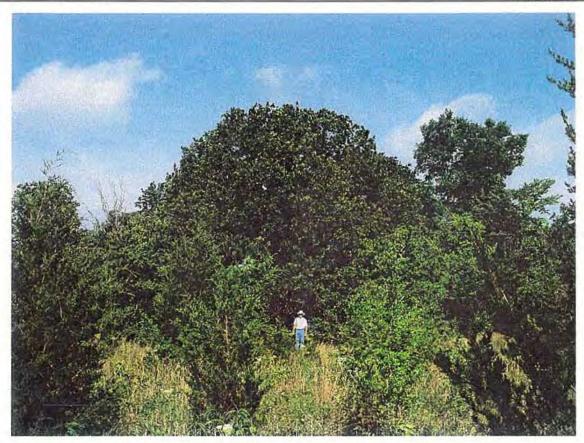


# REPRESENTATIVE PHOTOGRAPHS OF PARTIALLY WOODED AREAS

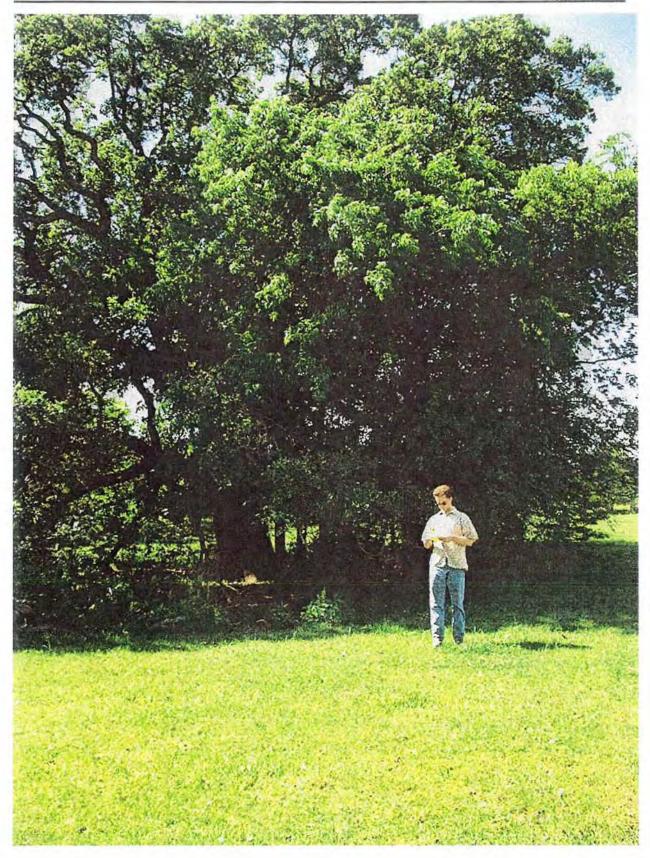
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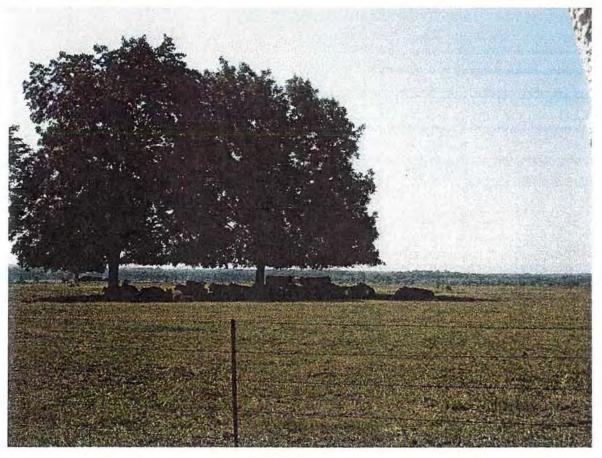








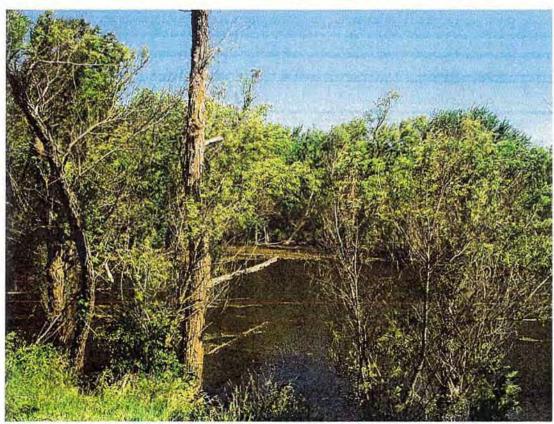




# REPRESENTATIVE PHOTOGRAPHS OF PONDS

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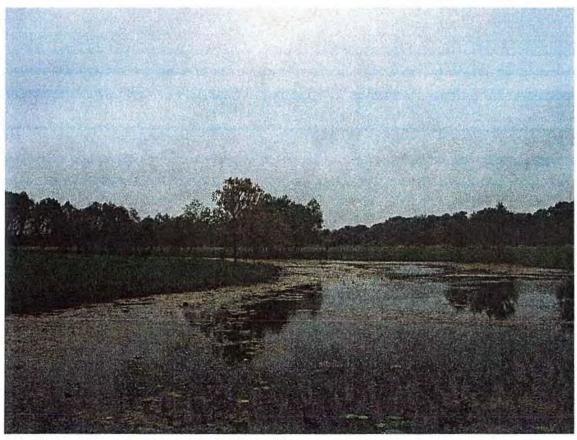


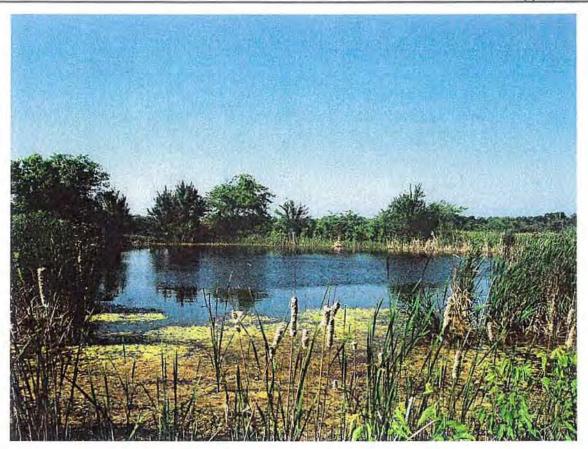












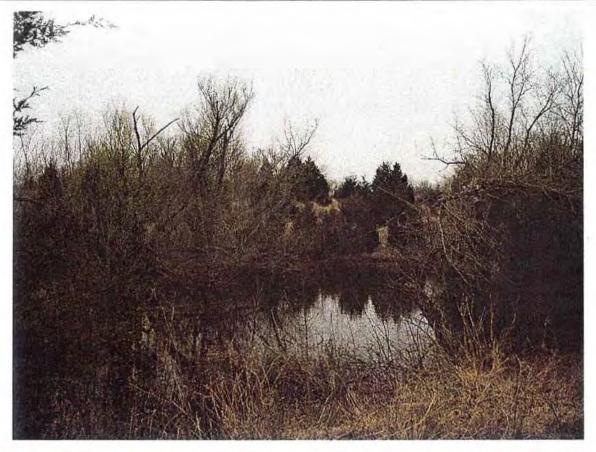




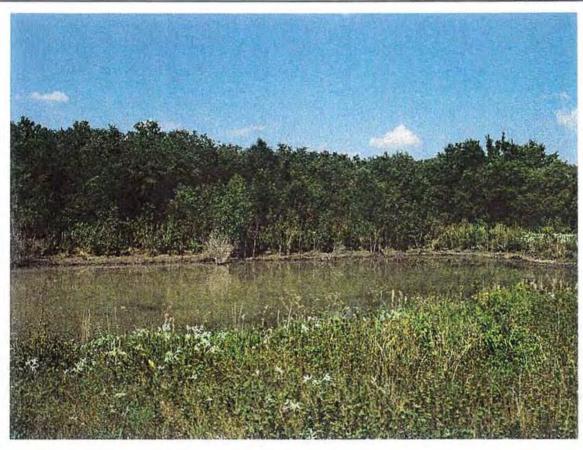


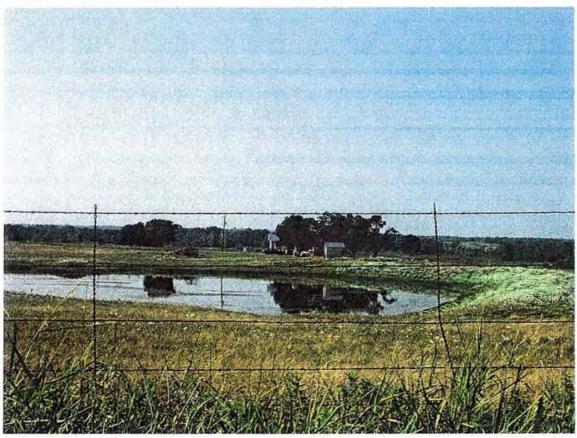












# BIOLOGICAL HABITAT COMPONENTS EVALUATION KEY

# **Biological Habitat Components Evaluation Key**

# Component 1 - Site Potential

Evaluate for all cover types.

Criteria <sup>2</sup>	Value
Substrate is composed or exhibits one or more of the following: 1) at least	
periodically supports predomi- nately hydrophytic vegetation; 2) is	
predominately undrained hydric soil and supports or is capable of supporting	
hydrophytic vegetation; 3) is saturated with water or covered by shallow water	r
during 1-2 months during the growing season of each year (swamps, bogs,	
marshes, and hardwood bottomlands exhibiting a high frequency of flooding).	. 25
Alluvial substrate although less hydric than above; only temporarily or	
intermittently inundated or saturated for short periods (higher terraces of hard	
wood bottoms, riparian drainages).	20
Uplands with thick surface layer (generally greater than or equal to 10 inches	
consisting of unrestricted loam (including sandy loam) or dark well structured	
(granulated) clay (including sandy clay).	12
Uplands with shallow surface layer (generally less than 10 inches) consisting	
of shallow soil over restrictive layer (rock, gravel, claypan, etc.) or deep,	
leached, droughty sand or, relatively light colored, poorly structured clay or	7
gravelly/stony sand or clay.	7
Organic matter minimal or absent at the surface. (Includes undrained or	0
saturated hydric soils not supporting vegetation i.e., mud flats).	3
Surface contains chemical compounds which would potentially limit growth of	
primary producers (salt, mine overburden containing heavy metals or acid	4
compounds, surface pollution).	1

Component 2 - Temporal Development of Existing Successional Stage
Determine currently existing successional stage (Criteria A); evaluate for all cover types
except marshes. For this habitat type use Criteria B.

Criteria A 3	Value
Old timber (100 or more years, trees >25 inches*)	20
Mature timber, old brush, climax prairie (40-99 years, trees 12-25 inches)	12
Pole and young timber, mature brush (11-39 years, trees <12 inches)	6
Grasslands in grazing disclimax** or early and mid- successional perennial	
grasses and forbs, hay meadows	5
Seedlings, saplings, young brush (3-10 years)	3
Annual native or introduced grasses, forbs, crops	1

<sup>\*</sup> Diameter at breast height (DBH)

### Criteria B

(Marsh wetlands)

Established mature communities within or adjacent to an enclosed coastal water

20

<sup>\*\*</sup> Example: Texas wintergrass-silver bluestem grasslands

body with a free connection to the sea and a measurable quantity of salt in its waters but with abundant or semi-abundant freshwater inflow (estuarine areas). Established mature communities or intermediate to well advanced successional stages occurring in fresh, brackish, or saline environments; freshwater inflow limited to generally small tributaries and localized runoff or overflow from flood conditions.

10

Aquatic or semi-aquatic communities occurring in generally early to intermediate successional stages as a result of periodic changes in moisture gradients; highly dependent on seasonal weather conditions.

### Component 3 - Uniqueness and Relative Abundance

1. Evaluate the habitat within the site according to the categories below.

Category	Value
Highly valuable for wildlife and is very uncommon, unique or irreplaceable	
(USFWS Mitigation Resource Category 1)	20
Highly valuable for wildlife but is relatively scarce or becoming scarce (USFWS	
Mitigation Resource Category 2)	15
Exhibits high to medium value for wildlife and is relatively abundant (USFWS	
Mitigation Resource Category 3)	10
Exhibits medium to low value for wildlife and is relatively abundant (USFWS	
Mitigation Resource Category 4)	5
Exhibits very low wildlife value regardless of abundance or scarcity	0

### Component 4 - Vegetation Species Diversity

### Criteria A

Diversity of Woody Species

Evaluate the composition of readily observable woody species in the overstory, midstory, and understory by determining the number of species groups as represented by the following categories. Evaluate for all cover types except Swamps (Criteria C) and Marsh wetlands (Criteria D). Worksheet for Criteria A&B provided on page 25.

Species Group <sup>4</sup>	Examples
Berry/Drupe	hackberry, mulberry, paw paw, hawthorn, winterberry, black haw, soapberry, persimmon, choke cherry, yaupon, dogwood, Am. beautyberry, greenbriar, dewberry, poison ivy, rattan vine, blackgum, grape, mulberry, holly, bumelia, huckleberry, sumac, Virginia creeper, sassafras, prickly ash, chinaberry, crab apple, agarito, lotebush, ivy tree vine, palmetto, peppervine; wax myrtle
Legume/Pod	mesquite, locust, redbud, Acacia spp., Eve's necklace, Sesbania spp.
Acorn	white oak, red oak, live oak, water oak, willow oak, post oak, bur oak
Nut/Nutlike	hickory, pecan, walnut, water elm, buttonbush,

	ephidra,bitternut, hornbean
Samara (Winged Fruit)	elm, ash, box elder, maple
Cone	pine, cypress, juniper
Achene	sycamore, Baccharis spp., sandsage, Clematis spp., salt bush
All others(capsules, follicles, burrs, hairy seeds)	willow, cottonwood, sweetgum, salt cedar, yucca, cactus, buttonbush, sweetgum, bois d'arc, creosotebush, Chinese tallow-tree

Value assigned is equivalent to the number of groups represented (Maximum=8, If none is represented then value is 0)

### Criteria B

Total Number of Occurring Woody Species

Determine the total number of readily observable woody species and assign value according to the following categories. Do not use for Swamps (Criteria C) or Marsh wetlands (Criteria D)

	Value
15 or more species	7
10-14 species	5
5-9 species	3
1-4 species	1
None occurring	0

### Criteria C

Diversity of Vegetation in Swamps

Evaluate swamp areas according to the following categories:5

	Value
Seasonally flooded mixed bottomland hardwoods; inundation resulting from freshwater inflow	15
Seasonally flooded vegetation dominated by cypress-tupelo; inundation resulting from freshwater inflow	10
Continually flooded or infrequent, abrasively flooded vegetation comprised of one or more species; inundation resulting from freshwater, brackish or saline	
inflow	6
Continually flooded vegetation; inundation resulting from stagnant or impounded freshwater, brackish, or saline water conditions	2

### Criteria D

Diversity of Vegetation in Marshes and other similar wetland areas

Determine the major types of wetland vegetation present according to the following categories: rooted emergent vegetation, rooted submergent vegetation, rooted

vegetation with floating leaves, algal mat communities (microalgae), benthic or drifting seaweeds (macroalgae).

	Value
High - includes three or more of above categories.	20
Medium - includes two of the above categories.	15
Low - includes one of the above categories.	5

# Component 5 - Vertical Vegetation Stratification<sup>6</sup>

Evaluate canopy coverage of the following three categories of vegetation for all cover types except crops and marsh wetlands.

Categories:

- 1. Vegetation greater than 12 feet high
- 2. Vegetation 3-12 feet high
- 3. Vegetation less than 3 feet high

Criteria	Value
All three categories present, each accounting for at least 25 percent of ground cover	5
Any two of the above categories present, each accounting for at least 25 percent of ground cover	4
Only one of the above categories present and accounting for at least 25 percent of ground cover	3
None of the categories together account for more than 25 percent of ground cover	1

### **Component 6- Additional Structural Diversity Components**

Evaluate for all cover types except crops. Determine the presence of brush piles, rock piles, rocky crevices, snags, fallen logs, thick grass cover, brambles or thickets according to the following categories.

Criteria	Value
Abundant - Three or more of the above components readily apparent and observable from most locations with the site	5
<u>Moderate</u> - Any of the above components present, and observable with very little search effort	3
<u>Sparse</u> - Any of the above components present, but occurring infrequently or requiring significant search effort to locate	1
Absent - None of the above components observed	0

# Component 7 - Condition of Existing Vegetation - Other

Use:

Criteria A&B for cover types (other than crops and marsh wetlands) containing woody and/or herbaceous vegetation.

Criteria C for cropland only. Criteria D for marsh wetlands.

### Criteria A

Degree of utilization of woody vegetation by vertebrates and invertebrates

	Value
Not evident - little or no evidence of plant utilization	5
Moderate - plant utilization observable with minimal damage to leaves and/or	
stems	3
Severe - damage to leaves and/or stems readily observable	1
No woody vegetation present	0

### Criteria B

Availability of Herbaceous Vegetation. Do not evaluate for Crops (Criteria C) or Marsh Wetlands (Criteria D)

	Value
Good - Eight or more combined species of grasses and forbs readily	
observable.	5
Fair - Four to seven combined species of grasses and forbs readily observable	3
Poor - One to three combined species of grasses and forbs readily observable	1
None - Herbaceous vegetation lacking or absent	0

### Criteria C

Available Biomass (Evaluate for croplands only)

	Value
<u>High</u> - Biomass removed periodically, although not necessarily annually; removed biomass supplanted by other vegetation resulting from natural succession of invading species or overseeding of introduced species; (Ex. Rice or other crop on multi-year rotational system allowing for additional biomass	
accumulations between harvests).	10
Moderate - Most biomass removed annually or semi-annually but with some residual amount remaining during portions of the rotational period. Minimal bare ground conditions (Hay operations, crops grown for pasture or grazing,	
chiseled crops).	5
<u>Low</u> - Most biomass removed annually due to clean farming practices creating significant bare ground conditions (intensive row crop farming).	1

### Criteria D

Condition of Marsh Wetlands

	Value
<u>Unaltered</u> - Quality of water and/or associated vegetation good, no foreseeable	
danger of environmental intrusion including pollution, contamination,	10

sedimentation, or stagnation.

Stable - Quality of water and/or associated vegetation good, although evidence exists that pollution, contamination sedimentation or stagnation could occur in	
the future or has occurred in the past.	5
<u>Degraded</u> - Degraded - Quality of water and/or associated vegetation poor or declining or degradation imminent.	1

# WILDLIFE HABITAT APPRAISAL PROCEDURE FIELD EVALUATION FORMS

Project Proposed Lake Ralph Hall	Date: 2005
Cover Type or Plant Association	Cropland

Habitat Components	Components Points (From Key)							
Site No.	179	458	434	127	546	32	543	Total
1. Site Potential	7	7	7	7	7	7	7	49
2. Temporal Development								
Criteria A	1	1	1	1	1	1	1	7
Criteria B (Marsh Wetlands Only)	NA	NA.	NA	NA	NA	NA	NA	NA
Uniqueness and     Relative Abundance	0	0	0	0	0	0	0	0
4. Vegetation Species Diversity								
Criteria A	NA	NA	NA	NA	NA	NA	NA.	NA
Criteria B	NA	NA	NA	NA	NA	NA	NA	NA
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	NA	NA	NA	NA	NA	NA	NA	NA
6. Additional Structural Diversity Components	0	0	0	0	0	0	0	0
7. Condition of Existing Vegetati	on							
Criteria A (Woody Vegetation)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B (Heibaceous Vegetation)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria C (Croptands Only)	1	1	3	1	1	1	1	9
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Qua	ality Score for all sit	es wi	hin	•
this cover type =	Total Points	X	1	=
Tota	1 number of sites	_	100	0.09

TABLE F-2
SPECIES LIST FOR CROP COVER TYPE

Common Name	Scientific Name	Group	Layer
Bermuda grass	Cynodon dactylon	Caryopsis	herbaceous
Foxtail grass	Setaria italica	Caryopsis	herbaceous
Giant Ragweed	Ambrosia trifida	Achene	herbaceous
Japanese brome	Bromus japonicus	Caryopsis	herbaceous
Johnson Grass	Sorghum halepense	Caryopsis	herbaceous
Perennial ryegrass	Lolium perenne	Caryopsis	herbaceous
Prairie Peppergrass	Lepidium densiflorum	Silique	herbaceous
Southern Crabgrass	Digitaria ciliaris	Caryopsis	Herbaceous
White Clover	Trifolium repens	Legume/Pod	herbaceous
Wild Rye	Elymus sp.	Caryopsis	herbaceous

Project Proposed Lake Ralph Hall	Date: 2005
Cover Type or Plant Association	Pasture

Habitat Components	Components Points (From Key)							
Site No.	458	23	108	131	520	742	38	Total
1. Site Potential	7	7	7	7	7	7	7	49
2. Temporal Development								
Criteria A	1	1	1	1	1	1	1	7
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Uniqueness and     Relative Abundance	5	5	5	5	5	5	5	35
4. Vegetation Species Diversity								
Criteria A	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B	NA	NA	NA	NA	ΝA	NA	NA	NA
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	ΝA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	3	3	3	3	3	3	3	21
6. Additional Structural Diversity Components	0	0	0	0	0	0	0	0
7. Condition of Existing Vegetati	on							
Criteria A (Woody Vegetation)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B (Hedbaceous Vegetation)	5	5	1	5	3	5	3	27
Criteria C (Croplands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat (	Suanty Score for all si	tes within		
this cover type =	Total Points	x 1	Total Control	
T	otal number of sites	100	0.20	

TABLE F-4
SPECIES LIST FOR PASTURE COVER TYPE

Common Name	Scientific Name	Group	Layer
Bermuda	Cynodon dactylon	Caryopsis	herbaceous
Buttercup	Ranunculus sp.	Achene	herbaceous
Cocklebur	Xanthium sp.	Achene	herbaceous
Curly Dock	Rumex crispus	Achene	herbaceous
Dewberry	Rubus trivialis	Berry/Drupe	herbaceous
Dotted Blue-eyed Grass	Sisyrinchium langloisii	Capsule	herbaceous
Fescue	Festuca arundinacea	Caryopsis	herbaceous
Fiddle Dock	Rumex pulcher	Achene	herbaceous
Johnson Grass	Sorghum halepense	Caryopsis	herbaceous
Prairie Phlox	Phlox pilosa	Capsule	herbaceous
Purple Threeawn	Aristida purpurea	Caryopsis	herbaceous
Showey Evening Primrose	Oenothera speciosa	Capsule	herbaceous
Spurred Butterfly Pea	Centrosema virginianum	Legume/Pod	herbaceous
Texas Prairie Parsley	Polytaenia texana	Schizocarp	herbaceous
Texas Toadflax	Nuttallanthus texanus	Capsule	herbaceous
Texas Vervain	Verbena halei	Nut/Nutlike	herbaceous
Trumpet Creeper	Campsis radicans	Capsule	herbaceous
Vetch	Vicia sp.	Legume/Pod	herbaceous
Violet	Viola sp.	Capsule	herbaceous
White Clover	Trifolium repens	Legume/Pod	herbaceous
Wild Onion	Allium canadense	Capsule	herbaceous
Woodsorrell	Oxalis sp.	Capsule	herbaceous
Yellow Thistle	Cirsium horridulum	Achene	herbaceous

### WHAP Biological Components Field Evaluation Form

Project Proposed Lake Ralph Hall	Date:	2005	
Cover Type or Plant Association	Grasses		

Habitat Components	Components Points (From Key)							
Site No.	510	330	321	577	535	683	53	Total
1. Site Potential	7	7	7	7	7	7	7	49
2. Temporal Development								
Criteria A	1	1	1	1	1	1	.5	11
Criteria B (Mansh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Uniqueness and     Relative Abundance	5	5	5	10	10	10	10	55
4. Vegetation Species Diversity								
Criteria A	NA	NA	NA	NA	NA	NA	NA	NA.
Criteria B	NA	NA	NA	NA	NA	NA	NA	NA
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	ΝA
Criteria D (Marsh Wedlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	3	3	3	3	3	3	3	21
6. Additional Structural Diversity Components	1	0	1	1	0	0	1	4
7. Condition of Existing Vegetati	on							
Criteria A (Woody Vegetation)	NA	NA	NA	ÑΑ	NA	NA	NA	NA
Criteria B (Herbaceous Vegetation)	5	3	5	5	5	5	5	33
Criteria C (Croplands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Westands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Quality Score for all sites within this cover type =  $\frac{\text{Total Points}}{\text{Total number of sites}}$  x  $\frac{1}{100}$  =  $\frac{0.25}{100}$ 

TABLE F-6
SPECIES LIST FOR GRASSES COVER TYPE

Common Name	Scientific Name	Group	Layer
Annual Ragweed	Ambrosia artemisiifolia	Achene	herbaceous
Beaked Cornsalad	Valerianella radiata	Achene	herbaceous
Bermuda	Cynodon dactylon	Caryopsis	herbaceous
Big Bluestem	Andropogon gerardii	Achene	herbaceous
Japanese Brome	Bromus japonicus	Caryopsis	herbaceous
Bushy Bluestem	Andropogon glomeratus	Achene	herbaceous
Buttercup	Ranunculus sp.	Achene	herbaceous
Catchweed Bedstraw	Galium aparine	Schizocarp	
			herbaceous
Clasping Venus' Looking-glass	Triodanis perfoliata	Capsule	herbaceous
Common Selfheal	Prunella vulgaris	Nut/Nutlike	herbaceous
Common Sunflower	Helianthus annuus	Achene	herbaceous
Common Yarrow	Achillea millefolium	Achene	herbaceous
Cross-vine	Bignonia capreolata	Capsule	herbaceous
Curly Dock	Rumex crispus	Achene	herbaceous
Dewberry	Rubus trivialis	Berry/Drupe	herbaceous
Dill Family	Anethum sp.	Schizocarp	herbaceous
Dotted Blue-eyed Grass	Sisyrinchium langloisii	Capsule	herbaceous
Fiddle Dock	Rumex pulcher	Achene	herbaceous
Flameleaf Sumac	Rhus copallinum	Berry/Drupe	herbaceous
Flax	Linum sp.	Capsule	herbaceous
Foxtail Grass	Setaria sp.	Caryopsis	herbaceous
Giant Ragweed	Ambrosia trifida	Achene	herbaceous
Goldenrod	Solidago sp.	Achene	herbaceous
Green Wild Indigo	Baptisia sphaerocarpa	Legume/Pod	herbaceous
Greenbriar	Smilax bona-nox	Berry/Drupe	herbaceous
Henbit	Lamium amplexicaule	Nut/Nutlike	herbaceous
Illinois Bundleflower	Desmanthus illinoensis	Legume/Pod	herbaceous
Indian paintbrush	Castilleja sp.	Capsule	herbaceous
Johnson Grass	Sorghum halepense	Caryopsis	herbaceous
Little Bluestem	Schizachyrium scoparium	Achene	herbaceous
Milkweed	Asclepias sp.	Follicle	herbaceous
Nettle Family		Achene	herbaceous
Nightshade	Solanum sp.	Berry/Drupe	herbaceous
Pigweed	Amaranthus sp.	Utricle	herbaceous
Prairie Peppergrass	Lepidium densiflorum	Silique	herbaceous
Prairie Plantain	Plantago elongata	Capsule	
Prickly Pear Cactus	Opuntia sp.	Berry/Drupe	herbaceous
Purple Threeawn	Aristida purpurea	Caryopsis	
Quakinggrass	Briza minor	Caryopsis	
Ryegrass	Lolium perenne	Caryopsis	
Sensitive Briar	Schrankia spp.	Legume/Pod	
Showy Evening Primrose	Oenothera speciosa	Capsule	<u> </u>
Spurge Family		Capsule	<del> </del>
Spurred Butterfly Pea	Centrosema virginianum	Legume/Pod	<u> </u>
Sunflower Family	Aster sp.	Achene	<u> </u>
Texas Dandelion	Pyrrhopappus carolinianus		
Texas Prairie Parsley	Polytaenia texana	Schizocarp	
Texas Vervain	Verbena halei	Nut/Nutlike	
Trumpet Creeper	Campsis radicans	Capsule	
Luminher Oreeher	Toampsis radicalis	L capsule	Herbaceous

TABLE F-6
SPECIES LIST FOR GRASSES COVER TYPE

Vetch	Vicia sp.	Legume/Pod	herbaceous
Virginia Creeper	Parthenocissus quinquefolia	Berry/Drupe	herbaceous
White Clover	Trifolium repens	Legume/Pod	herbaceous
Wild Geranium	Geranium caroliniuanum	Legume/Pod	herbaceous
Wild Onion	Allium canadense	Capsule	herbaceous
Wild Petunia	Ruellia sp.	Capsule	herbaceous
Yellow Sweet Clover	Melilotus indicus	Legume/Pod	herbaceous
Yellow Thistle	Cirsium horridulum	Achene	herbaceous

Project Proposed Lake Ralph Hall	Date: 2005
Cover Type or Plant Association Forest	

Habitat Components	Components Points (From Key)							
Site No.	684	510	706	330	518	539	742	Total
1. Site Potential	12	12	12	7	7	12	12	74
2. Temporal Development								
Criteria A	6	12	12	12	12	12	12	78
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	ΝA	ΝA	NA	NA
Uniqueness and     Relative Abundance	15	15	15	15	10	10	15	95
4. Vegetation Species Diversity								
Criteria A	7	8	7	6	5	4	8	45
Criteria B	7	7	7	7	5	3	5	41
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	4	5	4	5	5	4	4	31
6. Additional Structural Diversity Components	5	1	3	1	3	3	1	17
7. Condition of Existing Vegetati	on							
Criteria A (Woody Vegetation)	1	5	5	5	5	5	5	31
Criteria B (Herbaceous Vegetation)	5	5	5	5	5	3	5	33
Criteria C (Croptands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habita	it Quality Score for all si	tes within	
this cover type	<ul> <li>Total Points</li> </ul>	x 1 =	
	Total number of sites	100	0.64

TABLE F-8
SPECIES LIST FOR FOREST COVER TYPE

Common Name	Scientific Name	Group	Layer
American Elm	Ulmus americana	Samara	canopy
Black Willow	Salix nigra	Capsule	canopy
Blackjack Oak	Quercus marilandica	Acorn	canopy
Bois d' Arc	Maclura pomifera	Achene	canopy
Box Elder	Acer negundo	Samara	canopy
Bur Oak	Quercus macrocarpa	Acorn	canopy
Cedar Elm	Ulmus crassifolia	Samara	canopy
Cottonwood	Populus deltoides	Berry/Drupe	canopy
Eastern Red Cedar	Juniperus virginiana	Cone	canopy
Green Ash	Fraxinus pennsylvanica	Samara	canopy
Hackberry	Celtis laevigata	Berry/Drupe	
Hawthorn	Crataegus texana	Berry/Drupe	canopy
Honey Locust	Gleditsia triacanthos	Legume/Pod	canopy
		Nut/Nutlike	canopy
Pecan	Carya illinoensis		canopy
Post Oak	Quercus stellata	Acorn	canopy
Red Oak	Quercus texana	Acorn	canopy
Texas ash	Fraxinus texensis	Berry/Drupe	canopy
White Ash	Fraxinus americana	Samara	canopy
Winged Elm	Ulmus alata	Samara	canopy
American Elm	Ulmus americana	Samara	understory
Bamboo	Phyllostachys sp.	Other	understory
Black Willow	Salix nigra	Capsule	understory
Bois d' Arc	Maclura pomifera	Achene	understory
Box Elder	Acer negundo	Samara	understory
Cedar Elm	Ulmus crassifolia	Samara	understory
Chickasaw plum	Prunus angustifolia	Berry/Drupe	understory
Chinaberry	Melia azedarach	Berry/Drupe	
Chinese privet	Ligustrum sinese	Berry/Drupe	understory
Chinquapin Oak	Quercus muehlenbergii	Acorn	understory
Cottonwood	Populus deltoides	Berry/Drupe	understory
Deciduous Holly	llex decidua	Berry/Drupe	understory
Eastern Red Cedar	Juniperus virginiana	Cone	understory
Eve's Necklace	Sophora affinis	Legume/Pod	understory
Green Ash	Fraxinus pennsylvanica	Samara	understory
Gum Bumelia	Bumelia lanuginosum	Berry/Drupe	understory
Hackberry	Celtis laevigata	Berry/Drupe	
Hawthorn	Crataegus texana	Berry/Drupe	
Honey Locust	Gleditsia triacanthos	Legume/Pod	
Mexican Plum	Prunus mexicana	Berry/Drupe	<u> </u>
Pecan	Carya illinoensis	Nut/Nutlike	
Post Oak	Quercus stellata	Acorn	
Rattlebush	Sesbania drummondii	Legume/Pod	
Red Oak	Quercus shumardii	Acorn	
Redbud	Cercis canadensis	Legume/Pod	<del></del>
	Cornus drummondii	Berry/Drupe	<del></del>
Roughleaf Dogwood			
Sassafras	Sassafras albidum	Berry/Drupe	
Soapberry	Sapindus drummondii	Berry/Drupe	<u> </u>
Toothache Tree	Zanthoxylum clava-herculis	Berry/Drupe	
Wild Rose Bush	Rosa sp.	Achene	understory

TABLE F-8
SPECIES LIST FOR FOREST COVER TYPE

Annual Ragweed	Ambrosia artemisiifolia	Achene	herbaceous
Beaked Cornsalad	Valerianella radiata	Achene	herbaceous
Bermuda	Cynodon dactylon	Caryopsis	herbaceous
Browneyed Susan	Rudbeckia triloba	Achene	herbaceous
Bushy Bluestem	Andropogon glomeratus	Achene	herbaceous
Buttercup	Ranunculus sp.	Achene	herbaceous
Catchweed Bedstraw	Galium aparine	Schizocarp	herbaceous
Cocklebur	Xanthium sp.	Achene	herbaceous
Common Selfheal	Prunella vulgaris	Nut/Nutlike	herbaceous
Common Yarrow	Achillea millefolium	Achene	herbaceous
Coral Honeysuckle	Lonicera sempervirens	Berry/Drupe	herbaceous
Coralberry	Symphoricarpos orbiculatus	Berry/Drupe	herbaceous
Cross-vine	Bignonia capreolata	Capsule	herbaceous
Curly Dock	Rumex crispus	Achene	herbaceous
Dewberry	Rubus trivialis	Berry/Drupe	herbaceous
False Indigo	Amorpha fruticosa	Legume/Pod	herbaceous
Flameleaf Sumac	Rhus copallinum	Berry/Drupe	herbaceous
Foxtail Grass	Setaria italica	Caryopsis	herbaceous
Giant Ragweed	Ambrosia trifida	Achene	herbaceous
Giant Reed	Arundo donax	Caryopsis	herbaceous
Goldenrod	Solidago sp.	Achene	herbaceous
Grapevine	Vitis sp.	Berry/Drupe	herbaceous
Green Wild Indigo	Baptisia sphaerocarpa	Legume/Pod	herbaceous
Greenbriar	Smilax bona-nox	Berry/Drupe	herbaceous
Heavenly Bamboo	Nandina domestica	Berry/Drupe	herbaceous
Hedgenettle	Stachys sp.		herbaceous
Illinois Bundleflower	Desmanthus illinoensis	Legume/Pod	herbaceous
Indian Paintbrush	Castilleja sp.	Capsule	herbaceous
Inland Sea Oats	Chasmanthium latifolium	Achene	herbaceous
Japanese Honeysuckle	Lonicera japonica	Berry/Drupe	herbaceous
Johnson Grass	Sorghum halepense	Caryopsis	herbaceous
Little Bluestem	Schizachyrium scoparium	Achene	herbaceous
Lizard's Tail	Saururus cernuus	Capsule	herbaceous
May Apple	Podophyllum peltatum	Berry/Drupe	herbaceous
Milkweed	Asclepias sp.	Follicle	herbaceous
Mint Family		Nut/Nutlike	herbaceous
Mulberry	Morus sp.	Achene	herbaceous
Mustang Grape	Vitis mustangensis	Berry/Drupe	herbaceous
Mustard Family		Silique	herbaceous
Perennial Ryegrass	Lolium perenne	Caryopsis	herbaceous
Plantain	Plantago sp.	Capsule	herbaceous
Poison Ivy	Toxicodendron radicans	Berry/Drupe	herbaceous
Prairie Plantain	Plantago elongata	Capsule	herbaceous
Prickly Pear Cactus	Opuntia sp.	Berry/Drupe	herbaceous
Quakinggrass	Briza minor	Caryopsis	herbaceous
Queen Anne's Lace	Daucus carota	Schizocarp	herbaceous
Sedge	Carex sp.	Achene	herbaceous
Showy Evening Primrose	Oenothera speciosa	Capsule	herbaceous
Slender Fimbry	Fimbristylis autumnalis	Achene	herbaceous
Spurred Butterfly Pea	Centrosema virginianum	Legume/Pod	herbaceous
opulied butterily I ca	Toona osoma viigiinanuin	Legumen ou	11010000000

TABLE F-8
SPECIES LIST FOR FOREST COVER TYPE

Sunflower Family	Aster sp.	Achene	herbaceous
Texas Dandelion	Pyrrhopappus carolinianus	Achene	herbaceous
Texas Prairie Parsley	Polytaenia texana	Schizocarp	herbaceous
Texas Vervain	Verbena halei	Nut/Nutlike	herbaceous
Trumpet Creeper	Campsis radicans	Capsule	herbaceous
Vetch	Vicia sp.	Legume/Pod	herbaceous
Violet	Viola sp.	Capsule	herbaceous
Virginia Creeper	Parthenocissus quinquefolia	Berry/Drupe	herbaceous
Virginia Wildrye	Elymus virginicus	Caryopsis	herbaceous
White Clover	Trifolium repens	Legume/Pod	herbaceous
Wild Onion	Allium canadense	Capsule	herbaceous
Woodsorrel	Oxalis sp.	Capsule	herbaceous

Project Proposed Lake Ralph Hall	Date: 2005
Cover Type or Plant Association	Young Forest

Habitat Components	Components Points (From Key)							
Site No.	167	127	108	519	325	520	749	Total
1. Site Potential	12	12	7	7	7	7	7	59
2. Temporal Development			·					
Criteria A	6	6	6	6	6	6	6	42
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Uniqueness and     Relative Abundance	10	10	10	10	10	10	10	70
4. Vegetation Species Diversity								
Criteria A	5	7	7	4	3	8	5	39
Criteria B	3	5	5	5	3	7	3	31
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	4	4	4	4	4	4	4	28
6. Additional Structural Diversity Components	1	3	3	1	1	1	1	11
7. Condition of Existing Vegetati	on							
Criteria A (Woody Vegetation)	5	5	5	5	5	5	5	35
Criteria B (Herbaceous Vegetation)	5	5	1	5	5	3	1	25
Criteria C (Croplands Only)	NA	ΝA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Q	uality Score for all sit	es wi	thin		
this cover type = _	Total Points	х	1	=	
To	otal number of sites	•	100		0.49

TABLE F-10
SPECIES LIST FOR YOUNG FOREST COVER TYPE

Common Name	Scientific Name	Group	Layer
American Elm	Ulmus americana	Samara	canopy
Black Willow	Salix nigra	Capsule	canopy
Bois d' Arc	Maclura pomifera	Achene	canopy
Box Elder	Acer negundo	Samara	canopy
Bur Oak	Quercus macrocarpa	Acorn	canopy
Cedar Elm	Ulmus crassifolia	Samara	canopy
Cottonwood	Populus deltoides	Berry/Drupe	canopy
Eastern Red Cedar	Juniperus virginiana	Cone	canopy
Green Ash	Fraxinus pennsylvanica	Samara	
Hackberry	Celtis laevigata	Berry/Drupe	canopy
Honey Locust	01-14-1-11	Legume/Pod	canopy
Pecan		Nut/Nutlike	canopy
Post Oak	Carya illinoensis Quercus stellata		canopy
	<u> </u>	Acorn	canopy
Red Oak	Quercus shumardii	Acorn	canopy
Toothache Tree	Zanthoxylum clava-herculis	Berry/Drupe	canopy
Black Willow	Salix nigra	Capsule	understory
Bois d' Arc	Maclura pomifera	Achene	understory
Cedar Elm	Ulmus crassifolia	Samara	understory
Chickasaw plum	Prunus angustifolia	Berry/Drupe	understory
Chinese Privet	Ligustrum sinese	Berry/Drupe	understory
Deciduous Holly	Ilex decidua	Berry/Drupe	understory
Eastern Red Cedar	Juniperus virginiana	Cone	understory
Eve's Necklace	Sophora affinis	Legume/Pod	understory
Green Ash	Fraxinus pennsylvanica	Samara	understory
Gum Bumelia	Bumelia lanuginosum	Berry/Drupe	understory
Hackberry	Celtis laevigata	Berry/Drupe	
Hawthorn	Crataegus texana	Berry/Drupe	
Honey Locust	Gleditsia triacanthos	Legume/Pod	understory
Mesquite	Prosopis glandulosa	Legume/Pod	understory
Mexican Plum	Prunus mexicana	Berry/Drupe	
Rattlebush	Sesbania drummondii	Legume/Pod	understory
Redbud	Cercis canadensis	Legume/Pod	understory
Soapberry	Sapindus drummondii	Berry/Drupe	
Toothache Tree	Zanthoxylum clava-herculis	Berry/Drupe	<b> </b>
Wild Rose Bush	Rosa sp.	Achene	
American Pokeweed	Phytolacca americana	Berry/Drupe	
Annual Ragweed	Ambrosia artemisiifolia	Achene	herbaceous
Bermuda	Cynodon dactylon	Caryopsis	
Japanese Brome	Bromus japonicus	Caryopsis	herbaceous
Bushy Bluestem	Andropogon glomeratus	Achene	herbaceous
Buttercup	Ranunculus sp.	Achene	herbaceous
Catchweed Bedstraw	Galium aparine	Schizocarp	herbaceous
Coralberry	Symphoricarpos orbiculatus	Berry/Drupe	herbaceous
Curly Dock ·	Rumex crispus	Achene	herbaceous
False Garlic	Nothoscordum bivalve	Achene	
Giant Ragweed	Ambrosia trifida	Achene	
Greenbriar	Smilax bona-nox	Berry/Drupe	The state of the s
Henbit	Lamium amplexicaule	Nut/Nutlike	
Inland Sea Oats	Chasmanthium latifolium	Achene	

SPECIES LIST FOR YOUNG FOREST COVER TYPE

Japanese Honeysuckle	Lonicera japonica	Berry/Drupe	herbaceous
Johnson Grass	Sorghum halepense	Caryopsis	herbaceous
Mulberry	Morus sp.	Achene	herbaceous
Mustard Family		Silique	herbaceous
Perennial Ryegrass	Lolium perenne	Caryopsis	herbaceous
Poison Hemlock	Conium maculatum	Schizocarp	herbaceous
Poison Ivy	Toxicodendron radicans	Berry/Drupe	herbaceous
Prickly Pear Cactus	Opuntia sp.	Berry/Drupe	herbaceous
Sedge	Carex sp.	Achene	herbaceous
Spurge Family		Capsule	herbaceous
Sunflower Family	Aster sp.	Achene	herbaceous
Texas Prairie Parsley	Polytaenia texana	Schizocarp	herbaceous
Trumpet Creeper	Campsis radicans	Capsule	herbaceous
Virginia Wildrye	Elymus virginicus	Caryopsis	herbaceous

Project Proposed Lake Ralph Hall	Date: 2005
Cover Type or Plant Association Parks	

Habitat Components	onents Components Points (From Key)							
Site No.	534	701	749	321	126	535	706	Total
1. Site Potential	7	12	7	7	7	7	12	59
2. Temporal Development								
Criteria A	6	6	6	6	6	6	6	42
Criteria B (Marsh Wetlands Only)	NA.	NA	NA	NA	NA	NA	NA	· NA
Uniqueness and     Relative Abundance	5	5	5	5	5	5	5	35
4. Vegetation Species Diversity								
Criteria A	6	6	3	4	2	8	7	36
Criteria B	3	3	1	1	1	7	5	21
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	3	4	3	4	3	4	3	24
6. Additional Structural Diversity Components	0	1	0	1	3	1	1	7
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	5	5	5	5	5	5	5	35
Criteria B (Hestraceous Vegetation)	5	5	1	3	3	5	5	27
Criteria C (Croplands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Qu	uality Score for all sit	es wi	thin		
this cover type =	Total Points	X	1	<b>==</b>	
Tot	al number of sites		100		0.41

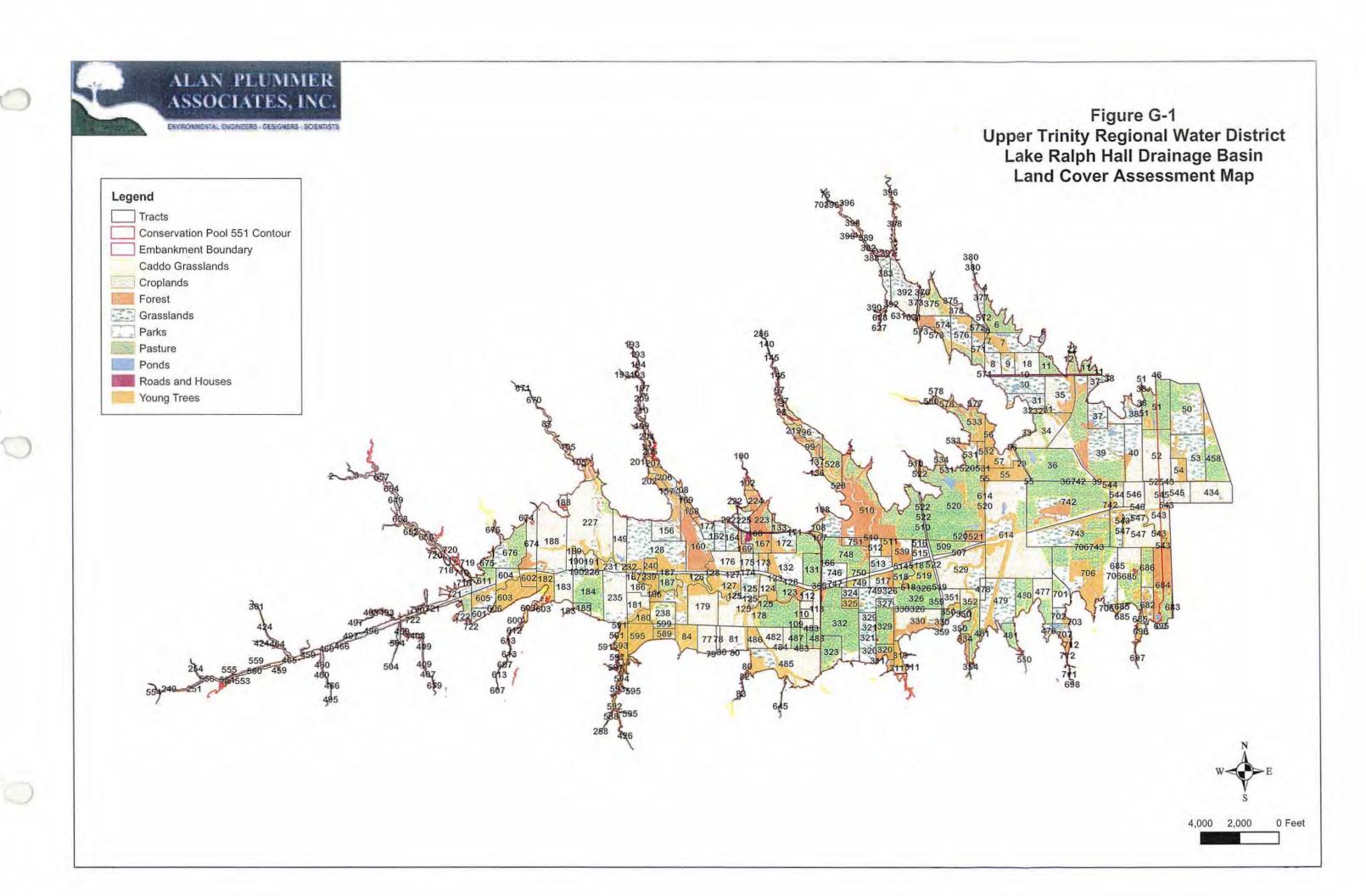
TABLE F-12
SPECIES LIST FOR PARKS COVER TYPE

American ellm Bols d' Arc Maclura pomifera Achene canopy Catalpa (cigar free) Catalpa speciosa Capsule canopy Green Ash Fraxinus pennsylvanica Black Willow Salfix nigration Catalpa (cigar free) Cettis laevigata Berry/Drupe Canopy Pecan Carya illinoensis NutNutilkie Canopy Post Oak Quercus stellata Acom canopy Black Willow Salfix nigra Capsule Black Willow Salfix nigra Capsule Chickasaw plum Prunus angustifolia Berry/Drupe Understory Chinquapin Oak Quercus stellate Acom canopy Berry/Drupe Understory Cedar Elm Ulmus crassifolia Samara Understory Unimus crassifolia Samara Understory Chickasaw plum Prunus angustifolia Berry/Drupe Understory Chinquapin Oak Quercus muehlenbergii Acorn Understory Chinquapin Oak Quercus muehlenbergii Berry/Drupe Understory Understory Understory Chinquapin Oak Quercus muehlenbergii Berry/Drupe Understory Understory Understory Understory Chinquapin Oak Quercus muehlenbergii Berry/Drupe Understory Understory Understory Understory Understory Understory Understory Understory Coren Ash Fraxinus pennsylvanica Green Ash Fraxinus pennsylvanica Samara Understory Under	Common Name	Scientific Name	Group	Layer
Bois d'Arc Mactura pomifera Achene canopy Catalpa (cigar tree) Catalpa speciosa Capsule canopy Catalpa (cigar tree) Catalpa speciosa Capsule canopy Green Ash Fraxinus pennsylvanica Samara canopy Hackberry Celtis (aevigata Berry/Drupe canopy Pecan Carya illinoensis NutVhutlike canopy Pecan Carya illinoensis NutVhutlike canopy Pecan Carya illinoensis NutVhutlike canopy Pest Oak Quercus stellata Acom canopy Red Oak Quercus stellata Acom canopy Black Willow Salix nigra Capsule understory Black Willow Salix nigra Capsule understory Bois d'Arc Mactura pomifera Achene understory Cedar Elm Ulmus crassifolia Samara understory Chickasaw plum Prunus angustifolia Berry/Drupe understory Chinquapin Oak Quercus muehienbergii Acom understory Chinquapin Oak Quercus muehienbergii Acom understory Chinquapin Oak Quercus muehienbergii Acom understory Deciduous Holly Ilex decidua Berry/Drupe understory Deciduous Holly Ilex decidua Berry/Drupe understory Eastern Red Cedar Juniperus virginiana Cone understory Eastern Red Cedar Sophora affinis Legume/Pod understory Green Ash Fraxinus pennsylvanica Samara understory Green Ash Fraxinus pennsylvanica Samara understory Hackberry Celtis faevigata Berry/Drupe understory Hackberry Celtis faevigata Berry/Drupe understory Hany Locust Gladitis triacanthos Legume/Pod understory Mesquite Prosopis glandulosa Capsopis herbaceous Beaked Cornsalad Valerianella radiata Achene herbaceous Beaked Cornsala				
Catalpa (cigar tree) Catalpa speciosa Cedar Elm Ulmus crassifolia Samara canopy Green Ash Fraxinus pennsylvanica Berry/Drupe Canopy Post Oak Quercus stellata Acom Canopy Red Oak Quercus stellata Berry/Brupe Black Willow Bolis d'Arc Catal Ilm Ulmus crassifolia Samara Acom Canopy Red Oak Quercus stellata Acom Canopy Black Willow Salix nigra Capsule Understory Bois d'Arc Maclura pomifera Achene Understory Cedar Elm Ulmus crassifolia Berry/Drupe Understory Chickasaw plum Prunus angustifolia Berry/Drupe Understory Chinquapin Oak Quercus muehlenbergii Acom Understory Castelace Sophora affinis Legume/Pod Understory Green Ash Fraxinus pennsylvanica Understory Understory Understory Green Ash Fraxinus pennsylvanica Green Ash Fraxinus pennsylvanica Understory Mexican Plum Prunus mexicana Berry/Drupe Understory Understory Understory Septimus Berry/Drupe Understory Understory Understory Understory Septimus Berry/Drupe Understory Understory Understory Understory Understory Understory Septimus Berry/Drupe Understory Understory Understory Understory Understory Understory Underst				
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Red Oak				
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Cedar Elm         Ulmus crassifolia         Samara         understory           Chickasaw plum         Prunus angustifolia         Berry/Drupe         understory           Chickasaw Privet         Ligustrum sinese         Berry/Drupe         understory           Chinguapin Oak         Quercus muehlenbergii         Aconn         understory           Deciduous Holly         Ilex decidua         Berry/Drupe         understory           Eastern Red Cedar         Juniperus virginiana         Cone         understory           Eve's Necklace         Sophora affinis         Legume/Pod         understory           Green Ash         Fraxinus pennsylvanica         Samara         understory           Gum Bumelia         Bumelia lanuginosum         Berry/Drupe         understory           Hackberry         Celtis laevigata         Berry/Drupe         understory           Hawthorn         Crataegus texana         Berry/Drupe         understory           Honey Locust         Gleditsia triacanthos         Legume/Pod         understory           Mesquite         Prosopis glandulosa         Legume/Pod         understory           Mesquite         Prosopis glandulosa         Legume/Pod         understory           Mesican Plum         Prunus mexicana         Ber		<u> </u>		
Chinckasaw plum				
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Eastern Red Cedar  Juniperus virginiana  Cone  Eve's Necklace  Sophora affinis  Green Ash  Fraxinus pennsylvanica  Gum Bumelia  Bumelia lanuginosum  Berry/Drupe  Understory  Hackberry  Celtis laevigata  Berry/Drupe  Understory  Honey Locust  Gleditsia triacanthos  Gegune/Pod  Horey Locust  Gleditsia triacanthos  Hesqueite  Prosopis glandulosa  Legume/Pod  Understory  Mexican Plum  Prunus mexicana  Berry/Drupe  Understory  Rattlebush  Sesbania drummondii  Berry/Drupe  Understory  Soapberry  Sapindus drummondii  Berry/Drupe  Understory  Wild Rose Bush  Rosa sp.  Achene  Herbaceous  Beaked Cornsalad  Valerianella radiata  Achene  Herbaceous  Bermuda  Cynodon dactylon  Caryopsis  Herbaceous  Big Bluestem  Andropogon gerardii  Achene  Herbaceous  Bull Nettle  Cnidoscolus texanus  Capsule  Herbaceous  Bull Nettle  Cnidoscolus texanus  Capsule  Herbaceous  Bull Nettle  Cnidoscolus texanus  Capsule  Herbaceous  Catchweed Bedstraw  Galium aparine  Schizocarp  Herbaceous  Clasping Venus' Looking-glass  Triodanis perfoliata  Capsule  Herbaceous  Cockspur Grass  Echinochloa crus-pavonis  Caryopsis  Herbaceous  Condenno Selfheal  Prunella vulgaris  NutfNutlike  Herbaceous  Common Selfheal  Prunella vulgaris  NutfNutlike  Herbaceous  Common Selfheal  Prunella vulgaris  Berry/Drupe  Herbaceous  Common Selfheal  Legume/Pod  Herbaceous  Coral Honeysuckle  Lonicera sempervirens  Berry/Drupe  Herbaceous  Coral Herbaceous  Coral Herbaceous  Berny/Drupe  Herbaceous  Coral Herbaceous  Herbaceous  Berny/Drupe  Herbaceous  Herba				
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Gum Bumelia         Bumelia lanuginosum         Berry/Drupe         understory           Hackberry         Celtis laevigata         Berry/Drupe         understory           Hawthorn         Crataegus texana         Berry/Drupe         understory           Honey Locust         Gleditsia triacanthos         Legume/Pod         understory           Mesquite         Prosopis glandulosa         Legume/Pod         understory           Mexican Plum         Prunus mexicana         Berry/Drupe         understory           Post Oak         Quercus stellata         Acorn         understory           Rattlebush         Sesbania drummondii         Legume/Pod         understory           Roughleaf Dogwood         Cornus drummondii         Berry/Drupe         understory           Roughleaf Dogwood         Cornus drummondii         Berry/Drupe         understory           Soapberry         Sapindus drummondii         Berry/Drupe         understory           Wild Rose Bush         Rosa sp.         Achene         understory           Mild Rose Bush         Rosa sp.         Achene         herbaceous           Bermuda         Ambrosia artemisiifolia         Achene         herbaceous           Bermuda         Cynodon dactylon         Caryopsis         herb	L			
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TABLE F-12
SPECIES LIST FOR PARKS COVER TYPE

Dewberry	Rubus trivialis	Berry/Drupe	herbaceous
Dotted Blue-eyed Grass	Sisyrinchium langloisii	Capsule	herbaceous
False Garlic	Nothoscordum bivalve	Achene	herbaceous
Fern		Other	herbaceous
Fiddle Dock	Rumex pulcher	Achene	herbaceous
Flameleaf Sumac	Rhus copallinum	Berry/Drupe	herbaceous
Flax	Linum sp.	Capsule	herbaceous
Foxtail Grass	Setaria sp.	Caryopsis	herbaceous
Giant Ragweed	Ambrosia trifida	Achene	herbaceous
Goldenrod	Solidago sp.	Achene	herbaceous
Green Wild Indigo	Baptisia sphaerocarpa	Legume/Pod	herbaceous
Greenbriar	Smilax bona-nox	Berry/Drupe	herbaceous
Honey Locust	Gleditsia triacanthos	Legume/Pod	herbaceous
Illinois Bundleflower	Desmanthus illinoensis	Legume/Pod	herbaceous
Indian Paintbrush	Castilleja sp.	Capsule	herbaceous
Johnson Grass	Sorghum halepense	Caryopsis	herbaceous
Little Bluestem	Schizachyrium scoparium	Achene	herbaceous
Lyreleaf Sage	Salvia lyrata	Nut/Nutlike	herbaceous
Milkweed	Asclepias sp.	Follicle	herbaceous
Nettle		Achene	herbaceous
Nightshade	Solanum sp.	Berry/Drupe	herbaceous
Poison Hemlock	Conium maculatum	Schizocarp	herbaceous
Poison Ivy	Toxicodendron radicans	Berry/Drupe	herbaceous
Prairie Peppergrass	Lepidium densiflorum	Silique	herbaceous
Prickly Pear Cactus	Opuntia sp.	Berry/Drupe	herbaceous
Purple Threeawn	Aristida purpurea	Caryopsis	herbaceous
Quakinggrass	Briza minor	Caryopsis	herbaceous
Sensitive-briar	Mimosa sp.	Legume/Pod	herbaceous
Showy Evening Primrose	Oenothera speciosa	Capsule	herbaceous
Spurred Butterfly Pea	Centrosema virginianum	Legume/Pod	herbaceous
Sunflower Family	Aster sp.	Achene	herbaceous
Texas Prairie Parsley	Polytaenia texana	Schizocarp	herbaceous
Texas Vervain	Verbena halei	Nut/Nutlike	herbaceous
Trumpet Creeper	Campsis radicans	Capsule	herbaceous
Vervain Family		Nut/Nutlike	herbaceous
Vetch	Vicia sp.	Legume/Pod	herbaceous
Virginia Creeper	Parthenocissus quinquefolia	Berry/Drupe	herbaceous
Virginia Wildrye	Elymus virginicus	Caryopsis	herbaceous
White Clover	Trifolium repens	Legume/Pod	herbaceous
Wild Onion	Allium canadense	Capsule	herbaceous
Yellow Thistle	Cirsium horridulum	Achene	herbaceous

LAND COVER ASSESSMENT MAP



Lake Ralph Hall	Appendix F
F-2: Summary of SWAMPIM and WH	IAP Memorandum

### **MEMORANDUM**

Date: November 10, 2009

To: Mary Verwers, United States Army Corps of Engineers

From: Jason Voight, Alan Plummer Associates, Inc.

