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A Survey of Nesting by Cliff Swallows (*Petrochelidon pyrrhonota*) and Barn Swallows (*Hirundo rustica*) at Highway Bridges in Southern Arkansas

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Abstract.—The Cliff Swallow (*Petrochelidon pyrrhonota*) and Barn Swallow (*Hirundo rustica*) both are migratory species that, in Arkansas, were known to nest only in the northern part of the state until the mid to late 1900s. The construction of concrete bridges apparently provided suitable nesting structure for both species. I conducted a survey of bridges along highways in southern Arkansas to look for evidence of nesting by these species. Nests of Cliff Swallows were found in Ashley, Bradley, Clark, Cleveland, Hempstead, Hot Spring, Howard, Lafayette, Lincoln, Little River, Miller, Nevada, Ouachita, Pike, Sevier, and Union Counties. Nests of Barn Swallows were more widespread and occurred in all counties surveyed.

Key words:—Cliff Swallow, *Petrochelidon pyrrhonota*, Barn Swallow, *Hirundo rustica*, migratory species, Arkansas, concrete bridges, nesting.

Introduction

The Cliff Swallow (*Petrochelidon pyrrhonota*) is a migratory species whose historic breeding range in Arkansas appeared to be limited to the Ozark Mountains (Baerg 1931, James and Neal 1986). Cliff Swallows were eventually documented utilizing new bridges for nest construction in Arkansas (Stewart 1976). James and Neal (1986) updated the Arkansas records of Cliff Swallows, noting nesting records in the Arkansas River valley in central Arkansas and in the Red River drainage of southwestern Arkansas. Since the construction of concrete bridges and dams, which has created new potential nesting sites extralimital to the historic breeding range, new records have extended the known breeding range southward even into Louisiana (Eyster 1980, Viet and Petersen 1993) and coastal states including Mississippi, Alabama, and Florida (Lewis and McNair 1998).

The Arkansas Audubon Society maintains a database of records of Arkansas birds (records since 1986 are available online at <http://www.arbirds.org/data/index.html>). A new breeding colony was reported in Little River County at Lake Millwood in 1988, and in 1991 nesting by Cliff Swallows was reported in Hempstead County at Millwood dam. A bridge over the Red River in Lafayette County was home to a nesting colony in 1996, and in 1997 juveniles were seen in Clark County, leading to the assumption that a nest was nearby.

Results of the annual migratory bird count in Arkansas, taken 13-14 May 2006, indicate that Cliff Swallows are increasing (Anderson 2006). However, counties included in the census are primarily northern, and only Ouachita County in southern Arkansas was represented in the survey (and no Cliff Swallows were found there).

Barn swallows (*Hirundo rustica*) also migrate, usually entering the state as early as mid-March, and nest throughout the state (James and Neal 1986). However, most of the breeding population has tended to be in the highlands region (James and Neal 1986). In the early 1900s, the Barn Swallow was known to

occur in summer only in the Ozarks; by the 1940s it was breeding in central Arkansas, and by the 1960s it was breeding in the southern lowlands. At the time it was becoming established in southwestern Arkansas, it was also gradually expanding into the southeastern part of the state. James and Neal (1986) noted that the construction of concrete bridges in the 1950s likely provided new nesting sites and allowed expansion of the breeding range of Barn Swallows. Indeed, human construction has created suitable nest sites for both Cliff and Barn Swallows (Erskine 1979).

The present study was undertaken to update the status of Cliff Swallows and Barn Swallows and to document their nesting expansion into southern Arkansas. Both species of swallows are known to nest on dams and other man-made structures, but only bridges were examined during this study to evaluate the impact of the concrete construction on the southern expansion in nesting range.

