

Partial Report to
Natural Resources and Enforcement Division
Directorate of Environmental Quality
Fort Sill Military Reservation
Fort Sill, Oklahoma

Contract No: DABT39-99-M-0181

Freshwater Mussels of Fort Sill Military Reservation

By

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INTRODUCTION

Freshwater mussels (Bivalvia: Unionacea) are one of the most imperiled groups in the world (Bogan 1993). In North America alone, 70% of the mussel fauna is either federally listed as endangered or threatened or considered to be in need of some protection (Neves 1993, Williams et al. 1993, U.S. Fish and Wildlife Service 1995, 1996). Further, in most cases not only are rare mussel species declining, but populations of more common species are also undergoing decline and becoming extirpated (Neves et al. 1997, Vaughn 1997, Vaughn & Taylor 1999, Vaughn 2000). The purpose of this study was to document the distribution and abundance of mussels in ponds and streams on the Fort Sill Military Reservation. This information can be used to manage current mussel populations and will establish a baseline that can be used for future monitoring efforts.

METHODS

We searched for mussels at 27 sites on Fort Sill Military Reservation. Twelve of the sites were ponds. We sampled seven streams, with some streams having more than one sample location, for a total of 15 stream sites. Descriptions and maps of each of these sites are given in Appendix 1. At each site we first looked for relict shell material on the banks and in the water. The presence of relict shells and shell fragments indicates that mussels either currently occur at a site or were there historically. When shell material was found or the habitat looked otherwise appropriate, a systematic, timed search was conducted by snorkeling over the habitat for a defined period of time or grubbing in the substrate for a defined period of time (Vaughn et al. 1997). Mussel sampling was conducted in September and October, 1999. Mussels are most

likely to be found when water levels are at their lowest, which in southwestern Oklahoma is typically in the late summer and early fall.

Living mussels were identified in the field, in some instances their shells were measured, and then they returned to the pond or stream alive. Some limited voucher specimens were taken and these are housed in the Mollusk Collection of the Oklahoma Biological Survey. Dead shell and shell fragments were also collected and are housed at the OBS.

RESULTS & DISCUSSION

Fort Sill Military Reservation contains sparse mussel populations characterized by common species. This is not unexpected since Fort Sill is at the western edge of range for many mussel species (McMahon & Bogan 2001). We found twelve species of native freshwater mussels (family Unionidae) on Fort Sill Military Reservation (Table 1). Of the twelve native species, we found living specimens of seven species, and five species were represented by relict shells alone. All of the mussel species that occur on Fort Sill Military Reservation are widespread and fairly common in this area of the country. We found no mussel species with special federal or state status or that are considered rare (Williams et al. 1993). In addition, we found both living and relict Asian clams (*Corbicula fluminea*), an exotic bivalve introduced from Asia that has spread across the United States (McMahon & Bogan 2001).

Living freshwater mussels were found in only one stream, East Cache Creek, and four ponds, Ketch Lake, Lake Elmer Thomas, Logon Pond, and Pottawatamie Twins Lake, on Fort Sill Military Reservation (Table 2; Appendix 1). Live *Corbicula* occurred in Medicine Creek and Logan Pond.

The most diverse and abundant mussel populations occurred in East Cache Creek and Logan Pond (Table 2; Appendix 1). Pottawatamie Twins Lake contained an abundant population of one species, *Pyganodon grandis*. The Archery Range site on Medicine Creek contained several species of relict shells indicating that it recently supported mussel populations. Ketch Creek and Post Oak Creek contained no evidence of bivalve populations. West Cache Creek and Beef Creek contained relict *Corbicula* shells, but no evidence of native mussels, living or dead. A relict shell of a common mussel species was found at one site on Blue Beaver Creek, but otherwise this creek only contained relict *Corbicula* shells. No living or relict bivalves were found in Frisco Twins Pond, Jackson Hole Pond, Man Dam Pond, Natches Pond and Shinnecock Pond.

RECOMMENDATIONS

East Cache Creek, Logan Pond, and Pottawatamie Twins Lake should be managed to sustain their native mussel populations. The primary threat to mussel populations at these sites is probably siltation as a result of runoff from military activities on or near the banks. Mussels are sedentary filter feeders that are rooted to approximately the same spot for their entire life span, which can be several decades. Because of this they are among the most sensitive organisms to siltation (Vaughn 1997). A heavy layer of silt can cause suffocation of an entire mussel bed. Maintaining the riparian area surrounding the water body and keeping heavy equipment away from banks should help prevent siltation in East Cache Creek, Logan Pond, and Pottawatamie Twins Lake.

The presence of a diversity of relict shells indicate that Medicine Creek at Archery Range once supported healthy mussel populations. In addition, this site currently supports a

population of exotic *Corbicula*. If this site is protected from siltation and other habitat degradation, mussel populations may be able to re-establish from downstream populations. There are living mussel populations downstream in Medicine Creek on the Wichita National Wildlife Refuge (Vaughn, pers. com.).

Some sites on Fort Sill Military Reservation should be monitored in the future to detect how mussel populations are faring. We will make recommendations concerning the location of monitoring sites, as well as further management recommendations, in the final report that will include information on all of the aquatic invertebrates of Fort Sill.

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Table 1. Mussel species of Fort Sill Military Reservation

Native species

Amblema plicata - Threeridge
Lampsilis teres - Yellow sandshell
Leptodea fragilis - Fragile papershell
Potamilus purpuratus - Bleufer
Pyganodon grandis - Fat floater
Quadrula quadrula - Pimpleback
Quadrula quadrula - Mapleleaf
Toxolasma parvus - Lilliput
Tritogonia verrucosa - Pistolgrip
Truncilla donaciformis - Fawnsfoot
Unio merus tetralasmus - Pondhorn
Utterbackia imbecillis - Paper pondshell

Exotic species

Corbicula fluminea - Asian clam

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Exotic species

Corbicula fluminea - Asian clam

Appendix 1. Site Descriptions.

Site name: Beef Creek

Collectors: Brian K. and Bernie E. Obermeyer

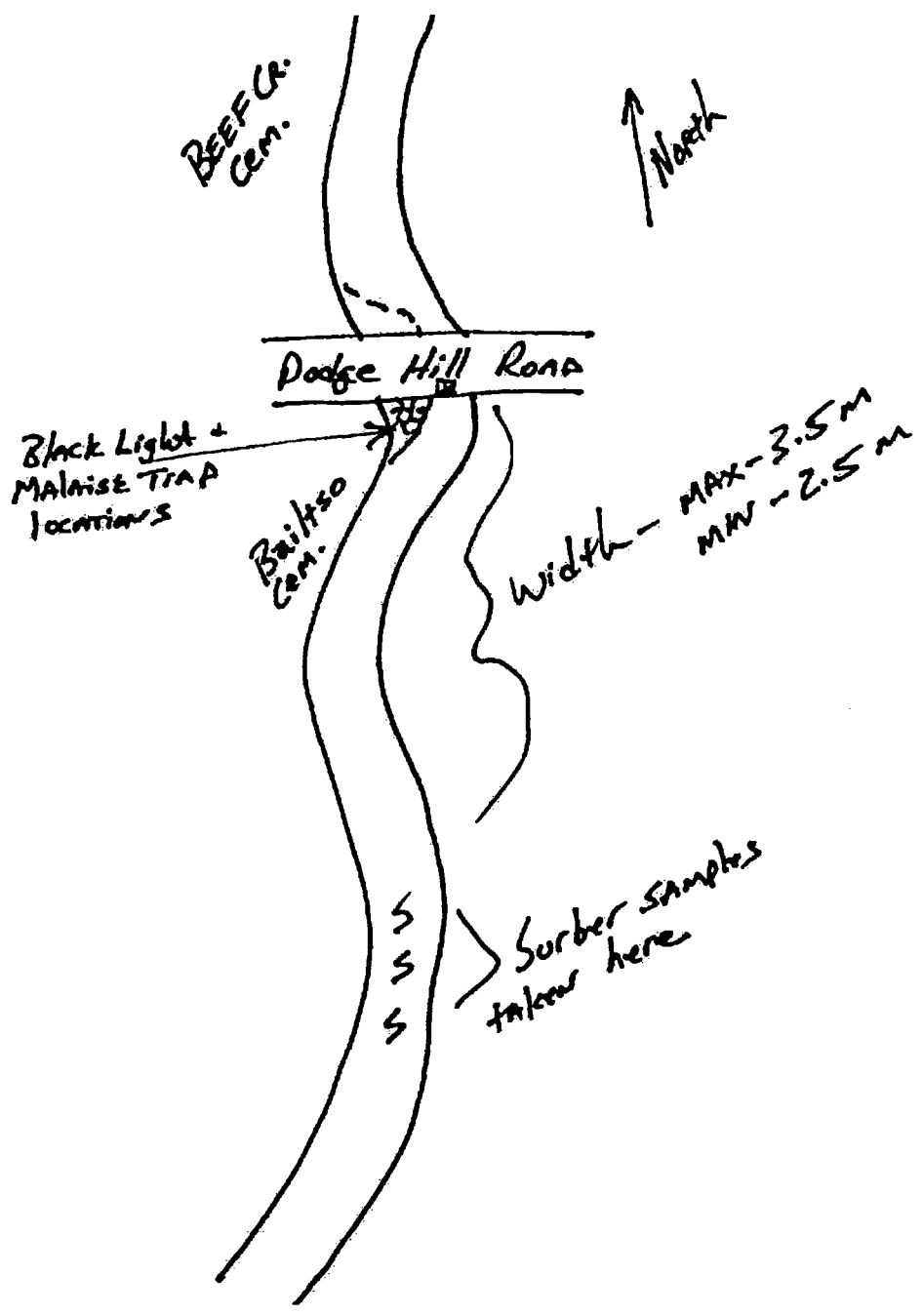
GPS coordinates (UTM 145):

0557653

3839373

Site description and remarks: Mussels were searched for downstream from the Dodge Hill Road bridge. The distance from the bridge to the water was 7 m, and the distance from top of bank to water was about 5.5 m. There was a well-developed riparian area both upstream and downstream from bridge (green ash, pecan, walnut, redbud, American elm, hackberry, bur oak, and cottonwood.).

Mussels: A mussel search was conducted from beneath bridge to where the stream turned westward (about 80 m downstream from bridge). The substrate was primarily gravel and fine sand. Sandy areas were very compacted. Concrete and military projectiles were found in this reach. Only one unionid valve of *Unio merus tetralasmus* was retrieved. A few *Corbicula* valves were found, along with one fingernail clam. (Comments: some of the reach was flowing while other areas were pooled.)



Beef Creek

Site name: Blue Beaver Creek (middle site)

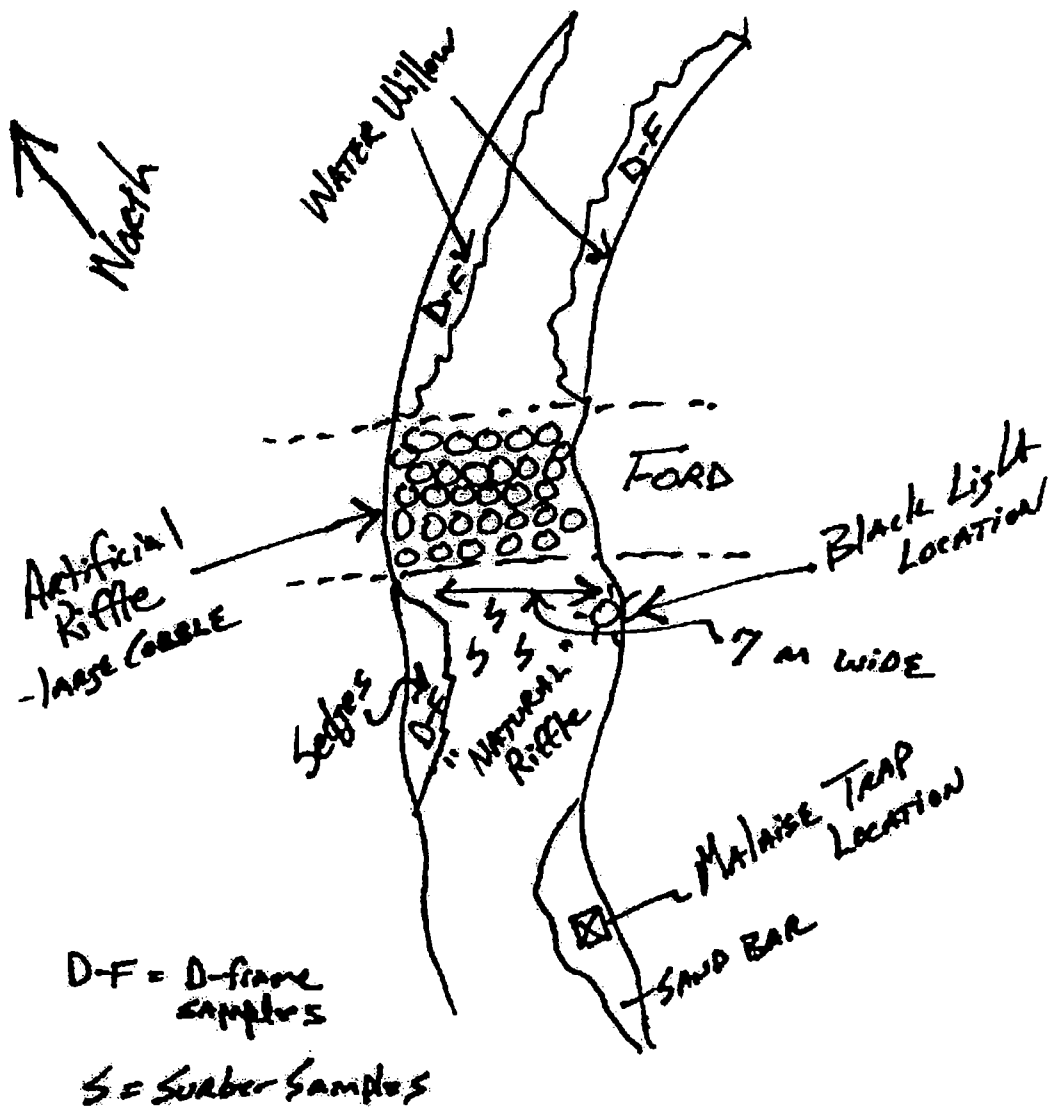
Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 14S):

0541417
3836950

Site description and remarks: This site looked stable, although the stream is being impacted by the road crossing. The substrate contained sand and gravel, but was dominated by granite cobble. No deep pools were located at this site. Water willow was abundant at this site, especially upstream from the crossing.