Loretta Mokry, Alan Plummer Associates, Inc.

Cc: Larry Patterson, P.E., Upper Trinity Regional Water District

Edward Motley, P.E., CH2MHill

File 0346-004-03

Subject: USACE Project Number 2003-00336

Summary of SWAMPIM and WHAP Data Sets and Reports for the

Proposed Lake Ralph Hall Project Site

### **Background**

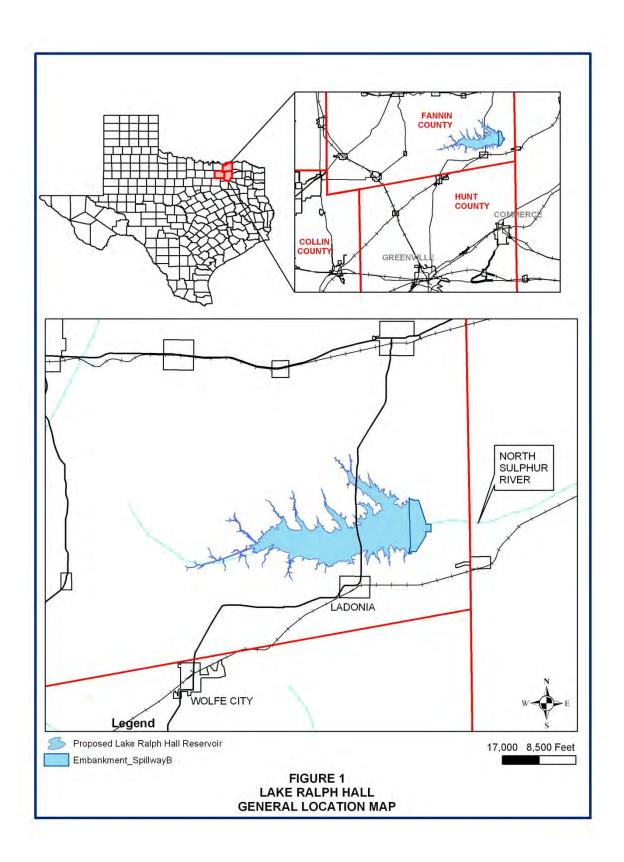
To date numerous reports and subsequent reports have been produced for the Lake Ralph Hall project documenting efforts conducted to assess aquatic resource functions as well as habitat quality. The following is a brief synopsis of the effort to date.

- August 2005 a draft Lake Ralph Hall Preliminary Habitat Assessment report documenting assessment of habitat and land cover within the project area using the Texas Parks and Wildlife Department's (TPWD) Wildlife Habitat Appraisal Procedure (WHAP) was circulated to the United States Army Corps of Engineers (USACE), U.S. Fish and Wildlife Department (USFWS), U.S. Environmental Protection Agency (USEPA), and the TPWD for review. During a project review meeting with Presley Hatcher (USACE Permits Chief) and Brent Jasper (USACE Project Manager for this project 2005-2008), the USACE provided a directive to use a functions based analysis rather than areal based analysis for developing appropriate mitigation for impacts associated with the project.
- January 2006 a project meeting was held with Presley Hatcher and Brent Jasper to discuss the outline for functions based analysis of Lake Ralph Hall. Comments were received from the USACE and incorporated into a draft Stream Watershed Assessment and Measurement Protocol Interaction Model (SWAMPIM) protocol for functional assessment of the Lake Ralph Hall project area.
- March 2006 the draft SWAMPIM protocol was submitted to the USACE for their review and comment; review comments were discussed at a project meeting with the USACE (Presley Hatcher and Brent Jasper).
- October 30, 2006 an application for a Section 404 permit was submitted to the Fort Worth District, USACE. The application included the Lake Ralph Hall Preliminary

Habitat Assessment dated December 6, 2005, the Biological Assessment of the North Sulphur River dated June 15, 2006, and the Draft Mitigation Plan dated October 26, 2006. The SWAMPIM protocol was used in the development of the mitigation plan to determine the existing aquatic resource functions of the project area and to project aquatic resource functions based on the mitigation proposal. A balance between pre- and post-project aquatic functions was shown to be obtainable within the proposed project boundary.

- February 4, 2009 an interagency meeting was hosted at the Lake Belton USACE office. At this meeting, a presentation was provided to the team to discuss the development of the SWAMPIM protocol and its application for assessing existing and post-project aquatic resources, which was used as the basis for the proposed draft mitigation plan. The interagency review team agreed to the use of the SWAMPIM and WHAP protocols for aquatic resource function and habitat assessment respectively within the Lake Ralph Hall project area. During the meeting, the agencies requested assessment of additional sampling points within the proposed mitigation areas along the upper reaches of tributaries to the North Sulphur River and within the Ladonia Unit of the Caddo National Grasslands. Attendees included representatives from the USACE, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the Texas Parks and Wildlife Department, the Texas Commission on Environmental Quality, the U.S. Forest Service, Upper Trinity Regional Water District, CPYI, CH2MHill, and Alan Plummer Associates, Inc.
- July 2009 USACE agreed to the proposed additional sampling points for SWAMPIM and WHAP assessment.
- August 24-29, 2009 representatives from APAI assessed the additional sampling points using SWAMPIM for the stream channels and WHAP for terrestrial habitat.
- September 16, 2009 the interagency review team participated in a field review of the additional sampling points. Based on the input received from the interagency review team during the on-site field review, the data sheets were revised for the additional sampling points. Attendees included representatives from the USACE, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the Texas Parks and Wildlife Department, the Texas Commission on Environmental Quality, Upper Trinity Regional Water District, CPYI, CH2MHill, and Alan Plummer Associates, Inc.

A general location map is provided as Figure 1.



Discussion of the Data within the Draft Mitigation Plan (dated October 26, 2006) to the Data Reassessed After 2009 Agency Review

### Wildlife Habitat Appraisal Procedure (WHAP)

On-site observations conducted during spring and summer 2005 were used to assess habitat quality and desktop analysis of a 2003 aerial photograph was used to quantify the areal extent of specific land cover categories within the proposed Lake Ralph Hall project area. The following table (Table 1) details the data presented in the draft mitigation plan dated October 26, 2006. As of the time of the mitigation submittal, the project area, excluding aquatic resources, consisted of 22 percent cropland, 19 percent grasses, 28 percent pasture, 7 percent partially wooded grassland (parklike), 8 percent forest, and 16 percent young forest. The two forested communities displayed the highest habitat quality scores.

Table 1: Wildlife Habitat Appraisal Procedure Data As Presented in the Draft Mitigation Plan

Cover-type Category	Average Habitat Quality Score (HQ)	Total Area (Acres)	Habitat Units (HQxArea)			
Cropland	0.09	1,720	154.8			
Grasses	0.25	1,435	358.75			
Pasture	0.2	2,192	438.4			
Partially Wooded Grassland	0.41	516	211.56			
Forest	0.59	602	355.18			
Young Forest	0.44	1,299	571.56			
T	otal	7,764	2,090.25			

During the September 16, 2009 agency review, not all habitat cover-types were included in the assessment of additional sampling points. Only cropland, pasture, forest, and young forest cover types were reassessed during the September 2009 interagency site field review. Of the habitat cover types that were assessed in 2009, habitat quality scores were adjusted both upwards and downwards from the comments received. The following illustrates the habitat quality scoring for data gathered at the additional sampling points pre- and post-agency review.

Site	Pre-Agency Visit	Post-Agency Visit
Cropland	0.15	0.20
Pasture	0.18	0.17
Forest	0.44	0.44
Young Forest	0.53	0.48

Scores for cropland improved, forest remained unchanged, but both pasture and young forest were downgraded slightly. All in all, there was less than one percent change downward from the pre-agency field review to the post-agency field review when all scores were summed (1.3 pre-agency review compared to 1.29 post-agency review).

When the scores for the additional sampling points are included with the original data for habitat assessment for the entire project area, the habitat quality scores decreased slightly from the values presented in the draft mitigation plan from 2,090.25 to 2,083.81, as shown in Table 2.

Table 2: Wildlife Habitat Appraisal Procedure Following September 2009 Agency Review Incorporated into the Entire Habitat Assessment

medipolated into the Entire Habitat Hisbershient				
Cover-type Category	Average Habitat Quality Score (HQ)	Total Area (Acres)	Habitat Units (HQxArea)	
Cropland	0.12	1,720	206.4	
Grasses*	0.25	1,435	358.75	
Pasture	0.19	2,192	416.48	
Partially Wooded Grassland*	0.41	516	211.56	
Forest	0.53	602	319.06	
Young Forest	0.44	1,299	571.56	
T	otal	7,764	2,083.81	

<sup>\*</sup>Represents data used from the mitigation plan assessment

As illustrated above, the WHAP data used in the draft mitigation plan is consistent with the post-agency field review data. Figure A-1 in Attachment A illustrates the WHAP data points for all assessments. The WHAP protocol and all WHAP data sheets are included in Attachment A.

# Stream Watershed Assessment and Measu rement Protocol Interaction Model (SWAMPIM)

The primary goal of the draft mitigation plan is to provide compensation to existing aquatic resource functions and terrestrial habitats impacted by the construction of the Lake Ralph Hall project on a watershed basis rather than on an areal basis. The SWAMPIM protocol was developed to facilitate development of a functions based mitigation plan by assessing existing conditions and functions capacity and projecting future functions capacity of the project area with the proposed Lake Ralph Hall in place. The SWAMPIM protocol accounts for functions and watershed interactions of both streams and impoundments. The following table (Table 3) summarizes the results of the pre- and post-project functional capacities for streams and impoundments as outlined in the draft mitigation plan.

Table 3: Functional Capacities for Streams and Impoundments as Outlined in the Draft Mitigation Plan dated October 26, 2006

	Pre-Project		Post-F	Project	
STREAMS	Linear Feet of	Functional	Linear Feet of	Functional	
	Stream	Capacity	Stream	Capacity	
Within Conservation	589,066	532.98	74,546	361.11	
Pool	307,000	332.76	74,540	301.11	
Outside of	113,111	94.43	113,111	165.94	
Conservation Pool	113,111	74.43	113,111	105.94	
Former NSR	11,020	22.59			
Restored NSR		-	14,500	125.08	
Total	124,131	650.0	202,157	652.13	
	Pre-P	roject	Post-Project		
IMPOUNDMENTS	Area (Acres)	Resource	Area (Acres)	Resource	
	Alea (Acies)	Capacity	Alea (Acies)	Capacity	
Within Conservation	72.5	30.83	7,566	5.783.5	
Pool	12.3	30.63	7,300	3,763.3	
Outside of	40.7	16.58	40.7	16.58	
Conservation Pool	40.7	10.38	40.7	10.38	
Total	113.2	47.41	7,606.7	5,800.08	

#### Streams

The North Sulphur River and its tributaries within the proposed Lake Ralph Hall project area are characterized as intermittent (North Sulphur River) and ephemeral (tributaries) which do not retain water in perennial pools during periods of insufficient rainfall. Based on observations of this character during field work conducted in 2006 and for the additional sampling points in August 2009, the SWAMPIM scoring for some functional parameters was zero. During the interagency field review, some agency team members expressed the opinion that the scoring of zero for these parameters based on no flow observed was unduly penalizing ephemeral streams. Based on the input received during the field review, data for the additional sampling points were upgraded for the various parameters that dealt with no water in the channel. The comparison of the pre-agency to post-agency field review functional capacity scores for the additional sampling points is as follows:

Site #	Pre-Agency Visit FC	Post-Agency Visit FC
N6	11.1	12.4
N16	11.1	11.0
N21	17.7	17.0
N21-Trib 18	1.4	1.3
N27	5.7	7.3
S52	12.4	14.3
S52-Trib 6	1.0	0.75
S56	7.0	6.8
S61	6.8	9.1

The data obtained from the post-agency field review was incorporated into the overall functional capacity data outlined in the draft mitigation plan. As shown in Table 4 when incorporating the post-agency reassessment data, the pre-project functional capacity within conservation pool decreased slightly whereas the outside of conservation pool functional capacity increased slightly.

Table 4: Comparison of Functional Capacity Scores from the Mitigation Plan and the 2009
Reassessment

Pre-Project Streams	Linear Feet of Stream	Mitigation Plan Functional Capacity	2009 Reassessment Functional Capacity
Within Conservation Pool	589,066	532.98	519.30
Outside of Conservation Pool	113,111	94.43	95.69
Former NSR	11,020	22.59	22.59
Total	124,131	650.0	637.58

The summary tables for the 2006 and 2009 pre- and post-project stream functional capacity calculations are included in Attachment B. These tables provide the linear feet and functional capacity index score for the stream channel categories identified by channel widths and the

corresponding functional capacity score for each category. As presented, the functional capacity indices outlined in the draft mitigation plan provided a more conservative picture of the aquatic resource functions within the proposed Lake Ralph Hall project area.

# On-channel Impoundments

No changes were made to on-channel impoundments from what was presented in the draft mitigation plan. The interagency review team did not express any comments or concerns regarding the functional capacity scores presented for the impoundments. However, it should be noted that the pre-project resource capacity for existing impoundments scored a 47.41 whereas the post-project resource capacity with the construction of Lake Ralph Hall scored 5,800.08. Lake Ralph Hall grossly improves the post-project impoundment aquatic resource.

Figure B-1 in Attachment B illustrates the SWAMPIM data points used during the original assessments and the additional sampling points for the assessed in August 2009. The SWAMPIM protocol and all SWAMPIM data sheets are included in Attachment B.

# *Summary*

Based on the mitigation proposal, a functional capacity score of 652.21 was primarily obtained through increased habitat potential, development of perennial pools within channels upstream of the conservation pool of the reservoir, and a decrease in erosion due to the curbing of current ongoing head cutting. In keeping with the USACE's directive of mitigating this project through a functions based assessment, both the 2006 and 2009 pre-project functional capacity scores of 650.0 and 637.58 respectively are at or below the projected functional capacity improvements to the project area.

ake Ralph Hall	Appendix
F-3: Biological Assessment of the	North Sulphur River

# ATTACHMENT 5 BIOLOGICAL ASSESSMENT OF NORTH SULPHUR RIVER

PREPARED BY
ALAN PLUMMER ASSOCIATES, INC.





# MEMO

TO: Chris Loft

Texas Commission on Environmental Quality

FROM:

**Bob Brandes** 

DATE:

October 30, 2006

SUBJECT:

Biological Sampling of the North Sulphur River and Instream Flow

Requirements for Lake Ralph Hall

As we have discussed on several occasions, development of appropriate instream flow requirements for the proposed Lake Ralph Hall on the North Sulphur River is a challenge because of the unique eroded nature of the river channel, the occurrence of significant river flows in the vicinity of the dam site only immediately after substantial rainfall events, the absence of any significant habitat within the river channel to support a viable aquatic ecosystem, and the fact that biological organisms often are not found in the river at all because its channel is essentially dry. To document these conditions and obtain site-specific data in the vicinity of the proposed dam site, the Upper Trinity Regional Water District (UTRWD), the project sponsor, commissioned Alan Plummer Associates, Inc. (APAI) to undertake a biological sampling program on the river earlier this year. These sampling efforts and their results are described in two letters from APAI dated June 15, 2006 and August 28, 2006, both of which are attached hereto as Attachments A and B, respectively.

It is apparent from the results from these field studies that the biological resources of this reach of the North Sulphur River are fairly limited, even with pools of water in the river channel following a series of small rainfall events as occurred prior to and during the May 5<sup>th</sup> sampling activity<sup>1</sup>. Only of a small variety of freshwater invertebrates were collected from the pools, with no fish species observed. Again, without rainfall, the channel of the river is essentially dry. As observed during the August 24<sup>th</sup> and 25<sup>th</sup> sampling event when no rainfall had previously occurred, there was no water present in the river channel and no biological activity.

Based on the results from the sampling that has been conducted by APAI, it is apparent that there is no significant existing biological community or aquatic ecosystem within the river channel that is sustained by the ephemeral flows that periodically occur in the river. At best, as described by APAI, the organisms that do occur are "opportunists" that are temporarily sustained by the occasional pools of water that occur after rainfall events and the temporary habitat that these

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About 1.5 inches of precipitation fell in the vicinity of the proposed Lake Ralph Hall dam site during the two weeks prior to the May 5<sup>th</sup> sampling event.

Mr. Chris Loft October 30, 2006 Page 2 of 3

pools provide. For this reason, it would appear that the development of some form of instream flow regime to attempt to mimic what occurs, or doesn't occur, naturally in the river under existing conditions would be difficult at best and may not be warranted. Instead, it might be more productive from a biological standpoint to utilize a portion of the inflows to Lake Ralph Hall, or some of the stored water in Lake Ralph Hall, to support a more viable ecosystem such as that being proposed by the UTRWD for restoration along a segment of the abandoned original channel of the North Sulphur River immediately below the dam.

As you know, we originally included in our water availability and yield analysis of Lake Ralph Hall a set of monthly instream flow requirements as a placeholder pending the development of more appropriate and meaningful information. These earlier instream flow requirements were derived using the Lyons desktop method applied to historical daily flow records from the existing streamflow gage on the North Sulphur River near Cooper. These calculations are summarized in the table included herewith as Attachment C, and as shown, even these estimated instream flow needs exhibit essentially zero values for four months of the year, i.e., July through October. Based on actual observations of the river flow in the vicinity of the dam site, it is obvious that the flows in the other eight months of the year certainly are not sustained at the levels indicated in the table, but rather are also zero the vast majority of the time when it is not raining in the river's upper watershed.

There is geologic evidence that there are certain formations along the channel of the North Sulphur River downstream of the dam site and closer to the streamflow gage near Cooper that potentially support sustained spring discharges, or at least seeps, for prolonged periods following rainfall events. Particularly, the Wolfe City and Pecan Gap sands are known to be characterized by such discharges. There is the possibility that it is the discharges from these formations that account for some of the observed river flows at the streamflow gage on the North Sulphur River near Cooper during the December-through-June period that result in the corresponding higher instream flow values derived with the Lyons method. It may be that this lower reach of the river in the vicinity of the gage simply has higher base flows than the reach upstream of the proposed Lake Ralph Hall dam site, and that the use of these flows to establish instream flow requirements for Lake Ralph Hall is not appropriate.

Enclosed with this memo is a copy of a video taken from a helicopter on October 11, 2005 of the reach of the North Sulphur River from the State Highway 24 crossing about 20 miles downstream of the proposed Lake Ralph Hall dam site (where the streamflow gage near Cooper is located) upstream to State Highway 68, which is about ten miles above the proposed Lake Ralph Hall dam site. This video clearly shows essentially no water in the river for about ten miles upstream and ten miles downstream of the proposed the Lake Ralph Hall dam site, but it does indicate the presence of isolated shallow pools of water along the lower segment of the river upstream of the streamflow gage near Cooper at the State Highway 24 crossing. Rainfall records for the area indicate that about one-half inch of precipitation fell in the watershed above the dam site on September 24<sup>th</sup>, followed by a few tenths of an inch of rainfall on September 28<sup>th</sup> and traces of rainfall on several days in early October. On the watershed below the dam site, over an inch of rain fell on September 24<sup>th</sup>, with another half inch on September 28<sup>th</sup>, thus contributing to the pools of water shown in the river channel above the gage.



Mr. Chris Loft October 30, 2006 Page 3 of 3

As an alternative approach for providing for environmental flows, the UTRWD proposes to make all of the low-flow releases from Lake Ralph Hall, to the extent possible, through an outlet that contributes flows directly to the proposed restoration segment of the abandoned channel of the North Sulphur River located immediately below the dam in the south floodplain of the river. The balance of these flows not consumed within the restored segment of the abandoned river channel would be discharged back into the existing river channel through a controlled outlet structure, thus providing some sustained flow in the river for a short distance. While the design of the channel restoration project is still in progress, the low-flow releases from the reservoir to the restored channel will provide the necessary flow regime required to maintain the restored wetland area, with only part of this flow actually being consumed within the restored channel itself. Current plans for the project call for approximately 14,500 linear feet of the abandoned river channel on the south floodplain of the river to be excavated and restored, with plantings for creation and enhancement of riparian zones, wetlands, and corridors connecting to adjacent terrestrial habitat. In a river bottom area void of such conditions, this seems to be a much more appropriate and productive use of water from the river for environmental purposes than simply passing it downstream to flow through the existing barren and eroded channel of the river with no sustained habitat or biological resources.

In summary, the UTRWD is requesting that you give serious consideration to the approach described herein for providing appropriate environmental flows and for meeting the TCEQ's obligations for assuring that the proposed Lake Ralph Hall project will not adversely impact instream uses or water quality. We believe that the proposed approach will be an effective means for restoring riverine habitat in the area. As plans for the proposed river channel restoration project continue to evolve, we will keep you apprised of how the project will be configured and operated, and we would welcome any suggestions you might have for its improvement. In the meantime, if you have questions regarding what is being proposed, we will be glad to discuss them with you. Or if you want to visit the site and see firsthand the segment of the abandoned river channel that is being proposed for restoration, please let us know and we will be happy to arrange such a trip.

We appreciate your help with this effort and look forward to your comments regarding the approach being proposed by the UTRWD.



# ATTACHMENT A

Letter Dated June 15, 2006 from Alan Plummer Associates, Inc. to Edward Motley, Chiang, Patel and Yerby, Inc.





JAMES C. ALTSTAETTER, P.E.
STEPHEN J. COONAN, P.E.
PEGGY W GLASS, Ph.D.
DAVID A. GUDAL, P.E.
BETTY L. JORDAN, R.E.
ALAN H PLUMMER, JR., P.E., DEE
RICHARD H SMITH, P.E.
ALAN R.TUCKER, P.E.

346-0402

June 15, 2006

Mr. Edward Motley, P.E. Chiang, Patel, and Yerby, Inc. 1820 Regal Row, Suite 200 Dallas, Texas 75235

RE: Biological Assessment of the Aquatic Community of the North Sulphur River

Dear Mr. Motley:

Samplings for the biological assessment study were conducted on May 5 and 10, 2006 to determine the type and extent of aquatic biological resources at three sampling locations within the North Sulphur River in the vicinity of the proposed Lake Ralph Hall dam site. The sampling locations were selected based on accessibility and their relationship to the proposed dam location to provide insight as to the degree of environmental flows required to support the existing aquatic ecosystem downstream of the dam. Prior to the on-site investigation, a procedure was developed based on existing sampling protocols, specifically the United States Environmental Protection Agency's Rapid Bioassessment Protocol for Streams and Wadeable Rivers (second edition) and the Texas Commission on Environmental Quality's (TCEQ) Surface Water Quality Monitoring Program, Habitat Assessment.

The locations of the three sampling stations are shown on Figure A-1, included in Attachment A. The three sampling stations were located upstream of the State Highway (SH) 34 Bridge, downstream of the Farm to Market Road (FM) 904 Bridge, and downstream of the SH 38 Bridge. The SH 34 site is located approximately 2.5 upstream of the proposed dam, and the most downstream site at SH 38 is about 7.5 miles below the dam. The FM 904 site is only about 1.5 miles downstream of the proposed dam site. Photographs from the on-site investigations of the sampling locations are also included in Attachment A.

At each of the three sampling locations, six pools were identified in the field to collect samples using three sampling techniques for each identified pool: 1) D-frame aquatic dip net for invertebrates, fish, and amphibians; 2) the Surber Stream Sampler for benthic invertebrates; and 3) a kick net for collecting large and small organisms in open water. The Surber Sampler is primarily used in flowing streams where the substrate is stirred allowing invertebrates to dislodge and flow downstream into the sampling net. However, due to the fact that there was not flow in the North Sulphur River at the time of the on-site investigations, samples from the Surber did not fully represent the community within the selected pool. The protocol for kick net sampling consists of sampling for a pre-determined time using a hand-held

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Mr. Edward Motley, P.E. June 15, 2006 Page 2 of 4

rectangular net. The collector stirs the substrate within the pool for five minutes while an assistant holds the net downstream and collects the sample. Since there was a lack of discernable flow and due to the shallow depths of the selected pools within the North Sulphur River, a field determination was made to use the D-frame aquatic dip net in lieu of the kick net. The collector walked in a clockwise direction in front of the D-frame aquatic dip net stirring the substrate within the pool for a total five minutes. The resulting D-frame samples provided a more detailed cross-section of the representative community within the various pools. Since a greater quantity of biota was collected with the D-frame, those samples were preserved and processed in the lab whereas the Surber samples were processed in the field.

In conjunction with the biological assessment, at each sampling location, a score was generated for the North Sulphur River's Functional Condition Index. The data sheets from that assessment are included in Attachment B. Lastly, TCEQ's Surface Water Quality Monitoring Habitat Assessment was performed for each the three sampling locations. The descriptions of the physical parameters observed and the resulting scores from the habitat assessment are as follows:

## SH 34

The pools sampled averaged approximately 20 meters by 15 meters with depths ranging from five to ten centimeters. The substrate consisted of clayey shale with some gravels intermixed. The shale observed was exposed bedrock. No discernable flow was observed and the water clarity was good. No rooted vegetation was observed. However, some detritus and filamentous algae were observed. The data collected were compiled into TCEQ's habitat assessment worksheet and the sampling location scored a 6, which is a habitat quality index of limited (poor). As an independent measure of the functional value of this location, the functional condition index for this sampling location is 0.31 out of a total possible score of 3.0.

# FM 904

The pools sampled averaged approximately 15 meters by 10 meters with depths ranging from five to 22 centimeters. The substrate consisted of clayey shale with some gravels intermixed. The shale observed was exposed bedrock. No discernable flow was observed and the water clarity was good. No rooted vegetation was observed. However, some detritus and filamentous algae were observed. The data collected were compiled into TCEQ's habitat assessment worksheet and the sampling location scored a 4, which is a habitat quality index of limited (poor). As an independent measure of the functional value of this location, the functional condition index for this sampling location is 0.53 out of a total possible score of 3.0.

# SH 38

<sup>&</sup>lt;sup>1</sup> The Functional Condition Index is a score based on a proposed method for evaluating stream functions. The proposed system is based on protocols used elsewhere in the United States. The proposed functional assessment protocol has not been approved by the USACE or any other regulatory agency.

The pools sampled averaged approximately 40 meters by 25 meters with depths ranging from five to 15 centimeters. The substrate consisted of clayey shale with some gravels intermixed. The shale observed was exposed bedrock. No discernable flow was observed and the water clarity was good. No rooted vegetation was observed. However, some detritus and filamentous algae were observed. The data collected were compiled into TCEQ's habitat assessment worksheet and the sampling location scored a 7, which is a habitat quality index of limited (poor). As an independent measure of the functional value of this location, the functional condition index for this sampling location is 0.47 out of a total possible score of 3.0.

From the three sampling locations, a variety of freshwater invertebrates were collected utilizing the aforementioned sampling techniques. The following table summarizes the total number of specimens collected for each sampling technique at each location. These numbers represent the total number of species identified at each of the six pools within the three sampling locations.

		Hwy 38	8 Bridge	Hwy 9	04 Bridge	Hwy 3	4 Bridge
Family	Common Name	Surber	D-Frame Dip Net	Surber	D-Frame Dip Net	Surber	D-Frame Dip Net
Amphipoda	Scuds	0	1	2	0	0	6
Baetidae	Mayflies	0	6	0	4	1	23
Caenidae	Mayflies	38	361	155	811	41	425
Cambaridae	Crayfish	0	0	0	0	0	1
Ceratopogonidae	Flies and Midges	0	21	2	13	0	22
Chironomidae	Flies and Midges	84	591	92	288	75	934
Cladocera	Water Fleas	0	0	0	0	284	56
Cocnagrionidae	Damselflies	0	0	0	2	0	0
Collembula	Spring Tails	0	0	0	0	0	11
Copepoda	Tiny Crustaceans	0	3	0	0	0	7
Corixidae	Aquatic and Semi-Aquatic Bugs	71	136	3	3	4	53
Culicidae	Mosquitoes	2	50	17	19	1	38
Dolichopodidae	Flies and Midges	0	0	0	0	2	3
Gyrinidae	Water Beetles	0	8	0	0	2	5
Haliplidac	Water Beetles	0	0	0	0	0	4
Heptageniidae	Mayflies	0	0	1	1	0	0
Hydracarina	Water Mites	0	2	6	0	0	1
Hydrophilidae	Water Beetles	0	14	5	15	5	25
Libellulidae	Dragonflies	3	12	8	24	3	55
Ostracoda	Seed Shrimp	0	38	0	0	0	48
Planorbidae	Freshwater Snail	0	0	0	0	0	l

Descriptions of the ecology for the identified species are included in Attachment C.

### SUMMARY

The two most abundant families of invertebrates identified include Caenidae and Chironomidae at 39 and 44 percent, respectively. Both of these families are more

tolerant of degraded streams and low dissolved oxygen conditions. It should be noted that all of the aforementioned invertebrates occur in areas typically found along the North Sulphur River including ponds, stock tanks, and ephemeral tributaries. During the on-site investigation, there were areas within the sampling locations where algae were colonizing thereby providing some habitat for the aforementioned species. Furthermore, detritus, decomposing shale sediment, and rooted terrestrial vegetation (e.g., Johnsongrass and rattlebush) were observed within the channel. This accumulation of sediment and rooted vegetation is most likely a product of the recent deficit of significant rainfall events in the area due to the extended drought conditions. Observations of the river channel in 2004 during a more normal rainfall period indicated that the channel is routinely scoured by flow resulting from typical rain events. This scouring includes removal of the oxidized shale in the river bottom, precluding any vegetative growth including algae. It should also be noted that the sampling was scheduled during spring rain events to ideally provide information when hopefully there was flow in the North Sulphur River. A rainfall event did occur on the morning of May 5th. However, this rain did not produce any detectable flow in the river. The limited pools within the river channel appeared to form more from seepage from small impoundments within the watershed, which enters the river channel along the shale bedrock layer.

The invertebrates identified during the sampling studies are common and abundant throughout the area and would be expected to colonize ephemeral to intermittent pools within the North Sulphur River even in the absence of river flow. The fact that flow in the river occurs only in response to rain events, leaving the bed of the river essentially dry the vast majority of the time would strongly suggest that a sustainable community of aquatic organisms (including invertebrates) cannot and does not exist within the river channel. The organisms observed are opportunists, temporarily sustained by the ephemeral pools and the limited temporal habitat these pools provide.

Should you have comments or questions, please feel free to phone either Loretta Mokry or myself at (817) 806-1700.

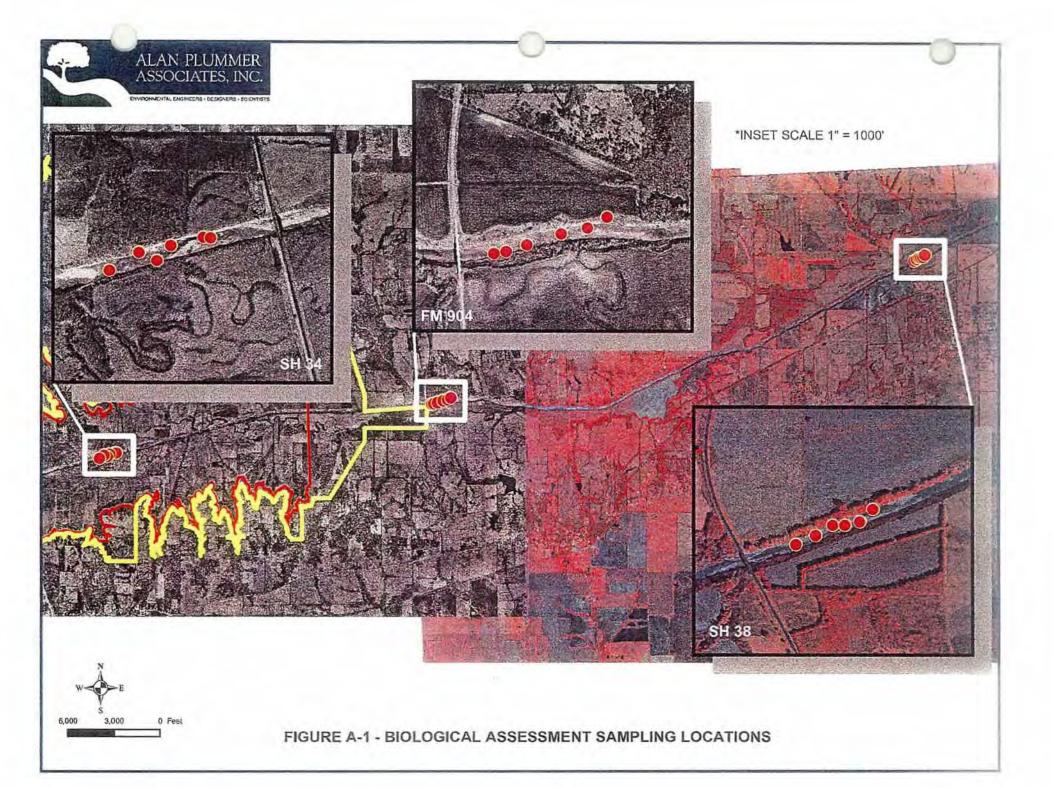
Sincerely,

ALAN PLUMMER ASSOCIATES, INC.

Jason Voigh

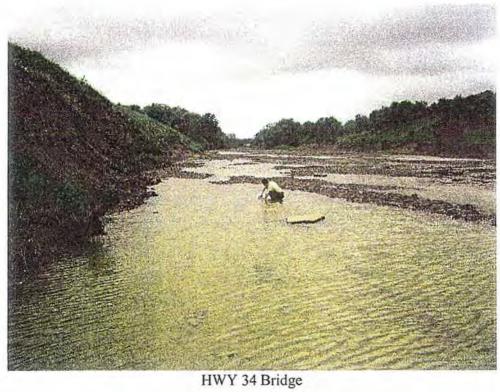
Attachments

ATTACHMENT A



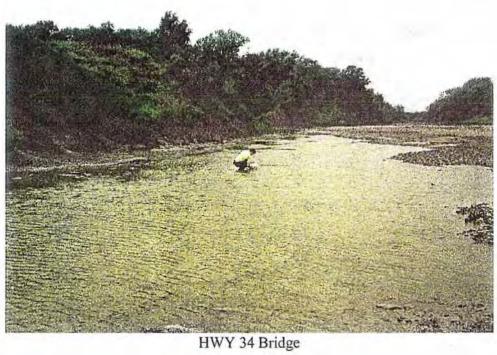


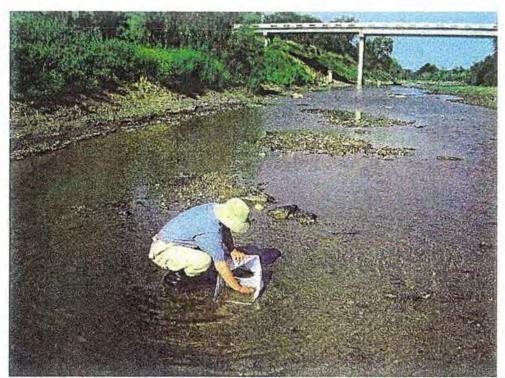
HWY 34 Bridge



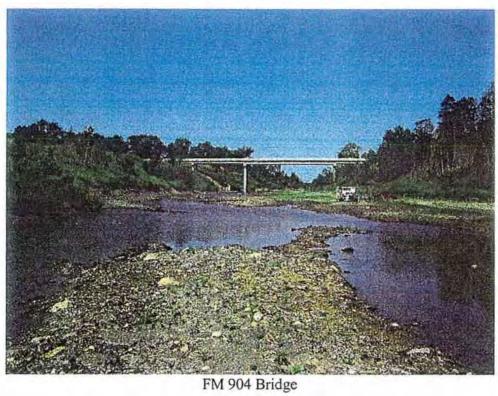


HWY 34 Bridge



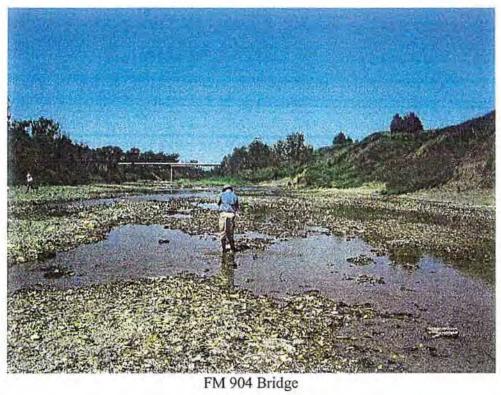


FM 904 Bridge



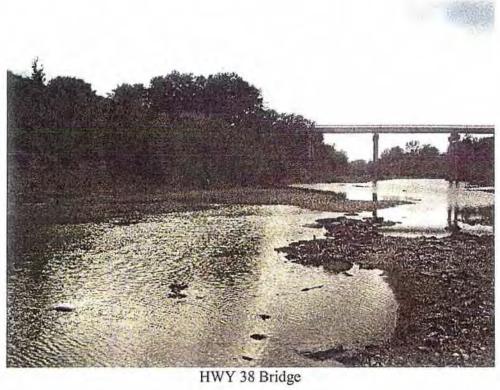


FM 904 Bridge



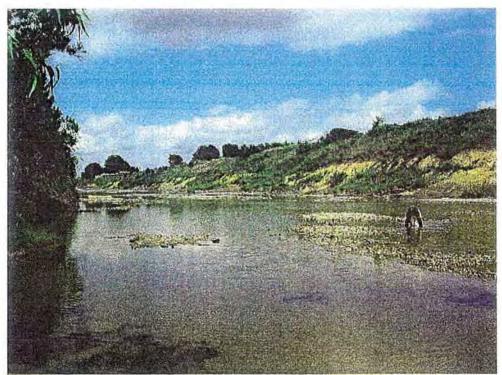


HWY 38 Bridge





HWY 38 Bridge



HWY 38 Bridge

ATTACHMENT B

	:			05\05\200	6	Highway 3	4 Bridge						SCORE	Source KDWP 2
TYPE		Perennial		Intermitte	ent w/ Pere	nnial Pools	Inter	mittent			meral			Kansas
Grade	10	9	8	7	6	5	4	3	2	<u></u>	1	0	4	Subjectiv
CHANNEL CON	ADITION: I	neasureme	ent or Obser	vation of St	ream Chani	nei Condition	18							
ľ				CON	IDITION C	ATEGORY (	GRADE or	SCORE	<del>.</del>					Barbour,
Ī		Optimal			Suboptima			rginal			or			EPA RBA
			structures or No evidence		hannelizatior areas) or pa	n (usually in		nnel; 40-80% n channelized				rncutting or ach riprap of		5-21; No
2a,Channel			essive lateral		on, but with			ted. Excess	channne	lized. D	egrada	lion dikes or		NRCS S
Condition/Alter		Normal fre				ed and banks of overbank		ion; braided ith excessive			it acces iplain.	ss to the		page 7
ation (natural,		nel and floc	ion between odplain.		vs onto flood			of overbank		HOOL	ipiani.			
altered, or			•			•	flows onto	he floodplain,						
downcutting)								incision,dikes es restrict						
	İ							dplain.						
														-
Grade	10	9	8	7	6	5	4	3	2		1	0	C	4
}		***************************************		CON	ADITION CA	ATEGORY O	SRADE or S	CORE						w/ assist
2b,Channel		Optimal			Suboptima	al	Ma	rginal			oor		4	and input
Capacity to			ow Frequency overflow from			ow Frequency overflow from		Capacity to lency Ratio is				w Frequency verflow from		Dr. Mike
Flow			a 1.25 to 2.5			frequent that		iency katio is bank overflov				equent than		Harvey a
Frequency Ratio (for 2-		ear frequen	icy.	every 1,2	25 years or le	ess frequent	from store	n events are				equent than		
year peak		0.75-1.25	*	tha	n every 2,5 y <0,75 or >1.			equent than ear or less	]	every 1	0 years 4 or >2	<b>&gt;</b> .		
flow)	ĺ						frequent	lhan every 5						
								ears. or >1.5						
Grade	10	9	8	7	6	5	4	3	2	T	1	0	(	5
				COI	VDITION C.	ATEGORY (	GRADE or	SCORE						Newton,
;		Optimal			Suboptima			rginal			oor			USDA/ N
			e of erosion o minimal; (<6%			requent, smal / healed over,		ely unstable; vegetation to				regetation at ion of both		SVAP p 10; Barb
2c.Channel	of ban	k affected),	perennial	5-30% of 1	oank in read	h has areas c	waterline s	parse (mainly	banks;	ecently	ехроѕе	d tree roots	ł	al., 1999
Bank Stability			ne; no raw or ne erosion on		r erosion and	d/or bank il vegetation t		or stripped by osion), bank				lor severely many eroded		RBA pag
(score each bank, left or			ends O.K.); no			ii vegelalion ( ices; recently		hard points				uent along	İ	26; USA
right facing	recently a		is; no recent	exposed t	ree roots ran	e but present		ck outcrops)				nds; obvious		Norfolk District,
downstream)		tree falls;	1					oded back e; 30-60% of		igning; 6 erosior		6 of bank has s.		Diomot, .
1				1			bank in rea	ch has areas						
								on and bank						
,								ling; recently ree roots and	ı					
C1- (1-6)	10	T	<del></del>	<del> </del>	1 6	<del></del>		aica common	2			0		
	10	9 9	8 8	7 7	6	5 5	4	3 3	2		<u>1</u> 1	0	4	ól
Grade (Left) Grade (Right)				-L								Avg.Score		<u> </u>
Grade (Right)					·····									
Grade (Right)	1 11 4 14 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	FACTORS	3										1	
	1												1	Barbour,
Grade (Right)				COI	NDITION C	ATEGORY	GRADE or	SCORE						EPA RB
Grade (Right) CHANNEL RO		Optimal			Suboptim	al	Ma	rginal			oor			
Grade (Right)	The bends	in the stream	m increase the	e The bends	Suboptime in the stream	al m increase the	Ma The bends	rginal in the stream		straight;	water	vay has been	Ĭ	Chapter
Grade (Righl)  CHANNEL ROI  3a.Channel Sinuosity (bends in low	The bends stream les	in the stream	m increase the 1 times longer	The bends	Suboptimi in the strear igth 1.5 to 2.	al n increase the .5 times longe	Ma The bends increase	rginal in the stream the stream	chann	straight; elized fo	water	g distance.		Chapter 5-25; KD
Grade (Righl)  CHANNEL ROI  3a.Channel Sinuosity (bends in low gradient	The bends stream lea	in the stream ngth 2.5 to 4 was straigh	m increase the	The bends stream fer than if it w	Suboptimi in the strear igth 1.5 to 2.	al m increase the .5 times longe t line. Chann	The bends increase length 1 longer th	rginal in the stream the stream to 1.5 times an if it was a	chann Channe	straight; elized fo	water		<b>X</b>	Chapter
Grade (Righl)  CHANNEL ROI  3a.Channel Sinuosity (bends in low	The bends stream lea	in the stream ngth 2.5 to 4 was straigh	m increase the 4 times longer nt. Channel	The bends stream fer than if it w	Suboptime in the stream ingth 1.5 to 2. as a straight	al m increase the .5 times longe t line. Chann	The bends The bends Increase I length 1 longer th straight li	rginal in the stream the stream to 1.5 times an if it was a ne. Channel	chann Chann	straight; elized fo	water	g distance.	<b>Management</b>	Chapter 5-25; KL
Grade (Righl)  CHANNEL ROI  3a.Channel Sinuosity (bends in low gradient	The bends stream lea	in the stream ngth 2.5 to 4 was straigh	m increase the 4 times longer nt. Channel	The bends stream fer than if it w	Suboptime in the stream ingth 1.5 to 2. as a straight	al m increase the .5 times longe t line. Chann	Ma The bends Increase Iength 1 Ionger th straight li Iength/val	rginal in the stream the stream to 1.5 times an if it was a	chann Channe	straight; elized fo	water	g distance. length_⊴.0	- The state of the	Chapter 5-25; KD 1996
Grade (Righl)  CHANNEL ROI  3a.Channel Sinuosity (bends in low gradient	The bends stream lea	in the stream ngth 2.5 to 4 was straigh	m increase the 4 times longer nt. Channel	The bends f stream fer than if it w length	Suboptim in the strear ngth 1.5 to 2. as a streight (valley length	at nicrease the 5 times longer time. Channin 1,2 to 1,5	The bends The bends Increase I length 1 Ionger th straight i Iength/val	rginal in the stream the stream to 1,5 times an if it was a ne. Channel ley length 1.6 0 1.2.	chann Chann	straight; elized fo	water	g distance.	- The state of the	Chapter 5-25; K£ 1996
Grade (Righl)  CHANNEL RO  3a.Channel Sinuosity (bends in low gradient stream)	The bends stream ler than if it length/va	in the strear ngth 2.5 to 4 was straigh alley length a	m increase the filmes longer tr. Channel at least >1,5.	The bends f stream fer than if it w length	Suboptimin the streamingth 1.5 to 2. as a straight fivalley length	at mincrease the 5 times longe times channed the Channed the 1.2 to 1.5	The bends The bends Increase I length 1 Ionger th straight Ii Iength/val to 4  GRADE or	rginal in the stream the stream to 1,5 times an if it was a ne. Channel ley length 1.6 1.2. 3 SCORE	chann Channe	straight; elized fo el length.	waterv r a long ivalley	g distance. length_⊴.0	- The state of the	Chapter 5-25; KC 1996
Grade (Righl)  CHANNEL RO  3a.Channel Sinuosity (bends in low gradient stream)	The bends stream lei than if it length/va	in the streamingth 2.5 to 4 to 4 to 4 to 4 to 4 to 4 to 4 to	m increase the 4 times longer t. Channel at least >1,5.	The bends stream fer than if it w length	Suboptim- in the stream of the	at mincrease the 5 times longe time. Channi h 1.2 to 1.5	The bends The bends Increase I	rginal in the stream the stream to 1.5 times an if it was a ne. Channel ley length 1.6 1.2. 3 SCORE	channe Channe ) 2	straight; elized fo el length	waterv r a long /valley	g distance. length_⊲ .0		Chapter 5-25; KL 1996 KDWP, Kansas
Grade (Righl)  CHANNEL ROI  3a,Channel Sinuosity (bends in low gradient stream)  Grade	The bends stream let than if it length/ve	in the streamingth 2.5 to 4 twas straigh alley length a grant of the straight and the strai	m increase the 4 times longer int. Channel at least >1.5.	The bends stream fer than if it we length:	Suboptim: in the stream of the	al mincrease the mincrease the mincrease the sound of the common of the	The bends in crease in crease in longer the straight it length/val to 4  GRADE or Mass Sediment sands, and	rginal in the stream to 1.5 times an if it was a ne. Channel ley length 1.0 1.2. 3 SCORE rginal bars of rocks d silt common	Channel	straight; elized fo el length. P divided nelized;	waterver a long fivalley 1  1  oor into brasubstra	g distance. length_d.0  0  uids or stream te is uniform		Chapter 5-25; KL 1996 KDWP, Kansas Subjecti
Grade (Righl)  CHANNEL ROI  3a.Channel Sinuosity (bends in low gradient stream)  Grade  3b. Boltom Substrate	The bends stream let than if it length/ve	in the streamingth 2.5 to 4 twas straigh alley length a grant of the straight and the strai	m increase the 4 times longer ont. Channel at least >1.5.	The bends stream fer than if it we length:	Suboptim: in the streamight 1.5 to 2. as a straight fivalley length  6  NDITION C Suboptimes are bors of c	al mincrease the mincrease the mincrease the sound of the common of the	The bends in crease in crease in longer the straight it length/val to 4  GRADE or Mass Sediment sands, and	rginal in the stream the stream to 1.5 times an if it was a ne. Channel ley length 1.0 1.2. 3 SCORE orginal bars of rocks	Channel	straight; elized fo el length. P divided nelized;	waterver a long fivalley 1  1  oor into brasubstra	g distance. length_<.0		Chapler 5-25; KL 1996 KDWP, Kansas Subjecti Evaluati Aquatic
Grade (Righl)  CHANNEL ROI  3a,Channel Sinuosity (bends in low gradient stream)  Grade	The bends stream let than if it length/ve	in the streamingth 2.5 to 4 twas straigh alley length a grant of the straight and the strai	m increase the 4 times longer int. Channel at least >1.5.	The bends stream fer than if it we length:	Suboptim: in the stream of the	al mincrease the mincrease the mincrease the sound of the common of the	The bends in crease in crease in longer the straight it length/val to 4  GRADE or Mass Sediment sands, and	rginal in the stream to 1.5 times an if it was a ne. Channel ley length 1.0 1.2. 3 SCORE rginal bars of rocks d silt common	Channel	straight; elized fo el length. P divided nelized;	waterver a long fivalley 1  1  oor into brasubstra	g distance. length_d.0  0  uids or stream te is uniform		Chapler 5-25; KL 1996 KDWP, Kansas Subjecti Evaluati Aquatic
Grade (Righl)  CHANNEL ROI  3a.Channel Sinuosity (bends in low gradient stream)  Grade  3b. Boltom Substrate	The bends stream let than if it length/ve	in the streamingth 2.5 to 4 twas straigh alley length a grant of the straight and the strai	m increase the 4 times longer int. Channel at least >1.5.	The bends stream fer than if it we length:	Suboptim: in the stream of the	al mincrease the mincrease the mincrease the sound of the common of the	The bends in crease in crease in longer the straight it length/val to 4  GRADE or Mass Sediment sands, and	rginal in the stream to 1.5 times an if it was a ne. Channel ley length 1.0 1.2. 3 SCORE rginal bars of rocks d silt common	Channel	straight; elized fo el length. P divided nelized;	waterver a long fivalley 1  1  oor into brasubstra	g distance. length_d.0  0  uids or stream te is uniform		Chapter 5-25; KC 1996 KDWP, Kansas Subjectiv Evaluation

Ĭ	CONDITION CATEGORY GRADE or SCORE		KI	DWP, 1996,
1	Optimal Suboptimal Marginal Poor		N	ewton et al.
3c. Instream Bottom Topography	bottom topography including the following: deep pools, items listed in Optimal Category ris, backwaters/oxbows, anging vegetation, riffles, tated shallows, rookwads, cut banks, or side channel		19 U	998 SDA/NRCS VAP page
	pools	<del></del>		
Or Or 3c. Manning's	CONDITION CATEGORY GRADE or SCORE			
or	Optimal Suboptimal Marginal Poor			
3c. Manning's	0.05 to 0.099 0.035 to 0.05 0.021 to 0.03 or >0.10 to obstruction to flow or 0.1 to channelization and channel	01 to 0.02 dud		
Grade	9 8 7 6 5 4 3 2 1	0		
	CONDITION CATEGORY GRADE or SCORE		U	ISACE,
3d. Channel	Oplimal Suboptimal Marginal Poor		1	lorfolk
Incision (TLB/BFD=BH R; 1/BHR*Adj Factor =CI)	In ratio ≥1.0 <1.2 and Where el slope >2%, Entrenchment ratio ≥2.0 and Where channel slope >2%, Entrenchment ratio >2.0 and Where channel slope ≤2%, Entrenchment ratio >2.0 Entrenchment ratio >2.0 Entrenchment ratio >2.0 Entrenchment ratio >2.0 Entrenchment ratio >2.0 Entrenchment ratio >2.0 Entrenchment ratio >2.0	ent ratio_4.4; ppe_2%,	Si Si G A:	District, 200 AAM Form 1 and VT Tream Geomorphic Seessment
TLB =	10 BHR = 1			
BFD =	10 9 8 7 6 5 4 3 2 1	1 0	О	
A DYNAMIC SU	VATER STORAGE			
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				
	CONDITION CATEGORY GRADE or SCORE		1	lewlon, et a
4a.Pools (abundant, present or absent)	Optimal Suboptimal Poor and shallow pools abundant; than 30% of the pool bottom is red due to depth, or pools are at least 3 feet deep.  Suboptimal Marginal Poor Hoods present, but not abundant, from 10-30% of the pool bottom is shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.		N p: B	998 USDA IRCS SVA age 14; Barbour, et 1999
	feet deep.			
Grade	9 8 7 6 5 4 3 2 1	To	1	
1	CONDITION CATEGORY GRADE or SCORE			
4b, Channel	Optimal Suboptimal Marginal Poor			Barbour, et
Flow Status	reaches base of both lower Water fills >75% of the available Water fills 25-75% of the Very little water in chan	nel and mostly		999 EPA I
	ss and minimal amount of channel; or <25% of channel available channel, and present as standing pool for infle substrate is exposed.  substrate is exposed.  substrate is exposed.  available channel, and present as standing pool for infle substrates are mostly exposed.	ls. No water =	9;	#5; TCEQ
Flow Status (degree to which channel	ss and minimal amount of channel; or <25% of channel available channel, and present as standing pool inel substrate is exposed. I/or riffle substrates are zero.	s. No water =	9:	
Flow Status (degree to which channel is filled)	ss and minimal amount of channel; or <25% of channel available channel, and present as standing pool for infle substrate is exposed.  substrate is exposed.  substrate is exposed.  available channel, and present as standing pool for infle substrates are mostly exposed.	0	9:	#5; TCEQ 999; VANE

ĺ	VARIABLES TYPE				SCORE
	NOTES				.} ~
1.	SEDIMENT TR	ANSPORT/DEPOSITION			-
			CONDITION CATEGORY	GRADE or SCORE	
l	1a, Bank	Optimal	Suboptimal	Marginal Poor	]
	Stability (score	Banks stable; evidence of erosion bank failure absent or minimal; lit			1
	each bank, left or right facing downstream)		6 of 5-30% of bank in reach has areas of erosion.		
	Grade (Left)	10 9 8	7 6 5	4 3 2 1 1 0	<del> </del>
	Grade (Right)	10 9 8	7 6 5	4 3 2 1 0	
				Avg.Score	
			CONDITION CATEGORY	GRADE or SCORE	-
	1b. Channel	Optimal	Suboptimal	Marginal Poor	1
One Variable	Bottom Bank Stability	Bottom 1/3 of bank is generally high resistant plant/soil matrix or mater	hly Bottom 1/3 of bank is generally rial resistant plant/soil matrix or materia	Bottom 1/3 of bank is generally highly erodible raterial; plant/soil matrix compromised.  Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.	
		10 9 8	7 6 5	4 3 2 1 0	
- Only		10 9 8	7 6 5	4 3 2 1 0	
ģ				Avg.Score	
Score	or		CONDITION CATEGORY	SRADE or SCORE	]
Ñ	1c. Channel	Optimal	Suboptimal	Marginal Poor	]
Enter	Sediments or Substrate Composition	>50% gravel or larger substrate gravel, cobble boulders; dominal substrate type is gravel or larger stable	ant dominant substrate type is mix of	substrate; dominant or bedrock; unstable	, <u> </u>
	Grade	10 9 8	7 6 5	4 3 2 1 0	
2	WATER APPE	ARANCE: Clarity or Visibility	CONDITION CATEGORY	CDADE or SCODE	1
		Optimal	Suboptimal	Marginal Poor	1
	Water Clarity	Very clear, or clear but tea-colore objects visible at depth 3-6 feet (lei if slightly colored); no oil sheen of surface; no noticeable film on submerged objects or rocks.	ed: Occasionally cloudy, especially after ess storm event, but clears rapidly; on objects visible at depth 1.5-3 ft; ma	Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pear-green; bottom rocks or sumerged objected	y
	Grade	10 9 8	7   6   5	covered with film.	
		<u> </u>			
		F AQUATIC VEGETATION: Pre	esence and Percent Coverage		i
<u>`</u>	PRESENCE O				1
<u>`</u>	PRESENCE O		CONDITION CATEGORY	GRADE or SCORE	1
, <u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>	PRESENCE O	Optimal	Suboptimal	Marginal Poor	
<u>o</u>	3 PRESENCE O  3a. Nutrient Enrichment		Suboptimal  i; Fairly clear or slightly greenish water  ly along entire reach; moderate alga  growth on stream substrates.	Marginal Poor Greenish water along entire Pea green, gray, or brown water along	
ಲ	3a. Nutrient	Optimal  Clear water along entire reach; diverse aquatic plant communit includes low quantaties of man; species of macrophytes; little alg	Suboptimal  i; Fairly clear or slightly greenish water  ly along entire reach; moderate alga  growth on stream substrates.	Marginal Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.  Marginal Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mals in stream or NO algae present due to unstable	
<u> </u>	3a. Nutrient Enrichment	Optimal  Clear water along entire reach; diverse aquatic plant communit includes low quantaties of man; species of macrophytes; little alg growth present.	Suboptimal  ; Fairly clear or slightly greenish wate along entire reach; moderate alga you growth on stream substrates.  7 6 5	Marginal  Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.  Mea green, gray, or brown water along entire reach; dense stands of macrophytes dog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.	
<u>e</u>	3a. Nutrient Enrichment Grade	Optimal  Clear water along entire reach; diverse aquatic plant communit includes low quantaties of man; species of macrophytes; little alg growth present.	Suboptimal    Fairly clear or slightly greenish wately along entire reach; moderate alga growth on stream substrates.    7   6   5	Marginal Greenish water along entire reach; overabundance of lush green macrophytes: abundant algal growth, especially during warmer months.  Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mals in stream or NO algae present due to unstable substrate. No water = zero.  4 3 2 1 0  GRADE or SCORE	
<del>14401111</del>	3a. Nutrient Enrichment	Optimal  Clear water along entire reach; diverse aquatic plant communit includes low quantaties of man; species of macrophytes; little alg growth present.	Suboptimal  Suboptimal  Suboptimal  Fairly clear or slightly greenish wate along entire reach; moderate alga growth on stream substrates.  7 6 5  CONDITION CATEGORY  Suboptimal  Algae dominant in pools, larger	Marginal  Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.  Mea green, gray, or brown water along entire reach; dense stands of macrophytes dog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.	

