Appendix E

Jurisdictional Determination of Waters of the U.S

E-1: Preliminary Jurisdictional Determination of Waters of the U.S

E-2: Supplement to the Preliminary Jurisdictional Determination

E-3: Jurisdictional Determination Supplement Report

E-4: Approved Jurisdictional Determination

E-1: Preliminary Jurisdictional Determination of Waters of the U.S

ATTACHMENT 3
PRELIMINARY JURSICTIONAL DETERMINATION OF WATER OF THE US
PROPOSED LAKE RALPH HALL

PREPARED BY
ALAN PLUMMER ASSOCIATES, INC.

UPPER TRINITY
REGIONAL WATER DISTRICT

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS - DESIGNERS - SCIENTISTS

PRELIMINARY JURISDICTIONAL DETERMINATION OF WATERS OF THE U.S.

PROPOSED LAKE RALPH HALL

SPONSOR:

UPPER TRINITY REGIONAL WATER DISTRICT

October 26, 2006

ALAN PLUMMER ASSOCIATES, INC.

TABLE OF CONTENTS

LIST OF TABLES

Preliminary Jurisdictional Determination of Waters of the United States
Upper Trinity Regional Water District's Lake Ralph Hall
Fannin County, Texas

1. Purpose

The Upper Trinity Regional Water District (the District) is proposing Lake Ralph Hall. The components of this system include an approximately 7,605-acre lake (proposed conservation pool), its associated dam and spillway system, and a raw water intake structure and pump station.

The purpose of this Preliminary Jurisdictional Determination (PJD) report is to document the extent of jurisdictional waters of the United States (U.S.) for the aforementioned reservoir components. The information contained within this PJD report will be utilized during the planning stages to determine permanent impacts associated with the conservation pool of the proposed raw water supply lake. The PJD is based upon the investigations of the lake's proposed conservation pool footprint (elevation 551 feet above mean sea level). Various areas within the reservoir footprint were not observed during the on-site investigations due to lack of right-of-entry; however, areas observed were compared to unobserved areas through the use of a 2003 and 2004 aerial photographs with two feet resolutions to assess inaccessible tracts.

The proposed project consists of four major elements as described below:

1. 7,605-acre reservoir with a conservation pool set at elevation 551 feet above mean sea level;
2. Embankment structure (dam);
3. Spillway system; and
4. Intake structure and pump station;

2. Methods

a. Contact Information

The sponsoring entity for this project is the Upper Trinity Regional Water District. The District has secured the professional services of Chiang, Patel, & Yerby, Inc. (CPYI) for design related to the reservoir project to which Alan Plummer Associates, Inc. (APAI) was subcontracted to prepare this PJD report. Questions concerning the content of this

PJD report should be directed to the District. Information regarding contacts for the District is as follows:

Company	Contact Name	Address	Telephone	Fax
Upper Trinity Regional Water District	Mr. Larry N. Patterson, P.E.	P.O. Box 305 Lewisville, Texas 75067	(972) 219-1228	(972) 219-7521

b. Delineation Methods

An on-site investigation for potential jurisdictional waters of the U.S. was conducted during August and September 2005 by APAI for the proposed raw water lake site. The lake is located solely in Fannin County, Texas. The delineation of wetlands was conducted based on the current regulatory procedures as outlined in the U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual, Technical Report Y-87-1 (on-line edition). Preliminary data (including but not limited to USGS topographic maps, National Wetland Inventory Maps, aerial photographs, and soil survey maps) suggested the potential for waters of the U.S.; therefore, the procedures for a routine, on-site determination for sites greater than five acres (as outlined in the previously referenced wetland delineation manual) were followed to determine the extent of waters of the U.S. within the project area.

c. Mapping Techniques

Prior to the on-site investigation, a review of the available resources was conducted to identify potential waters of the U.S. within the limits of the PJD. The resources reviewed included historic and current aerial photographs, the USGS topographic maps – Farmersville, Greenville NW, Celeste, Pike, Wolfe City, Gober, Ladonia, Honey Grove, and Dodd City quadrangles, the Soil Survey Fannin County, and National Wetlands Inventory maps associated with the proposed lake's USGS quadrangles. Once located, limits of the waters of the U.S. were determined using the guidelines outlined in Section 2b of this report, then mapped using a hand-held global positioning system (GPS) receiver (Garmin GPSMAP 76CS with 3-meter accuracy; field tested to 5-foot accuracy) during the on-site investigation. Waypoints recorded during the investigation were cross-

referenced with the topographic maps and aerial photographs to precisely determine the limits of waters of the U.S. within the limits of the PJD. In order to quantify the entire footprint for the proposed reservoir, Geographic Information System (GIS) technologies were used to identify various spectral signatures of the identified aquatic resources with respect to 2003 and 2004 aerial photographs and the USGS topographic quadrangles specific to the reservoir site. The identified signatures were then crossed-reference to the inaccessible tracts to determine the limits of the aquatic resource within those tracts; thereby, delineating the limits of aquatic resources for the entire reservoir footprint.

3. Results

a. Project Location

Lake Ralph Hall

The proposed Lake Ralph Hall site is located in Fannin County, Texas. Specifically it is located immediately north of the City of Ladonia along the North Sulphur River. The footprint for the conservation pool of the reservoir lies between Farm to Market Road (FM) 904 and State Highway (SH) 68 to the east and west, respectively and approximately FM 1550 and SH 64 to the north and south, respectively. Both FM 2990 and SH 34 essentially bisect the proposed reservoir project area from north to south. The location for the proposed reservoir site is shown on the general location map included as Figure A-1 in Appendix A. The approximate conservation pool elevation, which represents the area investigated for the PJD, is shown superimposed onto a 2003 aerial photograph included as Figure A-2 in Appendix A.

b. Description of Project Area

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 7,605-acre (conservation pool) reservoir. This reservoir would inundate the river and portions of its named and unnamed tributaries as well as the immediate river valley.

Beginning in the 1920's, 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 cotton in 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 varies from 200 to 300 feet wide and over 60 feet deep. Assorted tributaries were also channelized at varying distances 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 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 and its major tributaries resulting in continued loss of topsoil, riparian vegetation, stream properties, and stream functions. The North Sulphur River itself appears to be virtually sterile with little evidence of any aquatic life throughout the proposed project reach due to the constant slaking of the eroding shale within the current channel bottom.

As mentioned, the proposed reservoir will inundate portions of named and unnamed tributaries to the North Sulphur River. The named tributaries are as follows: Allen Creek; Bear Creek; Pot Creek; Brushy Creek; Pickle Creek; Davis Creek; Legget Branch; Bralley Pool Creek; Merrill Creek; Hedrick Branch; and Long Creek. The majority of the named creeks are located along the north side of the proposed reservoir footprint; however, there is an equal share of unnamed tributaries located along the south side of the proposed reservoir footprint. Some of these drainage systems have isolated areas of wooded riparian areas; however, the great majorities of these riparian areas are cleared and/or have been lost to channel erosion. During the time of the on-site investigation, all of the streams were completely dry with the exception of the North Sulphur River.

c. <u>Hydrology</u>

The proposed Lake Ralph Hall project site is located within the North Sulphur River drainage basin in an area where the North Sulphur River was channelized in the early

1900's. Over time, this channel has subsequently down cut and widened to the point where the 100-year flood is contained within the channel's banks. Due to the down cutting and widening of the North Sulphur River, the direct tributaries to this river have also experienced similar degradation.

As mentioned, the named tributary systems to the North Sulphur River include the following: Allen Creek; Bear Creek; Pot Creek; Brushy Creek; Pickle Creek; Davis Creek; Legget Branch; Bralley Pool Creek; Merrill Creek; Hedrick Branch; and Long Creek. The hydrology within the North Sulphur River and its tributaries within the project area is dominated by surface runoff following rain events. However, only the North Sulphur River experiences any inflow of groundwater thereby classifying it as an intermittent stream. Within the proposed lake conservation pool footprint, several streams are impounded, capturing surface runoff, and influencing the downstream flow regimes of those channels.

Although not an indicator of jurisdictional waters of the U.S., the National Wetland Inventory (NWI) maps for Ladonia, Gober, and Honey Grove, included as Figures C-1 through C-3 in Appendix C, identify numerous open water areas, rivers, and creeks within the footprint for the proposed reservoir's conservation pool. Each of those areas is given a specific classification code, which identifies its type of aquatic resource. An explanation detailing each of the NWI codes is included in Appendix C.

d. <u>Vegetation</u>

The proposed water supply lake project will inundate a variety of vegetative communities including open pasture, fence row tree lines, patches of forested riparian areas, fallow and active agricultural fields, prairie grasslands, and patches of upland woods along slopes. Most pasturelands are dominated by "improved" grasses such as coastal bermudagrass and tall fescue. The following Tables 1 and 2 list typical vegetation readily observed within the riparian and upland communities, respectively. Table 3 explains the Region 6 wetland plant indicator status classifications.

TABLE 1: VEGETATION LIST: RIPARIAN COMMUNITIES

Vegetative Type	Common Name	Scientific Name	Region 6 Indicator Status
Tree	American Elm	*Ulmus americana*	FAC
	Black Willow	*Salix nigra*	FACW+
	Bois d'Arc	*Maclura pomifera*	UPL
	Box Elder	*Acer negundo*	FACW-
	Cedar Elm	Ulmus crassifolia	FAC
	Green Ash	Fraxinus pennsylvanica	FACW-
	Honey-Locust	Gleditsia triacanthos	FAC
	Pecan	Carya illinoensis	FAC+
	Sugar Hackberry	*Celtis laevigata*	FAC
	Water Oak	*Quercus nigra*	FAC+
	Willow Oak	*Quercus phellos*	FACW
Sapling/Shrub	American Elm	*Ulmus americana*	FAC
	Bur Oak	*Quercus macrocarpa*	FAC-
	Cedar Elm	Ulmus crassifolia	FAC
	Honey-Locust	Gleditsia triacanthos	FAC
	Deciduous Holly	Ilex decidua	FACW-
	Eastern Redbud	Cercis canadensis	UPL
	Rough-leaf Dogwood	Cornus drummondii	FAC
	Sugar Hackberry	Celtis laevigata	FAC
	Yaupon Holly	*Ilex vomitoria*	FAC-
Woody Vine	Poison Ivy	Toxicodendron radicans	FAC
Herbaceous	American Elm	*Ulmus americana*	FAC
	Annual Sumpweed	Iva annua	FAC
	Butterfly-Pea	Centrosema virginianum	NI
	Cedar Elm	Ulmus crassifolia	FAC
	Frogfruit	Phyla nodiflora	FACW
	Giant Goldenrod	Solidago gigantea	FAC
	Giant Ragweed	Ambrosia trifida	FAC
	Inland Seaoats	Chasmanthium latifolium	FAC
	Japanese Honeysuckle	Lonicera japonica	FAC
	Poison Ivy	Toxicodendron radicans	FAC
	Purple Flatsedge	Cyperus rotundus	FAC
	Red Mulberry	Morus rubra	FACU
	Rough-Leaf Dogwood	Cornus drummondii	FAC
	Saw Greenbriar	Smilax bona-nox	FAC
	Virginia Creeper	*Parthenocissus quinquefolia*	FAC
	Virginia Wildrye	Elymus virginicus	FAC

TABLE 2: VEGETATION LIST: UPLAND COMMUNITIES

Vegetative Type	Common Name	Scientific Name	Region 6 Indicator Status
Tree	American Elm	*Ulmus americana*	FAC
	Black Walnut	*Juglans nigra*	FACU
	Eastern Red Cedar	*Juniperus viginiana*	OBL
	Sugar Hackberry	*Celtis laevigata*	FAC
Sapling/Shrub	American Elm	*Ulmus americana*	FAC
	Mexican Plum	*Prunus mexicana*	NI
	Yaupon Holly	*Ilex vomitoria*	FAC-
	Redbud	*Cercis canadensis*	UPL
Woody Vine	Mustang Grape	*Vitis mustangensis*	NI
Herbaceous	Annual Ragweed	*Ambrosia artemisiifolia*	FACU
	Annual Sumpweed	*Iva annua*	FAC
	Balloonvine	*Cardiospermum halicacabum*	FAC-
	Coralberry	*Symphoricarpos orbiculatus*	FACU*
	Cocklebur	*Xanthium strumarium*	FAC-
	Common Sunflower	*Helianthus annus*	FAC
	Bermudagrass	*Cynodon dactylon*	FACU+
	Giant Goldenrod	*Solidago gigantea*	FAC
	Giant Reed	*Arundo donax*	FAC+
	Illinois Bundleflower	*Desmanthus illinoensis*	FACU
	Japanese Honeysuckle	*Lonicera japonica*	FAC
	Johnsongrass	*Sorghum halepense*	FACU
	Partridge Pea	*Cassia fasiculata*	FACU-
	Poison Ivy	*Toxicodendron radicans*	FAC
	Greenbriar	*Smilax bona-nox*	FAC
	Southern Dewberry	*Rubus trivialis*	FAC

TABLE 3: EXPLANATION OF REGION 6 INDICATOR CATEGORIES

Plant Indicator Status Categories[1]		
Indicator Category	**Indicator Symbol**	**Definition**
Obligate Wetland Plants	OBL	Plants that occur almost always (estimated probability >99 percent) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1 percent) in nonwetlands. Examples: *Spartina alterniflora, Taxodium distichum.*
Facultative Wetland Plants	FACW	Plants that occur usually (estimated probability >67 percent to 99 percent) in wetlands, but also occur (estimated probability 1 percent to 33 percent) in nonwetlands. Examples: *Fraxinus pennsylvanica, Cornus stolonifera.*
Facultative Plants	FAC	Plants with a similar likelihood (estimated probability 33 percent to 67 percent) of occurring in both wetlands and nonwetlands. Examples: *Gleditsia triacanthos, Smilax rotundifolia.*
Facultative Upland Plants	FACU	Plants that occur sometimes (estimated probability 1 percent to <33 percent) in wetlands, but occur more often (estimated probability >67 percent to 99 percent) in nonwetlands. Examples: *Quercus rubra, Potentilla arguta.*
Obligate Upland Plants	UPL	Plants that occur rarely (estimated probability <1 percent) in wetlands, but occur almost always (estimated probability >99 percent) in nonwetlands under natural conditions. Examples: *Pinus echinata, Bromus mollis.*
No Indicator	NI	No definition for the specific vegetation is provided.

[1] Categories were originally developed and defined by the USFWS National Wetlands Inventory and subsequently modified by the National Plant List Panel. The three facultative categories are subdivided by (+) and (-) modifier with (+) typically denoting a greater probability of occurring in wetlands and a (-) denoting a lesser probability of occurring in wetlands.

e. Soils

According to the information obtained from the Soil Surveys of Collin, Hunt, and Fannin Counties (United States Department of Agriculture, Soil Conservation Service in cooperation with the Texas Agriculture Experiment Station), a total of 17 mapped soil units are within the area encompassed by the conservation pool elevation. The various mapped soil units encountered by the projects components are described in Table 4.

The routine wetland determination data forms are included in Appendix D. A map detailing the locations of the soil samples for the routine wetland determination data

forms is included as Figure D-1 also in Appendix D. The soil types relative to the general area of the proposed reservoir are included as Figures E-1 located in Appendix E. Descriptions of the mapped soil types encountered by the proposed project are included in Appendix E. Tinn clay, frequently flooded is the only nationally listed hydric soil (as determined by the Natural Resources Conservation Service) that the proposed project components will encounter.

TABLE 4: FANNIN COUNTY – LAKE RALPH HALL CONSERVATION POOL

County	Map Unit ID	Soil Series	Soil Description
Fannin	BkA	Benklin	Benklin silt loam, 0 to 1 percent slopes
	BoB	Bonham	Bonham silt loam, 1 to 3 percent slopes
	BuA	Burleson	Burleson clay, 0 to 1 percent slopes
	CrB	Crockett	Crockett loam, 1 to 3 percent slopes
	CrC2	Crockett	Crockett loam, 2 to 5 percent slopes
	FeD2	Ferris	Ferries clay, 5 to 12 percent slopes
	HeB	Heiden	Heiden clay, 1 to 3 percent slopes
	HfC2	Heiden-Ferris	Heiden-Ferris complex, 2 to 6 percent slopes
	Hm	Hopco	Hopco silt loam, occasionally flooded
	Hn	Hopco	Hopco silt loam, frequently flooded
	HoB	Houston Black	Houston Black clay, 1 to 3 percent slopes
	LvB	Lewisville	Lewisville silty clay, 1 to 3 percent slopes
	NoB	Normangee	Normangee clay loam, 1 to 3 percent slopes
	NoC2	Normangee	Normangee clay loam, 3 to 5 percent slopes
	Tc	Tinn	Tinn clay, occasionally flooded
	Tf	Tinn	Tinn clay, frequently flooded
	WzA	Wilson	Wilson silt loam, 0 to 1 percent slopes

4. Conclusions

a. Description of Potential Waters of the U.S.

I. Wetlands

Wetlands associated with the original North Sulphur River channel were identified within the footprint for the proposed reservoir; however, since the 100-year flood is contained within the banks of the North Sulphur River, they are considered isolated and not jurisdictional. Wetlands that occur along the fringes of on-channel ponds

are included in the open-water calculation. Furthermore, no other isolated wetlands were identified within the proposed reservoir site.

II. Other Water Types

The proposed reservoir will both impact and inundate the North Sulphur River as well as portions of its numerous unnamed and named tributaries within the project area. The named tributaries that will be impacted are as follows: Allen Creek; Bear Creek; Pot Creek; Brushy Creek; Pickle Creek; Davis Creek; Legget Branch; Bralley Pool Creek; Merrill Creek; Hedrick Branch; and Long Creek. The proposed Lake Ralph Hall will also inundate numerous tributaries to the aforementioned streams as well as numerous on-channel ponds. Since the North Sulphur River is a major tributary to the Sulphur River, which is considered a navigable river by the USACE, all of the aforementioned aquatic resources should be considered jurisdictional waters of the U.S. since they are all hydrologically connected to a navigable water of the U.S.

Also within the proposed footprint for Lake Ralph Hall, are intact remnants of the native channel for the North Sulphur River, which are being utilized for drainage features. However, there are aquatic resources within the proposed footprint, including some remnant segments of the native North Sulphur River channel that will be impacted by the proposed reservoir that should not be considered jurisdictional waters of the U.S. The resources include upland stock tanks (ponds not sighted on a defined drainage channel) and remnant North Sulphur River channels that do not maintain their original stream characteristics and are not hydraulically or hydrologically connected to the current North Sulphur River Channel. The remnant meander scars, oxbows, etc. that exist outside of the 100-year floodplain for the current North Sulphur River are excluded from being classified as jurisdictional.

III. Summary

Table 5 is a comprehensive summary of all the jurisdictional waters of the U.S. identified within the proposed Lake Ralph Hall conservation pool footprint. Table 6 summarizes the total impacts for the proposed Lake Ralph Hall conservation pool footprint. Figures A-3 through A-5 located in Appendix A illustrate the identified jurisdictional waters of the U.S. superimposed onto a 2003 for the raw water supply lake's conservation pool footprint.

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N1-A1	Tributary 1 to Baker Creek (Stream 1)	Ephemeral	0.5	1,283	0.015
N1-B1	Tributary 2 to Baker Creek (Stream 1)	Ephemeral	0.5	1,006	0.012
N2	Stream 2 - Unnamed	Ephemeral	1.0	2,561	0.059
N2-Trib1	Tributary 1 to Stream 2	Ephemeral	1.0	293	0.007
N3	Stream 3 - Unnamed	Ephemeral	1.0	4,301	0.099
N3-Trib1	Tributary 1 to Stream 3	Ephemeral	1.0	1,608	0.037
N4	Stream 4 - Unnamed	Ephemeral	0.5	920	0.011
N5	Stream 5 - Unnamed	Ephemeral	0.5	824	0.009
N6	Stream 6 - Merrill Creek	Ephemeral	25.0	24,115	13.866
N6-Trib1	Tributary 1 to Merrill Creek (Stream 6)	Ephemeral	4.0	6,104	0.562
N6-Trib1-A1	Secondary Tributary	Ephemeral	4.0	4,112	0.378
N6-Trib1-A2	Secondary Tributary	Ephemeral	4.0	340	0.031
N6-Trib1-A3	Secondary Tributary	Ephemeral	4.0	155	0.014
N6-TribA4	Secondary Tributary	Ephemeral	4.0	119	0.011
N6-Trib1-B1	Secondary Tributary	Ephemeral	4.0	184	0.017
N6-Trib1-B2	Secondary Tributary	Ephemeral	4.0	44	0.004
N6-Trib1-C1	Secondary Tributary	Ephemeral	4.0	2,893	0.266
N6-Trib1-C2	Secondary Tributary	Ephemeral	4.0	799	0.074
N6-Trib1-C3	Secondary Tributary	Ephemeral	4.0	638	0.059
N6-Trib2	Tributary 2 to Merrill Creek (Stream 6)	Ephemeral	1.5	523	0.018
N6-Trib3	Tributary 3 to Stream 6	Ephemeral	1.0	380	0.009
N6-Trib4	Tributary 4 to Merrill Creek (Stream 6)	Ephemeral	1.0	4,437	0.102
N6-Trib4-A1	Secondary Tributary	Ephemeral	1.0	2,004	0.046
N6-Trib4-B1	Secondary Tributary	Ephemeral	1.0	317	0.007
N6-Trib5	Tributary 5 to Merrill Creek (Stream 6)	Ephemeral	1.5	3,672	0.127
N6-Trib5-A1	Secondary Tributary	Ephemeral	1.5	549	0.019
N6-Trib5-B1	Secondary Tributary	Ephemeral	1.5	251	0.009
N6-Trib6	Tributary 6 to Merrill Creek (Stream 6)	Ephemeral	1.0	350	0.008
N6-Trib7	Tributary 7 to Merrill Creek (Stream 6)	Ephemeral	1.0	236	0.005
N6-Trib8	Tributary 8 to Merrill Creek (Stream 6)	Ephemeral	1.0	855	0.020
N6-Trib8-A1	Secondary Tributary	Ephemeral	1.0	233	0.005
N6-Trib9	Tributary 9 to Merrill Creek (Stream 6)	Ephemeral	6.0	5,415	0.747
N6-Trib9-A1	Secondary Tributary	Ephemeral	6.0	146	0.020
N6-Trib9-B1	Secondary Tributary	Ephemeral	6.0	2,658	0.367
N6-Trib9-C1	Secondary Tributary	Ephemeral	6.0	2,086	0.288
N6-Trib9-C2	Secondary Tributary	Ephemeral	6.0	1,763	0.243
N6-Trib10	Tributary 10 to Merrill Creek (Stream 6)	Ephemeral	1.0	675	0.016
N6-Trib11	Tributary 11 to Merrill Creek (Stream 6)	Ephemeral	4.0	3,902	0.359
N6-Trib11-A1	Secondary Tributary	Ephemeral	4.0	353	0.032

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N6-Trib11-B1	Secondary Tributary	Ephemeral	4.0	1,956	0.180
N6-Trib11-B2	Secondary Tributary	Ephemeral	4.0	181	0.017
N6-Trib11-C1	Secondary Tributary	Ephemeral	4.0	528	0.049
N6-Trib12	Tributary 12 to Merrill Creek (Stream 6)	Ephemeral	0.5	741	0.009
N6-Trib13	Tributary 13 to Merrill Creek (Stream 6)	Ephemeral	0.5	2,088	0.024
N6-Trib13-A1	Secondary Tributary	Ephemeral	0.5	279	0.003
N6-Trib14	Tributary 14 to Merrill Creek (Stream 6)	Ephemeral	1.0	366	0.008
N6-Trib14-A1	Secondary Tributary	Ephemeral	1.0	137	0.003
N6-Trib15	Tributary 15 to Merrill Creek (Stream 6)	Ephemeral	11.0	823	0.208
N6-Trib15-A1	Secondary Tributary	Ephemeral	11.0	1,403	0.355
N6-Trib15-A2	Secondary Tributary	Ephemeral	11.0	1,490	0.377
N6-Trib15-A3	Secondary Tributary	Ephemeral	5.0	502	0.058
N6-Trib15-B1	Secondary Tributary	Ephemeral	11.0	462	0.117
N6-Trib15-C1	Secondary Tributary	Ephemeral	1.0	7,220	0.166
N6-Trib15-C2	Secondary Tributary	Ephemeral	1.0	304	0.007
N6-Trib15-C3	Secondary Tributary	Ephemeral	1.0	306	0.007
N6-Trib15-D1	Secondary Tributary	Ephemeral	1.0	1,818	0.042
N6-Trib15-D2a	Secondary Tributary	Ephemeral	1.0	1,061	0.024
N6-Trib15-D2b	Secondary Tributary	Ephemeral	1.0	227	0.005
N6-Trib16	Tributary 16 to Merrill Creek (Stream 6)	Ephemeral	1.0	872	0.020
N6-Trib17	Tributary 17 to Merrill Creek (Stream 6)	Ephemeral	3.0	3,463	0.239
N6-Trib1-A1	Secondary Tributary	Ephemeral	3.0	855	0.059
N6-Trib17-B1	Secondary Tributary	Ephemeral	1.0	690	0.016
N6-Trib17-C1	Secondary Tributary	Ephemeral	1.0	1,426	0.033
N6-Trib18	Tributary 18 to Merrill Creek (Stream 6)	Ephemeral	3.5	651	0.052
N6-Trib18-A1	Secondary Tributary	Ephemeral	3.5	255	0.021
N6-Trib19	Tributary 19 to Merrill Creek (Stream 6)	Ephemeral	2.0	2,724	0.125
N6-Trib20	Tributary 20 to Merrill Creek (Stream 6)	Ephemeral	3.0	415	0.029
N6-Trib21	Tributary 21 to Merrill Creek (Stream 6)	Ephemeral	3.0	1,648	0.114
N6-Trib21-A1	Secondary Tributary	Ephemeral	3.0	295	0.020
N6-Trib22	Tributary 22 to Merrill Creek (Stream 6)	Ephemeral	15.0	3,486	1.203
N6-Trib22-A1	Secondary Tributary	Ephemeral	15.0	717	0.247
N6-Trib22-A2	Secondary Tributary	Ephemeral	15.0	474	0.164
N6-Trib22-A3	Secondary Tributary	Ephemeral	15.0	177	0.061
N6-Trib22-A3a	Secondary Tributary	Ephemeral	15.0	97	0.033
N6-Trib22-B1	Secondary Tributary	Ephemeral	15.0	196	0.068
N6-Trib22-C1	Secondary Tributary	Ephemeral	15.0	311	0.107
N6-Trib22-D1	Secondary Tributary	Ephemeral	15.0	113	0.039
N6-Trib22-E1	Secondary Tributary	Ephemeral	15.0	426	0.147

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N6-Trib22-E2	Secondary Tributary	Ephemeral	15.0	138	0.048
N6-Trib22-F1	Secondary Tributary	Ephemeral	15.0	469	0.162
N6-Trib23	Tributary 23 to Merrill Creek (Stream 6)	Ephemeral	4.0	117	0.011
N6-Trib24	Tributary 24 to Merrill Creek (Stream 6)	Ephemeral	15.0	5,266	1.817
N6-Trib24-A1	Secondary Tributary	Ephemeral	4.0	181	0.017
N6-Trib24-B1	Secondary Tributary	Ephemeral	4.0	167	0.015
N6-Trib24-C1	Secondary Tributary	Ephemeral	4.0	106	0.010
N6-Trib24-D1	Secondary Tributary	Ephemeral	4.0	132	0.012
N6-Trib24-E1	Secondary Tributary	Ephemeral	4.0	64	0.006
N6-Trib24-F1	Secondary Tributary	Ephemeral	4.0	86	0.008
N6-Trib24-F2	Secondary Tributary	Ephemeral	4.0	546	0.050
N6-Trib24-G1	Secondary Tributary	Ephemeral	4.0	99	0.009
N6-Trib24-H1	Secondary Tributary	Ephemeral	4.0	119	0.011
N6-Trib24-I1	Secondary Tributary	Ephemeral	4.0	156	0.014
N6-Trib24-J1	Secondary Tributary	Ephemeral	4.0	68	0.006
N6-Trib24-K1	Secondary Tributary	Ephemeral	6.0	208	0.029
N6-Trib24-L1	Secondary Tributary	Ephemeral	6.0	573	0.079
N6-Trib24-M1	Secondary Tributary	Ephemeral	6.0	135	0.019
N6-Trib25	Tributary 25 to Merrill Creek (Stream 6)	Ephemeral	3.0	233	0.016
N6-Trib26	Tributary 26 to Merrill Creek (Stream 6)	Ephemeral	3.0	326	0.022
N6-Trib27	Tributary 27 to Merrill Creek (Stream 6)	Ephemeral	4.0	824	0.076
N6-Trib27-A1a	Secondary Tributary	Ephemeral	4.0	542	0.050
N6-Trib27-A1b	Secondary Tributary	Ephemeral	4.0	70	0.006
N6-Trib28	Tributary 28 to Merrill Creek (Stream 6)	Ephemeral	2.5	256	0.015
N6-Trib29	Tributary 29 to Merrill Creek (Stream 6)	Ephemeral	6.0	454	0.063
N6-Trib30	Tributary 30 to Merrill Creek (Stream 6)	Ephemeral	4.0	60	0.006
N6-Trib31	Tributary 31 to Merrill Creek (Stream 6)	Ephemeral	15.0	215	0.074
N7	Stream 7 - Unnamed	Ephemeral	4.0	1,171	0.108
N8	Stream 8 - Unnamed	Ephemeral	2.0	2,850	0.131
N9	Stream 9 - Unnamed	Ephemeral	2.5	4,570	0.263
N9-Trib1	Tributary 1 to Stream 9	Ephemeral	2.5	1,191	0.068
N9-Trib2	Tributary 2 to Stream 9	Ephemeral	0.5	320	0.004
N10	Stream 10 - Unnamed	Ephemeral	2.5	3,126	0.180
N10-Trib1	Tributary 1 to Stream 10	Ephemeral	2.5	510	0.029
N10-Trib2	Tributary 2 to Stream 10	Ephemeral	2.5	733	0.042
N11	Stream 11 - Unnamed	Ephemeral	4.0	6,208	0.571
N11-Trib1	Tributary 1 to Stream 11	Ephemeral	4.0	1,104	0.102
N11-Trib2	Tributary 2 to Stream 11	Ephemeral	4.0	877	0.081
N11-Trib3	Tributary 3 to Stream 11	Ephemeral	4.0	8,438	0.776

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N11-Trib3-A1	Secondary Tributary	Ephemeral	2.0	2,185	0.101
N11-Trib3-B1	Secondary Tributary	Ephemeral	1.0	1,074	0.025
N11-Trib3-C1	Secondary Tributary	Ephemeral	1.0	237	0.005
N11-Trib3-D1	Secondary Tributary	Ephemeral	1.0	965	0.022
N11-Trib3-E1	Secondary Tributary	Ephemeral	1.0	550	0.013
N11-Trib3-E2	Secondary Tributary	Ephemeral	1.0	205	0.005
N11-Trib3-F1	Secondary Tributary	Ephemeral	1.0	960	0.022
N11-Trib4	Tributary 4 to Stream 11	Ephemeral	1.0	774	0.018
N11-Trib4-A1	Secondary Tributary	Ephemeral	1.0	237	0.005
N11-Trib5	Tributary 5 to Stream 11	Ephemeral	1.0	1,499	0.034
N11-Trib6	Tributary 6 to Stream 11	Ephemeral	2.0	3,187	0.147
N11-Trib6A1	Secondary Tributary	Ephemeral	1.0	437	0.010
N12	Stream 12 - Unnamed	Ephemeral	2.0	6,431	0.296
N12-Trib1	Tributary 1 to Stream 12	Ephemeral	2.0	756	0.035
N12-Trib2	Tributary 2 to Stream 12	Ephemeral	1.0	163	0.004
N12-Trib3	Tributary 3 to Stream 12	Ephemeral	1.0	181	0.004
N13	Stream 13 - Unnamed	Ephemeral	1.5	3,658	0.126
N13-Trib1	Tributary 1 to Stream 13	Ephemeral	1.5	788	0.027
N14	Stream 14 - Bralley Pool Branch	Ephemeral	15.0	18,299	6.313
N14-Trib1	Tributary 1 to Bralley Pool Branch (Stream 14)	Ephemeral	1.5	1,353	0.047
N14-Trib1-A1	Secondary Tributary	Ephemeral	1.5	210	0.007
N14-Trib2	Tributary 2 to Bralley Pool Branch (Stream 14)	Ephemeral	1.0	4,198	0.097
N14-Trib2-A1	Secondary Tributary	Ephemeral	1.0	217	0.005
N14-Trib2-B1	Secondary Tributary	Ephemeral	1.0	58	0.001
N14-Trib2-C1	Secondary Tributary	Ephemeral	1.0	96	0.002
N14-Trib2-D1	Secondary Tributary	Ephemeral	1.0	1,473	0.034
N14-Trib3	Tributary 3 to Bralley Pool Branch (Stream 14)	Ephemeral	1.0	737	0.017
N14-Trib3-A1	Secondary Tributary	Ephemeral	1.0	401	0.009
N14-Trib4	Tributary 4 to Bralley Pool Branch (Stream 14)	Ephemeral	5.0	1,998	0.230
N14-Trib4-A1	Secondary Tributary	Ephemeral	5.0	276	0.032
N14-Trib4-B1	Secondary Tributary	Ephemeral	5.0	119	0.014
N14-Trib5	Tributary 5 to Bralley Pool Branch (Stream 14)	Ephemeral	4.0	2,477	0.228
N14-Trib6	Tributary 6 to Bralley Pool Branch (Stream 14)	Ephemeral	2.0	1,591	0.073
N14-Trib7	Tributary 7 to Bralley Pool Branch (Stream 14)	Ephemeral	0.5	892	0.010
N14-Trib8	Tributary 8 to Bralley Pool Branch (Stream 14)	Ephemeral	0.5	906	0.010
N14-Trib8-A1	Secondary Tributary	Ephemeral	0.5	97	0.001
N14-Trib9	Tributary 9 to Bralley Pool Branch (Stream 14)	Ephemeral	0.5	384	0.004
N14-Trib10	Tributary 10 to Bralley Pool Branch (Stream 14)	Ephemeral	3.0	104	0.007