Mussels: This site was searched for mussels on 27 Sept. 1999. BEO searched site for mollusks, and found only a few *Corbicula* shells (nothing very recent).



Blue Beaver Creek
middle site

Site name: Blue Beaver Creek (North site)

Collectors: Brian K. and Bernie E. Obermeyer

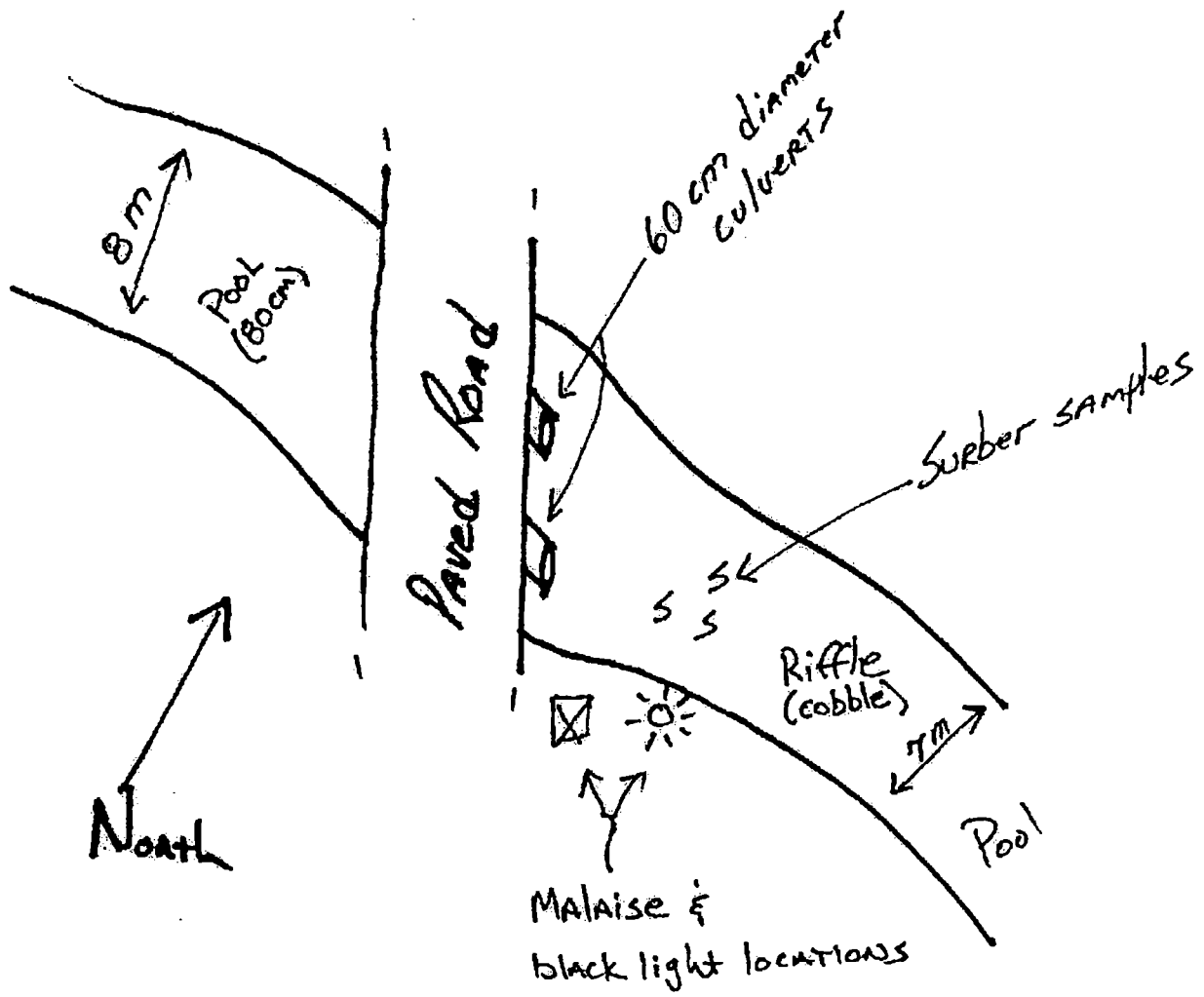
GPS coordinates (UTM 145):

0539787

3839809

Site description and remarks: The area sampled was immediately downstream from the low water bridge. The substrate was dominated by cobble and gravel. The site contained a nice, shaded riffle area.

Mussels: This site was searched for mussels on 27 Sept. 1999. BEO & BKO conducted a survey for mussels visual search for mussels in shallow water (by BKO) and on exposed gravel bars (BEO). No live mussels or dead shell material were found.



Blue Beaver Creek
north site

Site name: Blue Beaver Creek (South site)

Collectors: Brian K. and Bernie E. Obermeyer

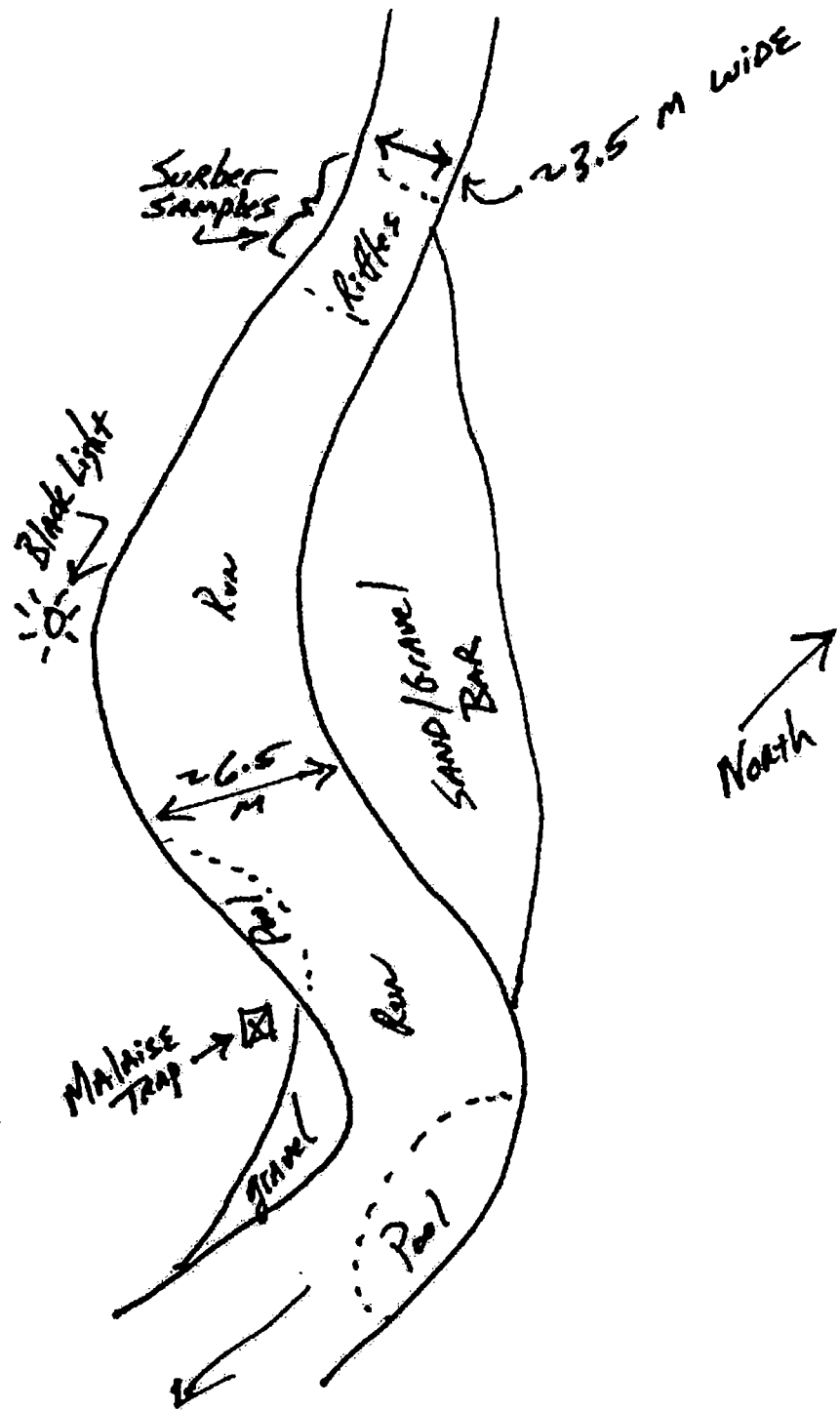
GPS coordinates (UTM 145):

0540843

3833544

Site description and remarks: This site contains several pools along with a nice stable riffle area. A steep cut bank lacking trees is situated on the west (right) side of stream. A large gravel bar is situated opposite of the cut bank. The riparian edge at the rest of site is about 75 to 100 m wide, with walnut, American elm, pecan, green ash, willow, and American plum. Evidence of beaver was observed. The substrate was comprised of sand, gravel and cobble. The water clarity was good. Algal growth was observed on the bottom sediment in shallow areas. Bass and carp were observed swimming in the stream. Maximum depth at the site ranged from 1 to 1.5 m.

Mussels: This site was searched for mussels on 27 Sept. 1999. Stream flow was marginal on this date. Water temperature (at elbow depth) was 19° C. BKO searched site for mollusks, and found only a few *Corbicula* shells (Blue Beaver *Corbicula* populations were not as abundant as sites located on West Cache Creek).



Blue Beaver Creek
south site

Site name: East Cache Creek @ Hoyle Bridge

Collectors: Brian K. and Bernie E. Obermeyer

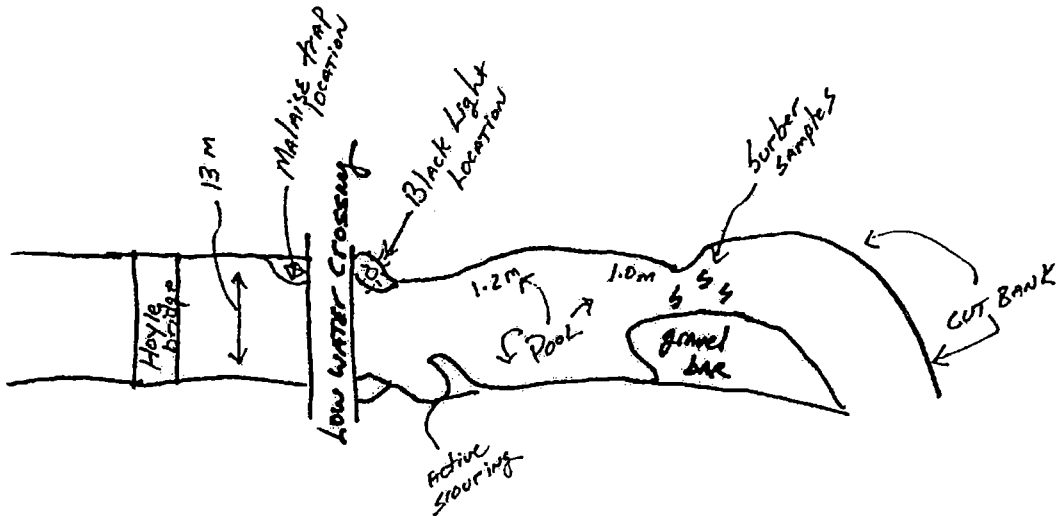
GPS coordinates (UTM 145):

0557485

3836613

Site description and remarks: Site appears to be relatively unstable. Lots of military debris. Low water bridge is located immediately upstream from where we sampled. A suspension bridge was located another 75 m upstream.

Mussels: Sampling for mussels was conducted on 3 October 1999. A 40 min. timed snorkel search for mussels was conducted in a 40 m reach of habitat downstream from the low water bridge. No live native mussels were collected, but a fresh *L. fragilis* was collected, along with weathered representatives of *T. verrucosa*, *P. purpuratus*, *L. teres*, *Q. pustulosa*, and *Q. quadrula*. Recently dead *Corbicula* were also observed. .