Methods and Materials

The nest of the Cliff Swallow is made of collected lumps of mud formed into a gourd-shaped structure with an opening that projects downward. Nests of Barn Swallows resemble half of a mud bowl, often with grass and other materials incorporated, adhering to a vertical surface. Because the nests are very easy to recognize and are relatively durable, evaluation of use of a site can be conducted even during the winter after the birds have migrated southward for the season. Such evaluation can only consider the degree to which a site has been used over several years, but not the effort in a given year. Swallows are known to re-use old nests (Brown and Brown 1995).

Between 4 November 2006 and 5 May 2007, I selected and drove routes that intersect a variety of streams of different sizes and with different types of bridge construction in southern Arkansas. Most of the localities were within counties of the West Gulf Coastal Plain physiographic province (Fig. 1A). Each

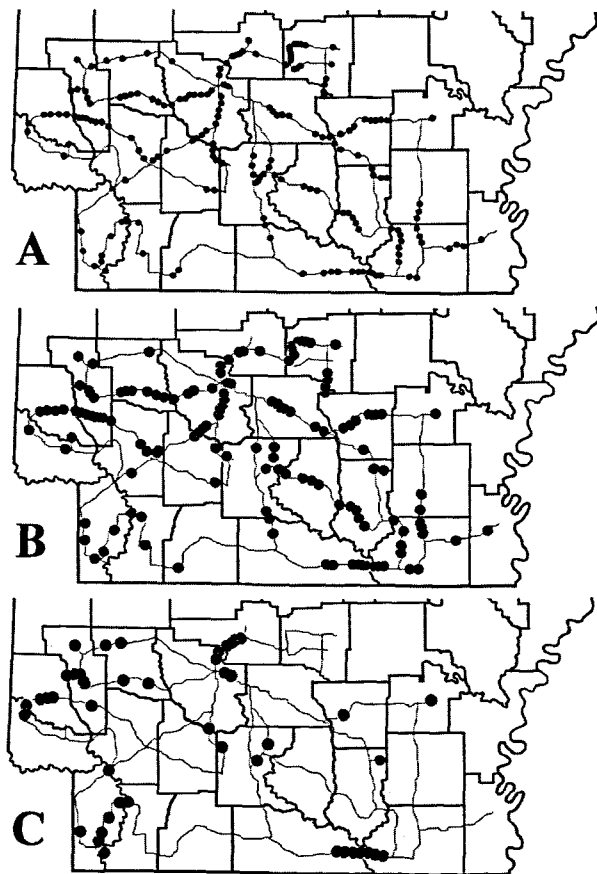


Fig. 1. A) Survey routes used to determine the presence of nests of Cliff and Barn Swallows at bridges in southern Arkansas; B) localities at which nests of Barn Swallows were found; C) localities at which nests of Cliff Swallows were found. Precise localities are provided in the appendix, including the number of nests counted at each site. Note: Some bridges were not accessible for thorough counts of nests – in these cases (indicated by ">"), a minimum is presented.

bridge was searched, from either side if necessary, to locate any nests attached to the structure. The kind of construction of each bridge (steel or concrete) was recorded. Any intact nests of either Cliff or Barn Swallows were counted as an index of the degree of use at the site.

Results and Discussion

Previous records of nesting by Cliff Swallows were available from Howard, Little River, Sevier, and Union counties in southern Arkansas (James and Neal 1986), and additional unpublished records from Hempstead and Lafayette counties are on file with the Arkansas Audubon Society. My survey verified that nests of Cliff Swallows presently occur in all of

those counties, and new records are herein reported for Ashley, Bradley, Clark, Cleveland, Hot Spring, Lincoln, Miller, Nevada, Ouachita, and Pike counties (Fig. 1C, Appendix).

Bridges used by Cliff Swallows span several drainage systems, including Bayou Bartholomew (Lincoln County), Saline River east (Bradley and Cleveland counties), Saline River west (Howard and Sevier counties), Ouachita River (Ashley, Clark, Hot Spring, Ouachita, and Union counties), Red River (Hempstead, Lafayette, and Miller counties), Little River (Little River and Sevier counties), Sulphur River (Miller County), Little Missouri River (Nevada, Ouachita, and Pike counties), and Cossatot River (Sevier County).

