

Enclosure 28

Memorandum for Record
Gulf Sturgeon Spawning Habitat Survey and Mapping
6-7 November 2003
20-21 November 2003
21-22 January 2004

MEMORANDUM FOR RECORD

SUBJECT: Gulf Sturgeon Spawning Habitat on the Apalachicola River – Continuation of Habitat Survey and Mapping, 06-07/20-21 November 2003, 21-22 January 2004

1. The Mobile District has agreed to consult with the USFWS on the effects of current water control operations on Gulf sturgeon spawning activities. USFWS has expressed concern that significant Gulf sturgeon spawning habitat located below Jim Woodruff Dam became exposed during extreme low flow stages experienced in the Spring of 2002. Gulf sturgeon utilize hard bottom habitat areas for spawning activities, in particular substrates with irregular surfaces that provide attachment for sturgeon eggs and shelter for non-free swimming larval stages. Preferred habitat areas are comprised of lime rock ledges, hard clay substrates, and gravel bars in areas of sufficient flow to wash the surface clean of sediments and debris, but with currents not so swift that the eggs or larvae would be washed off the site. Identification of the areal extent and relative depth of sturgeon spawning habitat available in the upper reaches of the Apalachicola River will assist in preparation of a biological assessment as part of Section 7 consultation under the Endangered Species Act. Collection of cross-sections at spawning habitat areas referenced to controlled elevation will provide information on relative depth of habitat areas. This data can be related to flow/stage rating information to determine extent of habitat inundated at various flow/stage regimes. This information can then be used in an assessment of water management operations during extended drought or low flow conditions to determine the effect on the Gulf sturgeon spawning activities.
2. On 06-07/20-21 November 2003 and 21-22 January 2004, members of the U.S. Army Corps of Engineers (USACE), Mobile District (CESAM), Panama City Site Office survey crew met with Joanne Brandt and Brian Zettle (CESAM-PD-EI) and Jerry Ziewitz of the U.S. Fish and Wildlife Service (USFWS), Panama City Field Office to conduct the follow-on data collection for the site mapping effort to map the upstream and downstream boundaries and areal extent of suitable spawning habitat for each of the sites identified during the October 2002 surveys. The Panama City Site Office survey crew collected cross-sections and prepared survey maps for the sites in the fall of 2002. The cross-section measurements extended across the entire river channel and up the bank within rock ledge areas; utilizing hydro and terrestrial survey techniques as necessary.
3. A Ponar sampler and probe were used to identify the bottom substrate (hard bottom, gravel bottom, or sand/silt bottom) at various points along each cross-section. A GPS coordinate (waypoint) was recorded for each substrate sample point. A probe was used to determine substrate composition in areas where water depth and clarity allowed for an accurate assessment of the bottom substrate. In all other areas the Ponar sampler was used to determine bottom substrate. A USFWS boat mounted with the Ponar sampling equipment was **tethered** to a USACE survey boat in order to ensure that the sample points occurred on the previously delineated cross-sections. The boats proceeded downstream from the Jim Woodruff Dam collecting substrate data along each cross-section. Sample points for each cross section began on the left bank and continued along the transect towards the right bank. The first sample point for each cross-section is generally located adjacent to the left bank. The results of the probe or

Ponar sample determined the location of the next sample point. However, sample points were generally located 50-100 feet apart. Extra sample points were taken in the
CESAM-PD-EI

11 February 2004

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transitional areas between hard bottom and sand/silt bottom in order to more accurately define the areal extent of the suitable spawning habitat. The left and right bank of each cross-section was photographed, as well as, representative dredge samples for each type of substrate observed. Attached are the field notes describing the data collected at each waypoint.

4. The data collected during the surveys will be used to produce maps identifying the upstream and downstream boundaries and areal extent of suitable spawning habitat located in the Apalachicola River between Jim Woodruff Dam and Bristol, Florida. Furthermore, the data will be used to determine relative depths of habitat areas compared to flow/stage rating information to determine extent of habitat inundated at various flow/stage regimes. This information will ultimately be used in an assessment of water management operations during extended drought or low flow conditions to determine the effect on Gulf sturgeon spawning activities.

Attachments

BRIAN ZETTLE
Biologist
Inland Environment Team

CF:

Jangula/ CESAM-OP-GE
Vaughan/CESAM-EN-HW
Hathorn,CESAM-EN-H
Brandt/ CESAM-PD-EI
Findley/CESAM-PD-E
Peck/CESAM-PD-EC
Ziewitz/USFWS, Panama City Field Office

Site- Rock 106:

Survey Cross-Section 2+00:

Waypoint 1: Water depth = 6.1 ft. Left bank at shoreline; ponar came up empty with a few small pea gravel; no corbicula shells; Substrate consisted of hard bottom with a little pea gravel.

Waypoint 2: Water depth = 15.3 ft. Ponar came up empty; Substrate consisted of hard bottom with a little pea gravel.

Waypoint 3: Water depth = 17.0 ft. Substrate consisted of hard bottom (small chunk lime rock).

Waypoint 4: Water depth = 15.2 ft. Just off right bank lock wall; Substrate consisted of Corbicula, gravel, silt bottom (too many fines to provide suitable habitat) [11:05 a.m.].

Waypoint 5: Water depth = 21.4 ft. Moved back 100-200 feet; ponar came up clean with no sand or silt. Substrate consisted of hard bottom.

Comments: Old gravel bar just off alignment of lock wall. Hard bottom extends from left bank at shoreline and waterward boundary located halfway between WP 4 and 5. Cross-section located just below buoy line. **Photos:** 1, 2, 3 (USFWS camera), 1 (USACE camera).

Survey Cross-Section 7+00:

Waypoint 6: Water depth = 3.0 ft. Substrate consisted of sand, gravel, and Corbicula (too much sand for suitable habitat – see photo of ponar sample).

Waypoint 7: Water depth = 9.5 ft. Ponar sample taken in mid-channel; came up clean; Substrate consisted of hard bottom [11:30 a.m.].

Waypoint 8: Water depth = 10.8 ft. Substrate consisted of gravel, cobble, Corbicula, and fines (not suitable bottom habitat).

Comments: Waypoint 6 was taken along sand/gravel bar overgrown with willows along left bank. The willows grew up during drought conditions and now act as a sediment trap. Two more samples were taken later in the day (3:05 p.m.) between the buried gravel/willow bar and the bank. However, the water was too shallow for the USACE survey boat so no waypoints were taken. The first sample was taken on the willow bar side of the powerhouse channel in 2.6 feet of water and the substrate consisted of gravel, Corbicula, and sand. The second sample was taken in water depth of 3.1 feet in the middle of the powerhouse channel, and consisted of gravel, cobble, and Corbicula. This gravel bar was exposed in the mid-1990s and provided suitable habitat for proposed mussel species (now listed). However, during the recent past drought years, the bar has become buried with sand and silt due to low flows, and has become vegetated with young willows. At this time the gravel bar does not provide suitable habitat for sturgeon spawning (May want to revisit after flood events to see if the bar becomes washed clean). **Photos:** 2, 3, 4 and 23.

Survey Cross-Section 12+00:

Waypoint 9: Water depth = 2.8 ft. Left bank, abutting submerged gravel/willow bar. Substrate consisted of silt, clay/sand mixture with Corbicula (not suitable habitat).

Waypoint 10: Water depth = 8.0 ft. Mid-channel sample. Substrate consisted of gravel (1/2" to 1"), Corbicula, and small amount of sand/silt (not suitable).

Waypoint 11: Water depth = 8.5 ft. Substrate consisted of gravel, Corbicula, and small amount of sand/silt.