East Cache Creek
@ Hoyle Bridge

Site name: East Cache Creek @ Peach Tree Crossing

Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

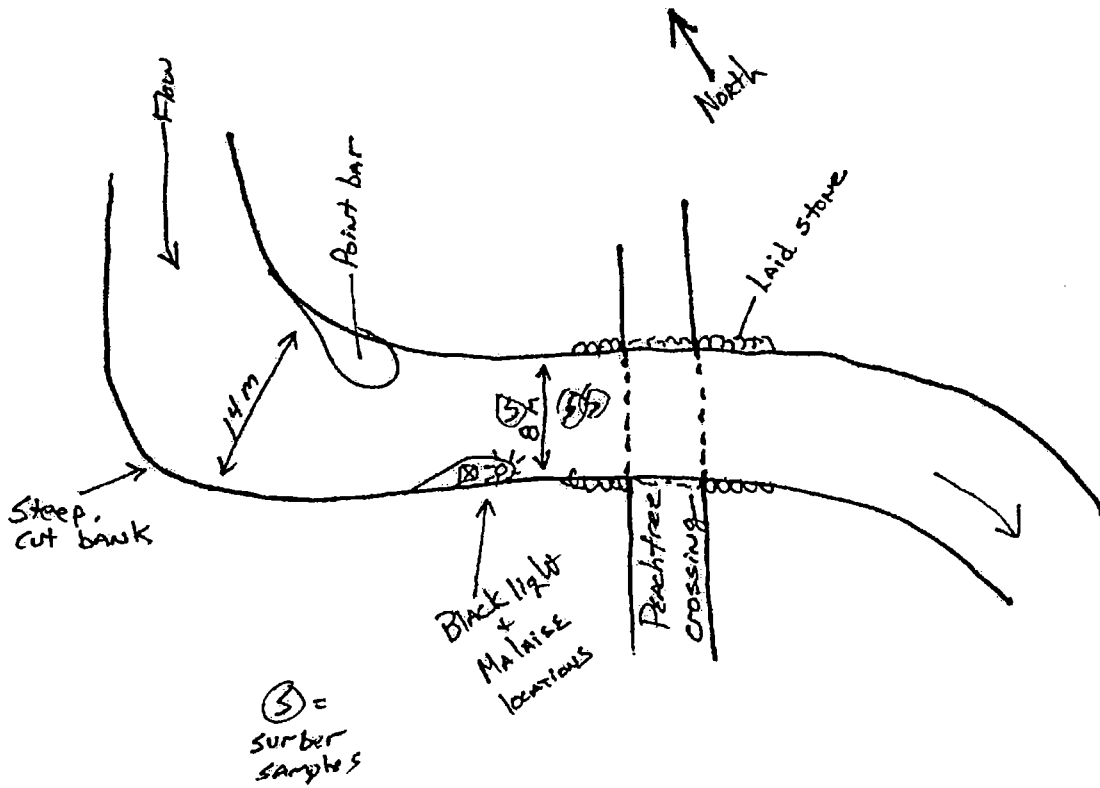
0556665

3838544

Site description and remarks: This site had stable substrate, consisting primarily of sand and gravel. There was quite a bit of woody debris mixed in the substrate, especially in the upstream portion of the sample area.

Mussels: BKO conducted an approximately one hour timed snorkel search (1523 to 1621; 58 minutes total) upstream of the bridge (from just below the upstream bend in river to about 10 m from bridge--about a 50 m reach (see attached map)). He found four live mussels: *T. verrucosa* (6 y old; 45 by 62 by 127mm), *Q. quadrula* (12 y old; 57 by 85 by 104mm), *P. purpuratus* (10 y old; 72 by 111 by 155mm), *P. grandis* (6 y old; 54 by 72 by 103). He also observed live and recently dead *Corbicula*.

Species	live	recent dead	weathered dead
<i>Lampsilis teres</i>	x
<i>Leptodea fragilis</i>	...	x	x
<i>Potamilus purpuratus</i>	1	x	x
<i>Pyganodon grandis</i>	1	...	x
<i>Quadrula pustulosa</i>	x
<i>Quadrula quadrula</i>	1	x	x
<i>Tritogonia verrucosa</i>	1



East Cache Creek
 @ Peach Tree Crossing

Site name: East Cache Creek at Swinging Bridge

Collectors: Brian K. and Bernie E. Obermeyer

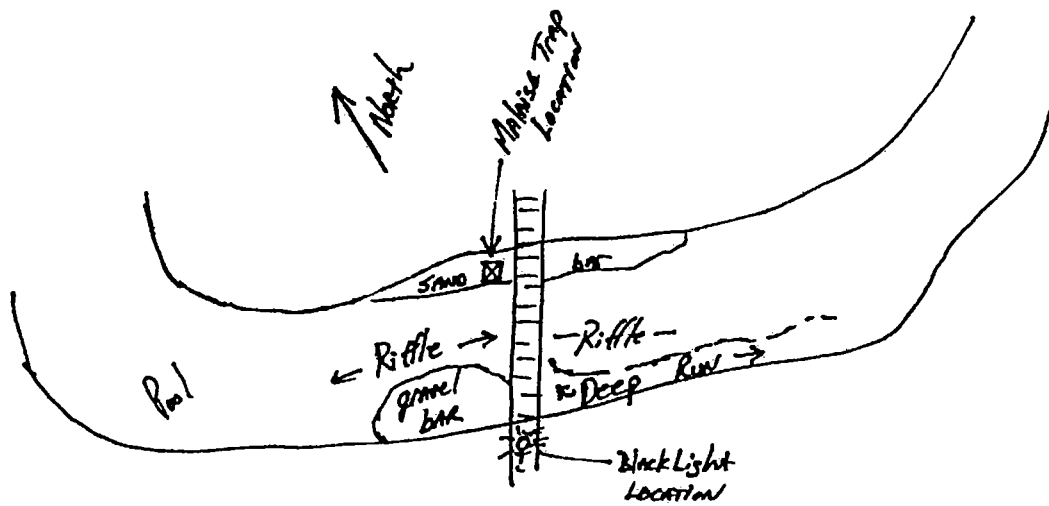
GPS coordinates (UTM 145):

0558117
3834600

Site description and remarks: This site is relatively secluded. A wooden pedestrian swinging bridge was located above the sampling site.

Mussels: This site was sampled for mussels on 13 Sept. 1999. BKO conducted a timed mussel search (1740 to 1808; 28 minutes) below and upstream of the swinging bridge in about a 40 m stretch of habitat. He collected one live *P. purpuratus* and several weathered valves of six additional species (see below for list of species represented by valves). BKO also collected *Corbicula* shells, but few that were very recent. Substrate consisted of areas with coarse sand and gravel along with areas of gravel. The predominantly sandy areas seemed unstable, whereas the gravel deposits were more stable.

Species	live	recent dead	weathered dead
<i>Lampsilis teres</i>	X
<i>Leptodea fragilis</i>	X
<i>Potamilus purpuratus</i>	1	X	X
<i>Pyganodon grandis</i>	X
<i>Quadrula pustulosa</i>	...	X	X
<i>Quadrula quadrula</i>	X
<i>Truncilla donaciformis</i>	X



East Cache Creek
@ Swinging Bridge

Site name: Ketch Creek

Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

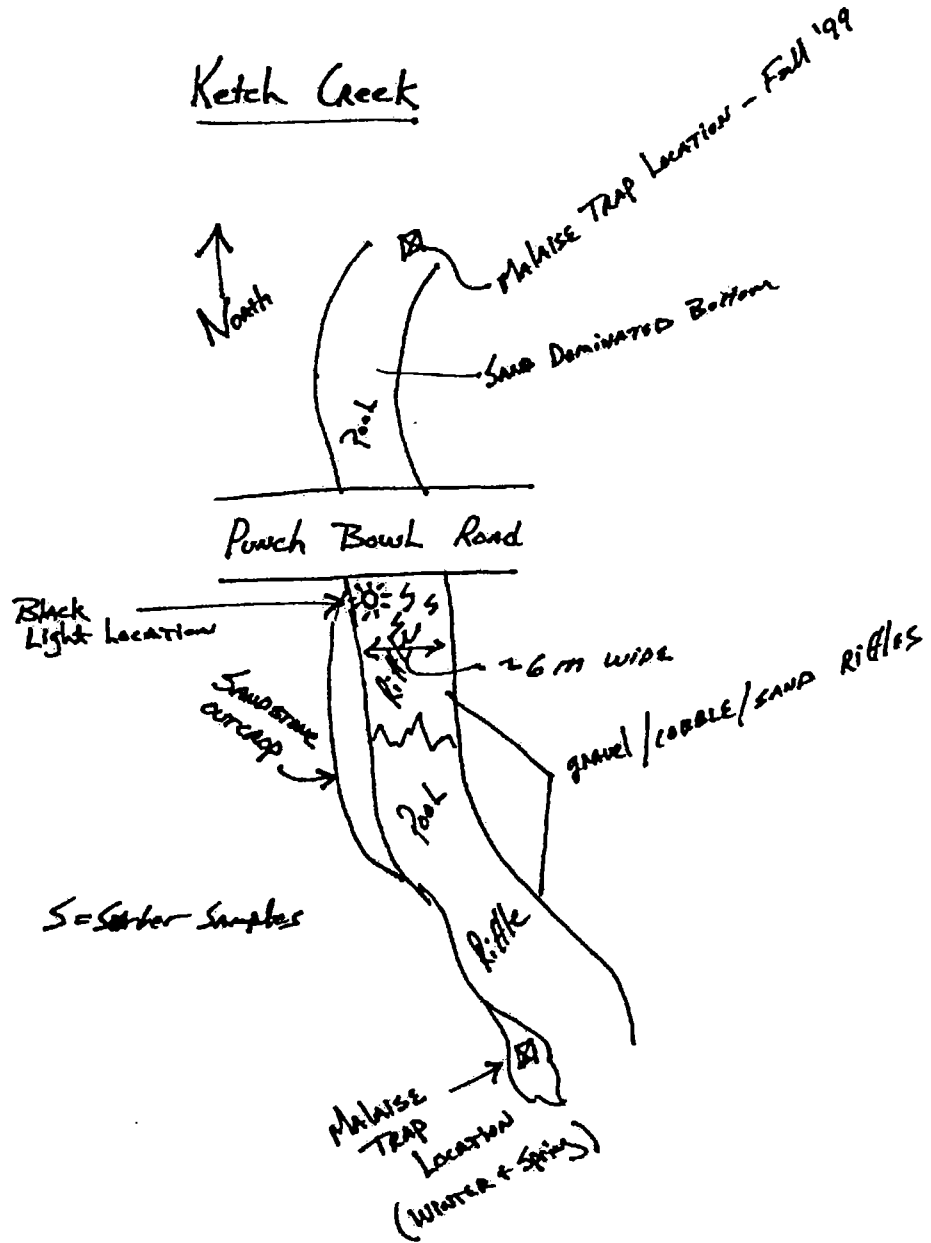
0551664

3840150

Site description and remarks: Ketch Creek is an intermittent, sandy stream. The stream was mostly dry during September, 1999.

Mussels: This site was searched for mussels on 12 Sept. 1999. Because the stream was mostly dry, with the exception of a few pools, a visual inspection of the stream bottom for mussel shells was possible. No live or dead shells were found, from about 35 m upstream and about 40 m downstream from the bridge.

Ketch Creek



Site name: Medicine Creek at 10-mile Crossing

Collectors: Brian K. and Bernie E. Obermeyer

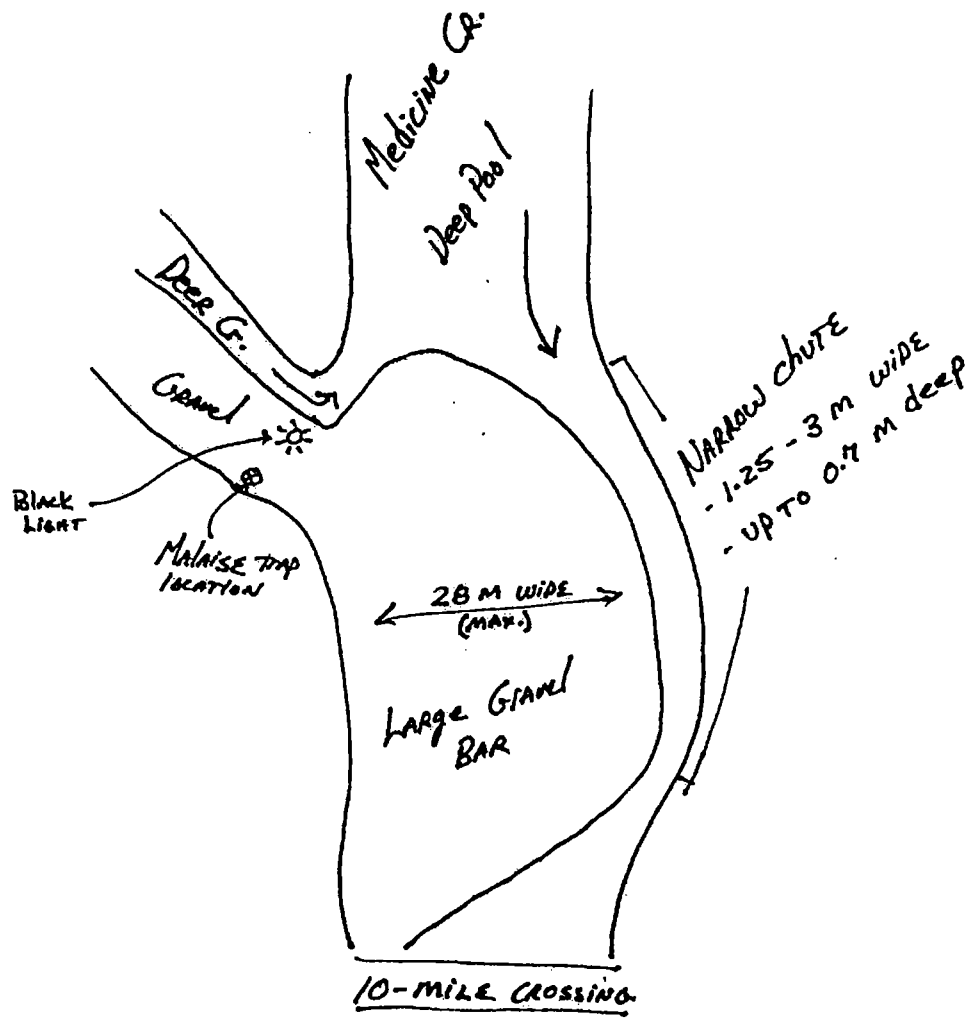
GPS coordinates (UTM 145):

