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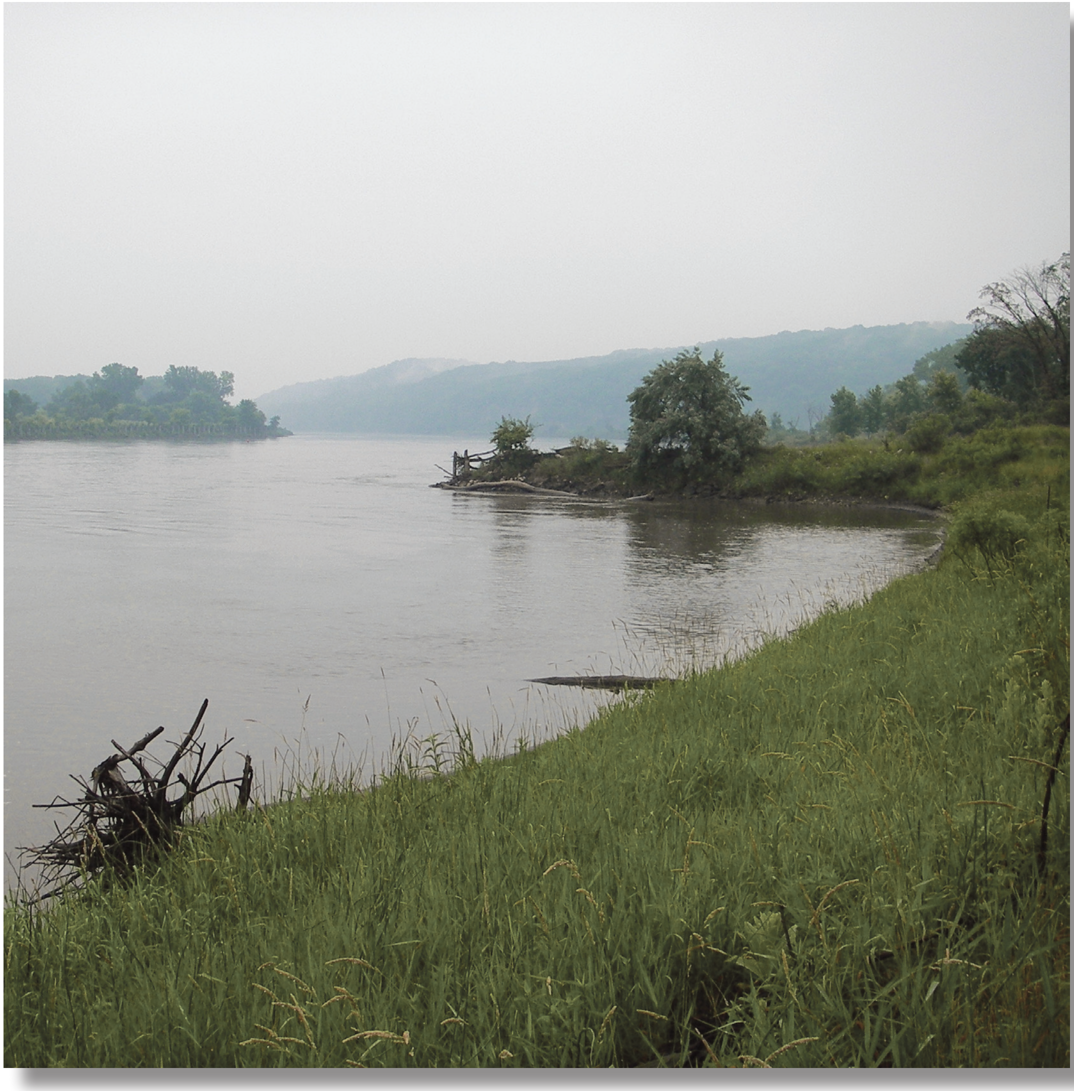
U.S. Army Corps of Engineers, Yankton, South Dakota

Hydraulic and Substrate Maps of Reaches Used by Sturgeon (Genus *Scaphirhynchus*) in the Lower Missouri River, 2005–07



Data Series 386

U.S. Department of the Interior
U.S. Geological Survey

Cover: Photograph of the channelized Missouri River near river mile 707.5.
Photograph taken by Joanna M. Reuter, U.S. Geological Survey, June 13, 2007.

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
mile (mi)	1.609	kilometer (km)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

SI to Inch/Pound

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
meter (m)	1.094	yard (yd)
	Flow rate	
cubic meter per second (m^3/s)	35.31	cubic foot per second (ft^3/s)

Distances along the Missouri River are given in river miles upstream from the junction with the Mississippi River at St. Louis, Missouri.

Horizontal coordinate information is referenced to the World Geodetic System of 1984 (WGS 84).

Hydraulic and Substrate Maps of Reaches Used by Sturgeon (Genus *Scaphirhynchus*) in the Lower Missouri River, 2005–07

By Joanna M. Reuter, Robert B. Jacobson, Caroline M. Elliott, Harold E. Johnson III, and Aaron J. DeLonay

Abstract

This report is a repository of reach-scale maps of hydraulic and substrate characteristics generated for the habitat-use portion of an interdisciplinary sturgeon research project on the Lower Missouri River (from Gavins Point Dam to the junction with the Mississippi River). The maps were derived from hydroacoustic data sets that were collected for the purpose of assessing physical aquatic habitat in the vicinity of locations of adult shovelnose sturgeon (*Scaphirhynchus platorynchus*) and pallid sturgeon (*S. albus*). Hydroacoustic data sets were collected at the reach scale (mean reach length, 2.4 kilometers) in order to include the immediate vicinity of a targeted sturgeon location as well as the full range of habitat available at the bend and crossover scale. Reaches typically were surveyed on the day following the relocation of a telemetered sturgeon and at a discharge within 10 percent of the discharge on the sturgeon relocation date in order to characterize as closely as possible the channel morphology and flow-field conditions at the time that the sturgeon was present. One hundred fifty-three reaches were mapped during April–September in the years 2005 through 2007, with the majority of data collection occurring in the months of May and June (coinciding with the period of sturgeon migration and spawning in the Lower Missouri River). Interpolated maps (grid cell size, 5 meters) depict depth, generalized substrate, and depth-averaged velocity. Side-scan sonar imagery is also available for a subset of reaches. Collectively, the maps represent more than 20 percent of the length of the Lower Missouri River.

Introduction

The physical character and the aquatic habitat of the Missouri River have changed substantially relative to the historical condition due to human alteration, including dam construction and operation, bank stabilization, and channelization (National Research Council, 2002; Galat and others, 2005). Altered habitat conditions are common among the large rivers that are inhabited by sturgeon throughout North America and the Northern Hemisphere. Many different species in the sturgeon family (Acipenseridae) are on the decline (Birstein and others, 1997). Habitat degradation is one of the factors often hypothesized to be a factor in the decline of sturgeon populations in general and pallid sturgeon (*Scaphirhynchus albus*) on the Missouri River in particular (U.S. Fish and Wildlife Service, 2000, 2003). Because of the assumed importance of habitat to sturgeon survival and reproduction, habitat assessments were identified as a research priority for pallid sturgeon in the Missouri River (Quist and others, 2004). One step in this process is to determine what habitats sturgeon utilize in the context of available habitat. To address the question of habitat use, mapping efforts were coordinated with a telemetry-based, sturgeon-tracking project to map depth, substrate, and water velocity at sites individual sturgeon were known to have occupied in the Lower Missouri River.

The Lower Missouri River is an approximately 1,305-kilometer (811-mile) section of river from Gavins Point Dam (the lowest main-stem dam on the Missouri River) to the junction with the Mississippi River (fig. 1). The degree of hydrologic and geomorphic alteration varies in different segments of the Lower Missouri River. Deviation from the natural flow regime is greatest immediately downstream from the dam but is progressively moderated by inputs from unregulated tributaries in the downstream direction (Galat and Lipkin, 2000; Jacobson and Heuser, 2002; Pegg and others, 2003). In contrast, the channel morphology most resembles the historical state in the unchannelized segment just downstream from Gavins Point Dam (Elliott and Jacobson, 2006). Downstream from Sioux City, Iowa, the river has been narrowed and stabilized for navigation, although the type and quantity of engineered structures changes longitudinally, as does the size of the river.

Riverine physical aquatic habitat is substantially dependent on interaction between flow regime and channel morphology (Jacobson and Galat, 2006). Ongoing, related studies are characterizing the sensitivity of physical aquatic habitat to changes in discharge and geomorphic change on the Missouri River (Jacobson and others, 2007). Preliminary analyses indicate that channel morphology within the stabilized banks can be very dynamic on the time scale of weeks to months. Because of the dynamic nature of both discharge and channel morphology on the Lower Missouri

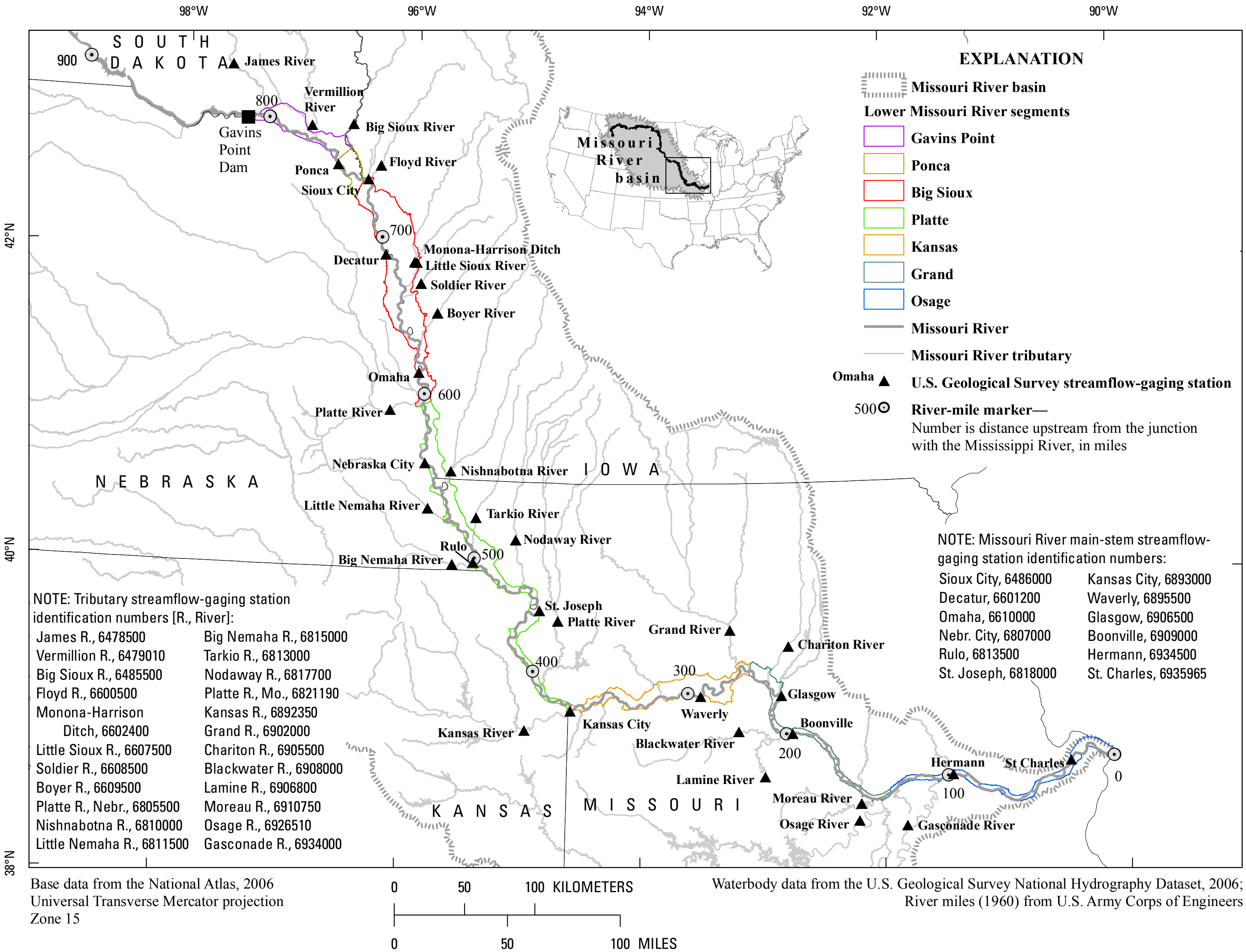


Figure 1. Map of the Lower Missouri River including U.S. Geological Survey streamflow-gaging stations and river segments. Segments are lengths of river bounded by major tributaries or defined by changes in channel morphology. Segment names are based on the tributary or feature bounding the segment on the upstream end.

River, physical aquatic habitat assessments are best completed near in time and at discharges similar to the discharge when sturgeon were relocated (fig. 2). Obtaining such map data sets requires a high degree of coordination with fisheries crews tracking telemetered sturgeon.

Two sturgeon species of the genus *Scaphirhynchus* are native inhabitants of the Missouri River. These species are the pallid sturgeon (*S. albus*), listed as endangered in 1990, and the more common shovelnose sturgeon (*S. platorynchus*). Both species exhibit periodical migratory behavior associated with spawning (DeLonay and others, 2007). Gravid female sturgeon typically migrate upstream, reach an upstream-most location (apex), and descend downstream (DeLonay and others, 2007). Spawning is assumed to occur at or near the apex location. Although spawning of both shovelnose and pallid sturgeon has been confirmed on the Lower Missouri River (U.S. Geological Survey, 2007), the exact spawning locations have not been identified. Lower Missouri River sturgeon migrate during spring and summer; the peak of spawning in the Lower Missouri River appears to occur during May and June (DeLonay and others, 2007; Simpkins and LaBay, 2007).

Habitat mapping coincided with the spring through summer sturgeon migration, including the time period when spawning occurs. The sturgeon targeted for mapping were predominantly gravid female shovelnose sturgeon (as determined at the time they were implanted with transmitters); some of the mapped sturgeon were later confirmed to have spawned (DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008). Some locations of male shovelnose sturgeon as well as male and female pallid sturgeon also were mapped.

Purpose and Scope

This report serves as a repository of maps of hydraulic and substrate characteristics that were generated during 2005 through 2007 as part of the Comprehensive Sturgeon Research Project at the Columbia Environmental Research Center (CERC). The report documents methods used for reach selection, data collection, data processing, and map production. Maps are presented for 153 reaches that collectively represent more than 20 percent of the length of the Lower Missouri River. Analysis of the data set is not within the scope of this report.

Acknowledgments

Funding for this project was provided by the U.S. Army Corps of Engineers (USACE), Missouri River Recovery–Integrated Science Program and the U.S. Geological Survey (USGS). This work is part of the Comprehensive Sturgeon Research Project, a large, interdisciplinary, multiyear research project to which numerous individuals have contributed. The following individuals in particular contributed to the habitat-use component of this project: Matt Smith and Chad Vishy (Arctic Slope Regional Corporation) worked as field technicians and assisted with data processing. Mark Laustrup (USGS) and David Gaeuman (National Research Council Post-Doctoral Fellow) also participated in data collection. Aaron DeLonay and his tracking crews (USGS) tagged and relocated sturgeon during 2005 to 2007. In addition, tracking crews with the Nebraska Game and Parks Commission provided some of the telemetry locations in 2007. Kim Chojnacki, Emily Tracy-Smith, and Sandy Clark-Kolaks (USGS) provided support through management and quality control of the sturgeon telemetry data, making possible the near-real-time analysis that allowed for selection of target mapping locations. Reviewers David Heimann and Jason Alexander (USGS) provided input that helped to improve this report.

Methods

The “Methods” section provides details relevant to map production, including information about the sturgeon telemetry project, target sturgeon selection, reach definition, data collection, and data processing. Each mapping crew used recent sturgeon relocations to select a target location for a mapping day; one or two mapping crews were deployed each day. After selecting a target location, mapping crews defined a reach to include the habitat in the immediate vicinity of the sturgeon and in the surrounding bend and crossover macrohabitats (fig. 3). The target location and surroundings were mapped by driving the hydroacoustic mapping boat (fig. 4) along predefined transects throughout the reach. We used the data to generate interpolated maps for each reach.

Sturgeon Locations

In the late winter/early spring of 2005, 2006, and 2007, CERC collaborators caught sturgeon and implanted selected individuals with telemetry transmitters (DeLonay and others, 2007); several hundred sturgeon were tagged and implanted with transmitters. Tagged, telemetered sturgeon were subsequently released and tracked to determine their movement patterns. Crews tracked sturgeon by navigating through sections of river, using boats outfitted with acoustic and radio receivers to determine the locations of telemetered sturgeon. These relocation points, accurate to approximately 2 meters, were obtained using a differential global positioning system (DGPS) receiver and were recorded in Universal Transverse Mercator (UTM) coordinates, Zone 15 North, using the World Geodetic System of 1984 (WGS 84) datum. Coordinates were typically made available to habitat-mapping crews on the evening that the relocation data were collected.

The spatial extent of habitat mapping was determined by the sampling design used in the telemetry studies and by the movement of tagged sturgeon. During 2005 and 2006 the sample design called for comparison between upstream and downstream locations. Downstream sturgeon were released in

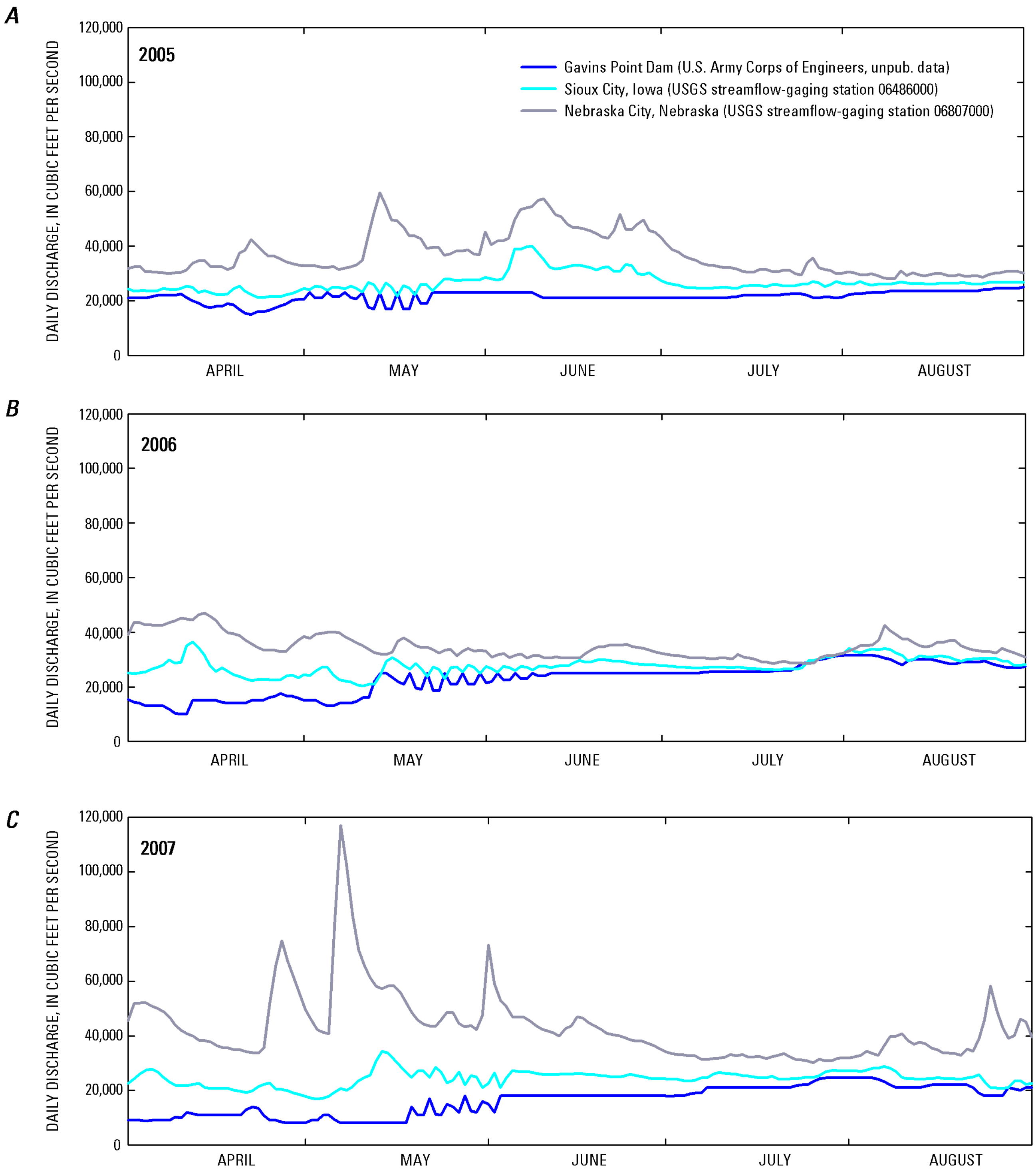
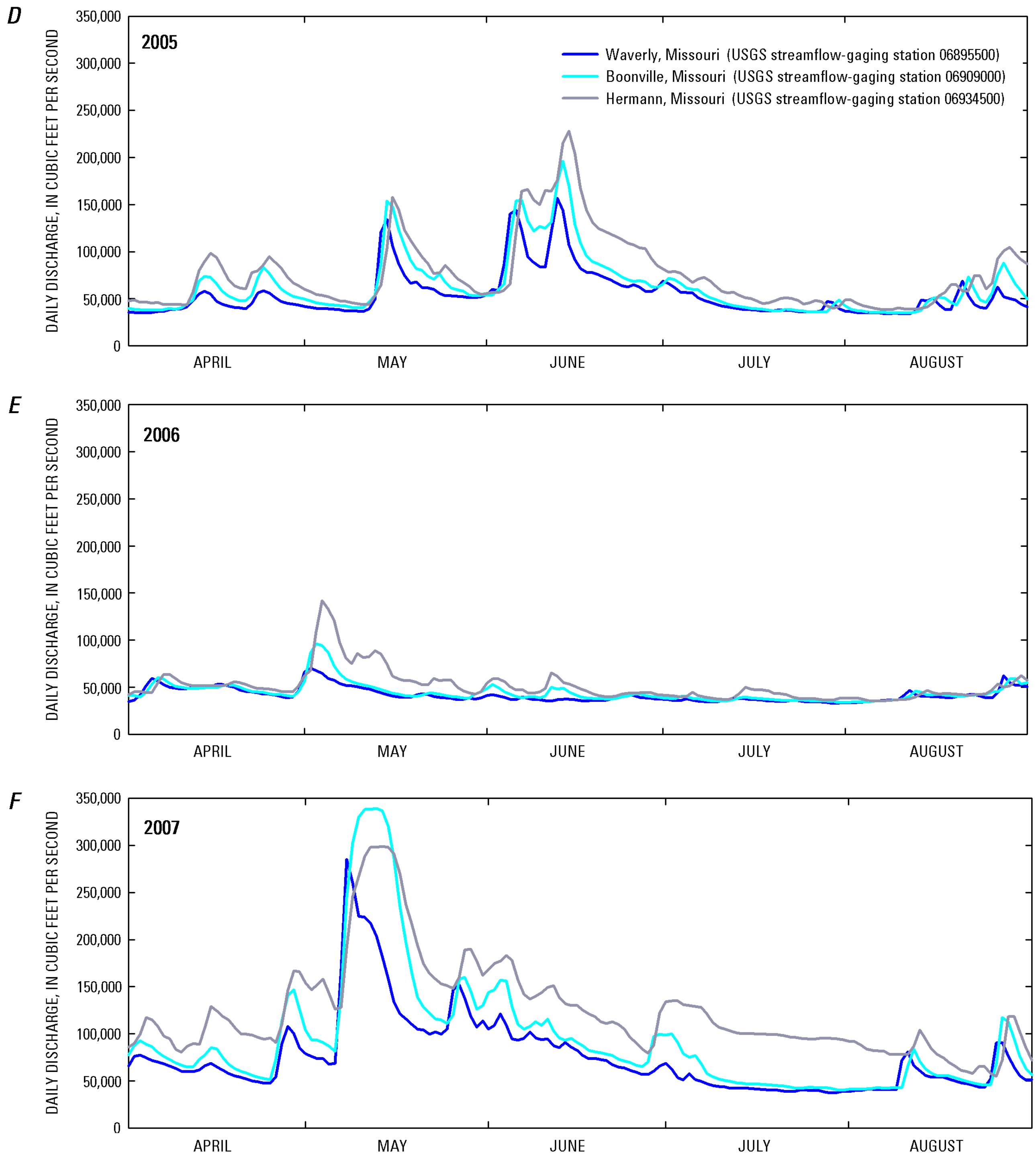


Figure 2. Hydrographs showing Missouri River daily mean discharge for April 1 through September 1 in each of the study years. Gages representing the Gavins Point segment (Gavins Point Dam), the Big Sioux segment (Sioux City), and the Platte segment (Nebraska City) are shown for (A) 2005, (B) 2006, and (C) 2007. Gages representing the Kansas segment (Waverly), the Grand segment (Boonville), and the Osage segment (Hermann) are shown for (D) 2005, (E) 2006, and (F) 2007.



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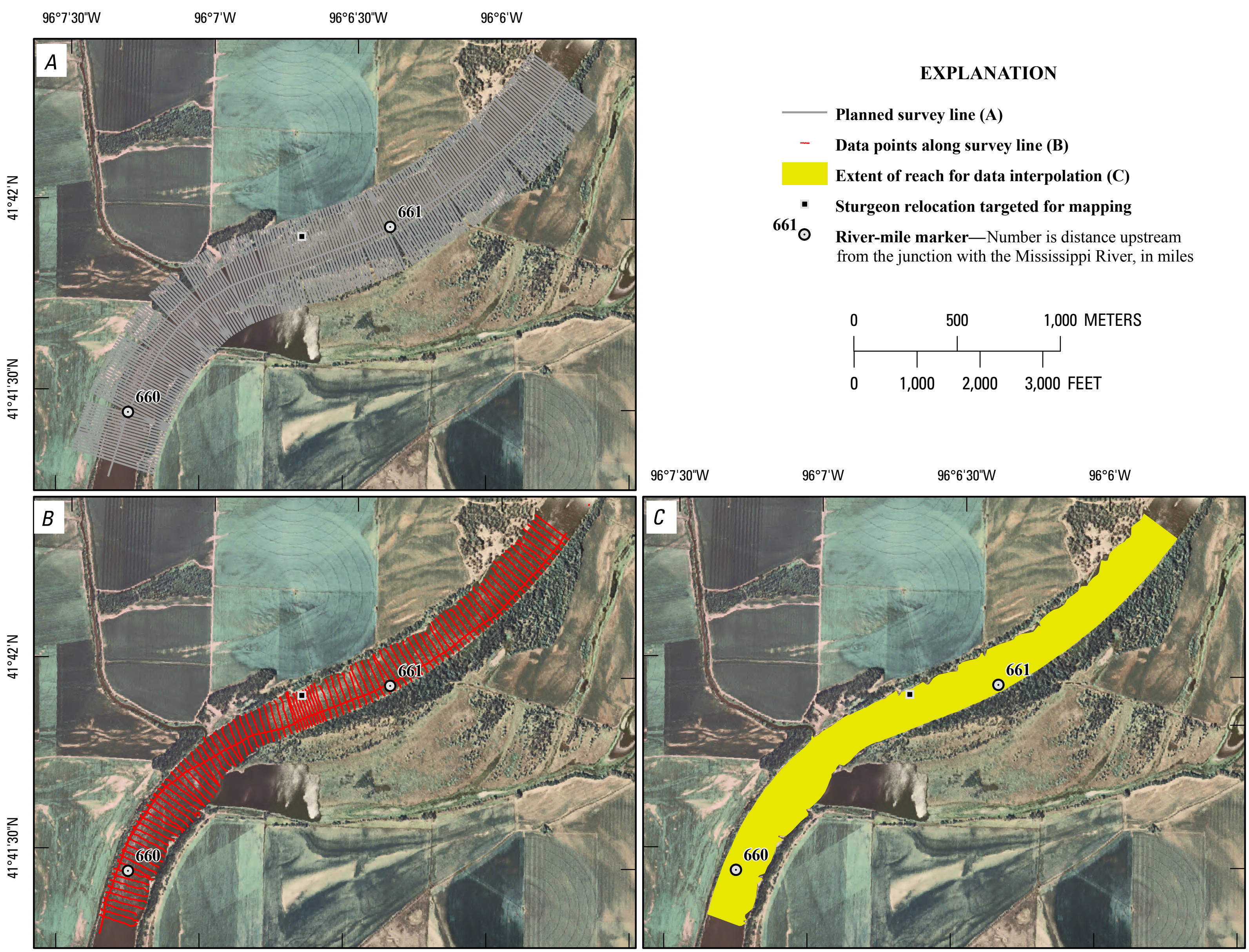

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; DeLonay, unpub. data, 2007

Figure 3. Map of example reach with (A) line file showing all planned transects, (B) locations of data points, and (C) extent of reach for data interpolation.

Figure 4. Photograph of the research vessel (R/V) Slim Funk actively collecting data.

the Missouri River between the Osage River and the Kansas River junctions, and the upstream sturgeon were released between the junctions of the Platte River and the Vermillion River in South Dakota (fig. 1). During 2007, releases were upstream from the Platte River.

Site Selection

Selection of a mapping site typically began with selection of a recent sturgeon relocation point, usually from the previous day of tracking. Locations for mapping were selected through either random or nonrandom methods. The randomized approach was used because randomly selected locations are best suited for unbiased assessments of habitat use and availability (Millspaugh and Marzluff, 2001). Sites were selected through nonrandom procedures for a variety of reasons, including the desire to target locations where spawning was suspected. Both random and nonrandom sites were mapped each year.

One prerequisite for site selection was to check that discharge on the day of mapping was anticipated to be within 10 percent of the discharge on the sturgeon-relocation date. We established this discharge goal because physical aquatic habitat conditions change with discharge, and it is important for the conditions at the time of mapping to be as similar as possible to conditions when the sturgeon was relocated. However, in some cases discharge changed more than the mapping crew anticipated, so not all maps meet the 10-percent criterion. In addition, the rapidly fluctuating flows from Gavins Point Dam in parts of May and June of 2006 and 2007 made strict adherence to this guideline difficult (fig. 2).

Randomization for the selection of reaches was implemented by assigning a random ranking to each qualifying sturgeon relocation point from the previous tracking day (typically the previous calendar day). The rankings were stratified by location either upstream or downstream from Rulo, Nebraska, to accommodate the location of staged boats. In 2005 and 2006, most of the tracked sturgeon were gravid female shovelnose, and all sturgeon relocations were considered for randomization. In 2007, only gravid female shovelnose sturgeon were targeted for random mapping. Occasionally, the relocation point with the highest randomized ranking had to be rejected for one of the following reasons: (1) the discharge criterion was not met at the site; (2) river or weather conditions threatened the safety of the boat or crew; (3) the site had already been mapped in the same year and at a similar discharge. In these cases, either the sturgeon with the second random ranking was mapped or a nonrandom site was selected.

Maps based on nonrandom selection of sturgeon relocations were made for a variety of specific reasons including the following: (1) to target suspected spawning sites; (2) to map sites where pallid sturgeon had been relocated (due to the endangered status of this species); (3) to map locations of nets where crews fished for gravid sturgeon; (4) to target relocations of sturgeon considered to be post-spawn; (5) to re-map sites with real-time kinematic GPS equipment; or (6) because fluctuations in discharge, threat of severe weather, or other logistical constraints precluded the use of randomly selected locations.

Suspected spawning sites were selected on the basis of judgment of collaborators, timing that coincided with the expected spawning period (late May/early June), and ongoing analysis of preliminary sturgeon movement data. Working under the assumption that spawning would occur at or near the migration apex (DeLonay and others, 2007; Papoulias and others, 2007), we looked at the movement histories of individual sturgeon to judge when upstream movement slowed or stopped, suggesting that the sturgeon might be near its apex. The best opportunity to use this approach was in 2007, when the large number and high frequency of relocations for many individual sturgeon allowed us to explore detailed movement histories of sturgeon individuals. Other approaches to suspected spawning site identification included looking for male and female sturgeon in close proximity to each other as well as looking for general aggregations of sturgeon. Some of our maps do include the upstream-most relocation for female shovelnose sturgeon that were later confirmed to have spawned. However, exact sturgeon spawning locations were not confirmed in the Lower Missouri River during the study period because of difficulties in documenting actual release of eggs, egg deposition, and egg hatch.

Definition of Reaches for Mapping

In the channelized river (downstream from river mile 753 near Ponca, Nebraska, fig. 1), the standard protocol was to define mapping reaches as a bend-crossover-bend sequence or a crossover-bend-crossover sequence, up to a maximum length of 3 kilometers (the most that can reasonably be mapped in a single day). In the Gavins Point segment (fig. 1), which is characterized by multithread channels, reach length was determined by the area that could be mapped in one day, and reaches were considerably shorter because of the difficulties of maneuvering boats in shallow water. Maps for some dates differ from the ideal of this protocol. Occasionally, mapping crews stopped collecting data short of the intended full reach length due to adverse weather conditions or equipment problems. At the beginning of the study in 2005, a few sites were mapped as a series of very short reaches in order to obtain multiple sturgeon positions (or, in some cases, net positions where sturgeon had been caught) in a single day. In 2007, a number of the suspected spawning reaches were shorter in length than called for by the standard protocol because only a single boat was available for both side-scan sonar and depth/substrate/velocity surveys, and both types of surveys were carried out in the same day.

Data collection for depth, substrate, and velocity took place along cross-sectional transects and a longitudinal profile (fig. 3). Planned transects were defined with Hypack software (Hypack, Inc., Middletown, Connecticut) and saved as a line file. Cross-sectional transects were spaced 15 meters apart upstream from Rulo, Nebraska; downstream from Rulo, transect spacing was 20 meters. Transect spacing increased downstream to scale with channel size; spacing was selected to produce accurate and realistic interpolated maps at the reach scale. To ensure high-resolution data near the sturgeon relocation, mapping crews collected data along every transect for a set of 10 transects centered on the target sturgeon relocation. In the rest of the reach, mapping crews collected data on every other transect (resulting in a 30-meter transect spacing upstream from Rulo and 40-meter transect spacing downstream from Rulo). In each reach, mapping crews also collected data along a longitudinal profile that was driven from upstream to downstream approximately following the thalweg. The collection of side-scan sonar data involved driving a series of longitudinal passes down the reach.

Instrumentation and Data Collection

Mapping was accomplished using boats outfitted with hydroacoustic instrumentation. The standard instrument configuration allowed for concurrent collection of depth, substrate, and velocity data through use of a single-beam echo sounder, a substrate sensor, and an acoustic Doppler current profiler (ADCP). In addition, at some reaches, we used side-scan sonar as an imaging tool. Side-scan sonar data sets were collected separately (either in time or by a second boat) from depth, substrate, and velocity data sets.

Positional Data

Global positioning system (GPS) data provided submeter or better positional accuracy for hydroacoustic data. Most sites were mapped with differential global positioning system (DGPS) instrumentation. Boats were equipped with Trimble (Trimble Navigation Ltd., Sunnyvale, California) 12-channel AgGPS 132 receivers that used OmniSTAR (OmniSTAR, Inc., Houston, Texas) satellites for differential correction. GPS positions were collected at 0.2-second intervals. For a few sites, we used survey-grade, 12-channel, real-time kinematic GPS equipment to georeference data to subdecimeter horizontal and vertical accuracy.

Depth, Substrate, Velocity

Hydroacoustic instrumentation included single-beam echo sounders, RoxAnn instruments (Marine Microsystems and Sonavision, Ltd., Aberdeen, United Kingdom), and acoustic Doppler current profilers (ADCP; Teledyne RD Instruments, Poway, California). Computers logged hydroacoustic data while the boat was driven along the planned transects from bank to bank or as depth allowed; transects ended where the water was too shallow for the boat to navigate (at depths less than approximately 0.6 meter). Boat speeds typically averaged around 2 meters per second for a survey, generally with lower speeds in shallow or slow water. In general, data collection followed standard procedures for hydroacoustic data as described in Elliott and others (2004).

Two boats were used for the collection of depth, substrate, and velocity data: the R/V (research vessel) Lucien M. Brush and the R/V Slim Funk (fig. 4). Both boats had mounts that suspended the echo sounder and ADCP transducers in the water on the starboard side of the boat near the bow. The GPS antenna was mounted above the transducers. The R/V Funk worked primarily in the upstream segments of the river (Gavins Point, Ponca, Big Sioux, and Platte; fig. 1). The R/V Brush worked in the downstream segments (Kansas, Grand, and Osage; fig. 1). The instrument configuration varied slightly between the boats and from year to year (table 1).

Depth data sets were generally collected with high-resolution, single-beam Hydrotrac echo sounders (Odom Hydrographic Systems, Inc., Baton Rouge, Louisiana). (The exception is that the R/V Brush did not have a Hydrotrac echo sounder installed in 2005, so depths were determined from ADCP data for that year.) Each echo sounder was calibrated regularly by using standard bar-check procedures: A metal plate was suspended below the echo-sounder transducer at alternating depths of one and two meters, and the speed of sound and draft were adjusted as needed to read the correct depth. Bar checks were performed approximately one time per week or as needed due to changes in water temperature. Data-collection rates of 5 hertz (Hz) were used along cross-sectional transects; collection rates were either 5 or 10 Hz for longitudinal profiles. A laptop computer logged depth data using Hypack software (version 4.3 or 4.3a Gold). Depth data were logged simultaneously with substrate and GPS data. Depth data values were visually inspected in cross-sectional view during collection, and gain was adjusted as needed to maximize data quality.

Substrate data sets were collected with RoxAnn instrumentation. RoxAnn instruments analyze the return

Table 1. Instrumentation used during each survey year, by boat.

[R/V, research vessel; x, standard equipment used; select, equipment used for selected surveys only; --, no data; kHz, kilohertz]

Instrumentation	R/V Funk			R/V Brush		R/V Schmudde	
	2005	2006	2007	2005	2006	2006	2007
Differential global positioning system	x	x	x	x	x	x	x
Real-time kinematic global positioning system	select	--	--	select	--	--	--
1200 kHz Workhorse Rio Grande acoustic Doppler current profiler	x	x	x	x	x	--	--
Odom Hydrotrac echo sounder	x	x	x	--	x	--	--
RoxAnn GD, digital, with function generator	--	--	--	--	x	--	--
RoxAnn, analog	x	x	x	--	--	--	--
900 kHz side-scan sonar	--	select	select	--	select	select	select

signals from the echo sounder and generate two parameters, E1 and E2, based on the first and second returns, respectively (Hamilton, 2001). Two different RoxAnn instruments were used; an analog RoxAnn was used on the R/V Funk, and a digital model (RoxAnn GD) was used on the R/V Brush. Each RoxAnn instrument was kept on the same boat, and the units were not recalibrated through the study period. The computer operator on the boat monitored collection of RoxAnn data; however, few options exist to adjust quality characteristics during data collection.

Velocity data sets were collected with 1,200 kHz Workhorse Rio Grande acoustic Doppler current profiler (ADCP) units. ADCP data were logged simultaneously with GPS data on a second laptop computer running WinRiver (version 10.06, Teledyne RD Instruments, Poway, California). Magnetic variation was set for each reach mapped by using either GeoMagix software (Interpex, Ltd., Golden, Colorado) or data from the National Geophysical Data Center of the National Oceanic and Atmospheric Administration (National Geophysical Data Center, 2008). Mapping crews performed the “Method 3” compass calibration procedure at each site by rotating the boat in a tight circle (RD Instruments, 2003). This procedure corrects for one-cycle errors. The procedure was repeated until the total error reading was less than 1 degree. Configuration settings for ADCP data collection included a bin (vertical cell) size of 25 centimeters and a blanking distance of 50 centimeters below the transducer. ADCP data were collected using water mode 1 with 6 water pings and bottom mode 5 with 1 bottom ping.

Side-Scan Sonar

In 2006 and 2007, mapping crews collected side-scan sonar data in a subset of reaches that had potential to contain spawning areas. Side-scan sonar provides an image of the riverbed based on hydroacoustic returns from a towfish that is deployed from the boat. The images are useful for visualizing channel substrate and detecting the presence of relatively large fish, including adult sturgeon. Data sets were collected with a 900-kHz towfish (Marine Sonic Technology, Ltd, White Marsh, Virginia) using an image width of 20 meters on each side, providing a 40-meter total swath width (Marine Sonic Technology Ltd., 2001). Side-scan sonar data were collected while making multiple longitudinal passes downstream through the reach. The highest quality images result from keeping the towfish a uniform distance off of the bottom, a task that can be challenging in a river environment. A powered winch was used to raise and lower the towfish by its cable while collecting data. Sea Scan PC software (Marine Sonic Technology, Ltd., White Marsh, Virginia) logged the data to a computer. Differential GPS was used to record the position of the boat. The GPS position provides only approximate georeferencing for the side-scan imagery, because the towfish position changes based on the amount of cable that is released to compensate for depth. Thus, the position of the towfish is not known precisely. Each side-scan data set was collected from one of three boats: the R/V Funk, the R/V Brush, or the R/V Schmudde (table 1).

Data Processing and Map Making

Converting raw data sets into finalized maps is a multistep process that includes editing to remove spurious data points, digitizing a blanking polygon to define the extent of the map, and interpolating the point data to a grid (raster) format. Additional details of these steps are described for each data type in the sections that follow. Processing steps that did not require human judgment were automated with Python scripts (Python Software Foundation, Hampton, New Hampshire), utilizing ArcGIS processing tools (version 9.x, Environmental Systems Research Institute, Inc., Redlands, California).

All depth, substrate, and velocity maps were generated with 5-meter grid cells and are stored in the Environmental Systems Research Institute (ESRI) grid format. All maps were projected to UTM Zone 15 North with the WGS 84 datum.

Depth

Depth maps were derived from echo-sounder data for most surveys (table 1). Echo-sounder data sets were edited in Hypack software by viewing each transect in cross-sectional view and removing data points with spurious depth values. Spurious depth data were associated with fish or rapidly varying bed conditions that prevented acquisition of accurate depth values. Depth data sets were exported to text files, and a Python script was used to convert the text files containing point locations and attributes to shapefiles. Blanking polygons were digitized on screen to define the spatial extent of the reach to which data could reasonably be interpolated based on the extent of the echo-sounder points. In a few reaches, depth values recorded by either the RoxAnn or the ADCP were used to supplement transects with missing echo-sounder data. A Python script automated the remaining map-production steps; these steps accomplish the interpolation of point data values to a 5-meter grid. Point data sets were prepared for interpolation by using filters to reduce the point density because point spacing of raw data along transects is very dense relative to the grid-cell size. The interpolation technique utilized was ordinary kriging, executed with the ArcGIS kriging tool from ArcToolbox. Variance of prediction grids were generated as an assessment of uncertainty of kriged values. Grids were finalized by cropping to the extent of the associated blanking polygons.

For surveys lacking echo-sounder data, depth grids were generated from ADCP data sets. This applies to most of the reaches from 2005 in the Osage, Grand, and Kansas segments because the R/V Brush did not have an echo sounder in that year (table 1). The ADCP data sets contain depth data at each of four beam locations for each data ensemble. Depth data from the ADCP were obtained by computing the position and depth for each of the four beams and exporting these values to a shapefile. Kriging and blanking procedures were similar to those used for the echo sounder data, although different kriging parameters were used because of the different spatial distribution of data points.

Generalized Substrate

We developed an interpretational framework for mapping substrate classes using the RoxAnn substrate classification systems, validated through sediment sampling, side-scan sonar interpretation, and repeat substrate mapping. These methods generally follow those established by other seabed classification studies (Cholwek and others, 2000; Brown and others, 2005), although methods had to be optimized for the turbid and high-velocity conditions of the Lower Missouri River. In particular, high turbidity prevented us from using videography to establish correlations between acoustic signatures and substrate types. To generate substrate maps, RoxAnn data were first classified into three classes based on signatures of the E1 and E2 parameters, as described below. The RoxAnn-based classifications were supplemented with other geospatial data to produce the generalized substrate maps in this report.

Three distinct signatures of E1 and E2 values are common in RoxAnn data on the Lower Missouri River (fig. 5). The first signature, defined by very high E1 or E2 values, corresponds to rock, gravel, and coarse, hard sand. The second signature is characterized by low and spatially uniform E1 values in combination with spatially fluctuating E2 values; this signature corresponds to sand dunes. Spatial variability in E2 was interpreted to be the result of differences in the hydroacoustic return across dune forms. The third signature, defined by low and spatially uniform E1 and E2, was interpreted to represent two distinct but hydroacoustically similar substrate types: fine sediment and transporting sand. This signature is associated with fine sediment (mud, silt) in areas of low velocity, such as behind wing dikes. Low, uniform E1 and E2 values were also recorded in the main channel, typically at relatively high discharges, and we interpret these patches to be transporting sand. The transporting sand is distinguished from sand dunes by consistently low values of E2, suggesting a more uniformly soft riverbed.

For shallow and relatively slow moving water, we established “ground-truth” correlations between hydroacoustic signatures and sediment types through sampling with a 5-cm coring device or with a “mini ponar” sediment sampler. Retrieved sediments were classified qualitatively into dominant particle-size classes. In deep and swift parts of the Missouri River, direct sampling was not possible. For these areas, correlations between acoustic signatures and sediment type were established through comparisons with side-scan imagery from selected locations. Side-scan imagery provided reliable identification of gravel and cobble based on bright acoustic returns and variable texture. Mud was identified as uniform areas of low acoustic returns. Sand dunes were readily apparent based on morphology, and transported sand was apparent as blurry uniform areas within sand-dune fields.

We developed an automated procedure to categorize data points into one of these three classes. To describe spatial variability, summary statistics were computed for E1 and E2 in the vicinity of each data point. For each data point, all other points within a 5-meter radius were identified, and quartile, mean, and standard deviation values were calculated. Following some exploration of data sets using multivariate statistics (discriminant analysis and K-means classification), as well as visual examination of the data sets, the third quartile for E1 and the third quartile for E2 emerged as reliable values for the basis of the classification.

Distributions of the spatial third-quartile values for E1 and E2 were used to determine cutoff values between substrate classes. Populations of these values varied between the two RoxAnn instruments used, and values also varied by water

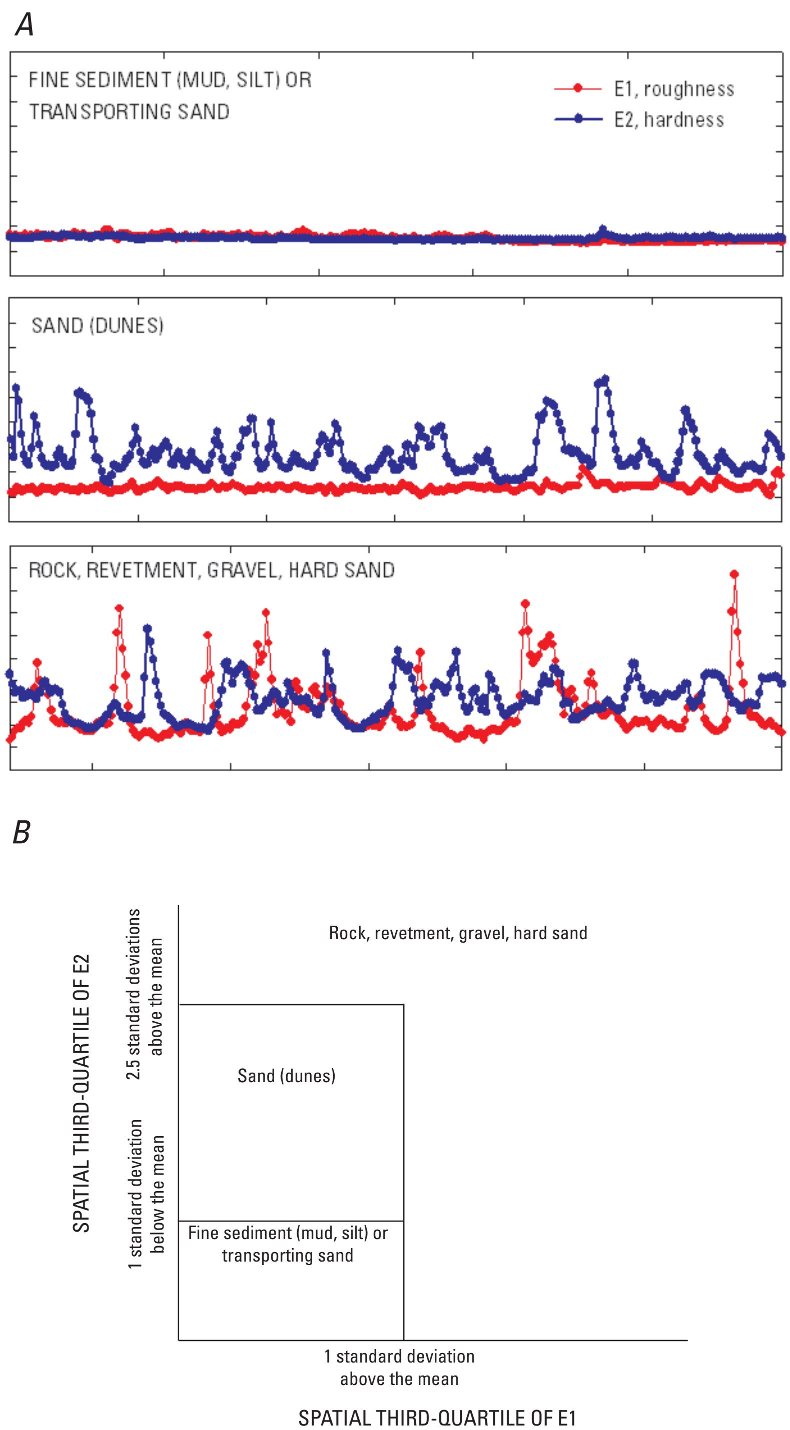

Figure 5. Illustrations of the schematic framework for interpretation of RoxAnn data. (A) Characteristic signatures of RoxAnn data along transect lines. (B) Automated classification of the three substrate signatures was based on cutoff values determined from the distribution of the spatial third-quartile values of E1 and E2.

temperature. To adjust for differences in environmental conditions and between instruments, we used relative cutoff values to define substrate classes based on the distribution of the spatial third-quartile E1 and E2 values in each reach (fig. 5B).

RoxAnn data were brought into Hypack software with the RoxAnn selected as the echo sounder, and points with spurious depth values were deleted because E1 and E2 values associated with spurious depths were unreliable. Data were then exported from Hypack software to a text file and converted to a shapefile. For each data point, quartile values were calculated based on the data points falling within a 5-meter radius of the point. Cutoff values between classes were determined by computing the standard deviations of the spatial third-quartile values for E1 and E2, as described previously. Each point was then classified into one of three general substrate classes. After classifying each data point, grids of substrate were made based on a discrete-value gridding approach: First, each grid cell that contained substrate data points was assigned the substrate class with the majority representation in the cell. Next, cells without points were assigned the value based on the nearest neighbor grid cell with an assigned substrate class. The resulting grids were smoothed with a majority operation in a moving window of 3 by 3 cells; larger windows were used to break ties. The result was a substrate grid based on RoxAnn values only with three preliminary classes: fine sediment/transporting sand, sand dunes, and rock/gravel.

Mud and transporting sand have similar RoxAnn signatures, but these substrate classes can be differentiated based on spatial context. We used the velocity maps to differentiate between these two classes, using a threshold value for transporting sand of 0.6 meter per second (m/s) based on Shield's diagram for sediment transport (Knighton, 1998). Grid cells that were classified as fine sediment/transporting sand were thus reclassified to fine sediment if the velocity was less than 0.6 m/s or transporting sand if the velocity was greater than 0.6 m/s. The new substrate grids were blanked to the extent of the velocity grids.

Bedrock and engineered rock structures at the margins of the channel were poorly represented in the initial substrate maps, largely because RoxAnn data were not viable for depths less than approximately 1.5 meters, the RoxAnn blanking depth. Therefore, we supplemented the substrate maps with two aerial-photograph-derived polygon data sets representing (1) distribution of navigation structures and bank revetments (U.S. Army Corps of Engineers, unpub. data, 2008) and (2) locations of bedrock (Laustrup and others, 2007). These supplemental data sets were superimposed onto the substrate grids, overriding existing classifications.

Substrate data sets are not available for some mapped reaches for two main reasons. The R/V Brush was not instrumented with a RoxAnn instrument in 2005 (table 1), so no substrate grids are available for most of the reaches downstream from Rulo, Nebraska, for that year. Other reaches lack substrate grids due to instrument malfunction or poor data quality. The RoxAnn's relatively large blanking distance, combined with generally poor performance in shallow water, resulted in rejection of data for the majority of the mapped reaches in the Gavins Point segment (fig. 1), which is characterized by relatively shallow depths.

Depth-Averaged Velocity

Acoustic Doppler current profiler (ADCP) data sets contain velocity values in ensembles (vertical sets of bins through the water column). Depth-averaged values of velocity for each ensemble, as computed from the bin values, were used for the purpose of generating the two-dimensional velocity grids contained in this report. The raw velocity data sets contain additional information that may be used for future analyses.

ADCP data processing consisted of several steps. The first step was to export the data from WinRiver, using the GPS-based frame of reference. The WinRiver export files were then parsed by a Python script that also calculated depth-averaged velocity values for each vertical data ensemble, converted the data into a shapefile format, projected the shapefile to UTM Zone 15 North, and performed some basic filtering to flag spurious data points. The depth-averaged velocities were computed by averaging the easting and northing components for each bin, then calculating the magnitude and direction of the depth-averaged velocity from the component vectors. We examined the shapefiles manually to identify and flag other spurious data points. For example, spurious velocity magnitudes tend to be associated with poor GPS values, often as a result of bridge interference with GPS signals. The point shapefiles, with good values selected, were used to guide digitization of blanking polygons that define the extent of the area for which values can be reasonably interpolated to a 5-meter grid. For each data set, the point velocity values were interpolated to a grid with a Python script that executes kriging in ArcGIS and clips the grid to the extent of the blanking polygon. In addition to the velocity grid, the procedure computed a variance of prediction grid that estimates the uncertainty of the kriged values.

Directional bias of recorded velocities is common in association with the standard method of driving the boat in alternating directions across the river (left bank to right bank for one transect, then right bank to left bank for the next). This bias can appear as slight striping in velocity grids. The magnitude of error associated with striping is small (less than 0.05 meter per second) and the effect is primarily visual. This error apparently relates to slight spatial variations in magnetic field that are not compensated by the daily compass calibration (Gaeuman and Jacobson, 2005). In postprocessing, we adjusted magnetic variation as needed to minimize the directional bias.

Side-Scan Sonar

Side-scan sonar data sets were used to generate images of the channel bottom in a high-resolution, minimally processed form (fig. 6) and also as georeferenced mosaics (fig. 7).

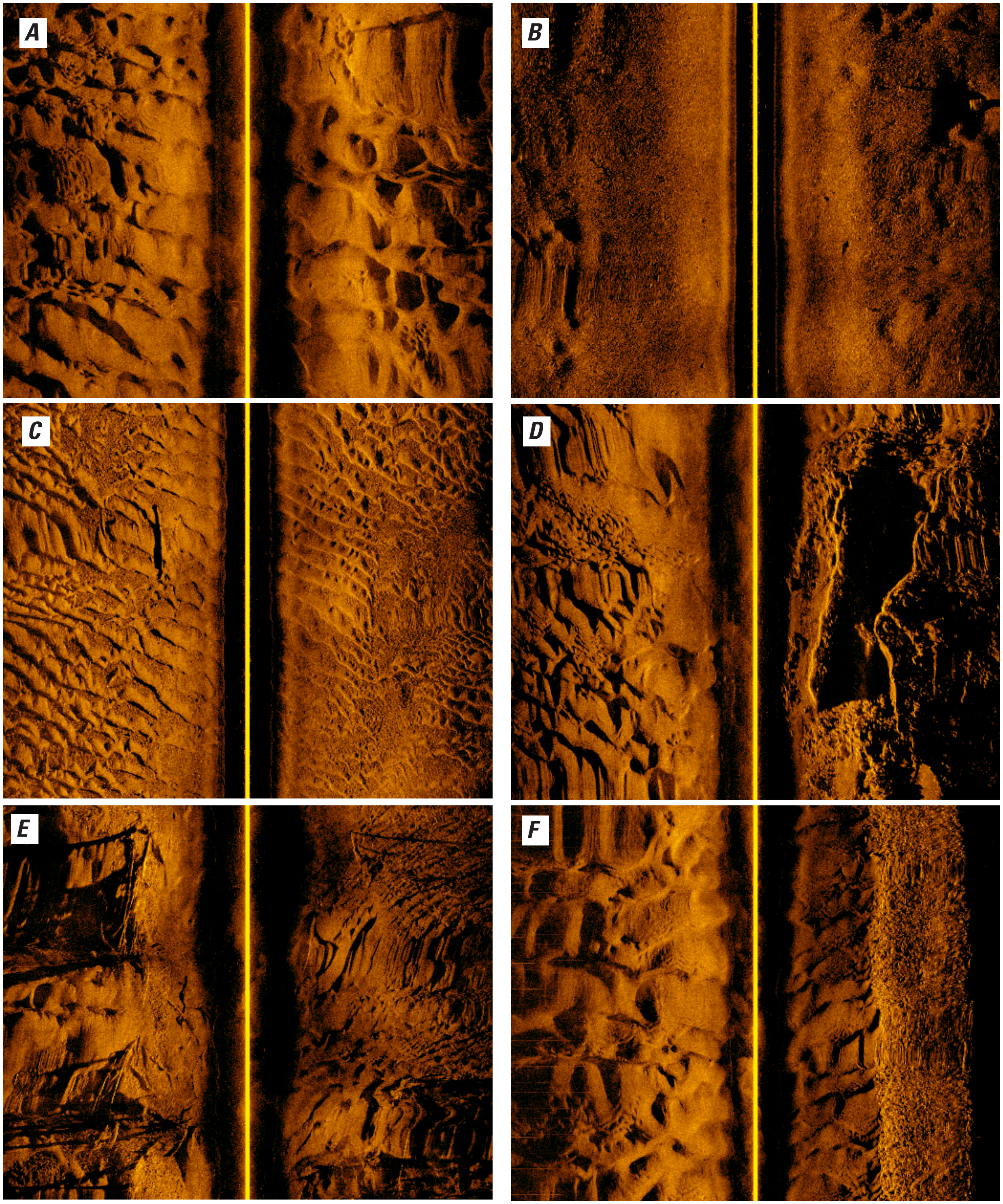

Figure 6. Images of nongeoreferenced side-scan sonar data. Examples illustrate substrate diversity and fish-detection capabilities. All images are oriented such that the bottom of the image is in the downstream direction. (A) Mid-channel dunes (June 2, 2007, Big Sioux segment), (B) gravel (May 22, 2007, Gavins Point segment), (C) sand dunes over gravel (May 22, 2007, Gavins Point segment), (D) bedrock, right side of image (May 23, 2007, Ponca segment), (E) large woody debris, left side of image (May 23, 2007, Ponca segment), (F) revetment, right side of image (June 2, 2007, Big Sioux segment), (G) aggregation of fish (species undetermined) on the lee side of a bar (May 23, 2007, Ponca segment), (H) fish and soft substrate in a dike field, left side of image (June 2, 2007, Big Sioux segment), (I) some fish visible; car bodies on left side demonstrate scale (May 24, 2007, Gavins Point segment).

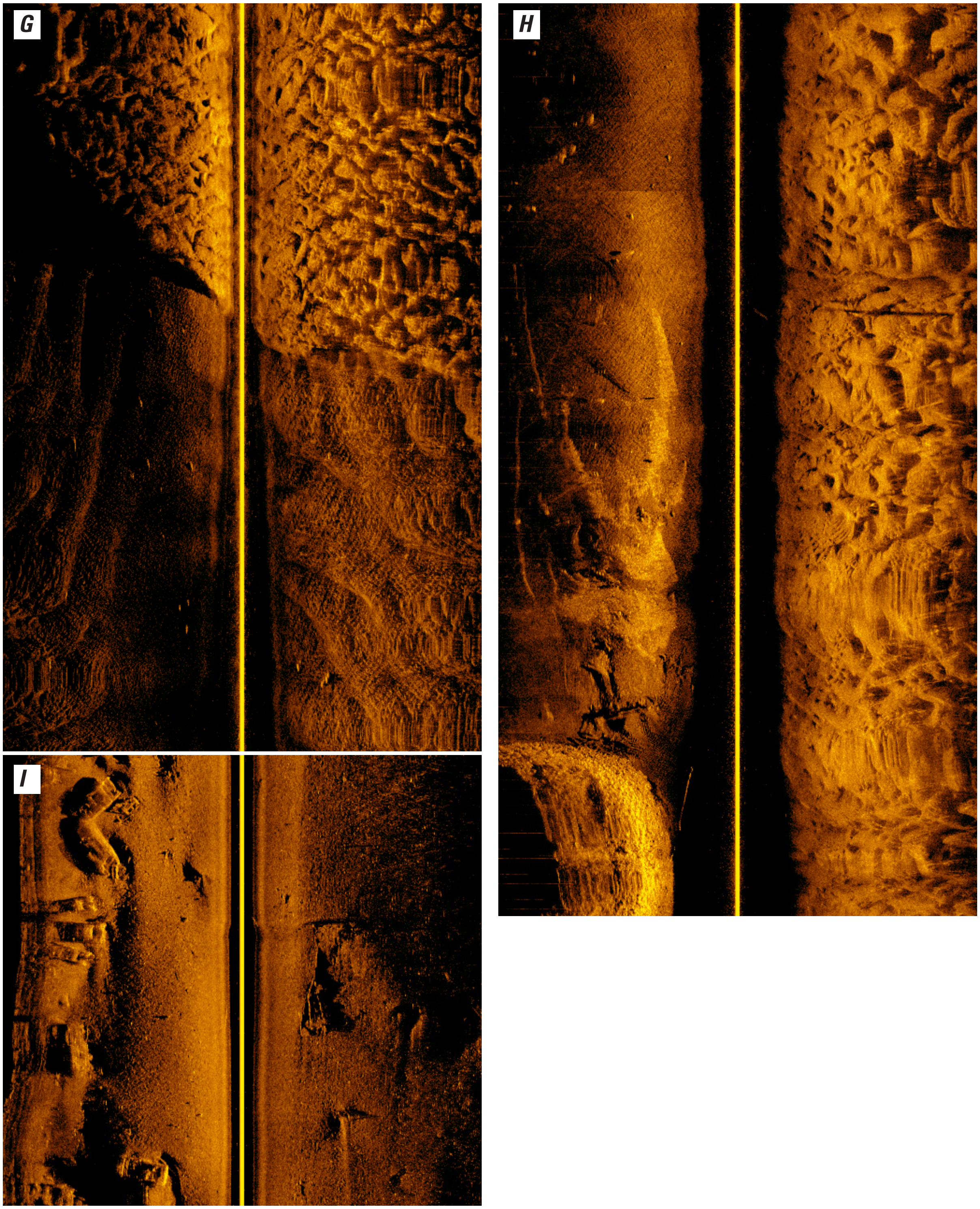

Figure 6. Images of nongeoreferenced side-scan sonar data. Examples illustrate substrate diversity and fish-detection capabilities. All images are oriented such that the bottom of the image is in the downstream direction. (A) Mid-channel dunes (June 2, 2007, Big Sioux segment), (B) gravel (May 22, 2007, Gavins Point segment), (C) sand dunes over gravel (May 22, 2007, Gavins Point segment), (D) bedrock, right side of image (May 23, 2007, Ponca segment), (E) large woody debris, left side of image (May 23, 2007, Ponca segment), (F) revetment, right side of image (June 2, 2007, Big Sioux segment), (G) aggregation of fish (species undetermined) on the lee side of a bar (May 23, 2007, Ponca segment), (H) fish and soft substrate in a dike field, left side of image (June 2, 2007, Big Sioux segment), (I) some fish visible; car bodies on left side demonstrate scale (May 24, 2007, Gavins Point segment).—Continued

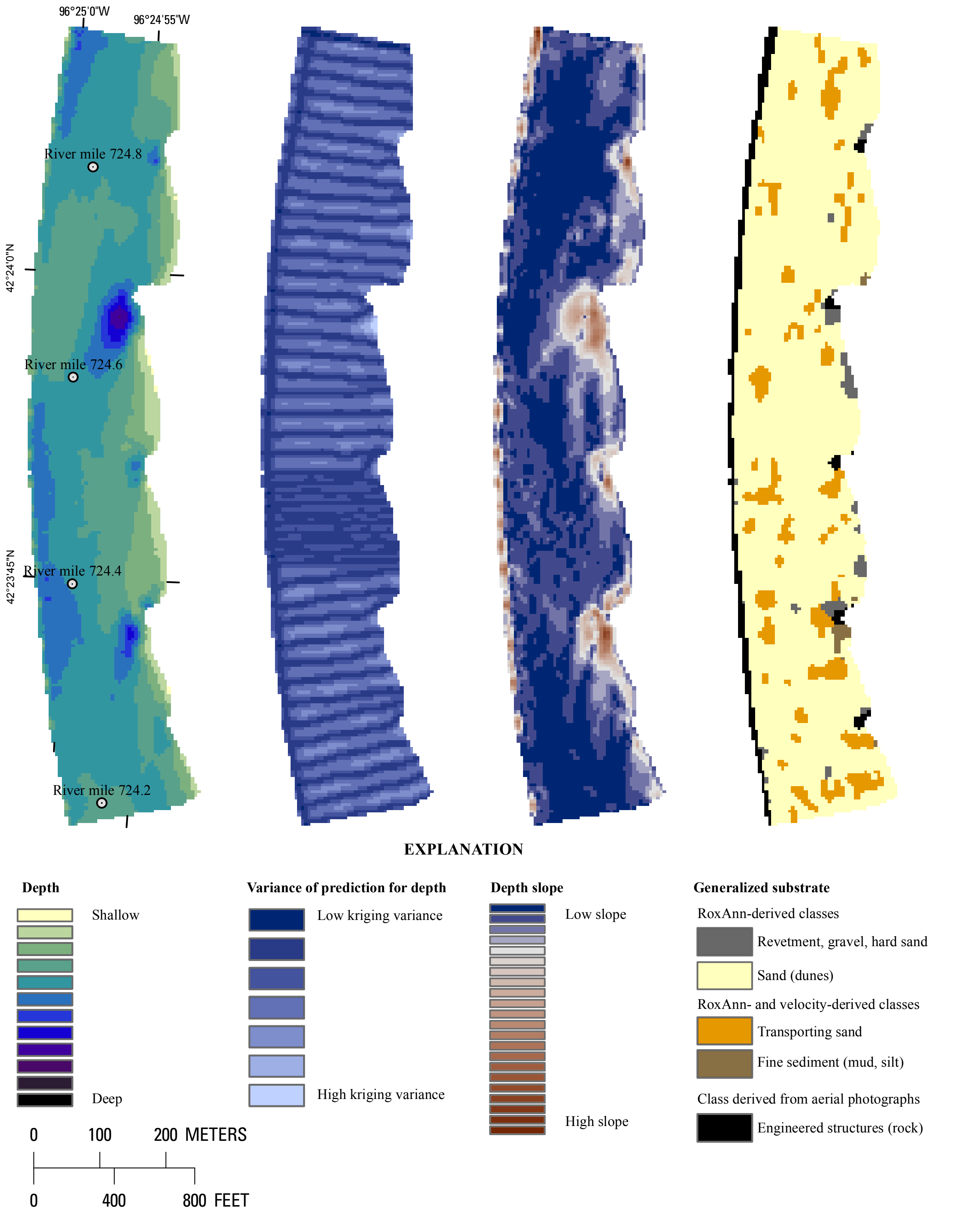

Figure 7. Maps of an example reach. Maps shown include the primary data types (depth, substrate, velocity, side-scan sonar), variance of prediction grids (estimates of the uncertainty of kriged values), and examples of derived grids (depth slope and velocity gradient).

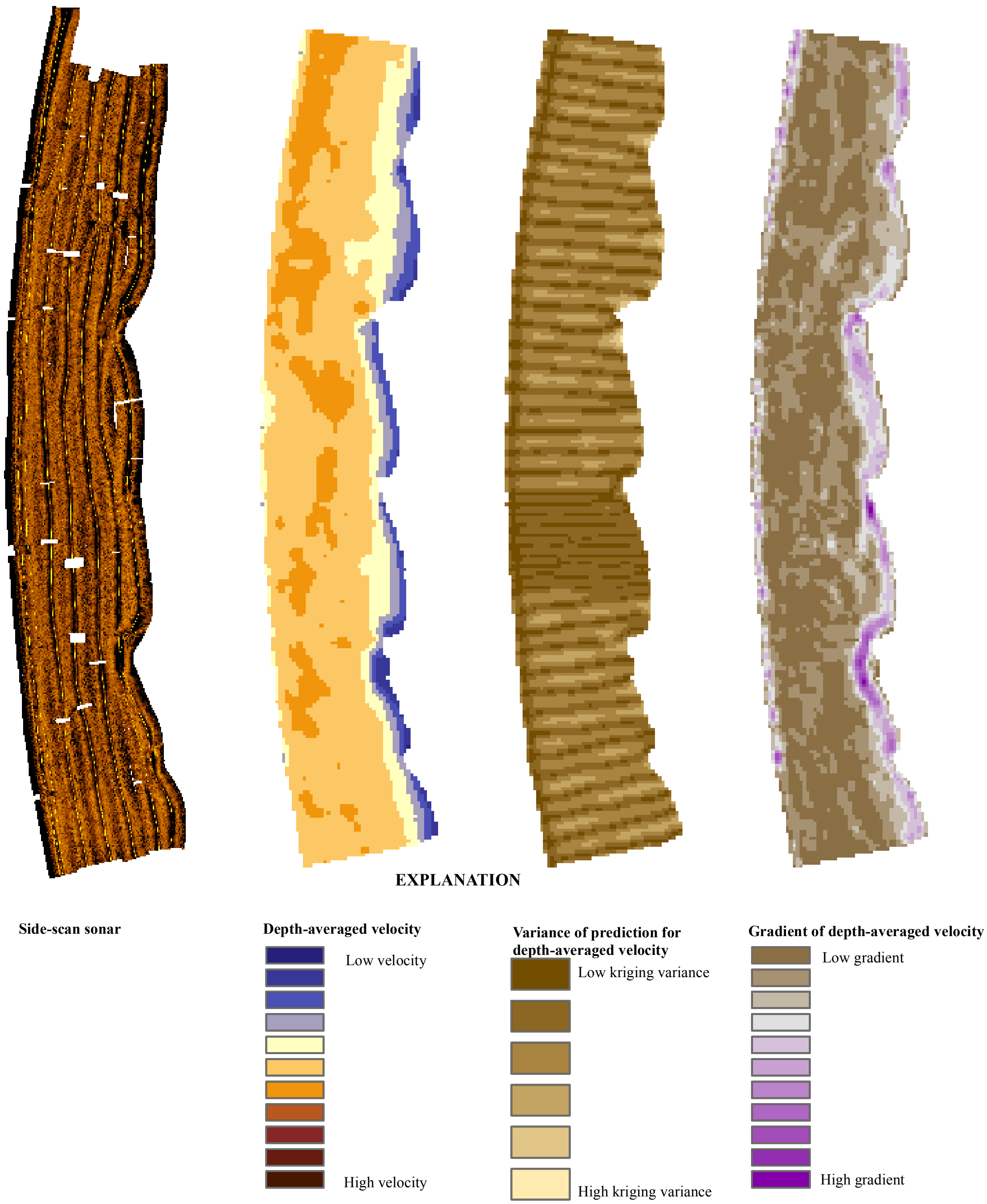

Figure 7. Maps of an example reach. Maps shown include the primary data types (depth, substrate, velocity, side-scan sonar), variance of prediction grids (estimates of the uncertainty of kriged values), and examples of derived grids (depth slope and velocity gradient).—Continued

We used SonarWeb software (Chesapeake Technology, Inc., Mountain View, California) for all side-scan sonar processing. Georeferenced images are based on DGPS navigation data. We did not compensate for the length of cable utilized during data collection (typically 3–10 m), so georeferencing is approximate. Because of stretching that occurs to the image during georeferencing, the quality and resolution of georeferenced images is degraded relative to the unprocessed images. However, both versions of the image can be used in conjunction for interpretation. For example, locations of fish or other features often can be discerned from the original images, and the georeferenced images can be used to determine the approximate locations of such features. The georeferenced images tend to be of sufficient quality to assist with identification of substrate. Where side-scan sonar data were collected, they were used to verify substrate classification produced by RoxAnn processing.

Discharge Estimation by Location

Estimates of discharge values were needed at the site of each mapped sturgeon for both the time period when the sturgeon was present and the time period when the reach was mapped. Discharge values are available at USGS streamflow-gaging stations on the Missouri River main stem and on tributaries (fig. 1). However, many mapped reaches are located some distance from gages, and in some locations substantial tributaries enter the Missouri River between a mapped reach and the nearest main-stem gage. We developed a systematic procedure to specify which gage or combination of gages to use to estimate discharge at any location along the Lower Missouri River, using daily mean discharge values served through the National Water Information System (U.S. Geological Survey, 2008). In addition, we used discharge values for Gavins Point Dam from the U.S. Army Corps of Engineers (Michael A. Swenson, unpub. data, 2007). The gages we used include Missouri River main-stem streamflow-gaging stations and streamflow-gaging stations for tributaries with drainage-basin areas greater than 1,000 square kilometers at the gage site.

The procedure uses daily values from the nearest Missouri River main-stem gage or combination of main-stem and tributary gages. For the length of the Lower Missouri River, subsegments of river were defined such that each end of a subsegment is bounded by either a gage or a tributary (table 2). For each of these subsegments, the gage or gage combination that would typically provide the best (primary) discharge estimate was identified; gages or gage combinations that can provide an alternate (secondary) estimate for verification were also identified (table 2). Differences between the primary and secondary estimates can be used as an indicator of uncertainty of the discharge estimate; the comparison often serves as an alert to rapidly changing conditions, as differences between discharge estimates tend to be highest during time periods of rapidly fluctuating flow. With the use of daily data, travel time was only considered if travel time between gages exceeded approximately one-half of a day. This was the case for some of the gages used in the secondary estimates, in which case the previous-day or next-day data were used, as appropriate.

The procedure involved accessing NWIS data by script and storing the data by river subsegment in a table that could be queried by date and location. Through this automated process, the discharge values that we used were regularly synchronized with the ones available from NWIS, so the best available values were accessible in the local database.

Maps of Hydraulic and Substrate Characteristics

Reach maps (figs. 8–416) are organized in order from upstream to downstream (in descending order by river mile). All data types available for a reach are on successive pages, ordered by depth, substrate, velocity, and side-scan sonar. Maps of side-scan sonar are included primarily to document the extent of mapping. Maps are in UTM Zone 15 North downstream from river mile 640; upstream from river mile 640, maps have been projected to UTM Zone 14 North. Two tables provide supplemental information about the maps. Table 3 contains the estimated daily discharge at the mapped reach on the day of mapping. Table 4 contains information about sturgeon relocation points and nets that were specifically targeted for mapping; these targeted sturgeon relocations also are shown on the maps. The maps depict physical conditions dependent on the discharge and channel morphology at the time of mapping.

Summary

The reach-scale maps presented in this report contain information about physical aquatic habitat available to and used by adult sturgeon of the genus *Scaphirhynchus* in the Lower Missouri River in the years 2005 to 2007. Close coordination with sturgeon tracking crews allowed us to rapidly obtain information about the sturgeon locations that we targeted for mapping. Reaches were typically mapped on the day after sturgeon were relocated, and usually within 10 percent of the discharge at the time of relocation.

Hydroacoustic data sets were collected from a boat mounted with a single-beam echo sounder for depth data, a RoxAnn instrument for substrate data, and an acoustic Doppler current profiler for velocity data. These data sets were collected along a longitudinal profile of the reach and in cross-sectional transects (at 15- to 40-meter spacing). Side-scan sonar data sets also were collected at reaches that were considered to be potential spawning areas based on the information available at the time. Data sets were georeferenced at the

Table 2. Gages used for discharge estimation by river subsegment.

[R., River; Gavins, Gavins Point Dam (U.S. Army Corps of Engineers); Missouri River main-stem streamflow-gaging stations and identification numbers: Sioux City, 6486000; Decatur, 6601200; Omaha, 6610000; Nebr. City, 6807000; Rulo, 6813500; St. Joseph, 6818000; Kansas City, 6893000; Waverly, 6895500; Glasgow, 6906500; Boonville, 69 09000; Hermann, 6934500; St. Charles, 6935965; Tributary streamflow-gaging stations and identification numbers: James R., 6478500; Vermillion R., 6479010; Big Sioux R., 6485500; Floyd R., 6600500; Mon.-H. (Monona-Harrison Ditch), 6602400; Little Sioux R., 6607500; Soldier R., 6608500; Boyer R., 6609500; Platte R., Nebr., 6805500; Nishnabotna R., 6810000; Little Nemaha R., 6811500; Big Nemaha R., 6815000; Tarkio R., 6813000; Nodaway R., 6817700; Platte R., Mo., 6821190; Kansas R., 6892350; Grand R., 6902000; Chariton R., 6905500; Blackwater R., 6908000; Lamine R., 6906800; Moreau R., 6910750; Osage R., 6926510; Gasconade R., 6934000; (+1), data from next day used; (-1), data from previous day used]

Subsegment	Upper river mile	Lower river mile	Primary estimate	Secondary estimate
Gavins Point Dam to James R.	811.1	800.5	Gavins	Sioux City (+1) - Big Sioux (+1) - Vermillion (+1) - James
James R. to Vermillion R.	800.5	772.0	Gavins + James	Sioux City (+1) - Big Sioux (+1) - Vermillion
Vermillion R. to Big Sioux R.	772.0	733.9	Sioux City - Big Sioux	Gavins (-1) + James (-1) + Vermillion
Big Sioux R. to Sioux City gage	733.9	732.4	Sioux City	Gavins (-1) + James (-1) + Vermillion (-1) + Big Sioux
Sioux City gage to Floyd R.	732.4	731.2	Sioux City	Decatur (+1) - Floyd
Floyd R. to Decatur gage	731.2	691.1	Decatur	Sioux City (-1) + Floyd (-1)
Decatur gage to Monona-Harrison Ditch	691.1	670.1	Decatur	Omaha (-1) - Boyer (-1) - Soldier - Little Sioux - Mon.-H.
Monona-H. Ditch to Little Sioux R.	670.1	669.2	Decatur + Mon.-H.	Omaha (+1) - Boyer - Soldier - Little Sioux
Little Sioux R. to Soldier R.	669.2	664.0	Decatur + Mon.-H. + Little Sioux	Omaha (+1) - Boyer - Soldier
Soldier R. to Boyer R.	664.0	635.2	Omaha - Boyer	Decatur (-1) + Mon.-H. + Little Sioux + Soldier
Boyer R. to Omaha gage	635.2	616.0	Omaha	Decatur (-1) + Mon.-H. (-1) + Little Sioux (-1) + Soldier (-1) + Boyer
Omaha gage to Platte R., Nebr.	616.0	594.7	Omaha	Nebr. City (+1) - Platte, Nebr.
Platte R., Nebr. to Nebraska City gage	594.7	562.6	Nebr. City	Omaha (-1) + Platte, Nebr.
Nebr. City gage to Nishnabotna R.	562.6	542.0	Nebr. City	Rulo (+1) - Tarkio (+1) - Little Nemaha - Nishnabotna
Nishnabotna R. to Little Nemaha R.	542.0	527.8	Nebr. City + Nishnabotna	Rulo (+1) - Tarkio - Little Nemaha
Little Nemaha R. to Tarkio R.	527.8	507.6	Rulo - Tarkio	Nebr. City (-1) + Nishnabotna + Little Nemaha
Tarkio R. to Rulo gage	507.6	498.0	Rulo	Nebr. City (-1) + Nishnabotna (-1) + Little Nemaha + Tarkio
Rulo gage to Big Nemaha R.	498.0	494.9	Rulo	St. Joseph (+1) - Nodaway - Big Nemaha
Big Nemaha R. to Nodaway R.	494.9	463.0	Rulo + Big Nemaha	St. Joseph (+1) - Nodaway
Nodaway R. to St. Joseph gage	463.0	448.2	St. Joseph	Rulo (-1) + Big Nemaha (-1) + Nodaway
St. Joseph gage to Platte R., Mo.	448.2	391.2	St. Joseph	Kansas City (+1) - Kansas (+1) - Platte, Mo.
Platte R., Mo. to Kansas R.	391.2	367.4	Kansas City - Kansas	St. Joseph (-1) + Platte, Mo.
Kansas R. to Kansas City gage	367.4	366.1	Kansas City	St. Joseph (-1) + Platte, Mo. + Kansas
Kansas City gage to Crooked R.	366.1	313.7	Kansas City	Waverly (+1)
Crooked R. to Waverly gage	313.7	293.4	Waverly	Kansas City (-1)

Table 2. Gages used for discharge estimation by river subsegment.—Continued

[R., River; Gavins, Gavins Point Dam (U.S. Army Corps of Engineers); Missouri River main-stem streamflow-gaging stations and identification numbers: Sioux City, 6486000; Decatur, 6601200; Omaha, 6610000; Nebr. City, 6807000; Rulo, 6813500; St. Joseph, 6818000; Kansas City, 6893000; Waverly, 6895500; Glasgow, 6906500; Boonville, 69 09000; Hermann, 6934500; St. Charles, 6935965; Tributary streamflow-gaging stations and identification numbers: James R., 6478500; Vermillion R., 6479010; Big Sioux R., 6485500; Floyd R., 6600500; Mon.-H. (Monona-Harrison Ditch), 6602400; Little Sioux R., 6607500; Soldier R., 6608500; Boyer R., 6609500; Platte R., Nebr., 6805500; Nishnabotna R., 6810000; Little Nemaha R., 6811500; Big Nemaha R., 6815000; Tarkio R., 6813000; Nodaway R., 6817700; Platte R., Mo., 6821190; Kansas R., 6892350; Grand R., 6902000; Chariton R., 6905500; Blackwater R., 6908000; Lamine R., 6906800; Moreau R., 6910750; Osage R., 6926510; Gasconade R., 6934000; (+1), data from next day used; (-1), data from previous day used]

Subsegment	Upper river mile	Lower river mile	Primary estimate	Secondary estimate
Waverly gage to Grand R.	293.4	249.9	Waverly	Glasgow (+1) - Chariton (+1) - Grand (+1)
Grand R. to Chariton R.	249.9	238.8	Glasgow - Chariton	Waverly (-1) + Grand
Chariton R. to Glasgow gage	238.8	226.3	Glasgow	Waverly (-1) + Grand + Chariton
Glasgow gage to Lamine R.	226.3	202.5	Glasgow	Boonville - Lamine - Blackwater
Lamine R. to Boonville gage	202.5	197.1	Boonville	Glasgow + Lamine + Blackwater
Boonville gage to Moreau R.	197.1	138.3	Boonville	Hermann (+1) - Gasconade (+1) - Osage (+1) - Moreau (+1)
Moreau R. to Osage R.	138.3	130.0	Boonville (-1) + Moreau	Hermann - Gasconade - Osage
Osage R. to Gasconade R.	130.0	104.4	Hermann - Gasconade	Boonville (-1) + Moreau + Osage
Gasconade R. to Hermann gage	104.4	97.9	Hermann	Boonville (-1) + Moreau + Osage + Gasconade
Hermann gage to Charrette Creek	97.9	67.7	Hermann	St. Charles (+1)
Charrette Creek to St. Charles gage	67.7	27.7	St. Charles	Hermann (-1)
St. Charles gage to mouth	27.7	0.0	St. Charles	St. Charles

Table 3. Locations, dates, and available data sets for habitat surveys.

[ft^3/s, cubic feet per second; GPS, global positioning system; R/V, research vessel; x, data available; --, data not available; DGPS, differential GPS; RTK GPS, real-time kinematic GPS]

River mile	Map date	Boat	Estimated discharge (ft^3/s)	Data types available				
				Depth	Substrate	Velocity	Side-scan sonar	GPS type
				Gavins Point Dam to Ponca				
807.9	July 11, 2006	R/V Funk	25,500	x	--	x	--	DGPS
806.9	May 16, 2007	R/V Funk	8,000	x	--	x	--	DGPS
806.6	May 24, 2007	R/V Funk	11,000	x	--	x	x	DGPS
805.4	June 13, 2006	R/V Funk	25,000	x	--	x	--	DGPS
805.4	June 14, 2006	R/V Funk	25,000	--	--	--	x	DGPS
805.4	June 21, 2006	R/V Funk	25,000	--	--	--	x	DGPS
801.9	May 10, 2007	R/V Funk	8,000	x	--	x	--	DGPS
799.8	May 22, 2007	R/V Funk	24,700	x	--	x	x	DGPS
797.1	June 01, 2007	R/V Funk	19,600	x	--	x	x	DGPS
791.3	July 17, 2007	R/V Funk	23,000	x	--	x	x	DGPS
782.5	May 18, 2007	R/V Funk	18,900	x	--	x	--	DGPS
775.2	May 30–31, 2006	R/V Funk	21,700	x	--	x	x	DGPS
775.1	May 30, 2007	R/V Funk	17,000	x	--	x	x	DGPS
774.2	June 08, 2006	R/V Funk	23,700	x	x	x	--	DGPS
759.8	June 15, 2005	R/V Funk	27,500	x	--	x	--	DGPS
759.6	May 21, 2007	R/V Funk	23,700	x	--	x	x	DGPS
				Ponca to Big Sioux River				
752.7	May 23, 2007	R/V Funk	25,300	x	--	x	x	DGPS
751.8	June 22, 2006	R/V Funk	26,800	x	x	x	--	DGPS
749.3	June 20, 2006	R/V Funk	26,400	x	--	x	--	DGPS
746.3	June 10, 2005	R/V Funk	32,400	x	x	x	--	DGPS
746.3	July 11, 2005	R/V Funk	22,800	x	x	x	--	RTK GPS
745.0	May 25, 2007	R/V Funk	19,600	x	x	x	x	DGPS
743.7	July 12, 2006	R/V Funk	26,200	x	x	x	--	DGPS
739.9	May 31, 2007	R/V Funk	18,200	x	--	x	x	DGPS
738.2	May 02, 2007	R/V Funk	12,100	x	x	x	--	DGPS
736.6	May 09, 2007	R/V Funk	15,000	x	x	x	--	DGPS
				Big Sioux River to Platte River				
733.8	May 03, 2007	R/V Funk	16,900	x	x	x	--	DGPS
733.8	June 12, 2007	R/V Funk	25,700	x	x	x	--	DGPS
732.4	June 16, 2005	R/V Funk	32,900	x	x	x	--	DGPS
729.5	June 15, 2007	R/V Funk	26,900	x	x	x	--	DGPS
726.5	May 04, 2007	R/V Funk	19,200	x	x	x	--	DGPS
725.0	May 23, 2006	R/V Funk	25,200	x	x	x	--	DGPS
724.6	June 02, 2007	R/V Funk	26,500	x	x	x	x	DGPS
717.8	June 09, 2007	R/V Funk	27,300	x	x	x	--	DGPS
716.9	Aug. 09, 2005	R/V Funk	27,300	x	x	x	--	DGPS

Table 3. Locations, dates, and available data sets for habitat surveys.—Continued

[ft³/s, cubic feet per second; GPS, global positioning system; R/V, research vessel; x, data available; --, data not available; DGPS, differential GPS; RTK GPS, real-time kinematic GPS]

River mile	Map date	Boat	Estimated discharge (ft^3/s)	Data types available				
				Depth	Substrate	Velocity	Side-scan sonar	GPS type
Big Sioux River to Platte River—Continued								
709.3	June 07, 2006	R/V Funk	26,800	x	x	x	--	DGPS
707.5	June 13, 2007	R/V Funk	26,900	x	x	x	--	DGPS
706.2	May 15, 2007	R/V Funk	35,200	x	--	x	--	DGPS
702.2	June 07, 2007	R/V Funk	27,600	x	x	x	--	DGPS
701.1	Aug. 10, 2005	R/V Funk	27,500	x	--	x	--	DGPS
697.8	June 03, 2005	R/V Funk	28,700	x	x	x	--	DGPS
693.4	June 09, 2005	R/V Funk	42,900	x	x	x	--	DGPS
693.0	June 17, 2005	R/V Funk	34,200	x	x	x	--	DGPS
692.7	July 12, 2005	R/V Funk	26,200	x	x	x	--	RTK GPS
691.9	May 19, 2007	R/V Funk	26,800	x	x	x	--	DGPS
689.2	May 17, 2007	R/V Funk	30,900	x	--	x	--	DGPS
687.7	May 26, 2007	R/V Funk	24,000	x	x	x	x	DGPS
686.6	May 18, 2005	R/V Funk	23,900	x	x	x	--	DGPS
683.9	June 24, 2005	R/V Funk	31,900	x	x	x	--	DGPS
673.8	May 10, 2005	R/V Funk	26,400	x	x	x	--	DGPS
672.4	June 02, 2005	R/V Funk	29,300	x	x	x	--	DGPS
670.4	Aug. 11, 2005	R/V Funk	28,000	x	--	x	--	DGPS
669.2	June 01, 2006	R/V Funk	26,600	x	x	x	--	DGPS
668.9	Apr. 22, 2005	R/V Funk	27,200	x	x	x	--	DGPS
665.6	June 06, 2006	R/V Funk	28,700	x	x	x	--	DGPS
663.0	June 08, 2005	R/V Funk	44,700	x	x	x	--	DGPS
660.8	May 12, 2007	R/V Funk	36,500	x	--	x	--	DGPS
657.4	May 19, 2005	R/V Funk	30,900	x	--	--	--	DGPS
654.7	May 07, 2005	R/V Funk	26,500	x	x	x	--	DGPS
652.0	May 25, 2005	R/V Funk	29,400	x	x	x	--	DGPS
651.8	July 13, 2005	R/V Funk	28,400	x	x	x	--	RTK GPS
650.4	June 23, 2005	R/V Funk	33,800	x	x	x	--	DGPS
650.3	June 08, 2007	R/V Funk	31,200	x	x	x	--	DGPS
647.6	May 01, 2007	R/V Funk	28,000	x	x	x	--	DGPS
647.5	May 11, 2005	R/V Funk	31,200	x	x	x	--	DGPS
644.8	June 14, 2005	R/V Funk	36,200	x	x	x	--	DGPS
643.6	June 14, 2007	R/V Funk	30,100	x	x	x	--	DGPS
642.7	Aug. 12, 2005	R/V Funk	28,100	x	--	x	--	DGPS
641.5	May 18, 2006	R/V Funk	34,400	x	x	x	--	DGPS
641.3	June 16, 2007	R/V Funk	29,600	x	x	x	--	DGPS
640.5	May 05, 2005	R/V Funk	27,400	x	x	x	--	DGPS
638.9	June 01, 2005	R/V Funk	32,600	x	x	x	--	DGPS
638.3	Apr. 20, 2005	R/V Funk	27,400	x	x	x	--	DGPS

Table 3. Locations, dates, and available data sets for habitat surveys.—Continued

[ft³/s, cubic feet per second; GPS, global positioning system; R/V, research vessel; x, data available; --, data not available; DGPS, differential GPS; RTK GPS, real-time kinematic GPS]

River mile	Map date	Boat	Estimated discharge (ft³/s)	Data types available				
				Depth	Substrate	Velocity	Side-scan sonar	GPS type
Big Sioux River to Platte River—Continued								
627.8	July 14, 2005	R/V Funk	28,600	x	x	x	--	RTK GPS
627.5	May 20, 2005	R/V Funk	35,000	x	x	x	--	DGPS
626.1	Sept. 01, 2005	R/V Funk	27,800	x	x	x	--	DGPS
622.8	June 22, 2005	R/V Funk	33,800	x	x	x	--	DGPS
620.1	May 12, 2005	R/V Funk	34,000	x	x	x	--	DGPS
618.6	June 21, 2005	R/V Funk	34,600	x	x	x	--	DGPS
616.5	Aug. 31, 2005	R/V Funk	27,800	x	x	x	--	DGPS
614.5	Apr. 30, 2005	R/V Funk	25,200	x	x	x	--	DGPS
611.6	Apr. 28, 2005	R/V Funk	25,100	x	x	x	--	DGPS
609.9	May 06, 2005	R/V Funk	26,800	x	x	x	--	DGPS
609.7	June 05, 2005	R/V Funk	33,100	x	x	x	--	DGPS
609.1	May 08, 2005	R/V Funk	28,000	x	x	x	--	DGPS
608.2	Apr. 29, 2005	R/V Funk	25,100	x	x	x	--	DGPS
606.5	May 17, 2005	R/V Funk	36,100	x	x	x	--	DGPS
606.4	Apr. 27, 2005	R/V Funk	25,300	x	x	x	--	DGPS
604.0	June 04, 2005	R/V Funk	32,900	x	x	x	--	DGPS
602.4	May 09, 2005	R/V Funk	28,500	x	x	x	--	DGPS
601.2	May 22, 2005	R/V Funk	31,100	x	x	x	--	DGPS
Platte River to Kansas River								
593.7	June 11, 2005	R/V Funk	57,300	x	x	x	--	DGPS
588.6	May 23, 2005	R/V Funk	39,400	x	x	x	--	DGPS
583.8	July 13, 2006	R/V Funk	30,200	x	x	x	--	DGPS
565.5	May 24, 2005	R/V Funk	39,600	x	x	x	--	DGPS
554.2	June 25, 2005	R/V Funk	46,300	x	x	x	--	DGPS
Kansas River to Grand River								
362.7	May 04, 2005	R/V Brush	39,200	x	--	x	--	DGPS
354.4	May 25, 2005	R/V Brush	52,900	x	--	x	--	DGPS
331.9	June 20, 2006	R/V Brush	35,600	x	x	x	--	DGPS
330.1	Apr. 29, 2005	R/V Brush	43,300	x	--	x	--	DGPS
326.8	May 24, 2006	R/V Brush	38,600	x	x	x	--	DGPS
325.2	May 11, 2005	R/V Brush	37,600	x	--	x	--	DGPS
315.1	Apr. 27, 2005	R/V Brush	45,000	x	--	x	--	DGPS
311.6	May 05, 2005	R/V Brush	39,200	x	--	x	--	DGPS
291.8	May 26, 2005	R/V Brush	53,000	x	--	x	--	DGPS
289.4	July 06, 2006	R/V Brush	36,200	x	x	x	--	DGPS
282.3	June 13, 2006	R/V Brush	36,700	x	x	x	--	DGPS
282.0	May 04, 2006	R/V Brush	65,100	x	x	x	--	DGPS
281.5	June 13, 2006	R/V Brush	36,700	x	x	x	--	DGPS

Table 3. Locations, dates, and available data sets for habitat surveys.—Continued

[ft^3/s, cubic feet per second; GPS, global positioning system; R/V, research vessel; x, data available; --, data not available; DGPS, differential GPS; RTK GPS, real-time kinematic GPS]

River mile	Map date	Boat	Estimated discharge (ft^3/s)	Data types available				
				Depth	Substrate	Velocity	Side-scan sonar	GPS type
Kansas River to Grand River—Continued								
280.0	June 27, 2006	R/V Brush	39,400	--	--	--	x	DGPS
280.0	June 28, 2006	R/V Brush	38,800	--	--	--	x	DGPS
280.0	July 25, 2006	R/V Funk	35,000	--	--	--	x	DGPS
279.7	June 08, 2006	R/V Brush	38,200	x	x	x	--	DGPS
278.1	June 14, 2006	R/V Brush	37,400	x	x	x	--	DGPS
275.8	June 10, 2005	R/V Brush	84,400	x	--	x	--	DGPS
Grand River to Osage River								
247.6	June 02, 2006	R/V Brush	45,700	x	x	x	--	DGPS
247.5	May 12, 2005	R/V Brush	44,400	x	--	x	--	DGPS
230.5	May 06, 2005	R/V Brush	42,700	x	--	x	--	DGPS
219.2	Apr. 15, 2005	R/V Brush	69,500	x	--	x	--	DGPS
218.8	May 19, 2006	R/V Brush	39,700	x	x	x	--	DGPS
217.4	June 27, 2005	R/V Brush	68,900	x	--	x	--	DGPS
208.7	July 05, 2005	R/V Brush	59,300	x	--	x	--	DGPS
206.1	June 07, 2006	R/V Brush	38,000	x	x	x	--	DGPS
206.1	June 09, 2006	R/V Brush	38,800	--	--	--	x	DGPS
203.3	Apr. 28, 2005	R/V Brush	53,300	x	--	x	--	DGPS
202.3	June 06, 2006	R/V Brush	40,100	x	x	x	--	DGPS
201.3	Apr. 07, 2005	R/V Brush	38,700	x	--	x	--	DGPS
201.3	Apr. 07, 2005	R/V Funk	38,700	x	--	--	--	DGPS
199.7	Apr. 08, 2005	R/V Funk	40,000	x	x	x	--	DGPS
197.5	May 18, 2005	R/V Brush	106,000	x	--	x	--	DGPS
197.0	July 13, 2005	R/V Brush	43,000	x	--	x	--	RTK GPS
196.0	July 07, 2006	R/V Brush	38,000	x	x	x	--	DGPS
186.8	May 27, 2005	R/V Brush	59,500	x	--	x	--	DGPS
178.0	Apr. 12, 2005	R/V Brush	48,500	x	--	x	--	DGPS
177.4	May 10, 2006	R/V Brush	54,000	x	x	x	--	DGPS
173.5	June 01, 2005	R/V Brush	53,600	x	--	x	--	DGPS
173.3	Apr. 22, 2005	R/V Brush	53,800	x	--	x	--	DGPS
168.0	July 01, 2005	R/V Brush	65,400	x	--	x	--	DGPS
166.8	May 19, 2005	R/V Brush	90,900	x	--	x	--	DGPS
165.5	June 21, 2006	R/V Brush	37,600	x	x	x	--	DGPS
160.5	May 10, 2005	R/V Brush	40,500	x	--	x	--	DGPS
146.5	June 03, 2005	R/V Brush	59,600	x	--	x	--	DGPS
146.5	Aug. 10, 2005	R/V Brush	35,000	x	--	x	--	DGPS
142.7	May 23, 2005	R/V Brush	71,000	x	--	x	--	DGPS
142.0	Aug. 09, 2005	R/V Brush	35,100	x	--	x	--	DGPS
140.9	June 02, 2005	R/V Brush	54,000	x	--	x	--	DGPS

Table 3. Locations, dates, and available data sets for habitat surveys.—Continued

[ft^3/s, cubic feet per second; GPS, global positioning system; R/V, research vessel; x, data available; --, data not available; DGPS, differential GPS; RTK GPS, real-time kinematic GPS]

River mile	Map date	Boat	Estimated discharge (ft^3/s)	Data types available				
				Depth	Substrate	Velocity	Side-scan sonar	GPS type
136.3	Apr. 14, 2005	R/V Funk	69,300	x	x	x	--	DGPS
130.6	Apr. 19, 2005	R/V Brush	53,600	x	--	x	--	DGPS
Osage River to mouth								
128.5	May 31, 2005	R/V Brush	53,600	x	--	x	--	DGPS
127.6	May 09, 2006	R/V Brush	69,700	x	x	x	--	DGPS
127.3	Apr. 26, 2005	R/V Brush	86,500	x	--	x	--	DGPS
120.6	Apr. 05, 2005	R/V Brush	43,500	x	--	x	--	DGPS
119.6	June 30, 2006	R/V Brush	41,700	x	x	x	--	DGPS
118.5	May 03, 2005	R/V Brush	52,700	x	--	x	--	DGPS
118.2	July 06, 2005	R/V Brush	66,800	x	--	x	--	DGPS
109.3	Aug. 31, 2005	R/V Brush	90,600	x	--	x	--	DGPS
81.9	Sept. 01, 2005	R/V Brush	87,200	x	--	x	--	DGPS
75.8	July 07, 2005	R/V Brush	70,600	x	--	x	--	DGPS
27.3	July 08, 2005	R/V Brush	71,800	x	--	x	--	DGPS

Table 4. Sturgeon relocations and nets targeted for mapping.

[ft³/s, cubic feet per second; SNS, shovelnose sturgeon; PLS pallid sturgeon; --, no data]

Sturgeon relocation date	River mile of sturgeon re-location	Estimated discharge, sturgeon relocation date (ft³/s)	Sturgeon identification code	Species	Sex	Selection method	Map date	Boat	Estimated discharge, map date (ft³/s)
July 10, 2006	808.2	25,500	PLS05-006	PLS	unknown	random	July 11, 2006	R/V Funk	25,500
May 15, 2007	807.0	8,000	SNS07-093	SNS	female	random	May 16, 2007	R/V Funk	8,000
May 23, 2007	806.6	11,300	SNS07-093	SNS	female	random	May 24, 2007	R/V Funk	11,000
June 5, 2006	805.8	22,500	Net	--	--	nonrandom	June 13, 2006	R/V Funk	25,000
May 9, 2007	801.9	8,000	SNS07-081	SNS	female	random	May 10, 2007	R/V Funk	8,000
May 21, 2007	799.8	19,400	SNS07-062	SNS	female	random	May 22, 2007	R/V Funk	24,700
May 21, 2007	799.7	19,400	SNS07-088	SNS	female	random	May 22, 2007	R/V Funk	24,700
May 21, 2007	799.1	19,400	SNS07-169	SNS	male	random	May 22, 2007	R/V Funk	24,700
May 31, 2007	797.0	20,800	SNS07-085	SNS	female	random	June 01, 2007	R/V Funk	19,600
May 23, 2007	791.2	18,500	SNS07-152	SNS	female	random	July 17, 2007	R/V Funk	23,000
June 2, 2007	791.1	16,500	SNS07-152	SNS	female	random	July 17, 2007	R/V Funk	23,000
June 4, 2007	791.1	22,300	SNS07-152	SNS	female	random	July 17, 2007	R/V Funk	23,000
June 8, 2007	791.1	21,900	SNS07-152	SNS	female	random	July 17, 2007	R/V Funk	23,000
June 10, 2007	791.1	21,900	SNS07-152	SNS	female	random	July 17, 2007	R/V Funk	23,000
May 27, 2007	791.0	17,700	SNS07-152	SNS	female	random	July 17, 2007	R/V Funk	23,000
May 17, 2007	782.5	20,100	SNS07-122	SNS	female	random	May 18, 2007	R/V Funk	18,900
May 20, 2006	775.1	20,400	SNS06-059	SNS	female	random	May 30, 2006	R/V Funk	21,700
May 29, 2007	775.1	17,700	SNS07-139	SNS	female	random	May 30, 2007	R/V Funk	17,000
May 29, 2007	775.1	17,700	SNS07-127	SNS	female	random	May 30, 2007	R/V Funk	17,000
May 29, 2007	775.1	17,700	SNS07-164	SNS	female	random	May 30, 2007	R/V Funk	17,000
May 25, 2006	774.2	25,800	SNS06-061	SNS	female	random	June 08, 2006	R/V Funk	23,700
June 14, 2005	759.7	27,300	SNS05-066	SNS	female	random	June 15, 2005	R/V Funk	27,500
May 20, 2007	759.5	23,400	PLS07-004	PLS	female	random	May 21, 2007	R/V Funk	23,700
May 20, 2007	759.5	23,400	PLS07-004	PLS	female	random	May 21, 2007	R/V Funk	23,700
May 22, 2007	752.9	21,500	SNS07-141	SNS	male	random	May 23, 2007	R/V Funk	25,300
May 22, 2007	752.9	21,500	SNS07-104	SNS	female	random	May 23, 2007	R/V Funk	25,300
June 14, 2006	752.2	26,400	SNS06-060	SNS	female	random	June 22, 2006	R/V Funk	26,800
June 16, 2006	752.1	27,400	SNS06-060	SNS	female	random	June 22, 2006	R/V Funk	26,800
May 22, 2007	752.0	21,500	SNS06-060	SNS	female	random	May 23, 2007	R/V Funk	25,300
June 1, 2006	751.8	25,200	PLS06-007	PLS	male	random	June 22, 2006	R/V Funk	26,800
June 16, 2006	749.5	27,400	SNS06-085	SNS	female	random	June 20, 2006	R/V Funk	26,400
June 16, 2006	749.4	27,400	SNS06-083	SNS	female	random	June 20, 2006	R/V Funk	26,400
June 9, 2005	746.3	34,000	SNS05-063	SNS	female	random	June 10, 2005	R/V Funk	32,400
June 15, 2005	746.3	27,500	SNS05-063	SNS	female	random	July 11, 2005	R/V Funk	22,800
May 24, 2007	745.1	23,500	SNS07-052	SNS	male	random	May 25, 2007	R/V Funk	19,600
July 11, 2006	743.8	26,200	SNS06-083	SNS	female	random	July 12, 2006	R/V Funk	26,200
May 30, 2007	740.0	22,300	SNS07-057	SNS	female	random	May 31, 2007	R/V Funk	18,200
May 1, 2007	738.2	12,400	SNS07-162	SNS	female	random	May 02, 2007	R/V Funk	12,100
May 8, 2007	736.4	13,700	SNS07-040	SNS	female	random	May 09, 2007	R/V Funk	15,000

Table 4. Sturgeon relocations and nets targeted for mapping.—Continued

[ft^3/s, cubic feet per second; SNS, shovelnose sturgeon; PLS pallid sturgeon; --, no data]

Sturgeon relocation date	River mile of sturgeon re-location	Estimated discharge, sturgeon relocation date (ft^3/s)	Sturgeon identification code	Species	Sex	Selection method	Map date	Boat	Estimated discharge, map date (ft^3/s)
May 2, 2007	733.8	17,100	SNS07-092	SNS	female	random	May 03, 2007	R/V Funk	16,900
June 11, 2007	733.8	25,700	SNS07-154	SNS	female	random	June 12, 2007	R/V Funk	25,700
June 15, 2005	732.4	32,400	SNS05-084	SNS	female	random	June 16, 2005	R/V Funk	32,900
June 14, 2007	730.2	27,500	SNS07-079	SNS	female	random	June 15, 2007	R/V Funk	26,900
May 3, 2007	726.6	18,600	SNS07-155	SNS	female	random	May 04, 2007	R/V Funk	19,200
May 22, 2006	724.8	25,400	SNS06-058	SNS	female	random	May 23, 2006	R/V Funk	25,200
May 31, 2007	724.5	24,200	SNS07-059	SNS	female	random	June 02, 2007	R/V Funk	26,500
June 8, 2007	717.8	27,600	SNS07-072	SNS	female	random	June 09, 2007	R/V Funk	27,300
July 7, 2005	716.7	26,100	SNS05-084	SNS	female	random	Aug. 09, 2005	R/V Funk	27,300
July 18, 2005	716.5	26,300	SNS05-084	SNS	female	random	Aug. 09, 2005	R/V Funk	27,300
May 31, 2006	709.8	26,400	SNS06-051	SNS	female	random	June 07, 2006	R/V Funk	26,800
May 22, 2006	709.7	25,400	SNS06-051	SNS	female	random	June 07, 2006	R/V Funk	26,800
June 12, 2007	707.2	26,700	SNS07-175	SNS	female	random	June 13, 2007	R/V Funk	26,900
May 14, 2007	706.2	33,900	SNS07-057	SNS	female	random	May 15, 2007	R/V Funk	35,200
June 6, 2007	702.1	27,800	SNS07-055	SNS	female	random	June 07, 2007	R/V Funk	27,600
July 7, 2005	700.8	26,100	SNS05-064	SNS	female	random	Aug. 10, 2005	R/V Funk	27,500
July 19, 2005	700.8	26,100	SNS05-064	SNS	female	random	Aug. 10, 2005	R/V Funk	27,500
June 2, 2005	697.7	29,300	SNS05-084	SNS	female	random	June 03, 2005	R/V Funk	28,700
June 8, 2005	693.4	41,900	SNS05-071	SNS	female	random	June 09, 2005	R/V Funk	42,900
June 16, 2005	693.0	34,100	SNS05-071	SNS	female	random	June 17, 2005	R/V Funk	34,200
May 27, 2005	692.6	27,900	SNS05-077	SNS	female	random	July 12, 2005	R/V Funk	26,200
May 18, 2007	692.0	28,500	SNS07-021	SNS	female	random	May 19, 2007	R/V Funk	26,800
May 16, 2007	689.1	33,400	SNS07-046	SNS	female	random	May 17, 2007	R/V Funk	30,900
May 24, 2007	687.7	29,700	SNS07-047	SNS	female	random	May 26, 2007	R/V Funk	24,000
May 17, 2005	686.4	24,100	SNS05-064	SNS	female	random	May 18, 2005	R/V Funk	23,900
May 17, 2005	686.4	24,100	SNS05-062	SNS	female	random	May 18, 2005	R/V Funk	23,900
June 23, 2005	683.9	32,500	SNS05-057	SNS	female	random	June 24, 2005	R/V Funk	31,900
June 23, 2005	683.4	32,500	SNS05-063	SNS	female	random	June 24, 2005	R/V Funk	31,900
May 9, 2005	674.2	25,700	SNS05-064	SNS	female	random	May 10, 2005	R/V Funk	26,400
May 9, 2005	673.3	25,700	SNS05-062	SNS	female	random	May 10, 2005	R/V Funk	26,400
June 1, 2005	672.5	28,800	SNS05-058	SNS	female	random	June 02, 2005	R/V Funk	29,300
June 1, 2005	671.8	28,800	SNS05-052	SNS	female	random	June 02, 2005	R/V Funk	29,300
July 6, 2005	670.1	26,300	SNS05-063	SNS	female	random	Aug. 11, 2005	R/V Funk	28,000
June 30, 2005	670.1	30,900	SNS05-063	SNS	female	random	Aug. 11, 2005	R/V Funk	28,000
May 31, 2006	669.4	26,600	SNS06-067	SNS	female	random	June 01, 2006	R/V Funk	26,600
May 31, 2006	669.1	28,900	SNS06-072	SNS	female	random	June 01, 2006	R/V Funk	26,600
Apr. 21, 2005	668.5	30,000	Net	--	--	nonrandom	Apr. 22, 2005	R/V Funk	27,200
May 31, 2006	665.8	28,900	SNS06-089	SNS	female	random	June 06, 2006	R/V Funk	28,700
June 7, 2005	662.8	40,900	SNS05-074	SNS	female	random	June 08, 2005	R/V Funk	44,700

Table 4. Sturgeon relocations and nets targeted for mapping.—Continued

[ft^3/s, cubic feet per second; SNS, shovelnose sturgeon; PLS pallid sturgeon; --, no data]

Sturgeon relocation date	River mile of sturgeon re-location	Estimated discharge, sturgeon relocation date (ft^3/s)	Sturgeon identification code	Species	Sex	Selection method	Map date	Boat	Estimated discharge, map date (ft^3/s)
May 11, 2007	660.7	36,300	SNS07-033	SNS	female	random	May 12, 2007	R/V Funk	36,500
May 18, 2005	657.9	31,400	SNS05-071	SNS	female	random	May 19, 2005	R/V Funk	30,900
May 18, 2005	657.3	31,400	SNS05-097	SNS	female	random	May 19, 2005	R/V Funk	30,900
May 6, 2005	654.6	26,500	SNS05-058	SNS	female	random	May 07, 2005	R/V Funk	26,500
May 24, 2005	651.9	30,400	SNS05-084	SNS	female	random	May 25, 2005	R/V Funk	29,400
May 24, 2005	651.8	30,400	SNS05-061	SNS	female	random	May 25, 2005	R/V Funk	29,400
May 18, 2005	651.8	31,400	SNS05-061	SNS	female	random	July 13, 2005	R/V Funk	28,400
June 22, 2005	650.5	33,300	SNS05-094	SNS	female	random	June 23, 2005	R/V Funk	33,800
June 7, 2007	650.4	31,600	SNS07-025	SNS	female	random	June 08, 2007	R/V Funk	31,200
May 10, 2005	648.0	28,300	SNS05-060	SNS	female	random	May 11, 2005	R/V Funk	31,200
Apr. 30, 2007	647.8	29,900	SNS07-045	SNS	female	random	May 01, 2007	R/V Funk	28,000
May 10, 2005	647.2	28,300	SNS05-052	SNS	female	random	May 11, 2005	R/V Funk	31,200
May 10, 2005	647.2	28,300	SNS05-053	SNS	female	random	May 11, 2005	R/V Funk	31,200
June 13, 2005	644.8	38,000	SNS05-054	SNS	female	random	June 14, 2005	R/V Funk	36,200
July 20, 2005	643.4	28,200	SNS05-099	SNS	female	random	Aug. 12, 2005	R/V Funk	28,100
Aug. 2, 2005	643.4	28,400	SNS05-099	SNS	female	random	Aug. 12, 2005	R/V Funk	28,100
Aug. 9, 2005	643.4	27,100	SNS05-099	SNS	female	random	Aug. 12, 2005	R/V Funk	28,100
June 13, 2007	643.4	29,800	SNS07-077	SNS	female	random	June 14, 2007	R/V Funk	30,100
May 17, 2006	641.5	35,400	SNS06-077	SNS	female	random	May 18, 2006	R/V Funk	34,400
June 14, 2007	640.9	30,100	SNS07-176	SNS	female	random	June 16, 2007	R/V Funk	29,600
May 5, 2005	640.6	27,400	SNS05-053	SNS	female	random	May 05, 2005	R/V Funk	27,400
May 31, 2005	639.6	31,600	SNS05-061	SNS	female	random	June 01, 2005	R/V Funk	32,600
Apr. 19, 2005	638.4	26,900	Net	--	--	nonrandom	Apr. 20, 2005	R/V Funk	27,400
May 31, 2005	638.2	31,600	SNS05-101	SNS	female	random	June 01, 2005	R/V Funk	32,600
May 19, 2005	628.2	31,600	SNS05-076	SNS	female	random	May 20, 2005	R/V Funk	35,000
May 19, 2005	627.8	31,600	SNS05-098	SNS	female	random	May 20, 2005	R/V Funk	35,000
May 19, 2005	627.8	31,600	SNS05-098	SNS	female	random	July 14, 2005	R/V Funk	28,600
May 25, 2005	627.7	29,900	SNS05-100	SNS	female	random	July 14, 2005	R/V Funk	28,600
May 19, 2005	627.6	31,600	SNS05-100	SNS	female	random	May 20, 2005	R/V Funk	35,000
May 19, 2005	626.7	31,600	SNS05-095	SNS	female	random	May 20, 2005	R/V Funk	35,000
July 21, 2005	626.3	28,400	SNS05-098	SNS	female	random	Sept. 01, 2005	R/V Funk	27,800
July 26, 2005	626.3	28,700	SNS05-098	SNS	female	random	Sept. 01, 2005	R/V Funk	27,800
June 20, 2005	622.7	35,500	SNS05-076	SNS	female	random	June 22, 2005	R/V Funk	33,800
May 11, 2005	620.0	32,200	SNS05-095	SNS	female	random	May 12, 2005	R/V Funk	34,000
June 20, 2005	618.8	35,500	SNS05-100	SNS	female	random	June 21, 2005	R/V Funk	34,600
July 21, 2005	616.4	28,400	SNS05-101	SNS	female	random	Aug. 31, 2005	R/V Funk	27,800
July 26, 2005	616.4	28,700	SNS05-101	SNS	female	random	Aug. 31, 2005	R/V Funk	27,800
--	614.5	--	Net	--	--	nonrandom	Apr. 30, 2005	R/V Funk	25,200
--	611.6	--	Net	--	--	nonrandom	Apr. 28, 2005	R/V Funk	25,100

Table 4. Sturgeon relocations and nets targeted for mapping.—Continued

[ft^3/s, cubic feet per second; SNS, shovelnose sturgeon; PLS pallid sturgeon; --, no data]

Sturgeon relocation date	River mile of sturgeon re-location	Estimated discharge, sturgeon relocation date (ft^3/s)	Sturgeon identification code	Species	Sex	Selection method	Map date	Boat	Estimated discharge, map date (ft^3/s)
May 5, 2005	610.7	27,700	SNS05-098	SNS	female	random	May 06, 2005	R/V Funk	26,800
May 5, 2005	609.9	27,700	SNS05-096	SNS	female	random	May 06, 2005	R/V Funk	26,800
June 3, 2005	609.9	33,600	SNS05-072	SNS	female	random	June 05, 2005	R/V Funk	33,100
June 3, 2005	609.7	33,600	SNS05-068	SNS	female	random	June 05, 2005	R/V Funk	33,100
May 5, 2005	609.4	27,700	SNS05-071	SNS	female	random	May 06, 2005	R/V Funk	26,800
May 7, 2005	609.1	26,800	SNS05-076	SNS	female	random	May 08, 2005	R/V Funk	28,000
May 7, 2005	608.8	26,800	SNS05-084	SNS	female	random	May 08, 2005	R/V Funk	28,000
May 7, 2005	608.8	26,800	SNS05-072	SNS	female	random	May 08, 2005	R/V Funk	28,000
May 7, 2005	608.7	26,800	SNS05-095	SNS	female	random	May 08, 2005	R/V Funk	28,000
May 7, 2005	608.6	26,800	SNS05-082	SNS	female	random	May 08, 2005	R/V Funk	28,000
--	608.2	--	Net	--	--	nonrandom	Apr. 29, 2005	R/V Funk	25,100
May 7, 2005	608.1	26,800	SNS05-077	SNS	female	random	May 08, 2005	R/V Funk	28,000
May 7, 2005	607.6	26,800	SNS05-101	SNS	female	random	May 08, 2005	R/V Funk	28,000
--	606.4	--	Net	--	--	nonrandom	Apr. 27, 2005	R/V Funk	25,300
May 16, 2005	606.4	33,300	SNS05-082	SNS	female	random	May 17, 2005	R/V Funk	36,100
June 3, 2005	604.6	33,600	SNS05-082	SNS	female	random	June 04, 2005	R/V Funk	32,900
May 16, 2005	604.0	33,300	SNS05-089	SNS	female	random	May 17, 2005	R/V Funk	36,100
June 3, 2005	603.3	33,600	SNS05-056	SNS	female	random	June 04, 2005	R/V Funk	32,900
May 8, 2005	602.9	28,000	SNS05-073	SNS	female	random	May 09, 2005	R/V Funk	28,500
May 8, 2005	601.9	28,000	SNS05-069	SNS	female	random	May 09, 2005	R/V Funk	28,500
May 20, 2005	601.2	35,000	SNS05-087	SNS	female	random	May 22, 2005	R/V Funk	31,100
June 10, 2005	593.4	56,700	SNS05-073	SNS	female	random	June 11, 2005	R/V Funk	57,300
May 20, 2005	588.6	43,700	SNS05-085	SNS	female	random	May 23, 2005	R/V Funk	39,400
July 12, 2006	583.8	30,500	PLS06-006	PLS	male	random	July 13, 2006	R/V Funk	30,200
May 20, 2005	565.3	43,700	SNS05-070	SNS	female	random	May 24, 2005	R/V Funk	39,600
June 24, 2005	554.1	51,600	SNS05-056	SNS	female	random	June 25, 2005	R/V Funk	46,300
May 3, 2005	362.1	39,300	SNS05-040	SNS	female	random	May 04, 2005	R/V Brush	39,200
May 24, 2005	354.6	52,900	SNS05-022	SNS	female	random	May 25, 2005	R/V Brush	52,900
June 19, 2006	331.6	35,600	PLS06-003	PLS	female	random	June 20, 2006	R/V Brush	35,600
Apr. 28, 2005	330.1	44,400	SNS05-006	SNS	female	random	Apr. 29, 2005	R/V Brush	43,300
May 23, 2006	326.6	38,700	PLS06-004	PLS	female	random	May 24, 2006	R/V Brush	38,600
May 10, 2005	324.9	36,600	SNS05-041	SNS	female	random	May 11, 2005	R/V Brush	37,600
Apr. 26, 2005	315.3	47,500	SNS05-037	SNS	female	random	Apr. 27, 2005	R/V Brush	45,000
May 4, 2005	311.5	39,400	SNS05-007	SNS	female	random	May 05, 2005	R/V Brush	39,200
May 25, 2005	291.7	53,000	SNS05-003	SNS	female	random	May 26, 2005	R/V Brush	53,000
July 5, 2006	289.4	38,000	SNS06-038	SNS	female	random	July 06, 2006	R/V Brush	36,200
May 3, 2006	280.4	67,700	SNS06-044	SNS	female	random	May 04, 2006	R/V Brush	65,100
May 31, 2006	279.8	38,600	SNS06-044	SNS	female	random	June 08, 2006	R/V Brush	38,200
June 7, 2006	279.8	39,600	SNS06-044	SNS	female	random	June 13, 2006	R/V Brush	36,700

Table 4. Sturgeon relocations and nets targeted for mapping.—Continued

[ft^3/s, cubic feet per second; SNS, shovelnose sturgeon; PLS pallid sturgeon; --, no data]

Sturgeon relocation date	River mile of sturgeon re-location	Estimated discharge, sturgeon relocation date (ft^3/s)	Sturgeon identification code	Species	Sex	Selection method	Map date	Boat	Estimated discharge, map date (ft^3/s)
June 9, 2005	275.6	88,700	SNS05-015	SNS	female	random	June 10, 2005	R/V Brush	84,400
June 1, 2006	248.1	45,400	SNS06-034	SNS	female	random	June 02, 2006	R/V Brush	45,700
May 11, 2005	247.4	39,200	SNS05-016	SNS	female	random	May 12, 2005	R/V Brush	44,400
May 5, 2005	230.6	43,100	SNS05-019	SNS	female	random	May 06, 2005	R/V Brush	42,700
Apr. 14, 2005	219.2	72,100	PLS04-001	PLS	unknown	random	Apr. 15, 2005	R/V Brush	69,500
May 18, 2006	219.2	40,200	SNS06-028	SNS	female	random	May 19, 2006	R/V Brush	39,700
June 24, 2005	216.7	70,700	SNS05-089	SNS	female	random	June 27, 2005	R/V Brush	68,900
June 24, 2005	216.5	70,700	SNS05-028	SNS	female	random	June 27, 2005	R/V Brush	68,900
July 1, 2005	208.2	66,000	SNS05-011	SNS	female	random	July 05, 2005	R/V Brush	59,300
July 1, 2005	208.1	66,000	SNS05-089	SNS	female	random	July 05, 2005	R/V Brush	59,300
June 1, 2006	206.5	46,500	SNS06-011	SNS	female	random	June 07, 2006	R/V Brush	38,000
May 22, 2006	206.4	43,300	SNS06-011	SNS	female	random	June 07, 2006	R/V Brush	38,000
May 25, 2006	206.4	39,700	SNS06-011	SNS	female	random	June 07, 2006	R/V Brush	38,000
Apr. 27, 2005	202.8	57,900	SNS05-017	SNS	female	random	Apr. 28, 2005	R/V Brush	53,300
May 20, 2006	202.8	39,800	SNS06-041	SNS	female	random	June 06, 2006	R/V Brush	40,100
Apr. 6, 2005	201.3	38,100	SNS05-034	SNS	female	random	Apr. 07, 2005	R/V Brush	38,700
Apr. 6, 2005	201.3	38,100	SNS05-034	SNS	female	random	Apr. 07, 2005	R/V Funk	38,700
Apr. 7, 2005	199.6	38,700	PLS04-002	PLS	unknown	random	Apr. 08, 2005	R/V Funk	40,000
May 17, 2005	197.7	124,000	SNS05-012	SNS	female	random	May 18, 2005	R/V Brush	106,000
May 6, 2005	197.0	43,600	SNS05-009	SNS	female	random	July 13, 2005	R/V Brush	43,000
July 6, 2006	195.9	38,500	SNS06-011	SNS	female	random	July 07, 2006	R/V Brush	38,000
May 26, 2005	186.5	61,300	SNS05-026	SNS	female	random	May 27, 2005	R/V Brush	59,500
Apr. 11, 2005	177.9	44,100	SNS05-027	SNS	female	random	Apr. 12, 2005	R/V Brush	48,500
May 9, 2006	177.2	55,700	PLS06-001	PLS	male	random	May 10, 2006	R/V Brush	54,000
Apr. 21, 2005	173.6	48,200	SNS05-027	SNS	female	random	Apr. 22, 2005	R/V Brush	53,800
May 27, 2005	173.5	59,500	SNS05-031	SNS	female	random	June 01, 2005	R/V Brush	53,600
June 30, 2005	168.0	62,100	PLS04-001	PLS	unknown	random	July 01, 2005	R/V Brush	65,400
May 18, 2005	166.8	106,000	SNS05-043	SNS	female	random	May 19, 2005	R/V Brush	90,900
June 20, 2006	165.5	37,700	SNS06-010	SNS	female	random	June 21, 2006	R/V Brush	37,600
May 6, 2005	160.7	43,600	SNS05-043	SNS	female	random	May 10, 2005	R/V Brush	40,500
June 2, 2005	146.6	54,000	SNS05-031	SNS	female	random	June 03, 2005	R/V Brush	59,600
Aug. 3, 2005	146.4	37,600	SNS05-031	SNS	female	random	Aug. 10, 2005	R/V Brush	35,000
May 19, 2005	142.3	90,900	SNS05-024	SNS	female	random	May 23, 2005	R/V Brush	71,000
July 5, 2005	142.3	61,400	SNS05-024	SNS	female	random	Aug. 09, 2005	R/V Brush	35,100
Aug. 3, 2005	142.1	37,600	SNS05-021	SNS	female	random	Aug. 09, 2005	R/V Brush	35,100
May 27, 2005	140.9	59,500	PLS05-003	PLS	female	random	June 02, 2005	R/V Brush	54,000
Apr. 13, 2005	136.4	49,700	SNS05-011	SNS	female	random	Apr. 14, 2005	R/V Funk	69,300
Apr. 18, 2005	130.8	58,300	PLS05-001	PLS	unknown	random	Apr. 19, 2005	R/V Brush	53,600
May 27, 2005	128.7	70,400	PLS05-001	PLS	unknown	random	May 31, 2005	R/V Brush	53,600

Table 4. Sturgeon relocations and nets targeted for mapping.—Continued

[ft^3/s, cubic feet per second; SNS, shovelnose sturgeon; PLS pallid sturgeon; --, no data]

Sturgeon relocation date	River mile of sturgeon re-location	Estimated discharge, sturgeon relocation date (ft^3/s)	Sturgeon identification code	Species	Sex	Selection method	Map date	Boat	Estimated discharge, map date (ft^3/s)
May 8, 2006	127.5	74,400	SNS06-012	SNS	female	random	May 09, 2006	R/V Brush	69,700
Apr. 25, 2005	127.1	92,700	PLS05-002	PLS	unknown	random	Apr. 26, 2005	R/V Brush	86,500
Apr. 4, 2005	120.5	45,100	PLS04-003	PLS	male	random	Apr. 5, 2005	R/V Brush	43,500
June 29, 2006	119.6	43,300	PLS06-001	PLS	male	random	June 30, 2006	R/V Brush	41,700
May 2, 2005	118.4	55,500	PLS04-003	PLS	unknown	random	May 03, 2005	R/V Brush	52,700
July 5, 2005	117.8	71,800	PLS04-003	PLS	unknown	random	July 06, 2005	R/V Brush	66,800
June 21, 2005	109.1	121,000	PLS05-001	PLS	unknown	random	Aug. 31, 2005	R/V Brush	90,600
July 5, 2005	109.1	71,800	PLS05-001	PLS	unknown	random	Aug. 31, 2005	R/V Brush	90,600
Aug. 22, 2005	109.0	58,000	PLS05-001	PLS	unknown	random	Aug. 31, 2005	R/V Brush	90,600
July 28, 2005	108.9	46,400	PLS05-001	PLS	unknown	random	Aug. 31, 2005	R/V Brush	90,600
July 6, 2005	75.7	67,400	PLS05-004	PLS	unknown	random	July 07, 2005	R/V Brush	70,600
July 7, 2005	27.3	68,500	SNS05-017	SNS	unknown	random	July 08, 2005	R/V Brush	71,800

submeter scale, utilizing differential global positioning system (DGPS) data for most survey dates and real-time kinematic global positioning system for a few surveys. Data processing included removal of spurious data points, digitization of data extent, and interpolation of data to grids with 5-meter cell resolution.