Waypoint 12: Water depth = 15.0 ft. Substrate consisted of Corbicula, and small amount sand/silt [11:55 a.m.].

Comments: Gravel bar portions of cross-section contain too much sand, silt or corbicula. No suitable spawning substrate was located along this transect. **Photos:** 5 and 6.

Survey Cross-Section 20+00:

Waypoint 13: Water depth = 5.0 ft. Left bank, immediately adjacent to willows on sandy bank. Substrate consisted of Corbicula and silt (not suitable habitat) [12:36 p.m.].

Waypoint 14: Water depth = 7.3 ft. Substrate consisted of Corbicula, sand, silt, and pea gravel (not suitable habitat).

Waypoint 15: Water depth = 13.4 ft. Ponar taken in mid-channel. Substrate consisted of Corbicula and sand.

Waypoint 16: Water depth = 19.5 ft. Substrate consisted of Corbicula, sand, silt, and small amount of gravel.

Comments: Just upstream of Hwy 90 bridge. No suitable spawning substrate was located along this transect. **Photos:** 7 and 8.

Survey Cross-Section 37+00:

Waypoint 17: Water depth = 2.5 ft. Substrate consisted of Corbicula, gravel, and a few limestone chunks (2") (possibly suitable habitat).

Waypoint 18: Water depth = 11.3 ft. Ponar taken in mid-channel near red buoy, came up clean with small amount of limerock. Substrate consisted of hard bottom (limerock).

Waypoint 19: Water depth = 10.5 ft. Moved back to mid-point between WP 17 and 18 (left of red buoy). Ponar came up clean with limerock fragments and clean shell. Substrate consisted of hard bottom (limerock). Hard bottom boundary possibly located between WP 17 and 19. [1:04 p.m.]

Waypoint 20: Water depth = 9.5 ft. Ponar taken near green buoy. Substrate consisted of Corbicula, gravel, small amount of limerock and few fines (not suitable habitat). Hard bottom boundary between WP 19 and 20. [1:11 p.m.]

Comments: Suitable spawning substrate extends from midway between waypoints 17 and 19 to midway between waypoints 19 and 20. **Photos:** 9 and 10.

Survey Cross-Section 43+00:

Waypoint 21: Water depth = 6.0 ft. Large rock observed in vicinity of ponar sample. Sand in ponar sample. Substrate consisted of sand interspersed with rock.

Waypoint 22: Water depth = 15.0 ft. (COE sounding) Ponar taken in mid-channel, very swift current; sample contained a fragment of limerock. Substrate consisted of hard bottom (limerock). [1:28 p.m.]

Waypoint 23: Water depth = 8.2 ft. Substrate consisted of sand (predominately), gravel, and Corbicula (not suitable).

Waypoint 24: Water depth = 15.0 ft.. Moved back to sample between WP 22 and 23. Substrate consisted of gravel, sand, and Corbicula. Hard bottom boundary between WP 22 and 24.

Comments: Left bank at limerock outcropping. Swift current in mid-channel. **Suitable hard bottom spawning substrate extends from the left bank to midway between waypoints 22 and 24.**
Photos: 11 and 12.

Survey Cross-Section 48+00:

Waypoint 25: Water depth = 4.5 ft. Limerock outcrop off left bank. Ponar came up clean. Substrate consisted of hard bottom (limerock).

Waypoint 26: Water depth = 17.1 ft. (COE sounding) Swift current. Ponar came up clean. Substrate consisted of hard bottom (limerock).

Waypoint 27: Water depth = 16.0 ft. Substrate consisted of gravel, Corbicula, and sand. [1:48 p.m.]

Comments: Suitable spawning substrate extends from rock outcrops on left bank to midway between waypoints 26 and 27. **Photos:** 13 and 14.

Survey Cross-Section 51+00:

Waypoint 28: Water depth = 3.5 ft. Boat on top of rock ledge on left bank. Ponar came up clean; algae on top of rock. Substrate consisted of hard bottom (limerock).

Waypoint 29: Water depth = 12.1 ft. Sample taken at edge of rock ledge. Swift current. Ponar came up clean, with large fragment of limerock. Substrate consisted of hard bottom (limerock).

Waypoint 30: Water depth = 16.5 ft. Swift current. Substrate consisted of hard bottom (limerock), and small amount of gravel and Corbicula.

Waypoint 31: Water depth = 10.5 ft. Swift current. Substrate consisted of fine gravel, sand, and Corbicula (not suitable habitat). [2:04 p.m.]

Comments: Suitable spawning substrate extends from left bank to midway between waypoints 30 and 31. Collected purple bankclimber mussel at waypoint 30 (note shell abraded due to gravel in swift current). **Photos:** 15, 16, and 17.

Survey Cross-Section 58+00:

Waypoint 32: Water depth = 5.0 ft. Ponar taken immediately at left bank shoreline. First sample collected large chunk of limerock and gravel; Second sample comprised of fines, sand, gravel and clay. Substrate consisted of rock overlain with gravel. Area disturbed due to barge offloading site for Dravo Sand and Gravel. [2:16 p.m.]

Waypoint 33 (1st Sample): Water depth = 14.3 ft. Ponar sample collected large chunk of limerock. Substrate consisted of rock interspersed with sand.

Waypoint 33 (2nd Sample): Water depth = 13.0 ft. Returned to waypoint to check bottom habitat. Substrate consisted of fines, pea gravel, sand, and silt (not suitable habitat). [2:26 p.m.]

Waypoint 34: Water depth = 21.5 ft. Sample taken in mid-channel. Substrate consisted of Corbicula and a small amount of gravel and silt (not suitable).

Comments: No suitable spawning substrate was located along this transect. **Photos:** 18, 19, and 20.

Survey Cross-Section 71+00:

Waypoint 35: Water depth = 3.5 ft. Substrate consisted of sand.

Waypoint 36: Water depth = 19.5 ft. Substrate consisted of Corbicula, sand, and gravel. [2:39 pm.]

Waypoint 37: Water depth = 27.0 ft. (COE sounding) Swift current. First Ponar sample in mid-channel came up clean with small fragment of limerock. Second sample came up clean. Substrate consisted of hard bottom (limerock).

Waypoint 38: Water depth = 24.0 ft. Silts observed in Ponar sample. Substrate consisted of pea gravel, sand, Corbicula, and fine silt.

Comments: Immediately downstream of Railroad trestle bridge (Note: underwater cable crossing). No Suitable spawning substrate was located along this transect?? Strip of hard bottom located in mid-channel deep water is not suitable due to swift currents??. **Photos:** 21 and 22.

Site- Rock 103.5:

Survey Cross-Section 8+00:

Waypoint 1: Water depth = 13.1 ft. Silty water. Substrate consisted of clay marl overlain by silt and a few Corbicula. [9:45 a.m.]

Waypoint 2: Water depth = 14.6 ft. Swifter current. Substrate consisted of sand, silt, gravel, and Corbicula.

Waypoint 3: Water depth = 8.5 ft. Substrate consisted of Corbicula, sand, and gravel.

Waypoint 4: Water depth = 5.5 ft. Substrate consisted of silt, sand, pea gravel, and Corbicula.
Too much silt to qualify the rock dikes as suitable spawning habitat?? What about when under water???

Comments: Immediately upstream of Jackson County Port Canal. Limerock dikes on left bank and sand on right bank (Rock removal disposal area, with rocks used to construct dikes). No Suitable spawning substrate was located along this transect. **Photos:** 27, 28, and 29.