0546536

3841817

Site description and remarks:

Mussels: There was no evidence of unionid mussels at this site. There was many live *Corbicula* at this site



Medicine Creek
@ 10 mile crossing

Site name: Medicine Creek at 4-mile Crossing

Collectors: Brian K. and Bernie E. Obermeyer

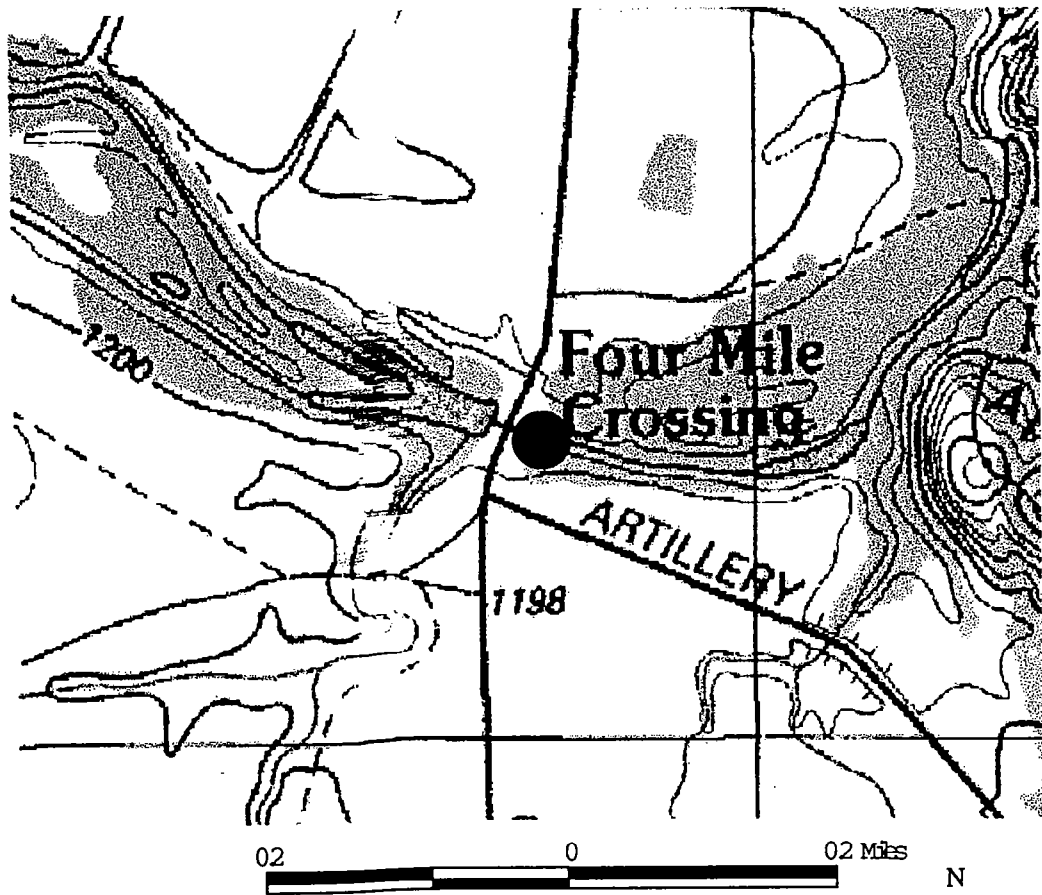
GPS coordinates (UTM 145):

0550770

3838523

Site description and remarks: Sampling occurred about 40 m downstream from the ford located at Four-mile crossing. This site was being negatively influenced by silt suspended by the ford crossing.

Mussels: This site was searched for mussels on 12 Sept. 1999. BKO began a groping search for mussels at the end of a long riffle (about 100 meter downstream from the 4-mile bridge). The start time for the mussel search was 1526 and the end time was 1600 (34 minutes). Most of the area sampled was in run habitat. Stream width was 3 to 4 m, and depth mostly ranged from 50 to 80 cm, along with a few shallow areas of ~15 cm. BKO also conducted a visual search in the shallow riffle habitat upstream. Water clarity was excellent, making the visual search viable. Despite the clear water, the substrate in the run habitat was covered with a layer of muck, which is probably a result of the ford crossing (used for heavy military equipment) immediately downstream from the bridge crossing. The substrate in the shallow riffle was relatively clean, and consisted of cobble/boulder along with coarse sand. A worn valve of *Tritogonia verrucosa* that lacked any periostracum was collected during the timed search but no live mussels were found. Also, worn fragments of other native mussels were found on the large gravel bar, but none were identifiable. There were lots of *Corbicula* shells found in the gravel deposits, though none were collected alive, and the dead shells of *Corbicula* were not fresh.



Medicine Creek
@ 4 mile crossing

Site name: Medicine Creek at Archery Range

Collectors: Brian K. and Bernie E. Obermeyer

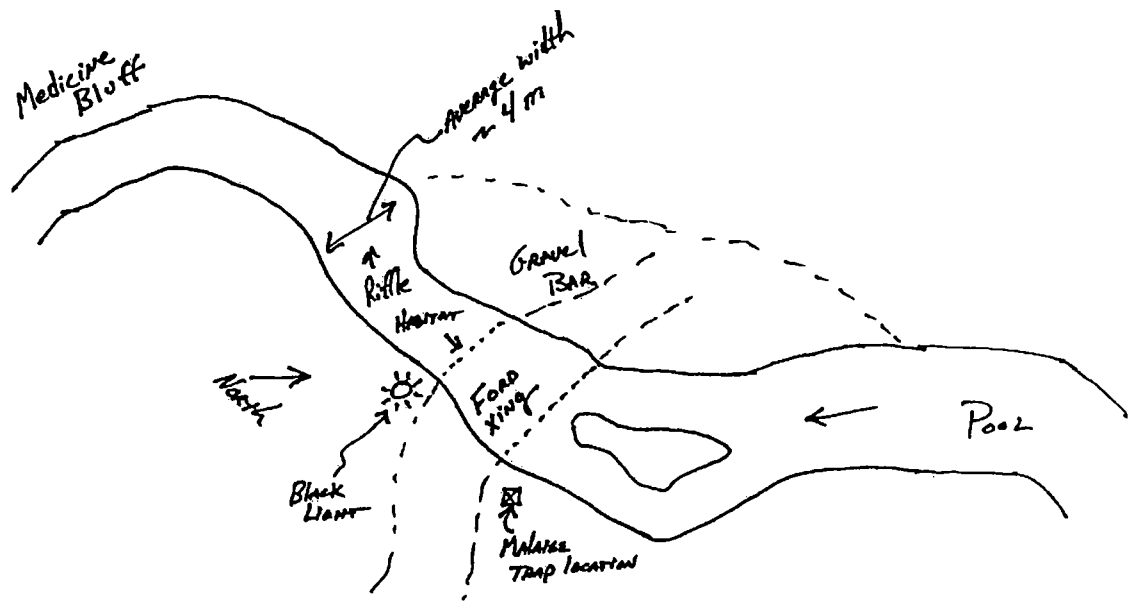
GPS coordinates (UTM 145):

0553048

3838755

Site description and remarks: Sampled just upstream from Medicine Mountain old ford site).

Mussels: This site was searched for mussels on 12 Sept. 1999. BKO searched for mussels using a snorkel and facemask in about a 100 m length of stream above ford (riffle/run habitat), and about a 35 m downstream (riffle/run habitat). The search began at 1013 and ended at 1106 (53 minutes). He did not collect any live native mussels, but did find eight live *Corbicula*. Shoreline and gravel bar searches yielded the following: *Leptodea fragilis* (1 weathered valve); *Lampsilis teres* (2 valves, both with periostracum and estimated to have been dead <5 years); *Tritogonia verrucosa* (4 valves, 1 with periostracum intact); *Potamilus purpuratus* (7 valves, ~2 of which was recent); *Amblema plicata* (1 weathered fragment); *Quadrula pustulosa* (1 weathered fragment).



Medicine Creek
@ Archery Range

Site name: Post Oak Creek

Collectors: Brian K. and Bernie E. Obermeyer

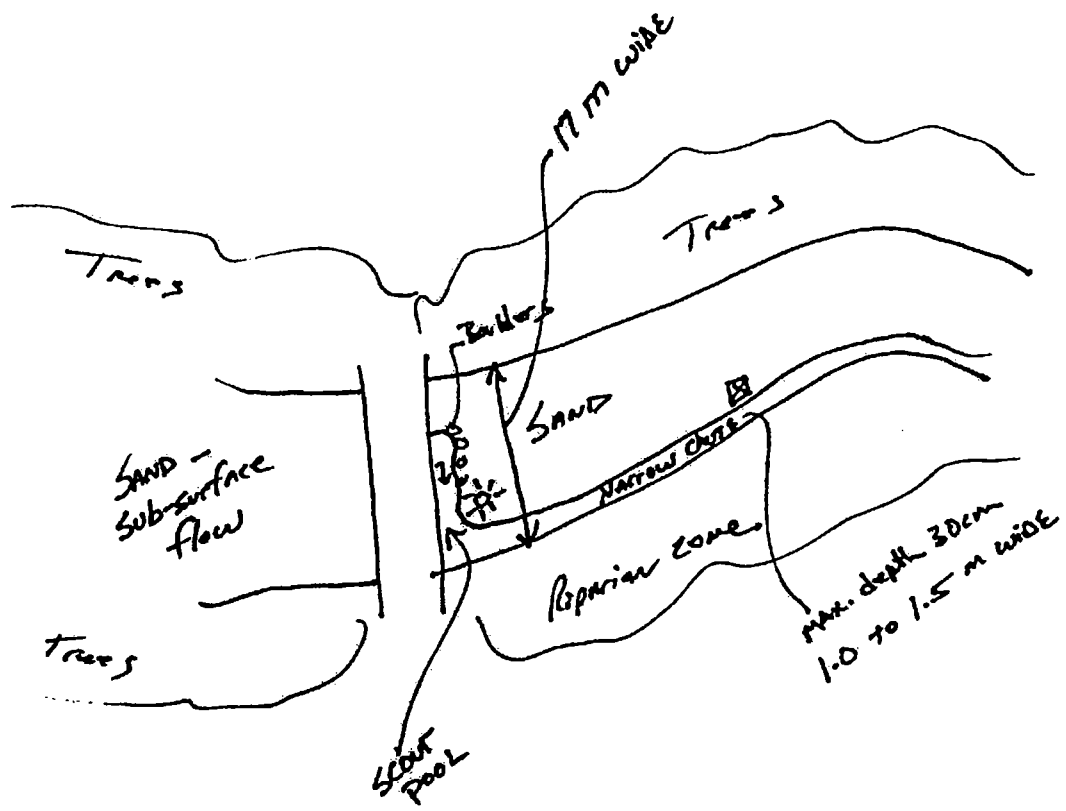
GPS coordinates (UTM 145):

0524484

3833379

Site description and remarks: This site was located at the first crossing heading north from the southern edge of the installation. Post Oak Creek is an intermittent, sandy stream, with some granite cobble and boulders. During summer, this stream likely has much if its flow below ground level.

Mussels: This site was sampled for mussels on 25 Sept. 1999. No flowing water was found at the site, only pooled areas. Water temperature in a pool directly below the bridge was very warm, 28° C. No mussel shells were detected.



Post Oak Creek

Site name: West Cache Creek (Middle site)

Collectors: Brian K. and Bernie E. Obermeyer

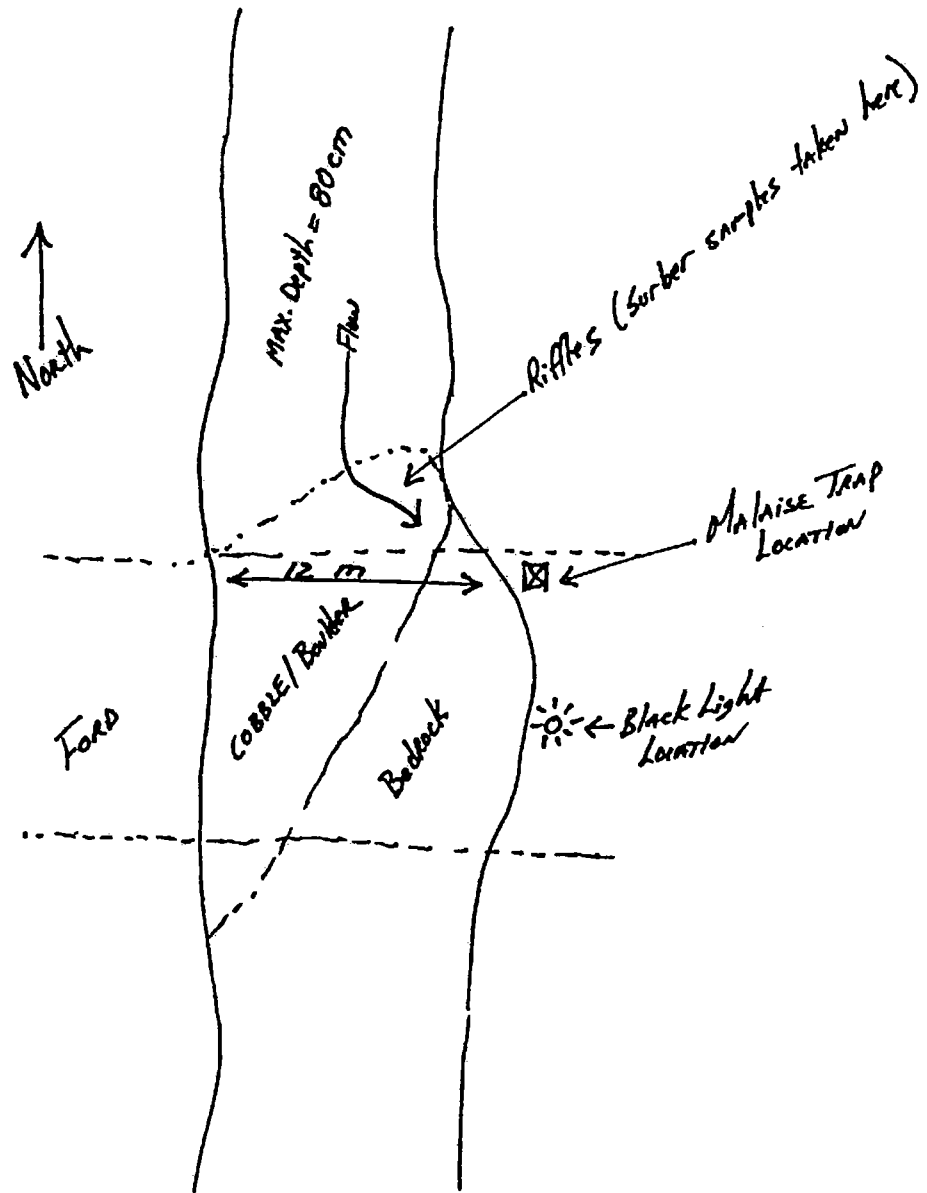
GPS coordinates (UTM 145):

0531365

3836238

Site description and remarks:

Mussels: BKO searched the site on 26 Sept. 1999. No unionids were observed.