CONDITION CATEGORY GRADE or SCORE   Proportion   Mainty consisting of leaves and wood   Leaves and wood   Scarce, fine   without sediment.   Suboptimal   Marginal   No leaves or woody   Fine organic sediment   Sediment	Optimal   Suboptimal   No leaves or woody debris: coarse and fine organic debris willhout sediment.   No leaves or woody debris: coarse and fine organic debris: willhout sediment.   Optimal sediment.   Optimal sediment.   Optimal Suboptimal   Optimal Suboptimal	GANIC MATTER: Detritus.			
Mainly consisting of leaves and wood   Leaves and wood scarce; fire   organic debris wilhout sediment.   Wilhout sediment.   organic debris wilhout sediment.   Sediment.	Mainly consisting of leaves and wood without sediment.    Carade				
Without sediment.   Organic debris without sediment.   debris, coarse and fine organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   organic matter with sediment.   Optimal	Grade 10 9 8 7 6 5 4 3 2 1 0  LAND USE PATTERN: Beyond Immediate Riparian Zone  CONDITION CATEGORY GRADE or SCORE  Undisturbed, consisting of forest, pristine native priarie, and/or natural wellands.  Permanent pasture mixed with woodlots and swamps, few row as isolated patches.  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Grade (Right) 4 No Continuory:  CONDITION CATEGORY GRADE or SCORE  Permanent pasture mixed with woodlots and swamps, few row as isolated patches.  Grade (Left) 4 9 8 7 6 5 4 3 2 1 1 0  Grade (Right) 6 9 8 7 6 5 4 3 2 1 1 0  Grade (Right) 7 6 5 4 3 2 1 1 0  Grade (Right) 8 7 6 5 4 3 2 1 1 0  Grade (Right) 9 8 7 6 5 4 3 2 1 1 0  Grade (Right) 6 of parisin zone x 18 metrs; (1-2 daive channes with weres, shrubs, or impacted zone.  Width of riparian zone but in pacted zone.  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 1 0  Grade (Right) 10 9 8 7 6 5 4 3 2 2 1 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 2 1 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 2 1 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 2 1 0  Grade (Right) 10 9 8				li in salar
CONDITION CATEGORY GRADE or SCORE   Diministry of consisting of forest, pristine native prairie, and/or natural woodlots and swamps, serv row wolders and swamps, serv row wolds are as may be present but as isolated patches	Second   10   9   8   7   6   5   4   3   2   1   0	without sediment. organic debris without sediment. debris; coarse and fine and foul organic matter with sediment	l odor (ana present du	aerobic lue to e	c) or no
CONDITION CATEGORY GRADE or SCORE   Dudisturbed, consisting of forest, pristine native prairie, and/or nature) wellands.   Permanent pasture mixed with woodlots and swamps, few row wellands.   Permanent pasture mixed with woodlots and swamps, few row crops   Description of the pristine native prairie, and/or nature) woodlots and swamps, few row wellands.   Permanent pasture mixed with woodlots and swamps, few row crops   Description of the pristine native prairie, and/or nature)   Permanent pasture mixed with woodlots and swamps, few row well and the pristine native prairie, and/or nature)   Permanent pasture mixed with woodlots and swamps, few row well and the pristine native prairie, and/or nature)   Permanent pasture mixed with woodlots and swamps, few row well and sincled patches   Poor   P	Optimal Suboptimal Marginal Poor Mainly row crops and Mainly row crops and Weltands.  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Avy.Score  RIPARIAN ZONE WIDTH AND CONTINUITY:  CONDITION CATEGORY GRADE or SCORE  Width of riparian zone >16 meters (1-2 dance) human activities have not impacted zone.  Grade (left) 10 9 8 7 6 5 4 3 2 1 0 0  Avy.Score  CONDITION CATEGORY GRADE or SCORE  Width of riparian zone >10 meters (1-2 dance) human activities have not impacted zone.  Grade (left) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 2 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 3 2 1 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 0 0  Grade (Right) 10 9 8 7 6 5 5 4 3 0 0  Grade (Right) 10 9 8		1 1	Ĭ	0
Optimal	Optimal Undisturbed, consisting of forest, pristine native prairie, and/or natura wetlands.  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score Final Poor High Poor	Beyond Immediate Riparian Zone			
Optimal	Optimal Undisturbed, consisting of forest, pristine native prairie, and/or natura wetlands.  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  RIPARIAN ZONE WIDTH AND CONTINUITY:  CONDITION CATEGORY GRADE or SCORE  Optimal Width of riparian zone >18 meters (1:2 channel widths with vees, shrubs, or larger grasses), human activities have not impacted zone.  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  CONDITION CATEGORY GRADE or SCORE  Width of riparian zone 6-12 meters (1:2 channel width with vees, shrubs, or larger grasses), human activities have not impacted zone.  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  CONDITION CATEGORY GRADE or SCORE meters (1:2 channel width with vees, shrubs, or larger grasses), human activities have not impacted zone.  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  CONDITION CATEGORY GRADE or SCORE meters (1:2 thannel width with vees, shrubs, or larger special prises), human activities have not impacted zone.  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  CONDITION CATEGORY GRADE or SCORE  Optimal Suboptimal Marginal  Optimal Suboptimal Marginal Poor  CONDITION CATEGORY GRADE or SCORE  Optimal Suboptimal Marginal Poor width, little riparian vegletation due to human activities  CONDITION CATEGORY GRADE or SCORE  Optimal Suboptimal Marginal Poor Avg.Score  CONDITION CATEGORY GRADE or SCORE  Suboptimal Marginal Poor Avg.Score  CONDITION CATEGORY GRADE or SCORE  Suboptimal Marginal Poor Avg.Score  CONDITION CATEGORY GRADE or SCORE Suboptimal vegetation of mixed grasses and sparse young tree or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.  Figure and the prise of the paster of the prise of the prise of the prise of the prise of the	OCHUTION OATEOORY OPARE OCORE			
Undisturbed, consisting of forest, pristine native prairie, and/or natura wetlands.  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0	Undisturbed, consisting of forest, pristine native prairie, and/or nature wellands.  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  GRIPARIAN ZONE WIDTH AND CONTINUITY:  CONDITION CATEGORY GRADE or SCORE  Grade (left) Grade (left) Optimal  Zone Width (from stream edge to field)  Grade (left) 10 9 8 7 6 5 4 3 2 1 0 Avg.Score  CONDITION CATEGORY GRADE or SCORE  Suboptimal Suboptimal Marginal Optimal Suboptimal Marginal or fiparian zone 518 meters (1)2 Avg.Score  CONDITION CATEGORY GRADE or SCORE  Width of riparian zone 518 meters (1)2 Avg.Score or Score		Poor	r	
Condition   Care   Right   Condition   Care	Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Avg.Score    CONDITION CATEGORY GRADE or SCORE   Suboptimal   Suboptima	turbed, consisting of forest, native prairie, and/or natura woodlots and swamps, few row wetlands, crops Mixed row crops and pasture; some woodled areas may be present but			
Avg.Score	6a. Riparian Zone Width (from stream edge to field)  Grade (left)  6b. Riparian Zone  6c. Riparian Zone  6c. Riparian Zone Width of riparian zone 218 meters (1-2 channel widths with tees, shrubs, or tall grasses), human activities have not impacted zone.  6c. Riparian Zone Visit (from stream edge to field)  6c. Riparian Zone  6c. Ripa				
Ga. Riparian Zone Width (from stream edge to field)  Grade (left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Condition Category Grade of the protection/ Completeness  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right)	6a. Riparian Zone Width (from stream edge to field)  Grade (left) 10 9 8 7 6 5 4 3 2 1 0 CONDITION CATEGORY GRADE or SCORE grasses), human activities have not impacted zone.  Grade (Right) 10 9 8 7 6 5 4 3 2 1 0 CONDITION CATEGORY GRADE or SCORE with the speciation of the speciatio	9 8 7 6 5 4 3 2	<u> </u>		
CONDITION CATEGORY GRADE or SCORE   Suboptimal   Marginal   Poor   Width of riparian zone >18 meters (1-2 channel width witness, shrubs, or tall grasses), human activities have not impacted zone.   Width of riparian zone continued and con	CONDITION CATEGORY GRADE or SCORE    Suboptimal   Suboptimal   Suboptimal   Marginal   Poor	ELI AND CONTINUITY		Av	vg.Score
Suboptimal   Suboptimal   Suboptimal   Marginal   Poor	Suboptimal   Sub				
(from stream edge to field)  channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.  Grade (left)  Grade (Right)  6b. Riparian Zone  Vegetation Protection/ Completeness  Channel width with rees, shrubs, or tall grasses), human activities have minimally impacted zone.  1 active channel width wegetated), impacted zone.  1 active channel width vegetated), impacted zone.  1 active channel width vegetated), impacted zone.  1 active channel width vegetated), impacted zone.  2 1 0 0  Avg. Score  CONDITION CATEGORY GRADE or SCORE  Suboptimal  2 0 1 0  Avg. Score  CONDITION CATEGORY GRADE or SCORE  Suboptimal  2 0 1 0  Avg. Score  CONDITION CATEGORY GRADE or SCORE  Suboptimal  2 0 1 0  Suboptimal  50-75% streambank vegetation, mixed shouse, praine grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.  Torne vegetation Protection/ Completeness  Crade (Left)  10 9 8 7 6 5 4 3 2 1 0  Grade (Left)  10 9 8 7 6 5 4 3 2 1 0  Grade (Right)  Grade (Right)  10 9 8 7 6 5 4 3 2 1 0  Grade (Right)  10 9 8 7 6 5 4 3 2 1 0  Grade (Right)  10 9 8 7 6 5 4 3 2 1 0	channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.    Channel width with trees, shrubs, or tall grasses), human activities have not impacted zone.    Channel width wegetated), impacted zone.   The properties of the proper		Poor	r	
Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Avg.Score  CONDITION CATEGORY GRADE or SCORE  Optimal Suboptimal Marginal Poor  Suboptimal Suboptimal Suboptimal Marginal Poor  Protection/ Completeness Protection/ Completeness Protection (Completeness Protection) Completeness Protection (Completeness Protection) (	Grade (Right) 10 9 8 7 6 5 4 3 2 1 0  Avg.Score  CONDITION CATEGORY GRADE or SCORE  Optimal Suboptimal Marginal Suboptimal Marginal Suboptimal Suboptimal Marginal Suboptimal Su	widths with trees, shrubs, or tall   1 active channel width w/trees, shrubs, or meters (1/3-1/2 active vegation less), human activities have not grasses), human activities have minimally channel width vegetated), width), little	ess than 1/3 le riparian vo	3 active o	channel
CONDITION CATEGORY GRADE or SCORE  Optimal  >90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.  Completeness  CONDITION CATEGORY GRADE or SCORE  Suboptimal  Suboptim	Avg.Score  CONDITION CATEGORY GRADE or SCORE  Optimal  >90% plant density of mature trees or shrubs, praine grasses, or marsh plants, riparian zone intact or disruption Protection/ Completeness  Avg.Score  CONDITION CATEGORY GRADE or SCORE  Suboptimal  Narginal  So-75% streambank vegetation, mixed shrubs, praine grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.  Avg.Score  CONDITION CATEGORY GRADE or SCORE  Suboptimal  Marginal  So-75% streambank vegetation of mixed grasses and sparse young tree or shrub species; breaks frequent with species; breaks frequent with some guilles and scars every 50 meters.  Avg.Score	9 8 7 6 5 4 3 2	1	$\neg \tau$	0
CONDITION CATEGORY GRADE or SCORE  Suboptimal  Suboptimal  Suboptimal  Suboptimal  Suboptimal  Some  Vegetation  Protection/ Completeness  Carade (Left)  10  9  8  7  6  Condition  Conde (Right)  Conde (District of Conders)  Conders (Conders of Conders (Left) (Conders of Conders	CONDITION CATEGORY GRADE or SCORE   Suboptimal   Suboptimal   Source   So	9 8 7 6 5 4 3 2	1		
Optimal  Suboptimal  Suboptimal  Marginal  Poor  50-75% streambank  Suboptimal  Poor  Subopt	Optimal  Suboptimal  Suboptimal  Suboptimal  Suboptimal  Some  Vegetation Protection/ Completeness  Optimal  Suboptimal  Suboptimal  Suboptimal  75-90% plant density of mature trees or shrubs, praine grasses, or marsh plants, inparian zone intact or disruption from grazing/mowing minimal.  Suboptimal  Suboptimal  75-90% streambank vegetation mixed 50-75% streambank vegetation of mixed grasses, and sparse young tree or shrub species; breaks frequent with some species along channel and mature trees bethind; disruption evident with breaks occurring at intervals of >50 meters.  Suboptimal  75-90% plant density of mature trees or shrubs, praine grasses, or marsh plants, trees bethind; disruption evident with breaks occurring at intervals of >50 meters.  Suboptimal  Marginal  50-75% streambank vegetation of mixed grasses, and sparse young tree or shrub species; breaks frequent with some pullies and sarse every 50 meters.  Suboptimal  75-90% plant density of mature trees or shrubs, praine grasses, or marsh plants, praine grasses, praine grasses, praine grasses, or marsh plants, praine grasses, or marsh plants, praine grasses, pra	CONDITION CATEGORY GRADE or SCORE		Av	/g.Score
Zone Vegetation Protection/ Completeness Shrubs, prainie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.  Strate (Left) 10 9 8 7 6 5 4 3 2 1 0 Grade (Right) 10 9 8 7 6 5 4 3 2 1 0	Zone Vegetation Protection/ Completeness  shrubs, praine grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.  young species along channel and mature trees behind; disruption evident with breaks occurring at intervals of >50 meters.  young species along channel and mature and sparse young tree or shrub species; breaks frequent with some guillies and scars every 50 meters.  coverage consisting mostly of pasture grasses, few trees & shrubs; low plant density; bank deeply scarred with guillies and scars every 50 meters.	Optimal Suboptimal Marginal	Poor	r	
Grade (Right) 10 9 8 7 6 5 4 3 2 1 0	Grade (Left) 10 1 9 8 7 6 5 4 3 2 1 0	prairie grasses, or marsh plants, young species along channel and mature trees behind; disruption evident with prazing/mowing minimal. trees behind; disruption evident with breaks occurring at intervals of >50 meters. trees when the species; breaks frequent with some guillies trees when the species and sparse young tree or shrub species; breaks density; bar	consisting m ew trees & s nk deeply sc	mostly of shrubs; I scarred w	f pasture low plant
			1	T	
AVg.Score		9 8 7 6 5 4 3 2	1_1_		
	Avg.score			AV	vg.Score

ABLES					05/05/2008		Highway 3	4 Bridge					SCORE
	1 FLOW REGI		rennial		Intermitte	nt w/ Perce	nial Pools	inton	nittent	1	Epheme	ral	7
	Grade	10	9	8	7	6	5	4	3	2	1	0	4
	A = 5/5 (1/1/1/1	0.10055.75(0.11)	1 101 5 00										
	2 EPIFAUNAL	SUBSTRATE/AVAIL	otimal	VER		Suboplima		Mar	ginal	T	Poor	····	4
		Wilhin stream bed	d, greater th		Within strear	n bed, 30-50	% coverage	Within stream	bed, 10-30%		n 10% habi	ital features	1
		coverage by stab			by stable ha				stable habitat able for stream		ack of habit ite unstable	at is obvious;	
		and/or fish/amphibla	an cover. Mo	ost habitat	fishlamphibi	an cover. M	any habitat	faunal colon	zation and/or	concrete	lined chann	els. Habitat	
		features non trans include snags, subs			features not	transient, (S y for habhat			cover; habitat v be less than		id poels but el bollom m	ried or lacking	Je
		banks, roots, cobble	e, rocks, per	sistent leaf		omponents.		desirable, sul	strate may be			, 20	
		packs, pools and g habitat at a stage						frequently dis Excellent Cate	sturbed. (See gory for habitat	l l			
		3						feature co	mpanents.)				
	Grade	10	9	8	7	6	5	4	3	2	1 1	0	
	3 STREAM BO	OTTOM SUBSTRAT		bstrate Ch									
		Op Mixture of substrate	olimal maleriale v	with across		Suboptima oft sand, m		Mar All mud or clay	ginal	Ward s-	Poor	lrock; no rool	-
		and firm sand prev	valent; root r	nats and		on sand, m e dominant:		little or no	ool mat; no		submerged		
		submerged veg	getation com	mon.	mals and :	submerged v present.	egatation	submerged	vegelation.				
	1	1				ргозен.							
	Grade	10	9	8	7	6	5	4	3	2	1 1	0	
	4 POOL VARIA	ARILITY		·								······································	-
	1002 1730	Op	ptimal	*		Suboptima			giral	I	Poor		_
		Even mix of large- small-shallow, small-				pools large- few shallow.	ieep; very		is much more in deep pools	Majority	ma aloog to eds aloog	all-shallow or	1
				•				,			,		
	Grade	10	9 1	8	7	6	5	4	1 3	2	1 1	1 0	
		DEPOSITION/SCOL	URING							<u> </u>			
		<5% of channel botto	plimal Iom affected b	W SENSE OF		Suboptima ed by scour o			ginal ted by scource	More than	Poor	oltom in a stat	_
			osition,	,, 000 07	Scour at cons	trictions and Some depositi	vehre grades	deposition. Dep abstructions, o	osits and scour a onstrictions and filling of pools.	of flux or ch minima	ange neorly I or obsent d	yearlang Poo	
		1						1					
	Grade	10	9	8	7	6	5	4	3	2	1	0	<del></del>
			9 [	8	7	6	5	4	] 3	2	1 1	0	
		LOW STATUS Op	ptimal			Suboptima		Ma	ginal		Poor		
		LOW STATUS Op Water reaches the	plimal ne base of bo	oth lawer	Water fills >	Suboptima	channel; or	Ma Water filts 2	ginal 5-75% of the	Very little	Poor water in the	e channel and	
		LOW STATUS Op Water reaches the banks; <5% of c	plimal ne base of bo	oth lawer	Water fills >	Suboptima	channel; or	Ma Water fills 2 available char	ginal	Very little	Poor water in the	e channel and	
	6 CHANNEL F	COW STATUS Opt Water reaches th banks; <5% of c exp	ptimal ne base of bo channel subs	oth lawer	Water fills >	Suboptima 75% of the channel sut	channel; or	Ma Water fills 2 available char	ginal 5-75% of the net and/or rifile	Very little	Poor water in the	e channel and	
	6 CHANNEL F	Op Water reaches th banks; <5% of c exp	ptimal ne base of bo channel subs posed	oth lower strate is	Water fills > <25% of	Suboptima -75% of the channel sut exposed	channel; or strate is	Mai Water fills 2 available char substrates are	ginal 5-75% of the net and/or riffle mostly exposed	Very little	Poor water in the esent in star stream is	e channel and ading pools; o dry	
	6 CHANNEL F	Water reaches the banks; <5% of c exp	ptimal ne base of bo channel subs sposed  9	oth lower strate is	VVater filis > <25% of	Suboptima -75% of the channel sut exposed	channel; or strate is	Mai Water fills 2 available char substrates are	ginal 5-75% of the net and/or riffle mostly exposed	Very little mostly pre	Poor water in the sent in star stream is a	e channel and ading pools; o dry	or
	6 CHANNEL F	Op Water reaches th banks; <5% of c exp	ptimal ne base of be channel subs sposed  g ptimal siteration, or c al; normal an	Nh lower strate is 8	Water fills > <25% of 7	Suboptima 75% of the channel sut exposed 6 Suboptima attion or cha	ichannel; or strate is  5	Mai Water fills 2 available char substrates are  4  Ma Alteration or may be	ginal 5-75% of the nel and/or riffle mostly exposed 3 ginal channelization extensive:	Very little mostly pre	Poor water in the sent in star stream is of the stream is	e channel and ding pools; o dry  0 bion, riprap, c or riprap lined	or
	6 CHANNEL F	Water reaches th banks; <5% of c exp	ptimal ne base of bo channel subs posed  g  ptimal deration, or o al; normal al; normal pallem, Alte	oth lower strate is 8  dredging d stable ration by	Water fills > <25% of   7   Some alter present structure abutments of	Suboptima -75% of the channel sub- exposed  6 Suboptima ation or cha usually adjress, (such as or culvents):	channel; or strale is 5	Mai Water fills 2 available char substrates are 4 Mai Alteration or may be embaokments	ginal 5-75% of the nel and/or rifile mostly exposed  3 ginal channelization	Very little mostly pre	Poor water in the sent in star stream is a	e channel and ding pools; o dry  0 bion, riprap, c or riprap lined	or or
	6 CHANNEL F	Water reaches the banks; <5% of cext o	ptimal ne base of bo channel subs posed  g  ptimal deration, or o al; normal al; normal pallem, Alte	oth lower strate is 8  dredging d stable ration by	Water fils > <25% of   7   Some alter present siructur abulments opast alternas	Suboptima 75% of the channel sub- exposed  6 Suboptima ation or cha usually adjres, (such as or culverts); on, (i.e., cha	shannel; or strale is  5  Innelization accent to bridge evidence of onnelization on energy and the strategy and the strategy are strategy as the strategy are str	Mai Water fills 2 available char substrates are 4 Ma Alteration or may be embankments pites or site or seekens on bot present on bot present on bot present on bot present on bot may be present on bot present on bot may be present on bot present on bot present on bot may be made and may	ginal 5-75% of the net and/or iffle mostly exposed  3 ginal channelization extensive; (including spoil ring structures h banks; norma	Very little mostly pro	Poor water in the sent in star stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream in the stream is a stream in the stream is a stream in the stream is a stream in the stream is a stream in the stream is a stream in the stream is a stream in the stream in the stream is a stream in the stream	e channel and nding pools; o dry  0  bion, riprap, or riprap lined am habilal y stormwater 80% of the	or or
	6 CHANNEL F	Water reaches the banks; <5% of cext o	ptimal ne base of bo channel subs posed  g  ptimal deration, or o al; normal al; normal pallem, Alte	oth lower strate is 8  dredging d stable ration by	Water fils > <25% of   7   Some alter present siructur abulments opast alternas	Suboptima 75% of the channel sut exposed  6 Suboptima atten or cha usually adject, (such as or culverts): on, (i.e., chasen), but sirt.	thannel; or strale is  5  Innelization occut to bridge evidence of nnelization) ram pattern pattern pattern pattern pattern pattern.	Mai Water filts 2 available char substrates are 4 Mai Alteration or may be embankments piles) or site present on boi stable stream	ginal 5-75% of the net and/or riffle mostly exposed  3 ginal channelization extensive: (including spoil ring structures	Very little mostly pro	Poor water in the sent in star stream is a large of the sent in star stream is a large of the sent in	e channel and nding pools; o dry  0  bion, riprap, or riprap lined am habilal y stormwater 80% of the	or or
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	6 CHANNEL F	Water reaches the banks; <5% of cext o	ptimal ne base of bo channel subs posed  g  ptimal deration, or o al; normal al; normal pallem, Alte	oth lower strate is 8  dredging d stable ration by	Water file: <25% of 7  Some alter present sinceture obtunents in past oliteral may be pre and stability alteration alteration.	Suboptima -75% of the channel sut exposed  6 Suboptima attion or cha usually adjit or characteristics, such as or culverts; on, (i.e., chascent, but sirrhave recovis not prese om stormwan.	channel; or strale is  5  Innelization accent to bridge evidence of orientation ampattern ered; recent nt. Minor	Mai Water filts 2 available char substrates are 4 Alteration or may be embankments pilcs) or she present on bot stable stream has not recov from stormwat extensive. 40	ginal 5-75% of the nel and/or rifile mostly exposed  ginal channelization extensive; (including spoil fing structures h banks; norma meander patter pred. Alteration or inputs may be 80% of stream	Very little mostly pre	Poor water in the sent in star stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream is a stream in the stream is a stream in the stream is a stream in the stream is a stream in the stream is a stream in the stream is a stream in the stream is a stream in the stream in the stream is a stream in the stream	e channel and nding pools; o dry  0  bion, riprap, or riprap lined am habilal y stormwater 80% of the	or or

		braiding is considere plains and other lov	times longer than if it ne. (Note - channel ed normal in coastal w-lying areas, This asily rated in these	The bends in the stream increat stream length 2 to 3 times lon than if it was in a strought lin	ger increase the stream 1 to 2	Channel straight; waierwa channelized for a long d		Barbour, al. 1999 RBA #7b; Parsons, al., 2001 AUSRIVA
	Grade	10	9   8	7 6 5	5 4 3	2 1	Ö	0
9	9 RANK STAR	ILITY (SCORE EACH	1 BANKI					
3	BANKSTAL		imal	Suboptimal	Marginal	Poor		
	ł	Banks stable; eviden- failure absent or mir	ce of erosion or bank	Moderately stable; infrequent, a areas of erosion mostly healed		Unstable: no perennial ver waterine; severe erosion		Barbour, al. 1999
					as of (mainly scoured or stripped by	banks; recently exposed	tree roots	RBA #8;
			enks (some erosion on er bends O.K.); no	minor erosion and/or bank underculling; perennial vegetati		common; tree falls and/or undercut trees common		Parsons,
			is; no recent tree falls;	waterline in most places; rece	ntly outcrops) and eroded back	eroded areas; "raw" areas	s frequent	al., 2001 AUSRIVA
				exposed free roots rare but pre	sent. elsewhere; 30-60% of bank in reach has areas of erosion and	along straight sections as obvious bank sloughing; 6		USACE
					bank undercutting; recently	bank has erosional s		Norfolk
					exposed tree roots and fine root hairs common; high erosion			District, 2004 SAI
					potential during floods			#3; Scho
			İ					and Boot from
								Henshaw
	Grade Grade	10	9 8	7 6 5	5 4 3	2 1 1	0	9
	Grade	1 10 1	3 1 6	<u> </u>	<u> </u>	Avg.Score		히
46	401/20554470	- 000==071011/07	2005 5100 5100					
10	TOVEGETATIV	E PROTECTION (SC	imal	Suboptimal	Marginal	Poor		
			streambank surfaces	70-90% of the streambank sun	faces 50-70% of the streambank	Less than 50% of the str		Barbour,
		and immediate ripari native vegetation	an zones covered by i, including trees.	covered by native vegetation, one class of plants is not we		surfaces covered by ver disruption of streambank		al. 1999 RBA #9;
			bs, or nonwoody live disruption through	represented; disruption eviden not affecting full plant growt		is very high; vegetation I removed to 5 centimeters		Parsons,
		grazing or moving m	inimal or not evident;	potential to any great extent; r	nore one-half of the potential plant	average stubble he		al., 2001 AUSRIVA
		almost all plants allow	wed to grow naturally,	than one-half of the potential p stubbte height remaining.	plant stubble height remaining.		)	KOWP
	J			2				2000;
	Condo	10	9 8	7 6	5 4 3	2 1 1	0	Petersen
	Grade Grade	10	9 8		5 4 3	2 1	ō	0
						Avg.Score		0
11	11 RIPARIAN Z	ONE (SCORE EACH	( BANK)					
			timal	Suboptimal	Marginal	Poor Width of riparian zone <		0-4
		activities (I.e., parking	y lols, roadbeds, clear-	Width of riparian zone 12-18 m human activities have impacted	zone meters; human activities have	little or no riparian vegeta	tion due to	Barbour, al., 1999
			s) have not impacted :	only minimaliy).	impacted zone a great deal.	human activities	5.	RBA #10
							44	Parsons, al., 2001
					· ·			AUSRIV
	Grade Grade	10	9 8		5 4 3 5 4 3	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	0	2 2
	Glade	1 10 1		1		Avg.Score		2
10	42 DIDADIANI	IABITAT CONDITION	J.CODE EACH D	ANI/1	***************************************			Norfolk
12	IZIKIFAKIANI		timal	Suboptimal	Marginal	Poor		SAAM
		Up:						
		Tree stratum (dbh>3		Tree stratum (dbh>3 inches) pr		Tree stratum absent; in		Form 1
		Tree stratum (dbh>3 >60% tree canopy co layers may include	ver. (Additional forest de: sapling, shrub,	with 30% to 60% tree canopy of (See Excellent Category for	cover. present, with <30% tree canop or cover. (See Excellent Category	Tree stratum absent; in surfaces, croplands, my lands, culverted streams.	nine spoil mowed and	Form 1 Field
		Tree stratum (dbh>3 >60% tree canopy co layers may includ herbaceous, and	ver. (Additional forest de: sapling, Shrub, leaf litter including	with 30% to 60% free canopy of (See Excellent Category for examples of additional forest to	cover. present, with <30% tree canopy or cover. (See Excellent Category dyers.) for examples of additional	Tree stratum absent; in y surfaces, croplands, m y lands, culverted streams, maintained herbaceou	nine spoil mowed and is areas.	
		Tree stratum (dbh>3 >60% tree canopy co layers may include herbaccous, and mosses/lichens and w the high end of Ex	over. (Additional forest de: sapling, shrub, leaf litter including woody debris.) Score at excellent range if \( \)2	with 30% to 60% free canopy of (See Excellent Category for examples of additional forest its Score at the high end of Good if ≥2 additional forest layers	present, with <30% tree canopy cover. (See Excellent Category for examples of additional range forest layers.) Score at the biging and of Fair range if ≥2	Tree stratum absent; in y surfaces, croplands, m y lands, culverted streams, maintained herbaceou	nine spoil mowed and is areas, rely grazed	
		Tree stratum (dbit>3 >60% tree canopy co layers may inclue herbaceous, and mosses/lichens and w the high end of Es additional layers are	over. (Additional forest de: sapling, Shrub, leaf litter including woody debris.) Score at	with 30% to 60% free canopy of (See Excellent Category for examples of additional forest to Score at the high end of Good	present, with <30% tree canopy cover. (See Excellent Categor pyers.) for examples of additional cange and of Fair range if ≥2 additional layers are present.  Score at low end if ≤1 Score at low end if ≤1	Tree stratum absent; in y surfaces, croplands, my lands, culverted streams, maintained herbaceou denuded surfaces, active	nine spoil mowed and is areas, rely grazed	
		Tree stratum (dbit>3 >60% tree canopy co layers may inclue herbaceous, and mosses/lichens and w the high end of Es additional layers are	over. (Additional forest de: sapling, shrub, leaf litter including voody debris.) Score at excellent range if >2 present. Score at low	with 30% to 60% free canopy of (See Excellent Category for Examples of additional forest its Score at the high end of Good it ≥2 additional forest layers present. Score at low end it additional forest layers are pro OR cutoyer areas with sturn	cover. (present, with <0% tree canop or yors.) for examples of additional range forest layers.) Score at the high are not Fair range it <2 additional layers are present. Score at low end it <2 psecure services are present.	Tree stratum absent; in y surfaces, croplands, my lands, culverted streams, maintained herbaceou denuded surfaces, active	nine spoil mowed and is areas, rely grazed	
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	<ol> <li>Delineat</li> <li>Determinent</li> </ol>	Tree stratum (dbh2s) >60% tree canopy co layers may includ herbaccous, and mosses/lichens and w the high end of E additional layers are end if ≤1 additional  10 e riparian areas alon the square foolage for 9 %Riparian Area (C) %Riparian Area (C)	wer. (Additional forest der saping, shrub, leaf litter including woody debris.) Score at least least litter including scellent range if \$2 present. Score at low I layers are present.	with 30% to 60% tree canopy of (See Excellent Category of examples of additional forest its Score at the high end of Good it 22 additional forest layers present. Score all low end if additional forest layers are pre OR cutover areas with sturn remaining.  7 6 into Condition Categories a conditional forest layers and the description of the condition of the condition of the condition categories are present.	over, (present, with <00% tree canop over. (See Excellent Categor over. (	Tree stratum absent; in surfaces, croplands, my lands, culverted streams, maintained herbaceous denuded surfaces, activity pasture, and etc. pasture, and etc. pasture and etc.	o Below Ensure the sums %Riparian Block equal 100	Field
	Delineat     Determing     Enter the	Tree stratum (dbh2s) >60% tree canopy co layers may includ herbaccous, and mosses/lichers and w, the high end of E additional layers are end if _1 additional  10 e riparian areas aton the square footage for y-Kriparian Area (or y-Kriparian	wer. (Additional forest der sapling, shrub, leaf litter including shoody debris.) Score at least least litter including soody debris.) Score at least	with 30% to 60% free canopy of (See Excellent Category of exemples of additional forest its Score at the high end of Good it ≥ 2 additional forest layers present. Score at lew end if additional forest layers are pro OR cutover areas with sturn remaining.  7 6 cinto Condition Categories ag or estimating length and wenter length and width) and Suboptimal	cover. (present, with <0% tree canopy or cover. (See Excellent Categor proyers.)  for examples of additional forest layers.) Score at the high are additional version of Fair range if ≥2 additional layers are present. Score at low end if ≥1 additional layers are present. OR area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.  5 4 3  and Condition Scores using the at idth. Land Use GIS maps may be Score for each riparian category in Marginal.	Tree stratum absent; in y surfaces, croplands, my lands, culvented streams, maintained herbaceous denuded surfaces, acidis pasture, and etc. pasture, and et	o Below Ensure the sums %Riparian Block equal 100	Field
	Delineat     Determit     Enter the     Right Bank	Tree stratum (dibi-3 >60% tree canopy co layers may includ herbaccous, and mosses/lichens and w. the high end of E additional layers are end if ≤1 additional layers end if ≤1 additional layers of E additional layers of E additional layers of E additional layers of E additional layers of E additional layers of E additional layers of E additional layers of E additional layers of E additional layers and in E additional layer	wer. (Additional forest der sapling, shrub, leaf litter including shoody debris.) Score at least least litter including soody debris.) Score at least	with 30% to 60% free canopy of (See Excellent Category of See Excellent Category of examples of additional forest its Score at the high end of Good it ≥ 2 additional forest layers present. Score all low end if additional forest layers are pre OR cutover areas with sturn remaining.  7 6 into Condition Categories or into Condition Categories or into Condition Categories and we enter length and we enter length and with a Suboptimal  0 into Condition Categories or into Condition Categories or into Condition Categories or into Condition Categories or into Condition Categories or into Condition Categories or into Condition Categories or into Condition Categories or into Categ	over, (see Excellent Category over,	Tree stratum absent; in y surfaces, croplands, my lands, culvented streams, maintained herbaceous denuded surfaces, acidis pasture, and etc. pasture, and et	o Below Ensure the sums %Riparian Block equal 100	Field
	Delineat     Determing     Enter the	Tree stratum (dbh2s) >60% tree canopy co layers may includ herbaccous, and mosses/lichers and w, the high end of E additional layers are end if _1 additional  10 e riparian areas aton the square footage for y-Kriparian Area (or y-Kriparian	wer. (Additional forest der sapling, shrub, leaf litter including shoody debris.) Score at least least litter including soody debris.) Score at least	with 30% to 60% free canopy of (See Excellent Category of exemples of additional forest its Score at the high end of Good it ≥ 2 additional forest layers present. Score at lew end if additional forest layers are pro OR cutover areas with sturn remaining.  7 6 cinto Condition Categories ag or estimating length and wenter length and width) and Suboptimal	cover. (present, with <0% tree canopy or cover. (See Excellent Categor proyers.)  for examples of additional forest layers.) Score at the high are additional version of Fair range if ≥2 additional layers are present. Score at low end if ≥1 additional layers are present. OR area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.  5 4 3  and Condition Scores using the at idth. Land Use GIS maps may be Score for each riparian category in Marginal.	Tree stratum absent; in y surfaces, croplands, my lands, culverted streams, maintained herbaceous denuded surfaces, active pasture, and etc. and et	o Below Ensure the sure alloo  400 100 100 100	Field
	Delineat     Determit     Enter the     Right Bank	Tree stratum (dbh/s² >-60% tree canopy co layers may includ herbacoous, and mosses/lichens and with high end of E additional layers are end if ≤1 additional layers are end if ≤1 additional control of the control of t	wer. (Additional forest der sapling, shrub, leaf litter including soody debris.) Score at scellent range if ≥2 present. Score at low I layers are present.  9 8 8 og each stream bank r each by measuring r each by measuring for field purposes, limal	with 30% to 60% free canopy of (See Excellent Category of examples of additional forest its Score at the high end of Good its 2st additional forest layers present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers are present layers. Score at low end if a forest layers are present layers are present layers. Score at low end if a forest layers are present layers are present layers. The present layers are present layers are present layers are present layers. The present layers are present layers are present layers are present layers are present layers. The present layers are pres	over, (present, with <0% tree canop or over. (See Excellent Categor over.	Tree stratum absent; in y surfaces, crophands, my lands, culvented streams, maintained herbaceous denuded surfaces, active pasture, and etc.  2 1  Dove descriptors used for this, in the blocks below.  Poor 100 2 2 1 SubCl=(%RA*Scores*	O Below Ensure the sums %Riparian Block equal 100  100	Field
	Delineat     Determit     Enter the     Right Bank	Tree stratum (dbh/s² >-60% tree canopy co layers may includ herbacoous, and mosses/lichens and with high end of E additional layers are end if ≤1 additional layers are end if ≤1 additional control of the control of t	wer. (Additional forest der sapling, shrub, leaf litter including soody debris.) Score at scellent range if ≥2 present. Score at low I layers are present.  9 8 8 og each stream bank r each by measuring r each by measuring for field purposes, limal	with 30% to 60% free canopy of (See Excellent Category of examples of additional forest its Score at the high end of Good its 2st additional forest layers present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if additional forest layers are present. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers are present layers. Score at low end if a forest layers are present layers. Score at low end if a forest layers are present layers are present layers. Score at low end if a forest layers are present layers are present layers. Score at low end if a forest layers are present layers are present layers. The present layers are present layers are present layers are present layers. The present layers are present layers are present layers are present layers are present layers. The present layers are pres	over, (present, with <0% tree canop or over. (See Excellent Categor over.	Tree stratum absent; in y surfaces, croplands, my lands, culverted streams, maintained herbaceous denuded surfaces, active pasture, and etc. and et	o Below Ensure the sums %Riparian Block equal 100  100  100  0.01) 2 Ci	Field

VARIABLES FLOW REGIME	<u>:</u>			05\10\200	5	Highway 9	04 Bridge					SCORE	Source
TYPE		Perennial		Intermitte	ent w/ Perer	nnial Pools	Inter	mittent		Ephemera	i		KDWP 20 Kansas
Grade CHANNEL COI	10	9	8	7	6	5	4	3	2	1	] 0	4	Subjective
CHAININEL COI	ADLLION:	wicasureme	III UI UDSEN	vauun 01 St	earn Chan	iei conditio	13						1
		A-2 /		CON		ATEGORY (			<del>,                                     </del>				Barbour,
	Natural c	Optimal channel; no s	tructures or	Some ch	Suboptima	il i (usually in		ginal	Channel	Poor is actively do	wncutting or		EPA RBA 5-21; Ne
	channelizat	tion minimal.	No evidence	bridge :	areas) or pas	st channel	of the reacl	n channelized	widening. >	>80% of the r	each riprap o		1998 US
2a.Channel		utling or exce	essive lateral		on, but with :	significant d and banks		ted. Excess ion; braided		zed. Degrad preventacci	ation, dikes or		NRCS S
Condition/Alter ation (natural,	hydrolog	ical connecti	on between	Acceptab	le frequency	of overbank	channel w	ith excessive		floodplain.			page 7
altered, or	char	nnel and floo	dplain.	flov	vs onto flood	lplain.		of overbank he floodplain					
downcutting)							Historical i	ncision,dikes					
								es restrict dplain.					
Grade	10	] 9	8	7	6	5	4	3	2	11	] 0	(	
		Optimal		CON	NDITION CA Suboptima	ATEGORY (		CORE roinal	Τ	Poor			w/ assista and input
2b.Channel Capacity to		apacity to Flo	w Frequency		spacity to Flo	w Frequency	Channel	Capacity to		apacity to FI	ow Frequency		Dr. Mike
Flow			overflow from a 1,25 to 2,5			overflow from frequent than		ency Ratio is ank overflow			overflow from frequent than	ı	Harvey ar
Frequency		year frequent		every 1.2	5 years or le	ess frequent	from store	n events are	every half	year or less	frequent than		Travant
Ratio (for 2- year peak		0.75-1.25		tha	n every 2.5 y <0.75 or >1.			quent than ear or less		every 10 yea <0.24 or >2			
flow)							frequent	han every 5			-		
								ears. or >1.5					
Grade	10	9	8	7	6	5	4	3	2	1 1	0	(	<u> </u>
' :				CON		ATEGORY (							Newton,
	Dante stat	Optimal	of erosion o	Atagaratal	Suboptima	equent, smal		rginal ely unstable;	Unalabla	Poor	vegetation at		USDA/ NI SVAP pa
	bank failur	e absent or i	ninimal; (<5%	areas of er	osion mostly	healed over.	perennial	vegelation to	waterlin	e; severe ero	sion of both		10; Barbo
2c.Channel Bank Stability		nk affected), ¡ on to waterlin			ank in react erosion and	n has areas c		parse (mainly r stripped by			ed tree roots d/or severely		al., 1999
(score each	undercul	banks (som	e erosion on	undercuttir	ng; perennia	vegetation t	lateral er	osion), bank	undercut tr	ees common	i; many erodeo		RBA page 26; USAC
bank, left or		meander be exposed rool	nds O.K.); na ls: no recent		in most plac ree roots rare	ces; recently but present		hard points ck outcrops)		aw" areas fre	equent along ends; obvious		Norfolk
right facing downstream)	,	free falls;				,	and er	oded back	bank sloug	ghing; 60-100	1% of bank has		District, 2
								e; 30-60% of ich has areas		erosional sca	ars,		
				l			of erosic	n and bank					
								ing; recently ree roots and					
Grade (Left)	10	T 9	8	7	6	1 2		irs common		1 1	0		2
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		2
											Avg.Score		2
CHANNEL RO	UGHNESS	FACTORS											
				CON		ATEGORY (			<del></del>				Barbour,
3a.Channel	The bends	Optimal in the stream	increase the	The bends	Suboptima in the stream			rginat in the stream	Channels	Poor traight; water	rway has beer		EPA RBA Chapter 5
Sinuosity (bends in low	stream le	ngth 2.5 to 4	times longer	stream len	gth 1.5 to 2.	5 times longe	increase	the stream	channe	lized for a lor	ng distance.		5-25; KDI
gradient		I was straigh alley length a			as a straight valley length	line. Channe 1.2 to 1.5		to 1.5 times an if it was a		length/valley	/ length_≤1.0		1996
stream)					, · · · · · · · · · · · · · · · · · · ·	,,,,	straight fi length/val	ne. Channel ley length 1.t					
Grade	10	T 9	8	7	1 6	1 5	4	1.2.	2	1 1	1 0		2
	ļ											<u> </u>	7
	<del> </del>	Optimal		<u> </u>	NDITION C. Suboptima	ATEGORY		SCORE rginal	T	Poor		1	KDWP, 1:
		no channel e			vel bars of c	oarse stones	Sediment	bars of rocks		livided into b	raids or stream	1	Subjective
3b, Boltom		ulling from se ulation; chann			ashed debris moderately	present, little		silt common ely unstable			ate is uniform rock; unstable		Evaluatio
Substrate Composition	accumillo	nation, Utalil	iot io alginig	SHL	, asoudiately	SIGNE	11:Ode:81	ory unstable	South, Sitt.	. way, or udu	יייה, טוופנשטופ		Aquatic Habitats
i	L					.,	<u> </u>					Γ	
Grade	10	9	8	7	6	5	4	3	2	1	0	1	0]

1 -		KDWP, 199
1 1		Newton et
3c. Instream Bottom Topography Grade	ing: deep pools, items listed in Optimal Category < 5 of the items listed in items listed in Optimal Category	1998 USDA/NR: SVAP pag
Grade	9 8 7 6 5 4 3 2 1 0 1	
<u> </u>	CONDITION CATEGORY GRADE of SCORE	
	mal Suboptimal Marginal Poor	
Or 3c, Manning's n	0.099 0.035 to 0.05 0.021 to 0.03 or >0.10 to 0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.	
Grade	9 8 7 6 5 4 3 2 1 0	ı
1	CONDITION CATEGORY GRADE or SCORE	USACE,
3d. Channel		Norfolk
Incision (TLB/BFD=BH R; 1/BHR*Adj Factor =CI)	channel slope >2%. Entrenchment ratio >1.4; Where channel slope >2% Entrenchment ratio >2.0 channel slope >2%. Entrenchment ratio >2.0 channel slope >2%. Entrenchment ratio >2.0 channel slope >2%. Entrenchment ratio >2.0 channel slope <2%. Entrenchment ratio >2.0 channel slope >2%.	District, 20 SAAM For #1 and VT Stream Geomorph Assessme Phase 2
TLB =	0 BHR = 1	
BFD =	0	1
Grade	9 8 7 6 5 4 3 2 1 0 1	
DYNAMIC SUR	TORAGE	
<b>l</b>	CONDITION CATEGORY GRADE or SCORE	Newton, e
	imal Suboptimal Marginal Poor	1998 USD
4a.Pools (abundant, present or absent)		NRCS SV page 14; Barbour, e 1999
Grade	9 8 7 6 5 4 3 2 1 0 3	
4b. Channel	CONDITION CATEGORY GRADE or SCORE	
Flow Status	imal Suboptimal Marginal Poor	Barbour. e
(degree to which channel is filled)	water fills >75% of the available channet; or <25% of channet substrate is exposed.  Water fills >75% of the available channet, and present as standing pools. No water = 7 / 7 / 7 / 7 / 7 / 7 / 7 / 7 / 7 / 7	1999 EPA page 5-19 9#5; TCEC 1999; VAN
Grade	9   8   7   6   5   4   3   2   1   0   2	2005

1.	SEDIMENT TR	ANSPOR	T/DEPOSI	TION											
	4 - 10 (		Optima	al .	C	NOITIONC Suboptin	CATEGORY mal		CORE ginal	Г	Poo	or			Newton, et al.,
	1a, Bank Stability (score each bank, left or right facing downstream)	bank failu	ble; eviden ire absent o	ice of erosion or minimal; lit oblems, <5%	lle areas of	ely stable; i erosion mo	nfrequent, sm stly healed ov ach has areas	Moderately 60% of bar areas of erosion po	unstable, 30- k in reach has rosion; high tential during ods.	areas fi sections sloughin	many ero requently	oded are along s is; obvio 0% of ba	traight ius bank		1998 USDA/NR CS SVAP page 10; Barbour, et al.,
	Grade (Left)	10	9	8	7	6	5	4	3	2	1		0	2	1999 EPA
	Grade (Right)	10	9	8	7	6	5	4	3	2	1		0 g.Score	2	
										*		AV	g.ocore		1
			Optima	-1	C	ONDITION Subopti	CATEGORY		CORE ginal	1	Pod	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		]	Galli, 1996
One Variable	1b. Channel Bottom Bank Stability		of bank is	generally high		n 1/3 of ban	mai nk is generally natrix or materi	Bottom 1 a. generally I material; p		Bottom 1/3 erodible sev	of bank i	is generi plant/sc	il matrix		Wash- COG RSAT No. 1
Ō -	Grade (Left)	10	9	8	7	6	5	4	3	2	1		0	- 0	
Į.	Grade (Right)	10	9	8	7	6	5	4	3	2	1		0	0	
e for			····			······································				····		AV	g.Score	<del> </del>	4
Score	or		Optima	~I	C	ONDITION Subopti	CATEGORY		CORE ginal	1	Pod			]	Barbour, et al.,
Enter	1c. Channel Sediments or Substrate Composition	gravel, c	ravel or larg	ger substrate ders; domina avel or large	nt domina	gravel or la	arger substrate e type is mix o iner sediments	; 10-29.9% g substrat substrate ty	ravel or larger a; dominant be is finer than may still be a	or		m sand,		***************************************	1999 ; Petersen, et al.,
	Grade	10	9	8	7	6	5	4	3	2	1		0	2	1992
2	WATER APPE	ARANCE:	Clarity or	Visibility											1
		<b></b>		,.,	C	ONDITION	CATEGORY	GRADE or S	CORE	·				1	Newton,
		Most eles	Optima			Suboptii			ginal	No. of the last	Poc			]	et al.,
	Water Clarity	objects vis if slightly surfac	sible at dept colored); r e;no notice	but tea-colore Ih 3-6 feet (let no oil sheen c eable film on ols or rocks.	s storm n objects have	event, but o	r, especially af- clears rapidly; pth 1.5-3 ft; m en color; no oil er surface.	most of the visible to d slow sectio pea-green or sumer	ole cloudiness time; objects opth 0.5-1.5 ft; as may appear bottom rocks and objected I with film.		bjecls visib 19 waler m ous waler   surface scr	ole to dep say be bri poliulants um, shee	th <0,5 ft; ght-green; s; floating n or heavy		1998 USDA/ NRCS SVAP page 11
	Grade	10	9	8	7	6	5	4	3	2	1 1		0		2
3	PRESENCE O	F AQUATI	C VEGET	ATION: Pre	sence and	Percent Co	overage							1	
		<u> </u>			C	ONDITION	CATEGORY	GRADE or S	CORE					1	Newton,
g.			Optima			Subopti	mal	Ma	rginal	Dec	Pod		for al-	]	et al.,
Score for Only One Variable	3a. Nutrient Enrichment	diverse includes species o	aquatic pla s low quant	ant communit laties of many sytes; little alg	/ along e / grow	ntire reach;	ly greenish wa moderale alg n substrates.	green macro algal growth,	ter along entire undance of lush hytes; abundant especially during r months.	entire macrophy blooms cre or NO als	reach; de tes clog str	nse stand ream; ser lgal mats al due to d	is of /ere algal in stream instable		1998 USDA/ NRCS SVAP page 12
Ö	Grade	10	9	8	7	6	5	4	3	2	1		0		1
le fc							CATECOCI							1	Bataraas
Sco	or		Optima			Subopti	CATEGORY mal		rginal	<u> </u>	Poo	or		1	Petersen, et al.,
Enter	3b. Aquatic Vegetation		eseni, aqua	atic vegetation nd patches o			n pools, larger	Algal mats	present, some s, few mosses	plants do algae	als cover	r bottom ne chan lue to ur	nel or NC istable		1992 RCE form No. 13
ļ	Grade	10	9	8	7	6	5	4	3	2	1 1		0	1	1
•	1													ı	1