Cliff Swallow nests at most locations numbered a few dozen or less, but large bridges spanning major rivers tended to support greater aggregations of nests. Larger colonies of Cliff Swallows were present at large bridges over the Red and Ouachita rivers. Over the Red River in Lafayette County on AR St. Hwy. 160, 1,136 Cliff Swallow nests were counted. At the bridge for U.S. Hwy. 82, there were 1,091 nests on the Miller County side and 3,198 on the Lafayette County side.

Brown et al. (2002) found that the amount of water in the foraging range was a significant predictor of colony size with larger colonies developing where more water was available. These swallows tend to be colonial, which may be related to the effects of the reproductive success of conspecifics (Brown et al 2000) and increased hatching success (Brown and Brown 2001), although increases in ectoparasitism is a cost (Brown and Brown 1986) that may lead to natal dispersal (Brown and Brown 1992). Coloniality does not appear to be caused by a limitation of breeding sites (Brown and Brown 2000).

Nesting was common at large bridges along the Ouachita River. The U.S. Hwy 82 bridge over the Ouachita River (Ashley-Union counties) had 581 nests, and when combined with 4 smaller bridges in the immediate vicinity, made a total of 1,065 nests (Appendix). The large bridges over the Ouachita River at Camden (U.S. Hwy. 79, Ouachita county) and at Arkadelphia (AR St. Hwy. 7, Clark county) supported a few nests (some of which were not readily visible, so an accurate count could not be made). The steel bridge over the Ouachita at Malvern (I-30, Hot Spring County) appeared to be void of nests, but several nests were present on the Ouachita River bridge at U.S. Hwy. 67 in Hot Spring County.

The nature of bridge construction is the likely cause for this distribution and the number of nests seen. Bridges with few or no nests were constructed with longitudinal support beams of steel, and no concrete lip was available as a nesting site along the side of the bridge. Nests on most bridges over the Ouachita and Red rivers were found almost exclusively on the concrete portions of those bridges. Concrete bridges are strongly preferred, likely due to the better ability of the nest to adhere to this material (Brown and Brown 1995).

Cliff Swallows nest throughout the western United States and prefer open areas for foraging, a source of mud of appropriate consistency to build nests, and an elevated vertical cliff face

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with a horizontal overhang on which to build the nest (Emlen 1954, Brown and Brown 1995). Although promoted by the construction of concrete bridges, movement of Cliff Swallows into the southeastern United States has been gradual. Lands in the southeast are largely forested, which limits the openness needed for foraging. Further, damp conditions observed under several bridges at the time of this survey (causing several nests of Barn Swallows to slide free of the concrete) and rust on metal parts indicate that many otherwise acceptable bridges may not be selected by Cliff Swallows because their nests cannot adhere to the surface.

Nests of Barn Swallows were found in all counties surveyed, and they were encountered much more commonly than those of Cliff Swallows (Fig. 1B, Appendix). The needs of Barn Swallows, however, are similar to those of Cliff Swallows. James and Neal (1986) noted that Barn Swallows tend to be absent from heavily forested areas. The open area created by a wide road and its mowed right-of-way apparently is adequate to sustain a few nests, particularly if open fields also occur in the vicinity.

Barn Swallows often nested in areas not selected by Cliff Swallows. They sometimes nested in sites that were within 2 m of the ground or water and under smaller bridges. In contrast, most nests of Cliff Swallows were at least 3 m (and usually >5 m) above the surface. Both species nested under the same bridge in many cases, but the nests tended to be in different areas of the bridge. Still, on several occasions I found nests of Cliff Swallows that were built on top of old nests of Barn Swallows – a phenomenon also observed in other studies (Mayhew 1958, Samuel 1971). At larger bridges, nests of Barn Swallows tended to be isolated from groups of Cliff Swallow nests.