The maps depict depth, velocity, and substrate conditions dependent on the discharge and channel morphology at the time of mapping. Collectively, the maps represent more than 20 percent of the length of the Lower Missouri River. This extensive set of maps is intended to provide better understanding of physical aquatic habitat use by sturgeon in the Lower Missouri River.

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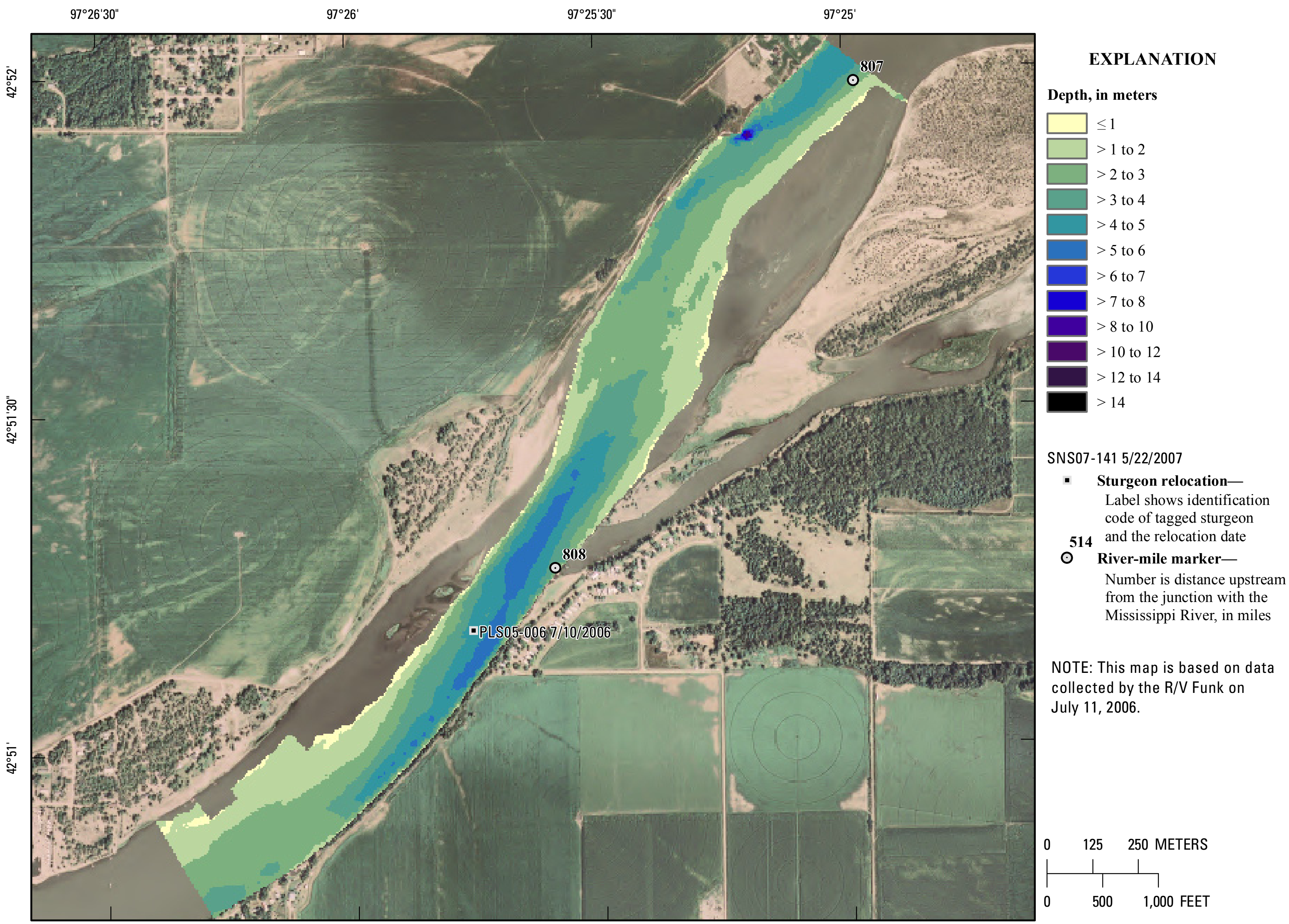
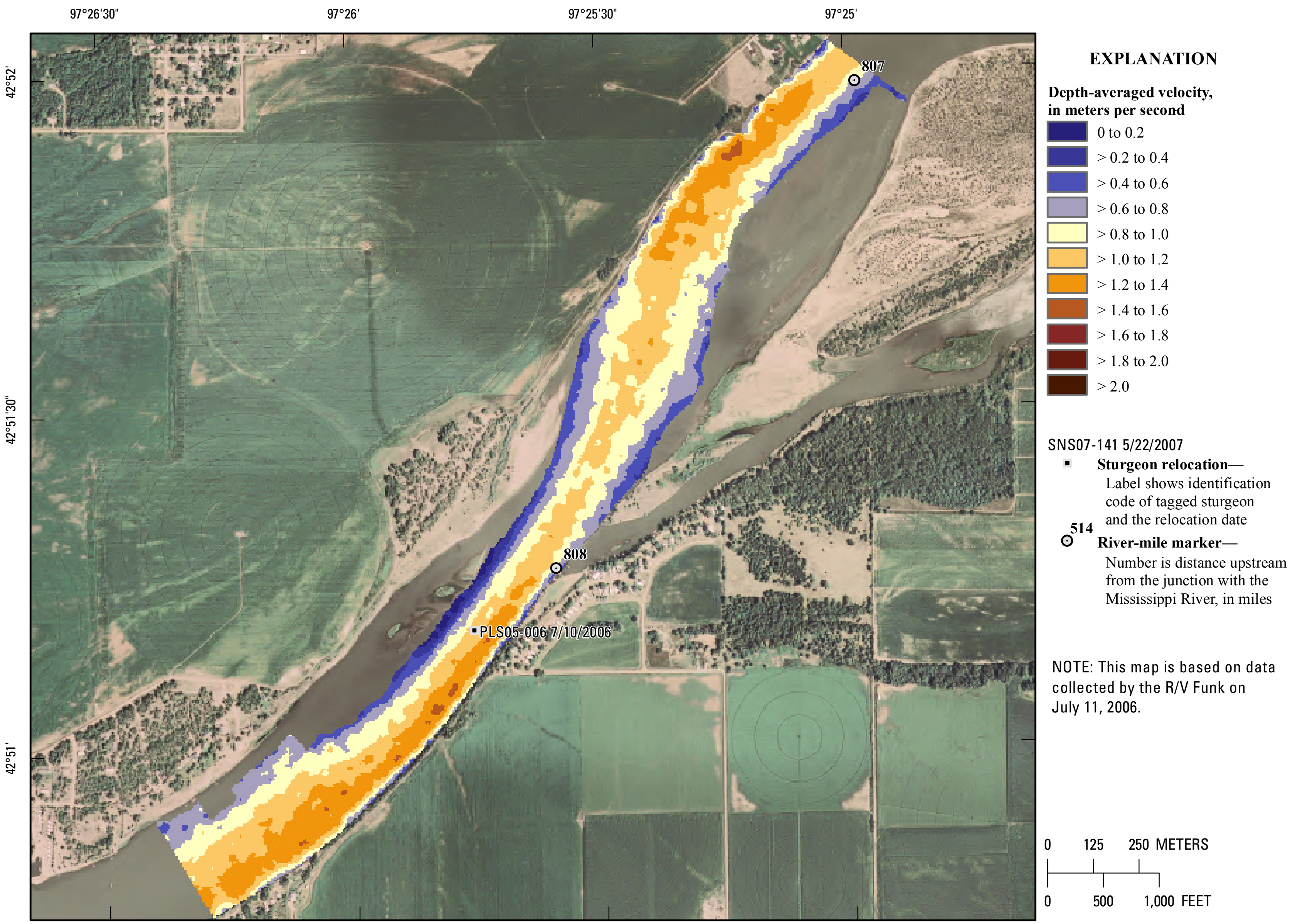


Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 8. Map of depth based on data collected on July 11, 2006, in the vicinity of river mile 808.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 9. Map of depth-averaged velocity based on data collected on July 11, 2006, in the vicinity of river mile 808.

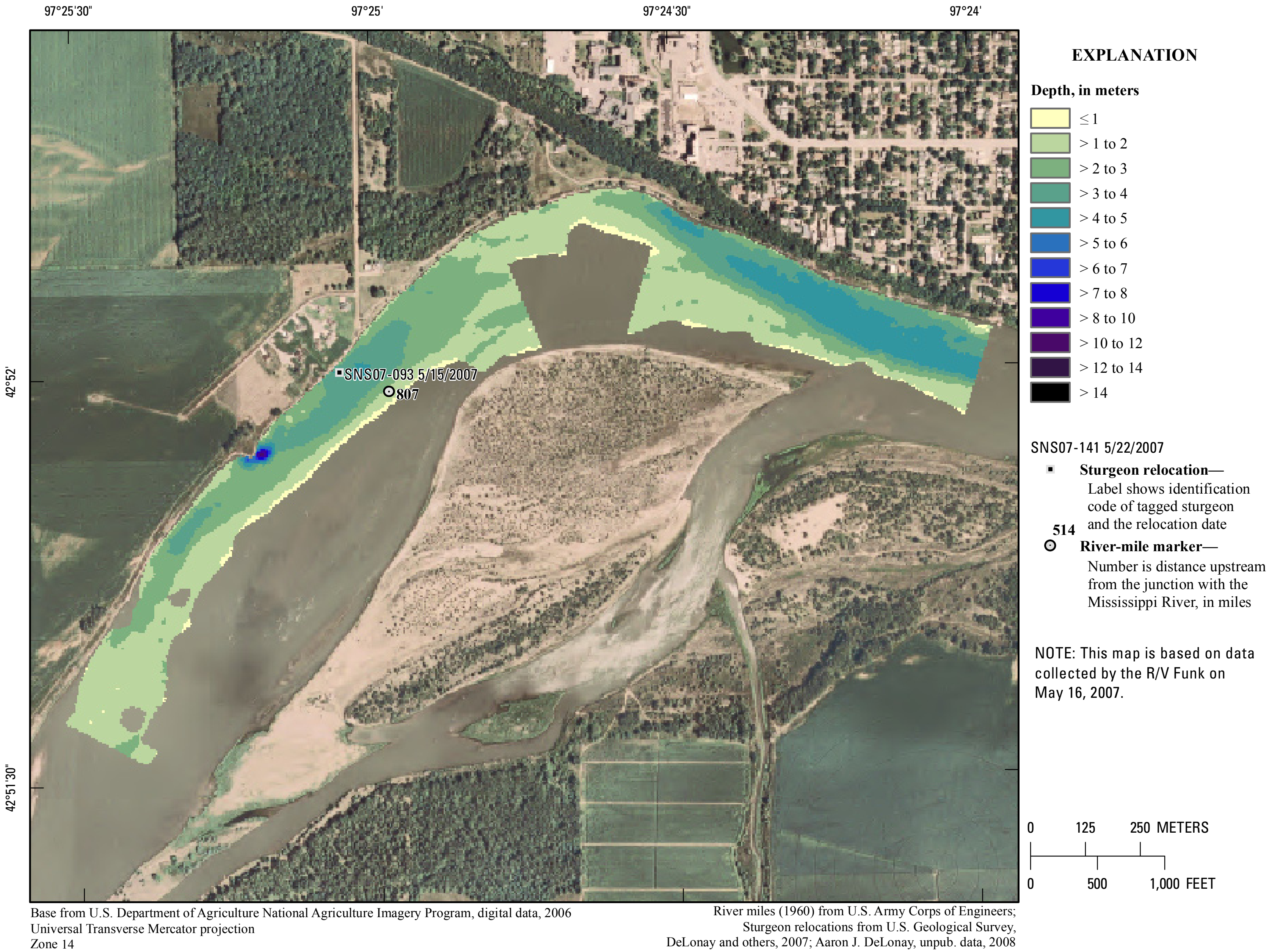


Figure 10. Map of depth based on data collected on May 16, 2007, in the vicinity of river mile 807.

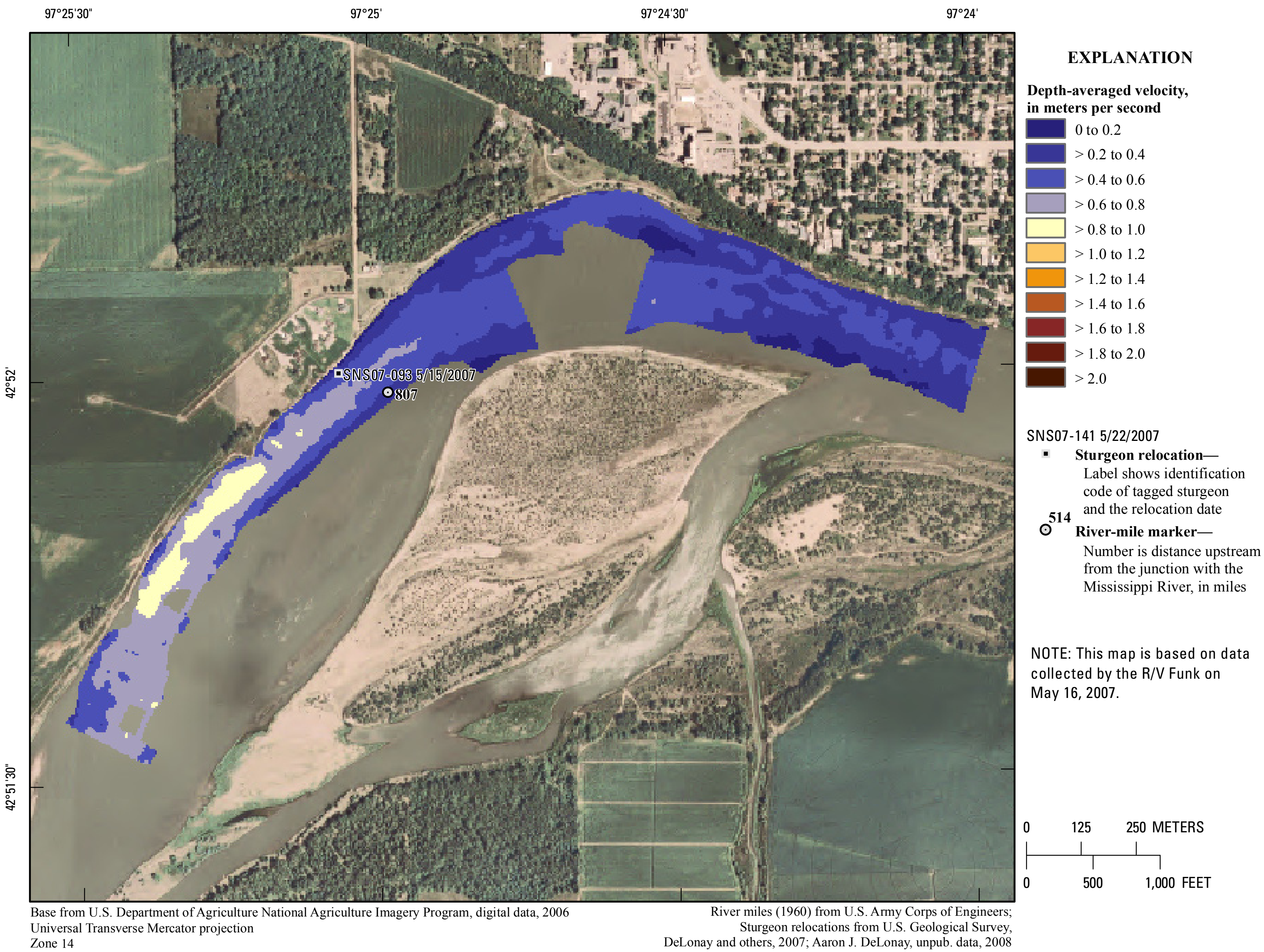


Figure 11. Map of depth-averaged velocity based on data collected on May 16, 2007, in the vicinity of river mile 807.

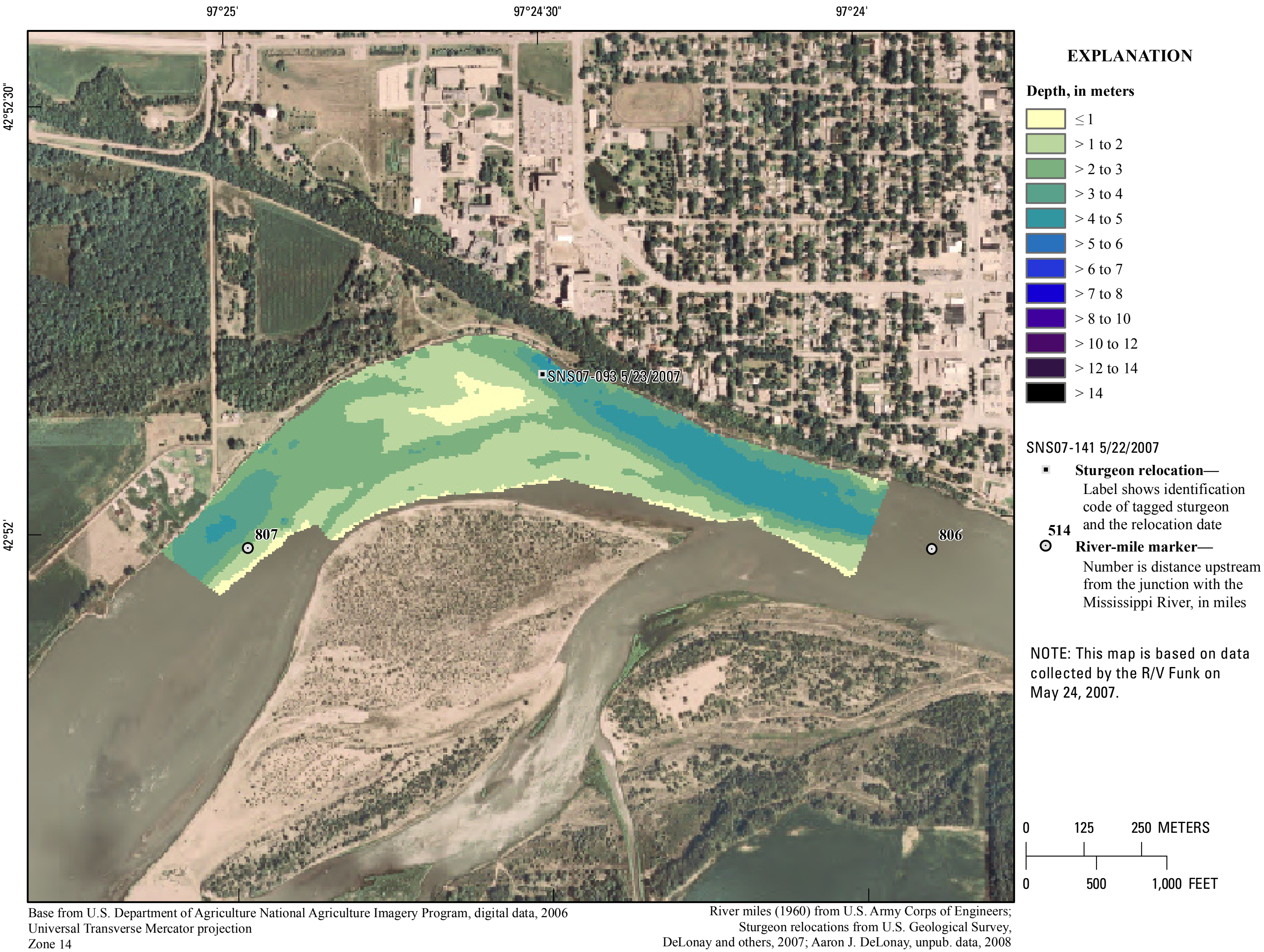
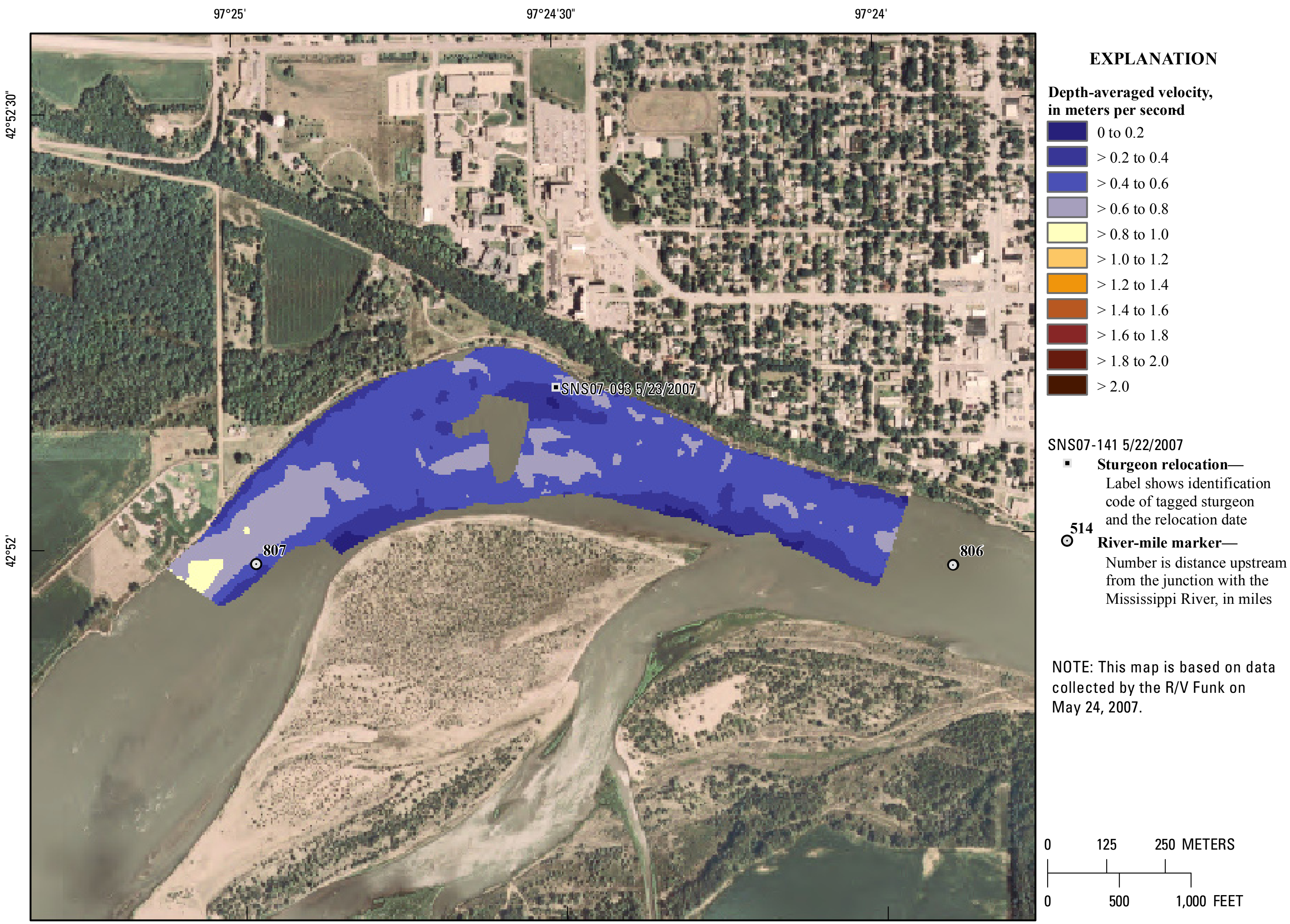


Figure 12. Map of depth based on data collected on May 24, 2007, in the vicinity of river mile 807.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 13. Map of depth-averaged velocity based on data collected on May 24, 2007, in the vicinity of river mile 807.

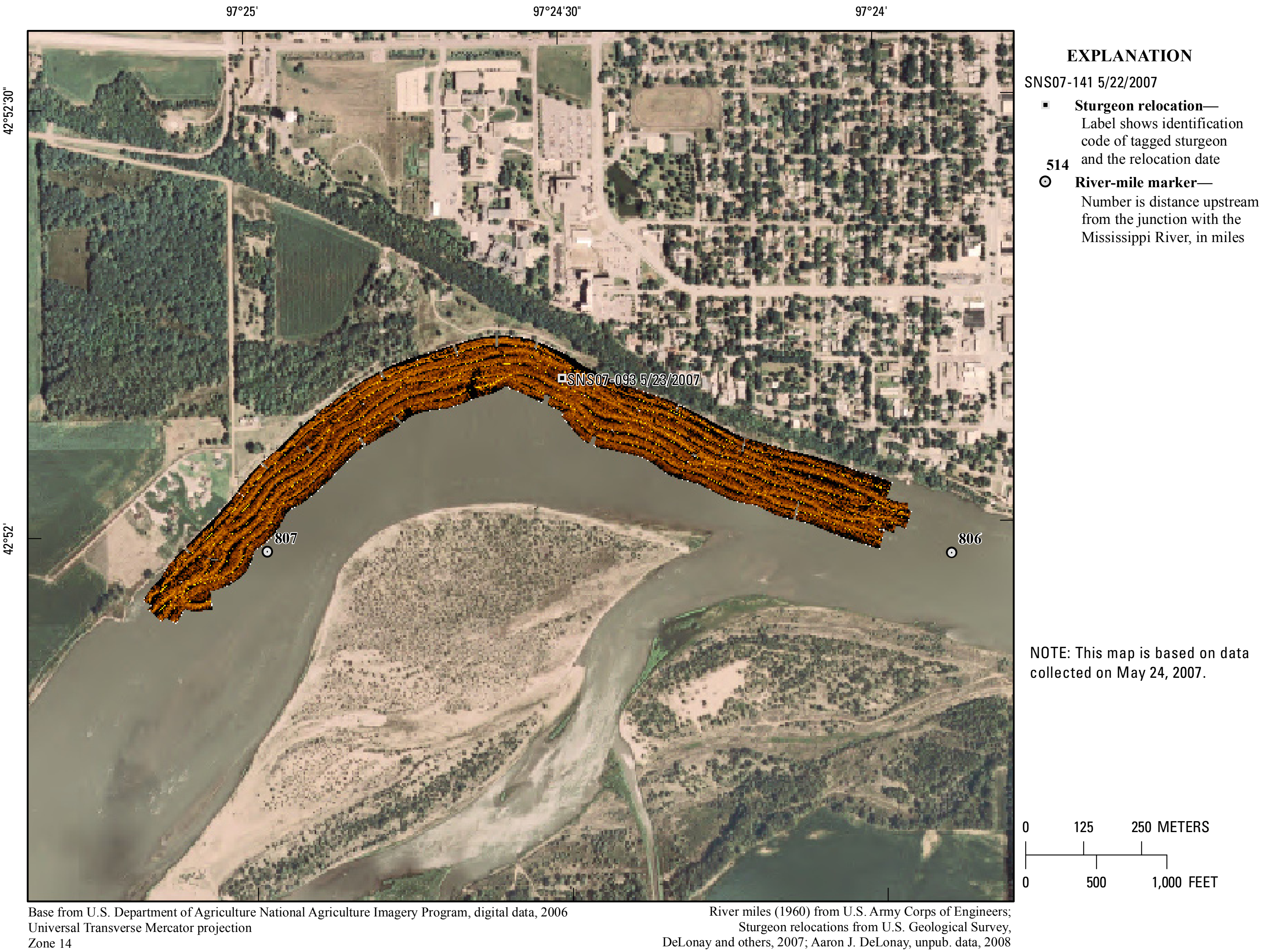
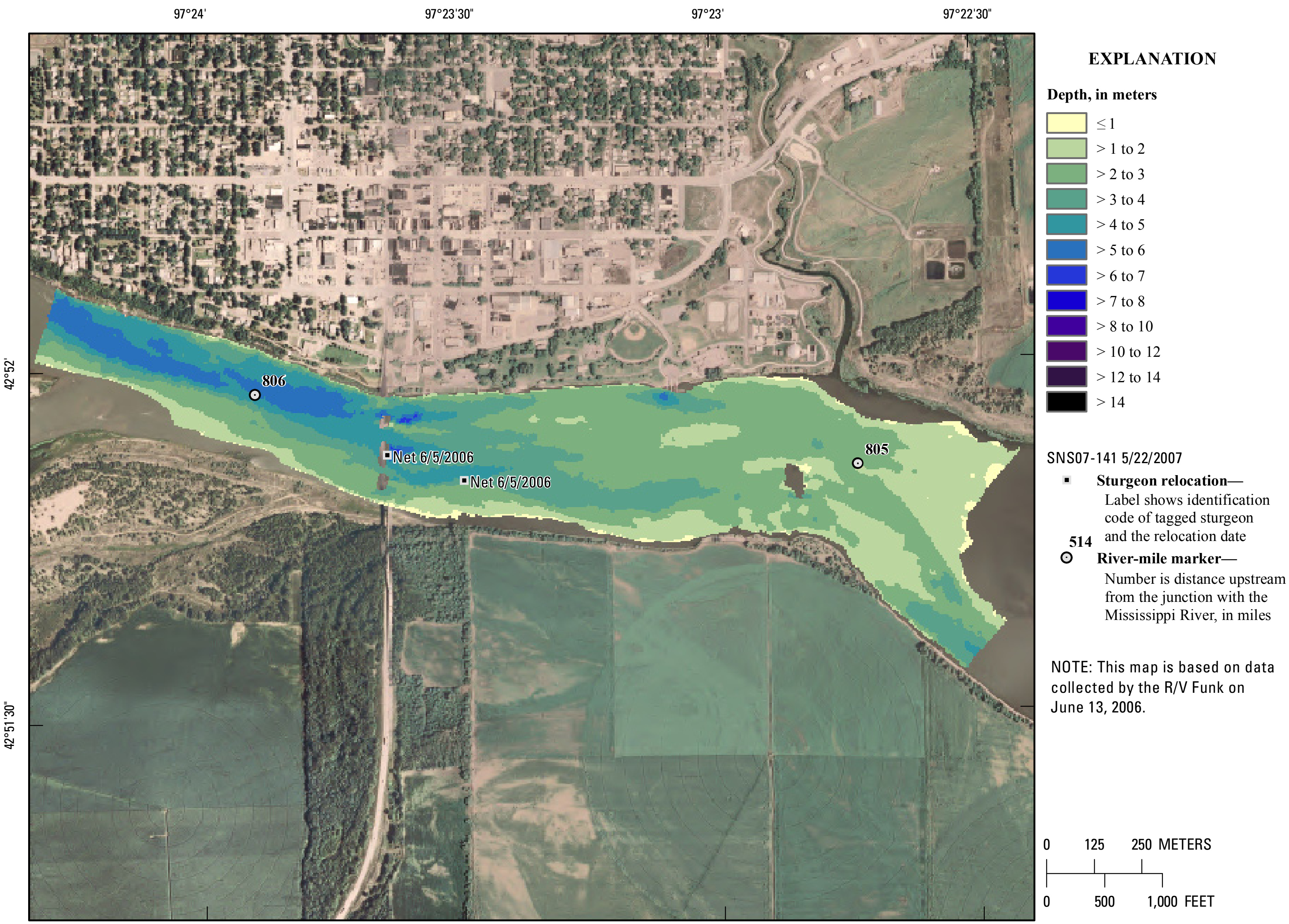


Figure 14. Map of side-scan sonar imagery based on data collected on May 24, 2007, in the vicinity of river mile 807.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 15. Map of depth based on data collected on June 13, 2006, in the vicinity of river mile 805. The target location for this survey was a drifted trammel net. The two points indicate starting (upstream) and stopping (downstream) positions.

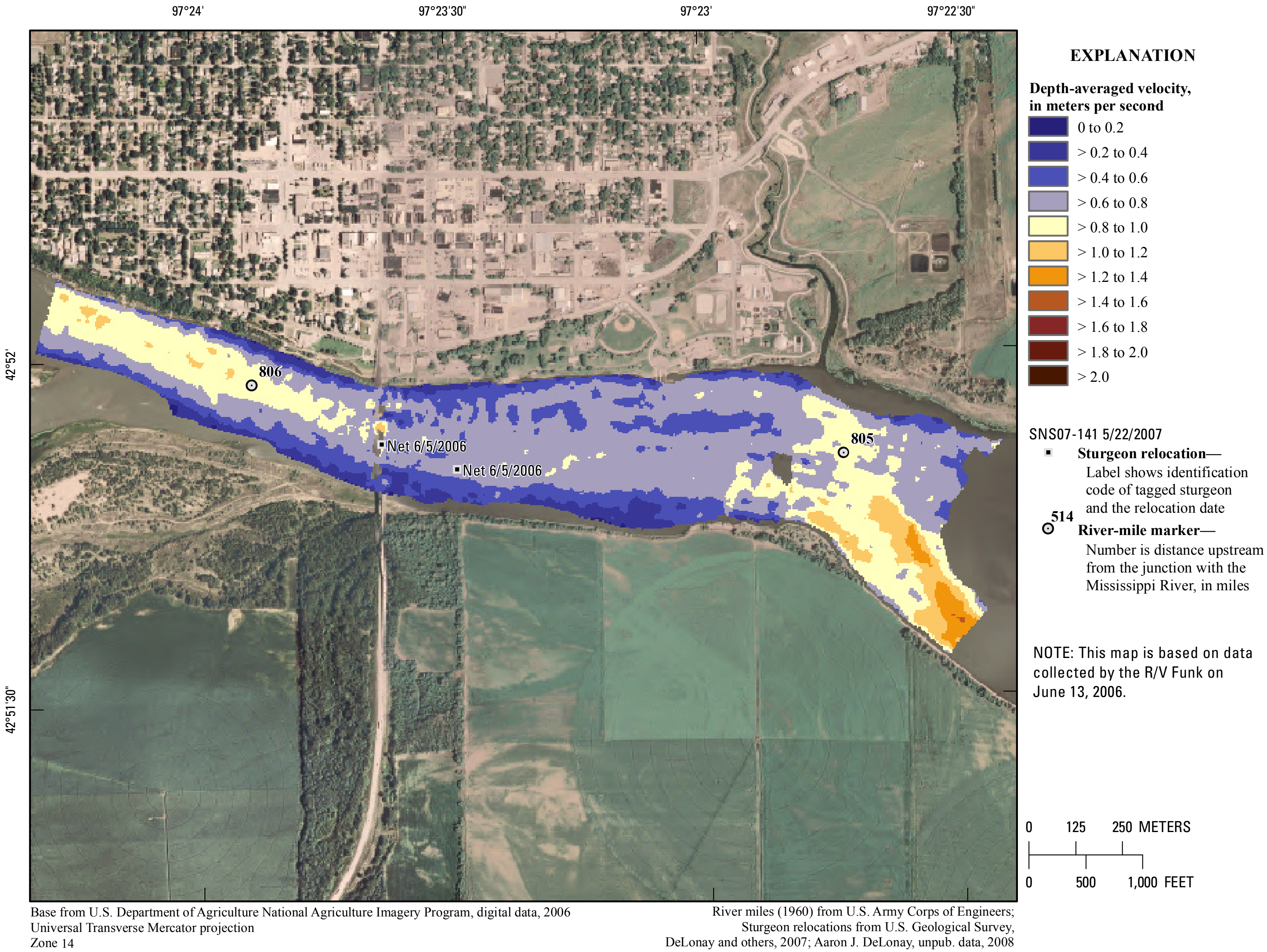


Figure 16. Map of depth-averaged velocity based on data collected on June 13, 2006, in the vicinity of river mile 805. The target location for this survey was a drifted trammel net. The two points indicate starting (upstream) and stopping (downstream) positions.

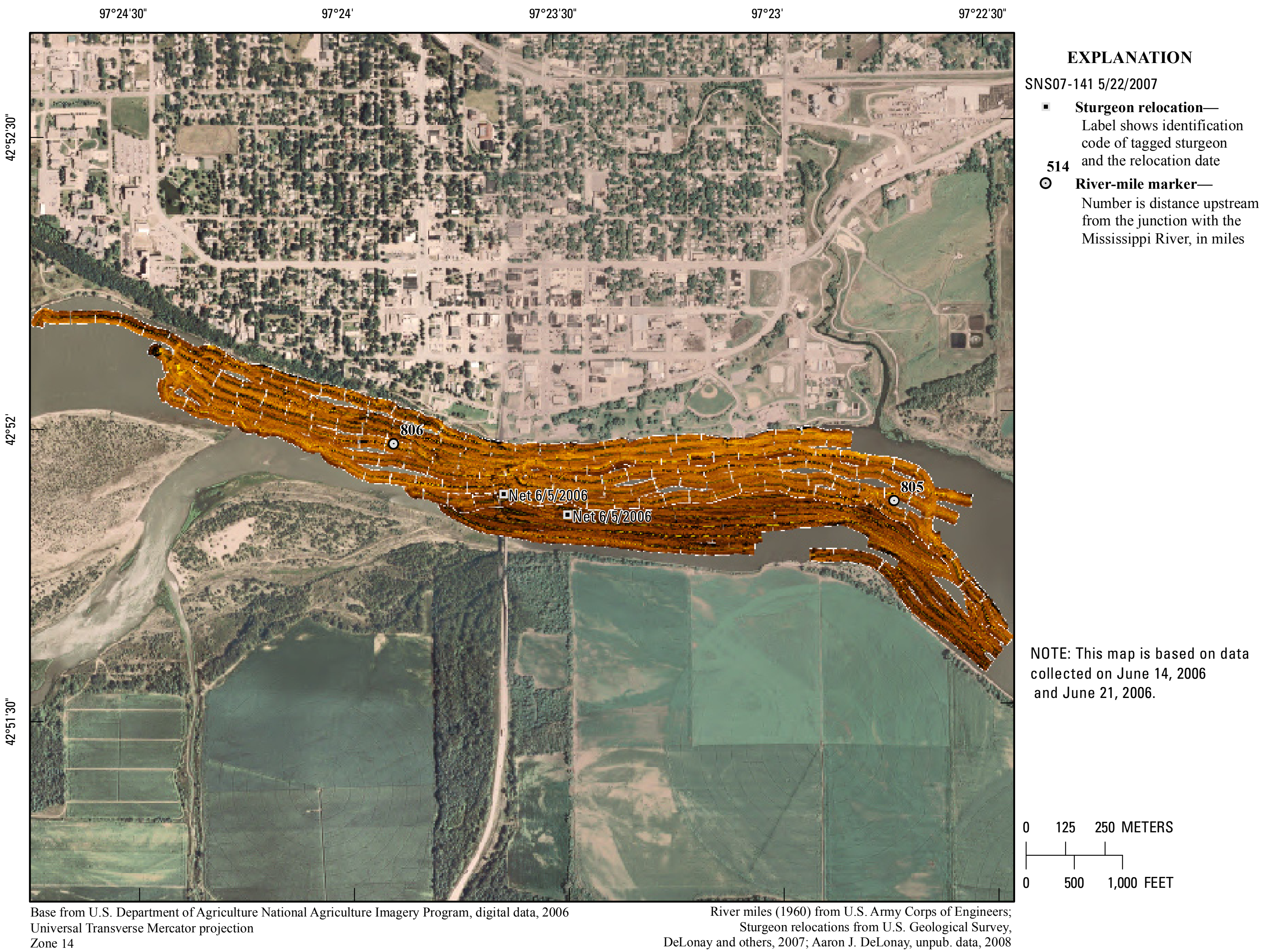
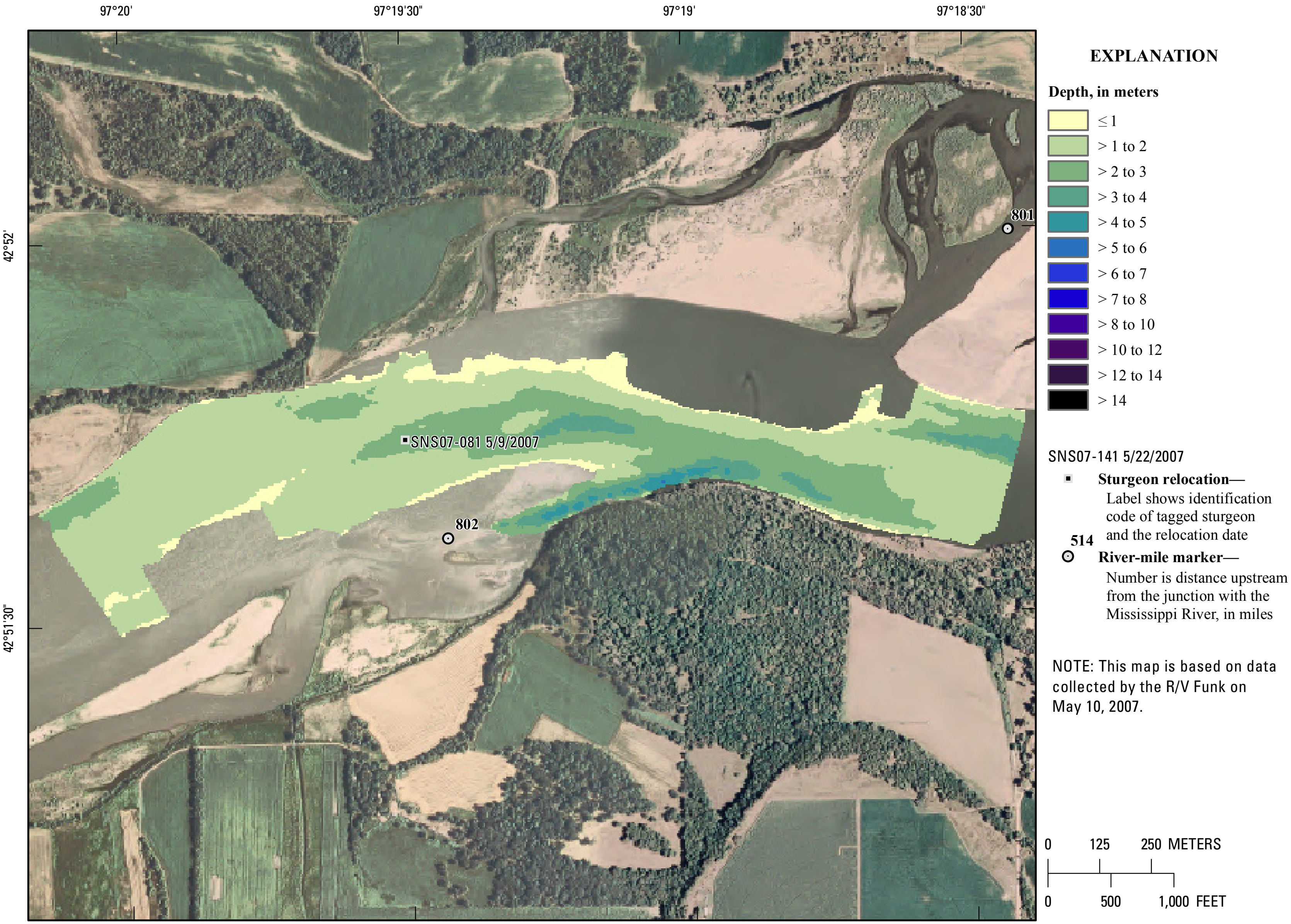


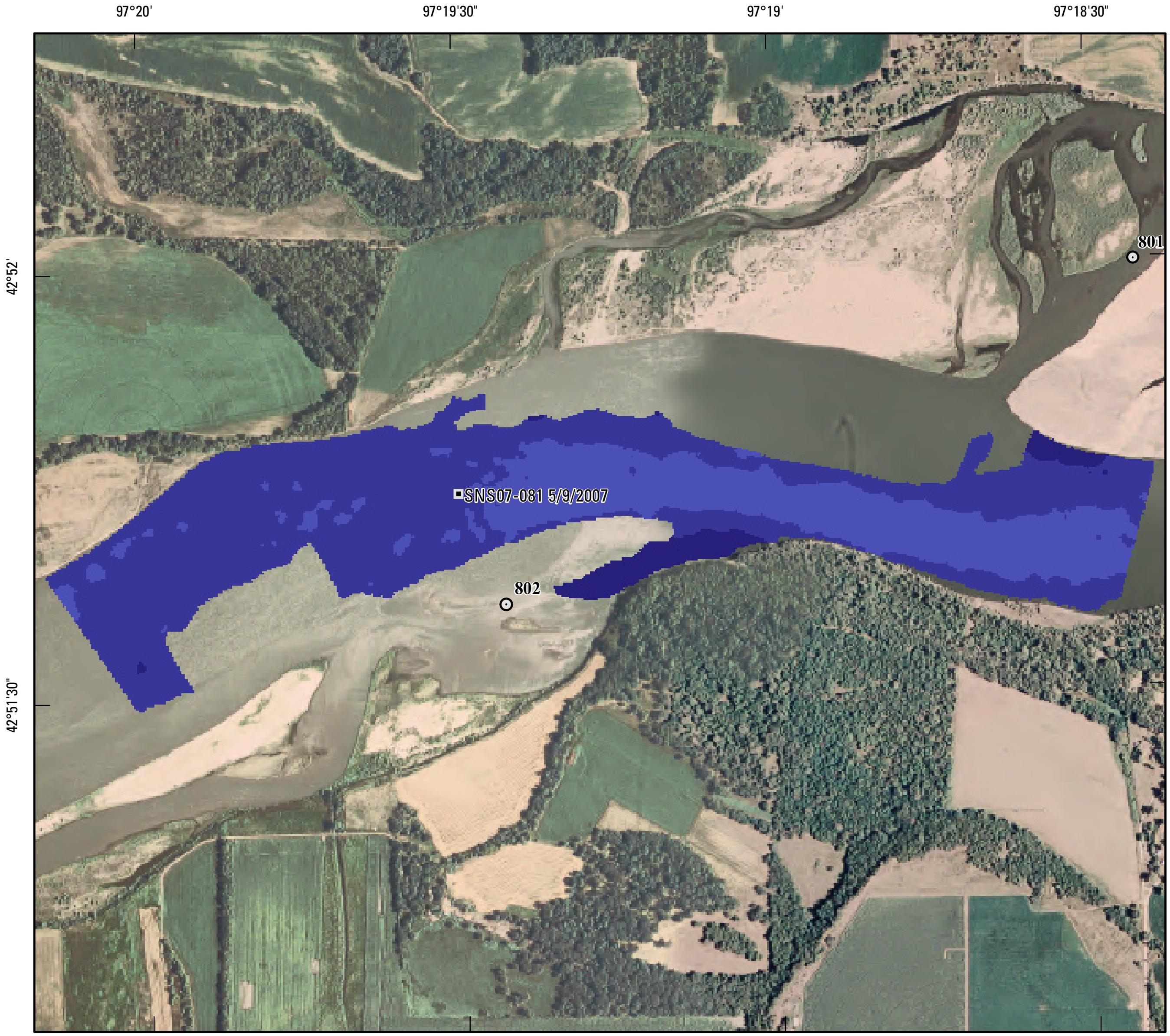
Figure 17. Map of side-scan sonar imagery based on data collected on June 14, 2006, and June 21,2006, in the vicinity of river mile 805.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 18. Map of depth based on data collected on May 10, 2007, in the vicinity of river mile 802.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 10, 2007.

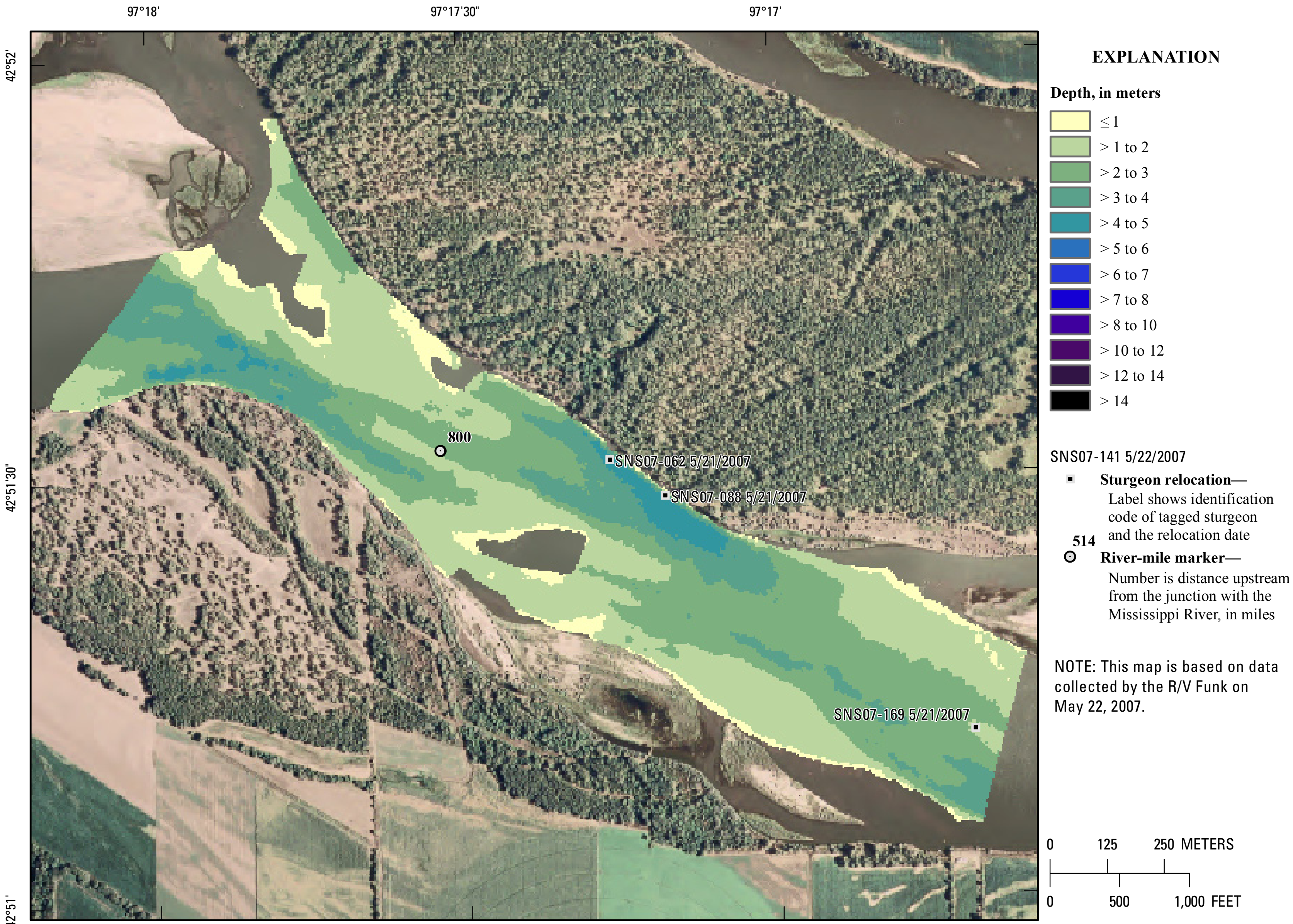
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

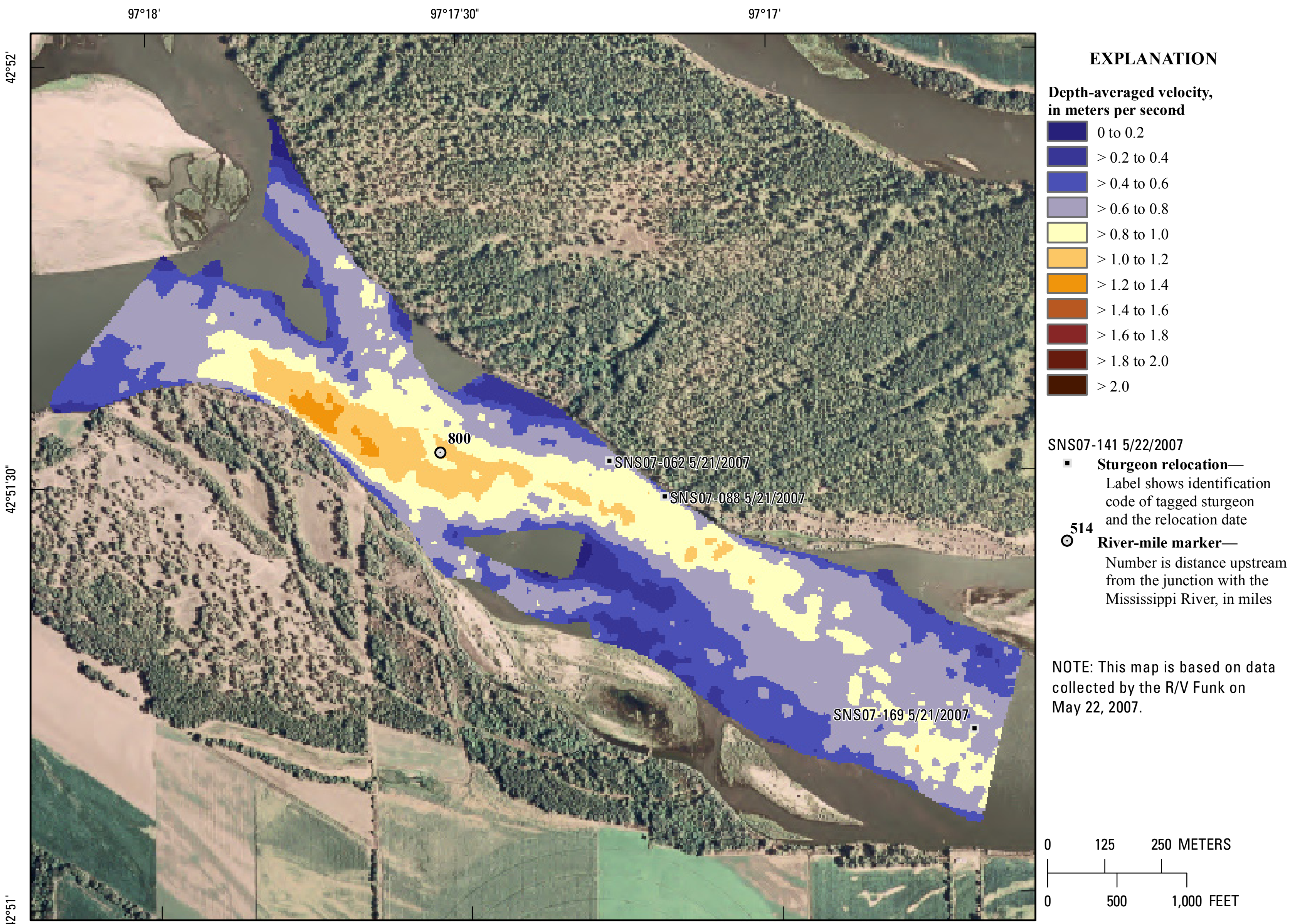
Figure 19. Map of depth-averaged velocity based on data collected on May 10, 2007, in the vicinity of river mile 802.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

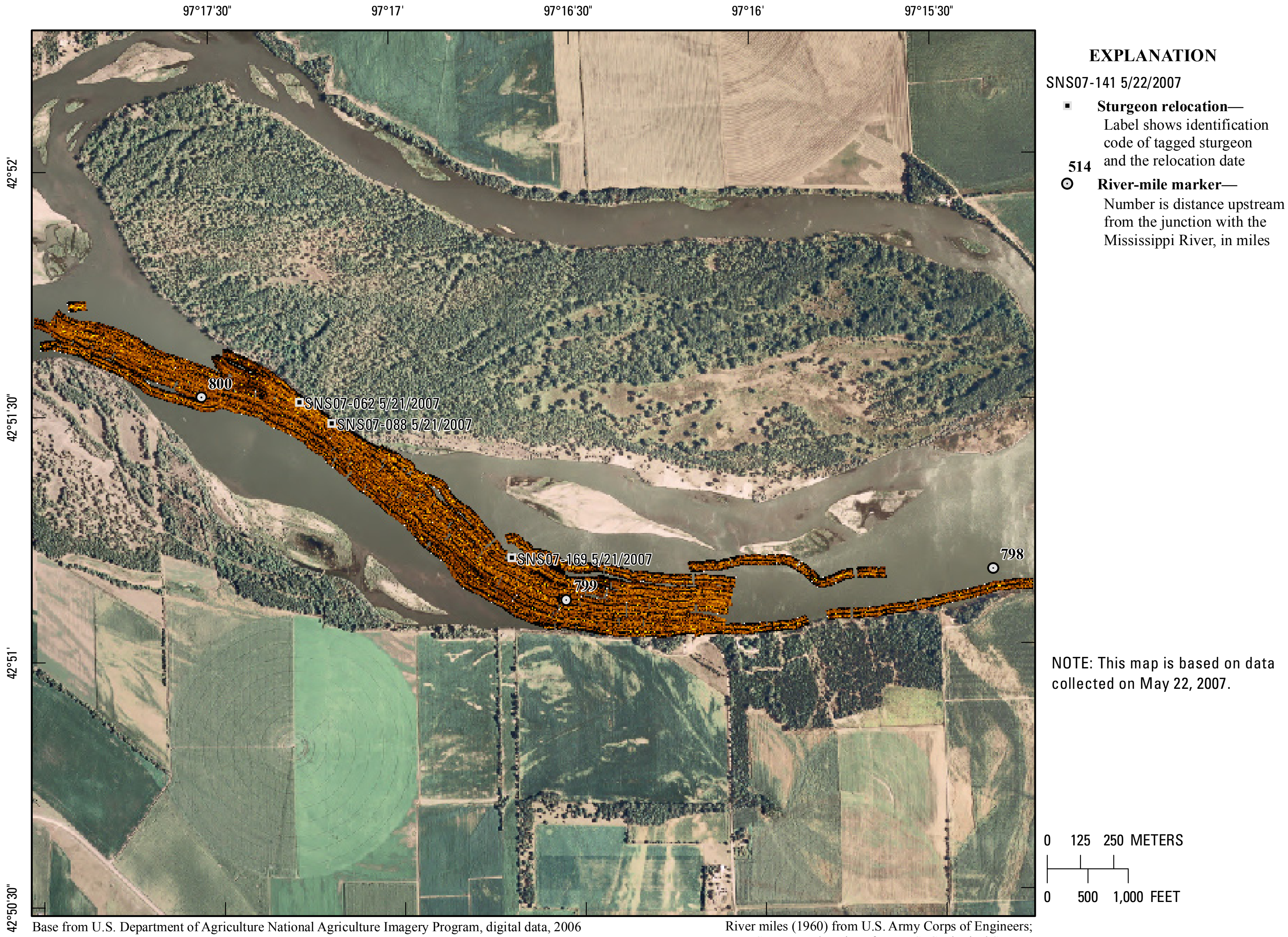
Figure 20. Map of depth based on data collected on May 22, 2007, in the vicinity of river mile 800.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

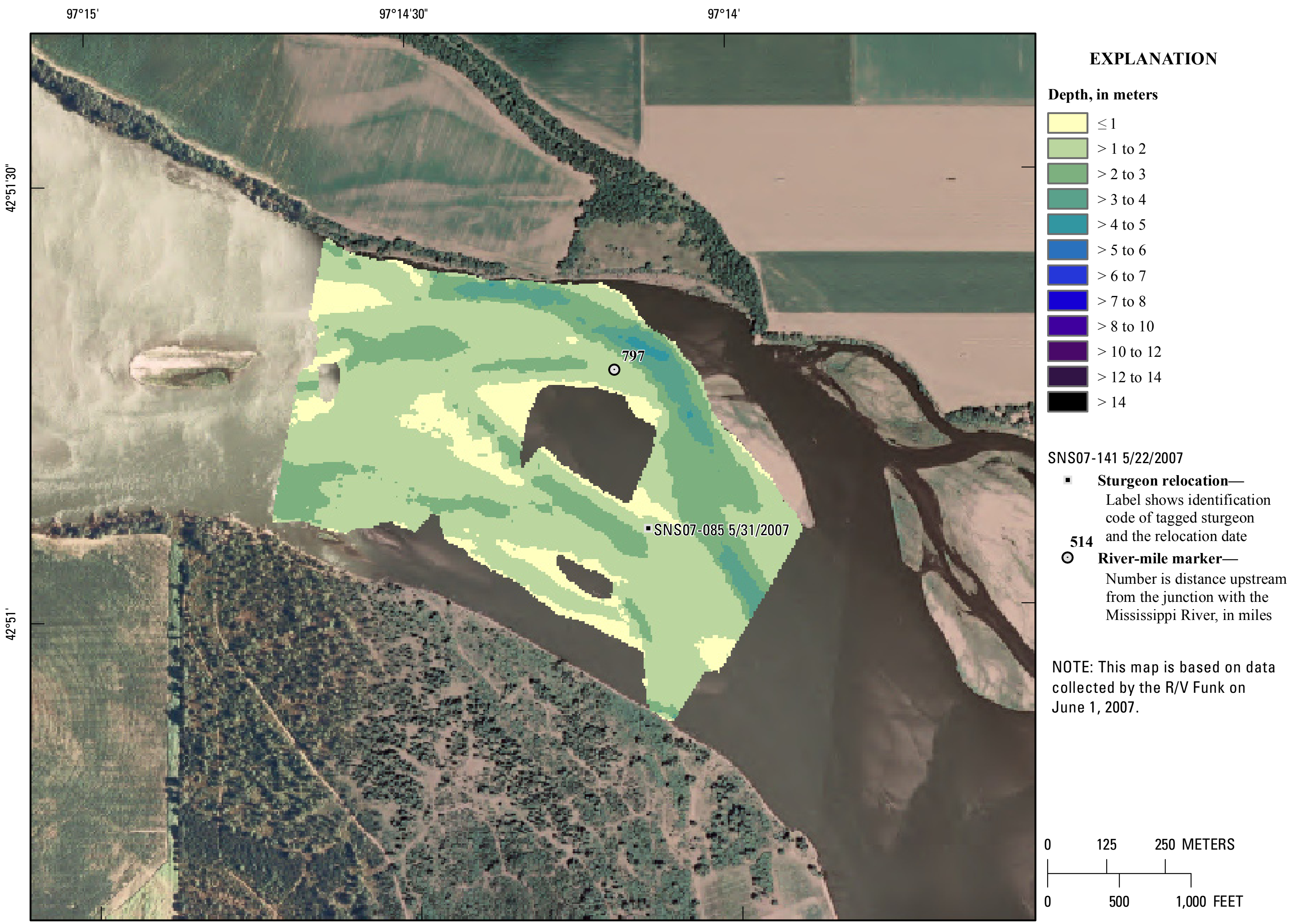
Figure 21. Map of depth-averaged velocity based on data collected on May 22, 2007, in the vicinity of river mile 800.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 22. Map of side-scan sonar imagery based on data collected on May 22, 2007, in the vicinity of river mile 800.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 23. Map of depth based on data collected on June 1, 2007, in the vicinity of river mile 797.

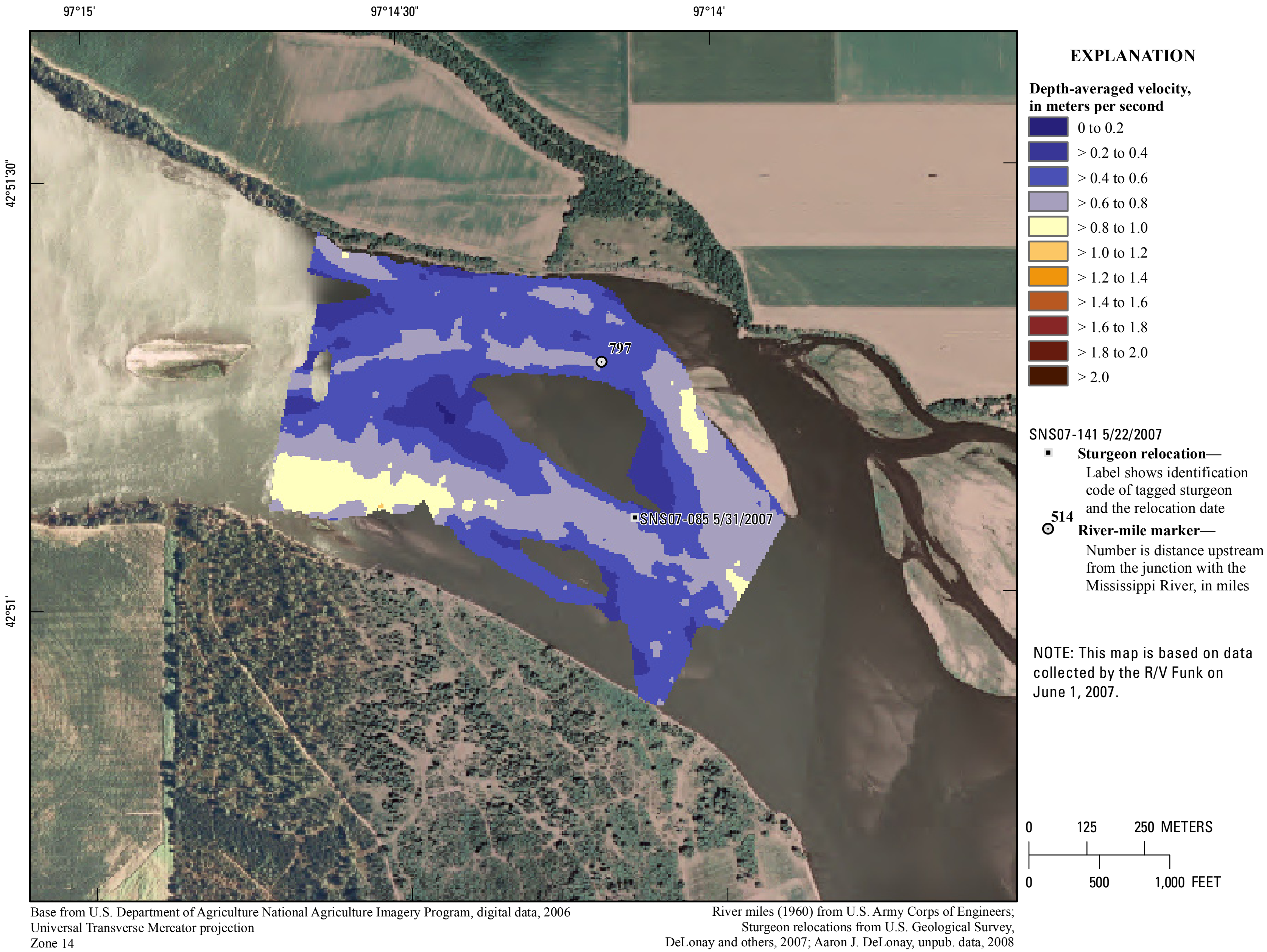
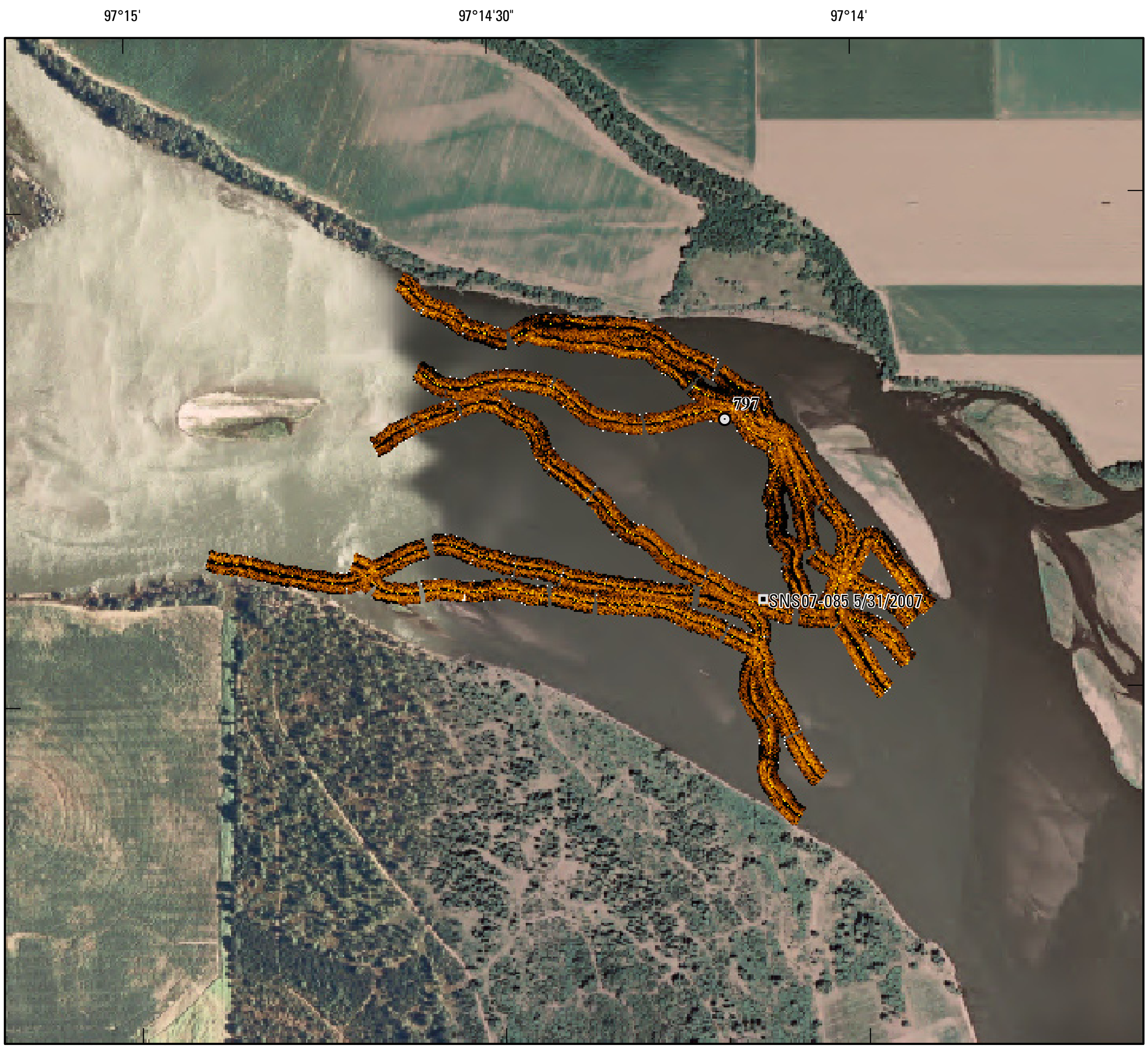


Figure 24. Map of depth-averaged velocity based on data collected on June 1, 2007, in the vicinity of river mile 797.



EXPLANATION

SNS07-141 5/22/2007 ▪ **Sturgeon relocation**—Label shows identification code of tagged sturgeon and the relocation date

514 ⊙ **River-mile marker**—Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected on June 1, 2007.

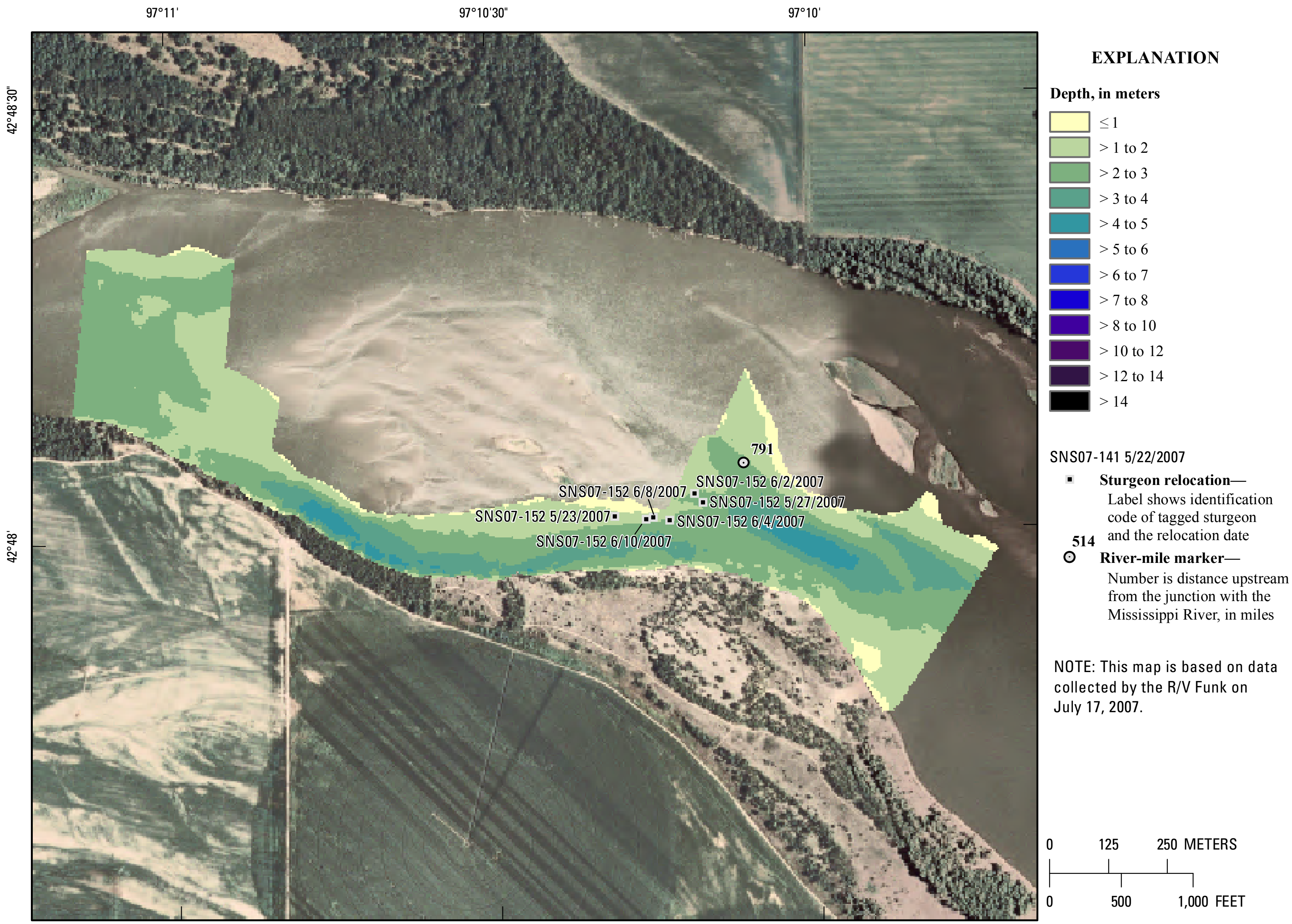
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

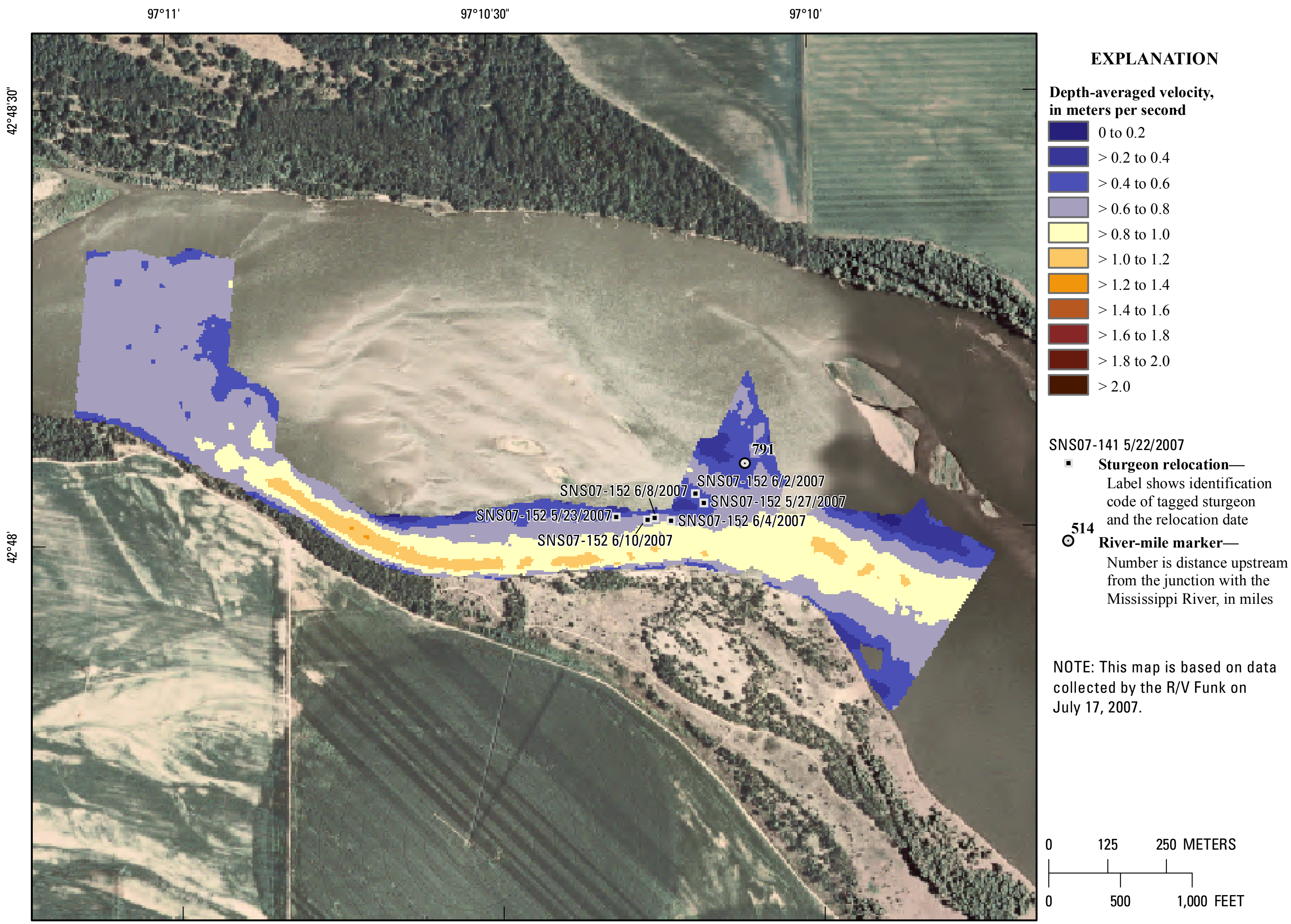
Figure 25. Map of side-scan sonar imagery based on data collected on June 1, 2007, in the vicinity of river mile 797.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

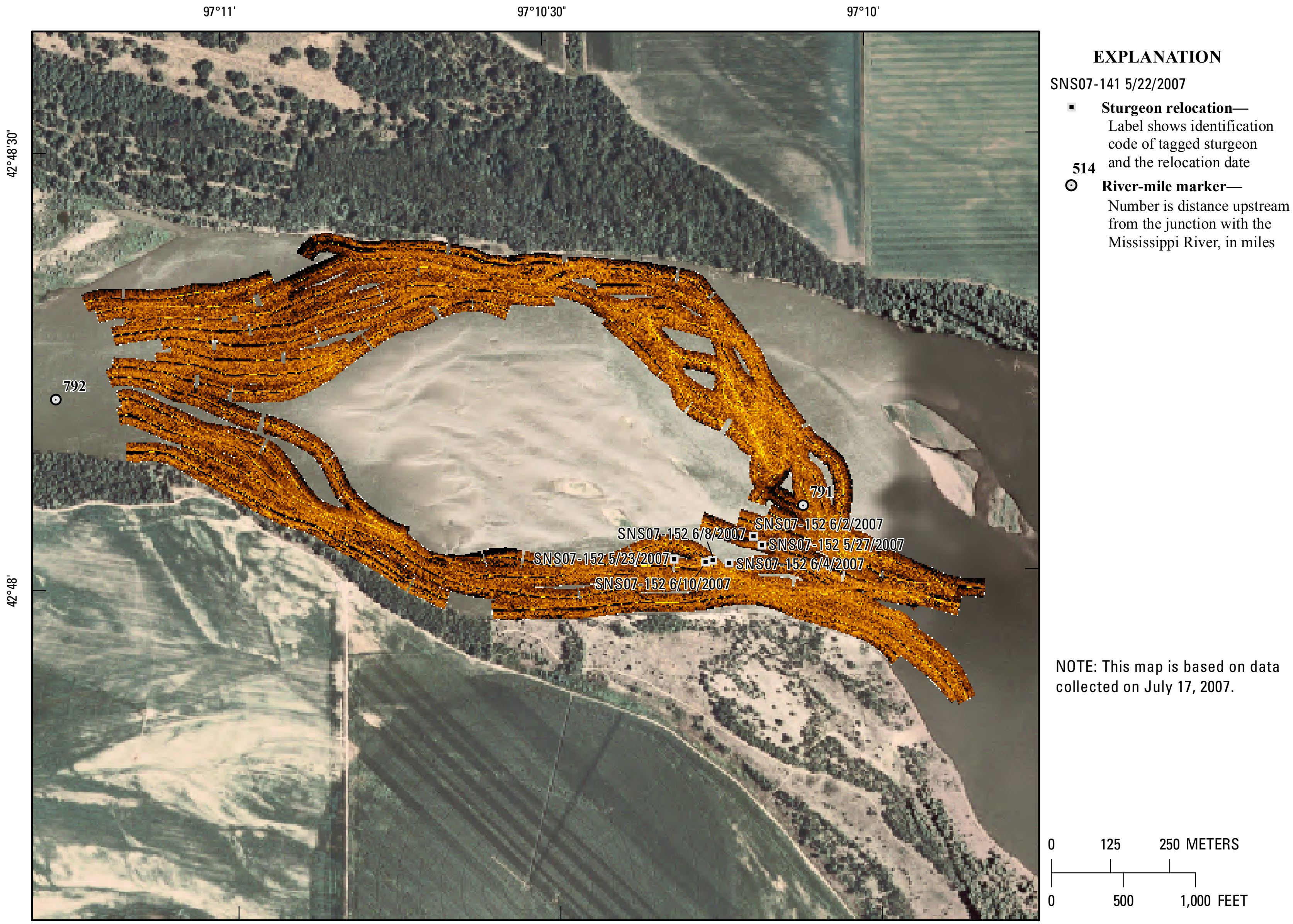
Figure 26. Map of depth based on data collected on July 17, 2007, in the vicinity of river mile 791.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

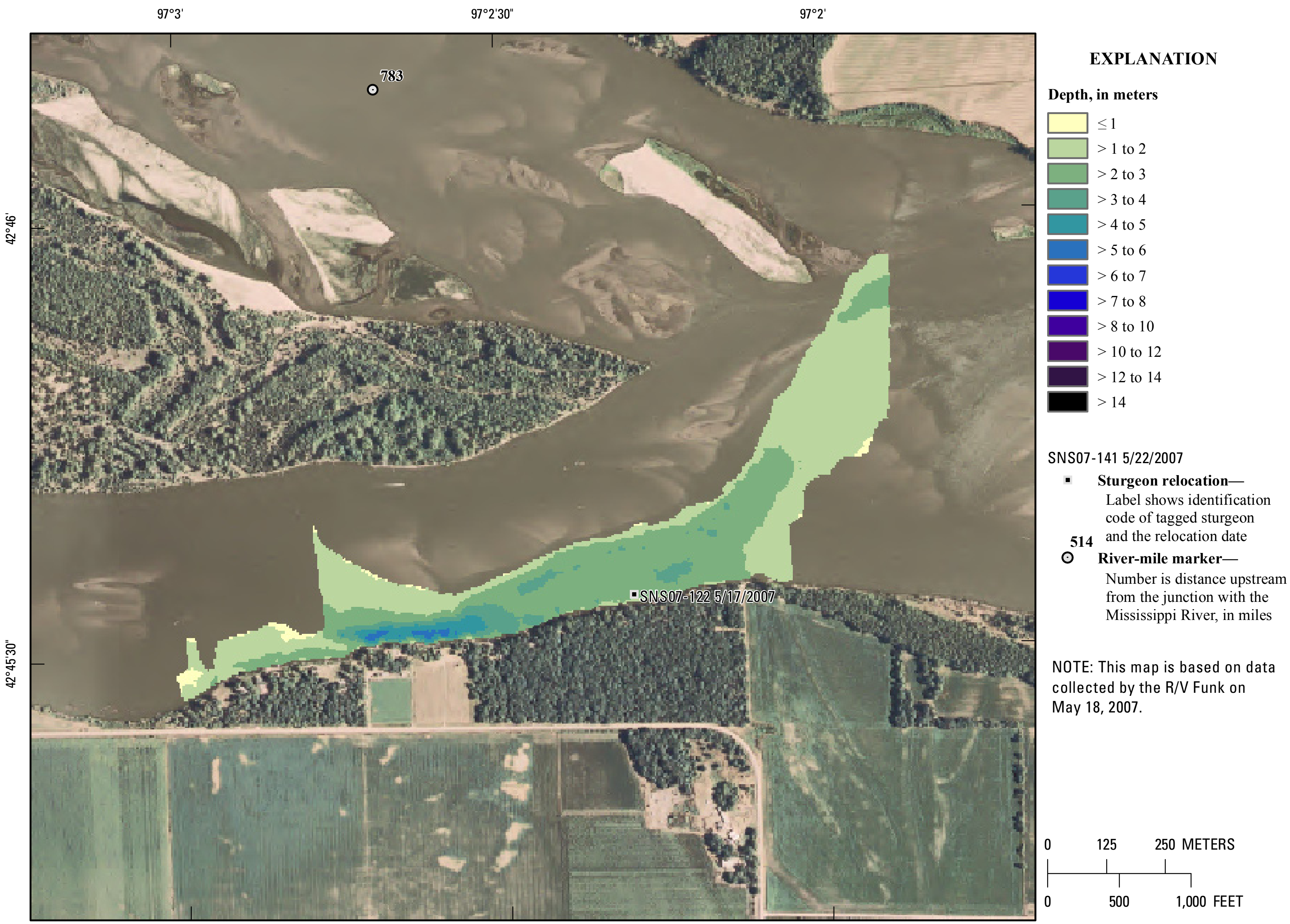
Figure 27. Map of depth-averaged velocity based on data collected on July 17, 2007, in the vicinity of river mile 791.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

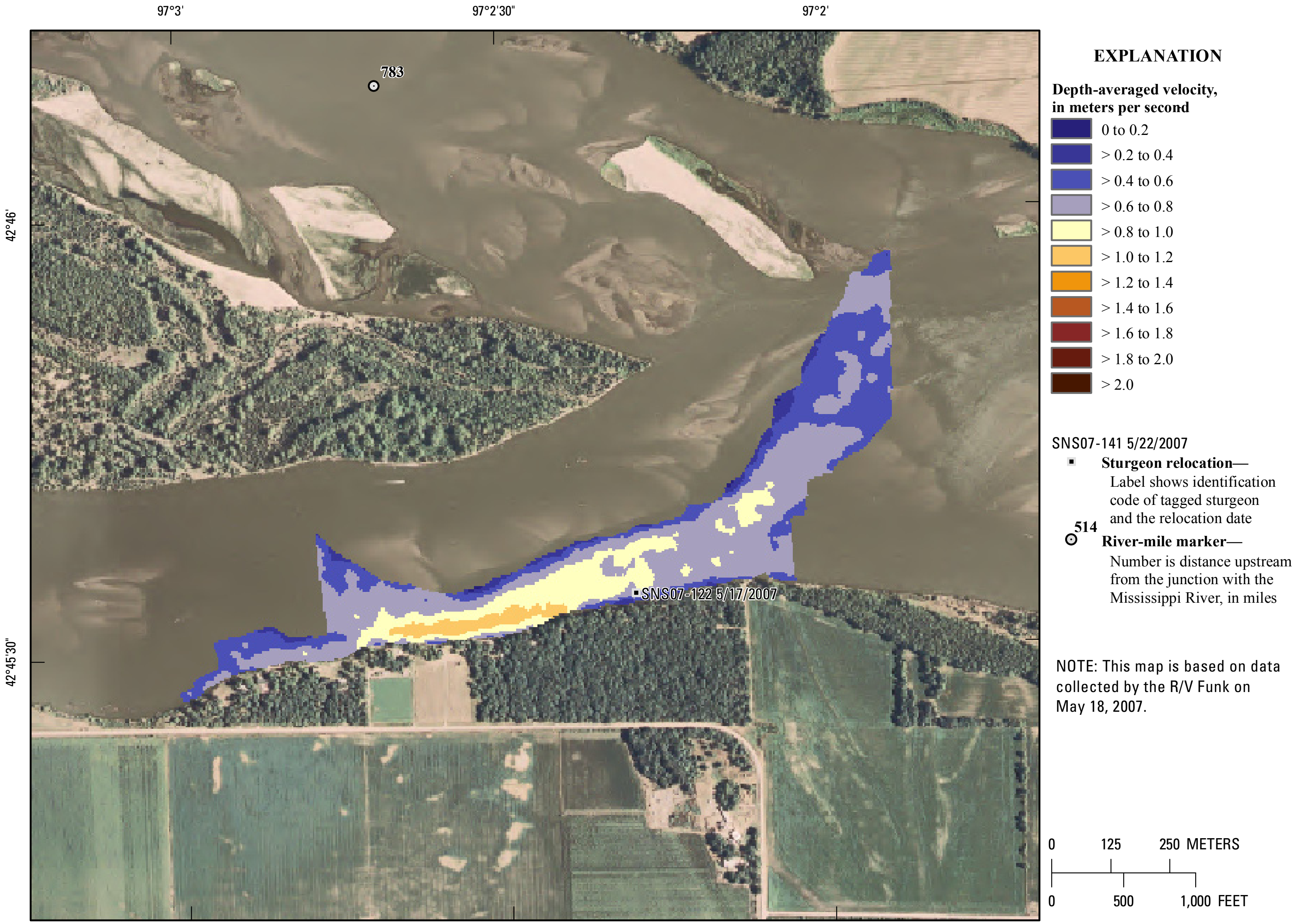
Figure 28. Map of side-scan sonar imagery based on data collected on July 17, 2007, in the vicinity of river mile 791.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

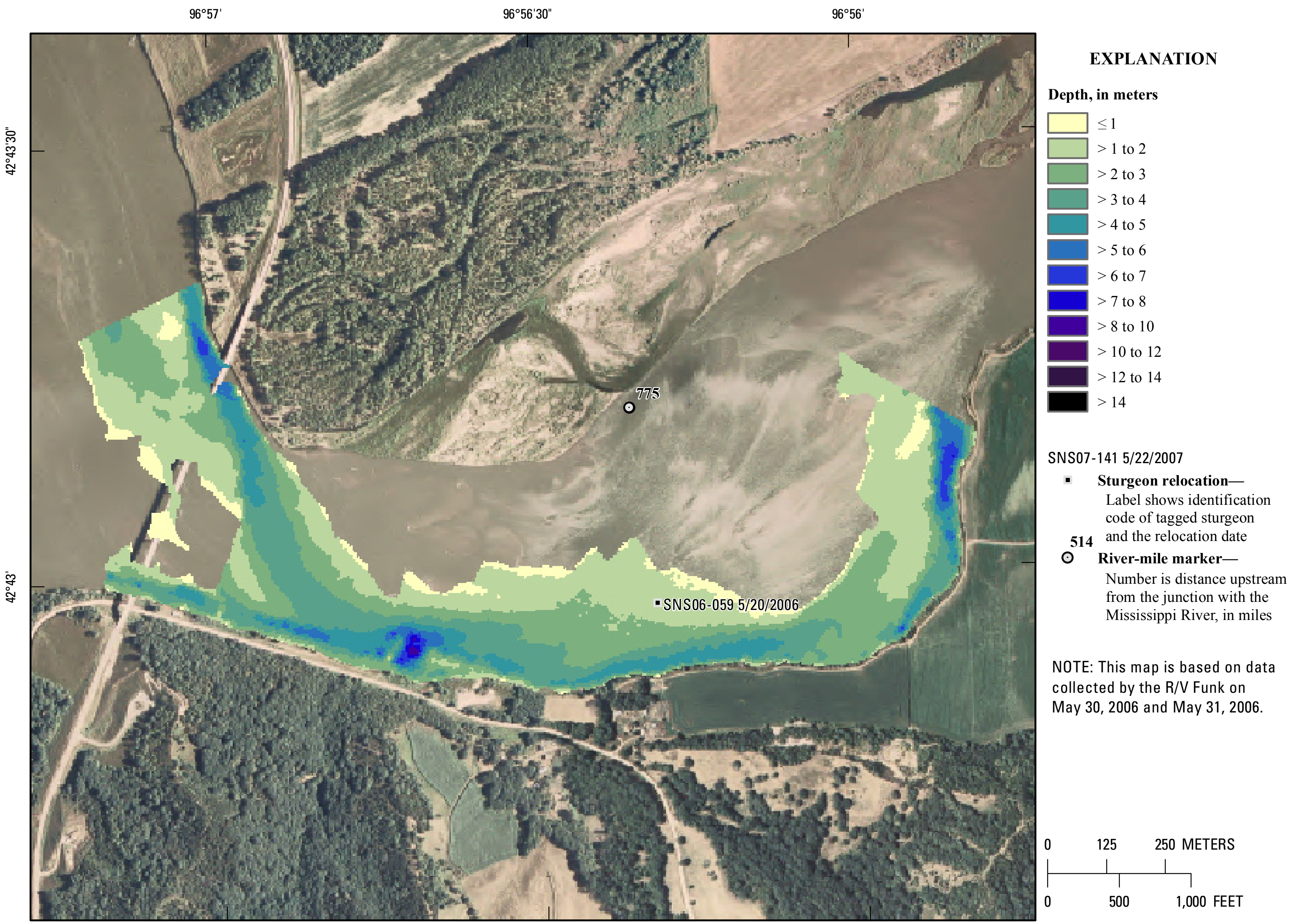
Figure 29. Map of depth based on data collected on May 18, 2007, in the vicinity of river mile 783.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

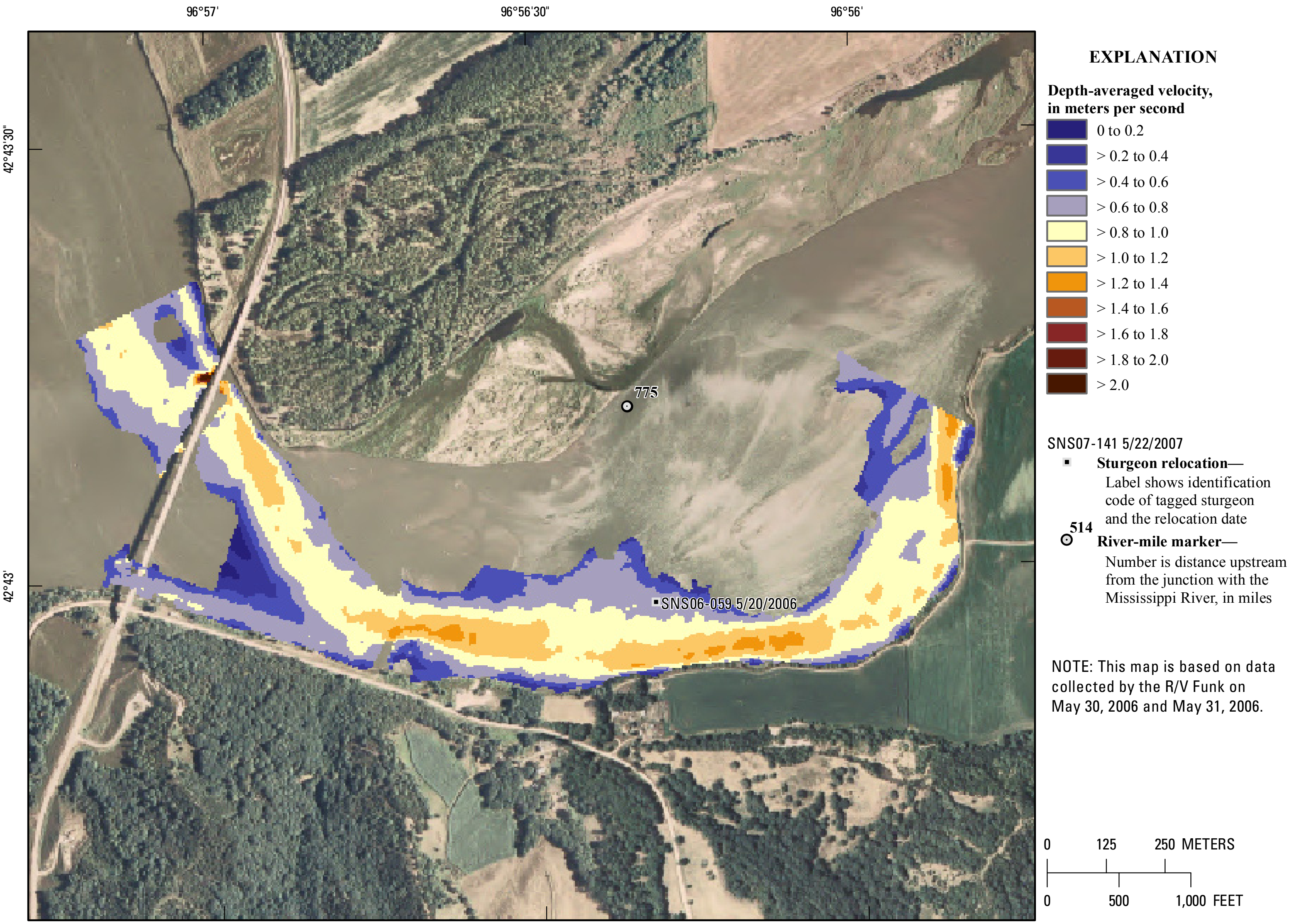
Figure 30. Map of depth-averaged velocity based on data collected on May 18, 2007, in the vicinity of river mile 783.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 31. Map of depth based on data collected on May 30, 2006, and May 31, 2006, in the vicinity of river mile 775.

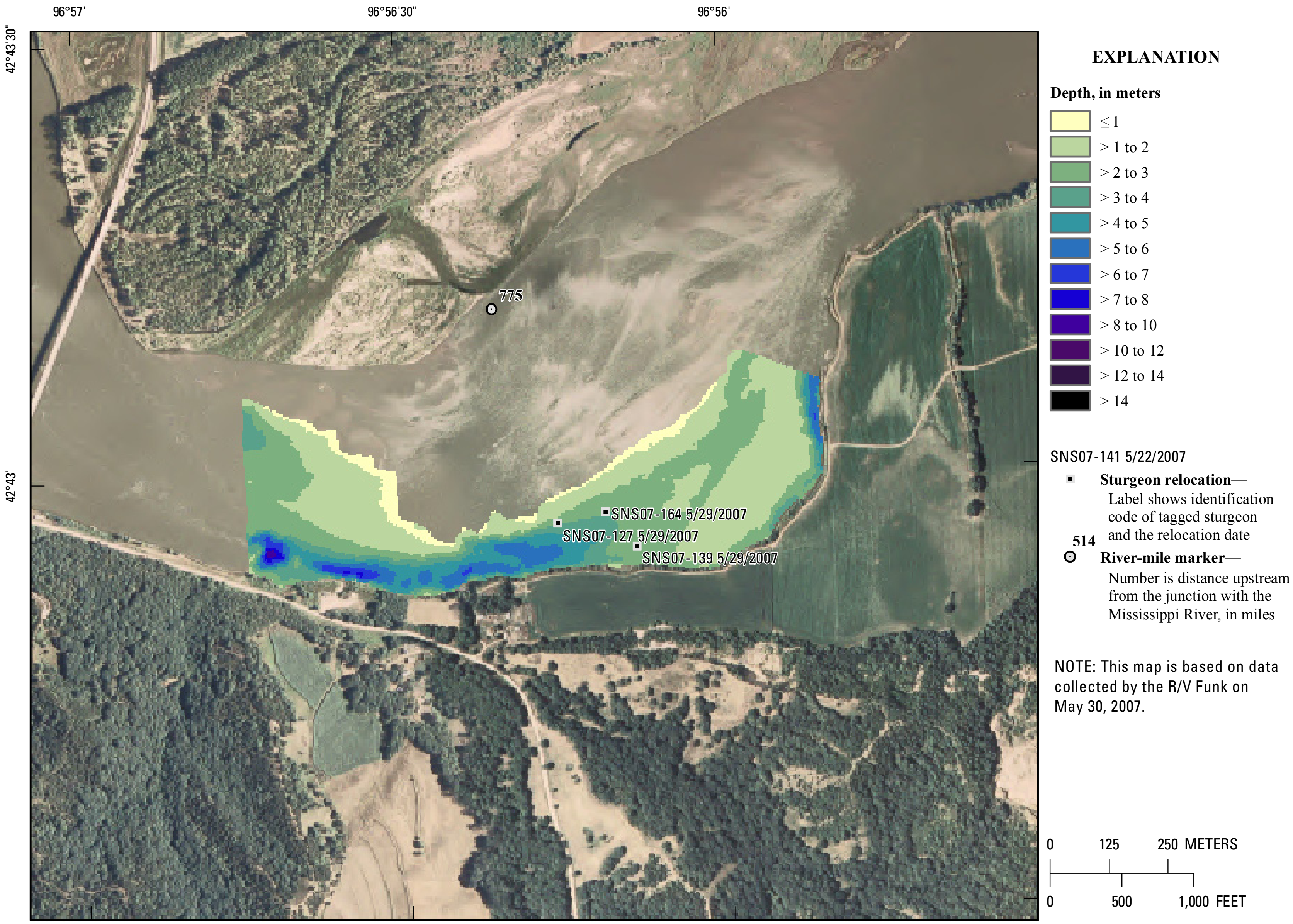


Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 32. Map of depth-averaged velocity based on data collected on May 30, 2006, and May 31, 2006, in the vicinity of river mile 775.

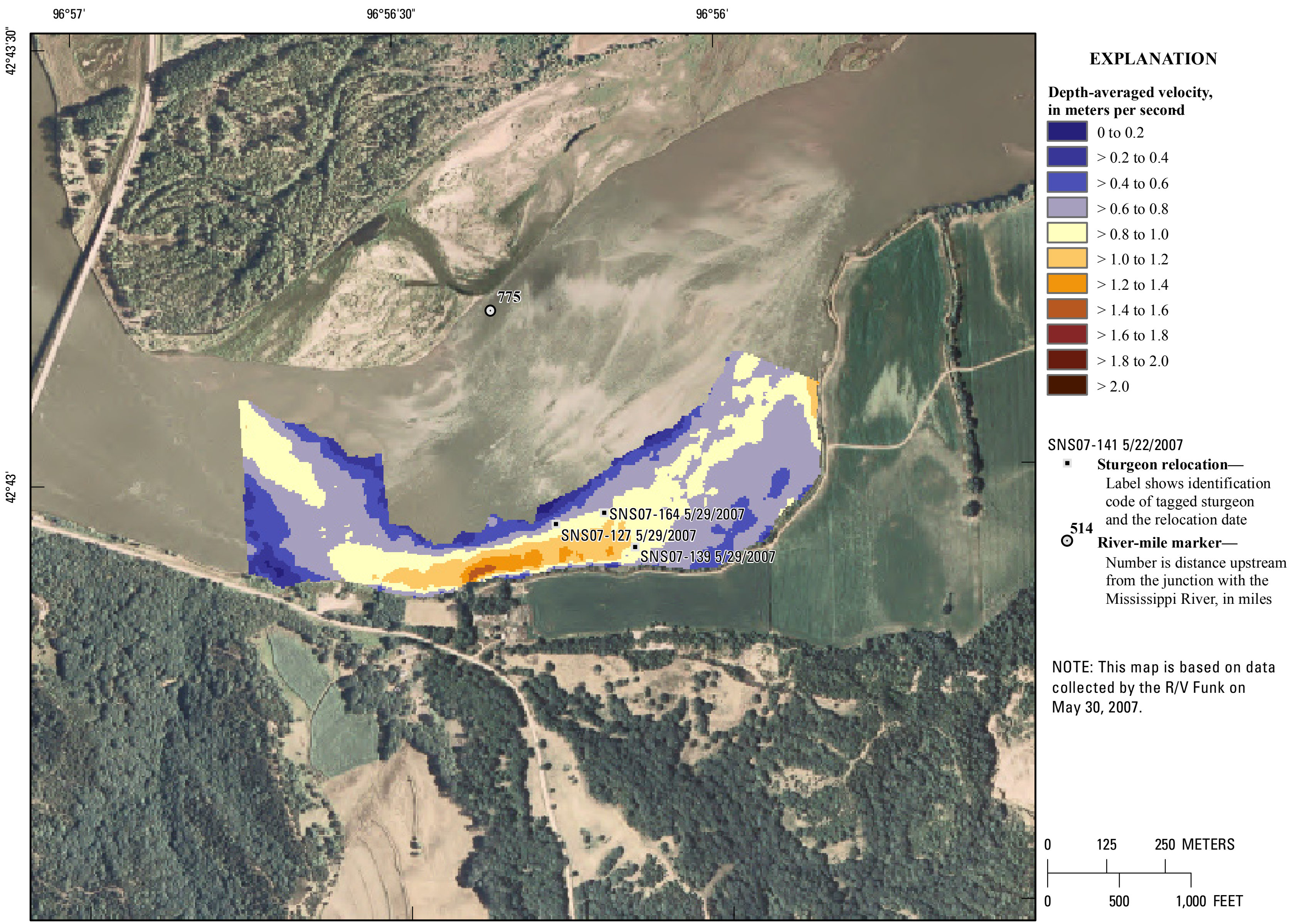
Figure 33. Map of side-scan sonar imagery based on data collected on May 30, 2006, and May 31, 2006, in the vicinity of river mile 775.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

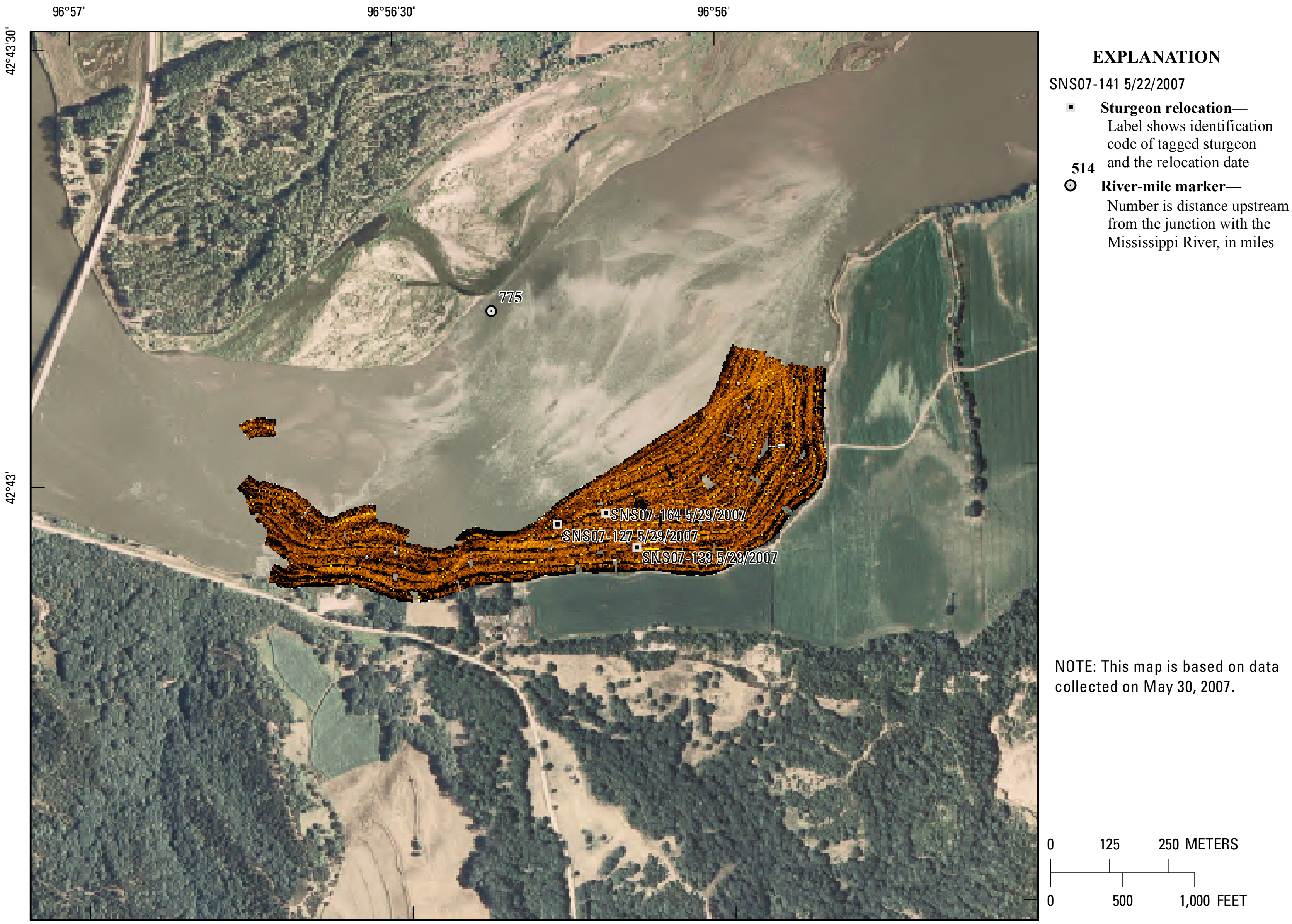
Figure 34. Map of depth based on data collected on May 30, 2007, in the vicinity of river mile 775.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

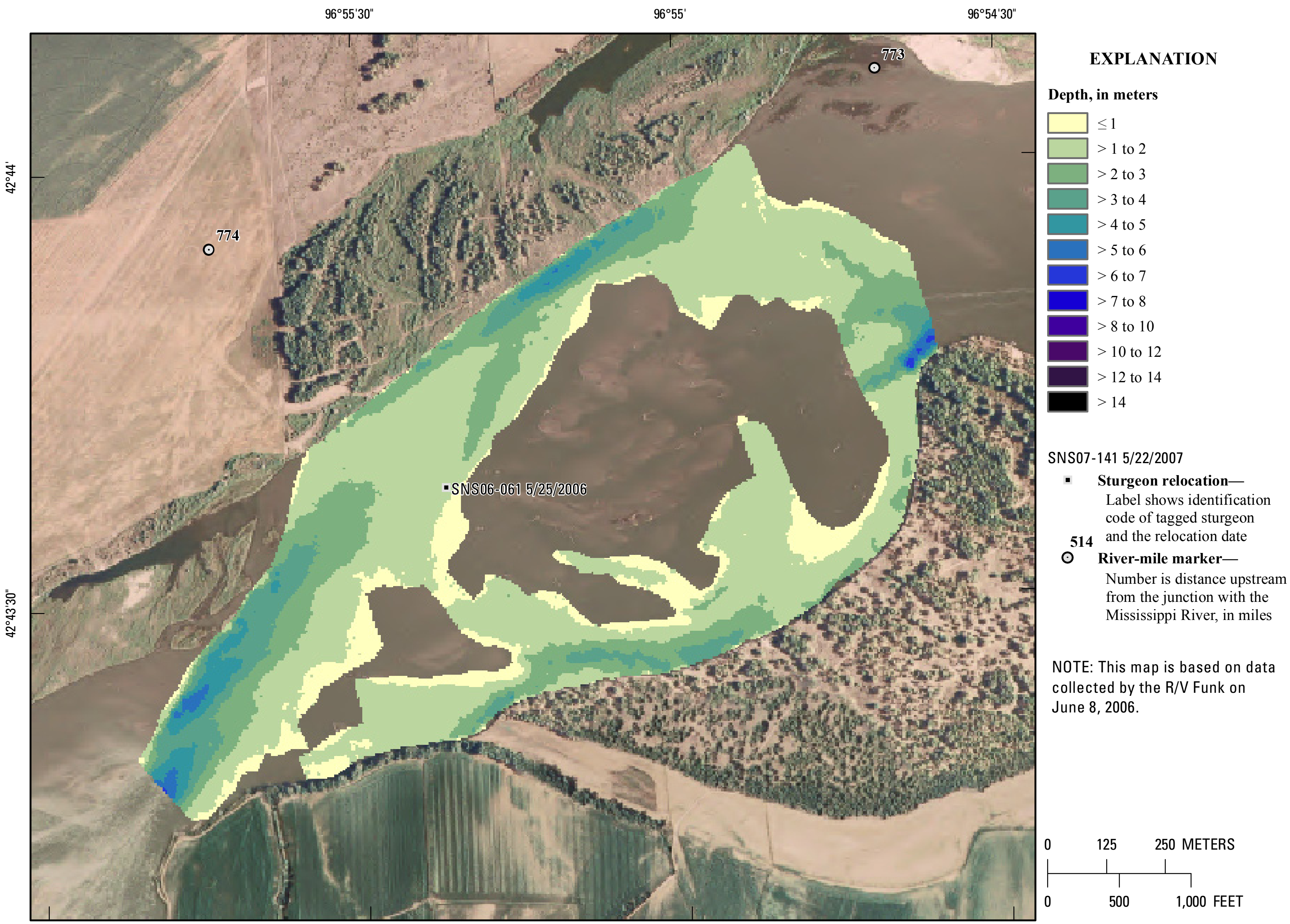
Figure 35. Map of depth-averaged velocity based on data collected on May 30, 2007, in the vicinity of river mile 775.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

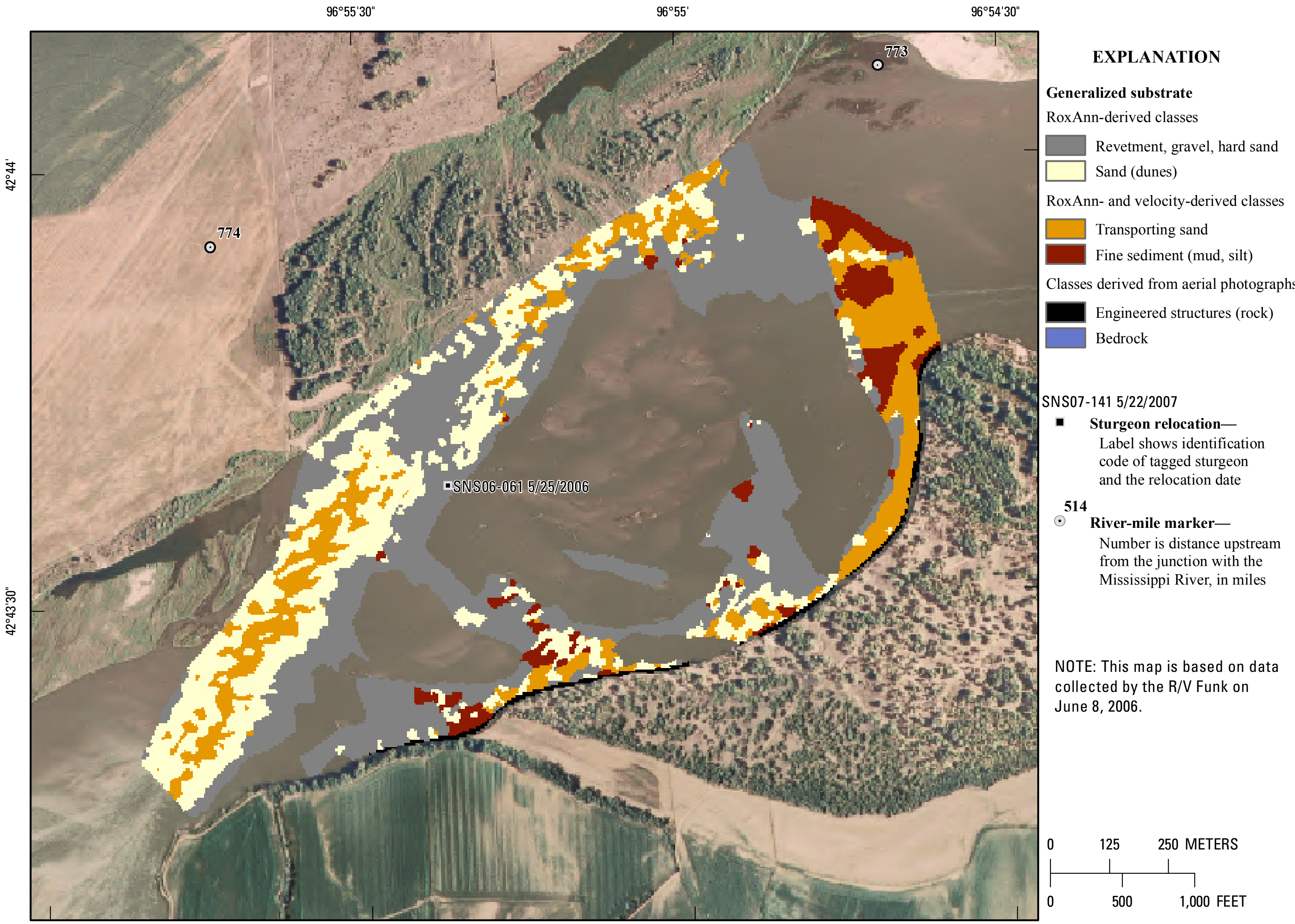
Figure 36. Map of side-scan sonar imagery based on data collected on May 30, 2007, in the vicinity of river mile 775.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

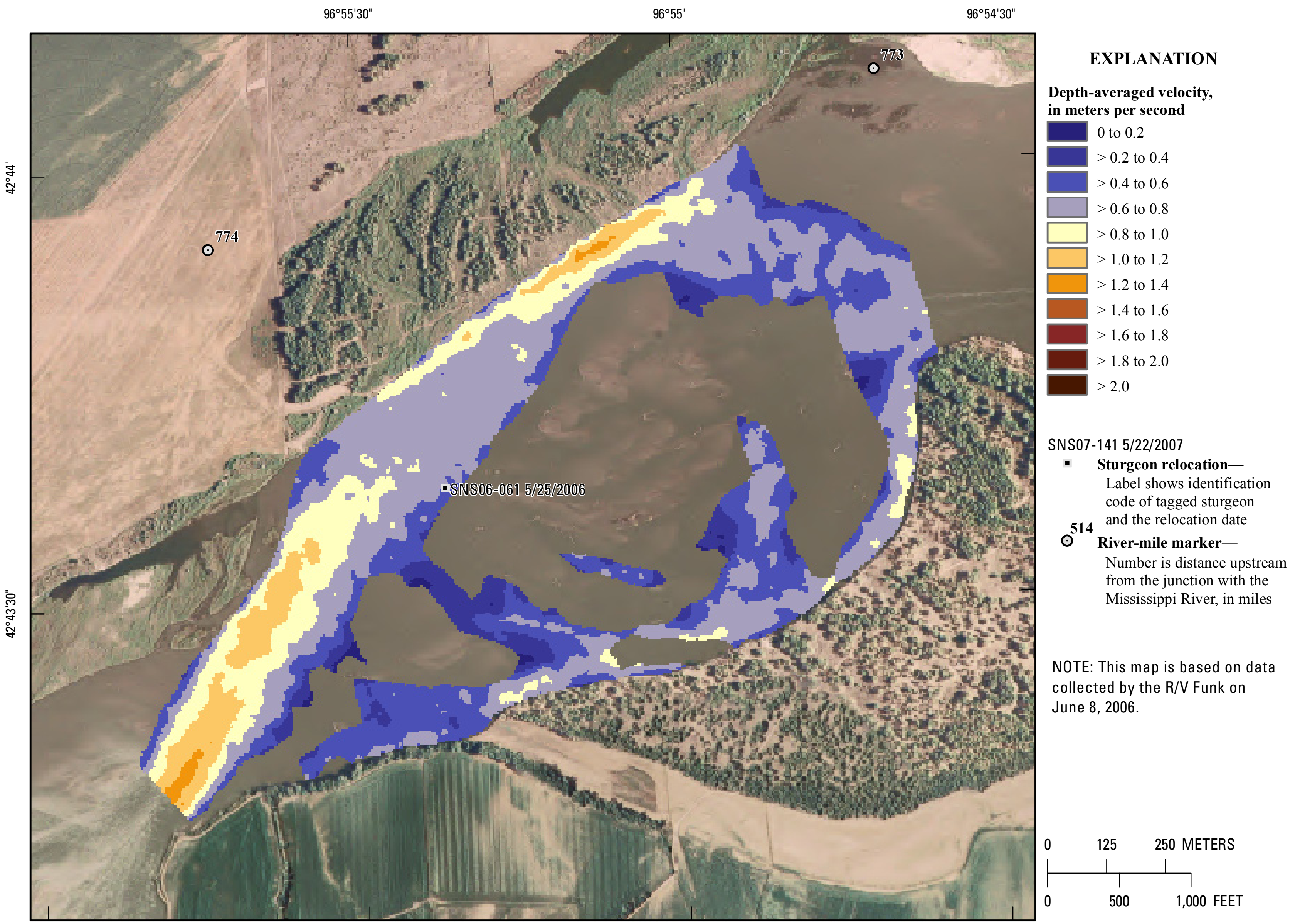
Figure 37. Map of depth based on data collected on June 8, 2006, in the vicinity of river mile 774.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 38. Map of generalized substrate based on data collected on June 8, 2006, in the vicinity of river mile 774.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 39. Map of depth-averaged velocity based on data collected on June 8, 2006, in the vicinity of river mile 774.