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N14-Trib11	Tributary 11 to Bralley Pool Branch (Stream 14)	Ephemeral	1.0	143	0.003
N14-Trib12	Tributary 12 to Bralley Pool Branch (Stream 14)	Ephemeral	3.0	112	0.008
N14-Trib13	Tributary 13 to Bralley Pool Branch (Stream 14)	Ephemeral	1.0	923	0.021
N14-Trib14	Tributary 14 to Bralley Pool Branch (Stream 14)	Ephemeral	4.0	267	0.025
N14-Trib14-A1	Secondary Tributary	Ephemeral	4.0	69	0.006
N14-Trib15	Tributary 15 to Bralley Pool Branch (Stream 14)	Ephemeral	1.0	456	0.010
N14-Trib15-A1	Secondary Tributary	Ephemeral	1.0	36	0.001
N14-Trib16	Tributary 16 to Bralley Pool Branch (Stream 14)	Ephemeral	2.0	244	0.011
N14-Trib17	Tributary 17 to Bralley Pool Branch (Stream 14)	Ephemeral	2.0	158	0.007
N15	Stream 15 - Unnamed	Ephemeral	1.0	660	0.015
N16	Stream 16 - Leggets Branch	Ephemeral	5.0	8,230	0.946
N16-Trib1	Tributary 1 to Leggets Branch (Stream 16)	Ephemeral	1.0	208	0.005
N16-Trib2	Tributary 2 to Leggets Branch (Stream 16)	Ephemeral	1.5	1,100	0.038
N16-Trib3	Tributary 3 to Leggets Branch (Stream 16)	Ephemeral	5.0	1,376	0.158
N16-Trib4	Tributary 4 to Leggets Branch (Stream 16)	Ephemeral	3.0	113	0.008
N17	Stream 17 - Unnamed	Ephemeral	0.5	237	0.003
N18	Stream 18 - Unnamed	Ephemeral	0.5	866	0.010
N19	Stream 19 - Unnamed	Ephemeral	2.0	81	0.004
N20	Stream 20 - Unnamed	Ephemeral	0.5	2,975	0.034
N21	Stream 21 - Davis Creek	Ephemeral	25.0	15,374	8.840
N21-Trib1	Tributary 1 to Davis Creek (Stream 21)	Ephemeral	5.0	157	0.018
N21-Trib2	Tributary 2 to Davis Creek (Stream 21)	Ephemeral	5.0	478	0.055
N21-Trib3	Tributary 3 to Davis Creek (Stream 21)	Ephemeral	5.0	219	0.025
N21-Trib4	Tributary 4 to Davis Creek (Stream 21)	Ephemeral	3.0	989	0.068
N21-Trib5	Tributary 5 to Davis Creek (Stream 21)	Ephemeral	1.5	329	0.011
N21-Trib6	Tributary 6 to Davis Creek (Stream 21)	Ephemeral	1.5	635	0.022
N21-Trib7	Tributary 7 to Davis Creek (Stream 21)	Ephemeral	1.5	566	0.020
N21-Trib8	Tributary 8 to Davis Creek (Stream 21)	Ephemeral	1.5	1,390	0.048
N21-Trib9	Tributary 9 to Davis Creek (Stream 21)	Ephemeral	1.5	701	0.024
N21-Trib10	Tributary 10 to Davis Creek (Stream 21)	Ephemeral	1.5	498	0.017
N21-Trib11	Tributary 11 to Davis Creek (Stream 21)	Ephemeral	1.0	278	0.006
N21-Trib11-A1	Secondary Tributary	Ephemeral	1.0	236	0.005
N21-Trib11-B1	Secondary Tributary	Ephemeral	1.0	178	0.004
N21-Trib12	Tributary 12 to Davis Creek (Stream 21)	Ephemeral	1.0	720	0.017
N21-Trib13	Tributary 13 to Davis Creek (Stream 21)	Ephemeral	3.0	671	0.046
N21-Trib14	Tributary 14 to Davis Creek (Stream 21)	Ephemeral	1.0	412	0.009
N21-Trib15	Tributary 15 to Davis Creek (Stream 21)	Ephemeral	1.0	455	0.010
N21-Trib16	Tributary 16 to Davis Creek (Stream 21)	Ephemeral	1.0	187	0.004
N21-Trib17	Tributary 17 to Davis Creek (Stream 21)	Ephemeral	0.5	423	0.005

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N21-Trib18	Tributary 18 to Davis Creek (Stream 21)	Ephemeral	20.0	1,254	0.577
N22	Stream 22 - Unnamed	Ephemeral	3.0	1,821	0.126
N22-Trib1	Tributary 1 to Stream 22	Ephemeral	0.5	445	0.005
N23	Stream 23 - Unnamed	Ephemeral	1.0	2,053	0.047
N23-Trib1	Tributary 1 to Stream 23	Ephemeral	0.5	532	0.006
N24	Stream 24 - Pickle Creek	Ephemeral	3.5	14,474	1.165
N24-Trib1	Tributary 1 to Pickle Creek (Stream 24)	Ephemeral	1.0	338	0.008
N24-Trib2	Tributary 2 to Pickle Creek (Stream 24)	Ephemeral	1.0	2,313	0.053
N24-Trib2-A1	Secondary Tributary	Ephemeral	1.0	6,590	0.152
N24-Trib2-A2a	Secondary Tributary	Ephemeral	0.5	1,105	0.013
N24-Trib2-A2b	Secondary Tributary	Ephemeral	0.5	344	0.004
N24-Trib2-B1	Secondary Tributary	Ephemeral	0.5	3,546	0.041
N24-Trib3	Tributary 3 to Pickle Creek (Stream 24)	Ephemeral	1.0	181	0.004
N24-Trib4	Tributary 4 to Pickle Creek (Stream 24)	Ephemeral	1.0	225	0.005
N24-Trib4-A1	Secondary Tributary	Ephemeral	1.0	50	0.001
N24-Trib5	Tributary 5 to Pickle Creek (Stream 24)	Ephemeral	0.5	267	0.003
N24-Trib6	Tributary 6 to Pickle Creek (Stream 24)	Ephemeral	1.0	623	0.014
N24-Trib6-A1	Secondary Tributary	Ephemeral	1.0	487	0.011
N24-Trib6-B1	Secondary Tributary	Ephemeral	1.0	912	0.021
N24-Trib6-C1	Secondary Tributary	Ephemeral	1.0	229	0.005
N24-Trib6-D1	Secondary Tributary	Ephemeral	1.0	357	0.008
N24-Trib7	Tributary 7 to Pickle Creek (Stream 24)	Ephemeral	0.5	106	0.001
N24-Trib8	Tributary 8 to Pickle Creek (Stream 24)	Ephemeral	0.5	113	0.001
N24-Trib9	Tributary 9 to Pickle Creek (Stream 24)	Ephemeral	0.5	160	0.002
N24-Trib10	Tributary 10 to Pickle Creek (Stream 24)	Ephemeral	0.5	132	0.002
N25	Stream 25 - Unnamed	Ephemeral	5.0	3,156	0.363
N25-Trib1	Tributary 1 to Stream 25	Ephemeral	1.0	91	0.002
N25-Trib2	Tributary 2 to Stream 25	Ephemeral	2.0	115	0.005
N25-Trib3	Tributary 3 to Stream 25	Ephemeral	2.0	125	0.006
N25-Trib4	Tributary 4 to Stream 25	Ephemeral	1.0	65	0.001
N25-Trib5	Tributary 5 to Stream 25	Ephemeral	1.5	98	0.003
N25-Trib6	Tributary 6 to Stream 25	Ephemeral	2.0	157	0.007
N25-Trib7	Tributary 7 to Stream 25	Ephemeral	1.5	178	0.006
N25-Trib8	Tributary 8 to Stream 25	Ephemeral	3.0	188	0.013
N25-Trib8-A1	Secondary Tributary	Ephemeral	1.0	111	0.003
N25-Trib8-A2	Secondary Tributary	Ephemeral	1.0	60	0.001
N25-Trib8-A3	Secondary Tributary	Ephemeral	1.0	56	0.001
N25-Trib8-B1	Secondary Tributary	Ephemeral	1.0	70	0.002
N26	Stream 26 - Unnamed	Ephemeral	4.0	1,762	0.162

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N26-Trib1	Tributary 1 to Stream 26	Ephemeral	2.0	402	0.018
N26-Trib2	Tributary 2 to Stream 26	Ephemeral	1.0	162	0.004
N26-Trib3	Tributary 3 to Stream 26	Ephemeral	1.0	171	0.004
N26-Trib4	Tributary 4 to Stream 26	Ephemeral	1.0	66	0.002
N26-Trib5	Tributary 5 to Stream 26	Ephemeral	1.0	111	0.003
N27	Stream 27 - Brushy Creek	Ephemeral	18.0	12,317	5.099
N27-Trib1	Tributary 1 to Brushy Creek (Stream 27)	Ephemeral	0.5	449	0.005
N27-Trib2	Tributary 2 to Brushy Creek (Stream 27)	Ephemeral	1.0	1,579	0.036
N27-Trib2-A1	Secondary Tributary	Ephemeral	0.5	272	0.003
N27-Trib3	Tributary 3 to Brushy Creek (Stream 27)	Ephemeral	2.0	294	0.014
N27-Trib4	Tributary 4 to Brushy Creek (Stream 27)	Ephemeral	3.0	1,326	0.091
N27-Trib5	Tributary 5 to Brushy Creek (Stream 27)	Ephemeral	2.0	606	0.028
N27-Trib6	Tributary 6 to Brushy Creek (Stream 27)	Ephemeral	2.5	175	0.010
N27-Trib7	Tributary 7 to Brushy Creek (Stream 27)	Ephemeral	2.5	156	0.009
N27-Trib8	Tributary 8 (Pot Creek) to Brushy Creek (Stream 27)	Ephemeral	6.0	2,604	0.359
N27-Trib8-A1	Secondary Tributary	Ephemeral	3.0	1,091	0.075
N28	Stream 28 - Unnamed	Ephemeral	2.5	564	0.032
N28-Trib1	Tributary 1 to Stream 28	Ephemeral	2.5	333	0.019
N29	Stream 29 - Unnamed	Ephemeral	3.5	870	0.070
N29-Trib1	Tributary 1 to Stream 29	Ephemeral	3.5	457	0.037
N29-Trib1-A1	Secondary Tributary	Ephemeral	3.5	80	0.006
N30	Stream 30 - Unnamed	Ephemeral	2.0	530	0.024
N30-Trib1	Tributary 1 to Stream 30	Ephemeral	1.0	68	0.002
N31	Stream 31 - Unnamed	Ephemeral	1.0	134	0.003
N32	Stream 32 - Unnamed	Ephemeral	1.0	256	0.006
N33	Stream 33 - Unnamed	Ephemeral	1.0	320	0.007
N34	Stream 34 - Unnamed	Ephemeral	15.0	2,708	0.934
N34-Trib1	Tributary 1 to Stream 34	Ephemeral	5.0	262	0.030
N34-Trib1-A1	Secondary Tributary	Ephemeral	5.0	146	0.017
N35	Stream 35 - Unnamed	Ephemeral	5.0	763	0.088
N36	Stream 36 - Bear Creek	Ephemeral	12.0	3,968	1.095
N36-Trib1	Tributary 1 to Bear Creek (Stream 36)	Ephemeral	1.5	199	0.007
N36-Trib2	Tributary 2 to Bear Creek (Stream 36)	Ephemeral	7.0	1,609	0.259
N36-Trib2-A1	Secondary Tributary	Ephemeral	0.5	196	0.002
N37	Stream 37 - Unnamed	Ephemeral	2.0	162	0.007
N38	Stream 38 - Allen Creek	Ephemeral	10.0	1,481	0.341

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
S39	Stream 39 - Hedrick Branch	Ephemeral	0.5	8,243	0.095
S39-Trib1	Tributary 1 to Hedrick Branch (Stream 39)	Ephemeral	0.5	1,054	0.012
S39-Trib2	Tributary 2 to Hedrick Branch (Stream 39)	Ephemeral	0.5	1,953	0.022
S39-Trib2-A1	Secondary Tributary	Ephemeral	0.5	564	0.006
S39-Trib2-A2	Secondary Tributary	Ephemeral	0.5	180	0.002
S39-Trib3	Secondary Tributary	Ephemeral	0.5	141	0.002
S40	Stream 40 - Unnamed	Ephemeral	2.5	8,922	0.513
S40-Trib1	Tributary 1 to Stream 40	Ephemeral	2.5	2,074	0.119
S40-Trib2	Tributary 2 to Stream 40	Ephemeral	0.5	3,719	0.043
S40-Trib3	Tributary 3 to Stream 40	Ephemeral	0.5	745	0.009
S41	Stream 41 - Unnamed	Ephemeral	1.0	742	0.017
S42	Stream 42 - Unnamed	Ephemeral	2.0	2,415	0.111
S43	Stream 43 - Unnamed	Ephemeral	4.5	8,946	0.926
S43-Trib1	Tributary 1 to Stream 43	Ephemeral	2.5	1,967	0.113
S43-Trib1-A1	Secondary Tributary	Ephemeral	2.5	1,372	0.079
S43-Trib2	Tributary 2 to Stream 43	Ephemeral	2.5	448	0.026
S43-Trib2-A1	Secondary Tributary	Ephemeral	2.5	111	0.006
S43-Trib3	Tributary 3 to Stream 43	Ephemeral	0.5	994	0.011
S43-Trib4	Tributary 4 to Stream 43	Ephemeral	2.0	606	0.028
S43-Trib5	Tributary 5 to Stream 43	Ephemeral	0.5	1,295	0.015
S43-Trib6	Tributary 6 to Stream 43	Ephemeral	0.5	1,007	0.012
S43-Trib7	Tributary 7 to Stream 43	Ephemeral	0.5	916	0.011
S43-Trib8	Tributary 8 to Stream 43	Ephemeral	0.5	348	0.004
S43-Trib8-A1	Secondary Tributary	Ephemeral	0.5	133	0.002
S43-Trib9	Tributary 9 to Stream 43	Ephemeral	0.5	120	0.001
S43-Trib10	Tributary 10 to Stream 43	Ephemeral	0.5	112	0.001
S43-Trib11	Tributary 11 to Stream 43	Ephemeral	0.5	172	0.002
S43-Trib11-A1	Secondary Tributary	Ephemeral	0.5	61	0.001
S43-Trib12	Tributary 12 to Stream 43	Ephemeral	0.5	348	0.004
S44	Stream 44 - Unnamed	Ephemeral	4.0	7,941	0.731
S44-Trib1	Tributary 1 to Stream 44	Ephemeral	0.5	651	0.007
S45	Stream 45 - Unnamed	Ephemeral	3.0	6,658	0.459
S45-Trib1	Tributary 1 to Stream 45	Ephemeral	1.5	6,982	0.241
S45-Trib1-A1	Secondary Tributary	Ephemeral	0.5	1,197	0.014
S45-Trib1-A2	Secondary Tributary	Ephemeral	0.5	306	0.004
S45-Trib1-B1	Secondary Tributary	Ephemeral	0.5	994	0.011
S45-Trib1-C1	Secondary Tributary	Ephemeral	0.5	854	0.010
S45-Trib1-D1	Secondary Tributary	Ephemeral	0.5	359	0.004
S45-Trib2	Tributary 2 to Stream 45	Ephemeral	0.5	3,340	0.038

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
S46	Stream 46 - Unnamed	Ephemeral	1.0	280	0.006
S46-Trib1	Tributary 1 to Stream 46	Ephemeral	1.0	526	0.012
S47	Stream 47 - Unnamed	Ephemeral	3.5	5,690	0.458
S47-Trib1	Tributary 1 to Stream 47	Ephemeral	1.0	172	0.004
S47-Trib2	Tributary 2 to Stream 47	Ephemeral	2.0	599	0.028
S47-Trib3	Tributary 3 to Stream 47	Ephemeral	3.0	2,372	0.164
S47-Trib3-A1	Secondary Tributary	Ephemeral	1.0	44	0.001
S47-Trib3-B1	Secondary Tributary	Ephemeral	1.0	123	0.003
S47-Trib3-C1	Secondary Tributary	Ephemeral	1.0	388	0.009
S47-Trib3-D1	Secondary Tributary	Ephemeral	0.5	249	0.003
S47-Trib3-E1	Secondary Tributary	Ephemeral	0.5	176	0.002
S47-Trib3-F1	Secondary Tributary	Ephemeral	0.5	73	0.001
S47-Trib4	Tributary 4 to Stream 47	Ephemeral	0.5	867	0.010
S47-Trib5	Tributary 5 to Stream 47	Ephemeral	0.5	404	0.005
S48	Stream 48 - Unnamed	Ephemeral	3.0	1,041	0.072
S49	Stream 49 - Unnamed	Ephemeral	5.0	3,696	0.425
S49-Trib1	Tributary 1 to Stream 49	Ephemeral	12.0	1,336	0.369
S50	Stream 50 - Unnamed	Ephemeral	2.5	7,353	0.423
S50-Trib1	Tributary 1 to Stream 50	Ephemeral	1.0	447	0.010
S50-Trib2	Tributary 2 to Stream 50	Ephemeral	1.0	231	0.005
S50-Trib3	Tributary 3 to Stream 50	Ephemeral	1.0	36	0.001
S50-Trib4	Tributary 4 to Stream 50	Ephemeral	2.0	5,447	0.251
S50-Trib4-A1	Secondary Tributary	Ephemeral	0.5	2,709	0.031
S50-Trib5	Tributary 5 to Stream 50	Ephemeral	1.5	2,866	0.099
S50-Trib5-A1	Secondary Tributary	Ephemeral	2.0	6,401	0.294
S50-Trib6	Tributary 6 to Stream 50	Ephemeral	0.5	5,257	0.060
S51	Stream 51 - Unnamed	Ephemeral	1.0	1,187	0.027
S52	Stream 52 - Unnamed	Ephemeral	15.0	9,816	3.387
S52-Trib1	Tributary 1 to Stream 52	Ephemeral	1.0	1,636	0.038
S52-Trib2	Tributary 2 to Stream 52	Ephemeral	1.0	2,669	0.061
S52-Trib3	Tributary 3 to Stream 52	Ephemeral	5.0	972	0.112
S52-Trib4	Tributary 4 to Stream 52	Ephemeral	3.0	276	0.019
S52-Trib5	Tributary 5 to Stream 52	Ephemeral	5.0	569	0.065
S52-Trib6	Tributary 6 to Stream 52	Ephemeral	5.0	1,395	0.160
S52-Trib6-A1	Secondary Tributary	Ephemeral	5.0	140	0.016
S52-Trib7	Tributary 7 to Stream 52	Ephemeral	5.0	828	0.095
S52-Trib7-A1	Secondary Tributary	Ephemeral	5.0	189	0.022
S52-Trib8	Tributary 8 to Stream 52	Ephemeral	3.0	1,625	0.112
S52-Trib8-A1	Secondary Tributary	Ephemeral	3.0	202	0.014
S52-Trib9	Tributary 9 to Stream 52	Ephemeral	3.0	2,332	0.161

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
S53	Stream 53 - Unnamed	Ephemeral	1.0	2,563	0.059
S54	Stream 54 - Unnamed	Ephemeral	1.0	2,661	0.061
S54-Trib1	Tributary 1 to Stream 54	Ephemeral	0.5	494	0.006
S55	Stream 55 - Unnamed	Ephemeral	1.0	125	0.003
S56	Stream 56 - Unnamed	Ephemeral	2.5	8,150	0.469
S56-Trib1	Tributary 1 to Stream 56	Ephemeral	2.5	249	0.014
S56-Trib1-A1	Secondary Tributary	Ephemeral	2.5	143	0.008
S57	Stream 57 - Unnamed	Ephemeral	0.5	1,024	0.012
S58	Stream 58 - Unnamed	Ephemeral	4.0	4,637	0.427
S58-Trib1	Tributary 1 to Stream 58	Ephemeral	2.0	987	0.045
S58-Trib2	Tributary 2 to Stream 58	Ephemeral	1.0	191	0.004
S59	Stream 59 - Unnamed	Ephemeral	0.5	485	0.006
S59-Trib1	Tributary 1 to Stream 59	Ephemeral	0.5	691	0.008
S60	Stream 60 - Unnamed	Ephemeral	1.0	192	0.004
S61	Stream 61 - Unnamed	Ephemeral	7.0	5,694	0.917
S61-Trib1	Tributary 1 to Stream 61	Ephemeral	3.0	2,231	0.154
S61-Trib1-A1	Secondary Tributary	Ephemeral	3.0	389	0.027
S61-Trib1-B1	Secondary Tributary	Ephemeral	3.0	454	0.031
S61-Trib2	Tributary 2 to Stream 61	Ephemeral	2.0	465	0.021
S61-Trib3	Tributary 3 to Stream 61	Ephemeral	2.0	208	0.010
S61-Trib4	Tributary 4 to Stream 61	Ephemeral	2.0	125	0.006
S61-Trib5	Tributary 5 to Stream 61	Ephemeral	2.0	137	0.006
S62	Stream 62 - Unnamed	Ephemeral	8.0	3,350	0.616
S62-Trib1	Tributary 1 to Stream 62	Ephemeral	3.0	147	0.010
S62-Trib1-A1	Secondary Tributary	Ephemeral	3.0	176	0.012
S62-Trib2	Tributary 2 to Stream 62	Ephemeral	1.5	37	0.001
S63	Stream 63 - Unnamed	Ephemeral	4.0	377	0.035
S64	Stream 64 - Unnamed	Ephemeral	1.0	164	0.004
S65	Stream 65 - Unnamed	Ephemeral	1.0	337	0.008
S66	Stream 66 - Long Creek	Ephemeral	22.0	2,831	1.432
S67	Stream 67 - Unnamed	Ephemeral	4.5	634	0.066
NSR	North Sulphur River	Intermittent	135.0	57,858	179.6

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N1-P1	Water 1 - Impoundment	On-Channel	N/A	N/A	0.62
N1-P2	Water 2 - Impoundment	On-Channel	N/A	N/A	0.12
N2-P1	Water 3 - Impoundment	On-Channel	N/A	N/A	1.14
N2-P1	Water 4 - Impoundment	On-Channel	N/A	N/A	1.41
N2-Trib1-P1	Water 5 - Impoundment	On-Channel	N/A	N/A	1.36
N3-P1	Water 6 - Impoundment	On-Channel	N/A	N/A	1.84
N3-P2	Water 7 - Impoundment	On-Channel	N/A	N/A	0.85
N3-P3	Water 8 - Impoundment	On-Channel	N/A	N/A	0.18
N3-Trib1-P1	Water 9 - Impoundment	On-Channel	N/A	N/A	0.56
N3-Trib1-P2	Water 10 - Impoundment	On-Channel	N/A	N/A	0.17
N6-Trib1-P1	Water 11 - Impoundment	On-Channel	N/A	N/A	1.04
N6-Trib1-P2	Water 12 - Impoundment	On-Channel	N/A	N/A	2.26
N6-Trib1-A1-P1	Water 13 - Impoundment	On-Channel	N/A	N/A	1.83
N6-Trib1-A1-P2	Water 14 - Impoundment	On-Channel	N/A	N/A	0.02
N6-Trib1-A3-P1	Water 15 - Impoundment	On-Channel	N/A	N/A	0.06
N6-Trib1-C2-P1	Water 16 - Impoundment	On-Channel	N/A	N/A	0.33
N6-Trib1-C3-P1	Water 17 - Impoundment	On-Channel	N/A	N/A	0.01
N6-Trib1-C3-P2	Water 18 - Impoundment	On-Channel	N/A	N/A	0.34
N6-Trib4-P1	Water 19 - Impoundment	On-Channel	N/A	N/A	0.65
N6-Trib4-P2	Water 20 - Impoundment	On-Channel	N/A	N/A	4.54
N6-Trib4-P3	Water 21 - Impoundment	On-Channel	N/A	N/A	0.24
N6-Trib4-P4	Water 22 - Impoundment	On-Channel	N/A	N/A	0.07
N6-Trib4-A1-P1	Water 23 - Impoundment	On-Channel	N/A	N/A	0.24
N6-Trib4-A1-P2	Water 24 - Impoundment	On-Channel	N/A	N/A	0.40
N6-Trib5-P1	Water 25 - Impoundment	On-Channel	N/A	N/A	0.23
N6-Trib5-P2	Water 26 - Impoundment	On-Channel	N/A	N/A	1.92
N6-Trib8-P1	Water 27 - Impoundment	On-Channel	N/A	N/A	0.29
N6-Trib8-P2	Water 28 - Impoundment	On-Channel	N/A	N/A	0.25
N6-Trib9-P1	Water 29 - Impoundment	On-Channel	N/A	N/A	0.98
N6-Trib9-B1-P1	Water 30 - Impoundment	On-Channel	N/A	N/A	0.09
N6-Trib9-B1-P2	Water 31 - Impoundment	On-Channel	N/A	N/A	0.14
N6-Trib9-B1-P3	Water 32 - Impoundment	On-Channel	N/A	N/A	0.03
N6-Trib11-P1	Water 33 - Impoundment	On-Channel	N/A	N/A	0.47
N6-Trib11-P2	Water 34 - Impoundment	On-Channel	N/A	N/A	2.00
N6-Trib12-P1	Water 35 - Impoundment	On-Channel	N/A	N/A	0.14
N6-Trib13-P1	Water 36 - Impoundment	On-Channel	N/A	N/A	0.39
N6-Trib13-P2	Water 37 - Impoundment	On-Channel	N/A	N/A	2.18
N6-Trib15-C1-P1	Water 38 - Impoundment	On-Channel	N/A	N/A	2.46
N6-Trib21-P1	Water 39 - Impoundment	On-Channel	N/A	N/A	0.36
N7-P1	Water 40 - Impoundment	On-Channel	N/A	N/A	1.18
N8-P1	Water 41 - Impoundment	On-Channel	N/A	N/A	1.90
N9-P1	Water 42 - Impoundment	On-Channel	N/A	N/A	0.57

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
N9-P2	Water 43 - Impoundment	On-Channel	N/A	N/A	0.24
N9-Trib2-P1	Water 44 - Impoundment	On-Channel	N/A	N/A	0.06
N10-Trib2-P1	Water 45 - Impoundment	On-Channel	N/A	N/A	2.84
N11-P1	Water 46 - Impoundment	On-Channel	N/A	N/A	9.08
N11-Trib2-P1	Water 47 - Impoundment	On-Channel	N/A	N/A	2.08
N11-Trib3-A1	Water 48 - Impoundment	On-Channel	N/A	N/A	0.08
N11-Trib3-B1	Water 49 - Impoundment	On-Channel	N/A	N/A	0.09
N11-Trib4-P1	Water 50 - Impoundment	On-Channel	N/A	N/A	0.31
N11-Trib4-P2	Water 51 - Impoundment	On-Channel	N/A	N/A	0.09
N11-Trib5-P1	Water 52 - Impoundment	On-Channel	N/A	N/A	0.12
N11-Trib6-P1	Water 53 - Impoundment	On-Channel	N/A	N/A	0.14
N11-Trib6A1-P1	Water 54 - Impoundment	On-Channel	N/A	N/A	0.45
N12-P1	Water 55 - Impoundment	On-Channel	N/A	N/A	0.93
N12-P2	Water 56 - Impoundment	On-Channel	N/A	N/A	1.11
N12-Trib2-P1	Water 57 - Impoundment	On-Channel	N/A	N/A	0.05
N12-Trib3-P1	Water 58 - Impoundment	On-Channel	N/A	N/A	0.15
N13-Trib1-P1	Water 59 - Impoundment	On-Channel	N/A	N/A	0.22
N14-Trib2-P1	Water 60 - Impoundment	On-Channel	N/A	N/A	0.87
N14-Trib2-P2	Water 61 - Impoundment	On-Channel	N/A	N/A	0.46
N14-Trib3-P1	Water 62 - Impoundment	On-Channel	N/A	N/A	0.18
N14-Trib4-P1	Water 63 - Impoundment	On-Channel	N/A	N/A	0.32
N14-Trib5	Water 64 - Impoundment	On-Channel	N/A	N/A	0.09
N14-Trib7	Water 65 - Impoundment	On-Channel	N/A	N/A	0.12
N14-Trib8	Water 66 - Impoundment	On-Channel	N/A	N/A	0.15
N15-P1	Water 67 - Impoundment	On-Channel	N/A	N/A	0.21
N16-Trib1-P1	Water 68 - Impoundment	On-Channel	N/A	N/A	0.25
N18-P1	Water 69 - Impoundment	On-Channel	N/A	N/A	0.90
N21-P1	Water 70 - Impoundment	On-Channel	N/A	N/A	0.32
N21-Trib4-P1	Water 71 - Impoundment	On-Channel	N/A	N/A	0.37
N21-Trib6-P1	Water 72 - Impoundment	On-Channel	N/A	N/A	0.16
N21-Trib6-P2	Water 73 - Impoundment	On-Channel	N/A	N/A	0.18
N21-Trib9-P1	Water 74 - Impoundment	On-Channel	N/A	N/A	0.14
N23-P1	Water 75 - Impoundment	On-Channel	N/A	N/A	0.46
N23-Trib1-P1	Water 76 - Impoundment	On-Channel	N/A	N/A	0.03
N23-Trib1-P2	Water 77 - Impoundment	On-Channel	N/A	N/A	0.06
N24-Trib2-B1-P1	Water 78 - Impoundment	On-Channel	N/A	N/A	0.30
N24-Trib6-B1-P1	Water 79 - Impoundment	On-Channel	N/A	N/A	0.45
N24-Trib6-B1-P2	Water 80 - Impoundment	On-Channel	N/A	N/A	0.11
N24-Trib6-C1-P1	Water 81 - Impoundment	On-Channel	N/A	N/A	0.22
N27-Trib4-P1	Water 82 - Impoundment	On-Channel	N/A	N/A	0.02

TABLE 5: COMPREHENSIVE LISTING OF AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE (Continued)

Identification #	Aquatic Resource	Classification	Proposed Impacts		
			Width at OHWM (Feet)	Length (L.F.)	Area (Acres)
S39-Trib1-P1	Water 83 - Impoundment	On-Channel	N/A	N/A	2.30
S39-Trib2-P1	Water 84 - Impoundment	On-Channel	N/A	N/A	1.89
S39-Trib2-A1-P1	Water 85 - Impoundment	On-Channel	N/A	N/A	0.18
S39-Trib2-A2-P1	Water 86 - Impoundment	On-Channel	N/A	N/A	0.03
S39-Trib2-A2-P2	Water 87 - Impoundment	On-Channel	N/A	N/A	0.03
S39-Trib3-P1	Water 88 - Impoundment	On-Channel	N/A	N/A	0.12
S40-P1	Water 89 - Impoundment	On-Channel	N/A	N/A	0.23
S40-P2	Water 90 - Impoundment	On-Channel	N/A	N/A	0.20
S40-Trib2-P1	Water 91 - Impoundment	On-Channel	N/A	N/A	0.21
S40-Trib3-P1	Water 92 - Impoundment	On-Channel	N/A	N/A	0.17
S43-P1	Water 93 - Impoundment	On-Channel	N/A	N/A	2.58
S43-Trib1-P1	Water 94 - Impoundment	On-Channel	N/A	N/A	0.03
S43-Trib3-P1	Water 95 - Impoundment	On-Channel	N/A	N/A	0.14
S43-Trib5	Water 96 - Impoundment	On-Channel	N/A	N/A	1.02
S44-P1	Water 97 - Impoundment	On-Channel	N/A	N/A	1.14
S45-Trib1-A1-P1	Water 98 - Impoundment	On-Channel	N/A	N/A	0.76
S45-Trib1-A2-P2	Water 99 - Impoundment	On-Channel	N/A	N/A	0.10
S54-Trib1-P1	Water 100 - Impoundment	On-Channel	N/A	N/A	0.10
S59-P1	Water 101 - Impoundment	On-Channel	N/A	N/A	0.34
S59-Trib1-P1	Water 102 - Impoundment	On-Channel	N/A	N/A	0.61
Total				**601,909**	**325.0**

TABLE 6: SUMMARY OF IMPACTS TO JURISDICTIONAL AQUATIC RESOURCES FOR THE PROPOSED LAKE RALPH HALL PROJECT SITE

Aquatic Resource	Proposed Impacts	
	Length (L.F.)	Area (Acres)
Streams	601,909	252.50
Waters (On-Channel Ponds)	N/A	72.50
Wetlands	N/A	N/A
Total	**601,909**	**325.00**

5. Supporting Information

a. References

Ajilvsgi, G (1988). Wildflowers of Texas, Third Edition. Fredericksburg, Texas: Shearer Publishing.