Nests of Barn Swallows were commonly found under steel bridges that apparently were not suitable for Cliff Swallows. Rust or paint make adhesion of mud nests difficult, but under those conditions Barn Swallows opted to seat their nests on the outward lip of I-beams or place them on top of steel support beams. In West Virginia, Samuel (1971) noted that these stant nests (with an under support) are less common than adherent ones in Barn Swallows, and that Cliff Swallows used only adherent nests. At some locations, I found nests of Barn Swallows constructed at almost every steel joint that provided seating.

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Appendix. Localities of bridges at which nests of Cliff Swallows and Barn Swallows were located. Numbers in parentheses following localities represent the number of intact nests observed at each site.

Petrochelidon pyrrhonota (Cliff Swallow)

Ashley County: Ouachita River relief on U.S. Hwy. 82 (Sec. 13, T18S, R10W) (135); Ouachita River relief #2 at U.S. Hwy. 82 (Sec. 13, T18S, R10W) (1); Ouachita River at U.S. Hwy. 82 (Sec. 14, T18S, R10W) (446). **Bradley County:** Saline River at U.S. Hwy. 278 (Sec. 2/3, T13S, R9W) (8). **Clark County:** Caney Creek at AR St. Hwy. 7 (Sec. 31, T6S, R19W) (96); Caddo River at AR St. Hwy. 7 (Sec. 31, T6S, R19W) (27); DeRoche Creek at U.S. Hwy. 67 (Sec. 22, T6S, R19W) (90); Saline Bayou at AR St. Hwy. 7 (Sec. 15, T7S, R19W) (59); Ouachita River at AR St. Hwy. 7 (Sec. 16, T7S, R19W) (>20). **Cleveland County:** Saline River overflow at U.S. Hwy. 79 (Sec. 33, T9S, R11W) (2). **Hempstead County:** Red River at U.S. Hwy. 67 (Sec. 20, T13S, R26W) (40). **Hot Spring County:** Ouachita River at U.S. Hwy. 67 (Sec. 14, T6S, R19W) (1); Ouachita River at U.S. Hwy. 67 (Sec. 5, T6S, R18W) (93); Ouachita River relief at U.S. Hwy. 67 (Sec. 4, T6S, R18W) (4); Ouachita River relief #2 at U.S. Hwy. 67 (Sec. 4, T6S, R18W) (13). **Howard