West Cache Creek
middle site

Site name: West Cache Creek (North site)

Collectors: Brian K. and Bernie E. Obermeyer

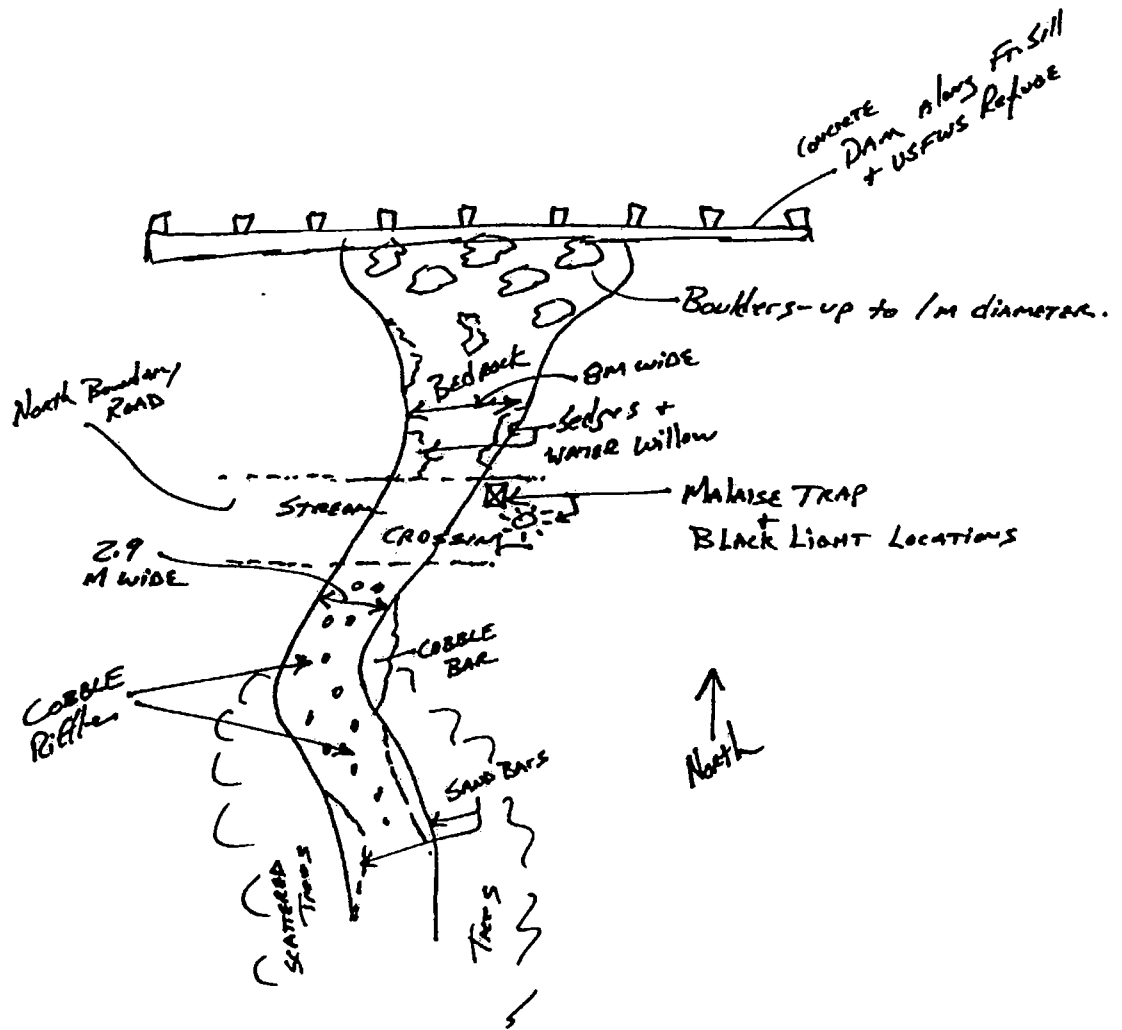
GPS coordinates (UTM 145):

0530687

3837777

Site description and remarks: Site is located immediately south of the USFWS Wichita Mountains Wildlife Refuge. There is a concrete dam located on the USFWS side, but did not appear to significantly impound water on the upstream side. Substrate consisted of sand and granite gravel, cobble and boulders. The dominant substrate in some of the riffles downstream from the crossing was cobble/gravel.

Mussels: No live mussels or dead shell material were found at this site.



West Cache Creek
north site

Site name: West Cache Creek (South site)

Collectors: Brian K. and Bernie E. Obermeyer

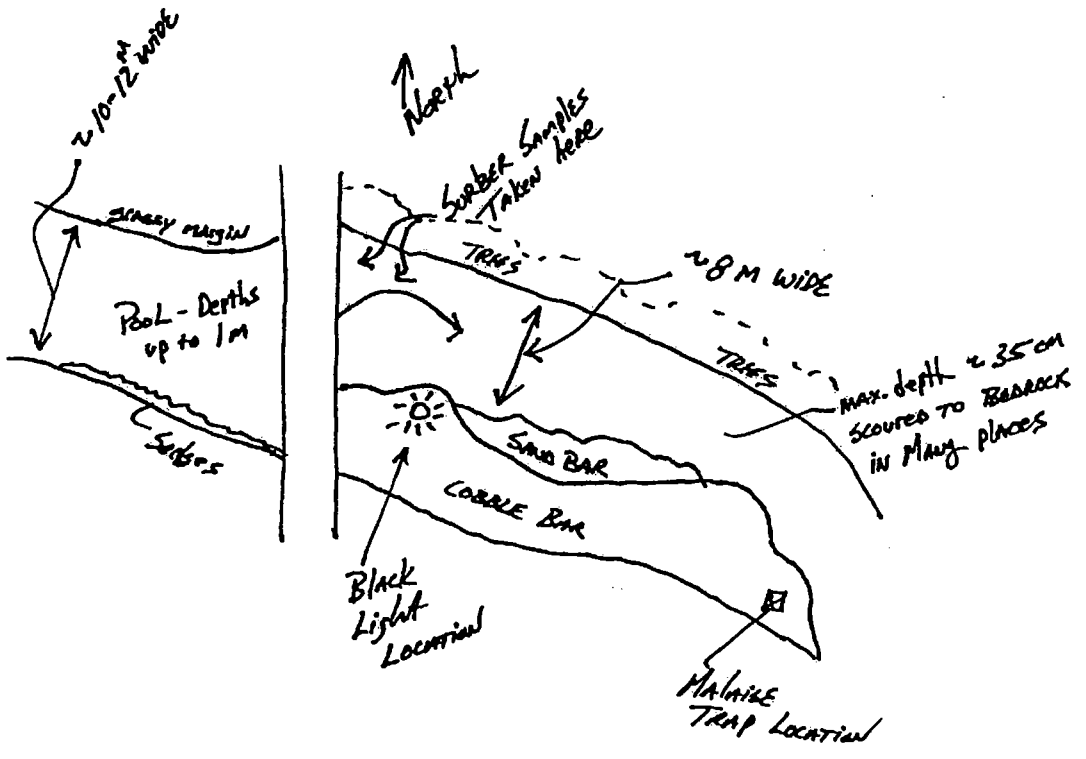
GPS coordinates (UTM 145):

0532047

3834308

Site description and remarks: This site is located above and below the road crossing on the southeast corner of Quanah Range. The upstream reach is somewhat impounded from the low-water bridge, whereas below the bridge the stream is somewhat scoured. Water depths above the bridge approached 1 m. Grasses and sedges grew to the water's edge. Downstream from the bridge, little aquatic vegetation was noted. Substrate ranged from coarse sand to large cobble. Cobble substrate was more common above the normal water level below the bridge, though there were a couple of gravel/cobble riffles downstream. There were also areas of bedrock.

Mussels: On 25 Sept. 1999, BEO conducted a visual search for mussels in shallow water and along exposed gravel/sand from bridge to about 50 m downstream. No unionids were found, only *Corbicula* valves, including two freshly dead specimens.



West Cache Creek
south site

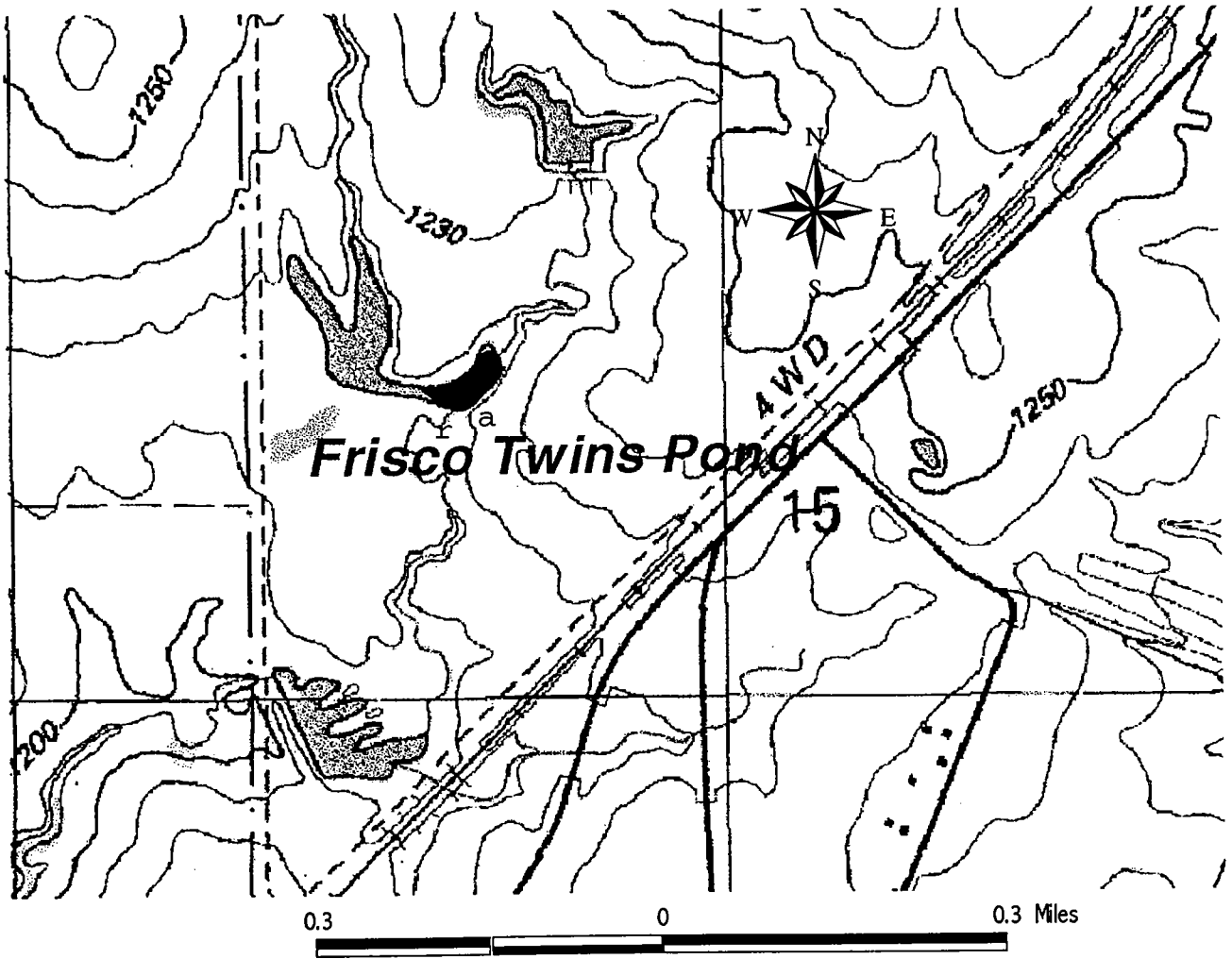
Site name: Frisco Twins Pond

Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates:
were not taken

Site description and remarks: This pond was shallow and silt laden. The dominant shoreline vegetation was willow, buttonbush, and cocklebur.

Mussels: No live mussels or dead shell material were observed at this site.