Correll, D.S. and H.B. Correll (1972). Aquatic and Wetland Plants of Southwestern United States. Stanford, California: Stanford University Press.

Diggs, G.M., B.L. Lipscomb, and R.J. O'Kennon (1999). Shinners and Mahler's Illustrated Flora of North Central Texas. Fort Worth, Texas: Botanical Research Institute of Texas.

Environmental Laboratory (1987). "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Goerdel, A.R. 1988. Soil Survey of Fannin County, Texas. United States Department of Agriculture, Soil Conservation Service, In cooperation with the Texas Agricultural Experiment Station.

Gould, F. W. (1975). The Grasses of Texas. College Station, Texas: Texas A&M University Press.

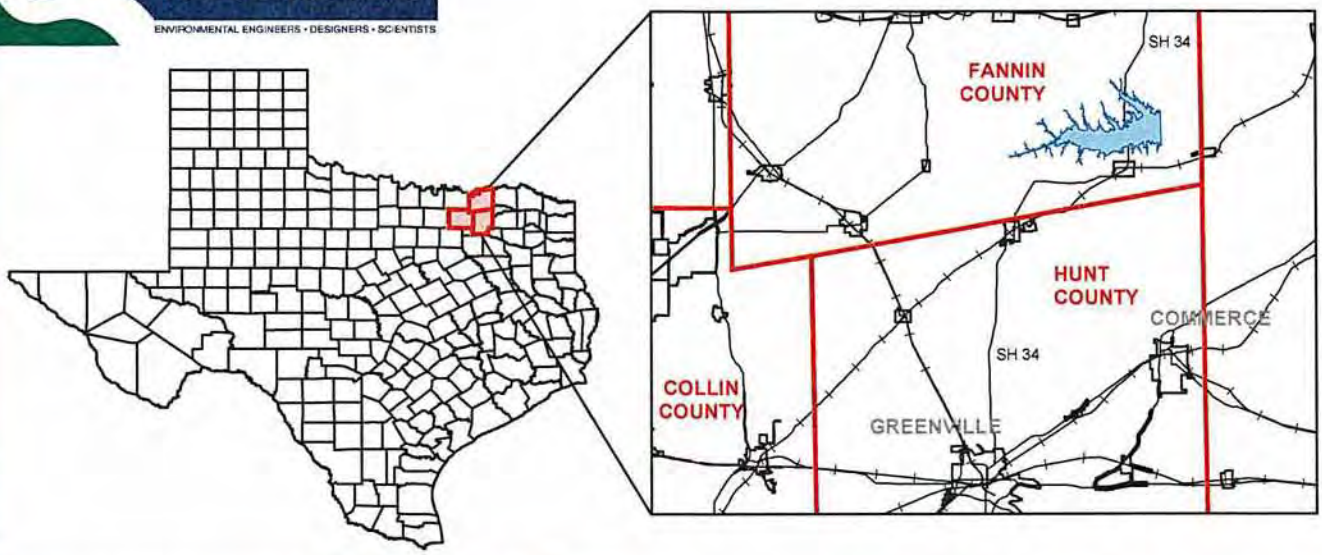
Reed, P.B., Jr. 1988. National List of Plant Species that Occur in Wetlands: South Plains (Region 6). U.S. Fish and Wildlife Service Biol. Rep. 88(26.6). 94 pp.

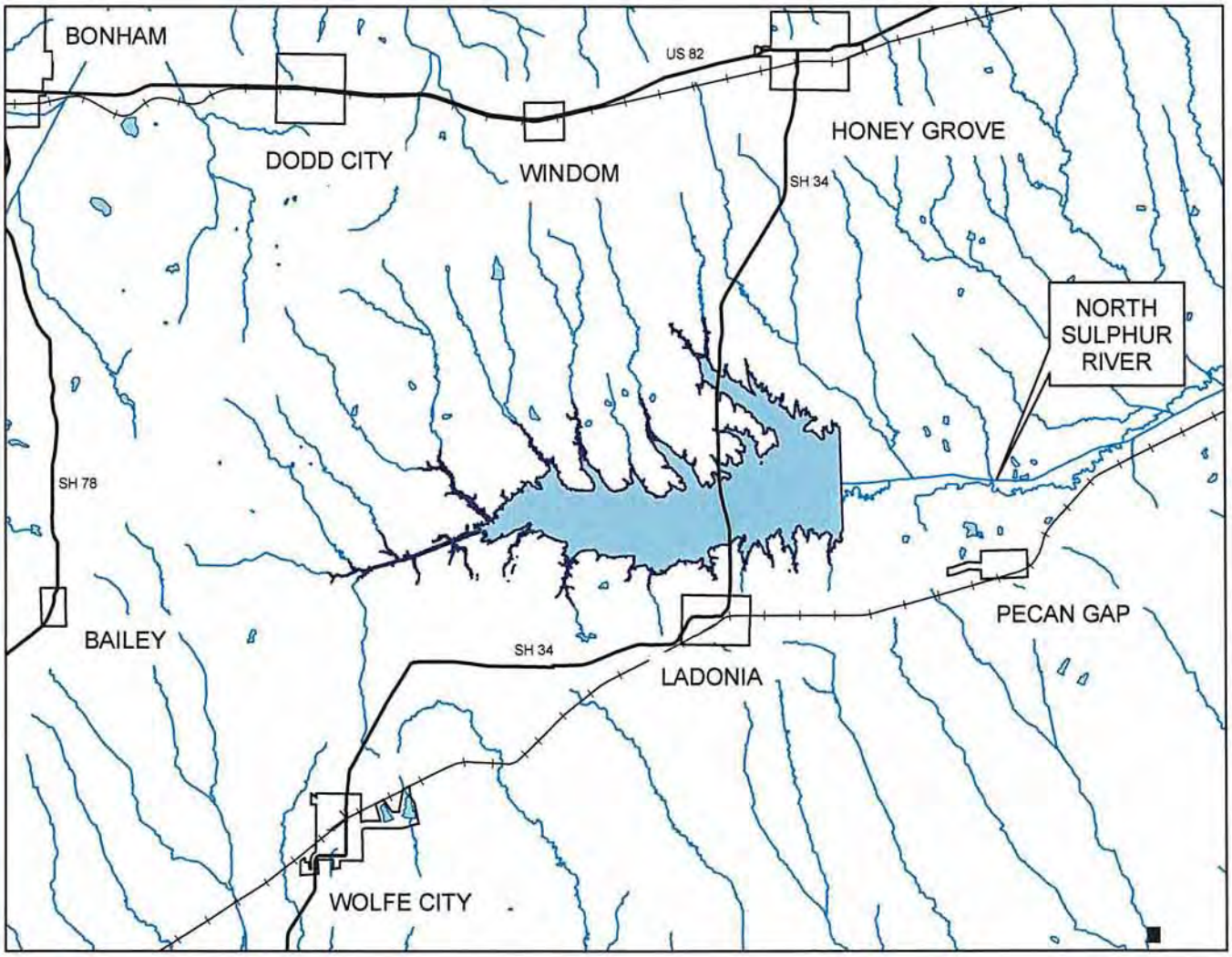
Willis, M.M., and H.S. Irwin (1983). Roadside Flowers of Texas. Austin, Texas: University of Texas Press.

APPENDIX A

FIGURES

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS • DESIGNERS • SCIENTISTS





Legend

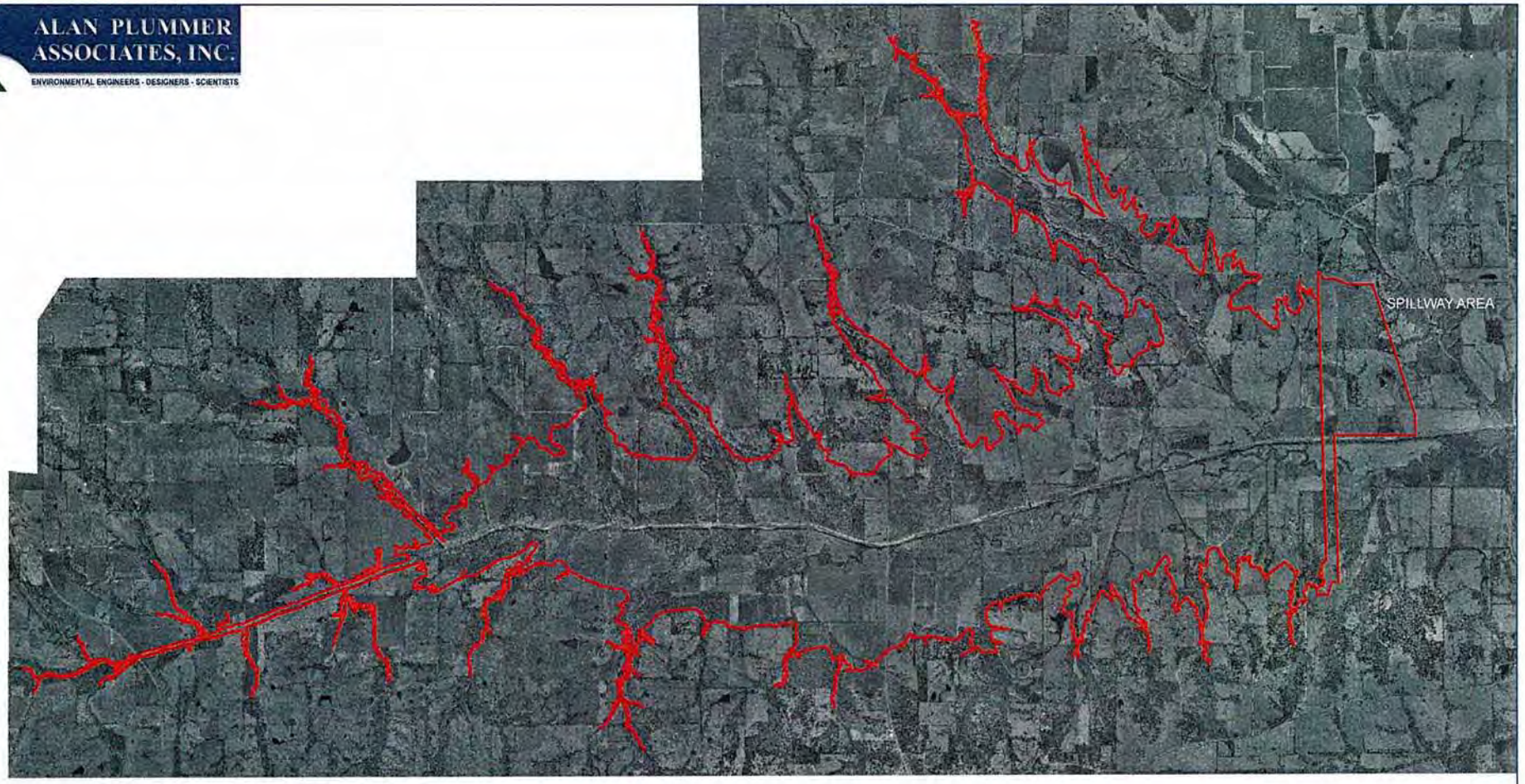
Proposed Lake Ralph Hall Reservoir

17,000 8,500 Feet

f/projects/346/0402/gis/permit_app/figure 18-1_general location map.mxd

FIGURE A-1
GENERAL LOCATION MAP

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS - DESIGNERS - SCIENTISTS



Legend

Proposed Lake Ralph Hall Reservoir

FIGURE A-2
PROPOSED CONSERVATION POOL FOR LAKE RALPH HALL
2003 AERIAL PHOTOGRAPH

0 2,000 4,000
Feet

Prepared by:
Jason Voight (10-10-06)
Figure 2 of 8

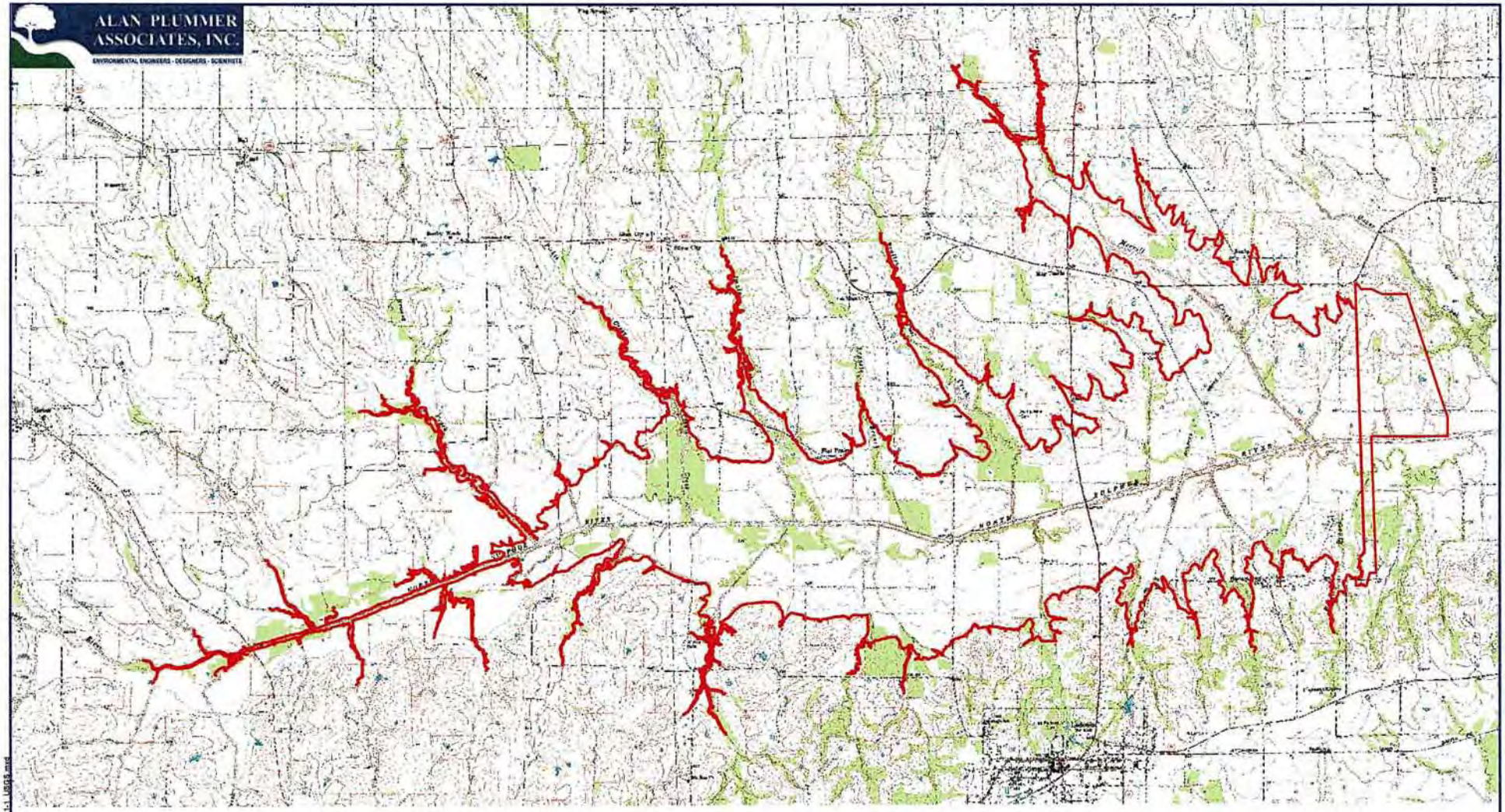


FIGURE A-3
USGS TOPOGRAPHIC MAPS:
LADONIA, GOBER, HONEY GROVE, AND PECAN GAP, TX QUADRANGLES

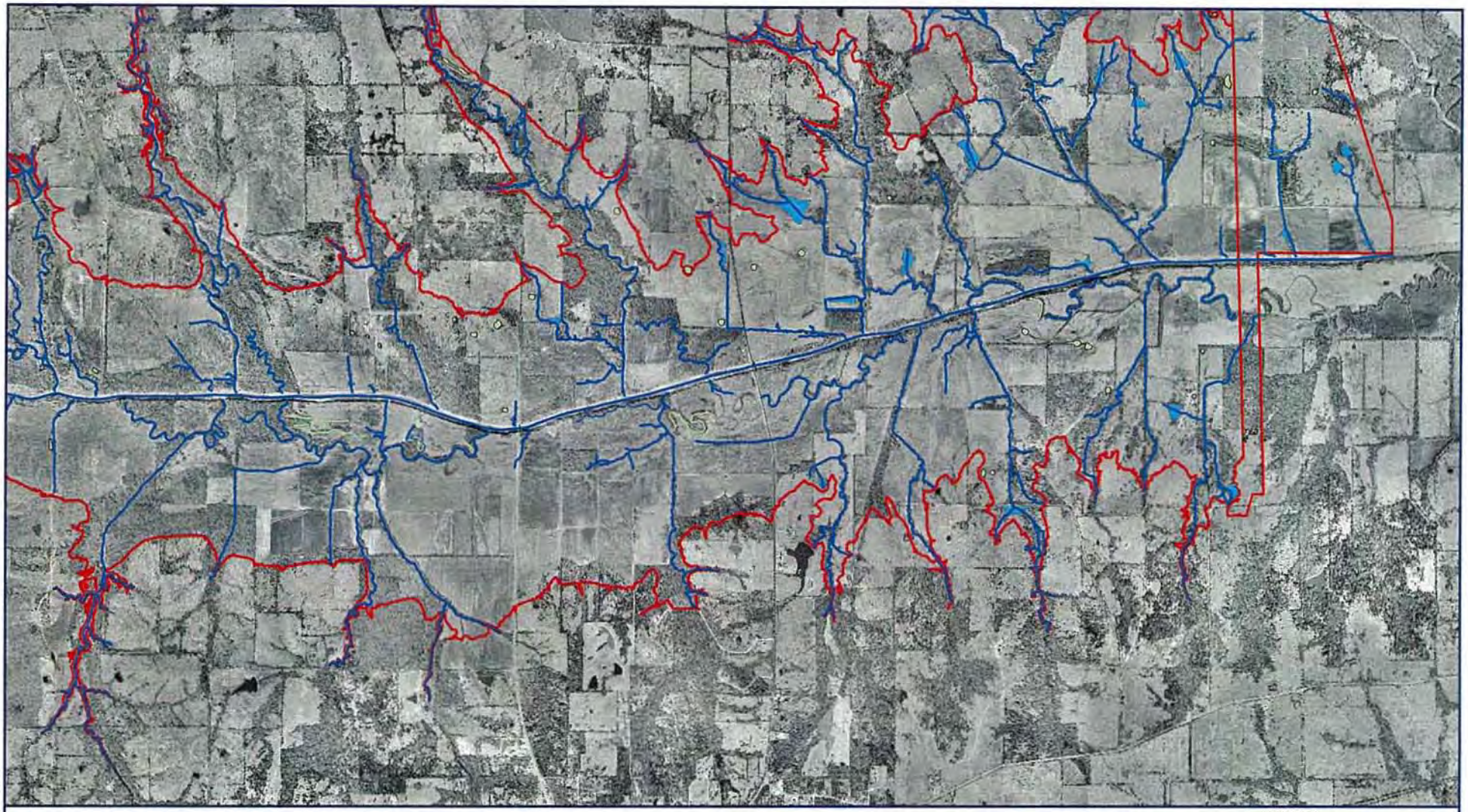


FIGURE A-4
PRELIMINARY JURISDICTIONAL DETERMINATION
OF WATERS OF THE U.S.

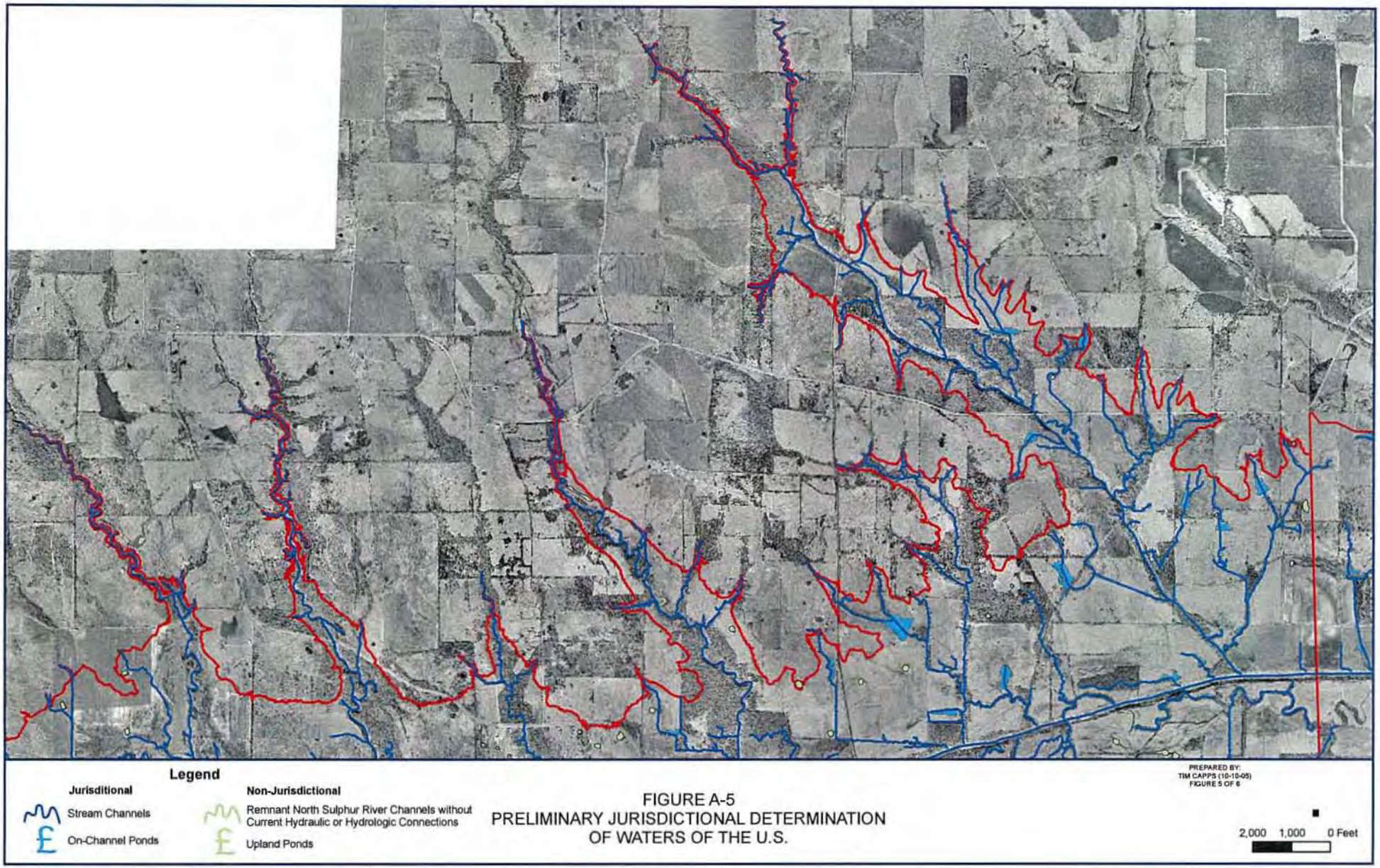


FIGURE A-5
PRELIMINARY JURISDICTIONAL DETERMINATION
OF WATERS OF THE U.S.

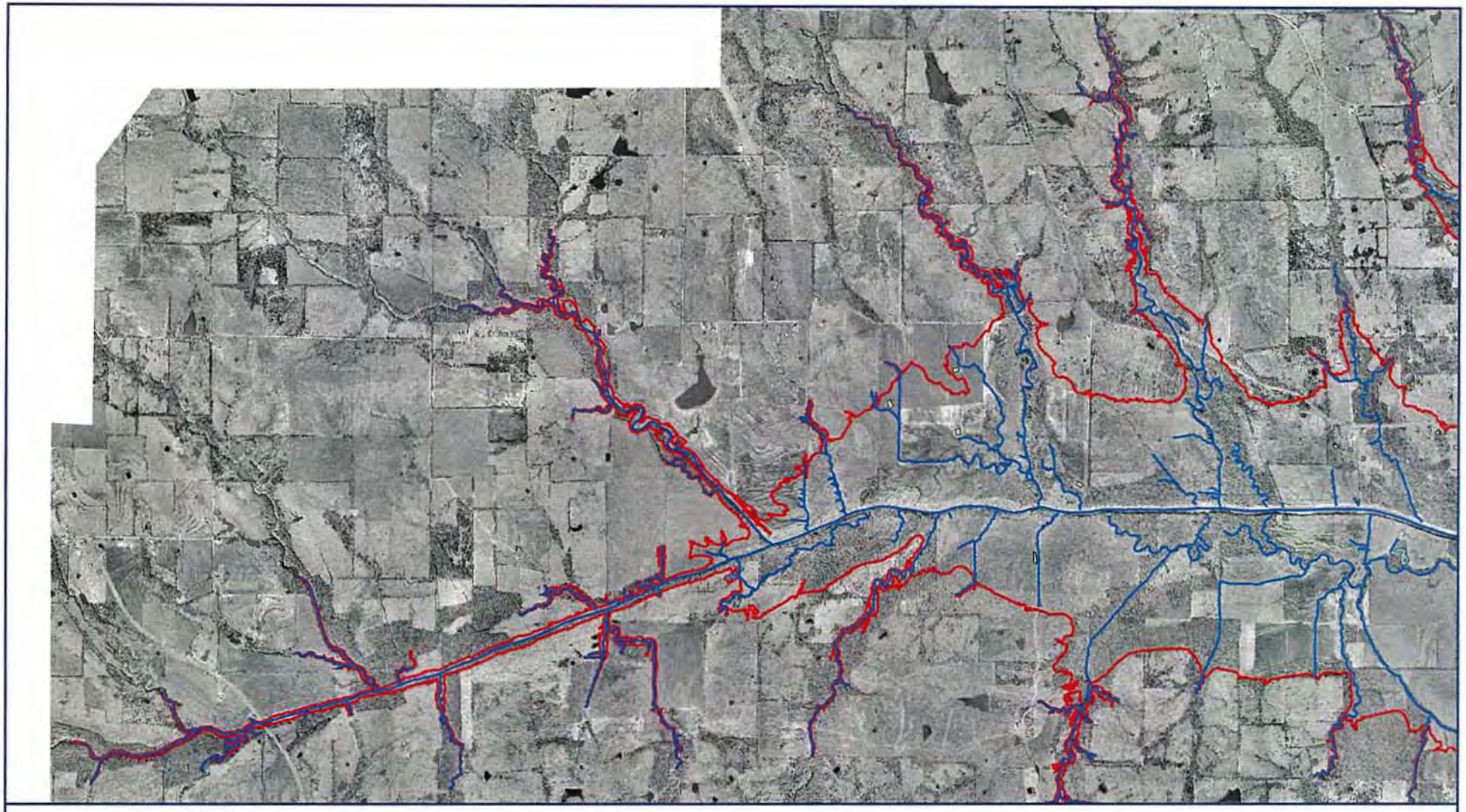


FIGURE A-6
PRELIMINARY JURISDICTIONAL DETERMINATION
OF WATERS OF THE U.S.