Survey Cross-Section 13+00:

Waypoint 5: Water depth = 16.5 ft. Silty effluent from ponar sample. Substrate consisted of fine silt/sand, a few small clay marl chunks, and a few Corbicula. [10:00 a.m.]

Waypoint 6: Water depth = 15.5 ft. Ponar sample in mid-channel, silty effluent from ponar. Substrate consisted of Corbicula, silt/sand, and pea gravel.

Waypoint 7: Water depth = 9.3 ft. Less current, silty effluent from ponar sample. Substrate consisted of silt/sand, Corbicula, and pea gravel.

Comments: No Suitable spawning substrate was located along this transect. **Photos:** No photos were taken at this transect.

Survey Cross-Section 19+73:

Waypoint 8: Water depth = 6.5 ft. 1st Ponar sample came up clean with clear effluent. 2nd Ponar sample collected cobble, limerock and Corbicula. 3rd Ponar sample collected large chunk of limerock. Substrate consisted of hard bottom (limerock), cobble, and Corbicula.

Waypoint 9: Water depth = 14.5 ft. Mid-channel, swifter current. 1st Ponar sample collected limerock chunk (Ponar stuck in open position); 2nd Ponar sample collected small amount of gravel and sand (sand overlying rock??); 3rd Ponar sample collected coarse sand, gravel and Corbicula. Substrate consisted of sand, gravel, and Corbicula overlying limerock???.

Waypoint 10: Water depth = 6.5 ft. Sample taken in mid-channel; silty effluent from Ponar. Substrate consisted of gravel, sand/silt, limerock chunks, and Corbicula overlying limerock???.

Waypoint 11: Water depth = 4.8 ft. Sample taken at mouth of Canal. Slower current. Silty effluent from Ponar sample. Substrate consisted of fine sand and Corbicula.

Waypoint 12: Water depth = 5.5 ft. Sample taken just inside Canal. Silty effluent, detrital debris and Elliptio mussels found in sample. Substrate consisted of silt/sand and Corbicula.

Comments: May want to track down old Before and After drawings for the rock removal that occurred at this location in the 1980s to assist in delimiting boundaries of this site. Suitable spawning substrate extends from left bank to midway between waypoints 8 and 9.??? Elliptio mussels observed at waypoint 12. **Photos:** 30, 31, 32, and 33.

Survey Cross-Section 33+00:

Waypoint 13: Water depth = 9.5 ft. Silty effluent from Ponar. Substrate consisted of fine silty mud.

Waypoint 14: Water depth = 17.5 ft. Sample from mid-channel. Swift current, little silt in effluent from Ponar. Substrate consisted of coarse sand, pea gravel, and Corbicula.

Waypoint 15: Water depth = 8.8 ft. Slower current. Limerock chunk in Ponar sample. Substrate consisted of coarse sand, pea gravel, and Corbicula overlying limerock???.

Comments: Cross section under powerline. No Suitable spawning substrate was located along this transect.??? **Photos:** 34 and 35.

Survey Cross-Section 38+00:

Waypoint 16: Water depth = 7.3 ft. Left bank of clay marl. Substrate consisted of fine sand over soft clay.

Waypoint 17: Water depth = 9.4 ft. Sample from mid-channel. 1st Ponar sample collected limerock chunk and cobble; 2nd Ponar sample collected a limerock chunk; 3rd Ponar sample collected cobble, Corbicula, limerock chunk and coarse sands (no fines) (Photo 36 taken of Ponar sample). Substrate consisted of limerock overlain with cobble, gravel, and coarse sand. [11:15 a.m.]

Waypoint 18: Water depth = 13.8 ft. Sample taken in mid-channel. Swifter current. Silty effluent from Ponar sample. Substrate consisted of Corbicula, silt/sand, and a small amount of pea gravel.

Waypoint 19: Water depth = 10.5 ft. Ponar sample collected Corbicula, coarse sand and a limerock chunk. Substrate consisted of Corbicula and coarse sand overlying limerock???

Comments: No Suitable spawning substrate was located along this transect.??? What about clean cobble, limerock shown in Photo 36??? **Photos:** 36, 37 and 38.

Survey Cross-Section 42+00:

Waypoint 20: Water depth = 3.3 ft. Clay marl on left bank, just upstream of rock training dikes on left bank. Moderate current. 1st Ponar sample clean with clear effluent; 2nd Ponar sample collected Corbicula, fine sand and limerock; and an Elliptio mussel. Substrate consisted of hard bottom (hard clay overlain with limerock and only a few fines). This would provide suitable habitat.

Waypoint 21: Water depth = 12.7 ft. Rock dikes just downstream on left bank. Sample taken in mid-channel, swifter current. 1st Ponar sample collected a large chunk of limerock; 2nd Ponar sample came up empty with clear effluent; 3rd Ponar sample came up empty with clear effluent. Substrate consisted of hard bottom (limerock). [11:40 a.m.]

Waypoint 22: Water depth = 9.8 ft. Mid channel, swift current. 1st Ponar sample collected limerock/marl chunk; 2nd Ponar sample collected coarse sands, Corbicula, and little gravel, with few fines in the effluent. Substrate consisted of limerock overlain with coarse sand, Corbicula, and a small amount of pea gravel.

Waypoint 23: Water depth = 6.0 ft. Right bank comprised of vegetated sandbar; and rock disposal area with rock used to form rock dikes. Rock cobble in ponar. Substrate consisted of hard bottom (hard clay overlain with limerock cobble due to rock disposal area).

Comments: Hard bottom extends across entire river channel, over the rock cobble on right bank, and up the left bank (moderate value habitat extends from a point halfway between

WP 21 and WP 22, to a point halfway between WP 22 and WP 23. Elliptio mussel observed at waypoint 20. **Photos:** 39, 40, 41 and 42.

Site 101.0:

Survey Cross-Section 4+00:

Waypoint 1: Water depth = 2.5 ft. Left bank of sandy clay. Silty effluent from Ponar. Substrate consisted of Corbicula and silt/sand.

Waypoint 2: Water depth = 7.5 ft. Sample taken in channel, moderate current. Clean effluent from Ponar. Substrate consisted of cobble, gravel, coarse sand, and a few Corbicula (too sandy to provide suitable habitat).

Waypoint 3: Water depth = 14.8 ft. Sample taken in mid-channel with swift current. Substrate consisted of coarse sand, pea gravel, Corbicula, and cobble limerock. [12:16 p.m.]

Waypoint 4: Water depth = 10.5 ft. Rock disposal area on sandbar on right bank. Silty effluent from Ponar. Substrate consisted of pea gravel, coarse sand, Corbicula, and a few fines (too sandy to provide suitable habitat).

Comments: No Suitable spawning substrate was located along this transect. **Photos:** 43 and 44.

Survey Cross-Section 10+00:

Waypoint 5: Water depth = 2.4 ft. Left bank sandy clay. Ponar sample collected small pieces of rock (hard clay). Substrate consisted of fine sand over hard clay.

Waypoint 6: Water depth = 2.5 ft. Slow current. Ponar sample came up empty. Substrate consisted of clean hard bottom (clay marl).

Waypoint 7: Water depth = 6.5 ft. Sample taken in mid-channel, with moderate to swift current. Ponar sample came up empty. Substrate consisted of hard bottom.

Waypoint 8: Water depth = 14.8 ft. Sample taken in mid-channel with swift current. 1st Ponar sample collected small chunk of limerock, with clear effluent; 2nd Ponar sample collected a limerock chunk. Substrate consisted of hard bottom (limerock).

Waypoint 9: Water depth = 12.7 ft. Sample taken in mid-channel with swift current. Ponar collected coarse sand, Corbicula, and pea gravel, with clear effluent. Substrate consisted of coarse sand, Corbicula, and pea gravel.