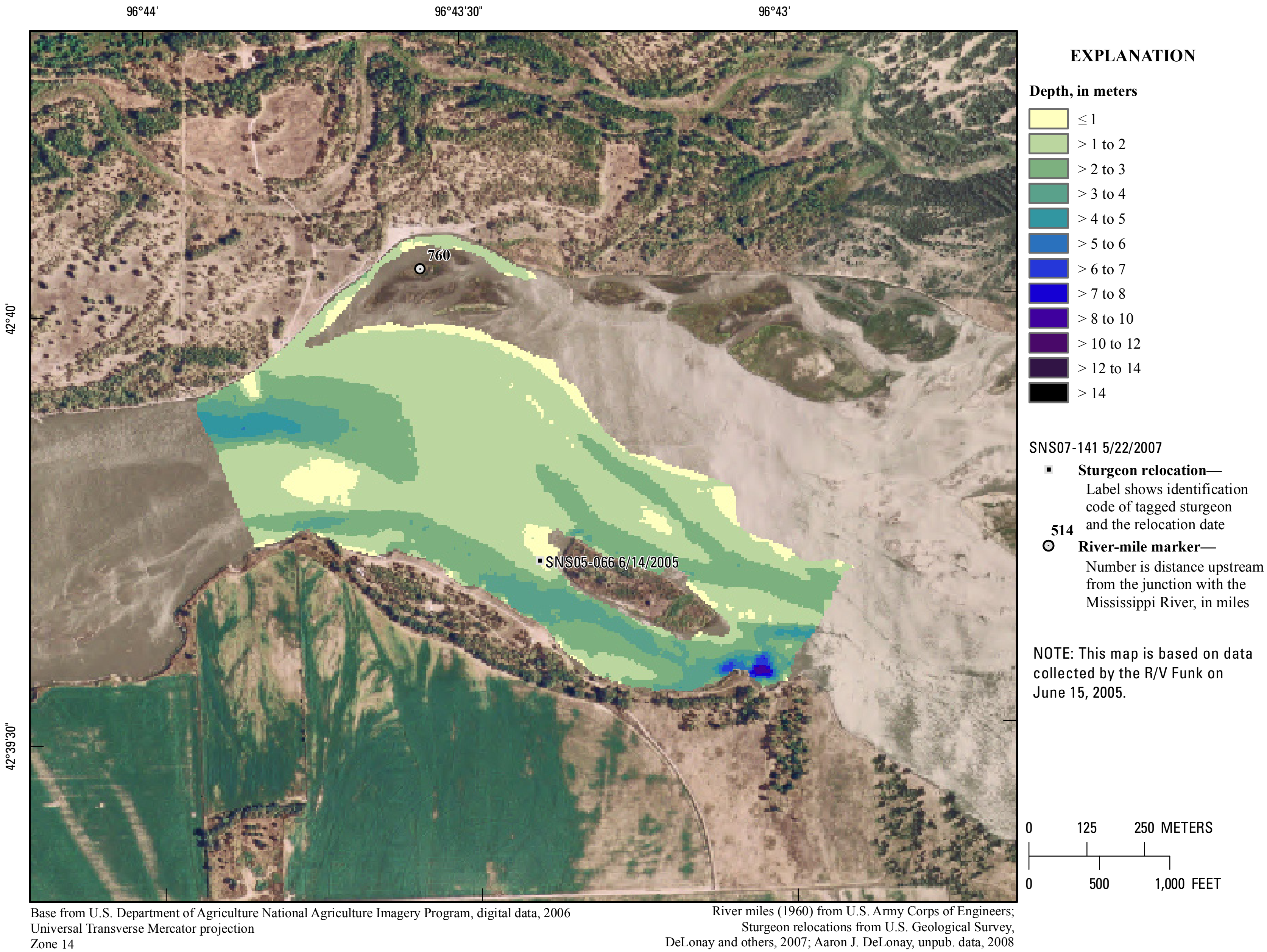
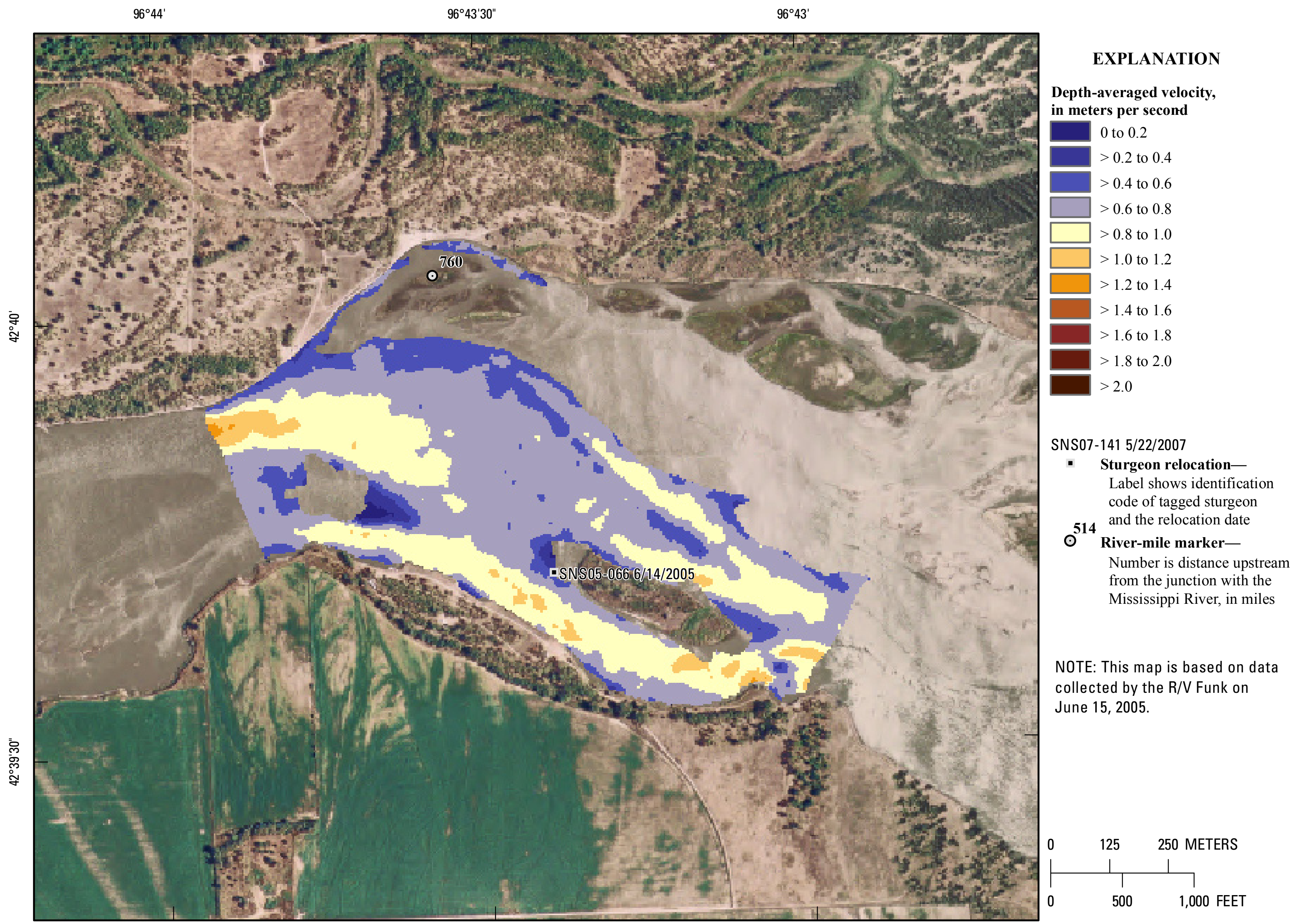


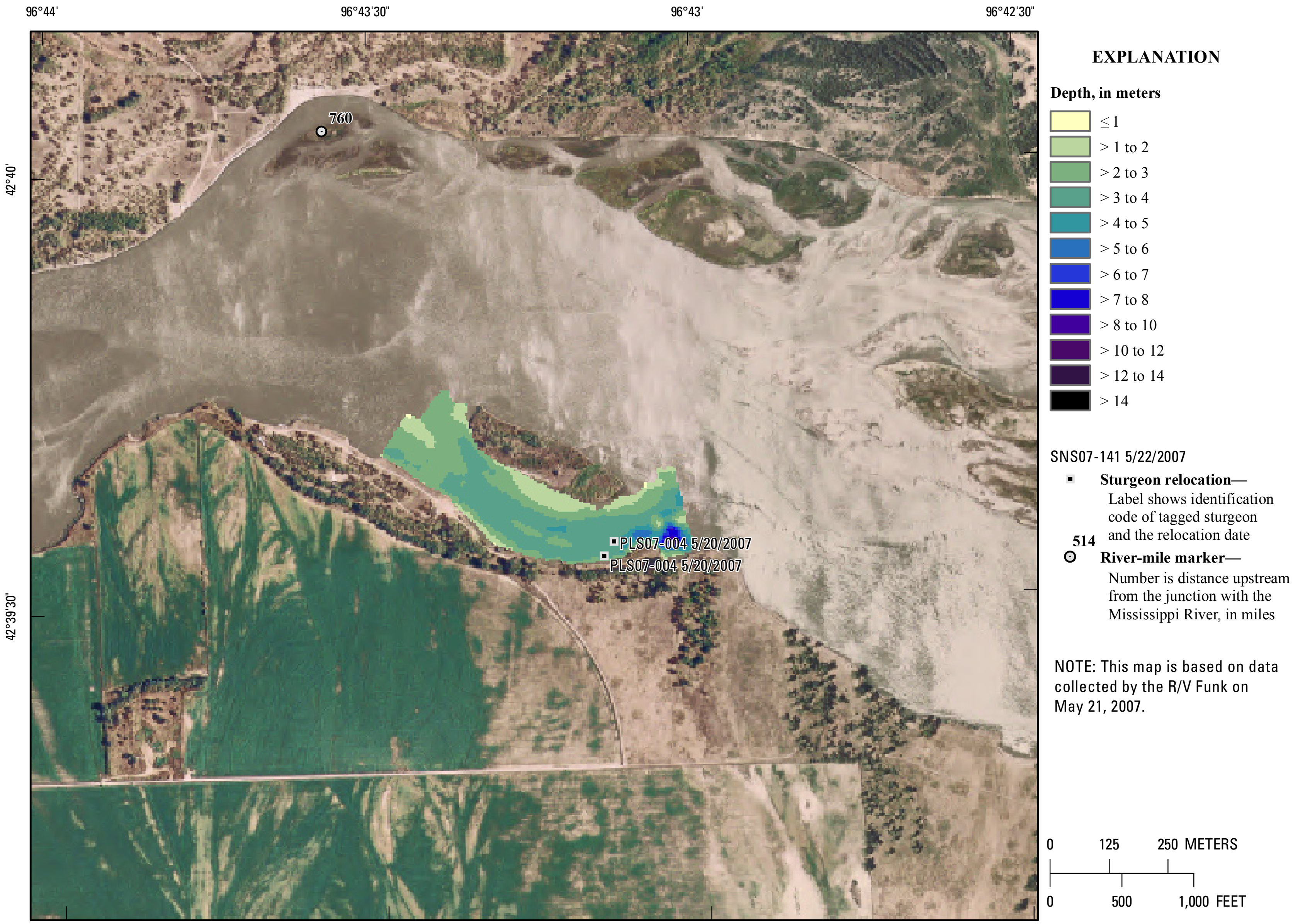
Figure 40. Map of depth based on data collected on June 15, 2005, in the vicinity of river mile 760.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

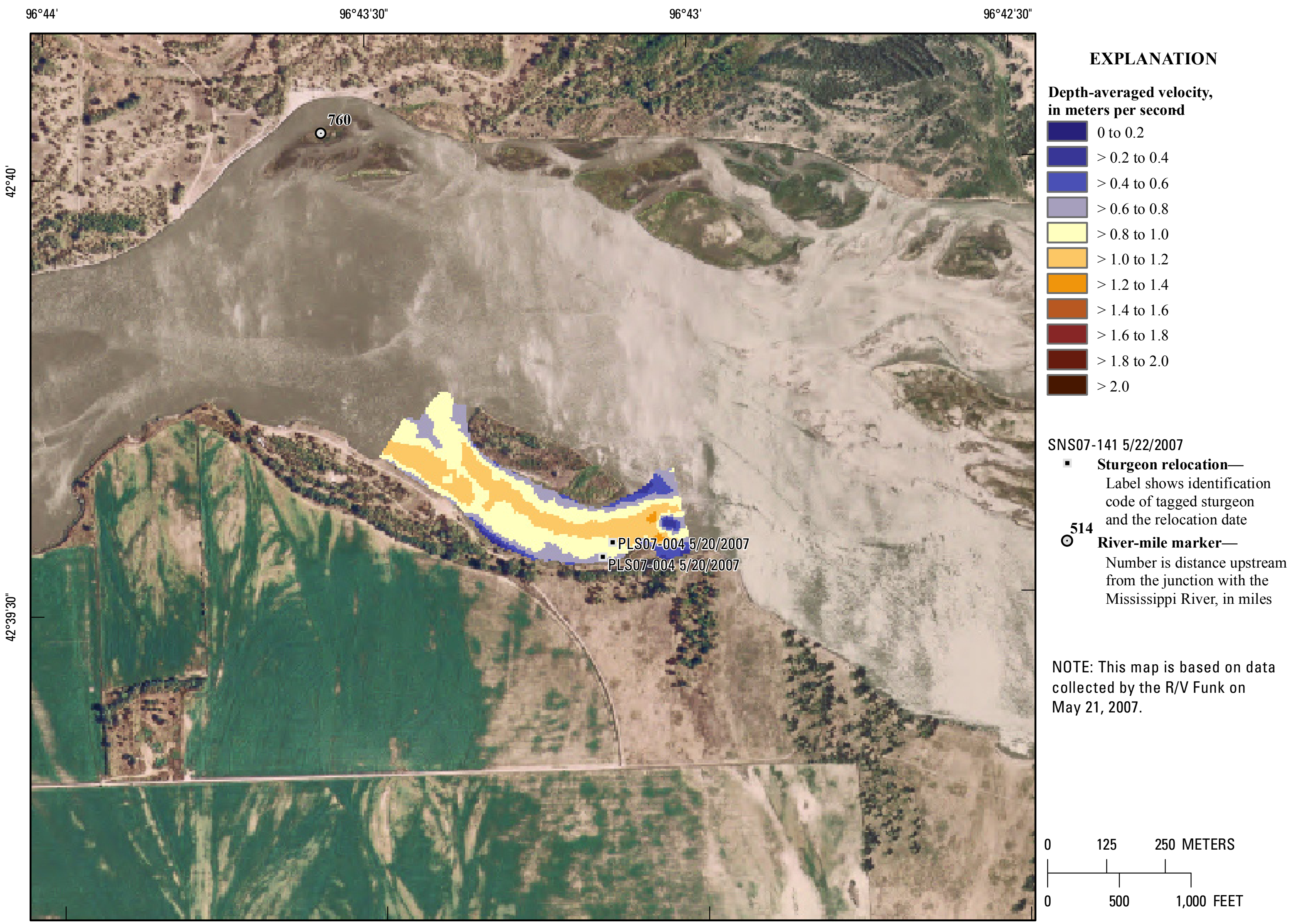
Figure 41. Map of depth-averaged velocity based on data collected on June 15, 2005, in the vicinity of river mile 760.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

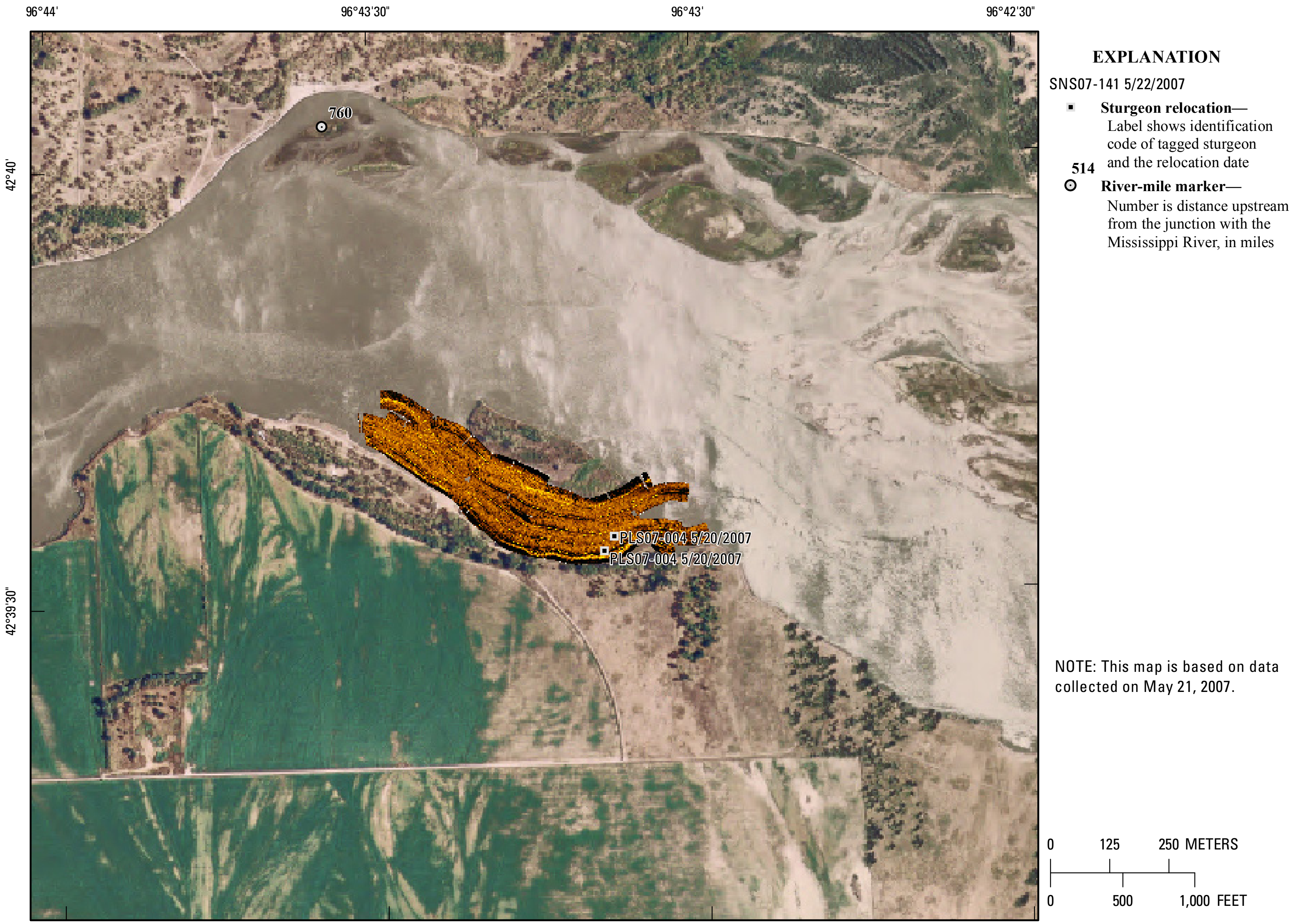
Figure 42. Map of depth based on data collected on May 21, 2007, in the vicinity of river mile 760.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 43. Map of depth-averaged velocity based on data collected on May 21, 2007, in the vicinity of river mile 760.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 44. Map of side-scan sonar imagery based on data collected on May 21, 2007, in the vicinity of river mile 760.

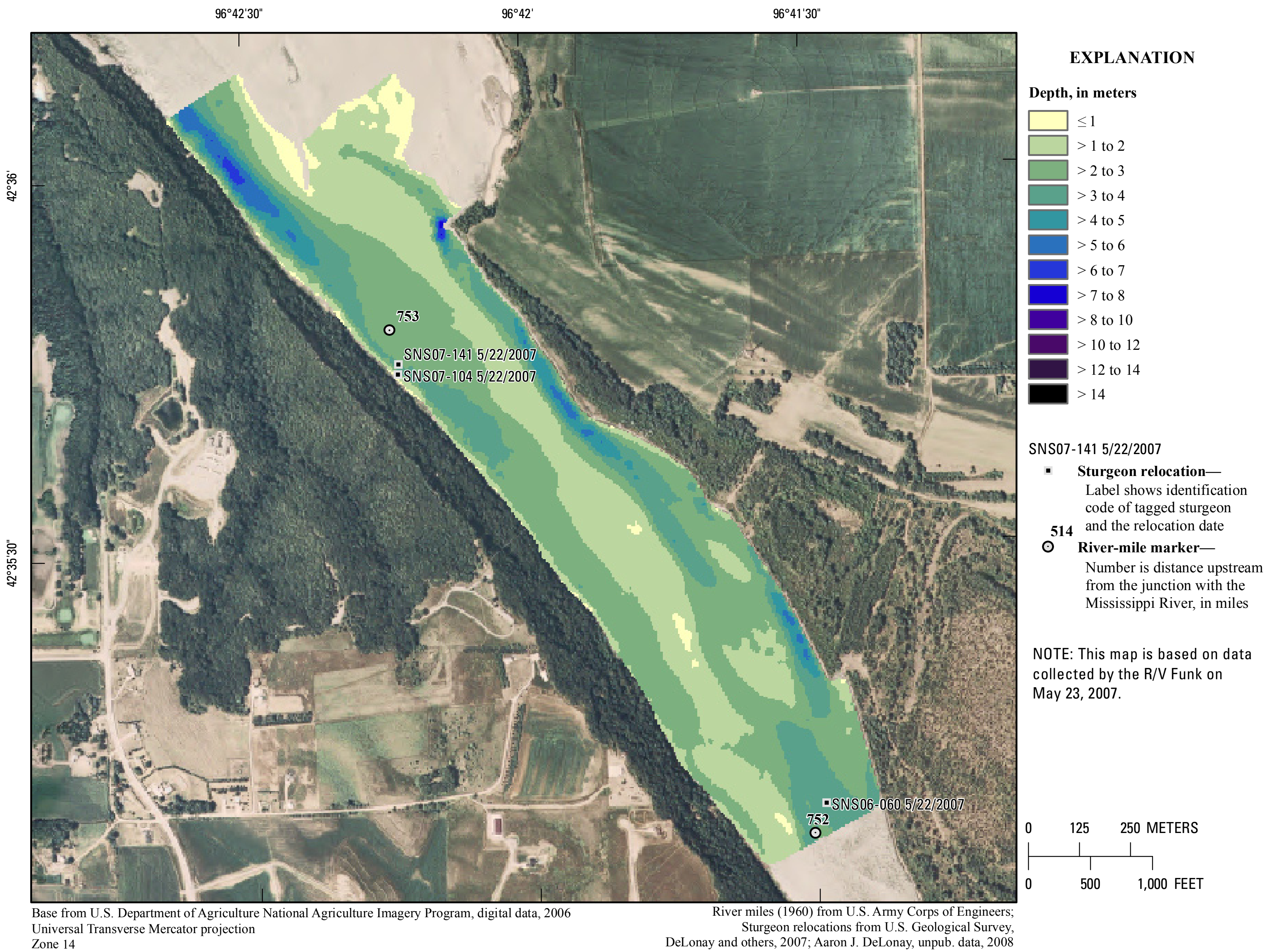
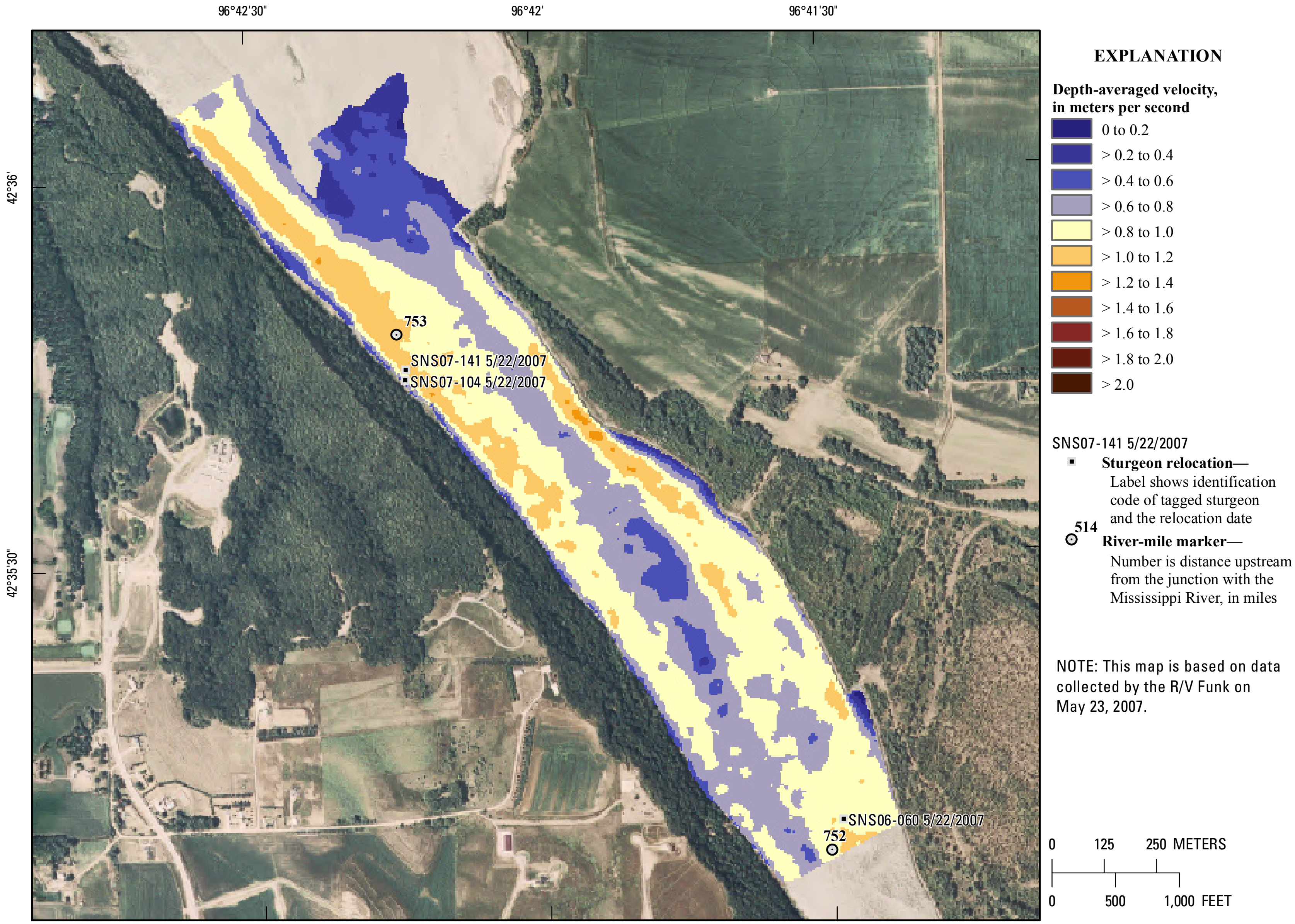


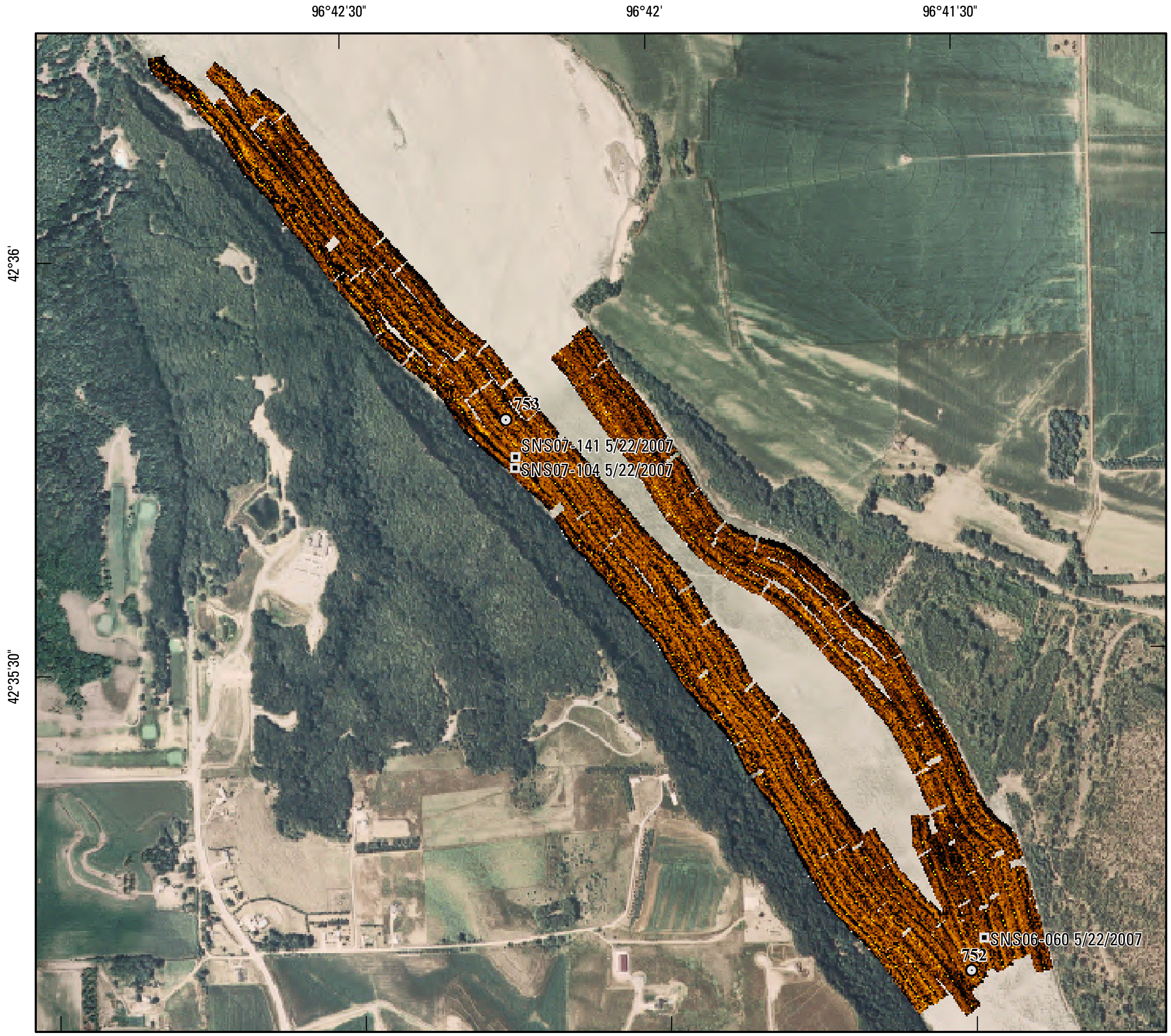
Figure 45. Map of depth based on data collected on May 23, 2007, in the vicinity of river mile 753.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 46. Map of depth-averaged velocity based on data collected on May 23, 2007, in the vicinity of river mile 753.



EXPLANATION

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▪ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514

⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected on May 23, 2007.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 47. Map of side-scan sonar imagery based on data collected on May 23, 2007, in the vicinity of river mile 753.

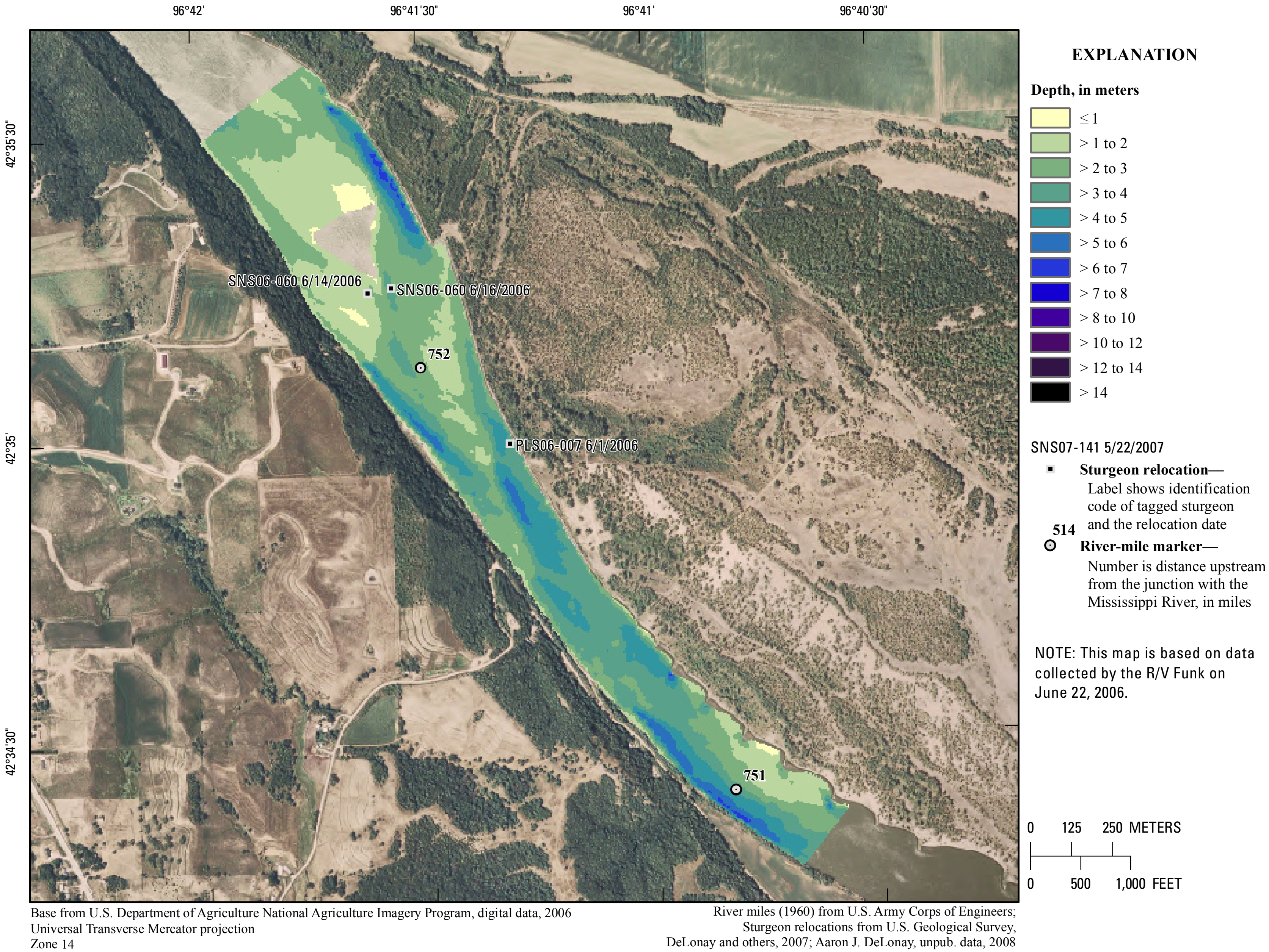
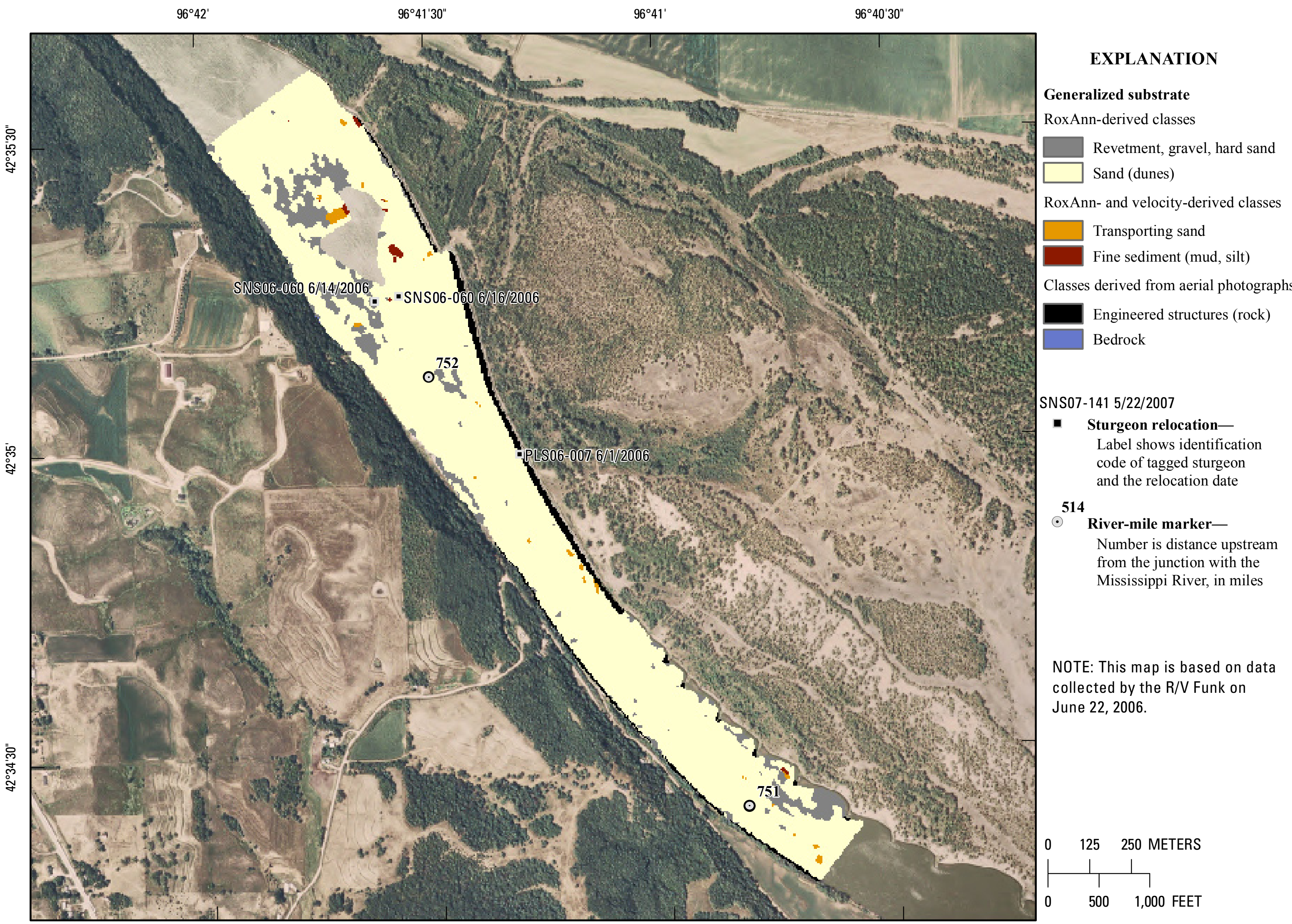


Figure 48. Map of depth based on data collected on June 22, 2006, in the vicinity of river mile 752.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 49. Map of generalized substrate based on data collected on June 22, 2006, in the vicinity of river mile 752.

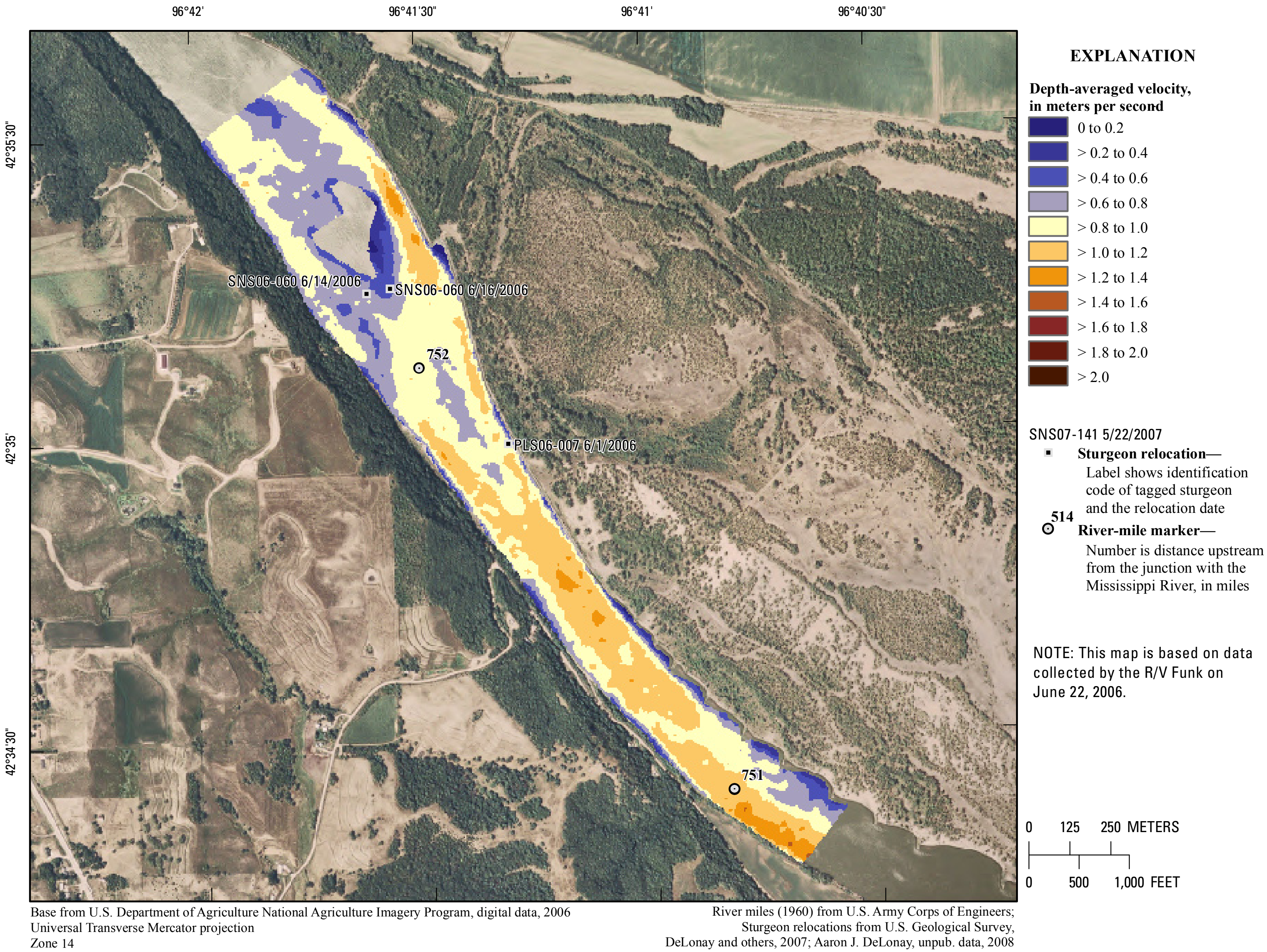
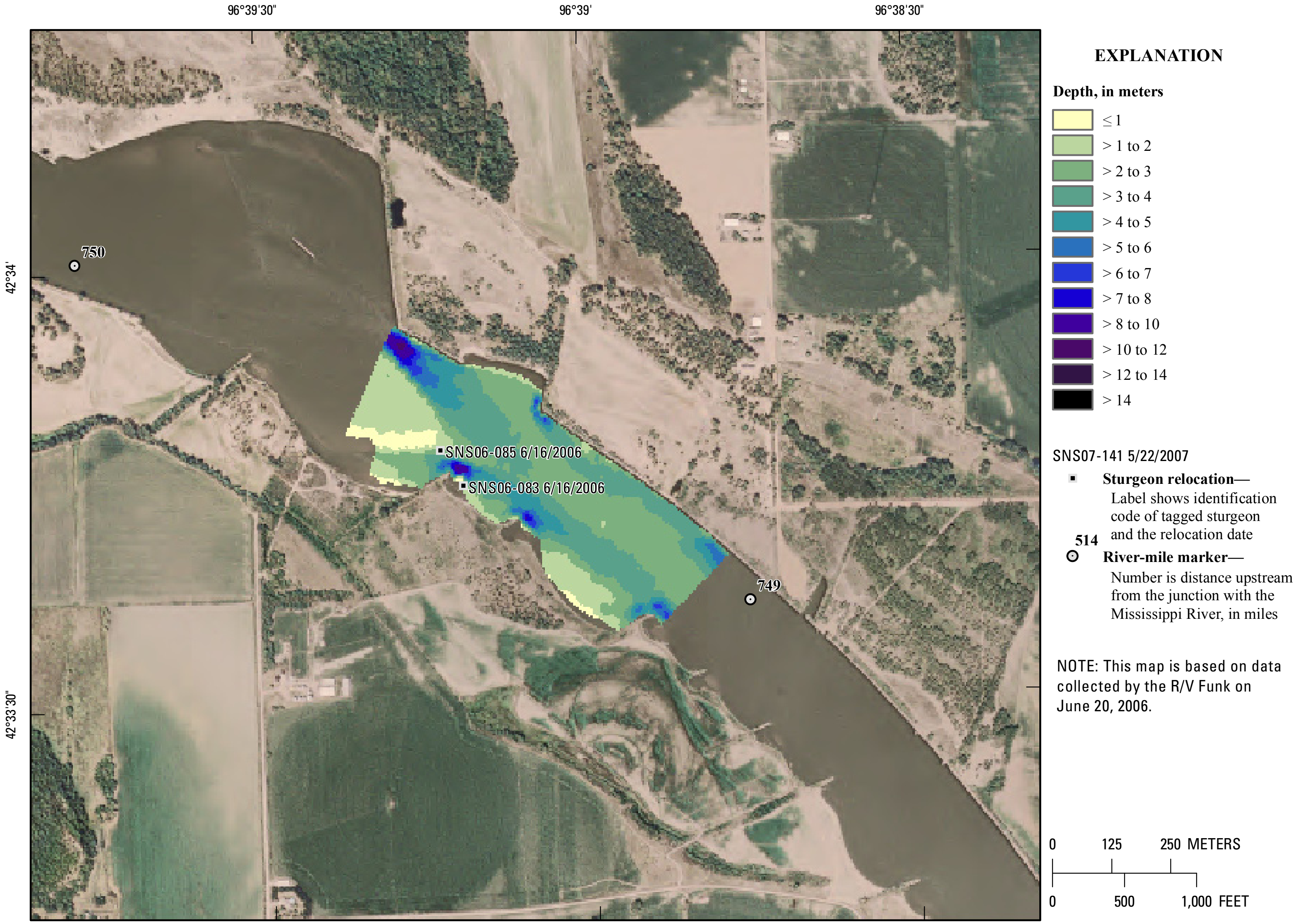


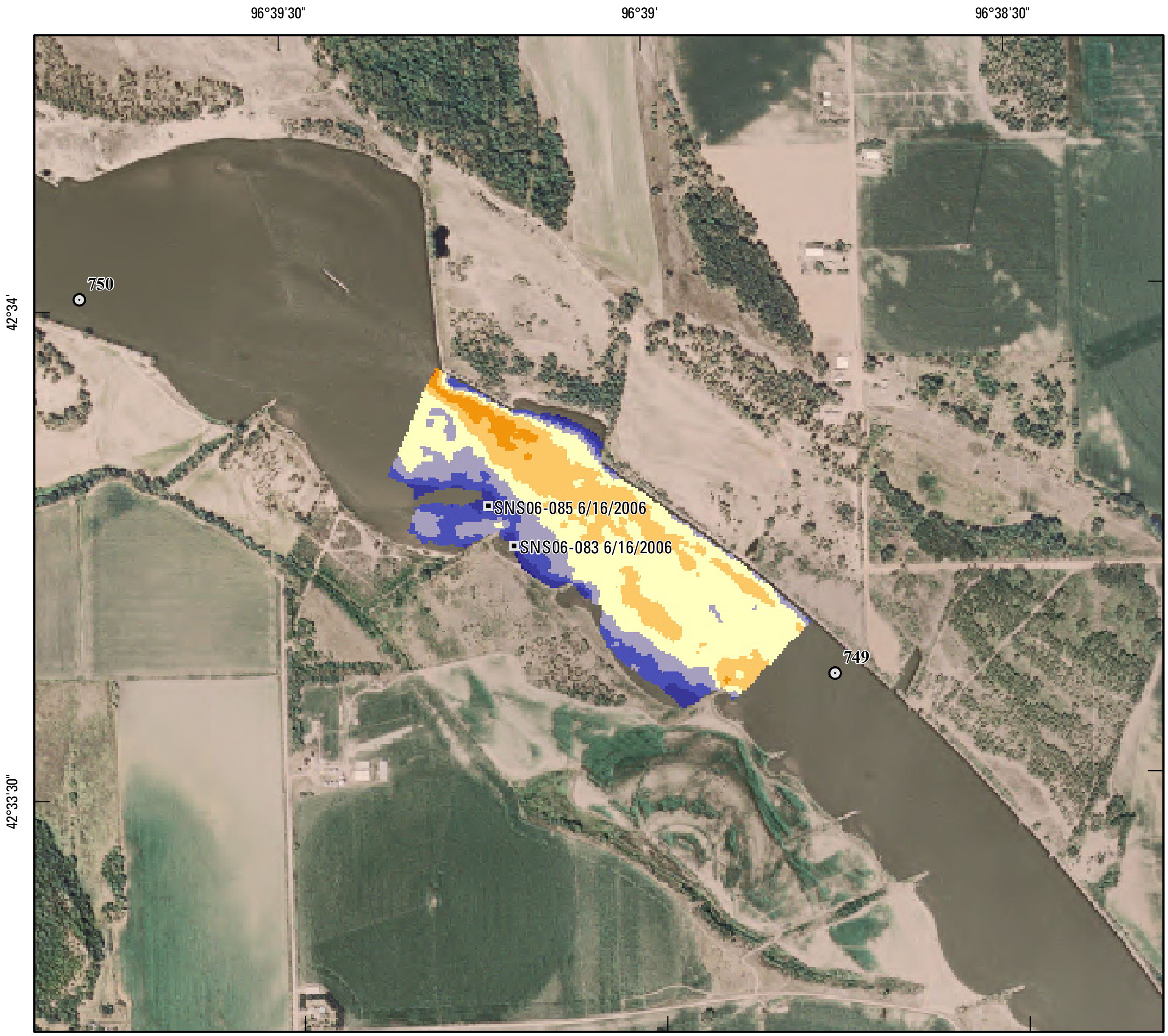
Figure 50. Map of depth-averaged velocity based on data collected on June 22, 2006, in the vicinity of river mile 752.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 51. Map of depth based on data collected on June 20, 2006, in the vicinity of river mile 749.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 20, 2006.

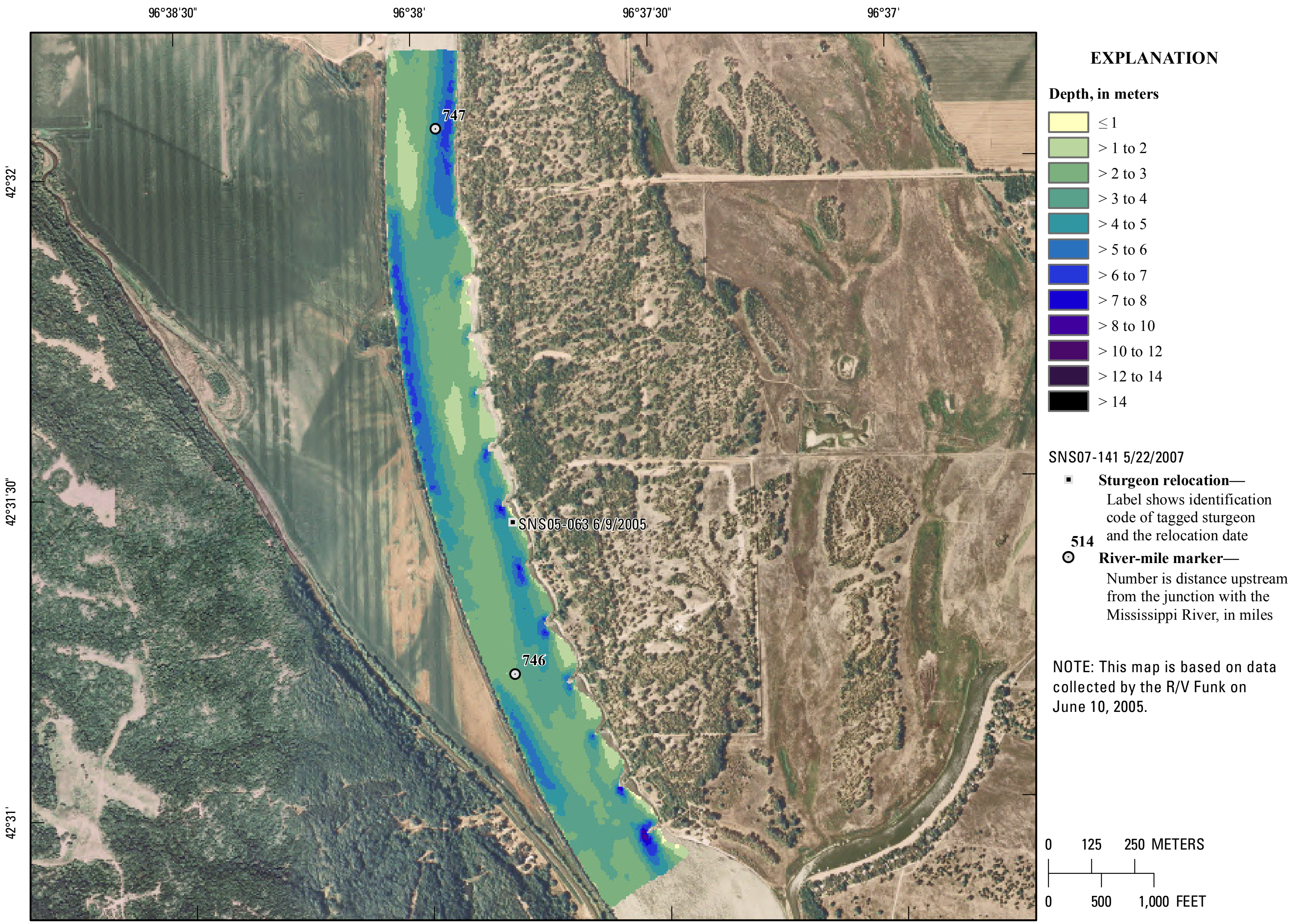
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 52. Map of depth-averaged velocity based on data collected on June 20, 2006, in the vicinity of river mile 749.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 53. Map of depth based on data collected on June 10, 2005, in the vicinity of river mile 746.

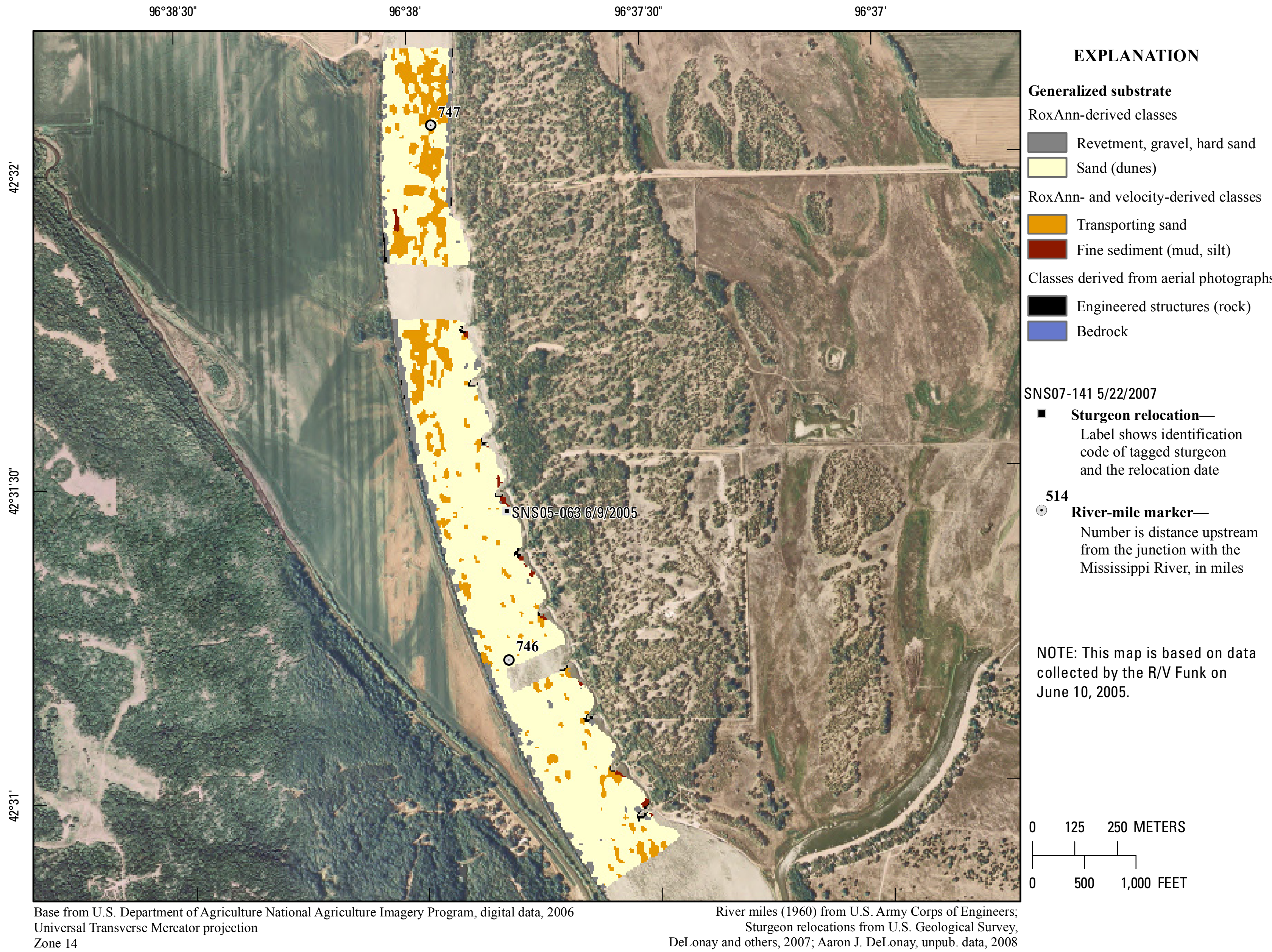
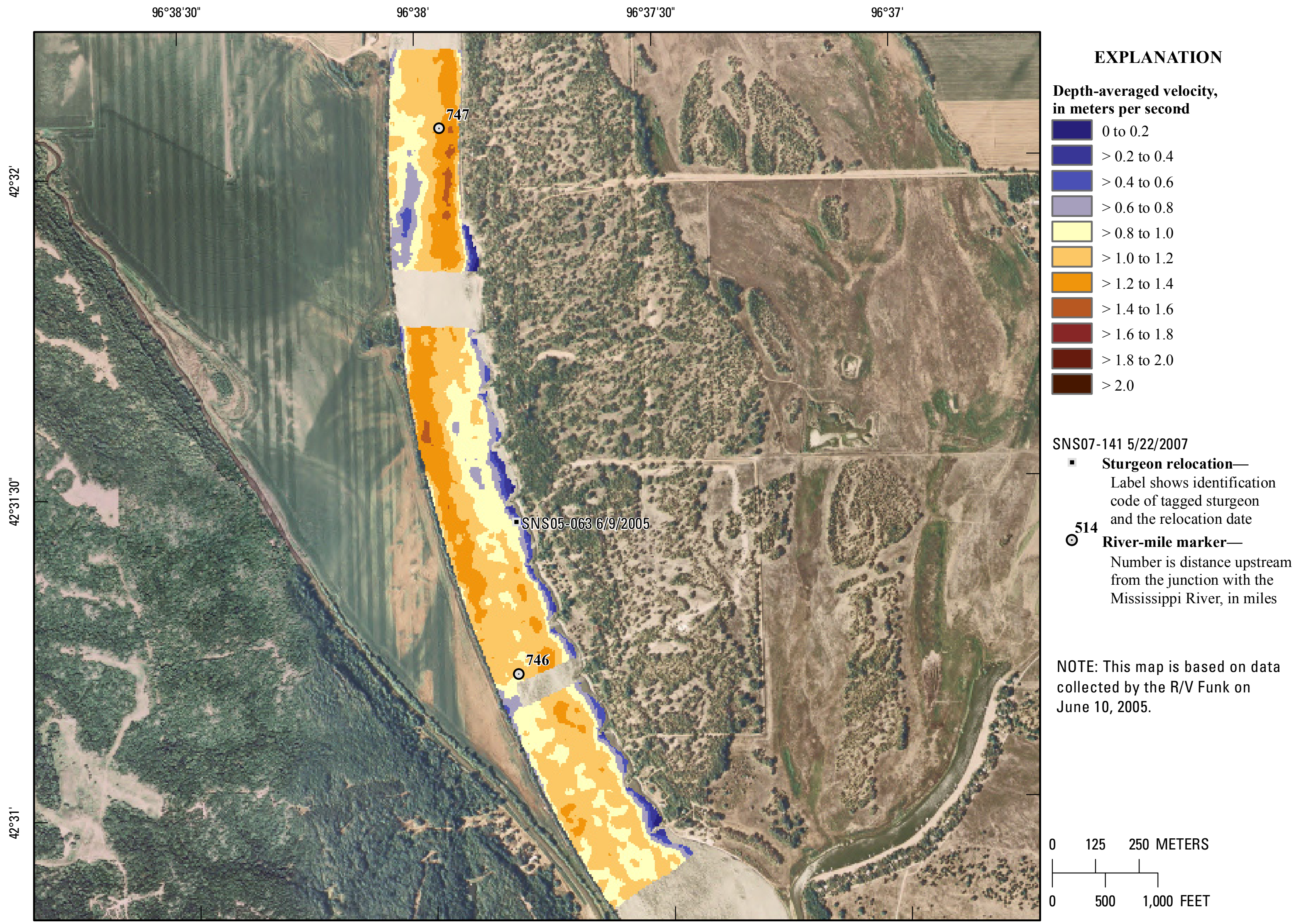


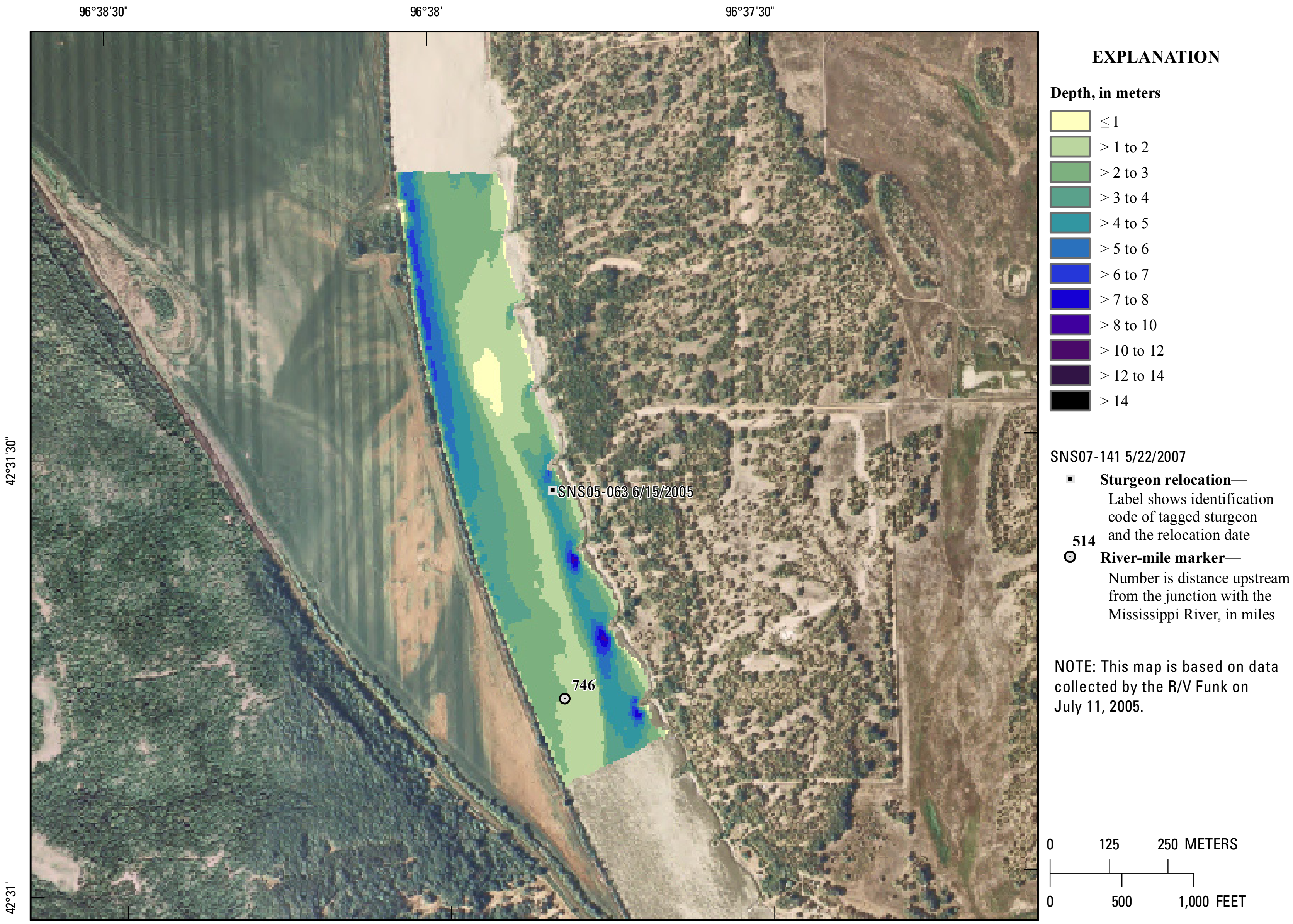
Figure 54. Map of generalized substrate based on data collected on June 10, 2005, in the vicinity of river mile 746.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

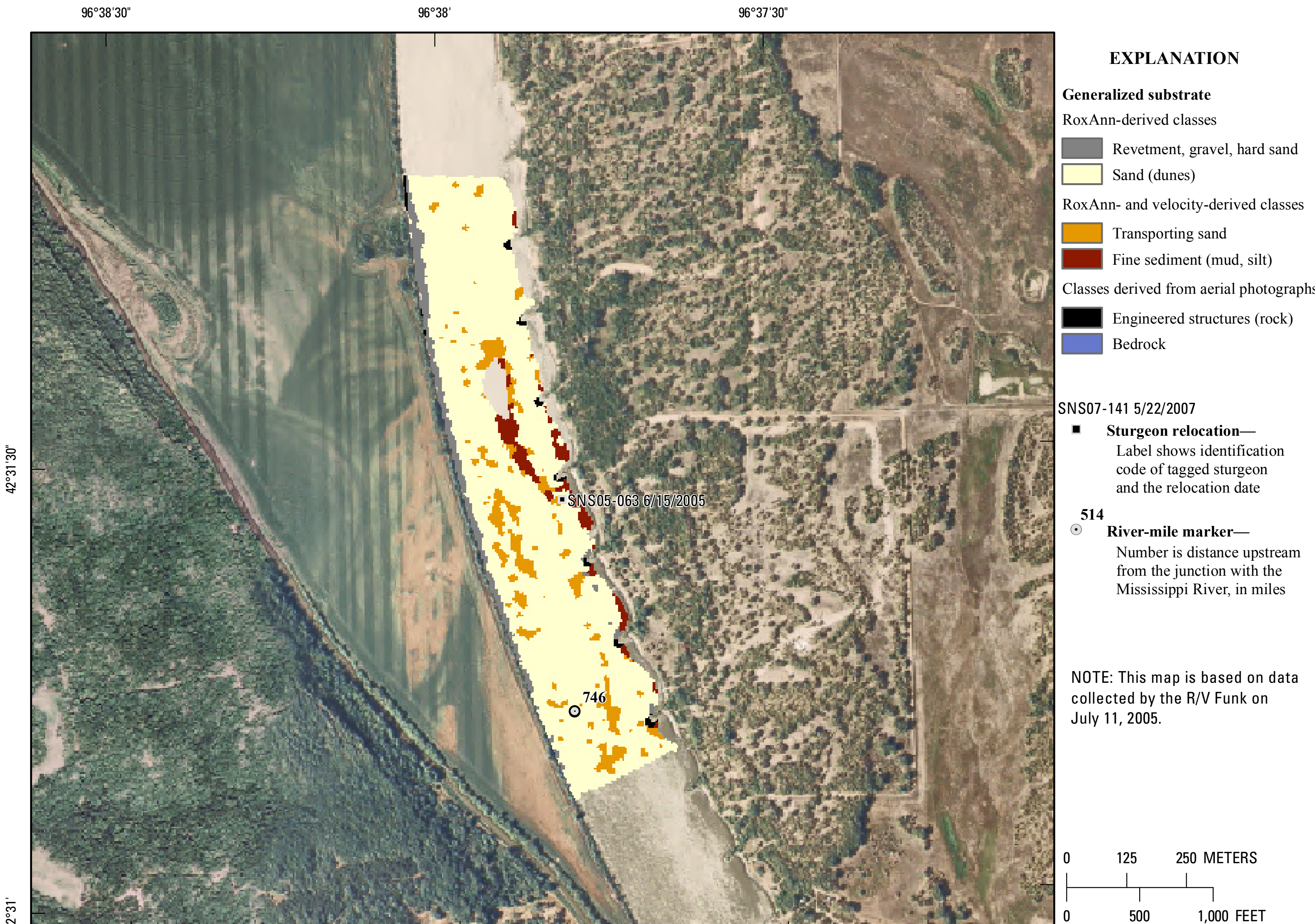
Figure 55. Map of depth-averaged velocity based on data collected on June 10, 2005, in the vicinity of river mile 746.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

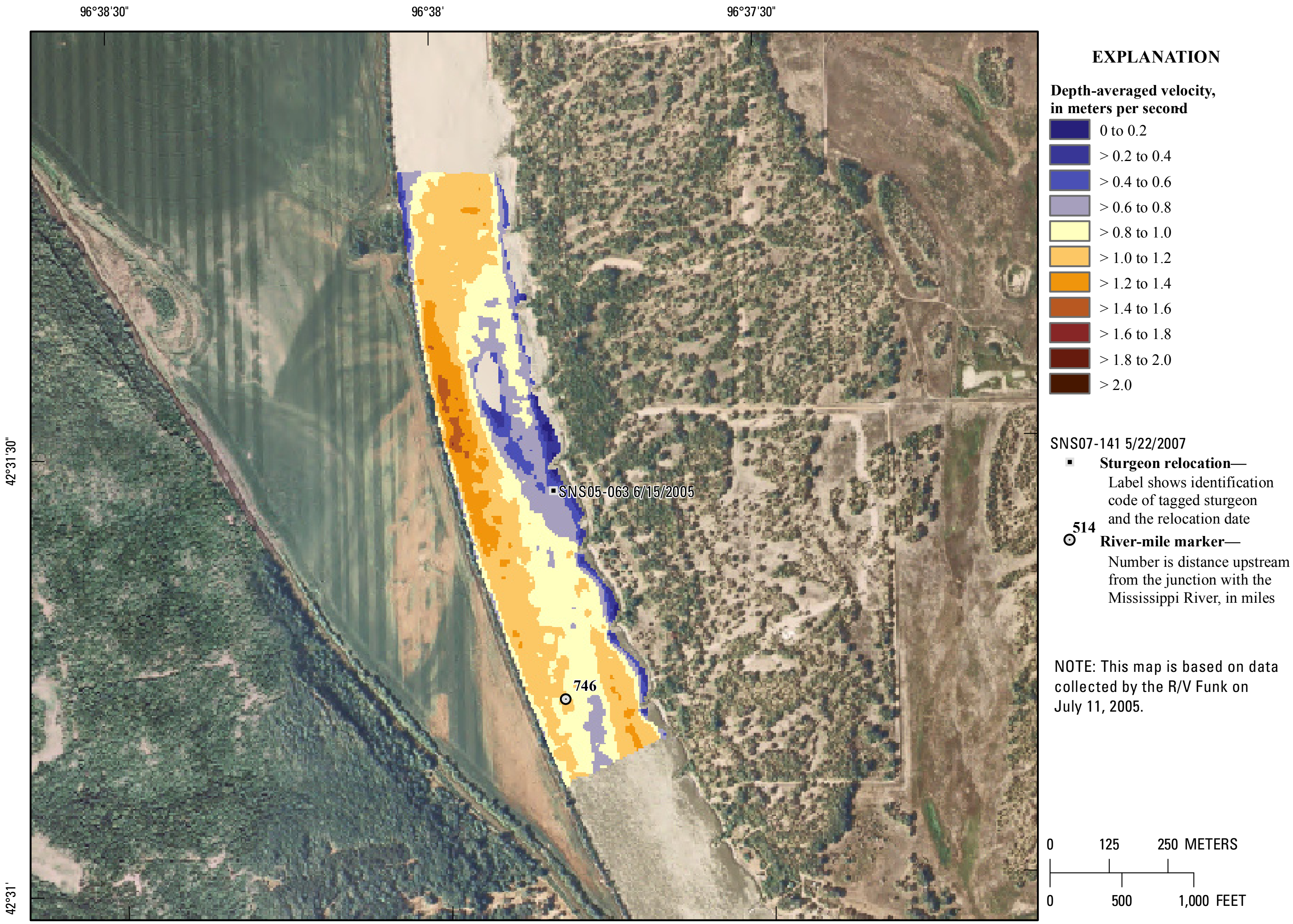
Figure 56. Map of depth based on data collected on July 11, 2005, in the vicinity of river mile 746.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

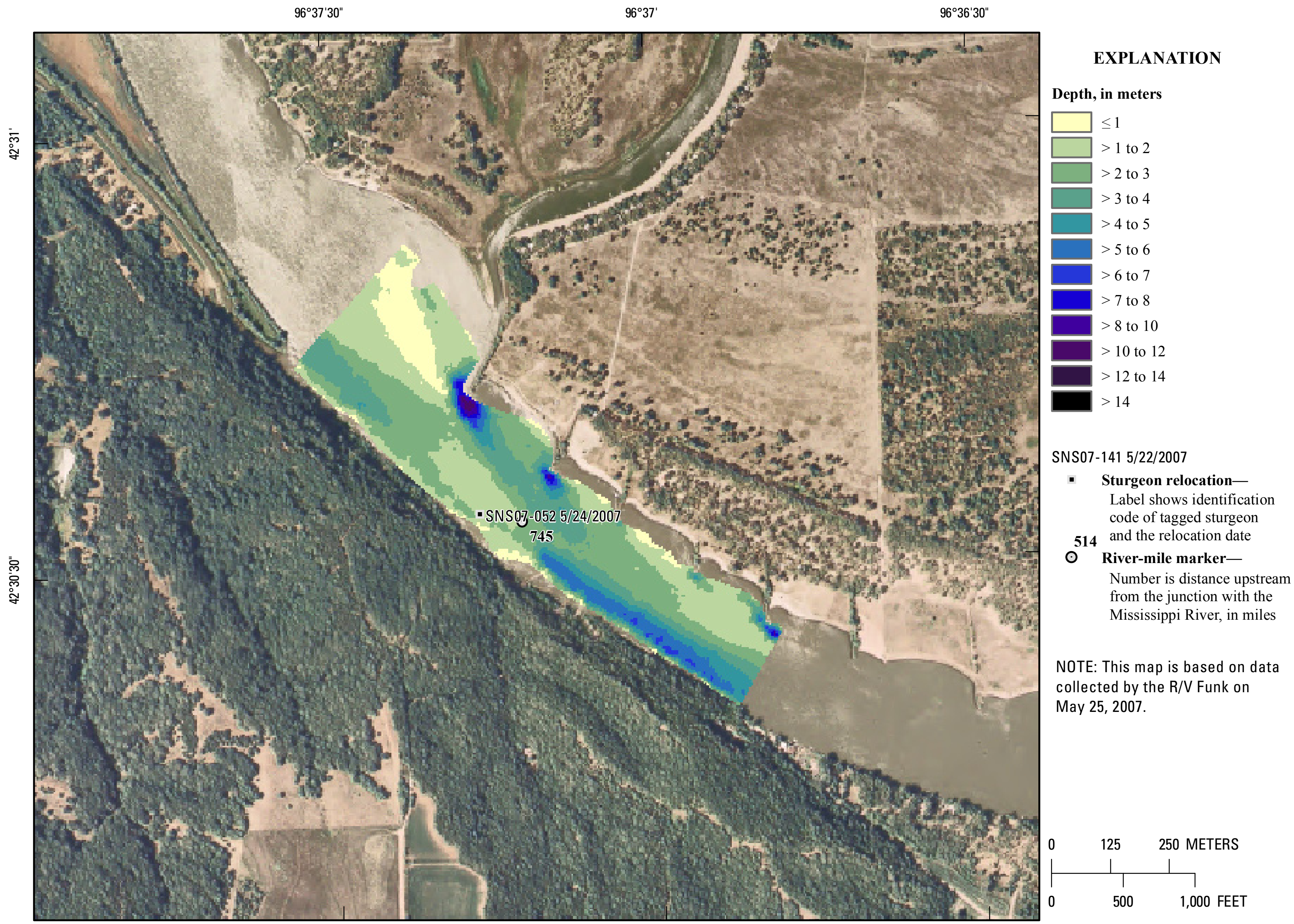
Figure 57. Map of generalized substrate based on data collected on July 11, 2005, in the vicinity of river mile 746.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 58. Map of depth-averaged velocity based on data collected on July 11, 2005, in the vicinity of river mile 746.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 59. Map of depth based on data collected on May 25, 2007, in the vicinity of river mile 745.

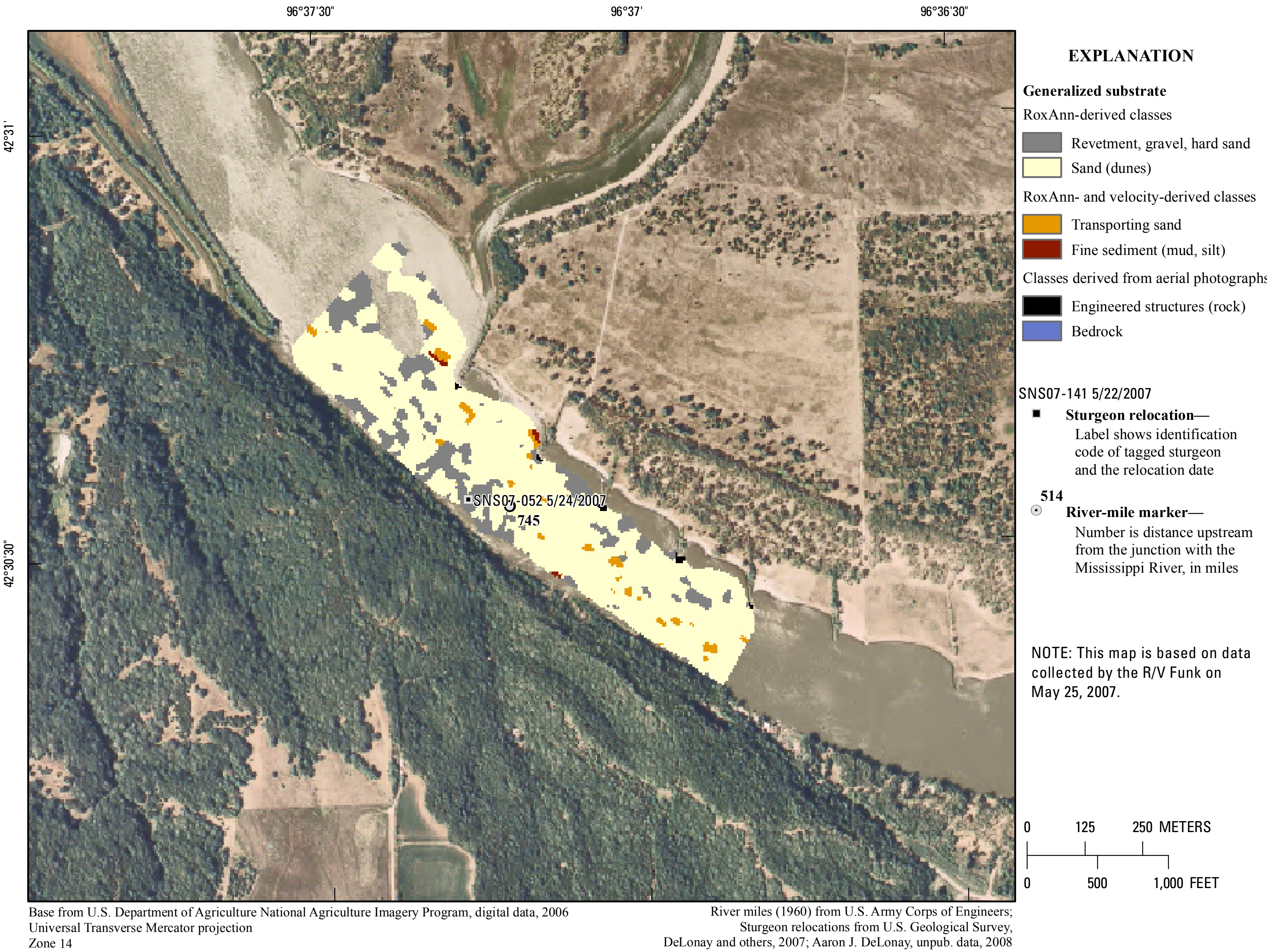
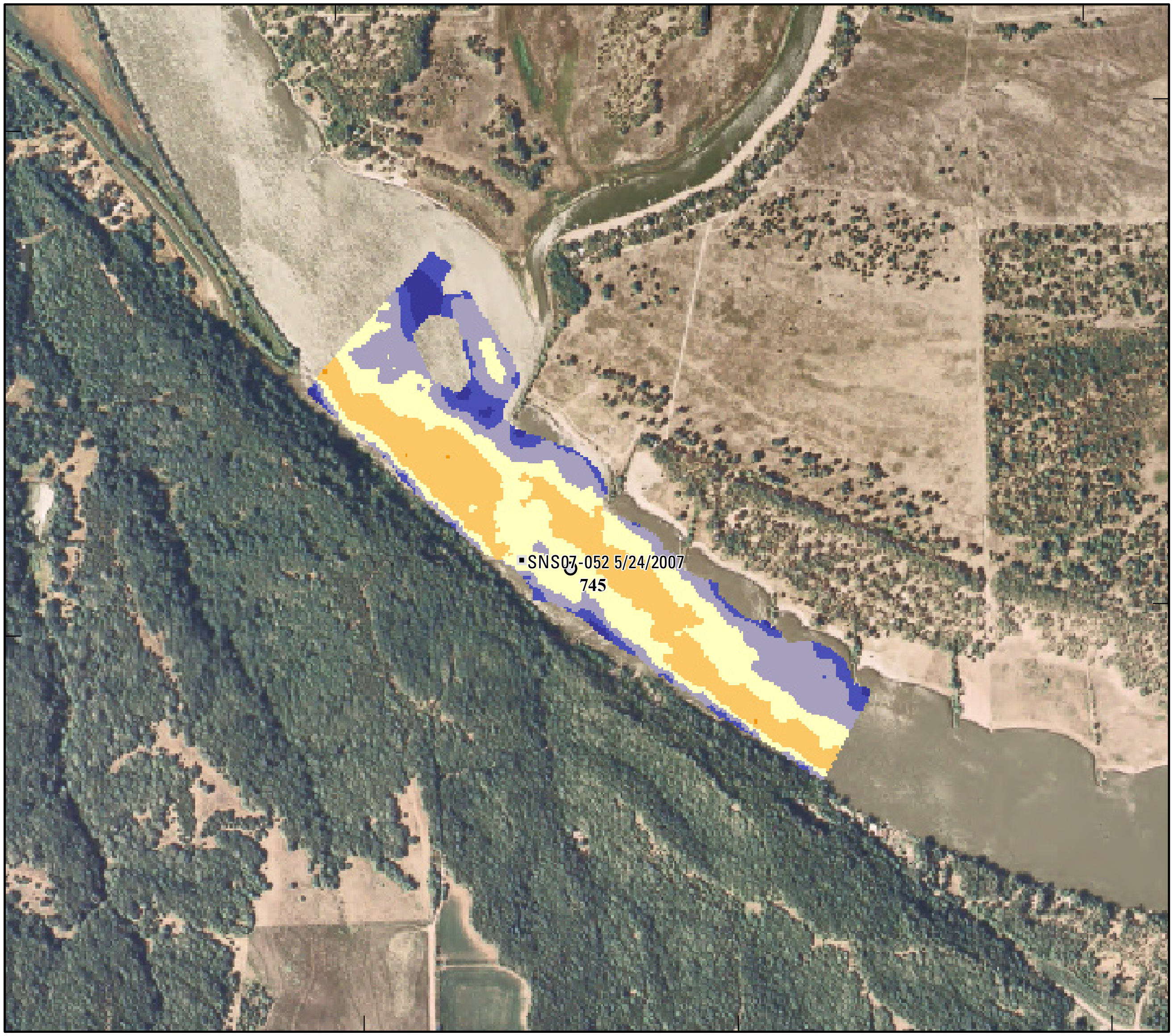


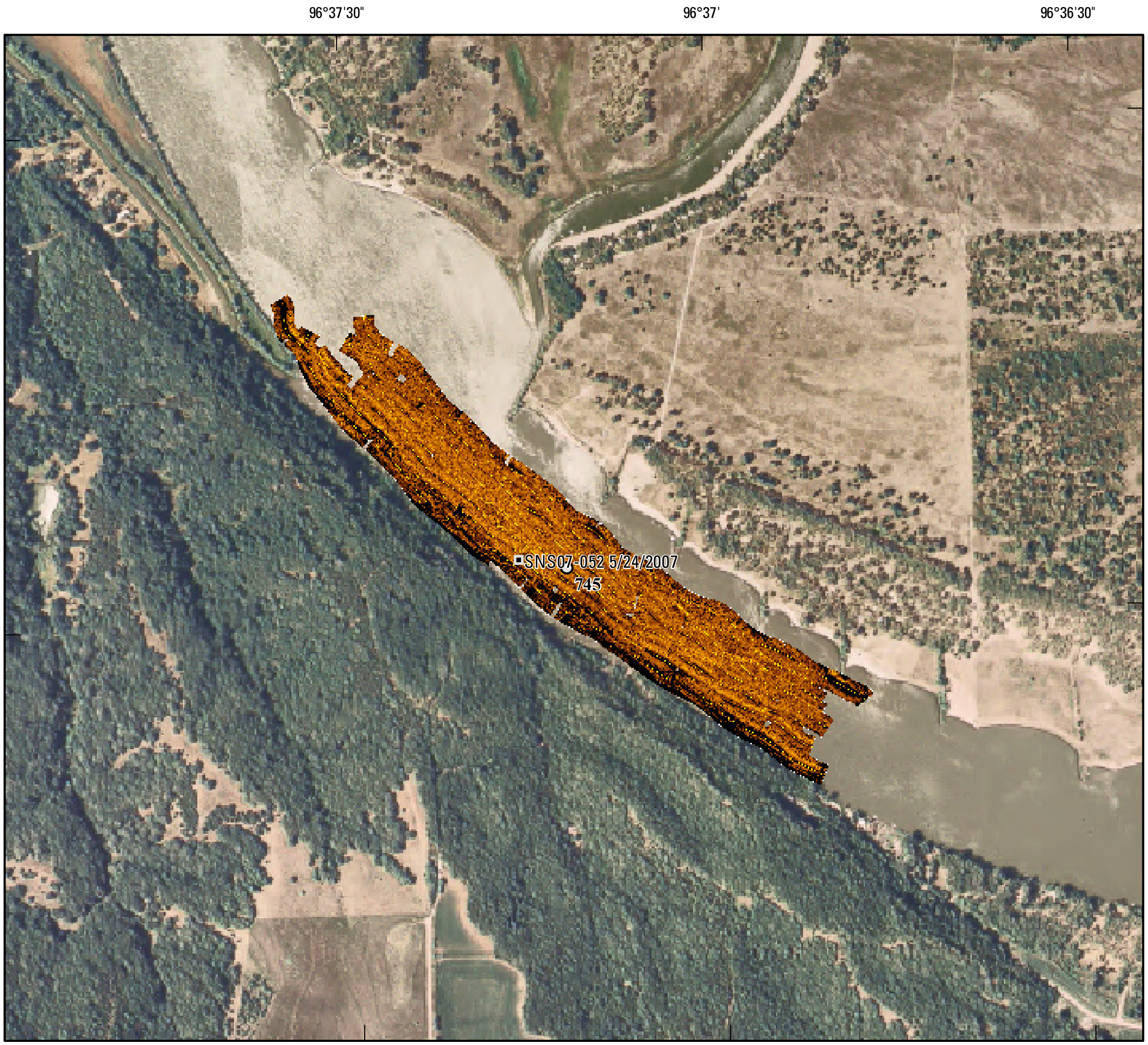
Figure 60. Map of generalized substrate based on data collected on May 25, 2007, in the vicinity of river mile 745.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 61. Map of depth-averaged velocity based on data collected on May 25, 2007, in the vicinity of river mile 745.



EXPLANATION

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected on May 25, 2007.

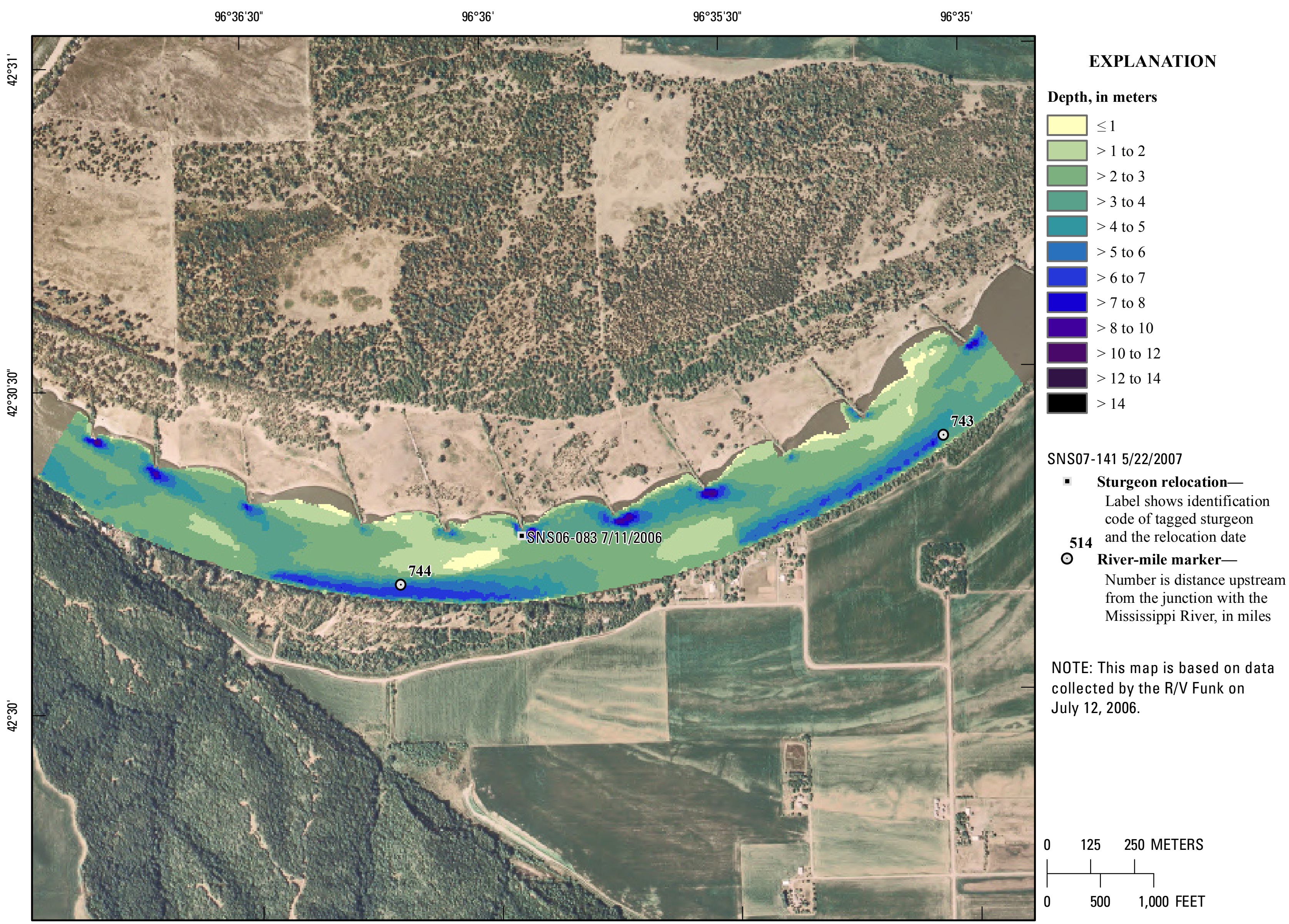
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

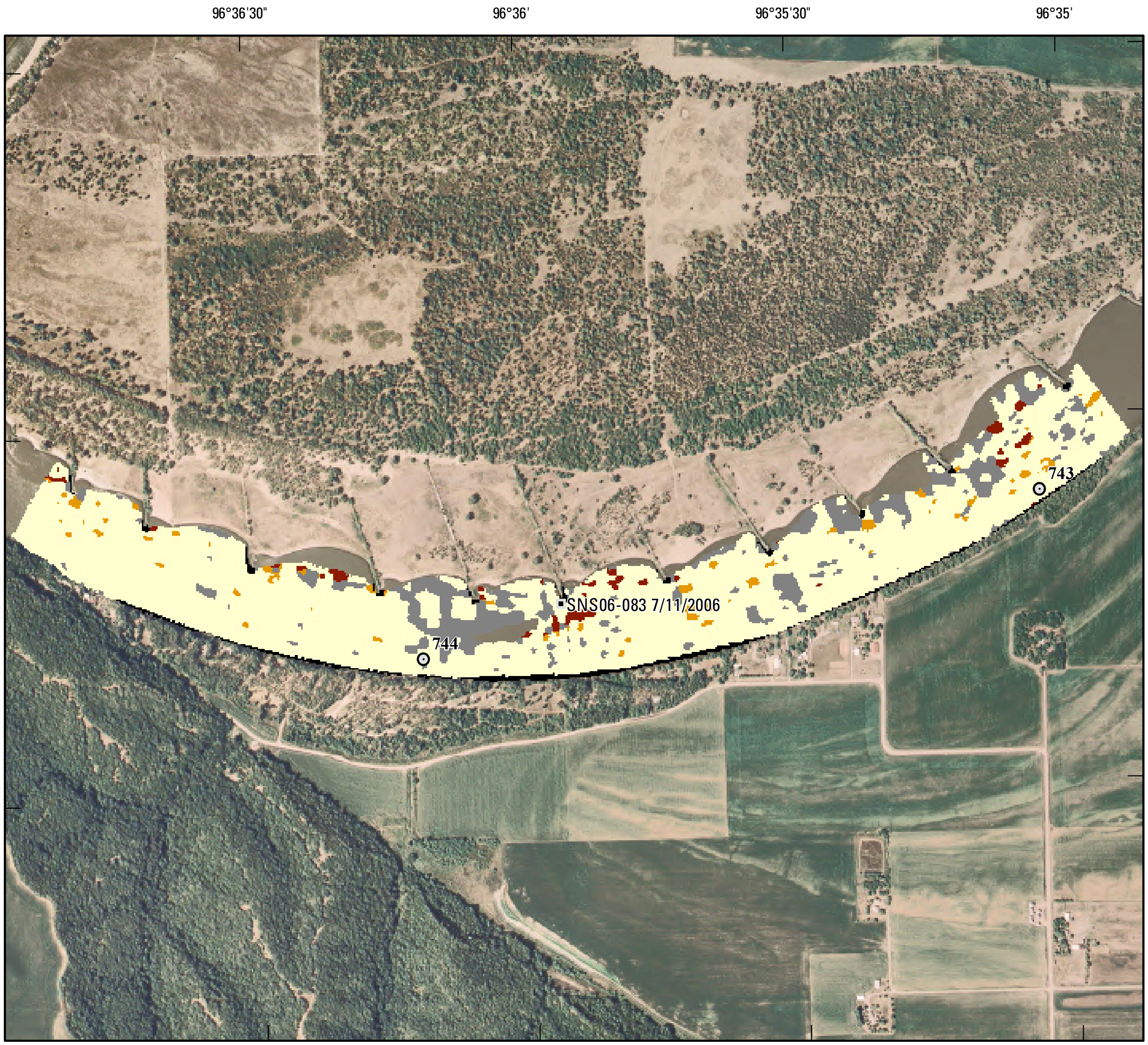
Figure 62. Map of side-scan sonar imagery based on data collected on May 25, 2007, in the vicinity of river mile 745.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 63. Map of depth based on data collected on July 12, 2006, in the vicinity of river mile 744.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

Revetment, gravel, hard sand

Sand (dunes)

RoxAnn- and velocity-derived classes

Transporting sand

Fine sediment (mud, silt)

Classes derived from aerial photographs

Engineered structures (rock)

Bedrock

SNS07-141 5/22/2007

Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on July 12, 2006.

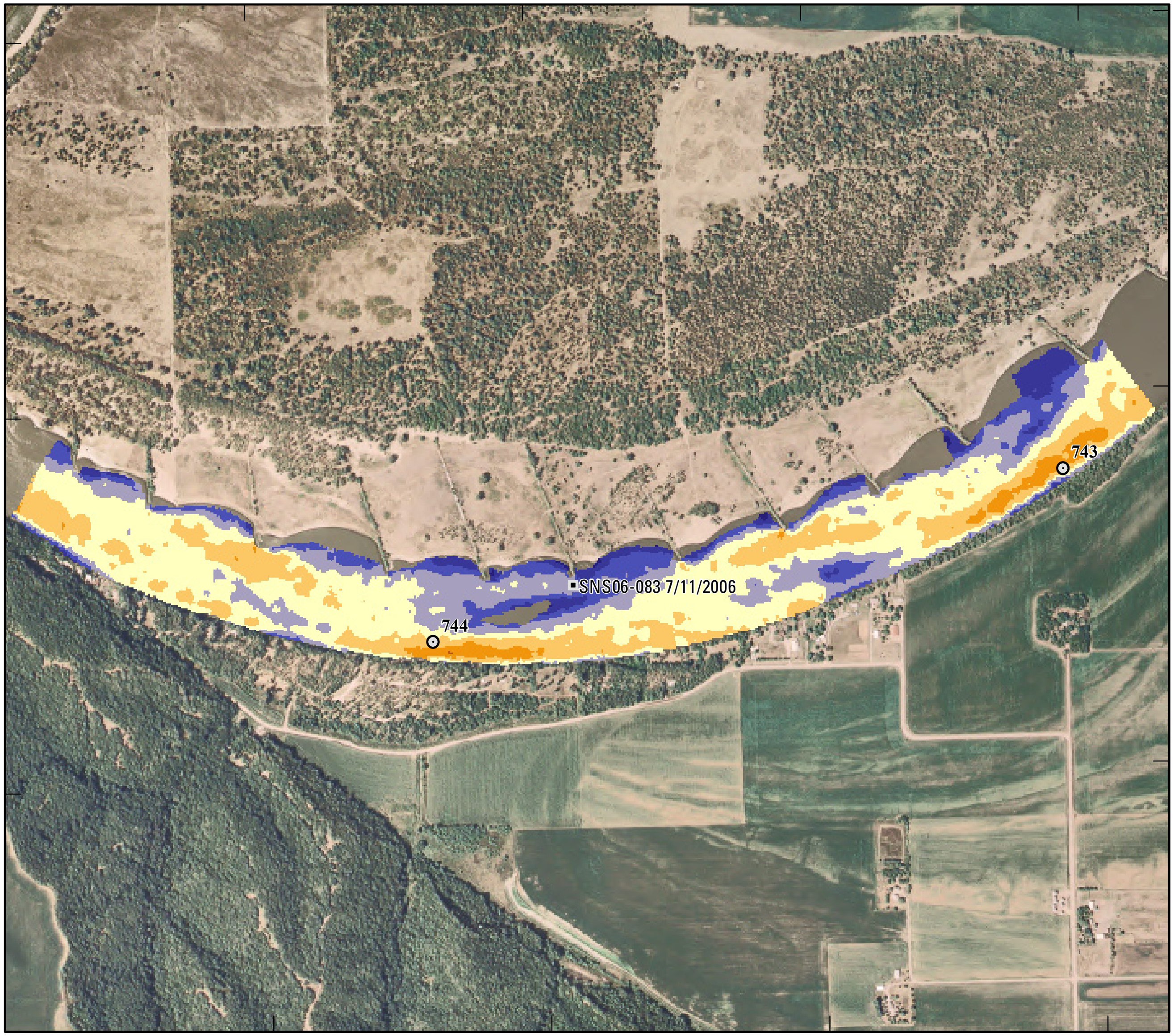
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers; Sturgeon relocations from U.S. Geological Survey, DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 64. Map of generalized substrate based on data collected on July 12, 2006, in the vicinity of river mile 744.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on July 12, 2006.

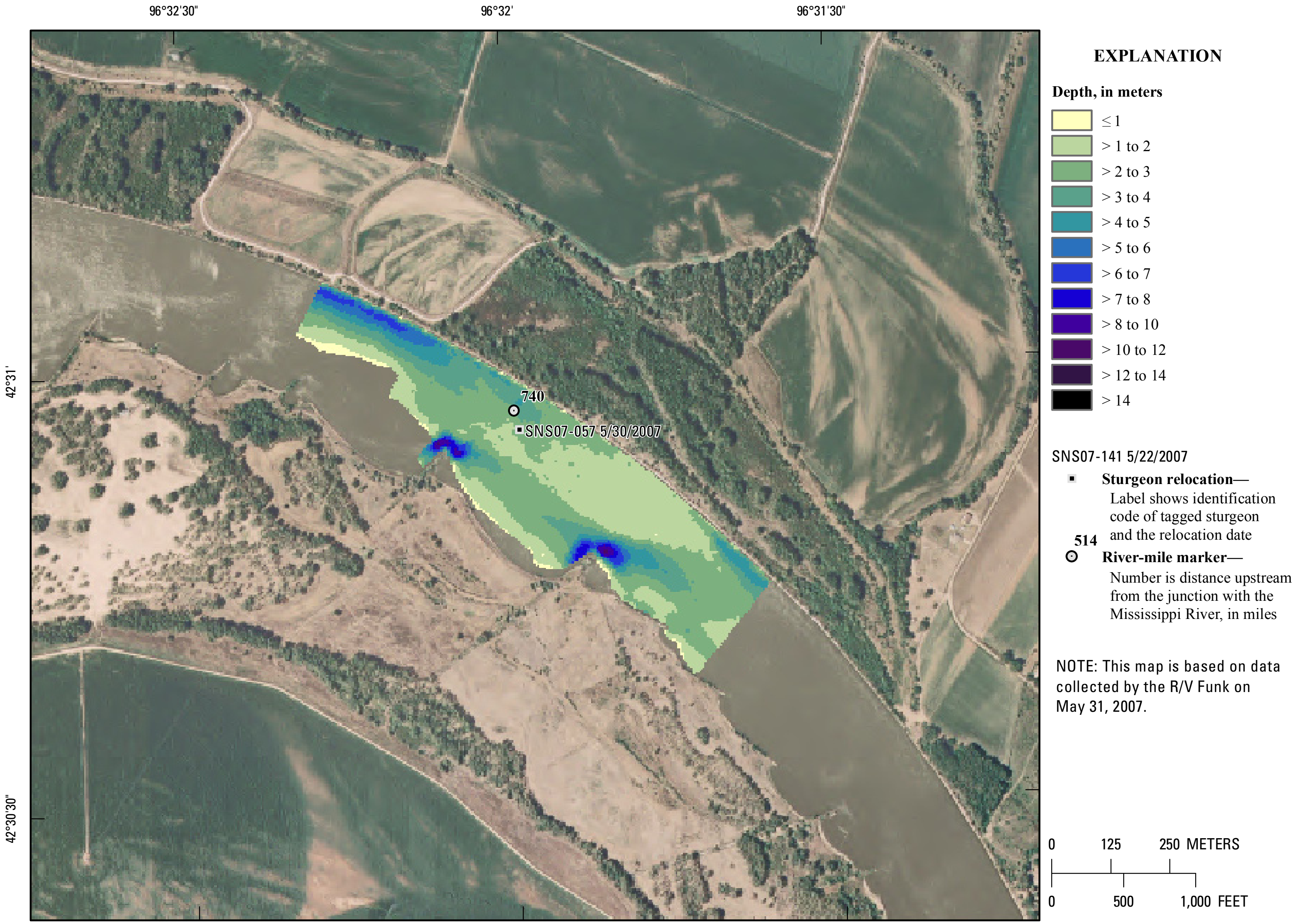
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

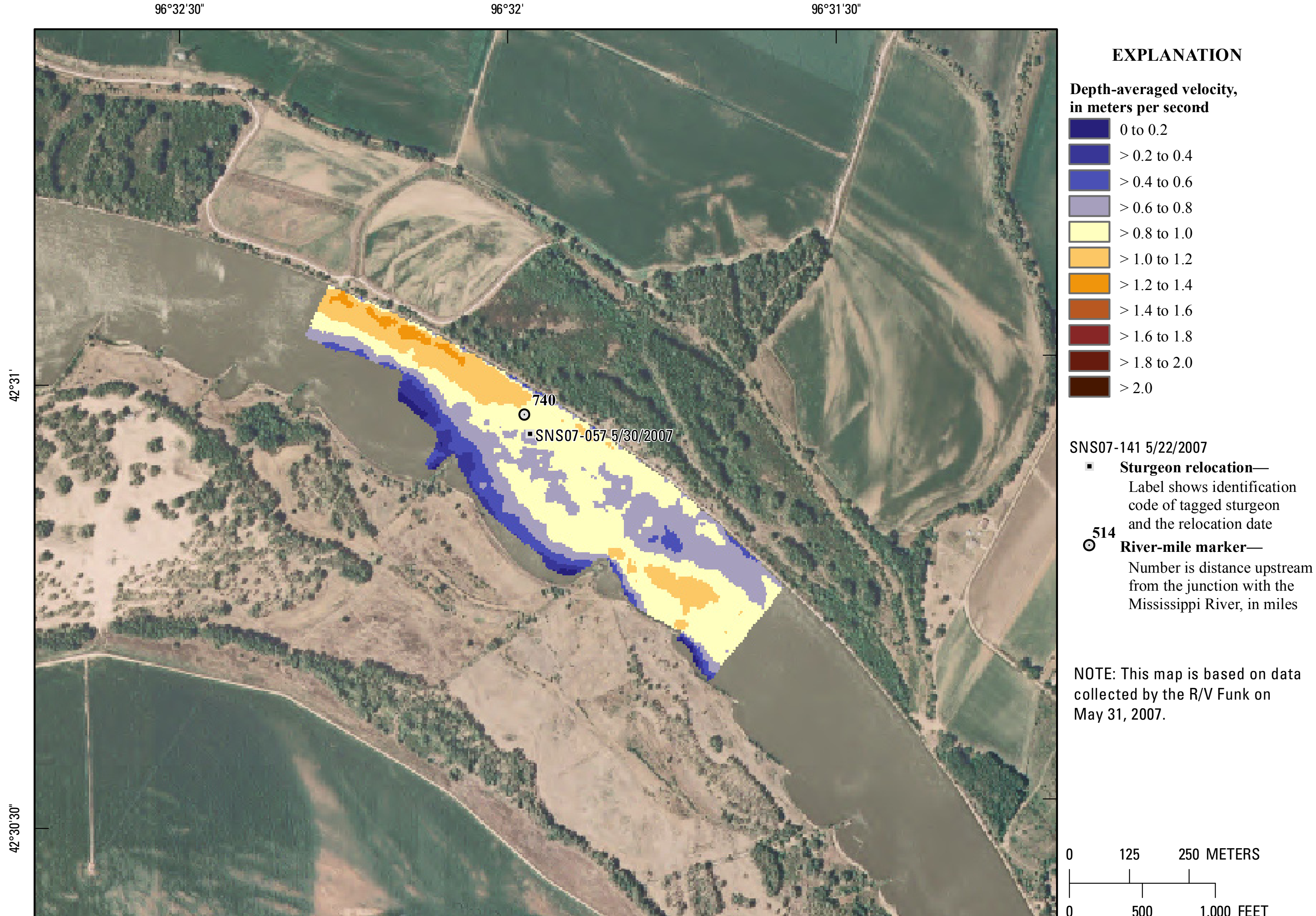
Figure 65. Map of depth-averaged velocity based on data collected on July 12, 2006, in the vicinity of river mile 744.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 66. Map of depth based on data collected on May 31, 2007, in the vicinity of river mile 740.

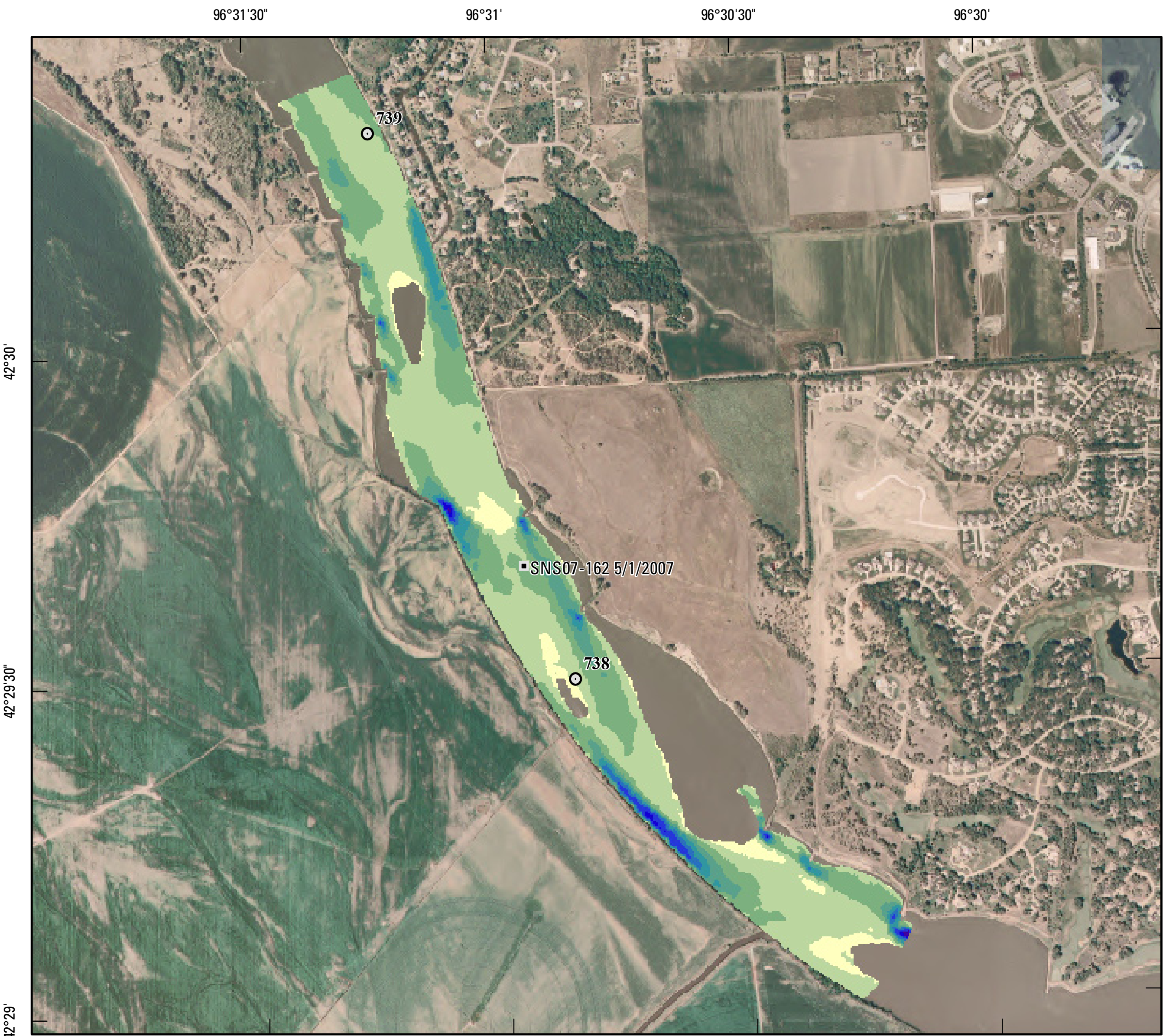


Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 67. Map of depth-averaged velocity based on data collected on May 31, 2007, in the vicinity of river mile 740.