County:** Saline River at U.S. Hwy. 278 (Sec. 25/26, T6S, R29W) (3); Saline River at U.S. Hwy. 70 (Sec. 3, T8S, R29W) (23); Rock Creek at U.S. Hwy. 70 (Sec. 36, T7S, R29W) (38); Holly Creek at U.S. Hwy. 278 (Sec. 29, T7S, R28W) (1 + 29 broken); Little Holly Creek at U.S. Hwy. 278 (Sec. 34, T7S, R28W) (38); Messer Creek at U.S. Hwy. 278 (Sec. 15, T8S, R28W) (19); Coleman Creek at U.S. Hwy. 371 (Sec. 22/27, T9S, R27W) (52). **Lafayette County:** Red River at AR St. Hwy. 160 (Sec. 22, T19S, R27W) (1,136); Red River at U.S. Hwy. 82 (Sec. 18, T16S, R25W) (3,198). **Lincoln County:** Bayou Bartholomew at AR St. Hwy. 11 (Sec. 1, T9S, R7W) (1). **Little River County:** Little River at AR St. Hwy. 41 (Sec. 10, T10S, R32W) (3); Little River relief at AR St. Hwy. 41 (2 bridges, Sec. 15, T10S, R32W) (1). **Miller County:** Red River at U.S. Hwy. 67 (Sec. 20, T13S, R26W) (40); Sulphur River at AR St. Hwy. 237 (Sec. 27/28, T17S, R28W) (53); Sulphur River relief at U.S. Hwy. 71 (Sec. 3, T19S, R27W) (36); Sulphur River at U.S. Hwy. 71 (Sec. 34, T18S, R27W) (264); McKinney Bayou at AR St. Hwy. 134 (Sec. 6, T18S, R26W) (52); Red River at U.S. Hwy. 82 (Sec. 18, T16S, R25W) (1,091). **Nevada County:** Little Missouri River at AR St. Hwy. 53 (Sec. 3, T11S, R20W) (13). **Ouachita County:** White Oak Lake at AR St. Hwy. 387 (Sec. 29, T12S, R19W) (83); Brushy Creek at U.S. Hwy. 79 (Sec. 22, T12S, R16W) (5); Ouachita River at U.S. Hwy. 79 (Sec. 24, T13S, R17W) (>12). **Pike County:** Self Creek (Lake Greeson) at U.S. Hwy. 70 (Sec. 15, T6S, R26W) (60); Little Missouri River at U.S. Hwy. 70 (Sec. 13, T6S, R27W) (16); Little Missouri River at AR St. Hwy. 27 (Sec. 24, T8S, R26W) (35); Saline Creek at AR St. Hwy. 26 (Sec. 8, T8S, R24W) (3). **Sevier County:** Saline River at U.S. Hwy. 70 (Sec. 3, T8S, R29W) (23); Little Cossatot River at AR St. Hwy. 24 (Sec. 21, T9S, R30W) (39); Cossatot River relief at AR St. Hwy.