Waypoint 10: Water depth = 7.0 ft. Sandy right bank. Substrate consisted of coarse sand, Corbicula, and pea gravel.

Comments: Suitable spawning substrate extends from midway between waypoints 5 and 6 to midway between waypoints 8 and 9. **Photos:** 45 and 46.

Survey Cross-Section 14+00:

Waypoint 11: Water depth = 2.5 ft. Left bank of soft sandy clay, located just downstream of slough. Substrate consisted of soft sand and clay.

Waypoint 12: Water depth = 3.0 ft. Silty effluent from Ponar sample. Substrate consisted of silt/sand, Corbicula, and pea gravel (sandy bottom over clay –too sandy for suitable habitat).

Waypoint 13: Water depth = 8.0 ft. Sample taken from mid-channel with swift current. Substrate consisted of silt/sand, pea gravel, and Corbicula.

Waypoint 14: Water depth = 4.9 ft. Clay cobble on bank, comprised of vegetated sandbar. Substrate consisted of cobble, coarse gravel, Corbicula, and a small amount of fine sand. Possible suitable habitat

Comments: Immediately downstream of slough. Potentially suitable spawning substrate (moderate value habitat) extends from midway between waypoints 13 and 14 to the right bank. Right bank consisted of vegetated sand bar overlain with clay and cobble. **Photos:** 47 and 48.

Site 100.3:

Survey Cross-Section 3+00:

Waypoint 1: Water depth = 2.0 ft. Left bank sandy. Probed bottom, no Ponar sample taken. Substrate consisted of hard clay overlain with silt/sand.

Waypoint 2: Water depth = 3.5 ft. Slow to moderate current. A few fines observed in effluent from Ponar sample. Substrate consisted of silt/sand and Corbicula.

Waypoint 3: Water depth = 7.8 ft. Ponar sample taken in mid channel. Swift current. Silty effluent observed from Ponar sample. Substrate consisted of coarse sand, pea gravel, Corbicula, and silt.

Waypoint 4: Water depth = 13.4 ft. Ponar sample taken from mid-channel. Moderate to swift current. 1st Ponar sample came up empty with clear effluent; 2nd sample collected a small chunk of limerock. Substrate consisted of hard bottom (limerock).

Waypoint 5: Water depth = 13.7 ft. Ponar sample taken near green can on right bank (deeper channel). Swift current. Ponar sample came up empty/clean. Substrate consisted of hard bottom (limerock).

Waypoint 6: Water depth = 1.0 ft. Probed substrate at limerock disposal area located on right bank. Substrate consisted of limerock overlain with sand.

Comments: Immediately upstream of I-10 bridge. Suitable spawning substrate extends from midway between waypoints 3 and 4 to midway between waypoints 5 and 6. **Photos:** 49 and 50.

Survey Cross-Section 8+00:

Waypoint 7: Water depth = 3.0 ft. Left bank soft sand. Probed bottom, no Ponar sample taken. Substrate consisted of soft sand.

Waypoint 8: Water depth = 7.5 ft. Ponar sample taken in mid-channel. Moderate to swift current. Substrate consisted of coarse sand, pea gravel, and Corbicula.

Waypoint 9: Water depth = 14.8 ft. Moderate to swift channel. 1st Ponar sample collected limerock chunk, with Ponar stuck open. 2nd Ponar sample collected small piece of limerock. Substrate consisted of hard bottom (limerock).

Comments: Suitable spawning substrate extends from midway between waypoints 8 and 9 to the rock disposal area on the right bank. **Photos:** 51 and 52.

Survey Cross-Section 11+00:

Waypoint 10: Water depth = 4.0 ft. Sandy left bank, located at DA 146B upstream boundary marker. Probed bottom, no Ponar sample taken. Substrate consisted of soft silt/sand.

Waypoint 11: Water depth = 11.0 ft. Ponar sample taken in mid-channel. Swift current. Substrate consisted of silt/coarse sand, pea gravel, and Corbicula.

Waypoint 12: Water depth = 11.1 ft. Ponar came up empty/clean. Substrate consisted of hard bottom (limerock).

Waypoint 13: Water depth = 14.0 ft. Moved back to point between WP 11 and WP 12. Ponar sample came up ajar with rock fragment, and some coarse sand, pea gravel and Corbicula. Substrate consisted of coarse sand, pea gravel, and Corbicula overlying limerock???. [2:10 p.m.]

Comments: Limerock ledge terrace just above I-10, with limerock disposal area located upstream on the right bank. Suitable spawning substrate extends from midway between waypoints 13 and 12 to the rock ledge on the right bank. **Photos:** 53 and 54.

Potential Sturgeon Spawning Habitat Areas
20-21 November 2003

Site 99.5:

Survey Cross-Section 0+00:

Waypoint 1: Water depth = 7.3 ft. Left bank is soft sand and clay, vegetated bank. Silty effluent from Ponar sample. Substrate consisted of clay, silt/sand, and Corbicula. [9:35 a.m.]

Waypoint 2: Water depth = 10.0 ft. Left bank on outside bend. Ponar sample taken near red buoy. Swifter current. Two Ponar samples taken and both came up empty/clean effluent from Ponar. Substrate consisted of hard bottom.

Waypoint 3: Water depth = 9.8 ft. Samples taken in mid-channel just downstream of most downstream training dike on right bank?? Two Ponar samples taken and both came up empty, clear effluent with very little sand. Substrate consisted of hard bottom.

Waypoint 4: Water depth = 15.0 ft. Swift current observed just upstream of downstream training dike. A little silt in effluent from Ponar. Substrate consisted of coarse sand, pea gravel, and Corbicula.

Comments: Suitable spawning substrate extends from midway between waypoints 1 and 2 to midway between waypoints 3 and 4. (Decided not to take sample between the last 2 downstream rock training dikes.) **Photos:** 1 and 2.

Survey Cross-Section 5+00:

Waypoint 5: Water depth = 3.5 ft. Mouth of Aspalaga Creek, just upstream of boat ramp. Vegetated clayey sand bank. Probed bottom, no Ponar sample taken. Substrate consisted of soft clay and silt. [10:00 a.m.]

Waypoint 6: Water depth = 14.9 ft. Swift current. 1st Ponar sample collected very small amount of pea gravel and Corbicula, with clear effluent; 2nd Ponar sample collected small amount of coarse sand and rock fragment. Substrate consisted of hard bottom overlain with very small amount of pea gravel and coarse sand.

Waypoint 7: Water depth = 14.0 ft. Ponar sample taken in mid-channel. 1st Ponar sample collected sandstone rock fragment with Ponar ajar, clear effluent; 2nd Ponar sample came up empty/clean. Substrate consisted of hard bottom.

Waypoint 8: Water depth = 14.0 ft. Ponar sample came up with clear effluent and small fragment of hard clay rock. Substrate consisted of hard bottom.

Waypoint 9: Water depth = 5.5 ft. Eddy area downstream of dike field and disposal area, with slower current. Very silty effluent from Ponar. Substrate consisted of silt/sand and Corbicula.

Comments: Mouth of Aspalaga Creek, immediately upstream of boat ramp. Suitable spawning substrate extends from midway between waypoints 5 and 6 to midway between waypoints 8 and 9. **Photos:** 3, 4, and 5.

Survey Cross-Section 9+99:

Waypoint 10: Water depth = 8.6 ft. Limerock bluff and rock shelf, with lots of submerged limerock boulders along left bank at shoreline. Rock bluff all the way to top of bank. No Ponar sample taken. Substrate consisted of hard bottom (limerock).