Figure 68. Map of side-scan sonar imagery based on data collected on May 31, 2007, in the vicinity of river mile 740.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

SNS07-141 5/22/2007 **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 2, 2007.

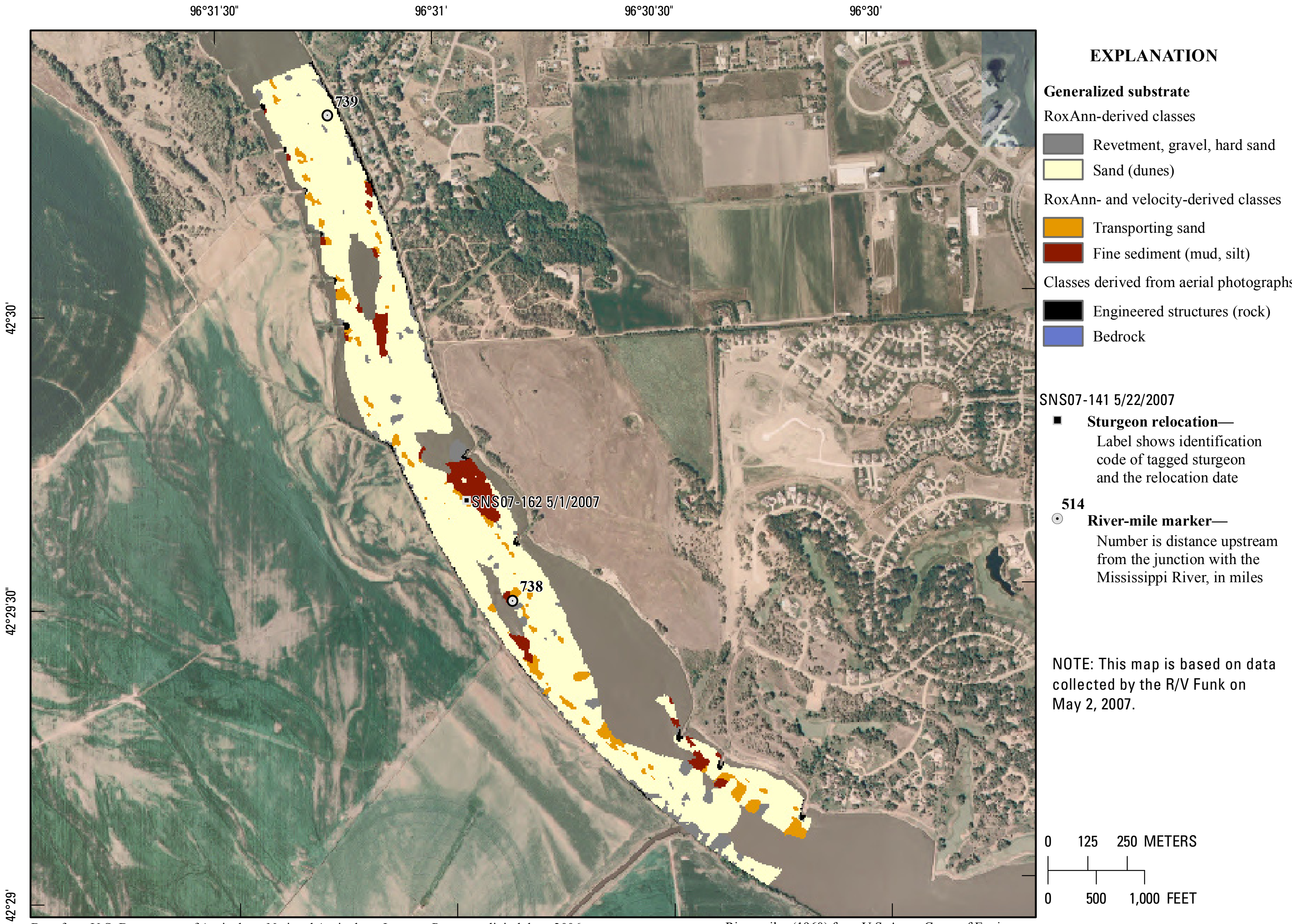
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

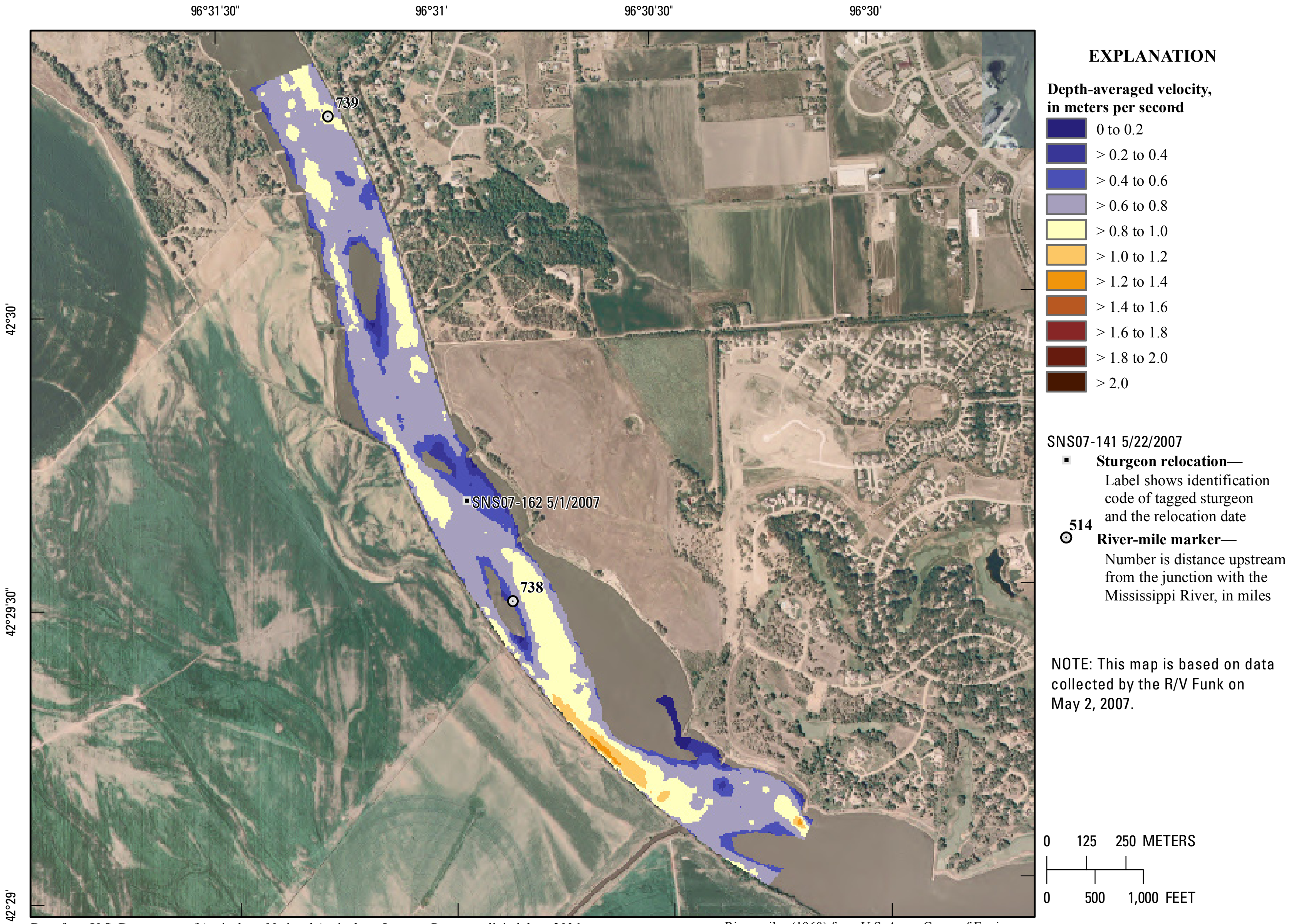
Figure 69. Map of depth based on data collected on May 2, 2007, in the vicinity of river mile 738.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 70. Map of generalized substrate based on data collected on May 2, 2007, in the vicinity of river mile 738.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 71. Map of depth-averaged velocity based on data collected on May 2, 2007, in the vicinity of river mile 738.

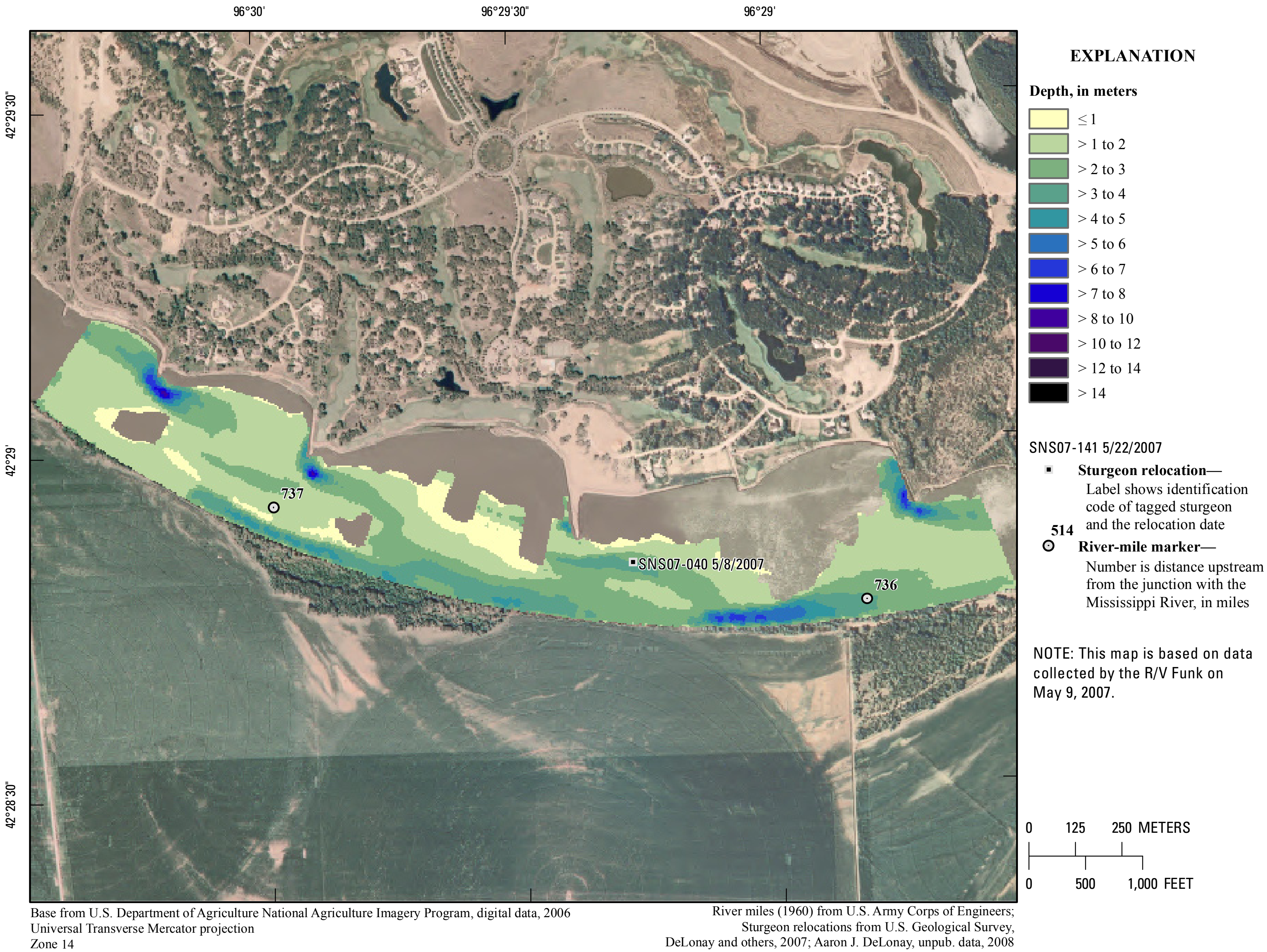
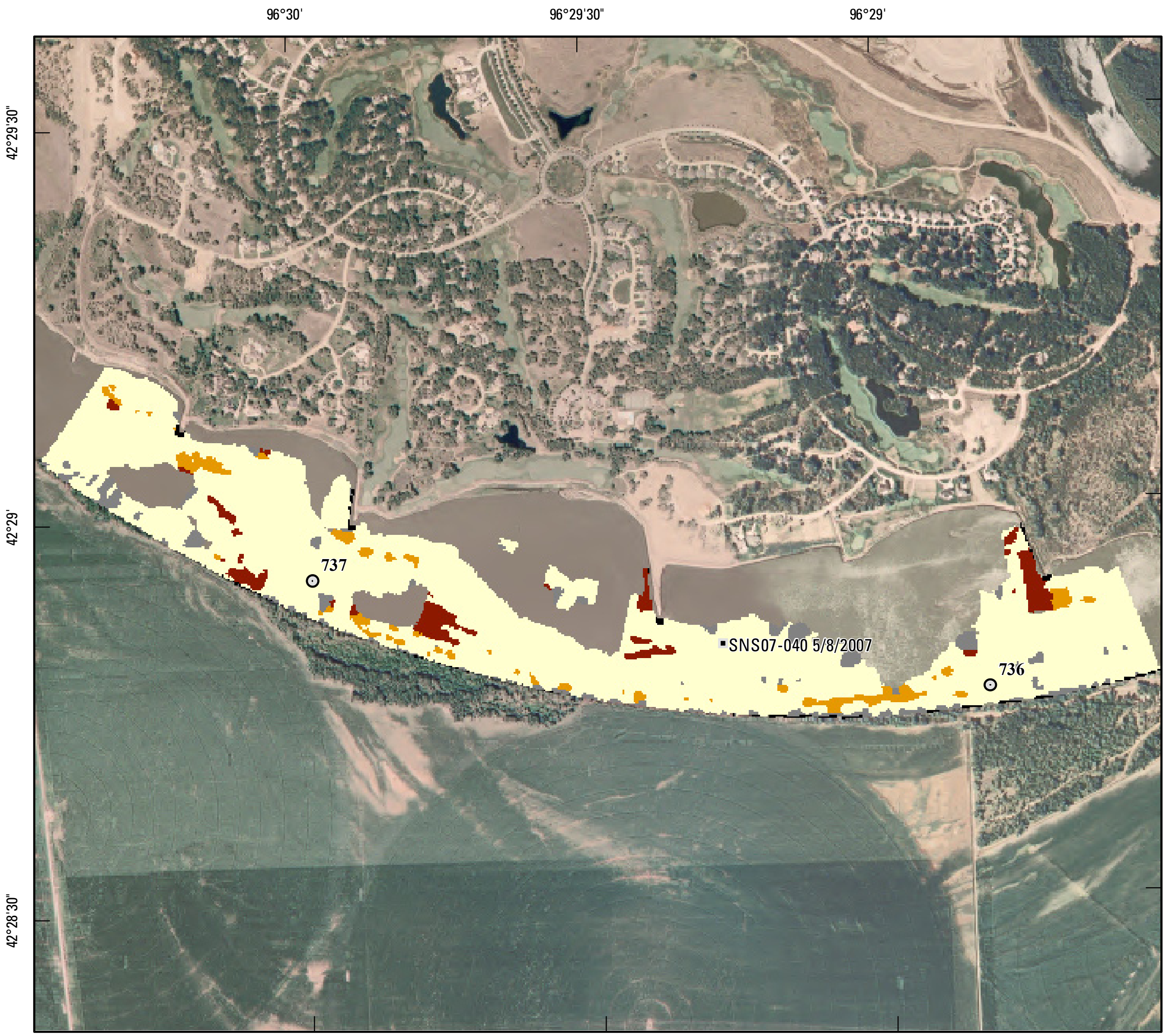


Figure 72. Map of depth based on data collected on May 9, 2007, in the vicinity of river mile 737.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 73. Map of generalized substrate based on data collected on May 9, 2007, in the vicinity of river mile 737.

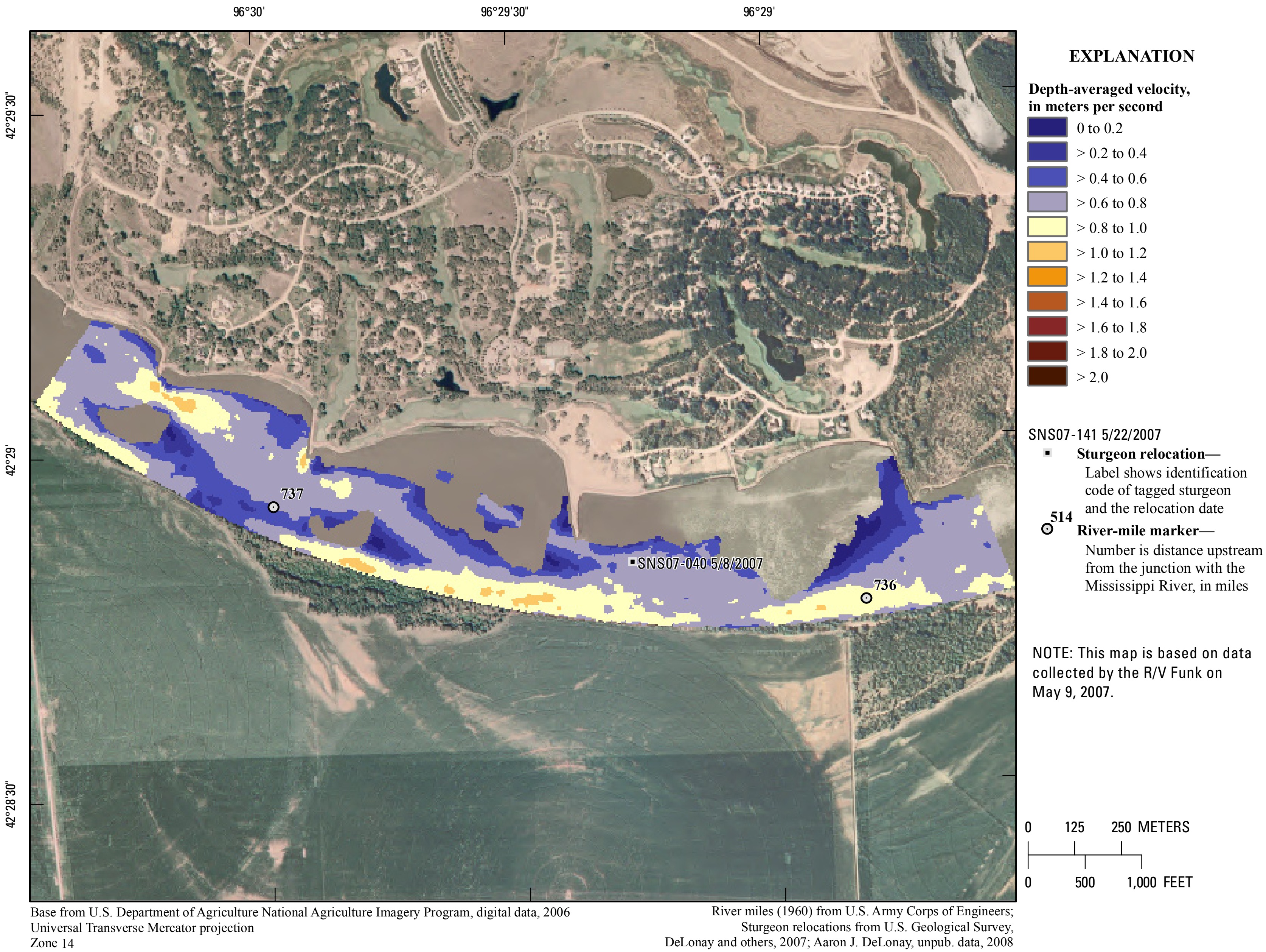
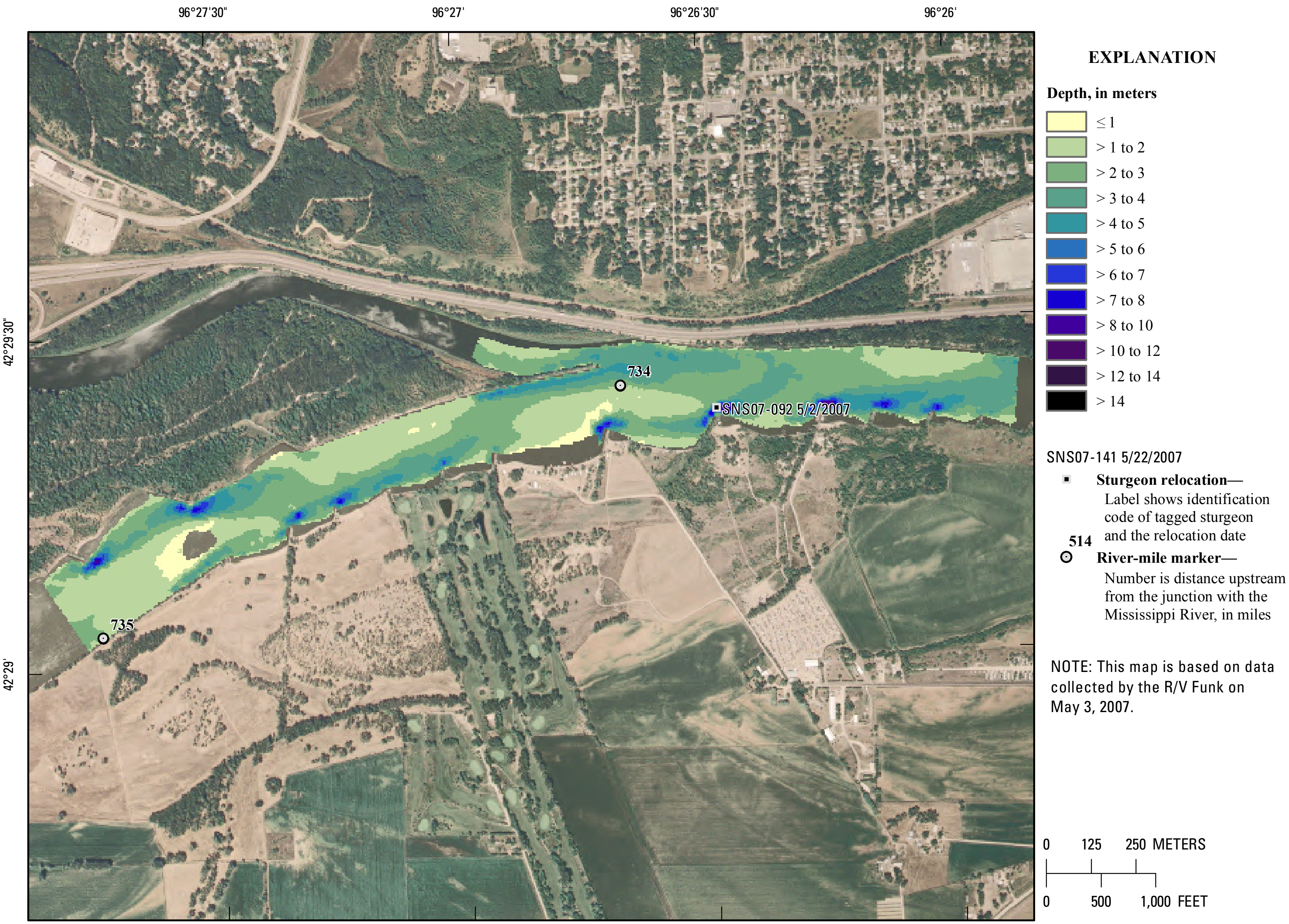


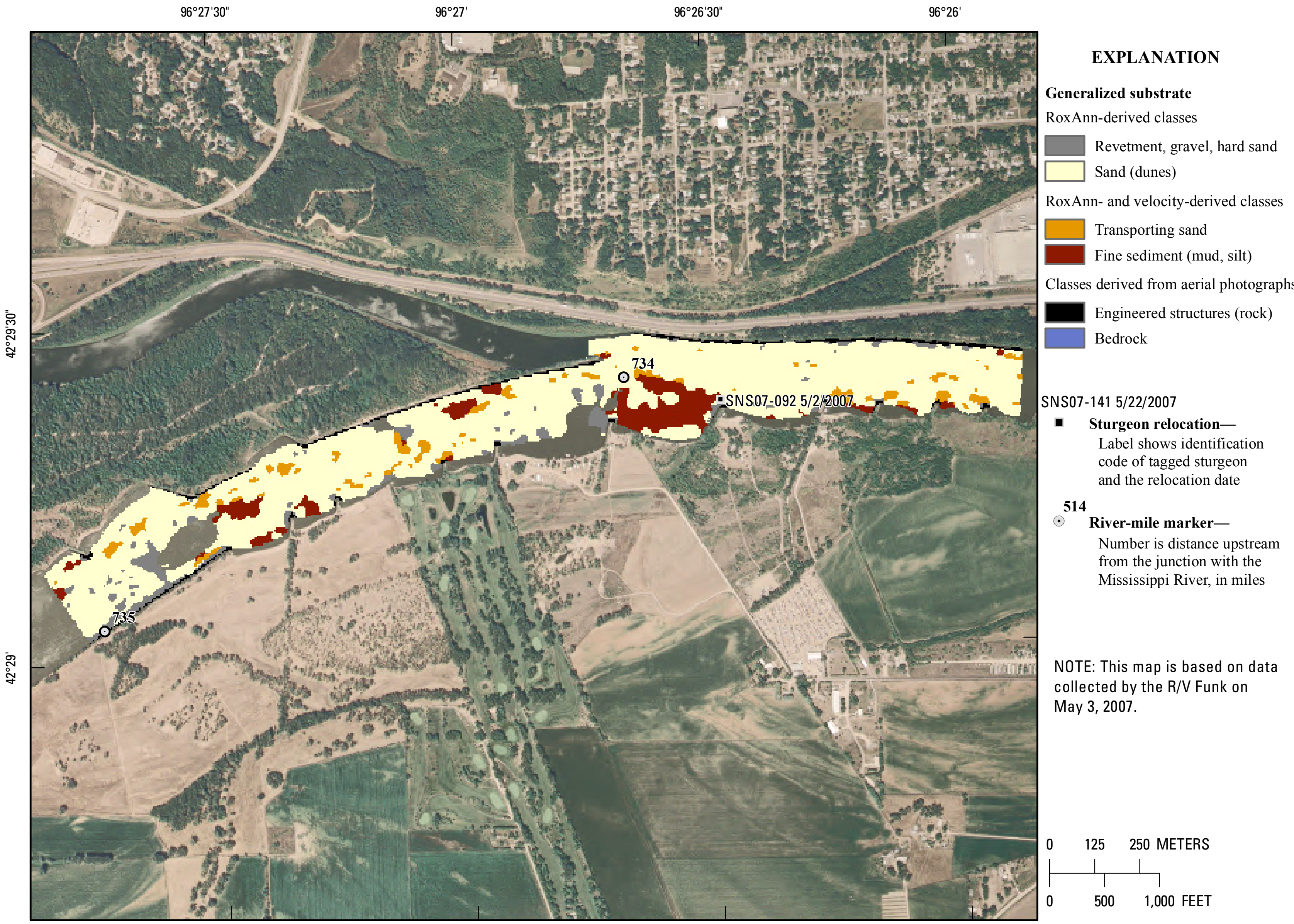
Figure 74. Map of depth-averaged velocity based on data collected on May 9, 2007, in the vicinity of river mile 737.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

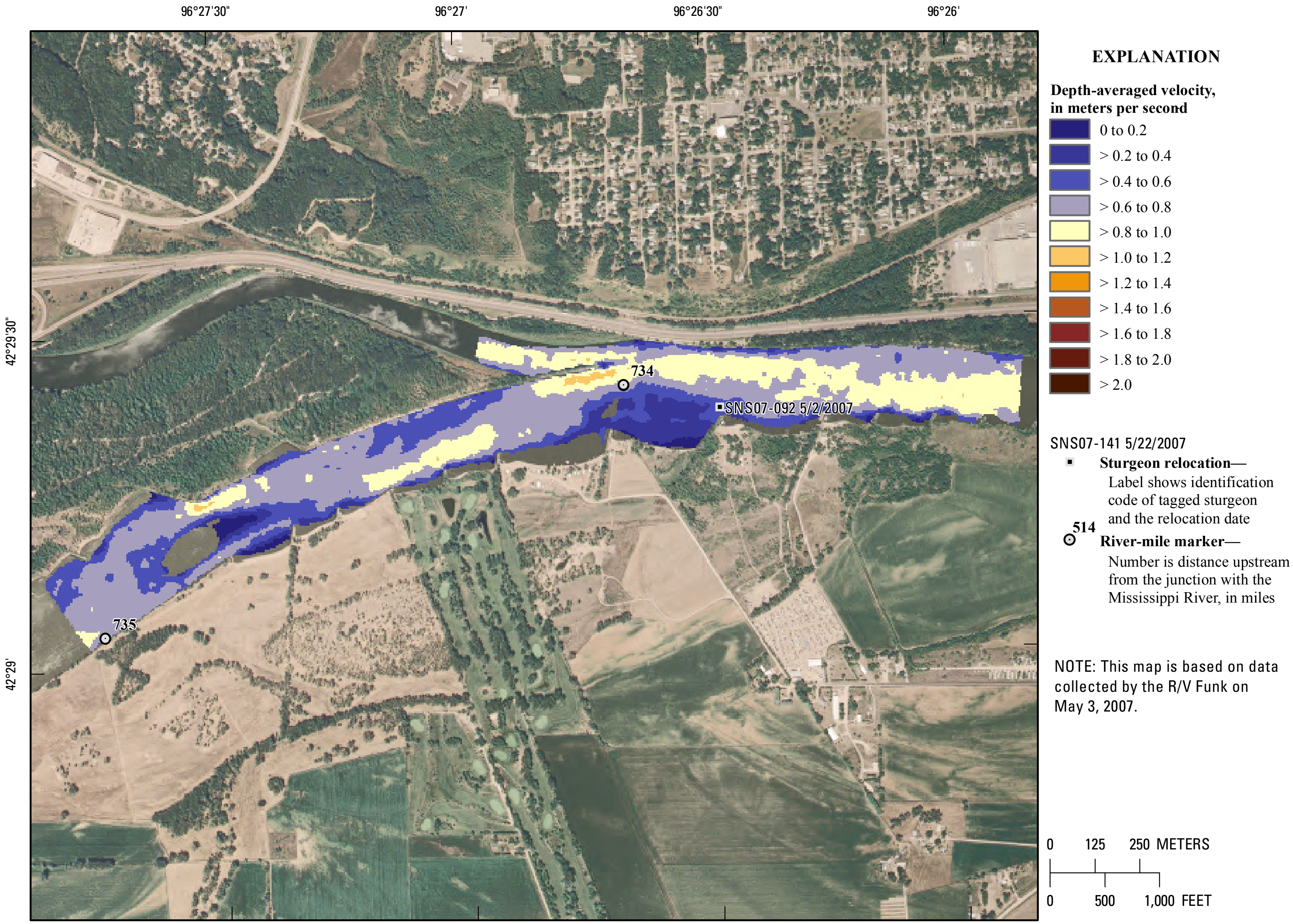
Figure 75. Map of depth based on data collected on May 3, 2007, in the vicinity of river mile 734.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 76. Map of generalized substrate based on data collected on May 3, 2007, in the vicinity of river mile 734.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 77. Map of depth-averaged velocity based on data collected on May 3, 2007, in the vicinity of river mile 734.

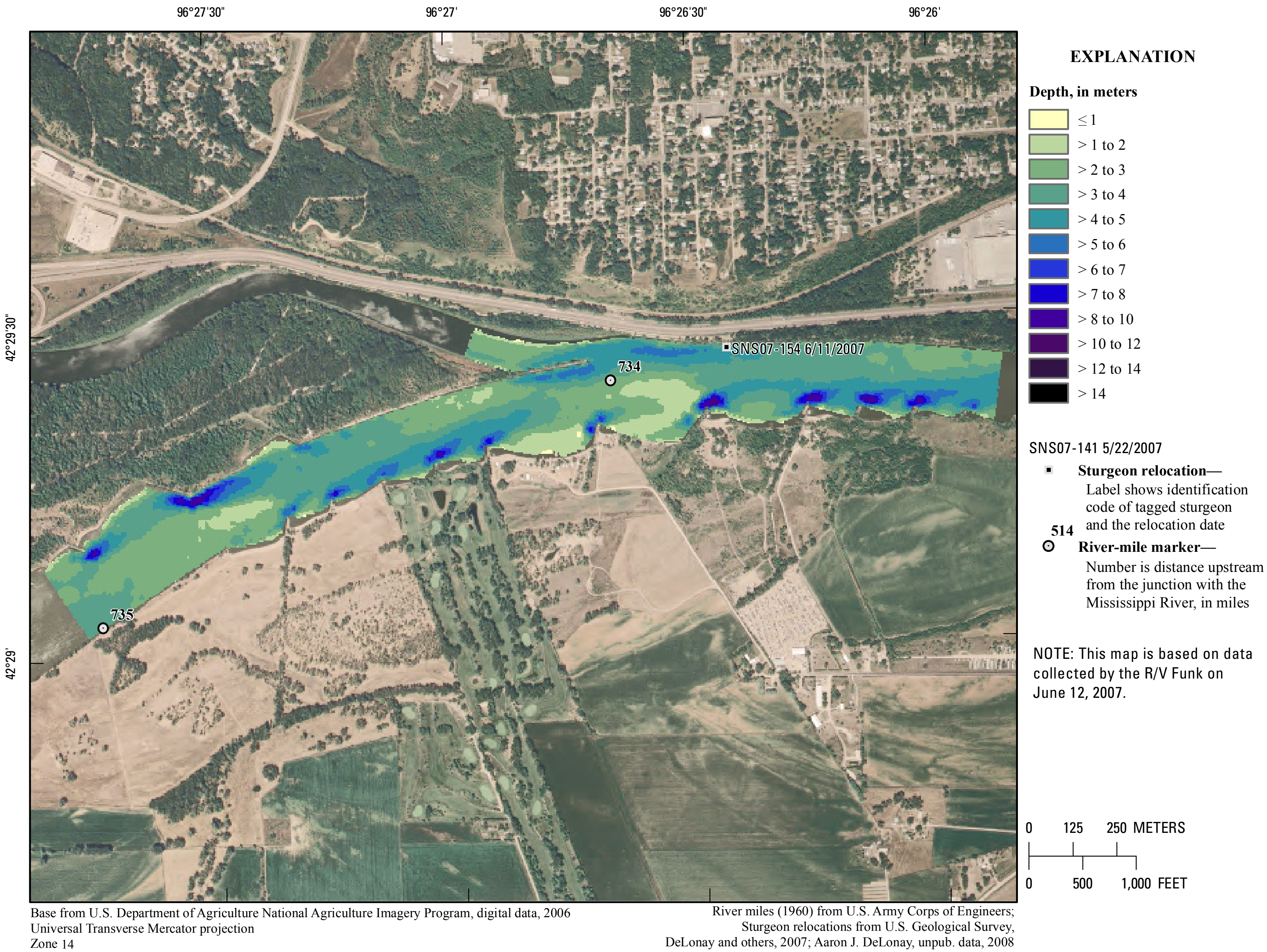
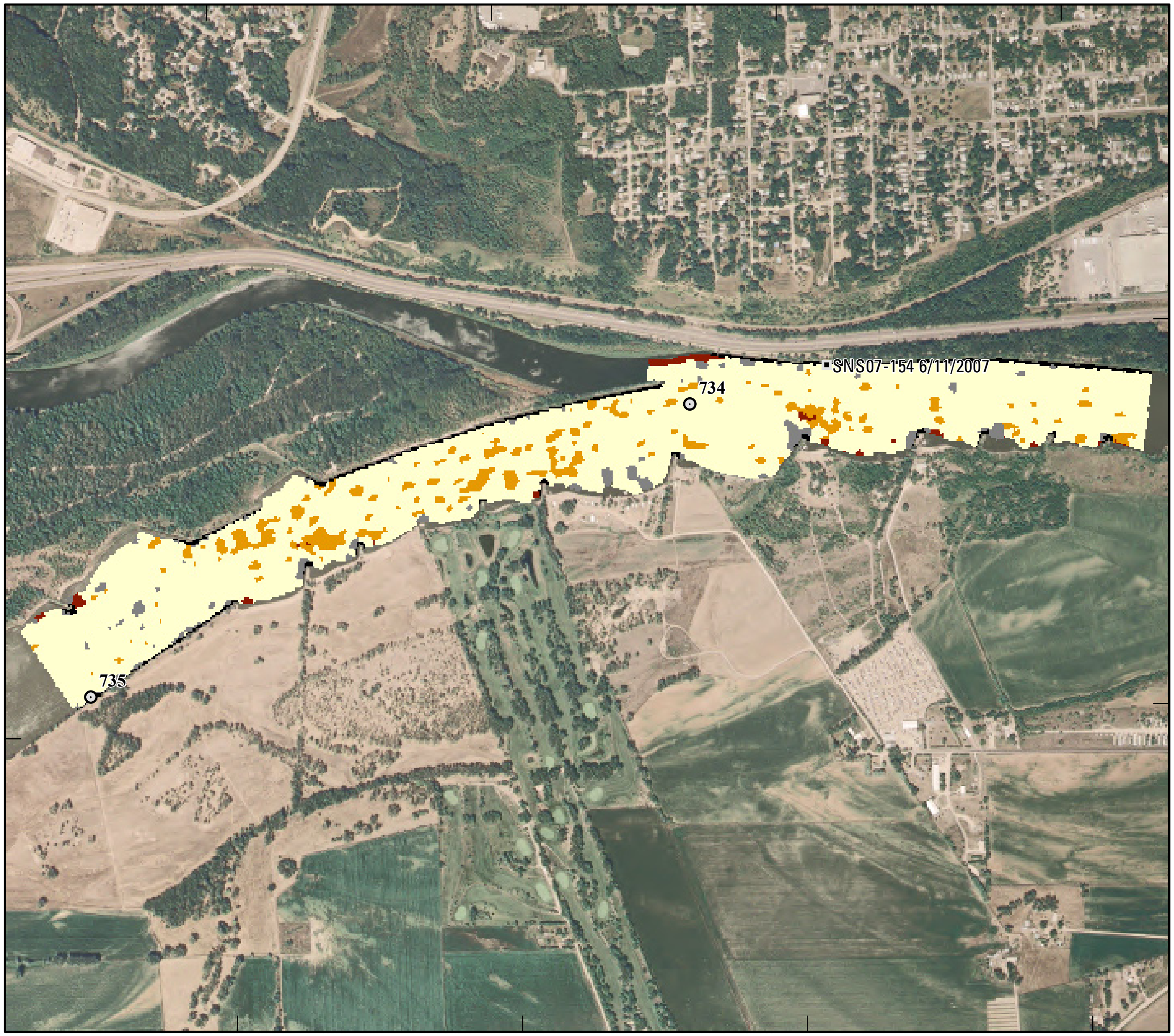


Figure 78. Map of depth based on data collected on June 12, 2007, in the vicinity of river mile 734.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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■ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514

⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 12, 2007.

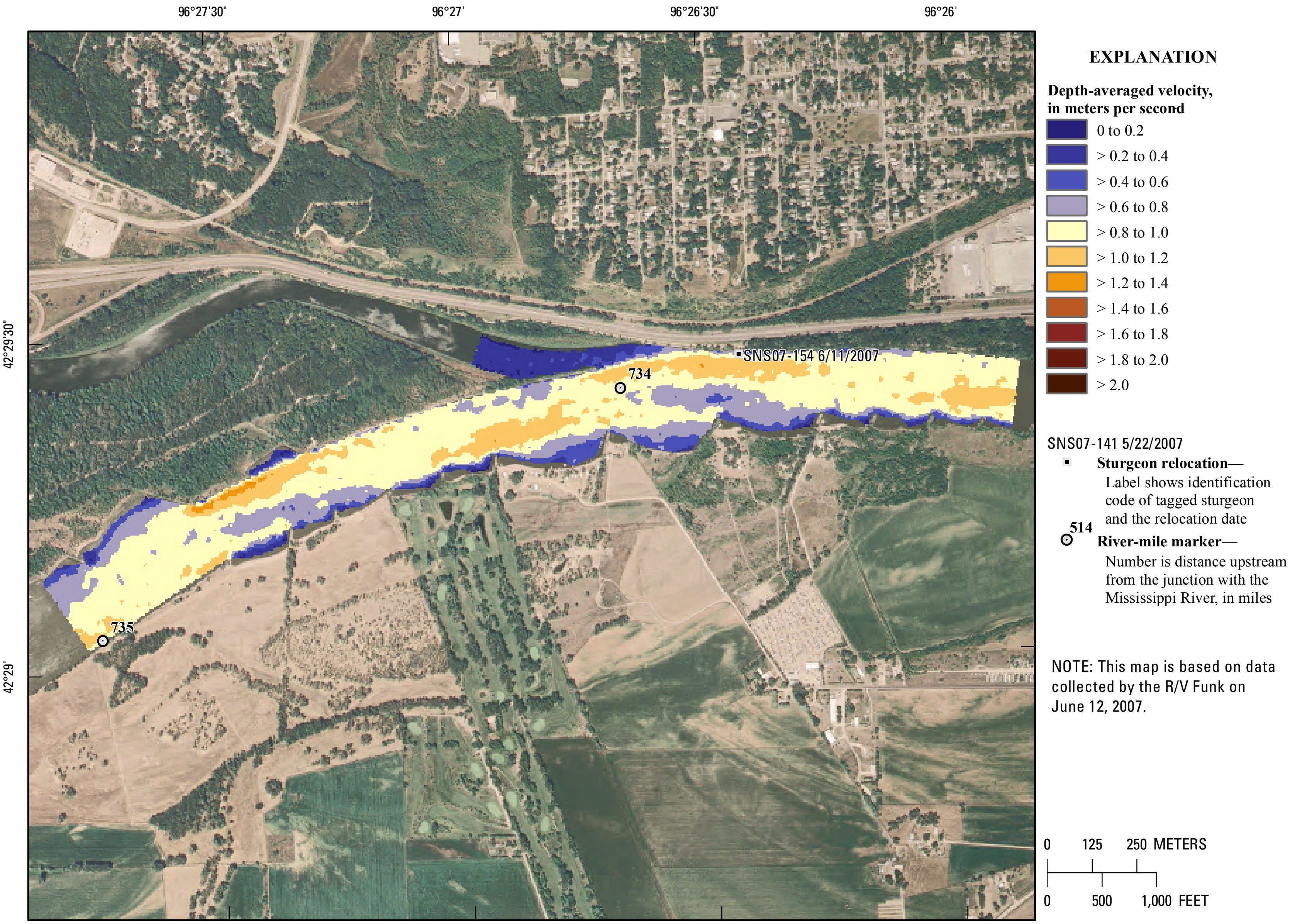
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

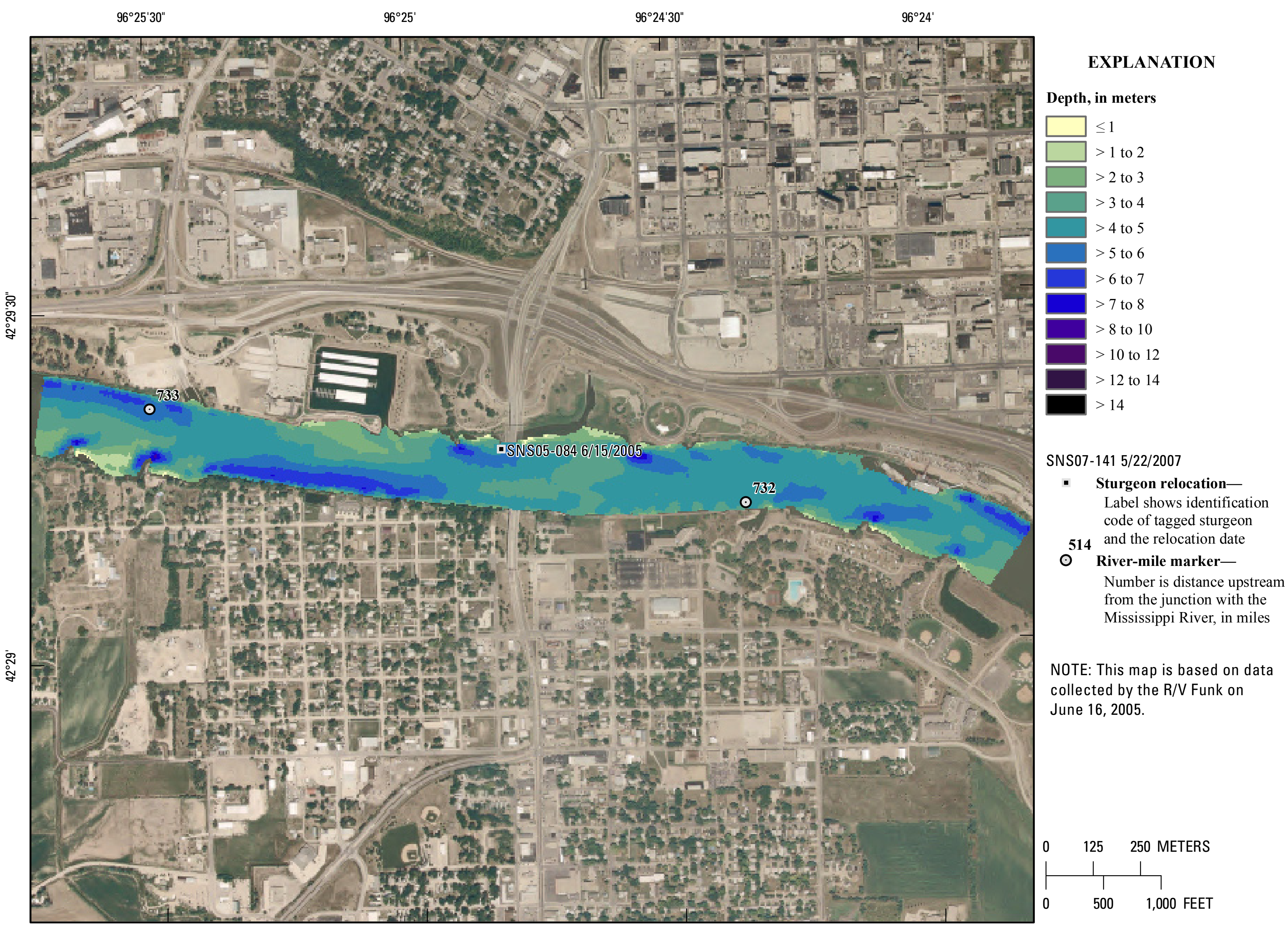
Figure 79. Map of generalized substrate based on data collected on June 12, 2007, in the vicinity of river mile 734.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 80. Map of depth-averaged velocity based on data collected on June 12, 2007, in the vicinity of river mile 734.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 81. Map of depth based on data collected on June 16, 2005, in the vicinity of river mile 732.

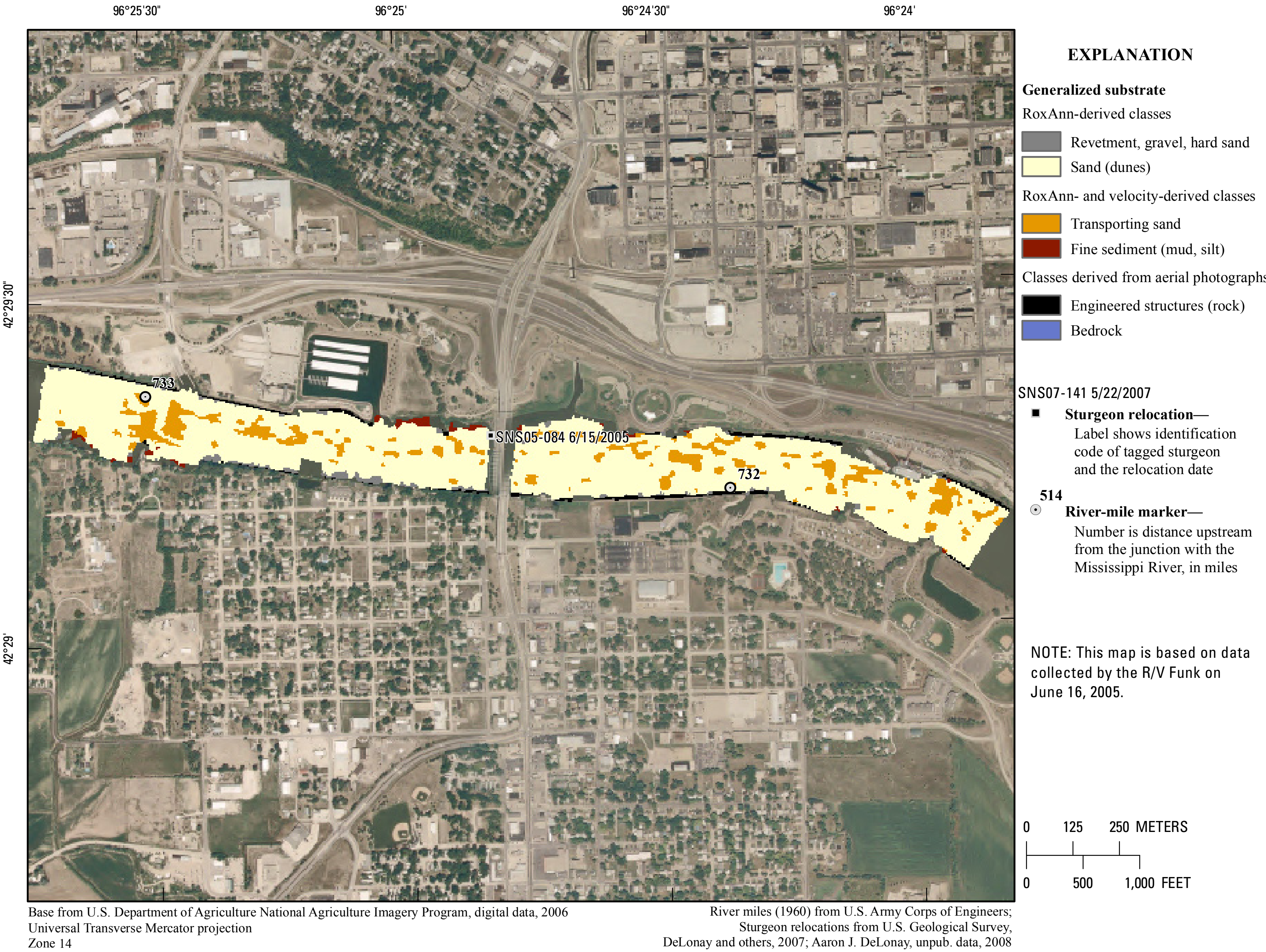
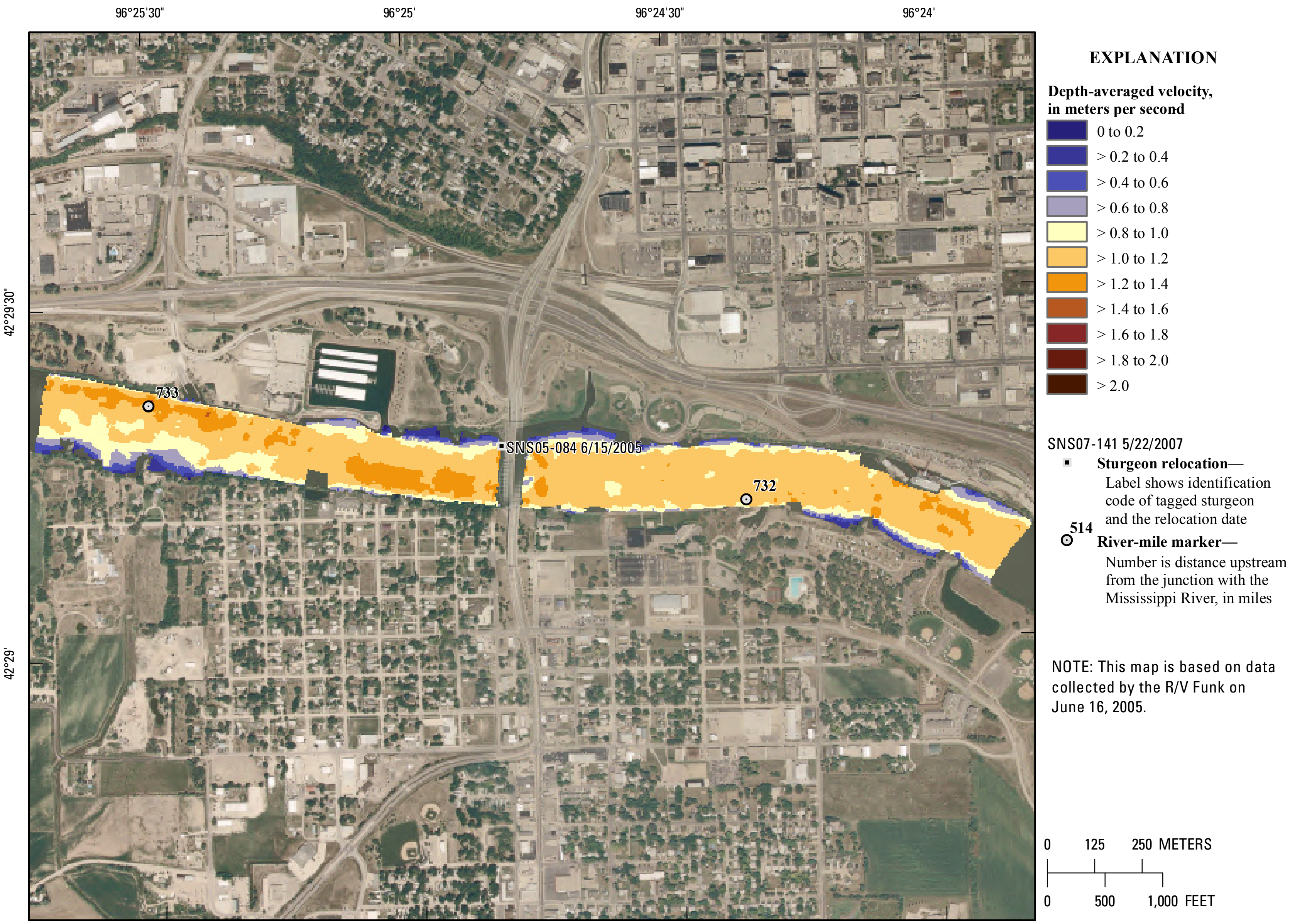


Figure 82. Map of generalized substrate based on data collected on June 16, 2005, in the vicinity of river mile 732.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 83. Map of depth-averaged velocity based on data collected on June 16, 2005, in the vicinity of river mile 732.

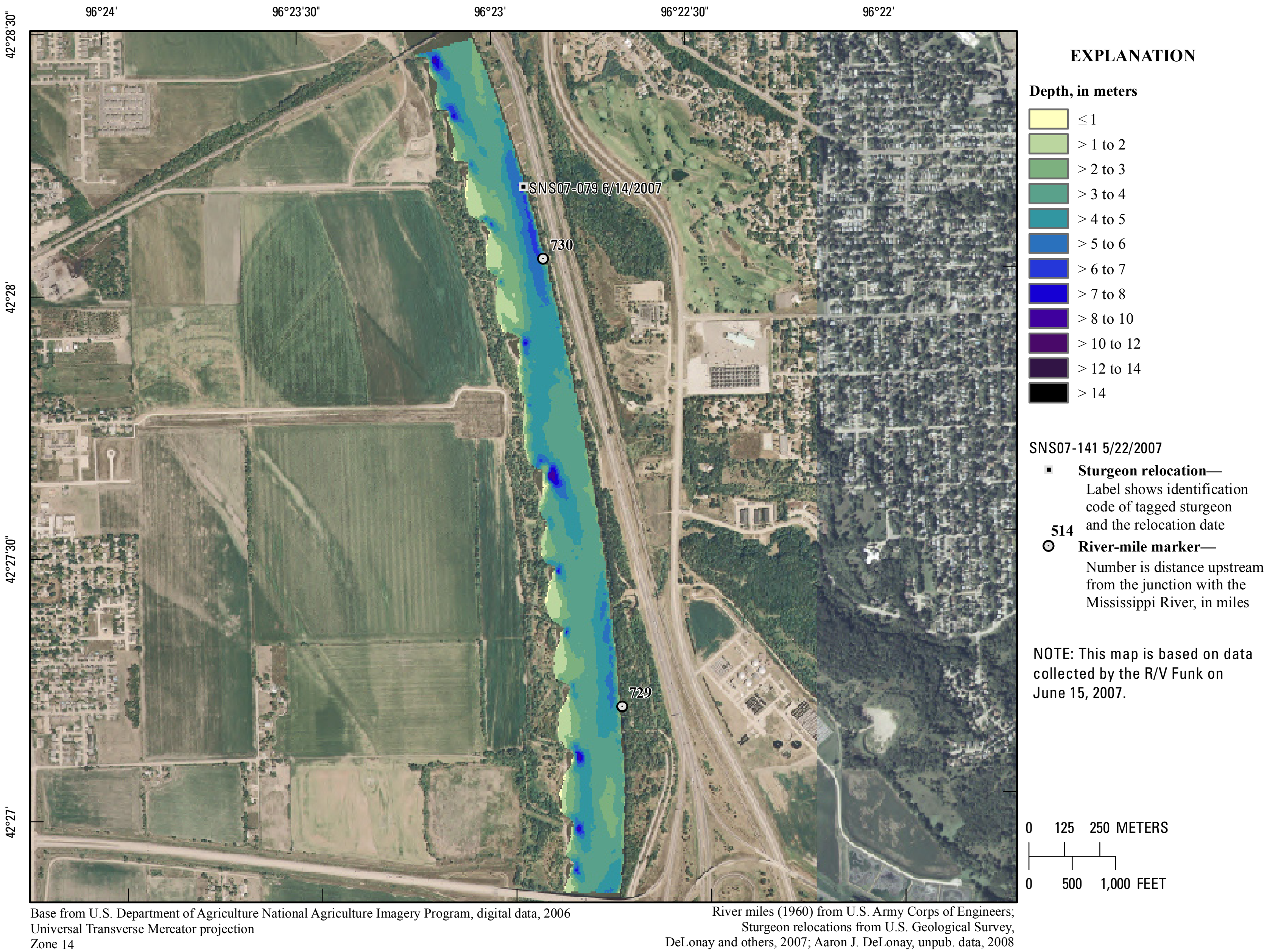
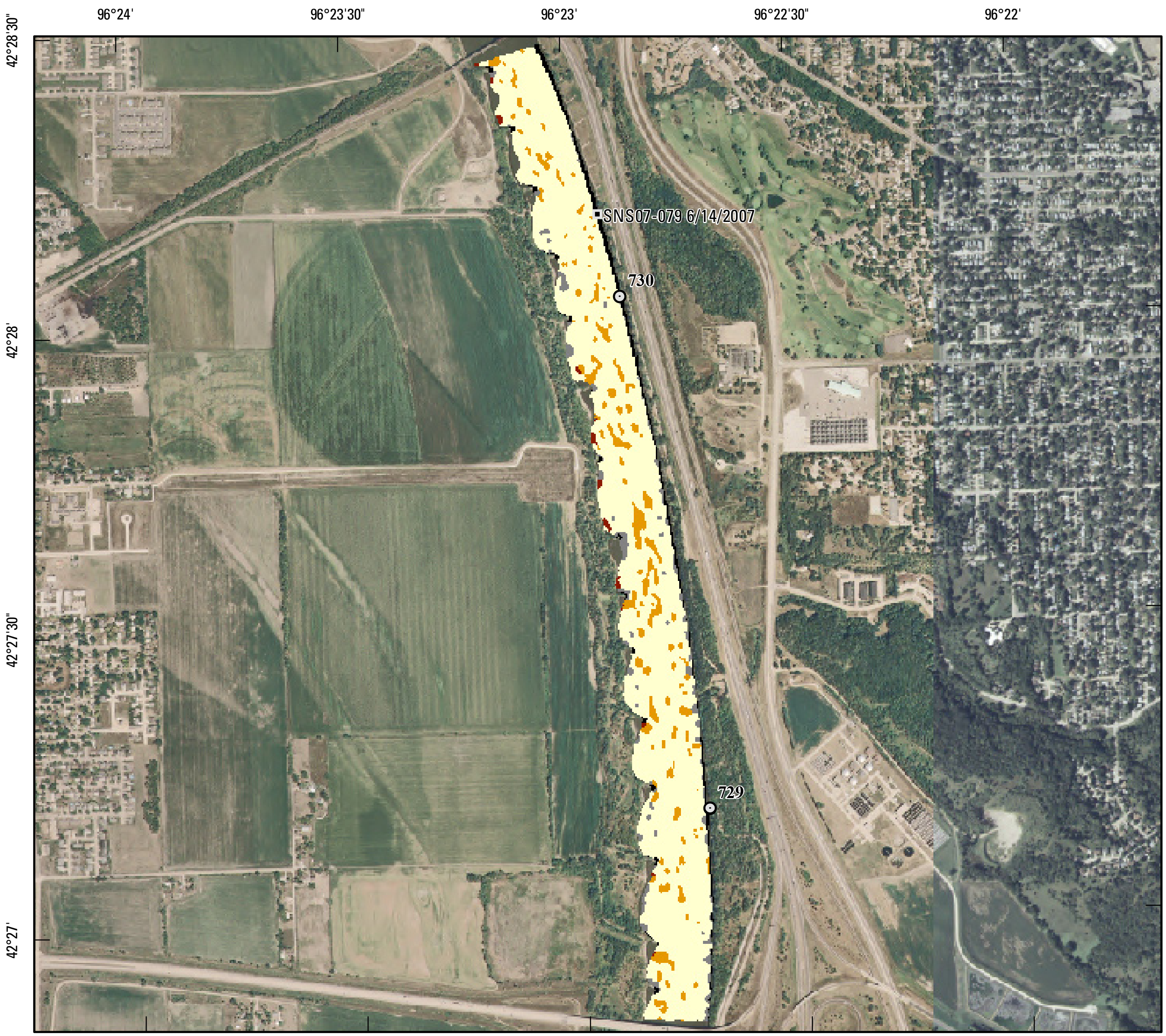


Figure 84. Map of depth based on data collected on June 15, 2007, in the vicinity of river mile 730.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

Revetment, gravel, hard sand

Sand (dunes)

RoxAnn- and velocity-derived classes

Transporting sand

Fine sediment (mud, silt)

Classes derived from aerial photographs

Engineered structures (rock)

Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 15, 2007.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 85. Map of generalized substrate based on data collected on June 15, 2007, in the vicinity of river mile 730.

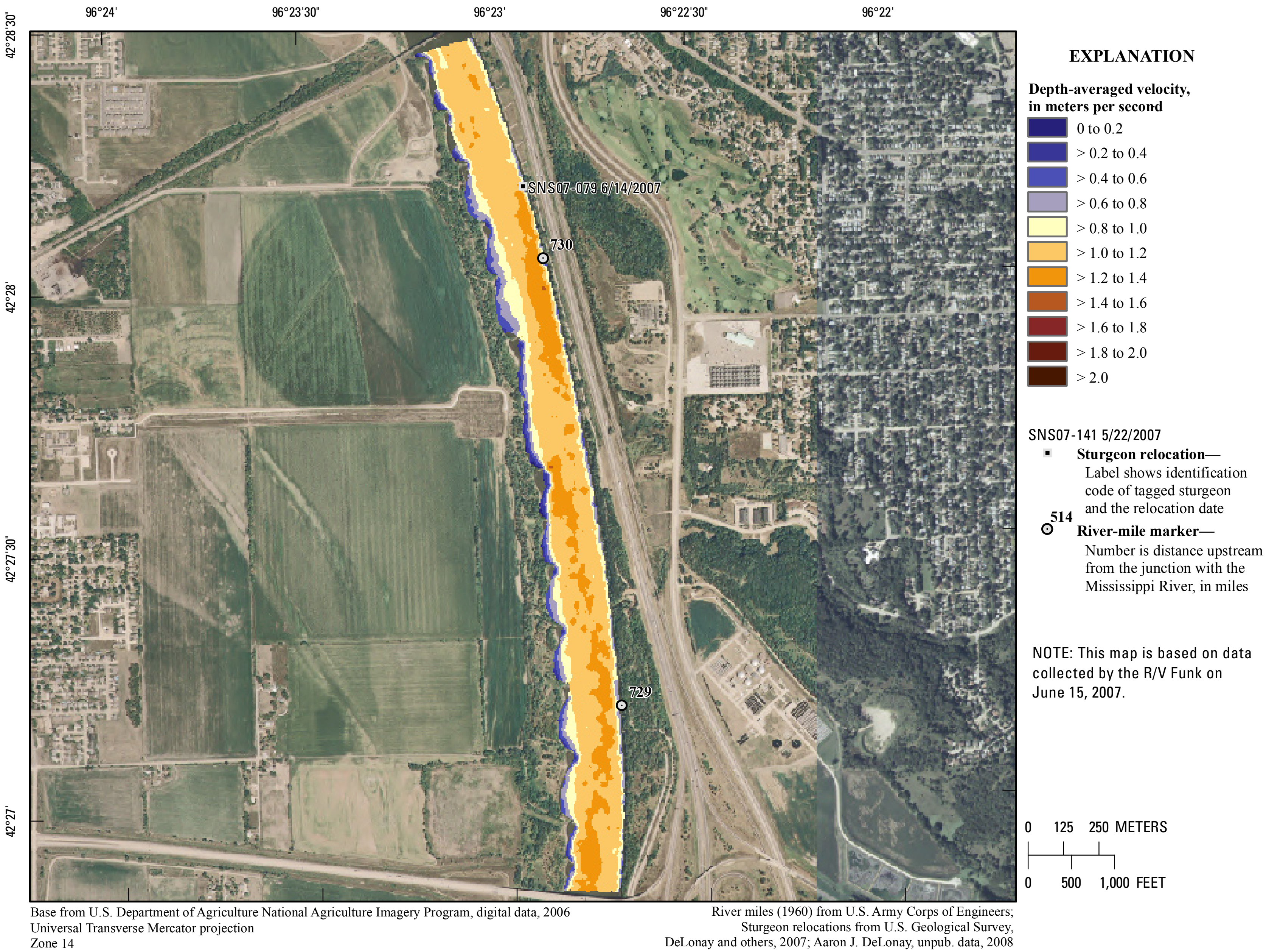
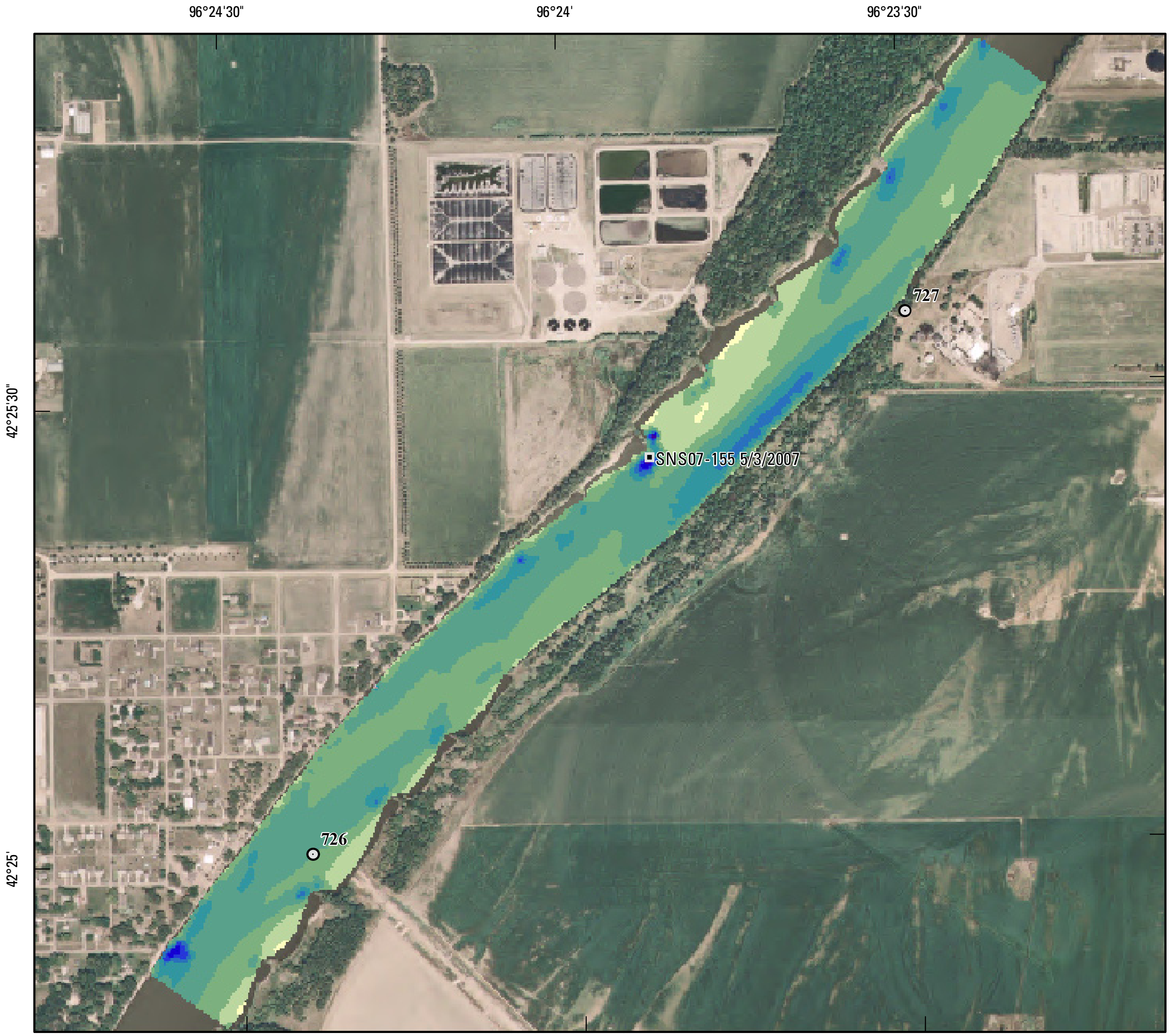


Figure 86. Map of depth-averaged velocity based on data collected on June 15, 2007, in the vicinity of river mile 730.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 4, 2007.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 87. Map of depth based on data collected on May 4, 2007, in the vicinity of river mile 727.

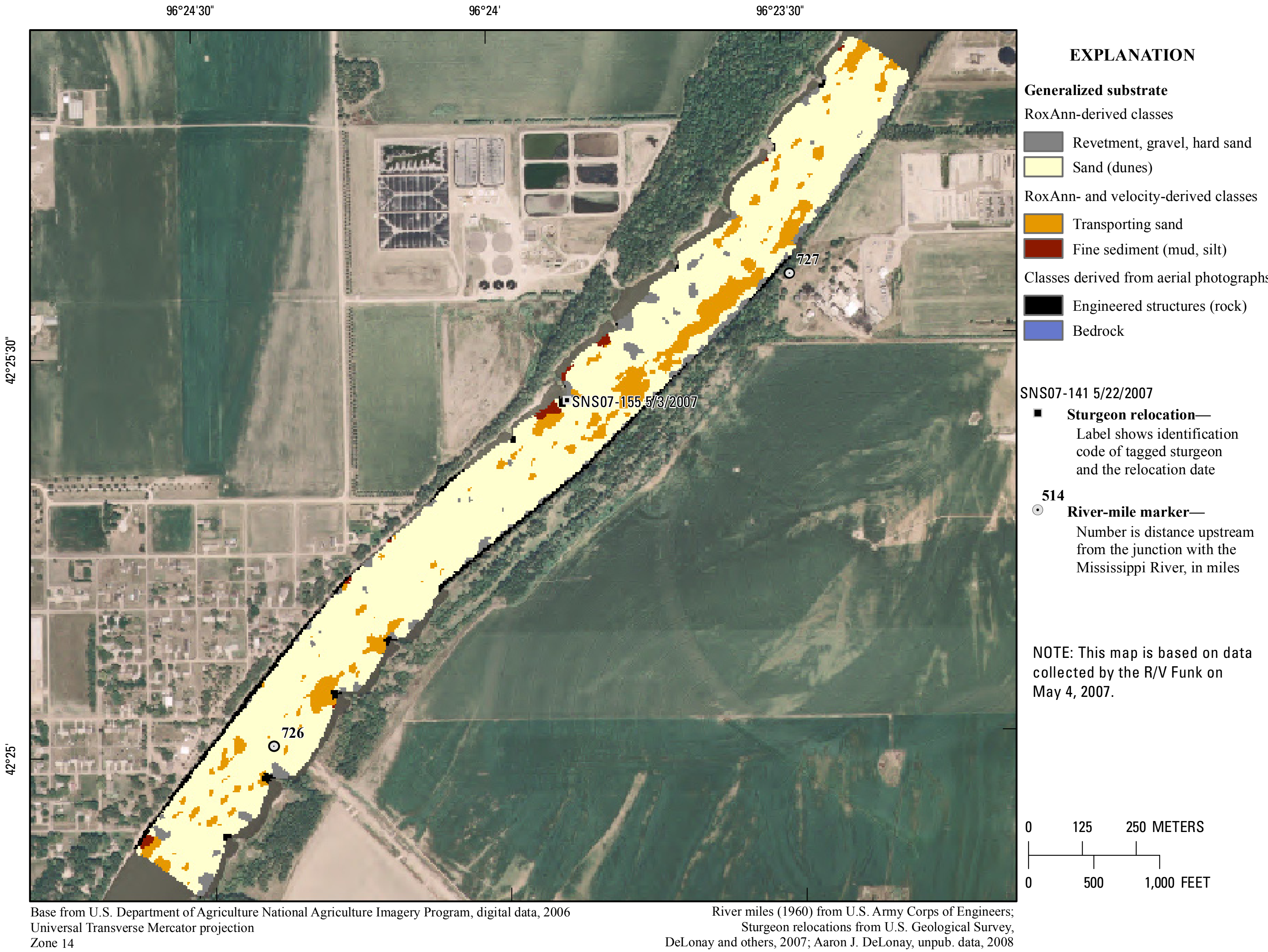
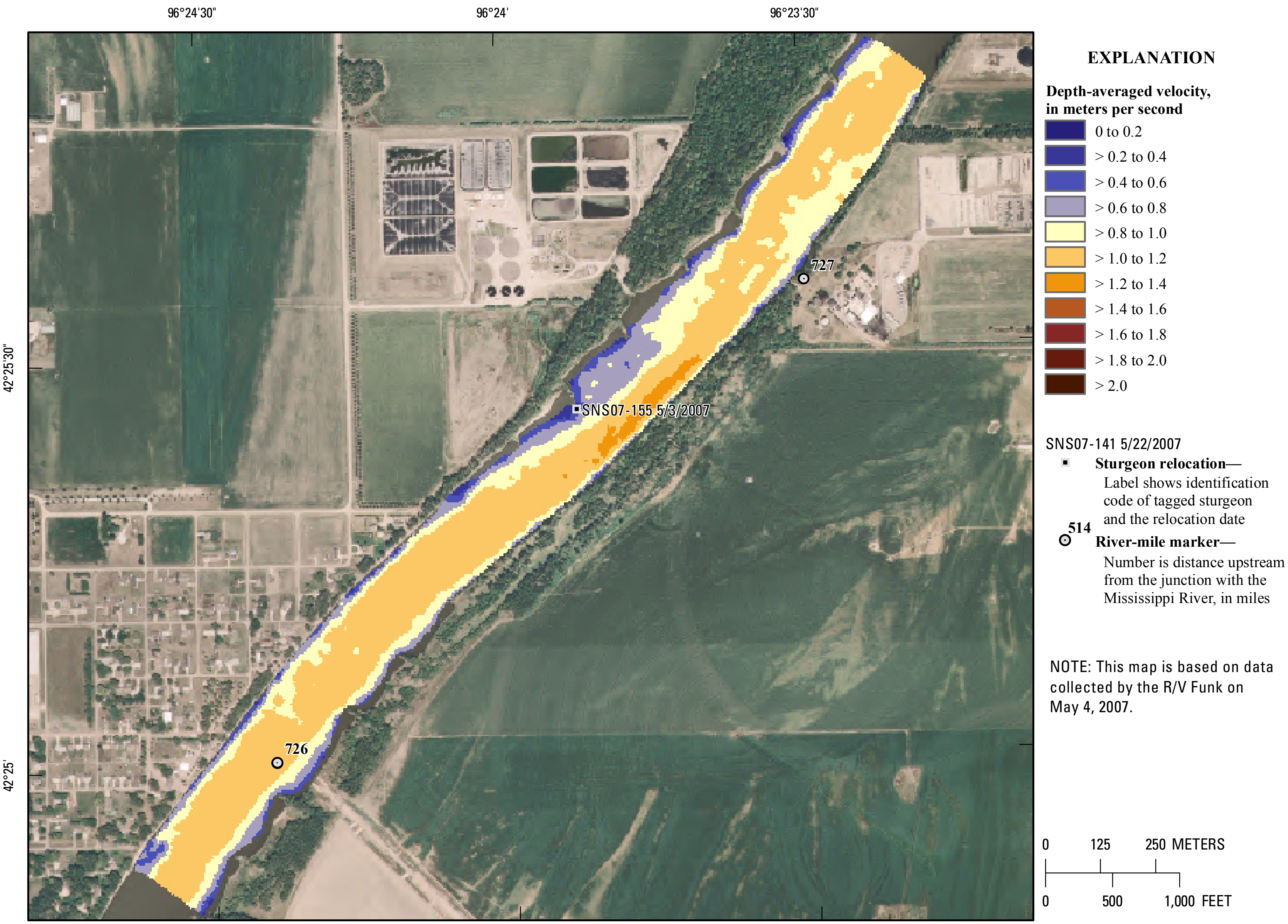


Figure 88. Map of generalized substrate based on data collected on May 4, 2007, in the vicinity of river mile 727.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 89. Map of depth-averaged velocity based on data collected on May 4, 2007, in the vicinity of river mile 727.

EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 23, 2006.

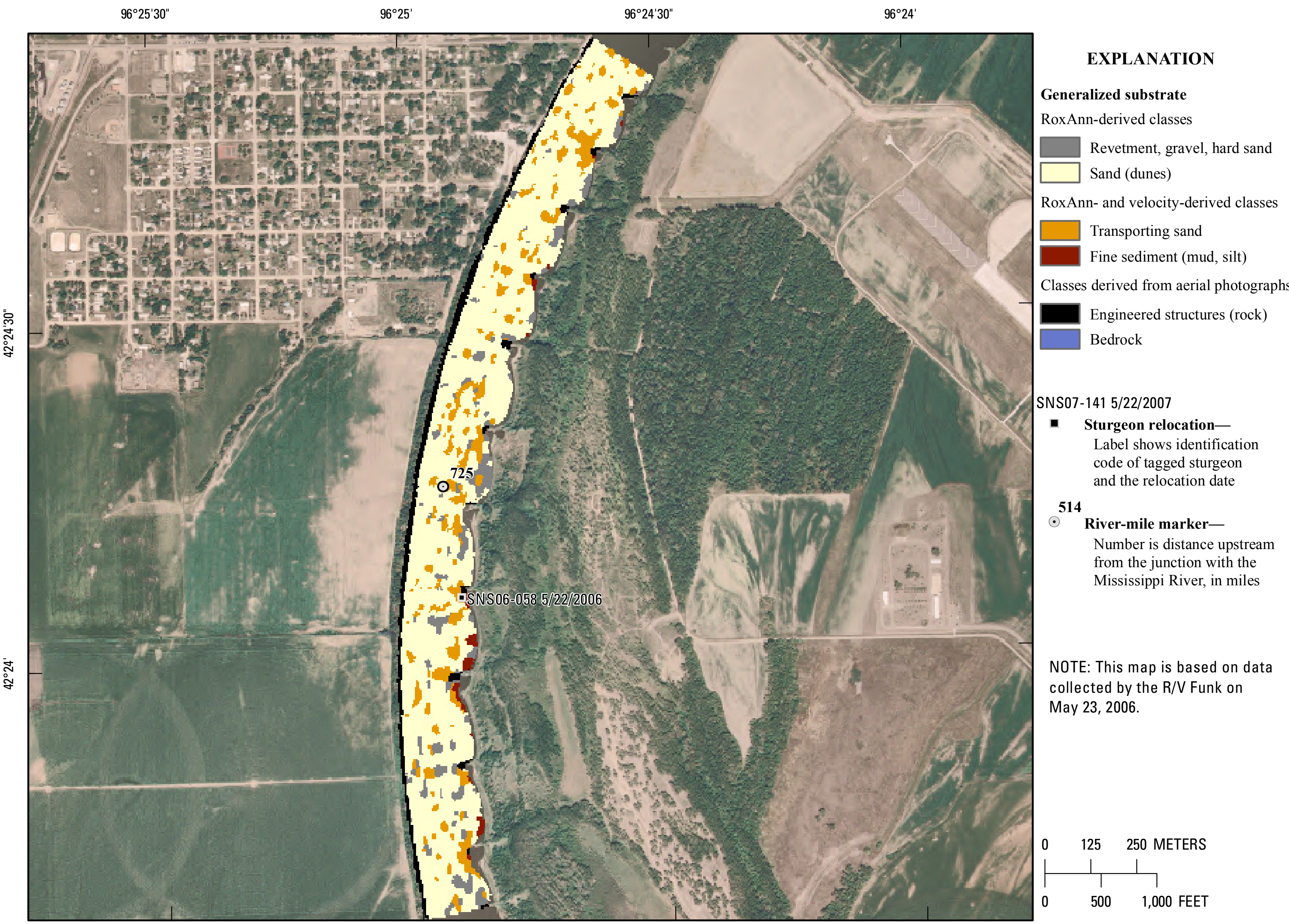
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 90. Map of depth based on data collected on May 23, 2006, in the vicinity of river mile 725.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 91. Map of generalized substrate based on data collected on May 23, 2006, in the vicinity of river mile 725.

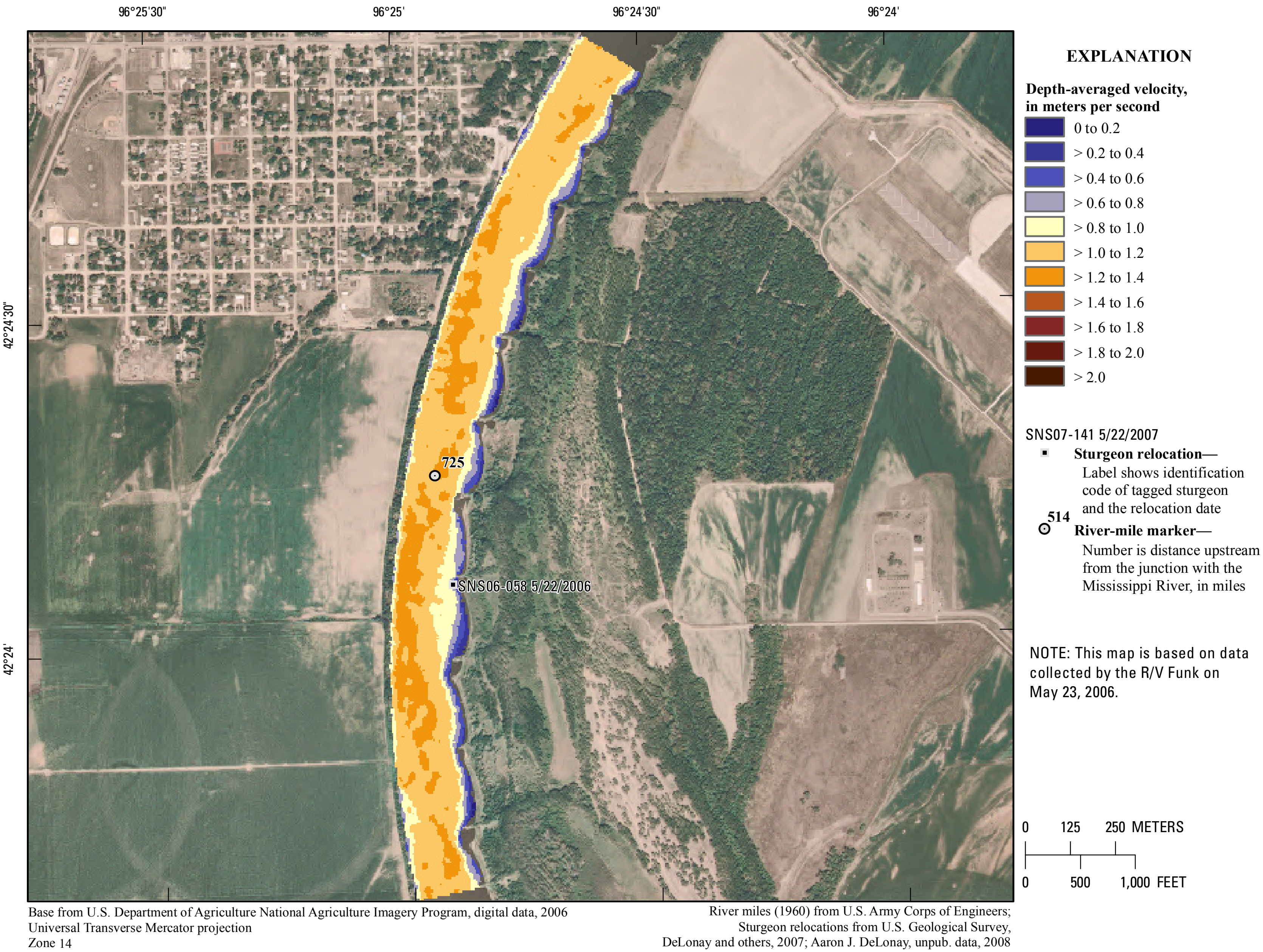
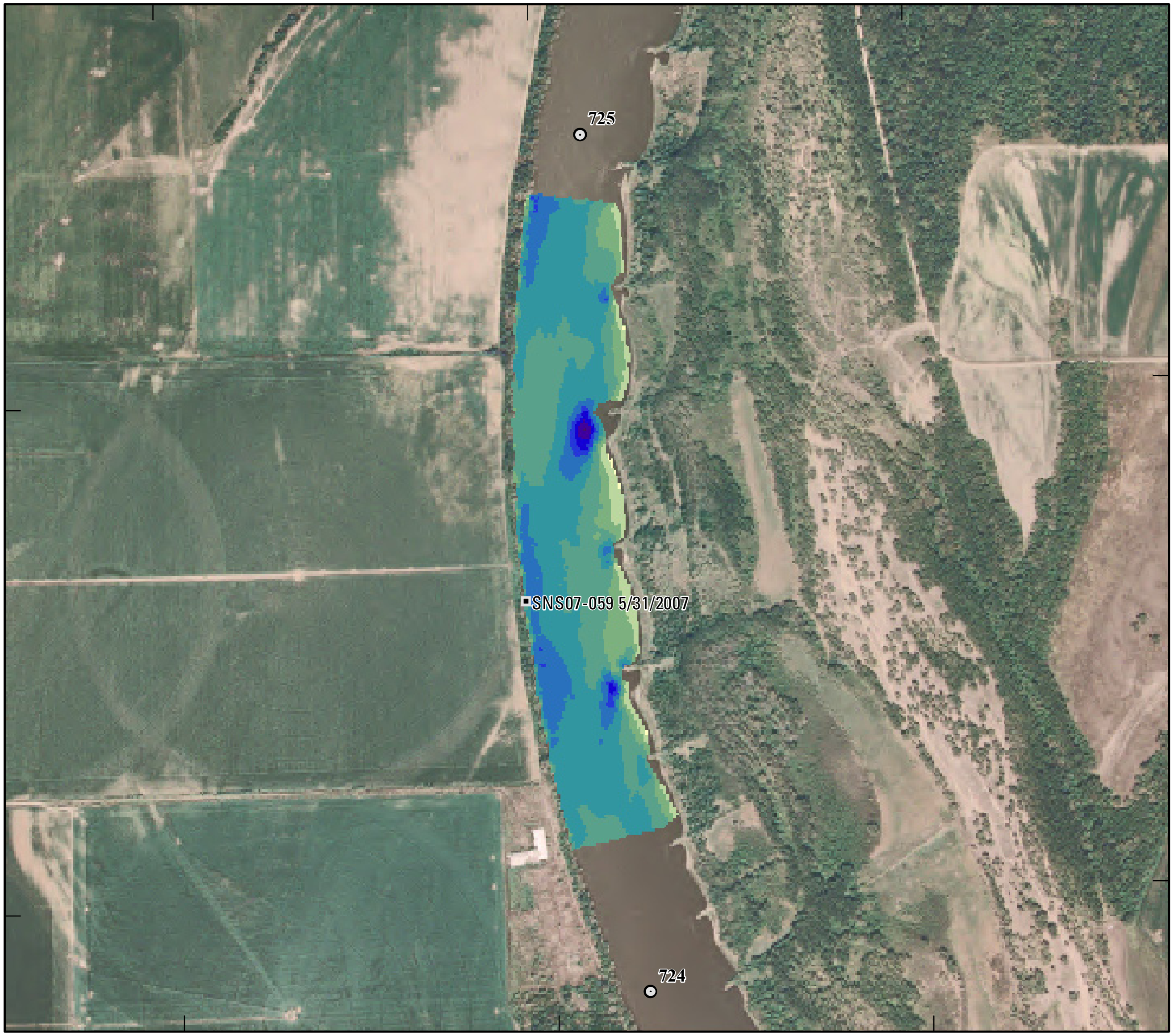


Figure 92. Map of depth-averaged velocity based on data collected on May 23, 2006, in the vicinity of river mile 725.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

SNS07-141 5/22/2007 **Sturgeon relocation**—Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker**—Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 2, 2007.

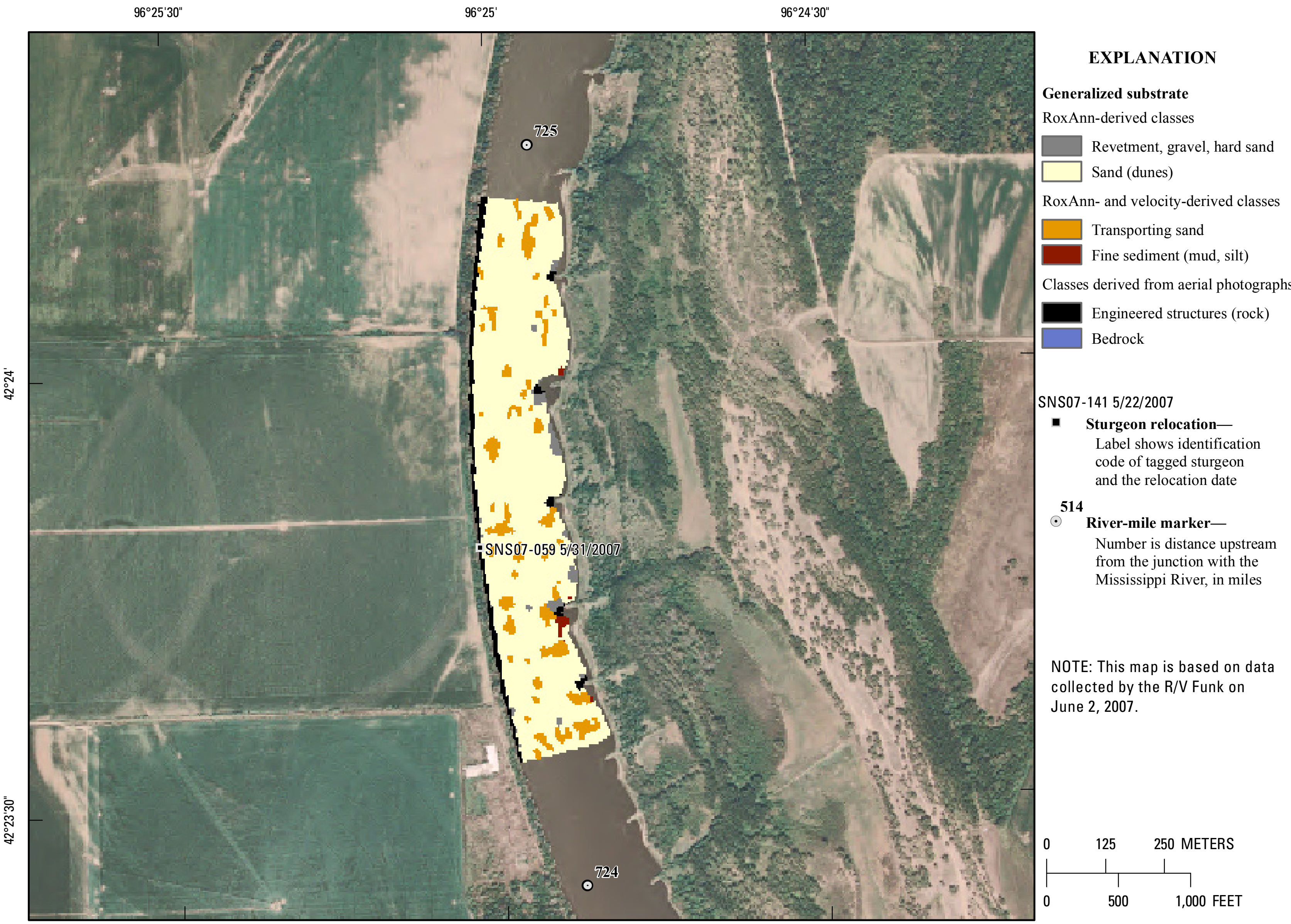
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

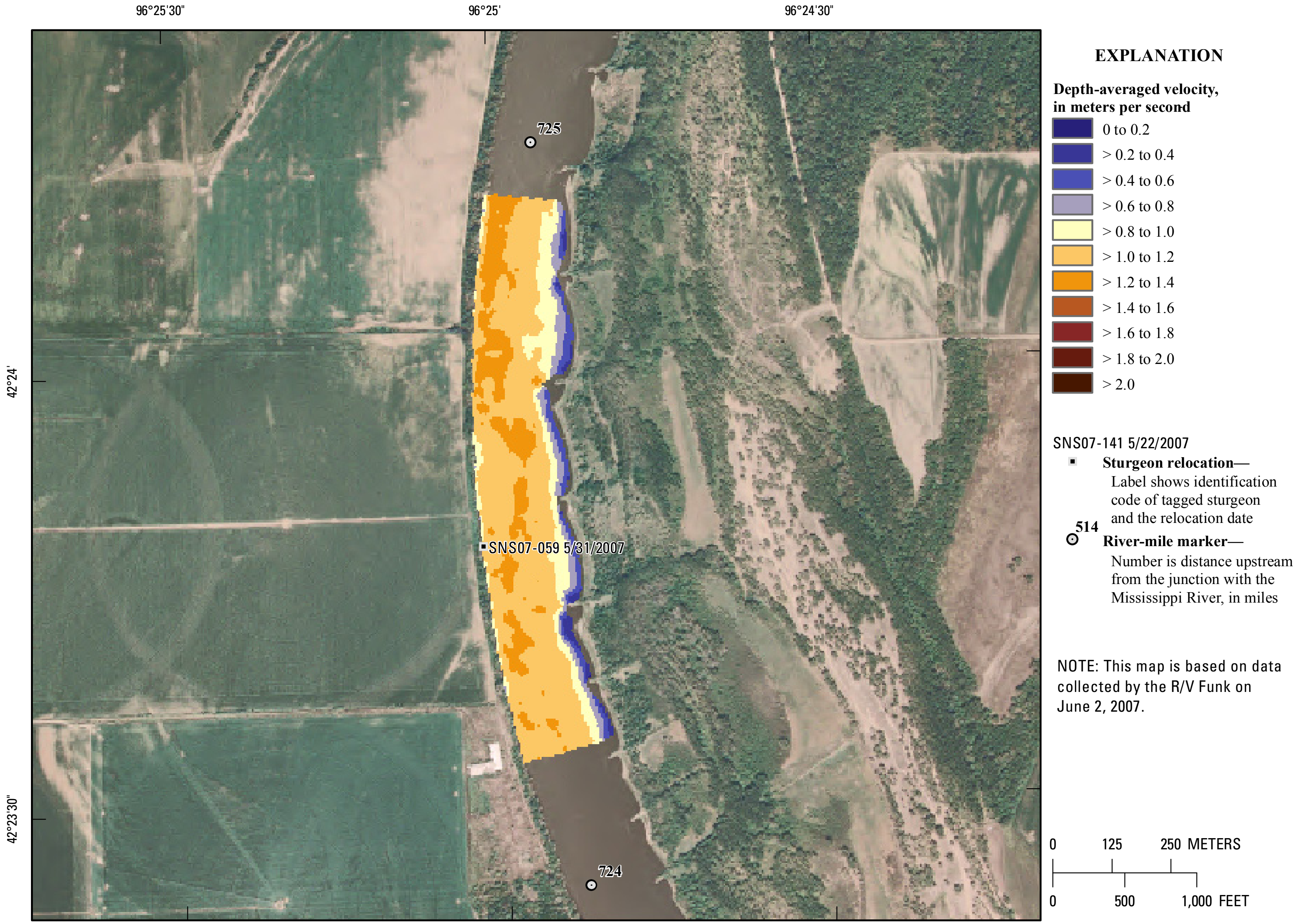
Figure 93. Map of depth based on data collected on June 2, 2007, in the vicinity of river mile 725.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 94. Map of generalized substrate based on data collected on June 2, 2007, in the vicinity of river mile 725.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 95. Map of depth-averaged velocity based on data collected on June 2, 2007, in the vicinity of river mile 725.

EXPLANATION

SNS07-141 5/22/2007

▪ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514 ⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected on June 2, 2007.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 96. Map of side-scan sonar imagery based on data collected on June 2, 2007, in the vicinity of river mile 725.

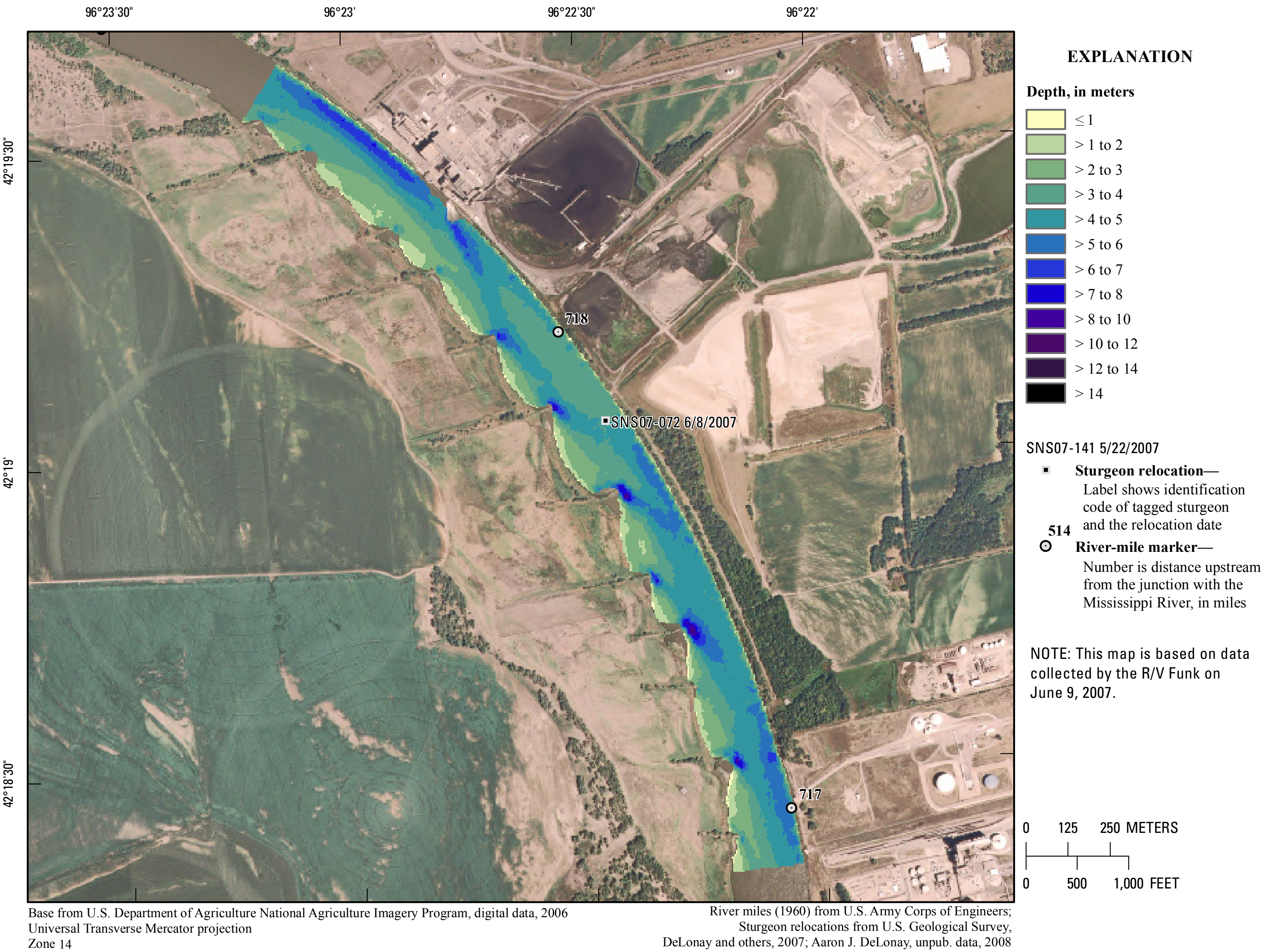
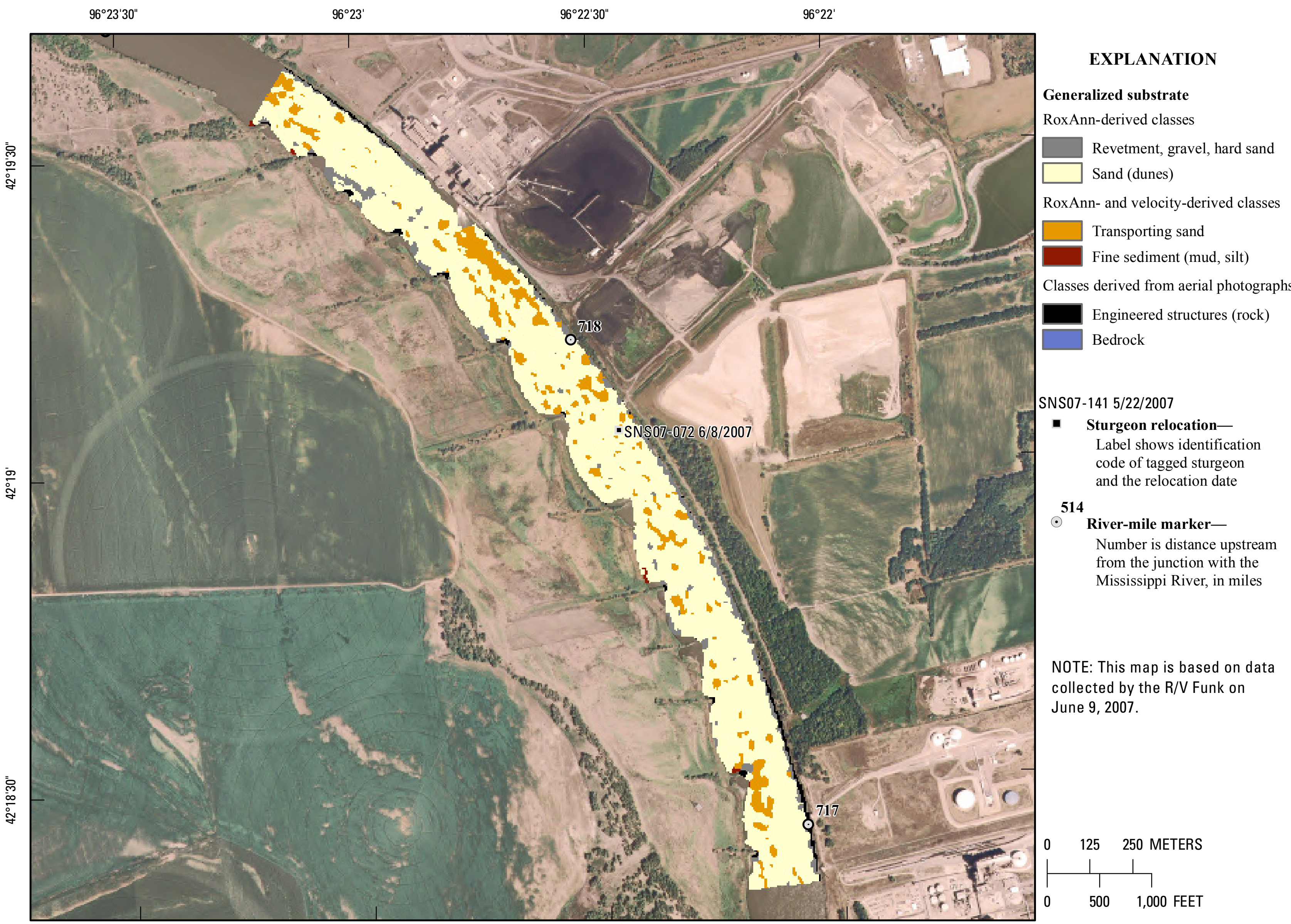


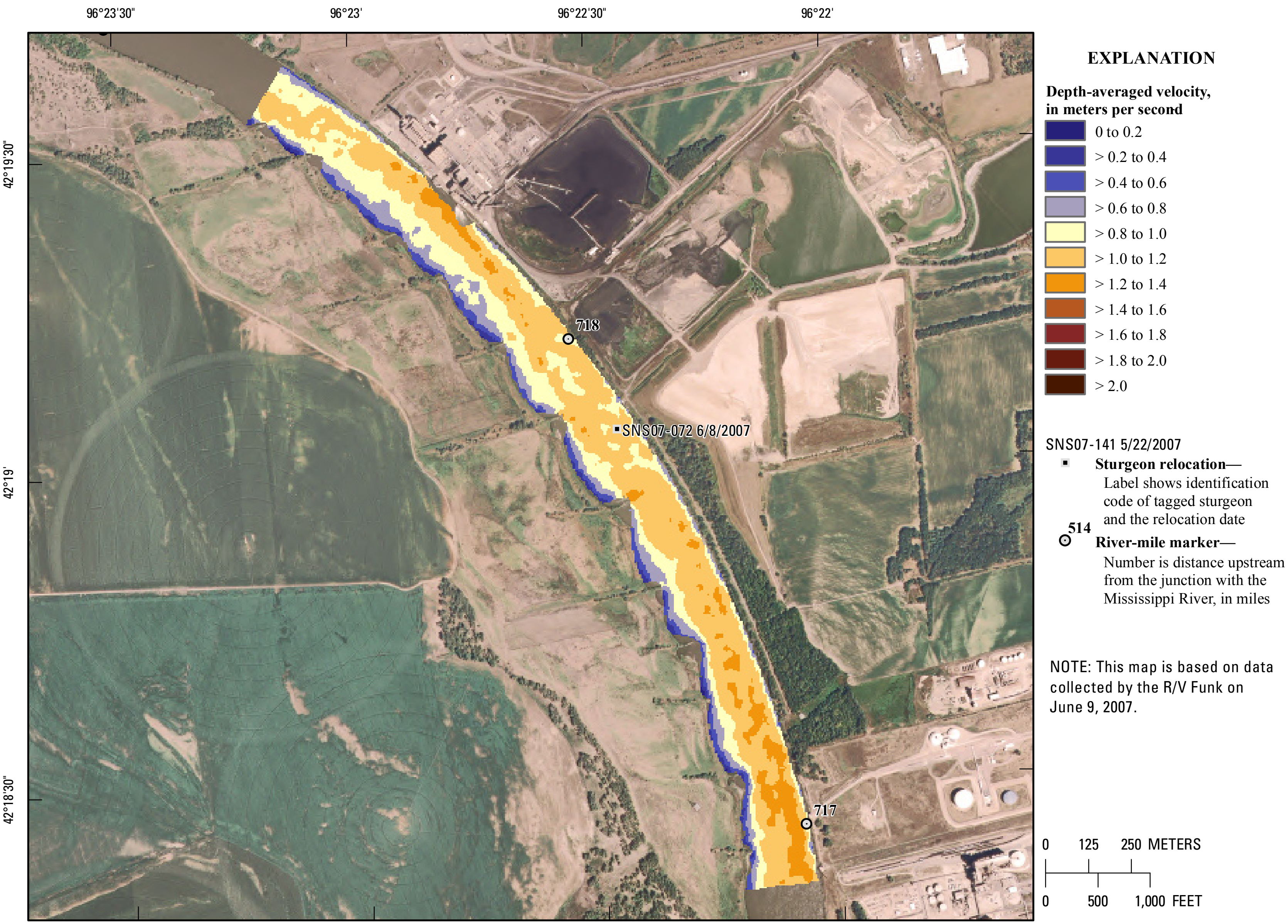
Figure 97. Map of depth based on data collected on June 9, 2007, in the vicinity of river mile 718.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

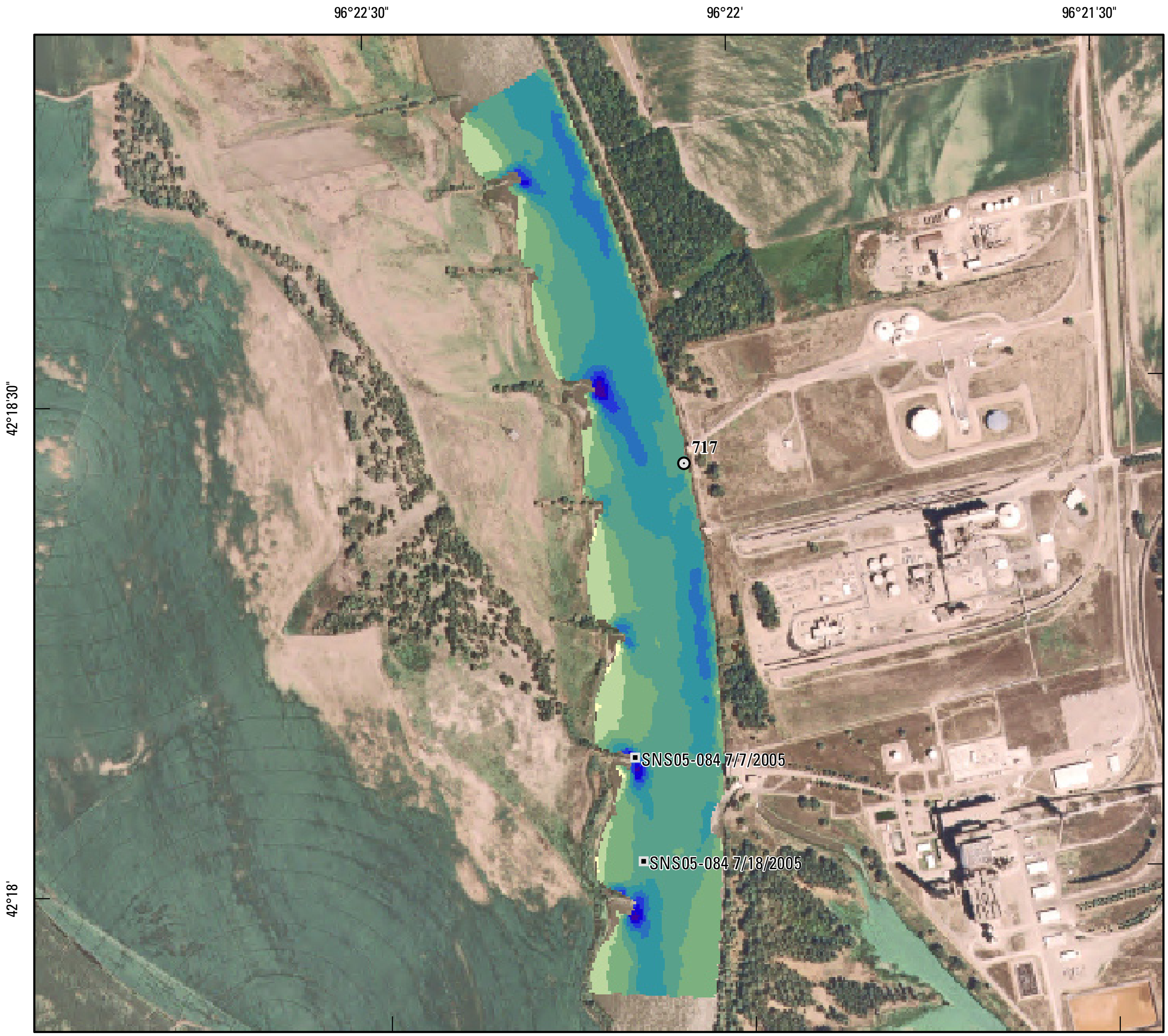
Figure 98. Map of generalized substrate based on data collected on June 9, 2007, in the vicinity of river mile 718.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 99. Map of depth-averaged velocity based on data collected on June 9, 2007, in the vicinity of river mile 718.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on August 9, 2005.