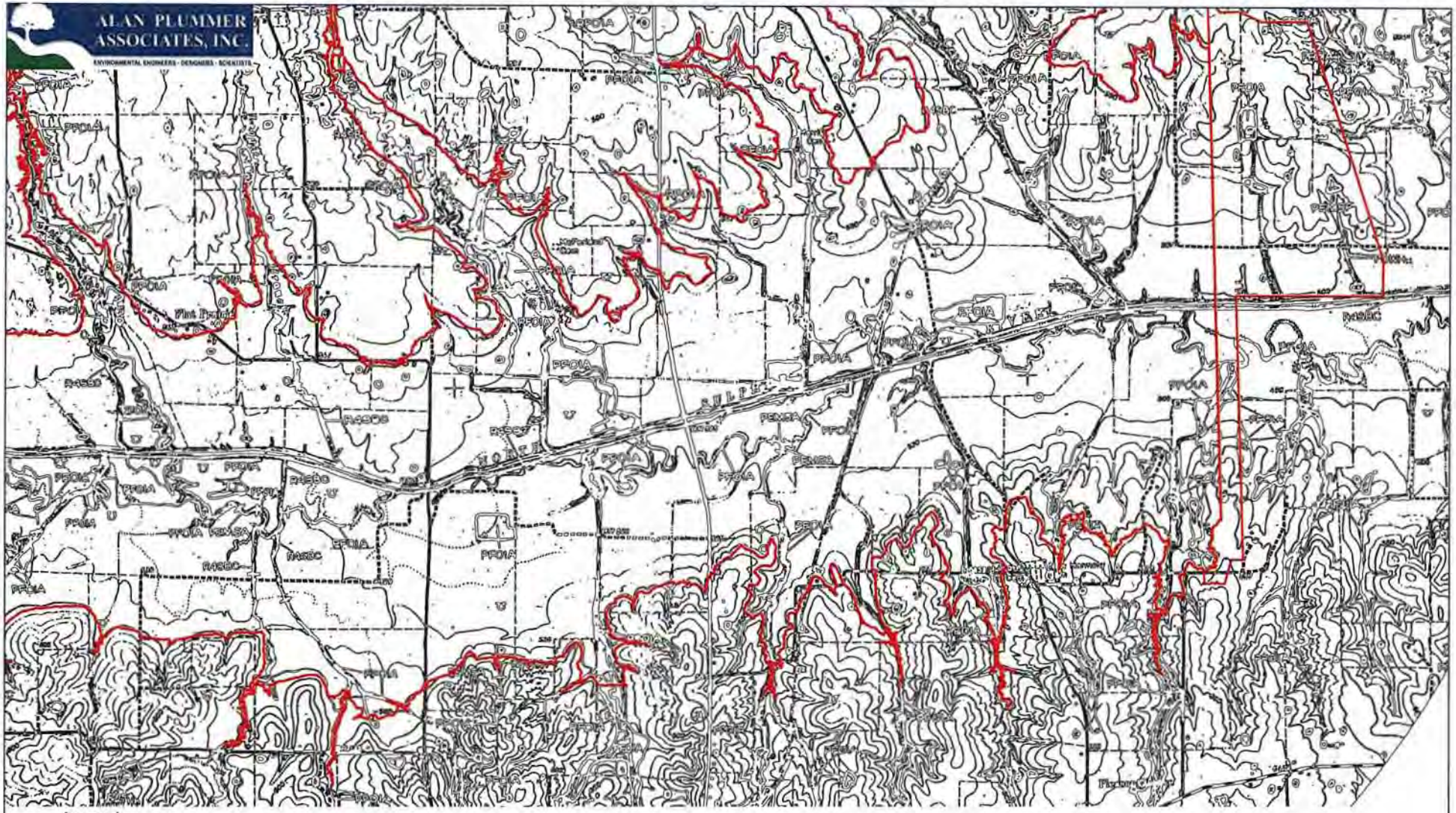


FIGURE C-1
NATIONAL WETLANDS INVENTORY MAPS:
LADONIA, GOBER, AND HONEY GROVE, TX QUADRANGLES

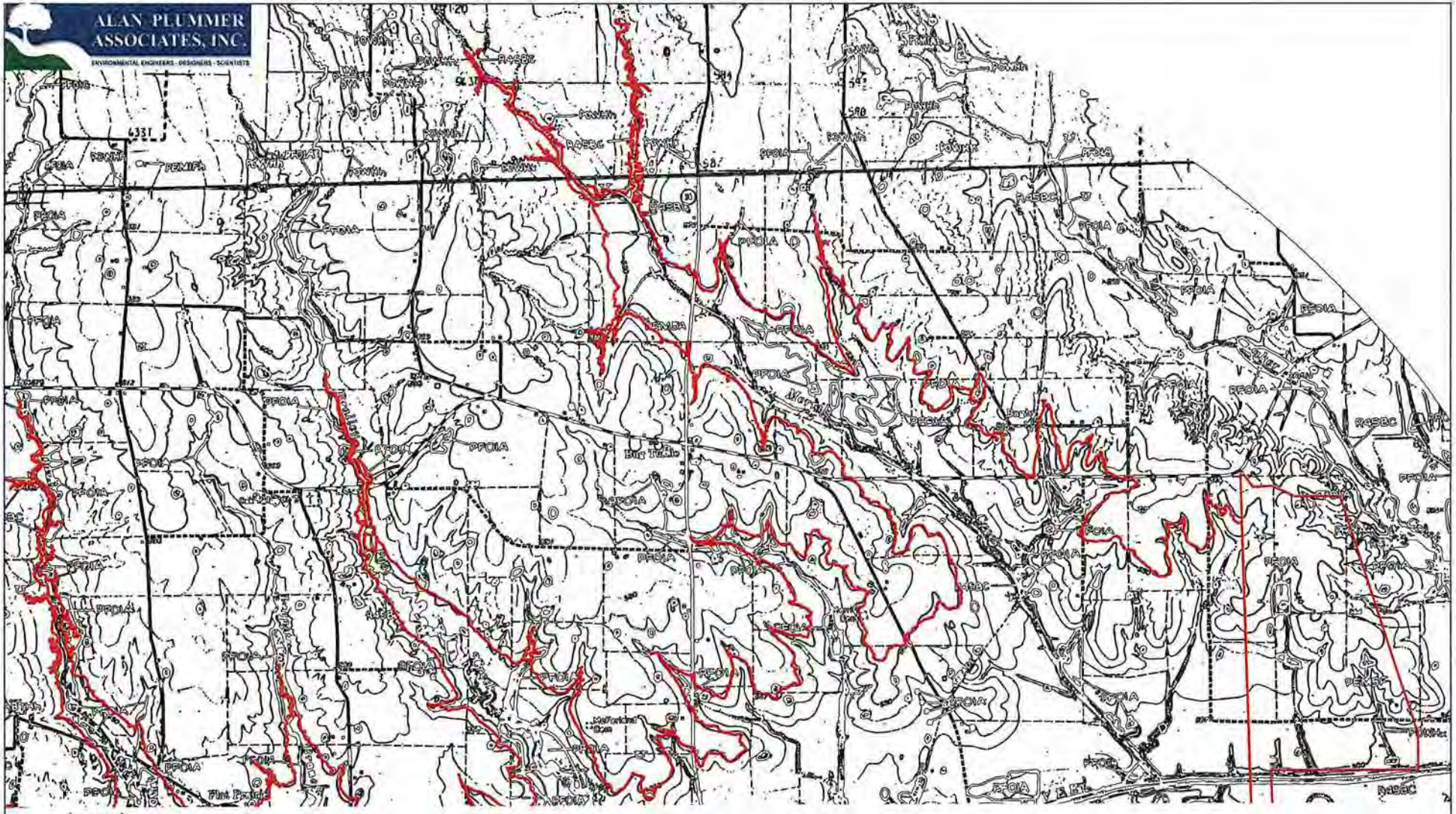


FIGURE C-2
NATIONAL WETLANDS INVENTORY MAPS:
LADONIA, GOBER, AND HONEY GROVE, TX QUADRANGLES

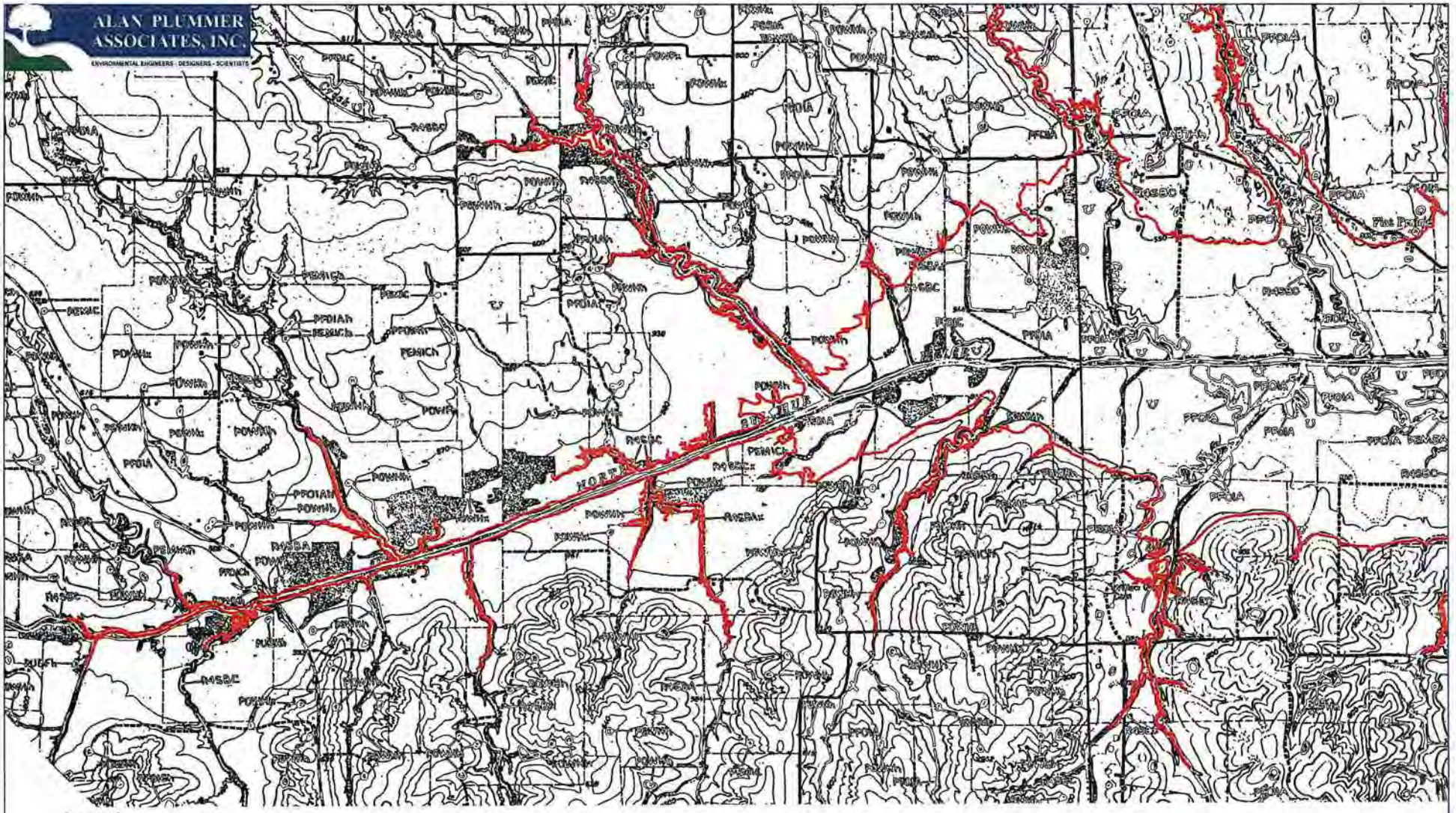


FIGURE C-3
NATIONAL WETLANDS INVENTORY MAPS:
LADONIA, GOBER, AND HONEY GROVE, TX QUADRANGLES

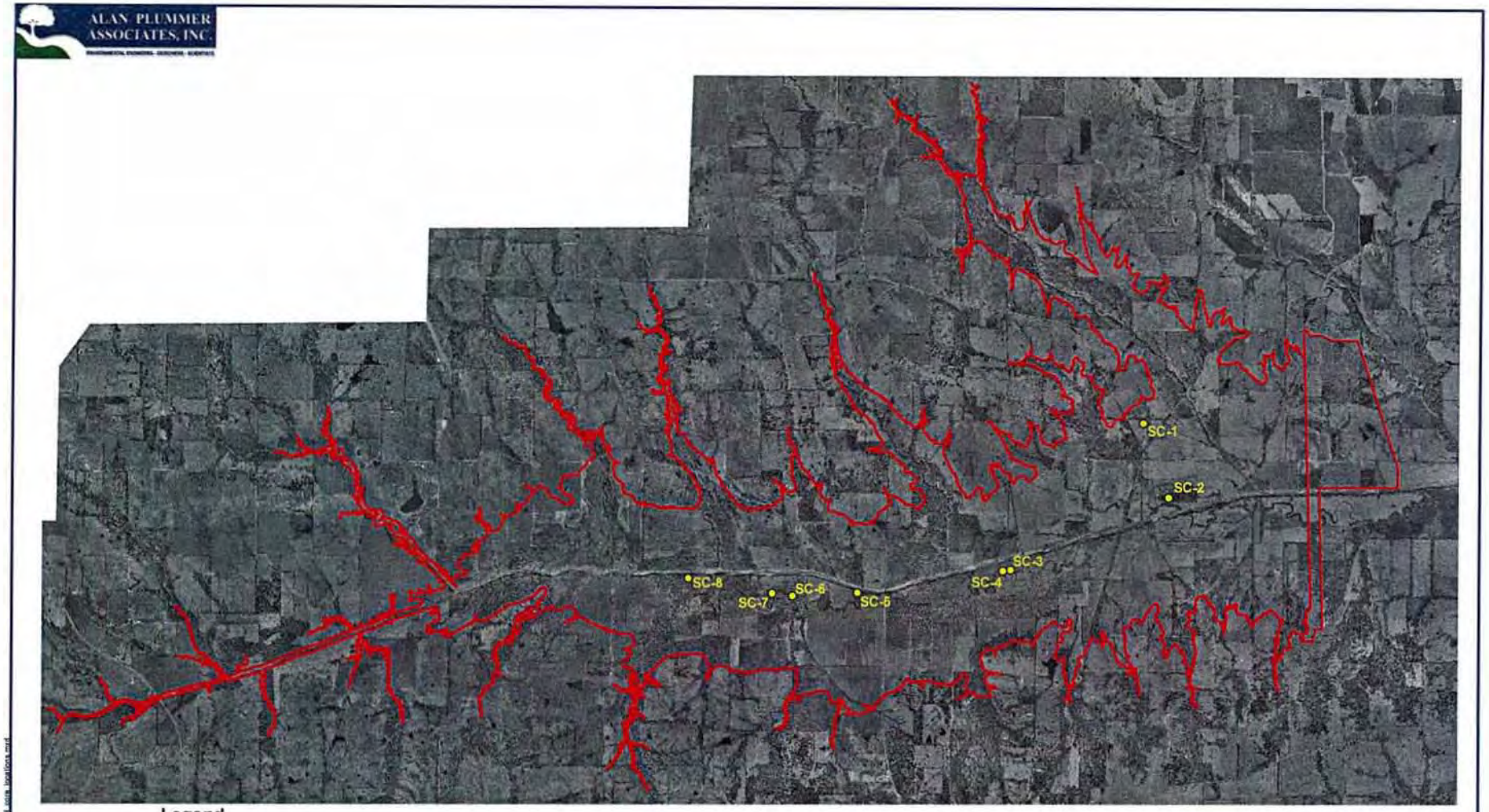
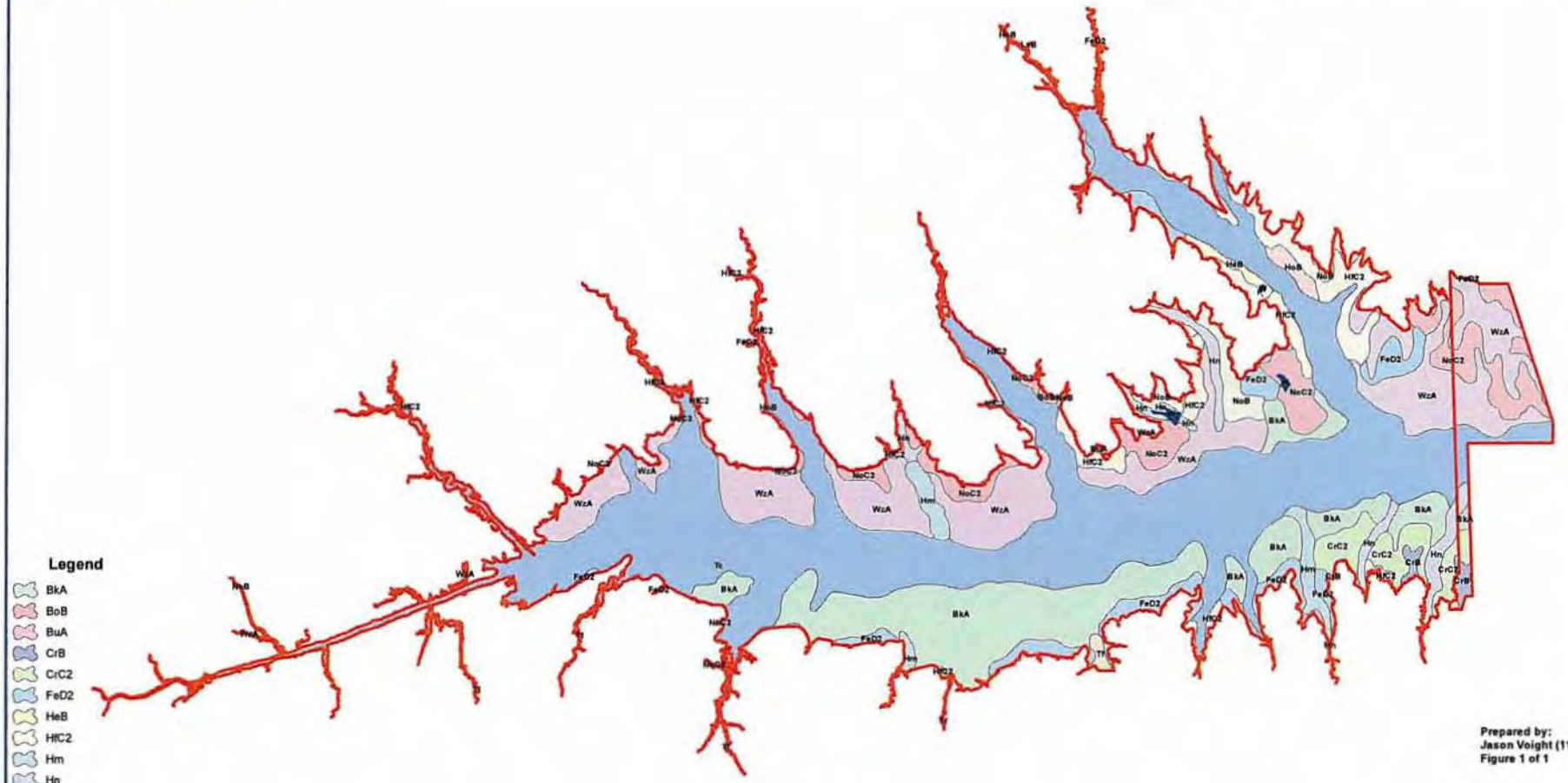


FIGURE D-1
ROUTINE WETLAND DETERMINATION DATA
SHEET SAMPLE LOCATIONS

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS - DESIGNERS - SCIENTISTS

(Source: Natural Resources Conservation Service Soil Data Mart)



(A detailed description of the mapped soils types is included within the PJD text.)

FIGURE E-1
SOILS WITHIN THE PROPOSED RESERVOIR AREA

APPENDIX B

RECENT PHOTOGRAPHS

Proposed Lake Ralph Hall Footprint

P1. Looking west along the North Sulphur River, west of State Highway 68. This area represents the western reaches of the proposed conservation pool. Inundation will essentially stay within the channel's banks at this location.

P2. Looking east along the North Sulphur River immediately west of State Highway 68.

Proposed Lake Ralph Hall Footprint

P3. Looking east along the North Sulphur River from an area approximately midway from State Highway 68 and Farm to Market Road 2990.

P4. Looking west along the North Sulphur River from approximately where the proposed embankment is sighted.

P5. Typical medium sized tributary channel observed near the upper reaches of the proposed reservoir site. Photograph take at the confluence with the North Sulphur River.

P6. Typical medium sized tributary channel observed near the upper reaches of the proposed reservoir site. Photograph taken at the confluence with the North Sulphur River.

P7. Typical large sized tributary channel observed along the mid-point of the proposed reservoir site.

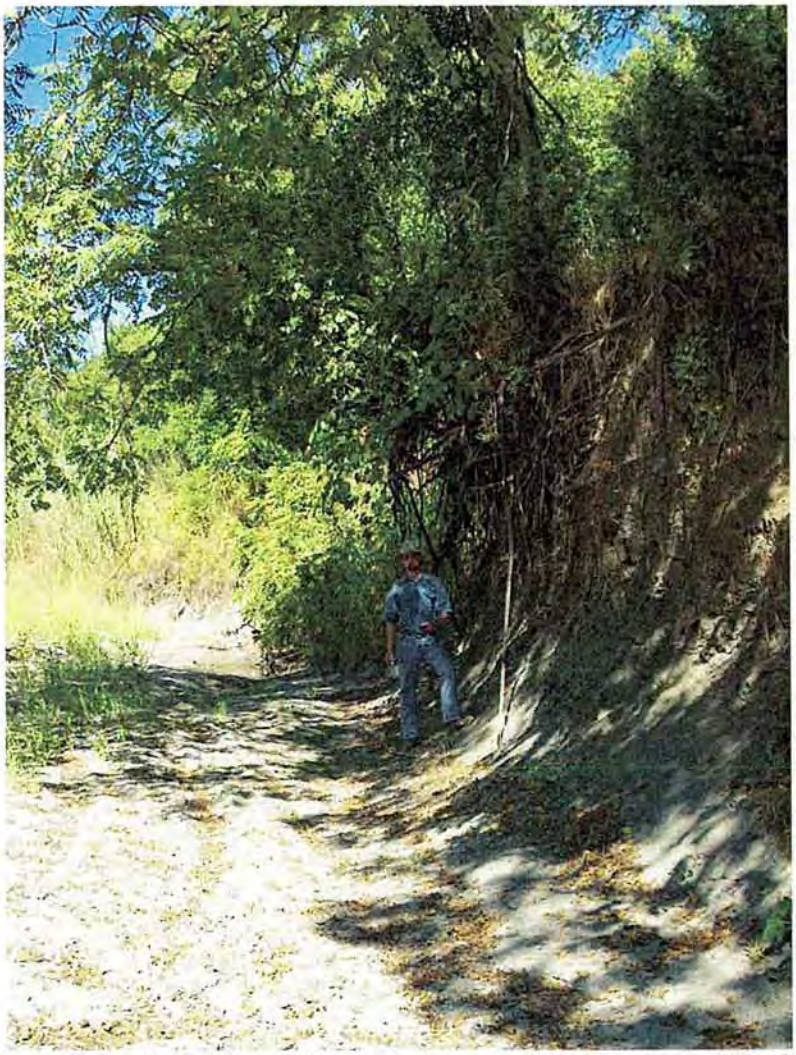
P8. Typical large sized tributary channel observed near the area for the proposed embankment for the reservoir site. This photograph was taken near the confluence with the North Sulphur River.

P9. Typical small sized tributary located along the confluence with the North Sulphur River.

P10. Typical small sized tributary located along the confluence with the North Sulphur River.

P11. Typical vegetation observed in jeopardy along one of the major tributaries to the North Sulphur River.

P12. Typical vegetation observed in jeopardy along the North Sulphur River.

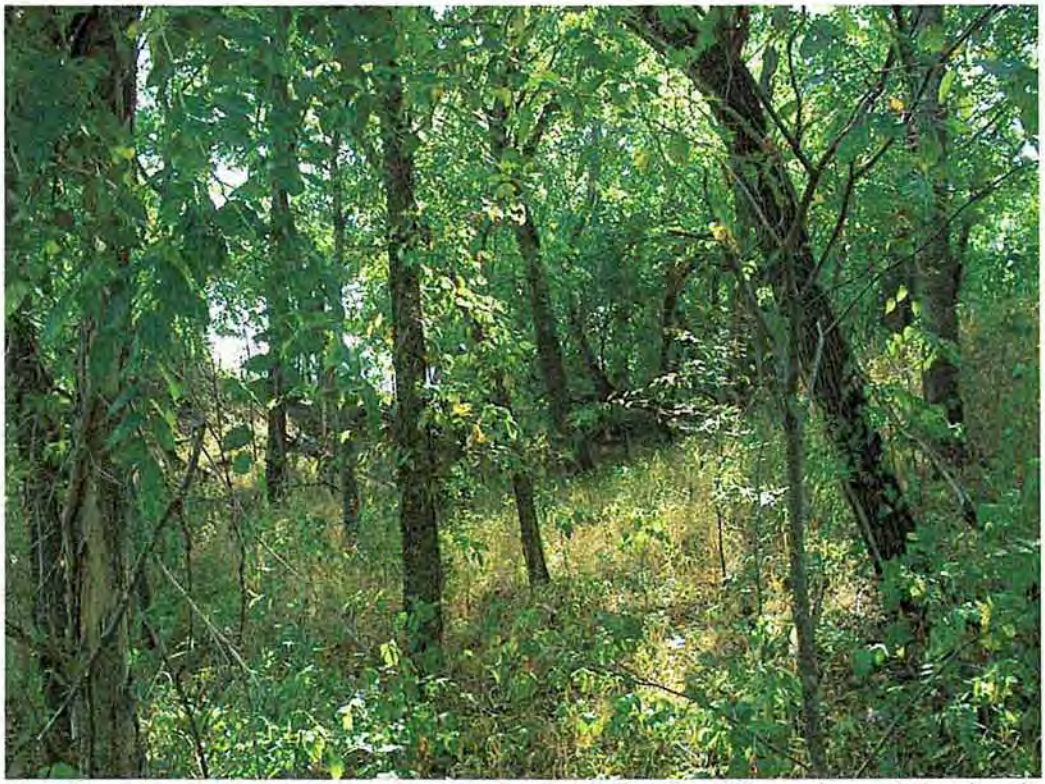


P13. Typical channel depth observed along the larger tributaries to the North Sulphur River.

P14. Outlet works for various on-channel ponds located along the tributaries to the North Sulphur River.

P15. Looking along shear vertical side slopes for one of the tributaries located along the North Sulphur River. This photograph was taken at the confluence with the North Sulphur River.

P16. Debris (trash) observed within one of the smaller tributaries to the North Sulphur River.



P17. Looking along a typical remnant native North Sulphur River channel that has lost its stream characteristics.

Proposed Lake Ralph Hall Footprint

P18. Looking along the typical remnant native North Sulphur River channel that is maintaining some of its stream characteristics.

P19. Looking along a typical on-channel pond located within the proposed Lake Ralph Hall footprint. This particular pond contains a mixture of wetland fringe vegetation.

P20. Looking along a typical area that has been contoured to prevent further loss of topsoil. The resulting contouring allows for water to accumulate thereby providing sufficient hydrology for hydrophytic vegetation to survive.

P21. Looking along a typical upland stock tank observed within the proposed reservoirs footprint.

Proposed Lake Ralph Hall Footprint

P22. Looking along typical native vegetation observed within the proposed footprint for Lake Ralph Hall.

P23. Looking along native prairie observed within the national grasslands.

P24. Looking at typical young forest located throughout most of the project area.

P25. Looking at a typical mixture of young and old growth within a forested area.

APPENDIX C

NWI MAPS AND CODES

National Wetlands Inventory Map Codes

R-RIVERINE

1-TIDAL

RB-ROCK	UB-UNCONSOLIDATED BOTTOM	SB-STREAMBED	AB-AQUATIC BED	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE	EM-EMERGENT	OW-OPEN WATER
1 Bedrock	1 Cobble-Gravel	1 Bedrock	1 Algal	1 Bedrock	1 Cobble-Gravel	2 Nonpersistent	*Unknown Bottom*
2 Rubble	2 Sand	2 Rubble	2 Aquatic Moss	2 Rubble	2 Sand		
	3 Mud	3 Cobble-Gravel	3 Rooted Vascular		3 Mud		
	4 Organic	4 Sand	4 Floating Vascular		4 Organic		
		5 Mud	5 *Unknown Submergent*		5 Vegetated		
		6 Organic	6 *Unknown Surface*				
		7 Vegetated					

2-LOWER PERENNIAL

RB-ROCK	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE	EM-EMERGENT	OW-OPEN WATER
1 Bedrock	1 Cobble-Gravel	1 Algal	1 Bedrock	1 Cobble-Gravel	2 Nonpersistent	*Unknown Bottom*
2 Rubble	2 Sand	2 Aquatic Moss	2 Rubble	2 Sand		
	3 Mud	3 Rooted Vascular		3 Mud		
	4 Organic	4 Floating Vascular		4 Organic		
		5 *Unknown Submergent*		5 Vegetated		
		6 *Unknown Surface*				

3-UPPER PERENNIAL

RB-ROCK	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE	OW-OPEN WATER
1 Bedrock	1 Cobble-Gravel	1 Algal	1 Bedrock	1 Cobble-Gravel	*Unknown Bottom*
2 Rubble	2 Sand	2 Aquatic Moss	2 Rubble	2 Sand	
	3 Mud	3 Rooted Vascular		3 Mud	
	4 Organic	4 Floating Vascular		4 Organic	
		5 *Unknown Submergent*		5 Vegetated	
		6 *Unknown Surface*			

4-INTERMITTENT

SB-STREAMBED
1 Bedrock
2 Rubble
3 Cobble-Gravel
4 Sand
5 Mud
6 Organic
7 Vegetated

National Wetlands Inventory Map Codes (Cont.)

R-RIVERINE (Cont.)

5-UNKNOWN PERENNIAL

RB-ROCK	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE	OW-OPEN WATER
1 Bedrock	1 Cobble-Gravel	1 Algal	1 Bedrock	1 Cobble-Gravel	*Unknown Bottom*
2 Rubble	2 Sand	2 Aquatic Moss	2 Rubble	2 Sand	
	3 Mud	3 Rooted Vascular		3 Mud	
	4 Organic	4 Floating Vascular		4 Organic	
		5 *Unknown Submergent*		5 Vegetated	
		6 *Unknown Surface*			

L-LACUSTRINE

1-LIMNETIC

RB-ROCK BOTTOM	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	OW-OPEN WATER/
1 Bedrock	1 Cobble-Gravel	1 Algal	*Unknown Bottom*
2 Rubble	2 Sand	2 Aquatic Moss	
	3 Mud	3 Rooted Vascular	
	4 Organic	4 Floating Vascular	
		5 *Unknown Submergent*	
		6 *Unknown Surface*	

2-LITTORAL

RB-ROCK BOTTOM	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE	EM-EMERGENT	OW-OPEN WATER/
1 Bedrock	1 Cobble-Gravel	1 Algal	1 Bedrock	1 Cobble-Gravel	2 Nonpersistent	*Unknown Bottom*
2 Rubble	2 Sand	2 Aquatic Moss	2 Rubble	2 Sand		
	3 Mud	3 Rooted Vascular		3 Mud		
	4 Organic	4 Floating Vascular		4 Organic		
		5 *Unknown Submergent*		5 Vegetated		
		6 *Unknown Surface*				

National Wetlands Inventory Map Codes (Cont.)

P-PALUSTRINE

RB-ROCK BOTTOM	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	US-UNCONSOLIDATED SHORE	ML-MOSS LICHEN	EM-EMERGENT	SS-SCRUB-SHRUB	FO-FORESTED	OW-OPEN WATER/
1 Bedrock	1 Cobble-Gravel	1 Algal	1 Cobble-Gravel	1 Moss	1 Persistent	1 Broad-Leaved Deciduous	1 Broad-Leaved Deciduous	*Unknown Bottom*
2 Rubble	2 Sand	2 Aquatic Moss	2 Sand	2 Lichen	2 Nonpersistent	2 Needle-Leaved Deciduous	2 Needle-Leaved Deciduous	
	3 Mud	3 Rooted Vascular	3 Mud			3 Broad-Leaved Evergreen	3 Broad-Leaved Evergreen	
	4 Organic	4 Floating Vascular	4 Organic			4 Needle-Leaved Evergreen	4 Needle-Leaved Evergreen	
		5 *Unknown Bottom*	5 Vegetated			5 Dead	5 Dead	
		6 *Unknown Surface*				6 *Deciduous*	6 *Deciduous*	
						7 *Evergreen*	7 *Evergreen*	

MODIFIERS

In order to more adequately describe wetland and deepwater habitats, one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

NON-TIDAL		TIDAL	
A Temporarily Flooded	H Permanently Flooded	K *Artificially Flooded*	*S Temporary-Tidal
B Saturated	J Intermittently Flooded	L Subtidal	*R Seasonal-Tidal
C Seasonally Flooded	K Artificially Flooded	M Irregularly Exposed	*T Semipermanent-Tidal
D *Seasonally Flooded/ Well Drained*	W Intermittently Flooded/ Temporarily	N Regularly Flooded	*V Permanent-Tidal
E *Seasonally Flooded/ Saturated*	Y Saturated/ Semipermanent/ Seasonal	P Irregularly Flooded	U *Unknown*
F Semipermanently Flooded	Z Intermittently Exposed/ Permanent	*These water regimes are only used in tidally influenced freshwater systems	
G Intermittently Exposed	U *Unknown*		

WATER CHEMISTRY

COASTAL HALINITY	INLAND SALINITY	pH MODIFIERS FOR ALL FRESH WATER
1 Hyperhaline	7 Hypersaline	a Acid
2 Euhaline	8 Eusaline	t Circumneutral
3 Mixohaline *(Brackish)*	9 Mixosaline	l Alkaline
4 Polyhaline	0 Fresh	
5 Mesohaline		
6 Oligohaline		
0 Fresh		

SOIL

g Organic	
n Mineral	

SPECIAL MODIFIERS

b Beaver	h *Diked Impounded*
d *Partially Drained/Ditched*	r Artificial Substrate
f Farmed	s *Spoil*
	x Excavated

APPENDIX D

ROUTINE WETLAND DETERMINATION DATA FORMS

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site **Lake Ralph Hall**	Date **10/26/2005**
Applicant / Owner **Upper Trinity Regional Water District**	County **Fannin**
Investigator **Jason Voight and Brian Holmes**	State **Texas**
Do Normal Circumstances exist on the site? YES ☑ NO ☐	Community ID **Pond**
Is the site significantly disturbed (Atypical Situation) YES ☐ NO ☑	Transect ID **WP-1**
Is the area a potential Problem Area? (If needed, explain on reverse) YES ☑ NO ☐	Plot ID **SC-1**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 **Cardiospermum halicacabum**	**H**	**FAC**	9		
2 **Polygonum pensylvanicum**	**H**	**FACW-**	10		
3			11		
4			12		
5			13		
6			14		
7			15		
8			16		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) **100%**

Remarks

The site is located within the upper reaches of an on-channel pond. Pond was significantly low due to below average rainfall.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)
- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☒ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	--	(in)
Depth to Free Water in Pit	--	(in)
Depth to Saturated Soil	>16"	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):
- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks

The vegetation passed the FAC-Neutral test with a 1 (wet) : 0 (non-wet) ratio. The Soil Survey of Fannin County indicates that the depth to high water table is greater than six feet below the surface for the mapped soil type. No primary hydrology indicators were observed at this location.