Waypoint 11: Water depth = 12.7 ft. Ponar sample came up empty with clear effluent. Substrate consisted of hard bottom.

Waypoint 12: Water depth = 14.0 ft. Ponar sample taken in mid-channel. Ponar came up empty, with a little coarse sand on top of Ponar, and with clear effluent. Substrate consisted of hard bottom. [10:40 a.m.]

Waypoint 13: Water depth = 14.0 ft. Ponar collected coarse sand with little pea gravel, and clear effluent. Substrate consisted of coarse sand and a small amount of pea gravel.

Comments: Left bank consists of limerock bluff and right bank includes a rock disposal area. Suitable spawning substrate extends from the left bank to midway between waypoints 12 and 13. **Photos:** 6 and 7.

Survey Cross-Section 15+00:

Waypoint 14: Water depth = 5.1 ft. Limerock shelf and limerock bluff on left bank. Ponar collected clear sample with very little coarse sand and rock fragments. Substrate consisted of hard bottom (limerock).

Waypoint 15: Water depth = 12.5 ft. Ponar sample taken in mid-channel, with very swift current. Ponar sample had a few crumbs of limerock with clear effluent. Substrate consisted of hard bottom (limerock).

Waypoint 16: Water depth = 12.3 ft. Ponar sample from mid-channel; clean with limerock chips. Substrate consisted of hard bottom (limerock).

Waypoint 17: Water depth = 12.0 ft. 1st Ponar sample clean with clear effluent; 2nd Ponar sample clear effluent with small amount of sand. Substrate consisted of hard bottom. (10:55 a.m.)

Waypoint 18: Water depth = 1.0 ft. No Ponar sample taken. Clean washed rock cobble disposal site; good rock habitat extends to the right bank at an elevation approximately 1 foot above current river stage water level; provides good bottom habitat with shelter from swift current. Substrate consisted of hard bottom (rock cobble).

Comments: Left bank consists of limerock shelf and bluff and right bank includes a rock disposal site. Suitable spawning substrate extends across entire transect. Rock cobble on right bank extends another 1.0 ft above current river stage. **Photos:** 8, 9, and 10.

Survey Cross-Section 20+00:

Waypoint 19: Water depth = 5.5 ft. Limerock shelf and limerock bluff on left bank. Ponar sample taken near red buoy but outside channel. Clean Ponar sample with limerock chips. Substrate consisted of hard bottom (limerock).

Waypoint 20: Water depth = 14.0 ft. Ponar sample taken in mid-channel with swift current; sample collected rock fragments/hard clay chunks (photo taken of Ponar sample). Substrate consisted of hard bottom (clayrock).

Waypoint 21: Water depth = 9.8 ft. Downstream portion of cobble rock disposal area on right bank. No Ponar sample taken. Same comments as for Waypoint 18. Substrate consisted of hard bottom (rock cobble). (11:25 a.m.)

Comments: Left bank consists of limerock shelf and bluff and right bank includes a rock disposal site. Suitable spawning substrate extends across entire transect. **Photos:** 11, 12, 13, and 14.

Survey Cross-Section 25+00:

Waypoint 22: Water depth = 5.0 ft. Limerock ledge and limerock bluff on left bank. Limerock ledge with boulders. Ponar collected clean sample with limerock fragments. Substrate consisted of hard bottom (limerock).

Waypoint 23: Water depth = 14.2 ft. Mid-channel with swift current. Clear effluent from Ponar, small amount of gravel, very little sand. Substrate consisted of hard bottom (limerock) overlain with a thin layer of gravel and a small amount of sand.

Waypoint 24: Water depth = 3.5 ft. Slow current area just downstream of rock disposal area on right bank. Silty sand effluent from Ponar sample. Substrate consisted of rock cobble overlain with silt/sand (not suitable habitat due to silty sands).

Comments: Left bank consists of limerock shelf and bluff and right bank consists of sand and clay with vegetation. Suitable spawning substrate extends from left bank to midway between waypoints 23 and 24. **Photos:** 15 and 16.

Survey Cross-Section 30+00:

Waypoint 25: Water depth = 4.9 ft. Slow current area – almost still current. Limerock ledge with boulders, interspersed with gravel. Spring observed seeping from left bank. No Ponar sample taken. Substrate consisted of hard bottom (limerock) boulders interspersed with gravel, Corbicula, and fine sand. Fines are probably washed away during spring flows, and the slower current is good for sturgeon spawning.

Waypoint 26: Water depth = 13.2 ft. Mid-channel. Ponar sample was clean with small rock fragments. Current was not as swift. Substrate consisted of hard bottom (limerock).

Waypoint 27: Water depth = 13.5 ft. Mid-channel, swift current. Ponar collected coarse sand and pea gravel. Substrate consisted of coarse sand and pea gravel.

Waypoint 28: Water depth = 8.2 ft. Right bank vegetated with sand and clay substrate. Less current than in mid-channel. Ponar sample collected lots of coarse sand, very little pea gravel, with clear effluent. Substrate consisted of coarse sand and small amount of pea gravel.

Comments: Left bank consists of limerock shelf and bluff and right bank consists of sand and clay with vegetation. Suitable spawning substrate extends from left bank to midway between waypoints 26 and 27. Fine sand observed at waypoint 25 probably is washed away during spring flows providing suitable habitat. **Photos:** 17 and 18.

Survey Cross-Section 35+00:

Waypoint 29: Water depth = 6.5 ft. Left bank comprised of hard sand/clay bank. Ponar sample collected silty sand with clay fragments; very silty in sample with some silt in effluent. Substrate consisted of silt/sand with clay fragments.

Waypoint 30: Water depth = 7.8 ft. 1st Ponar sample was ajoar due to cobble rock fragment, with small amount of sand; 2nd Ponar sample collected cobble rock and coarse gravel

with very little fines. (Photo taken of Ponar sample). Substrate consisted of rock cobble and coarse gravel, which would provide good hard bottom habitat.

Waypoint 31: Water depth = 14.0 ft. Moved to point between Waypoint 29 and Waypoint 30 to better define boundary. Ponar collected hard clay rock fragment with clean effluent. Substrate consisted of hard bottom (clayrock). (12:10 p.m.)

Waypoint 32: Water depth = 8.7 ft. Right bank is vegetated with sand/clay substrate. Slower current. Small amount of silt in Ponar effluent. Substrate consisted of fine silt/sand, pea gravel, and Corbicula.

Comments: Left bank consists of sand and clay. Right bank consists of sand and clay with vegetation. Suitable spawning substrate extends from midway between waypoints 29 and 31 to midway between waypoints 30 and 32. Root wads along left bank provide additional habitat. **Photos:** 19, 20, 21, and 22.

Survey Cross-Section 40+00:

Waypoint 33: Water depth = 6.5 ft. Substrate consisted of hard clay/sand.

Waypoint 34: Water depth = 12.5 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 35: Water depth = 12.5 ft. Substrate consisted of coarse sand.

Waypoint 36: Water depth = 6.0 ft. Substrate consisted of coarse sand and pea gravel.

Comments: Left bank consists of hard clay shelf and soft sand bluff and right bank consists of sand and clay with vegetation. Suitable spawning substrate extends from (define area). **Photos:** 23.

Survey Cross-Section 45+00:

Waypoint 37: Water depth = 6.5 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 38: Water depth = 14.2 ft. Substrate consisted of hard bottom (limerock cobble and boulders).

Waypoint 39: Water depth = 12.0 ft. Substrate consisted of coarse sand.

Waypoint 40: Water depth = 4.5 ft. Substrate consisted of coarse sand, pea gravel, and small amount of silt.