Frisco Twins Pond

Site name: Jackson Hole Pond

Collectors: Brian K. and Bernie E. Obermeyer

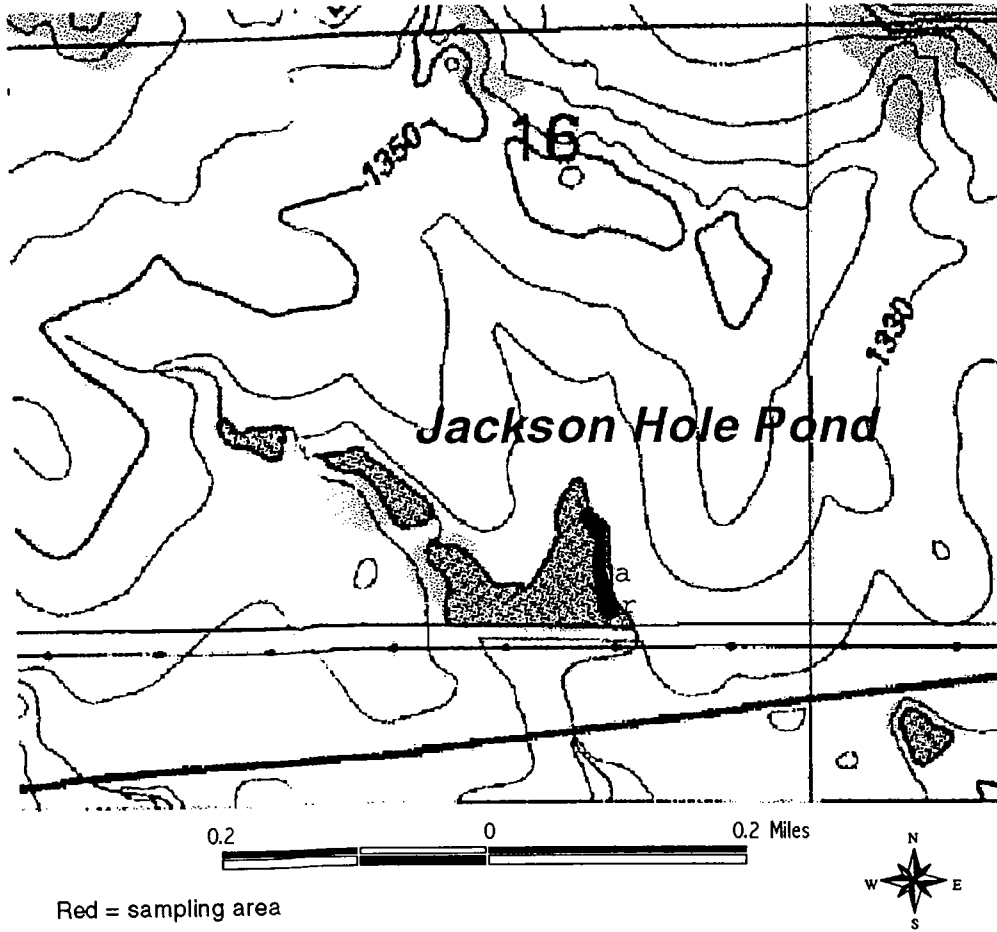
GPS coordinates (UTM 145):

0529723

3833218

Site description and remarks:

Mussels: This site was searched for mussels on 25 Sept. 1999. Water temperature was 18° C (at ~30 cm depth) at 1600 hr. Water clarity was very good. BEO searched the exposed shoreline (water level was about 1 m below normal) for mussel shells. Only one bivalve shell was collected (from a fingernail clam, family Sphaeriidae).



Jackson Hole Pond

Site name: Ketch Lake

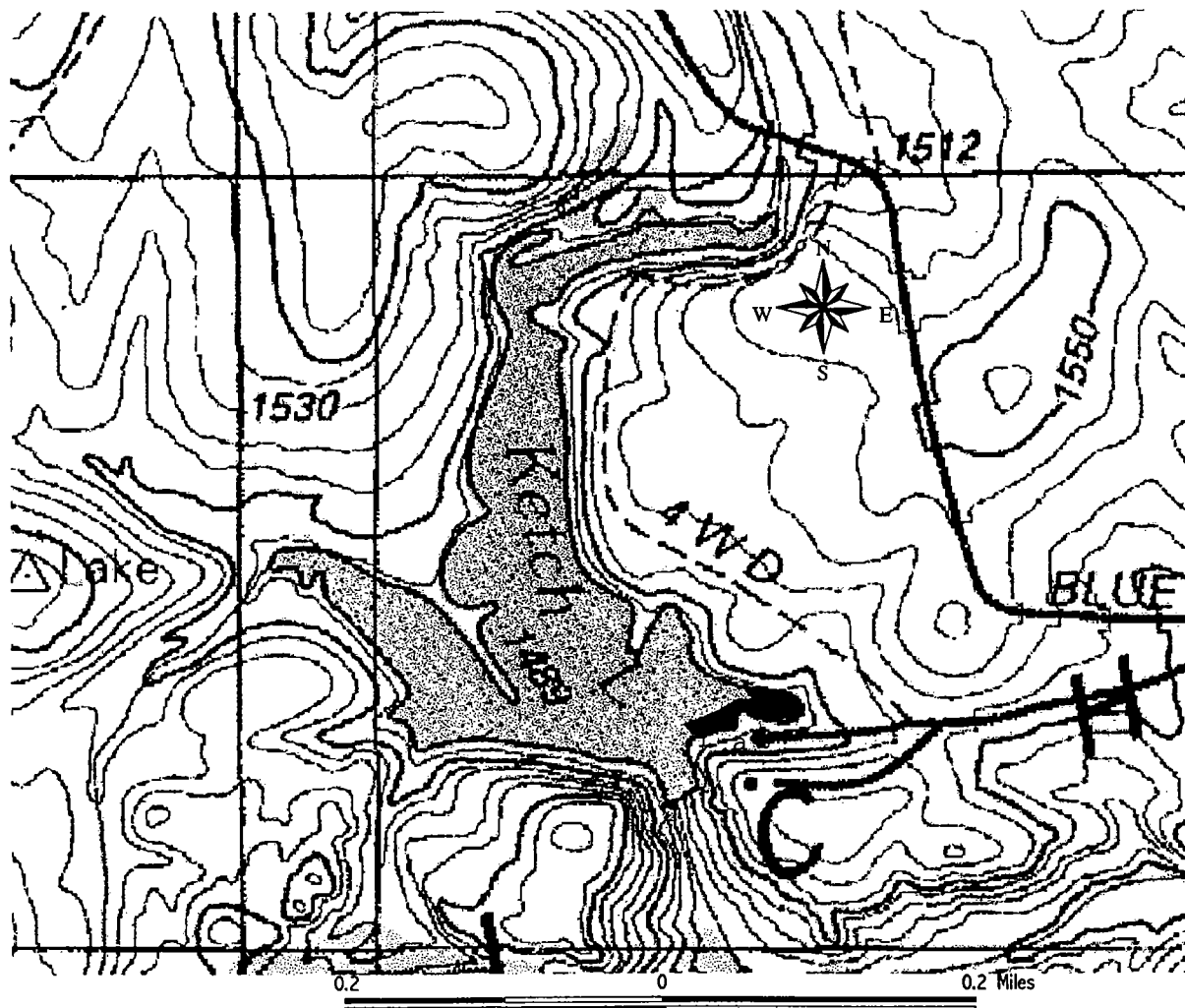
Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

0537355
3840436

Site description and remarks: Ketch Lake was built during the 1930s by the CCC. The lake is situated in a steep and narrow gorge, thus the dam is very tall and the lake is very deep. Sampling was restricted to a cove located at the boat ramp, where silt was the dominant substrate type (up to 50 cm deep), except along the wave-swept shoreline, where there was gravel and cobble (and glass). There was lots of aquatic vegetation, including American lotus and water willow. Buttonbush was the most common shoreline vegetation, along with sedges.

Mussels: This site was searched for mussels on 27 Sept. 1999. BKO and BEO both searched exposed shoreline for mussel shells for about 15 minutes each. BKO then conducted a visual search beginning at the boat ramp and working towards the dam (~ 10 minute search). They found two live *Utterbackia imbecillis* in soft mud (41 x 51 x 88 mm (7 yrs); 37 x 43 x 73 mm (5 yrs)). They found weathered shells of *Pyganodon grandis*. They also found a few weathered *Corbicula* shells at the boat ramp, but there was not evidence that *Corbicula* occurred in the lake. The *Corbicula* shells were brought in to the site with stream gravel for the boat ramp.



Ketch Lake

Site name: Lake Elmer Thomas (LETRA)

Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

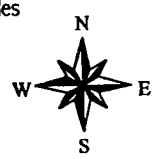
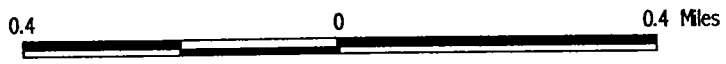
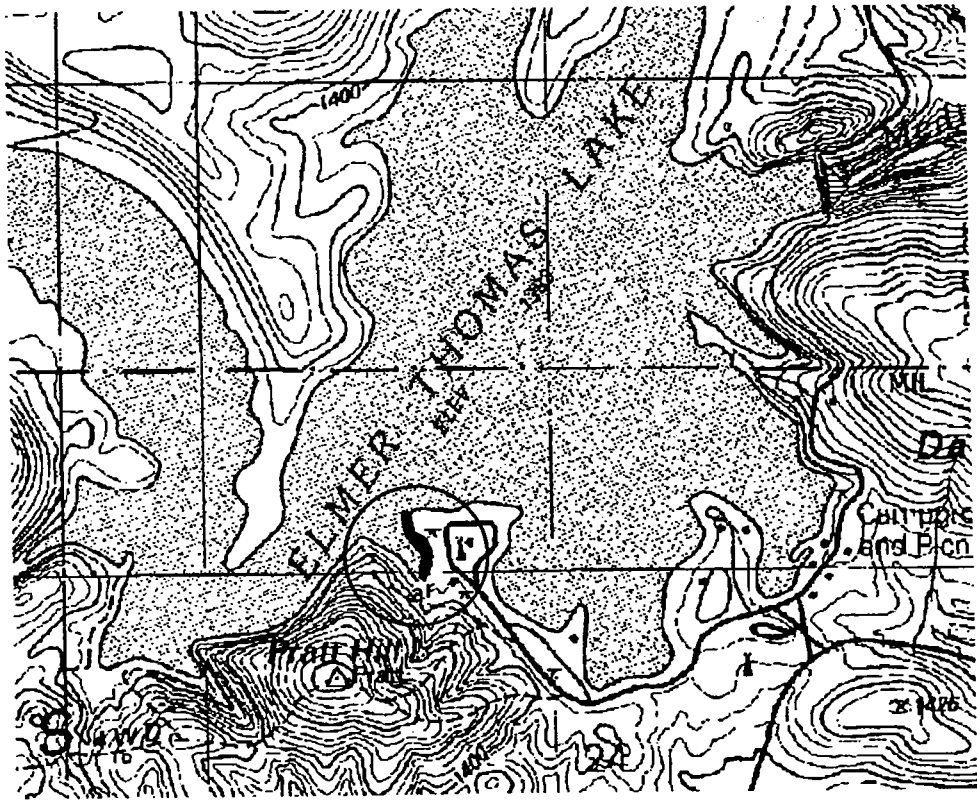
0543725

3842215

Site description and remarks:

Mussels: This site was sampled for mussels on 3 October 1999. BKO began a snorkel search for mussels at 1113 and finished at 1145. He surveyed about a 75 m stretch of shoreline habitat (max. depth ~1.2 m). He collected four live *Utterbackia imbecillis* (see Table). (Note: water level of LETRA was about 1 m below normal)

<u>Species</u>	<u>size</u> (mm; width x height x length)
<i>Utterbackia imbecillis</i>	35 x 45 x 73
<i>Utterbackia imbecillis</i>	25 x 34 x 51
<i>Utterbackia imbecillis</i>	33 x 40 x 64
<i>Utterbackia imbecillis</i>	30 x 39 x 60



Lake Elmer Thomas

Site name: Lake George

Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

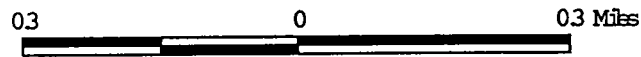
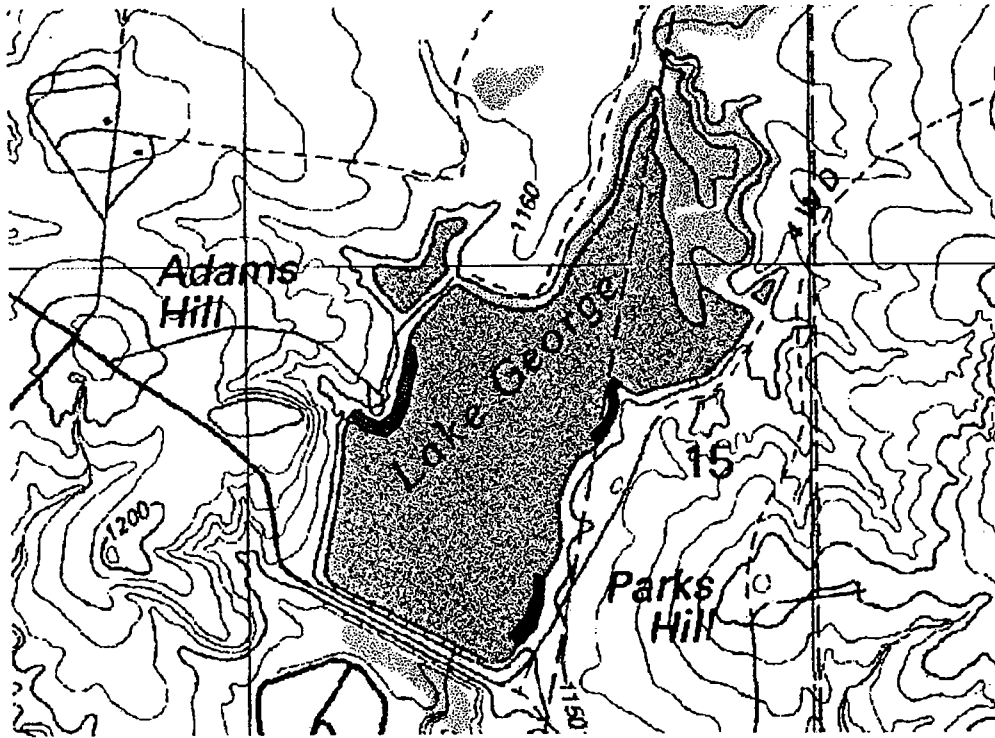
0560224
3833964

Site Description and remarks:

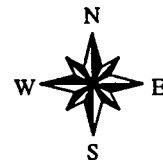
The water temperature was 22.5° C and the air temperature was 28.5° C (both were taken @ 1430). Partly cloudy and windy (out of the SE). BKO estimated a Secchi disk reading of 30 - 40 cm.