				CON	IDITION C	ATEGORY (	GRADE or S	CORE				P
		Optimal			Suboptima	1	Mai	rginal		Poor		e
		isting of leav ithout sedim	res and wood ent.		and wood si lebris withou		debris; co: organic	es or woody arse and fine malter with iment.	and foul	odor (anaer	black in color robic) or no to excessive	1 R N
Grade	10	9	8	7	6	5	4	3	2	1 1	0	2
AND USE PA	I TTERN: Be	yond Imme	diate Ripari	an Zone								1
		***************************************		CON	IDITION C	ATEGORY (	GRADE or S	CORE				P
		Optimal			Suboptima	l	Ma	rginal		Poor		e
		ied, consisti live prairie	ng of forest, and/or natura		ent pasture and swame			w crops and ome wooded	V	fainly row cr	ops	1 R
	F. 1.5,11.75	wetlands.			crops	, , , , , , , , , , , , , , , , , , ,	areas may	be present but ed patches				N
Grade (Left)	10	9	8	7	6	5	4	3	2	1 1	0	1
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0 Avg.Score	3 2
												1
	<u> </u>		***************************************	CON	VDITION C	ATEGORY (	GRADE or S	CORE				В
6a. Riparian		Optimal		CON	NDITION C		<del></del>	CORE rginal		Poor		a
Zone Width		arian zone >1		Width of ripa	Suboptima	l 18 meters (1/2-	Ma Width of rips	rginal anan zone 6-12		rian zone < 6	meters (natural	a.
Zone Width (from stream	channel wid grasses),	arian zone >1	shrubs, or tall es have not	Width of ripa 1 active char grasses), hur	Suboptima rian zone 12- nnel width w/tr	l 18 meters (1/2- ees, shrubs, or have minimally	Ma Width of npa meters (1 channel wid	rginal	vegation is width), little		ctive channel etation due to	a. 11 <i>P</i> e R U
Zone Width (from stream edge to field)	channel wid grasses),	arian zone >1 ths with frees, human activiti impacted zon	shrubs, or tall es have not e.	Width of ripa 1 active char grasses), hur	Suboptima rian zone 12- nel width w/tr nan activities	l 18 meters (1/2- ees, shrubs, or have minimally	Ma Width of npa meters (1 channel wid	rginal anan zone 6-12 /3-1/2 active dth vegetated),	vegation is width), little	rian zone < 6 ess than 1/3 ac e riparian vego	ctive channel etation due to	a 11 P e R U
Zone Width (from stream edge to field) Grade (left)	channel wid grasses),	arian zone >1 ths with frees, human activiti impacted zon	shrubs, or tall es have not e.	Width of ripa 1 active char grasses), hur	Suboptima rian zone 12- mel width witr nan activities impacted zon	ll 18 meters (1/2- ees, shrubs, oi have minimally e.	Ma Width of ripa meters (1 channel wid impacted by t	rginal anan zone 6-12 /3-1/2 active dith vegetated), numan activities.	vegation le width), littl	rian zone < 6 ess than 1/3 ac e riparian vego human activiti	ctive channel etation due to es.	a. 11 P e. R U
Zone Width (from stream edge to field) Grade (left)	channel wid grasses),	arian zone >1 ths with frees, human activiti impacted zon	shrubs, or tall es have not e.	Width of ripa 1 active char grasses), hur 7	Suboptima rian zone 12- nnel width w/tr nan activities impacted zon  6 6	Il 18 meters (1/2-ees, shrubs, or have minimally e. 5	Ma Width of npa meters (1 channel wid impacted by the	rginal snan zone 6-12 /3-1/2 active tith vegetated), numan activities.	vegation to width), little	rian zone < 6 ess than 1/3 ac e riparian vege human activitie	ctive channel etation due to es.	3 11 2
Zone Width (from stream edge to field) Grade (left)	channel wid grasses),	arian zone >1 ths with frees, human activiti impacted zon	shrubs, or tall es have not e.	Width of ripa 1 active char grasses), hur 7	Suboptima rian zone 12- rian with with nan activities impacted zon  6 6 NDITION C	II II II II II II II II II II II II II	Ma Width of npa meters (1 channel wic impacted by the	rginal enan zone 6-12 /3-1/2 active dith vegetated), human activities.  3 3 3	vegation to width), little	rian zone < 6 ess than 1/3 ac e riparian vego human activitio	ctive channel etation due to es.	3 1 2 E
Zone Width (from stream edge to field) Grade (left)	channel wid grasses), 10 10	arian zone >1 ths with frees, hurnan activiti impacted zon  9 9 Optimal t density of mi	shrubs, or tall es have not e	Width of ripa 1 active char grasses), hur 7 7	Suboptima rian zone 12- rian with with man activities impacted zon  6  6  VDITION C, Suboptima	II II II II II II II II II II II II II	Ma Width of npa meters (1 channel wic impacted by t  4 4 GRADE or S Ma	rginal snan zone 6-12 /3-1/2 active tith vegetated), numan activities.	vegation le width), little	rian zone < 6 cos than 1/3 ac e riparian vege human activitie 1 1 1 Poor	otive channel etation due to es.  0 0 Avg.Score	3 11 2 E e
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Grade 10 9 8 7 6 5 4 3 2 1 0 2  3 STREAM BOTTOM SUBSTRATE. POOL Substrate Characterization  Optimal Optimal Muture of substrate materials, with growed and firm and preventure, or unable and substrate of substrate materials, with growed and firm and preventure, or unable and substrate of substrate materials, with growed and firm and preventure, or unable and substrate of substrate materials, with growed and firm and preventure or unable and substrate of substrate materials, with growed and firm and preventure or unable and substrate of substrate materials, with growed and firm and preventure or unable and substrate of substrate materials or substrate of substrate materials, with growed and firm and preventure or unable and substrate of substrate materials, substrate or substr		1													
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and firm sand prevalent, root instea and submireged vegetation grossent.    Strade		1	Mixture of cubet		with proved			or class			Hard non		nck: no roet	+	Barbo
Submerged vegetation common.  The proof of t		1												1	al. 19
Grade 10 9 8 7 6 5 4 3 2 1 0 1 1 4 4 POOL VARIABILITY  Even mix of large-statilov, targe-steep, small-shallow, small-shallow, small-shallow, small-shallow, small-shallow, small-shallow, small-shallow, small-shallow, small-shallow, small-shallow, small-shallow or proble stage-steep, very few shallow, small-shallow or proble stage-steep, very few shallow, small-shallow or proble state-shallow or shallow or proble shallow or proble state-shallow or shallow or proble shallow or proble shallow or		1													RBA
Grade 10 9 8 7 6 5 4 3 2 1 0 1 1AU  POOL VARIABILITY  Cyplmal  Even mix of large-steallow, targe-steep, small-challow, small-deep pools present in facility of pools targe-steep, very few shallow.  Grade 10 9 8 7 6 5 4 3 2 1 0 1 1		1	l				present.							1	page
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POOL VARIABILITY   Suboptime   Marginal   Poor		L												1	al., 2
Suboptimal   Suboptimal   Majority of posts sumb-town or few shaflow.   Shaflow posts sumch more pools absent.   Shaflow posts much more pools absent.   Shaflow posts sumch more pools absent.   Shaflow pools amb-town or few shaflow.   Shaflow pools much more pools absent.   Shaflow pools amb-town or pools absent.   Shafl		Grade	10	9	8	7	6	5	4	3	2	1	0	1	AUSI
Suboptimal   Suboptimal   Majority of posts sumb-town or few shaflow.   Shaflow posts sumch more pools absent.   Shaflow posts much more pools absent.   Shaflow posts sumch more pools absent.   Shaflow pools amb-town or few shaflow.   Shaflow pools much more pools absent.   Shaflow pools amb-town or pools absent.   Shafl														4	1
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Sicepen   Some deposition in pools   Characterions and bends. Same falling of pools.   Characterions and bends. Same falling of pools.   Characterions and bends. Same falling of pools.   Characterions and bends. Same falling of pools.   Characterions and bends. Same falling of pools.   Characterions and bends. Same falling of pools.   Characterions and bends. Same falling of pools.   Characterions and bends. Same falling of pools.   Characterions and stable and bends.   Characterio			<5% of channel		by scour or	5-30% affect	ed by scout or t		30-50% affect	ed by scour or					Barb
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Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  CHANNEL FLOW STATUS  Water reaches the base of both lower banks; 45% of channel substrate is exposed  Grade 10 9 8 7 6 5 4 3 2 1 0 0  TOHANNEL ALTERATION  Channelization, alteration, or dredging absent or minimal stable stream meander pattern. Alteration by stormwater inputs absent or minimal alteration from stormwater inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 0  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1  Grade 10 9 8 7 6 5 4 3 3 2 1 0 1			1								1				Parsi
CHANNEL FLOW STATUS				<del></del>					· · · · · · · · · · · · · · · · · · ·						al., 2
Optimal   Water reaches like base of both lower banks; <5% of channel substrate is exposed   Value filis >75% of the channel; or valiable channel and/or rifle substrates are mostly exposed   Value filis >2.5% of thannel substrate is exposed   Value filis >75% of the channel; or valiable channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the available channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the available channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the dannel available channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the available channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrate of the substrate of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrate of the substrate of the substrate of the substrate of the substrates are mostly exposed   Value filis >2.5% of the substrate of the substrate is and the substr		Grade	10	1 9	8	7	6	5	4	] 3	2	<u> </u>	1 0		1
Optimal   Water reaches like base of both lower banks; <5% of channel substrate is exposed   Value filis >75% of the channel; or valiable channel and/or rifle substrates are mostly exposed   Value filis >2.5% of thannel substrate is exposed   Value filis >75% of the channel; or valiable channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the available channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the available channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the dannel available channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the available channel and/or rifle substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrate of the substrate of the substrates are mostly exposed   Value filis >2.5% of the substrates are mostly exposed   Value filis >2.5% of the substrate of the substrate of the substrate of the substrate of the substrates are mostly exposed   Value filis >2.5% of the substrate of the substrate is and the substr	,	COLLANDIEL E	OMOTETIO											4	705
Water filis >75% of the channet or banks; <5% of channet substrate is exposed  Grade 10 9 8 7 6 5 4 3 2 1 0 0  CHANNEL ALTERATION  Channelization, alteration, or dredging absent or minimal stormwater inputs absent or minimal alteration from stormwater or other inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 0  CHANNEL ALTERATION  Coptimal Suboptimal Subspirition by stormwater inputs absent or minimal alteration from stormwater or other inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 0 0  CHANNEL ALTERATION  Coptimal Suboptimal Suboptimal Marginal Poor Banks shored with gablon, riprap, or concrete, Concrete or riprap lined channets, Instream habital significantly altered by stormwater or other inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 1 0  Grade 10 9 8 7 6 5 4 3 2 1 0 1 0  Grade 10 9 8 7 6 5 4 3 2 1 0 1 0  Grade 10 9 8 7 6 5 4 3 2 1 0 1 1 0  Grade 10 9 8 7 6 5 4 3 2 1 0 1 1 0  Grade 10 9 8 7 6 5 4 3 2 1 0 1 1	· ·	CHANNEL F	LOW STATUS	Ontimal		<del></del>	Cubactimal		Mar	- loci	т	Door		-	1999
Banks; <5% of channel substrate is exposed substrate is exposed substrate is exposed substrate is exposed substrate is exposed substrate are mostly exposed substrates are mostly exposed stream is dry substrates are mostly exposed stream is dry substrates are mostly exposed stream is dry substrates are mostly exposed substrates are mostly exposed stream is dry substrates are mostly exposed subs	`				onth lower			annet ac			3/0-1300		channel and	4	Wrks
Grade 10 9 8 7 6 5 4 3 2 1 0 0    CHANNEL ALTERATION	`	1	t Motor mechan				75% of the ch					sent in stand	ding pools; or	r	Barb
Grade 10 9 8 7 6 5 4 3 2 1 0 0    CHANNEL ALTERATION   Channelization, or dredging absent or minimal stormwater inputs absent or minimal soft minimal alteration from stormwater inputs.   Suboptimal   Suboptimal   Suboptimal   Suboptimal   Some eitheration or channelization may be extensive; channels, instream habital significantly altered by stormwater or other inputs.   Some eitheration or channelization may be extensive; channels, instream habital significantly altered by stormwater or other inputs.   Suboptimal   Margunal   Poor   Banks shored with gablon, riprap, or concrete, Concrete or riprap lined channels, Instream habital significantly altered by stormwater or other inputs.   Suboptimal   Some eitheration or channelization may be extensive; channels, Instream habital significantly altered by stormwater or other inputs.   Suboptimal   Substream meander pattern and stability have recovered; recent lateration is not present. Minor alteration from stormwater or other inputs.   Substream meander pattern has not recovered. Alteration from stormwater inputs may be extensive, 40-80% of stream reach altered.   Significantly altered by stormwater or other inputs.   Significantly altered by stormwater or	`										mostly pre	etropm ie d	lry		al. 19
Grade 10 9 8 7 6 5 4 3 2 1 0 0 0 7 CHANNEL ALTERATION    CHANNEL ALTERATION	`	-		of channel sul			channel subsl		available chan	nel and/or riffle	mostly pre	menti is a			RBA
Grade 10 9 8 7 6 5 4 3 2 1 0 0 0  CHANNEL ALTERATION  Channelization, alteration, or dredging absent or minimal stable stream meander pattern and stability have recovered; recent alteration is not present. Minor alteration is not present. Minor alteration from stormwater or other inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 1 0  CHANNEL ALTERATION  Suboptimal Suboptimal Marginal Poor  Some afteration or channelization may be extensive; concrete or fight pined channels. Instream habital significantly altered by stormwater or other inputs. Over 80% of the stream meander pattern and stability have recovered; recent inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 1 1	·			of channel sul			channel subsl		available chan	nel and/or riffle	mostly pre	ween is a		1	page
CHANNEL ALTERATION  Optimal  Channelization, or dredging absent or minimal stream meander pattern. Alteration by stormwater inputs absent or minimal materia	·			of channel sul			channel subsl		available chan	nel and/or riffle	mostly pre	aneath is U			
CHANNEL ALTERATION  Optimal  Channelization, or dredging absent or minimal stable stream meander pattern. Alteration by stormwater inputs absent or minimal stability and stability and stability and stability and stability and stability and stability and stability and stability and stability and stability and stability and stability and stability and stability and stability and stability have recovered recent alteration from stormwater or other inputs.  Grade  10  9  8  9  10  10  10  10  10  10  10  10  10	·			of channel sul			channel subsl		available chan	nel and/or riffle	mostly pre	meath is u			Pars
Chamelization, of deedging absent or minimal, normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal streams and stable stream reacher pattern. Alteration by stormwater inputs absent or minimal streams and stable stream reacher pattern. Alteration by stormwater inputs absent or minimal abstraction, (i.e., channelization) may be present, but stream pattern and stabling have recovered; receivered; recovered; reco	·		banks; <5%	of channel sul exposed	ostrate is	<25% of	channel subsi	trate is	available chan substrates are	nel and/or riffe mostly exposed	mostly pre	************************			
absent or minimal, normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal stability have recovered; recent alteration is not present. Usually adjacent to structures, (such as stridge abstraction; (i.e., channelization) may be present, but stem meander pattern and stability have recovered; recent alteration from stormwater inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 1 1			banks; <5%	of channel sul exposed	ostrate is	<25% of	channel substoxposed	trate is	available chan substrates are	nel and/or riffe mostly exposed	mostly pre	11_	1 0		
stream meander pattern. Alteration by stormwater inputs absent or minimal abutments or culverts); evidence of past alteration, (i.e., channelis, the channelis, and between the past alteration, (i.e., channelis, the channelis, the past of both banks; normal stability have recovered; recent alteration from stormwater or other inputs.    Grade   10   9   8   7   6   5   4   3   2   1   0   1			banks; <5%  10  LTERATION	of channel sufexposed	ostrate is	<25% of	channel substance oxposed  6  Suboptimal	trate is	available chan substrates are 4	nel and/or tilfle mostly exposed	mostly pre	] 1 Poor			ō
stormwater inputs absent or minimal abutments or culvens); evidence of past alteration, (i.e., channelization) may be present on the treatment and stability have recovered; recent alteration is not present. Minor alteration is not present. Minor alteration from stormwater or other inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 1			banks; <5%  10  LTERATION  Channelization	of channel sufexposed  9  Optimal n, alteration, o	8	<25% of	channel subsite oxposed  6  Suboptimal alien or channel	5 nelization	available chan substrates are  4  Mar	nel and/or riffle mostly exposed  3  ginal channelization	mostly pre	1 1 Poor pred with gab	blon, riprap, o	ar .	USA
past alteration, (i.e., channelization) present on both banks; normal stability have recovered; recent alteration is not present. Minor alteration from stormwater of other inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 1			banks; <5%  1 10  LTERATION  Channelization absent or min	of channel sufexposed  9  Optimal n, elteration, onimal; normal a	8 r thredging and stable	<25% of	channel subst exposed  6  Suboptimal alion or chann, ususty adjac	5 nelization cent to	available chan substrates are  4  Mar Alteration or a	nel and/or riffle mostly exposed  3  ginal channelization extensive;	2  Banks sho concrete,	Poor Pred with gab	blon, riprap, or or riprap lined	ar .	USA Norfe
may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.  Grade 10 9 8 7 6 5 4 3 2 1 0 1			banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	<25% of	channel subsite oxposed  6  Suboptimal alien or chann, usually adjacres, (such as t	5 nelization cent to bridge	avaitable chan substrates are  4  Mar Alteration or may be combankments	nel and/or riffle mostly exposed  3  ginal channelization extensive; (including spoil	2  Banks sho concrete, chann	Poor Poor Ordered with gab Concrete o tels, Instrea	bion, riprap, or riprap lined um habitat	ar	USA Norfa Distr
Carade   10   9   8   7   6   5   4   3   2   1   0   1   1   1   1   1   1   1   1			banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	<25% of	channel subsite exposed  6  Suboptimal ration or channel, ususity adjactives, (such as the procured); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte); even to converte even to conver	5 nelization cent to bridge vidence of	Available chan substrates are  4  Mar Alteration or or may be a combankment being piles) or shore the substrate of the substr	nel and/or riffle mostly exposed  3  ginal channelization xxtensive; (including spoil ing structures	Banks sho concrete, chang significantly	Poor red will gab Concrete o lets. Instroa	bion, riprap, or or riprap lined om habitat stormwater o	ar	USA Norte Distr
alteration from stormwater of other   extensive, 40-80% of stream reach attered.   22   et			banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	<25% of  7  Some after present structurabutments past alteratii may be pre	channel subsite oxposed  6  Suboptimal ation or chann , usually adjactes, (such as to acculately); even on, (i.e., chann sent, but streat	5 nelization tent to bridge vidence of nelization) am pattern	Alteration or or may be companied piece or may be companied piece or present on boil stable stream in the stable s	nel and/or riffe mostly exposed  3  gmal channelization extensive; (including spoil ing structures in banks; normal neander pattern	Banks sho concrete, chanii significanti other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	bion, riprap, or or riprap lined or habitat stormwater o 80% of the	ar	USA Norfe Distri 2004 SAA
inputs. reach altered. et RE Parallel (Parallel		banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	Some after present structure abutments i past atterati may be pre and stability	6 Suboptimal ation or chann, usually adjacres, (such as to or culverls); evon, (i.e., chansenl, but strea have recover.	trate is  5  nelization cent to bridge vidence of nelization) am pattern ed; recent	available chan substrates are  4  Mar Alteration or any be embankments piles) or shor present on boll stable stream rhas not recover	nel and/or riffe mostly exposed  Ginal channelization extensive; (including spail ing structures th banks; normal meander pattern seed. Atteration	Banks sho concrete, chanii significanti other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	bion, riprap, or or riprap lined or habitat stormwater o 80% of the	ar	USA Norto Distri 2004 SAAI Form	
Grade 10 9 8 7 6 5 4 3 2 1 0 1			banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	7 Some after present structure past atteration past atteration past atteration and stability alteration.	6 Suboptimal alion or channe, usualy adjaces, (such as too, on, (i.e., chansen), but streat have recover	trate is  5  nelization tent to bridge widence of nelization) am pattern ed; recent t. Minor	Available chan substrates are 4  Mar Alteration or 1 may be embankments piles) or shot present on but stable stream in has not recover.	nel and/or tiffle mostly exposed  3  ginal channelization xxtensive; (including spoil ing structures th banks; normal meander pattern yeld. Alteration or inputs may be	Banks sho concrete, chanii significanti other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	bion, riprap, or or riprap lined or habitat stormwater o 80% of the	ar	USA Norfd Distr 2004 SAA Form (Field
Grade 10 9 8 7 6 5 4 3 2 1 0 1			banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	7 Some after present structure past atteration past atteration past atteration and stability alteration.	6 Suboptimal alion or chann, usually adjace, res, (such as to collect the coll	trate is  5  nelization tent to bridge widence of nelization) am pattern ed; recent t. Minor	Available chan substrates are 4  Alteration or may be embankments piles) or shor present on boll stable stream has not recover from stormwate extensive. 40	nel and/or tiffle mostly exposed  3 gunal channelization extensive; (including spoil ing structures in banks; normal meander pattern exed. Alteration er inputs may be 80% of stream	Banks sho concrete, chanii significanti other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	bion, riprap, or or riprap lined or habitat stormwater o 80% of the	ar	USA Norfd Distri 2004 SAAI Form (Field 2; Ba
Grade 10 9 8 7 6 5 4 3 2 1 0 1			banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	7 Some after present structure past atteration past atteration past atteration and stability alteration.	6 Suboptimal alion or chann, usually adjace, res, (such as to collect the coll	trate is  5  nelization tent to bridge widence of nelization) am pattern ed; recent t. Minor	Available chan substrates are 4  Alteration or may be embankments piles) or shor present on boll stable stream has not recover from stormwate extensive. 40	nel and/or tiffle mostly exposed  3 gunal channelization extensive; (including spoil ing structures in banks; normal meander pattern exed. Alteration er inputs may be 80% of stream	Banks sho concrete, chanii significanti other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	bion, riprap, or or riprap lined or habitat stormwater o 80% of the	ar	USA Norfd Distr 2004 SAA Form (Field
Grade 10 9 8 7 6 5 4 3 2 1 0 1			banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	7 Some after present structure past atteration past atteration past atteration and stability alteration.	6 Suboptimal alion or chann, usually adjace, res, (such as to collect the coll	trate is  5  nelization tent to bridge widence of nelization) am pattern ed; recent t. Minor	Available chan substrates are 4  Alteration or may be embankments piles) or shor present on boll stable stream has not recover from stormwate extensive. 40	nel and/or tiffle mostly exposed  3 gunal channelization extensive; (including spoil ing structures in banks; normal meander pattern exed. Alteration er inputs may be 80% of stream	Banks sho concrete, chanii significanti other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	bion, riprap, or or riprap lined or habitat stormwater o 80% of the	ar .	USA Norfd Distri 2004 SAAI Form (Field 2; Ba
			banks; <5%  10  LTERATION  Channelization absent or min stream meand	of channel suf exposed  9  Optimal n. elteration, o nimal; normal a der patiern. Al	8 r dredging and stable teration by	7 Some after present structure past atteration past atteration past atteration and stability alteration.	6 Suboptimal alion or chann, usually adjace, res, (such as to collect the coll	trate is  5  nelization tent to bridge widence of nelization) am pattern ed; recent t. Minor	Available chan substrates are 4  Alteration or may be embankments piles) or shor present on boll stable stream has not recover from stormwate extensive. 40	nel and/or tiffle mostly exposed  3 gunal channelization extensive; (including spoil ing structures in banks; normal meander pattern exed. Alteration er inputs may be 80% of stream	Banks sho concrete, chanii significanti other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	bion, riprap, or or riprap lined or habitat stormwater o 80% of the	ar .	USA Norfd Distr 2004 SAAI Form (Field 2: Ba et al. RBA Pars al., 2
RICHAMMEI SINI ICSITY		7 CHANNEL A	banks; <5%  10 LTERATION  Channelization absent or min stream meand stormwater in	of channel sui exposed  9  Optimal n, olleration, o imal, nornal i ter pattern, Al nputs absent o	8  r dredging and stable teration by r minimal	7 Some after present structure past atteration past atteration past atteration and stability alteration.	channel subsi oxposed  6  Suboptimal alien or chann, ususily adjaces, (such as to reclusers); even on, (i.e., chanses sent, but streas have recover is nol present om stormwate inputs.	5  bridge widence of nelization nelization nelization melization and pattern ed; recent l. Minor er or other	Available chan substrates are  4  Mar Alteration or may be embankments piles) or sho present on boll stable stream rhas not recove from stermwate extensive. 40	nel and/or tiffe mostly exposed  3  gunal channelization extensive; (including spoil ing structures in banks; normal meander pattern sed. Alteration or inputs may be 80% of stream altered.	Banks sho concrete, chann significantl other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	ulon, riprap, or or riprap lined on habitat stormwater o 80% of the altered.	ar .	USA Norfd Distr. 2004 SAAI Form (Field 2; Ba et al. RBA Pars
		7 CHANNEL A	banks; <5%  10 LTERATION  Channelization absent or min stream meand stormwater in	of channel sui exposed  9  Optimal n, olleration, o imal, nornal i ter pattern, Al nputs absent o	8  r dredging and stable teration by r minimal	7 Some after present structure past atteration past atteration past atteration and stability alteration.	channel subsi oxposed  6  Suboptimal alien or chann, ususily adjaces, (such as to reclusers); even on, (i.e., chanses sent, but streas have recover is nol present om stormwate inputs.	5  bridge widence of nelization nelization nelization melization and pattern ed; recent l. Minor er or other	Available chan substrates are  4  Mar Alteration or may be embankments piles) or sho present on boll stable stream rhas not recove from stermwate extensive. 40	nel and/or tiffe mostly exposed  3  gunal channelization extensive; (including spoil ing structures in banks; normal meander pattern sed. Alteration or inputs may be 80% of stream altered.	Banks sho concrete, chann significantl other in	Poor pred with gab Concrete o lets. Instread y altered by puts. Over	ulon, riprap, or or riprap lined on habitat stormwater o 80% of the altered.	ar .	USA Norfd Distr 2004 SAAI Form (Field 2: Ba et al. RBA Pars al., 2

	Grade BANK STABI	10 LITY (SCO																al., 20 AUSR
9 9 1	BANK STABI	LITY (SCO		9	1	8	7	6		5	4		3	2	1	0	2	
					K)													
		Banks stat failure ab affected), p no faw or u outside recently ex	ble; evices or sent or serennia indercute of mea	minimat; ( al vegetati t banks (s ander beno	(<5% a on to v ome er is O.K.	f bank vaterline; osion on ); no	undercuttir	rosion mos pank in rea erosion a ng; perenn in most p	nfreque stly hea ach has and/or b aial vege daces; r	eled over, areas of pank etalion to recently	Moderately vegetation (mainly sec lateral ero hard pe outcrops; elsewhere reach has a bank und exposed tre hairs com	to water oured o sion), b oints (to and er ; 30-60' areas o erculting er coots amon; h	all le: perennial rifine sparse r stripped by ank held by ees, rock oded back of bank in f crosion and g; reconly and fine rool igh erosion g floods	waterlir banks; r common under eroded s along st obvious t	Poor no perennial view severe eros ecently expose; tree falls and cut trees committees; "raw" are raight sections wank sloughing; k has erosiona	ion of both d tree roots for severely ion; many has frequent and bends; 60-100% of		Barbo al. 19 RBA Parso al., 20 AUSR USAC Nodo. District 2004 #3; So and B from
	Grade	10		9	1	8	7	6	T	5	4		3 3	2	1 1	0	2	Hensi
<u> G</u>	Grade	10		9		8		1 6		5	4		<u> </u>	2	Avg,Score	0	2	1
10 V	VEGETATIVE	PROTEC			EACH	BANK)												
			90% of diate rip vegeta ratory s es; vege mowing	parian zon dion, inclu hrubs, or d elative dis g minimal	es covi ding tre nonwood truption or not d	ered by ees. ody I through evident;	covered one cla represent not affi potential than one-	Subopt I the streat by native set; disrupt ecting full to any gre half of the ble height	mbank vegetati its is no ition evi plant gr pat exter potent	ion, but it well- ident but rowth nt; more liat plant	50-70% ( surfaces co disruption bare soil vegetation one half o	vered to obvious or close commi the po	treambank treambank by vegetation; c; patches of ely cropped on; less than tential plant emaining.	surface disruption is very removed	Poor an 50% of the siss govered by various streamban high: vegetation to 5 centimets erage stubble to	vegetation; ik vegetation n has been ers or less in		Barbo al. 19 RBA Parso al., 20 AUSI KDW 2000
	Grade Grade	10 10		9	1	8 8	7 7	6		5 5	4		3 3	2 2	1 1 Avg.Score	0	33	
11   R	RIPARIAN ZO	Width of ri	iparian : .e., pari	Optimal zone >18 king lots, i	meters	ds, clear-	Width of ri human act		ne 12-1 re impa		Width of meters; hu	ıman ac	nal zone 6-12 divities have great deal.		Poor Friperian zone o riparian vege human activiti	tation due to		Barbo al., 1: RBA Parso al., 2: AUS!
	Grade Grade	10		9		8	7 7	6		5	4	1	3 3	2	1 1	0		3
-	Srede			1											Avg.Score			3
12 R	RIPARIAN H	ABITAT CO			ORE E	ACH B/	NK)				r			γ				Norfe
		>60% tree layers herbac mosses/lich the high additional	um (dbi canopy may ind ceous, a hens an h end of layers i	y cover. (A clude: sap and leaf lilt ad woody o if Excellen	Addition oling, str er includebris.) I range 11. Scor	nal forest trub, iding Score al if ≥2 re at low	examples Score at the if ≥2 ad present additional	to 60% tre Excellent of addition	linches te cano Categor nal fore nd of Go rest lay t low er ers are s with s	py cover. ry for st layers.) bod range ers are and if ≤1 present	Tree strai present, wi cover. (Se for exan forest layer end of additional Score additional OR are maintain dense to	th <309 the Excel the Exce	h>3 inches) \$ free canopy ident Category additional re at the high nge if \$2 are present, and if \$1 are present sits of non- naturalized ous and/or	surfac lands, cu maint	Poor ratum absent; es, croplands, tverted stream ained herbaced d surfaces, act pasture, and	mine spoil s, mowed and ous areas, ively grazed		SAA Form Field
	Grade	10		9		8	7	6		5	4	工	3	2	1 1	0	Below	1
2	<ol> <li>Delineate</li> <li>Determine</li> <li>Enter the</li> </ol>	e square fo	ootage	for each	by m	easunn	g or estima	ating leng	gth and	d width. I	and Use (	3IS ma	aps may be	used for	this.	%Ripari	ne sums of an Blocks al 100	
		%Ripariar	(	Optimal			<u> </u>	Subopt				Margir 25			Poor 75	100	T T	7
E	Right Bank	Score	.,,,ed	<b> </b>	0		<u> </u>					3 0,75		1	1.5	1	<u> </u>	1
L		SubCI			Ť			0						<u> </u>	1.5			1
Ī,	Left Bank	%Ripariar Score	n Area				ļ	60 5			ļ ———	40 3		-		100	<del> </del>	+
L=		SubCl			Ö			3				1,2		Subcle	0 (%RA*Score	e*0.01\		7
														Rt Bank	.CI>	2.25	CI	_
F		L		<u></u>										LT Bank	( CI> Score/Total F	4,2	3.22	

	-	05\05\2006 Highway 3	o Ruade		SCORE Source
TYPE	Perennial	Intermittent w/ Perennial Pools	Intermittent	. Ephemeral	KDWP : Kansas
Grade	10 9 8	7 6 5	4 3	2 1 0	4 Subjecti
CHANNEL CON	4DITION: Measurement or Obse	rvation of Stream Channel Condilio	ns		]
		CONDITION CATEGORY	.,		Barbour
	Optimal Natural channel; no structures or	Suboptimal Some channelization (usually in	Marginal Altered channel, 40-80%	Poor Channel is actively downculting or	EPA RB 5-21; A
	channelization minimal. No evidence	e bridge areas) or past channel	of the reach channelized	widening, >80% of the reach riprap o	1998 U
2a.Channel Condition/Alter ation (natural, altered, or downcutting)	of downcutling or excessive laters cutting. Normal frequency of hydrological connection between channel and floodplain.	recovery of channel bed and banks			NRCS page 7
Grade	10 9 8	7 6 5	4 3	2 1 0	0
		CONDITION CATEGORY	RADE or SCORE		w/ assis
2b.Channel	Oplimal	Suboptimal	Marginal	Poor	and inpi
Capacity to Flow Frequency Ratio (for 2- year peak flow)	Channel Capacity to Flow Frequent Ratio is such that bank overflow fro storm events occur at a 1.25 to 2. year frequency. 0,75-1.25	Ratio is such that bank overflow from	Flow Frequency Ratio is	storm events are more frequent than	Harvey
Grade	10 9 8	7 6 5	4 3	2 1 0	0
	<u>.,,,</u>	CONDITION CATEGORY	GRADE or SCORE		Newton
	Optimal  Banks stable; evidence of erosion	Suboptimal	Marginal	Poor Unstable; no perennial vegetation at	USDA/ SVAP
2c.Channel Bank Stability (score each bank, left or right facing downstream)	bank failure absent or minimal; (<5 of bank affected), perennial vegetation to watertine; no raw o undercut banks (some erosion or outside of meander bends O.K.); recently exposed roots; no recentree falls;	5-30% of bank in reach has areas minor erosion and/or bank undercutting; perennial vegetation waterline in most places; recently	waterline sparse (mainly scoured or stripped by d lateral erosion), bank held by hard points. (frees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed free roots an	banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing: 60-100% of bank has erosional scars.	Norfolk
Grade (Left)	10 9 8	7 6 5	fine roof hairs common:	2 1 0	2
Grade (Right)	10 9 8	7 6 5	4 3	2 1 0 Avg.Score	2 2
CHANNEL DO	ICUNESS EACTORS			7,179,00010	
CHANNEL KOL	UGHNESS FACTORS				
	· Oatimal	CONDITION CATEGORY  Subortimal		Poor	Barbou
3a,Channel Sinuosity (bends in low gradient stream)		Suboptimal  The bends in the stream increase the stream length 1.5 to 2.5 times long than if it was a straight line. Chann tength/valley length 1.2 to 1.5	increase the stream	channelized for a long distance. Channel length/valley length_1.0	EPA RE Chapter 5-25; Ki 1996
Grade	10 9 8	7 6 5	4 3	2 1 0	0
		CONDITION CATEGORY	GRADE or SCORE		KDWP.
	Optimal  Little or no channel enlargemen resulting from sediment accumulation, channel is stable	Suboptimal	Marginal Sediment bars of rocks		Kansas Subject Evaluat
3b. Boltom Substrate Composition	accumulation, crange is stable				Habitat
Substrate	accumulation, creating is signed				Habitat

3 T		Optimal		001	Suboptime	ATEGORY (		rginal		Poor			KDWP, 1990 Newton et al
3c. Instream Bottom Topography Grade	>7 of the boulders/g debris, overhang vegetate	tom topograp following: da gravel, logs/la backwaters/c ging vegetatic ed shallows, re banks, or sid pools	eep pools, irge woody oxbows, on, riffles, ootwads,		ottom İncluc led in Optim	des 5-7 of the al Category	< 5 of the	ottom includes items listed in I Category		bottom inclu sted in Optin	des <3 of the aal Category		1998 USDA/NRC: SVAP page
Grade	10	9	8	7	6	5	4	3	2	1 1	0	0	
				CON	DITION C	ATEGORY	GRADE or	SCORE		····			
or 3c. Manning's		Optimal			Suboptima	al	Ma	rginal	T	Poor			
3c. Manning's n		0,05 to 0.099			0.035 to 0.0	05		03 or >0,10 to ),15	obstructio		.01 to 0.02 due clean, smooth		
Grade	10	9	8	7	6	5	4	3	2	1	0		
				CON	IDITION C	ATEGORY (	SRADE or	SCORE					USACE,
		Optimal		CON	Suboptima			rginal	T	Poor			Norfolk
3d. Channel Incision (TLB/BFD=BH R; 1/BHR*Adj Factor =CI)	channel slo ratio >1.4	lio ≥1.0 <1.2 z ope >2%; Eni l; Where char ntrenchment r	irenchment nnet slope	channel s ratio >1.	lope >2%, E	4 and Where intrenchment annel slope t ratio >2.0	and Who slop Entrenchm Where ch ≤2%, En	tio > 1.4 < 2.0 ere channel e > 2%, ent ratio > 1.4 nannel slope itrenchment o > 2.0	slope >29 Whe				District, 200 SAAM Forr #1 and VT Stream Geomorphic Assessmen Phase 2
TLB =		10		BHR =	1								
BFD = Grade	10	10	8	7	6	5	4	T 3	2	] 1	T 0	0	
4 DYNAMIC SUR	FACE WAT	TER STORA	AGE										
		Ontinoal		CON		ATEGORY (			,	Dogg			Newlon, et
	greater than	Optimal shallow pools n 30% of the	pool bottom or pools are	from 10-3 obscure d	30% of the p	ot abundant; ool bottom is , or the pools	Pools p shallow; f the poo obscure du	rginal resent, but rom 5-10% o ol botlom is ue to depth, o	disce	Poor sent, or the e mible. No wa	intire bottom is ater = zero.		1998 USD. NRCS SV/ page 14; Barbour, et 1999
4a.Pools (abundant, present or absent)		east 5 feet de	зер.					re less than 3 t deep.					
(abundant, present or			вер. 8	7	6	5			2	1 1	0	2	
(abundant, present or absent)	at le	east 5 feet de	,	7			fee 4	t deep.		1 1	0	. 2	
(abundant, present or absent)  Grade	at le	east 5 feet de	,	7		ATEGORY	fee 4 GRADE or	t deep.		1 1 Paor	1 0	. 2	
(abundant, present or absent)  Grade  4b. Channel	10 Water reac	east 5 feet de	8 both lower mount of	7 CON Water fill channe	IDITION C.	ATEGORY all he available of channel	GRADE or Ma Water fills available for riftle s	t deep.  3  SCORE	2 Very little present as	Poor water in char	nnel and mostly		Barbour, et 1999 EPA page 5-19 / 9#5; TCEQ 1999; VAN

ŀ	TYPE							T								Source
	NOTES SEDIMENT TRA	ANSDORTA	DEPOSITI	ON												
1	OLDIMERT IV	ntor Ortin	<u> </u>	~												
	4 . D		Optimal		COI	NDITION ( Suboptim		GRADE of	r SCOR Marginal		I		oor			Newton, et al.,
	1a. Bank Stability (score		e; evidence	of erosion o		y stable; in	frequent, sm	al Moderati	ely unsta	able; 30-		many	erode			1998
1	each bank, left or right facing downstream)	potential for		minimal; little llems. <5% o d.			ch has areas	o areas o	ank in re of erosion potentia floods.	n; high	areas sections sloughi	and b	nds; 0	of bank	bank	USDA/NR CS SVAP page 10; Barbour,
																et al., 1999 EPA
	Grade (Left)	10	9	8	7	6	5	4		3	2		1			3
ľ	Grade (Right)	10	9	8	1	6	5	4		3	2		1	Avg.S		 3
٦					001	NOTION	CATECOR	/CDADE a	- 0000							 Colli
	1b, Channel		Optimal		I	Suboptim	nal		√arginal				oor			Galli, 1996
릚	Bottom Bank			nerally highly			is generally		1/3 of b	ank is erodible	Bottom 1/3 erodible					Wash- COG
One Variable	Stability							material		oil matrix				omised.		RSAT No. 1
اح	Grade (Left)	10	9	8	7	6	5	4	<b>T</b>	3	2		1			 ō
	Grade (Right)	10	9	8	7	6	5	4		3	2		1	Avg.S		 히
Score for						LIDITION.		.cn.cc	- 0000							 7
Š	or 1c. Channel		Optimal		CO	NDITION ( Suboptin		GRADE O	r SCOR viarginal		T		oor			Barbour, et al.,
Enter	Sediments or		vel or large	r substrate; rs; dominant		ravel or lar	ger substrat								, clay.	1999 ;
۳	Substrate			rs; dominant rel or larger;			iype is mix o ner sediment		rate; don			r bedro	ur, un	alaule	]	Petersen,
1	Composition 1	Substitute														et al.,
	Composition		stable	1 6	n	noderately	stable	gravel, t		still be a			1	т	-	 1992
	Grade WATER APPEA	10	stable 9	8									1		)	
	Grade	10	stable 9	8	7	noderately s	stable 5	gravel, t	out may	still be a			1	] (	) —	1992
	Grade	10 ARANCE: (	stable 9 Clarity or V Optimal	8 isibility	7 CO	NDITION (	stable 5 CATEGOR	gravel, t	r SCOR	still be a	2		oor			1992 Newton, et al.,
	Grade	10 ARANCE: ( Very clear, objects visit	stable 9 Clarity or V Optimal or clear buttle at depth	8 isibility t tea-colored 3-6 feet (less	7 CO Cocasiona	NDITION ( Suboptimally cloudy, vent, but cl	CATEGOR  all especially a lears rapidly	gravel, by GRADE of the Consider most of	r SCOR Marginal erable clothe time	still be a  3  E  pudiness objects	2 Very turb	id or mu objects	OOF	pearance o depth <	mast 0.5 ft;	1992 3 Newlon,
	Grade	10 ARANCE: ( Very clear, objects visit if slightly of	stable 9 Clarity or V Optimal or clear bu ile at depth olored); no	8 isibility t tea-colored 3-6 feet (less oil sheen on	CO Occasional storm e objects vis	NDITION ( Suboptimally cloudy, vent, but cl	CATEGOR' nal especially a lears rapidly th 1.5-3 ft; n	gravel, t	r SCOR Varginal erable clothe time o depth 0	E pudiness objects 1.5-1.5 ft;	Very turb the time; of slow movi	id or mu objects ing wate rious wa	OOF ddy app isible to r may b er politi	pearance o depth < pe bright- utants; fic	mast 0.5 ft; green:	Newton, et al., 1998 USDA/ NRCS
	Grade WATER APPEA	10 ARANCE: (  Very clear, objects visit if slightly c surface	stable 9 Clarity or V Optimal or clear buttle at depth	8 Isibility  t tea-colored 3-6 feet (less oil sheen on ole film on	CO Cocasiona storm e objects vis have st	NDITION ( Suboptimally cloudy, vent, but cl	CATEGOR' nal especially a lears rapidly th 1.5-3 ft; n	gravel, t	r SCOR Marginal trable clothe time depth 0	E  Dudiness objects 0.5-1.5 ft; y appear om rocks objected	Very turbithe time; of slow moving other obv	id or mu objects ing wate rious wa surlace	ddy applisible to may there polle scum,	pearance depth < e bright- utants; fic sheen or	most 0.5 ft; green: pating heavy	Newton, et al., 1998 USDA/
2	Grade WATER APPEA Water Clarity	10 ARANCE: ( Very clear, objects visitified is submer submer	Stable 9 Clarity or V Optimal or clear bu le at depth olored); no on noticeal ged objects	8 isibility  t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.	CO Cocasiona storm e objects vis have st	NDITION ( Subottin Subottin Subottin Subottin Subottin Subottin Subottin Subottin Subottin Subottin Subottin Subottin Subottin	CATEGOR` nal especially a lears rapidly th 1.5-3 ft; n n color; no oir r surface.	GRADE O  GRADE O  M  fite Conside most of visible to slow sec pea-gre- or sum cove	r SCOR Marginal erable clothe time, depth 0 tions ma en; bolto	E  Dudiness ( objects 0.5-1.5 ft; y appeal m rocks objected film.	Very turb the time; c slow movi other obv alignt mats, coat of foat	id or mu objects ing wate rious wa surlace	OOF ddy applisible to r may ther polition scum, face, the	ocarance o depth o bright- utants; fic sheen or sheen or	most 0.5 ft; green: pating heavy = zero	Newton, et al., 1998 USDA/ NRCS SVAP
2	Grade  WATER APPEA  Water Clarity  Grade	10 ARANCE: (  Very clear, objects visit if slightly o surface submer	Stable  9  Clarity or V  Optimal  or clear bu le at depth olored); no no noticeat ged objects	8 Isibility  t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.	CO Occasions starm e objects vis have sti shee	NDITION ( Suboptin  ally cloudy, went, but cl  bible at dep  ghtly greer  en on water	CATEGOR nal especially a lears rapidly th 1.5-3 tr, n color, no or surface.	gravel, t	r SCOR Marginal erable clothe time, depth 0 tions ma en; bolto	E  Dudiness objects 0.5-1.5 ft; y appear om rocks objected	Very turb the time; c slow movi other obv	id or mu objects ing wate rious wa surlace	ddy applisible to may there polle scum,	ocarance o depth o bright- utants; fic sheen or sheen or	most 0.5 ft; green: pating heavy	Newton, et al., 1998 USDA/ NRCS SVAP
2	Grade WATER APPEA Water Clarity	10 ARANCE: (  Very clear, objects visit if slightly o surface submer	Stable  9  Clarity or V  Optimal  or clear bu le at depth olored); no no noticeat ged objects	8 Isibility  t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.	CO Occasions starm e objects vis have sti shee	NDITION ( Suboptin  ally cloudy, went, but cl  bible at dep  ghtly greer  en on water	CATEGOR nal especially a lears rapidly th 1.5-3 tr, n color, no or surface.	GRADE O  GRADE O  M  fite Conside most of visible to slow sec pea-gre- or sum cove	r SCOR Marginal erable clothe time, depth 0 tions ma en; bolto	E  Dudiness ( objects 0.5-1.5 ft; y appeal m rocks objected film.	Very turb the time; c slow movi other obv alignt mats, coat of foat	id or mu objects ing wate rious wa surlace	OOF ddy applisible to r may ther politic scum, face, the	ocarance o depth o bright- utants; fic sheen or sheen or	most 0.5 ft; green: pating heavy = zero	Newton, et al., 1998 USDA/ NRCS SVAP
2	Grade  WATER APPEA  Water Clarity  Grade	10 ARANCE: (  Very clear, objects visit if slightly o surface submer	stable 9 Darity or V Optimal Optimal or clear bu le at depth olored); no no noticeat ged objects	8 Isibility  t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.	CO Occasions storm e objects vision have sli sheet	NDITION ( Suboptim ally cloudy, vert, but cl cibble at dep ghtly greer an on water	CATEGOR all especially a lears rapidly th 1,5-3 ft; n oclor; no oir surface.	GRADE O  file Conside most of visible to slow sector or sum cove  4  Y GRADE O	r SCOR	E  Dudiness Objects Objected film  3	Very turb the time; c slow movi other obv alignt mats, coat of foat	id or mu objects ing water nous wa , surface m on su	ddy app ddy app isible ti r may t eer polk scum, face. t	ocarance o depth o bright- utants; fic sheen or sheen or	most 0.5 ft; green: pating heavy = zero	Newton, et al., 1998 USDA/ NRCS SVAP page 11
2	Grade  Water Clarity  Grade  PRESENCE OF	10 ARANCE: ( Very clear, objects visit if slightly c surface submer	Stable  9 Clarity or V  Optimal or clear bu les at depth olored); no noticeat ged objects  9 VEGETAT	8 Isibility  It tea-colored 3-6 feet (less oil sheen on ole film on or rocks.	CO Occasions storm e objects vision have sli sheet	NDITION ( Suboptim ally cloudy, vent, but cl ible at dep- gightly greers on water  6  RDITION ( NDITION ( NDITION ( Suboptim Suboptim Suboptim Suboptim Green on water	CATEGOR  CAT	gravel, t	r SCOR Warginal erable cle the time o depth C tions ma en; botte erged of red with	E  Dudiness copiects 5-1.5 ft; y appear m rocks film.	Very turb the time; cost of foat 2	id or mu objects ing wate nous wa surface m on su	COOF ddy applicated to the coordinate of the coo	pearance o depth < e bright- utants; fic sheen of No water	most 0.5 ft; green: bating heavy = zero.	Newton, et al., 1998 USDA/ NRCS SVAP page 11
2	Grade  WATER APPEA  Water Clarity  Grade	10 ARANCE: ( Very clear, objects visit if slightly or surface submer   10 Clear wa diverse a includes species of species	Optimal Optimal Or clear bu le at depth olored); no noticeat ged objects  VEGETAT  Optimal ter along et qualic plant ow quantat	t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.  8  FION: Prese tiere reach; community ties of many se; little algal	CO Occasions storm e objects vis have sti shee	NDITION ( Suboptim ally cloudy, vent, but cl cible at dep ghtly greer an on water  6 ercent Cor  NDITION ( Suboptim r or slightly life reach; r r or slightly	CATEGOR  CAT	GRADE O  flet Conside most of visible to slow sector pea-gre- or sum cove  4  Y GRADE O  A  GRADE O  G	r SCOR Marginal rrable cle the time o depth 0 tions ma en; bottc herged ole red with	E  Dudiness Cobjects Cobjects Cobjected Film  Cobjected Film	Very turb the time; cost of foat slow movi other obv algal mats, cost of foat 2 Pea gree entir macrophy blooms cr	id or mobjects on the control of the	POOF ddy applisable to isable to see a see	opearance o depth < br/> o depth < br/> o bright- ulants; fic sheen oi No water  un water  vn water stands on n; severe	most 0.5 ft, green: ating heavy exercises  along f algal stream	Newton, et al., 1998 USDA/ NRCS SVAP page 11
2	Grade WATER APPEA Water Clarity  Grade  PRESENCE OF	10 ARANCE: ( Very clear, objects visit if slightly or surface submer   10 Clear wa diverse a includes species of species	Optimal Optimal Or clear bu lie at depth olored); no no noticeat ged objects  VEGETAT  Optimal ter along et quatic plant toov quantat macrophyti	t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.  8  FION: Prese tiere reach; community ties of many se; little algal	CO Occasions storm e objects vis have sti shee	NDITION ( Suboptim ally cloudy, vent, but cl cible at dep ghtly greer an on water  6 ercent Cor  NDITION ( Suboptim r or slightly life reach; r r or slightly	CATEGOR  all especially a lears rapidly th 1,5-3 ft; n oclor; no oir surface.	GRADE O  flet Conside most of visible to slow sector pea-gre- or sum cove  4  Y GRADE O  A  GRADE O  G	r SCOR Marginal respective to depth 0 titles are bottle terged of the time. The score of the time. The score of the time. The score of the time. The score of the time. The score of the time. The score of the time. The score of the time. The score of the score of the time. The score of the time. The score of the time. The score of the time. The score of the time. The score of time. The score	E  Dudiness Cobjects Cobjects Cobjected Film  Cobjected Film	Very turb the time; cost of foat slow movi other obv algal mats, cost of foat 2 Pea gree entir macrophy blooms cr	id or mobjects on the control of the	POOF ddy applisable to isable to see a see	ocerrance o depth 4 sheen of the sheet of the sheet of th	most 0.5 ft, green: ating heavy exercises  along f algal stream	Newton, et al., 1998 USDA/ NRCS SVAP page 11  Newton, et al., 1998 USDA/ NRCS SVAP
2	Grade  Water Clarity  Grade  PRESENCE OF  3a. Nutrient Enrichment	10 ARANCE: ( Very clear, objects visit if slightly of surface submer   10 Clear war diverse a includes species of 9	Stable  9 Clarity or V  Optimal or clear buse at depth olored); no no noticeat ged objects  VEGETAT  Optimal ter along equatic plant one quantic plant one quantic macrophyly rowth prese	t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.  8  FION: Prese community tess of many tess of many tess fittle algal ant.	CO Occasions storm e objects vis have sli shee	NDITION ( Suboptim ally cloudy, very library and on water  6 ercent Cor NDITION ( Suboptim 6 ercent Cor NDITION ( Suboptim r or slightly ire reach; r on stream	stable    5     CATEGOR     all especially a lears rapidly a lears rapidly a lears rapidly a lear same	GRADE O  file Conside most of visible to slow sec pea-gregory or sum cove  4  Y GRADE O  File Conside most of visible to slow sec pea-gregory sum cove green madely all green madels green gr	r SCOR Marginal Frable cle the time o depth 0 tions ma en; boltc erged ol ered with  r SCOR Margina water ale rebundan rophytes; th, especi	E  Dudiness  objects  objects  objected  film	Very turb the time; cost of foat step and the time; cost of foat  Pea gree entir macrophy blooms cr or NO a sub	id or mobjects on the control of the	POOT  Tor brow dense stream of the low water to water the low water to be a low wate	ocerrance o depth 4 sheen of the sheet of the sheet of th	most 0.5 ft. green; heavy zero zero along f algal stream able	Newton, et al., 1998 USDA/ NRCS SVAP page 11  Newton, et al., 1998 USDA/ NRCS SVAP page 12
2	Grade  Water Clarity  Grade  PRESENCE OF  3a. Nutrient Enrichment  Grade	10 ARANCE: ( Very clear, objects visit if slightly c surface submer   10 Clear wa diverse a includes species of 9	Optimal Optimal	t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.  8  FION: Press community tes of many tes of many tes filtle algal ant.	CO Occasions storm e objects vis have sti shee	NDITION ( Suboptin  Suboptin  Suboptin  Suboptin  Suboptin  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Suboptin  Control  Suboptin  Suboptin  Suboptin	CATEGOR  all especially a lears rapidly th 1.5-3 tr, no color, no or surface.  CATEGOR  categorially a lears rapidly th 1.5-3 tr, no color, no or surface.	y GRADE o  file Conside most of visible to slow secupea-gree or sum cove  4  Y GRADE o  A  Y GRADE o  A  Y GRADE o  A  Y GRADE o  A  Y GRADE o  A  Y GRADE o  A  Y GRADE o  T  Y GRADE o  T  Y GRADE o  T  Y GRADE o  T  Y GRADE o  T  Y GRADE o  T  Y GRADE o	r SCOR Marginal rrable cle the time o depth 0 tions ma en; bottc herged of tred with  r SCOR Marginal water alc rabundan rrable, he, cope frophytes; th, especi	E  Suddiness (a bjects (b-1,5 ft) (by appeal (c) (c) (d) (d) (d) (d) (d) (d) (d) (d) (d) (d	Very turb the time; cost of foat algal mats, coat of foat 2  Pea gree entir macrophy blooms or or NO a sub	id or mu objects : ning wate surface m on su e reach ytes clo	1  Poor  A algale  Poor	ocarance depit - depit	most to 5 most t	Newton, et al., 1998 USDA/ NRCS SVAP page 11  Newton, et al., 1998 USDA/ NRCS SVAP page 12  1  Petersen, et al., et al.,
2	Grade  WATER APPEA  Water Clarity  Grade  PRESENCE OF  3a. Nutrient Enrichment  Grade	Very clear, objects visit if slightly of surface submer 10  Clear was diverse a includes species of 9  10  When pre-	Stable 9 Darity or V Optimal or clear bu le at depth lolored); no no noticeat ged objects  VEGETAT  Optimal ter along er quatic plant low quantat macrophylicowth prese	t tea-colored 3-6 feet (less oil sheen on ole film on or rocks.  8  FION: Prese community tess of many pes; little algal ent.	7 CO Cocasions storm e objects vis have sli sheet	NDITION ( Suboptin  Suboptin  Suboptin  Suboptin  Suboptin  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Control  Suboptin  Suboptin  Control  Suboptin  Suboptin  Suboptin	stable    5   CATEGOR   sale   sespecially a lears rapidly the 1,5-3 ft; in a color, no oir surface.    5   Verage   CATEGOR   substrates   substrates   5   CATEGOR   sale   pools, lerge   pools, lerge   category   categ	y GRADE o  file Conside most of visible to slow secupea-gree or sum cove  4  Y GRADE o  A  Y GRADE o  A  Y GRADE o  A  Y GRADE o  A  Y GRADE o  A  Y GRADE o  A  Y GRADE o  T  Y GRADE o  T  Y GRADE o  T  Y GRADE o  T  Y GRADE o  T  Y GRADE o  T  Y GRADE o	r SCOR Marginal respective to the time o depth 0 depth	E  Dudiness cobjects cobjects cobjected film.  3  E  Cobjected film.  3  E  Cobjected film.  3  E  Cobjected film.  3  E  Cobjected film.	Very turb the time; color of foat of f	id or mi. objects : object	Poor ddy appisible to re re politic scum, face. It seems dense stream k algal 1	pocarance depth, see bright- utants; fic sheen oil No water  un water stands o makes o	most 0.5 ft; 0.5 ft; osting in heavy along f algal stream algal stream alable	Newton, et al., 1998 USDA/ NRCS SVAP page 11  Newton, et al., 1998 USDA/ NRCS SVAP page 12  Petersen,