24 (Sec. 20, T9S, R30W) (4); Cossatot River at AR St. Hwy. 24 (Sec. 20, T9S, R30W) (38); Little River at AR St. Hwy. 41 (Sec. 10, T10S, R32W) (3). **Union County:** Ouachita River at U.S. Hwy. 82 (Sec. 14, T18S, R10W) (164); Ouachita River relief at U.S. Hwy. 82 (Sec. 15, T18S, R10W) (72); Deep Slough at U.S. Hwy. 82 (Sec. 17, T18S, R10W) (194); Lapoile Creek at U.S. Hwy. 82 (Sec. 18, T18S, R10W) (54).

Hirundo rustica (Barn Swallow)

Ashley County: Fountain Creek at AR St. Hwy. 133 (Sec.10/11, T16S, R8W) (11); Fountain Creek at U.S. Hwy. 425 (Sec.16, T16S, R7W) (4); trib. to Fountain Creek at U.S. Hwy. 425 (Sec. 4, T16S, R7W) (3); Flat Creek at U.S. Hwy. 425 (Sec. 29, T15S, R7W) (8); Big Brushy Creek at AR St. Hwy. 133 (Sec. 33, T17S, R8W) (7); Hanks Creek at U.S. Hwy. 82 (Sec. 16/21, T18S, R7W) (6); culvert at jct U.S. Hwys. 425 and 82 (Sec. 21, T18S, R7W) (53); trib. to Chemin-a-haut Creek at U.S. Hwy. 425 (Sec. 3, T17S, R7W) (5); Ouachita River relief at U.S. Hwy. 82 (Sec.13, T18S, R10W) (6); Ouachita River relief #2 at U.S. Hwy. 82 (Sec. 13, T18S, R10W) (15); Ouachita River at U.S. Hwy. 82 (Sec.14, T18S, R10W) (36); Perkins Slough at U.S. Hwy. 82 (Sec. 20, T16S, R4W) (3). **Bradley County:** Franklin Creek at AR St. Hwy. 8 (Sec. 30, T12S, R9W) (2); Saline River at AR St. Hwy. 8 (Sec. 30, T15S, R8W) (4); Moro Creek at AR St. Hwy. 160 (Sec. 9, T15S, R12W) (1); Beech Creek at AR St. Hwy. 160 (Sec. 5, T15S, R11W) (8); L'Aigle Creek relief at AR St. Hwy. 160 (Sec. 1, T15S, R11W) (2); L'Aigle Creek at AR St. Hwy. 160 (Sec. 1, T15S, R11W) (1); Snake Creek at AR St. Hwy. 160 (Sec. 8, T15S, R10W) (2). **Calhoun County:** Two Bayou on U.S. Hwy. 278 (Sec. 23/24, T13S, R16W) (28); Locust Bayou on U.S. Hwy. 278 (Sec. 32, T13S, R15W) (3); Dunn Creek at U.S. Hwy. 278 (Sec. 2, T14S, R14W) (3). **Chicot County:** Boeuf River at U.S. Hwy. 82 (Sec. 13, T16S, R3W) (3). **Clark County:** Caney Creek at AR St. Hwy. 7 (Sec. 31, T6S, R19W) (45); Caddo River at AR St. Hwy. 7 (Sec. 31, T6S, R19W) (4); DeRoche Creek at U.S. Hwy. 67 (Sec. 22, T6S, R19W) (24); Little Deceiper Creek at U.S. Hwy. 67 (Sec. 1, T8S, R20W) (4); Little Deceiper Creek at AR St. Hwy. 26 (Sec. 26, T7S, R20W) (3); Big Deceiper Creek at U.S. Hwy. 67 (Sec. 1, T8S, R20W) (4); unnamed bridge at U.S. Hwy. 67 (Sec. 12, T8S, R20W) (3); Terre Noire Creek at U.S. Hwy. 67 (Sec. 2, T9S, R20W) (6); Caney Creek at U.S. Hwy. 67 (Sec. 28, T9S, R20W) (3); Little McNeeley Creek at U.S. Hwy. 67 (Sec. 2/3, T10S, R21W) (3); Halfmoon Slough at U.S. Hwy. 67 (Sec. 7, T10S, R21W) (3); Little Missouri River at U.S. Hwy. 67 (Sec. 1, T10S, R22W) (4); Bell Creek at AR St. Hwy. 26 (Sec. 31, T7S, R21W) (1); Terre Noire Creek at AR St. Hwy. 26 (Sec. 31, T7S, R21W) (1); Antoine River at AR St. Hwy. 26 (Sec. 24, T8S, R23W) (5); Saline Bayou at AR St. Hwy. 7 (Sec. 15, T7S, R19W) (54); Ouachita River at AR St. Hwy. 7 (Sec. 16, T7S, R19W) (>20). **Cleveland County:** L'Aigle Creek at AR St. Hwy. 8 (Sec. 22, T11S, R11W) (2); Hudgin Creek at AR St. Hwy. 114 (Sec. 11/14, T9S, R9W) (3); Brushy Creek at AR St. Hwy. 114 (Sec. 10, T9S, R10W) (1); Big Creek at AR St. Hwy. 114 (Sec.10, T9S, R10W)