Mussels: This site was sampled for mussels on 11 Sept. 1999. A mussel groping search (1339-1417; 38 minutes) was conducted in area one (see attached map) by BKO (sampling length = 75 m; max. depth = 1 m). Substrate consisted of mud and gravel. No live mussels were found, although dead shells of *Utterbackia imbecillis*, *Pyganodon grandis*, and *Toxolasma parvus* were found. Another mussel search was conducted south of a vegetated rock fishing pier (start = 1529; end = 1601; total time = 30 minutes). Again, live mussels were not found, but BKO did collect three freshly dead *T. parvus* (two were articulated) and several weathered valves of *P. grandis*. Substrate at sample area two (see attached map) consisted of mud and decaying vegetation. No *Corbicula* were found in either search area. A third mussel survey was conducted on the west side of Lake George, north of the boat ramp (sample area three). BKO sampled along ~75 m of shoreline at depths up to 1.3 m (1658 to 1735; 37 minutes). Three live *P. grandis* (all ~1 y old), one young *U. imbecillis*, and one live *Corbicula* were found. Also, several fresh *T. parvus* were recovered. Most live mussels were found at depths > 1 m.

Lake George, Ft. Sill



Blue = Fall 1999 sample area 1
Red = Fall 1999 sample area 2
Pink = Winter and spring/summer sample area



Lake George

Site name: Lark Pond

Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

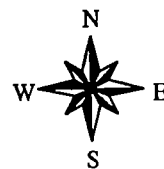
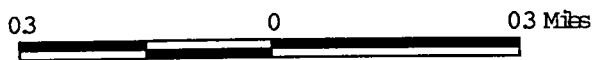
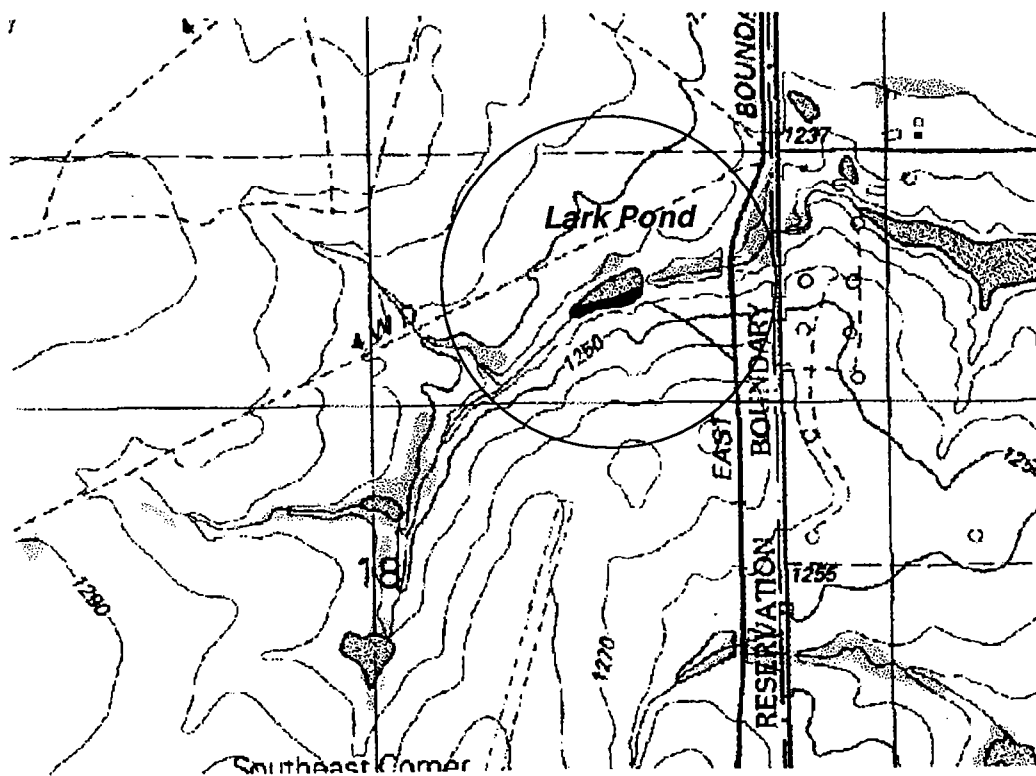
0565497

3834416

Site description and remarks: Lark Pond is located in the far southeast corner of Ft. Sill, East Range.

Mussels: On 12 Sept. 1999, BEO conducted a shoreline search for mussel shells, and found several dead *Utterbackia imbecillis* valves and a shell fragment of what was believed to be *Potamilus purpuratus* on the pond dam in some freshly disturbed soil. A *Unio merus tetralasmus* valve was also collected. It was believed that most of the mussels in this pond had become stranded because the water level was much below normal; the spillway was recently blown out. Most of the dead shell material was found near what was believed to be normal water level

Lark Pond, Ft. Sill



Lark Pond

Site name: Logan Pond

Collectors: Brian K. and Bernie E. Obermeyer

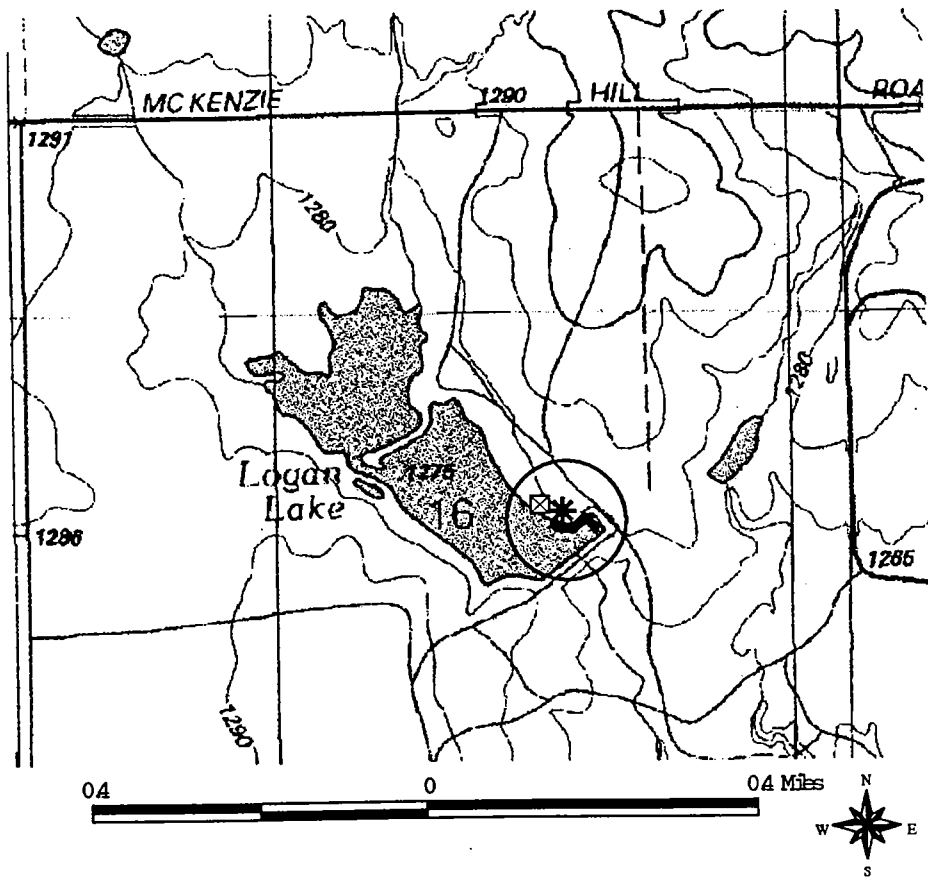
GPS coordinates (UTM 145):

0539519
3833811

Site description and remarks: Logan Pond is located on the southern edge of Ft. Sill in the West Range. The substrate was dominated by mud.

Mussels: This site was searched for mussels on 26 Sept. 1999. Water temperature was 20.5° C. Winds were out of the SW at 15 to 20 mph. Water clarity was poor (suspended silt). Water level was about 75 cm below normal. No aquatic vegetation was observed at the site (muddy shoreline). BKO conducted a snorkel search for mussels along the southeast corner of pond (between a fishing pier and the dam). The search began at 1115 and ended at 1207 h (52 minutes). He collected a total of 40 live mussels of three species: *Pyganodon grandis*, *Unio merus tetralasmus*, and *Quadrula quadrula* (see below). An effort was made to collect all *Corbicula* encountered during the timed search. A total of 55 were collected. Most of the mussels were collected at depths of 30 to 50 cm.

<u>Species</u>	<u>Number of live specimens observed</u>
<i>Pyganodon grandis</i>	9
<i>Unio merus tetralasmus</i>	4
<i>Quadrula quadrula</i>	27



Logan Pond

Site name: Man Dam (pond)

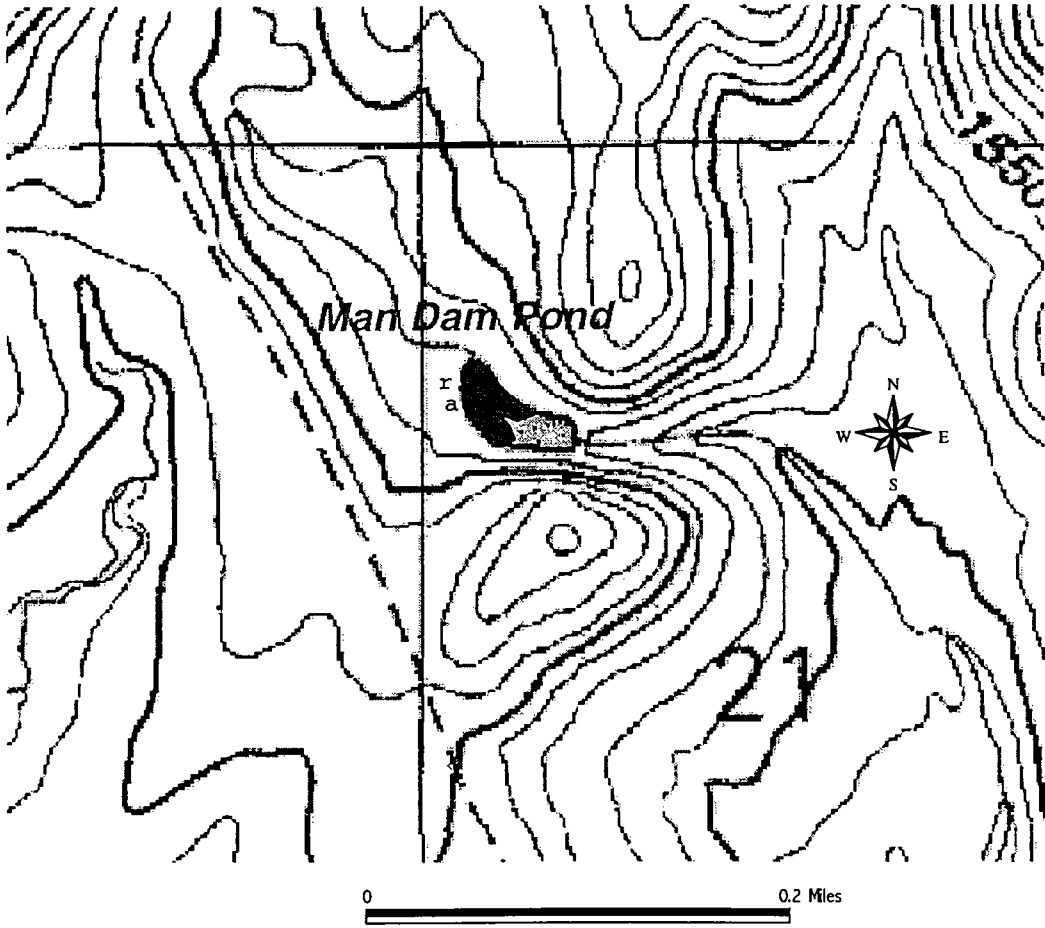
Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

0539011
3841978

Site description and remarks: The pond dam was built with stone and concrete by the CCC in the 1930s. The pond apparently lacks fish. The maximum depth of the pond is 175 cm. The substrate is hard, compact mud. There was lots of aquatic vegetation in upper portion of pond. The shoreline vegetation consisted of buttonbush, eastern red cedar, and persimmon. The pond is situated on tributary to Engineers Pond.