				400	IDITION C	ATEGORY (	SRADE or S	CORE				Pe
		Optimal			Suboptim			rginal		Poor		et
		isting of leav ithout sedim	es and wood ent.			scarce; fine ut sediment.	debris; co organic	es or woody arse and fine matter with liment.	and foul	odor (ana	- black in color erobic) or no se to excessive g	15 Ri
Grade	10	9	8	7	6	5	4	3	2	1 1	0	1
AND USE PA	TTERN: Be	yond Imme	diate Riparia	an Zone								
		<del></del>		CON	IDITION C	ATEGORY (	GRADE or S	CORE				P
		Optimal			Suboptim	al	Ma	rginal		Poor		et
		ed, consistir live prairie, a wetlands.	ng of forest, and/or natura			mixed with ps, few row	pasture; s areas may	w crops and ome wooded be present bu ed patches		lainly row	crops	19 R: N:
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	2
Grade (Right)	10	9	8	7	- 6	5	4	3	2	1	0 Avg.Score	1.5
	1			~~.	IDITIOLLO			<del>~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~</del>				
6a. Riparian		Optimal			Suboptim	al		rginal		Poor		Ba al.
Zone Width (from stream	channel wid grasses),	Optimal arian zone > 1 ths with trees, human activiti impacted zone	shrubs, or tall es have not	Width of npa 1 active char grasses), hur	Suboptim rian zone 12 inel width w/	al -18 molers (1/2- rees, shrubs, or have minimally	Ma Width of rip meters (1 channel win		vegation is width), little	rian zone < ss than 1/3	6 meters (natural active channel egetation due to vities.	al. 10 Pe et Ri U:
Zone Width	channel wid grasses),	arian zone > 1 ths with trees, human activiti	shrubs, or tall es have not	Width of npa 1 active char grasses), hur	Suboptim rian zone 12 nel width wh nan activities	al -18 molers (1/2- rees, shrubs, or have minimally	Ma Width of rip meters (1 channel win	rginal arian zone 6-12 /3-1/2 active din vegetated),	vegation is width), little	rian zone < ss than 1/3 e riparian vo	active channel egetation due to	al. 10 Pe et RI
Zone Width (from stream edge to field) Grade (left)	channel wid grasses),	arian zone > 1 ths with trees, human activiti impacted zone	shrubs, or tall es have not e.	Width of ripa 1 active char grasses), hur	Suboptim rian zone 12- inel width with nan activities impacted zon	al 18 molers (1/2- rees, shrubs, or have minimally ne.	Ma Width of rip meters (1 channel wid impacted by t	rginal arian zone 6-12 /3-1/2 active dih vegetated), human activities	vegation le width), littl	rian zone < ss than 1/3 e riparian vo numan activ	active channel egetation due to nities.	al 10 Pe et RI
Zone Width (from stream edge to field) Grade (left)	channel wid grasses), 10	arian zone > 1 ths with trees, human activiti impacted zone	shrubs, or tall es have not e.	Width of ripa 1 active char grasses), hur 7	Suboptim rian zone 12 nnet width w// man activities impacted zo 6 6	al -18 moters (1/2- rees, shrubs, or have minimally re. 5	Ma Width of ripe meters (1 channel wid impacted by 1 4 4	rginal arian zone 6-12 /3-1/2 active dith vegetated), human activities 3 3	vegation to width), little	rian zone < ss than 1/3 e riparian vo numan activ	active channel egetation due to rities.	al 10 Pe ef R: U: 3 1 2
Zone Width (from stream edge to field) Grade (left)	channel wid grasses), 10	arian zone > 1: ths with trees, human activiti impacted zone 9 9	shrubs, or tall es have not e.	Width of ripa 1 active char grasses), hur 7	Suboptim rian zone 12 rian vidth w// man activities impacted zor  6 6 NDITION C	al	Ma Width of rip meters (1 channel wir impacted by i	rginal arian zone 6-12 A3-1/2 active dith vegetated), human activities 3 3 3 SCORE	vegation to width), little	rian zone < ess than 1/3 e riparian vo numan activ	active channel egetation due to nities.	33 1 2 8
Zone Width (from stream edge to field) Grade (left) Grade (Right) 6b. Riparian Zone Vegetation Protection/	channel wid grasses),  10 10 10 >90% plan shrubs, prair riparian zo:	arian zone >1: ths with trees, hurnan activiti impacted zone  9  9  Optimal t density of ma	shrubs, or tall es have not e	Vyidth of ripa 1 active char grasses), hur  7  7  75-90% strr young specie trees behi	Suboptim rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone	al	Ma Width of ripe meters (1) channel wie impacted by i  4  4  3RADE or \$  Ma 50-75% vegetation o and sparse shrub spr frequent wie	rginal arian zone 6-12 /3-1/2 active dith vegetated), human activities 3 3	vegation to width), tittle 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	rian zone < ss than 1/3 e riparian vo numan activ  1 1 1 Poor 60% stream consisting m w trees & s	active channel getalized due to nities.  O O Avg.Score  bank vegetation posity of pasture hrubs; low plant arred with guilles	al 10
Zone Width (from stream edge to field) Grade (left) Grade (Right) 6b. Riparian Zone Vegetation Protection/ Completeness	channel wid grasses),  10 10 10 >90% plan shrubs, prair riparian zo:	arian zone >1: ths with trees, human activiti impacted zone  9  9  Optimal t density of mar rie grasses, or ne intact or dis	shrubs, or tall es have not e	Vyidth of ripa 1 active char grasses), hur  7  7  75-90% strr young specie trees behi	Suboptim rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone 12 rian zone	al 18 moters (1/2 rees, shrubs, or have minimally ne. 5 5 5 CATEGORY (al petation, mixed and mature or evident with	Ma Width of ripe meters (1) channel wie impacted by i  4  4  3RADE or \$  Ma 50-75% vegetation o and sparse shrub spr frequent wie	rginal arian zone 6-12 3-1/2 active dih vegetated), numan activities 3 3 SCORE rginal streambank f mixed grasses young tree or cities; breaks th some gullies	vegation to width), tittle 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	rian zone < ss than 1/3 e riparian vo numan activ  1 1 1 Poor 60% stream consisting m ww trees & s k deeply sc	active channel getalized due to nities.  O O Avg.Score  bank vegetation posity of pasture hrubs; low plant arred with guilles	al 110 Per 110
Zone Width (from stream edge to field) Grade (left) Grade (Right) 6b. Riparian Zone Vegetation	channel wid grasses).  10 10	arian zone >1 lits with trees, human activities impacted zone 9 9 9 Optimal to depth of the grasses, or ne intact or dis ing/mov/ing m	shrubs, or tall es have not e	Width of ripa 1 active char grasses), hur 7 7 7 CON 75-90% str young specit trees behild breaks oc	Suboptim rian zone 12 none 12	al .18 moters (1/2: rees, shrubs, or have minimally ree	Ma Width of rip meters (t channel wie impacted by I  4  4  4  SRADE or S  Ma 50-75% vegetation o and sparse shrub spar frequent width	rginal arian zone 6-12 AS-1/2 active dih vegetated), numan activities  3 3 SCORE rginal streambank nnixed grasses young tree or cies; breaks th some gullies very 50 meters.	vegation to width, tittle vegation to width, tittle vegation to very a vegation to very a vegation to very a vegation to very a vegation to vegation t	rian zone < sss than 1/3 e riparian va va va va va va va va va va va va va	active channel operation due to operatio	al 110 Per fire fire fire fire fire fire fire fi

VARIABLES				(	05\05\2006	Highway 3	8 Bridge					SCORE	Refe
1	FLOW REGI								,			]	
	TYPE Grade	Pe:	rennial 9	8	Intermittent w.	/ Perennial Pools 5 5	Intermi	ittent 3	2	Ephemeral 1	0	<del></del>	KD1 200
	Grade	10 1		-		5 5	4	<u> </u>	LL				200
2	EPIFAUNAL	SUBSTRATE/AVA	ILABLE COV	ER								1	
			ptimal			optimal	Marg			Poor		]	1
		Within stream be				d, 30-50% coverage	Within stream i			10% habitat			USA
		coverage by sta favorable for strea				t features favorable I colonization and/or	coverage by st features favorab			ck of habitat is e unstable or l			Non
		and/or fish/amphibi				over. Many habitat	faunal coloniza			ined channels.			200 SAF
		features non tran				sient. (See Excellent	fish/amphibian o			f pools buried			For
		include snags, sub banks, roots, cobbi				habitat feature	availability may desirable, subs		Channel	bottom may t	oe flat.		(pag
		packs, pools and			COMP	onents.)	frequently distr		}				Bar
		habitat at a stage					Excellent Catego						al. 1
	1						feature com	ponents.)					EP/
	1												Par
													al.,
													JAU:
	Grade	10	9	8	7	6 5	4 1	3	2	1	0	1 1	-
9	STREAM PO	TTOM SUBSTRAT	TE: Dool Subs	trata Chr	rectarization	··-	·······					-	
3			ptimal	Tona One		optimal	Marg	inal	i	Poor		1	
	1	Mixture of substrate	e materials, wit		Mixture of soft s	sand, mud, or clay;	All mud or clay o	or sand bollom;		clay or bedroc		1	Bar
		and firm sand pre				minant; some root	little or no ro		mat or su	ubmerged veg	jetation.		al.
	1	supmerged ve	getation comm	UII.		nerged vegalation esent,	submerged v	vegetatiön.					RB/
		ĺ		1	μιτ								pag Par
		ĺ							[				Par al.,
	Grade	10	9	8	7	6 5	4	3	2		0	+	AUS
						<u> </u>			<u> </u>			<del> </del>	1
4	POOL VARIA	BILITY									***************************************	]	
		0	ptimal			optimal	Marg			Poor		]	1.
		Even mix of large				s large-deep; very	Shallow pools			pools small-s		1	Bar
	[	small-shallow, sm	all-deep pools p	nesent	tew:	shallow.	prevalent than	i deep poots		pools absent		l	aí.
		[											RB.
				- 1									Pag Par
				į									al.
	Grade	10	9 1	8	7 1	6   5	4	3	1 2 1	1 1	0	1 1	-1
5		DEPOSITION/SCO	URING						1				1
			ptimal			optimal	Marg			Poor		]	1
		<5% of channel bott	ttorn affected by s position.			y scaur or deposition. ons and wehre grades	30-50% affecte deposition Depos			0% of the botto nge neatly year			Bar
			F			deposition in pools	obstructions, co	nstrictions and	m:simal o	or absent due t	to heavy		al. RB
		1					bends. Some fi	sload to built	deposition	n or excessive :	Sconting	1	pag
													Par
													at.,
	Grade	10	9	8	7	6 5	4	3	2	1	0	1	
												4	
9	CHANNELFI	LOW STATUS	ptimal	<del></del>	Sub	emitral	Marg	ringi		Poor		-	TC:
		Water reaches th		lower		optimal of the channel; or	Water filis 25		Very little v	valer in the ch	annel and	-	W
			channel substra			nnel substrate is	available chann	el and/or riffle		ent in standin			Bai
		ivotina, Tom Of							1	stream is dry			ai.
			xposed		ex	posed	substrates are n	nostly exposed	1 '	sticati is dry			RB
			xposed		хэ	posed	substrates are n	nostly exposed		sticani is dry		1	pag
			xposed		ex	posed	substrates are n	noslly exposed		sticall is dry		1	
		ex								Sucani is dry	***************************************		Pai
_	Grade	10	xposed 9	8	ex.	6 5	substrates are n	noslly exposed	2	1	0	1	
7	Grade CHANNEL A	10 LTERATION	9	8	7	6 5	4 [	3		1 1	0	1	
7		10 LITERATION	9		7   Sub	6 5	4 Marg	3 ginal	2	1 Poor		1	
7		10 LTERATION O Channelization, a basent or minim	9 potimal alteration, or dreal; normal and s	edging stable	7 Sub	6 5 Optimal n or channelization rally adjacent to	4 [	3 jinal hannelization	2 Banks short	Poor ed with gabior Concrete or ri	n, riprap, or iprap lined		US
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by	Sub Some atteration present, usu	6 5 optimal or channelization ality adjacent to (such as bridge	4 Marg Alteration or c may be ey embankments (i	3 pinal hannelization ktensive; pincluding spoil	Banks short concrete, channe	Poor ed with gabios Concrete or riels, Instream	n, riprap, or iprap lined habitat		US
7		10 LTERATION O Channelization, a basent or minim	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some atteration prosent, usu- structures, 4 abulments or cu	6 5 coptimal n or channelization rally adjacent to (such as bridge itverts); evidence of	4 Marg Alteration or ct may be es embankments (i piles) or shorir	jinal hannelization xtensive; including spoil ng structures	Banks short concrete. channel significantly	Poor ed with gabior Contrete or ri els, Instream allered by sto	n, riprap, or riprap lined habital ormwater o		US No Dis 200
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some atteration present, usu structures, 4 abulments or cu past alteration, (	6 5 optimal or channelization ality adjacent to (such as bridge	4 Marg Alteration or c may be ey embankments (i	3 pinal hannelization klensive; jincluding spoil ng structures banks; normal	Banks short concrete. channe significantly other inp	Poor ed with gabios Concrete or riels, Instream	n, riprap, or riprap lined habitat ormwater o % of the		US No Dis 200 SA
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some atteration prosent, usu- structures, i abulments or cu- past alteration, cu- past alteration, and stability hav	6 5 noptimal n or channelization fully adjacent to (such as bridge fuerts); evidence of l.e., channelization but stream patient e recovered; recent	Alteration or cl may be og embankments ( piles) or shorir present on both stable stream m has not recover	ginal hannelization ktensive; inctuding spoil ng structures banks; normal icander pattern red, Alteration	Banks short concrete. channe significantly other inp	Poor ed with gabiou Concrete or ri els. Instream altered by ste outs. Over 80'	n, riprap, or riprap lined habitat ormwater o % of the		US No Dis 200 SA Foi
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some alteration present, usus structures, a abuliments or cu past alteration, ( may be present, and stability hav alteration is no	6 5  optimal n or channelization rally adjacent to (such as bridge itverts): evidence of lec, channelization) but stream pattern e recovered; recent of present. Minor	Alteration or city pies) or shorin present on both stable stream m has not recover	ginal hannelization klensive; including spoil ng structures banks; normal leander pattern red, Alteration i inpuls may be	Banks short concrete. channe significantly other inp	Poor ed with gabiou Concrete or ri els. Instream altered by ste outs. Over 80'	n, riprap, or riprap lined habitat ormwater o % of the		US No. Dis 200 SA For
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some alteration present, usu structures, i abulments or cu past alteration, c may be present and stability hav alteration from s alteration from s	6 5 noptimal n or channelization rally adjacent to (such as bridge riverts); evidence of 1.e., channelization), but stream pattern the recovered; recent of communities of other	Alteration or et may be us entantments (piles) or shorir present on both stable stream m has not recover from stormwater extensive. 40-8	ginal hannelization ktunsive; including spoil ng structures banks; normal leander pattern red, Alleration inputs may be 80% of stream	Banks short concrete. channe significantly other inp	Poor ed with gabiou Concrete or ri els. Instream altered by ste outs. Over 80'	n, riprap, or riprap lined habitat ormwater o % of the		US No. Dis 200 SA. Foi (Fit
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some alteration present, usu structures, i abulments or cu past alteration, c may be present and stability hav alteration from s alteration from s	6 5  optimal n or channelization rally adjacent to (such as bridge itverts): evidence of lec, channelization) but stream pattern e recovered; recent of present. Minor	Alteration or city pies) or shorin present on both stable stream m has not recover	ginal hannelization ktunsive; including spoil ng structures banks; normal leander pattern red, Alleration inputs may be 80% of stream	Banks short concrete. channe significantly other inp	Poor ed with gabiou Concrete or ri els. Instream altered by ste outs. Over 80'	n, riprap, or riprap lined habitat ormwater o % of the		US Noi Dis 200 SA Foi (Fie
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some alteration present, usu structures, i abulments or cu past alteration, c may be present and stability hav alteration from s alteration from s	6 5 noptimal n or channelization rally adjacent to (such as bridge riverts); evidence of 1.e., channelization), but stream pattern the recovered; recent of communities of other	Alteration or et may be us entantments (piles) or shorir present on both stable stream m has not recover from stormwater extensive. 40-8	ginal hannelization ktunsive; including spoil ng structures banks; normal leander pattern red, Alleration inputs may be 80% of stream	Banks short concrete. channe significantly other inp	Poor ed with gabiou Concrete or ri els. Instream altered by ste outs. Over 80'	n, riprap, or riprap lined habitat ormwater o % of the		US No Dis 200 SA Foi (Fir 2; U
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some alteration present, usu structures, i abulments or cu past alteration, c may be present and stability hav alteration from s alteration from s	6 5 noptimal n or channelization rally adjacent to (such as bridge riverts); evidence of 1.e., channelization), but stream pattern the recovered; recent of communities of other	Alteration or et may be us entantments (piles) or shorir present on both stable stream m has not recover from stormwater extensive. 40-8	ginal hannelization ktunsive; including spoil ng structures banks; normal leander pattern red, Alleration inputs may be 80% of stream	Banks short concrete. channe significantly other inp	Poor ed with gabiou Concrete or ri els. Instream altered by ste outs. Over 80'	n, riprap, or riprap lined habitat ormwater o % of the		US No Dis 20t SA Foi (Fit 2; t RB Pai at.,
7		10 LTERATION  Channelization, a absent or minims stream meander	9 potimal alteration, or dreation, or dreation, Alteral pattern. Alteral	edging stable tion by inimal	7 Sub Some alteration present, usu structures, i abulments or cu past alteration, c may be present and stability hav alteration from s alteration from s	6 5 noptimal n or channelization rally adjacent to (such as bridge riverts); evidence of 1.e., channelization), but stream pattern the recovered; recent of communities of other	Alteration or et may be us entantments (piles) or shorir present on both stable stream m has not recover from stormwater extensive. 40-8	ginal hannelization ktunsive; including spoil ng structures banks; normal leander pattern red, Alleration inputs may be 80% of stream	Banks short concrete. channe significantly other inp	Poor ed with gabiou Concrete or ri els. Instream altered by ste outs. Over 80'	n, riprap, or riprap lined habitat ormwater o % of the		US No. Dis 200 SA. Foi (Fit
	CHANNEL A	10 LTERATION  Channelization, a absent or minim stream meander stormwater inpu	9 pptimal alteration, or dreat; normal and e pattern. Alterat uts absent or mi	edging stable tion by inimal	7 Sub Some alteration present, usu structures, i abulments or cu past alteration, c may be present and stability hav alteration from s alteration from s	6 5  noptimal n or channelization unity adjacent to (such as bridge ilverts); evidence of (i.e., channelization), but stream pattern the recovered; recent of present. Minor stormwater or other uputs.	Alteration or et may be ex entantknents (piles) or shorir present on both stable stream m has not recover from stormwater extensive. 40-8 (each at	ginal hannelization klunsive; including spoil ng structures banks; normal teander pattlern red. Alteration inpuls may be 80% of stream illered.	Banks short concrete. channe significantly other inp stress	Poor ed with gabino Concrete or ri- els. Instruem altered by stallered by stallered by stutts. Over 80 am reach afte	n, riprap, or iprap lined habitat ormwater o % of the ered.		US. No. Diss 200 SA. For (Fiel 2; U et a RB Pail al.,

		stream length 3 was in a straig braiding is cont plains and oth	the stream increase to 4 limes longe got lime, (Note - sidered normal intertow-lying area not easily rated areas).	r than if it channel n coastal as. This	stream le	ength 2 to 3	em increase t times longer straight line.	increase times longe	ds in the strea the stream 1 t r than if it was alght line	102		aight; waten	way has been g distance		Barbot al. 199 RBA # Parsor al., 200 AUSR
	Grade	10	9	8	7	6	5	4	3		2	1	0	0	<u> </u>
9	G BANK STA	BILITY (SCORE E	EACH BANKI					······································			*			1	
,	DANKOTA	T	Optimal		Γ	Suboptio	mal	T 1	Aarginal			Poor			
		failure absent of affected), perent no raw or underc	cut banks (some cander bends O	of bank waterline; erosion on .K.); no	areas of er 5-30% of the minor underculting waterline	rosion mosi cank in read r erosion ar rg; perenni in most pla	frequent, sma lly healed ove ch has areas nd/or bank al vegetation aces; recently are but preser	r. vegetation (mainly see interal eros o hard po outcrops) t. elsewhere; reach has a bank und exposed tre hairs com	unstable; per lo waterline sy ured or stripp: ion), bank he ints (trees, ror and eroded b 30-60% of ba reas of erosic eroutting; rece e roots and fir mon; high ero al during flood	parse ed by cock eack enk in or and of chily ne root ession	waterline; banks; rec common; t undercul eroded are along strai byjous bar	severe eros ently expos- ree falls and t trees commens; "raw" ar ight sections	eas frequent and bonds; ; 60-100% of		Barbon al. 199 RBA 1 Parson al., 20 AUSRI USAC Norfol Distric 2004 5 #3; Sc and Br
	Grade Grade	10	9 9	8 8	7 7	6	5	4 4	3 3		2 2	1 1	0	3	from Hensh
												Avg.Scor	el	2	2
)	10 VEGETATI	VE PROTECTION		CH BANK	)									1	
		native veget	riparian zones c etation, including y shrubs, or nony egetative disrupti ring minimat or no	overed by trees, roody ion through at evident;	covered one cla represent not affi potential than one-	by native viss of planti ed; disrupti ecting full p to any grea	nbank surface egetation, but s is not well- ion evident but and growth at extent; mor potential plan	s 50-70% o surfaces co- disruption of bare soil of vegetation one-half of	Marginal If the streamb vered by vege obvious; patch or closely crop common; less the potential reight remaini	elation; nes of d oped s than n plant	surfaces lisruption of is very hig emoved to	covered by of streamba jh; vegetatio	streambank vegetation; nk vegetation on has been ers or less in height.	are experience and a second and a second and a second and a second and a second and a second and a second and a	Barbo al. 199 RBA # Parso al., 20 AUSR KDWF 2000;
															Peters
	Grade	10	9	8	7	6	5	4	3		2	11	0	3	3
	Grade	10	9	8	<u> </u>	6_	5	4	3			Avg.Scor		1 2	
														]	
	11 RIPARIAN	ZONE (SCORE E	EACH BANK) Optimal		·	Subopti	mal	<del>,</del> ,	Marginal			Poor		4	
		activities (l.e., pa	in zone >18 mete	beds, clear-	human act	parian zon	e 12-18 mete impacted zo	s; Width of ne meters; hu	iparian zone t man activities zone a great e	have li	ille or no i	iparian zone	<6 meters; etation due to fies.		Barbo al., 19 RBA t Parso al., 20
	Grade	10	9	8	<del>  7</del>	6	5	4	1 3		2	1 1	1 0	<del>                                     </del>	AUSR
	Grade	10	9	8	7	6	5	4	3		2		0	1	Ĭ
												Avg.Scor	'e	] 2	2
	12 RIPARIAN	HABITAT CONDI	ITION (SCORE	EACH B	ANK)									1	Norfo
			Optimal			Subopti			Marginal		~	Poor		]	SAAN
		>60% tree canop layers may in herbaceous, mosses/lichens a the high end additional layers	dbh>3 lnches) pr py cover. (Addit include: sapling, , and leaf litter in and woody debri d of Excellent ran is are present. Sc littional layers are	ional forest shrub, cluding s.) Score at ge if \( \geq 2 \) tore at low	with 30% (See I (See I examples Score at if if ≥2 ad present additional	to 60% tree Excollent C of additiona he high enc ditional fore Score at I forest laye	e canopy covidategory for all forest tayers of Good ran ast layers are low end if <1 ers are preser with stumps	present, will cover. (See for exam pe forest layer end of additional Score additional OR area maintaint dense h	um (dblir-3 inth < 30% free Ca h < 30% free Ca ples of addition s.) Score at th Fair range if a layers are pre layers are pre consists of n d and natural erbaceous an by vegetation.	canopy ategory la conal ac high 2 esent 1 esent ion- lized d/or	surfaces inds, culvi maintair denuded	s, croplands erted stream ned herbace	lively grazed	d	Form Field
					1							1 1	0	Dolein	J
	0-24-		<del></del>			1 ~	1 -			. 1				Below	- 1
	Grade 1. Delinea	10 te riparian areas	9 J	8 ream bant	7 k into Cond	dition Cate	5 egories and	Condition Sc	ores using		re descri			he sums of	7
	Delinea     Delermi	te riparian areas ne square footag	along each sti ge for each by	ream bant measurin	k into Cond g or estima	dition Cate	egories and th and width	Condition So Land Use C	ores using l	the abov ay be us	ed for th	ptors is.	Ensure I %Ripar	ian Blocks	
	Delinea     Delermi	te riparian areas	along each st ge for each by ea (or for field p	ream bant measurin	k into Cond g or estima	dition Cate ating leng th and wit	egories and th and width dth) and Sc	Condition So Land Use O ore for each r	ores using l SIS maps maps maps maps maps maps maps maps	the abov ay be us	ed for th he block	ptors is. s below.	Ensure I %Ripar		
	Delinea     Delermi	te riparian areas ne square footag e %Riparian Area	along each sto ge for each by ea (or for field r Optimal	ream bant measurin	k into Cond g or estima	dition Cate	egories and th and width dth) and Sc	Condition So Land Use O ore for each r	ores using l	the abov ay be us	ed for th he block P	ptors is. s below.	Ensure I %Ripar	ian Blocks	
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	Delinea     Delermi     Enter th	te riparian areas ne square footag e %Riparian Arei %Riparian Arei	along each sto ge for each by ea (or for field r Optimal	ream bani measurin purposes,	k into Cond g or estima	dition Cate ating leng th and wit	egories and th and width dth) and Sc	Condition So Land Use O ore for each r	ores using l SIS maps maps maps maps maps maps maps maps	the abov ay be us	ed for th he block P	ptors is. s below. oor	Ensure I %Ripar equ	ian Blocks	
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	Delinea     Delermi     Enter th     Right Bank	te riparian areas ne square footag e %Riparian Area %Riparian Area Score SubCl %Riparian Area	along each stige for each by ea (or for field r Optimal	ream bani measurin purposes,	k into Cond g or estima	dition Cating leng th and with Suboption 0	egories and th and width dth) and Sc	Condition So Land Use O ore for each r	ores using list maps maps maps maps maps maps maps maps	the abov ay be us	ed for th he block P	ptors is, s below. oor 100	Ensure I %Ripar equ	ian Blocks	
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ATTACHMENT C

#### BRIEF DESCRIPTION OF THE ECOLOGY FOR THE IDENTIFIED SPECIES

#### **INSECTS**

Mayflies (Ephemeropterans) (all larvae identified)

Baetidae are widespread and abundant occurring in a variety of streams and also in permanent and temporary ponds or littoral zones (areas of shallow water where light penetrates to the bottom allowing for rooted plant growth) of lakes.

Caenidae are widespread and common in a variety of lotic (running or flowing streams) and lentic (standing water) habitats, including slow-moving streams of all sizes, spring seeps, marshes, swamps, ponds, and lakes. They frequent sediments and often are partially covered with silt. They are generally more tolerant of lower levels of dissolved oxygen.

Heptageniidae are widespread and abundant in streams, wave-swept shorelines of lakes, or in vernal (in the Spring) ponds adjacent to streams. They typically inhabit rocks, wood, debris, and other strata to which they cling.

Flies, midges, and mosquitoes (Dipterans) (all larvae identified)

Ceratopogonidae or biting midges typically live in moist terrestrial habitats; however, many species do occur in aquatic habitats that include marshes, swamps, ponds, lakes, and streams.

Chironomidae or midges are the largest family of aquatic insects. They inhabit all types of permanent and temporary aquatic habitats. Larvae are an extremely important part of the aquatic ecosystem serving as prey for other organisms. Larvae are quite tolerant of lowered levels of dissolved oxygen including some species surviving in areas where oxygen levels are undetectable (blood worms — which were identified at all sampling locations). The larvae are primarily herbivores and detritivores feeding on fine bottom particles.

Culicidae or mosquitoes are common and widespread usually occurring in shallow, non-flowing or semi-flowing habitats such as swamps, shallow temporary or permanent ponds and marshes, and heavily vegetated margins of lakes and streams. They are not found in moving water or water subjected to wave action. The reason for this is that they obtain oxygen from use of breathing tubes at the water surface and wave action and current disrupt the water surface inhibiting their ability to obtain oxygen. Mosquitoes often dominate the insect community of temporary ponds and marshes, especially those that flood in spring and summer. The mosquito larvae feed on organic debris and microorganisms.

Dolicopodidae or long-legged flies develop in a wide variety of lotic and lentic habitats. Little information is available for this family.

### Dragonflies and Damselflies (Odonates)

Libellulidae (Dragonfly) occur in a variety of permanent and temporary lentic habitats where they crawl on vegetation and debris. Usually found along littoral areas of lakes, permanent ponds, vernal ponds and marshes, cattail marshes, sphagnum swamps, and bogs. They are highly beneficial predators feeding primarily on insects, especially mosquitoes.

Coenagrionidae (Damselfly) is a lentic species found mostly in permanent ponds, marshes, swamps, and littoral zones of lakes. They occasionally occur among vegetation in parts of streams with little or no current. They are highly beneficial predators feeding primarily on insects, especially mosquitoes.

Aquatic and Semi-Aquatic Bugs (Hemipterans) (Adults)

Corixidae or water boatmen are found in most permanent aquatic habitats and frequently invade temporary ones as well. They feed primarily on detritus, algae, protozoans, and other extremely small animals including insects.

Water Beetles (Coleopterans) (Both larvae and adults)

Gyrinidae or whirligig beetles are widespread and abundant. Most species are lentic with larvae found mostly among submerged vegetation. Larvae are predators feeding on invertebrates while the adults are scavengers feeding on dead animals or preying on small invertebrates.

Haliplidae or crawling water beetles are often abundant in shallow lentic or lotic vegetation choked habitats. They are known to overwinter in terrestrial sites adjacent to the water. They are usually found on submerged vegetation or algae. Both the adult and larvae are predators of invertebrates.

Hydrophilidae or water scavenger beetles are a large and abundant family that mostly inhabits shallow, vegetated pool and pond habitats. Adults feed on both living and decaying vegetation whereas the larvae are voracious predators.

Collembula (Spring Tails) are grouped in the class Insecta; however, there is discussion as to the continued inclusion of Collembula in the class Insecta. For this discussion, they are included with the class Insecta. Spring tails are semi-aquatic species located on the surface of marshes, ponds, in quiet areas of lakes, and other damp areas feeding primarily on algae, detritus, and other organic material.

#### **CRUSTACEANS**

Amphipods or scuds (Peracarida) have a widespread distribution and are extremely abundant. Amphipods tend to be located in shallow, clear waters, including springs, spring brooks, streams, pools, ponds, and lakes typically attached to rooted vegetation or algae. They are omnivorous scavengers feeding on plant and animal material.

Cladocerans (Water Fleas) are widespread and abundant occurring in all but the harshest freshwater habitats. While they are more abundant in lakes, ponds, and sluggish streams, they also occur in quiet water and in marginal vegetation in rushing streams. Some species can tolerate low levels of dissolved oxygen. They primarily feed on organic detritus, bacteria, algae, and protozoans.

Copepods are found in a wide variety of aquatic environments ranging from lakes, slow moving streams and rivers, swamps, wetlands, marshes, temporary ponds, and small puddles. Copepods are present but less abundant in flowing water of streams and rivers. They are more tolerant of low dissolved oxygen than water fleas. They are an important link in the aquatic food chain.

Astacidae (specifically Cambaridae) or crayfish are typically found in the following habitats: shallow lentic and lotic waters, lakes, ponds, marshes, ditches, low-gradient large rivers, springs, and terrestrial burrows leading to groundwater. They feed on both plant and animal materials and are efficient scavengers.

Ostracods (Seed Shrimp) are found in nearly every conceivable aquatic habitat ranging from temporary and permanent ponds, lakes, intermittent and permanent streams, ditches and irrigation canals. Most are scavengers feeding on bacteria, molds, algae, and detritus.

### **ARACHNIDS**

Hydracarina (Water Mites) are widespread and abundant readily found in all types of aquatic environments. They are typically found in lakes, temporary pools, springs, riffle habitats, and interstitial spaces. They are food for many aquatic invertebrates.

### **GASTROPODS**

Planorbidae (Snails) are widespread and fairly diverse. Planorbids possess hemoglobin as a respiratory pigment and therefore can live in low oxygenated conditions. One of the most intriguing aspects of the biology of freshwater snails is their adaptation to the relative ephemerality of their habitats. They feed on microscopic algae, filamentous algae, aquatic plants, and dead organic matter.

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Pennak, R.W. 1989. Fresh-water Invertebrates of the United States – Protozoa to Mollusca, 3<sup>rd</sup> Edition. John Wiley and Sons, New York. 628 pp.

Thorp, J.H. and A.P. Covich, eds. 1991. Ecology and Classification of North American Freshwater Invertebrates. Academic Press, Inc., New York. 911 pp.

# **ATTACHMENT B**

Letter Dated August 28, 2006 from Alan Plummer Associates, Inc. to Edward Motley, Chiang, Patel and Yerby, Inc.





JAMES L. AETSTAETTER, P.E.
STEPHEN J. COONAN, P.E.
PEGGYW, GRASS, P.D.
DAMID A. GUDAL, P.E.
BETTY L. JORDAN, R.E.
ALAN H. PLUMMER, JR., P.E., DEE
RICHARD H. SMITH, P.E.
ALAN R. TUCKER, P.E.

346-0402

August 28, 2006

Mr. Edward Motley, P.E. Chiang, Patel, and Yerby, Inc. 1820 Regal Row, Suite 200 Dallas, Texas 75235

RE: Biological Conditions within the North Sulphur River – Proposed Lake Ralph Hall

Dear Mr. Motley:

An on-site investigation for assessment of the terrestrial and aquatic communities outside of the conservation pool and within the project area was conducted on August 24 and 25, 2006. This assessment was performed to quantify existing conditions pre-construction of Lake Ralph Hall and to predict the post-construction improvements or detriments to these communities. In conjunction with this assessment, the North Sulphur River was observed to determine the extent of water within the channel.

The North Sulphur River was visually assessed at three locations: FM 904 Bridge, FM 2920 Bridge, and the FM 64 Bridge. At each location, no water was observed within the channel. Photographs from the visual assessment are included in Attachment A. In a letter dated June 15, 2006, conditions within the North Sulphur River as of May 10, 2006 were described which included descriptions of aquatic organisms observed. The letter summarized that the aquatic organisms observed are "common and abundant throughout the area and would be expected to colonize ephemeral and intermittent pools within the North Sulphur River. The fact that flow in the river occurs only in response to rain events, leaving the bed of the river essentially dry the vast majority of the time would strongly suggest that a sustainable community of aquatic organisms cannot and does not exist within the river channel. The organisms observed are opportunists, temporarily sustained by the ephemeral pools and the limited temporal habitat these pools provide."

The observation of no pools or any water within the channel during the August 24 and 25, 2006 investigation substantiates this conclusion. Should you have any

720 SOUTH UNIVERSITY DRIVE TE 300 FORT WORTH TEXAS 76107-5737 PHONE 817-806-1700 METRO 817-970-2544 FAX 887-870-2536

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Mr. Edward Motley, P.E. August 28, 2006 Page 2 of 2

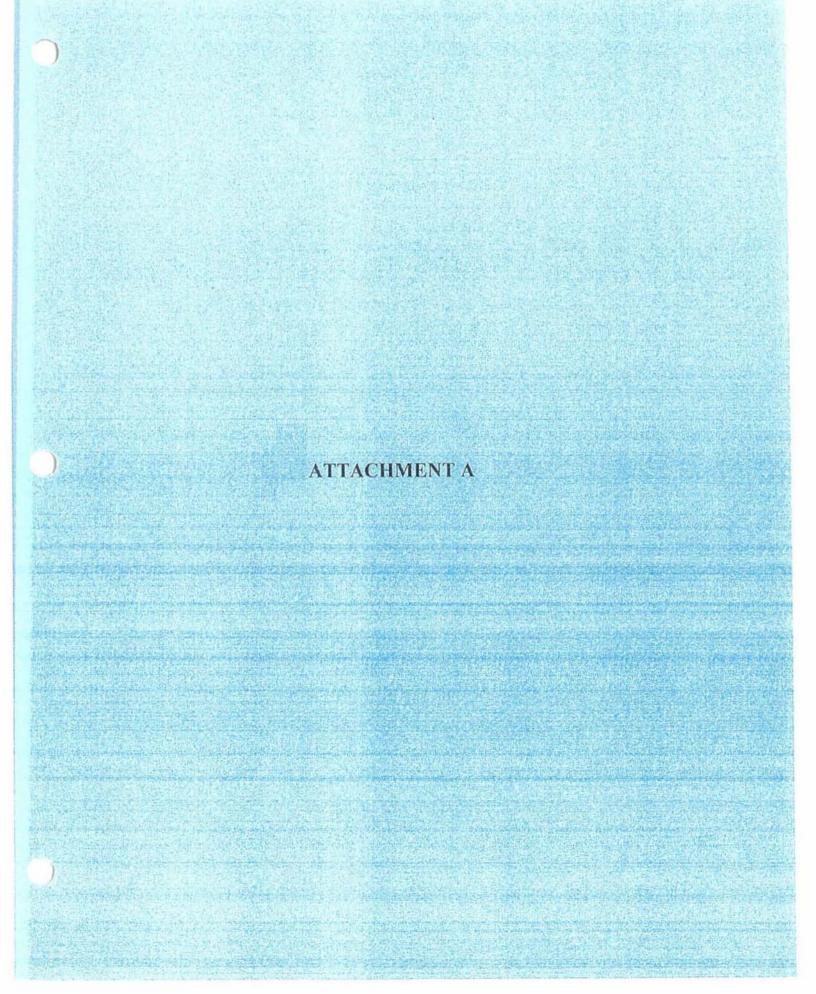
questions or comments, please feel free to phone either Loretta Mokry or myself at (817) 806-1700.

Sincerely,

ALAN PLUMMER ASSOCIATES, INC.

Jason Voight

Attachment





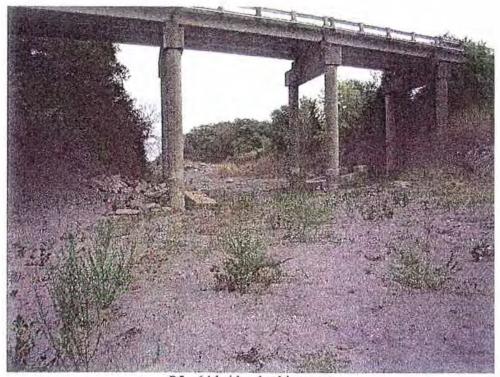
P1. 904 bridge looking west.





P3. 2920 bridge looking east





P5. 64 bridge looking east



# ATTACHMENT C

Calculations of Instream Flow Requirements for Lake Ralph Hall As Prepared by R. J. Brandes Company, August 20, 2003



# APPLICATION OF LYONS METHOD FOR INSTREAM FLOW REQUIREMENTS LAKE RALPH HALL - NORTH SULPHUR RIVER

RJBCO / 08-20-03

	Drainage Area	at Ralph Hall	Dam Site:	100.9	square miles	<b>;</b>	
	Drainage Area	at Gage No. 0	7343000	276.0	square miles	į	
	Ratio of Dam-t	o-Gage Draina	ige Areas:	0.366			
		m Flow for Wat	-	0.1	cfs (7Q2 Flo	ow)	
		m Flow for Wat	•		ac-ft/month	,	
			•				
MONTH	MEDIAN *	MEDIAN	LYONS	LYC	ONS	PRELIM	IINARY
	FLOW	FLOW	% OF	MINIL	JMUM	MINIM	иим
	AT	AT	MEDIAN	ENVIRON	I. FLOWS	ENVIRON	. FLOWS
	GAGE	DAM SITE	FLOW	AT DAI	M SITE	AT DAN	/ SITE
	cfs	cfs		cfs	ac-ft	cfs	ac-ft
JAN	26.0	9.5	40%	3.8	211	3.8	211
FEB	40.0	14.6	40%	5.8	325	5.8	325
MAR	36.0	13.2	60%	7.9	486	7.9	486
APR	28.0	10.2	60%	6.1	365	6.1	365
MAY	24.0	8.8	60%	5.3	324	5.3	324
JUN	11.0	4.0	60%	2.4	144	2.4	144
JUL	1.6	0.6	60%	0.4	22	0.4	22
AUG	0.2	0.1	60%	<0.1	3	0.1	6
SEP	0.5	0.2	60%	0.1	7	0.1	7
ОСТ	1.6	0.6	40%	0.2	14	0.2	14
NOV	9.3	3.4	40%	1.4	81	1.4	81
DEC	20.0	7.3	40%	2.9	180	2.9	180
,	* Based on 1949	9-2002 mean d	laily flow recor	ds.		Total =	2,164

Lake Ralph Hall Appendix G Appendix G **Hazardous Materials Radius Report** 



# Radius Report

**NEW:** GeoLens by Geosearch

### Target Property:

Proposed Lake Ralph Hall Project Area & Pipeline Alignment Fannin County, Texas

Prepared For:

Michael Baker International-Round Rock

Order #: 113649

Job #: 253814

Date: 08/28/2018



### **Table of Contents**

Target Property Summary
Database Summary
Database Radius Summary
Radius Map
Ortho Map
Topographic Map
Located Sites Summary
Elevation Summary
Unlocated Sites Summary
Environmental Records Definitions
Unlocatable Report
Zin Penert See Attachmen

#### Disclaimer

This report was designed by GeoSearch to meet or exceed the records search requirements of the All Appropriate Inquiries Rule (40 CFR  $i \ge 1/2$ 312.26) and the current version of the ASTM International E1527, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process or, if applicable, the custom requirements requested by the entity that ordered this report. The records and databases of records used to compile this report were collected from various federal, state and local governmental entities. It is the goal of GeoSearch to meet or exceed the 40 CFR  $i \ge 1/2$ 312.26 and E1527 requirements for updating records by using the best available technology. GeoSearch contacts the appropriate governmental entities on a recurring basis. Depending on the frequency with which a record source or database of records is updated by the governmental entity, the data used to prepare this report may be updated monthly, quarterly, semi-annually, or annually.

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### Target Property Summary

### **Target Property Information**

Proposed Lake Ralph Hall Project Area & Pipeline Alignment Texas

#### Coordinates

Area centroid (-95.968948, 33.4594742) 535 feet above sea level

#### **USGS Quadrangle**

Farmersville, TX Greenville Nw, TX Honey Grove, TX Celeste, TX Wolfe City, TX Commerce North, TX Gober, TX Ladonia, TX

### **Geographic Coverage Information**

County/Parish: Fannin (TX), Collin (TX), Hunt (TX)

ZipCode(s):

Celeste TX: 75423 Dodd City TX: 75438 Farmersville TX: 75442 Honey Grove TX: 75446 Ladonia TX: 75449 Leonard TX: 75452 Wolfe City TX: 75496

### **FEDERAL LISTING**

### **Standard Environmental Records**

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
EMERGENCY RESPONSE NOTIFICATION SYSTEM	<u>ERNSTX</u>	0	0	TP/AP
FEDERAL ENGINEERING INSTITUTIONAL CONTROL SITES	EC	0	0	TP/AP
LAND USE CONTROL INFORMATION SYSTEM	<u>LUCIS</u>	0	0	TP/AP
RCRA SITES WITH CONTROLS	<u>RCRASC</u>	0	0	TP/AP
RESOURCE CONSERVATION & RECOVERY ACT - GENERATOR	RCRAGR06	0	0	0.1250
RESOURCE CONSERVATION & RECOVERY ACT - NON- GENERATOR	RCRANGR06	0	0	0.1250
FEMA OWNED STORAGE TANKS	<u>FEMAUST</u>	0	0	0.2500
BROWNFIELDS MANAGEMENT SYSTEM	<u>BF</u>	0	0	0.5000
DELISTED NATIONAL PRIORITIES LIST	<u>DNPL</u>	0	0	0.5000
NO LONGER REGULATED RCRA NON-CORRACTS TSD FACILITIES	<u>NLRRCRAT</u>	0	0	0.5000
RESOURCE CONSERVATION & RECOVERY ACT - NON-CORRACTS TREATMENT, STORAGE & DISPOSAL FACILITIES	<u>RCRAT</u>	0	0	0.5000
SUPERFUND ENTERPRISE MANAGEMENT SYSTEM	<u>SEMS</u>	0	0	0.5000
SUPERFUND ENTERPRISE MANAGEMENT SYSTEM ARCHIVED SITE INVENTORY	<u>SEMSARCH</u>	0	0	0.5000
NATIONAL PRIORITIES LIST	<u>NPL</u>	0	0	1.0000
NO LONGER REGULATED RCRA CORRECTIVE ACTION FACILITIES	<u>NLRRCRAC</u>	0	0	1.0000
PROPOSED NATIONAL PRIORITIES LIST	<u>PNPL</u>	0	0	1.0000
RESOURCE CONSERVATION & RECOVERY ACT - CORRECTIVE ACTION FACILITIES	RCRAC	0	0	1.0000
RESOURCE CONSERVATION & RECOVERY ACT - SUBJECT TO CORRECTIVE ACTION FACILITIES	<u>RCRASUBC</u>	0	0	1.0000
SUBTOTAL	<u> </u>		0	
SUB-TOTAL		0	0	

### **Additional Environmental Records**

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
AEROMETRIC INFORMATION RETRIEVAL SYSTEM / AIR FACILITY SUBSYSTEM	<u>AIRSAFS</u>	0	0	TP/AP
BIENNIAL REPORTING SYSTEM	<u>BRS</u>	0	0	TP/AP
CERCLIS LIENS	<u>SFLIENS</u>	0	0	TP/AP
CLANDESTINE DRUG LABORATORY LOCATIONS	<u>CDL</u>	0	0	TP/AP
EPA DOCKET DATA	<u>DOCKETS</u>	0	0	TP/AP
ENFORCEMENT AND COMPLIANCE HISTORY INFORMATION	ECHOR06	1	0	TP/AP

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
FACILITY REGISTRY SYSTEM	FRSTX	3	0	TP/AP
HAZARDOUS MATERIALS INCIDENT REPORTING SYSTEM	HMIRSR06	0	0	TP/AP
INTEGRATED COMPLIANCE INFORMATION SYSTEM (FORMERLY DOCKETS)	<u>ICIS</u>	0	0	TP/AP
INTEGRATED COMPLIANCE INFORMATION SYSTEM NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM	<u>ICISNPDES</u>	1	0	TP/AP
MATERIAL LICENSING TRACKING SYSTEM	<u>MLTS</u>	0	0	TP/AP
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM	NPDESR06	0	0	TP/AP
PCB ACTIVITY DATABASE SYSTEM	<u>PADS</u>	0	0	TP/AP
PERMIT COMPLIANCE SYSTEM	PCSR06	0	0	TP/AP
SEMS LIEN ON PROPERTY	<u>SEMSLIENS</u>	0	0	TP/AP
SECTION SEVEN TRACKING SYSTEM	<u>SSTS</u>	0	0	TP/AP
TOXIC SUBSTANCE CONTROL ACT INVENTORY	<u>TSCA</u>	0	0	TP/AP
TOXICS RELEASE INVENTORY	<u>TRI</u>	0	0	TP/AP
ALTERNATIVE FUELING STATIONS	<u>ALTFUELS</u>	0	0	0.2500
HISTORICAL GAS STATIONS	<u>HISTPST</u>	0	0	0.2500
INTEGRATED COMPLIANCE INFORMATION SYSTEM DRYCLEANERS	<u>ICISCLEANERS</u>	0	0	0.2500
MINE SAFETY AND HEALTH ADMINISTRATION MASTER INDEX FILE	<u>MSHA</u>	0	0	0.2500
MINERAL RESOURCE DATA SYSTEM	<u>MRDS</u>	0	0	0.2500
OPEN DUMP INVENTORY	<u>ODI</u>	0	0	0.5000
SURFACE MINING CONTROL AND RECLAMATION ACT SITES	<u>SMCRA</u>	0	0	0.5000
URANIUM MILL TAILINGS RADIATION CONTROL ACT SITES	<u>USUMTRCA</u>	0	0	0.5000
DEPARTMENT OF DEFENSE SITES	<u>DOD</u>	0	0	1.0000
FORMER MILITARY NIKE MISSILE SITES	<u>NMS</u>	0	0	1.0000
FORMERLY USED DEFENSE SITES	<u>FUDS</u>	0	0	1.0000
FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM	<u>FUSRAP</u>	0	0	1.0000
RECORD OF DECISION SYSTEM	RODS	0	0	1.0000
SUB-TOTAL		5	0	

### STATE (TX) LISTING

### Standard Environmental Records

				Search Radius
Database	Acronym	Locatable	Unlocatable	(miles)
STATE INSTITUTIONAL/ENGINEERING CONTROL SITES	SIEC01	0	0	TP/AP
DRY CLEANER REGISTRATION DATABASE	<u>DCR</u>	0	0	0.2500
PETROLEUM STORAGE TANKS	<u>PST</u>	0	0	0.2500
BROWNFIELDS SITE ASSESSMENTS	<u>BSA</u>	0	0	0.5000
CLOSED & ABANDONED LANDFILL INVENTORY	<u>CALF</u>	1	0	0.5000
LEAKING PETROLEUM STORAGE TANKS	<u>LPST</u>	0	0	0.5000
MUNICIPAL SOLID WASTE LANDFILL SITES	<u>MSWLF</u>	1	0	0.5000
RADIOACTIVE WASTE SITES	<u>RWS</u>	0	0	0.5000
RAILROAD COMMISSION VCP AND BROWNFIELD SITES	<u>RRCVCP</u>	0	0	0.5000
VOLUNTARY CLEANUP PROGRAM SITES	<u>VCP</u>	0	0	0.5000
INDUSTRIAL AND HAZARDOUS WASTE CORRECTIVE ACTION SITES	<u>IHWCA</u>	0	0	1.0000
STATE SUPERFUND SITES	<u>SF</u>	0	0	1.0000
	1			
SUB-TOTAL		2	0	

### **Additional Environmental Records**

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
GROUNDWATER CONTAMINATION CASES	<u>GWCC</u>	0	0	TP/AP
HISTORIC GROUNDWATER CONTAMINATION CASES	<u>HISTGWCC</u>	0	0	TP/AP
LAND APPLICATION PERMITS	<u>LANDAPP</u>	0	0	TP/AP
MUNICIPAL SETTING DESIGNATIONS	<u>MSD</u>	0	0	TP/AP
NOTICE OF VIOLATIONS	NOV	0	0	TP/AP
SPILLS LISTING	<u>SPILLS</u>	0	0	TP/AP
TCEQ LIENS	<u>LIENS</u>	0	0	TP/AP
TIER I I CHEMICAL REPORTING PROGRAM FACILITIES	<u>TIERII</u>	0	0	TP/AP
INDUSTRIAL AND HAZARDOUS WASTE SITES	<u>IHW</u>	0	0	0.2500
PERMITTED INDUSTRIAL HAZARDOUS WASTE SITES	<u>PIHW</u>	0	0	0.2500
AFFECTED PROPERTY ASSESSMENT REPORTS	<u>APAR</u>	0	0	0.5000
DRY CLEANER REMEDIATION PROGRAM SITES	<u>DCRPS</u>	0	О	0.5000
INNOCENT OWNER / OPERATOR DATABASE	<u>IOP</u>	0	0	0.5000
RECYCLING FACILITIES	<u>WMRF</u>	0	0	0.5000
SALT CAVERNS FOR PETROLEUM STORAGE	STCV	0	О	0.5000

Order# 113649 Job# 253814 4 of 47

CUD TOTAL		_	l
I SUB-TUTAL	I U	ı U	I I

### TRIBAL LISTING

### **Standard Environmental Records**

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
UNDERGROUND STORAGE TANKS ON TRIBAL LANDS	<u>USTR06</u>	0	0	0.2500
LEAKING UNDERGROUND STORAGE TANKS ON TRIBAL LANDS	<u>LUSTR06</u>	0	0	0.5000
OPEN DUMP INVENTORY ON TRIBAL LANDS	<u>ODINDIAN</u>	0	0	0.5000
SUB-TOTAL		0	0	

### **Additional Environmental Records**

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
INDIAN RESERVATIONS	INDIANRES	0	0	1.0000
CUD TOTAL	T	0	0	
SUB-TOTAL		0	0	
TOTAL		7	0	

Order# 113649 Job# 253814 6 of 47

### **FEDERAL LISTING**

Standard environmental records are displayed in bold.

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
AIRSAFS	0.0200	0	NS	NS	NS	NS	NS	0
BRS	0.0200	0	NS	NS	NS	NS	NS	0
CDL	0.0200	0	NS	NS	NS	NS	NS	0
DOCKETS	0.0200	0	NS	NS	NS	NS	NS	0
EC	0.0200	0	NS	NS	NS	NS	NS	0
ECHOR06	0.0200	1	NS	NS	NS	NS	NS	1
ERNSTX	0.0200	0	NS	NS	NS	NS	NS	0
FRSTX	0.0200	3	NS	NS	NS	NS	NS	3
HMIRSR06	0.0200	0	NS	NS	NS	NS	NS	0
ICIS	0.0200	0	NS	NS	NS	NS	NS	0
ICISNPDES	0.0200	1	NS	NS	NS	NS	NS	1
LUCIS	0.0200	0	NS	NS	NS	NS	NS	o
MLTS	0.0200	0	NS	NS	NS	NS	NS	0
NPDESR06	0.0200	0	NS	NS	NS	NS	NS	0
PADS	0.0200	0	NS	NS	NS	NS	NS	0
PCSR06	0.0200	0	NS	NS	NS	NS	NS	0
RCRASC	0.0200	0	NS	NS	NS	NS	NS	0
SEMSLIENS	0.0200	0	NS	NS	NS	NS	NS	0
SFLIENS	0.0200	0	NS	NS	NS	NS	NS	0
SSTS	0.0200	0	NS	NS	NS	NS	NS	0
TRI	0.0200	0	NS	NS	NS	NS	NS	0
TSCA	0.0200	0	NS	NS	NS	NS	NS	0
RCRAGR06	0.1250	0	o	NS	NS	NS	NS	o
RCRANGR06	0.1250	0	o	NS	NS	NS	NS	0
ALTFUELS	0.2500	0	0	0	NS	NS	NS	0
FEMAUST	0.2500	0	o	О	NS	NS	NS	o
HISTPST	0.2500	0	0	0	NS	NS	NS	0
ICISCLEANERS	0.2500	0	0	0	NS	NS	NS	0
MRDS	0.2500	0	0	О	NS	NS	NS	0
MSHA	0.2500	0	0	0	NS	NS	NS	0
BF	0.5000	О	О	o	o	NS	NS	o
DNPL	0.5000	О	О	o	О	NS	NS	o
NLRRCRAT	0.5000	О	О	o	О	NS	NS	o
ODI	0.5000	0	0	0	О	NS	NS	0
RCRAT	0.5000	О	o	О	О	NS	NS	o

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
SEMS	0.5000	0	0	О	О	NS	NS	o
SEMSARCH	0.5000	0	o	О	О	NS	NS	o
SMCRA	0.5000	0	0	0	0	NS	NS	0
USUMTRCA	0.5000	0	0	0	0	NS	NS	0
DOD	1.0000	0	0	0	0	0	NS	0
FUDS	1.0000	0	0	0	0	0	NS	0
FUSRAP	1.0000	0	0	0	0	0	NS	0
NLRRCRAC	1.0000	0	0	О	О	o	NS	o
NMS	1.0000	0	0	0	0	0	NS	0
NPL	1.0000	0	0	О	О	o	NS	o
PNPL	1.0000	О	0	О	О	o	NS	o
RCRAC	1.0000	О	0	О	О	o	NS	o
RCRASUBC	1.0000	О	o	О	О	o	NS	o
RODS	1.0000	0	0	0	0	0	NS	0
SUB-TOTAL		5	0	0	0	0	0	5

### STATE (TX) LISTING

Standard environmental records are displayed in **bold**.