SOILS

Map Unit Name (Series and Phase): **Normangee clay loam, 2 to 5 % slopes, eroded**	Drainage Class: **Moderately Well Drained**
Taxonomy (Subgroup) **Fine, smectitic, thermic Udertic Haplustalfs**	Field Observations Confirm Mapped Type? YES ☑ NO ☐

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16"	**SAp-Bt1**	**10YR 3/2**	--	--	**clay**

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

The soil matched the given range for the mapped soil type. The low-chroma color observed is a characteristic of the mapped soil type; therefore, this area should be considered a problem area. The lack of distinct hydrology indicates that this site is neither inundated nor saturated for sufficient duration to develop hydric soil conditions.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES ☑ NO ☐	Is this Sampling Point Within a Wetland? YES ☐ NO ☑
Wetland Hydrology Present?	YES ☐ NO ☑	
Hydric Soils Present?	YES ☐ NO ☑	

Remarks

This site located within the upper reaches of an on-channel pond should not be considered a jurisdictional wetland.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site **Lake Ralph Hall**	Date **10/26/2005**
Applicant / Owner **Upper Trinity Regional Water District**	County **Fannin**
Investigator **Jason Voight and Brian Holmes**	State **Texas**
Do Normal Circumstances exist on the site? YES ☑ NO ☐	Community ID **Wooded Area**
Is the site significantly disturbed (Atypical Situation) YES ☐ NO ☑	Transect ID **WP-2**
Is the area a potential Problem Area? (If needed, explain on reverse) YES ☑ NO ☐	Plot ID **SC-2**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 **Quercus macrocarpa**	C	FAC-	9		
2. **Fraxinus pennsylvanica**	C	FACW-	10		
3 **Ulmus crassifolia**	C	FAC	11		
4 **Celtis laevigata**	C	FAC	12		
5 **Elymus virginicus**	H	FAC	13		
6 **Cyperus rotundus**	H	FAC	14		
7			15		
8			16		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) **83%**

Remarks

The site is located within a wooded area along a cut off oxbow of the original North Sulphur River channel. This site contained no sapling/shrub community.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☒ No Recorded Data Available

FIELD OBSERVATIONS		
Depth of Surface Water	--	(in)
Depth to Free Water in Pit	--	(in)
Depth to Saturated Soil	>16"	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks

The vegetation passed the FAC-Neutral test with a 1 (wet) : 0 (non-wet) ratio. The Soil Survey of Fannin Country indicates that the depth to high water table is greater than six feet below the surface for the mapped soil type. No primary hydrology indicators were observed at this location.

SOILS

Map Unit Name (Series and Phase): **Tinn clay, occasionally flooded**	Drainage Class: **Moderately Well Drained**
Taxonomy (Subgroup) **Fine, smectitic, thermic Typic Hapluderts**	Field Observations Confirm Mapped Type? YES ☑ NO ☐

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16"	**A-Bss1**	**10YR 2/1**	**--**	**--**	**clay**

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

The soil matched the given range for the mapped soil type. The low-chroma observed is a characteristic of the mapped soil type; therefore, this area should be considered a problem area. The lack of distinct hydrology indicates that this site is neither inundated nor saturated for sufficient duration to develop hydric soil conditions.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES ☑ NO ☐	Is this Sampling Point Within a Wetland? YES ☐ NO ☑
Wetland Hydrology Present?	YES ☐ NO ☑	
Hydric Soils Present?	YES ☐ NO ☑	

Remarks

This site located within a wooded area along a cut off oxbow of the original North Sulphur River should not be considered a jurisdictional wetland.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site **Lake Ralph Hall**	Date **10/26/2005**
Applicant / Owner **Upper Trinity Regional Water District**	County **Fannin**
Investigator **Jason Voight and Brian Holmes**	State **Texas**
Do Normal Circumstances exist on the site? YES ☑ NO ☐	Community ID **Depressional Area**
Is the site significantly disturbed (Atypical Situation) YES ☐ NO ☑	Transect ID **WP-3**
Is the area a potential Problem Area? (If needed, explain on reverse) YES ☑ NO ☐	Plot ID **SC-3**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 **Salix nigra**	C	FACW+	9		
2 **Salix nigra**	S/S	FACW+	10		
3 **Ulmus americana**	S/S	FAC	11		
4 **Celtis laevigata**	S/S	FAC	12		
5 **Cardiospermum halicacabum**	H	FAC	13		
6 **Iva annua**	H	FAC	14		
7			15		
8			16		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) **100%**

Remarks

The site is located within a depressional area west of State Highway 34. The depressional area was dominated by black willow.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☒ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	--	(in)
Depth to Free Water in Pit	--	(in)
Depth to Saturated Soil	>16"	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks

The vegetation passed the FAC-Neutral test with a 2 (wet) : 0 (nonwet) ratio. The Soil Survey of Fannin County indicates that the depth to high water table is greater than six feet below the surface for the mapped soil type. No primary hydrology indicators were observed at this location.

SOILS

Map Unit Name (Series and Phase): **Tinn clay, occasionally flooded**	Drainage Class: **Moderately Well Drained**
Taxonomy (Subgroup) **Fine, smectitic, thermic Typic Hapluderts**	Field Observations Confirm Mapped Type? YES ☑ NO ☐

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16"	**A-Bss1**	**10YR 3/1**	**--**	**--**	**clay**

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

The soil matched the given range for the mapped soil type. The low-chroma observed is a characteristic of the mapped soil type; therefore, this area should be considered a problem area. The lack of distinct hydrology indicates that this site is neither inundated nor saturated for sufficient duration to develop hydric soil conditions.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES ☑ NO ☐	Is this Sampling Point Within a Wetland? YES ☐ NO ☑
Wetland Hydrology Present?	YES ☐ NO ☑	
Hydric Soils Present?	YES ☐ NO ☑	

Remarks

This site located within a depressional area west of State Highway 34 should not be considered a jurisdictional wetland. The depressional area was dominated by black willow.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site **Lake Ralph Hall**	Date **10/26/2005**
Applicant / Owner **Upper Trinity Regional Water District**	County **Fannin**
Investigator **Jason Voight and Brian Holmes**	State **Texas**
Do Normal Circumstances exist on the site? YES ☑ NO ☐	Community ID **Depressional Area**
Is the site significantly disturbed (Atypical Situation) YES ☐ NO ☑	Transect ID **WP-4**
Is the area a potential Problem Area? (If needed, explain on reverse) YES ☑ NO ☐	Plot ID **SC-4**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 **Cardiospermum halicacabum**	**H**	**FAC**	9		
2 **Polygonum pensylvanicum**	**H**	**FACW-**	10		
3 **Xanthium strumarium**	**H**	**FAC-**	11		
4			12		
5			13		
6			14		
7			15		
8			16		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) **67%**

Remarks

The site is located within a depressional area representing a cut off oxbow of the original North Sulphur River channel.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☒ No Recorded Data Available

FIELD OBSERVATIONS		
Depth of Surface Water	--	(in)
Depth to Free Water in Pit	--	(in)
Depth to Saturated Soil	>16"	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks

The vegetation passed the FAC-Neutral test with a 1 (wet) : 0 (non-wet) ratio. The Soil Survey of Fannin County indicates that the depth to high water table is greater than six feet below the surface for the mapped soil type. No primary hydrology indicators were observed at this location.

SOILS

Map Unit Name (Series and Phase): **Tinn clay, occasionally flooded**	Drainage Class: **Moderately Well Drained**
Taxonomy (Subgroup) **Fine, smectitic, thermic Typic Hapluderts**	Field Observations Confirm Mapped Type? YES ☑ NO ☐

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16"	**A-Bss1**	**10YR 3/1**	**--**	**--**	**clay**

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

The soil matched the given range for the mapped soil type. The low-chroma observed is a characteristic of the mapped soil type; therefore, this area should be considered a problem area. The lack of distinct hydrology indicates that this site is neither inundated nor saturated for sufficient duration to develop hydric soil conditions.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES ☑ NO ☐	Is this Sampling Point Within a Wetland? YES ☐ NO ☑
Wetland Hydrology Present?	YES ☐ NO ☑	
Hydric Soils Present?	YES ☐ NO ☑	

Remarks

This site located within a depressional area representing a cut off oxbow of the original North Sulphur River channel should not be considered a jurisdictional wetland.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site **Lake Ralph Hall**	Date **10/26/2005**
Applicant / Owner **Upper Trinity Regional Water District**	County **Fannin**
Investigator **Jason Voight and Brian Holmes**	State **Texas**
Do Normal Circumstances exist on the site? YES ☑ NO ☐	Community ID **Wooded Area**
Is the site significantly disturbed (Atypical Situation) YES ☐ NO ☑	Transect ID **WP-5**
Is the area a potential Problem Area? (If needed, explain on reverse) YES ☑ NO ☐	Plot ID **SC-5**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 **Fraxinus pennsylvanica**	C	FACW-	9		
2 **Celtis laevigata**	C	FAC	10		
3 **Celtis laevigata**	S/S	FAC	11		
4 **Toxicodendron radicans**	WV	FAC	12		
5 **Campsis radicans**	H	FAC	13		
6 **Elymus virginicus**	H	FAC	14		
7 **Juniperus virginiana**	H	FACU-	15		
8			16		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) **86%**

Remarks

Site is located within a wooded area along an area representing a cut off oxbow of the original North Sulphur River channel.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☒ No Recorded Data Available

FIELD OBSERVATIONS		
Depth of Surface Water	--	(in)
Depth to Free Water in Pit	--	(in)
Depth to Saturated Soil	>16"	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☒ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks

The vegetation failed the FAC-Neutral test with a 1 (wet) : 1 (non-wet) ratio. The Soil Survey of Fannin County indicates that the depth to high water table is greater than six feet below the surface for the mapped soil type. Water marks were observed along the base of tree trunks to two inches.

SOILS

Map Unit Name (Series and Phase): **Tinn clay, occasionally flooded**	Drainage Class: **Moderately Well Drained**
Taxonomy (Subgroup) **Fine, smectitic, thermic Typic Hapluderts**	Field Observations Confirm Mapped Type? YES ☑ NO ☐

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16"	**A-Bss1**	**10YR 2/1**	--	--	**clay**

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☒ Other (Explain in Remarks)

Remarks:

The soil matched the given range for the mapped soil type. The low-chroma observed is a characteristic of the mapped soil type; therefore, this area should be considered a problem area. Since the vegetation contains a dominance of FAC or wetter vegetation as well as a primary hydrology indicator, it is inferred that this site stays either saturated or inundated for sufficient duration to develop hydric soil conditions.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES ☑ NO ☐	Is this Sampling Point Within a Wetland? YES ☑ NO ☐
Wetland Hydrology Present?	YES ☑ NO ☐	
Hydric Soils Present?	YES ☑ NO ☐	

Remarks

Although this site is located within a wooded area along an area representing a cut off oxbow of the original North Sulphur River channel should be considered a wetland, it is located outside of the 100-year floodplain as well as does not contain a hydrologic connection to the North Sulphur River or any of its tributaries. Therefore, it should not be considered jurisdictional.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site **Lake Ralph Hall**	Date **10/26/2005**
Applicant / Owner **Upper Trinity Regional Water District**	County **Fannin**
Investigator **Jason Voight and Brian Holmes**	State **Texas**
Do Normal Circumstances exist on the site? YES ☑ NO ☐	Community ID **Depressional Area**
Is the site significantly disturbed (Atypical Situation) YES ☐ NO ☑	Transect ID **WP-6**
Is the area a potential Problem Area? (If needed, explain on reverse) YES ☑ NO ☐	Plot ID **SC-6**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 **Fraxinus pennsylvanica**	C	FACW-	9		
2 **Celtis laevigata**	C	FAC	10		
3 **Celtis laevigata**	S/S	FAC	11		
4 **Fraxinus pennsylvanica**	S/S	FACW-	12		
5 **Carya illinoensis**	H	FAC+	13		
6 **Elymus virginicus**	H	FAC	14		
7 **Toxicodendron radicans**	H	FAC	15		
8 **Campsis radicans**	H	FAC	16		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) **100%**

Remarks

Site was located within a depressional area along a cut off oxbow of the original North Sulphur River channel.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☒ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	--	(in)
Depth to Free Water in Pit	--	(in)
Depth to Saturated Soil	>16"	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☒ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks

The vegetation passed the FAC-Neutral test with a 2 (wet) : 0 (non-wet) ratio. The Soil Survey of Fannin County indicates that the depth to high water table is greater than six feet for the mapped soil type. Water marks were observed along the base of tree trunks to two inches.

SOILS

Map Unit Name (Series and Phase): **Tinn clay, occasionally flooded**	Drainage Class: **Moderately Well Drained**
Taxonomy (Subgroup) **Fine, smectitic, thermic Typic Hapluderts**	Field Observations Confirm Mapped Type? YES ☑ NO ☐

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16"	**A-Bss1**	**10YR 2/1**	**--**	**--**	**clay**

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☒ Other (Explain in Remarks)

Remarks:

The soil matched the given range for the mapped soil type. The low-chroma observed is a characteristic of the mapped soil type; therefore, this area should be considered a problem area. Since the vegetation contains a dominance of FAC or wetter vegetation as well as a primary hydrology indicator, it is inferred that this site stays either saturated or inundated for sufficient duration to develop hydric soil conditions.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES ☑ NO ☐	Is this Sampling Point Within a Wetland? YES ☑ NO ☐
Wetland Hydrology Present?	YES ☑ NO ☐	
Hydric Soils Present?	YES ☑ NO ☐	

Remarks

Although this site is located within a depressional area along a cut off oxbow of the original North Sulphur River channel should be considered a wetland, it is located outside of the 100-year floodplain as well as does not contain a hydrologic connection to the North Sulphur River or any of its tributaries. Therefore, it should not be considered jurisdictional.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site **Lake Ralph Hall**	Date **10/26/2005**
Applicant / Owner **Upper Trinity Regional Water District**	County **Fannin**
Investigator **Jason Voight and Brian Holmes**	State **Texas**
Do Normal Circumstances exist on the site? YES ☑ NO ☐	Community ID **Depressional Area**
Is the site significantly disturbed (Atypical Situation) YES ☐ NO ☑	Transect ID **WP-7**
Is the area a potential Problem Area? (If needed, explain on reverse) YES ☑ NO ☐	Plot ID **SC-7**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 **Fraxinus pennsylvanica**	C	FACW-	9		
2 **Celtis laevigata**	C	FAC	10		
3 **Ulmus americana**	C	FAC	11		
4 **Campsis radicans**	H	FAC	12		
5 **Toxicodendron radicans**	H	FAC	13		
6			14		
7			15		
8			16		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) **100%**

Remarks

The site is located within a depressional area along a cut off oxbow of the original North Sulphur River. This site contained no sapling/shrub community.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)
- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☒ No Recorded Data Available

FIELD OBSERVATIONS		
Depth of Surface Water	–	(in)
Depth to Free Water in Pit	–	(in)
Depth to Saturated Soil	>16"	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☒ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):
- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks

The vegetation passed the FAC-Neutral test with a 1 (wet) : 0 (non-wet) ratio. The Soil Survey of Fannin County indicates that the depth to high water table is greater than six feet below the surface for the mapped soil type. Water marks were observed along the base of tree trunks to three inches.

SOILS

Map Unit Name (Series and Phase): **Tinn clay, occasionally flooded**	Drainage Class: **Moderately Well Drained**
Taxonomy (Subgroup) **Fine, smectitic, thermic Typic Hapluderts**	Field Observations Confirm Mapped Type? YES ☑ NO ☐

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16"	**A-Bss1**	**10YR 2/1**	**--**	**--**	**clay**

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☒ Other (Explain in Remarks)

Remarks:

The soil matched the given range for the mapped soil type. The low-chroma observed is a characteristic of the mapped soil type; therefore, this area should be considered a problem area. Since the vegetation contains a dominance of FAC or wetter vegetation as well as a primary hydrology indicator, it is inferred that this site stays either saturated or inundated for sufficient duration to develop hydric soil conditions.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES ☑ NO ☐	Is this Sampling Point Within a Wetland? YES ☑ NO ☐
Wetland Hydrology Present?	YES ☑ NO ☐	
Hydric Soils Present?	YES ☑ NO ☐	

Remarks

Although this site located within a depressional area along a cut off oxbow of the original North Sulphur River should be considered a wetland, it is located outside of the 100-year floodplain as well as does not contain a hydrologic connection to the North Sulphur River or any of its tributaries. Therefore, it should not be considered jurisidictional.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site **Lake Ralph Hall**	Date **10/26/2005**
Applicant / Owner **Upper Trinity Regional Water District**	County **Fannin**
Investigator **Jason Voight and Brian Holmes**	State **Texas**
Do Normal Circumstances exist on the site? YES ☑ NO ☐	Community ID **Depressional Area**
Is the site significantly disturbed (Atypical Situation) YES ☐ NO ☑	Transect ID **WP-8**
Is the area a potential Problem Area? (If needed, explain on reverse) YES ☑ NO ☐	Plot ID **SC-8**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 **Fraxinus pennsylvanica**	C	FACW-	9		
2 **Salix nigra**	C	FAC	10		
3 **Fraxinus pennsylvanica**	S/S	FACW-	11		
4 **Acer negundo**	S/S	FACW-	12		
5 **Cardiospermum halicacabum**	H	FAC	13		
6 **Iva annua**	H	FAC	14		
7 **Ambrosia trifida**	H	FAC	15		
8			16		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) **100%**

Remarks

The site is located within a depressional area, south of the current North Sulphur River channel.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)
- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☒ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	--	(in)
Depth to Free Water in Pit	--	(in)
Depth to Saturated Soil	>16"	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☒ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):
- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks

The vegetation passed the FAC-Neutral test with a 3 (wet) : 0 (non-wet) ratio. The Soil Survey of Fannin County indicates that the depth to high water table is greater than six feet for the mapped soil type. Water marks were observed along the base of the trunks to two inches.

SOILS

Map Unit Name (Series and Phase): **Tinn clay, occasionally flooded**	Drainage Class: **Moderately Well Drained**
Taxonomy (Subgroup) **Fine, smectitic, thermic Typic Hapluderts**	Field Observations Confirm Mapped Type? YES ☑ NO ☐

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16"	**A-Bss1**	**10YR 2/1**	**--**	**--**	**clay**

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☒ Other (Explain in Remarks)

Remarks:

The soil matched the given range for the mapped soil type. The low-chroma color observed is a characteristic of the mapped soil type; therefore, this area should be considered a problem area. Since the vegetation contains a dominance of FAC or wetter vegetation as well as a primary hydrology indicator, it is inferred that this site stays either saturated or inundated for sufficient duration to develop hydric soil conditions.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES ☑ NO ☐	Is this Sampling Point Within a Wetland? YES ☑ NO ☐
Wetland Hydrology Present?	YES ☑ NO ☐	
Hydric Soils Present?	YES ☑ NO ☐	

Remarks

Although this site located within a depressional area, south of the current North Sulphur River channel, should be considered a wetland, it is located outside of the 100-year floodplain as well as does not contain a hydrologic connection to the North Sulphur River or any of its tributaries. Therefore, it should not be considered jurisdictional.

APPENDIX E

SOIL SERIES DESCRIPTIONS

Descriptions of the Mapped Soil Units

(from the Texas NRCS and the United States Department of Agriculture,
Soil Conservation Service in cooperation with the
Texas Agricultural Experiment Station)

BENKLIN SERIES

The Benklin series consists of deep, somewhat poorly drained, moderately slow permeable soils. These soils are typically on the first terrace level of streams. They formed in loamy alluvial sediments. Slopes range from 0 to 1 percent.

TAXONOMIC CLASS: Fine-silty, mixed, thermic Aquic Argiudolls

TYPICAL PEDON: Benklin silt loam--idle cropland. (Colors are for moist soils unless otherwise
stated.)

Ap--0-6 inches, very dark grayish brown (10YR 3/2) silt loam, moderate medium granular structure; hard, friable; many fine roots; few worm channels; neutral; abrupt smooth boundary. (5 to 18 inches thick)

Bt1--6-18 inches, very dark brown (10YR 2/2) loam; moderate very fine and fine blocky structure; hard, friable; common fine roots; few fine pores; common wormcasts and channels; few patchy clay films; neutral; gradual smooth boundary. (6 to 17 inches thick)

Bt2--18-33 inches, very dark grayish brown (10YR 3/2) loam; common medium faint dark grayish brown (10YR 4/2) and brown (10YR 4/3) mottles; moderate fine and medium blocky structure; hard, friable; common fine roots; few fine pores; common wormcasts and channels; few black concretions 1 to 2 mm in diameter; many peds have dark brown (10YR 2/2) clay films; neutral; gradual smooth boundary. (8 to 32 inches thick)

Bt3--33-41 inches, dark grayish brown (10YR 4/2) clay loam; common medium faint brown (10YR 4/3) and yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure parting to moderate fine and medium blocky structure; hard, friable; few fine roots; common wormcasts and channels; few black concretions 1 to 2 mm in diameter; very dark grayish brown (10YR 3/2) clayflows on faces of prisms; mildly alkaline; gradual smooth boundary. (4 to 22 inches thick)

Bt4--41-63 inches, mottled yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) clay loam; few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium blocky structure; hard, friable; few fine roots; common black concretions 2 to 4 mm in diameter; few black nodules; dark grayish brown (10YR 4/2) clay flows on faces of prisms; mildly alkaline.

TYPE LOCATION: Delta County, Texas; from the intersection of Farm Roads 38 and 128 in Ben Franklin, Texas, 0.8 mile east on Farm Road 128, 1.0 mile east on county road, 0.6 mile north; and 300 yards west.

RANGE IN CHARACTERISTICS: Solum thickness is more than 60 inches. Thickness of the mollic epipedon is 20 to 45 inches. The control section has 18 to 32 percent clay and 20 to 40 percent sand with less than 15 percent sand coarser than very fine sand.

The A horizon is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), or very dark brown (10YR 2/2) loam or silt loam. Reaction ranges from medium acid to neutral.

The Bt1 horizon is very dark brown or very dark grayish brown loam, silty clay loam, or clay loam. Reaction is slightly acid or neutral.

The Bt2 and Bt3 horizons have hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. The texture is loam, silty clay loam, or clay loam. It contains few to many, faint or distinct mottles of dark grayish brown, grayish brown, brown, yellowish brown, dark yellowish brown, or strong brown. Reaction ranges from slightly acid to mildly alkaline.

The Bt4 horizon is loam, silty clay loam, or clay loam. It is typically mottled in shades of brown, yellow or red. Reaction ranges from neutral to moderately alkaline. Some pedons have a few pitted concretions of carbonate below a depth of 45 inches.

COMPETING SERIES: Competing series are the Armistead and Reelfoot in the same family and the similar Bonham, and Waskom series. Armistead soils have hues of 7.5YR or redder below the mollic epipedon. Bonham soils have a clayey control section. Reelfoot soils have a mollic epipedon 10 to 20 inches thick and have sola as thin as 30 inches. Waskom soils have a fine-loamy control section.

GEOGRAPHIC SETTING: Benklin soils are on nearly level to slightly concave terraces above overflow along major streams. Slope is 0 to 1 percent. Benklin soils formed in loamy alluvial sediments. The average annual precipitation ranges from 40 to 46 inches, the average annual temperature is about 63 degrees F., and the Thornthwaite P-E index is about 68.

GEOGRAPHICALLY ASSOCIATED SOILS: Associated soils are Caspiana, Kaufman, Muldrow, and Tinn series. Caspiana soils are well drained and do not have a water table in the upper 4 feet. Kaufman, Muldrow, and Tinn soils are more than 35 percent clay in the control section.

DRAINAGE AND PERMEABILITY: Benklin soils are somewhat poorly drained, have slow runoff, and have moderately slow permeability. The water table is within 24 inches of the soil surface for brief periods during the cool season in most years.

USE AND VEGETATION: Benklin soils are used mainly for growing cotton, grain sorghum, and soybeans. Many areas are in improved bermudagrass. Native vegetation is

a mixed forest of elm, hackberry, oak, osage orange and pecan with an understory of Virginia wildrye, sedges and long leaf uniola, in open areas eastern gama bluestems and panicums are common.

MLRA OFFICE RESPONSIBLE: Little Rock, Arkansas

DISTRIBUTION AND EXTENT: These soils are mainly in the northeastern part of Texas. They are of small extent. SERIES ESTABLISHED: Delta County, Texas; 1975.

BONHAM SERIES

The Bonham series consists of deep, moderately well drained, slowly permeable soils on uplands. They formed in alkaline clayey and loamy soil materials. Slopes range from 0 to 5 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Aquic Argiudolls

TYPICAL PEDON: Bonham silt loam--on a 2 percent convex north-facing slope in a native pasture.

A--0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and fine granular structure; hard, friable; many fine roots; many fine pores; slightly acid; clear smooth boundary. (7 to 12 inches thick)

Bt1--10 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; few fine faint brown mottles; moderate medium and fine subangular blocky structure; very hard, firm; many fine roots; many fine pores; few patchy clay films; medium acid; gradual wavy boundary. (5 to 10 inches thick)

Bt2--17 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; many fine prominent reddish brown (5YR 4/4) mottles and many fine distinct strong brown (7.5YR 5/6) mottles; moderate coarse prismatic structure parting to moderate fine and medium blocky; very hard, firm, sticky and plastic; common fine roots; common very fine pores; nearly continuous clay films on surface of prisms; medium acid; gradual wavy boundary. (10 to 20 inches thick)

Bt3--30 to 42 inches; mottled light olive brown (2.5YR 5/4) and yellowish brown (10YR 5/6) silty clay; moderate coarse prismatic structure parting to moderate fine blocky; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; continuous clay films on surface of prisms; few fine black concretions; slightly acid; gradual wavy boundary. (8 to 15 inches thick)

Bt4--42 to 56 inches; olive brown (2.5Y 4/4) silty clay, light olive brown (2.5Y 5/4) dry; few fine and medium faint yellowish brown (10YR 5/4) and pale yellow (10YR 7/4) mottles; weak coarse prismatic structure parting to moderate coarse blocky; extremely

hard, very firm, sticky and plastic; few fine roots; few very fine pores; few patchy clay films; few fine black concretions; neutral; gradual wavy boundary. (0 to 15 inches thick)

BC--56 to 65 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; common fine and medium faint gray (10YR 5/1) mottles, and common medium distinct dark yellowish brown (10YR 4/4), and strong brown (7.5YR 5/6) mottles; weak coarse blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few fine black concretions; few fine pitted calcium carbonate concretions; mildly alkaline; gradual wavy boundary. (6 to 15 inches thick)

C--65 to 80 inches; light olive gray (5Y 6/2) silty clay, light gray (5Y 7/2) dry, common fine and medium distinct yellow (10YR 7/6) mottles; massive; extremely hard, very firm, sticky and plastic; few very fine pores; few fine and medium black concretions; few fine pitted calcium carbonate concretions; noncalcareous; moderately alkaline.

TYPE LOCATION: Fannin County, Texas; from junction of Highways 82 and 78 in Bonham, 1.4 miles west on Highway 82; 0.7 mile south on Highway 121; 130 feet east of right-of-way in native pasture.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 60 to 80 inches. The mollic epipedon is 12 to 20 inches thick and includes the Bt1 horizon in most pedons. COLE ranges from 0.05 to 0.09 in the argillic horizon but lacks a layer 20 inches or more thick with COLE of 0.09, and the PLE is less than 2.4 inches in upper 50 inches of the solum.

The A horizon has hue of 10YR or 7.5YR, value and chroma of 2 or 3. Texture is silt loam or loam. Reaction ranges from medium acid to neutral.

The Bt1 horizon has hue of 10YR or 7.5YR, value and chroma of 2 or 3. Texture is clay loam, silty clay loam or silt loam. Reaction ranges from strongly acid to slightly acid.

The Bt2 horizon has hue of 7.5YR, 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. Reddish or brownish mottles range from few to many. Texture is clay, silty clay, or silty clay loam, with clay content of 35 to 50 percent. Reaction ranges from medium acid to neutral.

The Bt3 and Bt4 horizons have colors in shades of brown, red, yellow or olive with hue of 5YR to 5Y, value of 4 or 5, and chroma of 2 to 6. Texture is clay, silty clay or silty clay loam. Reaction ranges from slightly acid to mildly alkaline.

The BC horizon has colors in shades of brown, yellow and olive with or without mottles of these or grayish colors. Texture is silty clay loam or silty clay. Pitted calcium carbonate concretions range from none to a few. Reaction is mildly alkaline or moderately alkaline.

The C horizon has colors in shades of brown, gray, olive or yellow with mottles or strata of these colors. Texture is silty clay loam, silty clay or clay. Some pedons are interbedded with shaly clay. Some pedons contain a few pitted concretions of calcium carbonate. Reaction is mildly alkaline or moderately alkaline.

COMPETING SERIES: There are no other series in this family. Similar soils are the Apperson, Benchley, Blum, Durant, Eram, Garton, Kenoma, Parisian, and Summit series. The Apperson, Benchley, Durant, Kenoma, Parisian and Summit soils are members of a Vertic subgroup. Also, Apperson soils have bedrock at a depth of 40 to 60 inches. Benchley and Durant soils are in an ustic moisture regime. The Blum, Eram and Garton soils have mixed clay mineralogy. Also, Blum soils are in an ustic moisture regime.

GEOGRAPHIC SETTING: Bonham soils are on nearly level to gently sloping uplands. The slope gradient is typically 1 to 3 percent, but ranges from 0 to 5 percent. The soils formed in alkaline clayey and loamy sediments. Some pedons are interbedded with shaly materials. The annual temperature ranges from 63 to 66 degrees F., mean annual precipitation ranges from 34 to 44 inches, and Thornthwaite P-E indices range from 56 to 70.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Crockett, Normangee, and Wilson soils and to a lesser extent the Heiden, Lamar and Lewisville soils. Crockett, Normangee and Wilson soils lack a mollic epipedon and are classified in a Vertic subgroup. These soils are on positions similar to the Bonham series. Lamar and Lewisville soils lack argillic horizons and occur on sloping to steep sideslopes. In addition, Lamar soils lack a mollic epipedon. Heiden soils are clayey throughout and are typically on lower sideslopes.

DRAINAGE AND PERMEABILITY: Moderately well drained. Runoff is slow or medium. Permeability is slow.

USE AND VEGETATION: Mainly used for growing wheat, sorghum and improved pastures. Native vegetation is prairie grasses such as bluestems, switchgrass, indiangrass, and eastern gama, with scattered post oak, bois-d'arc, elm, and hackberry trees.

DISTRIBUTION AND EXTENT: Mainly in the Blackland Prairies of Texas and Cherokee Prairies of Oklahoma. This series is of moderate extent.

BURLESON SERIES

The Burleson series consists of very deep, moderately well drained, very slowly permeable soils that formed in alkaline clayey sediments. These soils are on nearly level to gently sloping Pleistocene terraces. Slopes range from 0 to 5 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Udic Haplusterts

TYPICAL PEDON: Burleson clay--native pasture; in a pit midway between center of microdepression and microknoll. (Colors are for moist soil unless otherwise stated).

A1--0 to 6 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate very fine angular blocky; very hard, very firm, very sticky and very plastic; many fine roots; cracks from 1/2 to 1 1/2 inches wide extend through the horizon; few snail shell fragments; few fine siliceous pebbles; slightly alkaline; gradual smooth boundary. (4 to 12 inches thick)

A2--6 to 12 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium angular blocky structure parting to moderate very fine angular blocky; very hard, very firm, very sticky and very plastic; many fine roots; cracks from 1/2 to 1 1/2 inches wide extend through the horizon; common distinct pressure faces; few fine siliceous pebbles; slightly alkaline. (0 to 12 inches thick)

Bss1--12 to 24 inches; very dark gray (10YR 3/1) clay; moderate medium and coarse angular blocky structure; few wedge-shaped peds: very hard, very firm, very sticky and very plastic; few fine roots; many large grooved slickensides tilted from horizontal 30 to 60 degrees; few fine siliceous pebbles; few fine iron-manganese concretions and masses; moderately alkaline; gradual wavy boundary. (8 to 30 inches thick)

Bss2--24 to 39 inches; very dark gray (10YR 3/1) clay; moderate medium and coarse angular blocky structure; common wedge-shaped peds: very hard, very firm, very sticky and very plastic; few fine roots; cracks from 1/2 to 1 inch wide extend through the horizon; many large grooved slickensides tilted from horizontal 30 to 60 degrees; few fine iron-manganese concretions and masses; few fine concretions and masses of calcium carbonate; few fine siliceous pebbles; very slightly effervescent; moderately alkaline; gradual wavy boundary. (8 to 30 inches thick)

Bss3--39 to 51 inches; dark gray (10YR 4/1) clay; few fine and medium streaks and spots of pink (5YR 7/4); moderate medium and coarse angular blocky structure; many wedge-shaped peds; very hard, very firm, very sticky and very plastic; few fine roots; many large grooved slickensides tilted from horizontal 30 to 60 degrees; few fine iron-manganese concretions and masses; few fine concretions of calcium carbonate; few fine siliceous pebbles; slightly effervescent; moderately alkaline; clear irregular boundary. (0 to 20 inches thick)

Bss4--51 to 76 inches; dark gray (10YR 4/1) clay; common reddish brown (5YR 4/3) streaks and spots of; moderate medium and coarse angular blocky structure; common wedge- shaped peds; very hard, very firm, very sticky and very plastic; few fine roots; many large grooved slickensides tilted from horizontal 30 to 60 degrees; few very dark gray crack fillings; few iron-manganese concretions; few concretions and masses of calcium carbonate; slightly effervescent; moderately alkaline. (0 to 36 inches thick)

2BCkss--76 to 80 inches; yellowish red (5YR 4/6) silty clay; few streaks of light gray (10YR 6/1); moderate coarse angular blocky structure; common wedge shaped peds; very

hard, very firm, very sticky and very plastic; few fine roots; many large grooved slickensides tilted from horizontal 30 to 60 degrees; few dark gray crack fillings; common concretions and masses of calcium carbonate; strongly effervescent; moderately alkaline.