Mussels: No living mussels or dead shells were observed at this site. The site was searched on 27 Sept. 1999.



Man Dam Pond

Site name: Natches Pond

Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

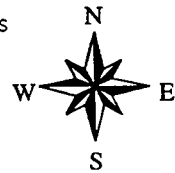
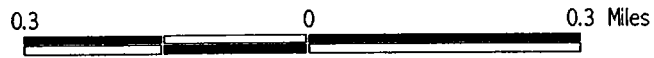
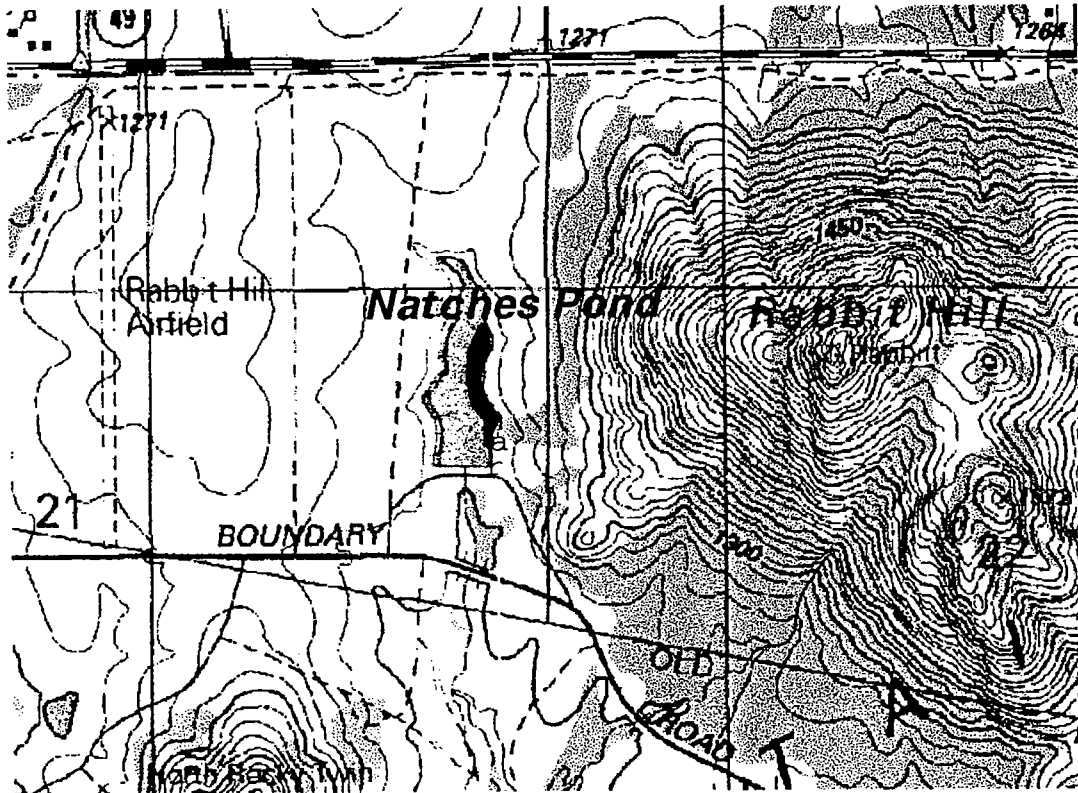
0548565

3841917

Site description and remarks: Sampling occurred at the southeast corner of the pond. The substrate consisted of mud.

Mussels: This site was searched for mussels on 12 Sept. 1999. BKO conducted a groping search for mussels between 1345 and 1418 (33 minutes). Evidence of mussels was not found. BEO conducted a shoreline search along the west shore. The pond was about two feet below normal, making it ideal to locate dead shells, had they been present.

Natches Pond



- a = Malaise trap
- r = Black light
- Red area = sampling area

Site name: Nine-mile Pond

Collectors: Brian K. and Bernie E. Obermeyer

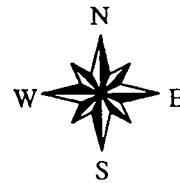
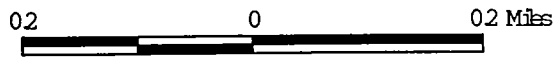
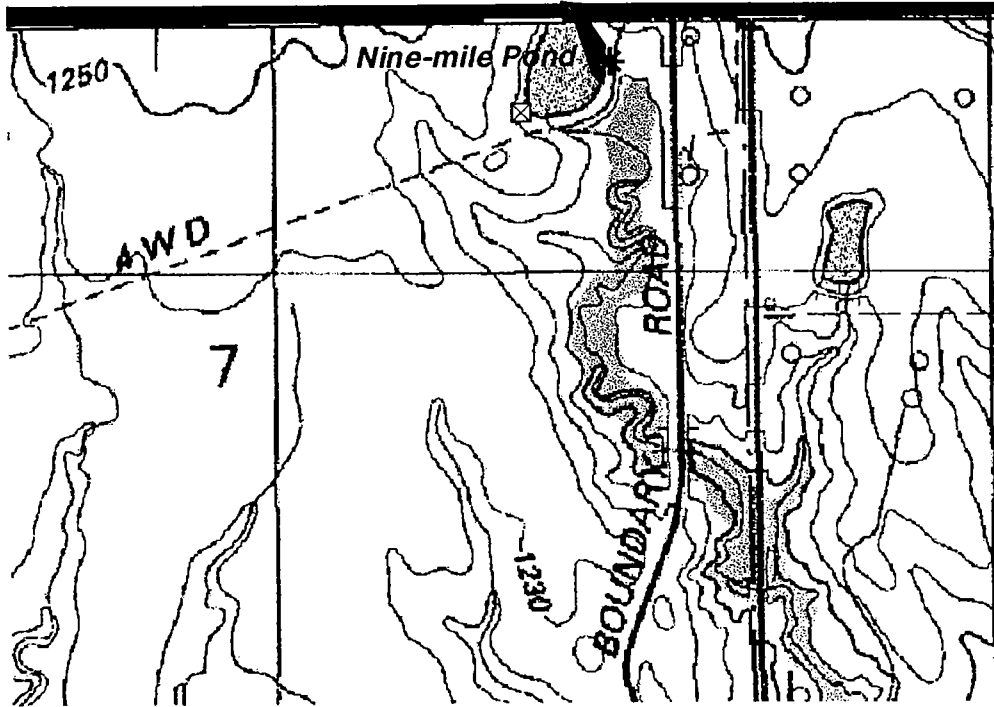
GPS coordinates (UTM 145):

0565432

3845479

Site description and remarks: Nine-mile pond is located in the far northeast corner of Ft. Sill, East Range.

Mussels: This site was searched for mussels on 12 Sept. 1999. A groping search (not timed) was conducted by BKO along the east side of the upper portion of Nine-mile Pond and did not yield any live mussels. BEO walked the entire shoreline of pond and found several recently dead *Utterbackia imbecillis*. No *Pyganodon* valves were found, only *Utterbackia*. Substrate consisted of mud and decaying vegetation.



☒ = Malaise trap

* = Black light

Red area = D-frame, sweep net.
and mussel sampling area

Nine-mile Pond

Site name: Pottawatamie Twins Lake

Collectors: Brian K. and Bernie E. Obermeyer

GPS coordinates (UTM 145):

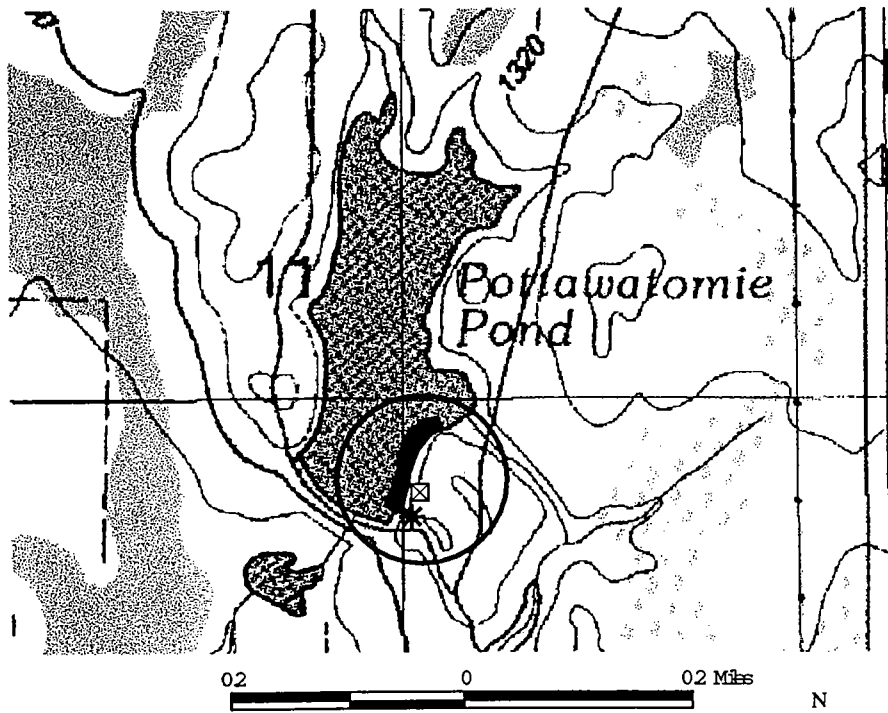
0532950

3835038

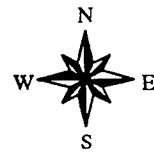
Site description and remarks: The exposed shoreline consisted of sand and large cobble. Silt was lacking. There was lots of aquatic vegetation in lake. Visibility was excellent.

Mussels: This site was sampled for mussels on 26 Sept. 1999. Water temperature was 18.5° C. Water level was ~50 cm below normal. BKO conducted a snorkel search for mussels (1322 to 1358 = 36 minutes) on the east side of stream from about 20 m north of dam and proceeded upstream approximately 50 m (at depths up to 1.2 m). He collected 11 live *Pyganodon grandis* amongst the vegetation. The maximum sampling depth was 80 cm. No *Corbicula* were found.

<u>Species</u>	<u>Estimated age</u>	<u>size (mm; width x height x length)</u>
<i>Pyganodon grandis</i>	11	73 x 89 x 146
<i>Pyganodon grandis</i>	8	64 x 85 x 145
<i>Pyganodon grandis</i>	6	63 x 80 x 145
<i>Pyganodon grandis</i>	8	68 x 80 x 149
<i>Pyganodon grandis</i>	5	61 x 75 x 125
<i>Pyganodon grandis</i>	3	55 x 71 x 110
<i>Pyganodon grandis</i>	3	53 x 67 x 111
<i>Pyganodon grandis</i>	3	50 x 63 x 99
<i>Pyganodon grandis</i>	2	39 x 47 x 71
<i>Pyganodon grandis</i>	2	28 x 38 x 57
<i>Pyganodon grandis</i>	2	28 x 41 x 61



Red = mussel, D-frame, and sweep net sampling area.



Pottawatomie Twins Lake

Site name: Shinnecock Pond

Collectors: Brian K. and Bernie E. Obermeyer

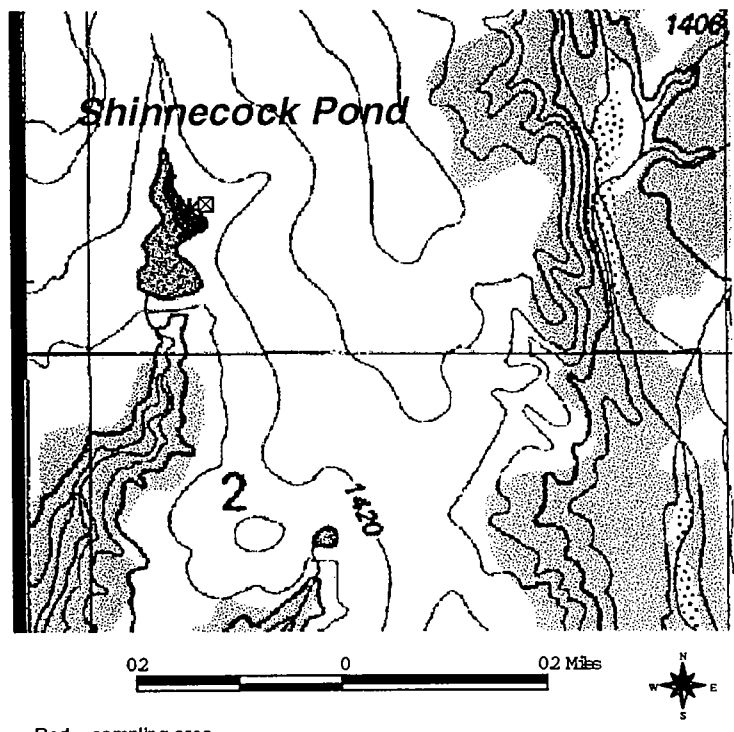
GPS coordinates (UTM 145):

0523130

3837349

Site description and remarks: This is a small pond ~ 1/2 acre in size during low level period, and is located in the shortgrass prairie/mesquite area of the Quanah Range. The area is fairly level and the soils are sandy with some granite cobble mixed in. The substrate in the pond was predominantly sand, with a little silt in the deeper areas. There was lots of emergent plants growing about 10 m out towards center of pond. The water was very clear. There was quite a bit of American lotus that was stranded during low water levels. Along the normal shoreline, the dominant vegetation was buttonbush.

Mussels: This site was searched for mussels on 25 Sept. 1999. The water level was about 3-4 feet below normal. There was lots of small fish activity on the surface of water and many odonates flying around. They found many recently stranded fingernail clams and gastropods, but no unionids.



Red = sampling area

Shinnecock Pond