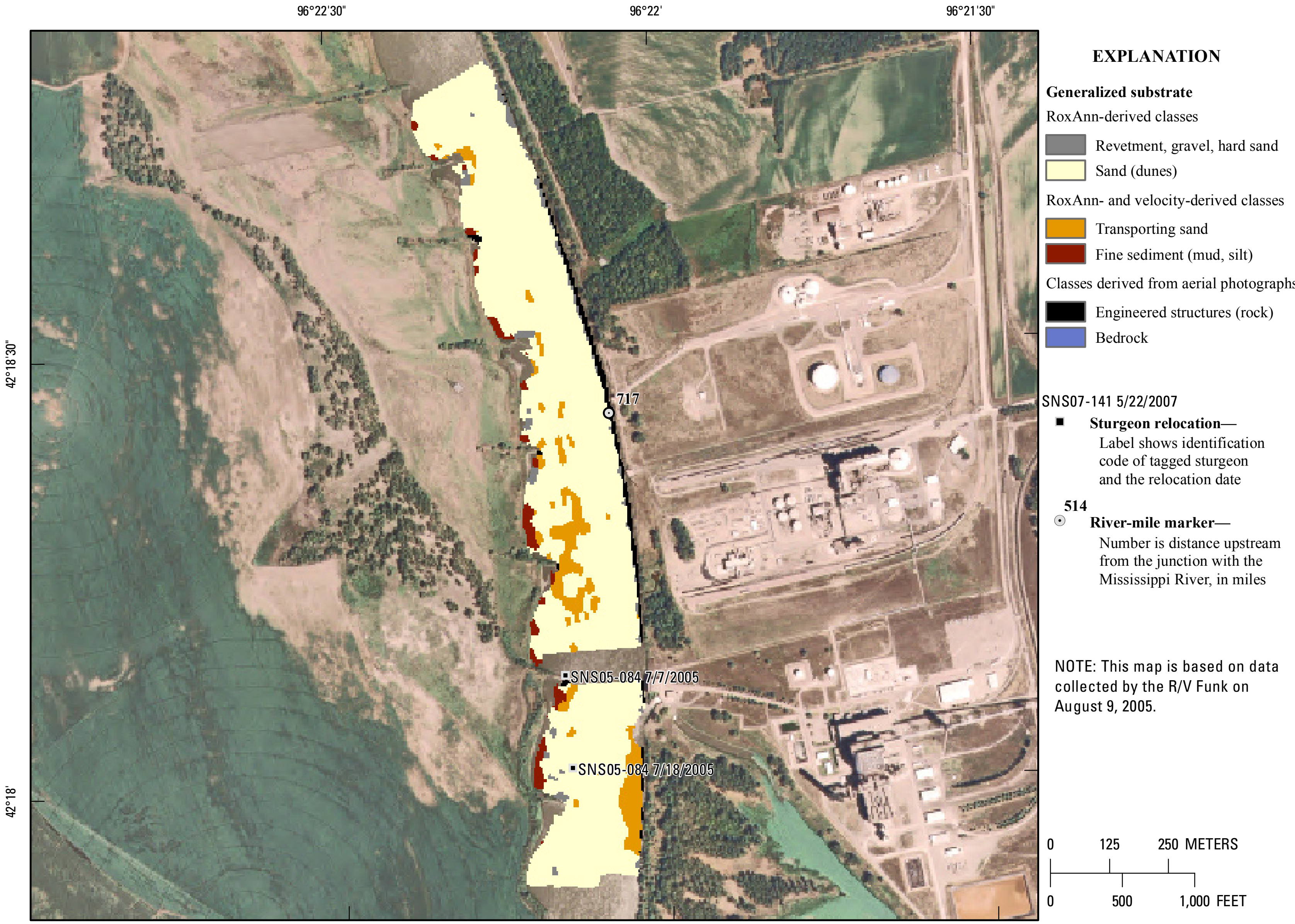
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

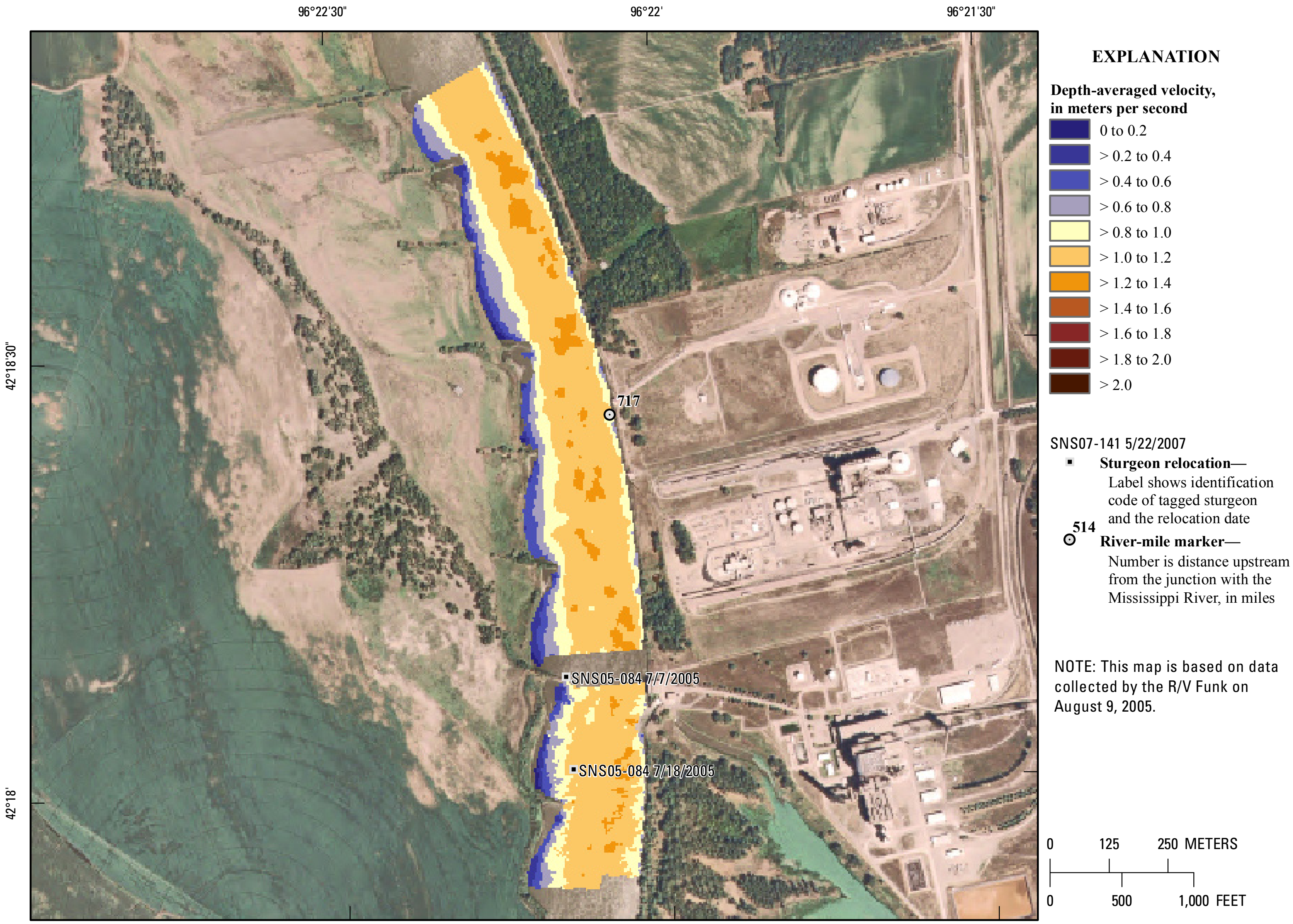
Figure 100. Map of depth based on data collected on August 9, 2005, in the vicinity of river mile 717.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

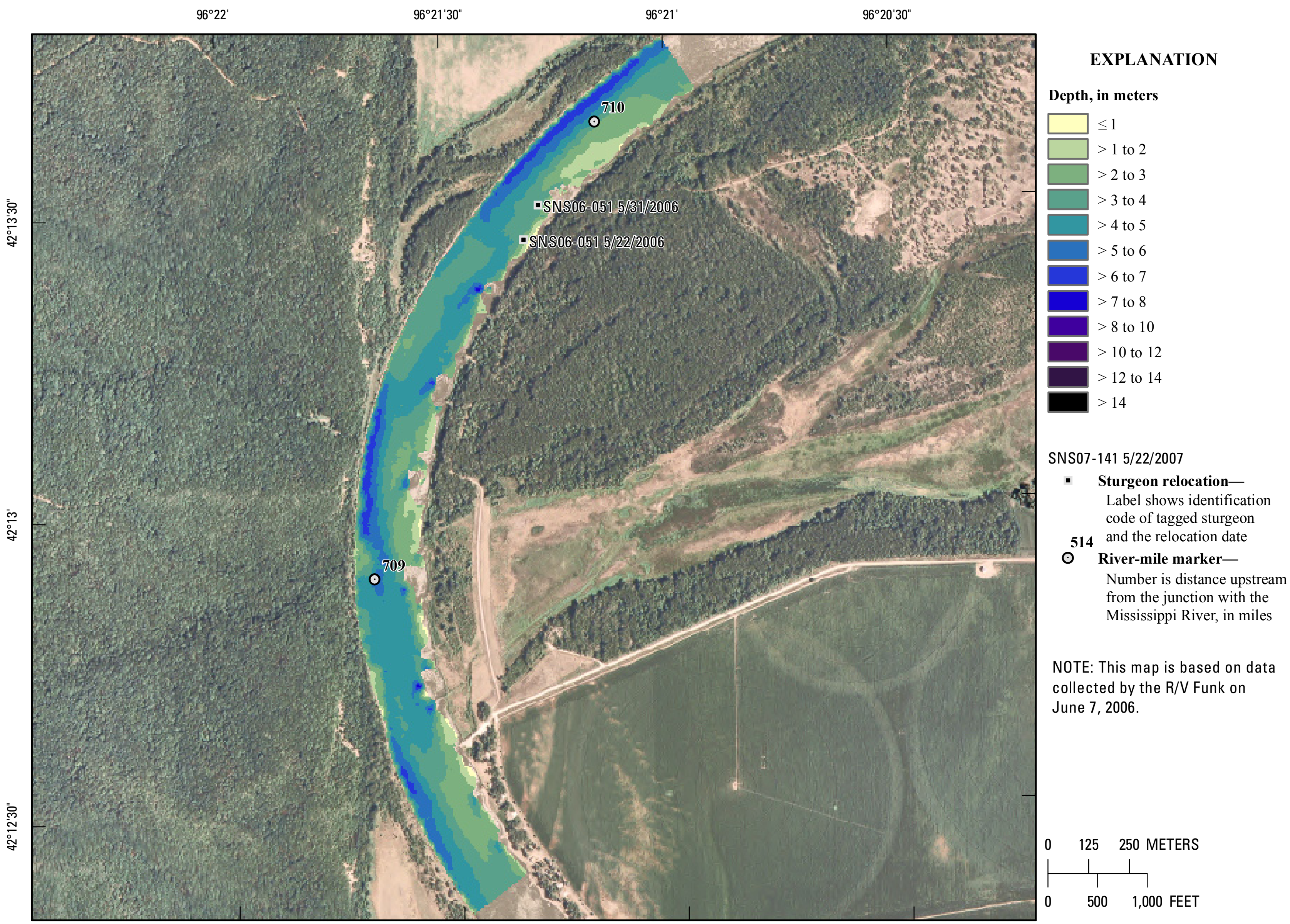
Figure 101. Map of generalized substrate based on data collected on August 9, 2005, in the vicinity of river mile 717.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 102. Map of depth-averaged velocity based on data collected on August 9, 2005, in the vicinity of river mile 717.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 103. Map of depth based on data collected on June 7, 2006, in the vicinity of river mile 709.

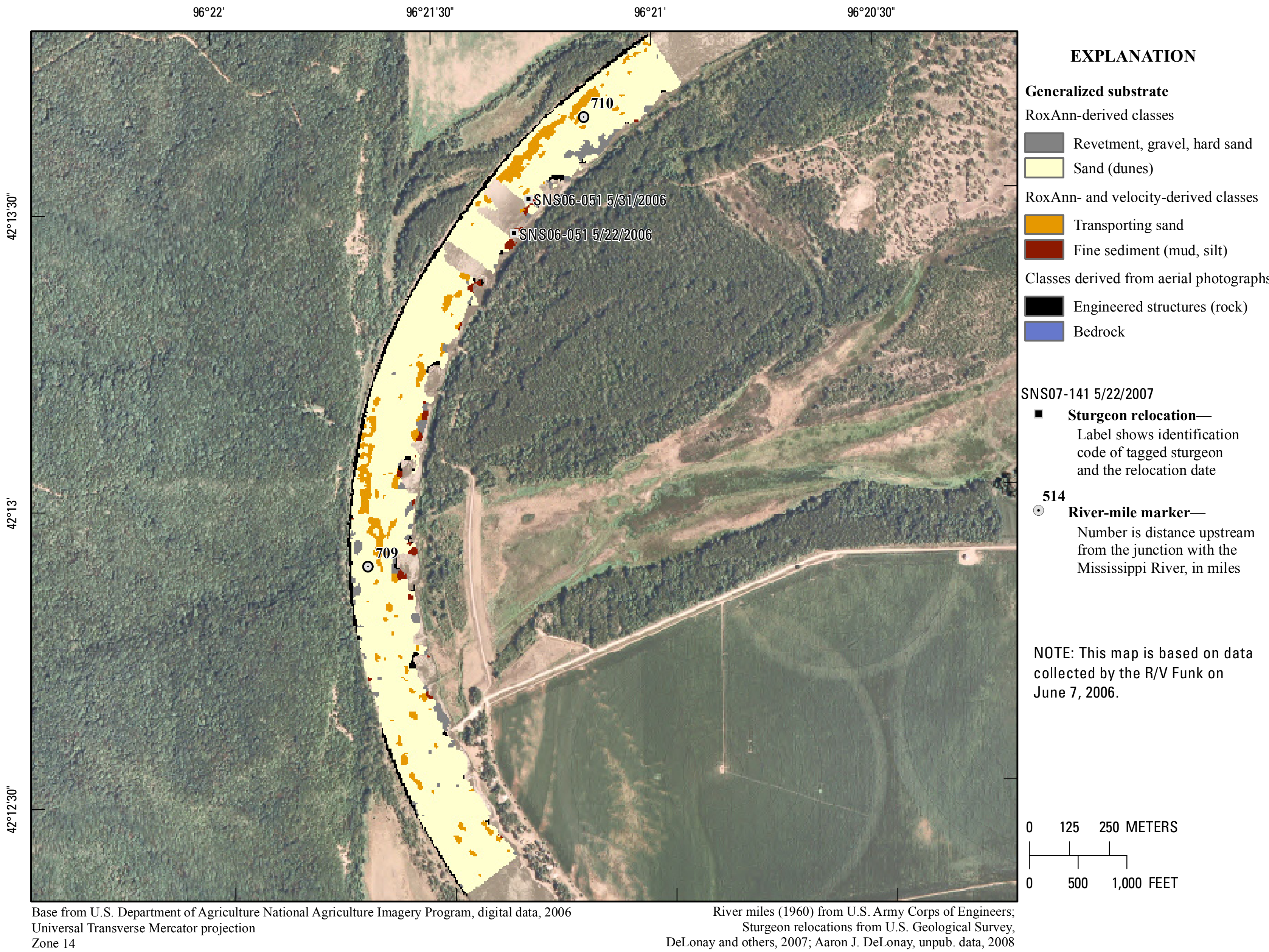
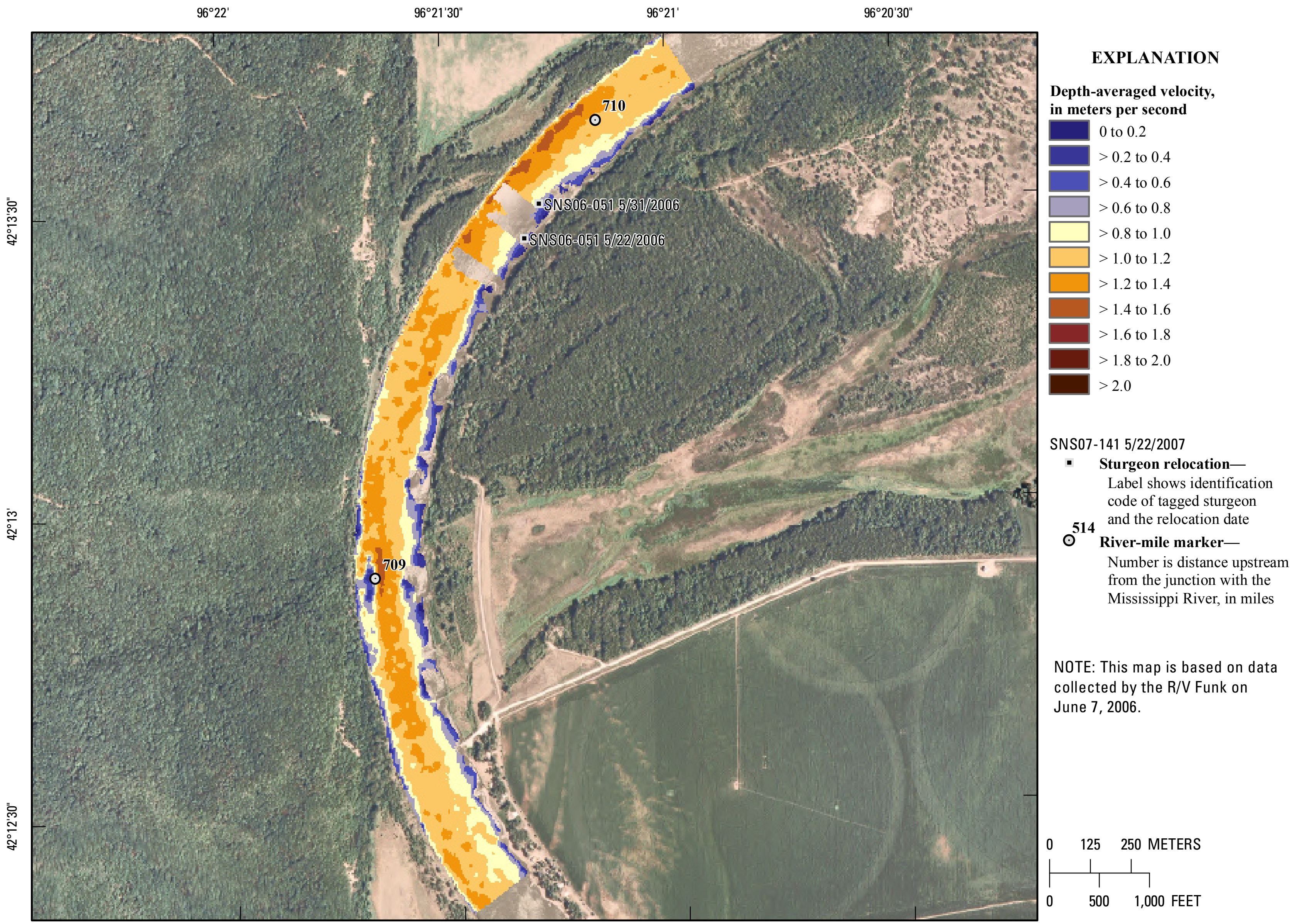


Figure 104. Map of generalized substrate based on data collected on June 7, 2006, in the vicinity of river mile 709.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 105. Map of depth-averaged velocity based on data collected on June 7, 2006, in the vicinity of river mile 709.

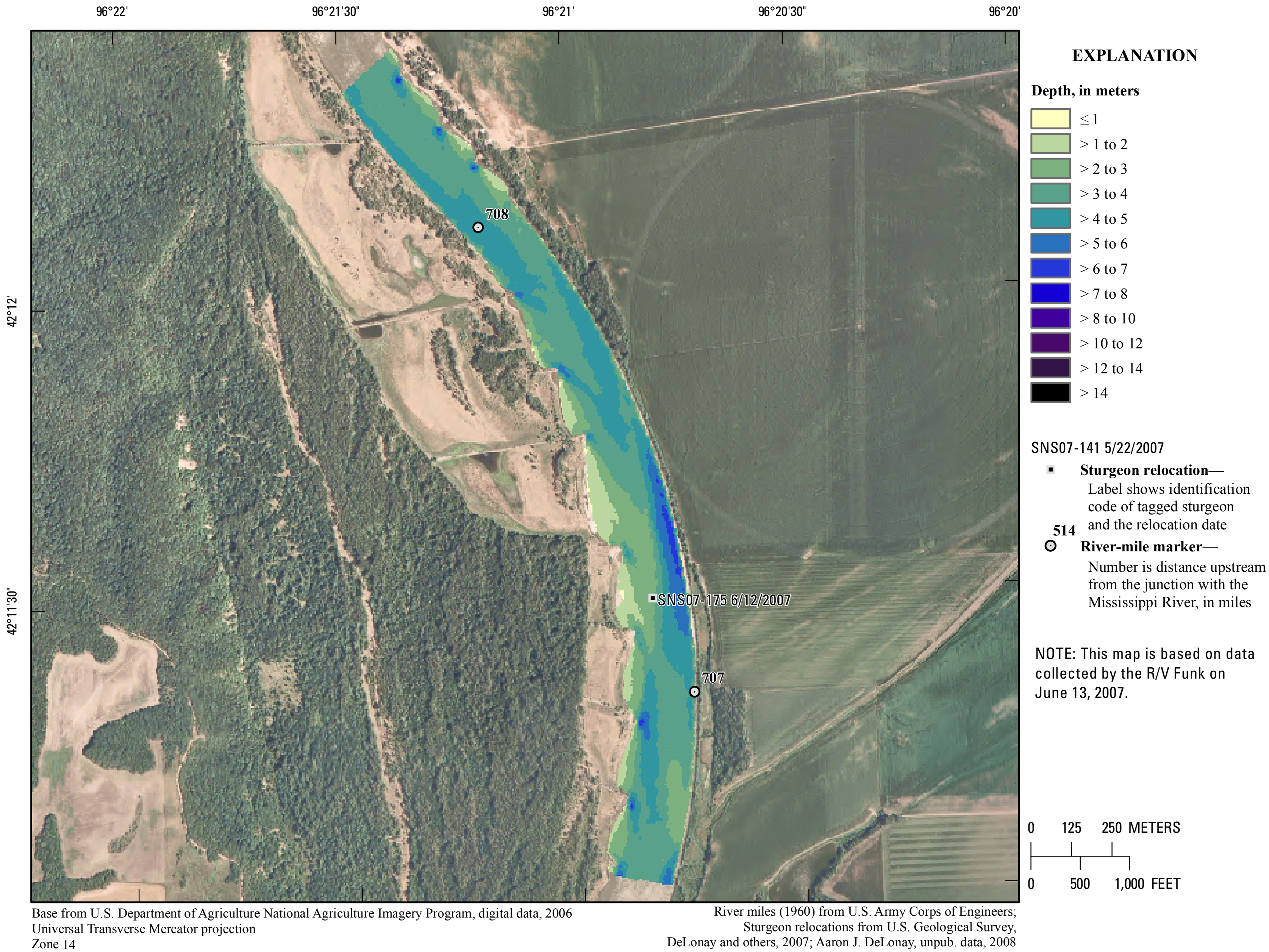
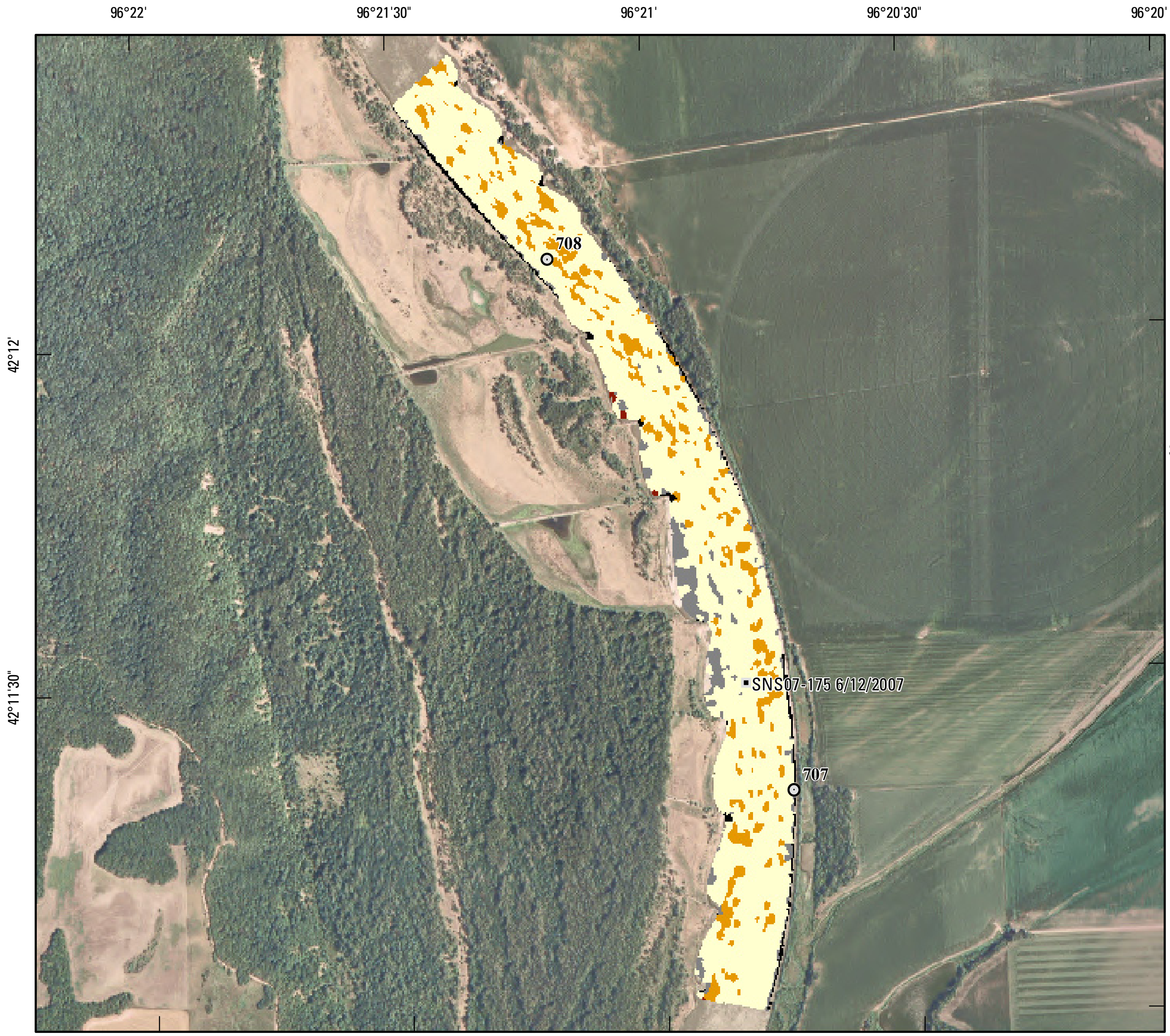


Figure 106. Map of depth based on data collected on June 13, 2007, in the vicinity of river mile 708.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

Revetment, gravel, hard sand

Sand (dunes)

RoxAnn- and velocity-derived classes

Transporting sand

Fine sediment (mud, silt)

Classes derived from aerial photographs

Engineered structures (rock)

Bedrock

SNS07-141 5/22/2007

Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 13, 2007.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 107. Map of generalized substrate based on data collected on June 13, 2007, in the vicinity of river mile 708.

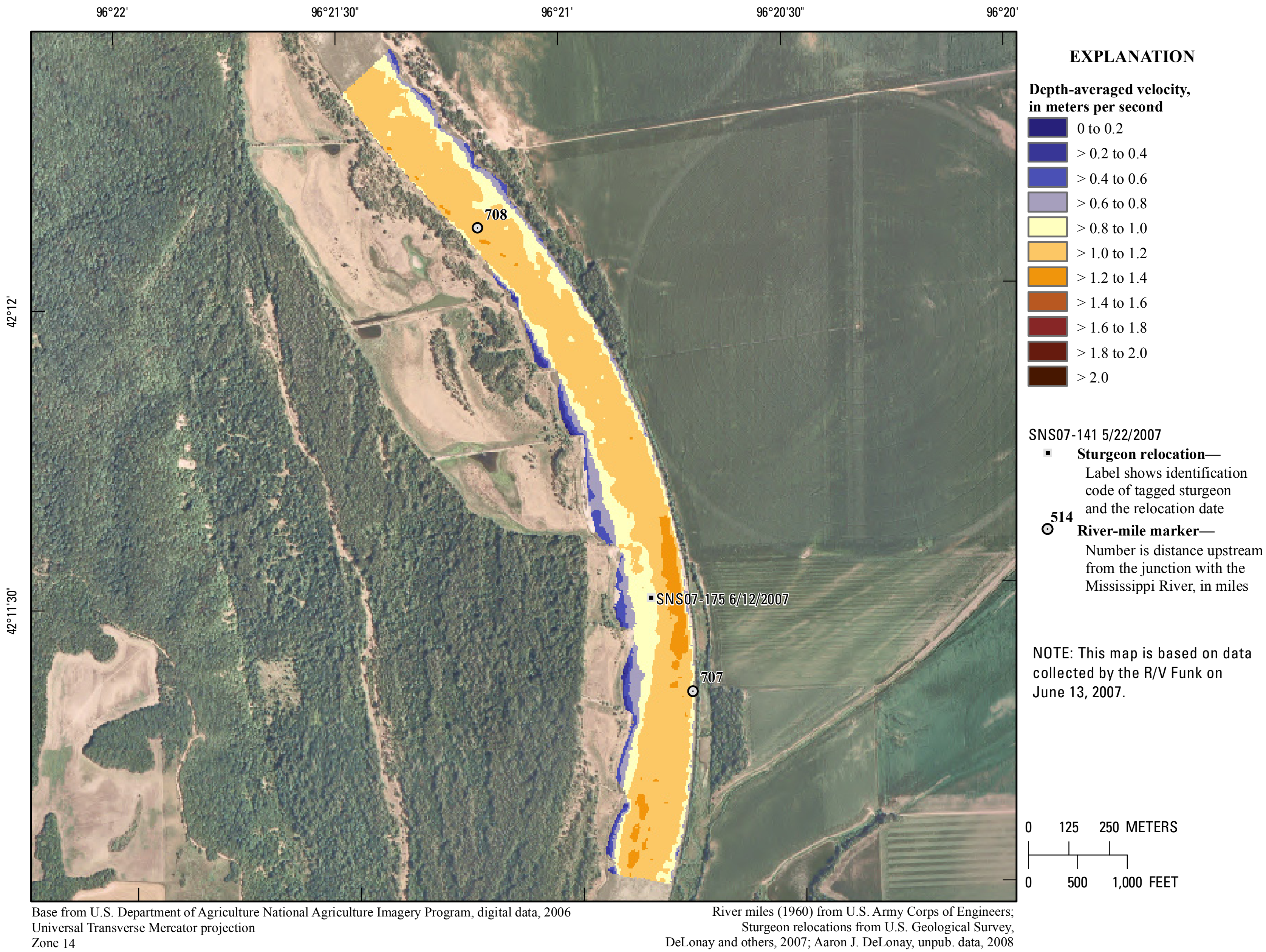


Figure 108. Map of depth-averaged velocity based on data collected on June 13, 2007, in the vicinity of river mile 708.

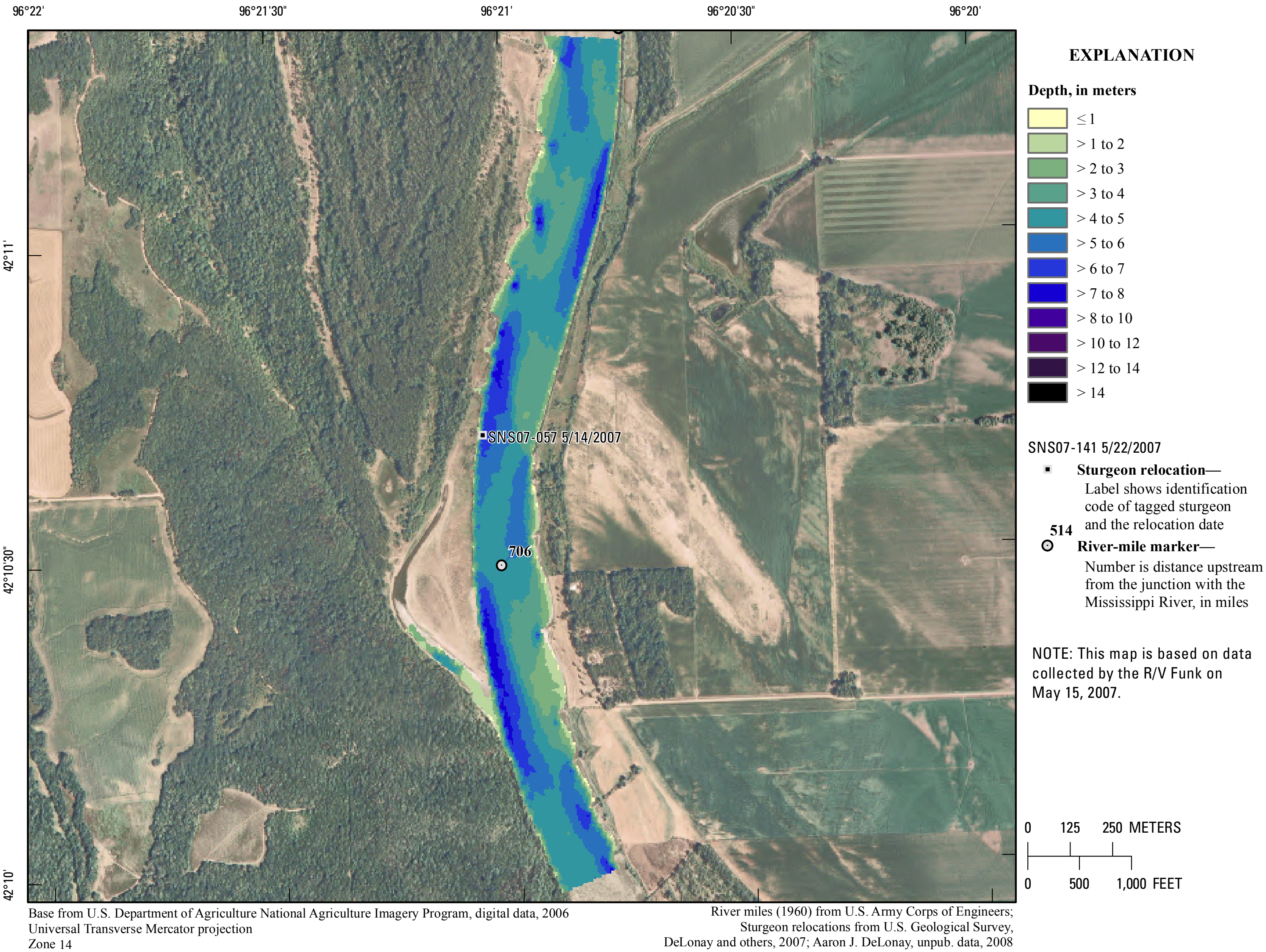


Figure 109. Map of depth based on data collected on May 15, 2007, in the vicinity of river mile 706.

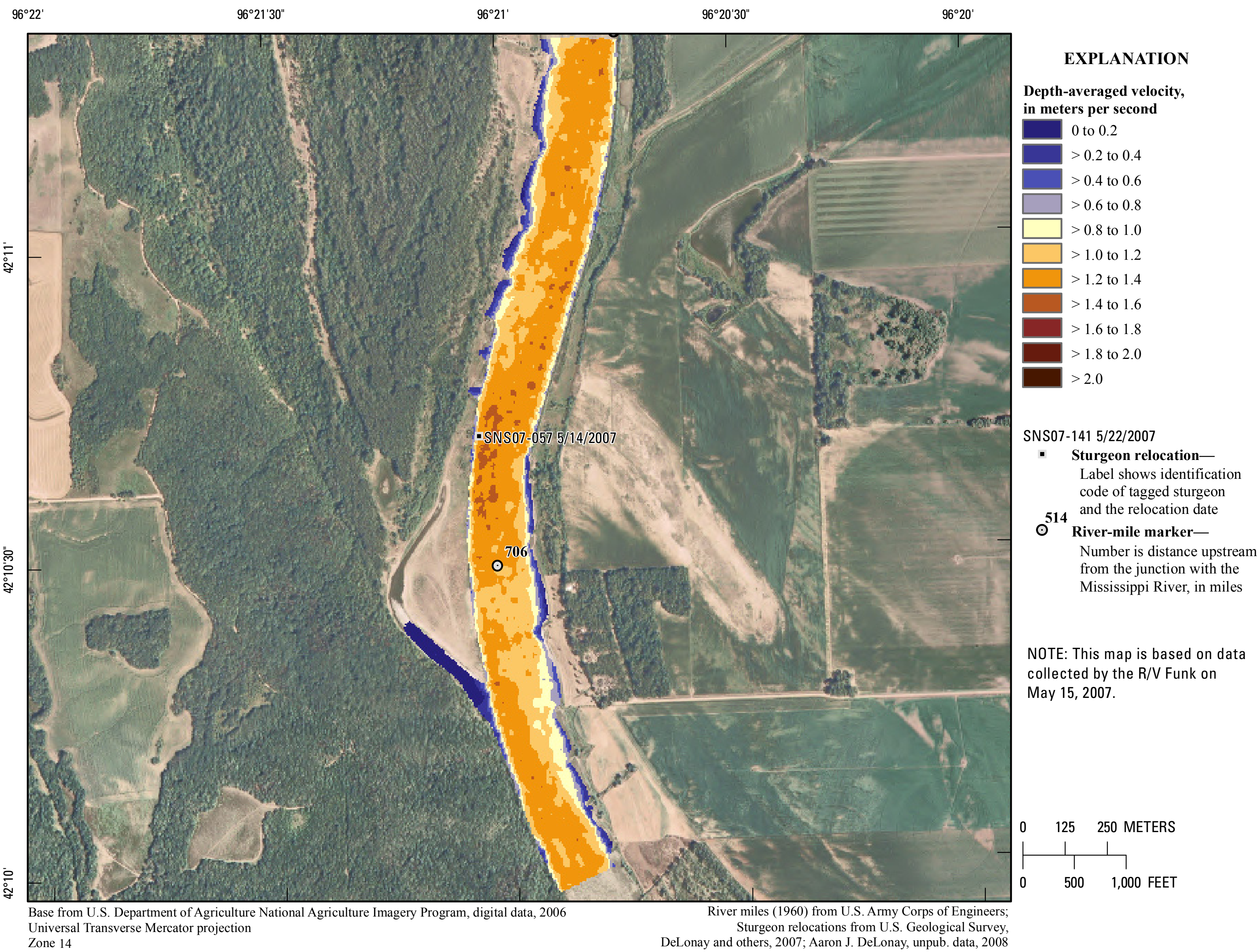


Figure 110. Map of depth-averaged velocity based on data collected on May 15, 2007, in the vicinity of river mile 706.

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 111. Map of depth based on data collected on June 7, 2007, in the vicinity of river mile 702.

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

SNS07-141 5/22/2007

Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

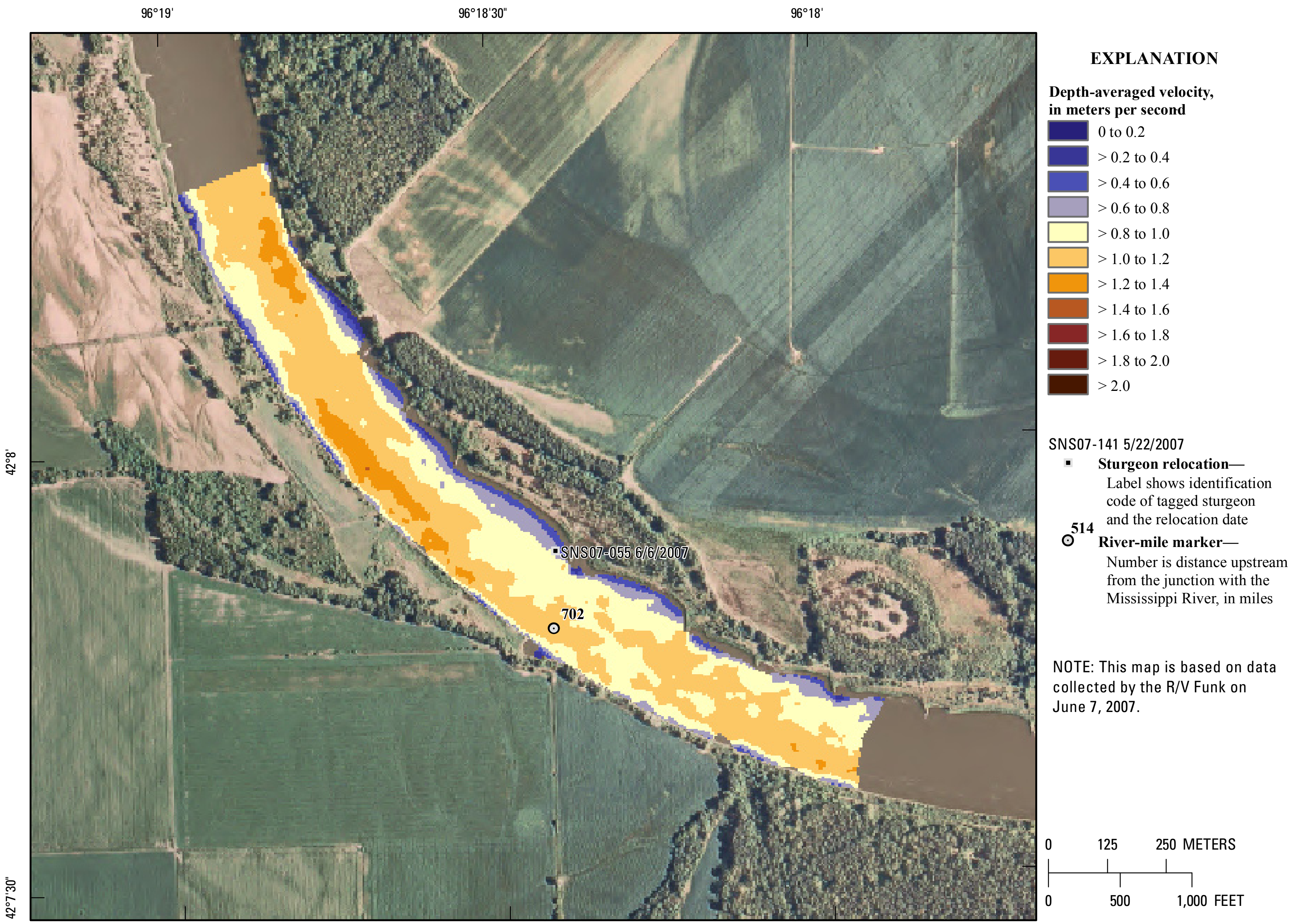
River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 7, 2007.

0 125 250 METERS

0 500 1,000 FEET

Figure 112. Map of generalized substrate based on data collected on June 7, 2007, in the vicinity of river mile 702.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 113. Map of depth-averaged velocity based on data collected on June 7, 2007, in the vicinity of river mile 702.

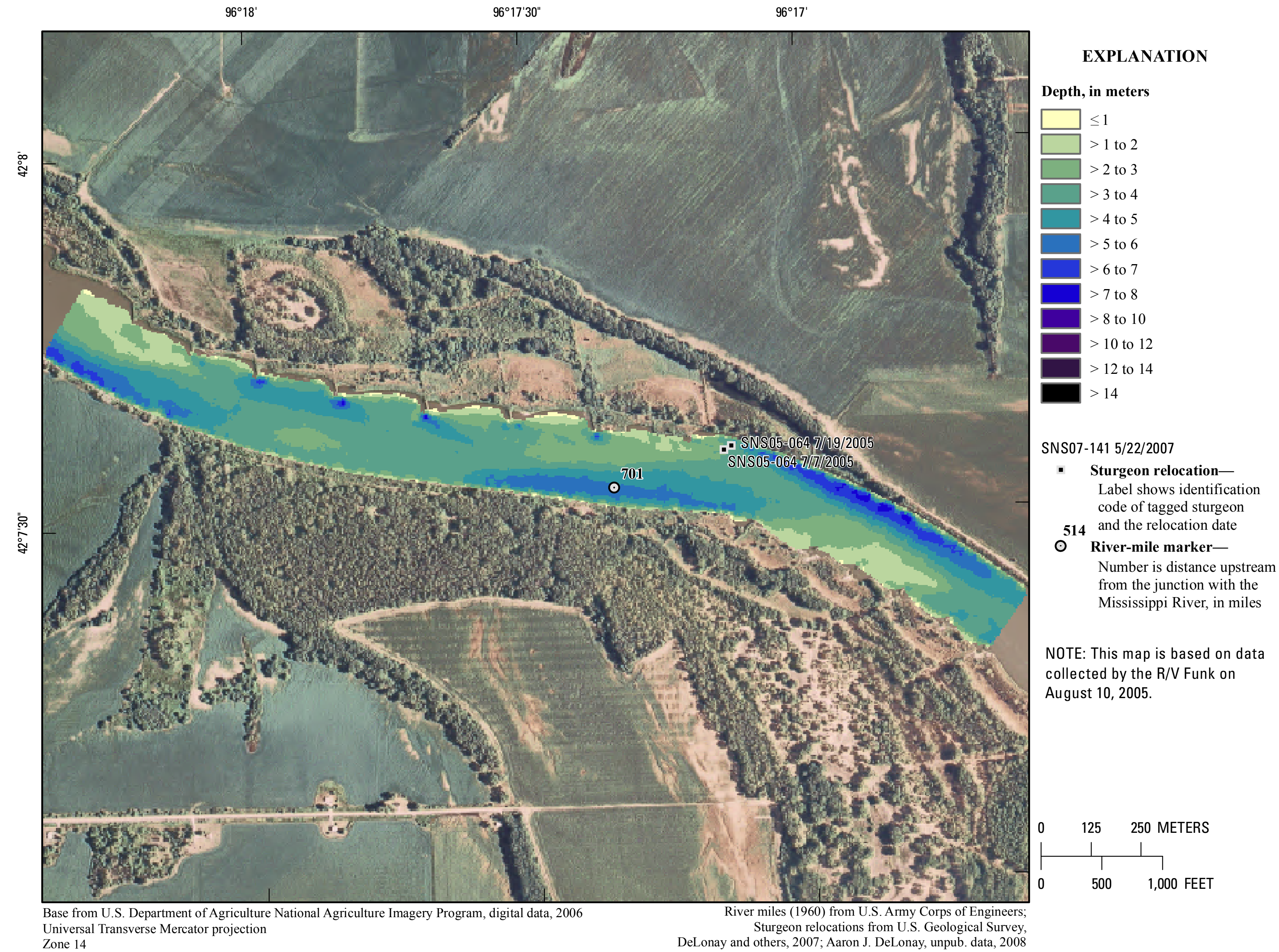
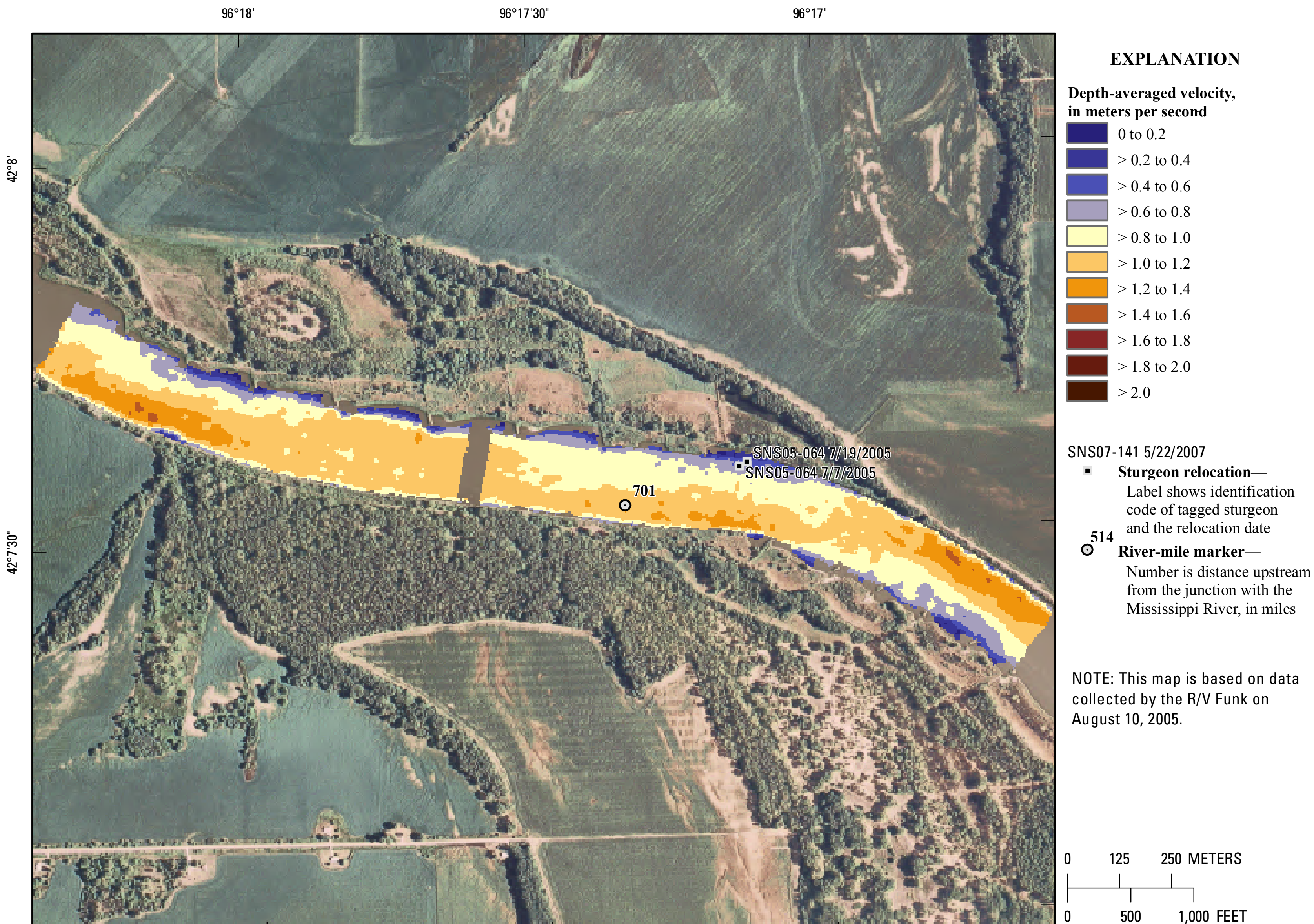


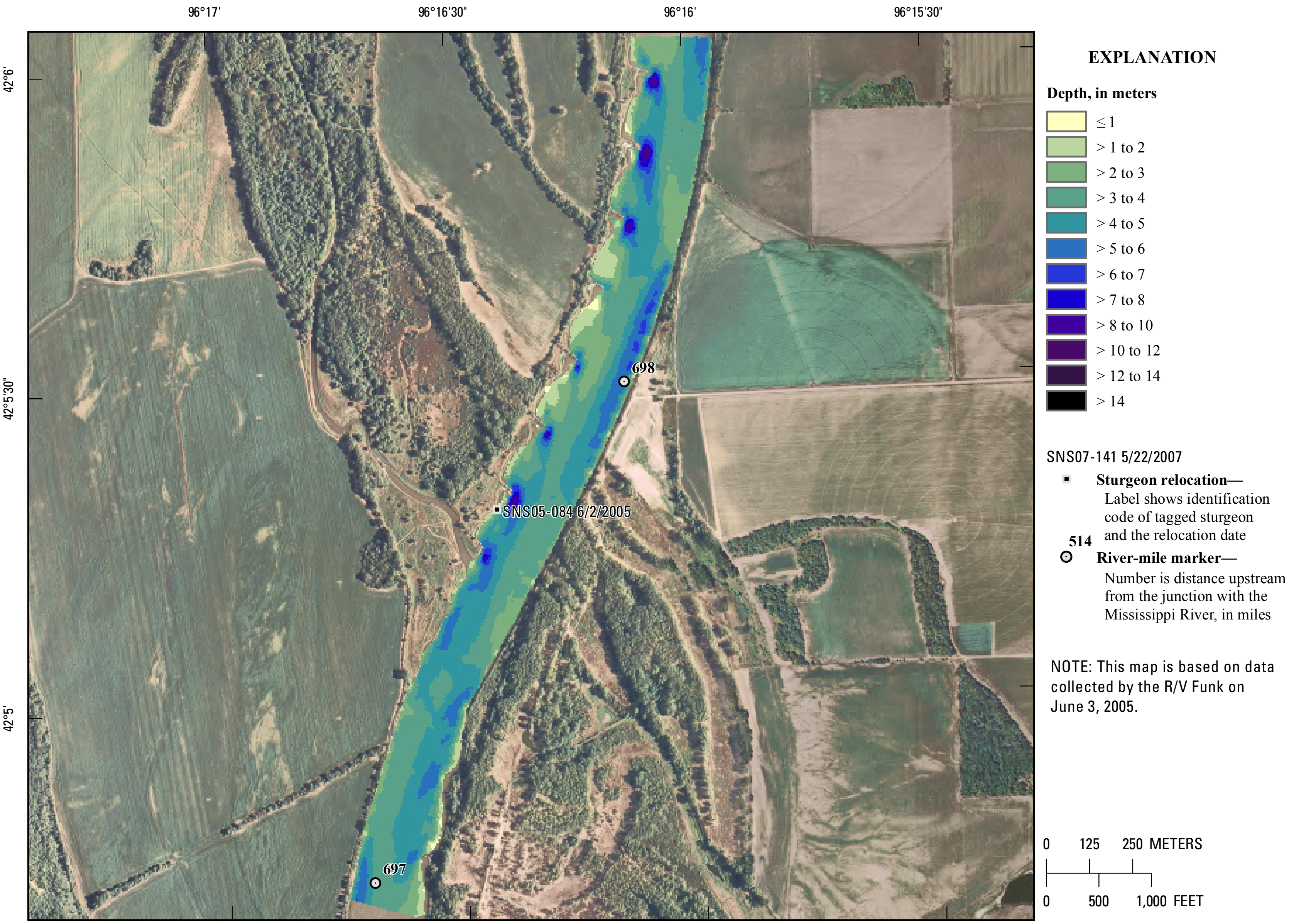
Figure 114. Map of depth based on data collected on August 10, 2005, in the vicinity of river mile 701.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 115. Map of depth-averaged velocity based on data collected on August 10, 2005, in the vicinity of river mile 701.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 116. Map of depth based on data collected on June 3, 2005, in the vicinity of river mile 698.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 3, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 117. Map of generalized substrate based on data collected on June 3, 2005, in the vicinity of river mile 698.

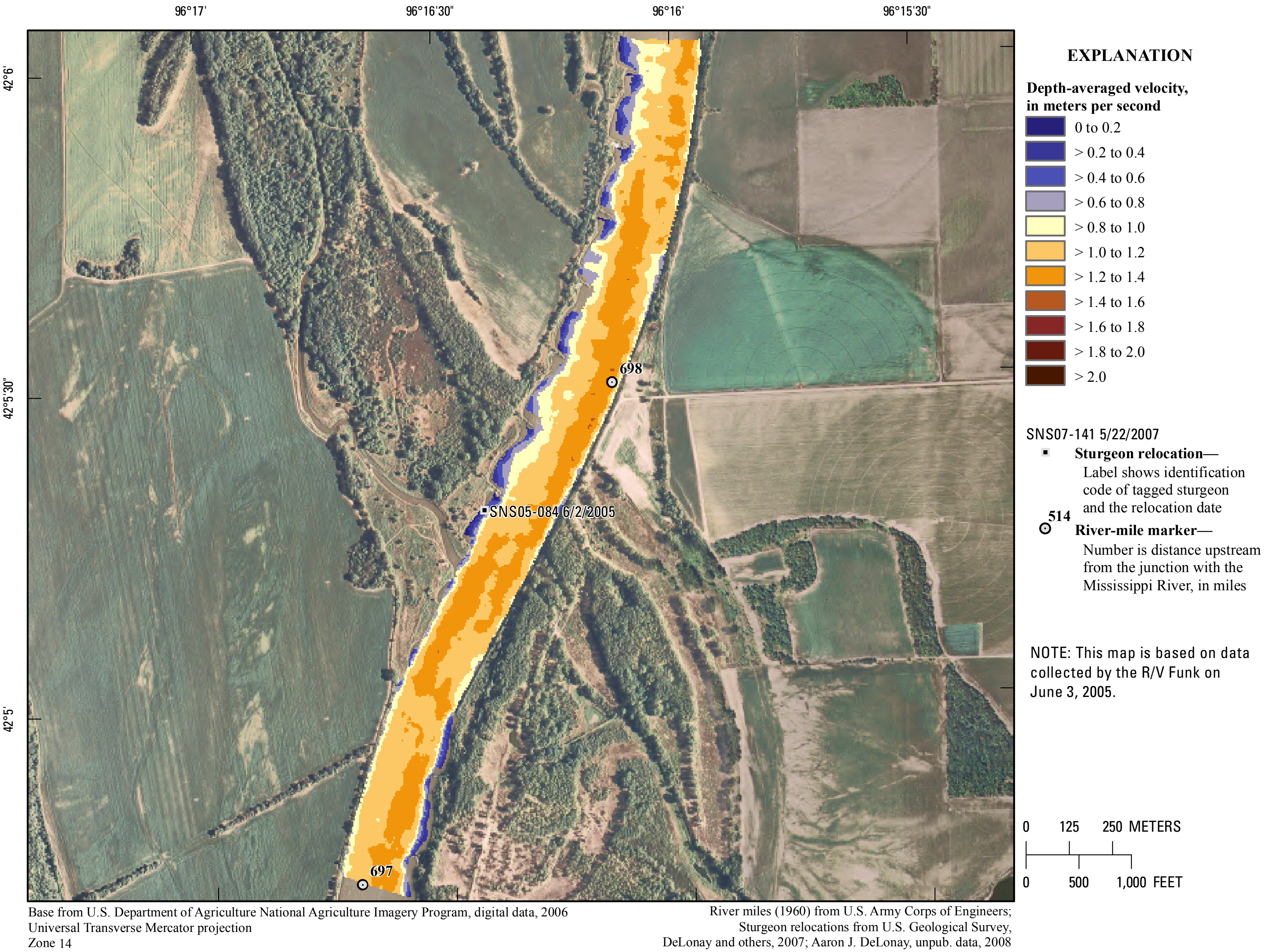
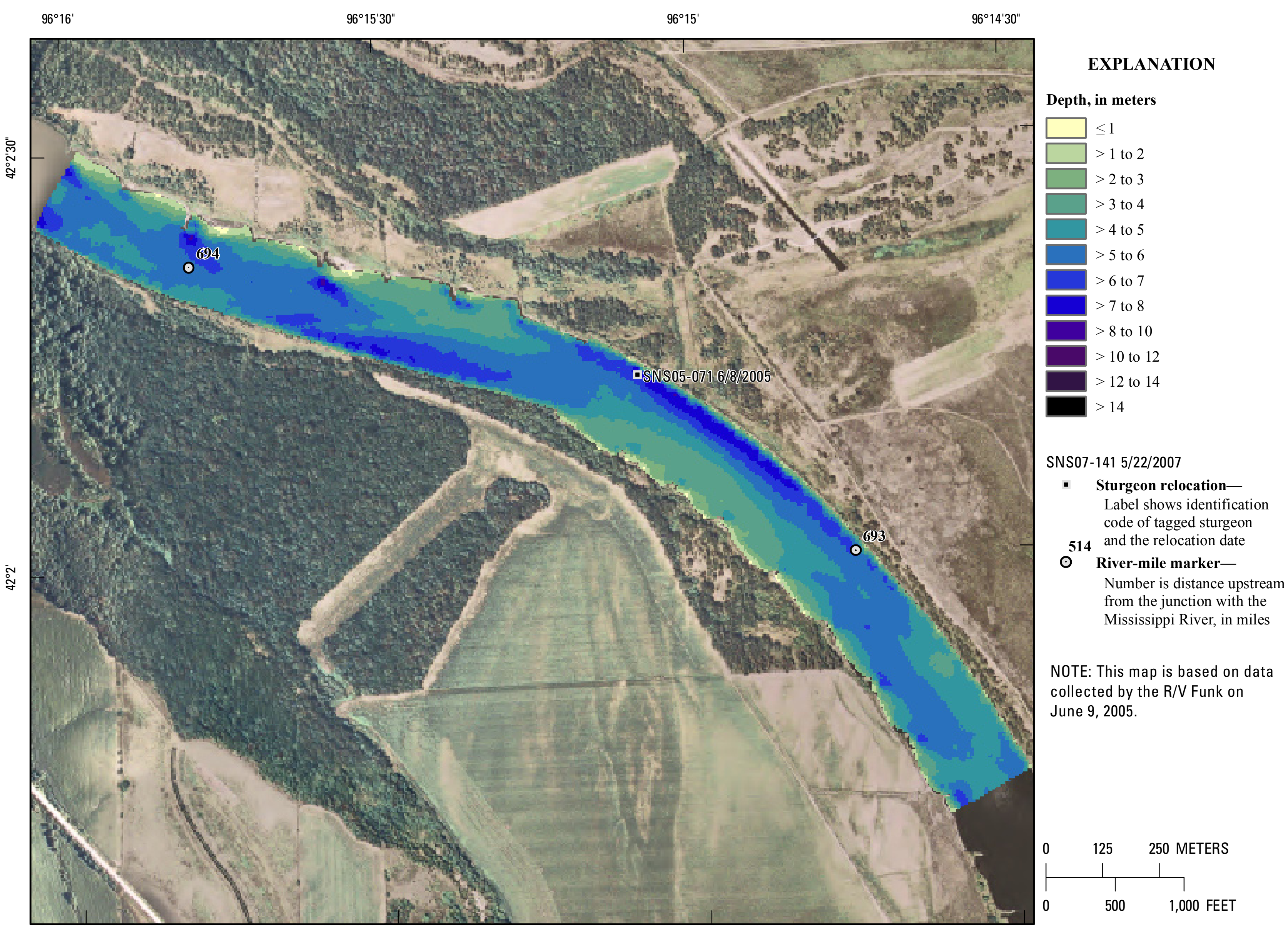


Figure 118. Map of depth-averaged velocity based on data collected on June 3, 2005, in the vicinity of river mile 698.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 119. Map of depth based on data collected on June 9, 2005, in the vicinity of river mile 693.

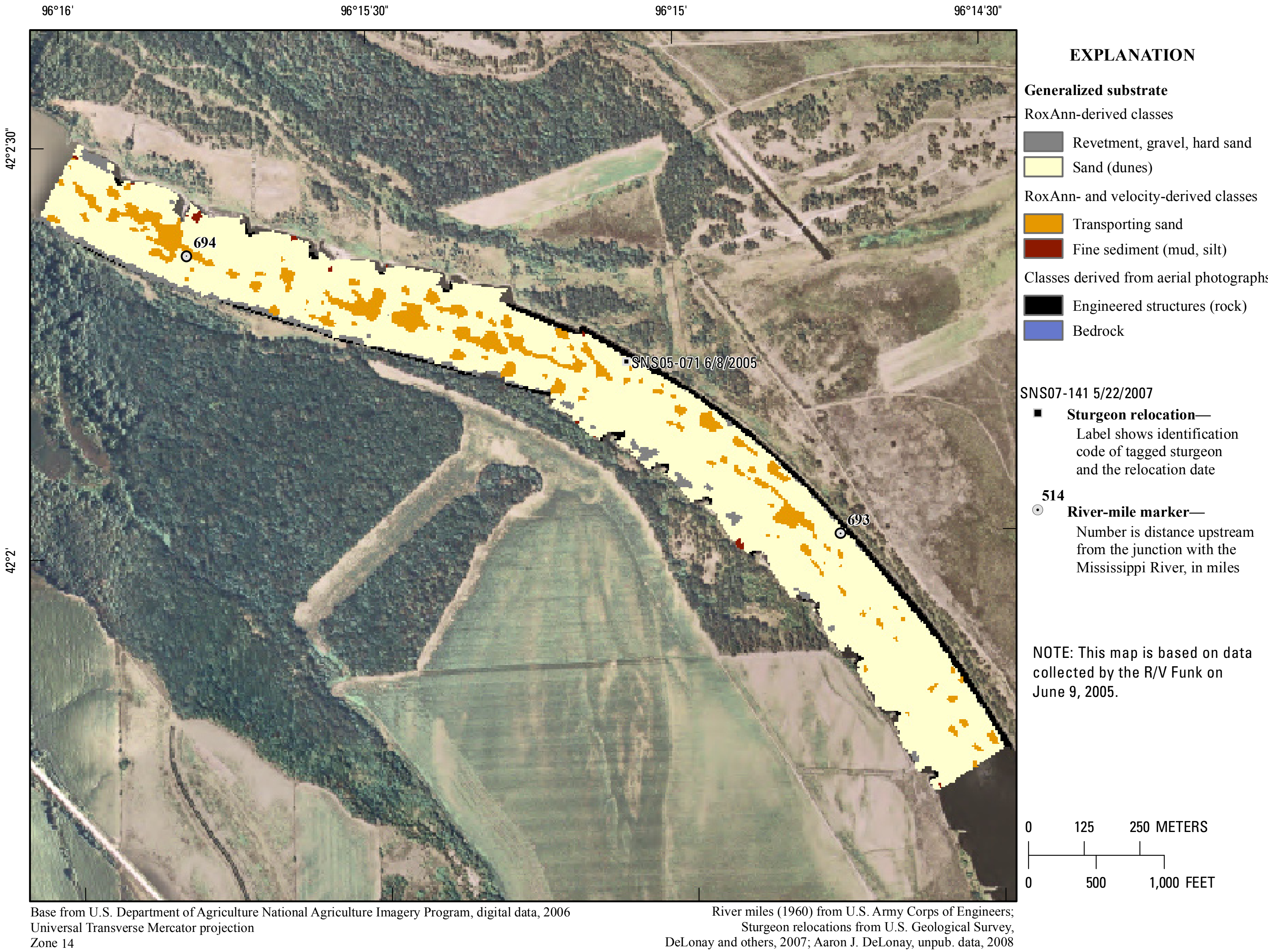
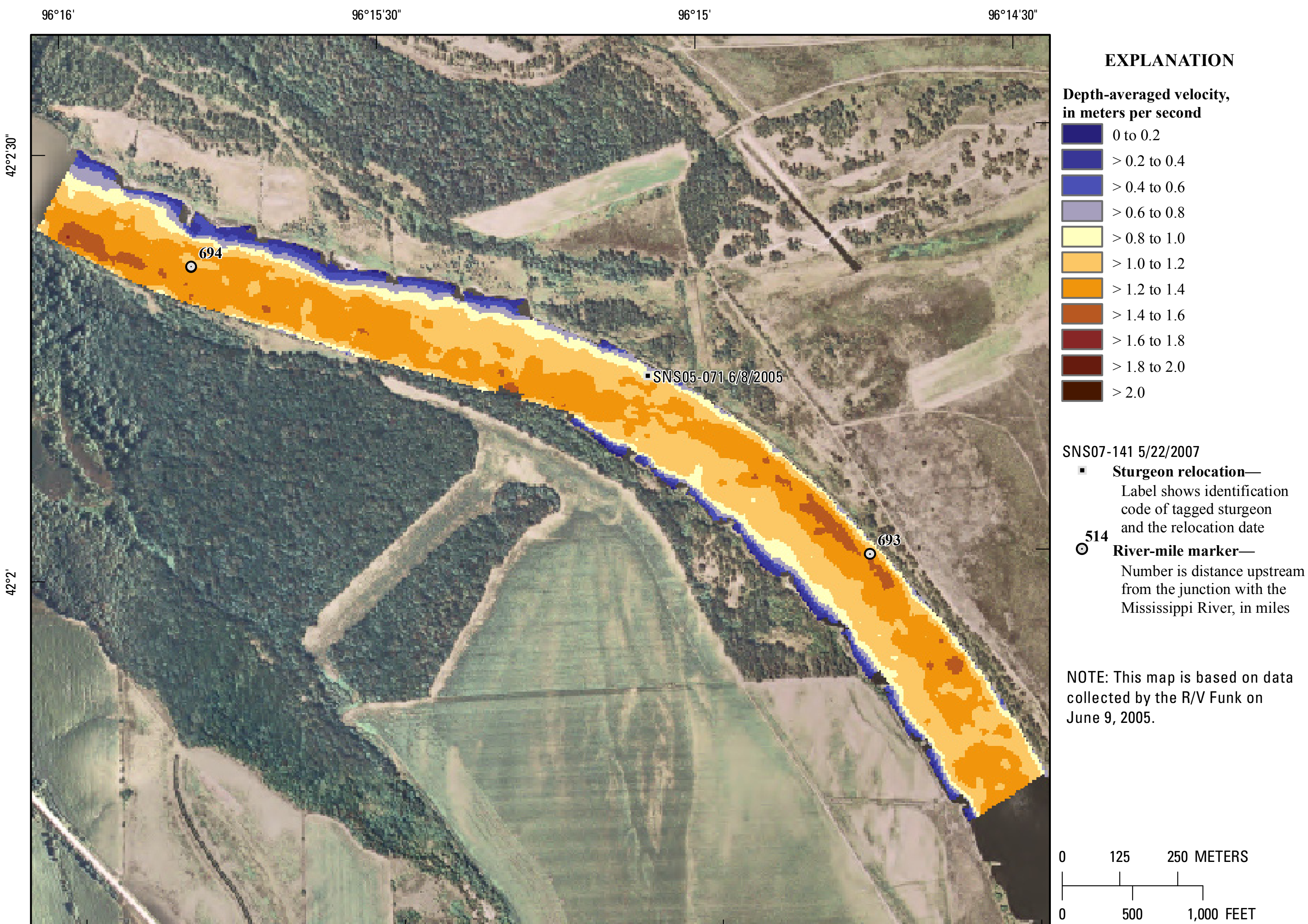


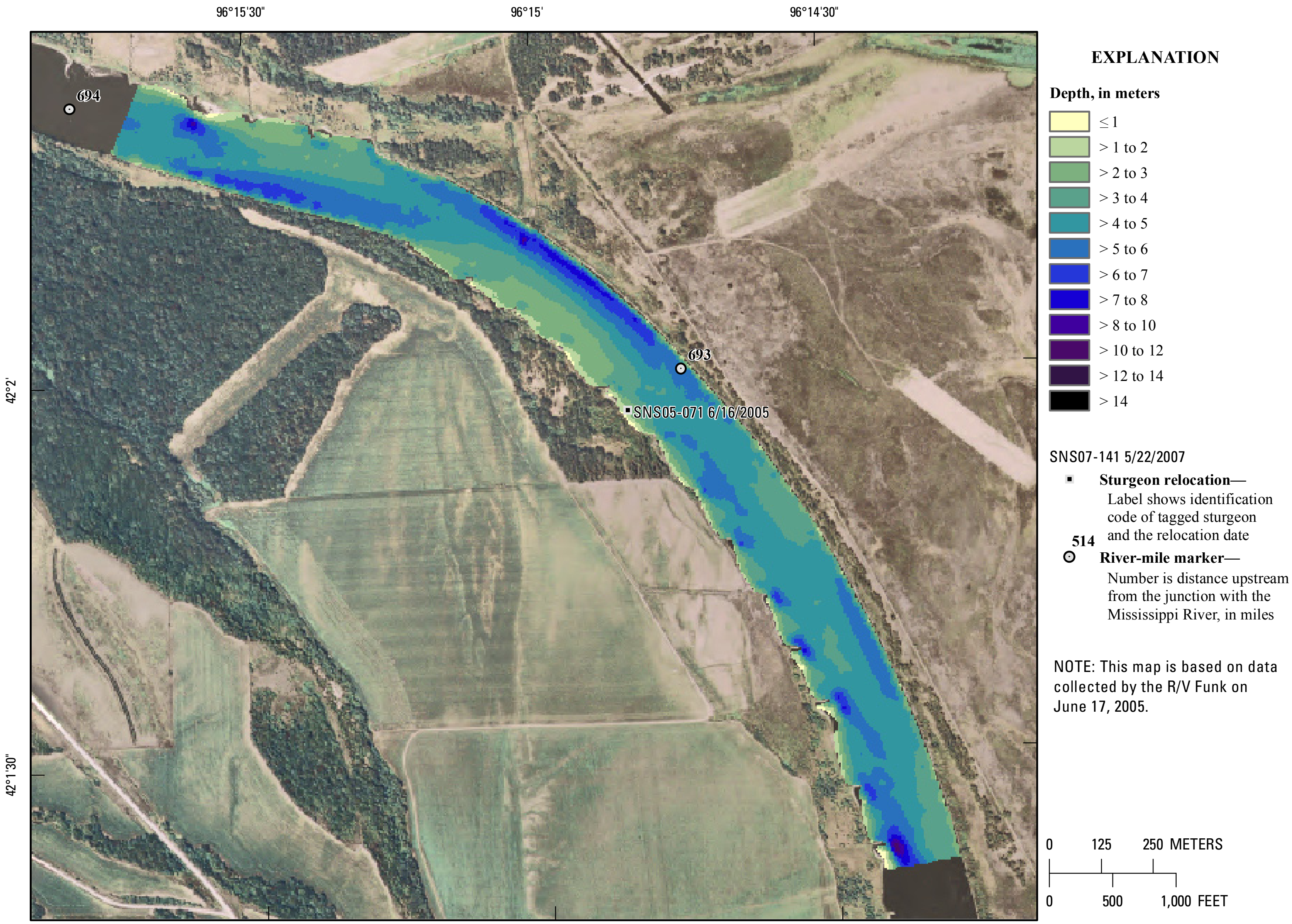
Figure 120. Map of generalized substrate based on data collected on June 9, 2005, in the vicinity of river mile 693.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 121. Map of depth-averaged velocity based on data collected on June 9, 2005, in the vicinity of river mile 693.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 122. Map of depth based on data collected on June 17, 2005, in the vicinity of river mile 693.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 17, 2005.

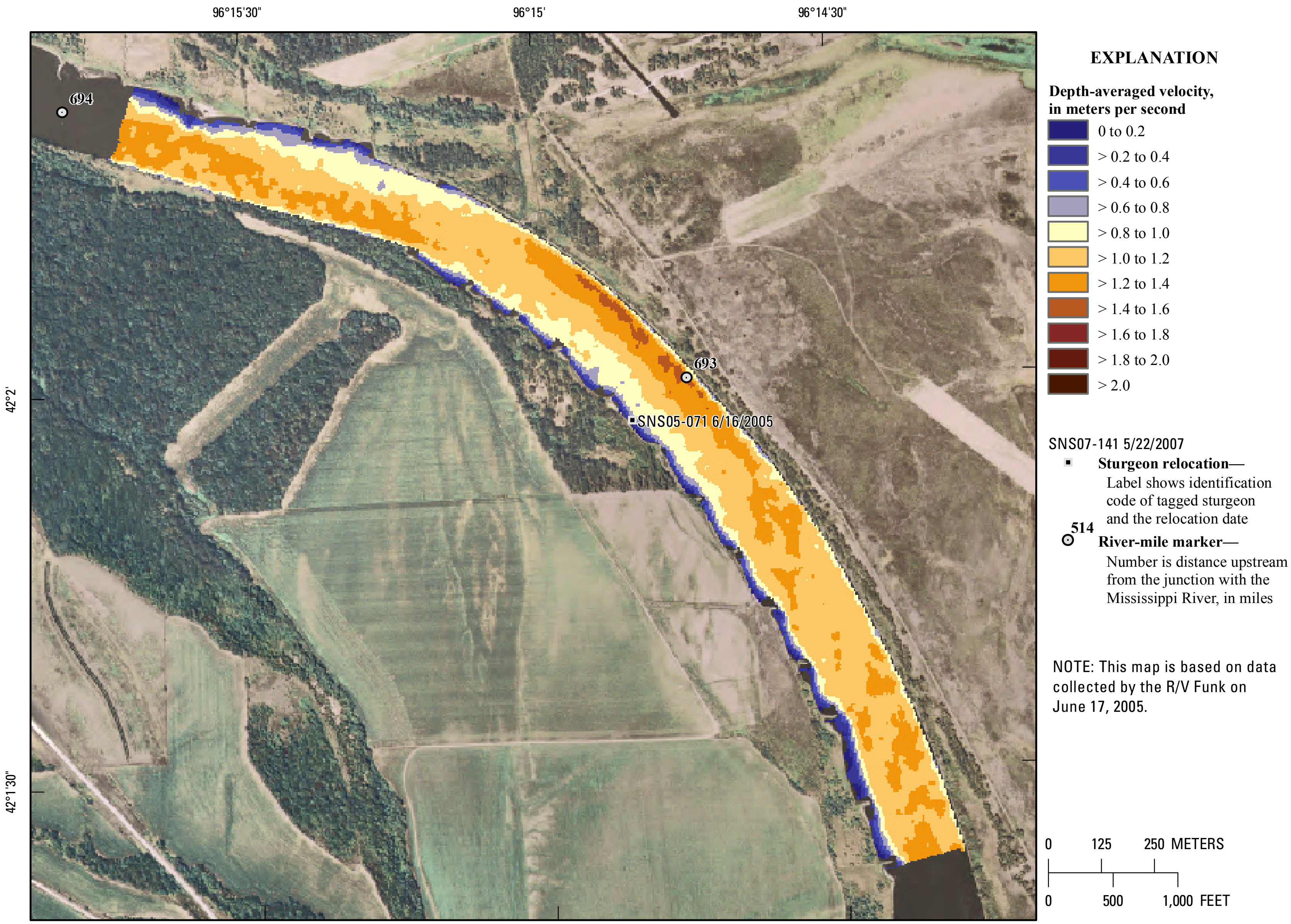
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

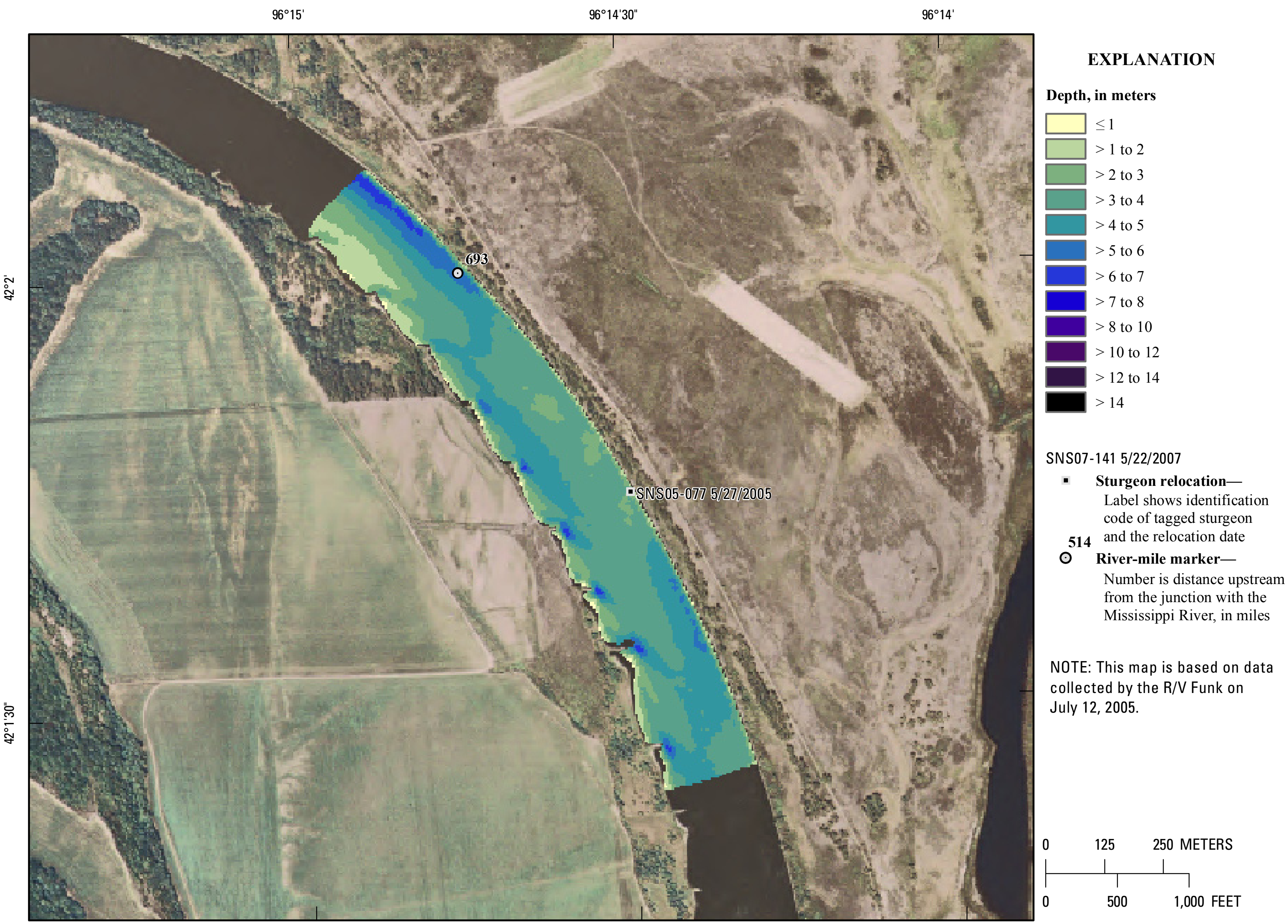
Figure 123. Map of generalized substrate based on data collected on June 17, 2005, in the vicinity of river mile 693.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

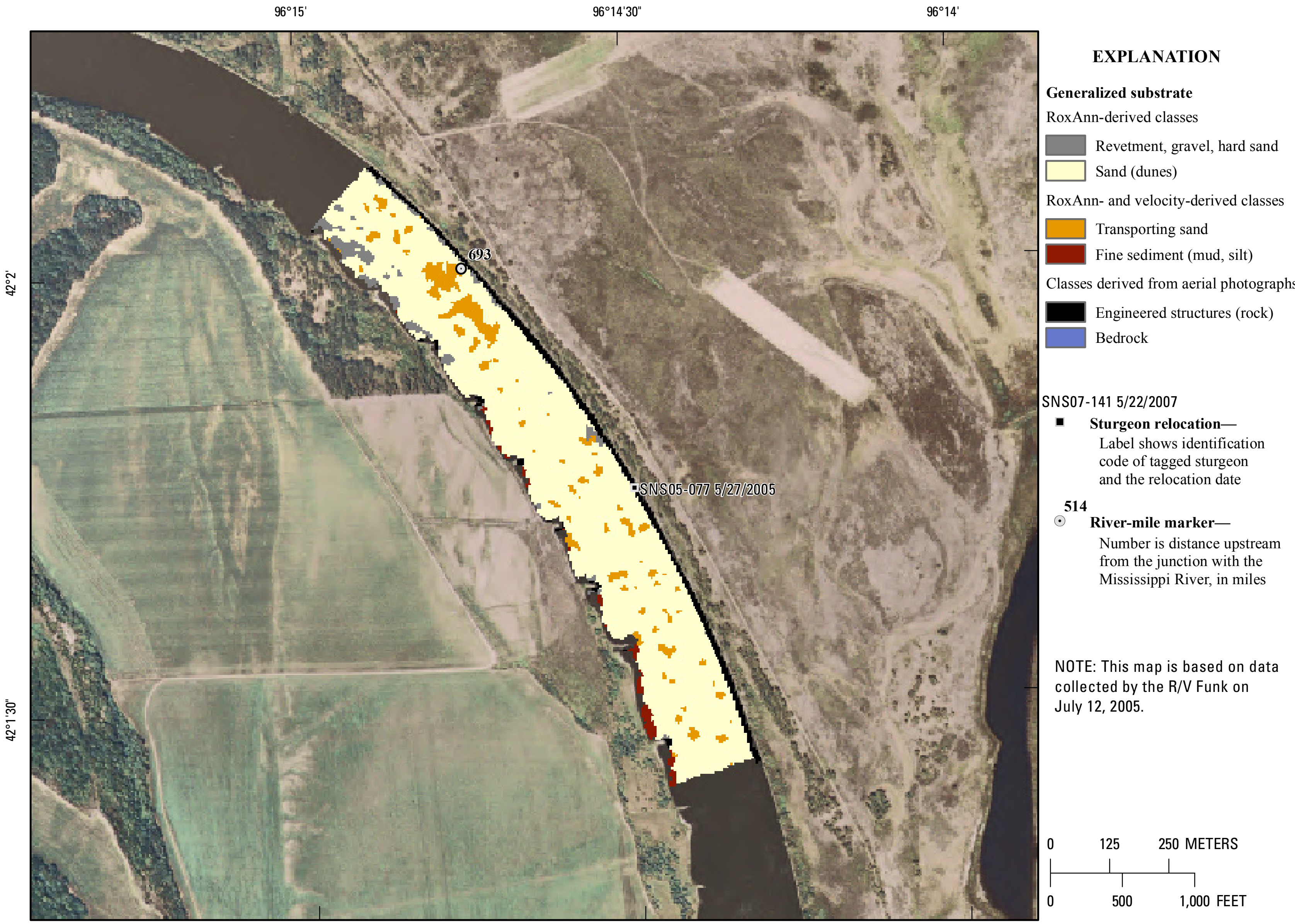
Figure 124. Map of depth-averaged velocity based on data collected on June 17, 2005, in the vicinity of river mile 693.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 125. Map of depth based on data collected on July 12, 2005, in the vicinity of river mile 693.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 126. Map of generalized substrate based on data collected on July 12, 2005, in the vicinity of river mile 693.

EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on July 12, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 127. Map of depth-averaged velocity based on data collected on July 12, 2005, in the vicinity of river mile 693.

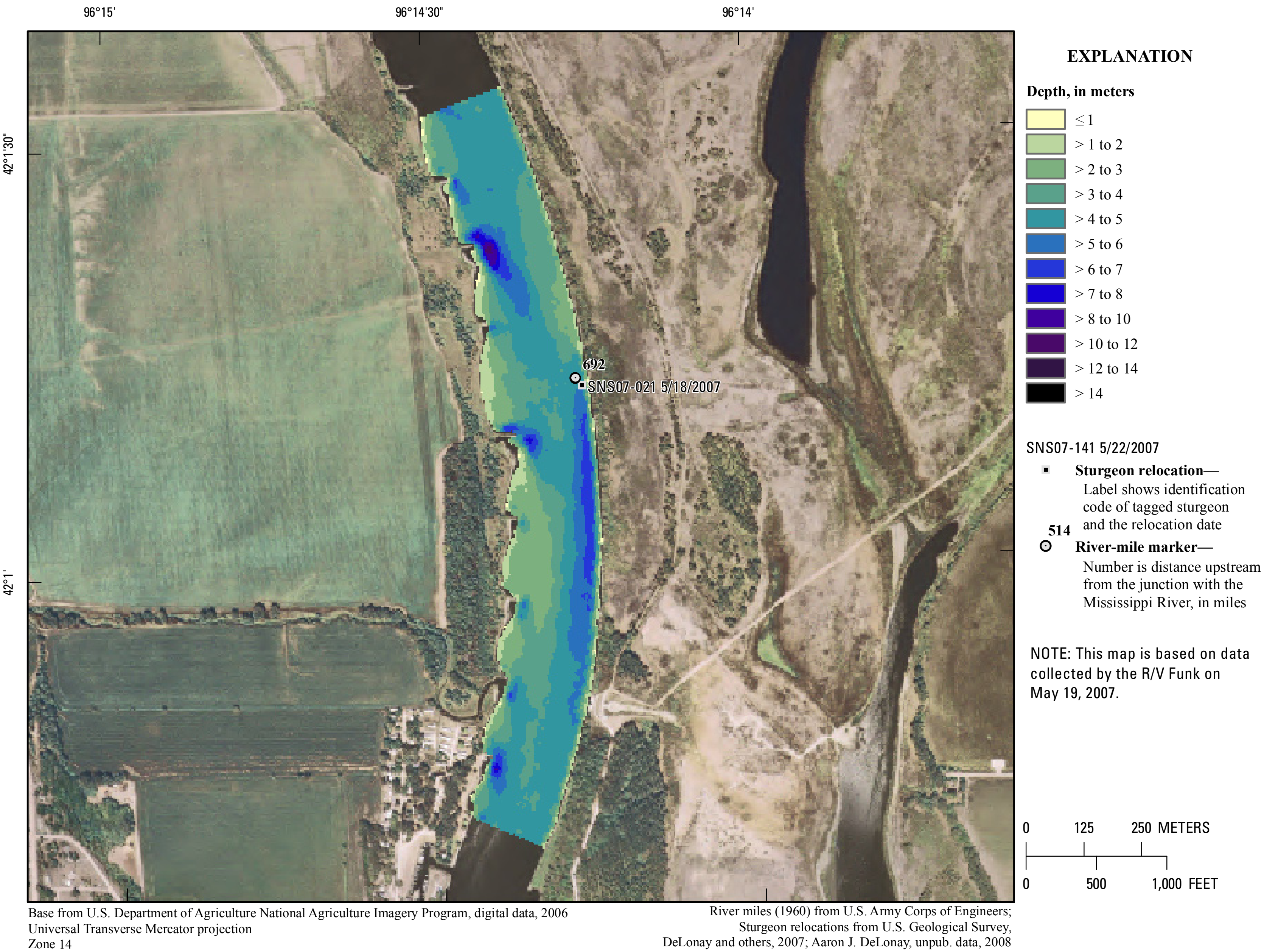


Figure 128. Map of depth based on data collected on May 19, 2007, in the vicinity of river mile 692.

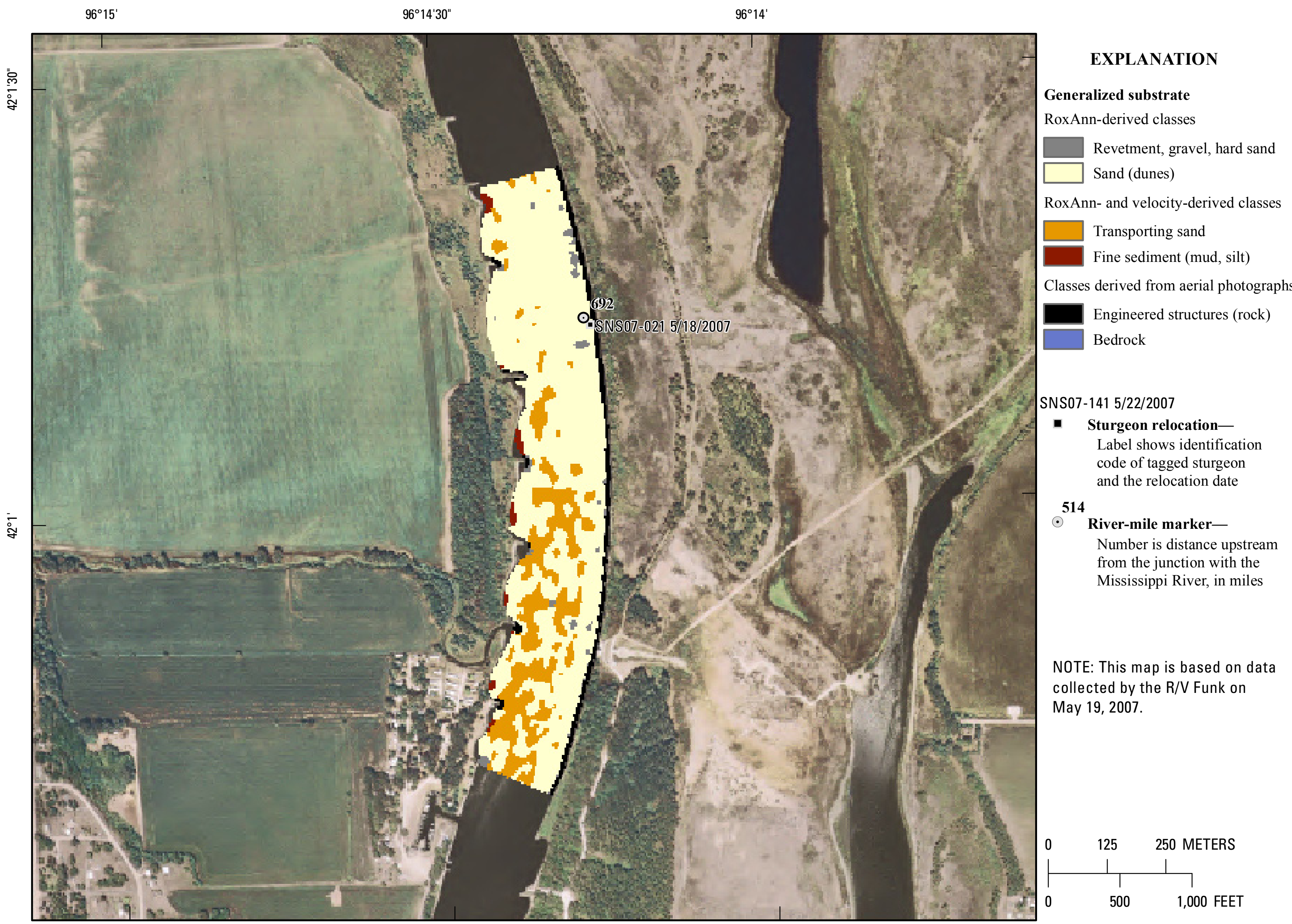


Figure 129. Map of generalized substrate based on data collected on May 19, 2007, in the vicinity of river mile 692.

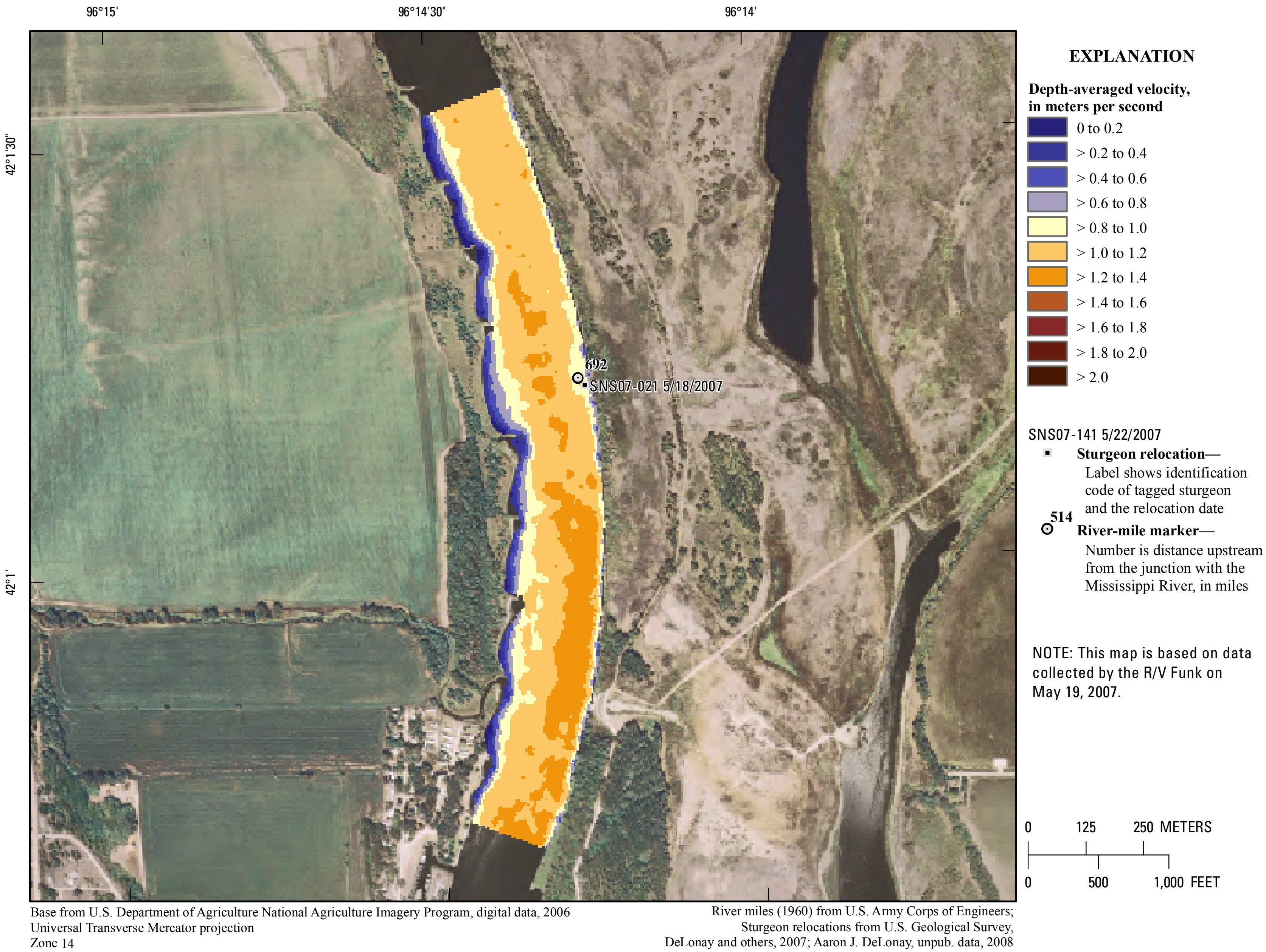
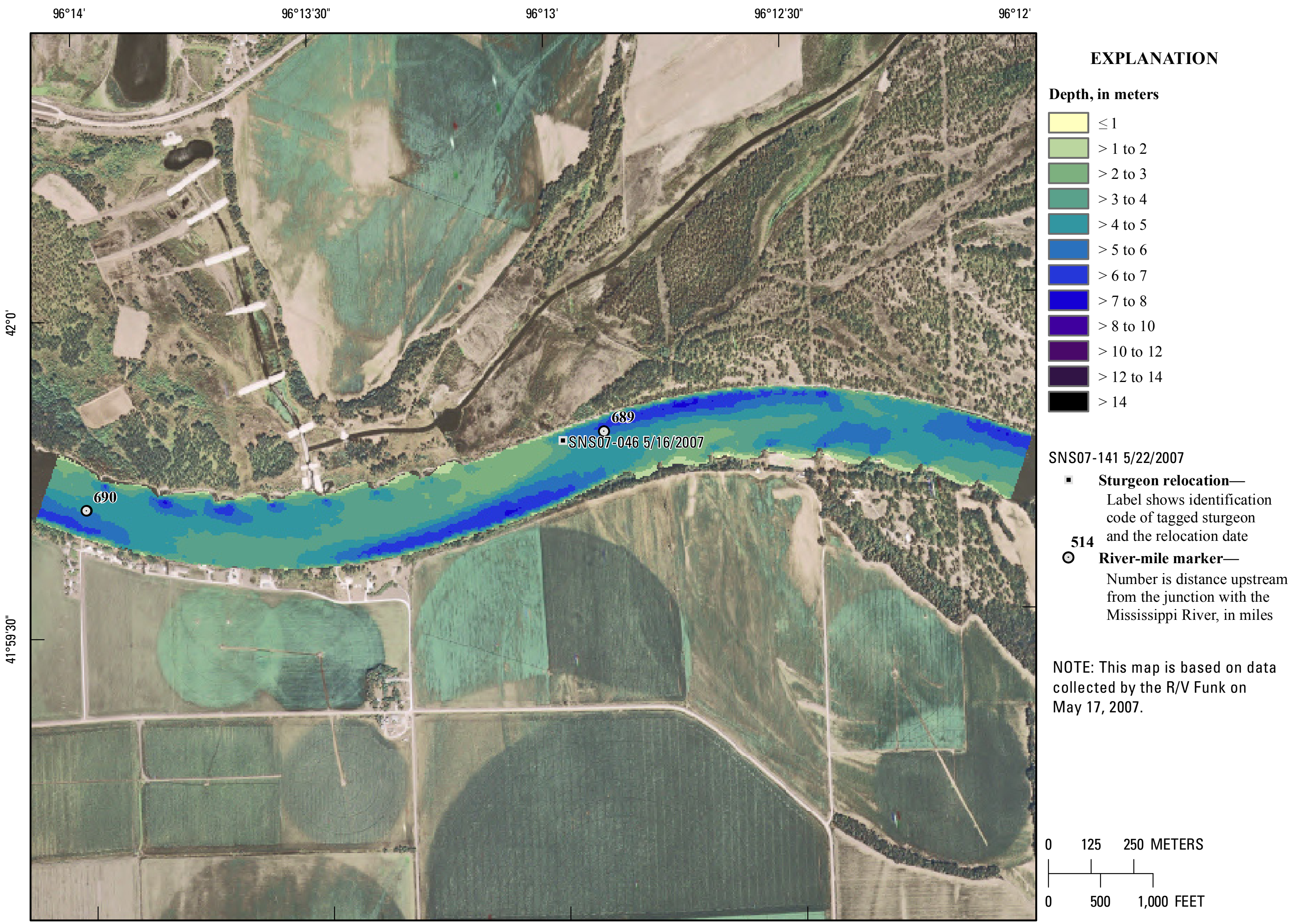


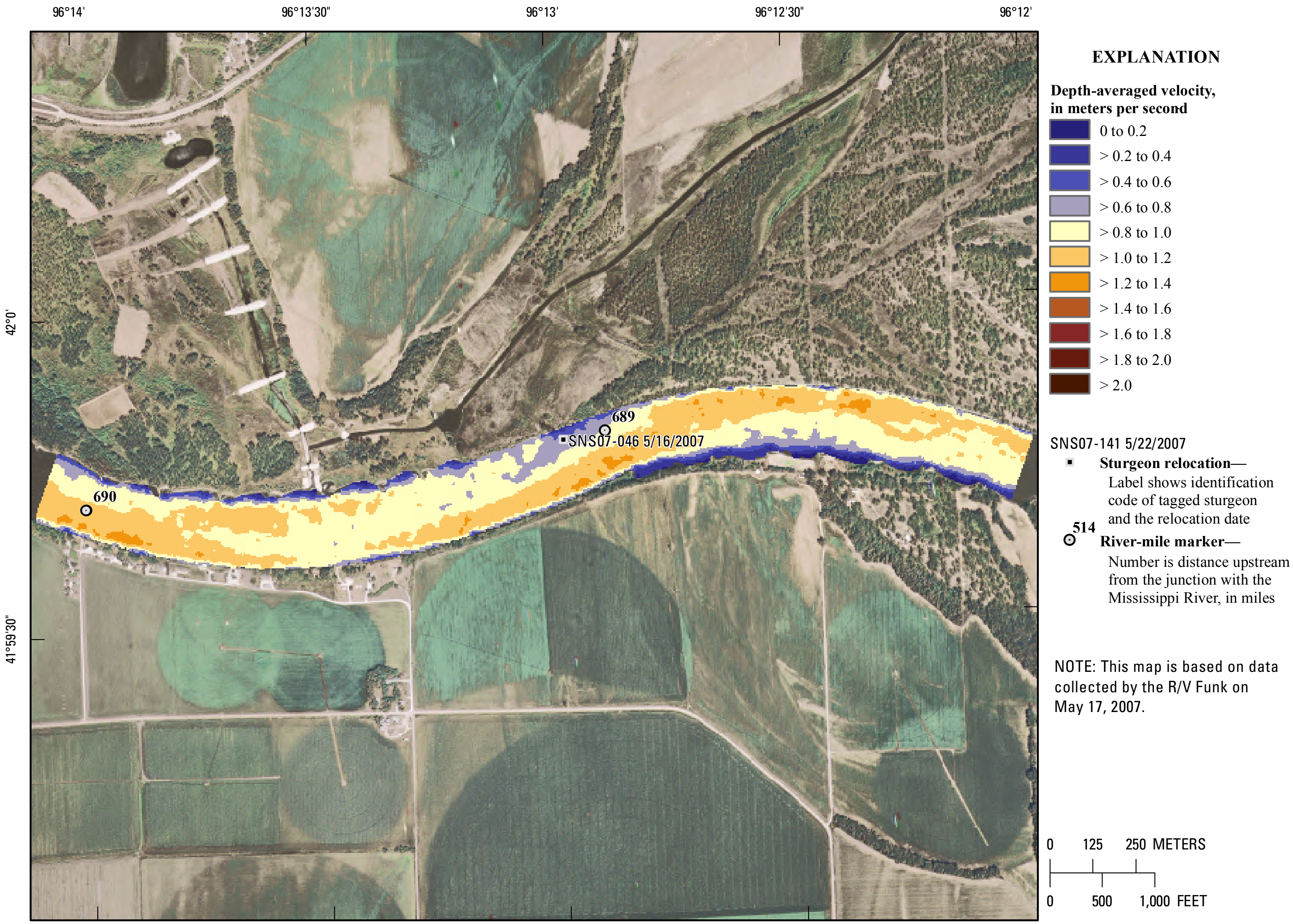
Figure 130. Map of depth-averaged velocity based on data collected on May 19, 2007, in the vicinity of river mile 692.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 131. Map of depth based on data collected on May 17, 2007, in the vicinity of river mile 689.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 132. Map of depth-averaged velocity based on data collected on May 17, 2007, in the vicinity of river mile 689.

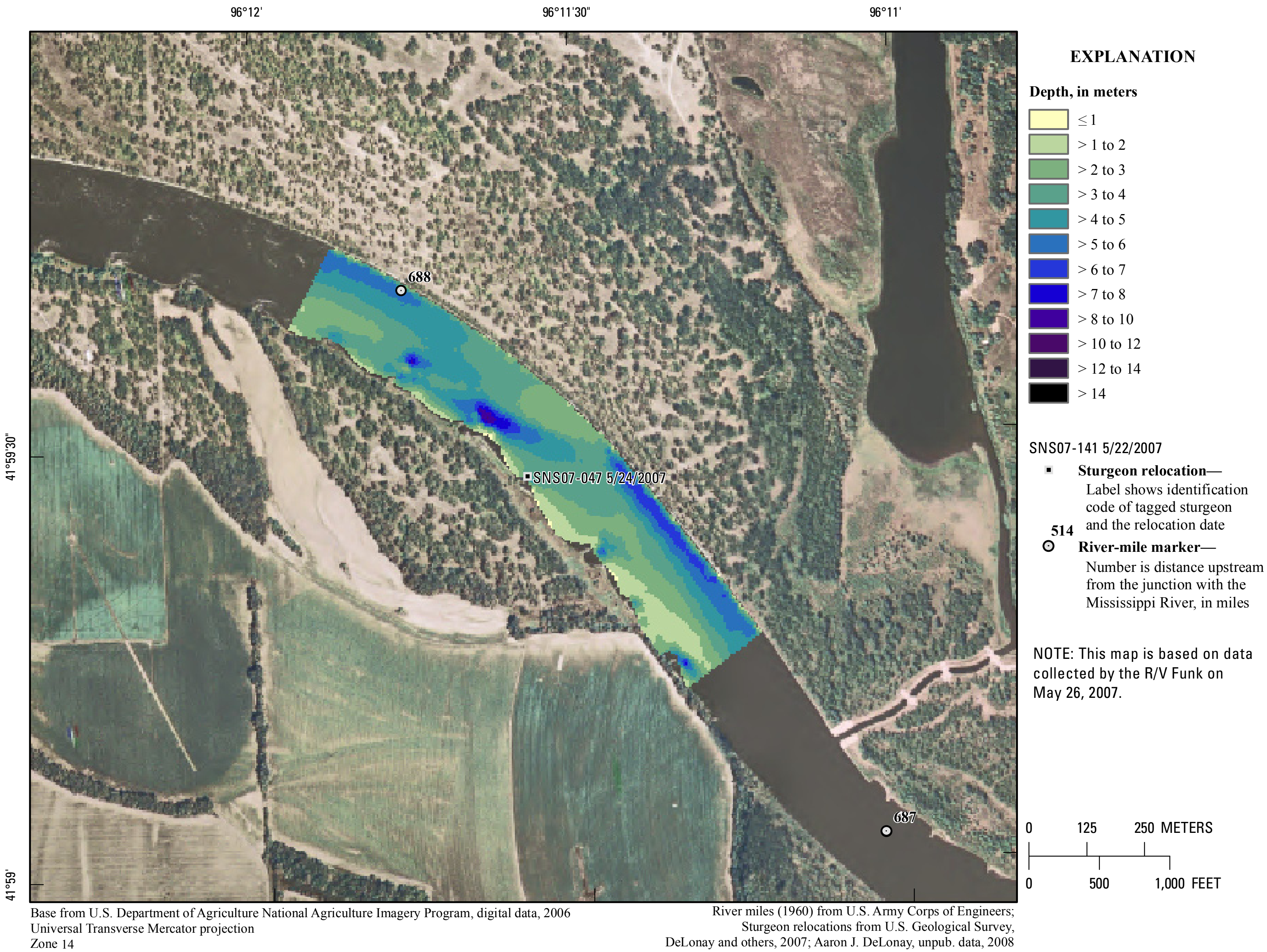


Figure 133. Map of depth based on data collected on May 26, 2007, in the vicinity of river mile 688.

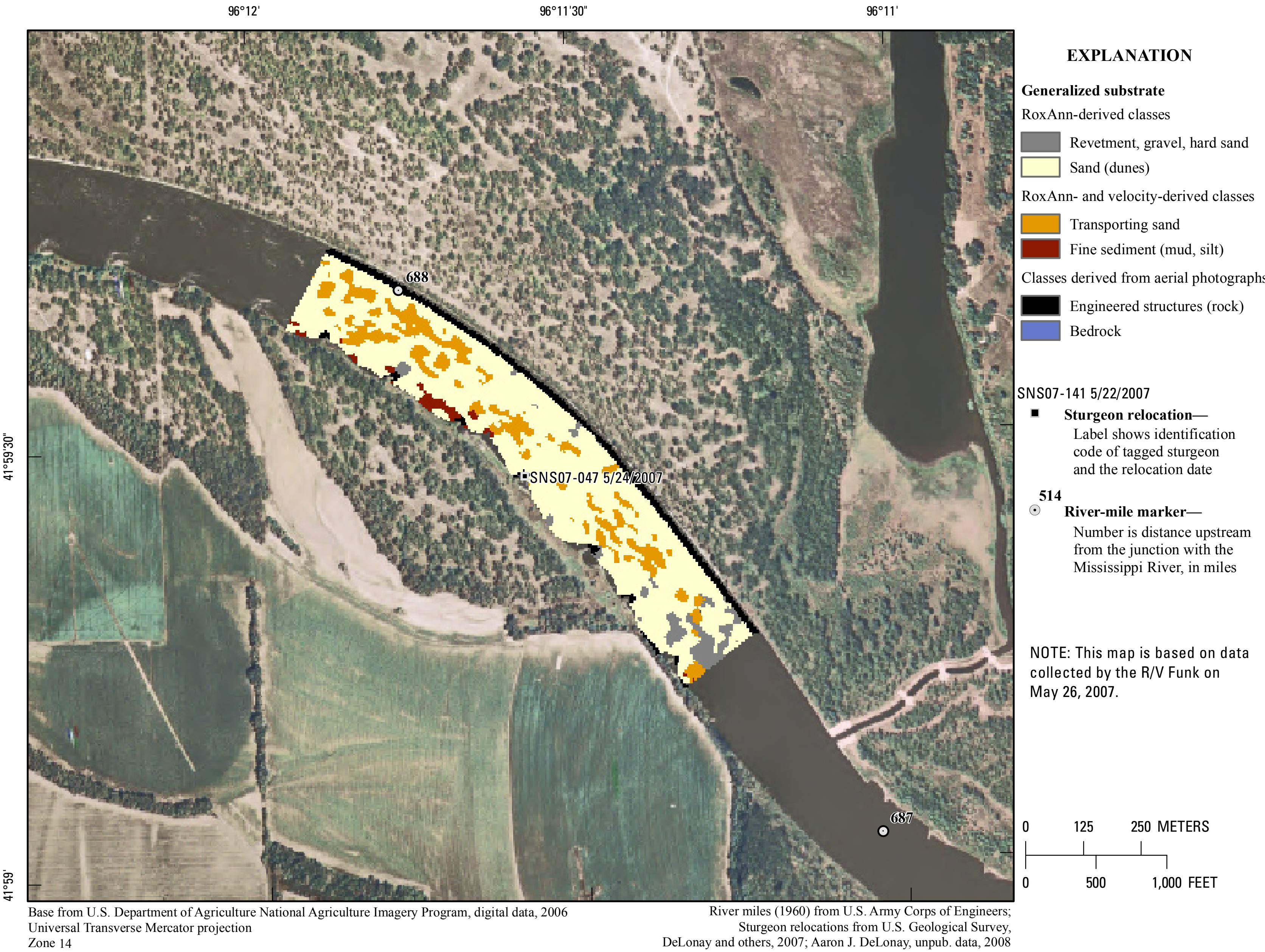


Figure 134. Map of generalized substrate based on data collected on May 26, 2007, in the vicinity of river mile 688.

EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 26, 2007.

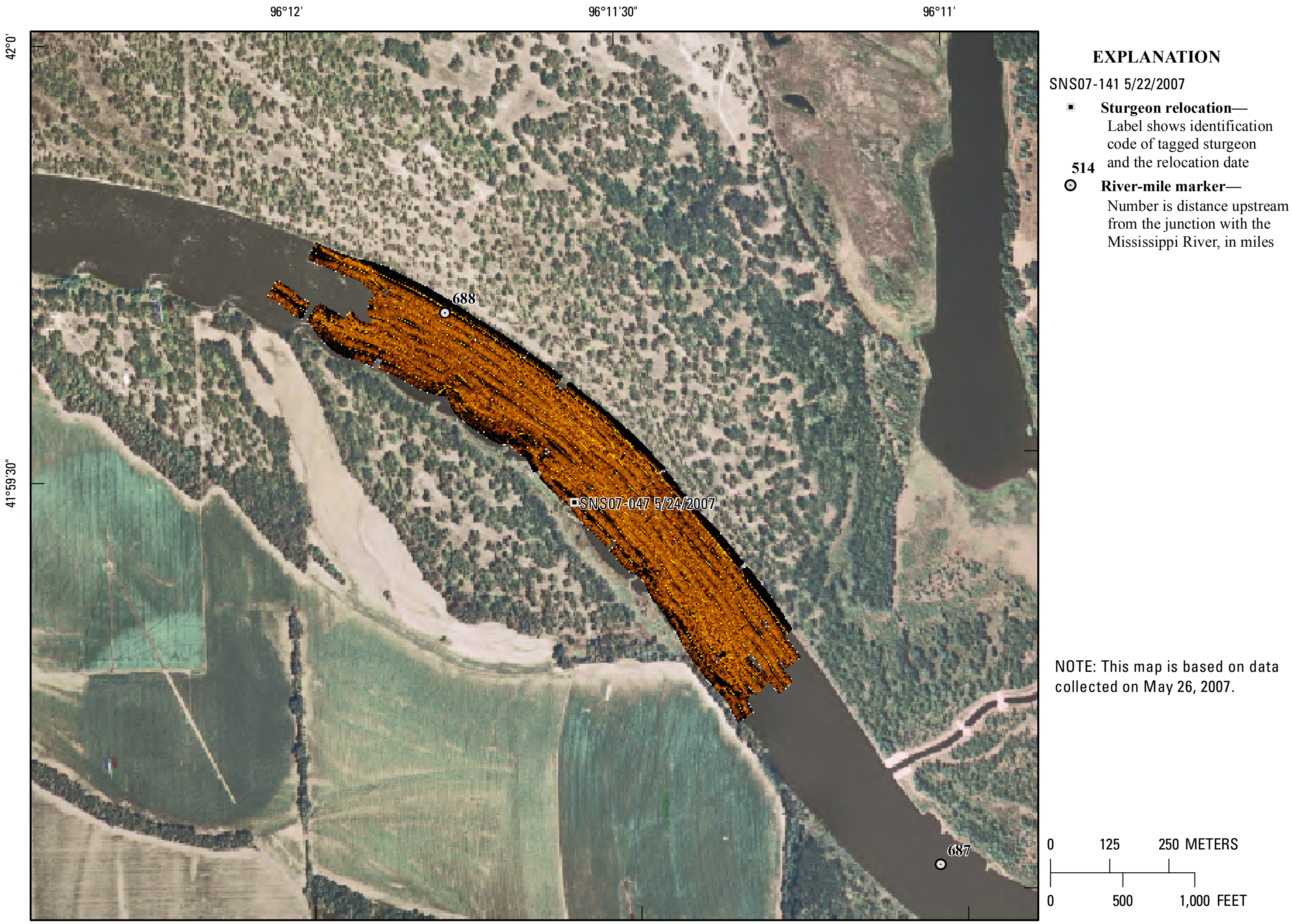
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

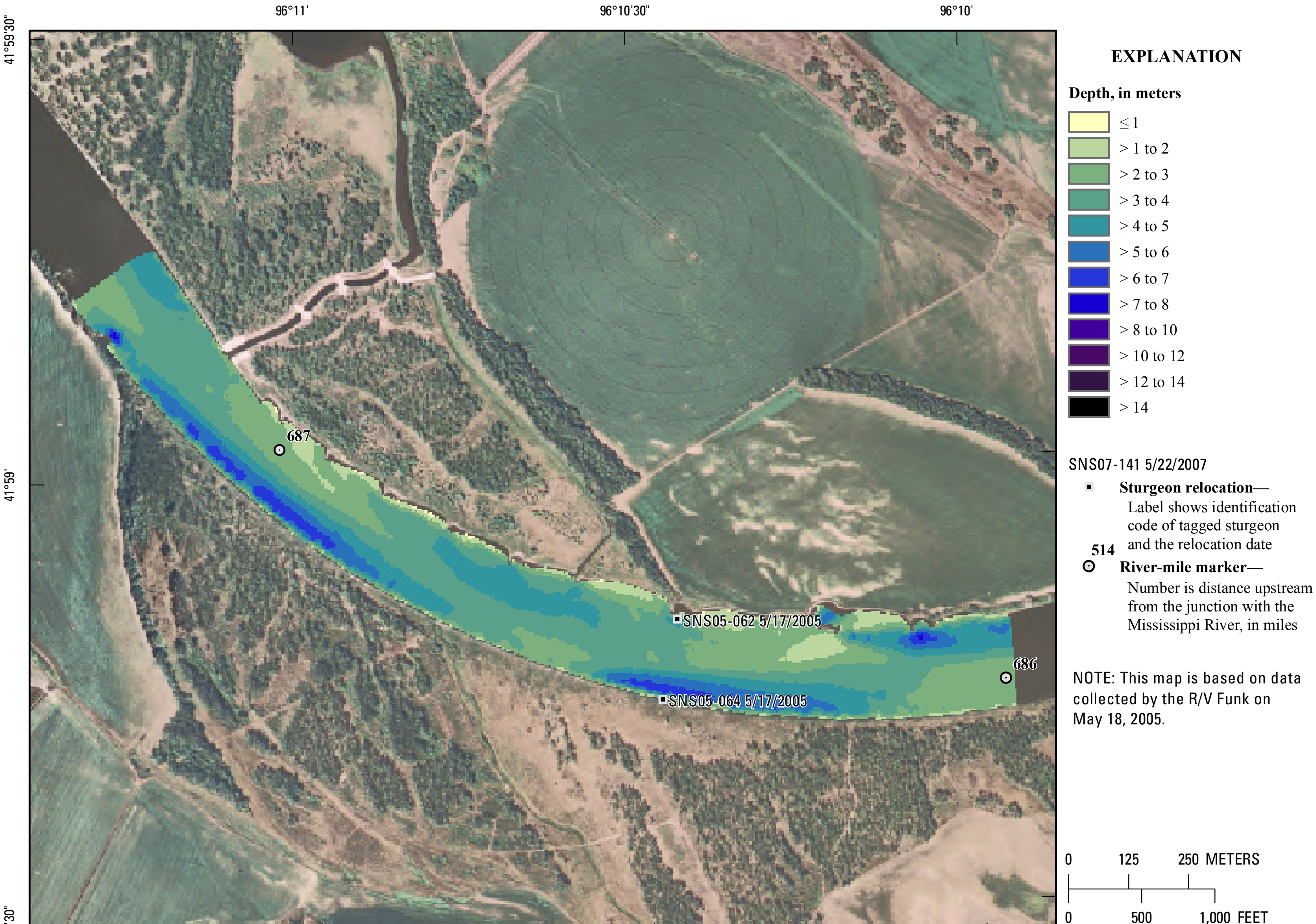
Figure 135. Map of depth-averaged velocity based on data collected on May 26, 2007, in the vicinity of river mile 688.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 136. Map of side-scan sonar imagery based on data collected on May 26, 2007, in the vicinity of river mile 688.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 137. Map of depth based on data collected on May 18, 2005, in the vicinity of river mile 687.