TYPE LOCATION: Burleson County, Texas; from intersection of Farm Road 2155 and Farm Road 60 in northwest edge of Snook, Texas; 0.7 mile southwest on Farm Road 60; 220 feet south in native pasture. (Latitude: 30 degrees, 29 minutes, 18 seconds north; Longitude: 96 degrees, 28 minutes, 50 seconds west)

RANGE IN CHARACTERISTICS: The solum is 60 to more than 80 inches thick. The control section has 40 to 60 percent clay and more than 28 percent silt. Iron-manganese concretions and masses range from none to few throughout. This is a cyclic soil and undisturbed areas have gilgai microrelief with microknolls 6 to about 12 inches higher than microdepressions. Distance between the center of the microknoll and the center of the microdepression is about 5 to 15 feet. The microknoll makes up about 20 percent, the intermediate, or area between the knoll and depression, about 50 percent, and the microdepression about 30 percent. When dry, cracks 1 to 3 inches wide extend from the surface to a depth of 40 inches or more. The cracks remain open for 90 to 150 cumulative days during most years. Slickensides begin at a depth of 8 to 24 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or less. Texture is clay, silty clay, or gravelly clay. Some pedons have loamy Ap horizons containing more than 35 percent clay. Gravelly layers are less than 20 inches thick and contain 15 to 35 percent siliceous pebbles. Reaction ranges from moderately acid to slightly alkaline. However, on microknolls some pedons are moderately alkaline.

The upper Bss horizons have hue of 10YR, value of 2 to 4 and chroma of 1 or less. Texture is silty clay or clay. Redoximorphic features range from none to few in shades of brown or gray. Siliceous pebbles range from none to few. Hard pitted concretions of calcium carbonate range from none to few. Reaction ranges from moderately acid to moderately alkaline and typically is noneffervescent.

The lower Bss or Bkss horizons have hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. Matrix chroma of 2 are below a depth of 40 inches, if encountered. Redoximorphic features in shades of yellow, brown, or gray range from none to common. Streaks or spots in shades of pink or red range from none to common. Texture is silty clay or clay. Siliceous pebbles range from none to about 5 percent. Reaction is slightly alkaline or moderately alkaline. It ranges from noneffervescent to strongly effervescent. Concretions and masses of calcium carbonate range from none to common.

The 2BCkss horizon, or 2CBkss horizon where present, has colors in shades of red, yellow, pink, or brown. Texture is clay loam, silty clay loam, or silty clay. Siliceous pebbles range from none to about 5 percent. Concretions and masses of calcium carbonate range from few to many. The reaction is moderately alkaline and effervescence ranges from slight to violent. The 2C horizon is not present in all pedons. It is mainly in

soils on the Brazos River terrace. Burleson soils on other terrace systems commonly have colors in shades of gray or brown. Texture is typically clay. Some pedons have sandy or loamy textures with or without strata of gravel below a depth of 80 inches and most pedons have these materials below a depth of 12 feet.

COMPETING SERIES: These include the Bleiblerville, Branyon, Clarita, Dimebox, Ellis, Fairlie, Heiden, Houston Black, Leson, Luling, Ovan, Sanger, Slidell, Tamford, and Watonga series. Bleiblerville, Heiden, Houston Black, and Sanger soils are calcareous throughout, and have more amplitude of waviness. Branyon and Slidell soils are calcareous at depths of less than 12 inches in over half the pedon. Clarita soils have subsoils in hue of 7.5YR or redder. Ellis soils have sola less than 60 inches. Fairlie soils have a paralithic contact with chalk at a depth of 40 to 60 inches. Dimebox soils contain ironstone fragments in the surface layer, have more amplitude of waviness, and are on uplands. Leson soils have more amplitude of waviness and typically have chroma of 2 or more within 40 inches of the surface. Luling soils have chroma of 2 throughout and are on uplands. Ovan soils have chroma of 2 throughout and are on flood plains. Tamford soils have red or reddish brown C horizons and have mean annual temperature less than 65 degrees F. Watonga soils have sola less than 60 inches thick and are on flood plains.

GEOGRAPHIC SETTING: Burleson soils are on stream terraces and Pleistocene Age terraces. These are associated mainly with upland soils. Slope gradients are mainly less than 2 percent, but range to 5 percent. The soil formed in alkaline, clayey, alluvial sediments. Mean annual precipitation ranges from 32 to 40 inches, and mean annual temperature ranges from about 65 to 70 degrees F. Frost free days range from 220 to 270, and elevation ranges from 300 to 800 feet. Thornthwaite annual P-E indices range from 48 to 68.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Heiden, Houston Black and Leson series and the Kaufman, Ships, and Wilson series. Kaufman and Ships soils have very-fine control sections, and Ships soils have hue redder than 10YR. Heiden, Houston Black, and Leson soils are on slightly higher uplands. Kaufman and Ships soils are on slightly lower flood plains. Wilson soils have argillic horizons, and are on similar positions.

DRAINAGE AND PERMEABILITY: Moderately well drained. Very slow permeability. Runoff is low on 0 to 1 percent slopes, medium on 1 to 3 percent slopes, and high on 3 to 5 percent slopes. Water enters the soil rapidly when it is dry and cracked, and very slowly when it is moist.

USE AND VEGETATION: Cultivated crops are mainly cotton, sorghum, corn and small grains. Areas in native rangeland produce little bluestem, big bluestem, Indiangrass, eastern gamma, and switchgrass in excellent condition. Pasture grasses include improved bermudagrass, common bermudagrass, and kleingrass.

DISTRIBUTION AND EXTENT: The Blackland Prairies of Texas (MLRA 86A and 86B). The series is extensive.

CROCKETT SERIES

The Crockett series consists of soils that are deep to weathered shale. They are moderately well drained, and very slowly permeable. These soils are on uplands. These nearly level to moderately sloping soils formed in alkaline residuum derived from shales and clays. Slopes are dominantly 1 to 5 percent, but range from 0 to 10 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Udertic Paleustalfs

TYPICAL PEDON: Crockett fine sandy loam--cropland. (Colors are for dry soil unless otherwise stated).

Ap--0 to 8 inches; dark brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; massive; very hard, friable; few wormcasts; moderately acid; abrupt wavy boundary. (4 to 15 inches thick)

Bt1--8 to 16 inches; distinctly and coarsely mottled reddish brown (5YR 4/4) and dark brown (10YR 4/3) clay, moderate fine and medium angular blocky structure; extremely hard, very firm; few fine pores; distinct clay films and dark grayish brown stains on surfaces of peds, few fine pressure faces; vertical cracks partially filled with darker soil; few fine black iron-manganese concretions; few fine and medium prominent dark red (10R 3/6) masses of iron accumulation; moderately acid; diffuse wavy boundary.

Bt2--16 to 30 inches; olive (5Y 5/4) clay, moderate medium and coarse angular blocky structure; extremely hard, very firm; few fine pores; thin clay films on surfaces of peds, few fine pressure faces; few small slickensides; few vertical streaks of dark brown soil that is less clayey; few fine black iron-manganese concretions; common medium and coarse distinct reddish brown (5YR 4/4), and yellow (10YR 7/6) masses of iron accumulation, common medium and coarse distinct grayish brown (10YR 5/2) iron depletions; slightly acid; gradual wavy boundary.

Bt3--30 to 42 inches; pale olive (5Y 6/4) clay, olive (5Y 5/4) moist; weak coarse angular blocky structure; extremely hard, very firm; thin patchy clay films; few fine pressure faces; few small slickensides; few fine black concretions; few black streaks or stains on faces of peds; common medium distinct pale yellow (5Y 7/4) masses of iron accumulation, and common medium distinct light brownish gray (2.5Y 6/2) iron depletions; neutral; gradual wavy boundary. (combined thickness of Bt horizons is 14 t 45 inches)

BCtk--42 to 57 inches; distinctly and coarsely mottled light brownish gray (2.5Y 6/2) and pale olive (5Y 6/4) clay; weak coarse angular blocky structure; extremely hard, very firm; few thin clay films on surfaces of peds; few pressure faces and cleavage planes; few calcium carbonate concretions; few masses of calcium carbonate to 1/2-inch in diameter;

few fine black iron-manganese concretions; few black streaks along pressure faces and cleavage planes; slightly alkaline; abrupt smooth boundary. (10 to 30 inches thick)

Ck1--57 to 73 inches; pale yellow (2.5Y 7/4) stratified clay loam, light yellowish brown (2.5Y 6/4) moist; massive; extremely hard and very firm in place, friable when broken; 25 percent of weakly cemented, brittle weathered shale fragments; 20 percent white calcium carbonate masses and concretions; common medium distinct dark yellowish brown (10YR 4/4) masses of iron accumulations, mainly along fractures of weathered shale; violently effervescent; moderately alkaline; diffuse smooth boundary. (0 to 30 inches thick)

Ck2--73 to 80 inches; pale yellow (2.5Y 7/4) clay loam containing about 40 percent interbedded weakly consolidated shale in layers of 1/2 to about 2 inches, shale is light olive brown (2.5Y 5/4) in lower part; massive; extremely hard, very firm in place, friable when broken; 10 percent masses of calcium carbonate in the upper part grading to none in the lower part; soil matrix is violently effervescent in spots and shale is noncalcareous; moderately alkaline.

TYPE LOCATION: Kaufman County, Texas; 250 feet east of Farm Road 986; 1.5 miles north of post office in Terrell.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 60 inches. Depth to secondary carbonates ranges from 30 to 60 inches. Some pedons do not have visible carbonates. When dry, cracks 1/2 to about 2 inches wide extend from the top of the Bt horizon to depths of 2 to 5 feet. If the A horizon is eroded or thin, the soil cracks to the surface. Pressure faces and slickensides range from few to common throughout the Bt horizon and in the BC and C horizon of some pedons. The average clay content of the control section ranges from 40 to 50 percent, and COLE ranges from 0.07 to 0.10.

The thickness of the A horizon averages less than 10 inches in 50 percent or more of the pedon but ranges up to 15 inches in subsoil troughs. It has colors with hue of 7.5YR or 10YR, value of 3 to 6, and chroma of 2 to 4. Texture is fine sandy loam, very fine sandy loam, loam, silt loam or their gravelly counterparts. Siliceous pebbles range from 0 to 35 percent by volume. Reaction ranges from moderately acid to slightly alkaline. The boundary between the A and Bt horizon is commonly wavy. It is abrupt over subsoil crests and clear in subsoil troughs with an abrupt textural between the A and Bt horizons.

The Bt horizon has a base saturation of 75 to 100 percent by sum of the cations. The dominant color, degree, and distinctness of redoximorphic features in the Bt1 horizon may be extremely variable within a distance of a few feet. It ranges from prominently mottled in shades of brown, yellow, red and olive, to a matrix of reddish brown, dark yellowish brown, or brown, with few to common redoximorphic features as described in the mottled matrix. Texture of the Bt horizon is clay loam, clay, or sandy clay. Siliceous pebbles range from 0 to 15 percent by volume. Reaction of the Bt1 horizon ranges from moderately acid to neutral.

The Bt2 and lower Bt horizons have colors in shades of brown, olive, and yellow with or without reddish redoximorphic features. The reddish features decrease with depth and range from none to a few below the Bt2 horizon. Gray iron depletions range from none to common below the Bt2 horizon. Reaction ranges from slightly acid to moderately alkaline and is typically noncalcareous.

The BCtk horizon has matrix colors in shades of brown, olive, gray, yellow or the matrix is mottled with these colors or there are redoximorphic features, strata or fragments with these colors. Texture of the BCk is clay loam, or clay with or without weathered shale fragments, pockets of loamy materials, or strata of these materials interbedded.

The Ck is in shades of brown, olive or gray. It is mainly shale or clayey siltstone stratified with soil material ranging from loam to clay. Silt and clay dominate the shale materials. Siliceous pebbles range from none to about 5 percent by volume. Reaction ranges from slightly acid to moderately alkaline but typically is slightly or moderately alkaline. Masses and concretions of calcium carbonate range from none to many.

COMPETING SERIES: These are the Axtell, Bremond, Crosstell, Kurten, Navo, Tabor, and Zulch series. Similar soils are the Normangee and Ponder series. Axtell, Kurten and Tabor soils are strongly acid in the Bt1 horizon and have base saturation of less 75 percent. Bremond soils have sola more than 60 inches thick. Crosstell and Kurten soils have hue of 7.5YR or redder in the upper part of the Bt horizon. Navo soils do not have an abrupt textural change between the A and B horizons. In addition, Axtell, Navo, and Tabor soils also have sola from 60 to greater than 80 inches. Zulch soils have sola 20 to 40 inches thick. Normangee soils do not have an abrupt textural change between the A and Bt horizons. Ponder soils do not have redoximorphic features in the upper part of the Bt horizon.

GEOGRAPHIC SETTING: Crockett soils are on broad nearly level to moderately sloping uplands. Slopes range from 0 to 10 percent, but are mostly between 1 and 5 percent. The soil formed in residuum derived from weathered alkaline marine clays, sandy clays, or shale, interbedded with sandier materials, mainly of Cretaceous age. Mean annual temperatures ranges from 64 to 70 degrees F., and mean annual precipitation ranges from 32 to 45 inches. Frost free days range from 230 to 275 days, and elevation ranges from 200 to 800 feet. Thornthwaite P- E indices ranges from 50 to 75.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the Axtell, Bonham, Burleson, Mabank, Normangee, Payne and Wilson series. Bonham soils have mollic epipedons and have sola greater than 60 inches. Burleson soils are clays throughout with slickensides. Mabank and Wilson soils are dominated by chromas or 2 or less. Axtell, Bonham, Normangee, and Payne soils are on similar landscapes with Crockett soils. Burleson, Mabank, and Wilson soils are on lower positions.

DRAINAGE AND PERMEABILITY: Moderately well drained. Permeability is very slow. Runoff is low on slopes less than 1 percent, medium on 1 to 3 percent slopes, high on 3 to 5 percent slopes, and very high on 5 to 10 percent slopes.

USE AND VEGETATION: Mainly used for growing cotton, grain sorghums, and small grain, but more than half the acreage is now in pastures. Native vegetation is prairie grasses such as bluestems, indiangrass, switchgrass, and gramas, with scattered elm, hackberry, and mesquite trees.

DISTRIBUTION AND EXTENT: Mainly in the Blackland Prairies of Texas (MLRA 86A, 86B, 87A) but minor areas are in Oklahoma. The series is extensive.

FERRIS SERIES

The Ferris series consists of soils that are deep to weathered shale. They are well drained, very slowly permeable soils that formed from weakly consolidated calcareous dense clays and shales. These soils are on sloping or moderately steep uplands. Slopes range from 1 to 20 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Chromic Udic Haplusterts

TYPICAL PEDON: Ferris clay--pasture. Pedon described above is an equal distance between its deep and shallow extremes. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 8 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; weak medium and fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; surface has a mulch about 1/2 inch thick of fine extremely hard discrete aggregates; many fine roots; few fine calcium carbonate concretions; strongly effervescent; moderately alkaline; gradual smooth boundary. (3 to 12 inches thick)

Bw--8 to 24 inches; pale olive (5Y 6/3) clay; olive (5Y 5/3) moist; moderate fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; common shiny pressure faces; few fine calcium carbonate concretions and masses; strongly effervescent; moderately alkaline. (6 to 20 inches thick)

Bss--24 to 40 inches; pale olive (5Y 6/3) clay; olive (5Y 5/3) moist; common fine faint brownish yellow mottles; moderate fine angular blocky structure forming wedge shaped peds having long axes tilted up to 45 degrees from the horizontal; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; common coarse slickensides; pressure faces are shiny; vertical cracks 1 to 5 cm wide and 18 inches apart extend to 40 inches; few fine calcium carbonate concretions and few fine powdery masses of calcium carbonate; violently effervescent; moderately alkaline; diffuse wavy boundary. (18 to 30 inches thick)

Ck--40 to 80 inches; coarsely and prominently mottled pale olive (5Y 6/3) and yellow (2.5Y 7/8) weakly consolidated shale that has clay texture; weak coarse angular blocky structure mixed with coarse blocky rock (shale) structure; extremely hard, very firm; few fine roots between blocks of rock structure; few slickensides; common fine masses and concretions of calcium carbonate; violently effervescent; moderately alkaline.

TYPE LOCATION: Navarro County, Texas; about 15 miles west of Corsicana on Texas Highway 22; from the northeast part of Blooming Grove, 3.3 miles northward on a county road; then 190 feet east in a pasture. This location is 1.2 miles north-northwest of FP site 105B.

RANGE IN CHARACTERISTICS: The solum ranges from 40 to 60 inches thick. Texture is clay or silty clay, with clay content ranging from 40 to 60 percent. Water worn siliceous pebbles are on the surface of some pedons. When dry, cracks 1/2 to 3 inches wide extend from the surface to a depth of more than 12 inches. Cracks remain open 120 to 150 cumulative days in most years. Calcium carbonate equivalent in the control section ranges from 2 to about 30 percent.

The A horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 4. The lower values and chromas occur where A horizons are thickest in the pedon. In pedons where the moist color value of the A horizon is less than 3.5, the horizon is less than 12 inches thick.

The Bw and Bss horizons have hue of 10YR to 5Y, value of 4 to 7, and chroma of 2 to 6. Some pedons do not have mottles in the upper part of the Bw. Gray mottles are inherited from the shale (lithochromic). Calcium carbonate concretions range from few to many in the Bw and Bss horizons, with total carbonates ranging from 2 to 30 percent.

The C horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 to 8. Most pedons are coarsely and prominently mottled. It is strongly weathered calcareous clay, weakly consolidated shale that has clay texture or shales. Gypsum crystals occur in the Ck horizon of some pedons.

COMPETING SERIES: These are the Depalt, Deport, Frelsburg, Latium, and Medlin series. Similar soils are the Ellis and Heiden series. Depalt and Deport soils are non calcareous in the surface layer and, in addition, Depalt soils have dominant hue of 7.5YR or redder, and Deport soils have chroma of less than 2 in the surface horizon. Frelsburg soils have sola 60 to 80 inches thick, and formed in Tertiary Age materials. Latium soils are in slightly more moist climates and have cracks that remain open for longer periods (120 to 150 days). In addition, Latium soils are on Tertiary Age materials. Medlin soils have more than 30 percent calcium carbonate equivalent, and are dry for longer periods of time. Ellis soils have sola 20 to 40 inches thick. Heiden soils have moist color value of 3.5 or less and chroma of 2.5 or less in the upper 12 inches in most pedons.

GEOGRAPHIC SETTING: Ferris soils are on uplands. The surfaces are convex to plane with slope gradients mostly between 5 and 12 percent, but ranging from 1 to 20 percent. Uncultivated areas often have narrow microridges and microvalleys that extend up and down the slope. The soil formed in weakly consolidated mostly Upper Cretaceous formations of calcareous marine sediments, high in montmorillonitic clays. Mean annual precipitation ranges from 28 to 42 inches, and mean annual temperature ranges from 64 to 70 degrees F. Frost free days range from 230 to 260 days and elevation ranges from 400 to 1,000 feet. The Thornthwaite P-E index is 44 to 66.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the similar Ellis and Heiden series and the Altoga, Houston Black, Lamar and McLennan series. Altoga, Lamar and McLennan soils have fine-silty control sections and are on similar positions. Houston Black soils have moist value of less than 3.5 and chroma of less than 1.5 throughout the upper 12 inches. Altoga, Ellis, and Lamar soils are on similar positions with Ferris. Heiden and Houston Black soils are on smoother slightly higher positions.

DRAINAGE AND PERMEABILITY: Well drained. Permeability is very slow. Runoff is medium on 1 to 3 percent slopes, high on 3 to 5 percent slopes, and very high on slopes greater than 5 percent. Infiltration is rapid when the soil is dry and cracked, but very slow when the soil is wet.

USE AND VEGETATION: Used mainly for pasture and production of hay. Most areas have been cultivated, eroded and are now in grass. Vegetation is mainly bluestems, buffalograss and threeawn grasses and scattered mesquite trees.

DISTRIBUTION AND EXTENT: Central and eastern Texas Blacklands (MLRA 86A). The series is of large extent, comprising more than 100,000 acres.

HEIDEN SERIES

The Heiden series consists of soils that are well drained and very slowly permeable. They are deep to weathered shale. These soils are on nearly level to moderately steep uplands. Slopes are mainly 3 to 8 percent but range from 0.5 to 20 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Udic Haplusterts

TYPICAL PEDON: Heiden clay--cropland. Pedon described near its deepest part. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 6 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; weak angular blocky structure; very hard, very firm, very sticky and very plastic; many fine roots; few wormcasts; few fragments of snail shells; strongly effervescent; moderately alkaline; abrupt boundary. (4 to 8 inches thick)

A--6 to 18 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine angular blocky structure; few wedge shaped peds in lower part; extremely hard, very firm ,very sticky and very plastic; few fine roots; shiny faces on peds; strongly effervescent; moderately alkaline; diffuse wavy boundary. (8 to 22 inches thick)

Bssk1--18 to 36 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse angular blocky structure, wedge shaped peds are about 1 to 3 inches long and axis tilted 10 to 60 degrees from the horizontal; extremely hard, very firm, very sticky and very plastic; many slickensides; common fine calcium carbonate concretions; strongly effervescent; moderately alkaline; diffuse wavy boundary. (0 to 20 inches thick)

Bssk2--36 to 58 inches; olive gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; few fine faint olive mottles and streaks; weak coarse angular blocky structure, wedge shaped peds are about 1 to 3 inches long and axis tilted 10 to 60 degrees from the horizontal; extremely hard, very firm, very sticky and very plastic; many distinct slickensides; common fine calcium carbonate concretions; violently effervescent; moderately alkaline; diffuse wavy boundary. (12 to 40 inches thick)

C--58 to 70 inches; prominently and coarsely mottled olive (5Y 5/3) moist; and yellow (5Y 7/6) moist, clay and weakly consolidated shale; few fine olive and yellow mottles; massive, with a few slickensides in the upper part; extremely hard, very firm and very plastic; violently effervescent; moderately alkaline.

TYPE LOCATION: Bell County, Texas; From the intersection of Texas Highway 36 and Farm Road 436 in Heidenheimer; 0.57 miles southeast on Texas Highway 36; 1 5 feet southwest of fence in cropland.

RANGE IN CHARACTERISTICS: Solum thickness ranges from about 40 to 65 inches. They are thinnest in microknolls or microridges and thickest in centers of microdepressions or microvalleys. Texture throughout the soil is clay or silty clay Weighted average clay content ranges from 40 to 60 percent. Cracks remain open 90 to 150 cumulative days in most years. Slickensides and wedge-shaped peds begin at a depth of 10 to 24 inches. Undisturbed areas have gilgai microrelief with microknolls about 4 to 10 inches above microdepressions. On slopes above 5 percent gilgai are linear with slope.

The A horizons have hue of 10YR, 2.5Y or 5Y, value of 3 to 5, and chroma of 1 to 3. Moist color values range from 2 to slightly less than 3.5. Where chromas are less than 1.5, the surface layer is less than 12 inches thick in more than one-half of the pedon. The A horizons are dominantly calcareous, but range to noncalcareous and slightly alkaline in the upper 12 inches. Smooth siliceous pebbles or limestone fragments less than 10 inches across are on and in the surface layers of some pedons.

The Bss horizons have hue of 10YR, 2.5Y or 5Y; value of 4 to 7; and chroma of 2 to 4. They are typically mottled with these colors. Calcium carbonate in the form of masses,

threads and concretions range from none in the upper part to many in the lower part with total carbonates ranging from 2 to 35 percent. Gypsum crystals are in the lower part of some pedons.

The C horizon varies from clay, strongly weathered shale, to slightly weathered calcareous shales, with an intermingling of soil and rock structure.

COMPETING SERIES: These include the Bleiblerville, Branyon, Burleson, Clarita, Dimebox, Fairlie, Houston Black, Leson, Luling, Ovan, Sanger, Slidell, Tamford and Watonga. Bleiblerville, Branyon, Burleson, Dimebox, Fairlie, Houston Black, Leson and Slidell have moist chroma of 1 throughout. Clarita and Tamford soils have hue of 7.5YR or redder in the subsoil.. Fairlie soils are underlain by chalk below 40 inches. Burleson, Dimebox, Leson and Luling are non- calcareous in the surface. Sanger and Slidell soils contain more calcium carbonate in the control section and are underlain by marl. Watonga soils have mean temperature cooler than 64 degrees. Ovan soils have sola over 80 inches thick and are in flood plains.

GEOGRAPHIC SETTING: Heiden soils are on erosional uplands. Slopes are mostly 3 to 8 percent, but range from 0 percent to 20 percent. Surfaces are dominantly convex but plane surfaces occur in some areas of low gradients. Most untilled areas have a microrelief of microvalleys 4 to 12 feet wide and 3 to about 12 inches deep, and microridges about 4 to 12 feet wide that extend up and down slope. The soils formed, mainly, in weakly consolidated Upper Cretaceous formations of calcareous marine sediments, high in montmorillonite clays. The climate is moist subhumid. The mean annual precipitation ranges from 28 to 42 inches and the mean annual temperature ranges from 64 to 70 degrees F. Frost free days range from 225 to 275 days and elevation ranges form 400 to 1000 feet. Thornthwaite annual P-E indices range from 44 to 66.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Branyon, Burleson, Crockett, Ellis, Fairlie, Ferris, Houston Black, Lott, McLennan, Ovan and Wilson series. Crockett and Wilson soils have argillic horizons. Ferris Ellis and McLennan soils have color values higher than 3.5 in the upper 12 inches. Lott and McLennan soils have fine silty control sections. Ferris, Ellis, Lott and McLennan soils are on lower more sloping positions. Branyon, Burleson, Crockett, Wilson and Ovan are on lower positions. Houston Black is on similar positions. Fairlie and Lott soils are on slightly higher positions.

DRAINAGE AND PERMEABILITY: Well drained. Permeability is very slow. Runoff is low on 0 to 1 percent slopes, medium on 1 to 3 percent slopes, high on 3 to 5 percent slopes and very high on 5 to 20 percent slopes. Infiltration is rapid when the soil is dry and cracked, but very slow when the soil is wet.

USE AND VEGETATION: Used mainly for pasture and hay. Many areas have been cultivated but are now in grass. Some areas are used for growing grain sorghum and cotton. Grasses are mainly bluestem, buffalograss, and threeawn grass. Scattered mesquite trees occur in places.

DISTRIBUTION AND EXTENT: Central and eastern Texas in the Blackland MLRA (86A). The series is extensive.

HOPCO SERIES

The Hopco series consists of deep, somewhat poorly drained, moderately slowly permeable soils on flood plains. They formed in recent loamy alluvium. The slopes range from 0 to 2 percent.

TAXONOMIC CLASS: Fine-silty, mixed, active, thermic Cumulic Epiaquolls

TYPICAL PEDON: Hopco silty clay loam--pasture. (Colors are for moist soil unless otherwise stated.)

A1--0 to 16 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few medium faint very dark gray (10YR 3/1) mottles; moderate fine subangular blocky structure; hard, friable; sticky; many fine roots; few medium pores; moderately alkaline; clear wavy boundary. (10 to 18 inches thick)

A2--16 to 48 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; hard, friable; sticky; few fine roots; common fine pores; moderately alkaline; gradual boundary. (14 to 34 inches thick)

A3--48 to 60 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; common medium faint dark grayish brown (10YR 4/2) and few fine distinct yellowish brown mottles; moderate medium and coarse subangular blocky structure; very hard, firm; sticky; few fine roots; neutral; gradual boundary. (0 to 30 inches thick)

Bw--60 to 80 inches; olive brown (2.5Y 4/4) clay loam; common medium distinct gray (10YR 6/1) and dark grayish brown (10YR 4/2) and few fine faint olive yellow mottles; weak subangular blocky structure; very hard, firm; few black concretions; neutral.

TYPE LOCATION: Hopkins County, Texas; from Federal Building in Sulphur Springs; 1.1 miles north on Church Street; 9.2 miles northwest on Farm Road 2285; 2.1 miles west on Farm Road 71; 60 feet south of road ditch.

RANGE IN CHARACTERISTICS: Solum thickness is more than 80 inches. The control section averages from 25 to 35 percent clay with less than 15 percent fine sand and coarser materials. The reaction ranges from neutral to moderately alkaline and is noncalcareous throughout the control section.

The A horizon has colors with hue of 10YR or 2.5Y, value of 3, and chroma of 1 or 2. Grayish or brownish mottles range from few to common, and some are distinct or prominent in the lower part. Texture is silt loam, silty clay loam, or clay loam.

The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 4. Mottles in shades of gray, brown, or yellow range from few to common. There are a few pitted concretions of calcium carbonate in the lower part of some pedons.

COMPETING SERIES: These are the Lanton and Wynona series in the same family and the closely similar Balmorhea, Gowker, Gowton, Kanebreak, and Kossee series. Lanton soils have cooler temperatures and are poorly drained. Wynona soils are strongly acid to slightly acid throughout. Balmorhea soils are members of a calcareous class. Gowker, Gowton, Kanebreak, and Kossee soils have fine-loamy control sections.

GEOGRAPHIC SETTING: Hopco soils are on nearly level flood plains. The soils flood one to four times each year and are saturated for short periods. Slope gradients are dominantly less than 1 percent, but range to 2 percent. The soil formed in recent loamy alluvium. Average annual precipitation is about 40 inches at the type location, mean annual temperature is about 65 degrees F., and Thornthwaite P-E index is about 66.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Kaufman and Nahatche series. Kaufman soils have very fine-textured control sections with intersection slickensides. Nahatche soils lack mollic epipedons and have fine-loamy control sections. These soils are on flood plains. Kaufman soils are on slightly lower positions. Nahatche soils are on similar positions.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained; slow runoff; moderately slow permeability. These soils have an apparent water table at depths of 2 to 4 feet.

USE AND VEGETATION: Most areas are in pasture. Pastures are commonly in bermudagrass, dallisgrass, and fescue. Overstory vegetation includes pecan, black walnut, bois d'arc, water oak, and willow oak, and cottonwood.

DISTRIBUTION AND EXTENT: Mainly in northeast Texas. The series is of minor extent.

HOUSTON BLACK SERIES

The Houston Black series consists of very deep, moderately well drained, very slowly permeable soils that formed from weakly consolidated calcareous clays and marls of Cretaceous Age. These soils are on nearly level to moderately sloping uplands. Slopes are mainly 1 to 3 percent, but range from 0 to 8 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Udic Haplusterts

TYPICAL PEDON: At center of microdepression--pasture. (Colors are for dry soil unless otherwise stated.)

A1--0 to 8 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine subangular blocky and moderate medium granular structure; extremely hard, very firm, very sticky and plastic; many fine roots; common very fine pores; common medium wormcasts; few fragments of snail shells; many very fine shiny faces of peds; few fine black concretions; few fine calcium carbonate concretions; strong effervescence; moderately alkaline; clear wavy boundary. (6 to 12 inches thick)

A2--8 to 24 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and very fine angular blocky natural fragments that form wedge like shapes peds; extremely hard, very firm, very sticky and very plastic; common fine roots; common very fine pores; shiny surfaces on many fine and very fine natural soil fragments; few fine black concretions; few fine calcium carbonate concretions; strong effervescence; moderately alkaline; gradual wavy boundary. (0 to 20 inches thick)

Bss--24 to 38 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; strong coarse angular blocky natural fragments that form wedge shaped peds: extremely hard, very firm, very sticky and very plastic; few fine roots; common very fine pores; many intersecting slickensides shiny surfaces on many fine, medium, and coarse ped faces; few fine black concretions; few fine calcium carbonate concretions; strong effervescence; moderately alkaline; clear wavy boundary. (0 to 20 inches thick)

Bssk1--38 to 80 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; few medium distinct olive brown (2.5YR 4/4) and many coarse faint gray (10YR 5/1) mottles; strong coarse angular blocky natural fragments that form wedge shaped peds; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; many intersecting slickensides shiny surfaces on many fine, medium, and coarse ped faces; few fine dark gray vertical streaks; few fine black concretions and soft brown masses; few fine and medium calcium carbonate concretions and soft masses; violent effervescence; moderately alkaline; gradual wavy boundary. (10 to 50 inches thick)

Bssk2--80 to 104 inches; coarsely and distinctly mottled light olive brown (2.5Y 5/4) and gray (10YR 6/1) clay; common fine faint olive brown mottles; weak medium and coarse angular blocky natural fragments that form wedge shaped peds; very firm, very sticky and very plastic; few very fine roots and pores; many prominent slickensides; few fine soft brown masses; few medium soft masses of calcium carbonate; violent effervescence; moderately alkaline.