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
GWCC	0.0200	0	NS	NS	NS	NS	NS	0
HISTGWCC	0.0200	0	NS	NS	NS	NS	NS	0
LANDAPP	0.0200	0	NS	NS	NS	NS	NS	0
LIENS	0.0200	0	NS	NS	NS	NS	NS	0
MSD	0.0200	0	NS	NS	NS	NS	NS	0
NOV	0.0200	0	NS	NS	NS	NS	NS	0
SIEC01	0.0200	0	NS	NS	NS	NS	NS	o
SPILLS	0.0200	0	NS	NS	NS	NS	NS	0
TIERII	0.0200	0	NS	NS	NS	NS	NS	0
DCR	0.2500	0	o	О	NS	NS	NS	o
IHW	0.2500	0	0	0	NS	NS	NS	0
PIHW	0.2500	0	0	0	NS	NS	NS	0
PST	0.2500	0	o	О	NS	NS	NS	o
APAR	0.5000	0	0	0	0	NS	NS	0
BSA	0.5000	0	o	o	О	NS	NS	0
CALF	0.5000	0	1	o	О	NS	NS	1
DCRPS	0.5000	0	0	0	0	NS	NS	0
IOP	0.5000	0	0	0	0	NS	NS	0
LPST	0.5000	0	o	o	О	NS	NS	0
MSWLF	0.5000	0	o	1	О	NS	NS	1
RRCVCP	0.5000	0	О	o	О	NS	NS	0
RWS	0.5000	0	o	o	О	NS	NS	0
STCV	0.5000	0	0	0	0	NS	NS	0
VCP	0.5000	o	О	О	o	NS	NS	o
WMRF	0.5000	0	0	О	0	NS	NS	0
IHWCA	1.0000	0	o	o	o	o	NS	0
SF	1.0000	0	0	0	0	0	NS	0
SUB-TOTAL		0	1	1	0	0	0	2

### TRIBAL LISTING

Standard environmental records are displayed in bold.

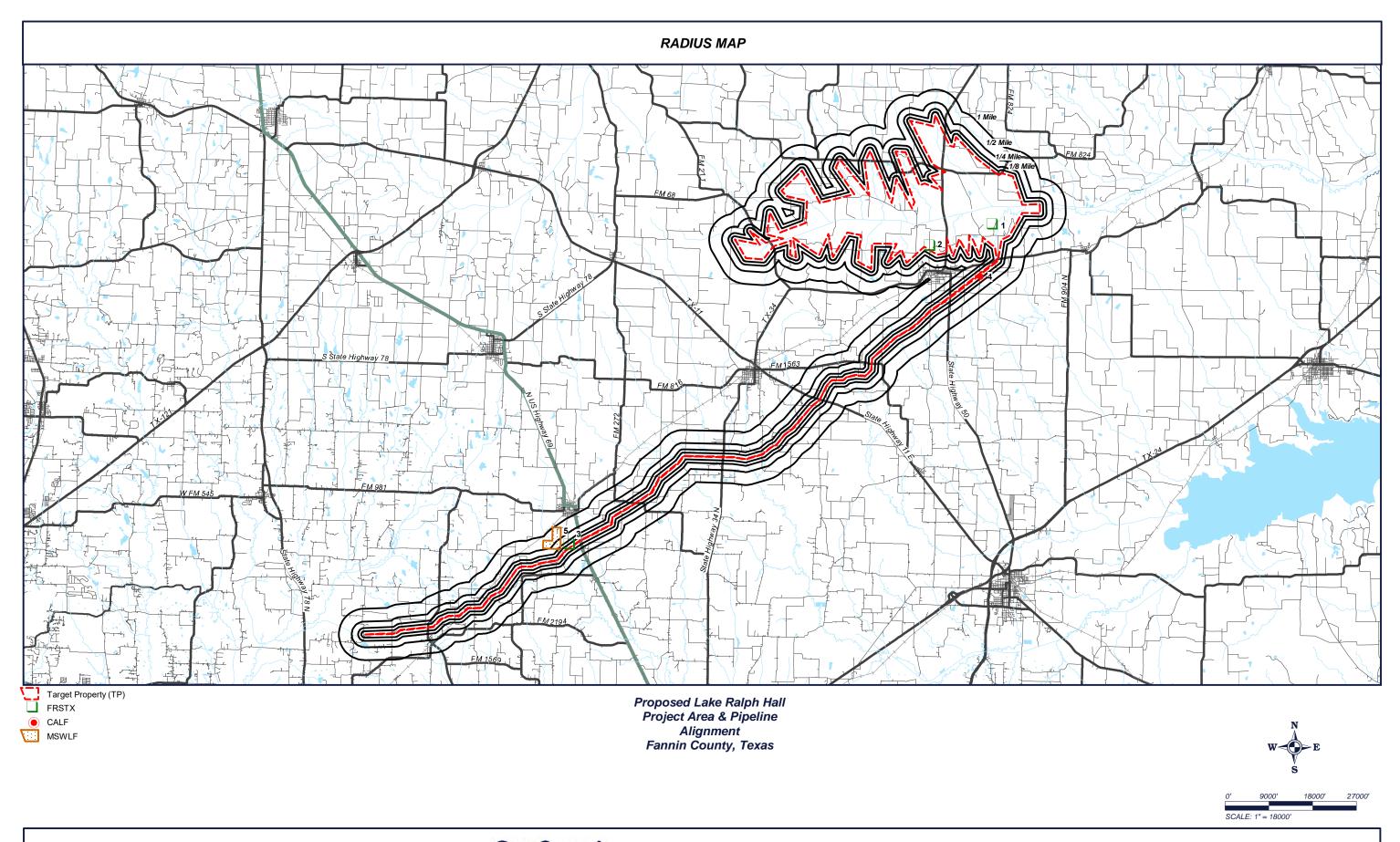
Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
USTR06	0.2500	0	0	0	NS	NS	NS	0
LUSTR06	0.5000	0	0	0	О	NS	NS	o
ODINDIAN	0.5000	0	0	0	О	NS	NS	o
INDIANRES	1.0000	0	0	0	0	0	NS	0
SUB-TOTAL		0	0	0	0	0	0	0

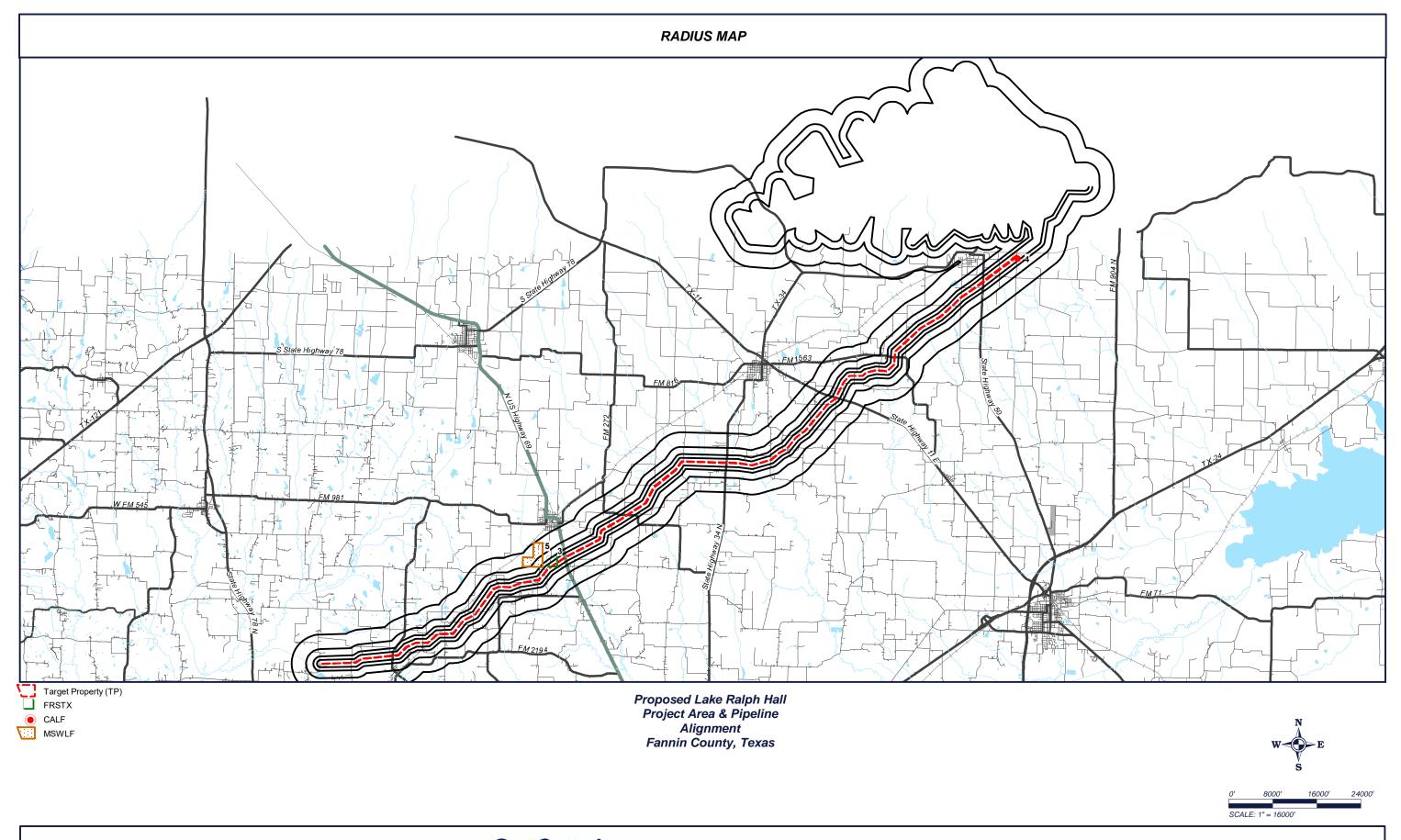
TOTAL	5	1	1	0	0	0	7

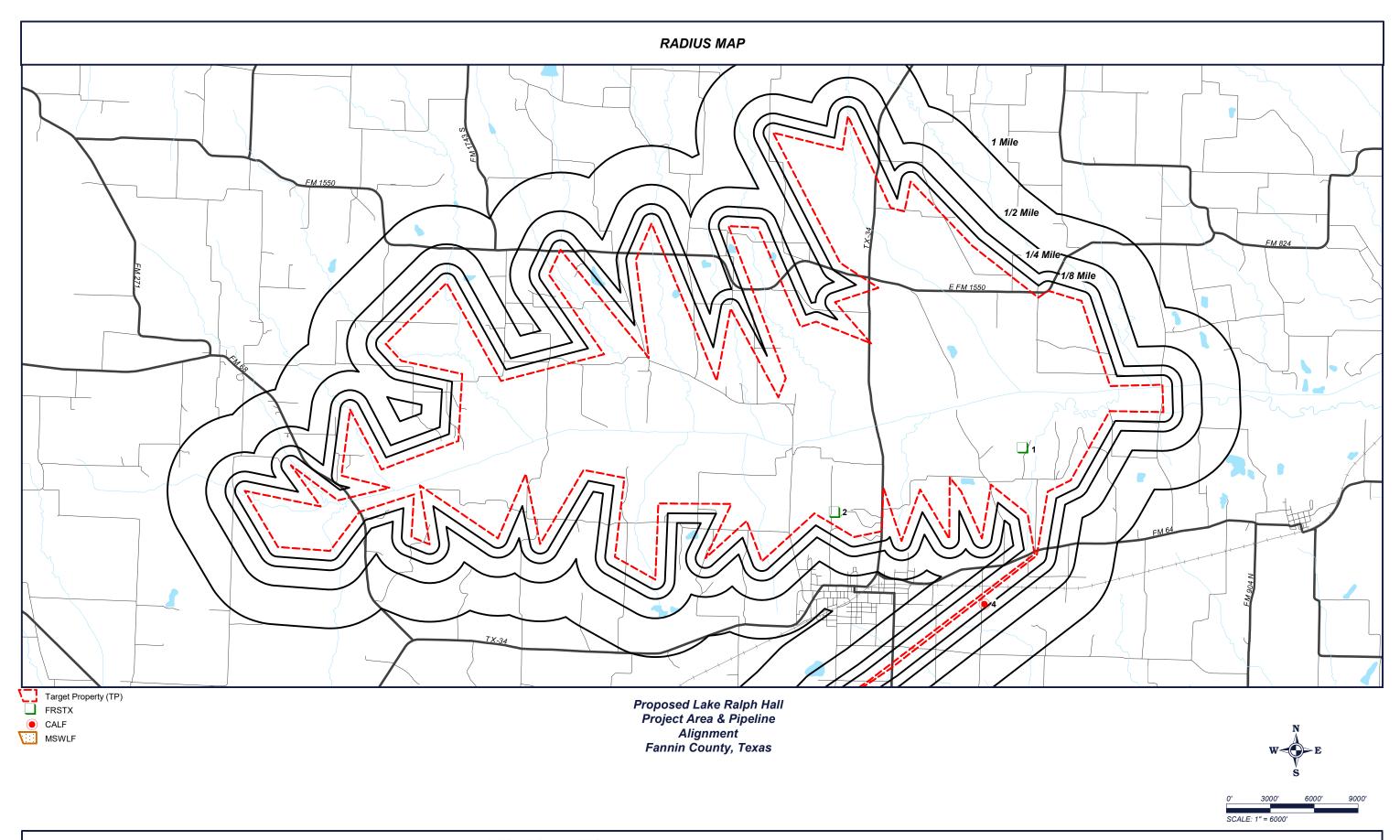
NOTES:

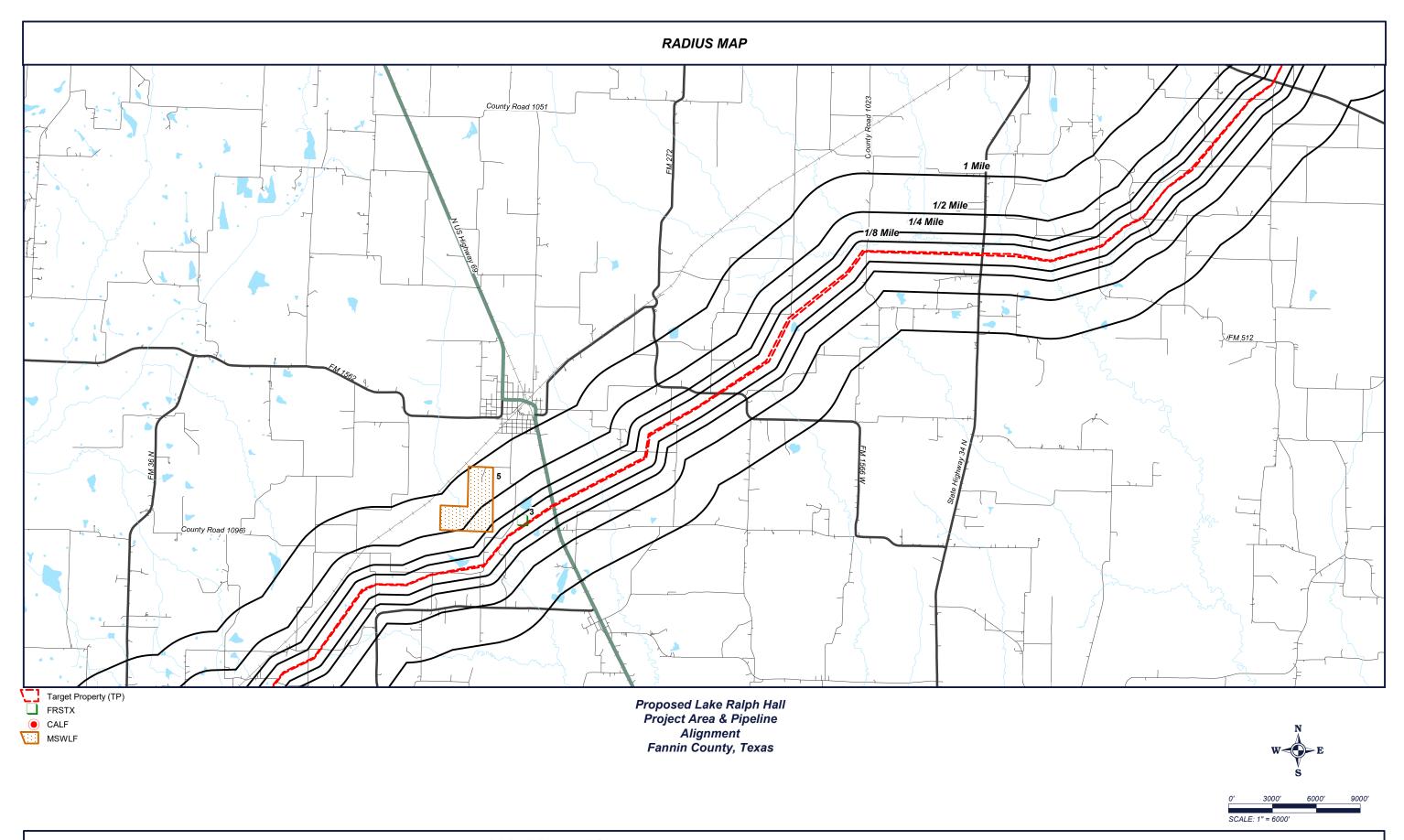
NS = NOT SEARCHED

TP/AP = TARGET PROPERTY/ADJACENT PROPERTY

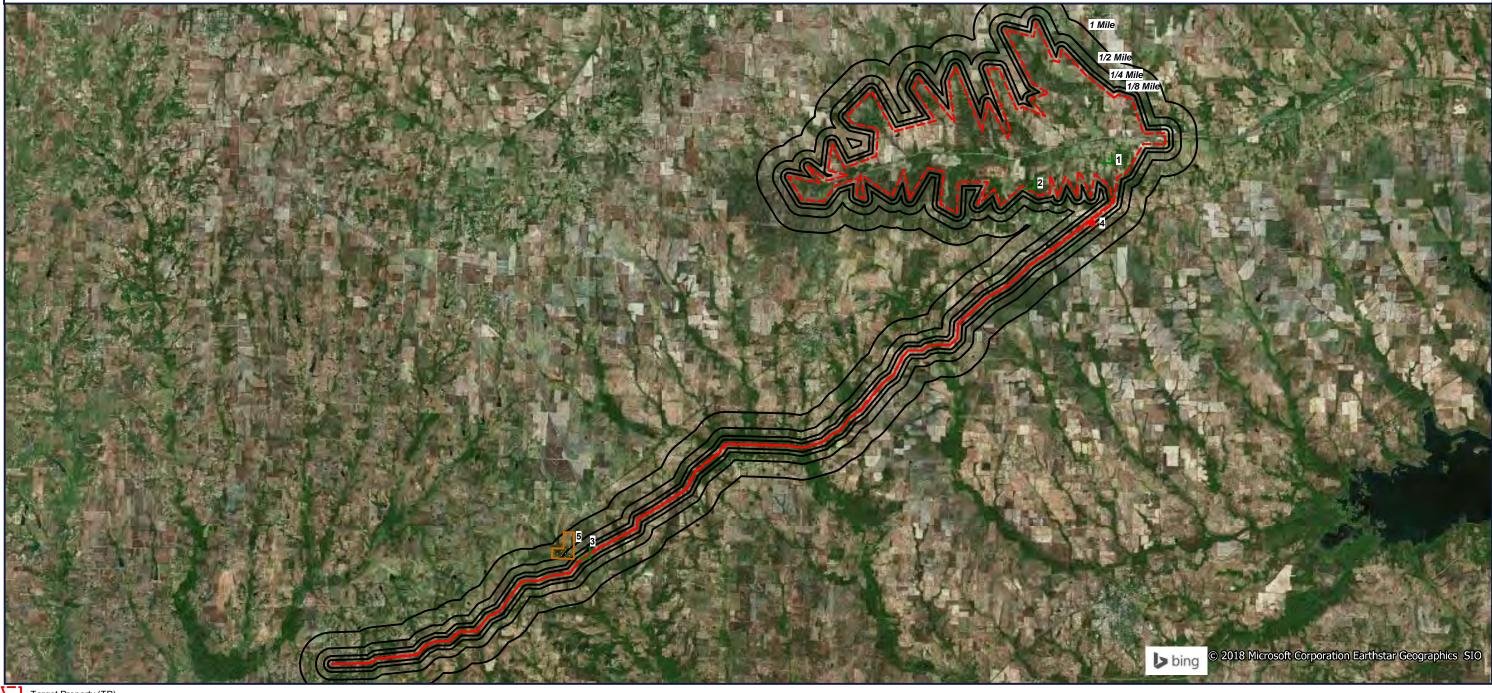


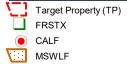




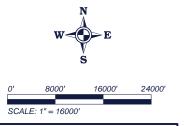


### ОКТНОРНОТО МАР





Quadrangle(s): Farmersville, Greenville Nw, Honey Grove, Celeste, Wolfe City, Commerce
North, Gober, Ladonia
Proposed Lake Ralph Hall
Project Area & Pipeline
Alignment
Fannin County, Texas



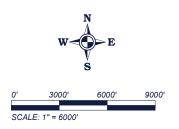
### ОКТНОРНОТО МАР



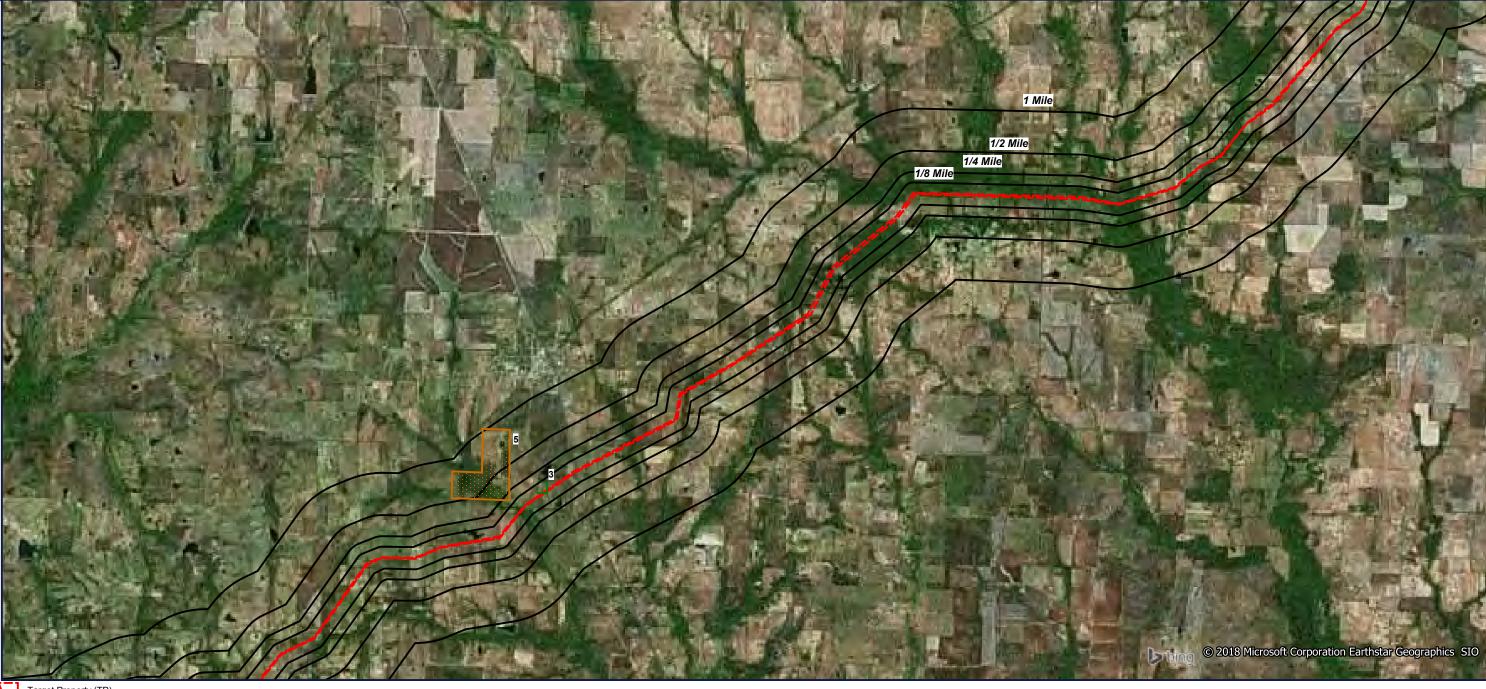
Target Pi Target Property (TP)

CALF MSWLF

Quadrangle(s): Farmersville, Greenville Nw, Honey Grove, Celeste, Wolfe City, Commerce
North, Gober, Ladonia
Proposed Lake Ralph Hall
Project Area & Pipeline
Alignment
Fannin County, Texas



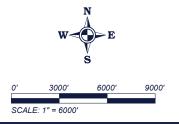
### ОКТНОРНОТО МАР

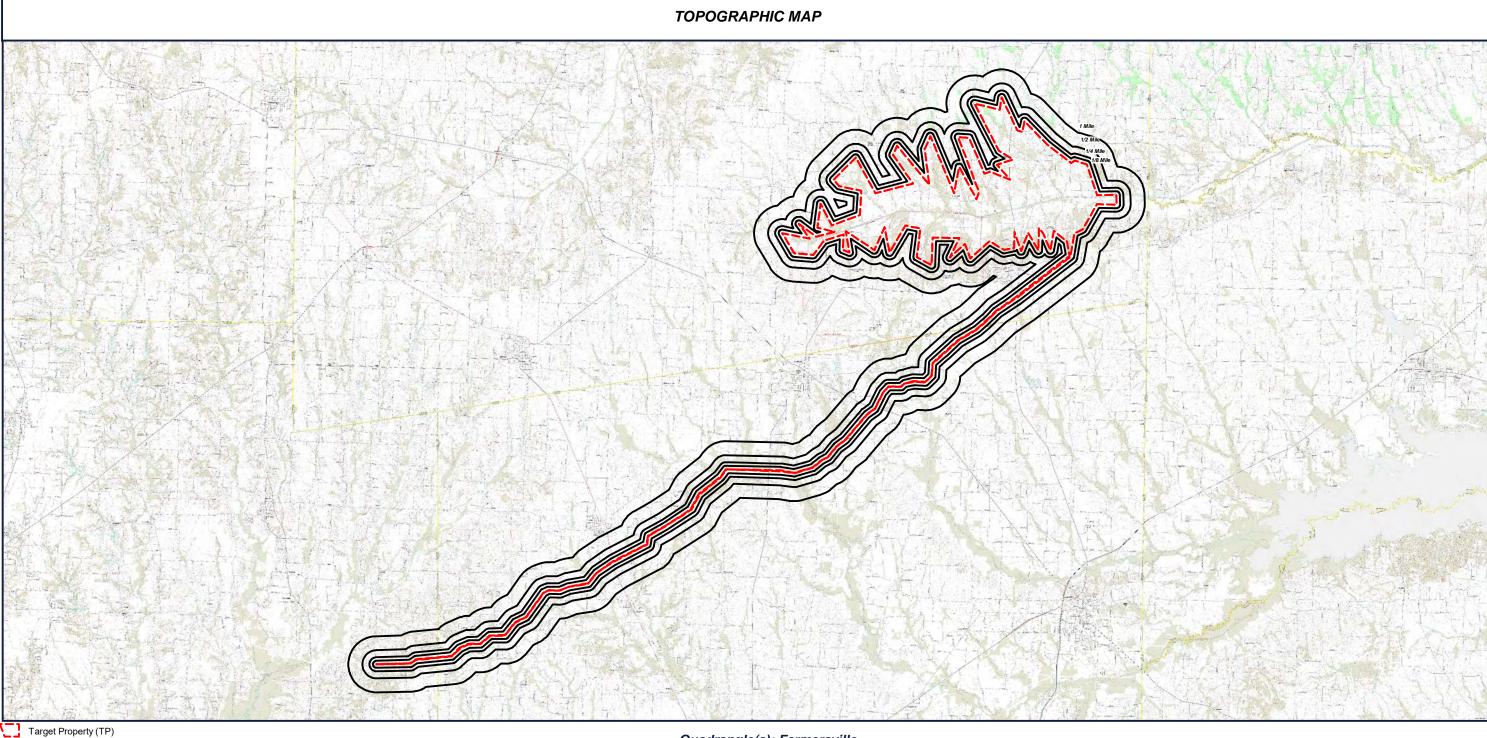


Target Pi Target Property (TP)

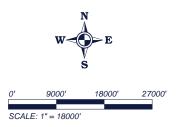
CALF MSWLF

Quadrangle(s): Farmersville, Greenville Nw, Honey Grove, Celeste, Wolfe City, Commerce North, Gober, Ladonia Proposed Lake Ralph Hall Project Area & Pipeline Alignment Fannin County, Texas





Quadrangle(s): Farmersville, Greenville Nw, Honey Grove, Celeste, Wolfe City, Commerce
North, Gober, Ladonia
Source: USGS, 03/08/2013
Proposed Lake Ralph Hall
Project Area & Pipeline
Alignment
Fannin County, Texas





# **Located Sites Summary**

NOTE: Standard environmental records are displayed in **bold**.

Map ID#	Database Name	Site ID#	Relative Elevation	Distance From Site	Site Name	Address	PAGE #
1	FRSTX	110034713594	Higher (538 ft.)	TP	MANN DAIRY	2551 COUNTY ROAD 3640, LADONIA, TX 75449	<u>21</u>
2	FRSTX	110033919446	Higher (561 ft.)	TP	GREG MORRIS PROPERTY	681 COUNTRY LN, LADONIA, TX 75449	<u>22</u>
3	ECHOR06	110070051243	Higher (632 ft.)	0.018 mi. NW (95 ft.)	LINE O21 STA. 406+84 TO 439+54 REPLACEMENT	CR 1089 WEST OF HWY 69, CELESTE, TX 75423	23
<u>3</u>	FRSTX	110070051243	Higher (632 ft.)	0.018 mi. NW (95 ft.)	LINE O21 STA. 406+84 TO 439+54 REPLACEMENT	CR 1089 WEST OF HWY 69, CELESTE, TX 75423	<u>24</u>
<u>3</u>	ICISNPDES	TXR10F4A3INP DES	Higher (632 ft.)	0.018 mi. NW (95 ft.)	LINE O21 STA. 406+84 TO 439+54 REPLACEMENT	CR 1089 WEST OF HWY 69, CELESTE, TX 75423	<u>25</u>
4	CALF	1012	Higher (610 ft.)	0.086 mi. SE (454 ft.)	LEDONIA	1.75 MI E ON FM 64, TX	<u>27</u>
<u>5</u>	MSWLF	1320	Higher (621 ft.)	0.181 mi. NW (956 ft.)	CITY OF CELESTE LANDFILL	1 MILE S OF CELESTE CITY LIMITS, CELESTE, TX	<u>28</u>

# **Elevation Summary**

Elevations are collected from the USGS 3D Elevation Program 1/3 arc-second (approximately 10 meters) layer hosted at the NGTOC. .

### **Target Property Elevation: 535 ft.**

NOTE: Standard environmental records are displayed in **bold**.

### **EQUAL/HIGHER ELEVATION**

Map ID#	Database Name	Elevation	Site Name	Address	Page #
1	FRSTX	538 ft.	MANN DAIRY	2551 COUNTY ROAD 3640, LADONIA, TX 75449	<u>21</u>
2	FRSTX	561 ft.	GREG MORRIS PROPERTY	681 COUNTRY LN, LADONIA, TX 75449	<u>22</u>
3	ECHOR06	632 ft.	LINE O21 STA. 406+84 TO 439+54 REPLACEMENT	CR 1089 WEST OF HWY 69, CELESTE, TX 75423	<u>23</u>
<u>3</u>	FRSTX	632 ft.	LINE O21 STA. 406+84 TO 439+54 REPLACEMENT	CR 1089 WEST OF HWY 69, CELESTE, TX 75423	<u>24</u>
<u>3</u>	ICISNPDES	632 ft.	LINE O21 STA. 406+84 TO 439+54 REPLACEMENT	CR 1089 WEST OF HWY 69, CELESTE, TX 75423	<u>25</u>
<u>4</u>	CALF	610 ft.	LEDONIA	1.75 MI E ON FM 64, TX	<u>27</u>
<u>5</u>	MSWLF	621 ft.	CITY OF CELESTE LANDFILL	1 MILE S OF CELESTE CITY LIMITS, CELESTE, TX	<u>28</u>

### **LOWER ELEVATION**

No Records Found

# Facility Registry System (FRSTX)

**MAP ID# 1** 

Distance from Property: 0 mi. (0 ft.) X Elevation: 538 ft. (Higher than TP)

FACILITY INFORMATION
REGISTRY ID: 110034713594

NAME: MANN DAIRY

LOCATION ADDRESS: 2551 COUNTY ROAD 3640

**LADONIA, TX 754494410** 

COUNTY: **FANNIN** EPA REGION: **6** 

FEDERAL FACILITY: NOT REPORTED
TRIBAL LAND: NOT REPORTED

**ALTERNATIVE NAME/S:** 

**MANN DAIRY** 

PROGRAM/S LISTED FOR THIS FACILITY

TX-TCEQ ACR - TEXAS COMMISSION ON EVIRONMENTAL QUALITY - AGENCY CENTRAL REGISTRY

STANDARD INDUSTRIAL CLASSIFICATION/S (SIC)

0241 - DAIRY FARMS

NORTH AMERICAN INDUSTRY CLASSIFICATION/S (NAICS)

**NO NAICS DATA REPORTED** 

**Back to Report Summary** 

# Facility Registry System (FRSTX)

**MAP ID# 2** 

Distance from Property: 0 mi. (0 ft.) X Elevation: 561 ft. (Higher than TP)

### **FACILITY INFORMATION**

REGISTRY ID: 110033919446

NAME: GREG MORRIS PROPERTY

LOCATION ADDRESS: 681 COUNTRY LN

**LADONIA, TX 754493825** 

COUNTY: FANNIN EPA REGION: 6

FEDERAL FACILITY: NOT REPORTED
TRIBAL LAND: NOT REPORTED

**ALTERNATIVE NAME/S:** 

**GREG MORRIS PROPERTY** 

PROGRAM/S LISTED FOR THIS FACILITY

TX-TCEQ ACR - TEXAS COMMISSION ON EVIRONMENTAL QUALITY - AGENCY CENTRAL REGISTRY

STANDARD INDUSTRIAL CLASSIFICATION/S (SIC)

**NO SIC DATA REPORTED** 

NORTH AMERICAN INDUSTRY CLASSIFICATION/S (NAICS)

NO NAICS DATA REPORTED

**Back to Report Summary** 

# Enforcement and Compliance History Information (ECHOR06)

**MAP ID# 3** 

Distance from Property: 0.018 mi. (95 ft.) NW

Elevation: 632 ft. (Higher than TP)

FACILITY INFORMATION
UNIQUE ID: 110070051243
REGISTRY ID: 110070051243

NAME: LINE O21 STA. 406+84 TO 439+54 REPLACEMENT

ADDRESS: CR 1089 WEST OF HWY 69
CELESTE, TX 75423

COUNTY: NOT REPORTED

FACILITY LINK: Facility Detail Report

**Back to Report Summary** 

# Facility Registry System (FRSTX)

**MAP ID# 3** 

Distance from Property: 0.018 mi. (95 ft.) NW

Elevation: 632 ft. (Higher than TP)

FACILITY INFORMATION

REGISTRY ID: 110070051243

NAME: LINE O21 STA. 406+84 TO 439+54 REPLACEMENT

LOCATION ADDRESS: CR 1089 WEST OF HWY 69

CELESTE, TX 75423

COUNTY: NOT REPORTED

EPA REGION: 6

FEDERAL FACILITY: NOT REPORTED
TRIBAL LAND: NOT REPORTED

**ALTERNATIVE NAME/S:** 

NO ALTERNATIVE NAME(S) LISTED FOR THIS FACILITY

PROGRAM/S LISTED FOR THIS FACILITY

NPDES - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

STANDARD INDUSTRIAL CLASSIFICATION/S (SIC)

NO SIC DATA REPORTED

NORTH AMERICAN INDUSTRY CLASSIFICATION/S (NAICS)

**NO NAICS DATA REPORTED** 

**Back to Report Summary** 

# Integrated Compliance Information System National Pollutant Discharge Elimination System (ICISNPDES)

**MAP ID# 3** 

Distance from Property: 0.018 mi. (95 ft.) NW

Elevation: 632 ft. (Higher than TP)

#### **FACILITY INFORMATION**

GEOSEARCH ID: TXR10F4A3INPDES

NPDES ID: TXR10F4A3 FACILITY #: 110070051243
NAME: LINE O21 STA. 406+84 TO 439+54 REPLACEMENT

PHYSICAL ADDRESS: CR 1089 WEST OF HWY 69

**CELESTE TX 75423** 

COUNTY: **NOT REPORTED**FACILITY TYPE: **NOT REPORTED**IMPAIRED WATERS: **NOT REPORTED** 

#### STANDARD INDUSTRIAL CLASSIFICATION

- NOT REPORTED -

### **PERMITS**

FACILITY TYPE INDICATOR: NON-POTABLE WATER
PERMIT TYPE: GENERAL PERMIT COVERED FACILITY

MAJOR MINOR FACILITY: MINOR DISCHARGER

PERMIT STATUS: **EFFECTIVE** WATER BODY: **NOT REPORTED** 

PERMIT NAME: ATMOS ENERGY CORPORATION

AGENCY TYPE: U.S. EPA

ORIGINAL ISSUE DATE: 4/18/2017

ISSUE DATE: 4/18/2017
ISSUING AGENCY: U.S. EPA
EFFECTIVE DATE: 4/18/2017
EXPIRATION DATE: 2/15/2022

RETIREMENT DATE: NOT REPORTED
TERMINATION DATE: NOT REPORTED
PERMIT COMPLIANCE STATUS: YES

PERMIT SUBJECT TO DMR RUN: **NOT REPORTED**REPORTABLE NONCOMPLIANCE TRACKING IS ON: **YES** 

#### **INSPECTIONS**

- NO INSPECTIONS REPORTED -

### **HISTORIC COMPLIANCE**

- NO HISTORIC COMPLIANCE REPORTED -

### SINGLE EVENT VIOLATIONS

- NO SINGLE EVENT VIOLATIONS REPORTED -

### FORMAL ENFORCEMENT ACTIONS

- NO FORMAL ENFORCEMENT ACTIONS REPORTED -

### **EFFLUENT VIOLATIONS**

- NOT REPORTED -

### **EFFLUENT VIOLATIONS contd..**

- NOT REPORTED -

**EFFLUENT VIOLATIONS contd..** 

Order# 113649 Job# 253814 25 of 47

# Integrated Compliance Information System National Pollutant Discharge Elimination System (ICISNPDES)

- NOT REPORTED -

**Back to Report Summary** 



### Closed & Abandoned Landfill Inventory (CALF)

**MAP ID# 4** 

Distance from Property: 0.086 mi. (454 ft.) SE

Elevation: 610 ft. (Higher than TP)

**SITE INFORMATION** 

SITE NUMBER: 1012
SITE NAME: LEDONIA

LOCATION:

1.75 MI E ON FM 64 COUNTY: FANNIN COMMENTS:

**IDENTIFIED IN 1968 US DEPT. OF HEW SURVEY;** 

INSPECTION:

10/23/73-ALL TYPES OF WASTE ACCEPTED; AREA FILL OPERATION; CLOSURE CONFIRMED IN TDH MEMO DATED 10/76

OWNER NAME: CITY OF LEDONIA

DATE OPEN: 0
DATE CLOSE: 1976
SIZE (ACRES): 14.00
SIZE (CUBIC YARDS): 0.00

PARTIES: LEDONIA
LANDFILL CONTENTS

HOUSEHOLD: YES CONSTRUCTION DEMOLITION: YES

INDUSTRIAL: YES TIRES: YES

AGRICULTURE: YES

OTHER: NR

LEGAL: YES

UNAUTHORIZED: NR HAZARD UNLIKELY: NR HAZARD PROBABLY: YES HAZARD CERTAINLY: NR DEPTH CD: NR MINIMUM THICKNESS: NR

MAXIMUM DEPTH: 0.00 USE: UK

OTHER DESCRIPTION: NOT REPORTED

REVIEWER: ACCORDING TO J.H. OCKELS THIS SITE CANNOT

**BE VERIFIED** 

**Back to Report Summary** 

# Municipal Solid Waste Landfill Sites (MSWLF)

**MAP ID# 5** 

Distance from Property: 0.181 mi. (956 ft.) NW

Elevation: 621 ft. (Higher than TP)

**FACILITY INFORMATION** 

PERMIT#: 1320

NAME: CITY OF CELESTE LANDFILL

ADDRESS: 1 MILE S OF CELESTE CITY LIMITS

**CELESTE, TX** 

COUNTY: HUNT
FACILITY DETAILS

FACILITY TYPE #: LANDFILL FACILITY (HISTORICAL TYPES THAT WERE REQUIRED TO UPGRADE TO TYPE 1 STANDARDS,

OR TO CLOSE AND INSTALL FINAL COVER)
PHYSICAL FACILITY STATUS: CLOSED

LEGAL STATUS: REVOKED

REFERENCE NUMBER(RN): RN102000981
REGION: REGION 04 - DFW METROPLEX

**Back to Report Summary** 

# **Unlocated Sites Summary**

This list contains sites that could not be mapped due to limited or incomplete address information.

No Records Found

AIRSAFS Aerometric Information Retrieval System / Air Facility Subsystem

VERSION DATE: 10/20/14

The United States Environmental Protection Agency (EPA) modified the Aerometric Information Retrieval System (AIRS) to a database that exclusively tracks the compliance of stationary sources of air pollution with EPA regulations: the Air Facility Subsystem (AFS). Since this change in 2001, the management of the AIRS/AFS database was assigned to EPA's Office of Enforcement and Compliance Assurance.

BRS Biennial Reporting System

VERSION DATE: 12/31/11

The United States Environmental Protection Agency (EPA), in cooperation with the States, biennially collects information regarding the generation, management, and final disposition of hazardous wastes regulated under the Resource Conservation and Recovery Act of 1976 (RCRA), as amended. The Biennial Report captures detailed data on the generation of hazardous waste from large quantity generators and data on waste management practices from treatment, storage and disposal facilities. Currently, the EPA states that data collected between 1991 and 1997 was originally a part of the defunct Biennial Reporting System and is now incorporated into the RCRAInfo data system.

CDL Clandestine Drug Laboratory Locations

VERSION DATE: 07/01/16

The U.S. Department of Justice ("the Department") provides this information as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments. The Department does not establish, implement, enforce, or certify compliance with clean-up or remediation standards for contaminated sites; the public should contact a state or local health department or environmental protection agency for that information.

**DOCKETS** EPA Docket Data

VERSION DATE: 12/22/05

The United States Environmental Protection Agency Docket data lists Civil Case Defendants, filing dates as far back as 1971, laws broken including section, violations that occurred, pollutants involved, penalties assessed and superfund awards by facility and location. Please refer to ICIS database as source of current data.

**EC** Federal Engineering Institutional Control Sites

**VERSION DATE: 08/03/15** 

This database includes site locations where Engineering and/or Institutional Controls have been identified as part



of a selected remedy for the site as defined by United States Environmental Protection Agency official remedy decision documents. A site listing does not indicate that the institutional and engineering controls are currently in place nor will be in place once the remedy is complete; it only indicates that the decision to include either of them in the remedy is documented as of the completed date of the document. Institutional controls are actions, such as legal controls, that help minimize the potential for human exposure to contamination by ensuring appropriate land or resource use. Engineering controls include caps, barriers, or other device engineering to prevent access, exposure, or continued migration of contamination.

ECHOR06

**Enforcement and Compliance History Information** 

VERSION DATE: 08/26/17

The EPA's Enforcement and Compliance History Online (ECHO) database, provides compliance and enforcement information for facilities nationwide. This database includes facilities regulated as Clean Air Act stationary sources, Clean Water Act direct dischargers, Resource Conservation and Recovery Act hazardous waste handlers, Safe Drinking Water Act public water systems along with other data, such as Toxics Release Inventory releases.

**ERNSTX** 

**Emergency Response Notification System** 

VERSION DATE: 04/29/18

This National Response Center database contains data on reported releases of oil, chemical, radiological, biological, and/or etiological discharges into the environment anywhere in the United States and its territories. The data comes from spill reports made to the U.S. Environmental Protection Agency, U.S. Coast Guard, the National Response Center and/or the U.S. Department of Transportation.

**FRSTX** 

Facility Registry System

VERSION DATE: 04/17/18

The United States Environmental Protection Agency's Office of Environmental Information (OEI) developed the Facility Registry System (FRS) as the centrally managed database that identifies facilities, sites or places subject to environmental regulations or of environmental interest. The Facility Registry System replaced the Facility Index System or FINDS database.

HMIRSR06

Hazardous Materials Incident Reporting System

VERSION DATE: 03/27/18

The HMIRS database contains unintentional hazardous materials release information reported to the U.S. Department of Transportation located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

ICIS

Integrated Compliance Information System (formerly DOCKETS)

VERSION DATE: 09/23/17

ICIS is a case activity tracking and management system for civil, judicial, and administrative federal Environmental Protection Agency enforcement cases. ICIS contains information on federal administrative and federal judicial cases under the following environmental statutes: the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, the Emergency Planning and Community Right-to-Know Act - Section 313, the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act, the Comprehensive Environmental Response, Compensation, and Liability Act, the Safe Drinking Water Act, and the Marine Protection, Research, and Sanctuaries Act.

**ICISNPDES** 

Integrated Compliance Information System National Pollutant Discharge Elimination System

VERSION DATE: 07/09/17

Authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

**LUCIS** 

Land Use Control Information System

VERSION DATE: 09/01/06

The LUCIS database is maintained by the U.S. Department of the Navy and contains information for former Base Realignment and Closure (BRAC) properties across the United States.

**MLTS** 

Material Licensing Tracking System

VERSION DATE: 06/29/17

MLTS is a list of approximately 8,100 sites which have or use radioactive materials subject to the United States Nuclear Regulatory Commission (NRC) licensing requirements.

NPDESR06

National Pollutant Discharge Elimination System

VERSION DATE: 04/01/07

Authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES database was collected from December 2002 until April 2007. Refer to the PCS and/or ICIS-NPDES database as source of current data. This database includes permitted facilities located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

**PADS** 

PCB Activity Database System

VERSION DATE: 07/18/17

PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

PCSR06 Permit Compliance System

VERSION DATE: 08/01/12

The Permit Compliance System is used in tracking enforcement status and permit compliance of facilities controlled by the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act and is maintained by the United States Environmental Protection Agency's Office of Compliance. PCS is designed to support the NPDES program at the state, regional, and national levels. This database includes permitted facilities located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. PCS has been modernized, and no longer exists. National Pollutant Discharge Elimination System (ICIS-NPDES) data can now be found in Integrated Compliance Information System (ICIS).

RCRASC RCRA Sites with Controls

VERSION DATE: 03/21/18

The Resource Conservation and Recovery Act (RCRA) gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities with institutional controls in place.

SEMSLIENS SEMS Lien on Property

VERSION DATE: 06/08/18

The U.S. Environmental Protections Agency's (EPA) Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation (OSRTI), has implemented The Superfund Enterprise Management System (SEMS), formerly known as CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) to track and report on clean-up and enforcement activities taking place at Superfund sites. SEMS represents a joint development and ongoing collaboration between Superfund's Remedial, Removal, Federal Facilities, Enforcement and Emergency Response programs. This is a listing of SEMS sites with a lien on the property.

SFLIENS CERCLIS Liens

VERSION DATE: 06/08/12

A Federal CERCLA ("Superfund") lien can exist by operation of law at any site or property at which United States Environmental Protection Agency has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties. This database contains those CERCLIS sites where the Lien on Property action is complete.

SSTS Section Seven Tracking System

VERSION DATE: 02/01/17

The United States Environmental Protection Agency tracks information on pesticide establishments through the Section Seven Tracking System (SSTS). SSTS records the registration of new establishments and records pesticide production at each establishment. The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) requires that production of pesticides or devices be conducted in a registered pesticide-producing or device-producing establishment. ("Production" includes formulation, packaging, repackaging, and relabeling.)

TRI Toxics Release Inventory

VERSION DATE: 12/31/16

The Toxics Release Inventory, provided by the United States Environmental Protection Agency, includes data on toxic chemical releases and waste management activities from certain industries as well as federal and tribal facilities. This inventory contains information about the types and amounts of toxic chemicals that are released each year to the air, water, and land as well as information on the quantities of toxic chemicals sent to other facilities for further waste management.

TSCA Toxic Substance Control Act Inventory

**VERSION DATE: 12/31/12** 

The Toxic Substances Control Act (TSCA) was enacted in 1976 to ensure that chemicals manufactured, imported, processed, or distributed in commerce, or used or disposed of in the United States do not pose any unreasonable risks to human health or the environment. TSCA section 8(b) provides the United States Environmental Protection Agency authority to "compile, keep current, and publish a list of each chemical substance that is manufactured or processed in the United States." This TSCA Chemical Substance Inventory contains non-confidential information on the production amount of toxic chemicals from each manufacturer and importer site.

RCRAGR06 Resource Conservation & Recovery Act - Generator

VERSION DATE: 03/01/18

The Resource Conservation and Recovery Act (RCRA) gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities currently generating hazardous waste. EPA region 6 includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

RCRANGR06 Resource Conservation & Recovery Act - Non-Generator

VERSION DATE: 03/01/18

The Resource Conservation and Recovery Act (RCRA) gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities classified as non-generators. Non-Generators do not presently generate hazardous waste. EPA Region 6 includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

**ALTFUELS** Alternative Fueling Stations

VERSION DATE: 01/22/18

Nationwide list of alternative fueling stations made available by the US Department of Energy's Office of Energy Efficiency & Renewable Energy. Includes Biodiesel stations, Ethanol (E85) stations, Liquefied Petroleum Gas (Propane) stations, Ethanol (E85) stations, Natural Gas stations, Hydrogen stations, and Electric Vehicle Supply Equipment (EVSE).

FEMAUST FEMA Owned Storage Tanks

VERSION DATE: 12/01/16

This is a listing of FEMA owned underground and aboveground storage tank sites. For security reasons, address information is not released to the public according to the U.S. Department of Homeland Security.

HISTPST Historical Gas Stations

VERSION DATE: NR

This historic directory of service stations is provided by the Cities Service Company. The directory includes Cities Service filling stations that were located throughout the United States in 1930.

ICISCLEANERS Integrated Compliance Information System Drycleaners

VERSION DATE: 09/23/17

This is a listing of drycleaner facilities from the Integrated Compliance Information System (ICIS). The Environmental Protection Agency (EPA) tracks facilities that possess NAIC and SIC codes that classify businesses as drycleaner establishments.

MRDS Mineral Resource Data System

VERSION DATE: 03/15/16

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MRDS (Mineral Resource Data System) is a collection of reports describing metallic and nonmetallic mineral resources throughout the world. Included are deposit name, location, commodity, deposit description, geologic characteristics, production, reserves, resources, and references. This database contains the records previously provided in the Mineral Resource Data System (MRDS) of USGS and the Mineral Availability System/Mineral Industry Locator System (MAS/MILS) originated in the U.S. Bureau of Mines, which is now part of USGS.

**MSHA** 

Mine Safety and Health Administration Master Index File

VERSION DATE: 09/01/17

The Mine dataset lists all Coal and Metal/Non-Metal mines under MSHA's jurisdiction since 1/1/1970. It includes such information as the current status of each mine (Active, Abandoned, NonProducing, etc.), the current owner and operating company, commodity codes and physical attributes of the mine. Mine ID is the unique key for this data. This information is provided by the United States Department of Labor - Mine Safety and Health Administration (MSHA).

BF

**Brownfields Management System** 

VERSION DATE: 06/27/18

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. The United States Environmental Protection Agency maintains this database to track activities in the various brown field grant programs including grantee assessment, site cleanup and site redevelopment. This database included tribal brownfield sites.

DNPL

**Delisted National Priorities List** 

VERSION DATE: 06/08/18

This database includes sites from the United States Environmental Protection Agency's Final National Priorities List (NPL) where remedies have proven to be satisfactory or sites where the original analyses were inaccurate, and the site is no longer appropriate for inclusion on the NPL, and final publication in the Federal Register has occurred.

**NLRRCRAT** 

No Longer Regulated RCRA Non-CORRACTS TSD Facilities

VERSION DATE: 03/01/18

This database includes RCRA Non-Corrective Action TSD facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements. This listing includes facilities that formerly treated, stored or disposed of hazardous waste.

Open Dump Inventory

VERSION DATE: 06/01/85

The open dump inventory was published by the United States Environmental Protection Agency. An "open dump" is defined as a facility or site where solid waste is disposed of which is not a sanitary landfill which meets the criteria promulgated under section 4004 of the Solid Waste Disposal Act (42 U.S.C. 6944) and which is not a facility for disposal of hazardous waste. This inventory has not been updated since June 1985.

**RCRAT** 

Resource Conservation & Recovery Act - Non-CORRACTS Treatment, Storage & Disposal Facilities

VERSION DATE: 03/01/18

The Resource Conservation and Recovery Act (RCRA) gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities recognized as hazardous waste treatment, storage, and disposal sites (TSD).

**SEMS** 

Superfund Enterprise Management System

VERSION DATE: 06/08/18

The U.S. Environmental Protections Agency's (EPA) Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation (OSRTI), has implemented The Superfund Enterprise Management System (SEMS), formerly known as CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) to track and report on clean-up and enforcement activities taking place at Superfund sites. SEMS represents a joint development and ongoing collaboration between Superfund's Remedial, Removal, Federal Facilities, Enforcement and Emergency Response programs.

**SEMSARCH** 

Superfund Enterprise Management System Archived Site Inventory

VERSION DATE: 06/08/18

The Superfund Enterprise Management System Archive listing (SEMS-ARCHIVE) has replaced the CERCLIS NFRAP reporting system in 2015. This listing reflect sites that have been assessed and no further remediation is planned and is of no further interest under the Superfund program.

**SMCRA** 

Surface Mining Control and Reclamation Act Sites

VERSION DATE: 08/25/17

An inventory of land and water impacted by past mining (primarily coal mining) is maintained by OSMRE to provide information needed to implement the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The inventory contains information on the location, type, and extent of AML impacts, as well as, information on the cost associated with the reclamation of those problems. The inventory is based upon field surveys by State, Tribal, and OSMRE program officials. It is dynamic to the extent that it is modified as new problems are identified and existing problems are reclaimed.