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(2); Saline River at U.S. Hwy. 79 (Sec. 27, T9S, R11W) (7); Saline River overflow at U.S. Hwy. 79 (Sec. 33, T9S, R11W) (1); unnamed bridge at U.S. Hwy. 79 (Sec. 9, T10S, R12W) (1). **Columbia County:** Dorcheat Bayou at AR St. Hwy. 160 (Sec. 9, T19S, R22W) (2). **Dallas County:** Cypress Creek at AR St. Hwy. 8 (Sec. 13, T8S, R17W) (2); W. Tulip Creek at AR St. Hwy. 8 (Sec. 33, T8S, R16W) (8); Brown's or Hall's Creek at AR St. Hwy. 8 (Sec. 35, T8S, R16W) (2); E. Tulip Creek at AR St. Hwy. 8 (Sec. 34, T8S, R15W) (3); Cook's Creek at AR St. Hwy. 8 (Sec. 18, T10S, R13W) (5); trib. to Moro Creek at U.S. Hwy. 79 (Sec. 16, T10S, R12W) (1); vic. Saline River at U.S. Hwy. 167 (2 bridges, Sec. 15, T7S, R13W) (6). **Drew County:** S. Fork Panther Creek at U.S. Hwy. 425 (Sec. 8, T15S, R7W) (2); Brown Creek at U.S. Hwy. 425 (Sec. 21, T14S, R7W) (6). **Grant County:** Brush Creek at AR St. Hwy. 229 (Sec. 3, T6S, R15W) (7); Brush Creek at AR St. Hwy. 222 (Sec. 8, T6S, R15W) (2); Bradley Creek at AR St. Hwy. 229 (Sec. 3, T6S, R15W) (4); Mud Creek at AR St. Hwy. 229 (Sec. 21, T5S, R15W) (6); Husky Creek at AR St. Hwy. 229 (Sec. 16, T5S, R15W) (7); Clear Creek at AR St. Hwy. 229 (Sec. 17, T5S, R15W) (3); Big Creek at AR St. Hwy. 229 (Sec. 5, T5S, R15W) (6); Francois Creek at U.S. Hwy. 270 (Sec. 4, T5S, R15W) (30); trib. to Francois Creek at U.S. Hwy. 270 (2 bridges, Sec. 2, T5S, R15W) (11); Saline River at U.S. Hwy. 270 (Sec. 2, T5S, R15W) (14); Gambles Slough at U.S. Hwy. 167 (Sec. 10, T7S, R13W) (1); Gambles Slough relief at U.S. Hwy. 167 (Sec. 10, T7S, R13W) (5). **Hempstead County:** Garland Creek at U.S. Hwy. 67 (Sec. 8, T12S, R23W) (5); Terre Rouge Creek at U.S. Hwy. 67 (Sec. 18, T12S, R23W) (20); Caney Creek at U.S. Hwy. 278 (Sec. 24, T12S, R25W) (3); Town Creek at U.S. Hwy. 278 (Sec. 35, T11S, R25W) (3); unnamed bridge E of Fulton on U.S. Hwy. 67 (Sec. 14, T13S, R26W) (1). **Hot Spring County:** Ouachita River relief at U.S. Hwy. 67 (Sec. 4, T6S, R18W) (40); Ouachita River relief #2 at U.S. Hwy. 67 (Sec. 4, T6S, R18W) (30); Ouachita River at U.S. Hwy. 67 (Sec. 5, T6S, R18W) (12); L'Eau Frais Creek at AR St. Hwy. 222 (Sec. 15, T6S, R17W) (2). **Howard County:** Holly Creek at U.S. Hwy. 70 (Sec. 9, T7S, R28W) (1); Saline River at U.S. Hwy. 278 (Sec. 25/26, T6S, R29W) (18); Rock Creek at U.S. Hwy. 70 (Sec. 36, T7S, R29W) (8); Holly Creek at U.S. Hwy. 278 (Sec. 29, T7S, R28W) (3); Little Holly Creek at U.S. Hwy. 278 (Sec. 34, T7S, R28W) (13); Messer Creek at U.S. Hwy. 278 (Sec. 15, T8S, R28W) (19); Sandy Branch at U.S. Hwy. 278 (Sec. 36, T9S, R27W) (2); Mine Creek at AR St. Hwy. 27 (Sec. 25, T9S, R27W) (2); Coleman Creek at U.S. Hwy. 371 (Sec. 22/27, T9S, R27W) (20); Dillard Creek at U.S. Hwy. 371 (Sec. 30, T9S, R27W) (14); Blue Bayou at U.S. Hwy. 371 (Sec. 26, T9S, R28W) (3); Rock Creek on U.S.