TYPE LOCATION: Travis County, Texas; from intersection of Farm Road 973 and U. S. Highway 290 in Manor, 3.5 miles east on U. S. Highway 290, 2.4 miles northeast on Farm Road 1100, 1.0 mile northwest and 3.0 miles northeast on Manda Road, 0.5 mile southeast on Lund Road, 900 feet southwest on field road, 105 feet east in pasture.

RANGE IN CHARACTERISTICS: Thickness of the combined A and B horizons is more than 80 inches. The weighted average clay content of the particle size control

section is 40 to 60 percent The soil is usually moist, but when dry it has cracks ranging from 0.5 to 4 inches wide extend from the surface to a depth of 12 inches or more Cracks remain open for 90 to 150 cumulative days in most years. Slickensides begin at depths ranging from about 16 to 24 inches below the soil surface. The soil is clayey throughout with dominant textures being clay or silty clay. Some pedons have 15 to 30 percent by volume of siliceous and other pebbles in the upper 12 inches. Dominant textures are clay or silty clay in the upper 12 inches. When dry the surface has a granular mulch about 1/2 inch thick of extremely hard discrete granules. Cycles of microdepressions and microknolls are repeated each 10 to 24 feet. In virgin areas, microknolls are 3 to 18 inches higher than microdepressions. Chromas are less than 1.5 to depths of 30 to 60 inches in the center of microdepressions and 10 to 18 inches in the center of microknolls. The extremes of amplitude or waviness of the boundary between the A and B horizons vary from about 20 to 48 inches from the center of the microknoll to the center of the microdepression.

The A horizons have hue of 10YR to 5Y, value of 2 to 4, and chroma of 0 or 1. Soil reaction is moderately alkaline and calcareous, however, in the center of the microdepressions, the reaction ranges from slightly alkaline to moderately alkaline.
The Bss horizon has hue of 10YR, value of 2 to 4 and chroma of 0 to 1. Chroma ranges to 2 in some pedons: The lower B horizons have hue of 10YR, 2.5Y or 5Y, value of 4 to 7, and chroma of 2 to 6. The grayish brown and dark grayish brown colors occur in microdepressions and grayish brown to olive or yellow colors occur in microknolls. In some pedons chroma ranges to 8 in microknolls.

The lower B or Bk horizon has olive, brown and yellow mottles or is olive to yellow with gray mottles. Calcium carbonate content in the form of masses, threads and concretions range from few to many with total carbonate content ranging from 2 to 35 percent.
Water worn gravel of chert and quartzite are on the surface or within the A and B horizons of some pedons. Few weakly cemented iron manganese oxide concretions ranging from 1 to 5 mm in diameter occur throughout the soil.

COMPETING SERIES: These are the Bleiblerville, Branyon, Burleson, Clarita, Dimebox, Fairlie, Heiden, Leson, Luling, Ovan, Sanger, Slidell, Tamford, and Watonga soils. Bleiblerville soils are formed on Tertiary age sediments. Branyon soils are on terraces and have less amplitude of waviness. Burleson and Leson soils on terraces and are non-calcareous in the surface layer. Clarita soils have hue of 7.5YR or redder in the subsoil.. Dimebox is non-calcareous in the surface. Fairlie soils have a paralithic contact with chalk at 40 to 60 inches. Heiden, Luling, Ovan and Sanger soils have matrix chroma of 2 or more throughout and Ovan soils are on flood plains. Slidell soils contain more calcium carbonate in the control section and are underlain by marl. Tamford soils have hue of 7.5YR or redder in the subsoil. Watonga soils have sola less than 60 inches thick and are in slightly cooler climates

GEOGRAPHIC SETTING: Houston Black soils are on nearly level to sloping uplands. Slopes range from 0 to 8 percent, but are mainly 1 to 3 percent. The soil formed in calcareous clays and marls mainly of the Taylor Marl geological formation. In places, the

substrata are chalks or shales. The climate is warm and subhumid. The mean annual precipitation ranges from 28 to 42 inches and the mean annual temperature ranges from 63 to 70 degrees F. Frost free days range from 220 to 250 days and elevation ranges from 400 to 1000 feet. Thornthwaite annual P-E indices range from 44 to 66.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Burleson, Branyon, Fairlie, Heiden and Ovan in the same family.and the similar Austin and Ferris soils. Burleson, Branyon and Ovan soils are on lower positions. Heiden soils are on similar landscapes with Houston Black. Austin soils are on slightly higher positions. Austin soils are underlain by chalk 20 to 40 inches dry, and prairie soils have chalk at 40 to 60 inches in depth. Ferris soils are on slightly sloping hillsides and have moist color values more than 3.5 and chroma more than 1.5 in the upper 12 inches.

DRAINAGE AND PERMEABILITY: Moderately well drained. Slow to rapid surface runoff. Water enters the soil rapidly when it is dry and cracked, and very slowly when it is moist. Permeability is very slow.

USE AND VEGETATION: Nearly all is cultivated and used for growing cotton, sorghums, and corn. Cotton root rot is prevalent on most areas and limits cotton yields and the use of some legumes in rotations. Native vegetation consists of tall and mid grass prairies of little bluestem, big bluestem, indiangrass, switchgrass, and sideoats grama, with scattered elm, mesquite, and hackberry trees.

DISTRIBUTION AND EXTENT: The Blackland Prairies and eastern part of the Grand Prairies of Texas. The series is extensive.

LAMAR SERIES

The Lamar series consists of very deep, well drained, moderately permeable soils developing from calcareous loamy sediments. These soils are on gently sloping to moderately steep uplands. Slopes range from 1 to 20 percent.

TAXONOMIC CLASS: Fine-silty, mixed, active, thermic Udic Haplustepts

TYPICAL PEDON: Lamar clay loam--pasture. (Colors are for dry soil unless otherwise stated.)

A--0 to 4 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky and granular structure; hard, friable; many fine roots; many fine pores; many wormcasts; calcareous; moderately alkaline; clear smooth boundary. (2 to 10 inches thick)

Bw--4 to 18 inches; light yellowish brown (2.5YR 6/4) clay loam, light olive brown (2.5YR 5/4) moist; moderate fine subangular blocky structure; hard, friable; common fine

roots; many fine pores; common wormcasts; few fine calcium carbonate concretions; calcareous; moderately alkaline; clear smooth boundary. (8 to 20 inches thick)

Bk--18 to 32 inches; olive yellow (2.5YR 6/6) clay loam, light olive brown (2.5Y 5/6) moist; moderate fine angular and subangular blocky structure; hard, firm; few fine roots; many fine pores; few wormcasts; common soft masses of calcium carbonate and fine calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary. (10 to 20 inches thick)

Ck--32 to 62 inches; brownish yellow (10YR 6/6) clay loam, yellowish brown (10YR 5/6) moist; massive, but with some horizontal cleavage planes; very hard, friable; few fine roots; many soft masses of calcium carbonate; calcareous; moderately alkaline.

TYPE LOCATION: Navarro County, Texas; from intersection of Farm Road 1603 and Interstate 45 about 7 miles north of Corsicana; 3 miles east to Tupelo; 3.5 miles south; 1450 feet east and 290 feet south of fence.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 20 to 50 inches. The A and B horizons range from neutral to moderately alkaline and calcareous or noncalcareous. Films, threads, and calcium carbonate concretions in the B and C horizons range from barely discernable to an estimated 20 percent by volume, but comprise less than 40 percent calcium carbonate equivalent.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. In some pedons the A horizon has moist values of less than 3.5 in the upper 7 inches. It is loam, clay loam, or silty clay loam.

The B and C horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. Some pedons have a few yellowish and brownish mottles. They are loam, clay loam, or silty clay loam. Less than 15 percent of the sand is coarser than very fine sand.

COMPETING SERIES: There are no series in the same family. Similar series are the Altoga, Aspermont, Cuthand, Enterprise, Karnes, Obaro, Shep, Throck, Venus, Weymouth, Wise, and Woodward series. Aspermont and Obaro soils are dry for longer periods and are redder than 10YR. Altoga and Karnes soils have more than 40 percent carbonates in some horizons and in addition, Altoga soils have more than 35 percent total clay in the control section. Enterprise and Woodward soils have less than 18 percent clay in the control section. Cuthand soils have less than 18 percent silicate clay in the control section and have carbonatic mineralogy. Shep, Venus and Weymouth soils have more than 15 percent material coarser than very fine sand in the control section, and in addition, Venus soils have mollic epipedons and the Weymouth soils are dry for longer periods. The Throck soils are more clayey and are dry for longer periods of time. The Wise soils have siliceous mineralogy.

GEOGRAPHIC SETTING: Gently sloping to moderately steep, rolling or hilly erosional uplands, mainly in breaks between level uplands and flood plains. Slope

gradients range from 1 to 20 percent but are mainly between 5 and 12 percent. The soil formed in calcareous, loamy, marine sediments of Cretaceous Age. Climate is moist subhumid. Mean annual precipitation ranges from 30 to 40 inches, mean annual temperature ranges from 64 to 67 degrees F., Frost free days range from 220 to 250 days and elevation ranges from 400 to 800 feet. Thornthwaite annual P-E indices range from 44 to 64.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the similar Altoga and Venus series, as well as the Crockett, Ferris, Heiden, Houston Black, Lewisville, and Wilson series. Crockett and Wilson soils have clayey Bt horizons. Ferris, Heiden, and Houston Black soils are clayey and have intersecting slickensides. Lewisville soils have mollic epipedons and more than 35 percent clay in the control section.

DRAINAGE AND PERMEABILITY: Well drained; medium to rapid runoff; moderate permeability.

USE AND VEGETATION: Mainly in pasture. Some of the less sloping areas are planted to cotton and grain sorghums. Most areas that have ever been cultivated are eroded. Original vegetation was mid and tall grass prairie.

DISTRIBUTION AND EXTENT: Blackland Prairies of Texas. The series is of moderate extent.

LESON SERIES

The Leson series consists of very deep, moderately well drained, very slowly permeable soils that formed in alkaline shales and clays. These soils are on nearly level or gently sloping uplands. Slopes range from 0 to 5 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Udic Haplusterts

TYPICAL PEDON: Leson clay--cropland. Midway between microhigh and microlow. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 10 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine angular blocky structure; on the surface there is a one-half inch layer that has moderate medium granular structure; extremely hard, very firm; common shiny pressure faces; few fine black concretions; moderately alkaline; gradual wavy boundary. (3 to 20 inches thick)

Bss--10 to 30 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak coarse angular blocky structure parting to moderate medium angular blocky; extremely hard, very firm; common intersecting slickensides and wedge-shaped peds having long axis tilted 30 to 45 degrees from the horizontal; few fine iron-manganese concretions; moderately alkaline; gradual wavy boundary. (6 to 40 inches thick)

Bkss--30 to 60 inches; pale olive (5Y 6/3) clay, olive (5Y 5/3) moist; common medium and coarse distinct very dark gray (10YR 3/1) and many fine faint light olive brown (2.5Y 5/6) mottles; moderate fine angular blocky structure; very hard, firm; common slickensides; common fine and medium calcium carbonate concretions and few masses of calcium carbonate; lower part of layer contains few shale fragments; slightly effervescent; moderately alkaline; gradual wavy boundary. (15 to 30 inches thick)

Ck--60 to 80 inches; olive gray (5Y 5/2) weakly consolidated shale that has clay texture; with alternating layers of light olive brown (2.5Y 5/6); evident bedding planes; extremely hard, very firm; few slickensides; contains approximately 10 percent calcium carbonate in the form of concretions and masses; few iron-manganese concretions; strongly effervescent; moderately alkaline.

TYPE LOCATION: Hopkins County, Texas; from intersection of Texas Highway 11 and 19 in Sulphur Springs, 10.8 miles west on Highway 11; 225 feet north in field.

RANGE IN CHARACTERISTICS: Solum thickness range from 60 to 80 inches. The weighted average clay content of the particle size control section ranges from 40 to 60 percent. When dry cracks 1/2 to 3 inches extend from the surface to a depth of more than 12 inches. In undisturbed areas there is gilgai microrelief. Distance between the microknoll and microdepression ranges from 4 to about 16 feet. There are few to many slickensides below a depth of about 15 inches. About 55 to 80 percent of the pedon has matrix colors of chroma 2 or more within 40 inches of the soil surface. Carbonates are below the A horizon and ranges from 9 to 60 inches.

The A horizons have hue of 10YR to 5Y and N, value of 2 to 4, and chroma of 0 or 1. Some pedons contain a few mottles in colors and shades of brown and olive in the lower part. The A horizon ranges from 12 to 20 inches thick on microknolls and 30 to 60 inches thick in microdepressions. It is clay or silty clay and is slightly acid to moderately alkaline.

The Bss horizons have hue of 10YR to 5Y, value of 2 and chroma of 0 to 1 in the upper part and value of 3 to 5, and chroma of 2 to 4 in the lower part. There are few to many mottles in colors and shades of gray, brown, and yellow. It is calcareous or noncalcareous clay or silty clay and typically contains few to common calcium carbonate concretions and soft masses. The Bkss horizon is neutral to moderately alkaline.

The Ck horizon has hue of 10YR to 5Y, value of 4 to 6 and chroma of 2 to 6. It is stratified clay and weakly consolidated shale; bedding planes are evident in most pedons. Few to common concretions and soft masses of calcium carbonate are in most pedons. Gypsum crystals range from none to common. The Ck horizon is mildly or moderately alkaline.

COMPETING SERIES: These are the Bleiberville, Branyon, Burleson, Clarita, Dimebox, Fairlie, Heiden, Houston Black, Luling, Ovan, Sanger, Slidell, Tamford and

Watonga series. Bleiberville, Branyon, Fairlie, Heiden, Houston Black, Ovan, Sanger, and Slidell are calcareous in the surface layer. Burleson soils have matrix chrmas of 1 or less throughout the upper 40 inches. Clarita and Tamford soils have hue of 7.rYR or redder in the subsoil. Dimebox soils have ironstone pebbbles and contin calcium sulfate in all parts of the pedon. Fairlie soils are underlain by chalk at 40 to 60 inches depth. Luling soils have chroma of 1.5 or more in the surfae layers. Watonga soils have sola less than 60 inches thick, and are in slighly cooler climates.

GEOGRAPHIC SETTING: Leson soils are on nearly level to gently sloping uplands. Slope gradients range from 0 to 5 percent, but mainly are 1 to 3 percent. The soil formed in alkaline shales and clays. The climate is warm and subhumid. The mean annual precipitation ranges from 34 to 44 inches and mean annual average temperature ranges from 63 to 70 degrees F. Frost free days range from 230 to 260 days and elevation ranges from 350 to 750 feet. Thornthwaite annual P-E indices are 44 to 72.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Branyon, Burleson, Houston Black and Heiden in the same family.also the Ferris and Wilson series. Heiden and Ferris soils have A horizons with chroma 1 of 2. Wilson soils have loamy surface layers and firm textured Bt horizons. Ferris, Heiden, and Houston Black are on higher areas. Branyon, Burleson and Wilson are in similar or slightly lower positions.

DRAINAGE AND PERMEABILITY: Moderately well drained. Runoff is medium; Permeability is very slow. Water enters the soil rapidly when it is dry and cracked, and very slowly when it is moist.

USE AND VEGETATION: Mainly cultivated and used for crops such as cotton, grain sorghums, and corn. Native grasses are mainly bluestem, indiangrass, and gramas. Improved pastures are planted to bermudagrass and lovegrass. Scattered trees include bois d'arc, hackberry, elm, post oak, and locust.

DISTRIBUTION AND EXTENT: The Blackland Prairies of Texas. The series is extensive.

LEWISVILLE SERIES

The Lewisville series consists of very deep, well drained, moderately permeable soils that formed in ancient loamy and calcareous sediments. These upland soils have slopes of 0 to 10 percent.

TAXONOMIC CLASS: Fine-silty, mixed, thermic Udic Calciustolls

TYPICAL PEDON: Lewisville silty clay--pasture. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 6 inches; dark grayish brown (10YR 4/2) silty clay; very dark grayish brown (10YR 3/2) moist; moderate very fine subangular blocky and granular structure; hard, friable; contains a few strongly cemented calcium carbonate concretions; calcareous; moderately alkaline; abrupt smooth boundary. (0 to 7 inches thick)

A--6 to 16 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; few root channels; common strongly cemented calcium carbonate concretions about 2 to 5 mm in diameter; calcareous; moderately alkaline; gradual smooth boundary. (7 to 15 inches thick)

Bk1--16 to 34 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; very hard, firm; common strongly cemented calcium carbonate concretions 2 to 5 mm in diameter; a few threads of soft calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary. (13 to 30 inches thick)

Bk2--34 to 62 inches; pale brown (10YR 6/3) silty clay; brown (10YR 5/3) moist; weak subangular blocky structure; hard, firm; common soft masses of segregated calcium carbonate, few small, strongly cemented calcium carbonate concretions; calcareous; moderately alkaline.

TYPE LOCATION: Collin County, Texas; from the intersection of Farm Road 546 and Texas Highway 75 in McKinney, 5 miles southeast on Farm Road 546, 1.2 miles south on county road, 60 feet east in pasture.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 60 to about 80 inches. It is clay loam, silty clay loam, or silty clay with silicate clay content ranging from 24 to 35 percent. Calcium carbonate equivalent in the 10- to 40-inch control section ranges from about 20 to 40 percent.

The A horizon has color in hue of 7.5YR and 10YR, value of 3 to 5, and chroma of 2 and 3. Thickness is 10 to 20 inches.

The Bk1 horizon is grayish, brownish, or yellowish in hue of 2.5Y to 7.5YR, value of 4 to 6, and chroma of 2 to 4. Some pedons in hue of 10YR and 7.5YR have chroma of 6. Soft bodies, concretions, films, and threads of calcium carbonate comprise about 3 to 8 percent by volume.

The Bk2 horizon has colors similar to the Bk1 horizon except they have values about 1 or 2 units higher. Some pedons have hue of 5YR and chroma of 6. Secondary forms of calcium carbonate comprise 5 to about 15 percent by volume.

Some pedons are underlain at depths of 3 to 15 feet by sediments containing 15 to 50 percent gravel.

COMPETING SERIES: There are no other series in this family. Similar series are the Altoga, Austin, Nuvalde, Quanah, Venus, and Volente series. Nuvalde and Quanah soils are dry in the moisture control section for longer periods. Altoga and Austin soils have more than 40 percent calcium carbonate equivalent in the control section. In addition, Altoga soils lack mollic epipedons. Venus soils have fine-loamy control sections. Volente soils have more than 35 percent silicate clay content in the control section.

GEOGRAPHIC SETTING: Nearly level to rolling landscapes having plane to convex surfaces. Slopes range from 0 to 10 percent, but they are mostly 2 to 6 percent. The soil formed in ancient loamy and limy alluvium assumed to have originated in areas underlain by limestone. The climate is moist subhumid with an annual mean precipitation of about 28 to 38 inches and the Thornthwaite P-E index of 44 to 66. At the type location the mean annual temperature is 66 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the competing Altoga, Venus, and Volente series and Eddy, Krum, and Stephen series. Altoga, Eddy, and Stephen soils occur on erosional surfaces at higher elevations. Eddy and Stephen soils are less than 20 inches thick and are underlain by chalk or weakly cemented limestone. In addition, Eddy soils contain more than 35 percent by volume of coarse fragments. Krum, Venus, and Volente soils occur at lower elevations as stream terraces or lower portions of narrow valleys. In addition, Krum soils have clayey control sections and vertic features of cracking widely and deeply when dry.

DRAINAGE AND PERMEABILITY: Well drained; runoff is slow to medium; permeability is moderate.

USE AND VEGETATION: Mostly cultivated, mainly to small grains. Originally vegetation was mid and tall grasses and a few widely separated elm, hackberry, and mesquite trees.

DISTRIBUTION AND EXTENT: Mainly in Texas, along major streams in the Blackland Prairies and the Grand Prairie; possibly in Oklahoma. The series is of moderate extent.

NORMANGEE SERIES

The Normangee series consists of soils that are deep to weakly consolidated shale. They are moderately well drained, very slowly permeable soils that formed in Cretaceous Age clay materials. These soils are on nearly level to moderately sloping uplands. Slopes range from 0 to 8 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Udertic Haplustalfs

TYPICAL PEDON: Normangee clay loam - pastureland. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 7 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium angular blocky structure; very hard, firm; few dark ferromanganese concretions and few rounded pebbles of quartz; slightly acid; clear wavy boundary. (4 to 9 inches thick)

Bt1--7 to 18 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; few fine distinct mottles of yellowish brown (10YR 5/6), dark grayish brown (10YR 4/2), and reddish brown (5YR 4/4); moderate medium angular blocky structure; extremely hard, extremely firm; few fine ferromanganese concretions and pebbles of quartz; distinct clay films on peds; medium acid; gradual smooth boundary. (8 to 16 inches thick)

Bt2--18 to 34 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; few fine faint mottles of olive brown and yellowish brown; moderate medium and fine angular blocky structure; distinct clay films on peds; extremely hard, extremely firm; distinct clay films on face of peds; neutral; gradual smooth boundary. (12 to 20 inches thick)

Bt3--34 to 44 inches, light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; common fine and medium distinct mottles of yellowish brown (10YR 5/8) and olive yellow (2.5Y 6/8); weak fine angular blocky structure; extremely hard, extremely firm; few clay films; few fine soft masses of calcium carbonate; moderately alkaline; gradual smooth boundary. (6 to 15 inches thick)

Ck--44 to 64 inches; very pale brown (10YR 7/3) weakly consolidated shale; that has clay texture; yellowish brown (10YR 5/4) moist; massive; few fine distinct mottles of brownish yellow and brown; extremely hard, very firm; common soft masses of calcium carbonate up to about 1/2 inch. i. size; moderately alkaline.

TYPE LOCATION: Anderson County, Texas; about 4.0 miles northwest of Cayuga; about 1.5 miles west of Cayuga, 1.8 miles north of U.S. Highway 287 and 1.75 miles west on county road.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 60 inches. Depth to secondary carbonates is greater than 30 inches. Some pedons lack visible carbonates. The clay content of the control section averages 40 to 50 percent. The COLE values range from .07. to .10 The soil has cracks 1/2 inch wide to a depth of more than 20 inches when dry.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. The texture is sandy clay loam, loam, clay loam or their gravelly counterparts. It is hard or very hard when dry. Reaction ranges from medium acid to neutral.

The upper Bt horizon has matrix with hue of 5YR, 7.5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. Reddish and brownish mottles range from few to common. Lower Bt horizons are in shades of brown or olive in hue of 10YR or 2.5Y with or without mottles in shades of yellow, brown, or red. The texture of the Bt horizon is clay, however, some

pedons have clay loam lower B horizons. Reaction of the upper Bt horizon ranges from medium acid to moderate;y alkaline. Reaction of the lower Bt horizon ranges from slightly acid to moderately alkaline. Some pedons are calcareous in the lower part. Calcium carbonate in the form of concretions and masses ranges from none to common.

The C horizon is weakly consolidated shale with clay texture that is stratified with clay loam, clay and shaly clay. Colors are in shades of gray, olive, yellow and brown. The reaction ranges from neutral to moderately alkaline. Some pedons are calcareous. Visible carbonates range from none to common.

COMPETING SERIES: There are no other series in the same family. Similar soils are the Axtell, Bazette, Chaney, Crockett, Payne, Ponder and Steedman series. Axtell, Chaney, and Crockett soils have an abrupt texture change between the A and Bt horizon. Bazette and Payne soils lack vertic properties. Ponder soils have sola more than 60 inches thick and Steedman soils have sola 20 to 40 inches thick.

GEOGRAPHIC SETTING: Normangee soils occur on nearly level to moderately sloping uplands. Slope gradients are predominantly 1 to 6 percent, but range from 0 to 8 percent. The soil formed in alkaline marine sediments of shale, clay, and sandy clay underlain in places by sandstone or limestone. Mean annual temperature ranges from 67 F. and mean annual precipitation ranges from 32 to 42 inches. Frost free days range from 220 to 270 days and elevation ranges from 350 to 800 feet. Thornthwaite annual P-E indices are 50 to 70.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the competing Axtell and Crockett series and the Ellis and Wilson soils. Axtell and Crockett soils are on similar positions. The Ellis soils are clayey throughout and are on similar or more sloping positions. Wilson soils are gray throughout and are on flat, wetter positions.

DRAINAGE AND PERMEABILITY: Moderately well drained. Runoff is slow to rapid; Permeability is very slow.

USE AND VEGETATION: Principal use is pasture. A few areas are farmed to cotton, grain sorghum, small grain, or corn. Native vegetation is thin strands of postoak with bluestems, Indiangrass, switchgrass, and grama grasses in open areas.

DISTRIBUTION AND EXTENT: Blackland Prairie and Texas Claypan areas; possibly in the Cross Timbers areas of Texas and Oklahoma. The series is of moderate extent.

TINN SERIES

The Tinn series consists of very deep, moderately well drained, very slowly permeable soils that formed in calcareous clayey alluvium. These soils are on flood plains of streams that drain the Blackland Prairies. Slopes are dominantly less than 1 percent but range from 0 to 2 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Typic Hapluderts

TYPICAL PEDON: Tinn clay--cultivated. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 6 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate coarse angular blocky structure parting to moderate very fine and fine angular blocky structure; very hard, very firm; plastic; few fine roots; few fine and medium pores; slightly effervescent; moderately alkaline; abrupt smooth boundary. (4 to 8 inches thick)

A--6 to 18 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate coarse angular blocky structure parting to moderate very fine and fine angular blocky; very hard, very firm; few fine roots; few fine and medium pores; common pressure faces; few fine slickensides; about 2 percent fine siliceous pebbles, and about 2 percent fine ironstone pebbles; few worm casts; few medium grayish brown (2.5Y 5/2) streaks along root channels; slightly effervescent; moderately alkaline; gradual wavy boundary. (6 to 15 inches thick)

Bss1--18 to 28 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate coarse angular blocky structure parting to moderate fine and medium angular blocky; very hard, very firm; few fine roots; few fine and medium pores; common fine pressure faces; common fine slickensides; about 2 percent fine siliceous pebbles, and about 2 percent fine ironstone pebbles; few worm casts; few medium grayish brown (2.5Y 5/2) streaks along root channels; slightly effervescent; moderately alkaline; gradual wavy boundary. (8 to 20 inches thick)

Bss2--28 to 54 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate coarse angular blocky structure parting to moderate fine and medium angular blocky structure; very hard, very firm; few fine roots; few fine and medium pores; many prominent grooved slickensides that range from 5 to 10 cm across; most slickensides are oriented at 45 degrees; few fine black concretions; few medium calcium carbonate concretions that are pitted; about 2 percent siliceous pebbles; about 2 percent shell fragments; few worm casts; few coarse very dark gray (10YR 3/1) masses; slightly effervescent; moderately alkaline; gradual wavy boundary. (0 to 30 inches thick)

Bss3--54 to 72 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate coarse angular blocky structure parting to moderate fine and medium angular blocky; very hard, very firm; few fine roots; few fine and medium pores; common prominent grooved slickensides up to 1 meter across, slickensides are oriented at 45 to 60 degrees; few fine and medium calcium carbonate concretions that are pitted; few worm casts; slightly effervescent; moderately alkaline; gradual wavy boundary. (10 to 24 inches thick)

Bkss--72 to 80 inches; very dark grayish brown (2.5Y 3/2) clay, dark grayish brown (2.5Y 4/2) dry, moderate coarse angular blocky structure parting to moderate fine and medium angular blocky; very hard, very firm; few fine roots; few fine and medium pores; few fine grooved slickensides up to 50 cm across, slickensides are oriented at 45 to 60 degrees; common fine and medium calcium carbonate concretions; few fine and medium masses of gypsum; few black (10YR 2/1) streaks; slightly effervescent; moderately alkaline.

TYPE LOCATION: Limestone County, Texas; from the intersection of Farm Road 171 and Farm Road 73 in Coolidge, 2.8 miles northeast on Farm Road 73, 0.6 miles north on county road, and 400 feet east on Pin Oak Creek floodplain in cropland.

RANGE IN CHARACTERISTICS: Solum thickness is greater than 80 inches. Reaction is slightly alkaline or moderately alkaline. Effervescence ranges from very slight to strong. Weighted average clay content of the particle size control section ranges from 40 to 60 inches. Texture is silty clay or clay throughout. Undisturbed areas have subdued gilgai, with microhighs 2 to 6 inches higher than microlows. Slickensides and/or wedge-shaped aggregates begin at depths from 6 to 20 inches, becoming more distantly expressed between 20 and 60 inches. The soil cracks when dry and the cracks are 0.5 inch to about 2 inches wide and extend to a depth of more than 12 inches. The cracks remain open from 60 to 90 cumulative days in most years.

The A horizon has dark colors in hue of 10YR to 5Y, value of 2 or 3, and chroma of 1. Texture is silty clay or clay.

A Bw horizon is present in some pedons. Where present, the colors and textures are similar to those of the A horizon.

The Bss and Bkss horizons have hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 to 4. Redox concentrations in shades of brown, olive or yellow range from none to common. Calcium carbonate masses and concretions range from none to common.

COMPETING SERIES: These are the Eastham and Hallsbluff series. Similar soils are the Branyon, Burleson, Kaufman, and Trinity soils. Eastham soils are not calcareous in the upper 20 inches. Hallsbluff soils have a mollic epipedon with chroma of 2. Branyon and Burleson soils are Usterts. In addition, Burleson soils are noncalcareous in the upper 20 inches. Kaufman and Trinity soils have very-fine control sections.

GEOGRAPHIC SETTING: Tinn soils are on nearly level flood plains. Slopes are mainly less than 1 percent, but some are as much as 2 percent. The soil formed in calcareous clayey alluvium. Mean annual precipitation ranges from 32 to 42 inches, and mean annual temperature ranges from 64 to 68 degrees F. Frost free days range 230 to 270 days and elevation ranges from 250 to 550 feet. Thornthwaite P-E indices exceed 44.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Branyon, Burleson, Ferris, Heiden, Houston Black, and Trinity series. Branyon and Burleson soils are on

higher terrace positions. Ferris and Heiden soils have chroma of 2 or more in the upper 12 inches. Houston Black soils have greater amplitude of waviness and are on uplands in a higher position. Trinity soils have very-fine particle-size control sections and are in similar positions.

DRAINAGE AND PERMEABILITY: Moderately well drained. Permeability is very slow. Runoff is low. Flooding is common except where the soil is protected. Duration of flooding is very brief or brief.

USE AND VEGETATION: Most areas are in pasture or cultivated to crops such as cotton, corn, sorghums, or small grains. Native vegetation is elm, hackberry, oak, and ash, with an understory of grasses such as species of paspalums and panicums.

DISTRIBUTION AND EXTENT: Mainly in central Texas on streams draining the Blackland Prairies (MLRA 86A). The series is extensive.

WILSON SERIES

The Wilson series consists of very deep, moderately well drained, very slowly permeable soils that formed in alkaline clayey sediments. These soils are on nearly level to gently sloping stream terraces or terrace remnants on uplands. Slopes are mainly less than 1 percent but range from 0 to 5 percent.

TAXONOMIC CLASS: Fine, smectitic, thermic Oxyaquic Vertic Haplustalfs

TYPICAL PEDON: Wilson silt loam--cropland. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 5 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; massive when dry; very hard, firm, sticky and plastic; common fine roots; moderately acid; abrupt wavy boundary. (3 to 10 inches thick)

Bt--5 to 20 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; thin continuous clay films 1/2 unit of value darker than interior of peds; vertical cracks 1/2 inch wide are filled with material from the Ap horizon; slightly acid; gradual wavy boundary. (10 to 20 inches thick)

Btssg1--20 to 32 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; moderate medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; few slickensides; few medium pressure faces; thin continuous clay films on surface of peds; vertical cracks 1/4 inch wide partly filled with material from above; few fine crystals of gypsum; few fine calcium carbonate concretions; slightly alkaline; diffuse wavy boundary.