Comments: Left bank consists of hard clay shelf and soft sand bluff and right bank consists of sand and clay with vegetation. Suitable spawning substrate extends from left bank to midway between waypoints 38 and 39. **Photos:** 24, 25, and 26.

Survey Cross-Section 49+00:

Waypoint 41: Water depth = 6.0 ft. Substrate consisted of silt and clay cobble.

Waypoint 42: Water depth = 10.0 ft. Substrate consisted of hard bottom (rock cobble).

Waypoint 43: Water depth = 13.0 ft. Substrate consisted of coarse sand and pea gravel.

Waypoint 44: Water depth = 2.5 ft. Substrate consisted of silt/sand covering hard bottom.

Comments: Left bank consists of sand/clay terraced ledge and right bank consists of sand/clay with rock cobble. Right bank covered with too much silt to be suitable. Suitable spawning substrate extends from midway between waypoints 41 and 42 to midway between waypoints 42 and 43. **Photos:** 27 and 28.

Survey Cross-Section 54+00:

Waypoint 45: Water depth = 10.0 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 46: Water depth = 12.0 ft. Substrate consisted of hard bottom (limerock/clayrock).

Waypoint 47: Water depth = 12.0 ft. Substrate consisted of hard bottom (limerock) and a small amount of coarse gravel.

Waypoint 48: Water depth = 7.5 ft. Substrate consisted of coarse sand and Corbicula.

Waypoint 49: Water depth = 7.5 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of sand/clay and right bank consists of disposal area 141A (sand and rock cobble). Suitable spawning substrate extends from left bank to midway between waypoints 47 and 48. **Photos:** 29 and 30.

Survey Cross-Section 63+00:

Waypoint 50: Water depth = 4.9 ft. Substrate consisted of clay cobble interspersed with fine sand and gravel.

Waypoint 51: Water depth = 13.5 ft. Substrate consisted of fine sand, pea gravel, and Corbicula.

Waypoint 52: Water depth = 7.6 ft. Substrate consisted of coarse sand and Corbicula.

Comments: Left bank consists of clay cobble overlain with fine sand and right bank consists of disposal area 141A (sand and rock cobble). Suitable spawning substrate does not exist on this transect. **Photos:** 31 and 32.

Survey Cross-Section 73+00:

Waypoint 53: Water depth = 4.7 ft. Substrate consisted of fine sand/silt and clay.

Waypoint 54: Water depth = 10.0 ft. Substrate consisted of fine sand, pea gravel, and Corbicula.

Waypoint 55: Water depth = 5.1 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of sand/clay and right bank consists of disposal area 141A (sand revegetated with willow, sycamore, and river birch). Suitable spawning substrate does not exist on this transect. **Photos:** 33 and 34.

Survey Cross-Section 83+00:

Waypoint 56: Water depth = 6.5 ft. Substrate consisted of silt and fine sand.

Waypoint 57: Water depth = 10.8 ft. Substrate consisted of coarse and fine sand.

Waypoint 58: Water depth = 7.8 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of sand and transect is located immediately upstream of rock dikes. Right bank consists of sand. Suitable spawning substrate does not exist on this transect. **Photos:** 35, 36, and 37.

Site 95.2:

Survey Cross-Section 10+00:

Waypoint 1: Water depth = 1.5 ft. Substrate consisted of hard bottom (limerock).

Waypoint 2: Water depth = 9.0 ft. Substrate consisted of hard bottom (limerock).

Waypoint 3: Water depth = 9.8 ft. Substrate consisted of hard bottom (limerock).

Waypoint 4: Water depth = 9.5 ft. Substrate consisted of hard bottom overlain with thin layer of coarse sand.

Comments: Immediately downstream of disposal area 138A and slough that was recently opened. Left bank consists of limestone edge and right bank consists of terraced sand with vegetation and root wads. Suitable spawning substrate extends from left bank to midway between waypoints 3 and 4. **Photos:** 38 and 39.

Survey Cross-Section 14+00:

Waypoint 5: Water depth = 3.5 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 6: Water depth = 10.0 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 7: Water depth = 14.8 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 8: Water depth = 9.0 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of hard clayrock overlain by sand/clay bluff and right bank consists of terraced sand. Suitable spawning substrate extends from left bank to midway between waypoints 7 and 8. **Photos:** 40 and 41.

Survey Cross-Section 18+00:

Waypoint 9: Water depth = 4.5 ft. Substrate consisted of hard bottom (limerock/clayrock).

Waypoint 10: Water depth = 15.0 ft. Substrate consisted of hard bottom (limerock/clayrock).

Waypoint 11: Water depth = 13.5 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of limerock over clayrock and right bank consists of terraced sand. Suitable spawning substrate extends from left bank to midway between waypoints 10 and 11. **Photos:** 42, 43, 44, and 45.

Site 94.0:

Survey Cross-Section 0+00:

Waypoint 1: Water depth = 5.5 ft. Substrate consisted of silt/sand.

Waypoint 2: Water depth = 15.4 ft. Substrate consisted of coarse and fine sands.

Waypoint 3: Water depth = 10.7 ft. Substrate consisted of silt/sand and Corbicula.

Comments: Immediately downstream of disposal area 138A and slough that was recently opened. Left bank consists of terraced sand bluff and right bank consists of sand and limerock cobble at disposal area 136. Suitable spawning substrate does not exist on this transect. **Photos:** 46 and 47.

Survey Cross-Section 4+70:

Waypoint 4: Water depth = 3.9 ft. Substrate consisted of hard silt/sand.

Waypoint 5: Water depth = 13.0 ft. Substrate consisted of coarse sand.

Waypoint 6: Water depth = 7.7 ft. Substrate consisted of hard bottom (limerock).

Waypoint 7: Water depth = 41.0 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of terraced sand bluff and right bank consists of gravel size limerock (possible old disposal area). Suitable spawning substrate extends from right bank to midway between waypoints 6 and 7. **Photos:** 48 and 49.

Survey Cross-Section 10+00:

Waypoint 8: Water depth = 3.5 ft. Substrate consisted of coarse sand.

Waypoint 9: Water depth = 21.5 ft. Substrate consisted of coarse sand and pea gravel.

Waypoint 10: Water depth = 28.0 ft. Substrate consisted of hard bottom (limerock).

Waypoint 11: Water depth = 27.5 ft. Substrate consisted of hard bottom (limerock).

Comments: Left bank consists of sand and right bank consists of clay/sand with tree stumps. Suitable spawning substrate extends from right bank to midway between waypoints 11 and 9. **Photos:** 50 and 51.

Survey Cross-Section 15+00:

Waypoint 12: Water depth = 3.0 ft. Substrate consisted of coarse sand and a small amount of limerock cobble.

Waypoint 13: Water depth = 13.3 ft. Substrate consisted of hard bottom (limerock).

Waypoint 14: Water depth = 8.0 ft. Substrate consisted of coarse sand.

Waypoint 15: Water depth = 14.8 ft. Substrate consisted of hard bottom (limerock).

Comments: Left bank consists of sand and right bank consists of clay and cypress stumps. Suitable spawning substrate extends from right bank to midway between waypoints 13 and 14. **Photos:** 52, 53, and 54.

Survey Cross-Section 20+00:

Waypoint 16: Water depth = 3.0 ft. Substrate consisted of coarse sand with scattered limerock cobble.

Waypoint 17: Water depth = 7.2 ft. Substrate consisted of coarse sand.

Waypoint 18: Water depth = 8.5 ft. Substrate consisted of coarse sand.