USUMTRCA Uranium Mill Tailings Radiation Control Act Sites

VERSION DATE: 03/04/17

The Legacy Management Office of the Department of Energy (DOE) manages radioactive and chemical waste, environmental contamination, and hazardous material at over 100 sites across the U.S. The L.M. Office manages this database of sites registered under the Uranium Mill Tailings Control Act (UMTRCA).

DOD Department of Defense Sites

VERSION DATE: 12/01/14

This information originates from the National Atlas of the United States Federal Lands data, which includes lands owned or administered by the Federal government. Army DOD, Army Corps of Engineers DOD, Air Force DOD, Navy DOD and Marine DOD areas of 640 acres or more are included.

FUDS Formerly Used Defense Sites

VERSION DATE: 06/01/15

The Formerly Used Defense Sites (FUDS) inventory includes properties previously owned by or leased to the United States and under Secretary of Defense Jurisdiction, as well as Munitions Response Areas (MRAs). The remediation of these properties is the responsibility of the Department of Defense. This data is provided by the U.S. Army Corps of Engineers (USACE), the boundaries/polygon data are based on preliminary findings and not all properties currently have polygon data available. DISCLAIMER: This data represents the results of data collection/processing for a specific USACE activity and is in no way to be considered comprehensive or to be used in any legal or official capacity as presented on this site. While the USACE has made a reasonable effort to insure the accuracy of the maps and associated data, it should be explicitly noted that USACE makes no warranty, representation or guaranty, either expressed or implied, as to the content, sequence, accuracy, timeliness or completeness of any of the data provided herein. For additional information on Formerly Used Defense Sites please contact the USACE Public Affairs Office at (202) 528-4285.

**FUSRAP** Formerly Utilized Sites Remedial Action Program

VERSION DATE: 03/04/17

The U.S. DOE established the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1974 to remediate sites where radioactive contamination remained from the Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations. The DOE Office of Legacy Management (LM) established long-term surveillance and maintenance (LTS&M) requirements for remediated FUSRAP sites. DOE evaluates the final site conditions of a remediated site on the basis of risk for different future uses. DOE then confirms that LTS&M requirements will maintain protectiveness.

NLRRCRAC No Longer Regulated RCRA Corrective Action Facilities

VERSION DATE: 03/01/18



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This database includes RCRA Corrective Action facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements.

NMS Former Military Nike Missile Sites

VERSION DATE: 12/01/84

This information was taken from report DRXTH-AS-IA-83A016 (Historical Overview of the Nike Missile System, 12/1984) which was performed by Environmental Science and Engineering, Inc. for the U.S. Army Toxic and Hazardous Materials Agency Assessment Division. The Nike system was deployed between 1954 and the mid-1970's. Among the substances used or stored on Nike sites were liquid missile fuel (JP-4); starter fluids (UDKH, aniline, and furfuryl alcohol); oxidizer (IRFNA); hydrocarbons (motor oil, hydraulic fluid, diesel fuel, gasoline, heating oil); solvents (carbon tetrachloride, trichloroethylene, trichloroethane, stoddard solvent); and battery electrolyte. The quantities of material a disposed of and procedures for disposal are not documented in published reports. Virtually all information concerning the potential for contamination at Nike sites is confined to personnel who were assigned to Nike sites.

During deactivation most hardware was shipped to depot-level supply points. There were reportedly instances where excess materials were disposed of on or near the site itself at closure. There was reportedly no routine site decontamination.

NPL National Priorities List

VERSION DATE: 06/08/18

This database includes United States Environmental Protection Agency (EPA) National Priorities List sites that fall under the EPA's Superfund program, established to fund the cleanup of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action.

PNPL Proposed National Priorities List

VERSION DATE: 06/08/18

This database contains sites proposed to be included on the National Priorities List (NPL) in the Federal Register. The United States Environmental Protection Agency investigates these sites to determine if they may present long-term threats to public health or the environment.

RCRAC Resource Conservation & Recovery Act - Corrective Action Facilities

VERSION DATE: 03/01/18

The Resource Conservation and Recovery Act (RCRA) gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities with corrective action activity.

RCRASUBC Resource Conservation & Recovery Act - Subject to Corrective Action Facilities

VERSION DATE: 03/01/18

The Resource Conservation and Recovery Act (RCRA) gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities subject to corrective actions.

RODS Record of Decision System

VERSION DATE: 06/08/18

These decision documents maintained by the United States Environmental Protection Agency describe the chosen remedy for NPL (Superfund) site remediation. They also include site history, site description, site characteristics, community participation, enforcement activities, past and present activities, contaminated media, the contaminants present, and scope and role of response action.

**GWCC** Groundwater Contamination Cases

VERSION DATE: 08/26/16

This report contains a listing of groundwater contamination cases which were documented for the 2013 calendar year. Texas Water Code, Section 26.406 requires the annual report to describe the current status of groundwater monitoring activities conducted or required by each agency at regulated facilities or associated with regulated activities. The agencies reporting these contamination cases include the Texas Commission on Environmental Quality, Railroad Commission of Texas, Texas Alliance of Groundwater Districts, and Department of State Health Services.

HISTGWCC Historic Groundwater Contamination Cases

**VERSION DATE: 12/31/12** 

This historic report contains all agency groundwater contamination cases documented from 1994 to 2012. The agencies that reported these contamination cases included the Texas Commission on Environmental Quality, Railroad Commission of Texas, Texas Alliance of Groundwater Districts, and Department of State Health Services.

LANDAPP Land Application Permits

VERSION DATE: 03/01/13

Texas Land Application Permits are a requirement from the Texas Commission on Environmental Quality for any domestic facility that disposes of treated effluent by land application such as surface irrigation, evaporation, drainfields or subsurface land application.

LIENS TCEQ Liens

VERSION DATE: 06/06/18

Liens filed upon State and/or Federal Superfund Sites by the Texas Commission on Environmental Quality.

MSD Municipal Setting Designations

VERSION DATE: 06/01/18

The Texas Commission on Environmental Quality defines an MSD as an official state designation given to property within a municipality or its extraterritorial jurisdiction that certifies that designated groundwater at the property is not used as potable water, and is prohibited from future use as potable water because that groundwater is contaminated in excess of the applicable potable-water protective concentration level. The prohibition must be in the form of a city ordinance, or a restrictive covenant that is enforceable by the city and filed in the property records. The MSD property can be a single property, multi-property, or a portion of property.

NOV Notice of Violations

VERSION DATE: 02/24/16

This database containing Notice of Violations (NOV) is maintained by the Texas Commission on Environmental Quality. An NOV is a written notification that documents and communicates violations observed during an inspection to the business or individual inspected.

SIEC01 State Institutional/Engineering Control Sites

VERSION DATE: 06/06/18

The Texas Risk Reduction Program (TRRP) requires the placement of institutional controls (e.g., deed notices or restrictive covenants) on affected property in different circumstances as part of completing a response action. In its simplest form, an institutional control (IC) is a legal document that is recorded in the county deed records. In certain circumstances, local zoning or ordinances can serve as an IC. This listing may also include locations where Engineering Controls are in effect, such as a cap, barrier, or other engineering device to prevent access, exposure, or continued migration of contamination. The sites included on this list are regulated by various programs of the Texas Commission on Environmental Quality (TCEQ).

SPILLS Spills Listing

VERSION DATE: 07/20/18

This Texas Commission on Environmental Quality database includes releases of hazardous or potentially hazardous materials into the environment.

TIERII Tier I I Chemical Reporting Program Facilities

VERSION DATE: 12/31/12

The Texas Tier II Chemical Reporting Program in the Department of State Health Services (DSHS) is the state repository for EPCRA-required Emergency Planning Letters (EPLs), which are one-time notifications to the state from facilities that have certain extremely hazardous chemicals in specified amounts. The Program is also the state repository for EPCRA/state-required hazardous chemical inventory reports called Texas Tier Two Reports. This data contains those facility reports for the 2005 through the 2012 calendar years. Please contact the Texas Commission on Environmental Quality Tier II Chemical Reporting Division as the current source for this data, due to confidentiality and safety reasons details such as the location and capacity of on-site hazardous chemicals is only available to local emergency planning agencies, fire departments, and/or owners.

DCR Dry Cleaner Registration Database

VERSION DATE: 05/01/18

The database includes dry cleaning drop stations and facilities registered with the Texas Commission on Environmental Quality.

IHW Industrial and Hazardous Waste Sites

VERSION DATE: 07/06/18

Owner and facility information is included in this database of permitted and non-permitted industrial and hazardous waste sites. Industrial waste is waste that results from or is incidental to operations of industry, manufacturing, mining, or agriculture. Hazardous waste is defined as any solid waste listed as hazardous or possesses one or more hazardous characteristics as defined in federal waste regulations. The IHW database is maintained by the Texas Commission on Environmental Quality.

PIHW Permitted Industrial Hazardous Waste Sites

VERSION DATE: 07/06/18

Owner and facility information is included in this database of all permitted industrial and hazardous waste sites. Industrial waste is waste that results from or is incidental to operations of industry, manufacturing, mining, or agriculture. Hazardous waste is defined as any solid waste listed as hazardous or possesses one or more hazardous characteristics as defined in federal waste regulations. Permitted IHW facilities are regulated under 30 Texas Administrative Code Chapter 335 in addition to federal regulations. The IHW database is maintained by the Texas Commission on Environmental Quality.

**PST** Petroleum Storage Tanks

VERSION DATE: 06/20/18

The Petroleum Storage Tank database is administered by the Texas Commission on Environmental Quality (TCEQ). Both Underground storage tanks (USTs) and Aboveground storage tanks (ASTs) are included in this report. Petroleum Storage Tank registration has been a requirement with the TCEQ since 1986.

APAR Affected Property Assessment Reports

VERSION DATE: 12/18/17

As regulated by the Texas Commission on Environmental Quality, an Affected Property Assessment Report is required when a person is addressing a release of chemical of concern (COC) under 30 TAC Chapter 350, the Texas Risk Reduction Program (TRRP). The purpose of the APAR is to document all relevant affected property information to identify all release sources and COCs, determine the extent of all COCs, identify all transport/exposure pathways, and to determine if any response actions are necessary. The Texas Administrative Code Title 30 §350.4(a)(1) defines affected property as the entire area (i.e. on-site and off-site; including all environmental media) which contains releases of chemicals of concern at concentrations equal to or greater than the assessment level applicable for residential land use and groundwater classification.

**BSA** Brownfields Site Assessments

VERSION DATE: 06/06/18

The Brownfields Site Assessments database is maintained by the Texas Commission on Environmental Quality



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(TCEQ). The TCEQ, in close partnership with the U.S. Environmental Protection Agency (EPA) and other federal, state, and local redevelopment agencies, and stakeholders, is facilitating cleanup, transferability, and revitalization of brownfields through the development of regulatory, tax, and technical assistance tools.

CALF Closed & Abandoned Landfill Inventory

VERSION DATE: 11/01/05

The Texas Commission on Environmental Quality, under a contract with Texas State University, and in cooperation with the 24 regional Council of Governments (COGs) in the State, has located over 4,000 closed and abandoned municipal solid waste landfills throughout Texas. This listing contains "unauthorized sites". Unauthorized sites have no permit and are considered abandoned. The information available for each site varies in detail and this historical information is not updated. Please refer to the specific regional COG for the most current information.

**DCRPS** Dry Cleaner Remediation Program Sites

VERSION DATE: 03/01/18

This list of DCRP sites is provided by the Texas Commission on Environmental Quality (TCEQ). According to the TCEQ, the Dry Cleaner Remediation Program (DCRP) establishes a prioritization list of dry cleaner sites and administers the Dry Cleaning Remediation fund to assist with remediation of contamination caused by dry cleaning solvents.

IOP Innocent Owner / Operator Database

VERSION DATE: 06/06/18

Texas Innocent Owner / Operator (IOP), created by House Bill 2776 of the 75th Legislature, provides a certificate to an innocent owner or operator if their property is contaminated as a result of a release or migration of contaminants from a source or sources not located on the property, and they did not cause or contribute to the source or sources of contamination. The IOP database is maintained by the Texas Commission on Environmental Quality.

LPST Leaking Petroleum Storage Tanks

VERSION DATE: 06/08/18

The Leaking Petroleum Storage Tank listing is derived from the Petroleum Storage Tank (PST) database and is maintained by the Texas Commission on Environmental Quality. This listing includes aboveground and underground storage tank facilities with reported leaks.

MSWLF Municipal Solid Waste Landfill Sites

VERSION DATE: 06/08/18

The municipal solid waste landfill database is provided by the Texas Commission on Environmental Quality. This

GeoSearch www.geo-search.com 888-396-0042

database includes active landfills and inactive landfills, where solid waste is treated or stored.

RRCVCP Railroad Commission VCP and Brownfield Sites

VERSION DATE: 04/11/18

According to the Railroad Commission of Texas, their Voluntary Cleanup Program (RRC-VCP) provides an incentive to remediate Oil & Gas related pollution by participants as long as they did not cause or contribute to the contamination. Applicants to the program receive a release of liability to the state in exchange for a successful cleanup.

RWS Radioactive Waste Sites

VERSION DATE: 07/11/06

This Texas Commission on Environmental Quality database contains all sites in the State of Texas that have been designated as Radioactive Waste sites.

STCV Salt Caverns for Petroleum Storage

VERSION DATE: 09/01/06

The salt caverns for petroleum storage database is provided by the Railroad Commission of Texas.

VCP Voluntary Cleanup Program Sites

VERSION DATE: 06/06/18

The Texas Voluntary Cleanup Program (VCP) provides administrative, technical, and legal incentives to encourage the cleanup of contaminated sites in Texas. Since all non-responsible parties, including future lenders and landowners, receive protection from liability to the state of Texas for cleanup of sites under the VCP, most of the constraints for completing real estate transactions at those sites are eliminated. As a result, many unused or underused properties may be restored to economically productive or community beneficial uses. The VCP database is maintained by the Texas Commission on Environmental Quality.

WMRF Recycling Facilities

VERSION DATE: 11/01/12

This listing of recycling facilities is provided by the Texas Commission on Environmental Quality's Recycle Texas Online service. The company information provided in this database is self-reported. Since recyclers post their own information, a facility or company appearing on the list does not imply that it is in compliance with TCEQ regulations or other applicable laws. This database is no longer maintained and includes the last compilation of the program participants before the Recycle Texas Online program was closed.

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IHWCA Industrial and Hazardous Waste Corrective Action Sites

VERSION DATE: 05/11/18

This database is provided by the Texas Commission on Environmental Quality (TCEQ). According to the TCEQ, the mission of the industrial and hazardous waste corrective action program is to oversee the cleanup of sites contaminated from industrial and municipal hazardous and industrial nonhazardous wastes. The goals of this program are to: Ensure that sites are assessed and remediated to levels that protect human health and the environment; Verify that waste management units or facilities are taken out of service and closed properly; and to Facilitate revitalization of contaminated properties.

SF State Superfund Sites

VERSION DATE: 09/23/16

The state Superfund program mission is to remediate abandoned or inactive sites within the state that pose an unacceptable risk to public health and safety or the environment, but which do not qualify for action under the federal Superfund program (NPL - National Priority Listing). As required by the Texas Solid Waste Disposal Act, Texas Health and Safety Code, Chapter 361, the Texas Commission on Environmental Quality identifies and evaluates these facilities for inclusion on the state Superfund registry. This registry includes any recent developments and the anticipated action for these sites.

USTR06 Underground Storage Tanks On Tribal Lands

VERSION DATE: 04/01/18

This database, provided by the United States Environmental Protection Agency (EPA), contains underground storage tanks on Tribal lands located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

LUSTR06 Leaking Underground Storage Tanks On Tribal Lands

VERSION DATE: 04/01/18

This database, provided by the United States Environmental Protection Agency (EPA), contains leaking underground storage tanks on Tribal lands located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

ODINDIAN Open Dump Inventory on Tribal Lands

VERSION DATE: 11/08/06

This Indian Health Service database contains information about facilities and sites on tribal lands where solid waste is disposed of, which are not sanitary landfills or hazardous waste disposal facilities, and which meet the criteria promulgated under section 4004 of the Solid Waste Disposal Act (42 U.S.C. 6944).

INDIANRES Indian Reservations

VERSION DATE: 01/01/00

The Department of Interior and Bureau of Indian Affairs maintains this database that includes American Indian Reservations, off-reservation trust lands, public domain allotments, Alaska Native Regional Corporations and Recognized State Reservations.

Lake Ralph Hall Appendix H Appendix H **Tribal Consultation Letters** 



### **DEPARTMENT OF THE ARMY**

FORT WORTH DISTRICT, CORPS OF ENGINEERS P. O. BOX 17300 FORT WORTH, TEXAS 76102-0300

May 2, 2017

Regulatory Division

Subject: Project Number: SWF 2003-00336, Lake Ralph Hall

Mr. Phil Cross Tribal Historic Preservation Officer Caddo Nation of Oklahoma P.O. Box 487 117 Memorial Lane Binger, Oklahoma 73009

Dear Mr. Cross:

This letter addresses cultural resources requirements under Section 404 of the Clean Water Act associated with a proposal by the Upper Trinity Regional Water District (UTRWD), to construct and operate the proposed Lake Ralph Hall in Fannin County, Texas. The U.S. Army Corps of Engineers, Fort Worth District (USACE) is currently reviewing a permit application for the development of the water supply project. This project has been assigned Project Number SWF-2003-00336. Please include this number in all future correspondence concerning this project.

The proposed Lake Ralph Hall (Project) will include the dam site, the approximate 7,605 acre flood pool (elevation 560.0 amsl), mitigation area, and associated pipelines. In 2005 an archeological survey investigated approximately 15 percent of the flood pool for cultural resources and recorded a total of 17 prehistoric and historic sites. In 2009 a reconnaissance survey for historic-age resources identified 114 resources within the flood pool. Currently the USACE is working with the State Historic Preservation Office (SHPO) and permit Applicant to develop a research design for future cultural resource investigations across the Project.

This letter is to invite you to consult on this project under 36 CFR 800(c)(2)(ii). The USACE and the SHPO plan on developing a Programmatic Agreement (PA), under 36 CFR 800.4(c)(2), to guide future work (testing and mitigation) on the identified sites. The enclosed compact disc (CD) contains copies of the draft research design and draft PA. While the proposed reservoir lies in an area with no known tribal lands or trust lands, the Caddo Nation was historically associated with the area. The USACE requests you review the enclosed documents and notify us of any cultural or religious significance you might attach to this site or this area. We request your participation and consultation in development of the PA.

Thank you for your time, and this opportunity to provide you these review documents. We look forward to working with you on this project. Please direct any questions to Mr. Jimmy Barrera at 817-886-1838.

Sincerely,

Stephen L Brooks Chief, Regulatory Division

Enclosure



### **DEPARTMENT OF THE ARMY**

FORT WORTH DISTRICT, CORPS OF ENGINEERS P. O. BOX 17300 FORT WORTH, TEXAS 76102-0300

May 2, 2017

**Regulatory Division** 

Subject: Project Number: SWF 2003-00336, Lake Ralph Hall

Dr. Ian Thompson Tribal Historic Preservation Officer Choctaw Nation of Oklahoma P.O. Box 1210 Durant, Oklahoma 74702-1210

Dear Dr. Thompson:

This letter addresses cultural resources requirements under Section 404 of the Clean Water Act associated with a proposal by the Upper Trinity Regional Water District (UTRWD), to construct and operate the proposed Lake Ralph Hall in Fannin County, Texas. The U.S. Army Corps of Engineers, Fort Worth District (USACE) is currently reviewing a permit application for the development of the water supply project. This project has been assigned Project Number SWF-2003-00336. Please include this number in all future correspondence concerning this project.

The proposed Lake Ralph Hall (Project) will include the dam site, the approximate 7,605 acre flood pool (elevation 560.0 amsl), mitigation area, and associated pipelines. In 2005 an archeological survey investigated approximately 15 percent of the flood pool for cultural resources and recorded a total of 17 prehistoric and historic sites. In 2009 a reconnaissance survey for historic-age resources identified 114 resources within the flood pool. Currently the USACE is working with the State Historic Preservation Office (SHPO) and permit Applicant to develop a research design for future cultural resource investigations across the Project.

This letter is to invite you to consult on this project under 36 CFR 800(c)(2)(ii). The USACE and the SHPO plan on developing a Programmatic Agreement (PA), under 36 CFR 800.4(c)(2), to guide future work (testing and mitigation) on the identified sites. The enclosed compact disc (CD) contains copies of the draft research design and draft PA. While the proposed reservoir lies in an area with no known tribal lands or trust lands, the Choctaw Nation was historically associated with the area. The USACE requests you review the enclosed documents and notify us of any cultural or religious significance you might attach to this site or this area. We request your participation and consultation in development of the PA.

Thank you for your time, and this opportunity to provide you these review documents. We look forward to working with you on this project. Please direct any questions to Mr. Jimmy Barrera at 817-886-1838.

Sincerely,

Stephen L Brooks Chief, Regulatory Division

Enclosure



## **DEPARTMENT OF THE ARMY**

FORT WORTH DISTRICT, CORPS OF ENGINEERS P. O. BOX 17300 FORT WORTH, TEXAS 76102-0300

May 2, 2017

**Regulatory Division** 

Subject: Project Number: SWF 2003-00336, Lake Ralph Hall

Ms. Martina Callahan
Director, Comanche Nation Historic Preservation Office
Comanche Nation of Oklahoma
#6 SW 'D' Avenue, Suite C
Lawton, Oklahoma 73507

Dear Ms. Callahan:

This letter addresses cultural resources requirements under Section 404 of the Clean Water Act associated with a proposal by the Upper Trinity Regional Water District (UTRWD), to construct and operate the proposed Lake Ralph Hall in Fannin County, Texas. The U.S. Army Corps of Engineers, Fort Worth District (USACE) is currently reviewing a permit application for the development of the water supply project. This project has been assigned Project Number SWF-2003-00336. Please include this number in all future correspondence concerning this project.

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Sincerely,

Stephen L Brooks Chief, Regulatory Division

Enclosure



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FORT WORTH DISTRICT, CORPS OF ENGINEERS P. O. BOX 17300 FORT WORTH, TEXAS 76102-0300

May 2, 2017

**Regulatory Division** 

Subject: Project Number: SWF 2003-00336, Lake Ralph Hall

Mr. Russell L. Martin President Tonkawa Tribe of Oklahoma 1 Rush Buffalo Road Tonkawa, Oklahoma 74653

Dear Mr. Martin:

This letter addresses cultural resources requirements under Section 404 of the Clean Water Act associated with a proposal by the Upper Trinity Regional Water District (UTRWD), to construct and operate the proposed Lake Ralph Hall in Fannin County, Texas. The U.S. Army Corps of Engineers, Fort Worth District (USACE) is currently reviewing a permit application for the development of the water supply project. This project has been assigned Project Number SWF-2003-00336. Please include this number in all future correspondence concerning this project.

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Thank you for your time, and this opportunity to provide you these review documents. We look forward to working with you on this project. Please direct any questions to Mr. Jimmy Barrera at 817-886-1838.

Sincerely,

Stephen L Brooks Chief, Regulatory Division

Enclosure



## **DEPARTMENT OF THE ARMY**

FORT WORTH DISTRICT, CORPS OF ENGINEERS P. O. BOX 17300 FORT WORTH, TEXAS 76102-0300

May 2, 2017

**Regulatory Division** 

Subject: Project Number: SWF 2003-00336, Lake Ralph Hall

Ms. Terri Parton President Wichita and Affiliated Tribes P.O. Box 729 Anadarko, Oklahoma 73005

Dear Ms. Parton:

This letter addresses cultural resources requirements under Section 404 of the Clean Water Act associated with a proposal by the Upper Trinity Regional Water District (UTRWD), to construct and operate the proposed Lake Ralph Hall in Fannin County, Texas. The U.S. Army Corps of Engineers, Fort Worth District (USACE) is currently reviewing a permit application for the development of the water supply project. This project has been assigned Project Number SWF-2003-00336. Please include this number in all future correspondence concerning this project.

The proposed Lake Ralph Hall (Project) will include the dam site, the approximate 7,605 acre flood pool (elevation 560.0 amsl), mitigation area, and associated pipelines. In 2005 an archeological survey investigated approximately 15 percent of the flood pool for cultural resources and recorded a total of 17 prehistoric and historic sites. In 2009 a reconnaissance survey for historic-age resources identified 114 resources within the flood pool. Currently the USACE is working with the State Historic Preservation Office (SHPO) and permit Applicant to develop a research design for future cultural resource investigations across the Project.

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Thank you for your time, and this opportunity to provide you these review documents. We look forward to working with you on this project. Please direct any questions to Mr. Jimmy Barrera at 817-886-1838.

Sincerely,

Stephen L Brooks Chief, Regulatory Division

Enclosure

Lake Ralph Hall	Appendix l
Append	ix I
Final Lake Ralph Hall Water R	esources Technical Report
•	•

# Final Lake Ralph Hall Water Resources Technical Report

Prepared for:

U.S. Army Corps of Engineers

Submitted by:

Michael Baker International

March 2017



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## 1.0 Introduction

This report provides an assessment of the current condition of the North Sulphur River and the potential impacts of the proposed Lake Ralph Hall (LRH) Dam construction to receiving waters. This assessment is based on literature review, monitoring data, field assessment data, Water Availability Model (WAM)/ Water Rights Analysis Package (WRAP) and RiverWare model results, and qualitative estimates of pollutant loading and water quality. This assessment utilized data from previous reports in support of the LRH Environmental Impact Statement (EIS) including:

- Biological Assessment of the North Sulphur River (Alan Plummer Associates, Inc. [APAI], 2006a)
- Mitigation Plan for Impacts to Aquatic Resources and Terrestrial Habitats (APAI, 2012)
- Environmental Information Document (APAI, 2006b)
- Hydrologic and Hydraulic Studies of Lake Ralph Hall (Brandes, 2004)
- Lake Ralph Hall RiverWare Modeling Memorandum (Brandes, 2015)
- Evaluation of Hydrologic Modeling in Support of the Lake Ralph Hall Environmental Impact Statement (DiNatale, 2016a)
- Response to Comments from Texas Parks and Wildlife Department Memorandum (DiNatale, 2016b)
- Preliminary Jurisdictional Determination of Waters of the U.S. Proposed Lake Ralph Hall (APAI, 2006c)
- Supplement Number 1 to the Preliminary Jurisdictional Determination of Waters of the U.S. Proposed Lake Ralph Hall (APAI, 2008)
- Lake Ralph Hall Preliminary Habitat Assessment (APAI, 2005)
- Habitat Assessment for Proposed Lake Ralph Hall (APAI, 2011)
- Geomorphic and Sedimentation Evaluation of North Sulphur River and Tributaries for the Lake Ralph Hall Project (Mussetter Engineering, Inc [MEI], 2006)
- Archaeology and Quaternary Geology at Lake Ralph Hall (AR Consultants, Inc., 2005)

## 1.1 Project Description

The proposed LRH would be located in Fannin County, Texas, and would be constructed on the existing channel of the North Sulphur River (**Exhibit 1**). The proposed LRH project would include the construction of an earth-filled dam embankment across the valley of the North Sulphur River with a concrete uncontrolled principal spillway located within the existing channel of the river and a concrete ogee-type emergency spillway located within the embankment on the northern floodplain of the river. The top of the dam embankment would occur at an elevation of 562.0 feet above mean sea level and would adjoin the existing ground surface on both ends of the structure. Current studies indicate the proposed LRH reservoir would have a conservation pool storage capacity of approximately 160,000 acre-feet (AF) at an elevation of 551.0 feet above MSL. The surface area of the

reservoir would be approximately 7,605 acres. The maximum depth of the reservoir at the dam would be approximately 90 feet. The firm annual yield of the proposed project would be approximately 34,050 AF/year.

## 2.0 Affected Environment

## 2.1 Study Area

The study area includes the Sulphur River Basin extending 127 miles long with a width that varies from 17 to 43 miles (Sulphur River Basin Authority [SRBA], 2014) (Exhibit 1). The Sulphur River Basin is located south of the Red River Basin beginning in Fannin County and flowing east to the Texas-Arkansas Border. The basin passes through three ecoregions with the western portion consisting mostly of row crop agriculture and cattle farming. The Sulphur River Basin is divided into seven watersheds including the Lower Sulphur River Watershed, Wright Patman Lake Watershed, Sulphur River Watershed, White Oak Creek Watershed, Days Creek Watershed, North Sulphur River Watershed and South Sulphur River Watershed. The proposed LRH would be located within the North Sulphur River Watershed and includes a portion of the North Sulphur River (Exhibit 2).

## 2.2 North Sulphur River

The North Sulphur River extends from the confluence with the Sulphur River in Lamar County to a point 4.2 miles upstream of Farm to Market Road (FM) 68 in Fannin County (Texas Commission on Environmental Quality [TCEQ] Atlas, 2004) (Exhibit 2).

## 2.2.1 Morphology

MEI completed the *Geomorphic and Sedimentation Evaluation of the North Sulphur River and Tributaries for the Lake Ralph Hall Project* in October 2006. The report provides a description of current conditions of the North Sulphur River and anticipated changes due to the proposed LRH project.

The North Sulphur River and its tributaries, upstream and downstream of the proposed LRH, are downcut, deeply incised, and eroding (MEI, 2006). During the 1920's, the river was channelized to control flooding (AR Consultants, 2005). The channelized portion of the river extends for approximately 40 miles east from the proposed LRH. Current conditions of the river are a result of channelization and straightening of the sinuous and meandering river. Prior to channelization, the river was meandering with an approximate slope of 4.3 feet per mile (MEI, 2006). Prior to channelization, the North Sulphur River at the proposed LRH dam site was approximately 48 feet wide and 6 feet deep but is currently 300 feet wide and 40 feet deep and is composed of erodible shale. Historically, the river had a hydraulic capacity between 700 cubic feet per second (cfs) and 1,000 cfs. Currently, the river at the dam site location contains flows in excess of the 100-year flood peak at approximately 38,000 cfs. Between the late 1920s and the present, approximately 28

million tons of sediment have been eroded from the mainstem of the river and its tributaries upstream of the proposed dam site (MEI, 2006).

## 2.2.2 Hydrology

The proposed LRH is located solely within the North Sulphur River Watershed on the North Sulphur River (**Exhibit 2**). The North Sulphur River Watershed includes extensive row crop agriculture and high soil productivity (SRBA, 2014). Major tributaries to the North Sulphur River that could be inundated and/or affected by the proposed reservoir include Allen Creek, Bear Creek, Pot Creek, Brushy Creek, Pickle Creek, Davis Creek, Legget Branch, Bralley Pool Creek, Merrill Creek, Hedrick Branch, Long Creek, Baker Creek, and McClure Creek. Hydrology of the North Sulphur River is variable and normally exhibits little to no flow.

Historical data from USGS gage stations in the North Sulphur River Watershed were collected and analyzed to describe with and without project conditions utilizing various models (Brandes, 2004; Brandes, 2015; DiNatale, 2016a; DiNatale, 2016b). Flows in the North Sulphur River primarily consist of runoff, although spring discharges occur for sustained periods following rainfall events (Brandes, 2004). The USGS maintains a streamflow gage on the North Sulphur River and is referred to as the "North Sulphur River near Cooper, TX" gage. Mean daily streamflow records from this gage are available from 1949 to present. The gage is located approximately 20 river miles downstream from the proposed LRH dam site (Exhibit 1). Records from this gage indicate a mean daily flow of 261 cfs and a median daily flow of 11 cfs indicating low flow during much of the time with periodic flood events (Brandes, 2004). Data from this gage also indicate zero flow for 10 percent of the time and flow above 306 cfs approximately 10 percent of the time (Brandes, 2004). Historical monthly flows show variable flows with periods of no flow and other periods indicating significant flood flows (Brandes, 2004). During rain events flows increase rapidly in the North Sulphur River Watershed but recede within a day or two to nearly no flow. Small ponds and puddles typically form within the river channel.

## 2.2.3 Water Quality

Water quality regulatory programs in Texas are administered by TCEQ with the substantial involvement of local river authorities as well as other state and local groups, and are conducted under the Texas Clean Rivers Program and other relevant legislation. The Texas Administrative Code (TAC), Title 30, Chapter 307 promulgates surface water quality criteria, regulations, and standards. In addition, TCEQ regulations require certification that a permit allowing the discharge of dredged or fill material would comply with state water quality standards, under Section 401 of the Clean Water Act (CWA).

The Texas Surface Water Quality Standards establish explicit goals for the quality of streams, rivers, lakes, and bays throughout Texas. Water quality standards are developed to maintain the quality of surface waters in Texas to support public health and enjoyment while protecting aquatic life. Water quality standards identify appropriate uses for surface waters including aquatic life, recreation, and public

water supply (drinking water). Criteria for evaluating support of these uses include dissolved oxygen, temperature, pH, dissolved minerals, toxic substances, and bacteria. TCEQ adopted revisions to the standards which became effective in 2014. However, the Environmental Protection Agency (EPA) has not approved all the 2014 standards revisions. In particular, a revision to the North Sulphur River segment stating the benthic macroinvertebrate community should be assessed as a limited aquatic life was disapproved by the EPA and is currently under review. The 2014 standards are described in **Table 1**.

Table 1. Site-Specific Uses and Criteria for the North Sulphur River (TCEQ, 2014).

	Recreation	Public Contact Recreation
Uses	Aquatic Life	Intermediate <sup>1</sup>
	Domestic Water Supply	_
	Other	_
	Cl-1 (mg/L)	190
	SO <sub>4</sub> -2 (mg/L)	475
	TDS (mg/L)	1,320
Criteria	Dissolved Oxygen (mg/L)	5.0
	pH Range (SU)	6.0 – 8.5
	Indicator Bacteria <sup>1</sup> (#/100ml)	126
	Temperature (°F)	93

mg/L - milligrams per liter; SU - standard units; °F - degrees Fahrenheit

The Texas Integrated Report of Surface Water Quality describes the status of natural waters based on historical data and assigns water bodies various categories depending on the extent to which they attain standards. In accordance with the federal CWA 305(b) and 303(d), the TCEQ produces an updated report every two years.

According to the 2014 Texas Integrated Report of Surface Water Quality, the North Sulphur River consists of two assessment segments. Segment 0305\_01 includes the portion of the river from the confluence with the South Sulphur River upstream approximately 25 miles to Morrison Creek. Segment 0305\_02 includes the portion of the river from the confluence with Morrison Creek upstream approximately 23 miles to the headwaters. Stations associated with Segment 0305\_01 include 10230 and 10231. Stations associated with Segment 0305\_02 include 17613, 18844, and 18846. Assessment results from TCEQ (2014) are included in **Table 2** and **Table 3**.

<sup>&</sup>lt;sup>1</sup>According to TCEQ, "The intermediate aquatic life use applies only to the fish community. The benthic community is to be assessed using a limited aquatic life use." This language is under EPA review and has not been approved by EPA.

Table 2. 2014 Texas Integrated Water Quality Assessment Results, Segment 0305\_01, December 2005 to November 2012.

Parameter	# Samples	Mean of Samples	# of Sample Exceeding Criteria	Mean of Samples Exceeding Criteria	Criteria	Sample Sizes	Level of Support		
		A	Aquatic Life U	se					
DO-Grab Screening Level (mg/L)	25	-	0	-	5.00	AD	NC		
DO-Grab Min (mg/L)	25	-	0	-	3.00	AD	FS		
Recreation Use									
Bacteria*	14	52.72	0	1	126.00	LD	NC		
			General Use						
Water Temp (°C)	25	_	0	-	33.90	AD	FS		
High pH (SU)	25	_	1	9.2	8.50	AD	FS		
Low pH (SU)	25	-	0	ı	6.00	AD	FS		
TDS (mg/L)	39	676.32	0	-	1,320.00	AD	FS		
Chloride (mg/L)	36	43.77	0	-	190.00	AD	FS		
Sulfate (mg/L)	36	306.67	0	-	475.00	AD	FS		
Nitrate (mg/L)	25	_	1	3.72	1.95	AD	NC		
Ammonia (mg/L)	25	_	0	-	0.33	AD	NC		
Total Phosphorus (mg/L)	22	-	0	-	0.69	AD	NC		
Chlorophyll- <i>a</i> (µg/L)	23	-	7	25.57	14.10	AD	CS		

<sup>\*</sup> E. Coli (Colonies/100mL)

AD – Adequate Data; LD – Limited Data; NC – No Concern; FS – Fully Supporting; CS – Screening Level Concern; °C – Degrees Celsius; μg - Micrograms

Table 3. 2014 Texas Integrated Water Quality Assessment Results, Segment 0305\_02,
December 2005 to November 2012.

Parameter	# Samples	Mean of Samples	# of Sample Exceeding Criteria	Mean of Samples Exceeding Criteria	Criteria	Sample Sizes	Level of Support				
	Aquatic Life Use										
DO-Grab Screening Level (mg/L)         12         -         0         4.9         4.00         AD         NC											
DO-Grab Min (mg/L)	12	-	0	-	3.00	AD	FS				
DO-24hr Avg (mg/L)	6	ı	0	ı	5.00	LD	NC				
DO-24hr Min (mg/L)	6	-	0	-	3.00	LD	NC				
Habitat	3	19.00	_	1	14.00	AD	NC				
Macrobenthic Community	6	22.00	-	-	22.00	AD	FS				
Fish Community	6	39.00	_	-	33.00	AD	FS				
		]	Recreation Us	se .							
Bacteria	12	9.08	0	1	126.00	LD	NC				
			General Use								
Water Temp (°C)	12	1	0	-	33.90	AD	FS				
High pH (SU)	12	-	0	-	8.50	AD	FS				
Low pH (SU)	12	-	0	_	6.00	AD	FS				
Sulfate (mg/L)	36	306.67	0	-	475.00	AD	FS				
TDS (mg/L)	39	676.32	0	-	1,320.00	AD	FS				
Chloride (mg/L)	36	43.77	0	_	190.00	AD	FS				
Chlorophyll- <i>a</i> (µg/L)	12	-	0	-	14.10	AD	NC				
Total Phosphorus (mg/L)	12	-	0	-	0.69	AD	NC				
Nitrate (mg/L)	12	1	3	3.06	1.95	AD	NC				
Ammonia (mg/L)	12	-	0	_	0.33	AD	NC				

\* E. Coli

AD - Adequate Data; LD - Limited Data; NC - No Concern; FS - Fully Supporting; CS - Screening Level Concern

TCEQ (2014) indicates the majority of parameters assessed fully support the use or are no concern. Chlorophyll-a in Segment 0305\_01 is the only parameter indicating a concern for water quality based on screening levels from a nonpoint source. Seven out of twenty-three samples exceeded the criteria with a mean exceedance of 25.57  $\mu$ g/L. Currently, there is no concern for non-attainment of the standard based on numeric criteria.

The Section 303(d) list identifies water bodies in Texas too polluted or otherwise degraded to meet water quality standards. The North Sulphur River is not included in the TCEQ (2014) 303(d) List and is not considered impaired.

Flows in the North Sulphur River are primarily fed by overland runoff, although sustained flow can result from springs (Brandes, 2004). The drainage area of the proposed LRH project footprint includes the Pot Creek and Bralley Pool Creek subwatersheds (**Exhibit 3**) and is approximately 104 square miles. **Table 4** includes

the breakdown of land cover in the drainage area of the proposed LRH Dam. Land cover in the drainage area below the proposed LRH project (**Exhibit 3**) was calculated to the furthest point downstream included in the WAM model (Brandes, 2015). **Table 5** includes the breakdown of land cover in the drainage area of the Sulphur River downstream of the proposed LRH dam site. The primary land cover classifications from both drainage areas are undeveloped and agriculture. The primary pollutants of concern associated with overland flow from agriculture uses are nutrients, organic material, bacteria, sediment, pesticides, and herbicides. There is a very small percentage of developed land in both drainage areas, so impacts from pollutants associated with developed industrial or commercial land, such as metals, organochlorines, or mercury, are not likely to be a concern.

Table 4. Land Cover Values for the LRH Drainage Area.

Class/Value	Classification Description	Area (Square Miles)	Percent of Total Area (%)
Water	Open Water	0.587	0.566
	Developed, Open Space	4.473	4.315
Developed	Developed, Low Intensity	0.139	0.134
	Developed, Medium Intensity	0.025	0.024
	Developed, High Intensity	0.004	0.004
	Deciduous Forest	14.637	14.119
Forest	Evergreen Forest	1.113	1.074
	Mixed Forest	0.027	0.026
Shrubland	Shrub/Scrub	0.167	0.161
Herbaceous	Grassland/Herbaceous	50.51	48.721
Dlanta d /Cultivata d	Pasture/Hay	7.697	7.424
Planted/Cultivated	Cultivated Crops	24.262	23.403
Wetlands	Emergent Herbaceous Wetlands	0.031	0.030
	m · 1	400 (50	

(111.05)

Total 103.672

100

Source: National Land Cover Database (NLCD)

Table 5. Land Cover Values for the Sulphur River Downstream of the LRH Drainage Area.

Class/Value	Classification Description	Area (Square Miles)	Percent of Total Area (%)
Water	Open Water	38	2.19
	Developed, Open Space	59	3.38
Davidonad	Developed, Low Intensity	29	1.65
Developed	Developed, Medium Intensity	4	0.21
	Developed, High Intensity	2	0.10
Barren	Barren Land	3	0.17
	Deciduous Forest	283	16.22
Forest	Evergreen Forest	17	0.97
	Mixed Forest	1	0.06
Shrubland	Shrub/Scrub	57	3.26
Herbaceous	Grassland/Herbaceous	350	20.07
Dlantad /Cultivatad	Pasture/Hay	570	32.67
Planted/Cultivated	Cultivated Crops	203	11.61
Wetlands	Woody Wetlands	117	6.73
wedands	Emergent Herbaceous Wetlands	12	0.70

Total 1,745

Source: National Land Cover Database (NLCD)

EPA (1983) provides median concentrations for various pollutants of concern for various land use categories including residential, mixed, commercial, and nonurban. Current pollutant loading and water quality conditions were assessed for the LRH drainage area above the proposed dam and the North Sulphur River drainage area below the proposed dam to the furthest point downstream included in the WAM model (downstream site). In order to calculate runoff from 1-year and 2-year storm events, the *Soil Conservation Service Curve Number Method* was utilized including the following equation:

$$Q = (P - I_a)^2 / (P - I_a) + S$$

Where:

Q = runoff (inches)

P = rainfall (inches)

S = retention of moisture (inches)

I<sub>a</sub> = the initial abstraction (inches)

In order to calculate average annual runoff the *Simple Method to Calculate Urban Stormwater Loads* (Stormwater Manager's Resource Center, n.d.) was used including:

$$R = P \times P_i \times R_v$$

Where:

R = annual runoff

P = annual rainfall (inches)

P<sub>j</sub> = fraction of annual rainfall events that produce runoff

 $R_v$  = runoff coefficient

Pollutant loading at the proposed dam location and downstream site of the proposed LRH were calculated utilizing the equation:

 $\Sigma_{LU}$  (A<sub>LU</sub> x C<sub>LU</sub> x Q<sub>LU</sub>) = L<sub>C</sub>

Where:

Alu = land use area

C = constituent concentration for the specific land use

Q<sub>LU</sub> = runoff depth from the land use area

 $L_C$  = total load for the constituent of concern

 $\Sigma_{LU}$  = sum of loads for all land uses

Estimated current pollutant concentrations at the downstream site were assessed to evaluate concentrations in the river based on the estimated upstream and downstream loads. To assess mixing of the constituents downstream, the following equation was used assuming conservation of mass:

$$(L_{C-U} + L_{C-D}) / (\Sigma (Q_u + Q_D)) = C_{EOI}$$

Where:

 $L_{C-U}$  = load for each constituent upstream of the dam

L<sub>C-D</sub> = load for each constituent downstream of the dam

 $Q_u$  = runoff volume that will be obtained from the WAM model for the location upstream of the proposed dam

 $Q_D$  = runoff volume obtained from the WAM model for the location at the downstream extent of impact

C<sub>EOI</sub> = the constituent concentration at the downstream extent of impact (assessed as described below)

The changes in concentration and resulting water quality conditions were evaluated downstream based on concentrations assuming complete mixing downstream of the dam. Pollutant loads and water quality were assessed during the 50-percentile monthly flow condition from the WAM model (Brandes, 2015). The 50-percentile monthly flow was used because it does not represent an overly arid condition or large rainfall event.

Estimated pollutant loads and concentrations at the proposed LRH dam site and downstream site are included in **Table 6** and **Table 7**.

Table 6. Pollutant Loads and Concentrations at Proposed LRH Dam Site.

		Load (Poun	ds)	Concentration
Pollutant	1-Year	2-Year	Annual	(mg/L)
	Storm	Storm	Rainfall	
TSS	1,713,567	2,135,686	6,813,382	133.50
Lead	734	915	2,920	0.06
Zinc	4,774	5,949	18,980	0.37
Kjeldahl Nitrogen	23,623	29,442	93,927	1.84
Nitrite / Nitrate	13,292	16,567	52,852	1.04
Total Phosphorus	2,962	3,692	11,777	0.23
Soluble Phosphorus	636	793	2,531	0.05

Table 7. Pollutant Loads and Concentrations at Downstream Site.

		Load (Pounds	Concentration	
Pollutant	1-Year	2-Year	Annual	(mg/L)
	Storm	Storm	Rainfall	
TSS	24,311,018	30,676,321	111,089,157	100.49
Lead	10,419	13,147	47,610	0.04
Zinc	67,724	85,455	309,463	0.28
Kjeldahl Nitrogen	335,145	422,895	1,531,443	1.39
Nitrite / Nitrate	188,584	237,961	861,734	0.78
Total Phosphorus	42,023	53,026	192,026	0.17
Soluble Phosphorus	9,030	11,394	41,262	0.04

## 2.2.4 Aquatic Organisms

Aquatic organisms have been documented in pools in the North Sulphur River within the proposed LRH footprint and downstream of the proposed LRH dam.

The North Sulphur River Segment 0305\_02 was first listed on the 303(d) list in 2006 for impaired habitat, macrobenthic community, and fish community. The impairment for habitat was lowered to a concern for screening level in 2008 and listed as no concern in 2012. The concern for macrobenthic community and fish community was removed from the 303(d) list in 2012 due to a revision in the standard.

The SRBA conducted biological monitoring in the North Sulphur River at three sampling stations (SRBA, 2008) in May 2007 and August 2007. Stations sampled included 17613, 18844, and 18846.

Station 17613 was rated as intermediate for fish community for both events. The macrobenthic community was rated as limited for the May event with ten species and intermediate for the August event due to an increase in the number of species collected. The Habitat Quality Index was rated as high due to the number of riffles, stability of substrate, and amount of available in stream cover.

Station 18844 was rated as limited for macrobenthic community for both events. The fish community for the May event was rated as high with 11 species and intermediate

during the August event with 6 species. The Habitat Quality Index was rated as high due to the number of riffles, stability of substrate, and amount of available in stream cover.

Station 18846 was rated as limited for macrobenthic community and intermediate for fish community during both events. The number of species collected increased during the August event but was not sufficient to change the rating. The Habitat Quality Index for this site was intermediate due to the instability of banks and channelization.

**Table 8** and **Table 9** summarize the total number of specimens collected at each sampling location.

Table 8. Fish Species Identified at Each Sample Location (May and August 2007).

	Common	Station	n 17613	Station 18844		Station 18846	
Scientific Name	Name	May 2007	August 2007	May 2007	August 2007	May 2007	August 2007
Ameiurus melas	Black bullhead						1
Ameiurus natalis	Yellow bullhead			1		1	
Campostoma anomalum	Central stoneroller	5					1
Cyprinella lutrensis	Red shiner	38	59	139	4	114	17
Fundulus notatus	Blackstripe topminnow			11			
Gambusia affinis	Western mosquitofish	1	4	4	1		1
Ictalurus punctatus	Channel catfish			1			
Ictiobus bubalus	Smallmouth buffalo		1				
Lepomis cyanellus	Green sunfish	8	25	74	50	18	60
Lepomis humilis	Orangespotted sunfish	1		8	1		
Lepomis macrochirus	Bluegill			5	8	1	5
Lepomis megalotis	Longear sunfish			6	2		1
Micropterus salmoides	Largemouth bass	2	2	2		6	5
Notemigonus Crysoleucas	Golden shiner		16				
Notropis stramineus	Sand Shiner	124					
Pimephales Vigilax	Bullhead minnow		5	126		43	

Table 9. Aquatic Organisms Identified at Each Sample Location (May and August 2007).

	0 : .:6	Statio	n 17613	Station 18844		Station 18846	
Family	Scientific Name	May 2007	August 2007	May 2007	August 2007	May 2007	August 2007
Dytiscidae	Acilius	1				11	1
Aeshnidae	Aeshna						1
Coenagrionidae	Argia		2		1		
Baetidae	Baetis	2	4		11		
Belostomatidae	Belostoma		6		1		1
Hydrophilidae	Berosus	1	2		1		
Ceratopogonidae	Bezzia		1				
Caenidae	Caenis	11	102		89	2	73
Corydalidae	Chauliodes						
Chironomidae	Chironomidae	111	17	102	51	132	42
Gammaridae	Gammarus	14	15		11		
Gerridae	Gerris		1		1		1
Planorbidae	Gyraulus						3
Gyrinidae	Gyrinus				1	1	
Calopterygidae	Hetaerina		1				
Ephemeridae	Hexagenia					2	
Dytiscidae	Hydaticus			3			
Dolichopodidae	Hydrophorus	7		10	1		
Coenagrionidae	Ischnura	6	9		15	1	2
Hydrophilidae	Laccobius					2	
Veliidae	Microvelia		9				
Pleidae	Neoplea	1					
Physidae	Physa	2	3	8	4	1	
Gerridae	Rheumatobates		1				
Simuliidae	Simulium			69		34	
Heptageniidae	Stenacron		2				
Elmidae	Stenelmis		1				
Hydrophilidae	Tropisternus						1
Valvatidae	Valvatidae		2		1		6

In addition to the TCEQ biological data, biological sampling was conducted by the applicant via APAI in May 2006 and August 2006.

## May 2006 Biological Sampling Event

Biological sampling was conducted by APAI on the North Sulphur River in May 2006 (Brandes, 2006). Two weeks prior to the May 2006 sampling event, approximately 1.5 inches of precipitation fell in the vicinity of the proposed LRH Dam site. Three stations were sampled and included sites upstream of the SH 34 Bridge, downstream of FM 904 Bridge, and downstream of the SH 38 Bridge (Exhibit 2). Six pools at each sampling location were identified for collection utilizing a D-frame aquatic dip net for invertebrates, fish, and amphibians; a Surber Stream Sampler for benthic invertebrates; and a kick net for collecting large and small organisms in open water. The substrate at all three locations consisted of clayey shale with gravel intermixed.

No flow or rooted vegetation was observed at any of the three locations. However, detritus and filamentous algae was observed at all three locations. Pools at the SH 34 location averaged approximately 20 meters by 15 meters with a depth ranging from five to ten centimeters. Pools at the FM 904 location averaged approximately 15 meters by 10 meters with depths ranging from five to 22 centimeters. Pools at the SH 38 location averaged approximately 40 meters by 25 meters with depths ranging from five to 15 centimeters. Data collected were compiled into TCEQ's habitat assessment worksheet with each location scoring a limited (poor) habitat quality index.

A variety of freshwater invertebrates were collected from the three sampling locations. **Table 10** summarizes the total number of specimens collected at each sampling location. Invertebrates identified during the sampling event are common and abundant throughout the area and normally colonize ephemeral to intermittent pools within the North Sulphur River. These organisms are opportunist and are temporarily sustained by these pools. No fish species were collected at any of the three sample locations.

Table 10. Aquatic Organisms Identified at Each Sample Location (May 2006).

		Hwy 38 Bridge		Hwy 904 Bridge		Hwy 34 Bridge	
Scientific Name	Common Name	Surber	D- Frame Dip Net	Surber	D- Frame Dip Net	Surber	D- Frame Dip Net
Amphipoda	Scuds	0	1	2	0	0	6
Baetidae	Mayflies	0	6	0	4	1	23
Caenidae	Mayflies	38	361	155	811	41	425
Cambaridae	Crayfish	0	0	0	0	0	1
Ceratopogonidae	Flies and Midges	0	21	2	13	0	22
Chironomidae	Flies and Midges	84	591	92	288	75	934
Cladocera	Water Fleas	0	0	0	0	284	56
Coenagrionidae	Damselflies	0	0	0	2	0	0
Collembula	Spring Tails	0	0	0	0	0	1
Copepoda	Tiny Crustaceans	0	3	0	0	0	7
Corixidae	Aquatic and Semi- Aquatic Bugs	71	136	3	3	4	53
Culicidae	Mosquitoes	2	50	17	19	1	38
Dolichopodidae	Flies and Midges	0	0	0	0	2	3
Gyrinidae	Water Beetles	0	8	0	0	2	5
Haliplidae	Water Beetles	0	0	0	0	0	4
Heptageniidae	Mayflies	0	0	1	1	0	0
Hydracarina	Water Mites	0	2	6	0	0	1
Hydrophilidae	Water Beetles	0	14	5	15	5	25
Libellulidae	Dragonflies	3	12	8	24	3	55
Ostracoda	Seed Shrimp	0	38	0	0	0	48
Planorbidae	Freshwater Snail	0	0	0	0	0	1

The majority of aquatic organisms collected during the sampling event were identified as Chironomidae (41 percent), Caenidae (36 percent) Cladocera (7 percent), and Corixidae (5 percent).

## **Chironomidae**

Chironomidae is the largest family of aquatic insects and inhabits temporary and permanent aquatic habitats. There are 61 common genera found in Texas that are difficult to identify to genus and species. Chironomidae feeding groups include collector-gatherers, filter-collectors, and predators. Species within this family occupy

burrows and are tolerant to poor water quality and low dissolved oxygen levels (TCEQ, 2009). Chironomidae was the most abundant family collected and was collected at all sampling locations.

## <u>Caenidae</u>

Caenidae species are widespread and common in a variety of lentic and lotic habitats in streams, swamps, spring seeps, marshes, lakes, and ponds. These organisms usually occur in sediment and are often partially covered with silt. Adults live only a few hours and mate shortly after emerging. Caenidae species are collector-gathers and filter-collectors and are considered sprawlers. Caenidae species are tolerant to low dissolved oxygen levels and generally sensitive to moderately tolerant to pollution (TCEQ, 2009). Caenidae species were the second most abundant collected and were collected at all sampling locations.

## Cladocera

Cladocera species are widespread and common in freshwater and can be found in most streams with the exception of fast-flowing streams and extremely polluted waters. The majority of species feed on organic detritus, bacteria, and protozoans. Only a few species can handle low oxygen levels (TCEQ, 2009).

#### Corixidae

Corixidae are abundant to common insects in ponds with some species occurring in streams or brackish pools. Corixidae species are swimmers that spend the majority of time clinging to submerged vegetation and feeding on algae and other small organisms (TCEQ, 2009).

## **August 2006 Site Investigation**

A second on-site investigation was conducted in August of 2006 to quantify existing conditions and observe flows within the North Sulphur River channel. The sample locations included the FM 904 Bridge, FM 2990 Bridge, and the FM 68 Bridge (**Exhibit 2**). No water was observed in the North Sulphur River at any of the sample locations due to the lack of rainfall.

#### 2.3 Groundwater

The Trinity and Woodbine aquifers are the two predominant groundwater sources located within the project vicinity (**Exhibit 4 and Exhibit 5**). The Trinity aquifer, as recognized by the TCEQ and the Texas Water Development Board, is listed as a major aquifer for Texas. This aquifer consists of limestone, sand, clay, gravel, and conglomerates. The Trinity aquifer is one of the most extensive and highly used groundwater resources in Texas. It is primarily used by municipalities; however, it is also used for irrigation, livestock, and other domestic purposes.