Btssg2--32 to 65 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; weak coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; few slickensides; patchy clay films on surface of peds; common fine crystals of gypsum; few fine masses of calcium carbonate; slightly alkaline; gradual smooth boundary. (combined Btss subhorizons are 25 to 60 inches thick)

BCkss--65 to 80 inches; olive gray (5Y 5/2) silty clay, light gray (5Y 7/2) dry; weak coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; few slickensides; few coarse masses of calcium carbonate; few small fragments of clay; very slightly effervescent; moderately alkaline.

TYPE LOCATION: Kaufman County, Texas; 4 miles southeast of the intersection of Texas Highway 34 and U. S. Highway 175 in Kaufman, 0.15 mile northeast and 0.2 mile southeast of intersection of county road and U. S. Highway 175, 150 feet southwest in field.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 60 to more than 80 inches. The weighted average clay content of the upper 20 inches of the argillic horizon ranges from 35 to 50 percent. When dry, cracks at least 1/4 inch wide extend from the top of the argillic horizon through a thickness of 12 inches or more within the upper 50 inches of the soil. Slickensides and/or wedged-shaped aggregates and pressure faces range from few to common and begin at a depth of 14 to 26 inches. Linear extensibility is greater than 2.5 inches (6 cm) within 40 inches (100 cm) of the soil surface. COLE ranges from 0.07 to 0.10 in the upper 50 inches of the argillic horizon. The surface layer is variable in thickness with a series of micro crests and troughs in the Bt horizon that range from 4 to about 20 feet apart. Redoximorphic features are contemporary in the upper Bt1 horizon and are mainly relic in the lower part of the Bt horizon. The soil does not have aquic soil conditions in the upper 20 inches in most years.

The A horizon is less than 10 inches thick in more than 50 percent of the pedon, but it is as much as 15 inches thick in some subsoil troughs. It has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. Texture is loam, silt loam, silty clay loam, clay loam or their gravelly counterparts. Siliceous pebbles and small cobbles range from 0 to 35 percent. It is massive and hard or very hard when dry but is soft or friable with structure when moist. Some pedons have a thin E horizon in subsoil troughs. Reaction ranges from moderately acid to neutral.

The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 or less. Texture is clay loam, silty clay loam, silty clay, or clay. Some pedons have iron concentrations in shades of brown or yellow that range from few to common. Siliceous pebbles range from 0 to about 15 percent by volume. Reaction ranges from slightly acid to slightly alkaline.

The Btss horizon has hue of 10YR to 5Y, value of 3 to 7, and chroma of 2 or less. Iron concentrations in shades of yellow, brown or olive range from none to common. Texture

is commonly silty clay or clay and less commonly silty clay loam or clay loam. Reaction ranges from moderately acid to slightly alkaline and is typically noncalcareous.

The BCk or BC horizon has colors in shades of gray or brown. Redoximorphic features of these colors and in other shades of yellow, red or olive range from few to many. Texture is clay loam, silty clay loam, silty clay, or clay. Some pedons have fragments or thin strata of shale or marl. These materials make up less than 35 percent of the matrix. Reaction ranges from neutral to moderately alkaline. Concretions and masses of calcium carbonate range from none to common.

The C horizon, where encountered, is shale or marl or stratified layers of shale, marl and clay.

COMPETING SERIES: There are no competing series. Similar soils are the Dacosta, Herty, Lufkin, Mabank, and Steedham series. Dacosta soils have a mollic epipedon and are members of the hyperthermic family. Herty, Lufkin and Mabank soils have an abrupt texture change between the A and Bt horizon. In addition, Herty soils are in the udic moisture regime. Steedham soils have sola from 20 to 40 inches thick, and are well drained.

GEOGRAPHIC SETTING: Wilson soils are on nearly level to gently sloping terraces or remnants of terraces. Slope gradients are 0 to 5 percent but dominantly less than 1 percent. The soil formed in alkaline clayey alluvium. Mean annual temperature ranges from 64 to 70 degrees F., and mean annual precipitation ranges from 32 to 45 inches. Frost free days range from 220 to 270 days and elevation ranges from 250 to 700 feet. Thornthwaite P-E indices from 50 to 70.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bonham, Burleson, Crockett, Houston Black, Lufkin, Mabank, and Normangee series. Bonham soils have mollic epipedons. Burleson soils are on similar positions. Burleson and Houston Black soils are clayey to the surface and have slickensides (Vertisols). Crockett and Normangee soils have Bt horizons with chroma of more than 2. Bonham, Houston Black, Crockett and Normangee soils are on slightly higher positions above Wilson. Lufkin soils are on similar or slightly lower concave positions. Mabank soils are on similar positions.

DRAINAGE AND PERMEABILITY: Moderately well drained. Permeability is very slow. Runoff is low on 0 to 1 percent slopes, medium on 1 to 3 percent slopes, and high on 3 to 5 percent slopes. Very slow internal drainage. The soil is seasonally wet and is saturated in the surface layer and upper part of the Bt horizon during the winter and spring seasons for periods of 10 to 30 days.

USE AND VEGETATION: Wilson soils are cropped to cotton, sorghums, small grain, and corn. Many areas are now idle or are used for unimproved pasture. Original vegetation was tall prairie grasses, mainly andropogon species, and widely spaced motts of elm and oak trees. Most areas that are not cropped have few to many mesquite trees.

DISTRIBUTION AND EXTENT: Mainly in the Blackland Prairies of Texas, with small areas in Oklahoma. The soil is extensive, probably exceeding 1,000,000 acres.

E-2: Supplement to the Preliminary Jurisdictional Determination

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS - DESIGNERS - SCIENTISTS

Supplement Number 1 to the Preliminary Jurisdictional Determination of Waters of the U.S. – Proposed Lake Ralph Hall

SPONSOR:

UPPER TRINITY REGIONAL WATER DISTRICT

JANUARY 30, 2008

ALAN PLUMMER ASSOCIATES, INC.

FIGURES A4-A6
SHOWING STREAMS AND TRIBUTARIES WITH IDENTIFICATION LABELS THAT CORRESPOND TO TABLE 5

Legend

Jurisdictional

Stream Channels

On-Channel Ponds

Non-Jurisdictional

Remnant North Sulphur River Channels without Current Hydraulic or Hydrologic Connections

Upland Ponds

FIGURE A-4
PRELIMINARY JURISDICTIONAL DETERMINATION
OF WATERS OF THE U.S.

PREPARED BY:
TIM CAPPS (10-10-05)
FIGURE 4 OF 6

2,000 1,000 0 Feet

F:\PROJECTS\0346\0402\GIS\REPORT\FIGURES\PJD\PJDFIGURE4A_PJD_LAKE.MXD

Legend

Jurisdictional

Stream Channels

On-Channel Ponds

Non-Jurisdictional

Remnant North Sulphur River Channels without Current Hydraulic or Hydrologic Connections

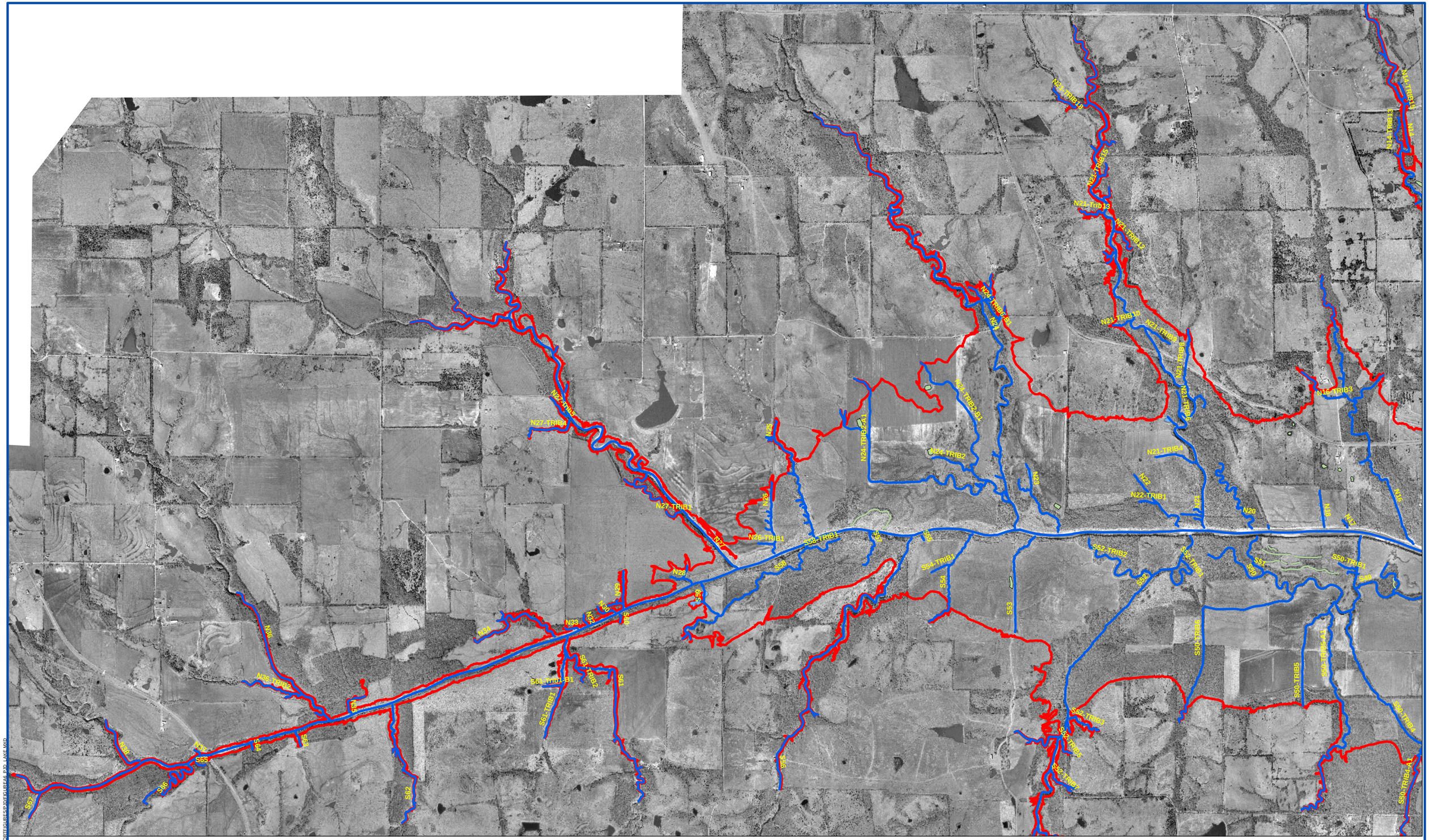
Upland Ponds

FIGURE A-5
PRELIMINARY JURISDICTIONAL DETERMINATION
OF WATERS OF THE U.S.

PREPARED BY:
TIM CAPPS (10-10-05)
FIGURE 5 OF 6

2,000 1,000 0 Feet

E:\PROJECTS\03450\002\GIS\REPORTS\FIGURES\PJD\FIGURE A5_PJD_LAKE.MXD



Legend

Jurisdictional

Stream Channels

On-Channel Ponds

Non-Jurisdictional

Remnant North Sulphur River Channels without Current Hydraulic or Hydrologic Connections

Upland Ponds

FIGURE A-6
PRELIMINARY JURISDICTIONAL DETERMINATION
OF WATERS OF THE U.S.

PREPARED BY:
TIM CAPPS (10-10-05)
FIGURE 6 OF 6

2,000 1,000 0 Feet

F:\PROJECTS\03460\002\GIS\REPORTFIGURES\P JDFIGURE A6 P.D. LAKE.MXD

PRELIMINARY JURISDICTIONAL DETERMINATION
PHOTOGRAPH LOCATION MAP

P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20
P21
P22
P23
P24
P25

Legend

Jurisdictional

Stream Channels

On-Channel Ponds

Non-Jurisdictional

Remnant North Sulphur River Channels without Current Hydraulic or Hydrologic Connections

Upland Ponds

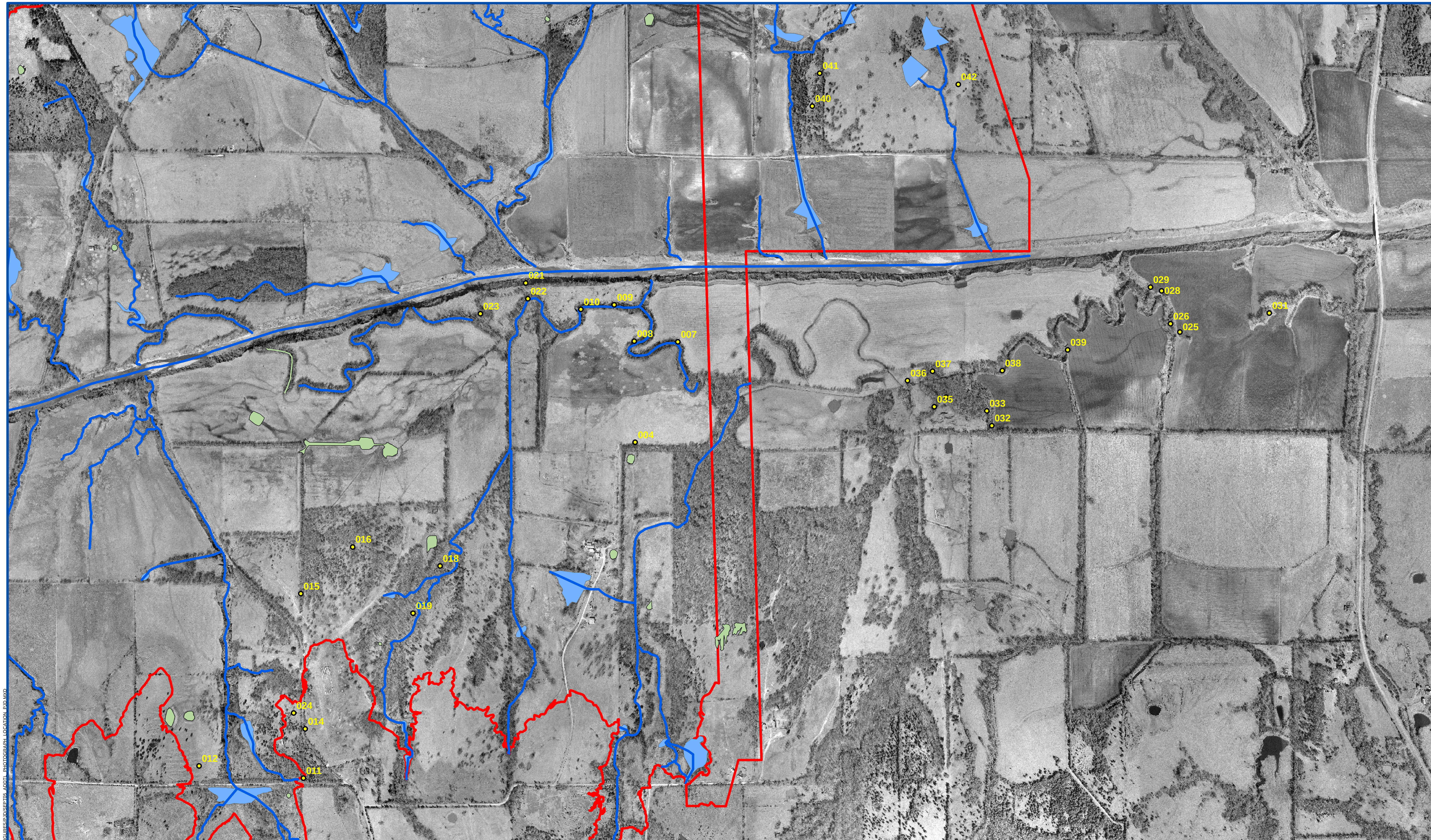
FIGURE B-1
PHOTOGRAPH LOCATIONS

PREPARED BY:
JASON VOIGHT (1-29-08)
FIGURE 1 OF 1

3,000 1,500 0 Feet

F:\PROJECTS\3646\MXD\GISREPORT\FIGURES\PJV\PHOTOGRAPH_LOCATION_B.MXD

ADDITIONAL PHOTOGRAPHS



Legend

Jurisdictional

Stream Channels

On-Channel Ponds

Non-Jurisdictional

Remnant North Sulphur River Channels without Current Hydraulic or Hydrologic Connections

Upland Ponds

APRIL 20-22, 2005
ADDITIONAL PHOTOGRAPH LOCATIONS

PREPARED BY:
JASON VOIGHT (1-29-08)
FIGURE 1 OF 1

1,000 500 0 Feet

F/PROJECTS/0346/0402/GIS/REPORTFIGURES/PJD/SEPT05_ADDTL_PHOTOGRAPH_LOCATION_PJD.MXD

PHOTOGRAPHS FROM APRIL 20-22, 2005
SITE INVESTIGATION

WP4

WP7

WP8

WP9

WP10

WP11

WP12

WP14

WP15

WP16

WP18

WP19

WP21

WP22

WP23

WP24

WP25

WP26

WP28

WP29

WP31

WP32

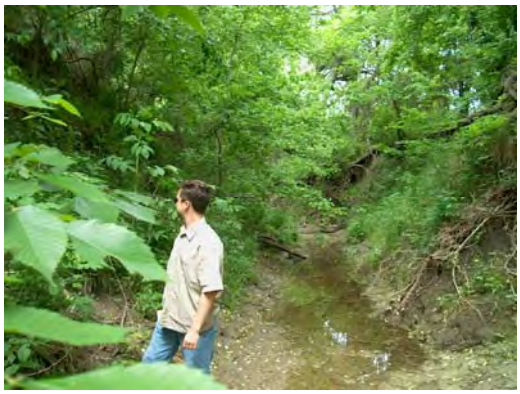
WP33

WP34

WP35

WP36

WP37



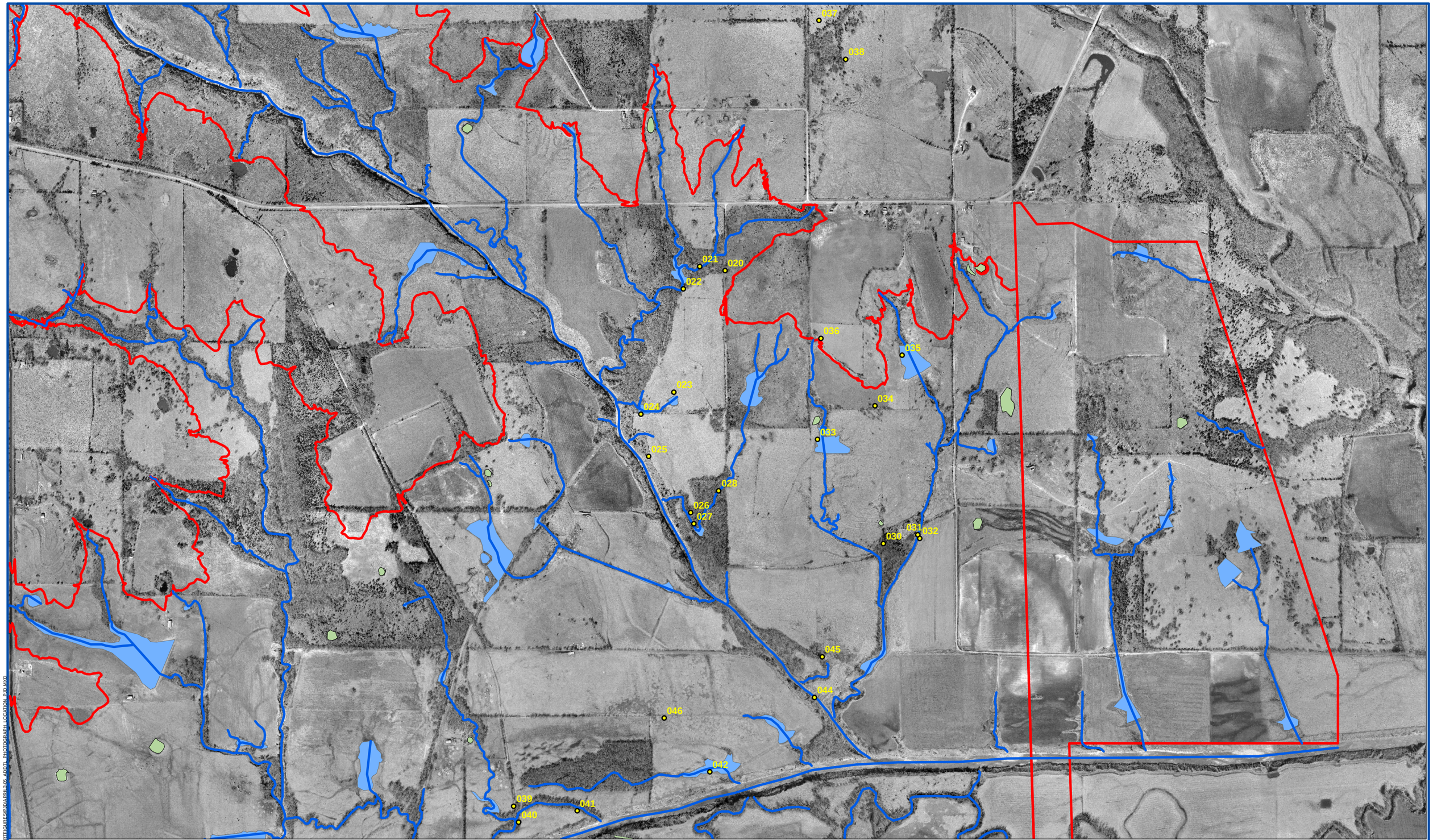
WP38

WP39

WP40

WP41

WP42



Legend

Jurisdictional

Stream Channels

On-Channel Ponds

Non-Jurisdictional

Remnant North Sulphur River Channels without Current Hydraulic or Hydrologic Connections

Upland Ponds

APRIL 28-29, 2005
ADDITIONAL PHOTOGRAPH LOCATIONS

PREPARED BY:
JASON VOIGHT (1-29-08)
FIGURE 1 OF 1

1,000 500 0 Feet

F:\PROJECTS\0346\0402\GIS\REPORTFIGURES\PJVAPRIL2-05_ADDTL_PHOTOGRAPH_LOCATION_P.JD.MXD

PHOTOGRAPHS FROM APRIL 28-29, 2005
SITE INVESTIGATION

WP20

WP21

WP22

WP23

WP24

WP25

WP26

WP27

WP28

WP30

WP31

WP32

WP33

WP34

WP35

WP36

WP37

WP38

WP39

WP40

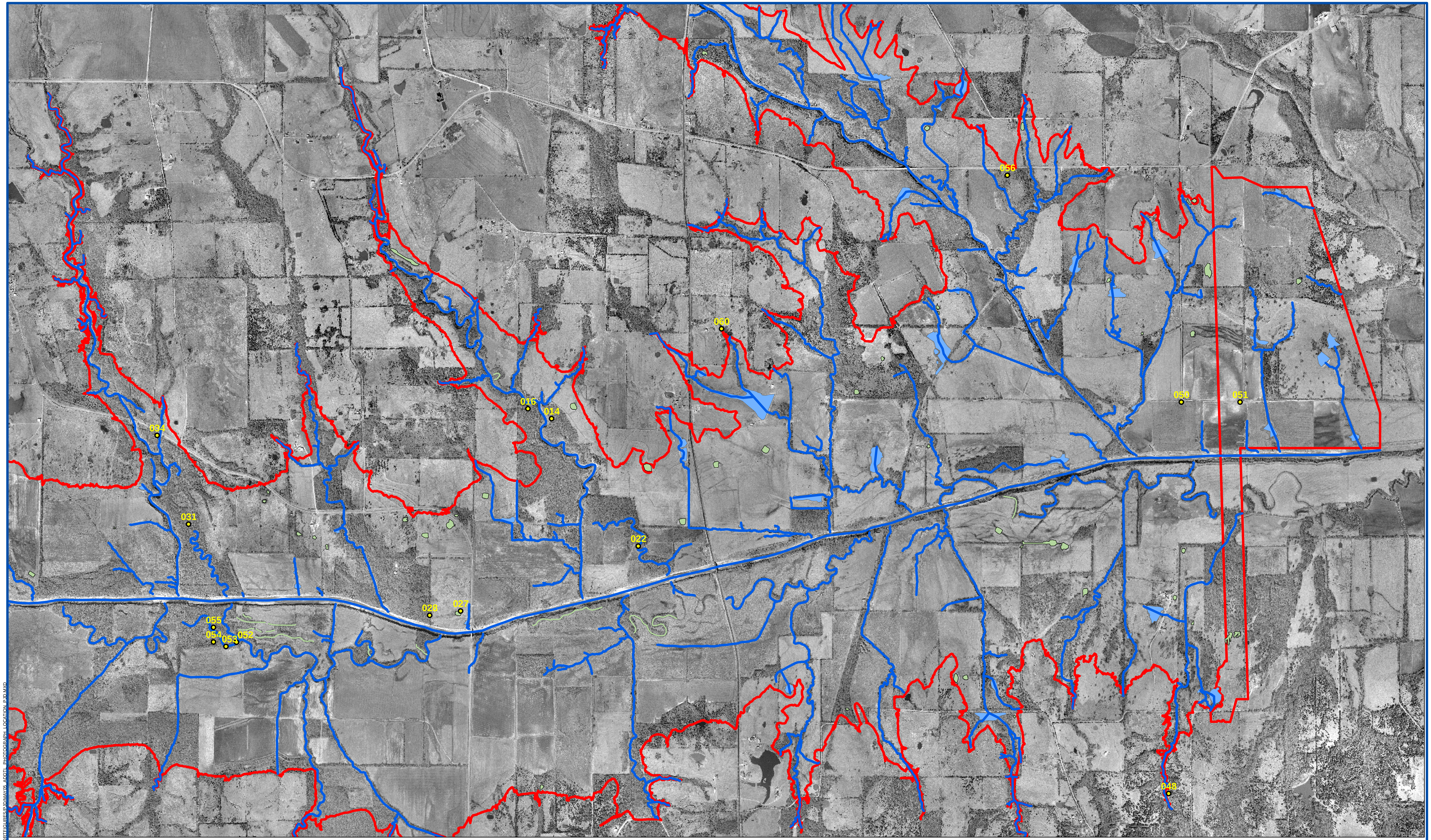
WP42

WP42

WP44

WP45

WP46



Legend

Jurisdictional

Stream Channels

On-Channel Ponds

Non-Jurisdictional

Remnant North Sulphur River Channels without Current Hydraulic or Hydrologic Connections

Upland Ponds

MAY 2005
ADDITIONAL PHOTOGRAPH LOCATIONS

PREPARED BY:
JASON VOIGHT (1-29-08)
FIGURE 1 OF 1

2,000 1,000 0 Feet

PHOTOGRAPHS FROM MAY 2005
SITE INVESTIGATION

WP14

WP16

WP22

WP27

WP28

WP31

WP34

WP48

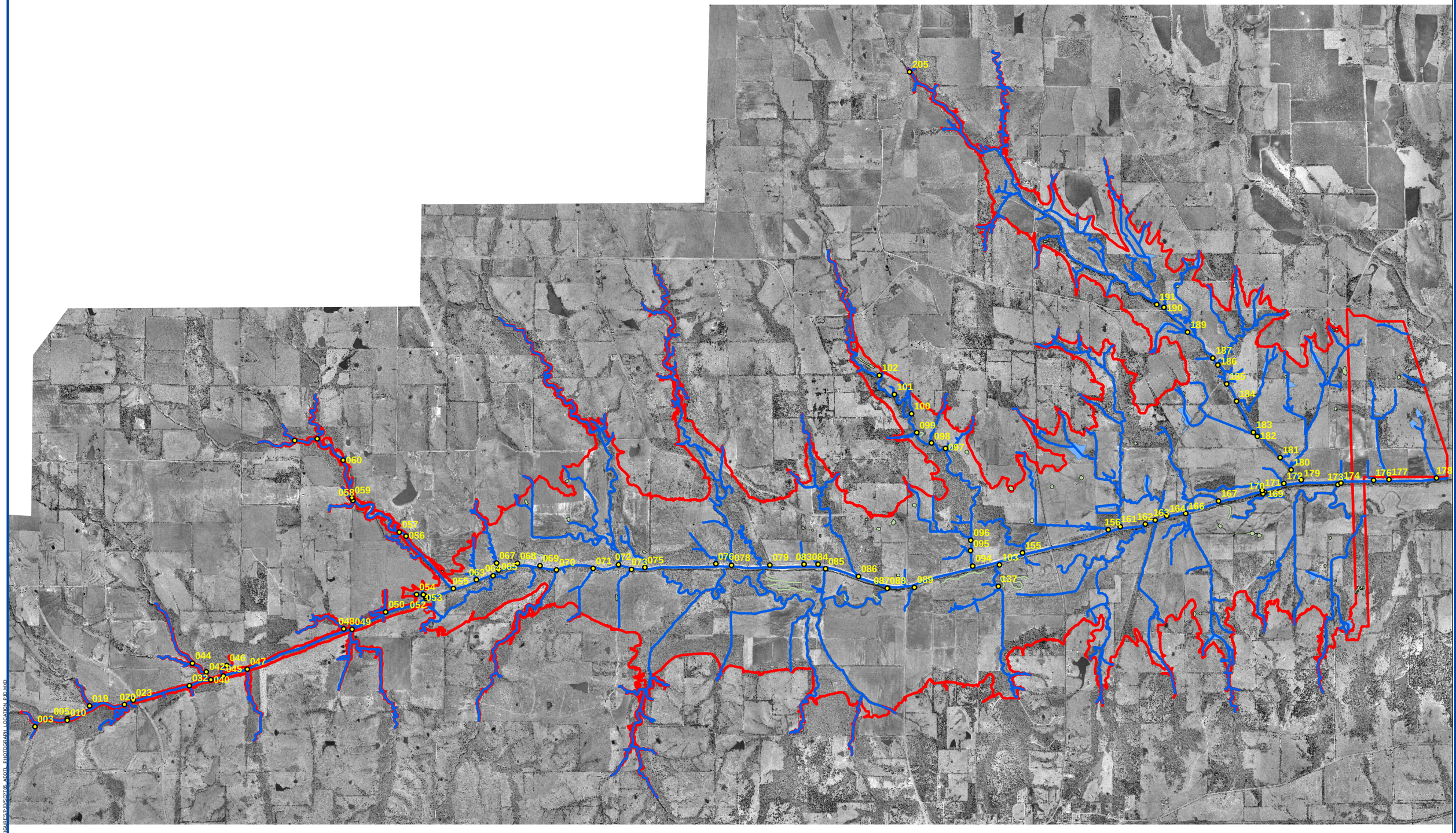
WP50

WP51

WP53

WP54

WP55



Legend

Jurisdictional

Stream Channels

On-Channel Ponds

Non-Jurisdictional

Remnant North Sulphur River Channels without Current Hydraulic or Hydrologic Connections

Upland Ponds

SEPTEMBER 2005
ADDITIONAL PHOTOGRAPH LOCATIONS

PREPARED BY:
JASON VOIGHT (1-29-08)
FIGURE 1 OF 1

3,000 1,500 0 Feet

F:\PROJECTS\036\0402\GIS\REPORTFIGURES\PJVSEP05_ADDTL_PHOTOGRAPH_LOCATION_FIG.MXD

PHOTOGRAPHS FROM SEPTEMBER 2005 SITE INVESTIGATION

WP3

WP5

WP10

WP19

WP20

WP23

WP32

WP40

WP42

WP44

WP45

WP46

WP47

WP48

WP49

WP50

WP51

WP52

WP53

WP54

WP55

WP56

WP57

WP58

WP59

WP60

WP61

WP62

WP63

WP64

WP65

WP67

WP68

WP69

WP70

WP71

WP72

WP73

WP75

WP76

WP78

WP79

WP83

WP84

WP85

WP86

WP87

WP88

WP89

WP94

WP95

WP96

WP97

WP98

WP99

WP100

WP101

WP102

WP103

WP137

WP137U

WP155

WP156

WP161

WP162

WP163

WP164

WP166

WP167

WP169

WP170

WP171

WP172

WP173

WP174

WP176

WP177

WP178

WP179

WP180

WP181

WP182

WP183

WP184

WP185

WP186

WP187

WP189

WP190

NEAR WP190

NEAR WP190

WP191

WP205