Waypoint 19: Water depth = 10.0 ft. Substrate consisted of hard bottom overlain with thin layer of coarse gravel/sand and Corbicula.

Waypoint 20: Water depth = 11.0 ft. Substrate consisted of hard bottom.

Comments: Left bank consists of sand and right bank consists of eroding sand/clay bank.

Suitable spawning substrate extends from right bank to midway between waypoints 18 and 19. **Photos:** 55 and 56.

Survey Cross-Section 24+89:

Waypoint 21: Water depth = 3.0 ft. Substrate consisted of sand with a small amount of gravel.

Waypoint 22: Water depth = 5.0 ft. Substrate consisted of coarse sand.

Waypoint 23: Water depth = 10.0 ft. Substrate consisted of coarse sand with a small amount of gravel.

Waypoint 24: Water depth = 11.0 ft. Substrate consisted of hard bottom.

Comments: Left bank consists of sand and right bank consists of terraced sand/clay. Suitable spawning substrate extends from right bank to midway between waypoints 23 and 24. **Photos:** 57 and 58.

Survey Cross-Section 29+00:

Waypoint 25: Water depth = 2.5 ft. Substrate consisted of sand/silt with a small amount of gravel.

Waypoint 26: Water depth = 9.2 ft. Substrate consisted of coarse sand.

Waypoint 27: Water depth = 9.8 ft. Substrate consisted of hard bottom (limerock).

Waypoint 28: Water depth = 9.5 ft. Substrate consisted of gravel with a small amount of coarse sand.

Comments: Left bank consists of sand and right bank consists of eroded sand/clay. Suitable spawning substrate extends from right bank to midway between waypoints 27 and 28. **Photos:** 59 and 60.

Survey Cross-Section 34+00:

Waypoint 29: Water depth = 2.5 ft. Substrate consisted of coarse sand, silt, and gravel.

Waypoint 30: Water depth = 6.5 ft. Substrate consisted of coarse sand, silt, and gravel.

Waypoint 31: Water depth = 16.0 ft. Substrate consisted of hard bottom.

Waypoint 32: Water depth = 8.7 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of sand and right bank consists of eroded clay bank. Suitable spawning substrate extends from right bank to midway between waypoints 31 and 32. **Photos:** 61 and 62.

Survey Cross-Section 38+41:

Waypoint 33: Water depth = 4.7 ft. Substrate consisted of coarse/fine sand and a small amount of pea gravel.

Waypoint 34: Water depth = 9.9 ft. Substrate consisted of coarse sand.

Waypoint 35: Water depth = 15.0 ft. Substrate consisted of gravel, small amount of fines, and Corbicula.

Comments: Left bank consists of sand and right bank consists of eroded sand/clay bank. Gravel area may represent suitable spawning substrate. **Photos:** 63 and 64.

Survey Cross-Section 43+00:

Waypoint 36: Water depth = 6.1 ft. Substrate consisted of coarse sand.

Waypoint 37: Water depth = 9.7 ft. Substrate consisted of coarse sand, pea gravel, and Corbicula.

Waypoint 38: Water depth = 13.9 ft. Substrate consisted of coarse gravel, pea gravel, Corbicula, and a small amount of fines.

Waypoint 39: Water depth = 12.0 ft. Substrate consisted of silt/sand.

Comments: Immediately downstream of rock disposal area. Left bank consists of rock disposal area and right bank consists of eroded clay bank. Suitable spawning substrate does not exist on this transect. **Photos:** 65, 66, and 67.

Survey Cross-Section 48+00:

Waypoint 40: Water depth = 5.0 ft. Substrate consisted of coarse sand.

Waypoint 41: Water depth = 10.5 ft. Substrate consisted of coarse sand.

Waypoint 42: Water depth = 18.7 ft. Substrate consisted of pea gravel, coarse gravel, sand, and Corbicula.

Comments: Located at upstream end of rock disposal area. Left bank consists of sand/clay sloped bank with vegetation and right bank consists of eroded clay bank with cypress stumps and snags. Suitable spawning substrate does not exist on this transect. **Photos:** 68 and 69.

Survey Cross-Section 53+00:

Waypoint 43: Water depth = 8.5 ft. Substrate consisted of fine sand.

Waypoint 44: Water depth = 14.5 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 45: Water depth = 14.0 ft. Substrate consisted of hard bottom (clayrock).

Comments: Located at upstream end of rock disposal area. Left bank consists of sand and right bank consists of eroded clay bank. Suitable spawning substrate extends from right bank to midway between waypoints 43 and 44. **Photos:** 70 and 71.

Survey Cross-Section 58+00:

Waypoint 46: Water depth = 6.0 ft. Substrate consisted of silt/sand.

Waypoint 47: Water depth = 14.3 ft. Substrate consisted of coarse sand.

Waypoint 48: Water depth = 16.5 ft. Substrate consisted of hard bottom (coarse gravel and clayrock).

Waypoint 49: Water depth = 13.4 ft. Substrate consisted of coarse sand and pea gravel.

Comments: Left bank consists of sand and right bank consists of eroded clay bank. Suitable spawning substrate extends from right bank to midway between waypoints 48 and 49. **Photos:** 72 and 73.

Site 92.7:

Survey Cross-Section 0+00:

Waypoint 1: Water depth = 7.0 ft. Substrate consisted of silt and mud.

Waypoint 2: Water depth = 19.0 ft. Substrate consisted of coarse sand.

Waypoint 3: Water depth = 22.0 ft. Substrate consisted of coarse sand and pea gravel.

Comments: Located at mouth of slough. Left bank consists of sand and right bank consists of eroded clay bank. Suitable spawning substrate does not exist on this transect. **Photos:** 74, 75, and 76.

Survey Cross-Section 4+50:

Waypoint 4: Water depth = 22.0 ft. Substrate consisted of mud/silt over rock.

Waypoint 5: Water depth = 36.0 ft. Substrate consisted of coarse and fine sand.

Waypoint 6: Water depth = 25.0 ft. Substrate consisted of coarse sand.

Waypoint 7: Water depth = 6.5 ft. Substrate consisted of coarse sand and pea gravel.

Comments: Left bank consists of limerock and right bank consists of terraced sand overlain with sand/clay. **Suitable spawning substrate** is limited to the left bank area. **Photos:** 77, 78, 79, and 80.

Survey Cross-Section 10+00:

Waypoint 8: Water depth = 15.0 ft. Substrate consisted of hard bottom (limerock).

Waypoint 9: Water depth = 34.0 ft. Substrate consisted of coarse sand.

Waypoint 10: Water depth = 28.2 ft. Substrate consisted of fine sand.

Comments: Immediately upstream of slough opening. Left bank consists of limerock ledge with boulders and right bank consists of terraced sand. Suitable spawning substrate extends from left bank to midway between waypoints 8 and 9. **Photos:** 81, 82, 83, and 84.

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Site 92.7 (continued):

Survey Cross-Section 15+00:

Waypoint 11: Water depth = 7.0 ft. Substrate consisted of hard bottom (limerock).

Waypoint 12: Water depth = 22.0 ft. Substrate consisted of gravel, sand, and silt.

Waypoint 13: Water depth = 18.0 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of limerock ledge and right bank consists of sand. Suitable spawning substrate extends from left bank to midway between waypoints 11 and 12. **Photos:** 1, 2, and 3.

Survey Cross-Section 20+00:

Waypoint 14: Water depth = 4.5 ft. Substrate consisted of sand.

Waypoint 15: Water depth = 13.0 ft. Substrate consisted of sand with a small amount of Corbicula and gravel.

Waypoint 16: Water depth = 16.0 ft. Substrate consisted of sand with a small amount of gravel.