Hwy. 371 (Sec. 21, T9S, R28W) (1); Prairie Creek on U.S. Hwy. 371 (Sec. 24, T9S, R29W) (11); Saline River relief at U.S. Hwy. 371 (Sec. 23, T9S, R29W) (1); Saline River at U.S. Hwy. 371 (Sec. 23, T9S, R29W) (5). **Lafayette County:** Red River at U.S. Hwy. 82 (Sec. 18, T16S, R25W) (2); Field Bayou at U.S. Hwy. 82 (Sec. 18, T16S, R24W) (1); Lake Erling at AR St. Hwy. 360 (Sec. 9, T18S, R24W) (6). **Lincoln County:** Bayou Bartholomew at AR St. Hwy. 11 (Sec. 1, T9S, R7W) (4). **Little River County:** Little River relief at AR St. Hwy. 41 (2 bridges, Sec. 15, T10S, R32W) (4); Lick Creek at AR St. Hwy. 234 (Sec. 1/12, T12S, R30W) (2); Little River at U.S. Hwy. 71 (Sec. 25, T11S, R30W) (4). **Miller County:** Days Creek at AR St. Hwy. 237 (Sec. 33, T16S, R28W) (1); Sulphur River at AR St. Hwy. 237 (Sec. 27/28, T17S, R28W) (6); Sulphur River relief at U.S. Hwy. 71 (Sec. 3, T19S, R27W) (6); McKinney Bayou at AR St. Hwy. 134 (Sec. 6, T18S, R26W) (3); E. Fork Kelly Bayou at AR St. Hwy. 160 (Sec. 12, T19S, R27W) (1). **Nevada County:** Cypress Creek at U.S. Hwy. 278 (Sec. 35, T13S, R20W) (4); Snake Branch at AR St. Hwy. 53 (Sec. 10, T11S, R20W) (1). **Ouachita County:** Freeo Creek at AR St. Hwy. 7 (Sec. 13, T12S, R17W) (5); White Oak Lake at AR St. Hwy. 387 (Sec. 29, T12S, R19W) (24); Smackover Creek at AR St. Hwy. 7 (Sec. 32, T15S, R16W) (5); Brushy Creek at U.S. Hwy. 79 (Sec. 22, T12S, R16W) (3); Woodard Lake at U.S. Hwy. 79 (Sec. 8, T13S, R16W) (1); Little Taylor Creek at U.S. Hwy. 278 (Sec. 1, T14S, R14W) (3); Champagnolle Creek at U.S. Hwy. 278 (Sec. 6, T14S, R13W) (3); Ouachita River at U.S. Hwy. 79 (Sec. 24, T13S, R17W) (>6). **Pike County:** Antoine River at AR St. Hwy. 84 (Sec. 4, T6S, R24W) (6); Little Missouri relief at AR St. Hwy. 27 (Sec. 24, T8S, R26W) (6); Little Missouri River at AR St. Hwy. 27 (Sec. 24, T8S, R26W) (16); Lake Slough at AR St. Hwy. 27 (Sec. 18, T8S, R25W) (11); Saline Creek at AR St. Hwy. 26 (Sec. 8, T8S, R24W) (5); Wolf Creek at AR St. Hwy. 26 (Sec. 19, T8S, R23W) (9); Mill Creek at AR St. Hwy. 26 (Sec. 20, T8S, R23W) (1). **Sevier County:** Big Bellville Creek at U.S. Hwy. 371 (Sec. 23, T9S, R30W) (1); Little Cossatot River at AR St. Hwy. 24 (Sec. 21, T9S, R30W) (6); Cossatot River relief at AR St. Hwy. 24 (Sec. 20, T9S, R30W) (4); Cossatot River at AR St. Hwy. 24 (Sec. 20, T9S, R30W) (3). **Union County:** Ouachita River at U.S. Hwy. 82 (Sec. 14, T18S, R10W) (40); Ouachita River relief at U.S. Hwy. 82 (Sec. 15, T18S, R10W) (12); Deep Slough at U.S. Hwy. 82 (Sec. 17, T18S, R10W) (12); Lapoile Creek at U.S. Hwy. 82 (Sec. 18, T18S, R10W) (4); Lapile Creek at U.S. Hwy. 82 (Sec. 34, T18S, R12W) (6); Cannon Creek at U.S. Hwy. 82 (Sec. 26, T18S, R12W) (4); Holmes Creek at AR St. Hwy. 7 (Sec. 12, T16S, R16W) (3); Smackover Creek relief at AR St. Hwy. 7 (2 bridges, Sec. 32, T15S, R16W) (10).