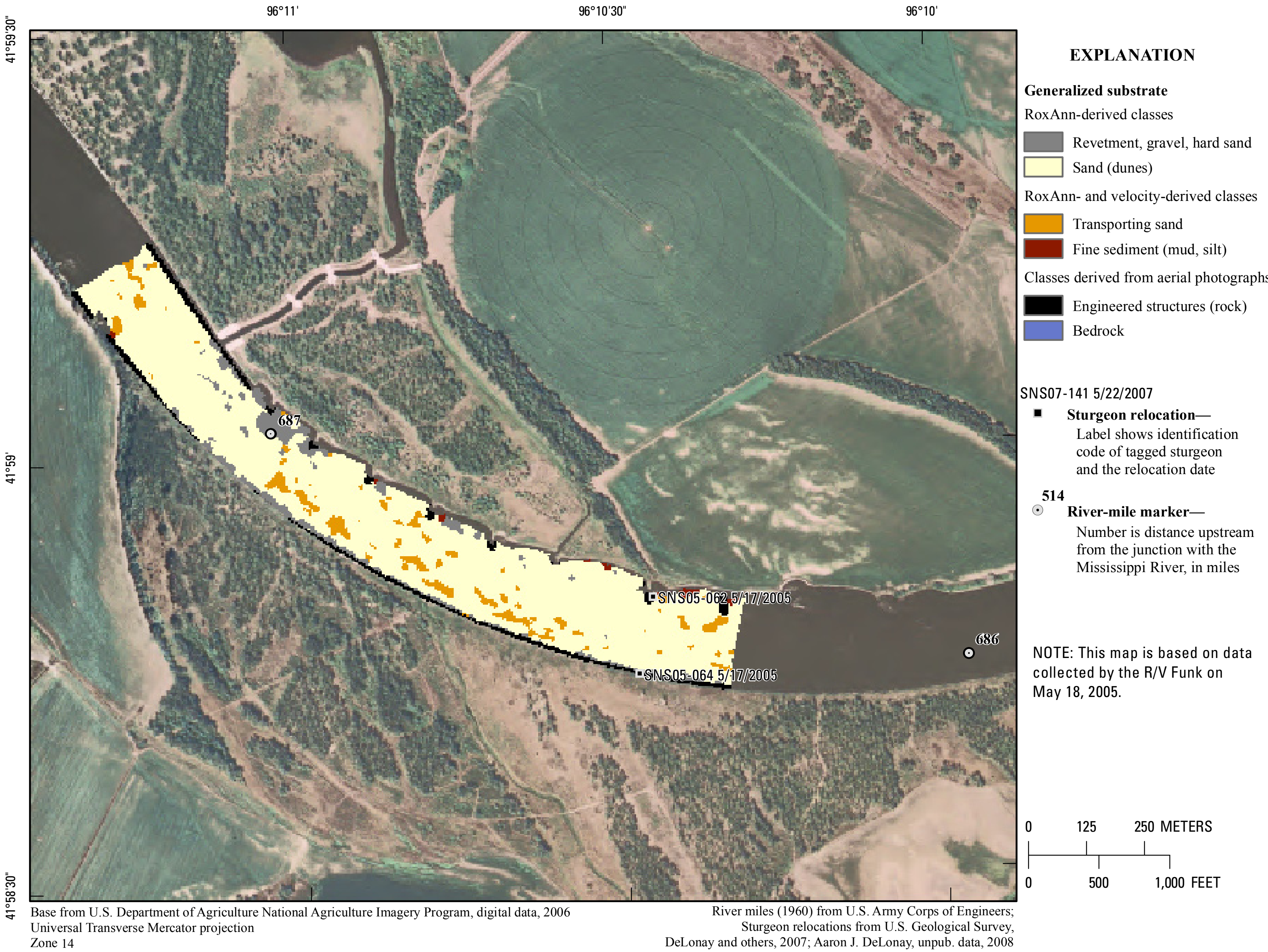
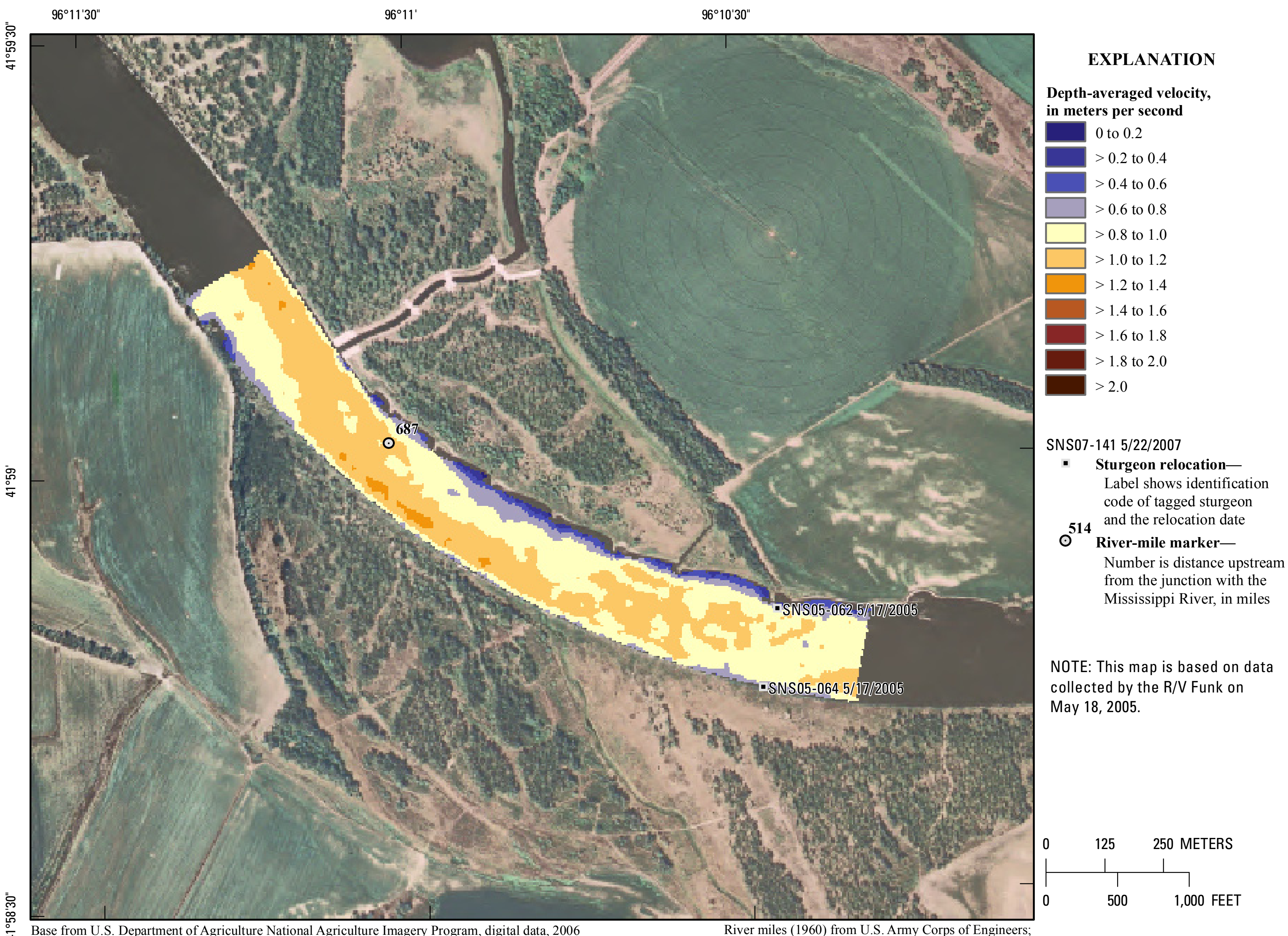


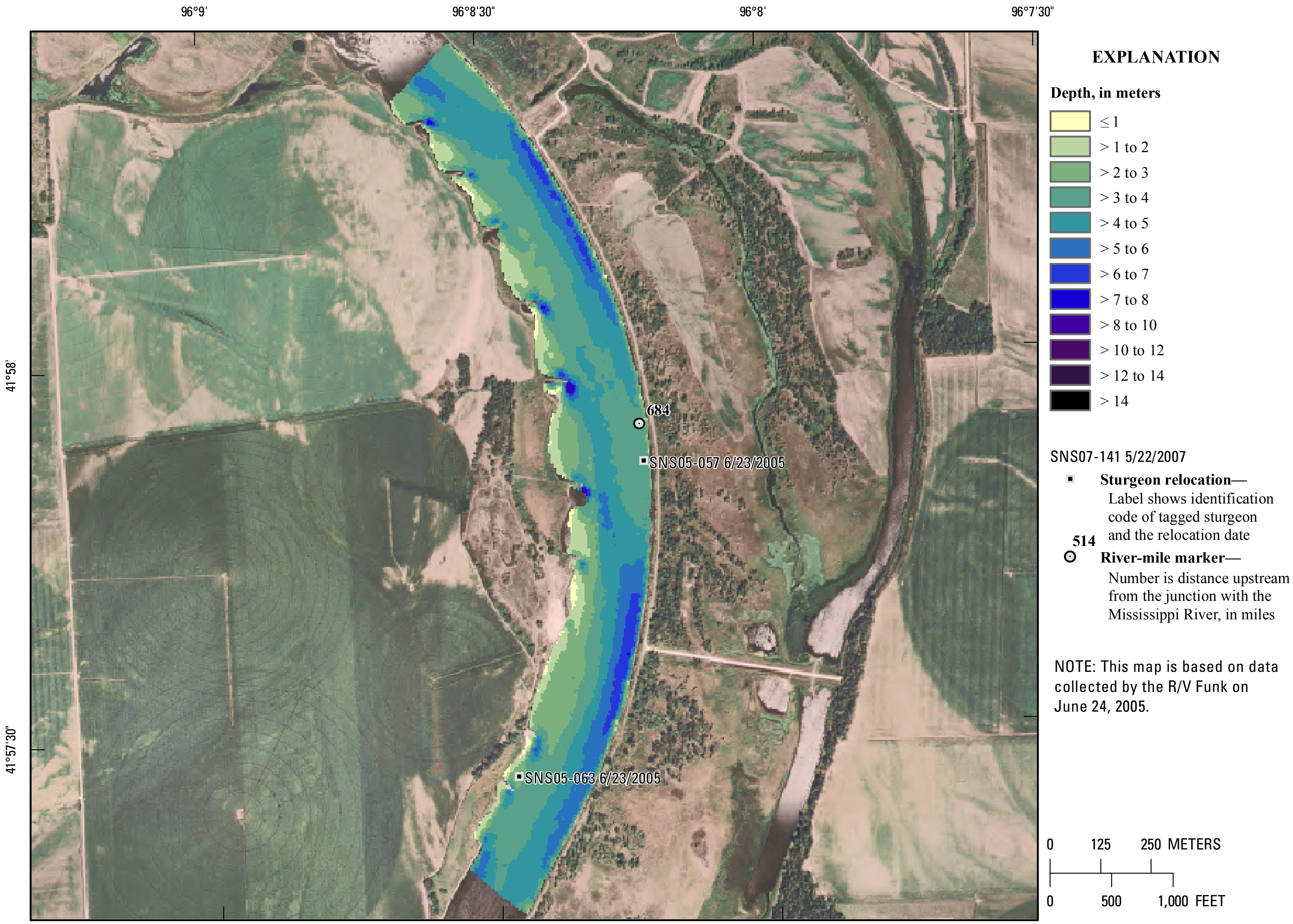
Figure 138. Map of generalized substrate based on data collected on May 18, 2005, in the vicinity of river mile 687.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 139. Map of depth-averaged velocity based on data collected on May 18, 2005, in the vicinity of river mile 687.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 140. Map of depth based on data collected on June 24, 2005, in the vicinity of river mile 684.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 24, 2005.

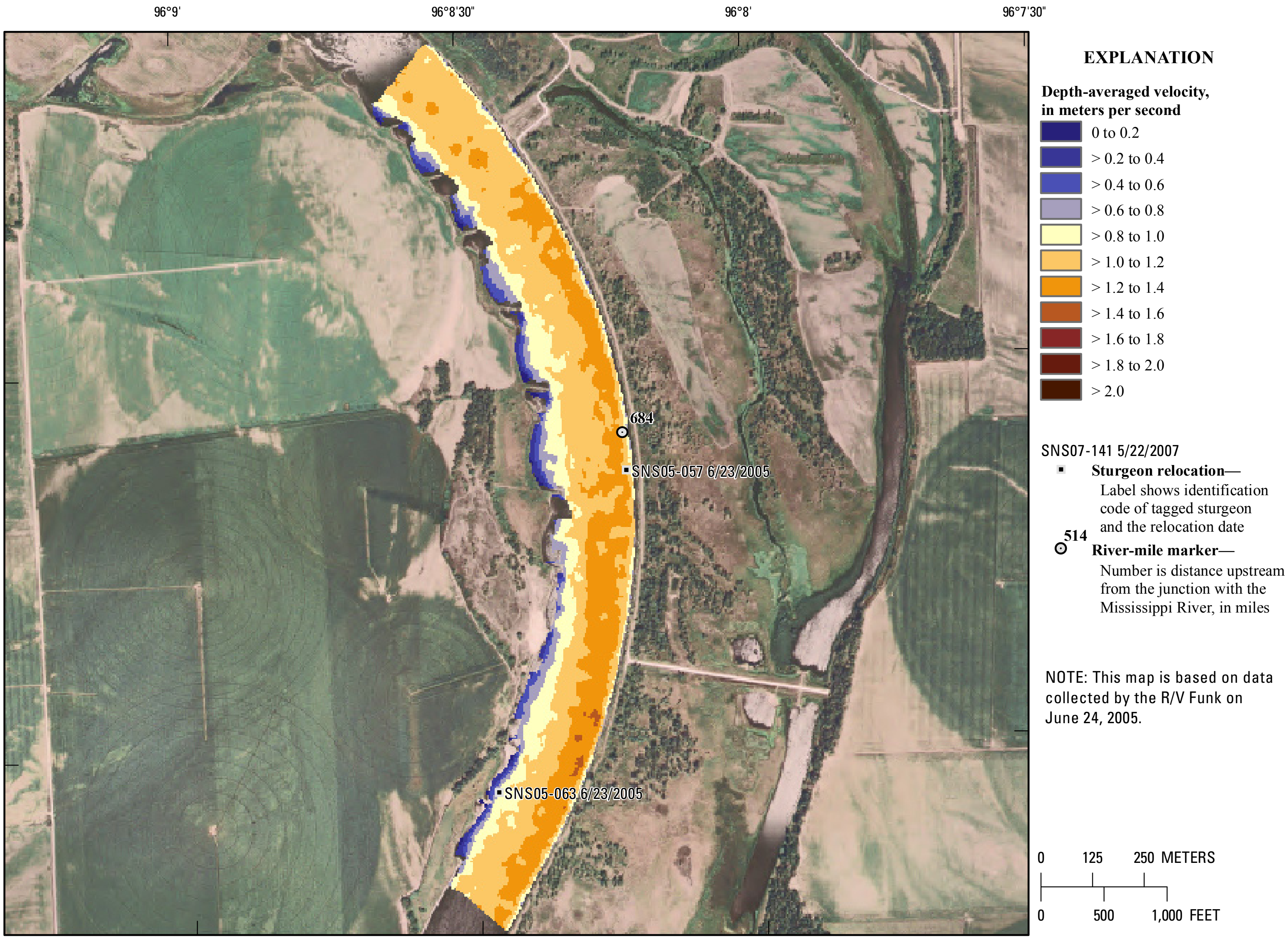
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 141. Map of generalized substrate based on data collected on June 24, 2005, in the vicinity of river mile 684.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 142. Map of depth-averaged velocity based on data collected on June 24, 2005, in the vicinity of river mile 684.

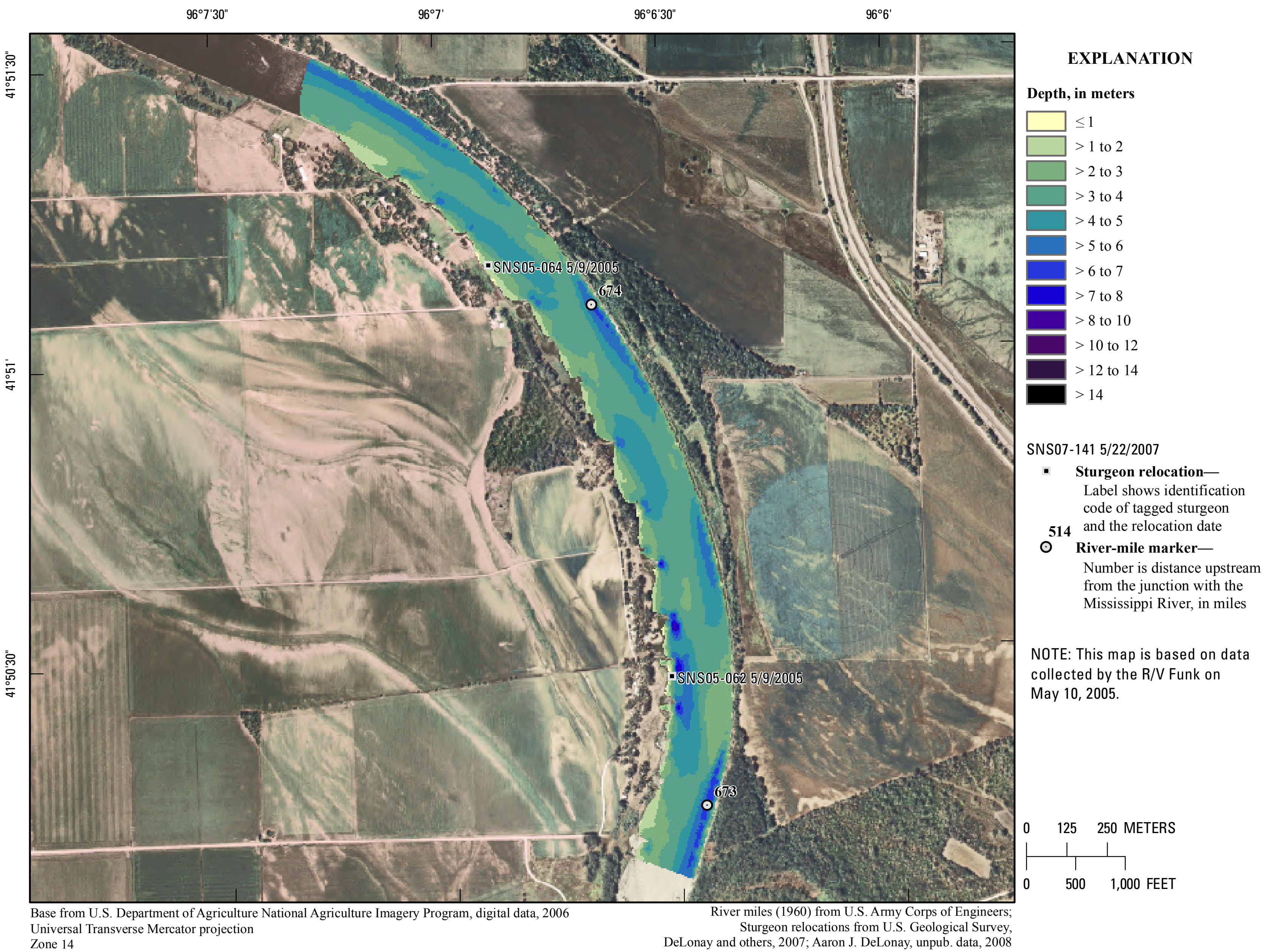
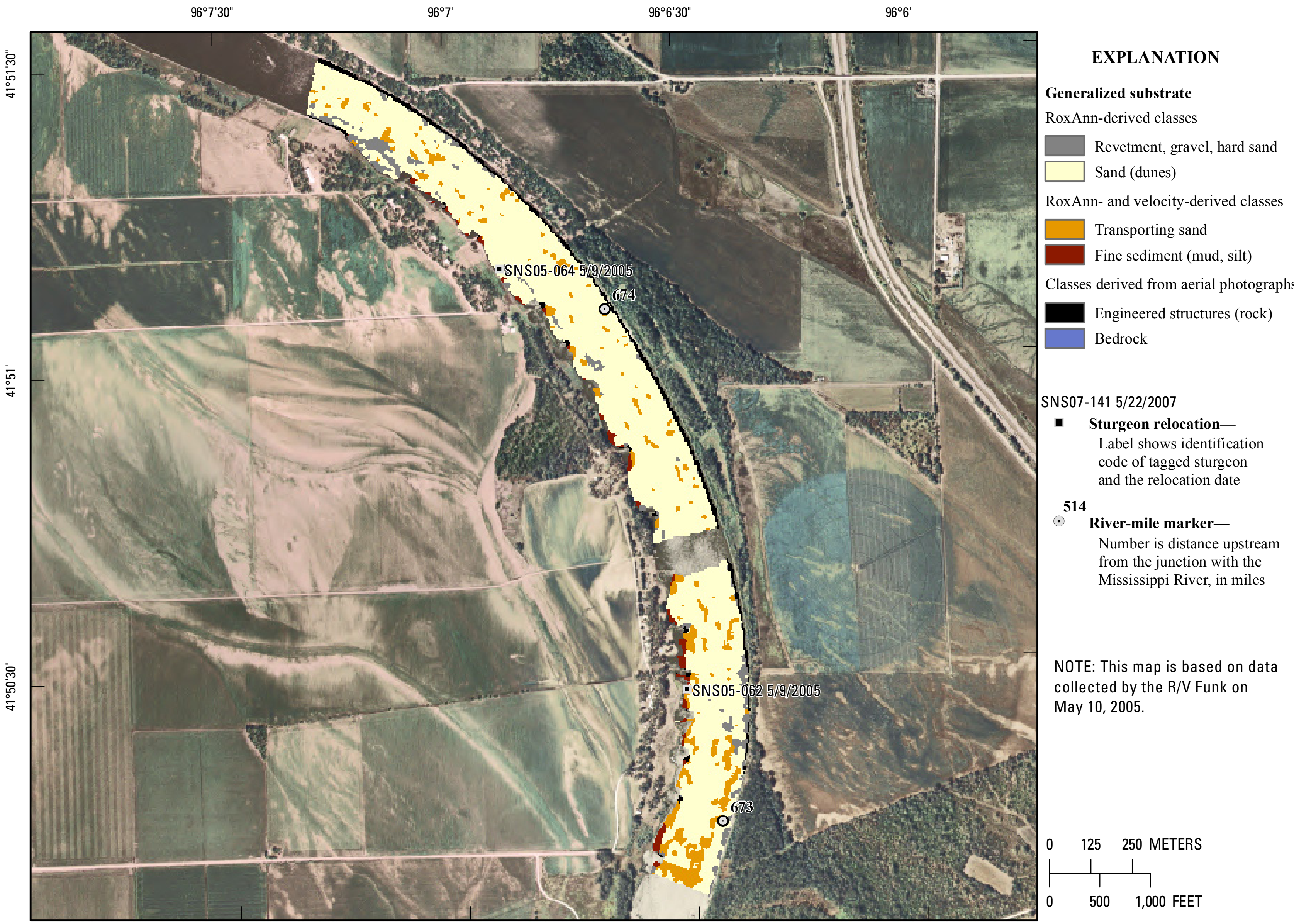


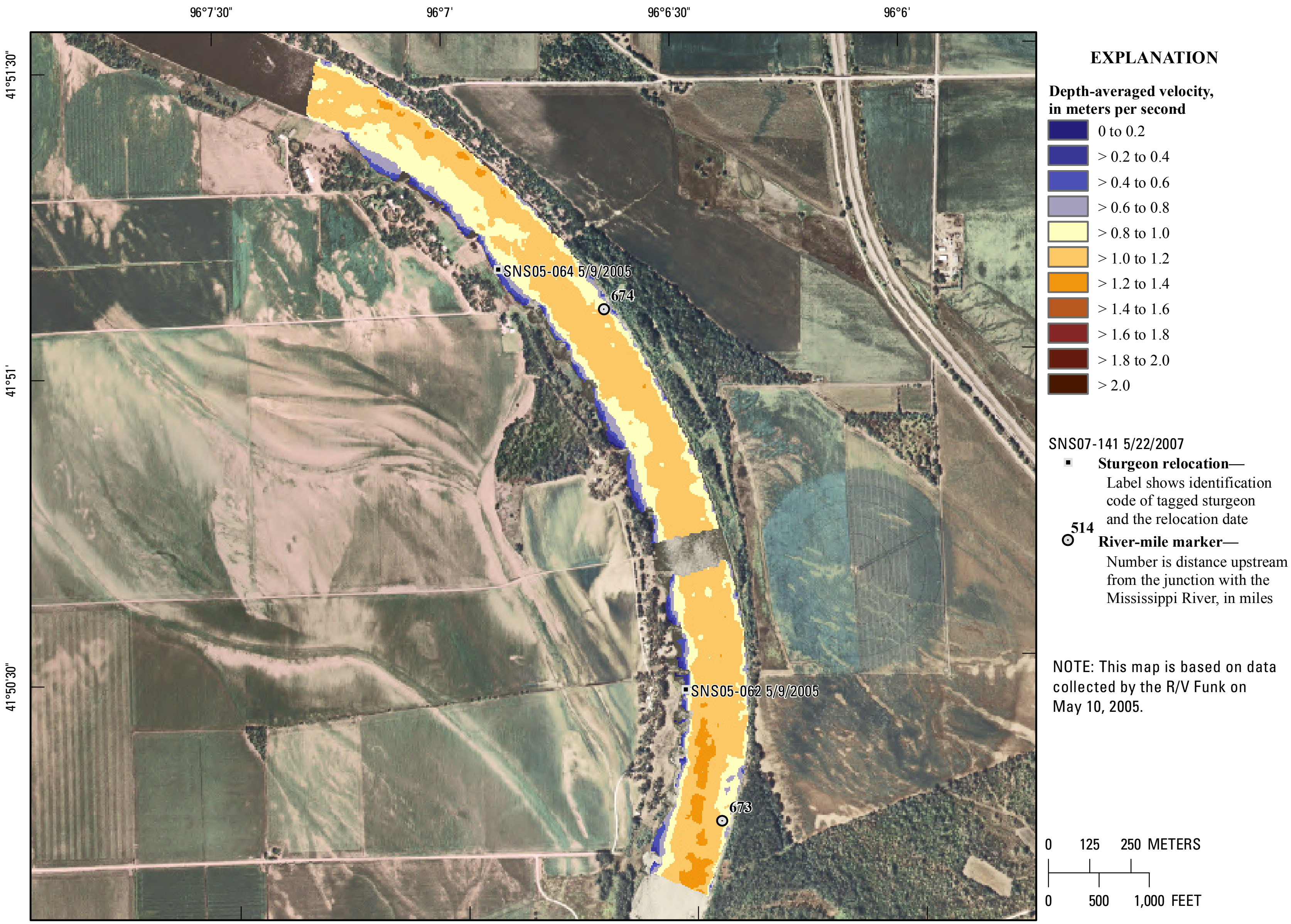
Figure 143. Map of depth based on data collected on May 10, 2005, in the vicinity of river mile 674.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

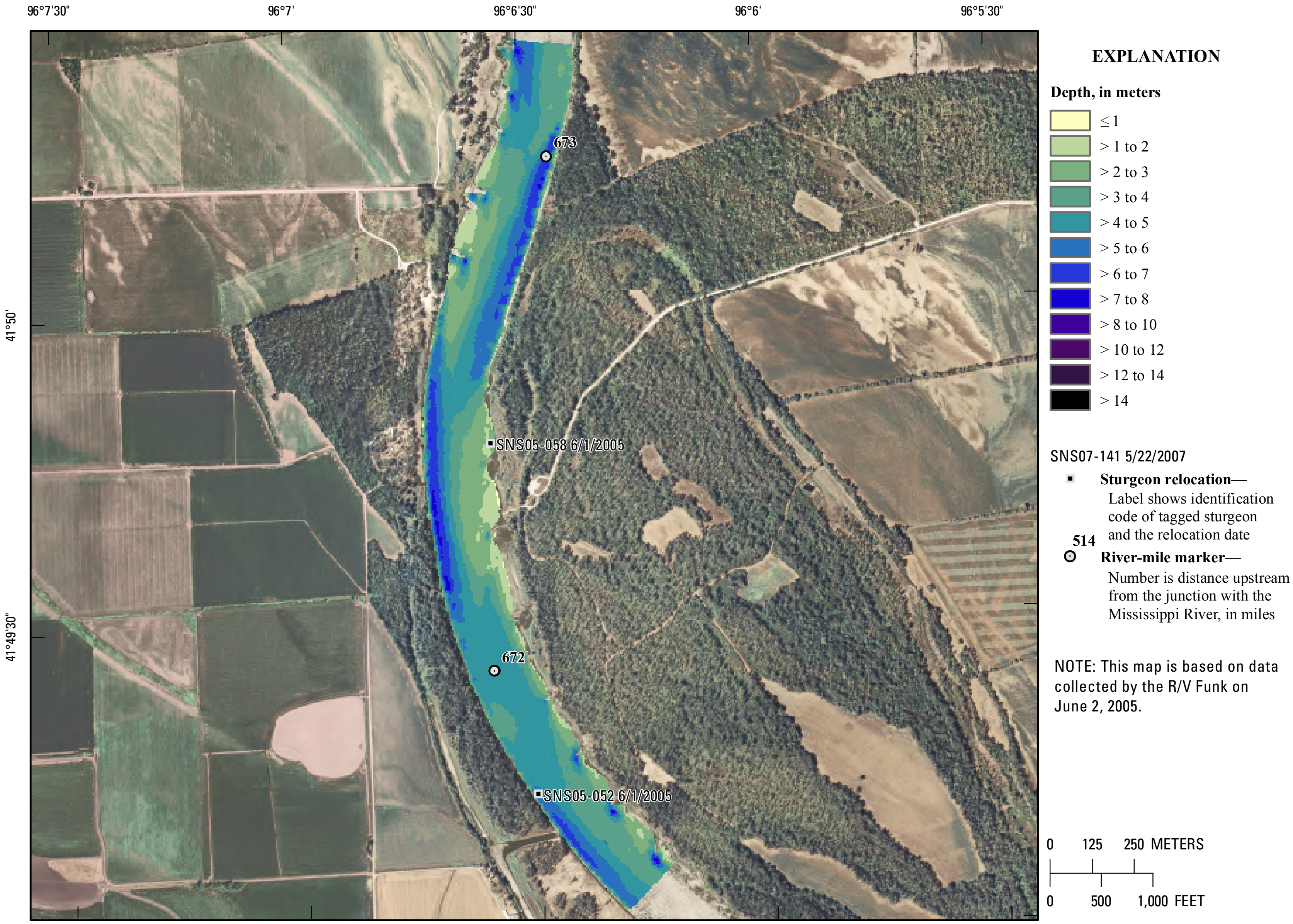
Figure 144. Map of generalized substrate based on data collected on May 10, 2005, in the vicinity of river mile 674.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 145. Map of depth-averaged velocity based on data collected on May 10, 2005, in the vicinity of river mile 674.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 146. Map of depth based on data collected on June 2, 2005, in the vicinity of river mile 672.

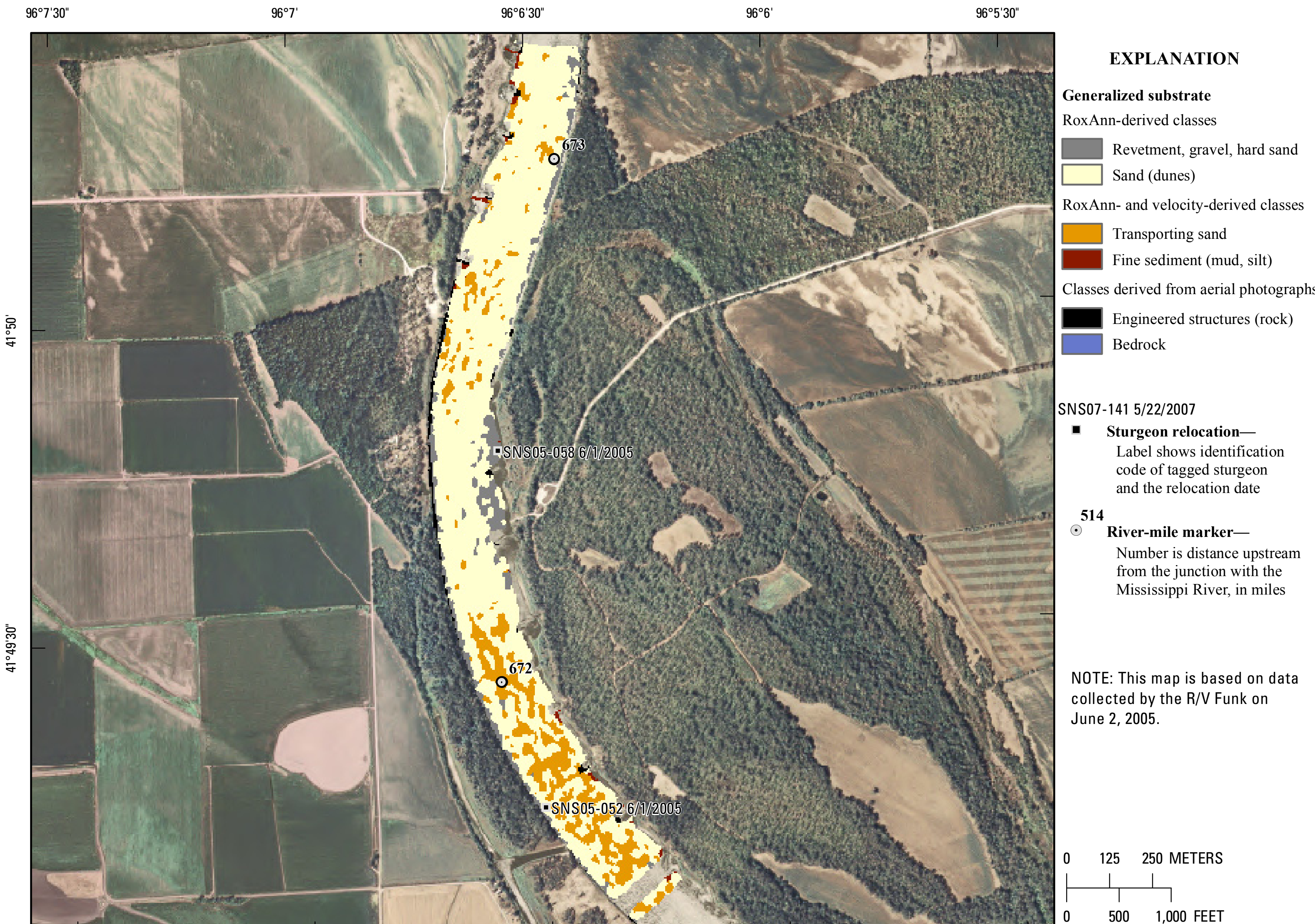
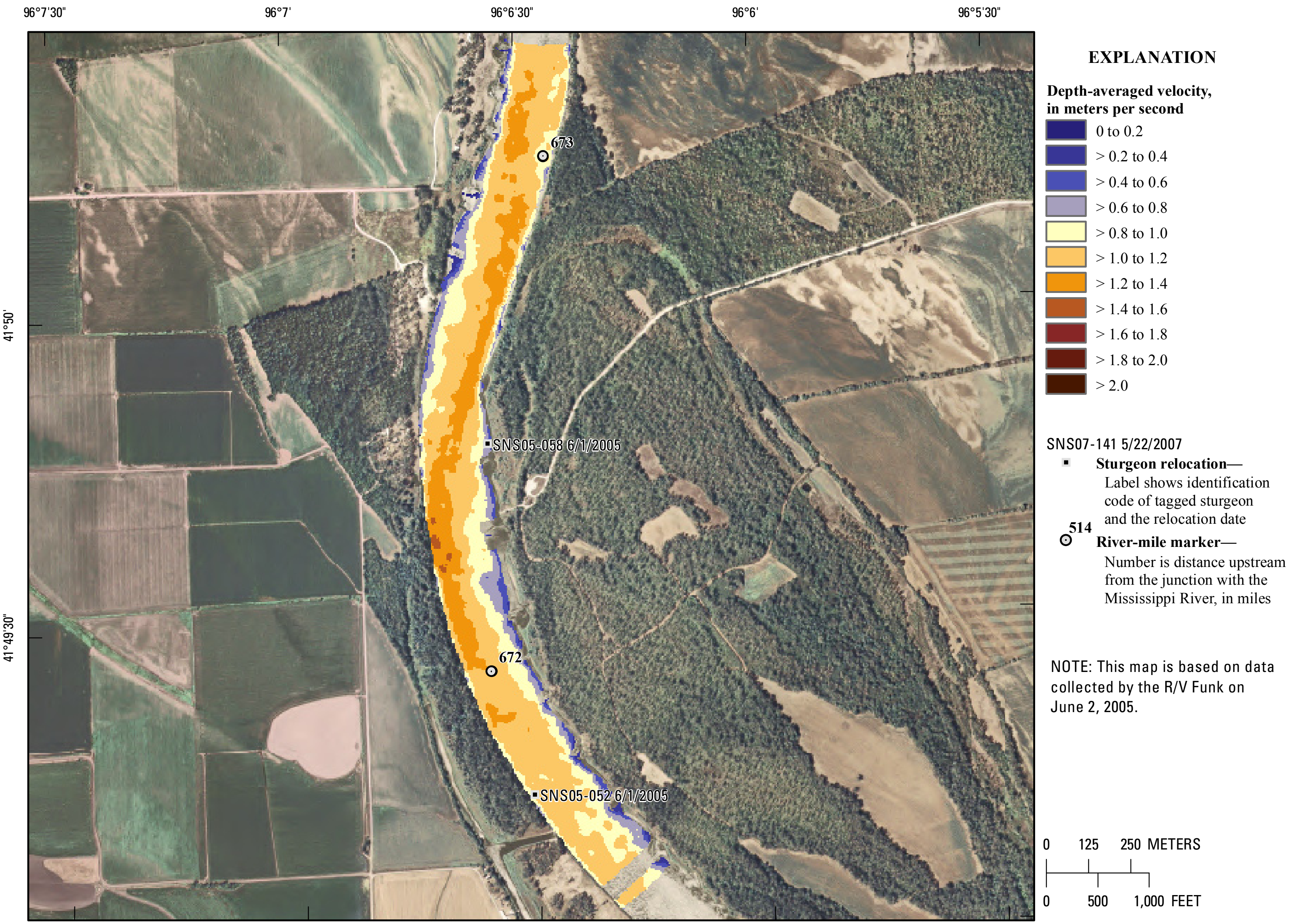


Figure 147. Map of generalized substrate based on data collected on June 2, 2005, in the vicinity of river mile 672.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 148. Map of depth-averaged velocity based on data collected on June 2, 2005, in the vicinity of river mile 672.

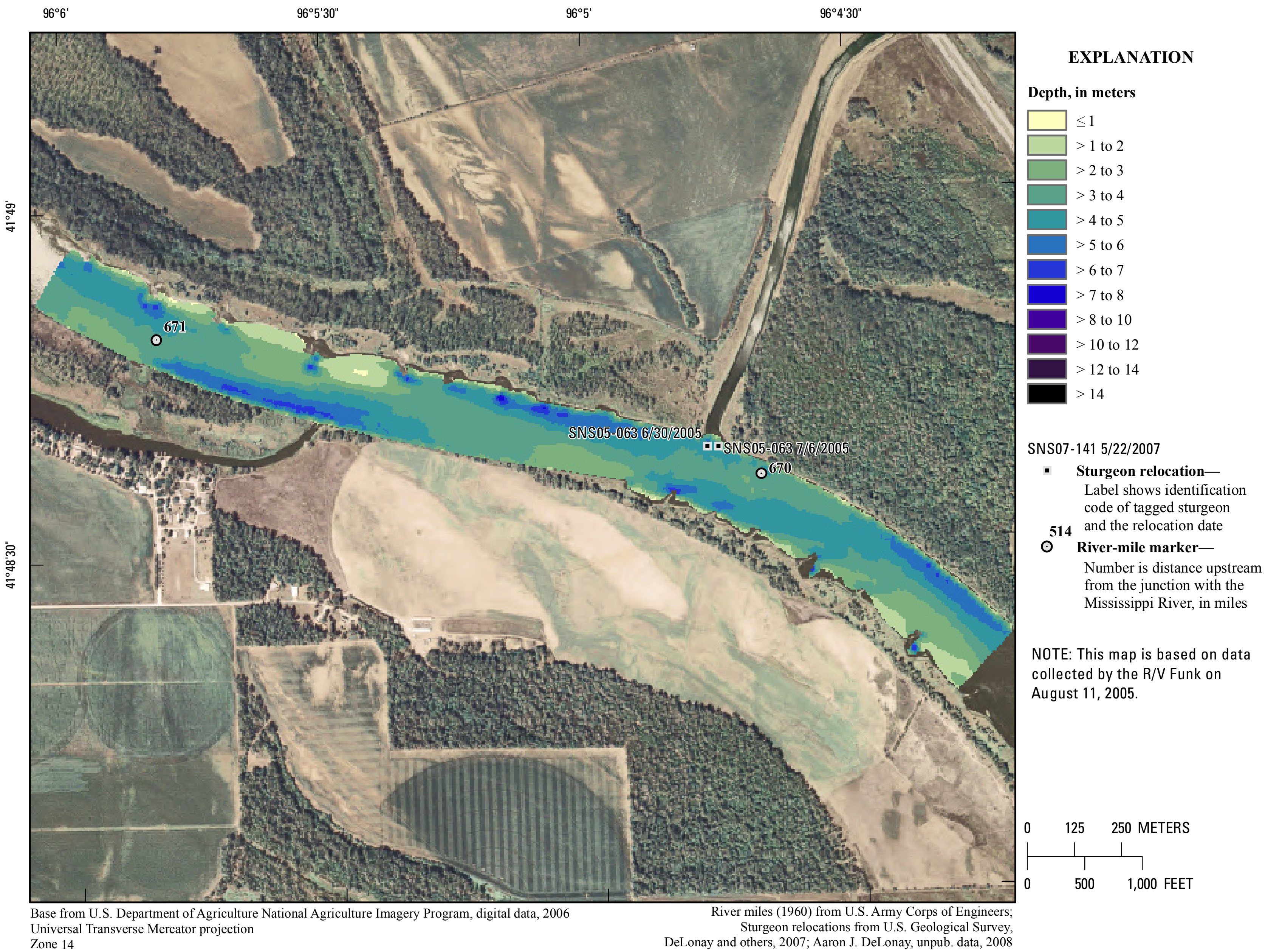
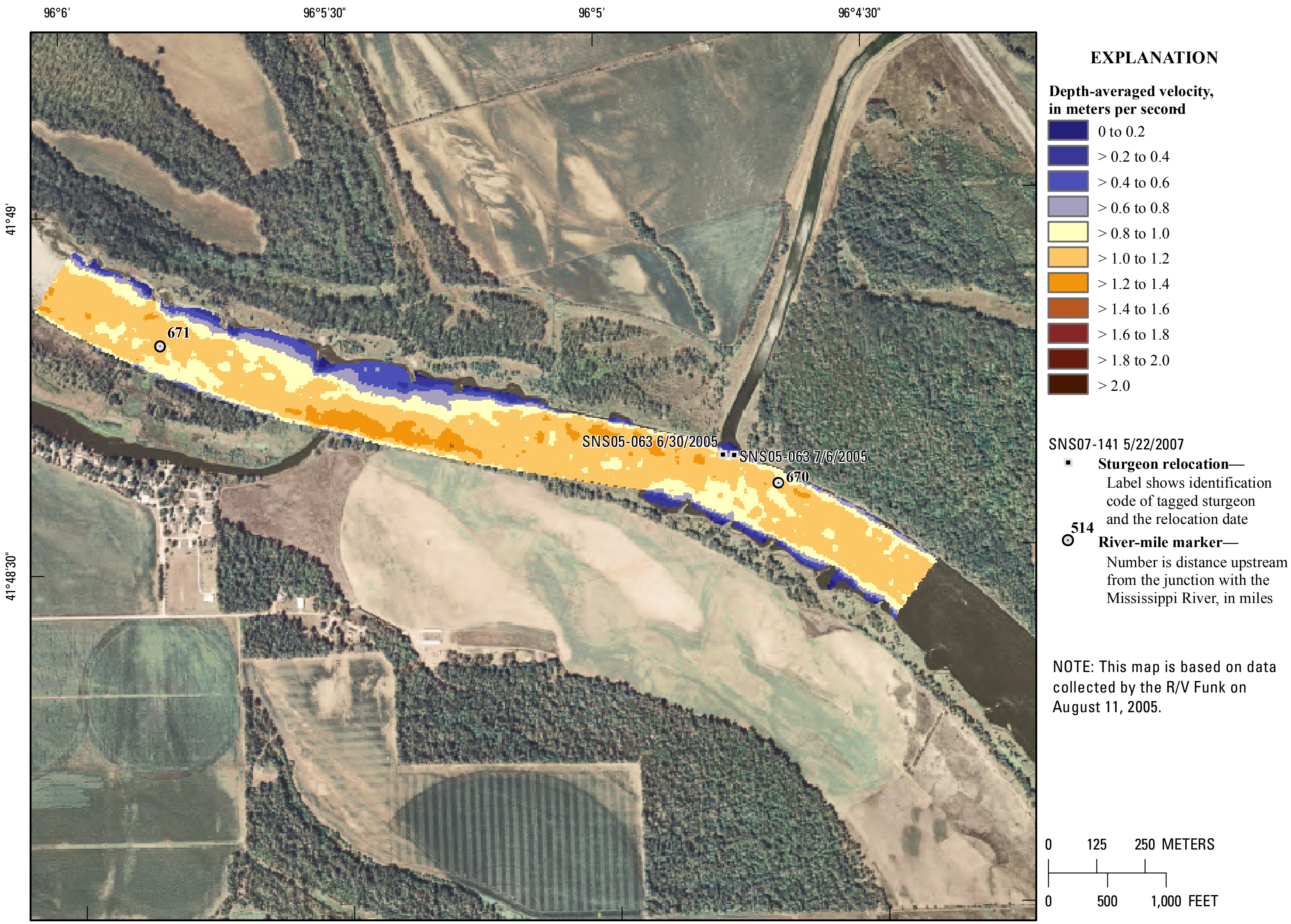


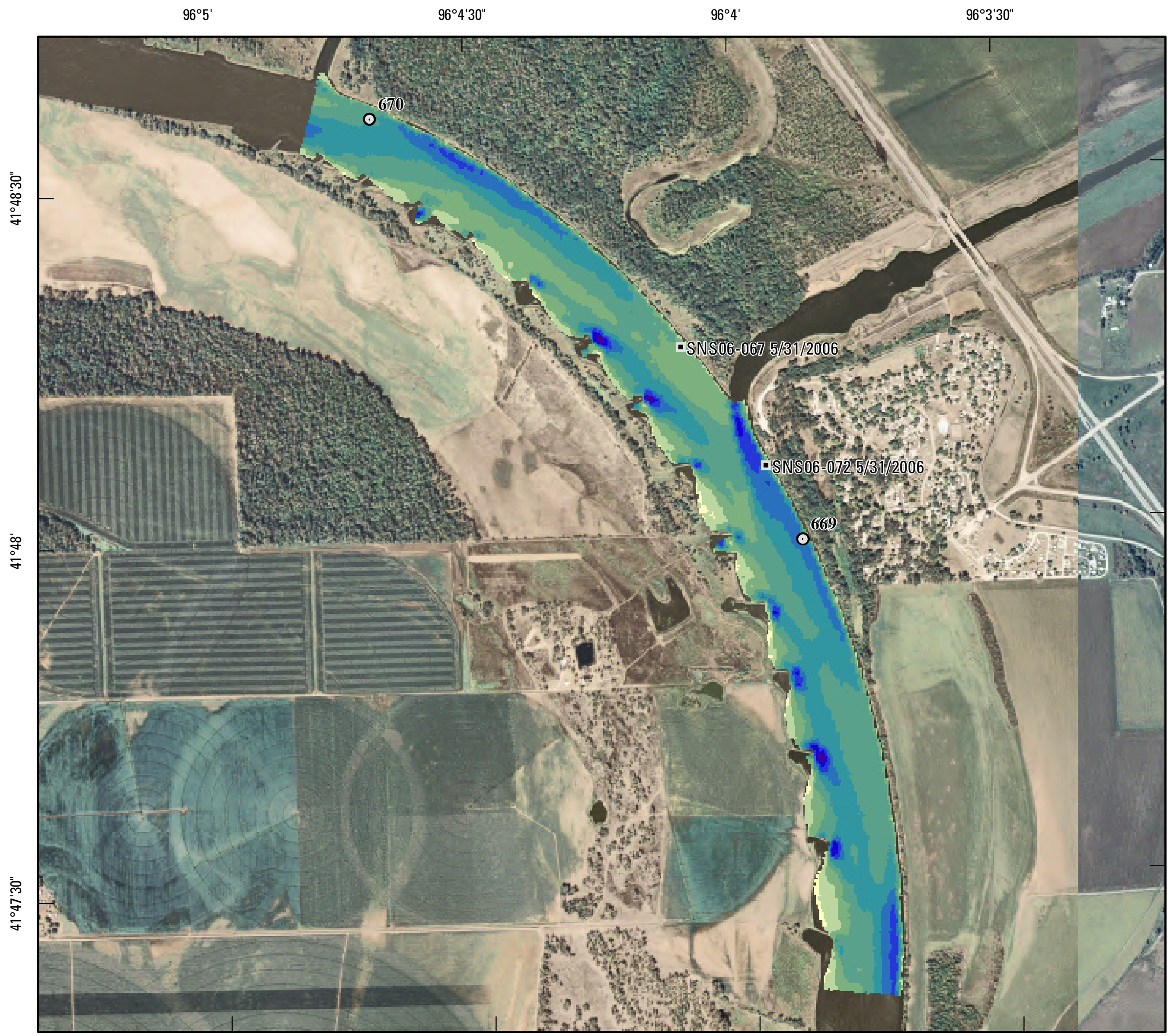
Figure 149. Map of depth based on data collected on August 11, 2005, in the vicinity of river mile 670.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 150. Map of depth-averaged velocity based on data collected on August 11, 2005, in the vicinity of river mile 670.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation—Label shows identification code of tagged sturgeon and the relocation date

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River-mile marker—Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 1, 2006.

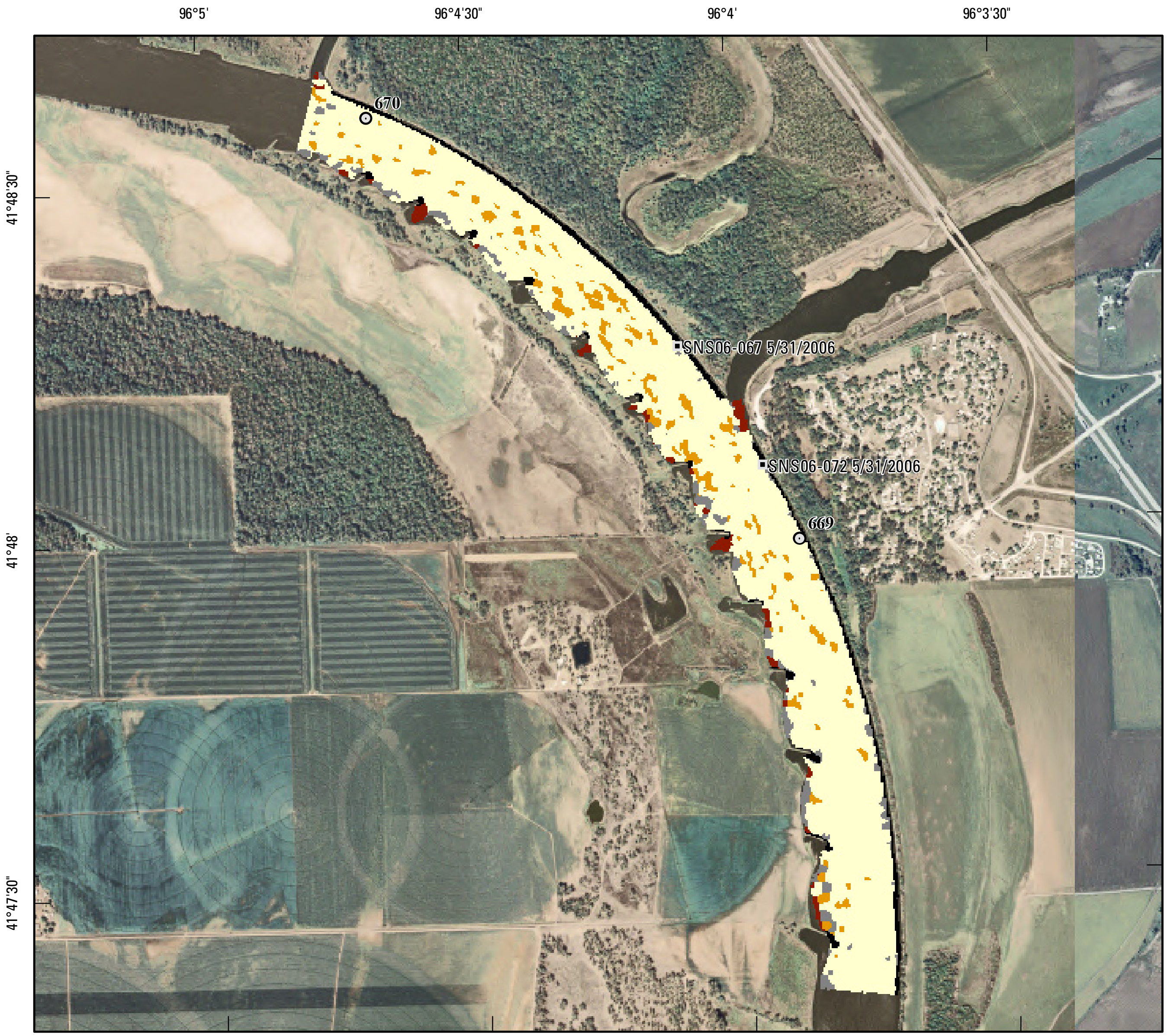
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 151. Map of depth based on data collected on June 1, 2006, in the vicinity of river mile 669.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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■ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514

⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 1, 2006.

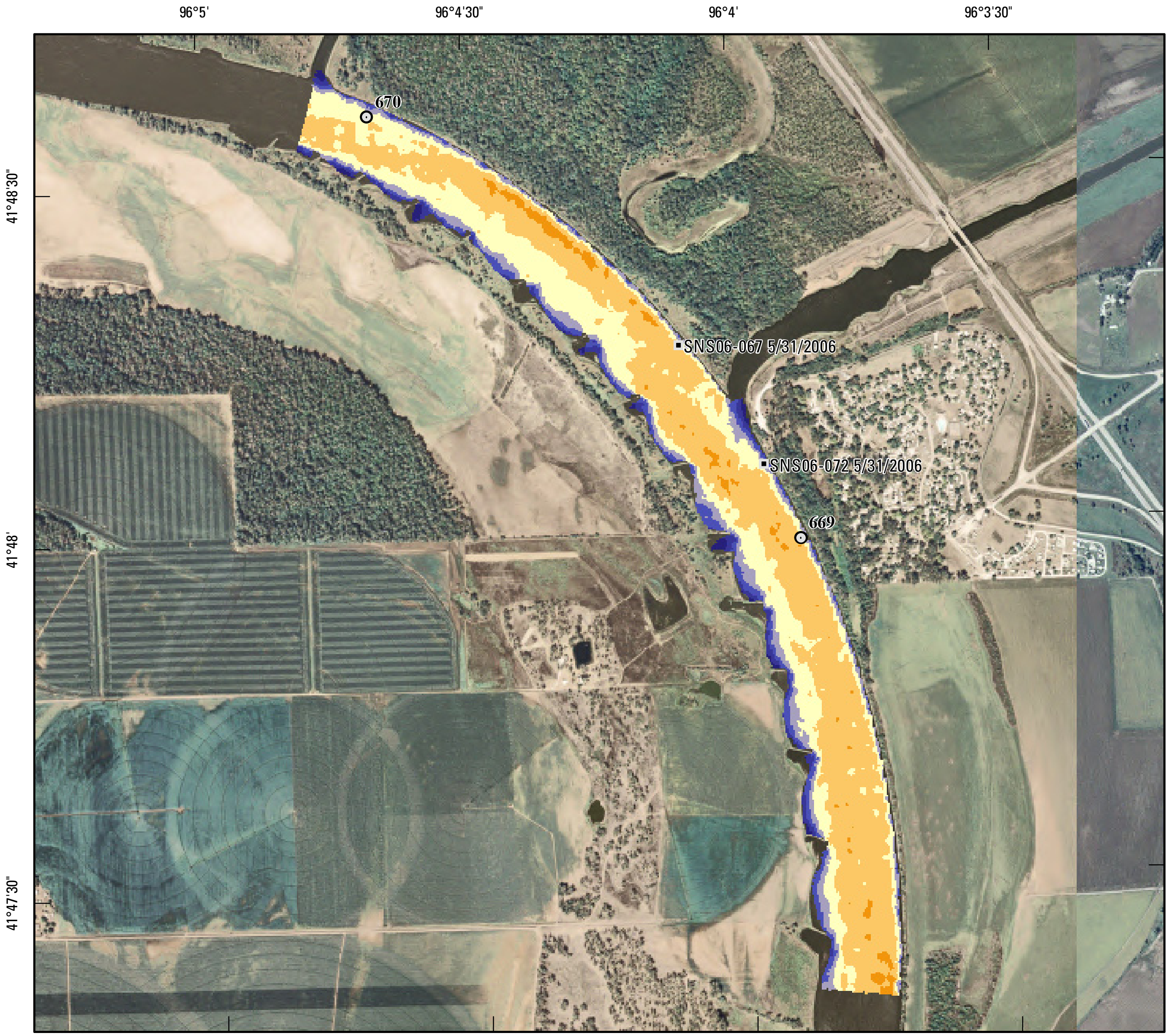
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 152. Map of generalized substrate based on data collected on June 1, 2006, in the vicinity of river mile 669.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514
River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

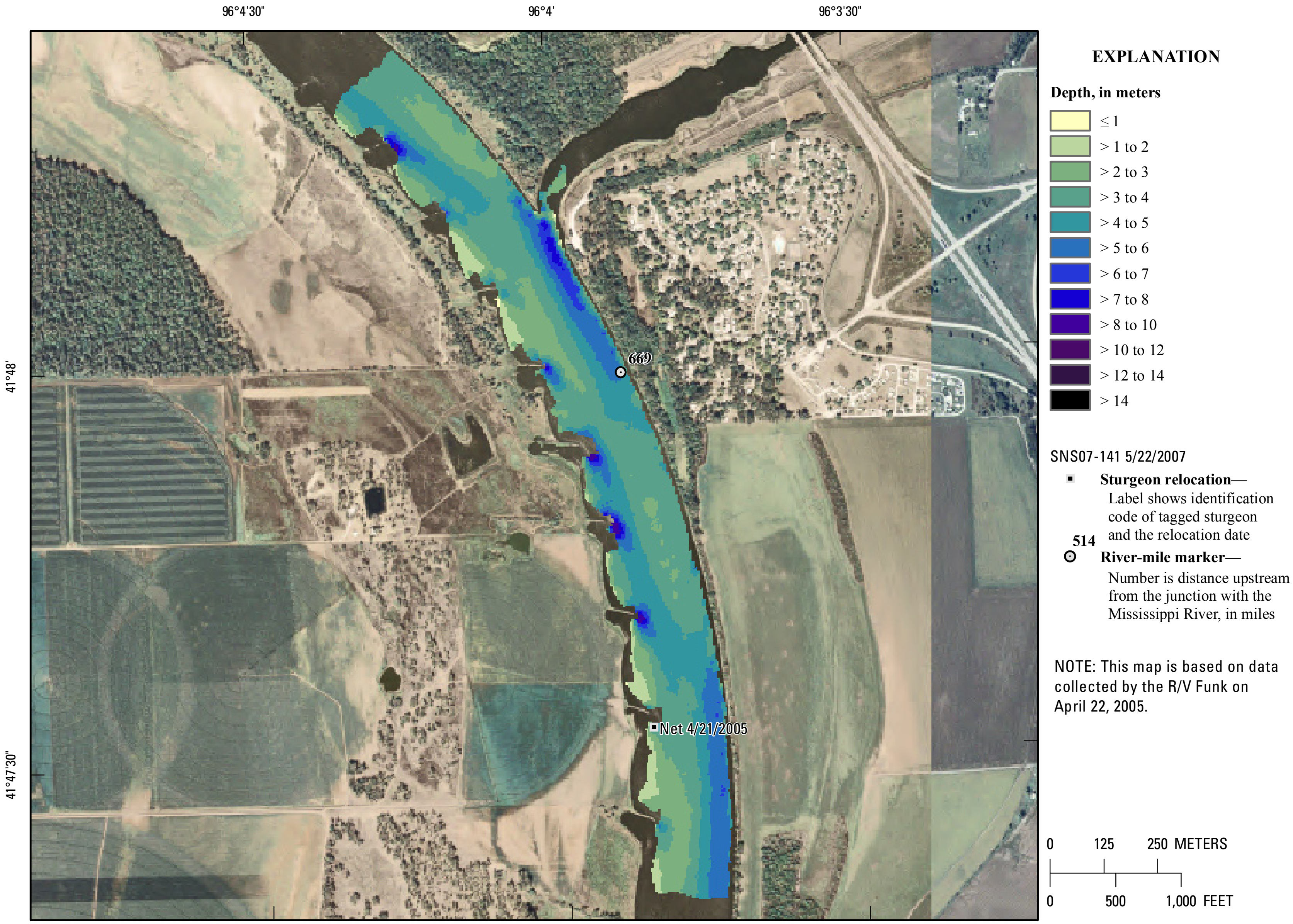
NOTE: This map is based on data collected by the R/V Funk on June 1, 2006.

0 125 250 METERS
0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

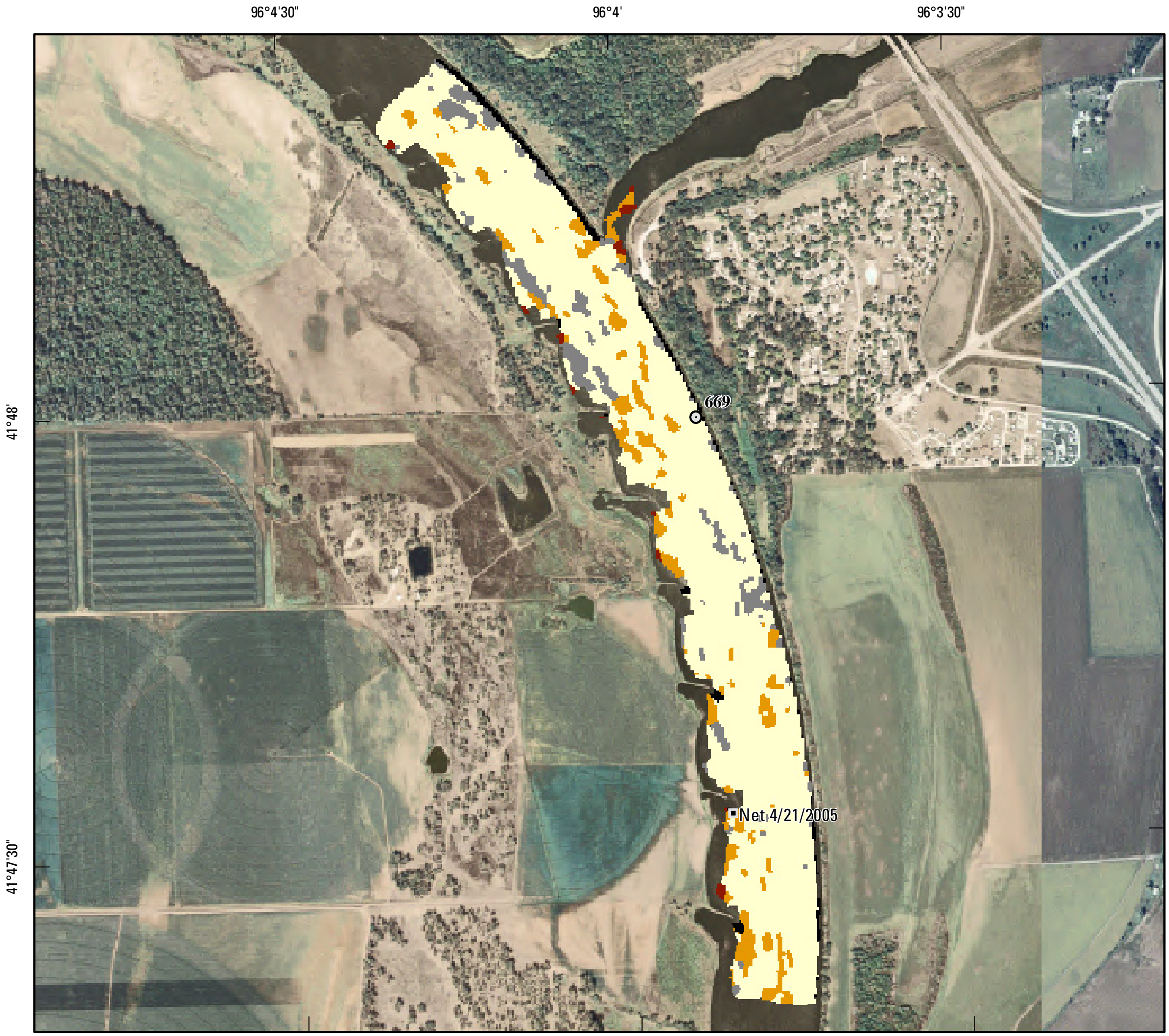
Figure 153. Map of depth-averaged velocity based on data collected on June 1, 2006, in the vicinity of river mile 669.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 154. Map of depth based on data collected on April 22, 2005, in the vicinity of river mile 669.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

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River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on April 22, 2005.

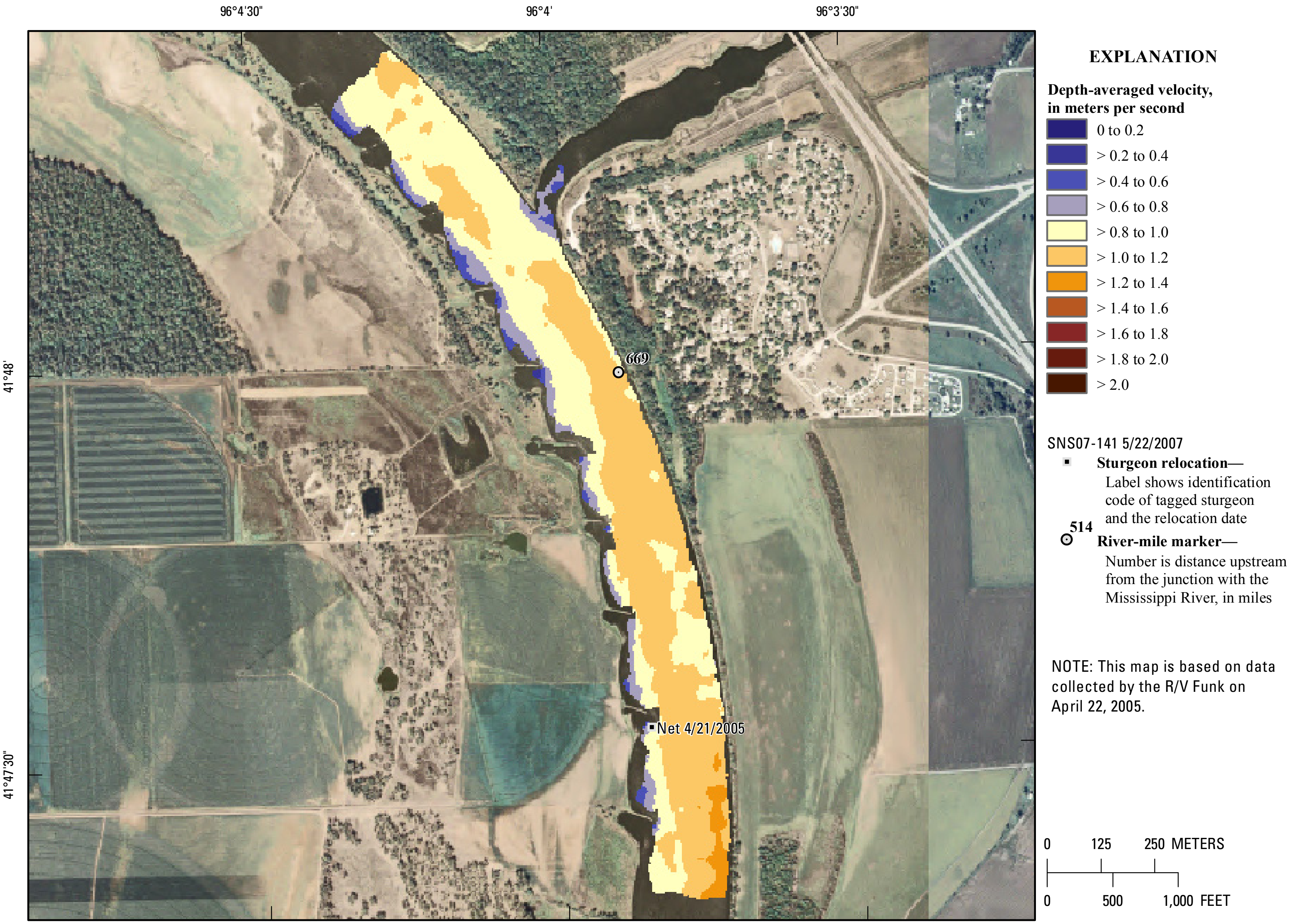
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 155. Map of generalized substrate based on data collected on April 22, 2005, in the vicinity of river mile 669.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 156. Map of depth-averaged velocity based on data collected on April 22, 2005, in the vicinity of river mile 669.

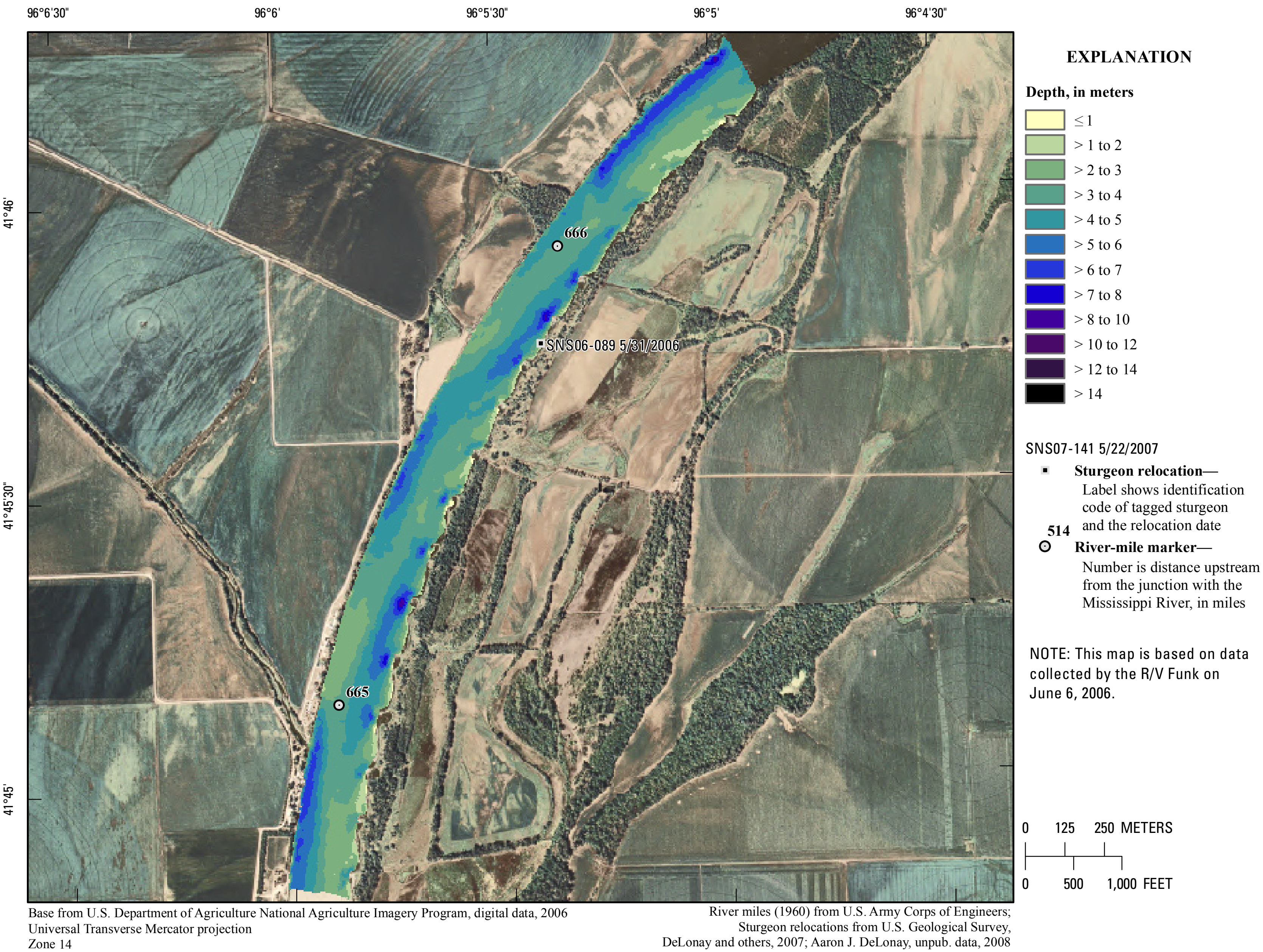
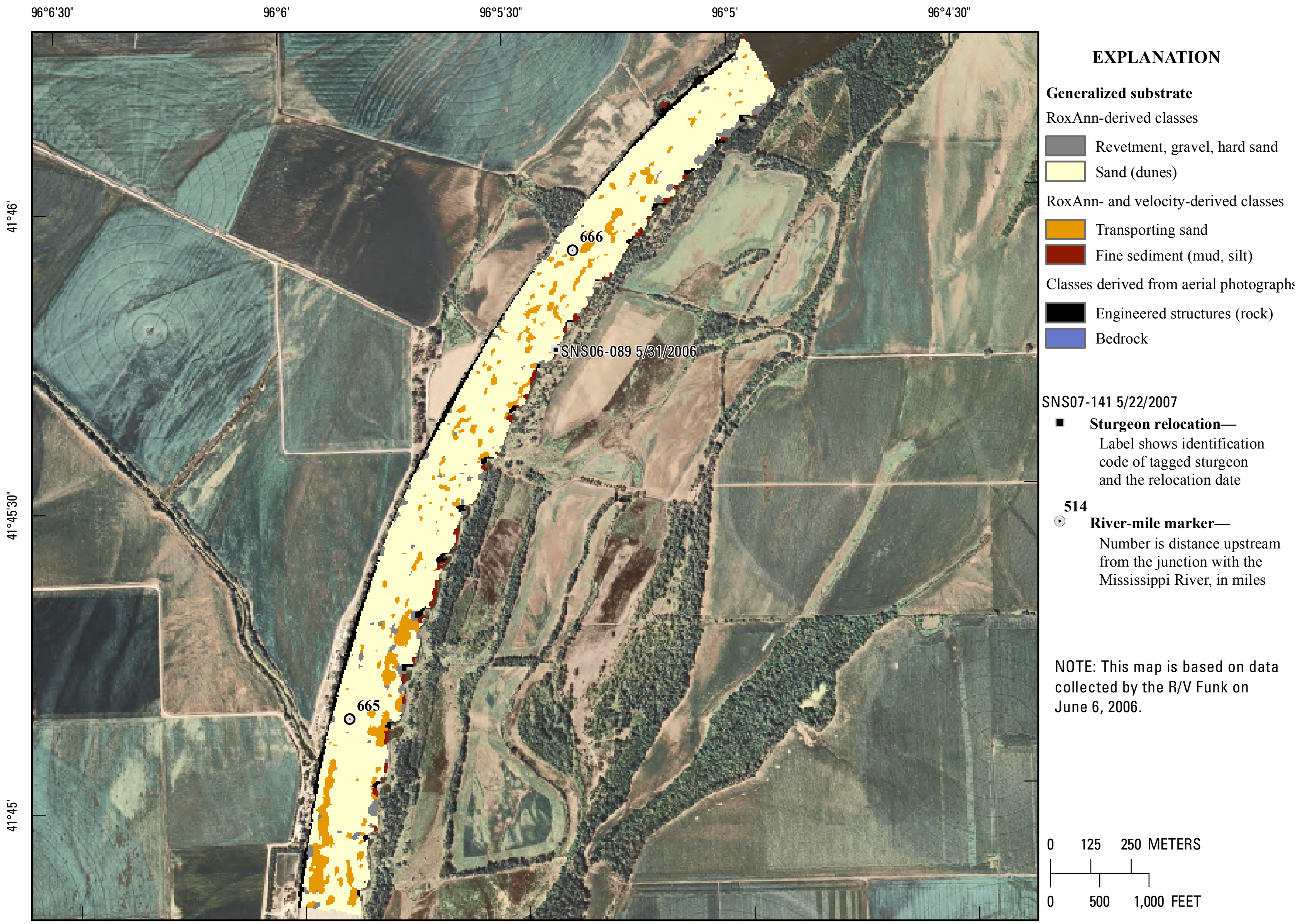


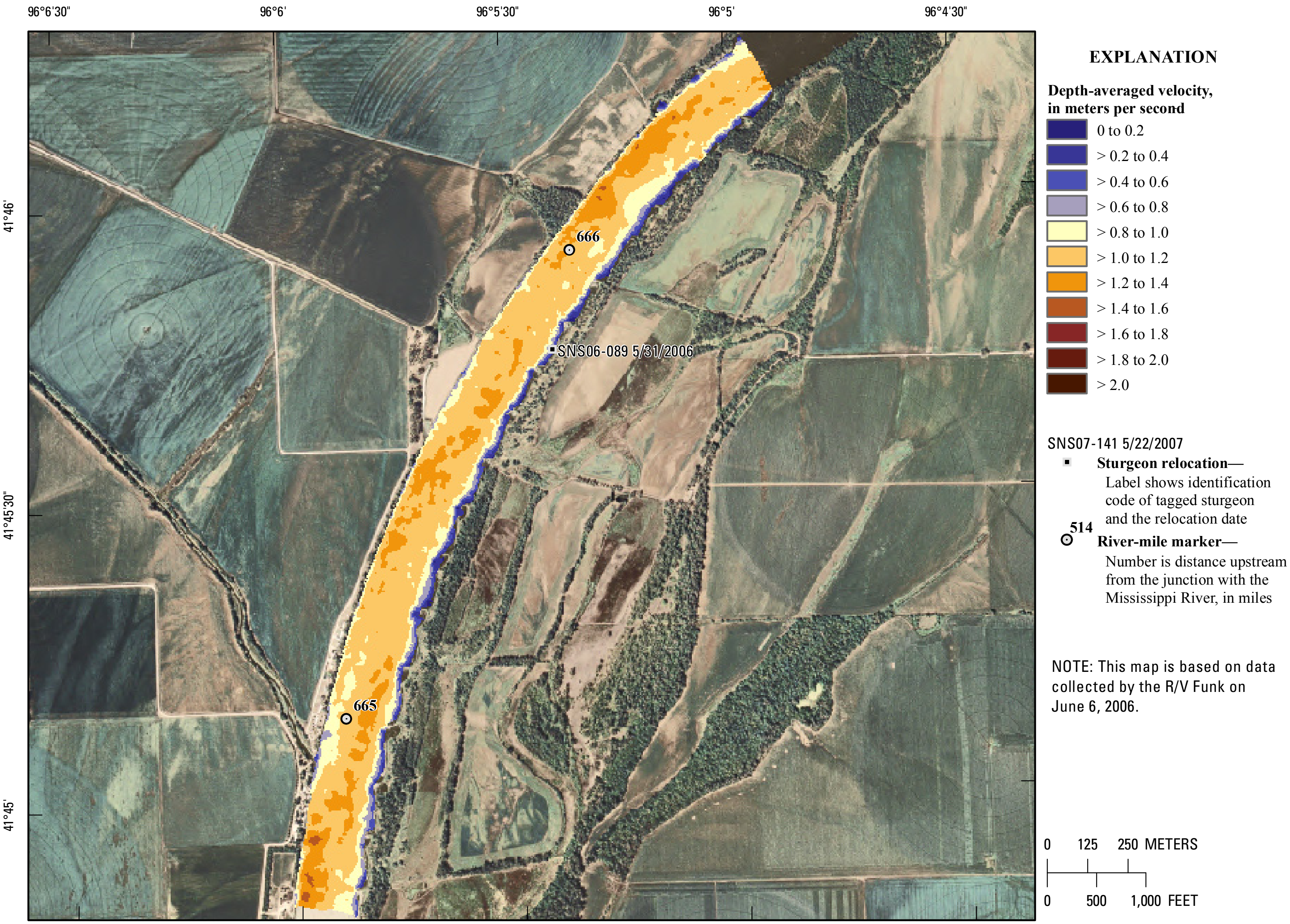
Figure 157. Map of depth based on data collected on June 6, 2006, in the vicinity of river mile 666.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 158. Map of generalized substrate based on data collected on June 6, 2006, in the vicinity of river mile 666.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 159. Map of depth-averaged velocity based on data collected on June 6, 2006, in the vicinity of river mile 666.

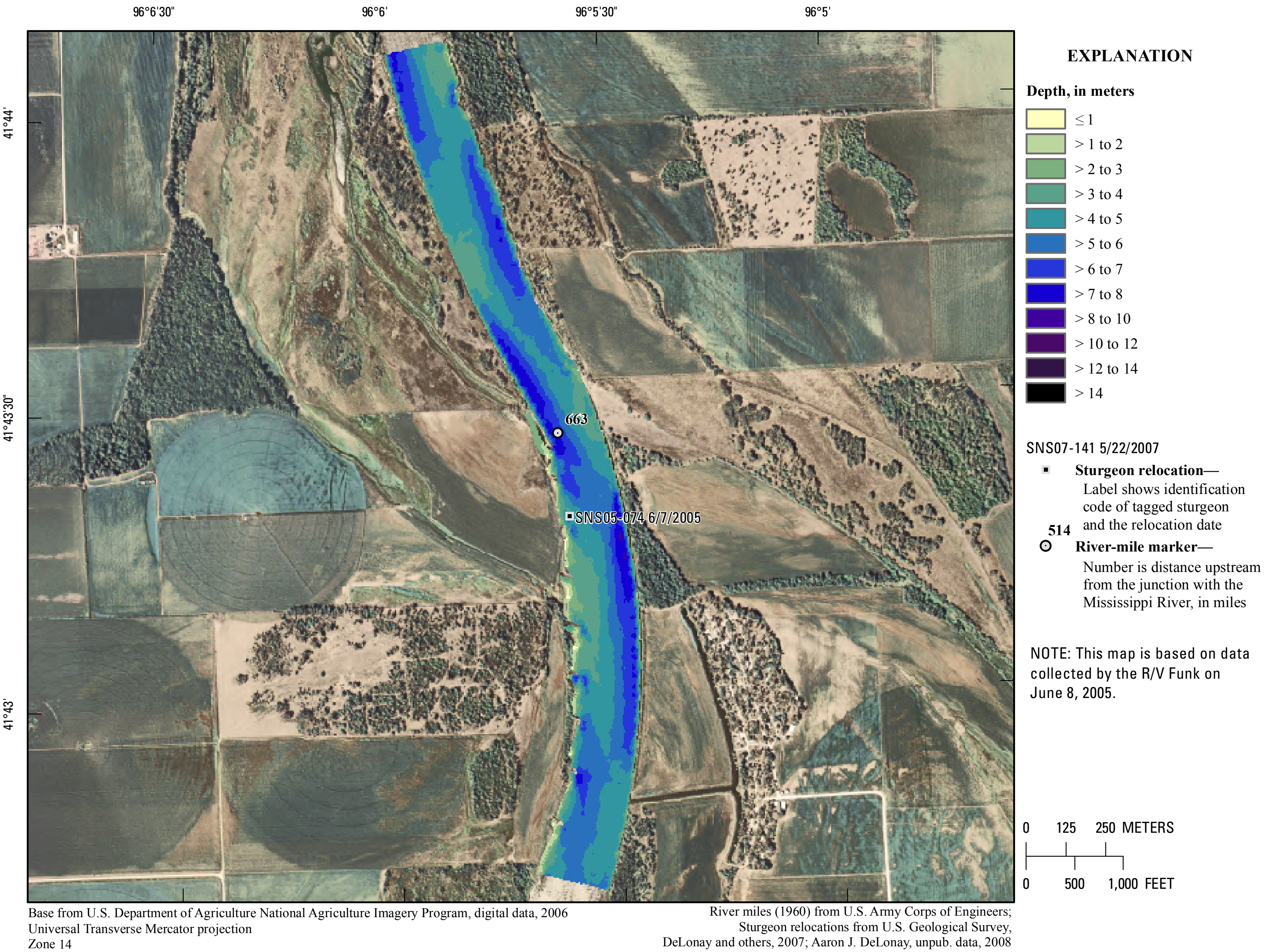
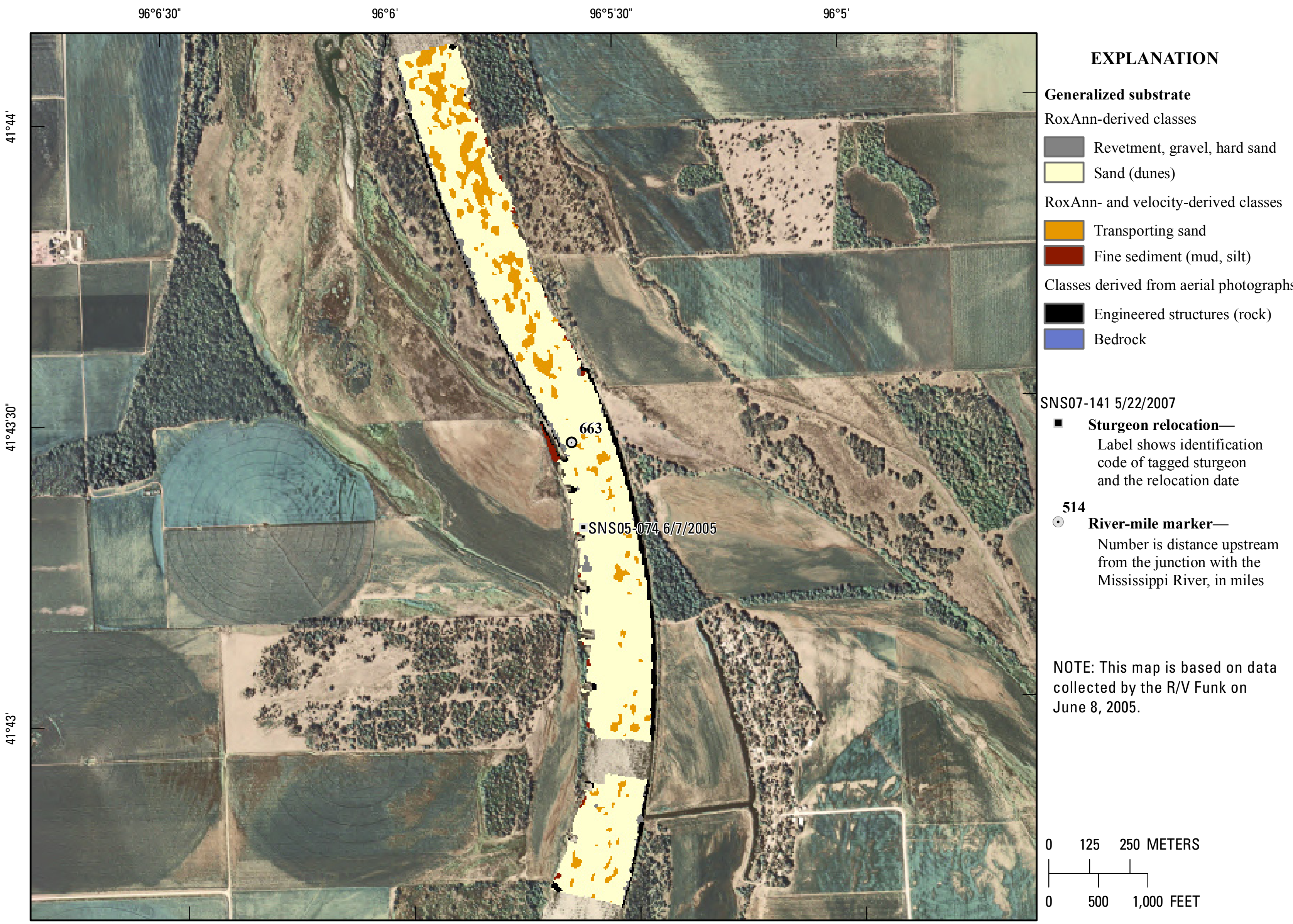


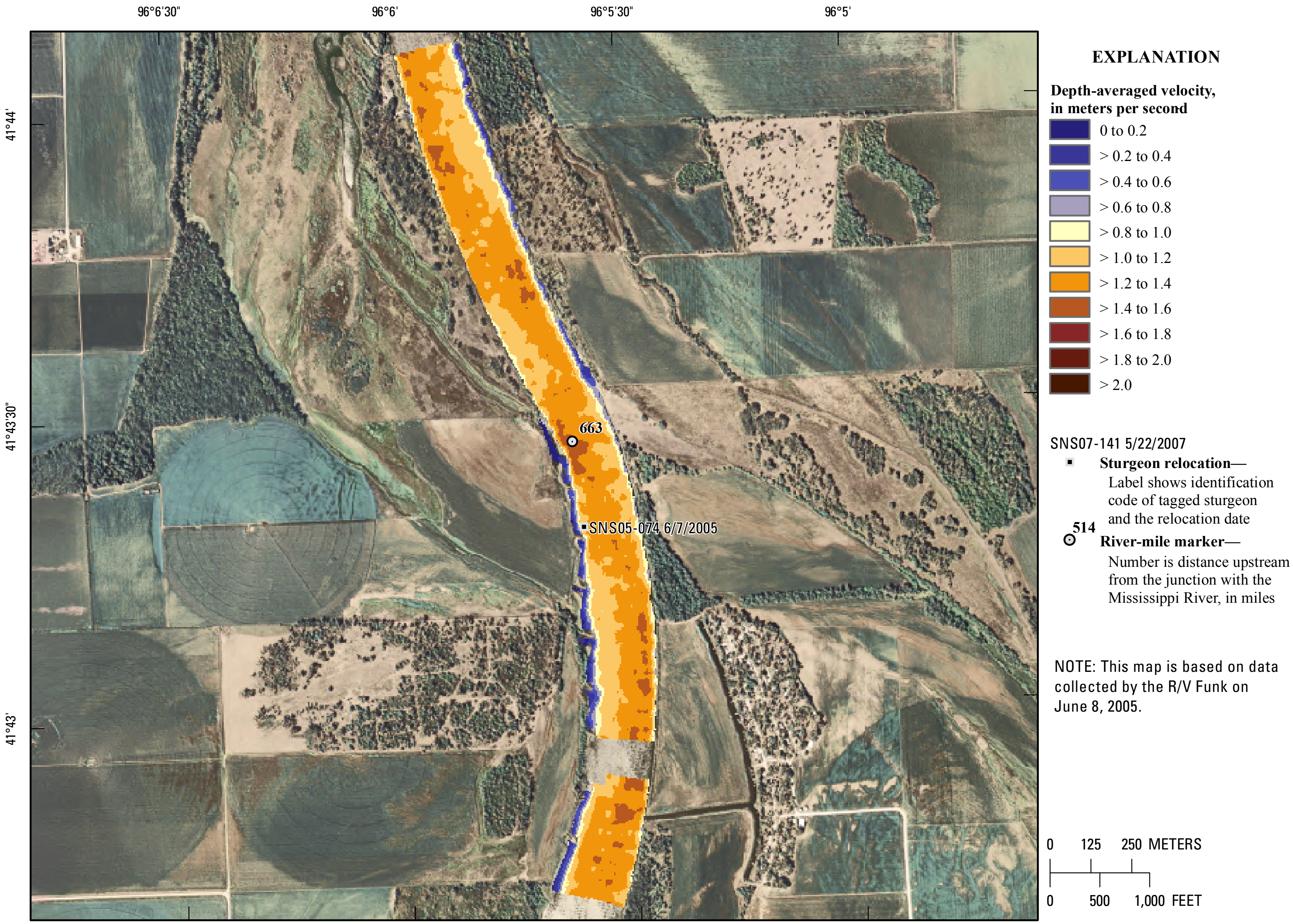
Figure 160. Map of depth based on data collected on June 8, 2005, in the vicinity of river mile 663.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 161. Map of generalized substrate based on data collected on June 8, 2005, in the vicinity of river mile 663.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 162. Map of depth-averaged velocity based on data collected on June 8, 2005, in the vicinity of river mile 663.

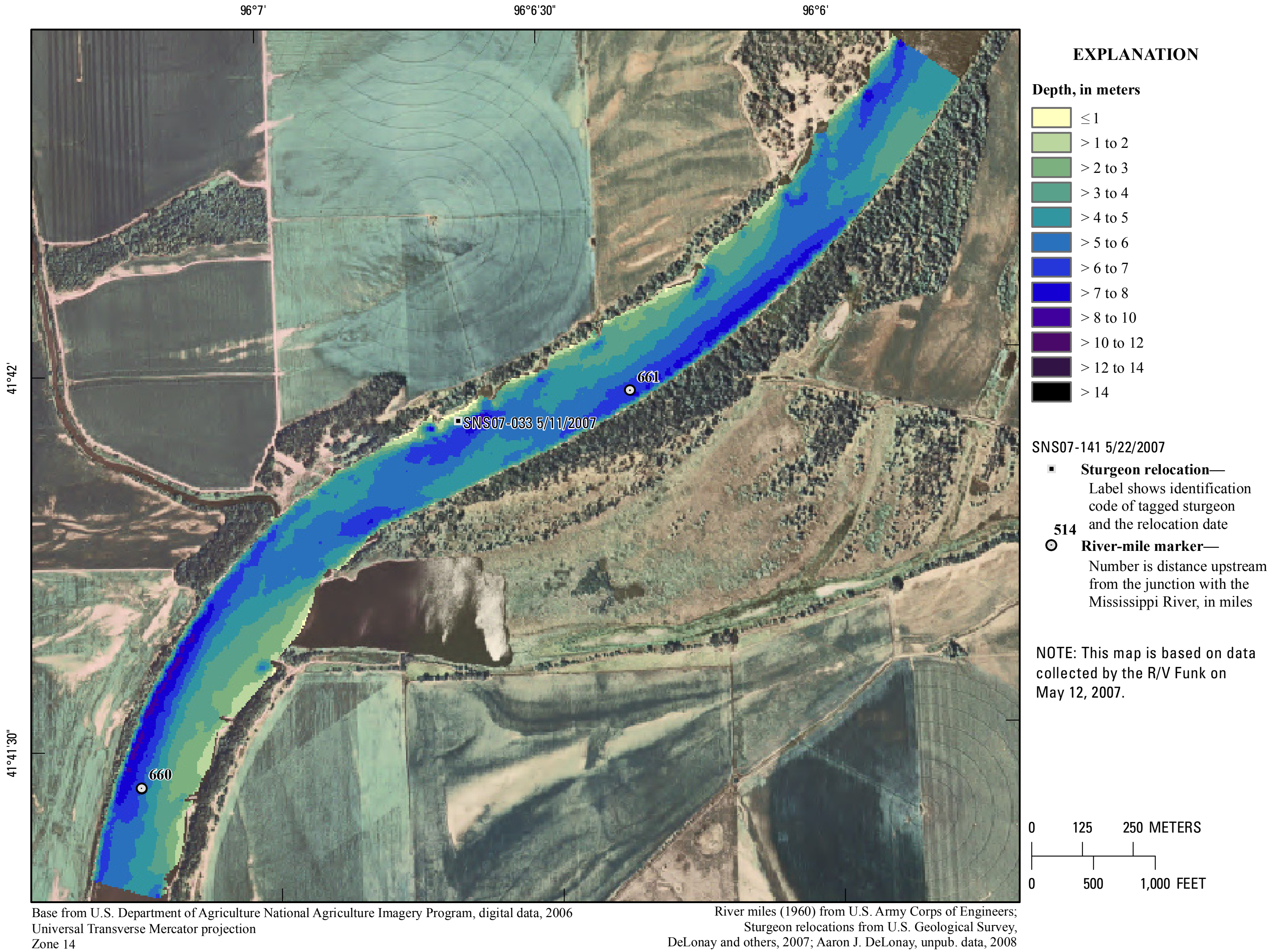


Figure 163. Map of depth based on data collected on May 12, 2007, in the vicinity of river mile 661.

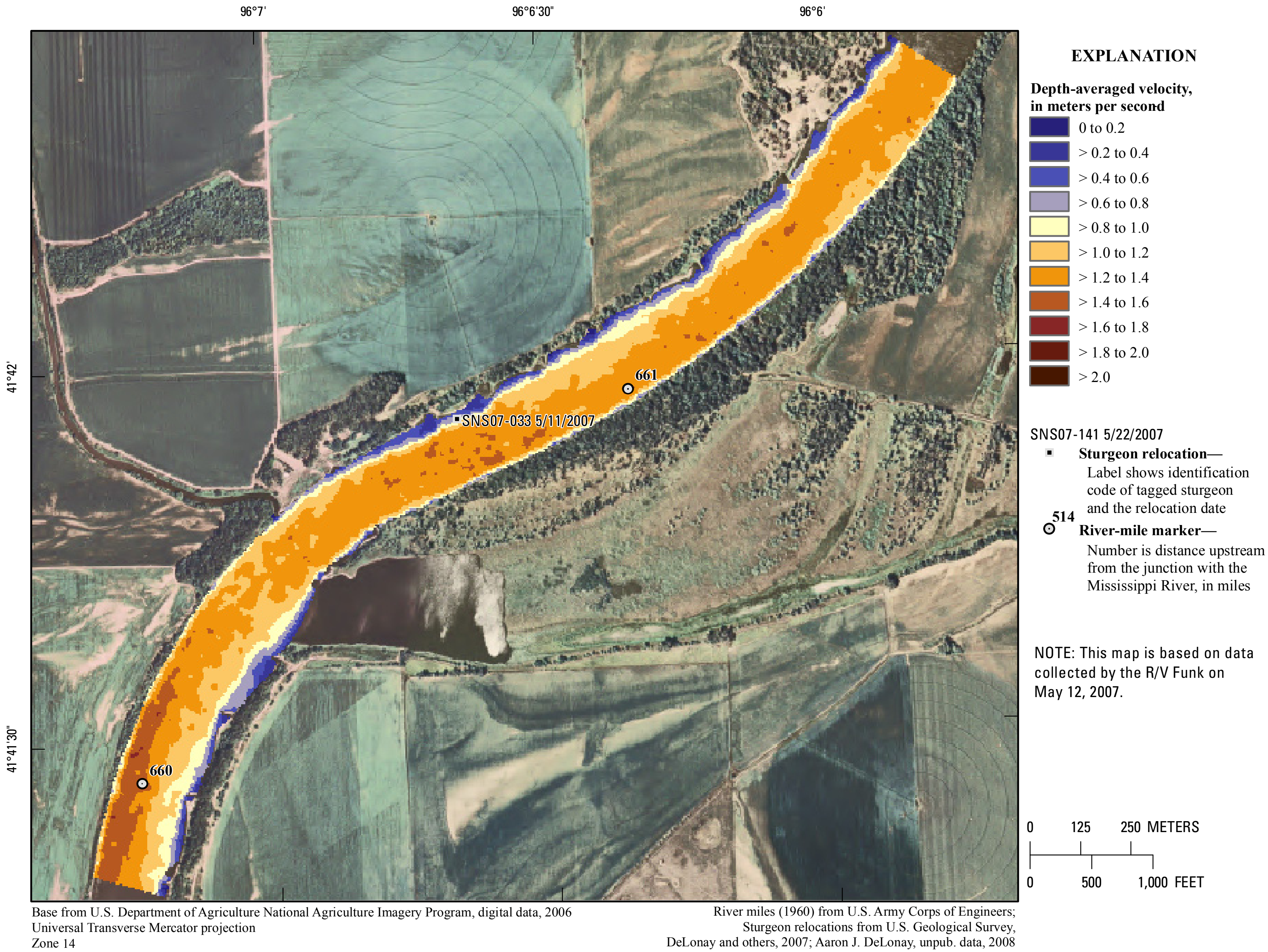
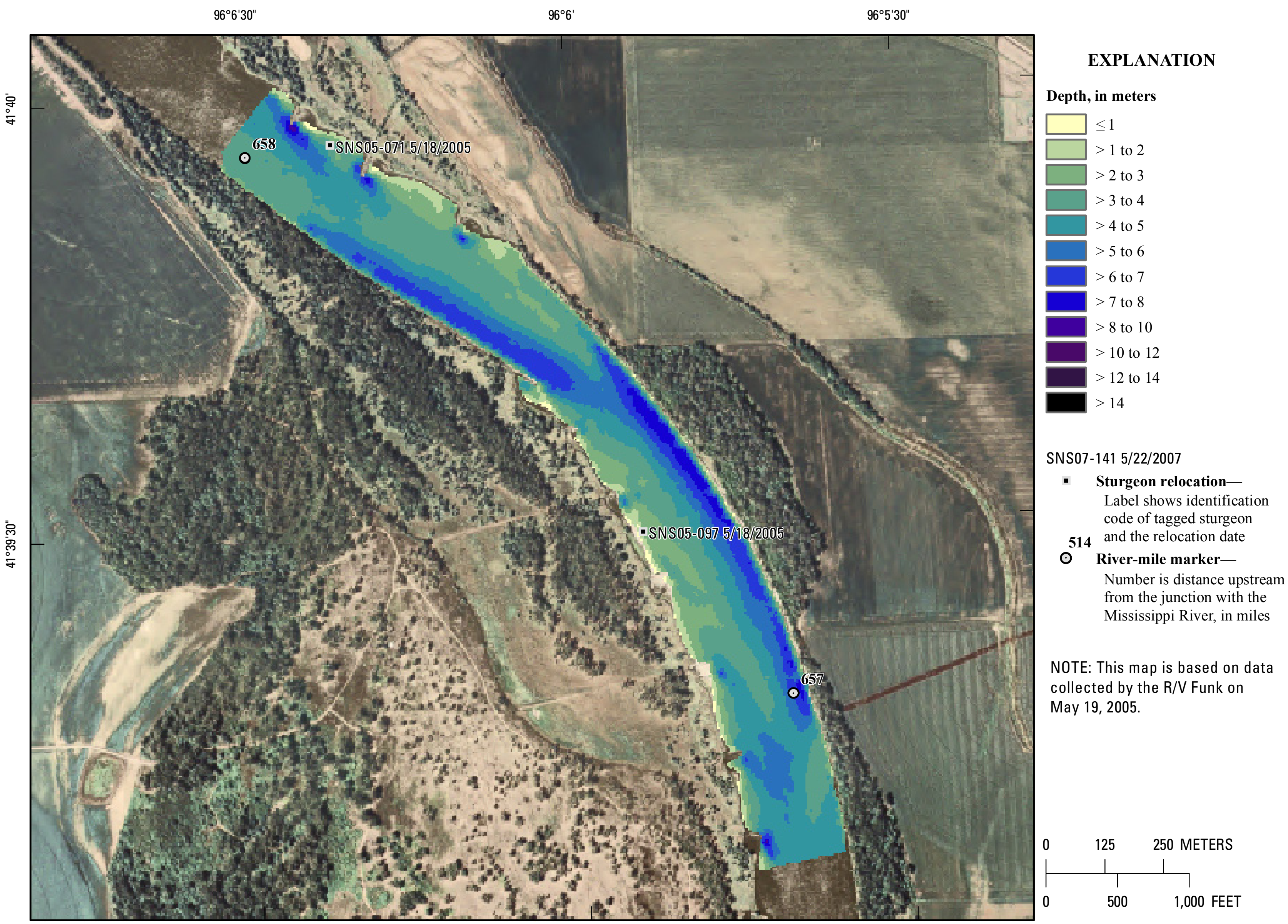


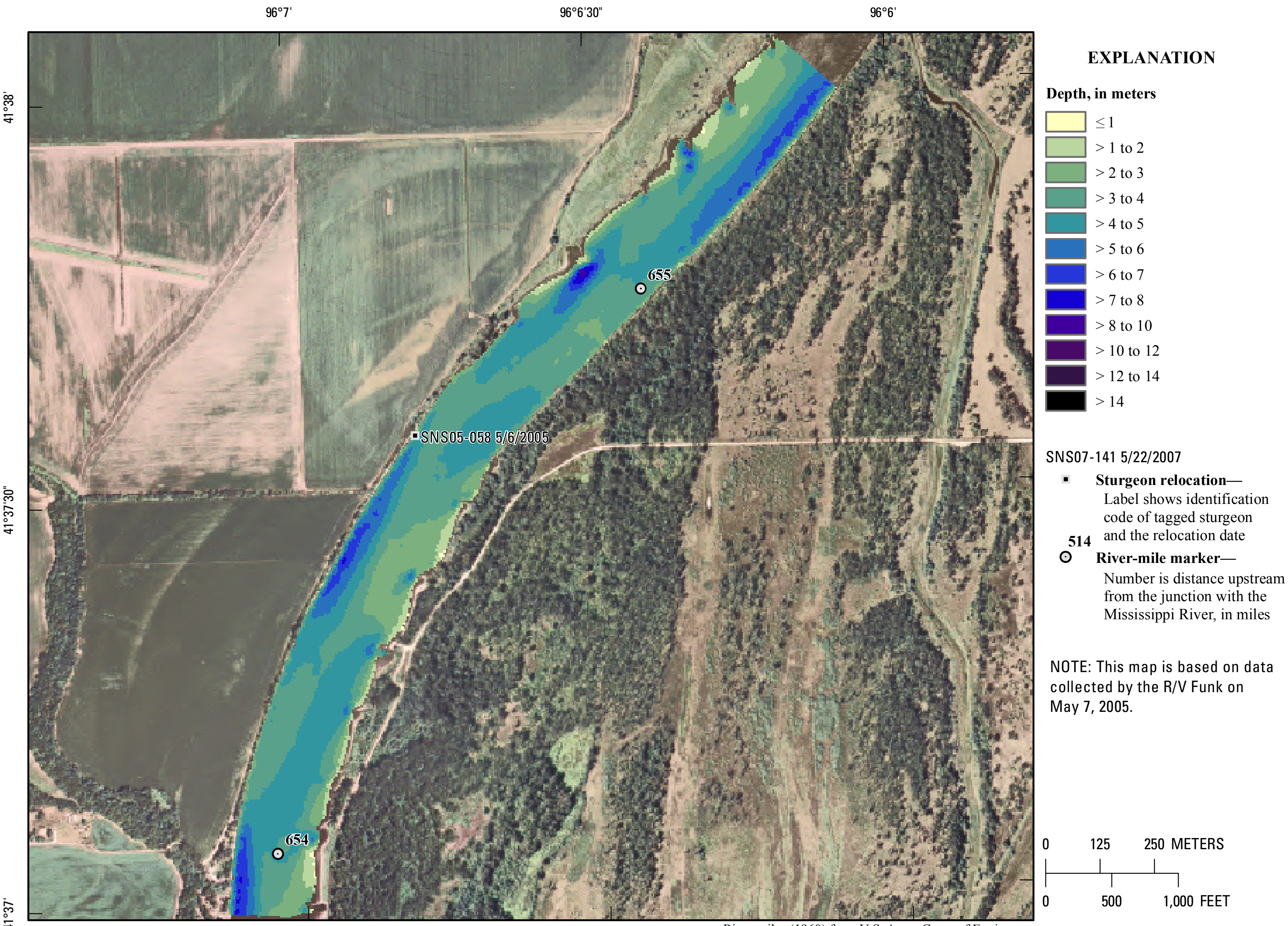
Figure 164. Map of depth-averaged velocity based on data collected on May 12, 2007, in the vicinity of river mile 661.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 165. Map of depth based on data collected on May 19, 2005, in the vicinity of river mile 657.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 166. Map of depth based on data collected on May 7, 2005, in the vicinity of river mile 655.

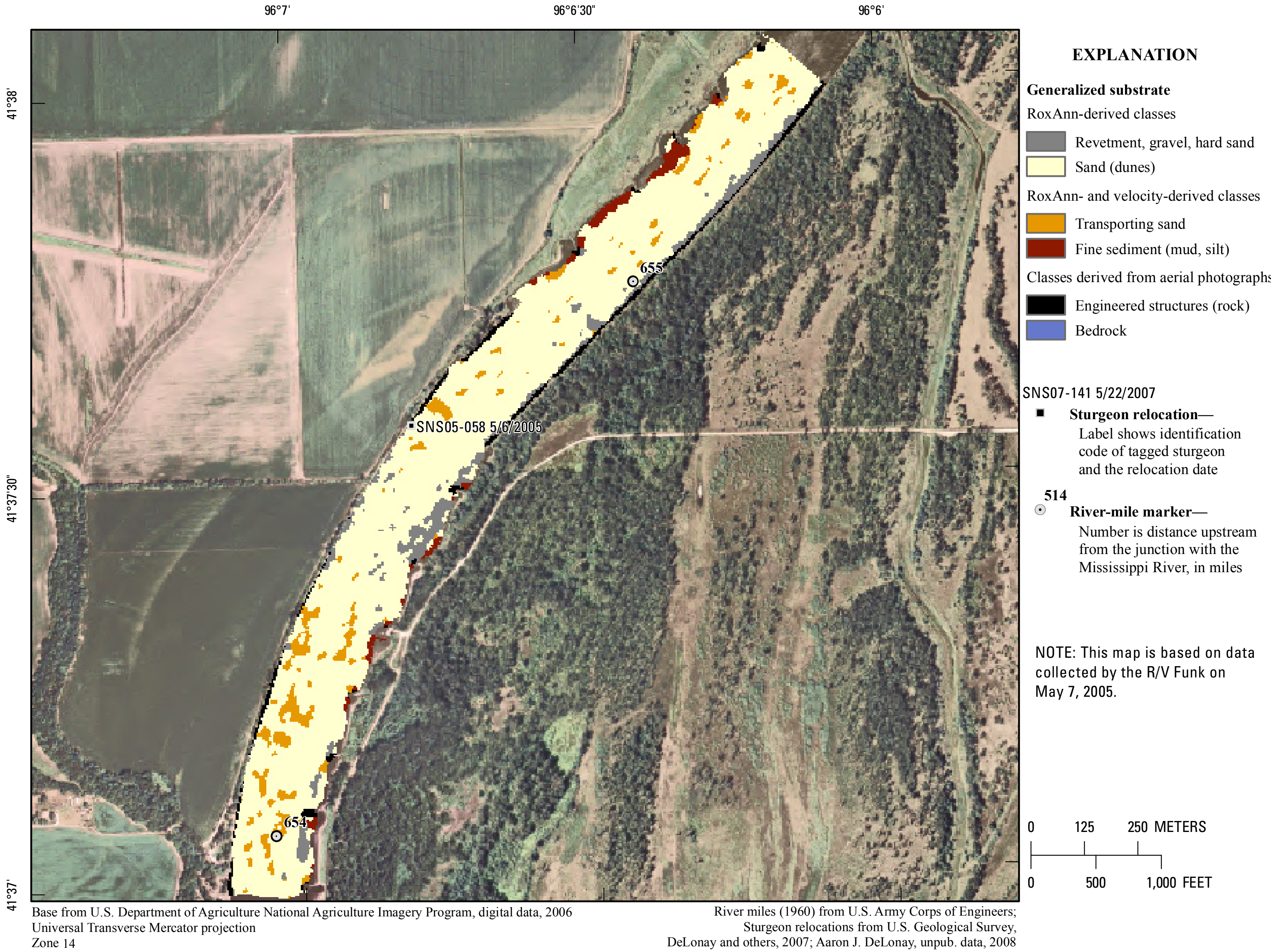
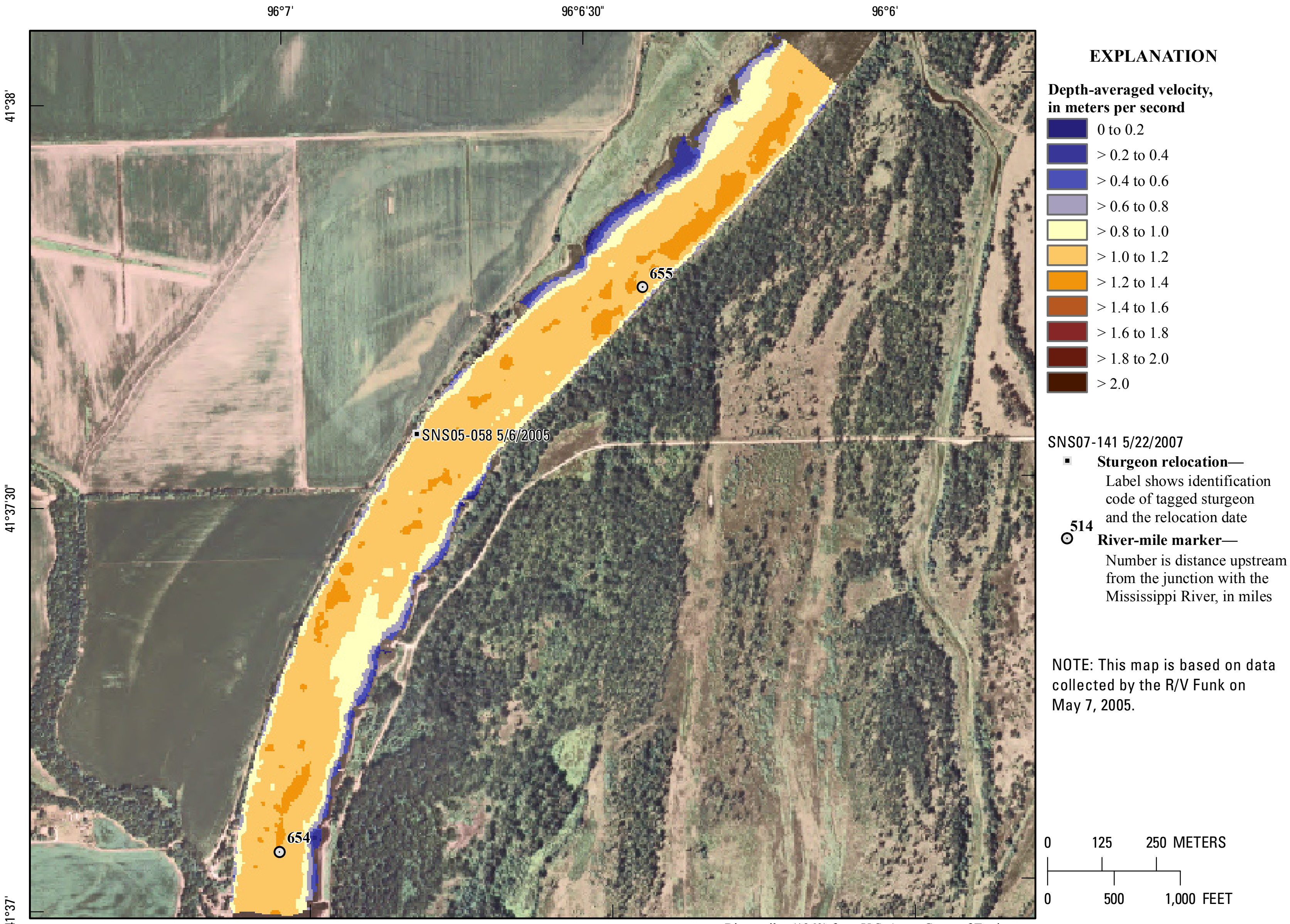


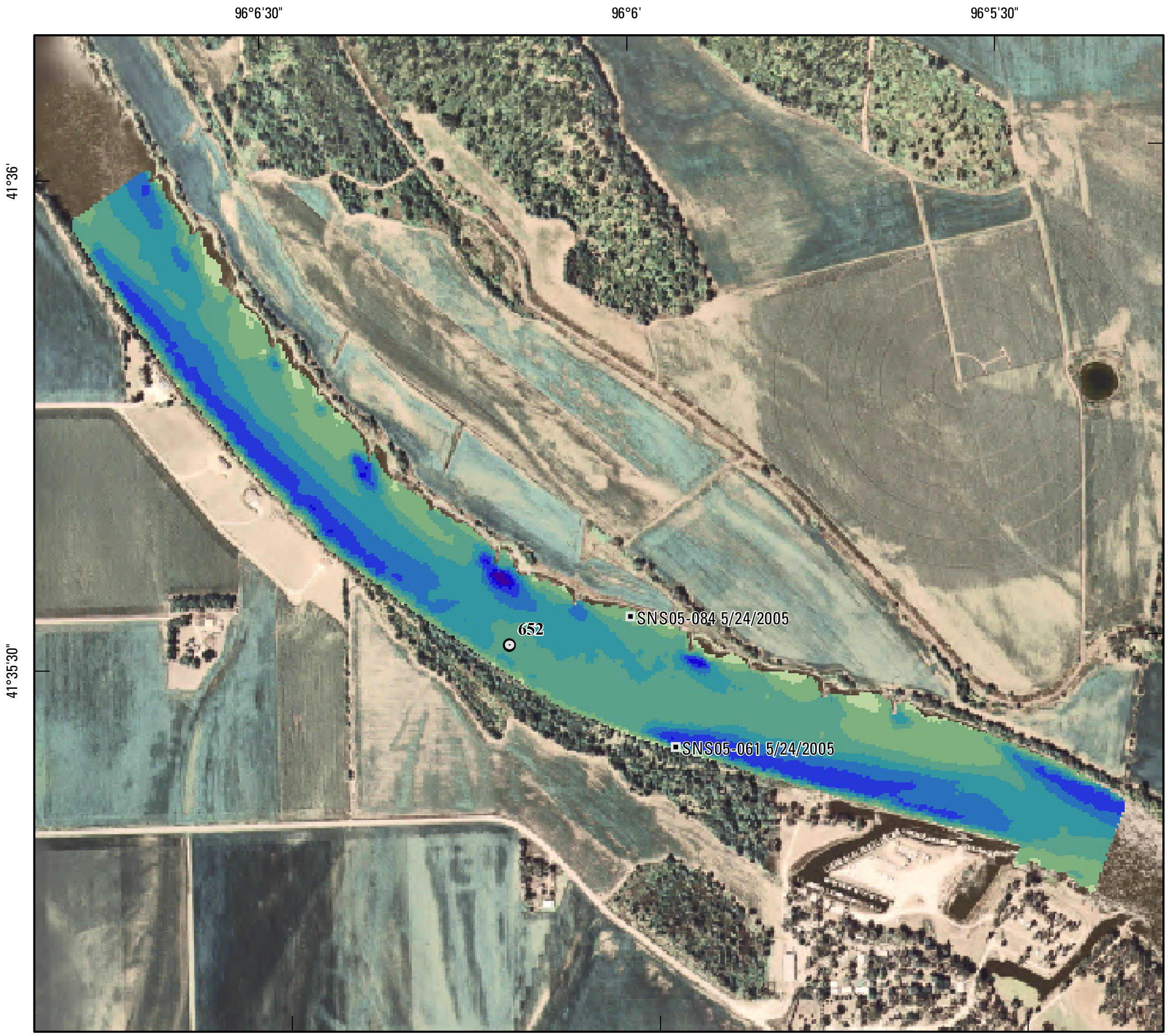
Figure 167. Map of generalized substrate based on data collected on May 7, 2005, in the vicinity of river mile 655.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 168. Map of depth-averaged velocity based on data collected on May 7, 2005, in the vicinity of river mile 655.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 25, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 169. Map of depth based on data collected on May 25, 2005, in the vicinity of river mile 652.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

Revetment, gravel, hard sand

Sand (dunes)

RoxAnn- and velocity-derived classes

Transporting sand

Fine sediment (mud, silt)

Classes derived from aerial photographs

Engineered structures (rock)

Bedrock

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Sturgeon relocation—
Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker—
Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 25, 2005.

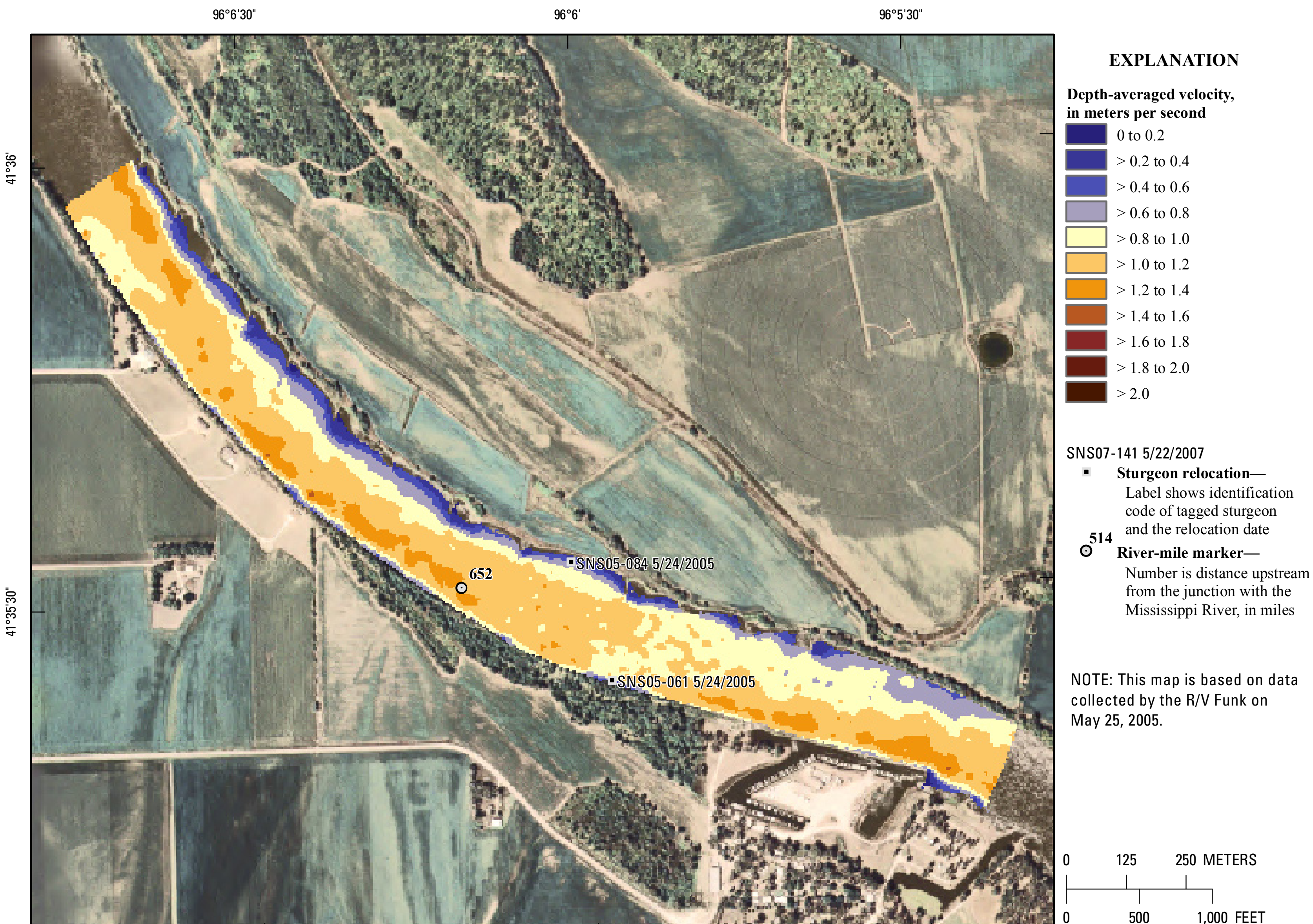
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 170. Map of generalized substrate based on data collected on May 25, 2005, in the vicinity of river mile 652.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 171. Map of depth-averaged velocity based on data collected on May 25, 2005, in the vicinity of river mile 652.