Comments: Rock dikes on left bank. Left bank consists of sand and right bank consists of sand. Suitable spawning substrate does not exist on this transect. **Photos:** 4, 5, 6, and 7.

Survey Cross-Section 21+36:

Waypoint 17: Water depth = 9.8 ft. Substrate consisted of sand over limerock/clay (soft).

Waypoint 18: Water depth = 12.5 ft. Substrate consisted of coarse sand.

Waypoint 19: Water depth = 18.5 ft. Substrate consisted of coarse sand.

Comments: Located outside of dike field. Left bank consists of sand and right bank consists of sand over limerock/clay (soft). Suitable spawning substrate does not exist on this transect.

Photos: 8, 9, and 10.

Site 84.5:

Survey Cross-Section 0+00:

Waypoint 1: Water depth = 5.0 ft. Substrate consisted of hard silt/clay.

Waypoint 2: Water depth = 18.8 ft. Substrate consisted of coarse and fine sand.

Waypoint 3: Water depth = 10.8 ft. Substrate consisted of coarse sand and a small amount of gravel.

Comments: Left bank consists of sand/clay and right bank consists of sand. Suitable spawning substrate does not exist on this transect. **Photos:** 11 and 12.

Survey Cross-Section 10+00:

Waypoint 4: Water depth = 11.0 ft. Substrate consisted of hard bottom (limerock/alum clay), boulders, with sand in interstices.

Waypoint 5: Water depth = 22.0 ft. Substrate consisted of hard bottom (limerock/alum clay), boulders, with sand in interstices.

Waypoint 6: Water depth = 24.0 ft. Substrate consisted of pea gravel and coarse sand.

Waypoint 7: Water depth = 15.0 ft. Substrate consisted of coarse sand.

Comments: Alum bluff boundary begins approximately half way between waypoints 3 and 4. Left bank consists of limerock boulders below sheer rock bluff and right bank consists of sand. Suitable spawning substrate extends from left bank to midway between waypoints 5 and 6.

Photos: 13, 14, and 15.

Survey Cross-Section 20+00:

Waypoint 8: Water depth = 11.0 ft. Substrate consisted of silt/sand.

Waypoint 9: Water depth = 12.8 ft. Substrate consisted of coarse sand and pea gravel.

Waypoint 10: Water depth = 14.7 ft. Substrate consisted of coarse sand.

Comments: Recent sand slide off of Alum bluff. Left bank consists of limerock boulders below sheer rock bluff and right bank consists of sand/clay. Suitable spawning substrate is limited to the rock areas along the left bank??. **Photos:** 16, 17, and 18.

Survey Cross-Section 30+00:

Waypoint 11: Water depth = 19.5 ft. Substrate consisted of hard bottom (sand/clayrock).

Waypoint 12: Water depth = 25.0 ft. Substrate consisted of coarse sand.

Waypoint 13: Water depth = 9.0 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of hard sand/clayrock ledge and right bank consists of sand/clay. Suitable spawning substrate extends from left bank to midway between waypoints 11 and 12.

Photos: 19, 20, 21, 22, and 23.

Survey Cross-Section 41+00:

Waypoint 14: Water depth = 5.4 ft. Substrate consisted of fine sand.

Waypoint 15: Water depth = 21.5 ft. Substrate consisted of fine and coarse sand.

Waypoint 16: Water depth = 16.0 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of sand and right bank consists of sand. Suitable spawning substrate does not exist on this transect. **Photos:** 24, 25, 26, and 27.

Survey Cross-Section 43+86:

Waypoint 17: Water depth = 6.5 ft. Substrate consisted of silt and sand/clay.

Waypoint 18: Water depth = 17.7 ft. Substrate consisted of fine and coarse sand.

Waypoint 19: Water depth = 16.4 ft. Substrate consisted of fine silt/sand.

Comments: Left bank consists of clay and right bank consists of sand/clay. Suitable spawning substrate does not exist on this transect. **Photos:** 28 and 29.

Site 81.2:

Survey Cross-Section 0+00:

Waypoint 1: Water depth = 5.0 ft. Substrate consisted of silt/clay.

Waypoint 2: Water depth = 11.0 ft. Substrate consisted of coarse sand.

Waypoint 3: Water depth = 11.2 ft. Substrate consisted of coarse sand and pea gravel.

Comments: Left bank consists of clay and right bank consists of eroded sand and clay. Suitable spawning substrate does not exist on this transect. **Photos:** 30 and 31.

Survey Cross-Section 10+00:

Waypoint 4: Water depth = 16.5 ft. Substrate consisted of hard bottom (limerock).

Waypoint 5: Water depth = 27.0 ft. Substrate consisted of coarse sand.

Waypoint 6: Water depth = 7.5 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of limerock and hard clay boulders with fine sand in interstices. Right bank consists of sand. Suitable spawning substrate extends from left bank to midway between waypoints 4 and 5. **Photos:** 32, 33, and 34.

Survey Cross-Section 20+00:

Waypoint 7: Water depth = 16.0 ft. Substrate consisted of hard bottom (clay/sand composite rock) with sand/silt/clay in interstices.

Waypoint 8: Water depth = 24.8 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 9: Water depth = 16.5 ft. Substrate consisted of coarse sand and pea gravel.

Waypoint 10: Water depth = 7.5 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of hard clay/sand composite rock bluff and right bank consists of sand. Suitable spawning substrate extends from left bank to midway between waypoints 8 and 9. **Photos:** 35, 36, and 37.

Survey Cross-Section 30+86:

Waypoint 11: Water depth = 11.0 ft. Substrate consisted of hard bottom (clay sandstone).

Waypoint 12: Water depth = 27.0 ft. Substrate consisted of coarse sand and pea gravel.

Waypoint 13: Water depth = 10.3 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of hard clay sandstone cliff and right bank consists of sand disposal area 117A. Suitable spawning substrate extends from left bank to midway between waypoints 11 and 12. **Photos:** 38, 39, and 1 (begin USFWS camera).

Survey Cross-Section 40+00:

Waypoint 14: Water depth = 18.0 ft. Substrate consisted of hard bottom (clayrock).

Waypoint 15: Water depth = 23.3 ft. Substrate consisted of coarse sand and pea gravel.

Waypoint 16: Water depth = 13.0 ft. Substrate consisted of coarse sand.

Comments: Left bank consists of hard clay sandstone ledge and right bank consists of sand. Suitable spawning substrate extends from left bank to midway between waypoints 14 and 15.

Photos: 2 and 3.

Survey Cross-Section 51+00:

Waypoint 17: Water depth = 3.5 ft. Substrate consisted of hard bottom (limerock/sandstone).

Waypoint 18: Water depth = 9.0 ft. Substrate consisted of hard bottom (limerock/sandstone).

Waypoint 19: Water depth = 18.0 ft. Substrate consisted of coarse sand.

Comments: Immediately downstream of Bristol boat ramp. Left bank consists of crushed limerock/sandstone bank protection and right bank consists of sand. Suitable spawning substrate extends from left bank to midway between waypoints 18 and 19. **Photos:** 4, 5, and 6.

Survey Cross-Section 52+73:

Waypoint 20: Water depth = 4.0 ft. Substrate consisted of fine sand.

Waypoint 21: Water depth = 13.0 ft. Substrate consisted of coarse sand, pea gravel, and fine gravel.

Waypoint 22: Water depth = 13.0 ft. Substrate consisted of coarse sand and fine sand.

Comments: Left bank consists of fine sand and scattered rock fragments and right bank consists of sand. Suitable spawning substrate does not exist on this transect. **Photos:** 7, 8, and 9.