The Woodbine aquifer is listed as a minor aquifer in Texas. This aquifer overlies the Trinity aquifer and consists of sandstone interbedded with shale and clay. The Woodbine aquifer provides water for municipal, industrial, domestic, livestock, and

small irrigation supplies. Both of these aquifers provide water supply for the rural areas of Fannin County.

The Trinity and Woodbine formations are more than 2,000 feet below ground surface in this area and are separated from the surface by significant thickness of aquicludes or aquitards. These aquifers recharge very slowly and only approximately 3 percent of water that falls as rain over the outcrop area ends up recharging the aquifer. The amount of recharge to the Trinity and Woodbine aquifers is estimated to be less than one inch per year (Nordstrom, 1982) No other groundwater formations are known to occur within the project vicinity.

# 3.0 Environmental Consequences

## 3.1 North Sulphur River

## 3.1.1 Hydrologic Models

The UTRWD has utilized hydrologic models to assess stream impacts to the North Sulphur River and Sulphur River. This modeling was conducted to analyze potential impacts to aquatic resources from the proposed LRH project. DiNatale Water (2016a) evaluated the adequacy of the hydrologic modeling for the purposes of the EIS, verified the modeling performed by UTRWD, and performed additional modeling.

The UTRWD utilized the State of Texas Water Availability Model that uses the Water Rights Analysis Package modeling platform (WAM/WRAP) and the RiverWare model developed by the U.S. Army Corps of Engineers (USACE) for the Red River Basin. The USACE also provided a HEC-RAS model developed for the Sulphur River Basin. DiNatale Water (2016a) evaluated the adequacy of these models to assess impacts to aquatic resources. The RiverWare model results provide the lower end of expected flow while the WAM results provide the upper end of expected flow below LRH (DiNatale, 2016a). In addition, DiNatale Water created a Daily Excel Model to simulate the filling and evaporation from pools on a daily basis (DiNatale, 2016b).

## WAM/WRAP Model

TCEQ has developed several hydrologic water availability models for different river basins throughout Texas. WRAP is the modeling package while the input files specific to each river basin is referred to as the WAM. These input files describe hydrology, water rights, demands, and other features unique to each basin. The Sulphur River WAM model simulates the North Sulphur River, South Sulphur River, Sulphur River, White Oak Creek, and the watershed above Wright Patman Lake using a monthly time step.

## RiverWare Model

The USACE developed a river network model for the Red River basin using the RiverWare modeling platform. RiverWare was developed at the Center for Advanced Decision Support for Water and Environmental Systems at the University of Colorado.

These models simulate complex river and reservoir networks. The user-developed policy rules featured in this model allow nearly unlimited flexibility to develop and simulate different operating policies and protocols. The Red River Basin RiverWare model includes the Sulphur River and North Sulphur River which are tributaries to the Red River. The model is a daily model that was developed to evaluate different USACE operations including flood control of the Red River Basin. This model includes LRH but does not include simulated diversions to the UTRWD and does not pass water to downstream senior water rights. The UTRWD modified the model to include the UTRWD diversion at LRH to produce a with-project RiverWare model. In addition, UTRWD disabled LRH to simulate without-project conditions.

## HEC-RAS Model

The USACE developed the Sulphur River Basin HEC-RAS model that includes unsteady flow simulations of calculated probable maximum floods. The model includes multiple geometries with various proposed reservoirs in the basin, not including the proposed LRH. The HEC-RAS model was used to evaluate the potential impacts to floodplain resources.

## Daily Excel Model

DiNatale Water developed an Excel spreadsheet model to address comments received from the Texas Parks and Wildlife Department (TPWD). TPWD requested a daily time step model be developed to more accurately predict impacts to pools within the North Sulphur River (DiNatale, 2016b). In order to evaluate the potential benefits of a daily model, the RiverWare model was used to develop a daily model of the volume of water within the pools in the river channel. The model simulated filling of pools from streamflow and outflow from evaporation on a daily basis. The Excel spreadsheet model was used to compute statistics on the percent of time the pools were full, >75 percent full, >50 percent full, >25 percent full, and not empty. In order to determine impacts to aquatic organisms, the statistics for pools >75 percent full were used. According to DiNatale (2016a), there were only negligible differences between with and without LRH model runs for both the RiverWare and WAM models below the Cooper Gage. Downstream of the Cooper Gage, no impacts to pools are anticipated due to the increased drainage area below the Cooper Gage.

## 3.1.2 Morphology

MEI conducted a geomorphic and sedimentation study of the proposed LRH project (MEI, 2006). The primary objectives of the study were:

- Quantification of the sedimentation delivery to the reservoir site for the 50year project life under pre- and post-project conditions,
- Evaluation of the downstream effects of the dam on channel conditions and flow capacity, and
- Assessment of the potential for reducing or managing the upstream sediment supply to the reservoir.
- Assessment of future conditions in the North Sulphur River and tributaries upstream of the dam site in the absence of the project.

# **APPENDIX**

## **EXHIBITS**

Potential sources of sediment include channel erosion of the North Sulphur and its tributaries as well as watershed erosion. Analysis of the USGS North Sulphur River near Cooper gage and HEC-1/HEC-RAS models were used to estimate flows. Field observations indicated the morphological adjustment of the North Sulphur and its tributaries can be described by a geomorphic model of incised channel evolution (MEI, 2006). A channel evolution model was developed for the North Sulphur River and its tributaries. Estimates of the sheet-and-rill erosion in the watershed were developed with the Modified Universal Soil Equation (MUSLE) with parameters based on subbasin topography and soil types.

The MEI (2006) study concluded channelization-induced degradation and widening of the North Sulphur River and its principal tributaries upstream of the dam site has resulted in the erosion of approximately 28 million tons of sediment since the late 1920s.

MEI (2006) also estimated total annual sediment yield to the proposed LRH dam site under pre and post-project conditions. A range of estimates were provided based on conservative assumptions and worst-case assumptions. The worst-case assumptions assumed 100 percent of the watershed under cultivation with no soil conservation measures. Estimates of total annual sediment yield to the dam site location pre-project conditions ranges from 86 AF to 217 AF. Post-project conditions reduce the contributing watershed area and the length of the channel supplying sediment to the proposed LRH dam site. Estimates of total annual sediment yield to the dam site location post-project conditions ranges from 51 AF to 74 AF. According to MEI (2006), an estimated delivery to the 106,000 AF reservoir over a 50-year period assuming 100 percent trap efficiency would range from 2,570 AF to 3,700 AF. These estimates represent a loss of storage capacity over a 50-year period ranging from 1.6 percent loss to 2.3 percent loss.

Erosion of the North Sulphur River and its tributaries will continue without the proposed LRH. In areas where shale is exposed, channel depths will increase approximately 8 feet and channel bottom widths will increase approximately 16 feet over a 50-year period. Increasing channel depths are likely to cause further failure of the alluvial portions of the banks increasing channel top widths (MEI, 2006).

No adverse downstream impacts on channel morphology or capacity are expected as a result of sediment trapping in the reservoir, or operation of the reservoir (MEI, 2006). The North Sulphur River downstream of the proposed dam site is composed of shale bedrock. Shale bedrock erosion rates are controlled by the number of wetting and drying cycles and not hydraulic processes. Therefore, the proposed LRH dam is unlikely to have any effect on erosion rates downstream of the dam site. In addition, only 25 percent of the annual total sediment yield to the dam site is composed of bed material. The bulk of sediment delivered to the North Sulphur River and its tributaries downstream of the proposed dam site is composed of shale clasts that break down into wash-load size materials as they are exposed to transport and

weathering processes (slaking). Furthermore, the North Sulphur River is a supply-limited system that has the capacity to transport considerably more bed material than is currently being supplied to the channel. Consequently, it is unlikely that significant amounts of sediment will accumulate in the bed of the river downstream of the dam (MEI, 2006).

## 3.1.3 Hydrology

As described in DiNatale (2016b), using the daily method evaluated at more than 75 percent full is a reasonable, but still conservative estimate of the hydrologic impacts to pools between LRH and the North Sulphur River at the Cooper Gage. **Table 11** summarizes the amount of time pools are >75 percent full with and without the proposed LRH.

Table 11. Percent of Time Pools are > 75 Percent Full (1994 to 2014 Study Period).

Reach	Without LRH	With LRH	Difference
Downstream of Lake Ralph Hall Dam Site	81.9%	33.6%	-48.3%
Downstream of mouth of Baker Creek	80.2%	77.8%	-2.4%
Downstream of mouth of Bledsoe Creek	76.6%	70.5%	-6.0%
Downstream of mouth of Wafer Creek	77.2%	77.2%	0.0%
Downstream of mouth of Ghost Creek	80.3%	80.3%	0.0%
Downstream of mouth of Morrison Creek	73.5%	72.6%	-0.9%
Downstream of mouth of Rowdy Creek	71.9%	68.2%	-3.7%
Downstream of mouth of Cane Creek	74.2%	74.2%	0.0%
Downstream of mouth of Maxwell Creek*	68.3%	65.9%	-2.4%

Source: DiNatale, 2016b \*Reach Ends at Cooper Gage

The results of the model indicate the greatest amount of change to pools >75 percent full occur just below the proposed LRH Dam to Baker Creek (48.3 percent). Changes to pools below Baker Creek to the Cooper Gage range from 0.0 percent to 6.0 percent (**Exhibit 6**). These differences are based on the length of reach and size of pools within each reach.

## 3.1.4 Water Quality

LRH is estimated to have a maximum storage capacity of 160,000 AF. At capacity, the surface area of the reservoir would be about 11.9 square miles with a maximum depth of about 90 feet. The firm yield of the project is estimated at approximately 34,050 AF/year with expected annual withdrawals of up to 45,000 AF (Brandes, 2004).

The retention of water upstream of a dam can cause numerous water quality issues for the water stored at the reservoir and also for waters downstream. The period of retention of water is a function of the capacity of the reservoir, the flow of water into and out of the reservoir, and the mixing of the reservoir. The period of retention, design, and operation of the reservoir impacts water temperature, dissolved oxygen levels, and sediment and nutrient transport.

In order to predict potential water quality issues in LRH, water quality data from a similar reservoir within the Sulphur River Basin was reviewed. Jim Chapman Lake is

located in Delta and Hopkins counties approximately 13 miles southeast of the proposed LRH. Similar to LRH, Jim Chapman Lake is located in an area consisting mostly of rural land cover. Jim Chapman Lake is located in the Sulphur River Basin with a storage capacity of approximately 298,930 AF. Due to the proximity of the proposed LRH, Jim Chapman Lake could share similar water quality characteristics to LRH once constructed. **Table 12** includes the 2014 water quality standards for Jim Chapman Lake.

Table 12. Site-Specific Uses and Criteria for Jim Chapman Lake (TCEQ, 2014).

	Recreation	Public Contact Recreation
Uses	Aquatic Life	High
	Domestic Water Supply	Public Water Supply
	Other	-
	Cl-1 (mg/L)	50
	SO <sub>4</sub> -2 (mg/L)	50
	TDS (mg/L)	225
Criteria	Dissolved Oxygen (mg/L)	5.0
	pH Range (SU)	6.5 – 9.0
	Indicator Bacteria <sup>1</sup> (#/100ml)	126
	Temperature (°F)	93

Assessment results from TCEQ (2014) for Jim Chapman Lake at Segment 0307 are included in **Table 13.** 

Table 13. 2014 Texas Integrated Water Quality Assessment Results, Jim Chapman Lake, Segment 0307, Lower 5,000 Acres Near Dam.

Parameter	# Samples	Mean of Samples	# of Sample Exceeding Criteria	Mean of Samples Exceeding Criteria	Criteria	Sample Sizes	Level of Support
		A	Aquatic Life U	se			
DO-Grab Screening Level (mg/L)	9	ı	0	ı	5.00	LD	NC
DO-Grab Min (mg/L)	9	-	0	-	3.00	LD	NC
		]	Recreation Us	se			
Bacteria*	6	2.42	0	-	126.00	LD	NC
			General Use				
Water Temp (°C)	9	_	0	_	33.90	LD	NC
High pH (SU)	9	_	1	8.6	8.50	LD	NS
Low pH (SU)	9	-	0	_	6.00	LD	NC
Total Phosphorus (mg/L)	8	ı	0	-	0.20	LD	NC
Chlorophyll- <i>a</i> (µg/L)	9	-	2	32.9	26.70	LD	NC
Ammonia (mg/L)	9	-	1	0.17	0.11	LD	NC
Nitrate (mg/L)	8	-	2	0.69	0.37	LD	NC
Public Water Supply Use							
Nitrate	46	0.21	0	-	10.00	AD	FS
Fluoride	48	0.15	0	ı	4.00	AD	FS

<sup>\*</sup> E. Coli

AD – Adequate Data; LD – Limited Data; NC – No Concern; FS – Fully Supporting; CS – Screening Level Concern; NS - Nonsupport

TCEQ (2014) indicates most parameters assessed fully support the use or are no concern. TCEQ (2014) issued a nonsupport for high pH based on a reading above the standard and other information used for the report. Lake Jim Chapman was first placed on the Section 303(d) list for pH in 2000 and is included in the 2014 list. The segment is categorized as a "5C" meaning additional data or information will be collected and/or evaluated before a management strategy is selected. TCEQ lists a potential source for this impairment as a nonpoint source.

LRH may experience similar water quality characteristics as Lake Jim Chapman. Other than elevated pH, no other water quality issues are associated with Lake Jim Chapman. No other activities within the basin were identified as potential sources of pollutants to the proposed LRH.

Post-project estimated pollutant loads were calculated at the proposed LRH dam site location and downstream site using similar methods described in **Section 2.2.3**. In addition, estimated 50-percentile flows from the WAM model were used to calculate estimated pollutant concentrations at both locations (**Table 12** and **Table 13**). Calculations indicate lower pollutant concentrations at the proposed LRH dam site due to a decrease of overland runoff area as a result of the construction of LRH. The

downstream site calculations indicate a slight increase in pollutant concentrations due to decreased flow as a result of LRH. The WAM model calculated average monthly flows at the downstream site with and without LRH. Flows at the downstream site without LRH are estimated to be 33,876 AF/month while flows with LRH decrease to 32,715 AF/month.

Table 14. Loading and Concentrations at Dam Site Post-Project.

	Load (Pounds)			Concentration (mg/L)		
Pollutant	1-Year	2-Year	Annual Rainfall	With LRH	Without LRH	
	Storm	Storm				
TSS	1,533,567	1,909,624	6,041,414	118.37	133.50	
Lead	657	818	2,589	0.05	0.06	
Zinc	4,272	5,320	16,830	0.33	0.37	
Kjeldahl Nitrogen	21,141	26,326	83,285	1.63	1.84	
Nitrite / Nitrate	11,896	14,813	46,864	0.92	1.04	
Total Phosphorus	2,651	3,301	10,443	0.20	0.23	
Soluble Phosphorus	570	709	2,244	0.04	0.05	

Table 15. Loading and Concentration at River Site Post-Project.

		Load (Pound	Concentration (mg/L)		
Pollutant	1-Year	2-Year	Annual	With LRH	Without LRH
	Storm	Storm	Rainfall		
TSS	24,131,018	30,450,258	110,317,189	103.34	100.49
Lead	10,342	13,050	47,279	0.04	0.04
Zinc	67,222	84,826	307,312	0.29	0.28
Kjeldahl Nitrogen	332,663	419,779	1,520,801	1.42	1.39
Nitrite / Nitrate	187,188	236,207	855,746	0.80	0.78
Total Phosphorus	41,712	52,635	190,691	0.18	0.17
Soluble Phosphorus	8,963	11,310	40,975	0.04	0.04

## 3.1.5 Aquatic Organisms

As described in Section 2.2.4, aquatic organisms occupy pools within the North Sulphur River channel downstream from the proposed LRH Dam location. The aquatic biological community within these pools is dependent on water quality conditions and available habitat within each pool. Changes in water levels within stream pools can lead to changes in water quality including changes in pH, dissolved oxygen, conductivity, siltation level, and concentrations of ions, toxins, or pollutants (Williams, 1987; Stanely et al., 1994; Lake, 2000). These changes affect the composition and interactions of the macroinvertebrate communities within stream pools. Taxa can vary seasonally within pools as flow velocities and water levels change in intermittent streams. In addition, water quality in adjacent pools within the same reach can vary substantially in nutrient concentrations and dissolved oxygen levels as water levels decrease. As water quality within a stream pool changes, the macroinvertebrate community changes and adapts to conditions within the pool. In addition, other factors such as species competition, and predators such as fish, amphibians, and birds can affect the abundance, density, and taxonomic

composition of the macroinvertebrate community (Xerces Society for Invertebrate Conservation, n.d.).

In order to provide a conservative estimate of impacts to aquatic organisms within North Sulphur River pools, model calculations for pools >75 full were used. This method assumes aquatic organisms are impacted in pools experiencing decreasing levels from 100 percent full to 75 percent full.

Biological sampling conducted by APAI indicated the presence of opportunistic invertebrates sustained by pools within the river channel. These pools ranged in depth from 5 centimeters to 22 centimeters. The majority of organisms sampled are tolerant to poor water quality and low dissolved oxygen levels. Based on the biological sampling effort conducted, it is assumed similar aquatic organisms occupy pools downstream of the proposed LRH Dam location. Therefore, similar aquatic organisms would be impacted in downstream pools experiencing decreasing flows and water levels.

According to the DiNatale (2016b) Daily Excel Model, the majority of impacts to pools >75 percent full in the North Sulphur River would occur between the LRH Dam site and Baker Creek (**Table 11**). Pools in reaches below Baker Creek would experience lower levels of change ranging from 0.0 percent to 6.0 percent (**Exhibit 6**). It is anticipated impacts to aquatic organisms in pools with decreasing levels would occur between the proposed LRH dam and the Cooper Gage. Both the RiverWare Model and WAM Model indicated almost no change to reaches below the Cooper Gage.

## 3.2 Groundwater

Groundwater aquifers at the LRH site area are much deeper than the North Sulphur River channel. In addition, the river channel is primarily comprised of shale bedrock that impedes vertical flow to lower aquifers. Therefore, the potential for the project to impact groundwater in the LRH site area is minimal. Downstream locations near Lake Wright Patman may have increased groundwater interaction. However, due to the minimal differences in flow to LRH, changes to the surface-groundwater interaction would be small or negligible.

## 4.0 Conclusion

MEI completed a geomorphic and sedimentation study of the proposed LRH. The study concluded channelization-induced degradation and widening of the North Sulphur River and its principal tributaries upstream of the dam site has resulted in the erosion of approximately 28 million tons of sediment since the late 1920s. The study also concluded erosion would continue without the proposed LRH with channel depths increasing 8 feet and channel bottom widths increasing 16 feet over a 50-year period. Without the proposed LRH, sediment yield at the proposed dam site location would range from 86 AF to 217 AF. With the proposed LRH, sediment yield at the proposed dam site would range from 51 AF to 74 AF resulting in a 1.6 percent to 2.3 percent loss of storage capacity over a 50-year period. No adverse downstream

impacts on channel morphology or capacity are expected as a result of the sediment trapping in the reservoir, or operation of the reservoir (MEI, 2006).

According to TCEQ (2014), water quality within the North Sulphur River meets water quality standards and is not included on the 2014 Section 303(d) List. Period of retention, design, and operation of the reservoir impacts water temperature, dissolved oxygen levels, and sediment and nutrient transport. Pollutant loading and concentration calculations indicate a slight increase of 2.83 percent in pollutant concentrations at the downstream site. The increase in pollutant concentrations are a result of lower flows at the downstream site due to the construction of LRH.

A daily Excel model was used to estimate potential impacts to pools >75 percent full downstream of the proposed LRH Dam. The results of the model indicate varying changes to pools >75 percent full in the North Sulphur River between the proposed LRH dam and the Cooper Gage. The reach extending from the proposed LRH Dam to Baker Creek would experience the largest amount of change to pools >75 percent full (**Exhibit 6**). As a result, the largest impacts to aquatic organisms would occur in the reach just below the LRH Dam. A portion of this reach would be completed filled to construct the proposed dam and is the area subject to the greatest hydrologic modification. The USACE considers such effects a complete loss. Lower impacts would occur further downstream at varying levels to the Cooper Gage. Based on the May 2006 sampling event, the majority of aquatic organisms would include Chironomidae, Caenidae, Cladocera, and Corixidae.

Groundwater aquifers at the proposed LRH study area are not anticipated to be impacted due to the depth of the groundwater aquifers. In addition, the river channel is comprised of shale bedrock impeding vertical flow to lower aquifers.

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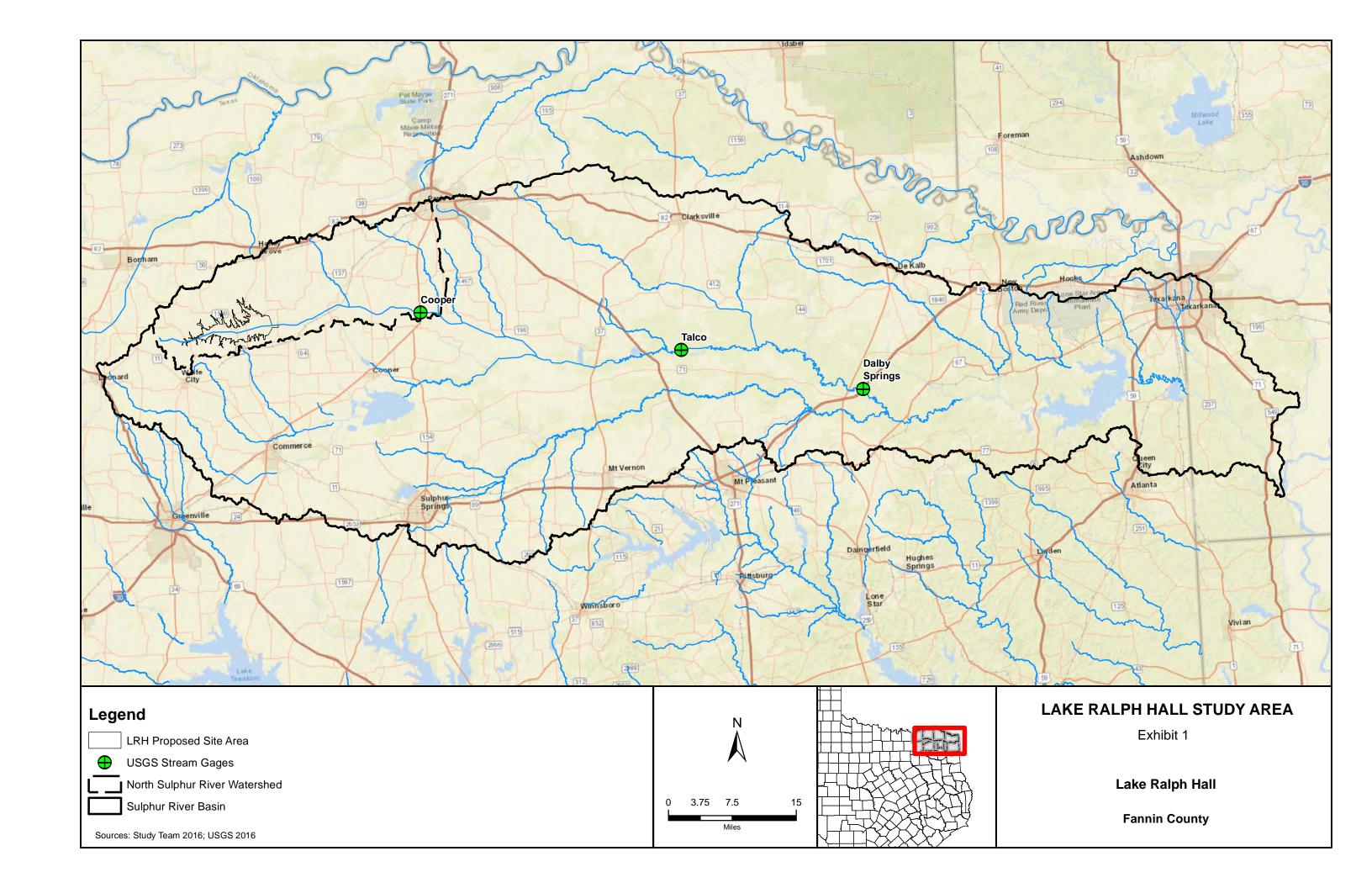
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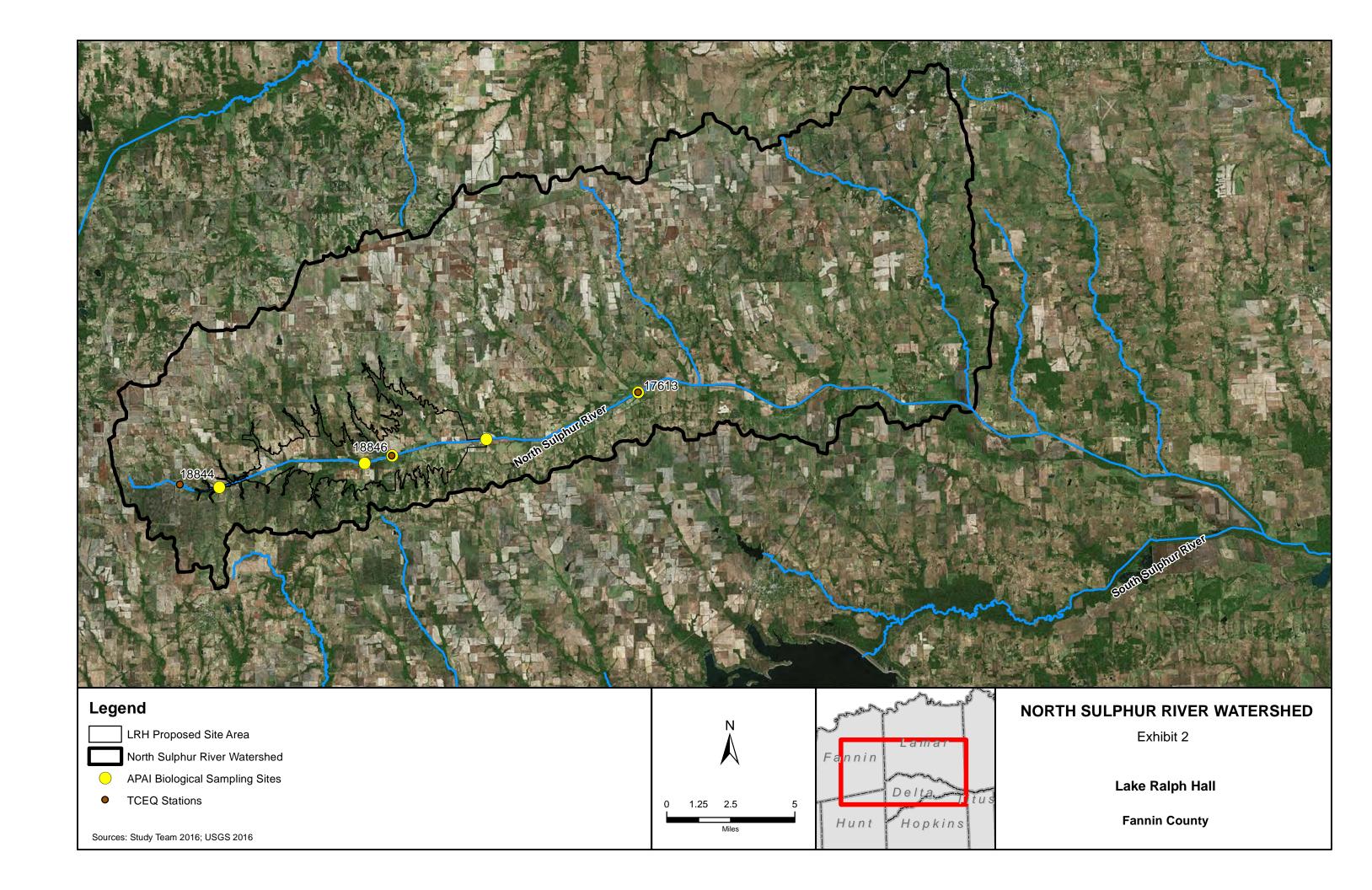
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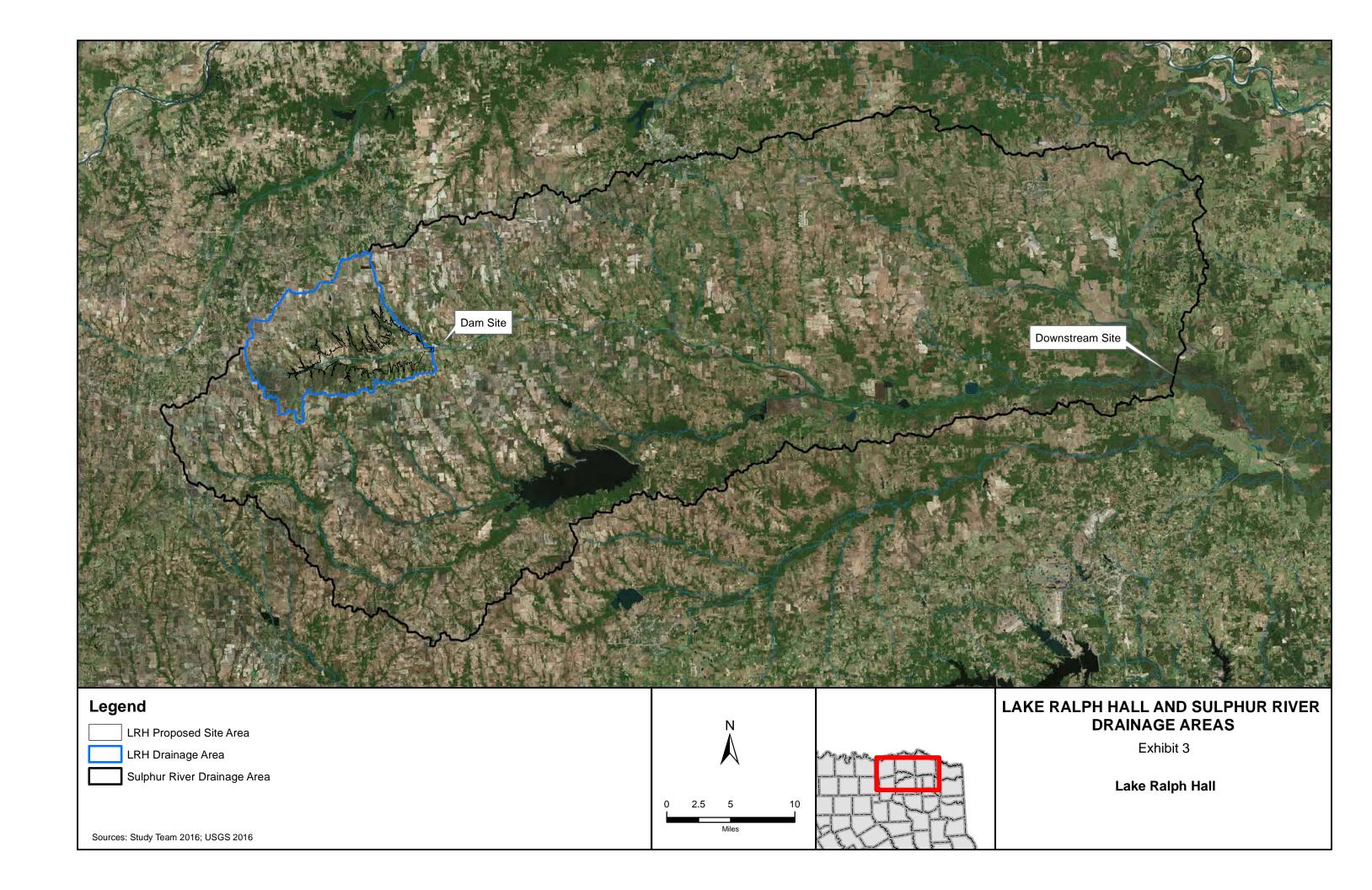
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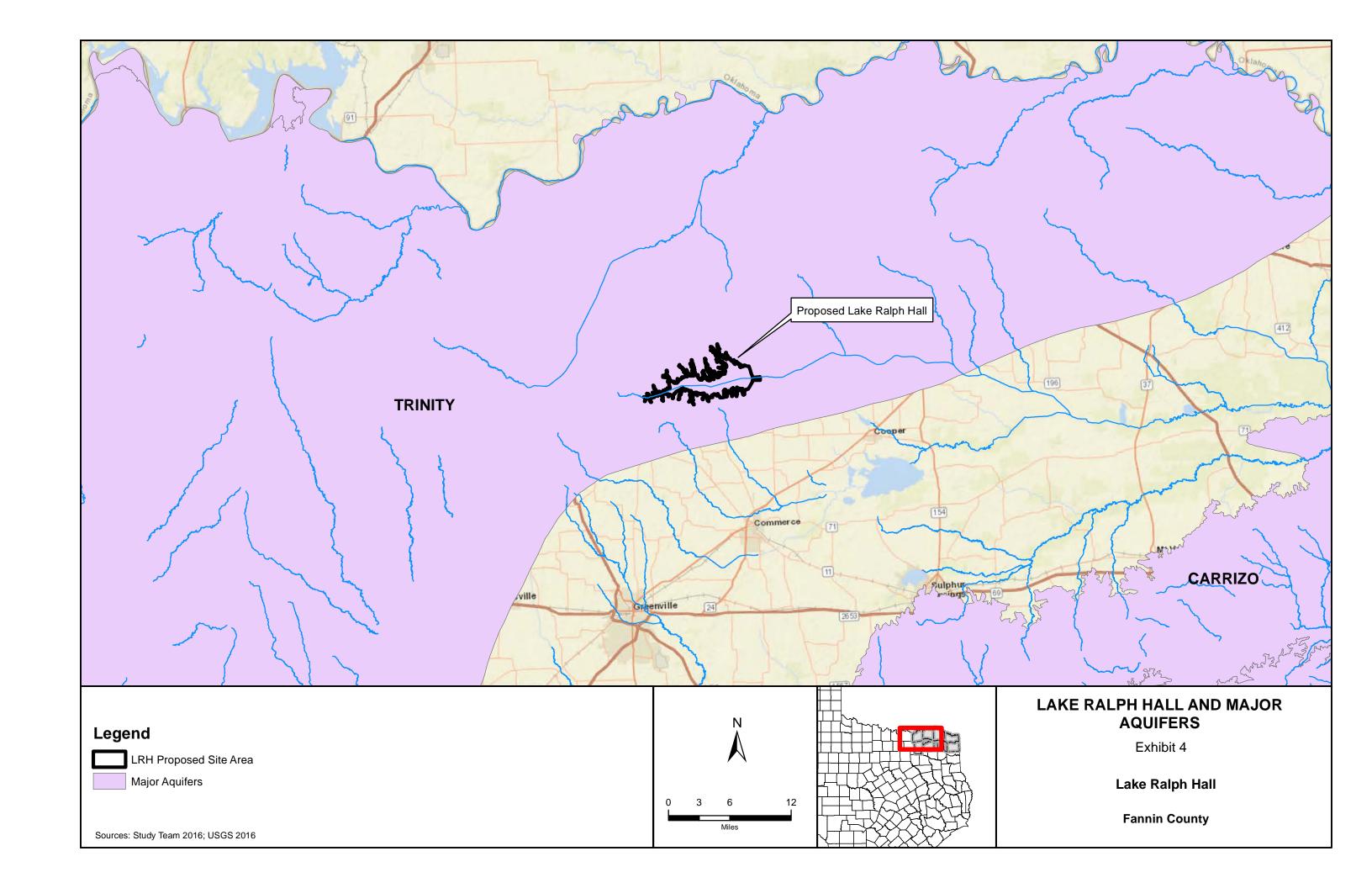
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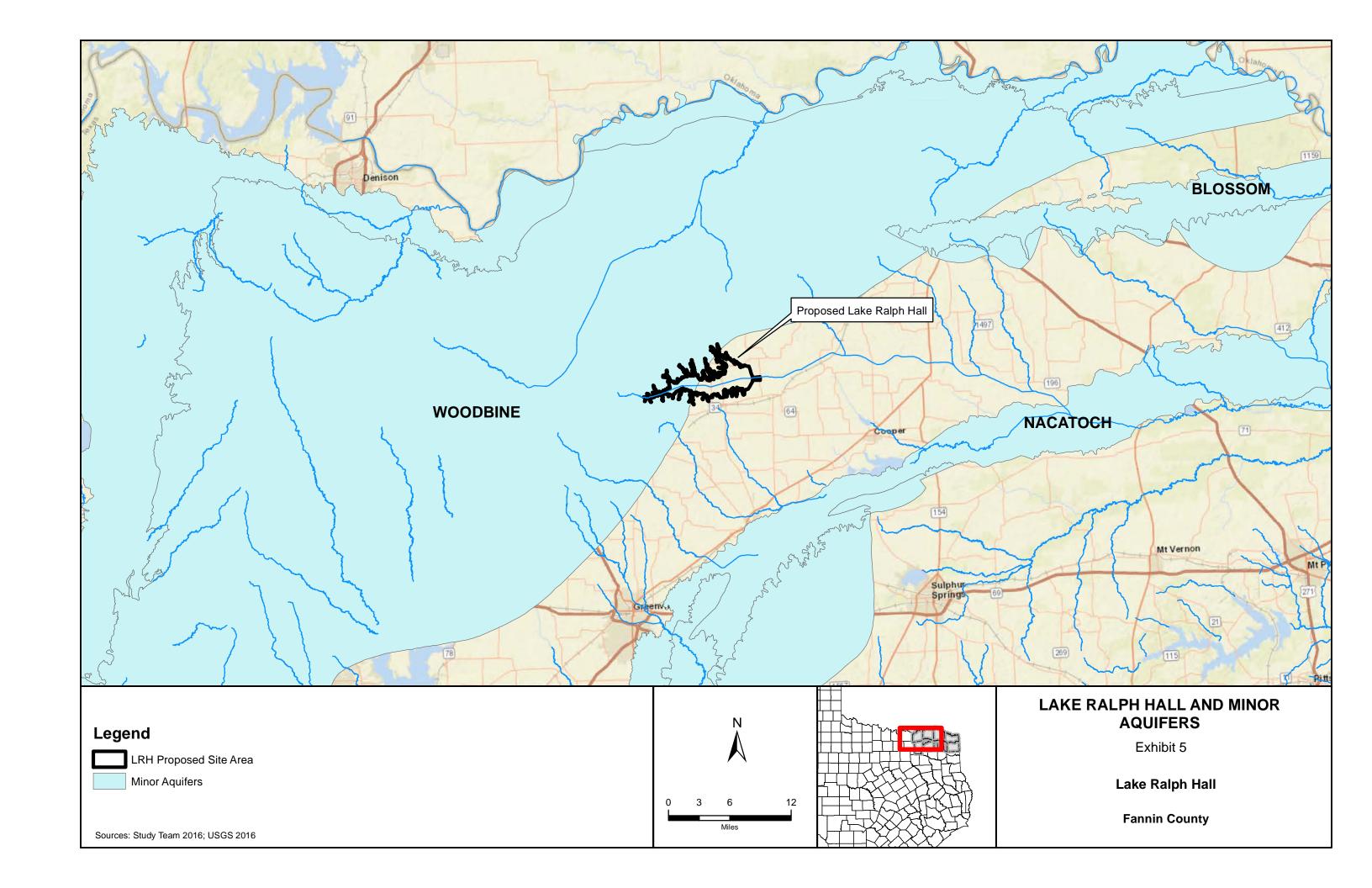
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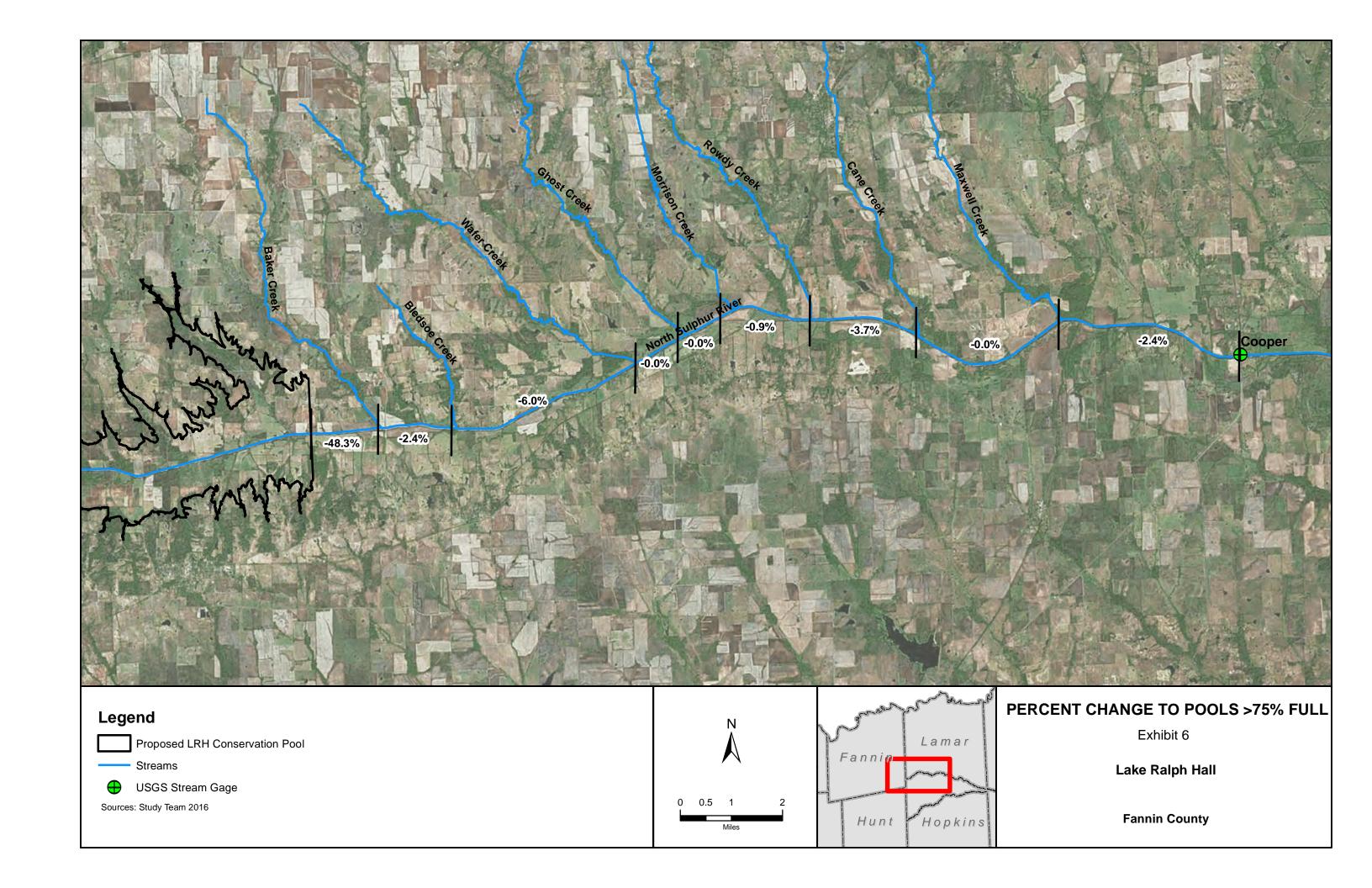












Lake Ralph Hall Appendix J Appendix J **Final Order from Court of Appeals** 



### Court of Appeals First District of Texas

NO. 01-15-00374-CV

UPPER TRINITY REGIONAL WATER DISTRICT AND TEXAS COMMISSION ON ENVIRONMENTAL QUALITY, Appellants

V. .

NATIONAL WILDLIFE FEDERATION, Appellee

Appeal from the 126th District Court of Travis County. (Tr. Ct. No. D-1-GN-13-004342).

#### TO THE 126TH DISTRICT COURT OF TRAVIS COUNTY, GREETINGS:

Before this Court, on the 26th day of January 2017, the case upon appeal to revise or to reverse your judgment was determined. This Court made its order in these words:

This case is an appeal from the final judgment signed by the trial court on March 6, 2015, which was transferred by the Supreme Court of Texas to this Court from the Court of Appeals for the Third District of Texas. After submitting the case on the appellate record and the arguments properly raised by the parties, the Court holds that there was reversible error in the trial court's judgment in the following respect: the partial reversal of the TCEQ's October 2, 2013 order. Accordingly, the Court **reverses** the trial court's judgment and **renders** judgment affirming TCEQ's October 2, 2013 order.

The Court orders that the appellee, National Wildlife Federation, pay all appellate costs.

The Court **orders** that this decision be certified below for observance.

Judgment rendered January 26, 2017.

Panel consists of Justices Jennings, Massengale, and Huddle. Opinion delivered by Justice Huddle.

WHEREFORE, WE COMMAND YOU to observe the order of our said Court in this behalf and in all things to have it duly recognized, obeyed, and executed.

June 9, 2017

Date

CHRISTOPHER A. PRINE CLERK OF THE COURT





# Court of Appeals First District of Texas BILL OF COSTS

No. 01-15-00374-CV

Upper Trinity Regional Water District and Texas Commission on Environmental Quality

V.

#### National Wildlife Federation

NO. D-1-GN-13-004342 IN THE 126TH DISTRICT COURT OF TRAVIS COUNTY

TYPE OF FEE	CHARGES	PAID/DUE	STATUS	PAID BY
MT FEE	\$10.00	04/20/2016	E-PAID	ANT
MT FEE	\$10.00	08/10/2015	E-PAID	ANT
MT FEE	\$10.00	05/22/2015	Ę-PAID	ANT
CLK RECORD	\$0.00	05/12/2015	UNKNOWN	ANT
RPT RECORD	\$475.00	04/27/2015	PAID	ANT
TRANSFER	\$20.00	04/08/2015	TRANSFER	ANT
TRANSFER	\$100.00	04/08/2015	TRANSFER	ANT
TRANSFER	\$25.00	04/08/2015	TRANSFER	ANT
TRANSFER	\$50.00	04/08/2015	TRANSFER	ANT
TRANSFER	\$50.00	04/01/2015	TRANSFER	ANT
TRANSFER	\$100.00	04/01/2015	TRANSFER	ANT
TRANSFER	\$25.00	04/01/2015	TRANSFER	ANT
TRANSFER	\$20.00	04/01/2015	TRANSFER	ANT

## The costs incurred on appeal to the First Court of Appeals Houston, Texas are \$895.00.

#### Court costs in this case have been taxed in this Court's judgment

I, Christopher A. Prine, Clerk of the Court of Appeals for the First District of Texas, do hereby certify that this is a true statement of the costs of appeal in this case.

IN TESTIMONY WHEREOF, witness my hand and the seal of the Court of Appeals for the First District of Texas, this 9<sup>th</sup> of June, 2017.

TOF APOLITION OF THE OF

CHRISTOPHER A. PRINE CLERK OF THE COURT

Lake Ralph Hall Appendix K

# Appendix K Draft Operations Plan

# Lake Ralph Hall Draft Operations Plan





Revised: October 9, 2017 Lake Ralph Hall

**Draft Operations Plan** 

Revised October 9, 2017

Introduction

This Draft Operations Plan (Plan) for Lake Ralph Hall presents a strategy for operating the proposed

reservoir in conjunction with Upper Trinity Regional Water District's (UTRWD or District) other water

resources to meet the water supply needs of the District's current and potential future members and

customers. This Plan outlines procedures to guide UTRWD in making decisions regarding how much water

to divert from Lake Ralph Hall on an annual basis and on a daily basis in order to integrate this new supply

with the District's other existing water resources. Actual daily operations will depend on UTRWD's

inventory of water available in its portfolio of different supply sources, along with the capacity of its

infrastructure to convey and treat raw water (considering maintenance, emergencies and other factors).

This Plan is considered to be preliminary and subject to change depending on the District's future water

demand and supply conditions.

System Limitations and Assumptions

UTRWD's current sources of water supply are available through contracts with the City of Dallas (DWU)

that allow the District to divert water from Lewisville Lake and Ray Roberts Lake in the Elm Fork Trinity

River basin and a contract with the City of Commerce that allows the District to divert water from Jim

Chapman Lake in the Sulphur River basin. The District also has a permit from the Texas Commission on

Environmental Quality (TCEQ), and supporting pass-through agreements with the Cities of Dallas and

Denton, that allow the District to reuse a portion of the water it imports from Jim Chapman Lake.

Preliminary

Page 1

UTRWD operates two water treatment plants (WTP), the Tom Harpool WTP (Harpool Plant) located in

Aubrey, Texas, and the Thomas E. Taylor WTP (Taylor Plant) located in Lewisville, Texas.

Presently the Harpool Plant is supplied with raw water from Jim Chapman Lake (Chapman Lake)

via the Irving Pipeline, which the District is authorized to use under a contract with the City of

Irving. Once Lake Ralph Hall is constructed and placed into service, it will be used in conjunction

with Chapman Lake to supply the Harpool Plant. For purposes of this Plan, the Harpool Plant's

raw water supply sources are assumed to include Chapman Lake, Lake Ralph Hall, or a

combination of the two, with deliveries made via a direct pipeline connection. Currently the Taylor

Plant is supplied raw water from the following sources.

o Raw water diverted directly from Lewisville Lake

Raw water from Chapman Lake delivered to Lewisville Lake via the Irving Pipeline and Doe

Branch Creek

o Chapman Lake reuse water after it has been treated and discharged into the Elm Fork

Trinity River basin upstream of Lewisville Lake

Once Lake Ralph Hall is constructed, the Taylor Plant will draw its raw water supply according to

the following priority:

Any water available to the District under its Reuse Permit issued by TCEQ

o Supplies available from Chapman Lake and/or Lake Ralph Hall (up to firm yield) not used

at the Harpool Plant

Water purchased from City of Dallas

In summary, for the purposes of this Plan, it is assumed that the Harpool Plant will only utilize raw water

from Chapman Lake or Lake Ralph Hall, and the Taylor Plant will utilize raw water from Lewisville Lake,

Preliminary

Chapman Lake, and Lake Ralph Hall and reuse water originating from either Chapman Lake or Lake Ralph

Hall.

Under the Texas water rights permit No. 5821, the UTRWD is authorized to impound flows in Lake Ralph

Hall on the North Sulphur River and to divert up to a maximum of 45,000 acre-feet/year of water from

the reservoir to meet the water supply needs of the District's customers and certain users in Fannin

County, Texas. Lake Ralph Hall will be constructed with a maximum conservation storage capacity of

160,235 acre-feet when the water surface of the reservoir is at elevation 551.0 feet msl. When the level

of the reservoir is above this storage condition, an uncontrolled overflow spillway will automatically pass

inflows downstream to the North Sulphur River, to the extent they are not diverted by UTRWD to meet

its water supply needs. When Lake Ralph Hall is not full, low-flow outlet facilities also will be able to pass

inflows through the reservoir to which downstream senior-priority water rights are entitled as directed

by the TCEQ. Stored water will not be released for meeting these senior-priority calls. Lake Ralph Hall

will have one or more pump station(s) to divert water from the reservoir to meet the water supply needs

of the District's customers and certain users in Fannin County, with the Fannin County supply limited to

the needs of those portions of Fannin County that lie within the North Sulphur River Basin (less any

supplies from other sources) under the terms of the contract between UTRWD and the City of Ladonia.

General System Operating Concepts

As described above, UTRWD's available water resources for meeting its customers' demands include Lake

Ralph Hall, Jim Chapman Lake, the City of Dallas Water Utilities (DWU) contract, and treated wastewater

reuse at Lake Lewisville. These various sources of supply will be utilized by UTRWD through a system

operation that attempts to optimize the overall supply in a manner that maximizes water availability while

minimizing the cost to UTRWD's customers. Outlined below are general underlying concepts for

operation of the District's water supply system:

Preliminary

Page 3

The Lake Ralph Hall and Jim Chapman Lake supplies will function as a sub-system within the

District's overall water supply system (LRH/JCL Sub-system), with water utilized from each

reservoir in a manner that attempts to optimize the total supply from both reservoirs.

While UTRWD will assess its water supply and demand conditions on a weekly basis, generally

UTRWD will utilize its different water supply resources on a daily basis to meet its customers'

demands in the following priority order; although, day to day demand changes and system

conditions occasionally may dictate a different priority order:

i. Reuse of all available treated wastewater discharged into Lake Lewisville the previous day

Use of water from LRH/JCL Sub-system to the maximum extent possible in order to ii.

maximize the available supply of reuse water on the following day

iii. Purchase of DWU contract water (stored water) to meet any remaining demands

Generally, Lake Ralph Hall water will be utilized on a daily basis in the following priority order;

although, day to day demand changes and system conditions occasionally may dictate a different

priority order:

i. To provide raw water supply for Harpool Plant

ii. To provide raw water supply for Taylor Plant after evaluating the availability of other

contract supplies

For temporary raw water sales, if agreed to by UTRWD, to District members and other iii.

customers

Preliminary Pre-decisional

Page 4

Operation of LRH/JCL Sub-System

The Plan as outlined herein presents a basis for UTRWD to make operational decisions regarding

diversions from Lake Ralph Hall and the District's other water resources. The actual daily operations will

vary and focus on maximizing the total quantity of water available from UTRWD's water resource portfolio

while minimizing costs, subject to contractual and permit limitations. With Lake Ralph Hall and Chapman

Lake operated as a sub-system of the District's overall water supply system, the key elements of how

these projects will be utilized are described below:

Initially, the overarching goal of utilizing water from the LRH/JCL Sub-system will be to maximize

annual diversions to the extent of each reservoir's firm annual yield, without intentionally

overdrafting either reservoir. This goal may change after experience is gained operating the

system in order to more effectively meet the water demands of the District's customers.

Generally, the LRH/JCL Sub-system will be operated in a manner that utilizes water from each

reservoir in proportion to the reservoirs' firm annual yields, taking into consideration current

reservoir storage conditions.

Although differences in the reservoirs' storage, evaporation, and/or hydrologic conditions

occasionally may dictate the use of certain modified operating procedures, generally UTRWD will

utilize water from the LRH/JCL Sub-system in the following priority order:

i. When the water surface of Lake Ralph Hall is above its conservation pool level (Elev. 551

feet) and the volume of storage in the District's pool in Jim Chapman Lake is below its

conservation pool capacity (30,003 acre-feet), then only diversions from Lake Ralph Hall

will be made up to the maximum allowable diversion rate and to the extent these

diversions can meet the LRH/JCL Sub-system demand (see 1.c above).

Preliminary

- ii. When the volume of storage in the District's pool in Jim Chapman Lake is at its conservation pool capacity (30,003 acre-feet) and the water surface of Lake Ralph Hall is below its conservation pool level, then only diversions from Jim Chapman Lake will be made up to the maximum allowable diversion rate and to the extent these diversions can meet the LRH/JCL Sub-system demand (see 1.c above).
- iii. If neither Case i or Case ii above is in effect or if the water surface of Lake Ralph Hall is above its conservation pool level and the volume of storage in the District's pool in Jim Chapman Lake is at its conservation pool capacity, then the diversions from Lake Ralph Hall and from Jim Chapman Lake to meet the LRH/JCL Sub-system demand (see 1.c above) will be adjusted to be approximately proportional to the firm annual yields of the two reservoirs. For this purpose, the firm annual yield of Lake Ralph Hall is set at 34,050 acrefeet/year, and the firm annual yield of the District's pool in Jim Chapman Lake is set at 12,909 acre-feet/year. Based on these firm annual yield amounts, 72.5% of the LRH/JCL Sub-system demand will be met with diversions from Lake Ralph Hall, and 27.5% of the LRH/JCL Sub-system demand will be met with diversions from Jim Chapman Lake.
- Hall conservation pool or in the District's pool in Jim Chapman Lake to zero, when the storage in either of these pools falls to less than 25% of its full conservation pool capacity, all diversions to meet the LRH/JCL Sub-system demand will be made from the other pool. This mode of operation will continue until the storage in both pools is less than 25% of their conservation pool capacities or until the storage in both pools is greater than 25% of their full conservation pool capacities, at which time diversions from the pools will be made in accordance with the procedures described above for Case iii.