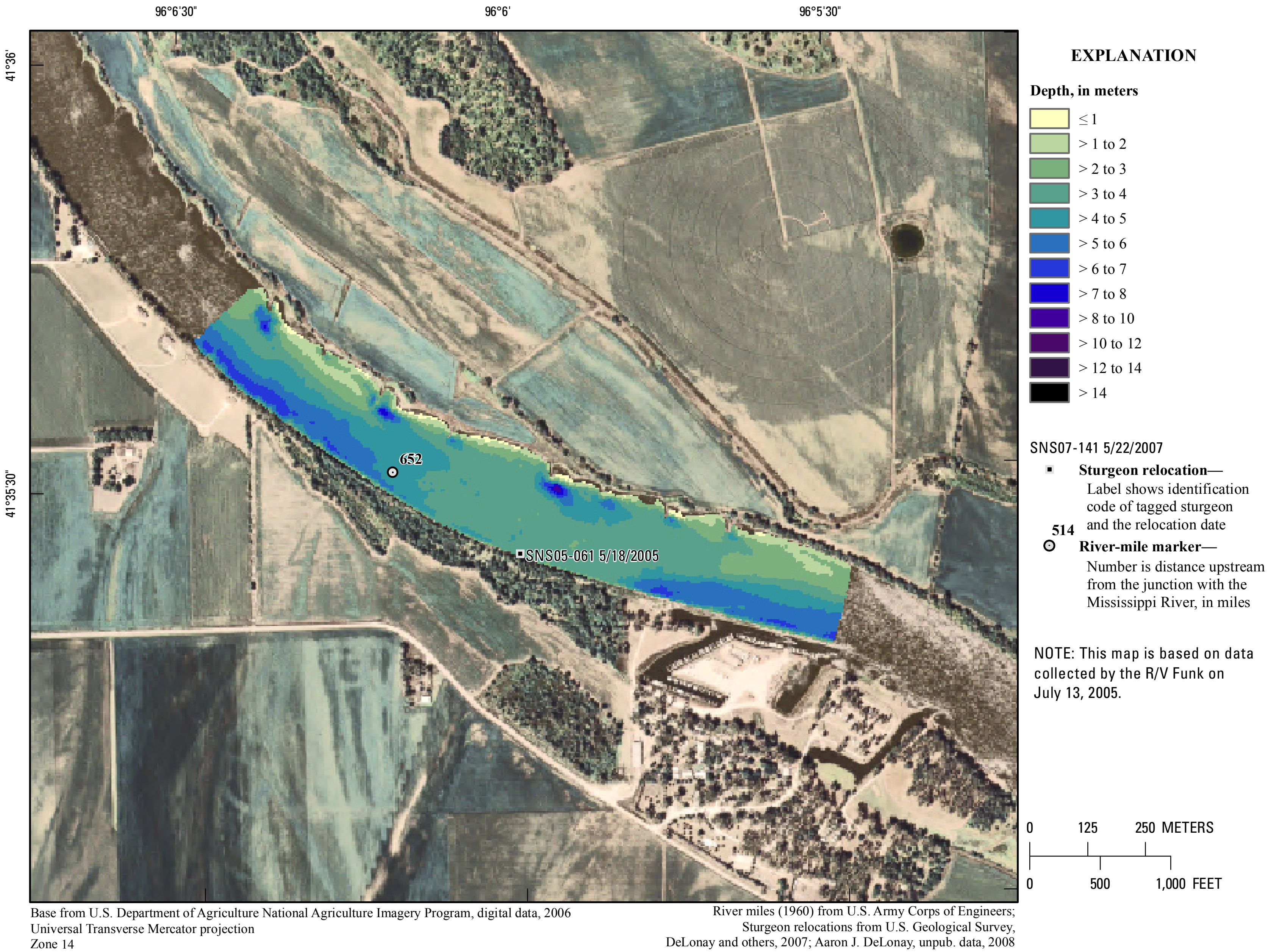


Figure 172. Map of depth based on data collected on July 13, 2005, in the vicinity of river mile 652.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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■ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514

⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on July 13, 2005.

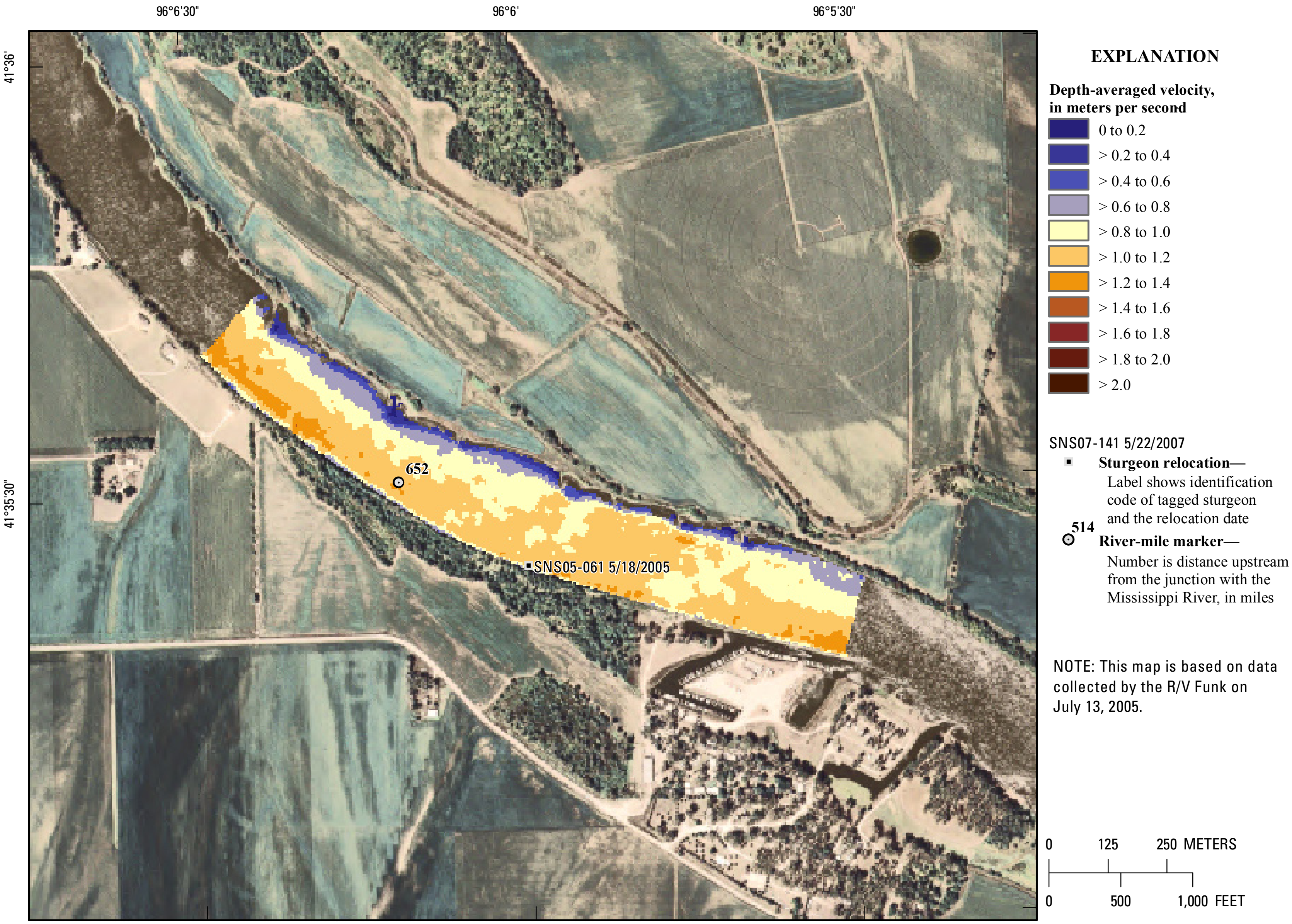
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 173. Map of generalized substrate based on data collected on July 13, 2005, in the vicinity of river mile 652.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 174. Map of depth-averaged velocity based on data collected on July 13, 2005, in the vicinity of river mile 652.

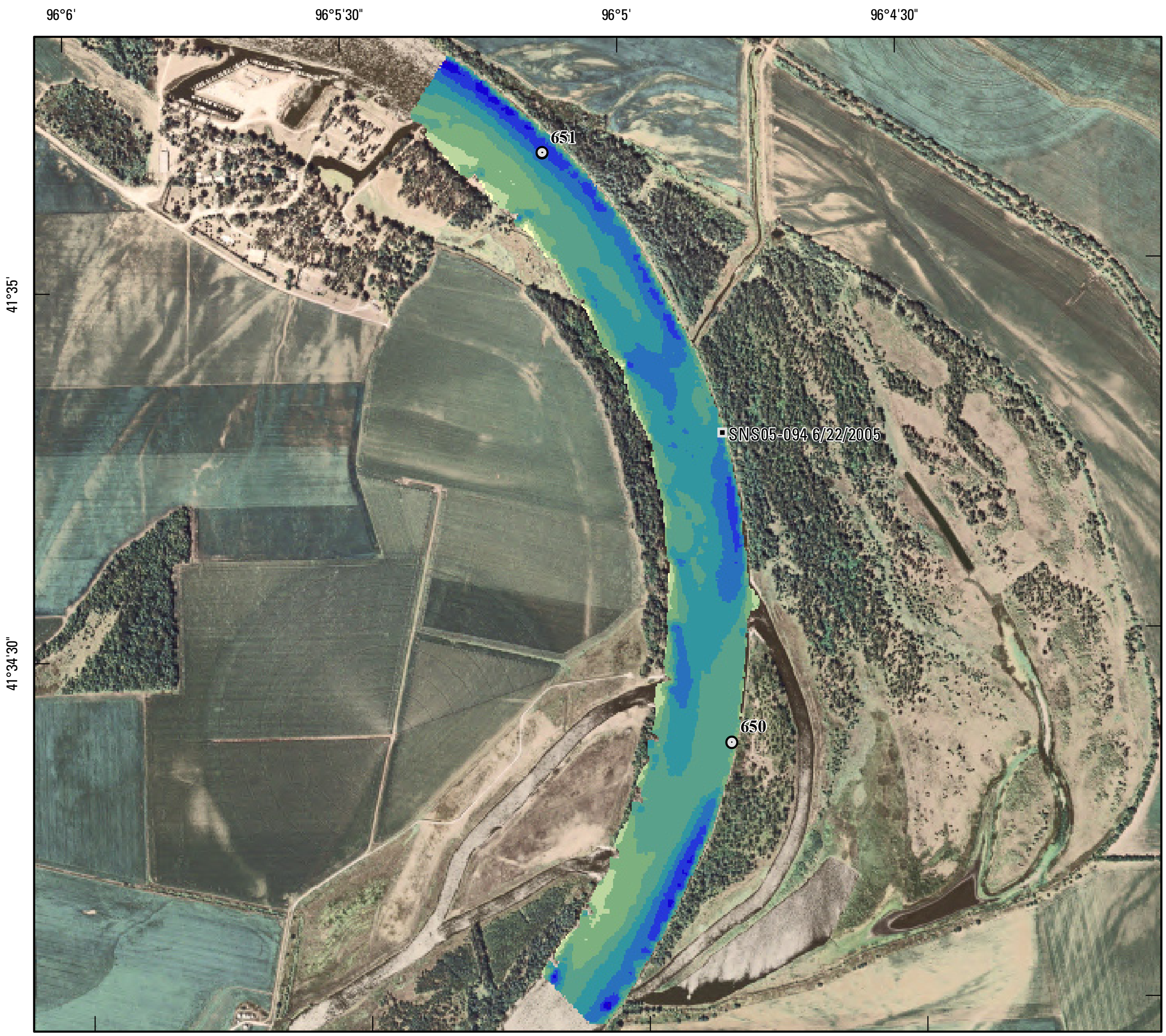


Figure 175. Map of depth based on data collected on June 23, 2005, in the vicinity of river mile 650.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

Revetment, gravel, hard sand

Sand (dunes)

RoxAnn- and velocity-derived classes

Transporting sand

Fine sediment (mud, silt)

Classes derived from aerial photographs

Engineered structures (rock)

Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 23, 2005.

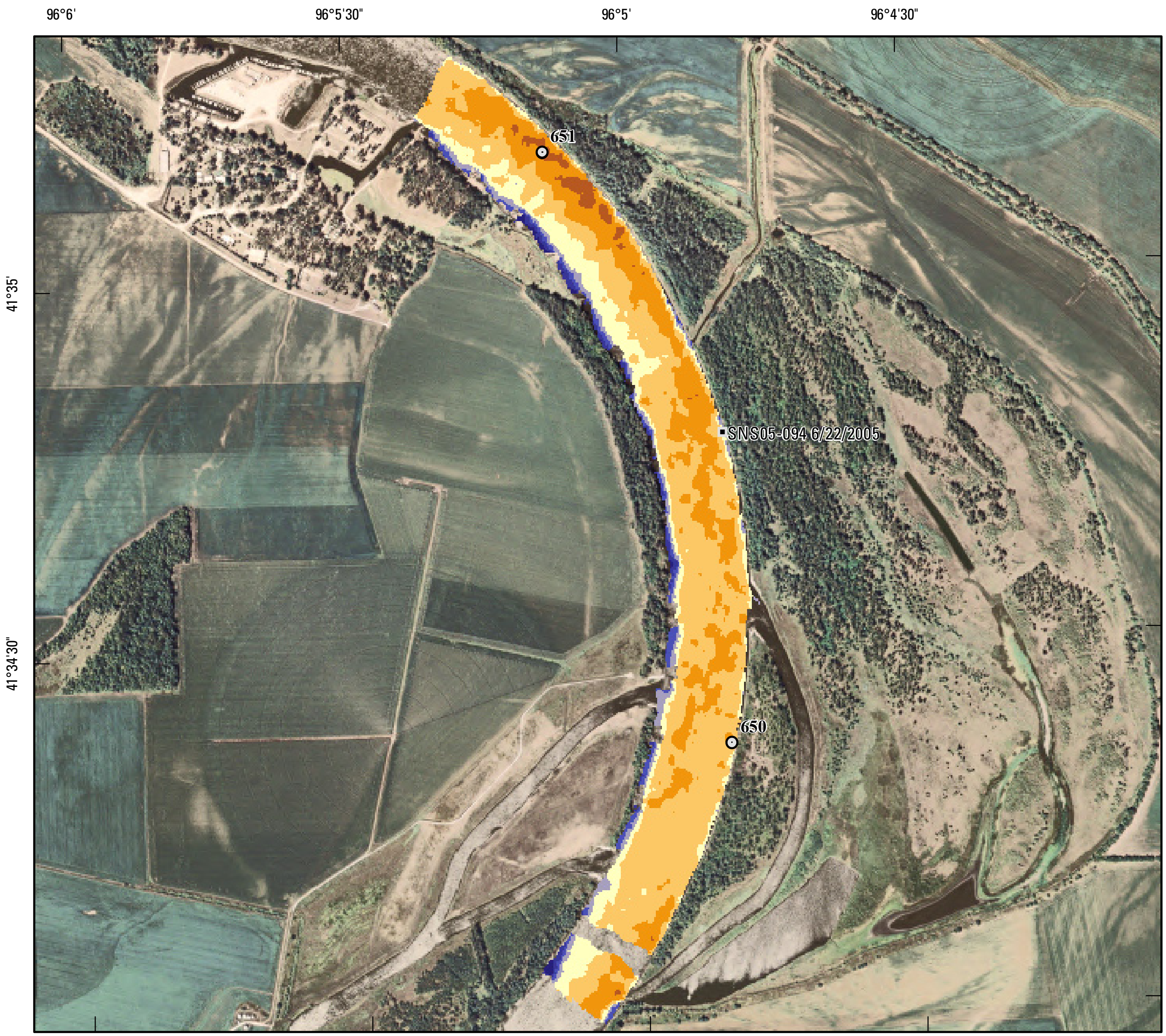
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 176. Map of generalized substrate based on data collected on June 23, 2005, in the vicinity of river mile 650.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 177. Map of depth-averaged velocity based on data collected on June 23, 2005, in the vicinity of river mile 650.

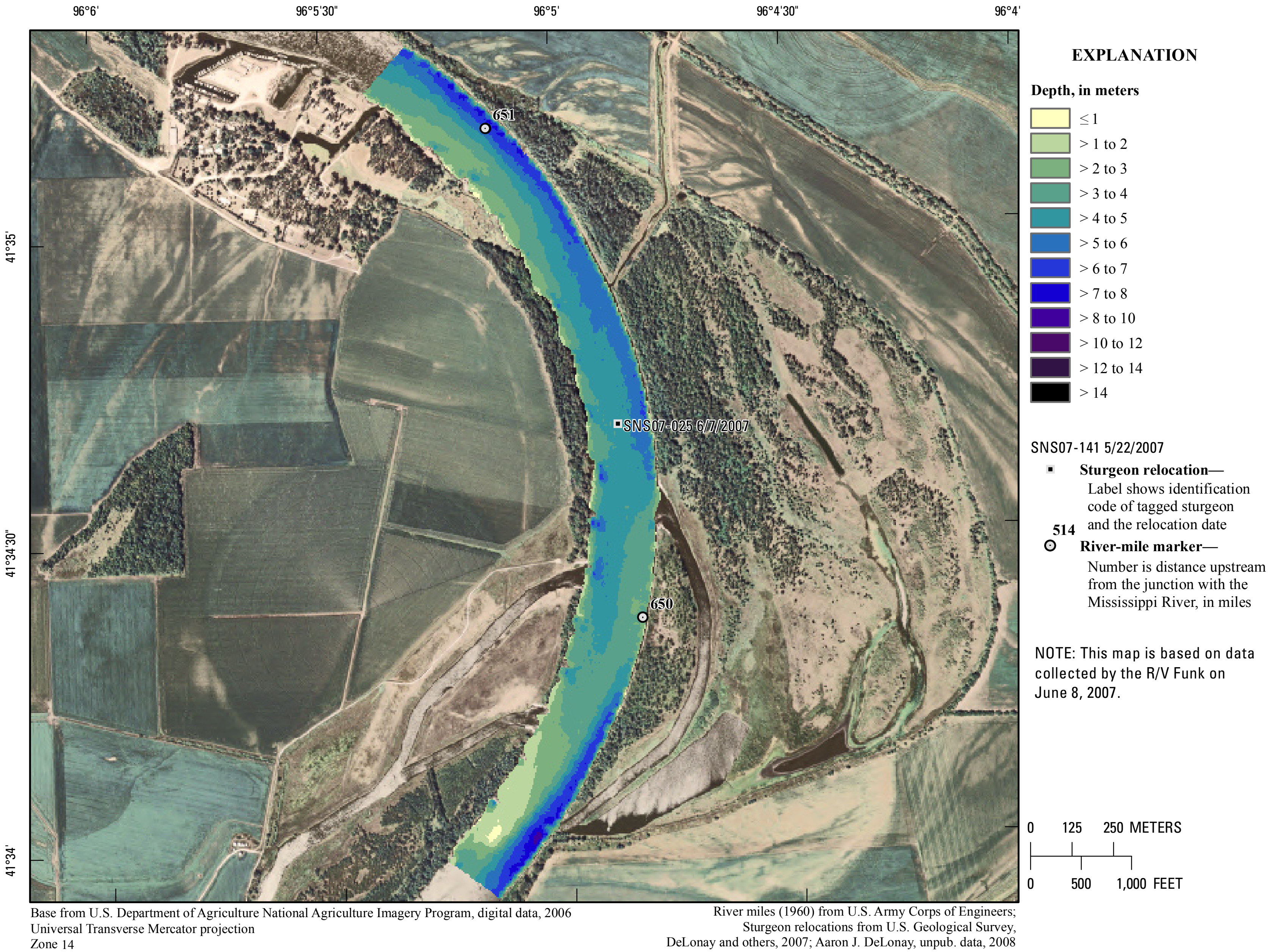
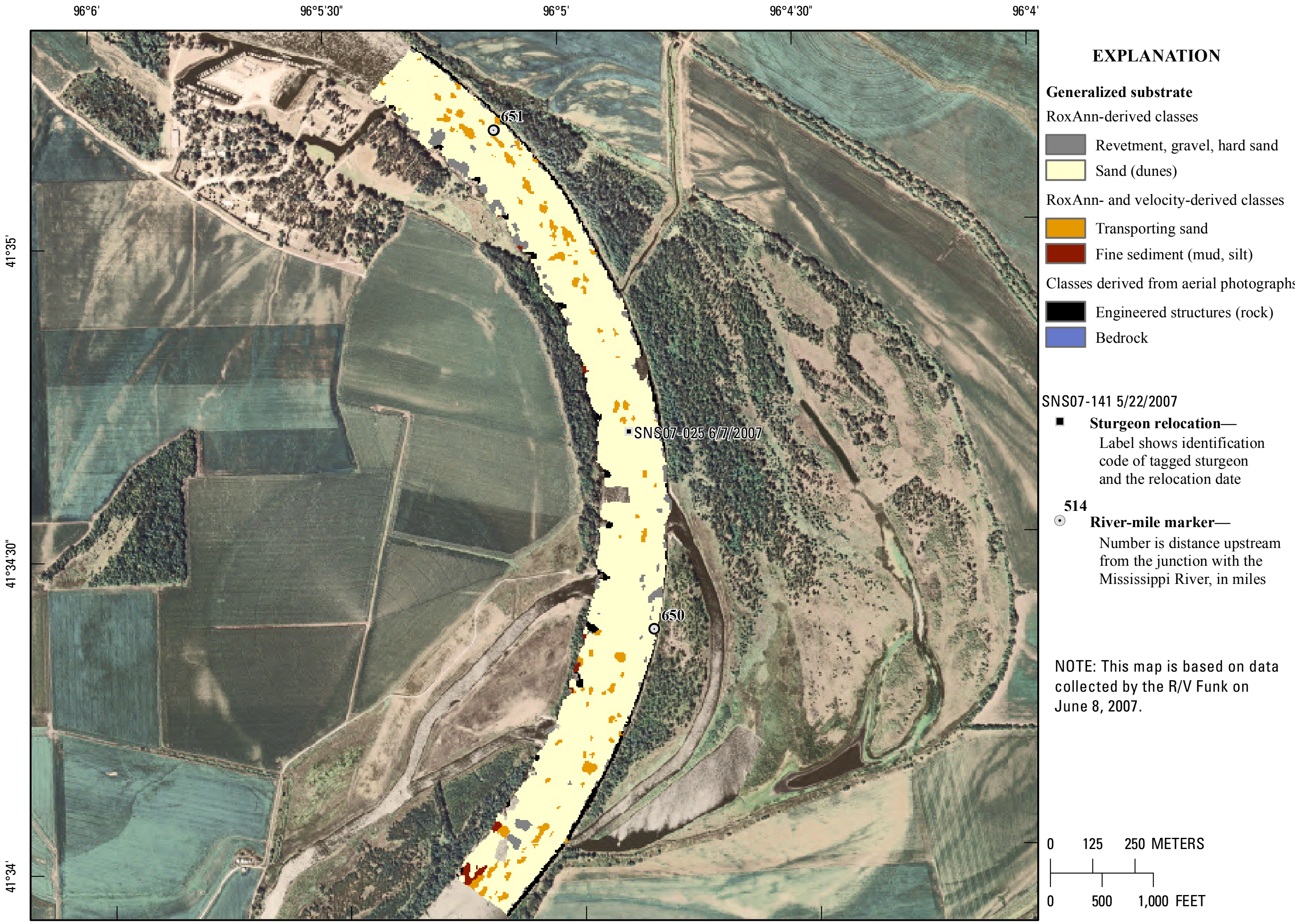


Figure 178. Map of depth based on data collected on June 8, 2007, in the vicinity of river mile 650.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 179. Map of generalized substrate based on data collected on June 8, 2007, in the vicinity of river mile 650.

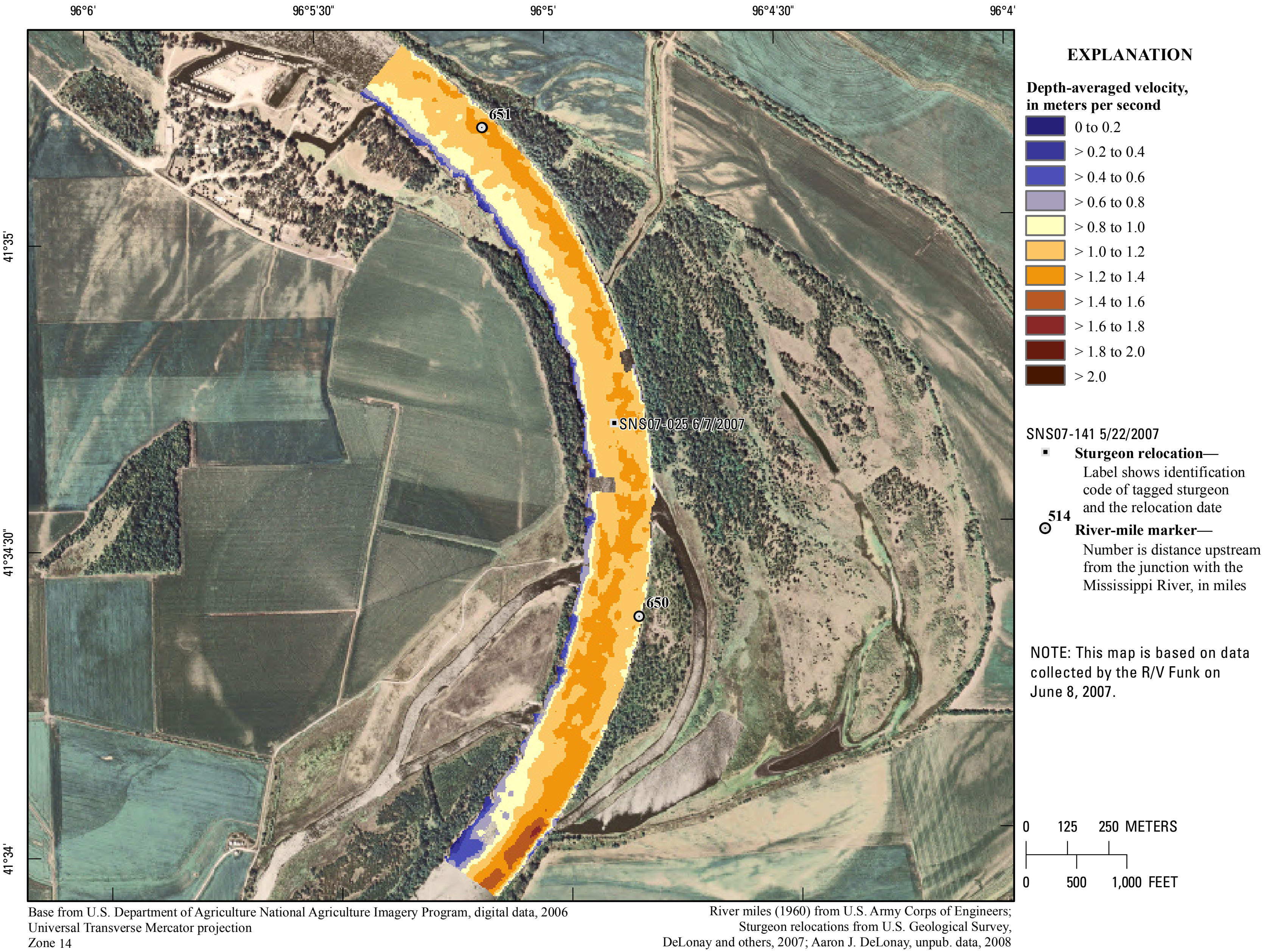
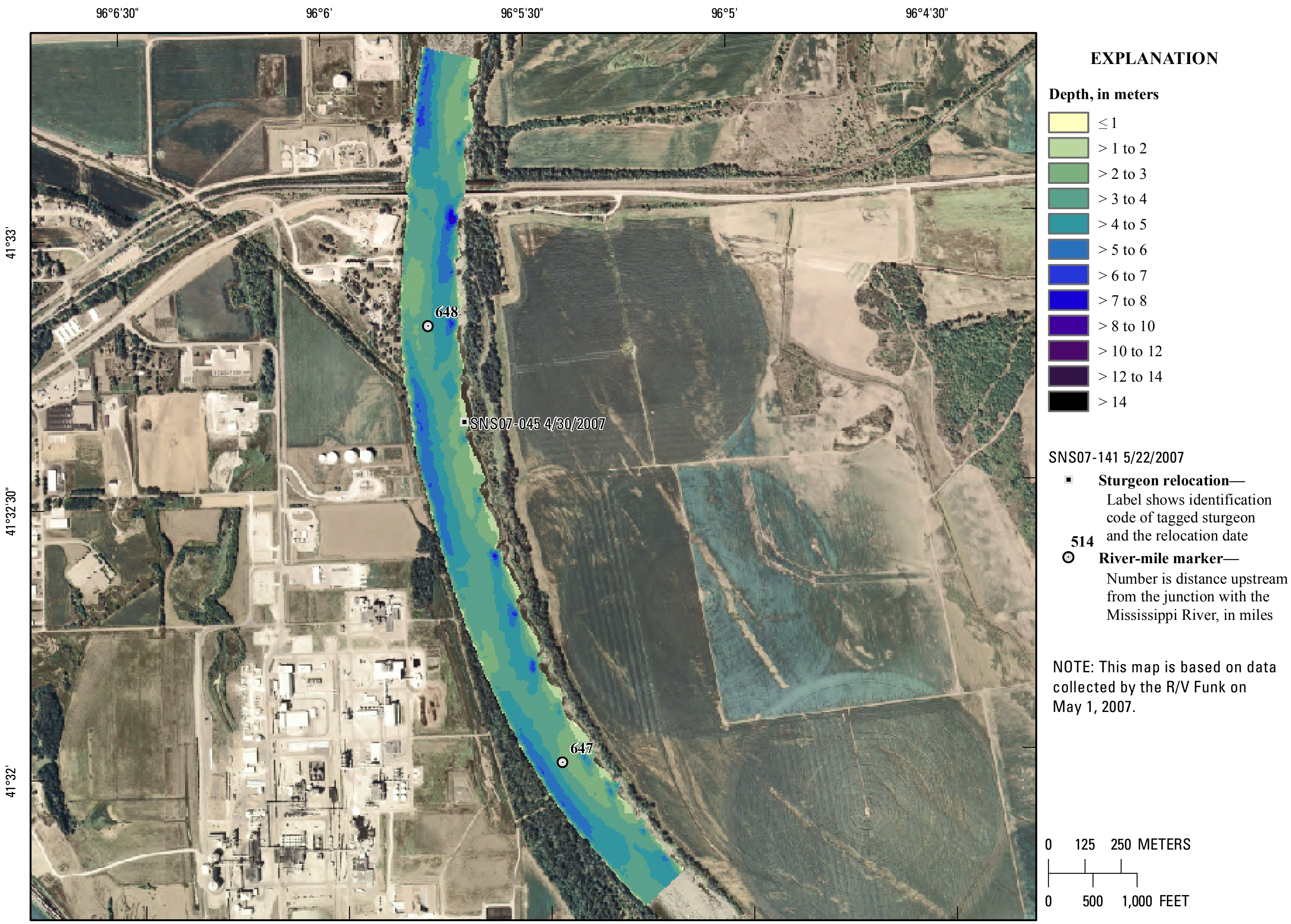


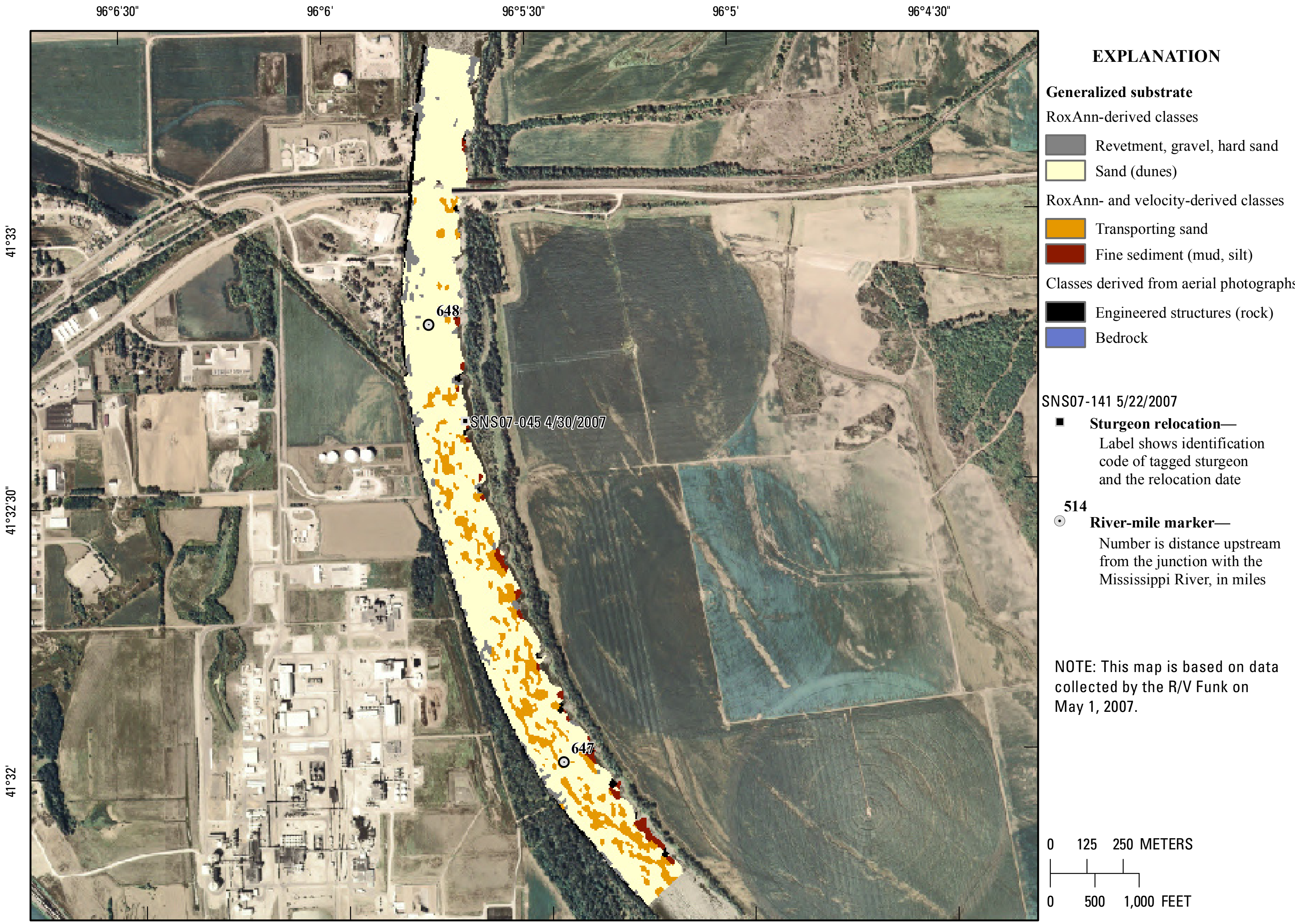
Figure 180. Map of depth-averaged velocity based on data collected on June 8, 2007, in the vicinity of river mile 650.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

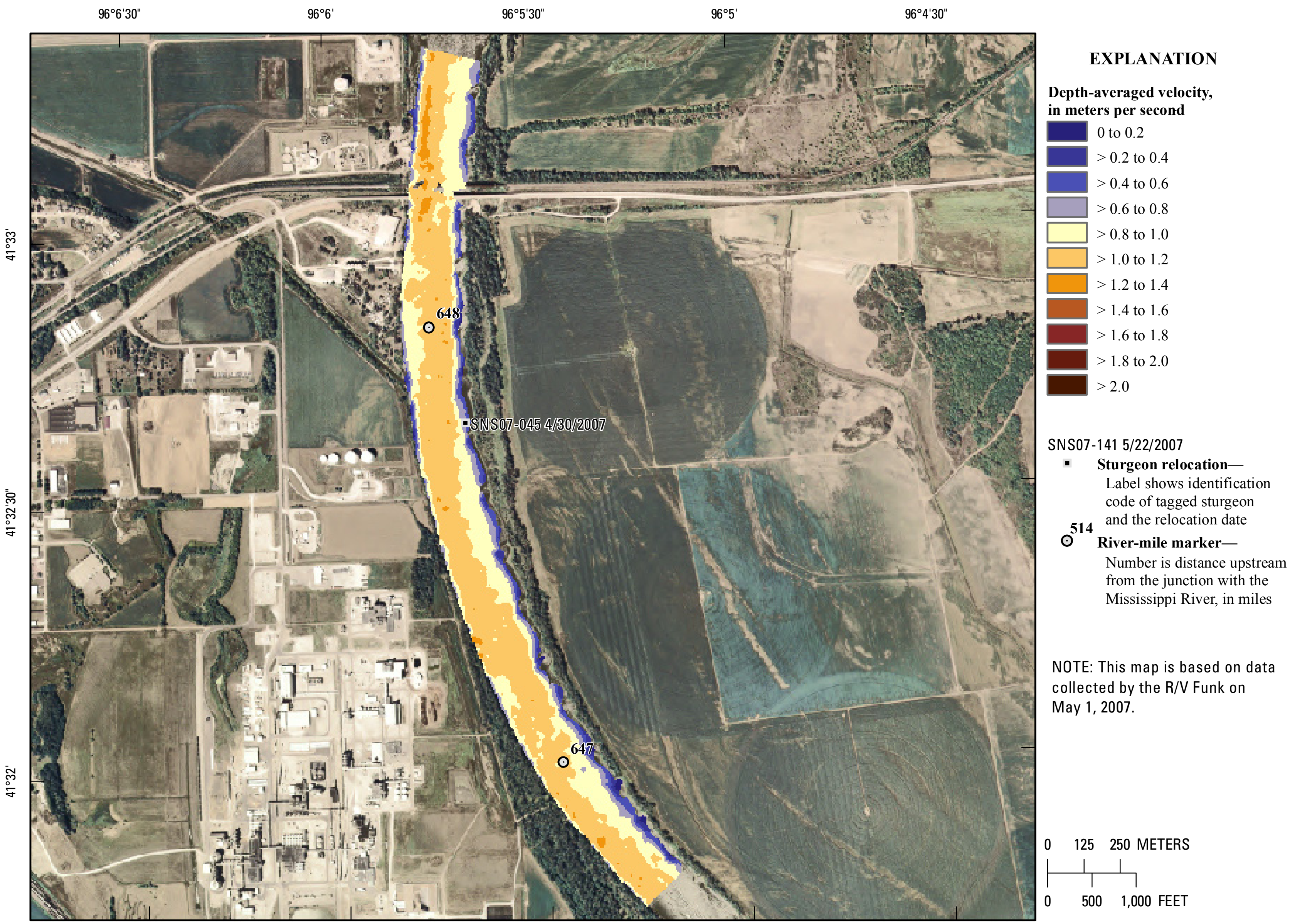
Figure 181. Map of depth based on data collected on May 1, 2007, in the vicinity of river mile 648.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 182. Map of generalized substrate based on data collected on May 1, 2007, in the vicinity of river mile 648.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 183. Map of depth-averaged velocity based on data collected on May 1, 2007, in the vicinity of river mile 648.

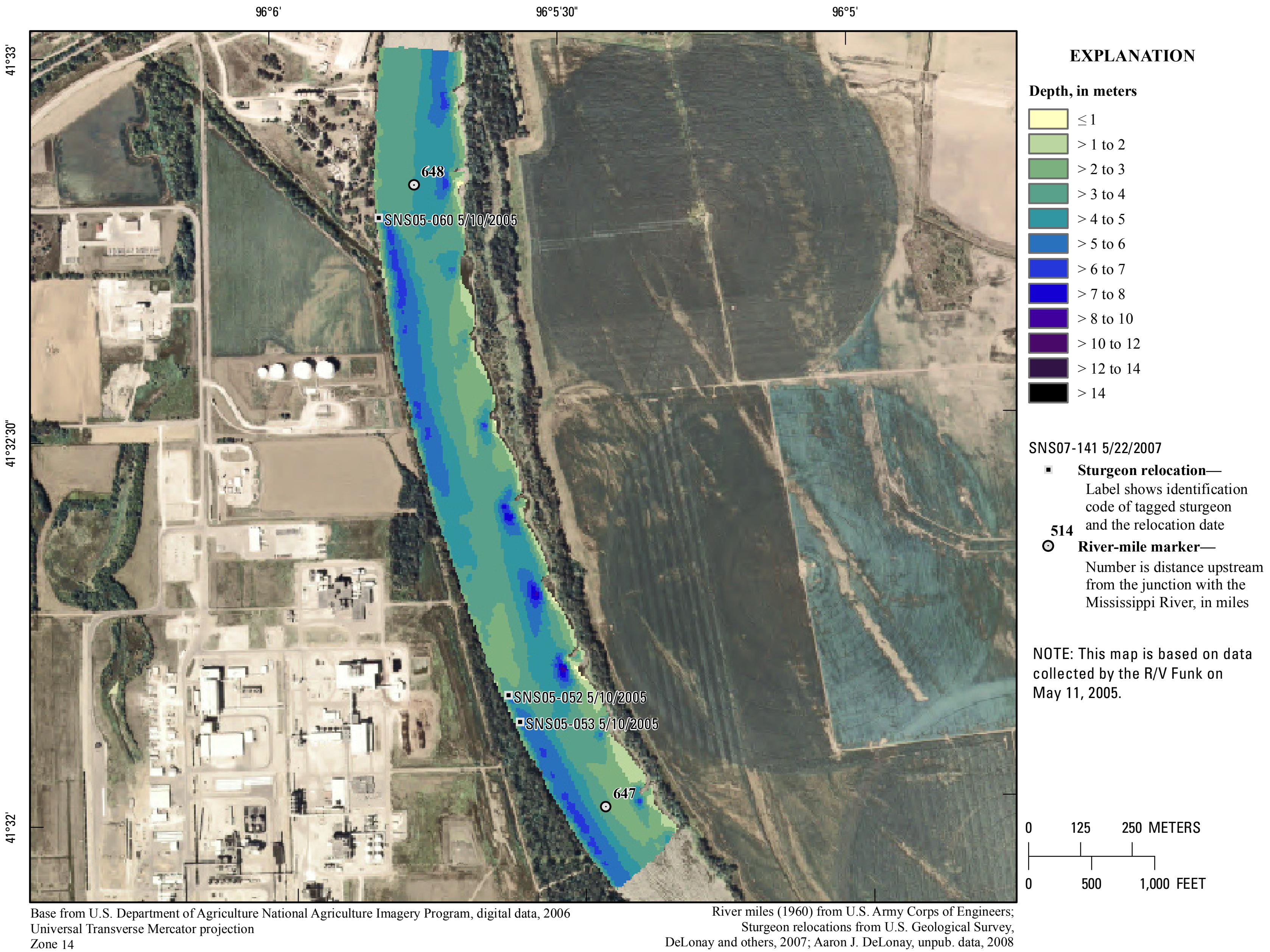
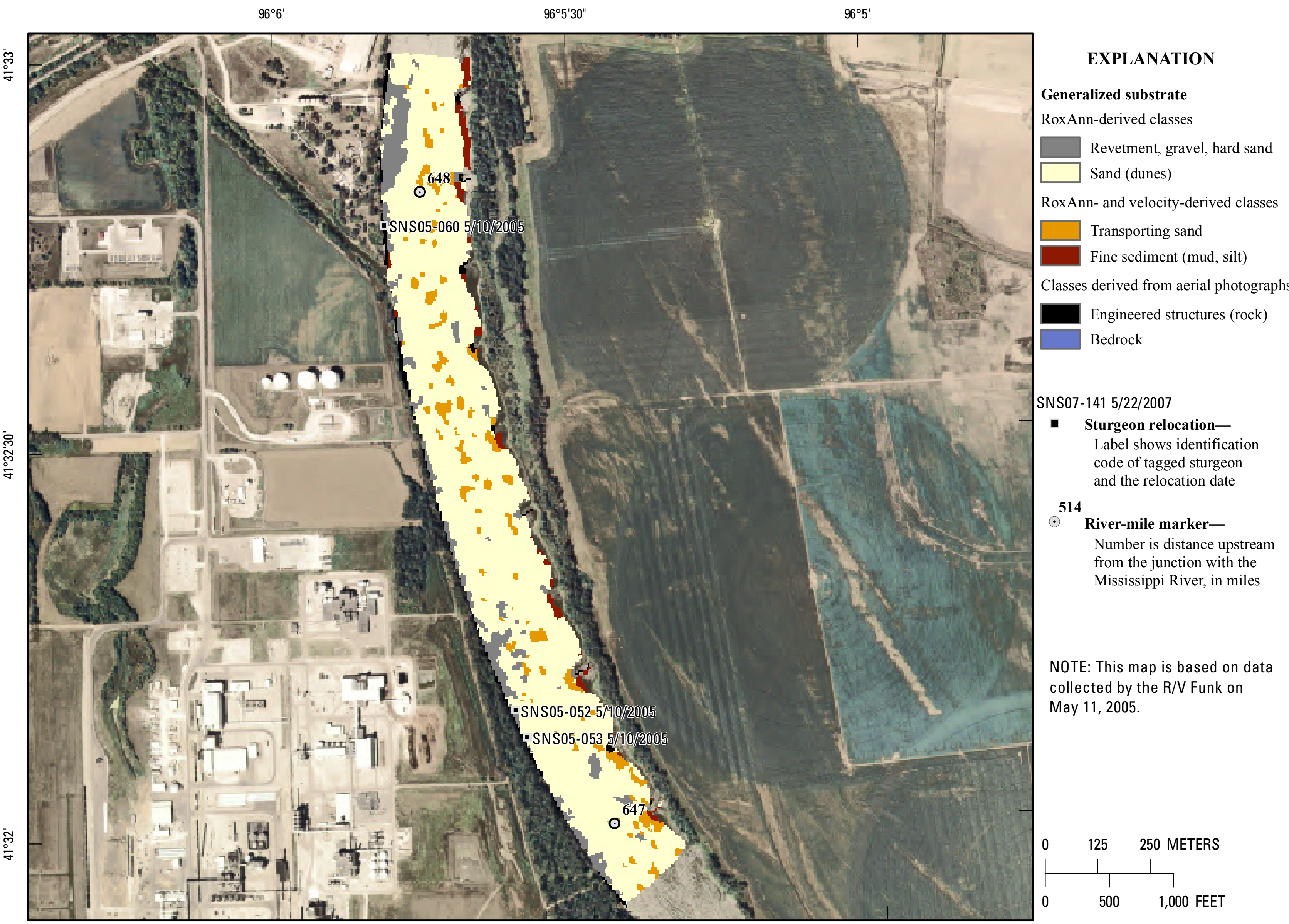


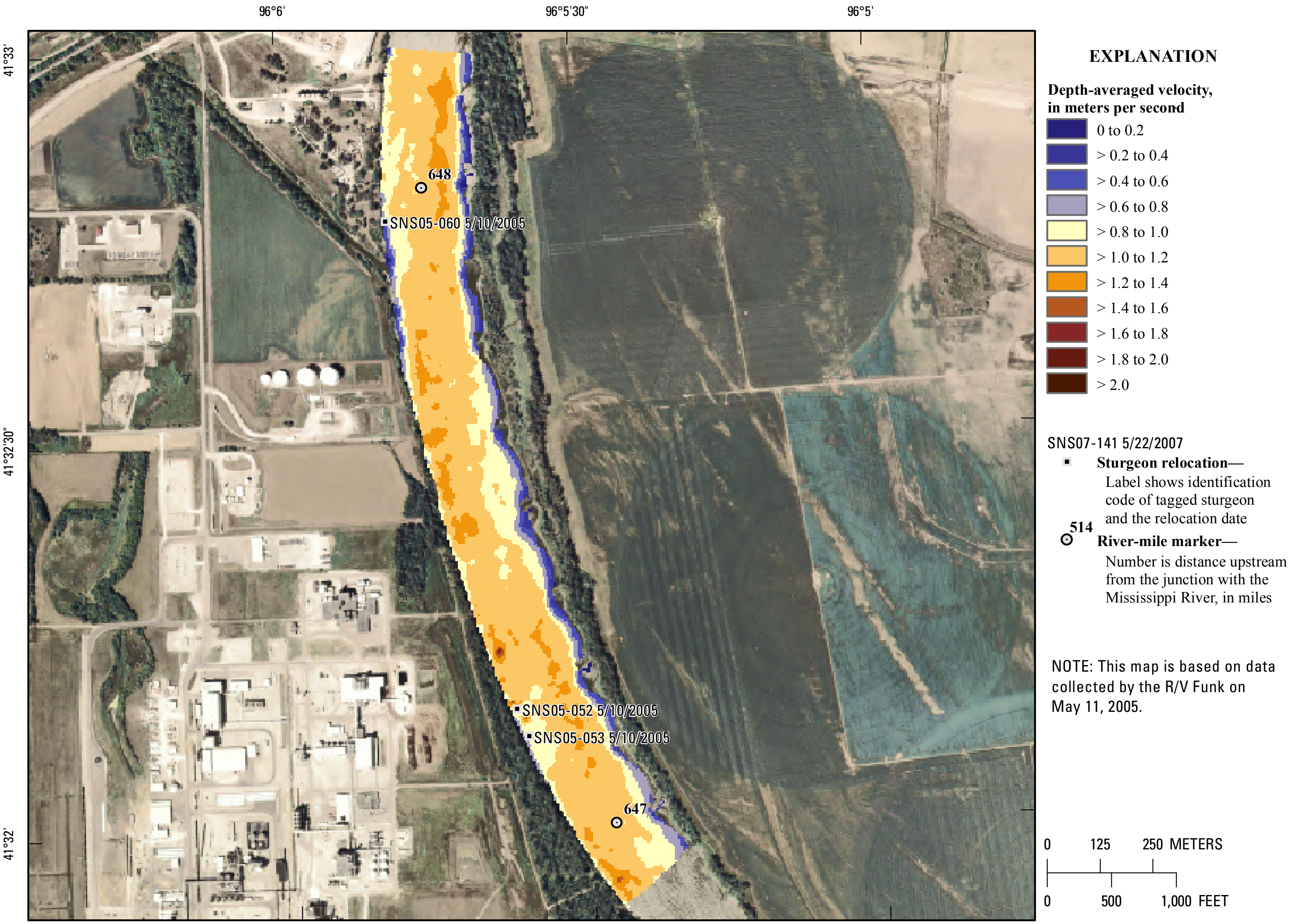
Figure 184. Map of depth based on data collected on May 11, 2005, in the vicinity of river mile 648.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

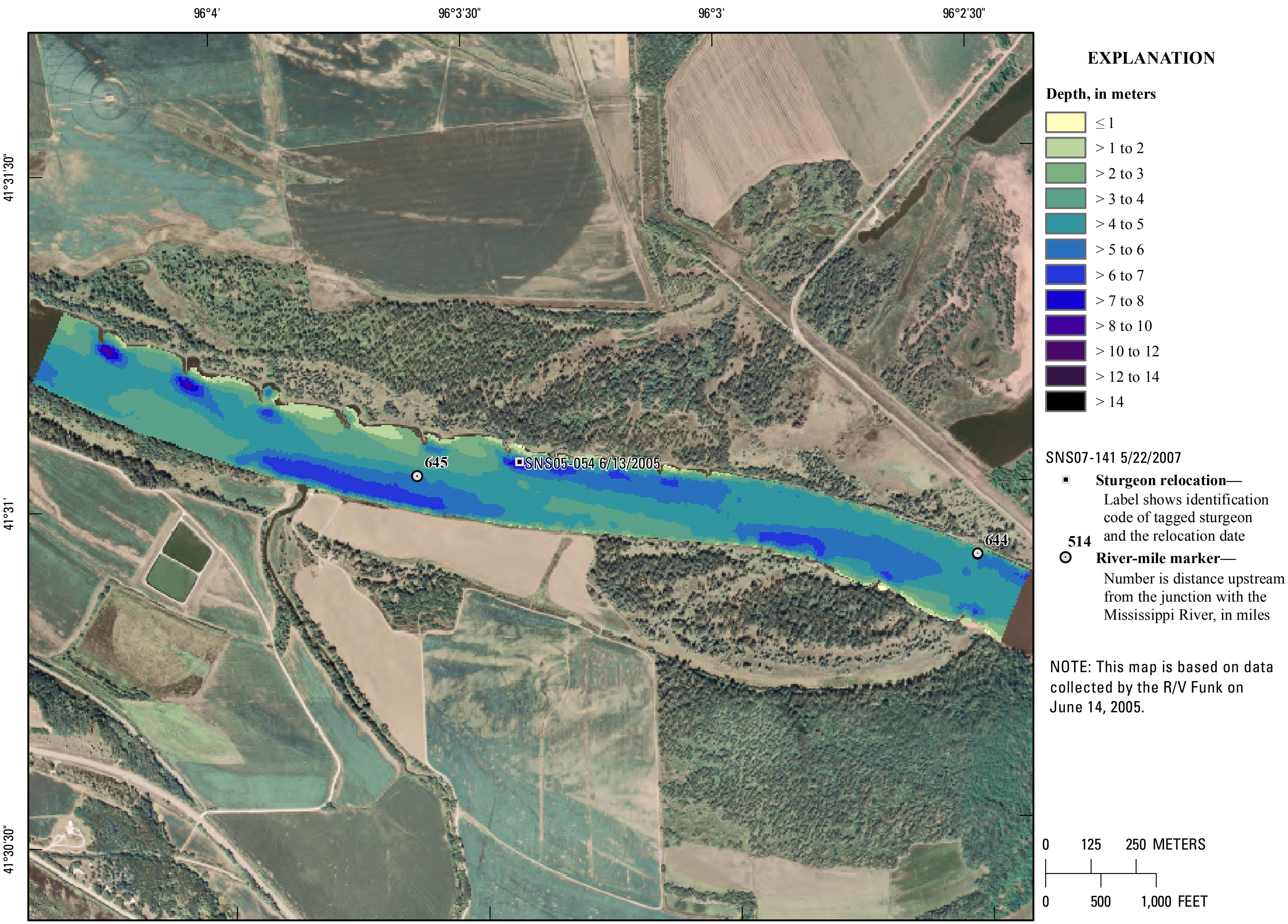
Figure 185. Map of generalized substrate based on data collected on May 11, 2005, in the vicinity of river mile 648.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 186. Map of depth-averaged velocity based on data collected on May 11, 2005, in the vicinity of river mile 648.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

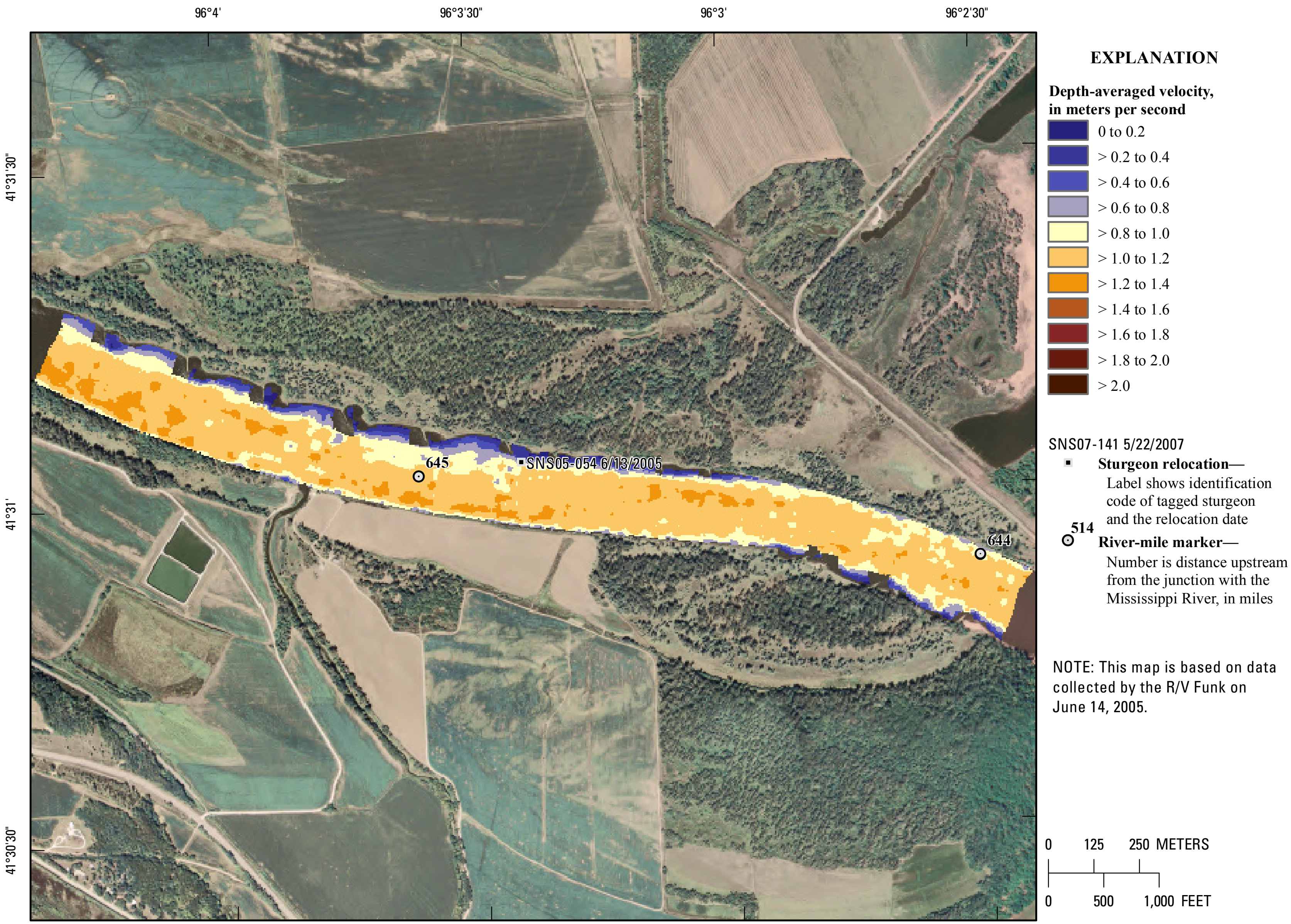
River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 187. Map of depth based on data collected on June 14, 2005, in the vicinity of river mile 645.

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 188. Map of generalized substrate based on data collected on June 14, 2005, in the vicinity of river mile 645.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 189. Map of depth-averaged velocity based on data collected on June 14, 2005, in the vicinity of river mile 645.

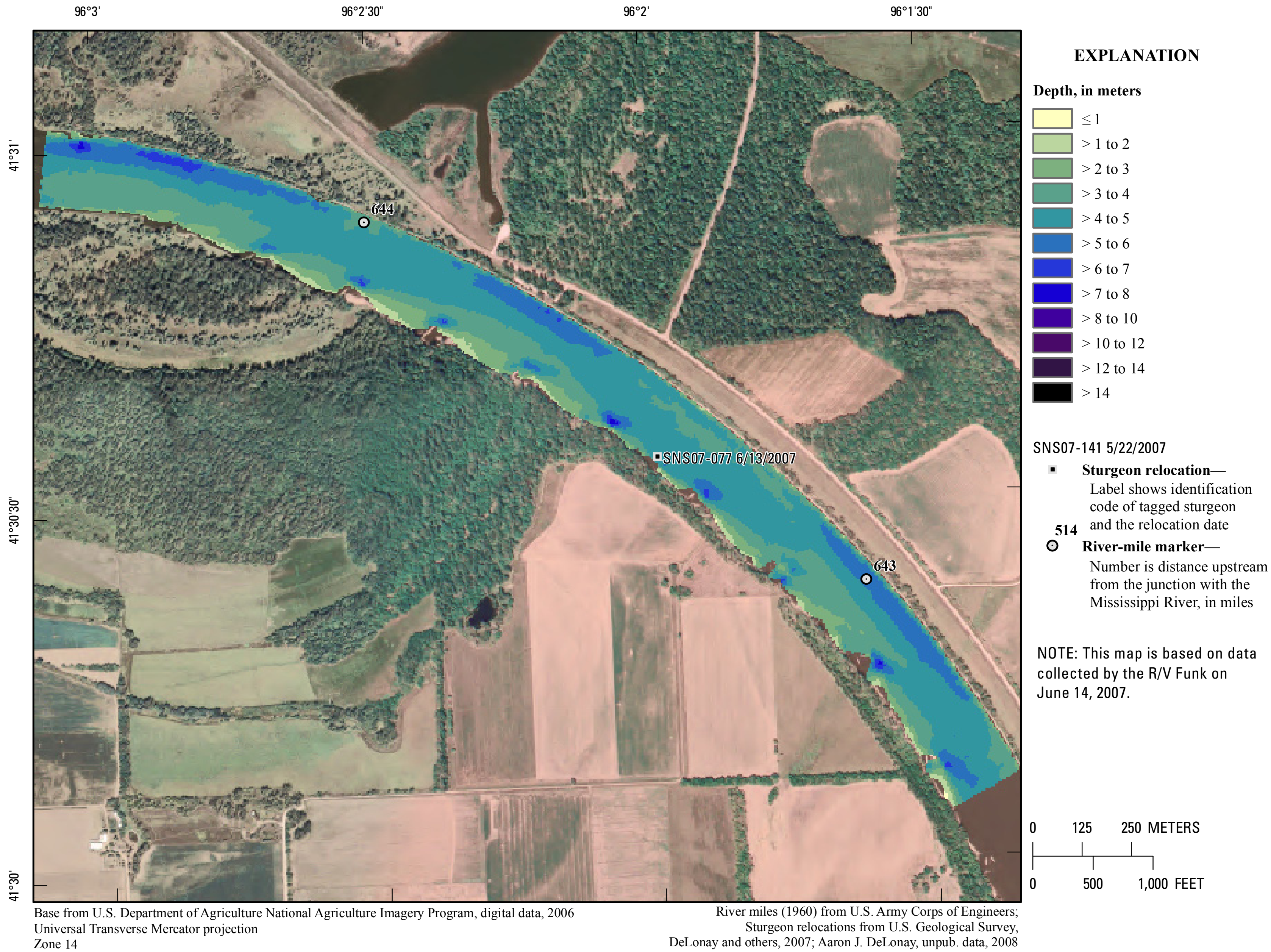
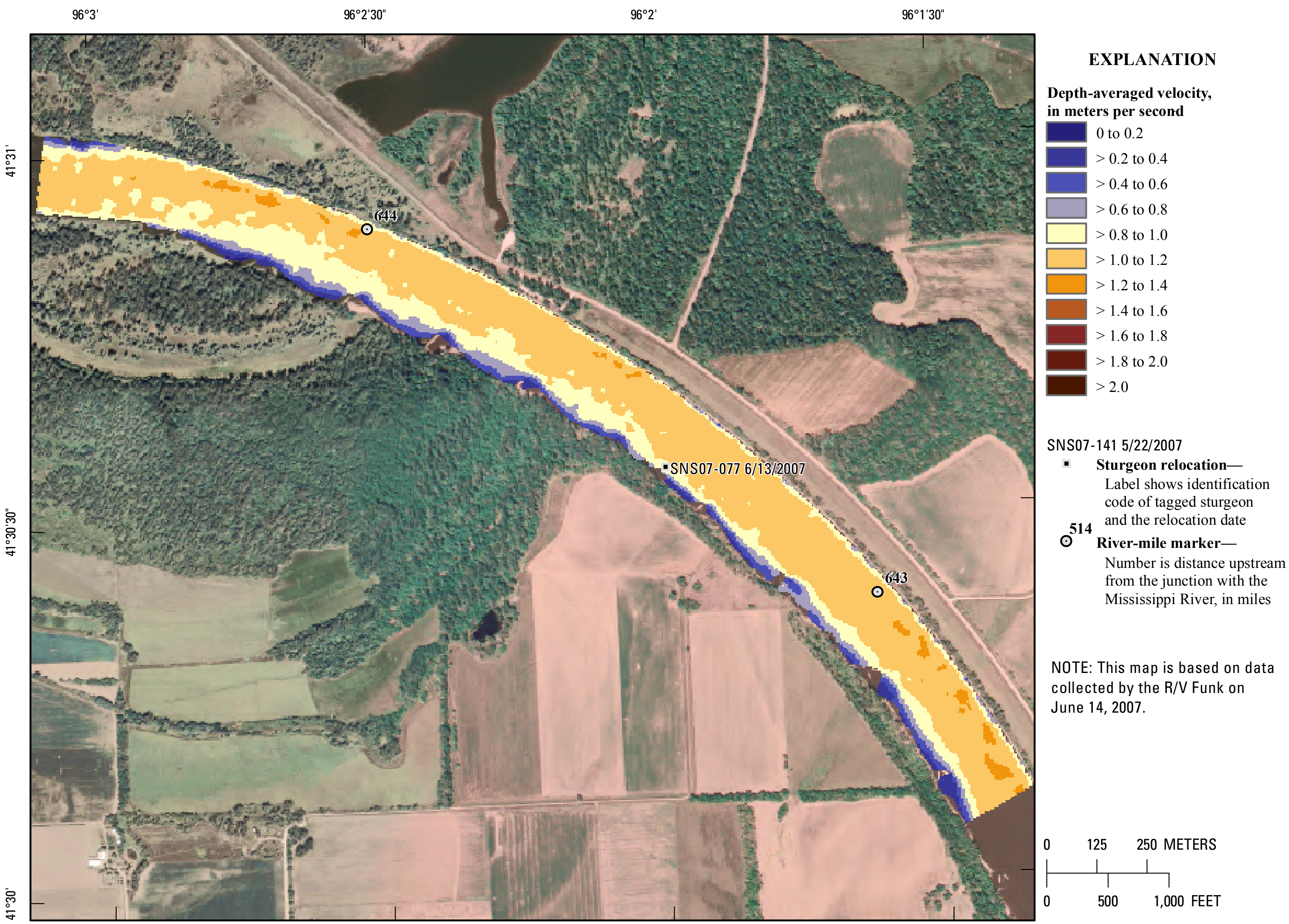


Figure 190. Map of depth based on data collected on June 14, 2007, in the vicinity of river mile 644.

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

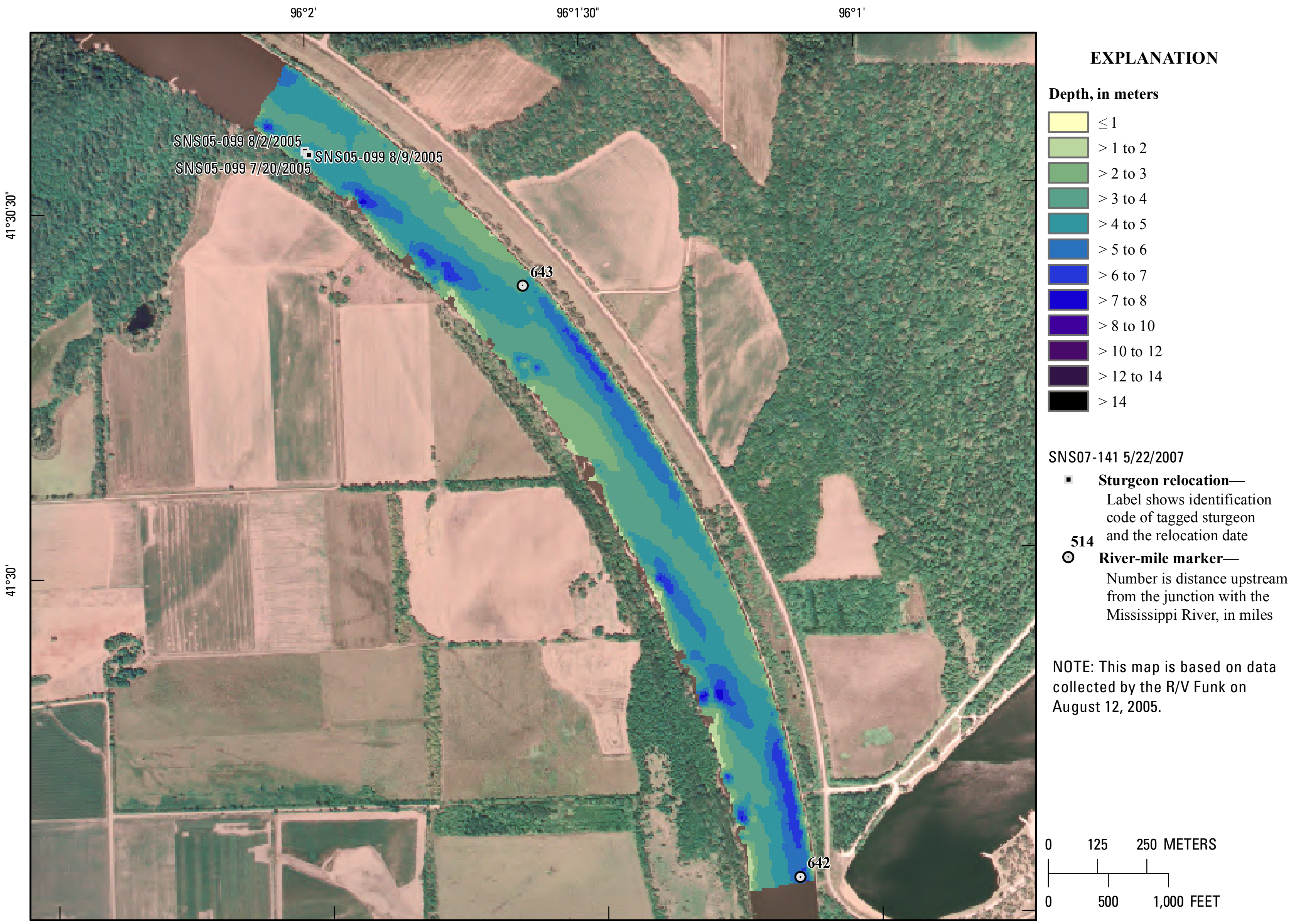
Figure 191. Map of generalized substrate based on data collected on June 14, 2007, in the vicinity of river mile 644.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

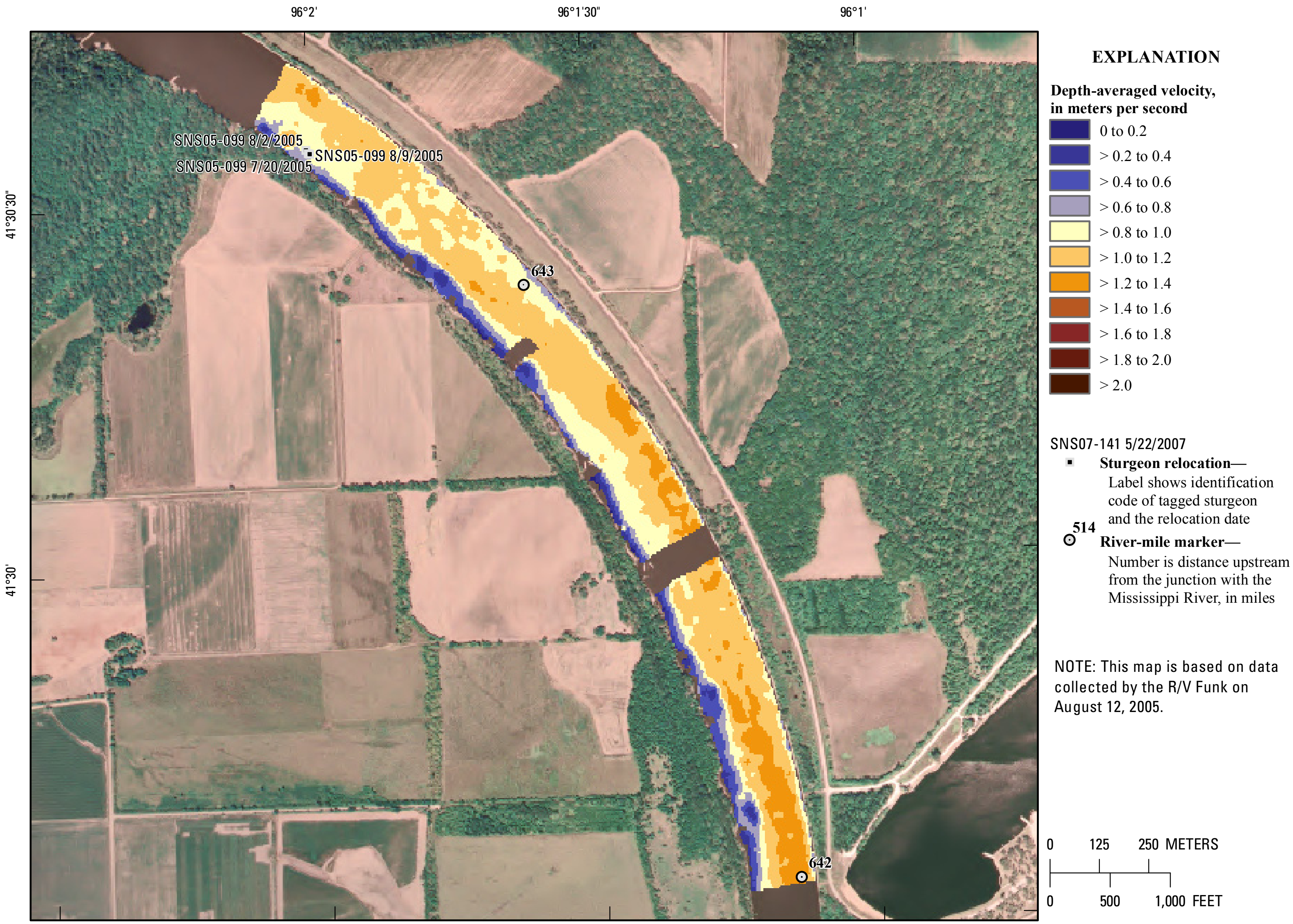
Figure 192. Map of depth-averaged velocity based on data collected on June 14, 2007, in the vicinity of river mile 644.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

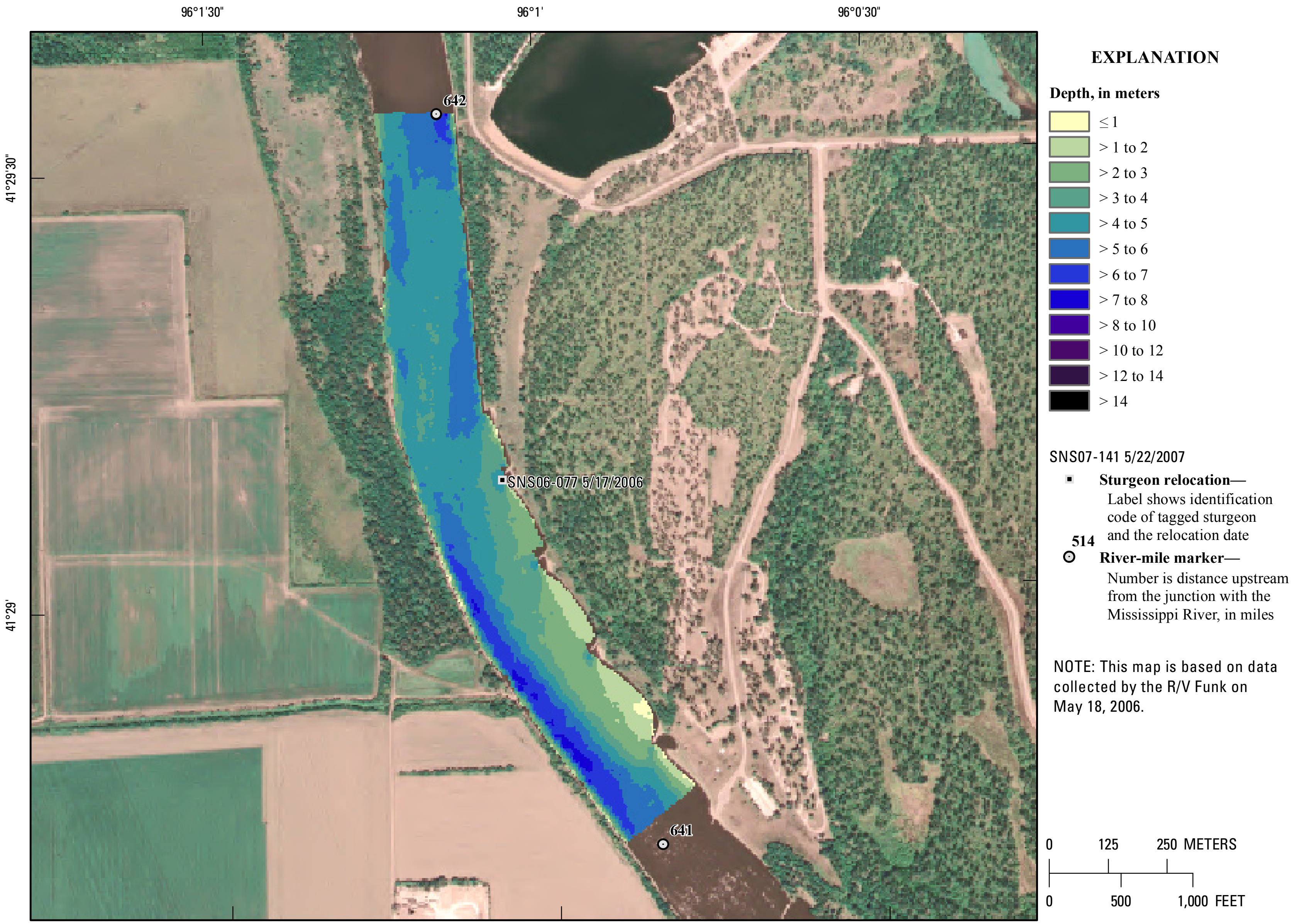
Figure 193. Map of depth based on data collected on August 12, 2005, in the vicinity of river mile 643.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 194. Map of depth-averaged velocity based on data collected on August 12, 2005, in the vicinity of river mile 643.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 195. Map of depth based on data collected on May 18, 2006, in the vicinity of river mile 642.

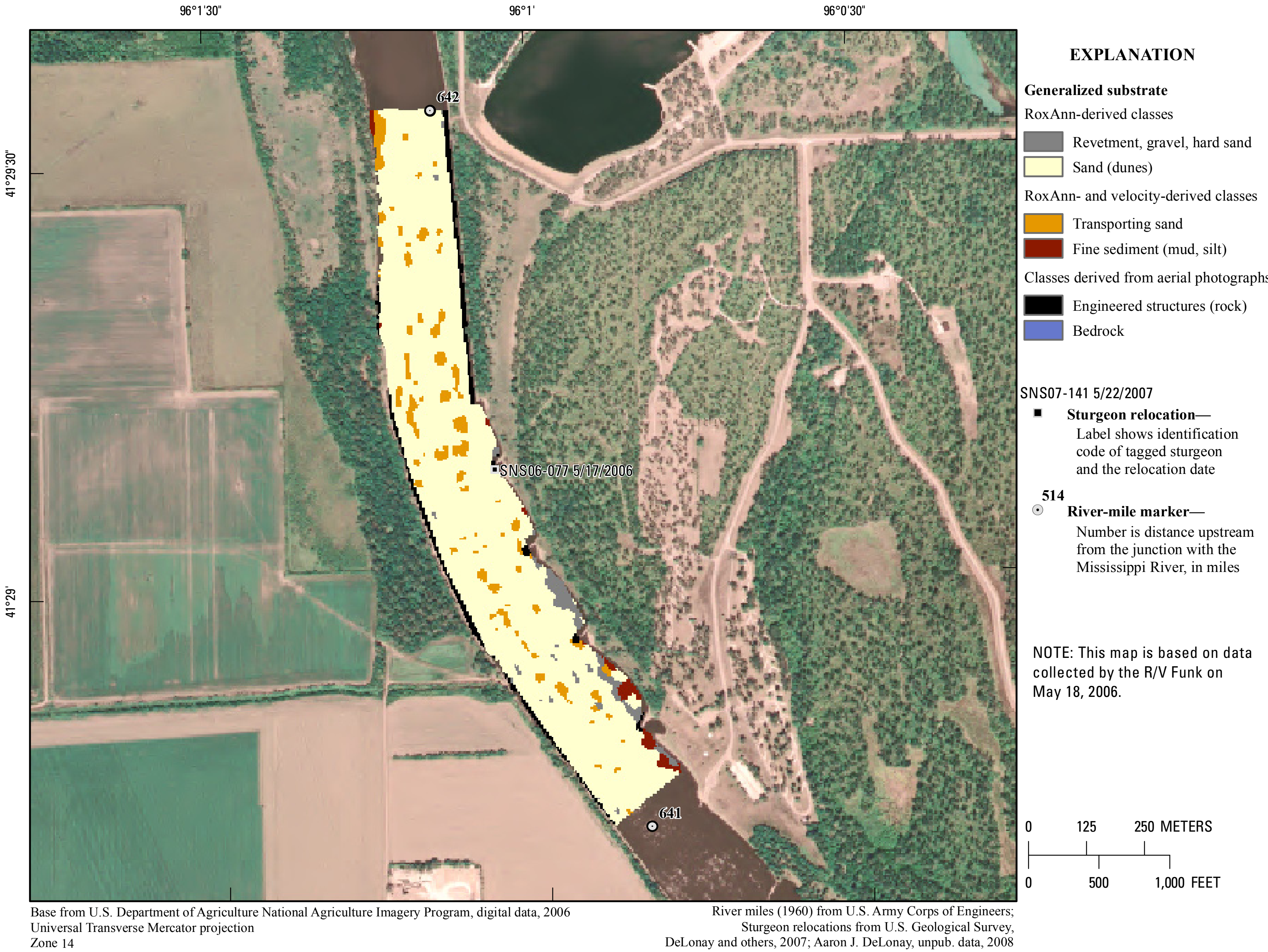
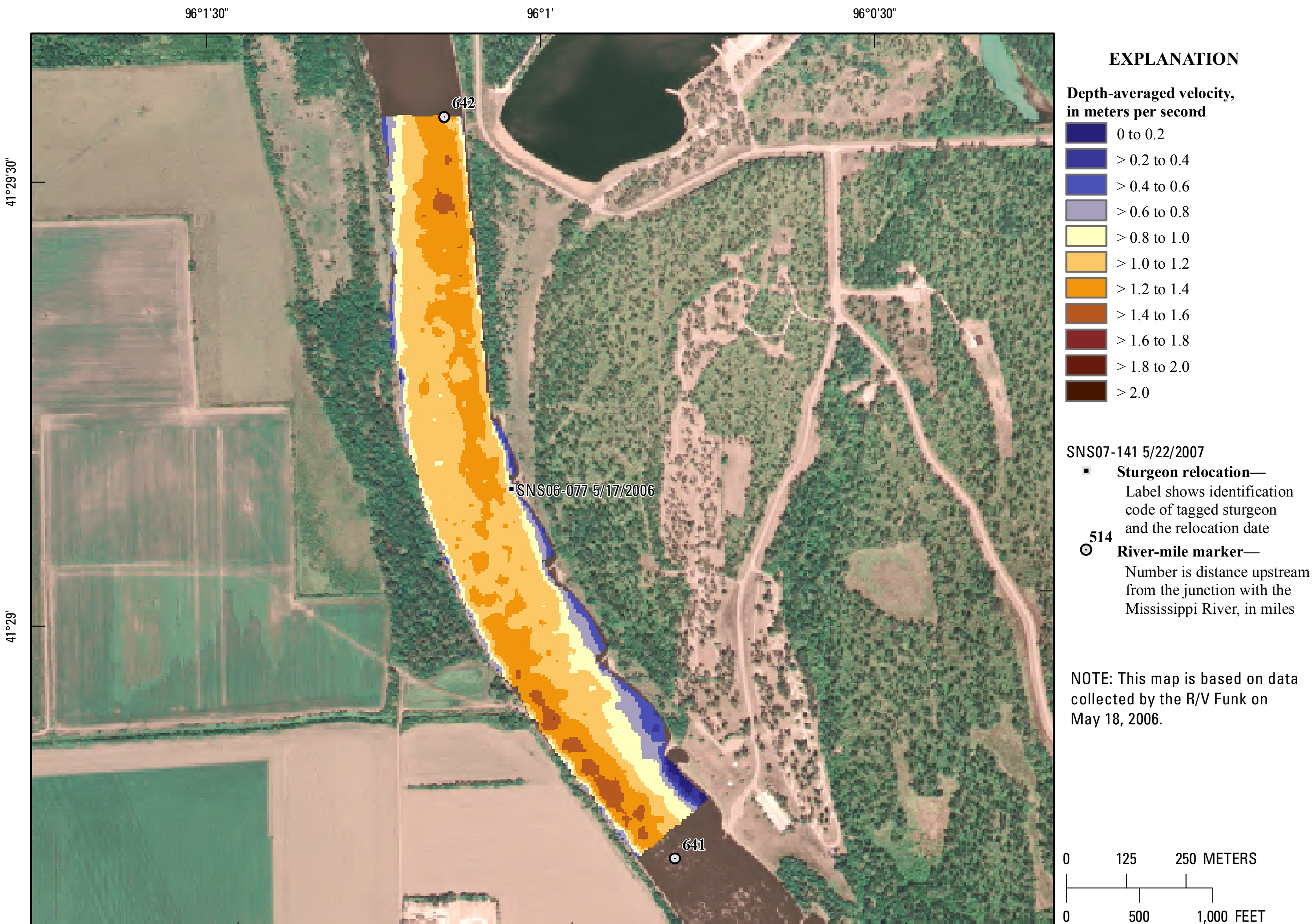


Figure 196. Map of generalized substrate based on data collected on May 18, 2006, in the vicinity of river mile 642.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 197. Map of depth-averaged velocity based on data collected on May 18, 2006, in the vicinity of river mile 642.

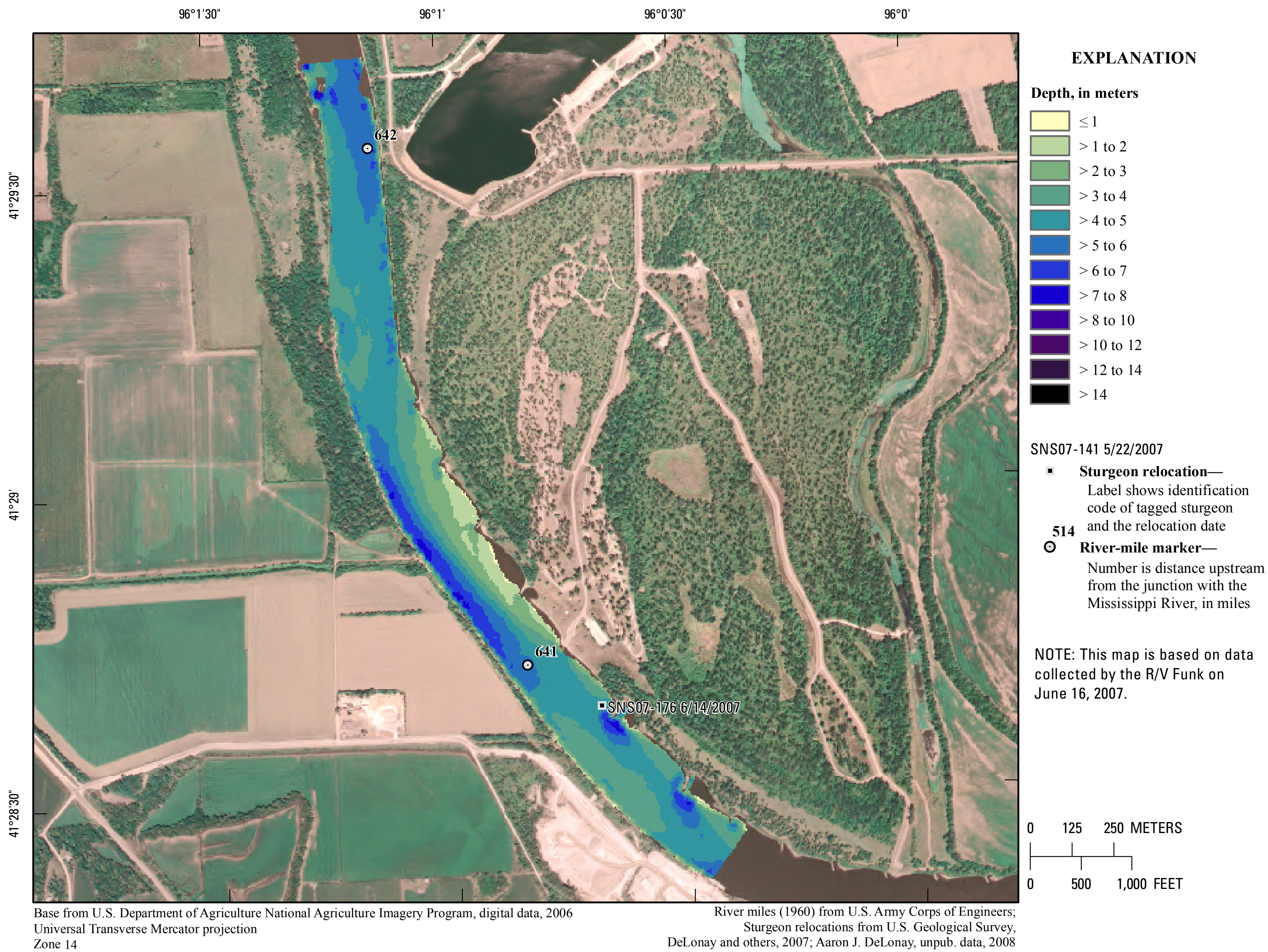
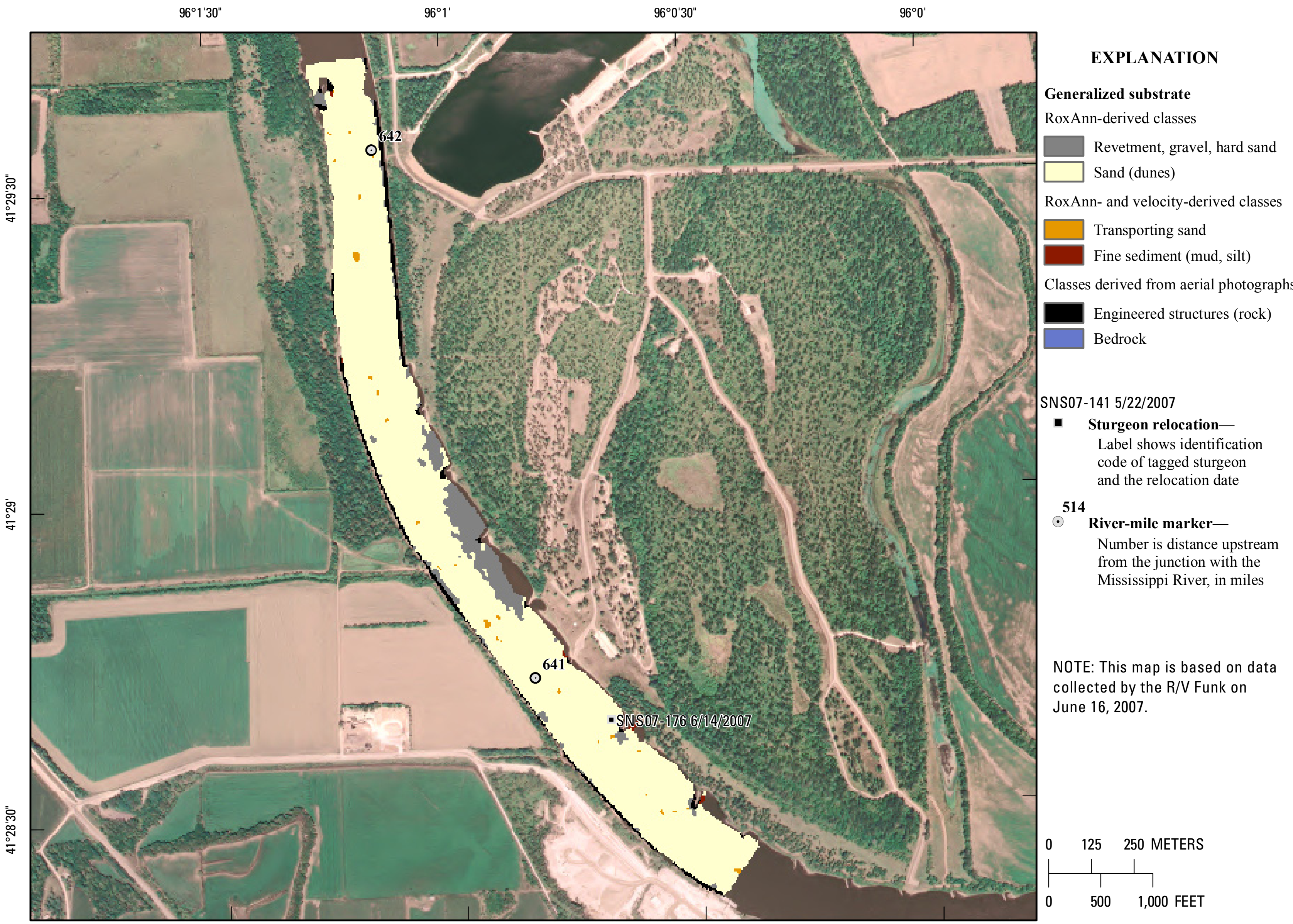


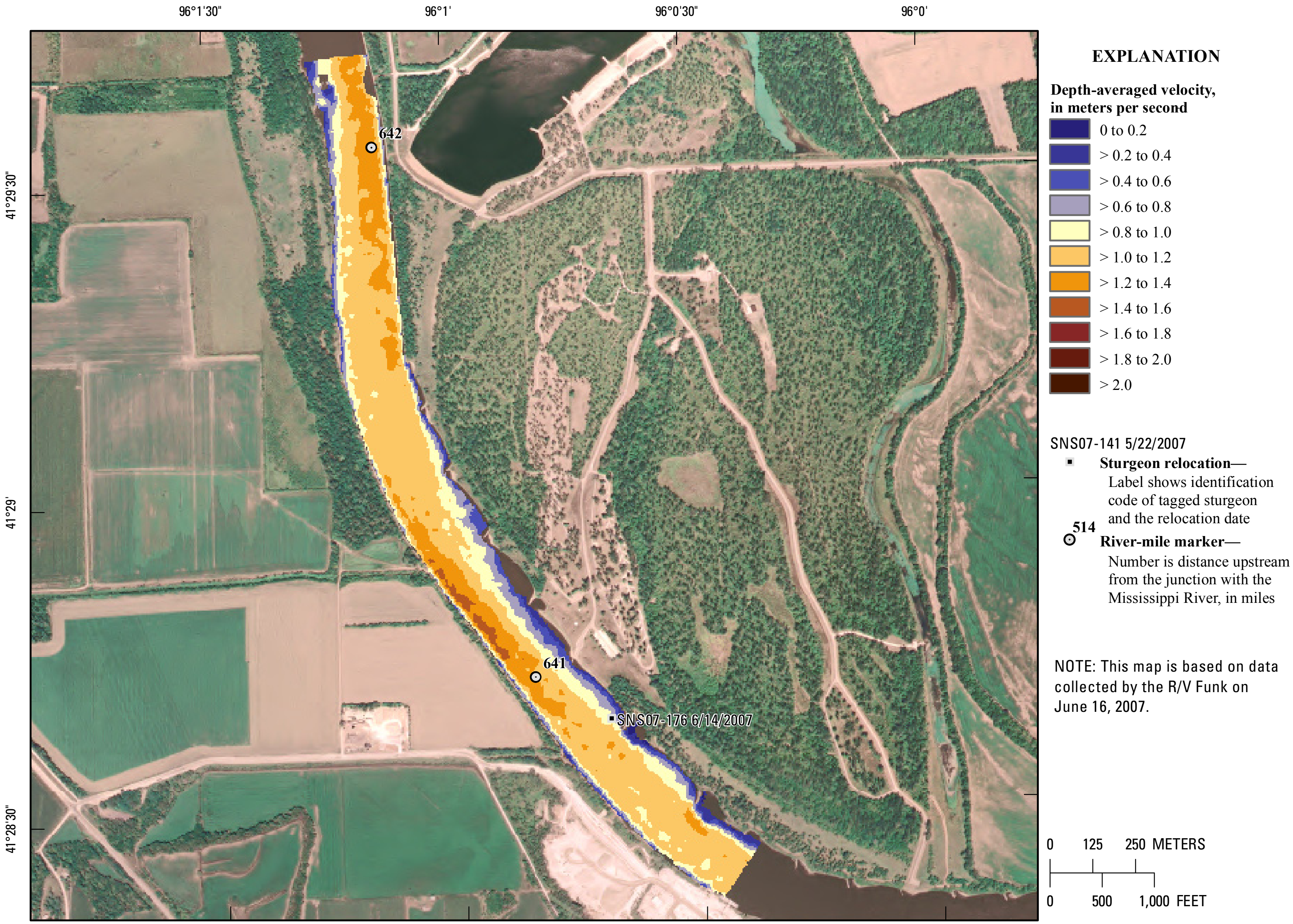
Figure 198. Map of depth based on data collected on June 16, 2007, in the vicinity of river mile 641.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

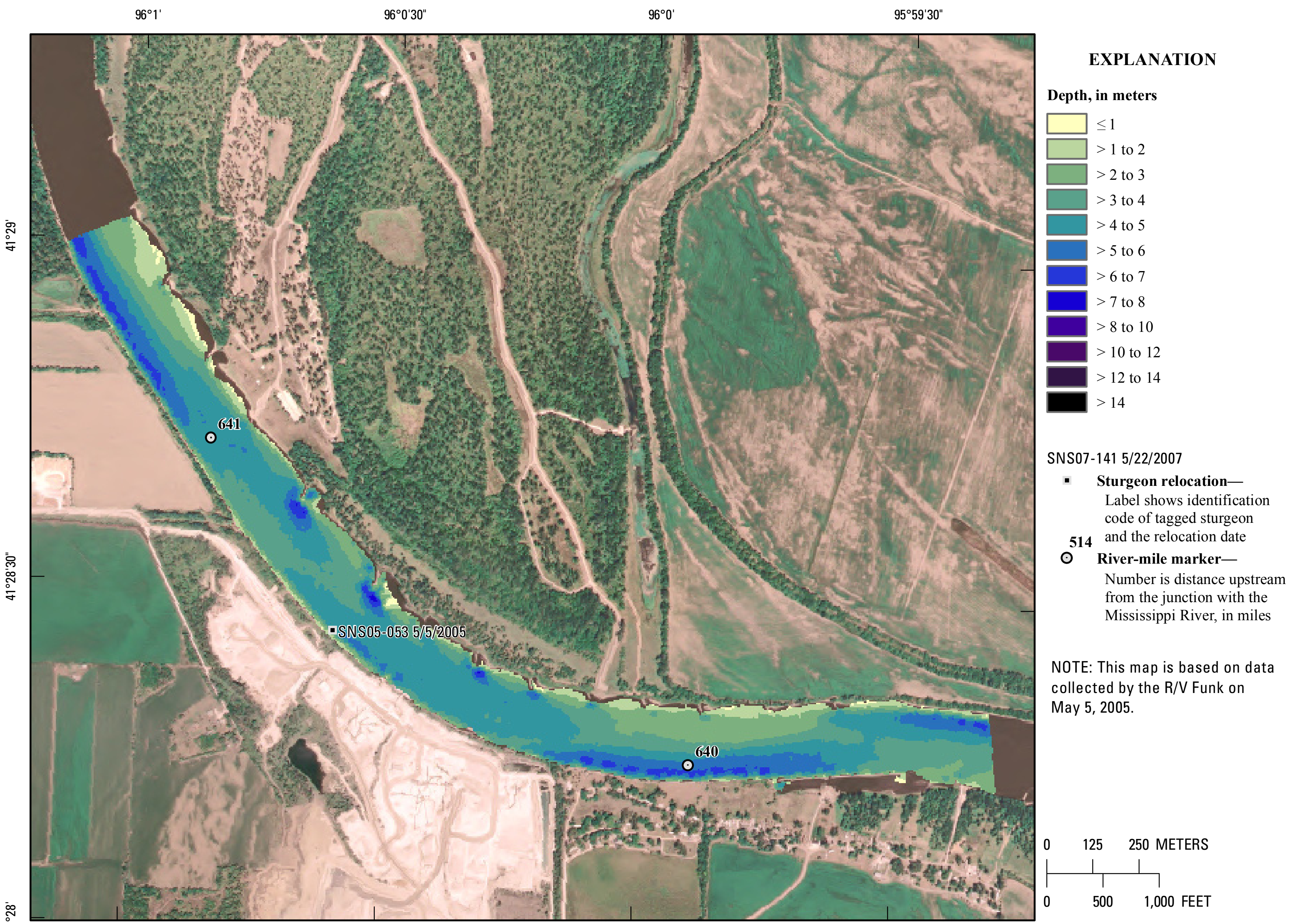
Figure 199. Map of generalized substrate based on data collected on June 16, 2007, in the vicinity of river mile 641.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 14

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

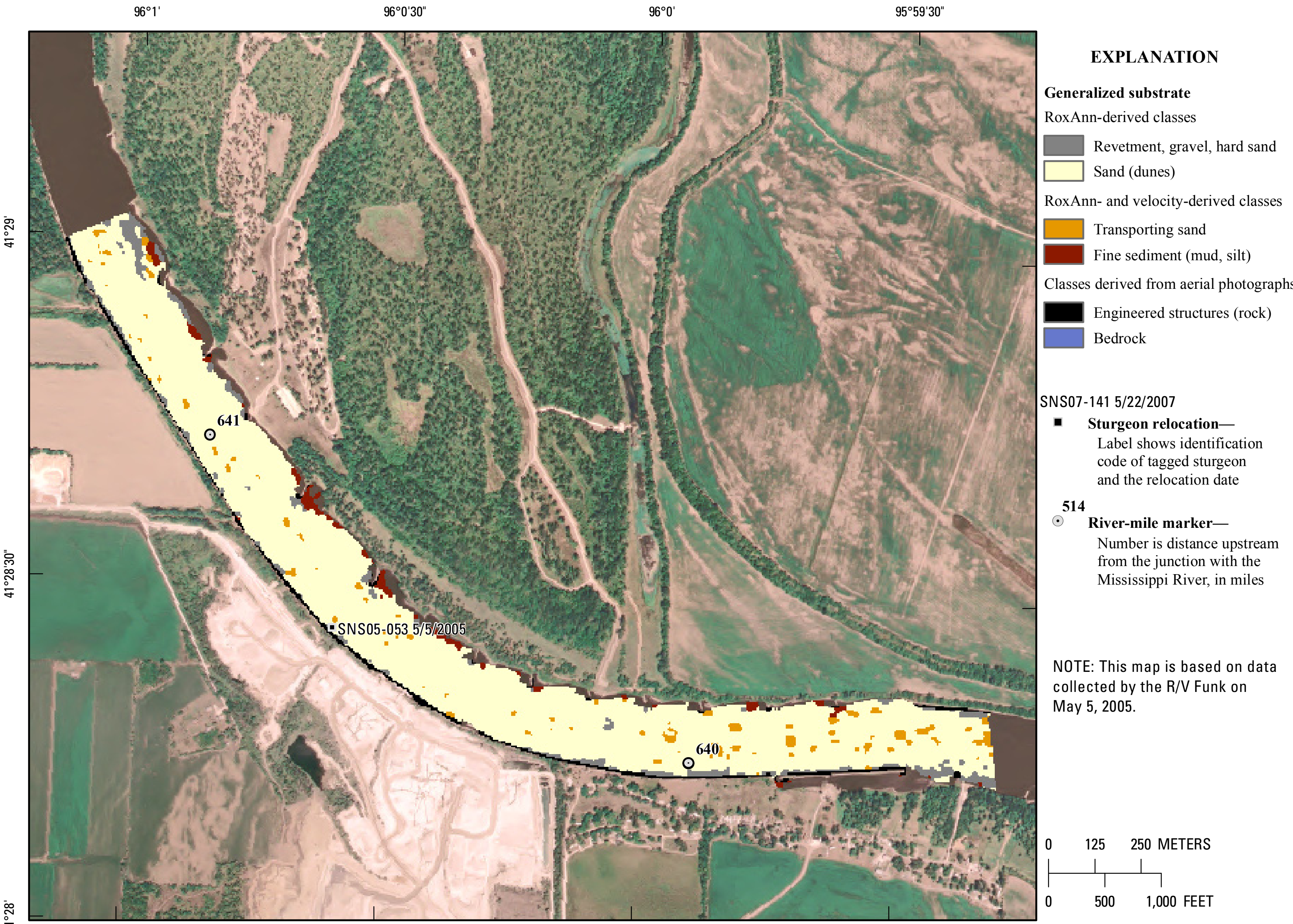
Figure 200. Map of depth-averaged velocity based on data collected on June 16, 2007, in the vicinity of river mile 641.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

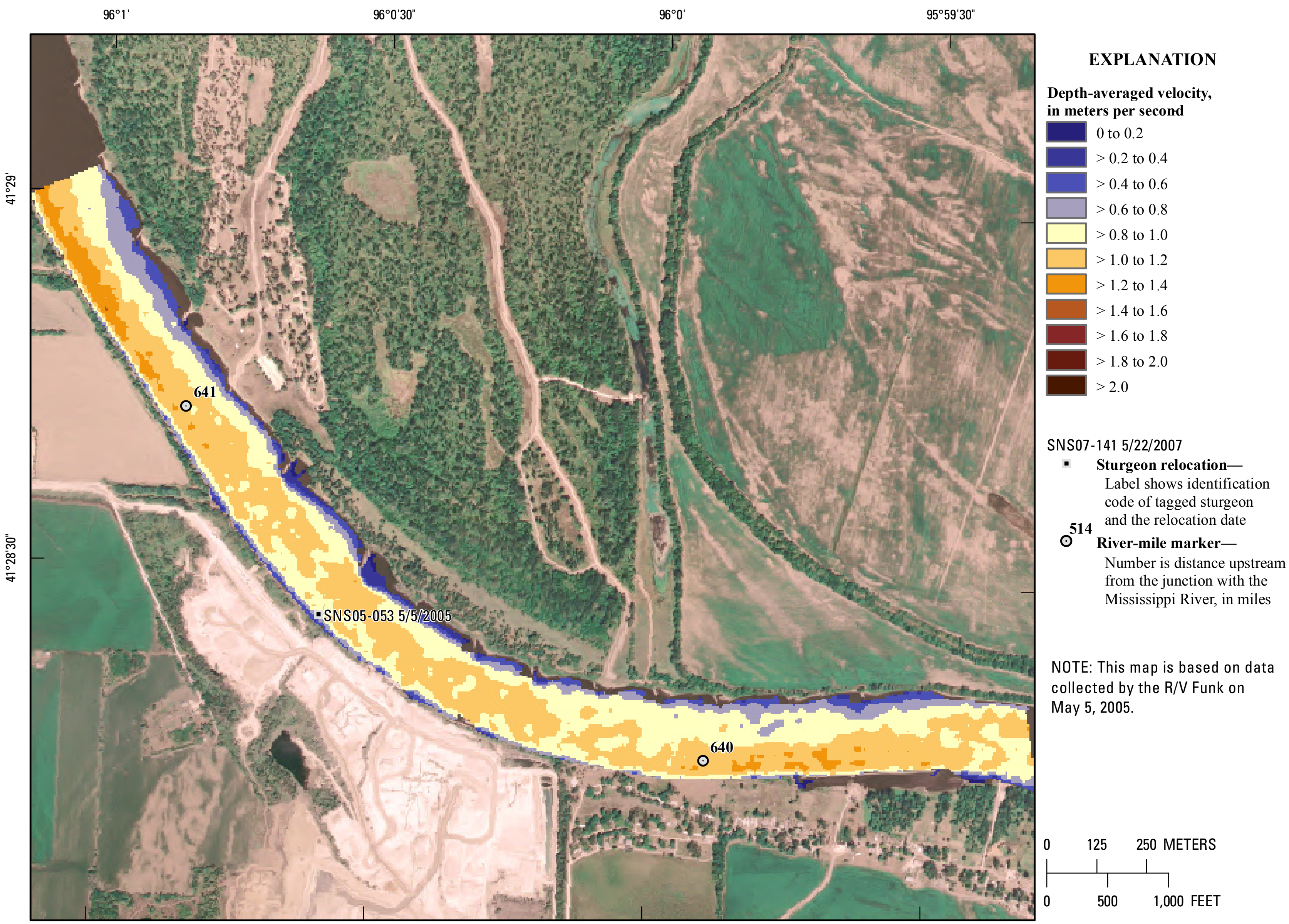
Figure 201. Map of depth based on data collected on May 5, 2005, in the vicinity of river mile 641.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 202. Map of generalized substrate based on data collected on May 5, 2005, in the vicinity of river mile 641.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 203. Map of depth-averaged velocity based on data collected on May 5, 2005, in the vicinity of river mile 641.

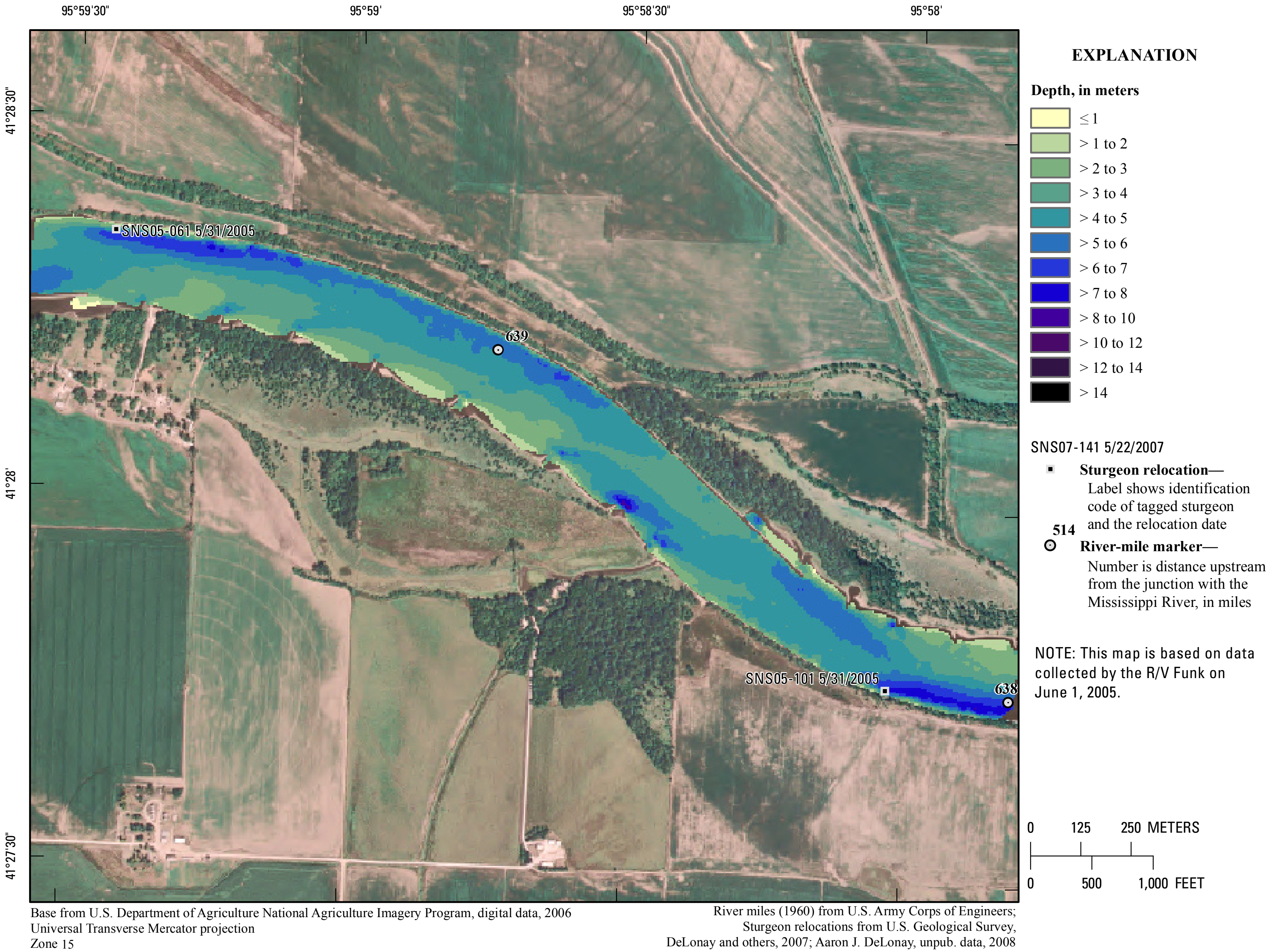
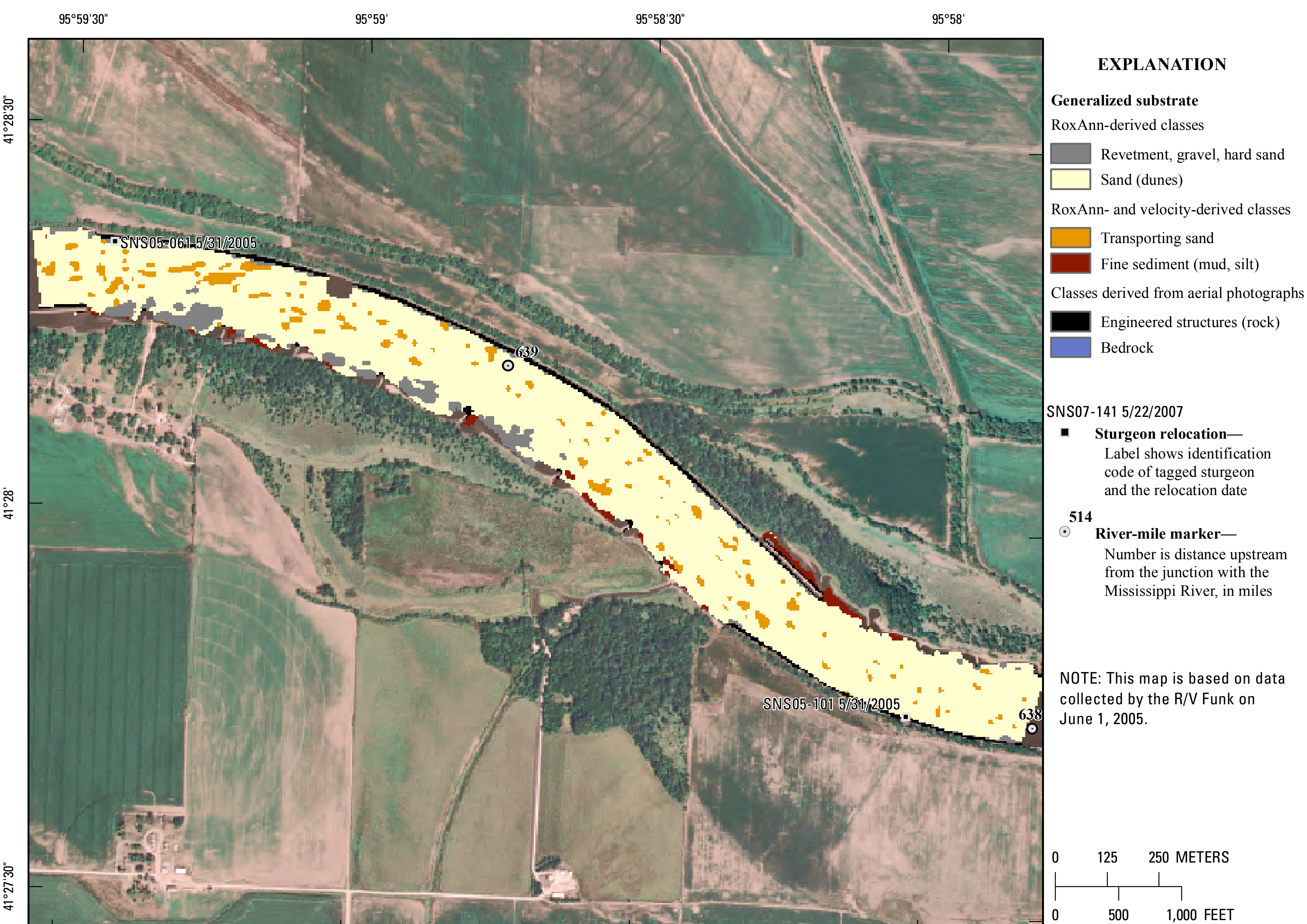


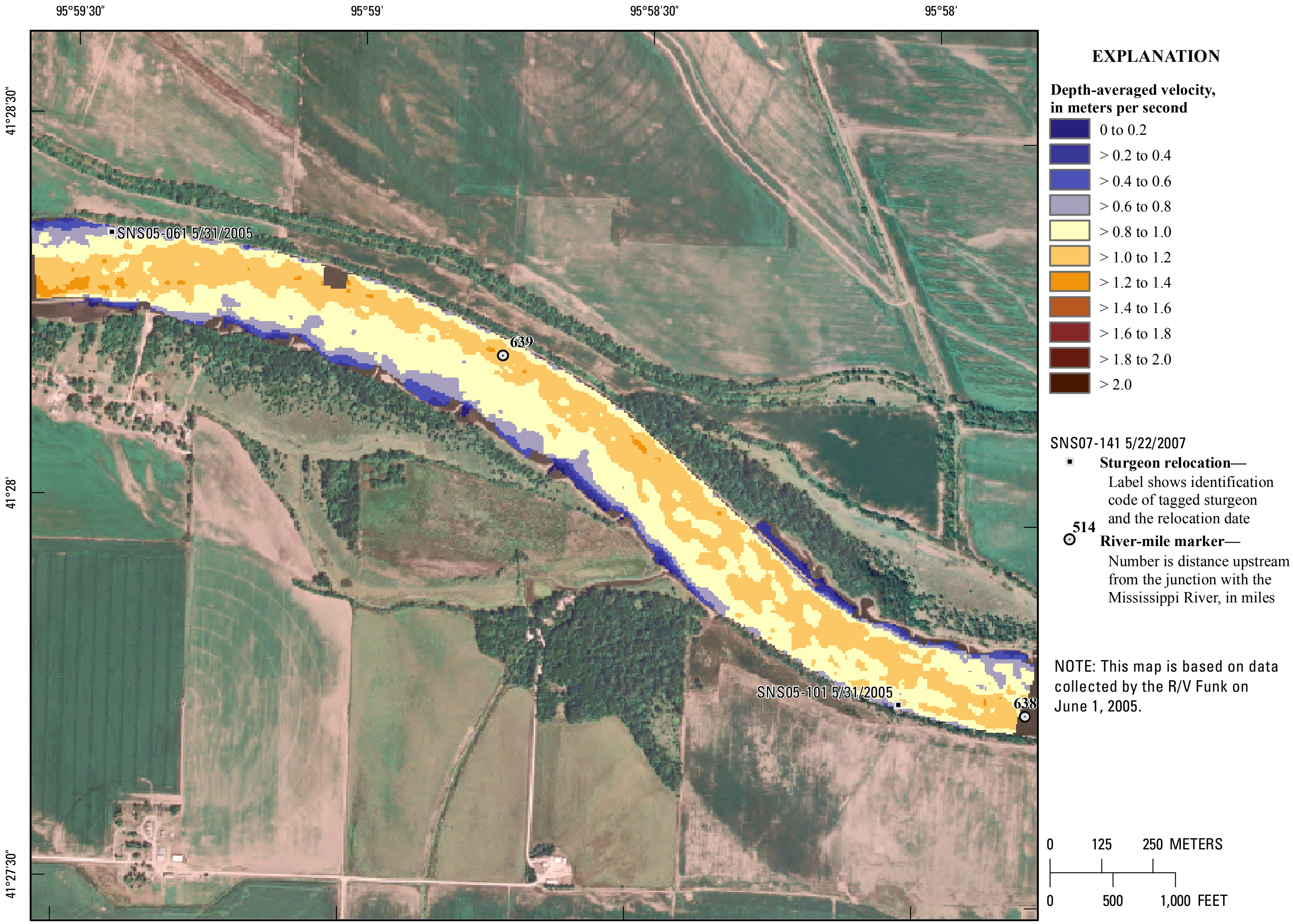
Figure 204. Map of depth based on data collected on June 1, 2005, in the vicinity of river mile 639.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

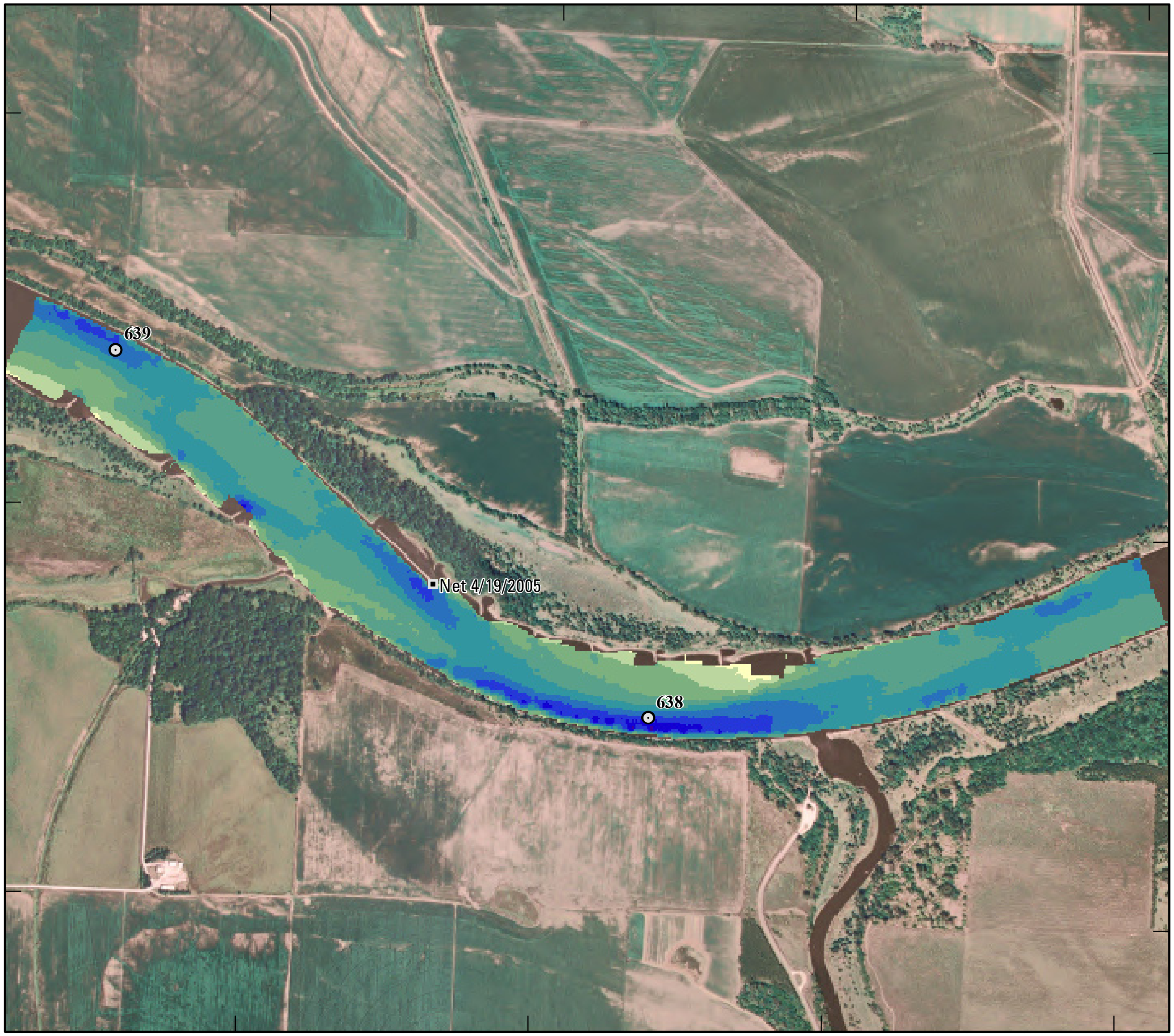
Figure 205. Map of generalized substrate based on data collected on June 1, 2005, in the vicinity of river mile 639.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 206. Map of depth-averaged velocity based on data collected on June 1, 2005, in the vicinity of river mile 639.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on April 20, 2005.

0 125 250 METERS

0 500 1,000 FEET

Figure 207. Map of depth based on data collected on April 20, 2005, in the vicinity of river mile 638.

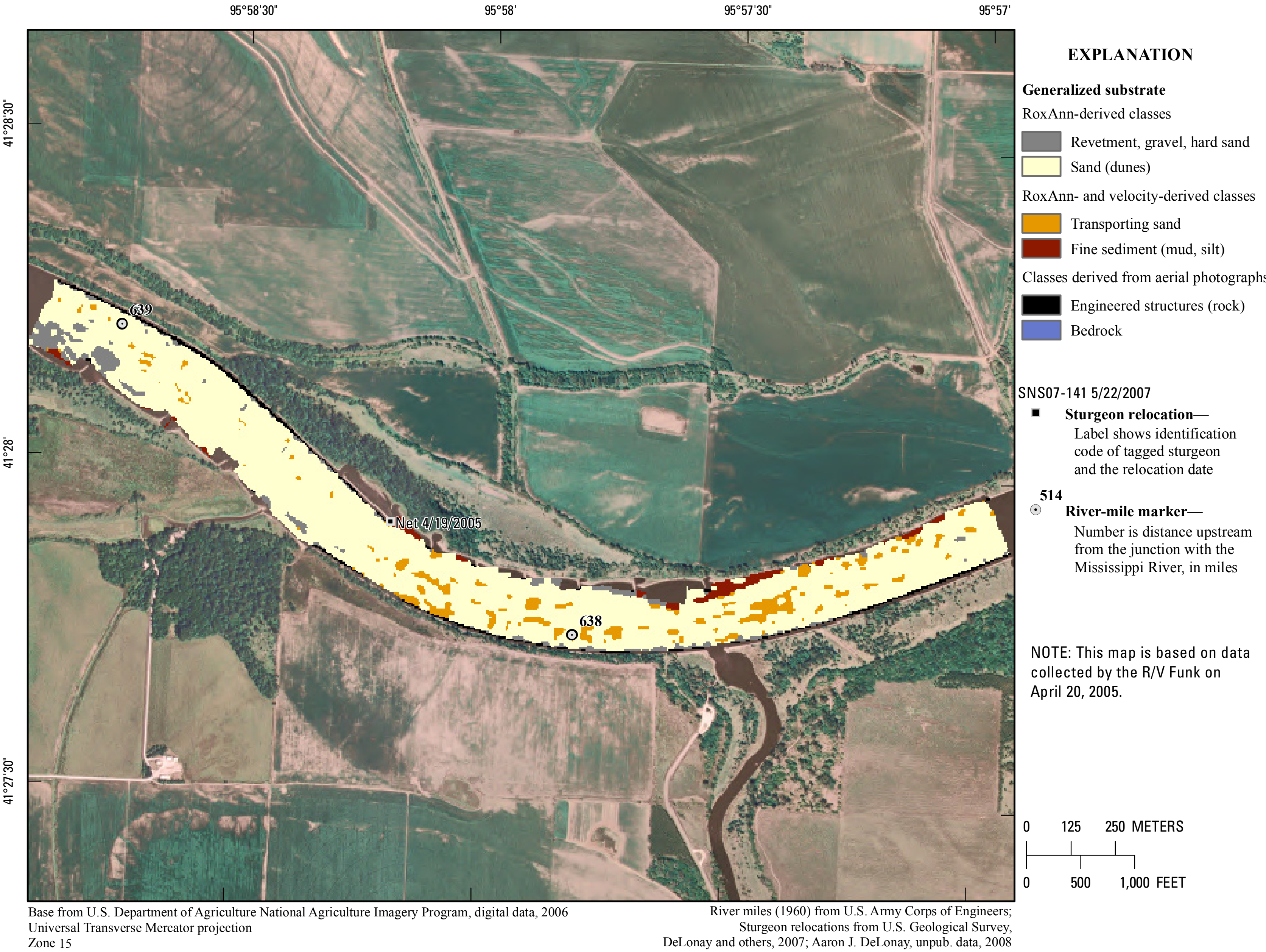

Figure 208. Map of generalized substrate based on data collected on April 20, 2005, in the vicinity of river mile 638.

EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation—Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker**—Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on April 20, 2005.

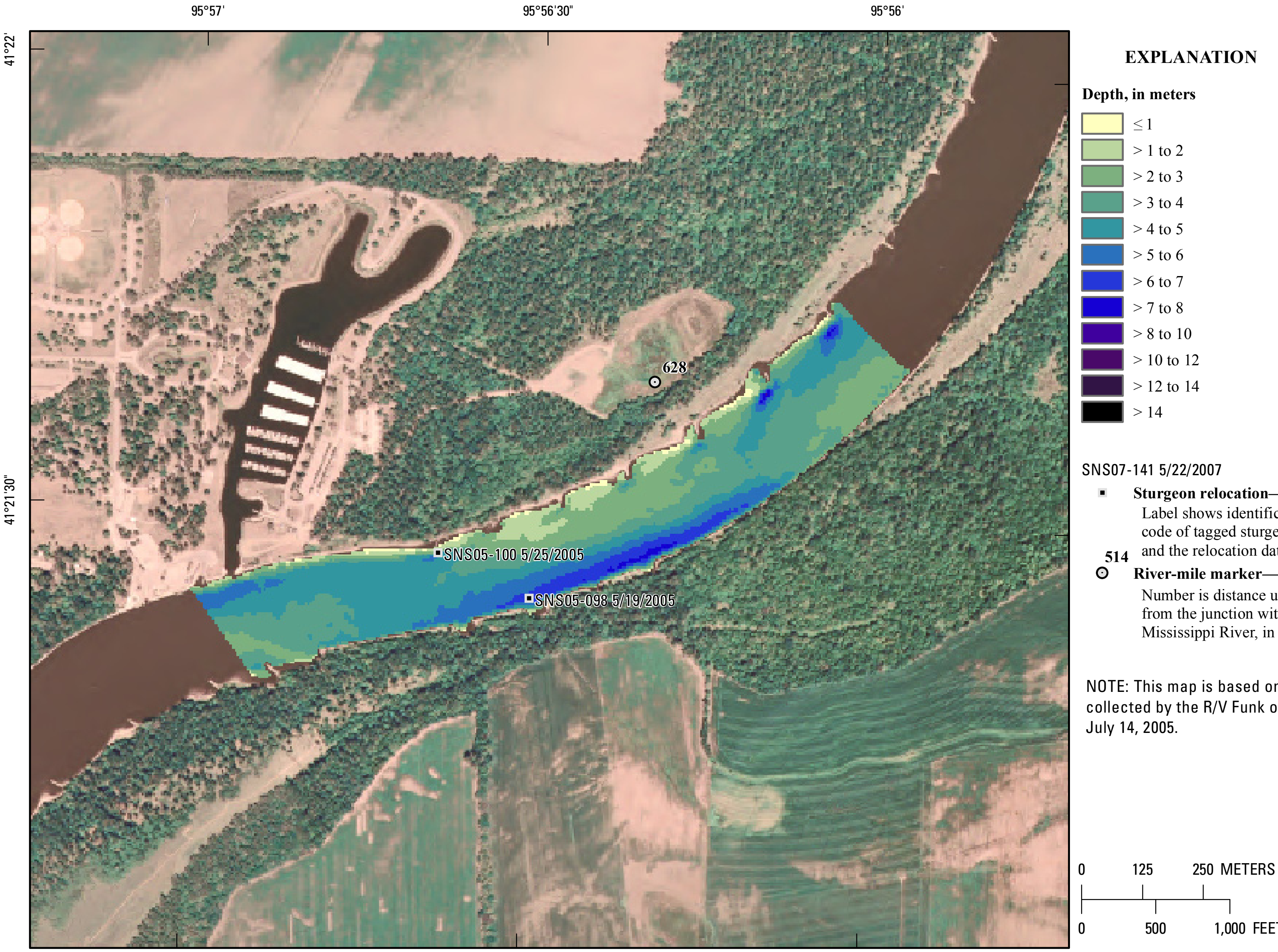
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

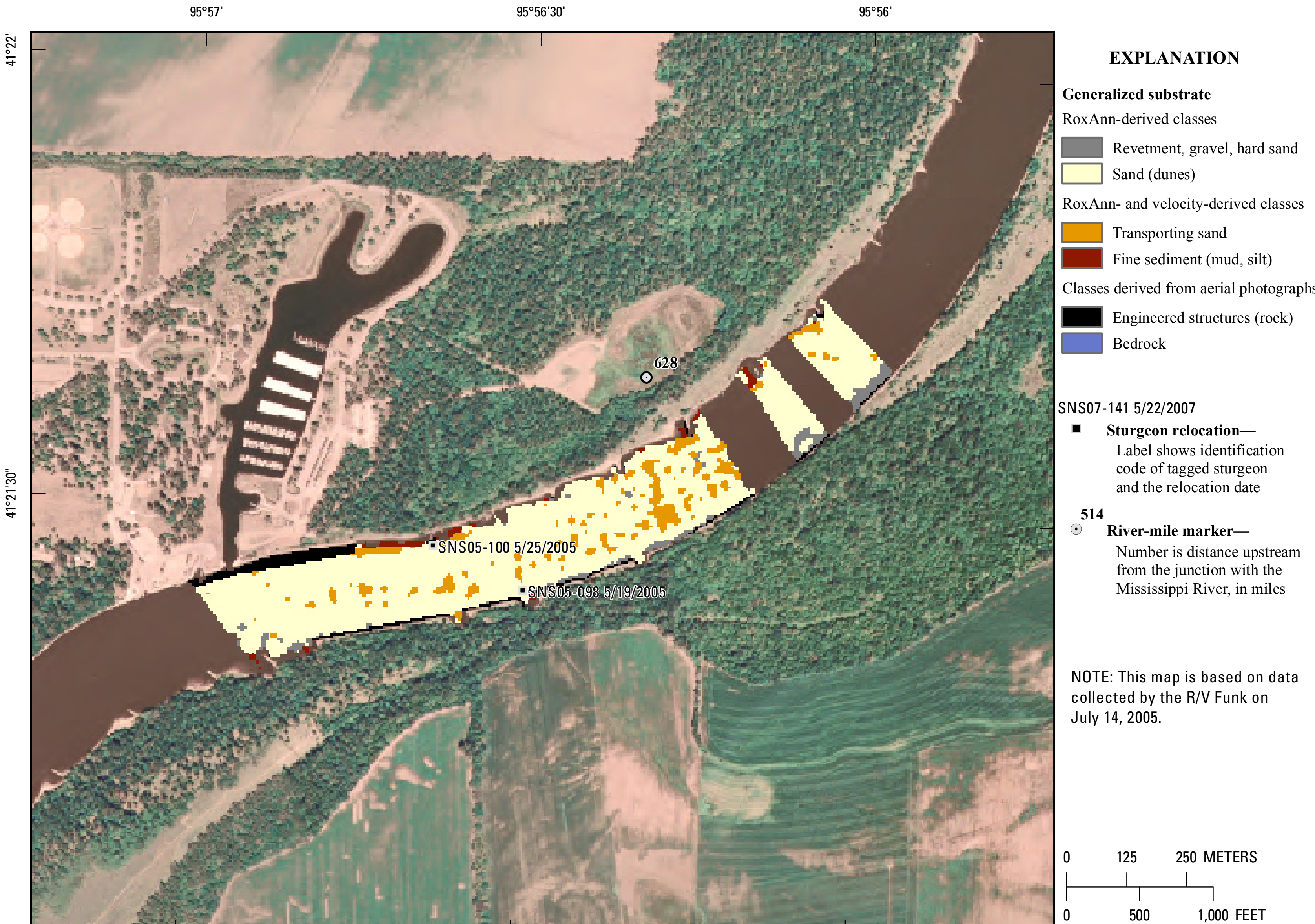
Figure 209. Map of depth-averaged velocity based on data collected on April 20, 2005, in the vicinity of river mile 638.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

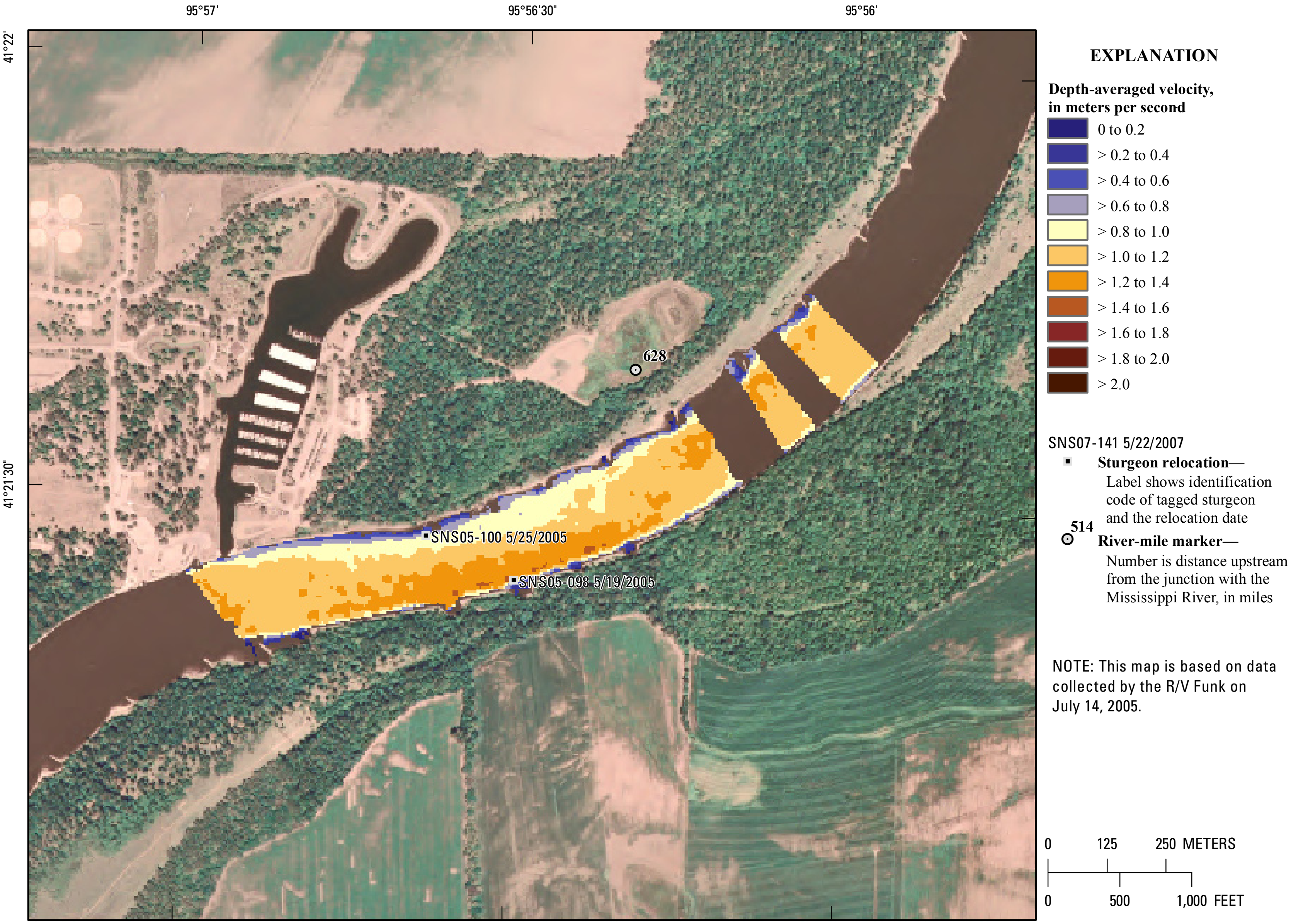
Figure 210. Map of depth based on data collected on July 14, 2005, in the vicinity of river mile 628.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

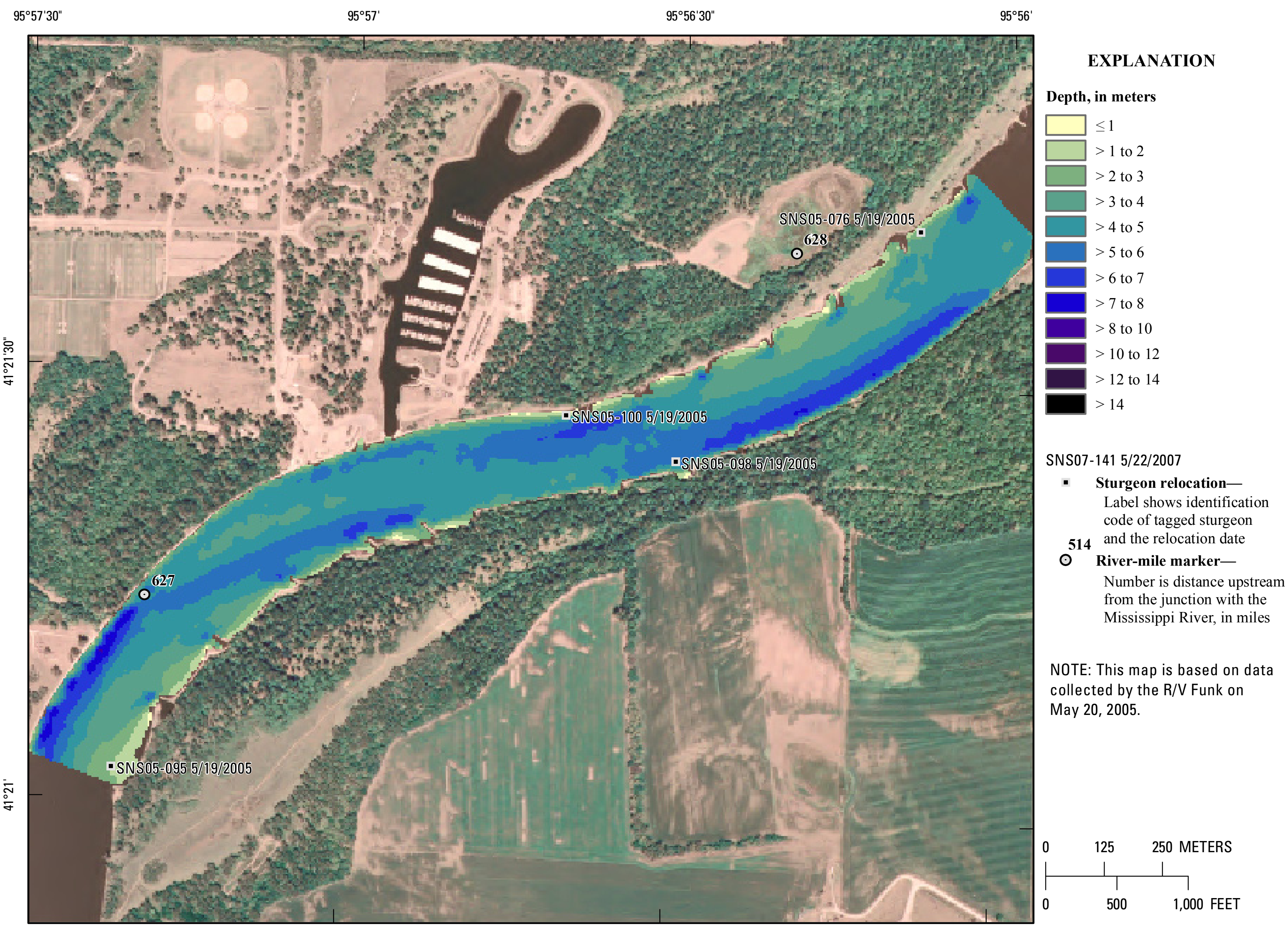
Figure 211. Map of generalized substrate based on data collected on July 14, 2005, in the vicinity of river mile 628.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 212. Map of depth-averaged velocity based on data collected on July 14, 2005, in the vicinity of river mile 628.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 213. Map of depth based on data collected on May 20, 2005, in the vicinity of river mile 628.

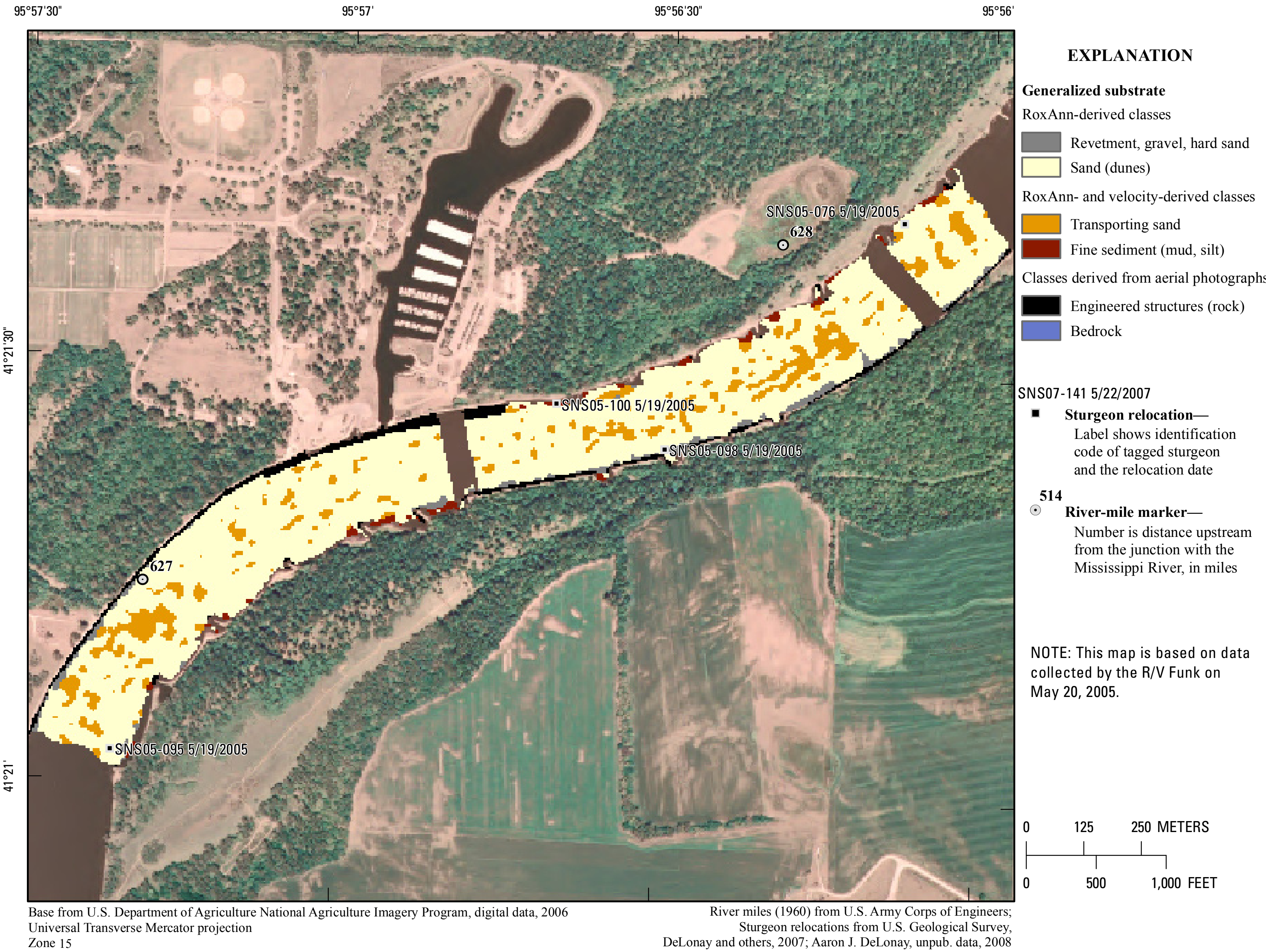
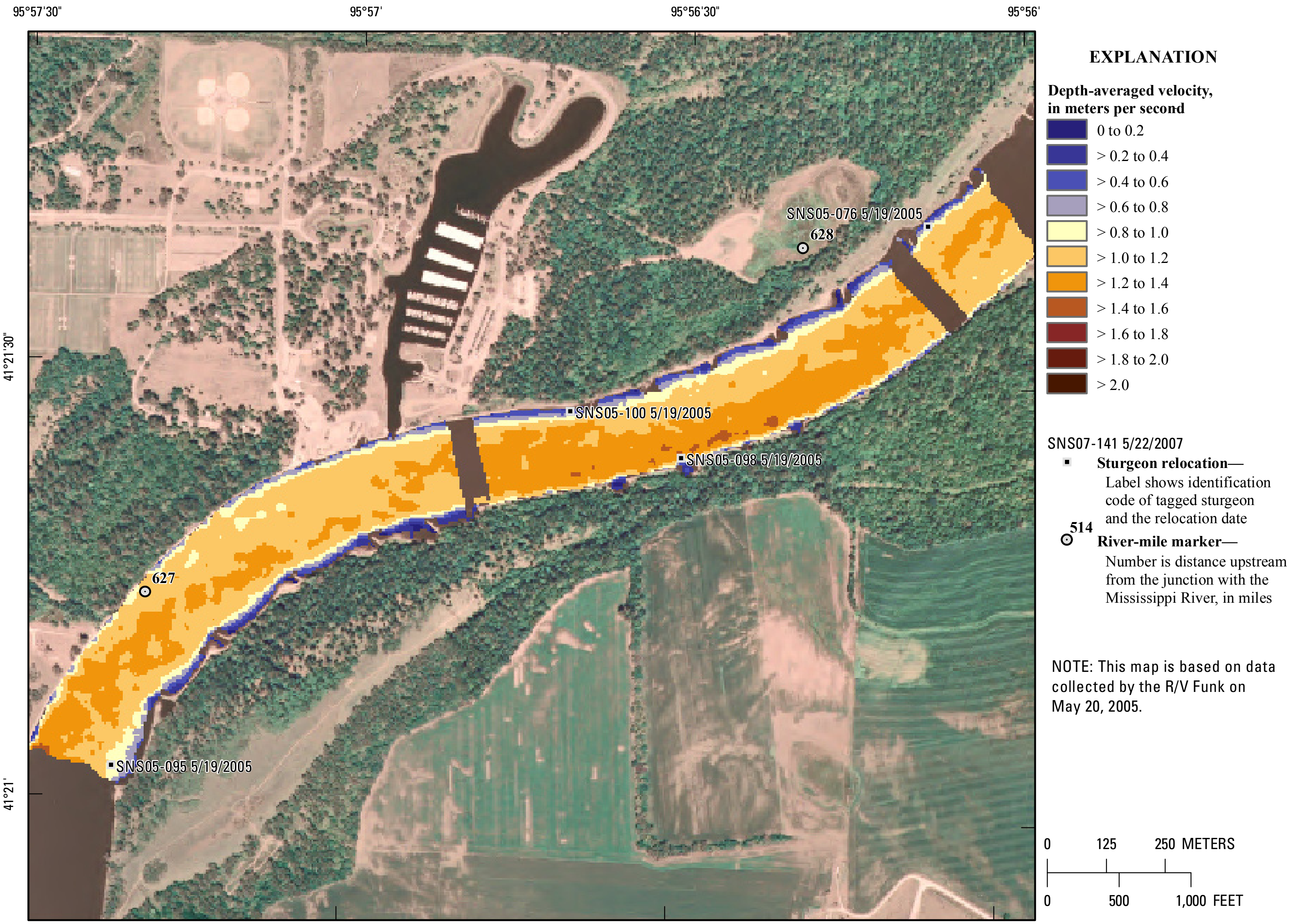


Figure 214. Map of generalized substrate based on data collected on May 20, 2005, in the vicinity of river mile 628.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 215. Map of depth-averaged velocity based on data collected on May 20, 2005, in the vicinity of river mile 628.

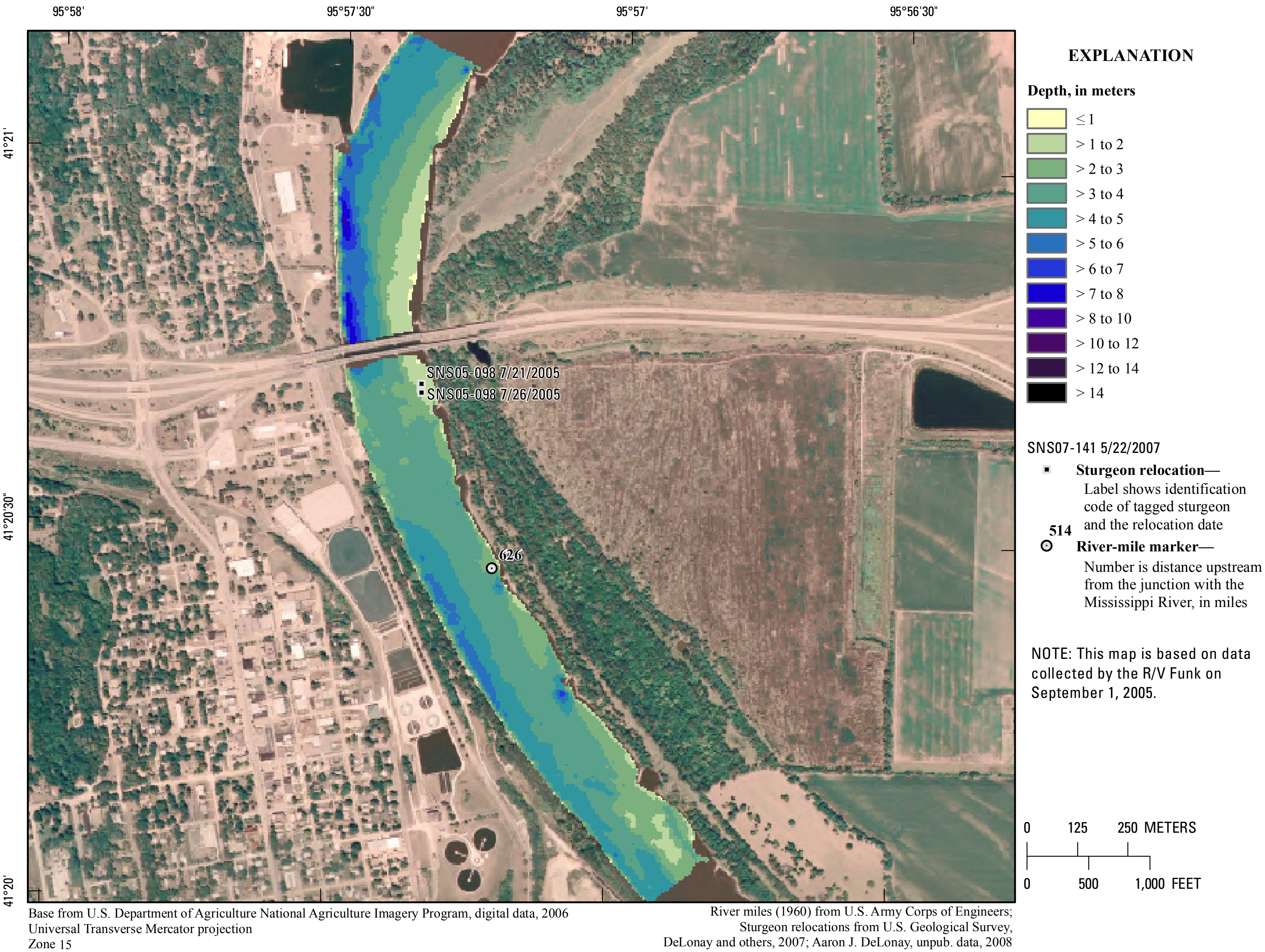
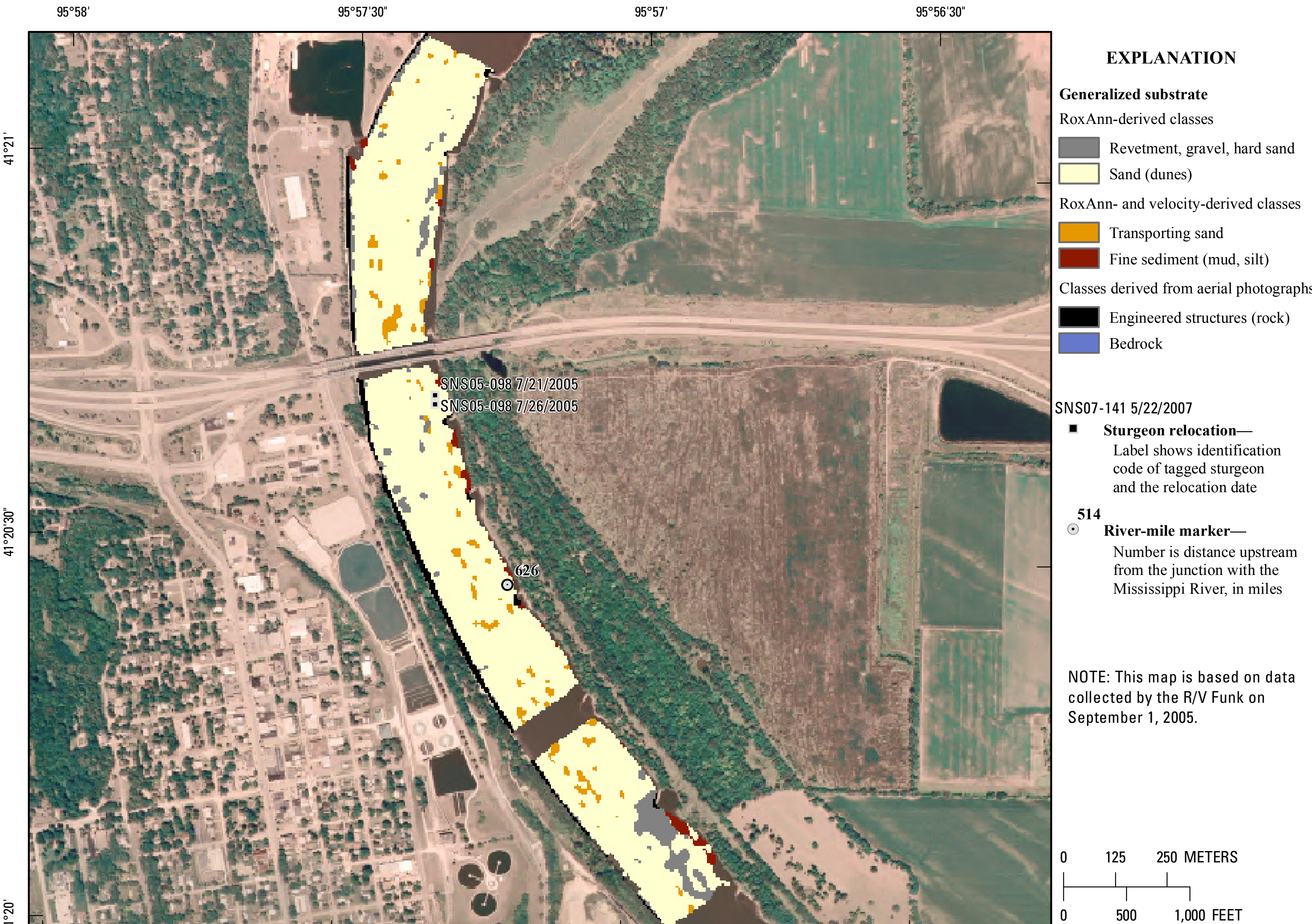


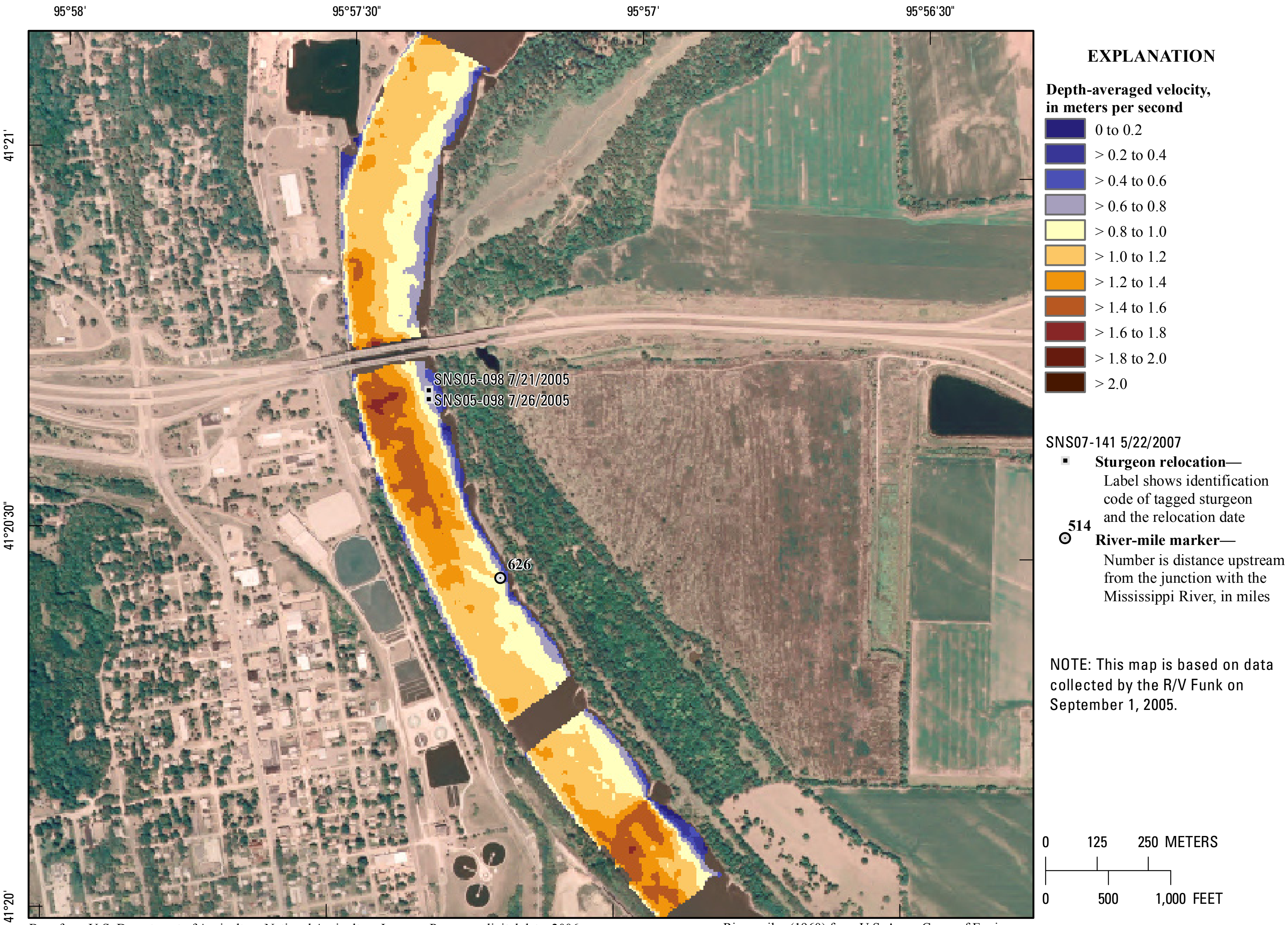
Figure 216. Map of depth based on data collected on September 1, 2005, in the vicinity of river mile 626.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

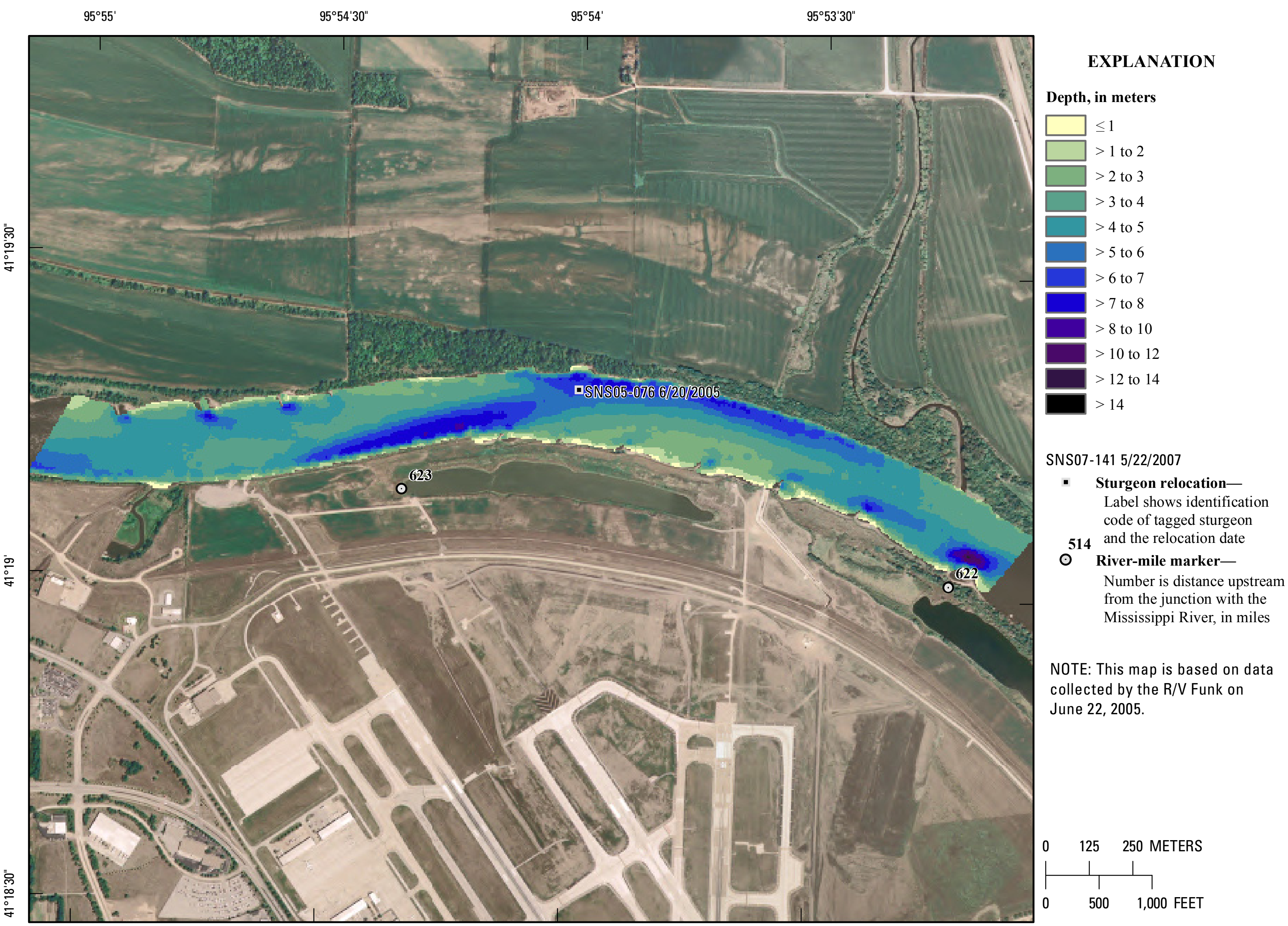
Figure 217. Map of generalized substrate based on data collected on September 1, 2005, in the vicinity of river mile 626.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 218. Map of depth-averaged velocity based on data collected on September 1, 2005, in the vicinity of river mile 626.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 219. Map of depth based on data collected on June 22, 2005, in the vicinity of river mile 623.

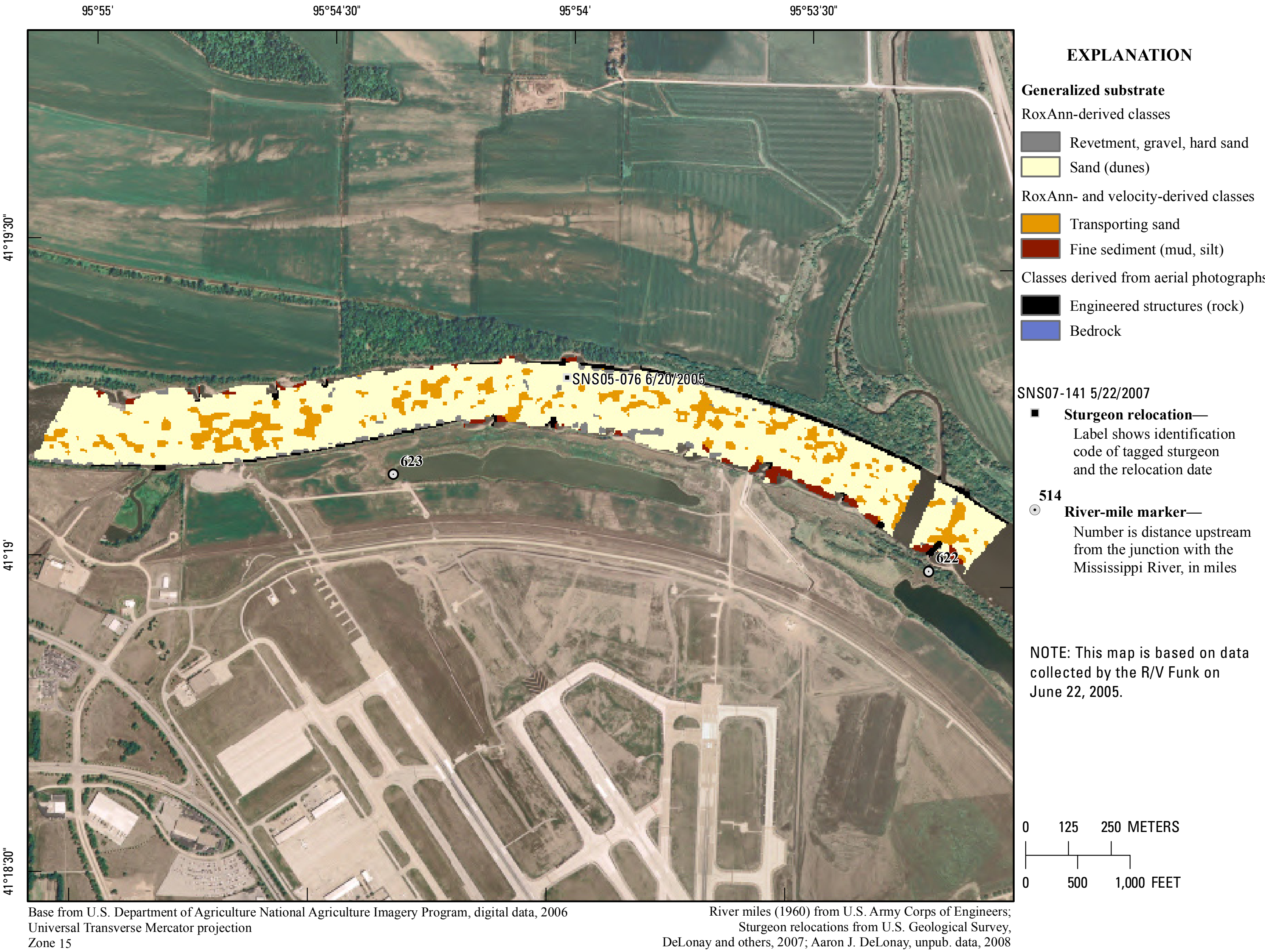
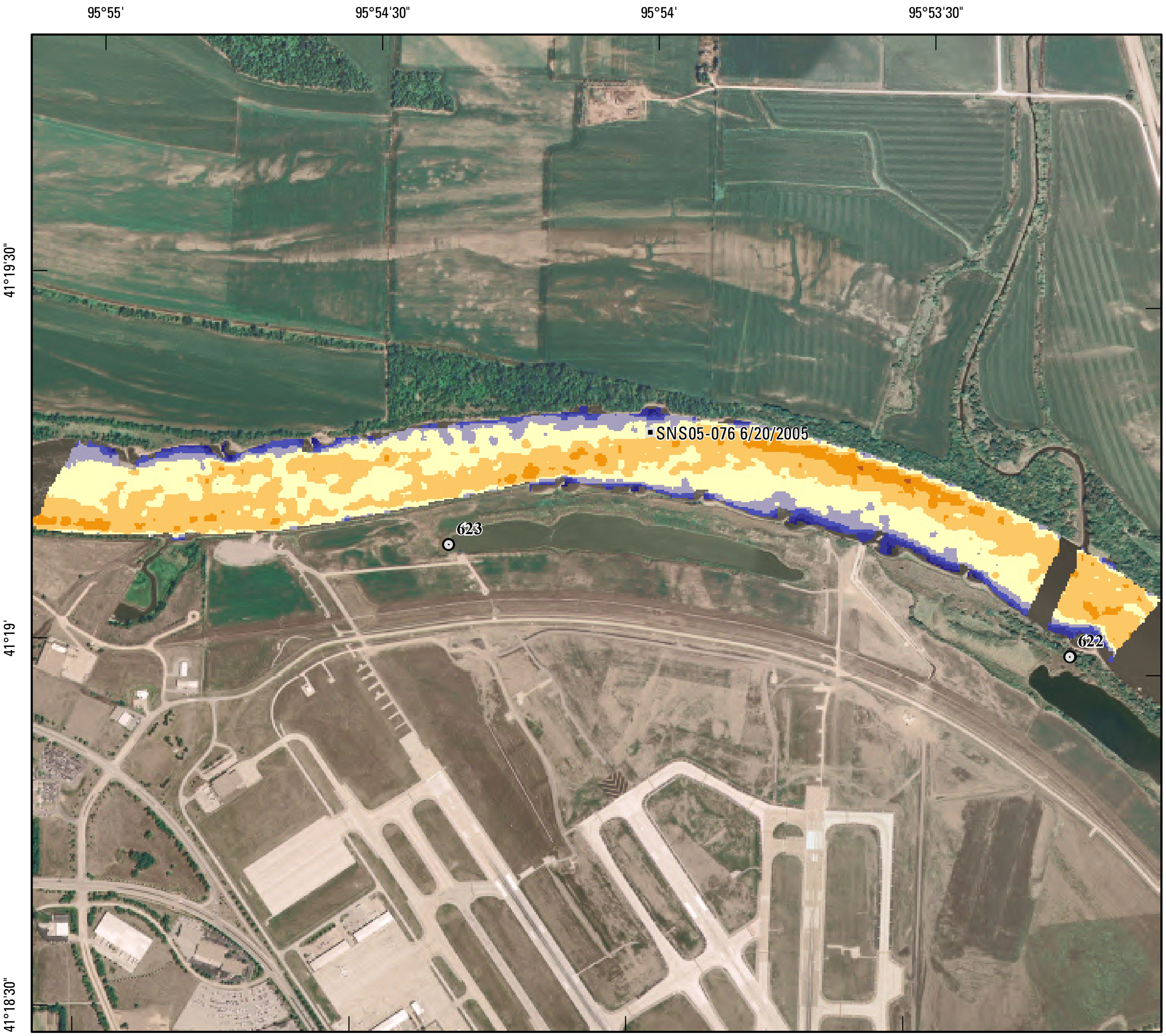


Figure 220. Map of generalized substrate based on data collected on June 22, 2005, in the vicinity of river mile 623.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 22, 2005.

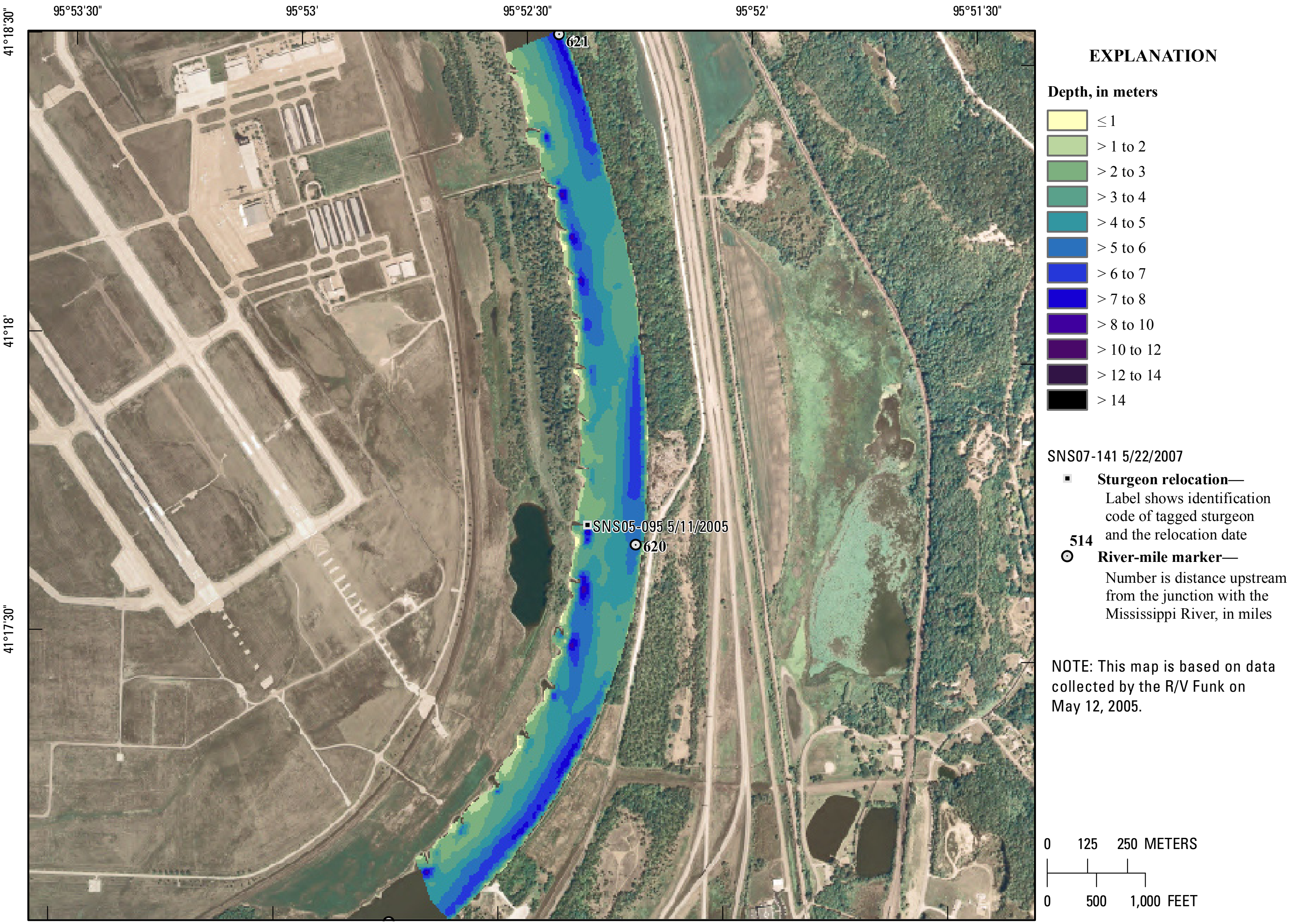
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

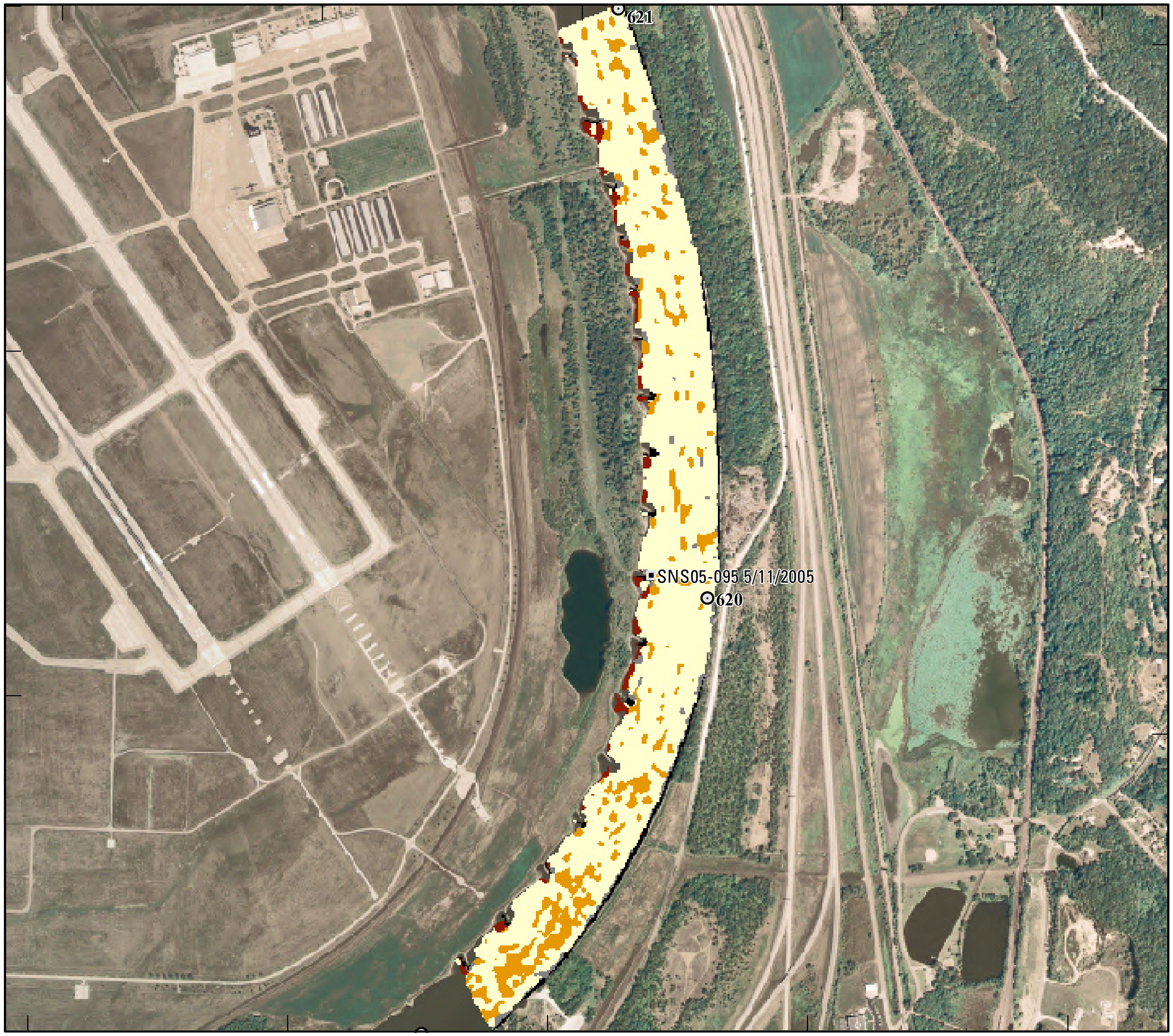
Figure 221. Map of depth-averaged velocity based on data collected on June 22, 2005, in the vicinity of river mile 623.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 222. Map of depth based on data collected on May 12, 2005, in the vicinity of river mile 620.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 12, 2005.

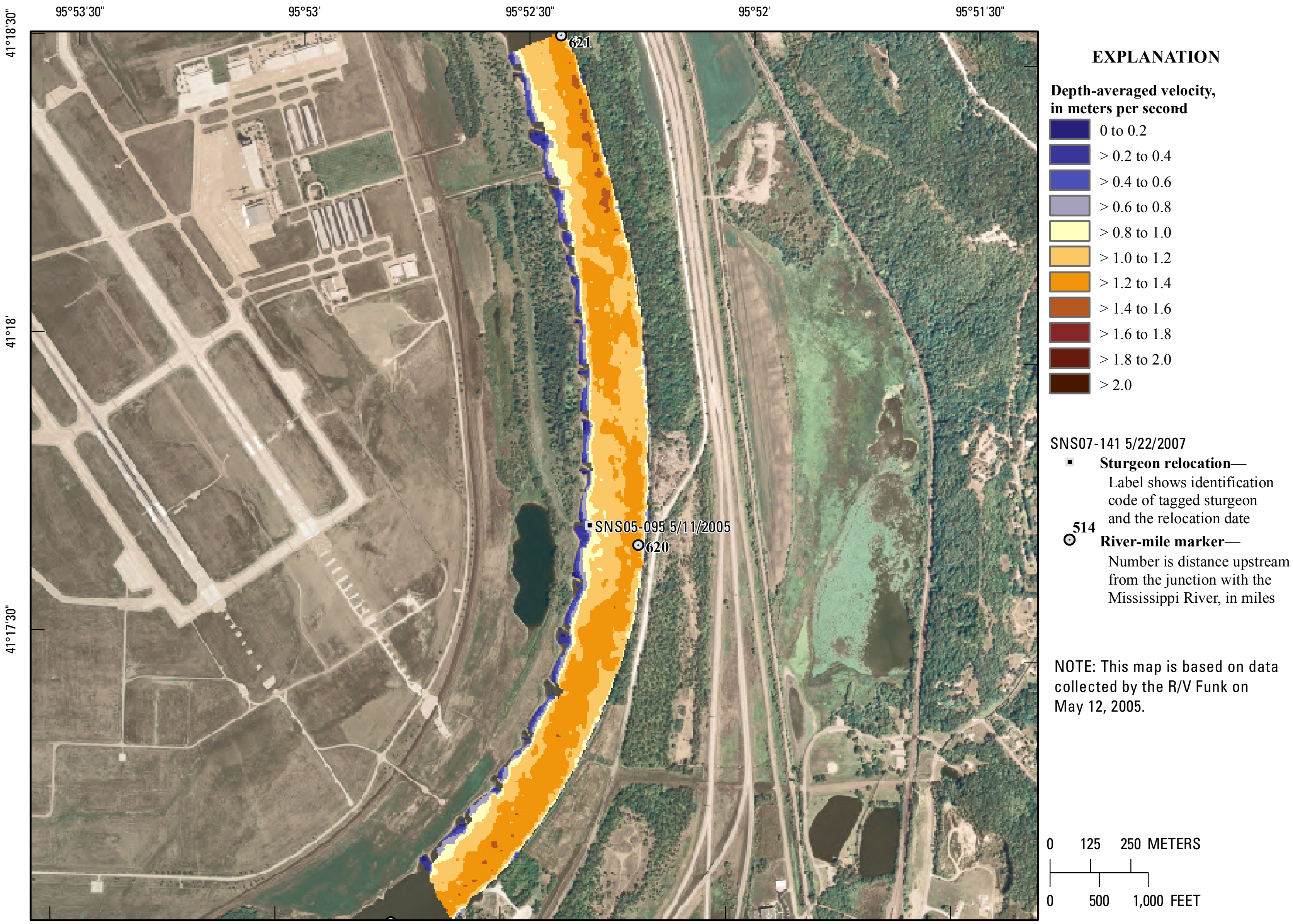
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

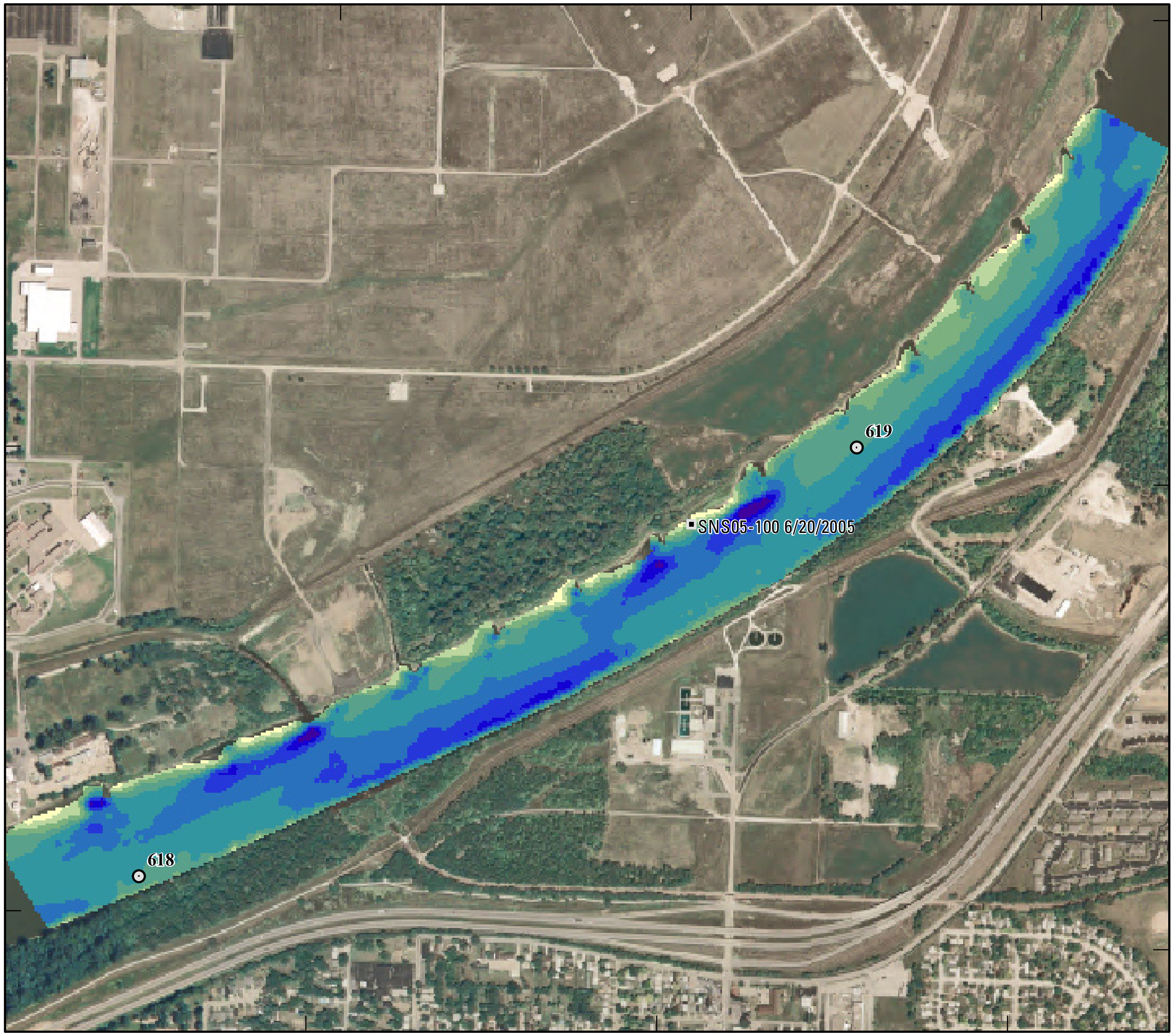
Figure 223. Map of generalized substrate based on data collected on May 12, 2005, in the vicinity of river mile 620.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 224. Map of depth-averaged velocity based on data collected on May 12, 2005, in the vicinity of river mile 620.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 225. Map of depth based on data collected on June 21, 2005, in the vicinity of river mile 619.

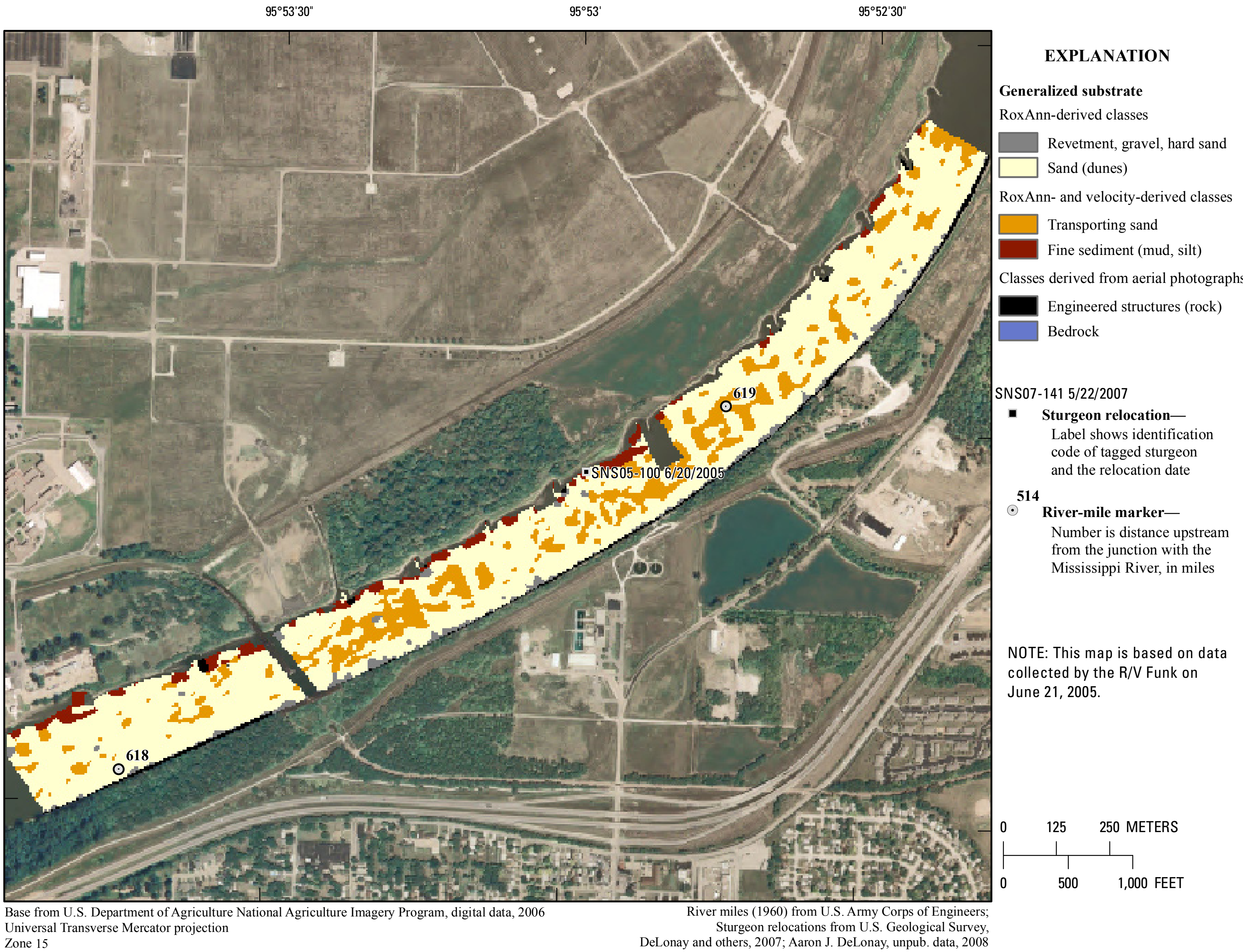
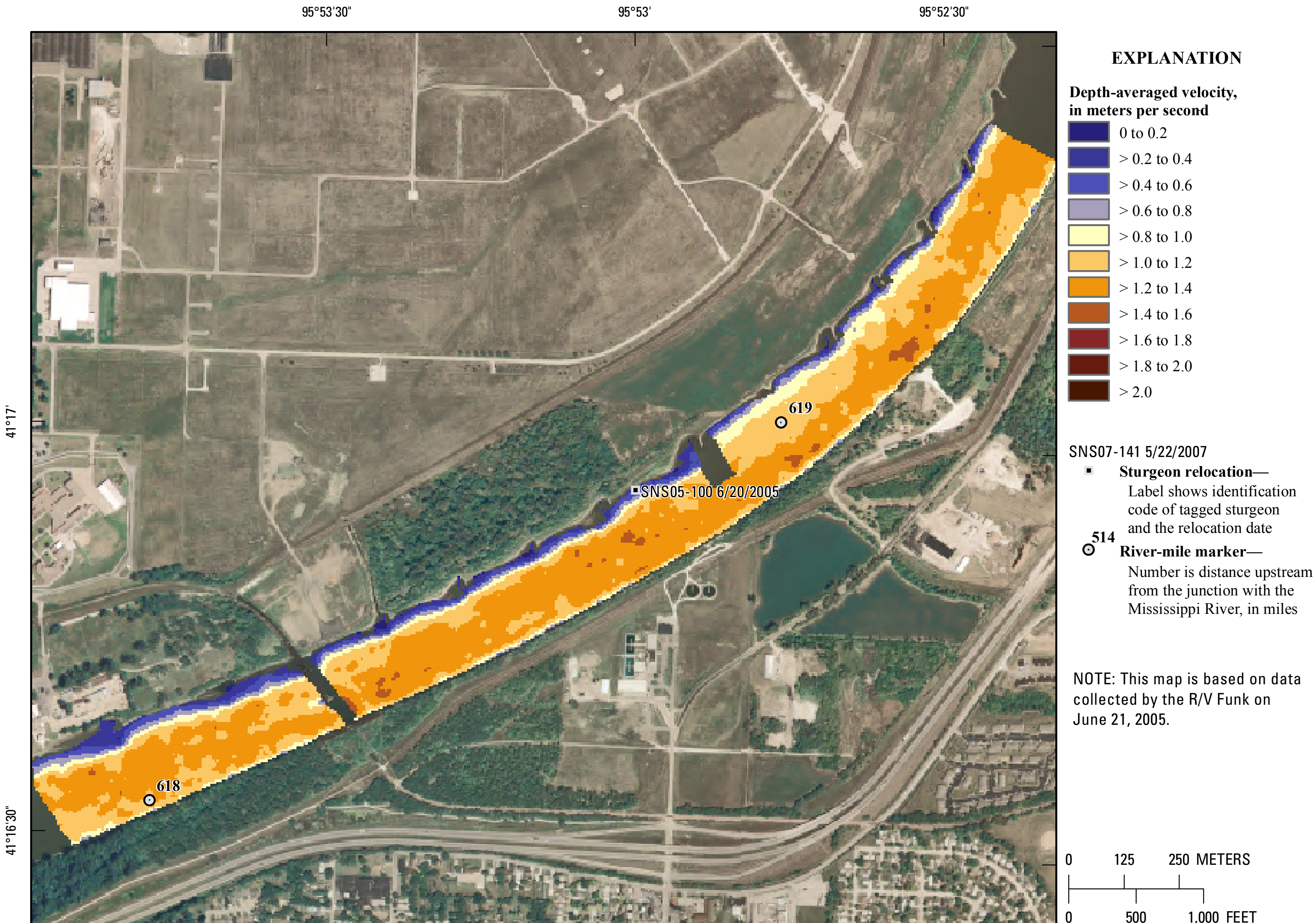


Figure 226. Map of generalized substrate based on data collected on June 21, 2005, in the vicinity of river mile 619.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 227. Map of depth-averaged velocity based on data collected on June 21, 2005, in the vicinity of river mile 619.

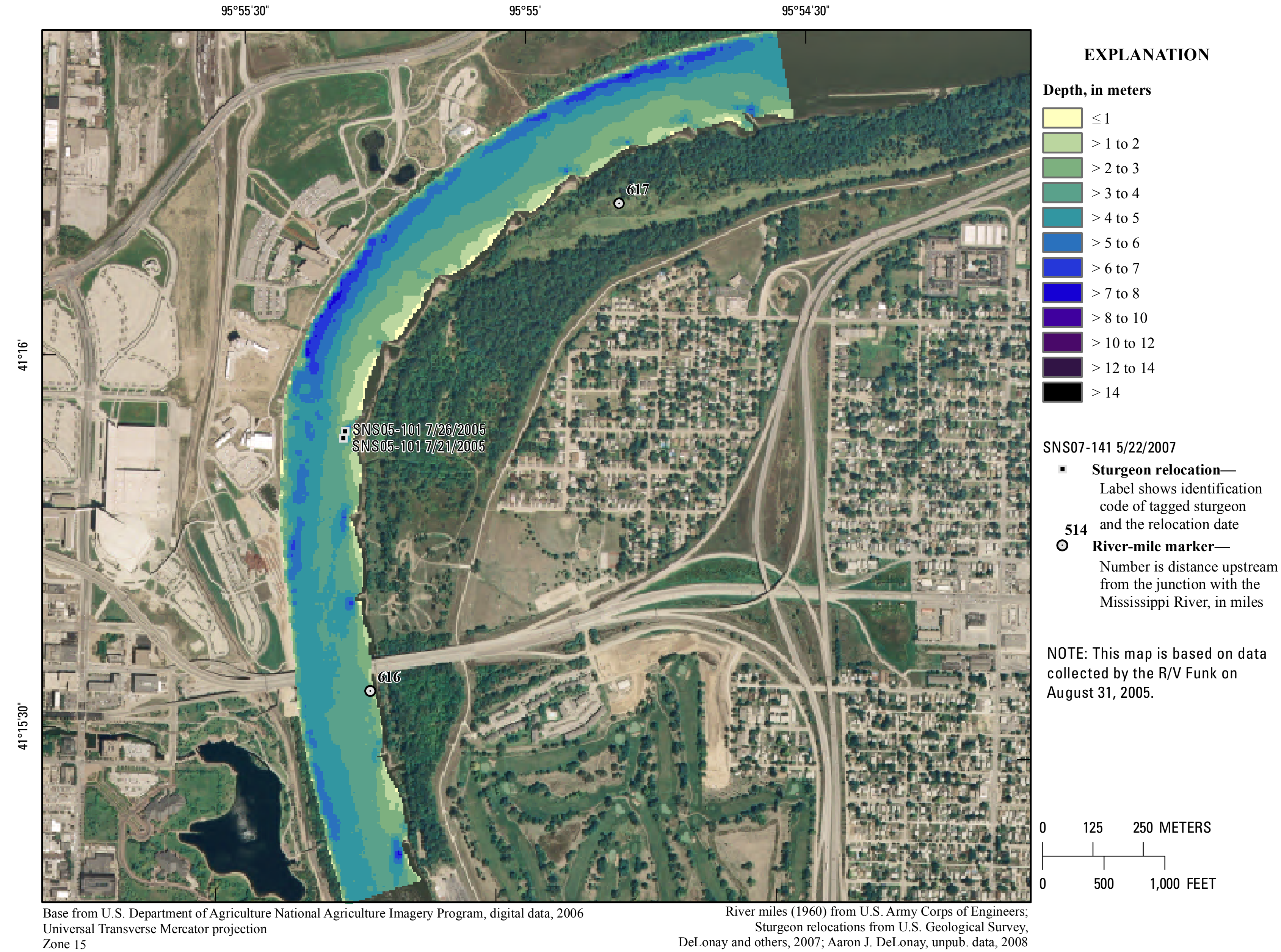
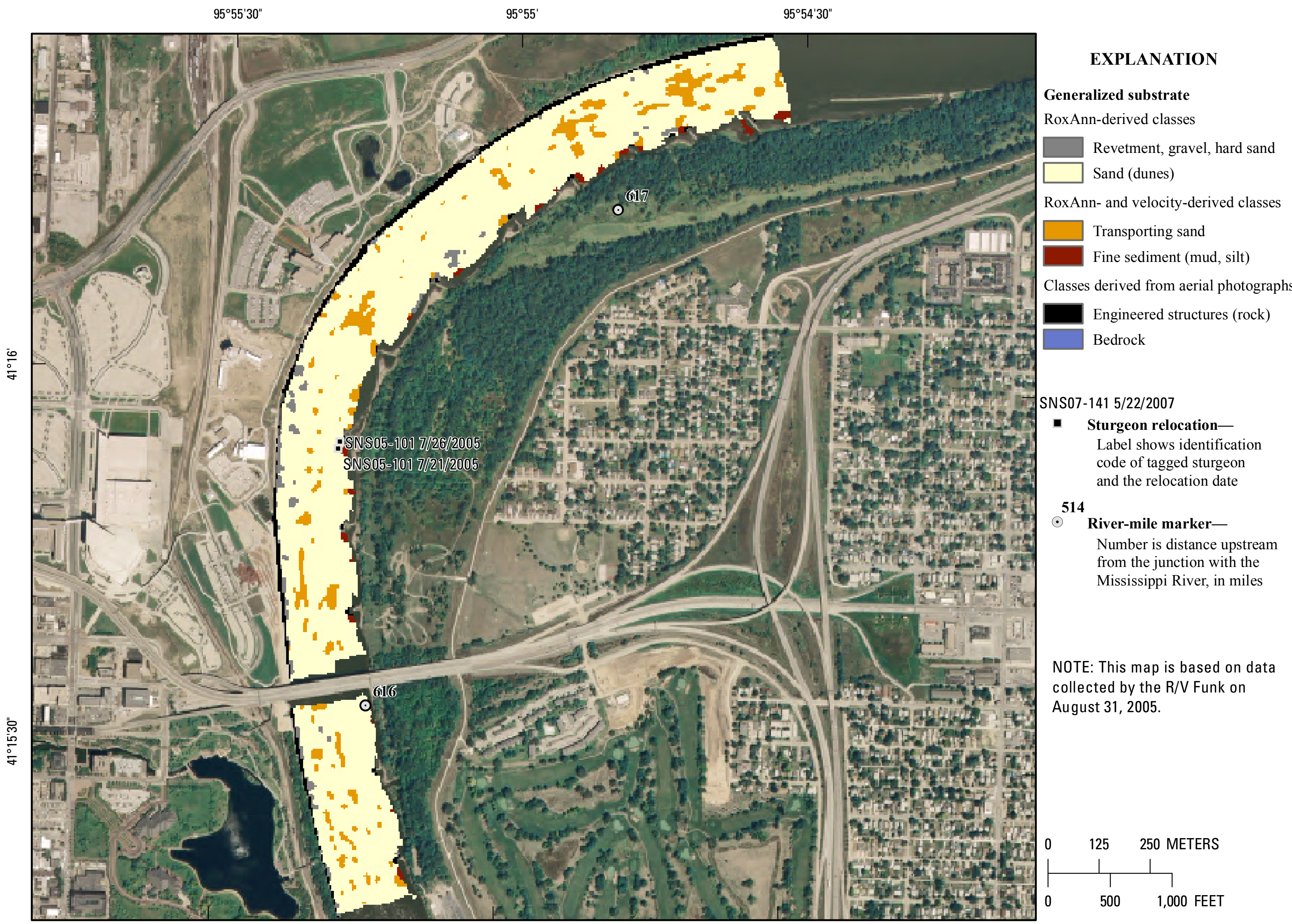


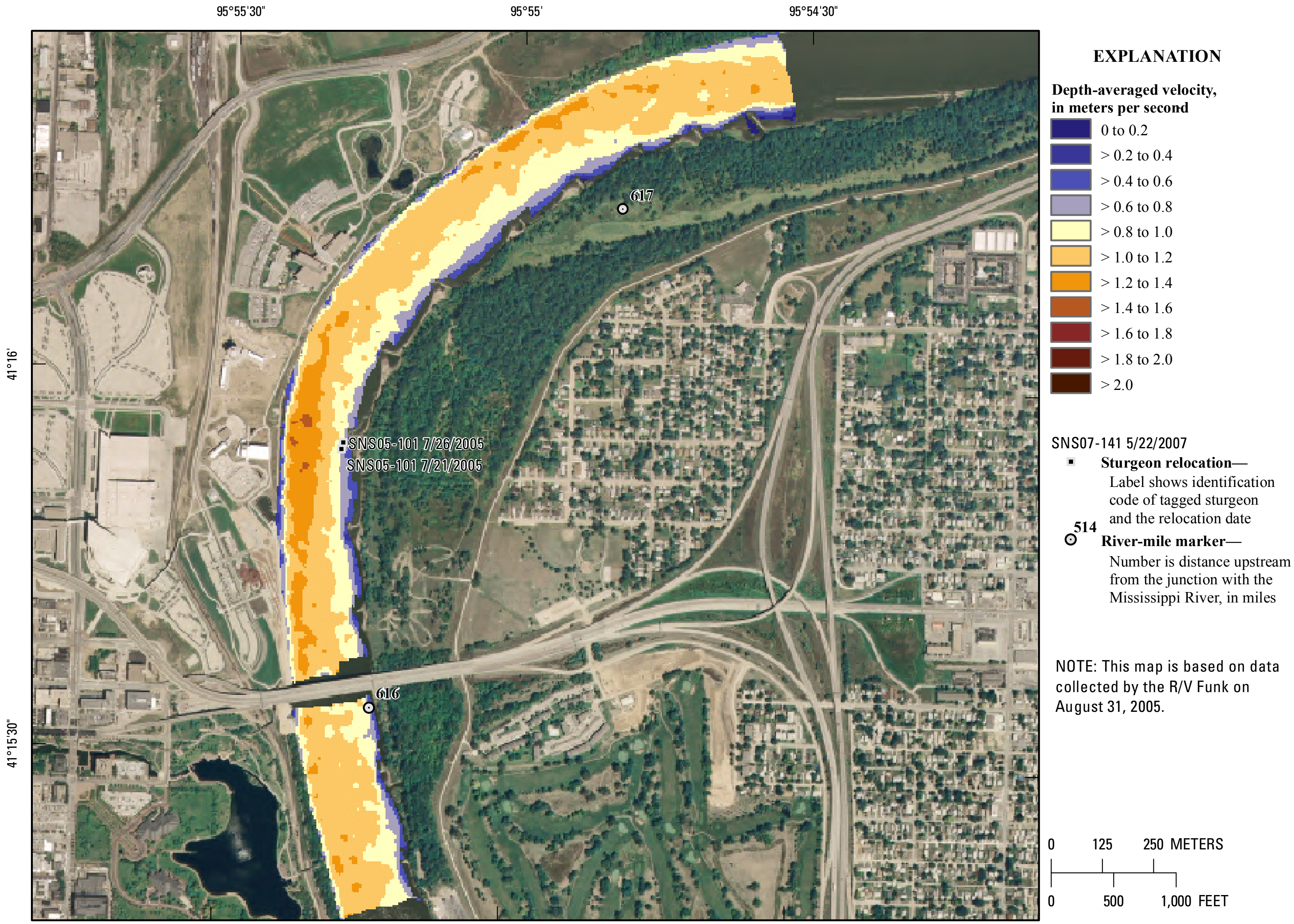
Figure 228. Map of depth based on data collected on August 31, 2005, in the vicinity of river mile 617.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

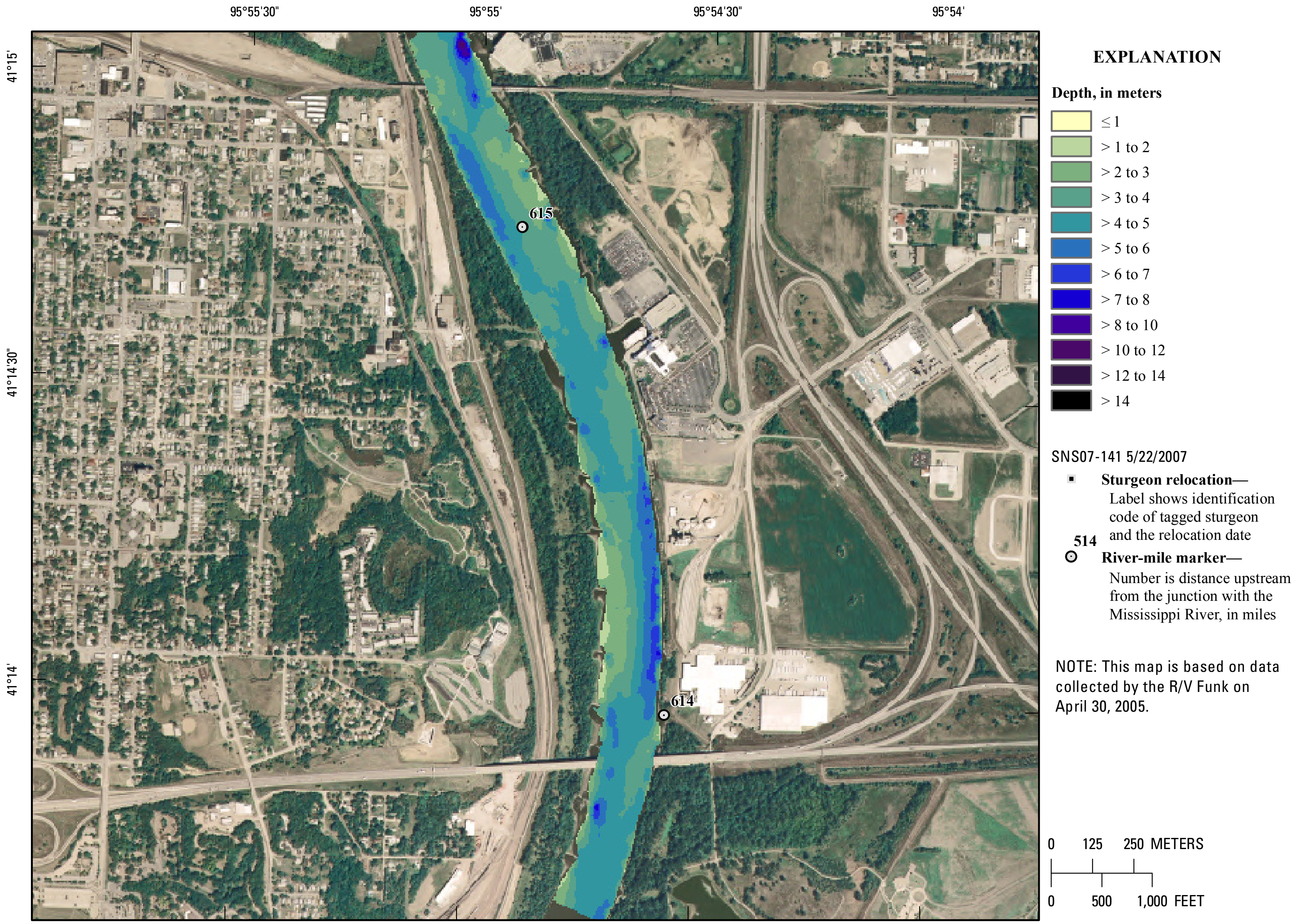
Figure 229. Map of generalized substrate based on data collected on August 31, 2005, in the vicinity of river mile 617.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

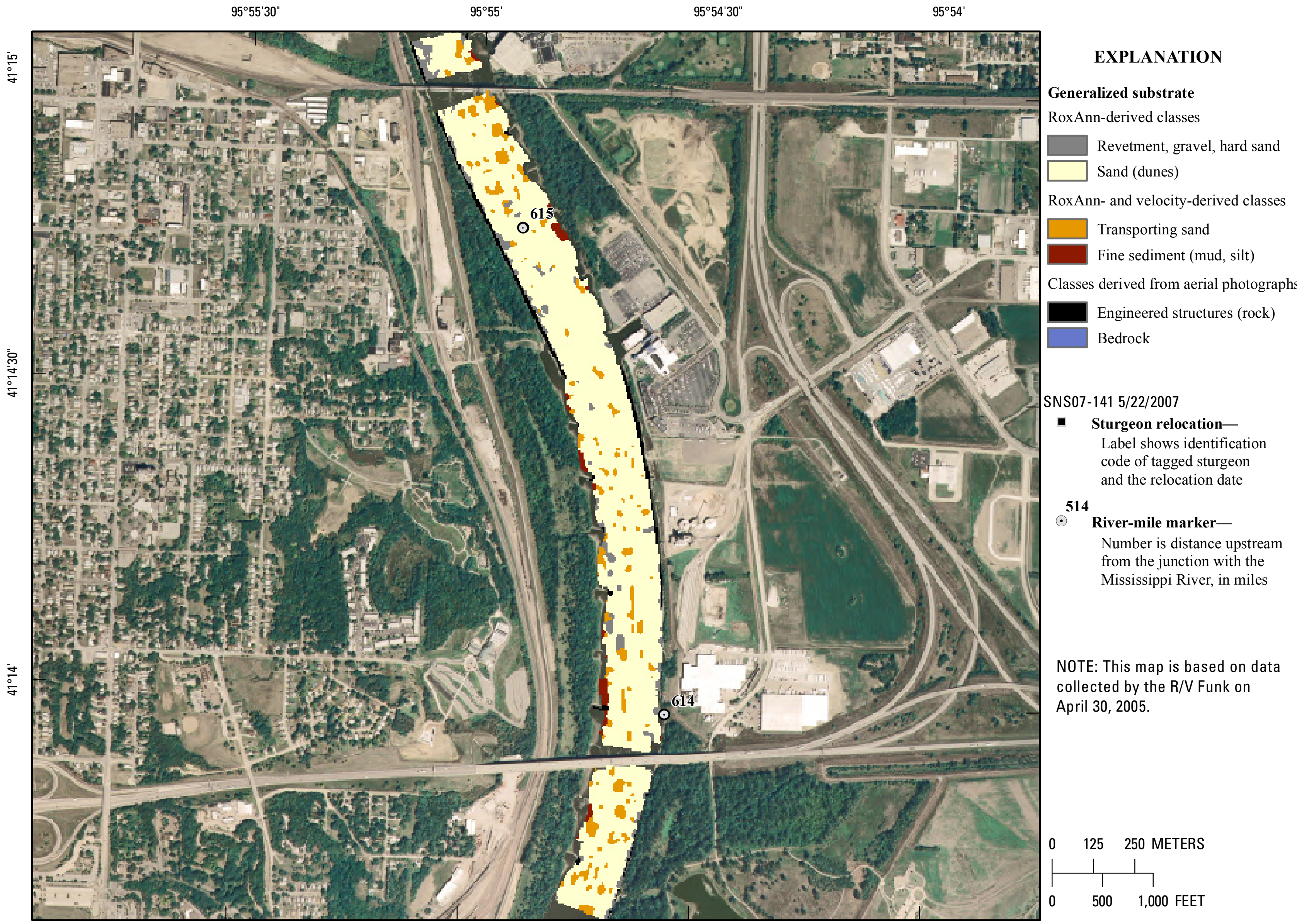
Figure 230. Map of depth-averaged velocity based on data collected on August 31, 2005, in the vicinity of river mile 617.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

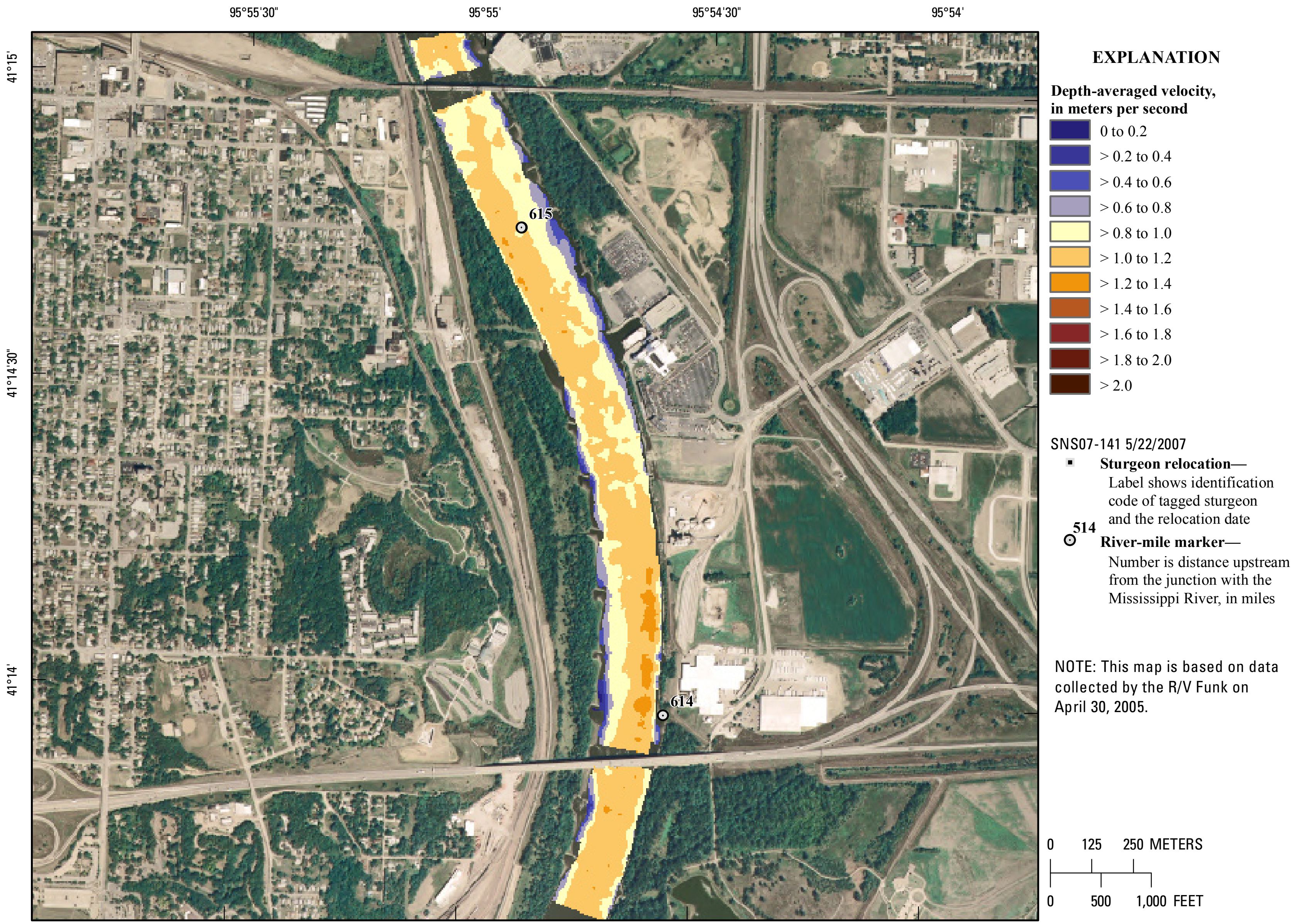
Figure 231. Map of depth based on data collected on April 30, 2005, in the vicinity of river mile 615.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

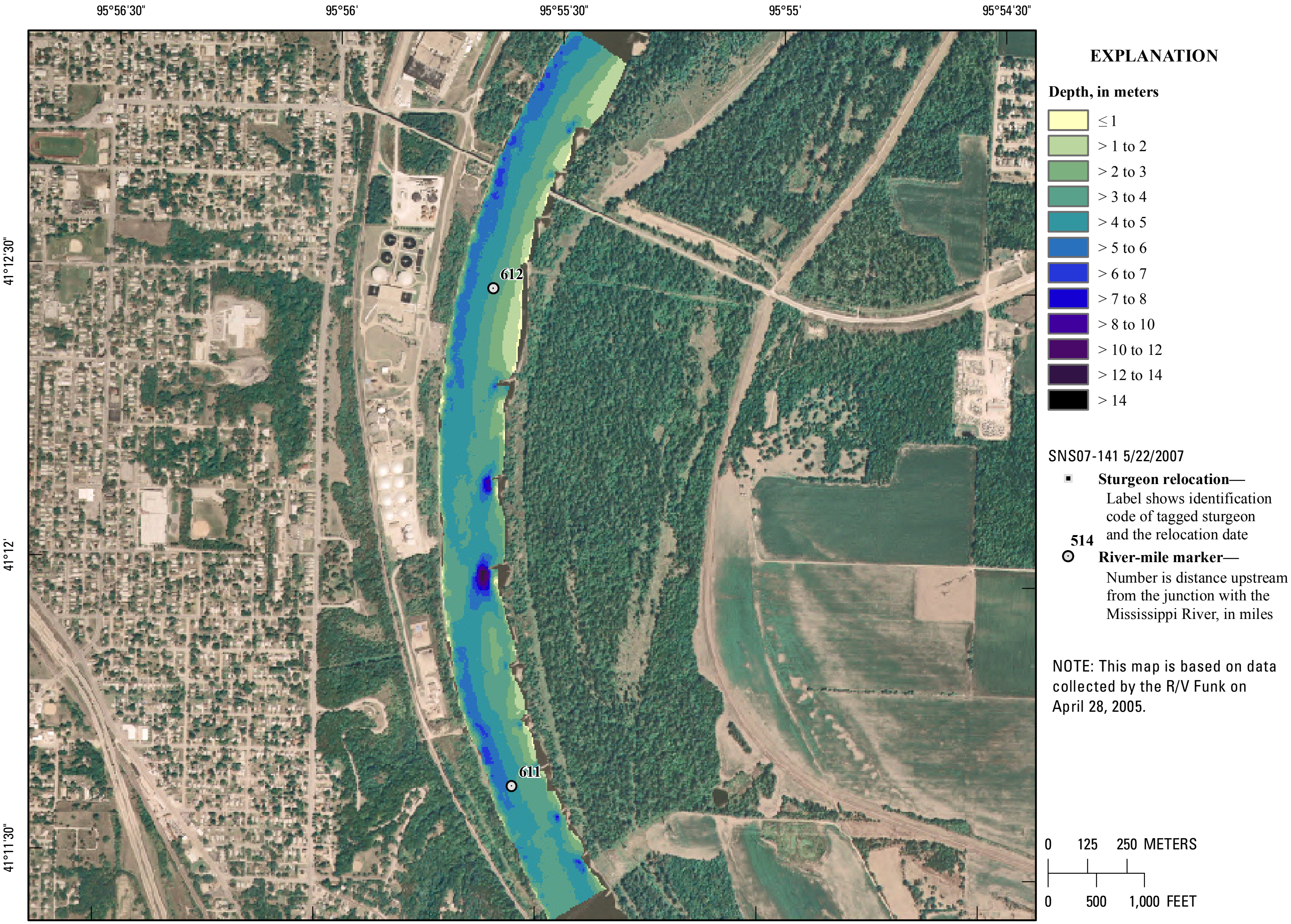
Figure 232. Map of generalized substrate based on data collected on April 30, 2005, in the vicinity of river mile 615.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

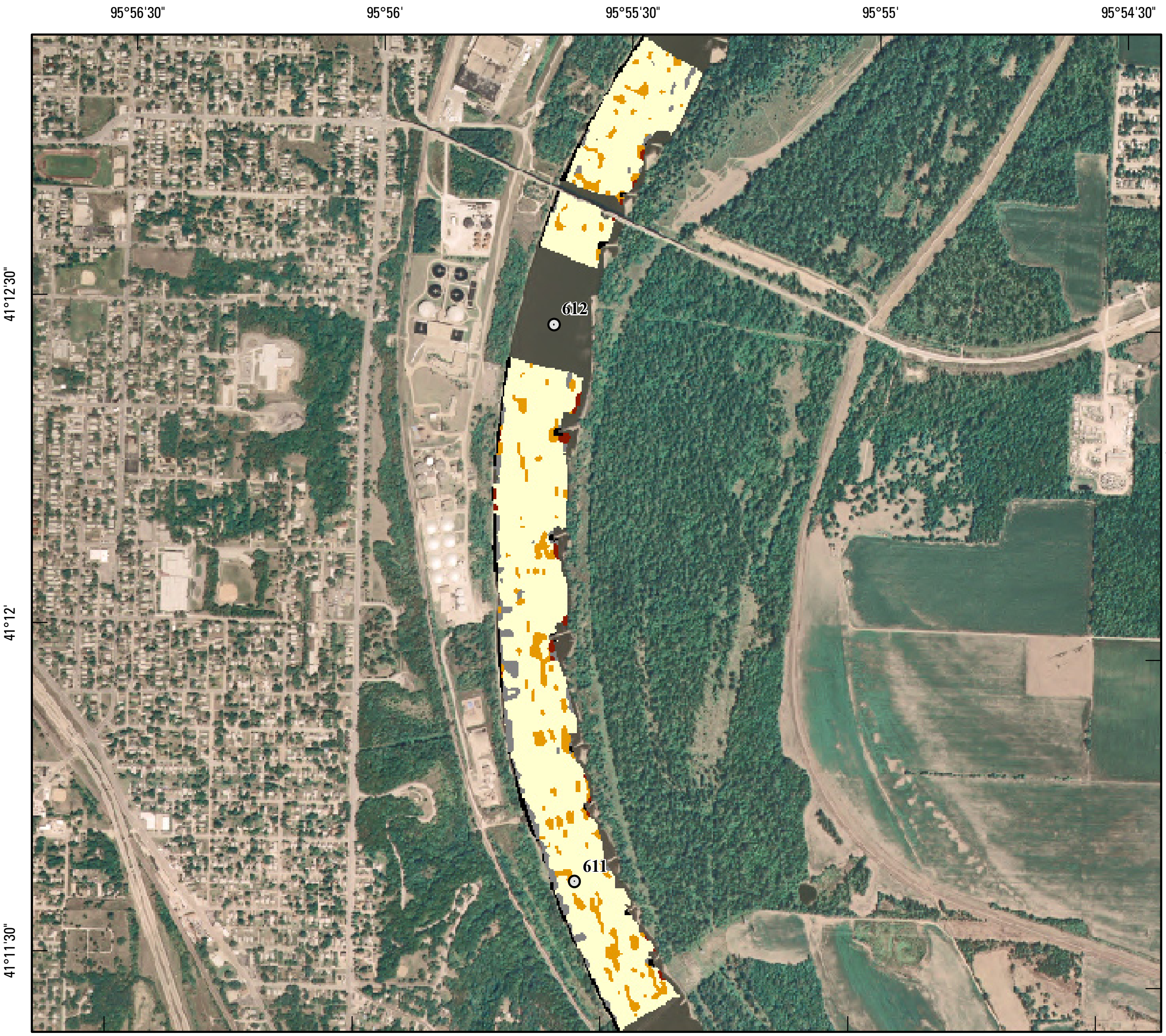
Figure 233. Map of depth-averaged velocity based on data collected on April 30, 2005, in the vicinity of river mile 615.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 234. Map of depth based on data collected on April 28, 2005, in the vicinity of river mile 612.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

Revetment, gravel, hard sand

Sand (dunes)

RoxAnn- and velocity-derived classes

Transporting sand

Fine sediment (mud, silt)

Classes derived from aerial photographs

Engineered structures (rock)

Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on April 28, 2005.

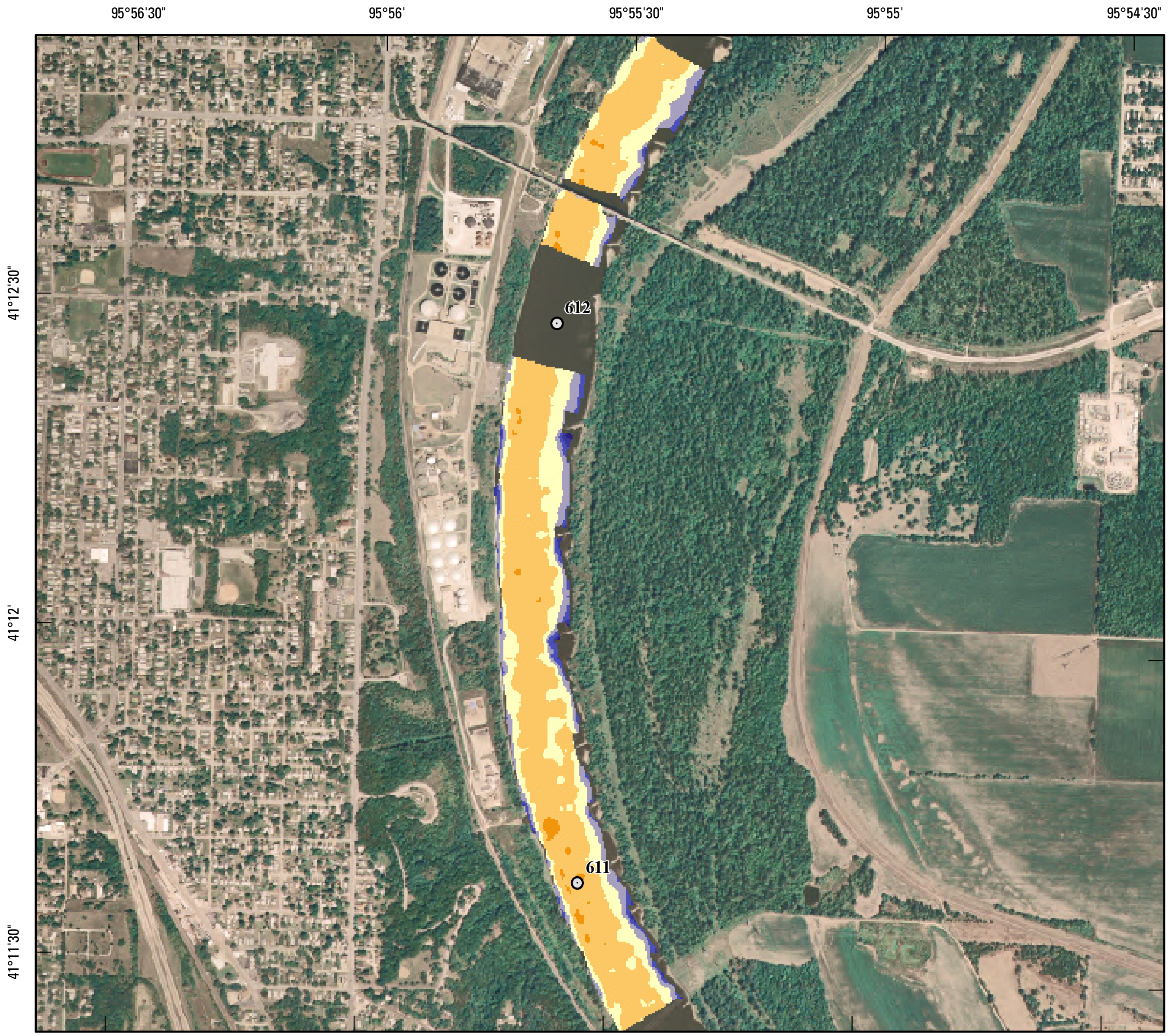
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

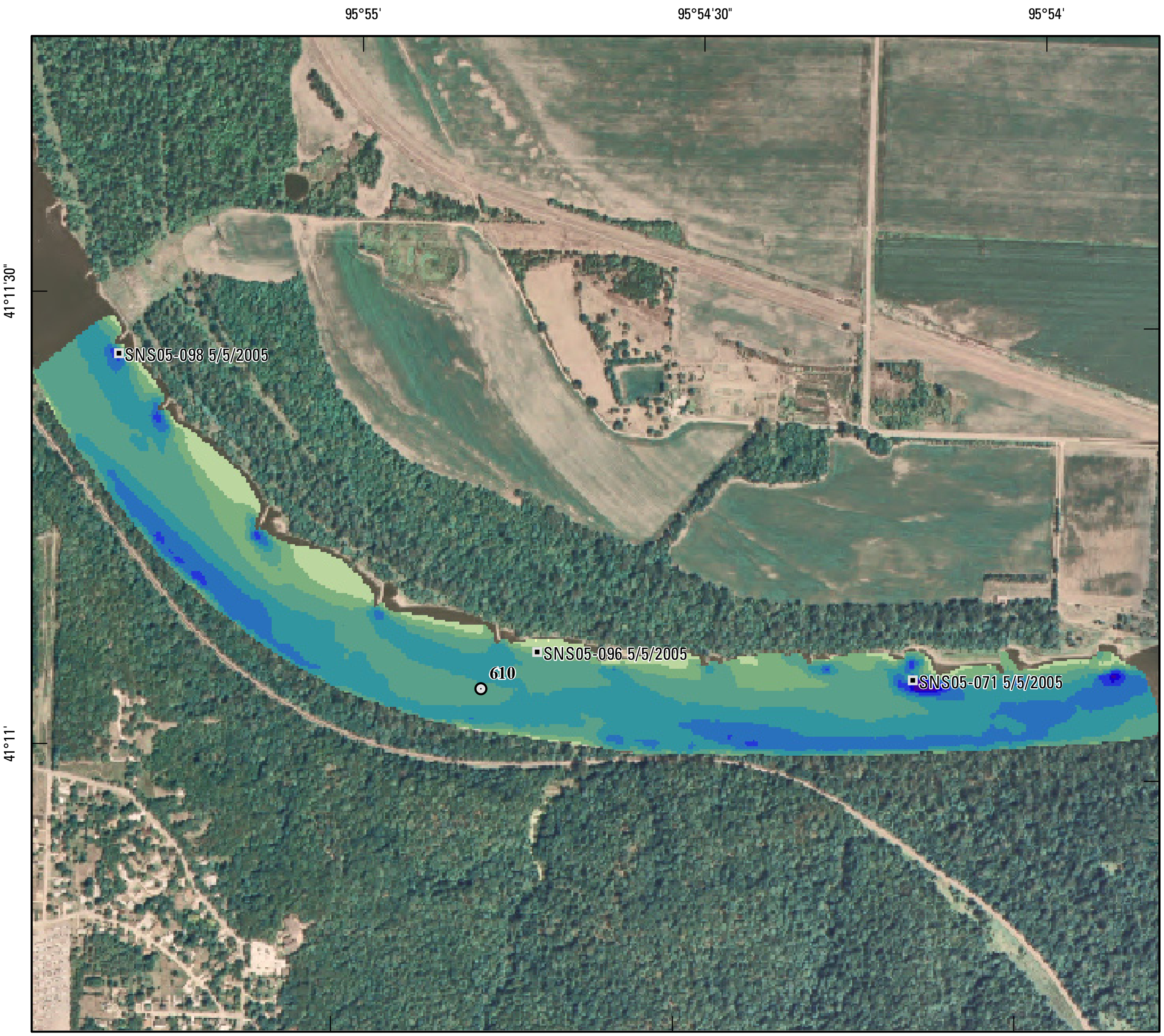
Figure 235. Map of generalized substrate based on data collected on April 28, 2005, in the vicinity of river mile 612.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 236. Map of depth-averaged velocity based on data collected on April 28, 2005, in the vicinity of river mile 612.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 6, 2005.

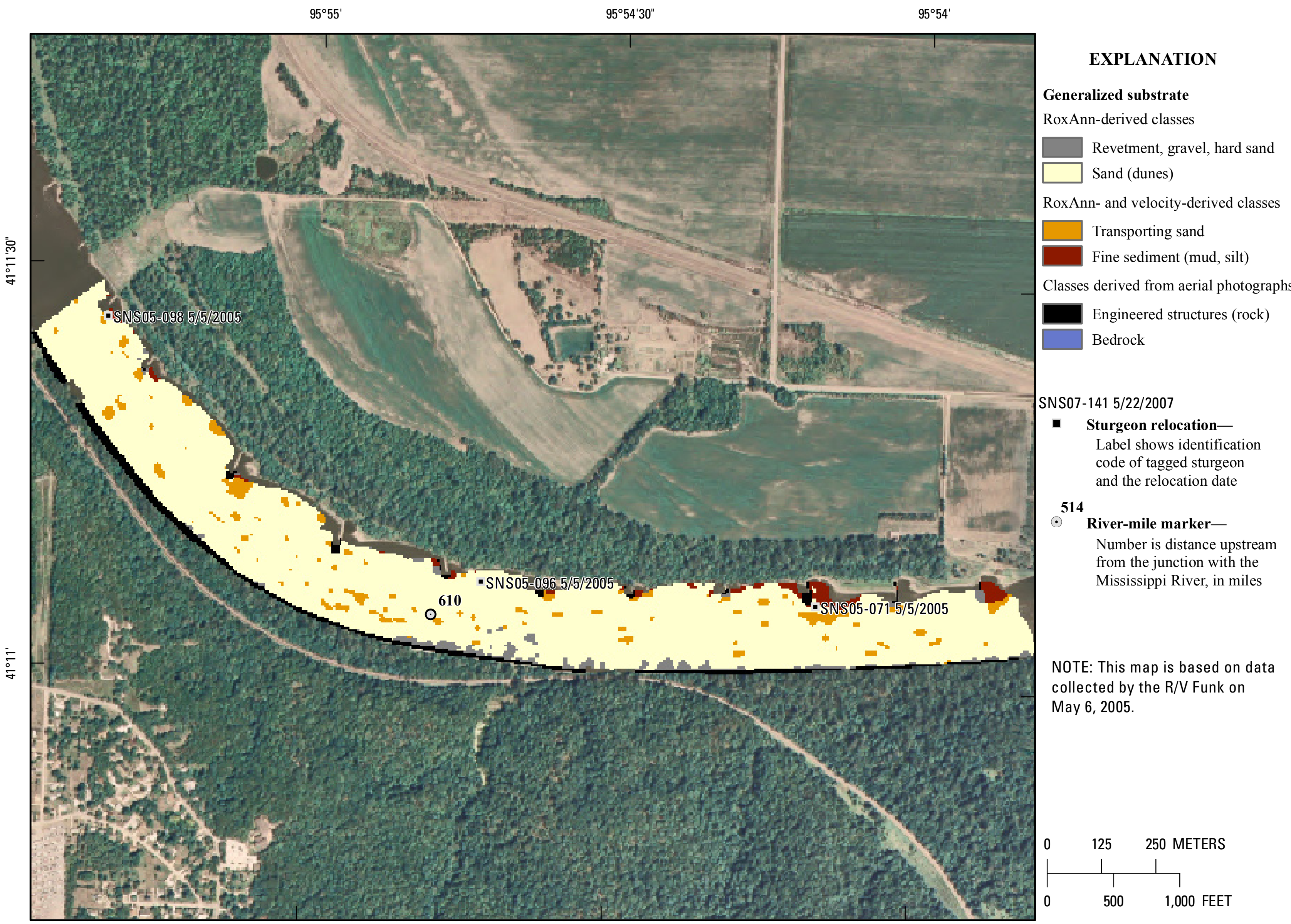
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

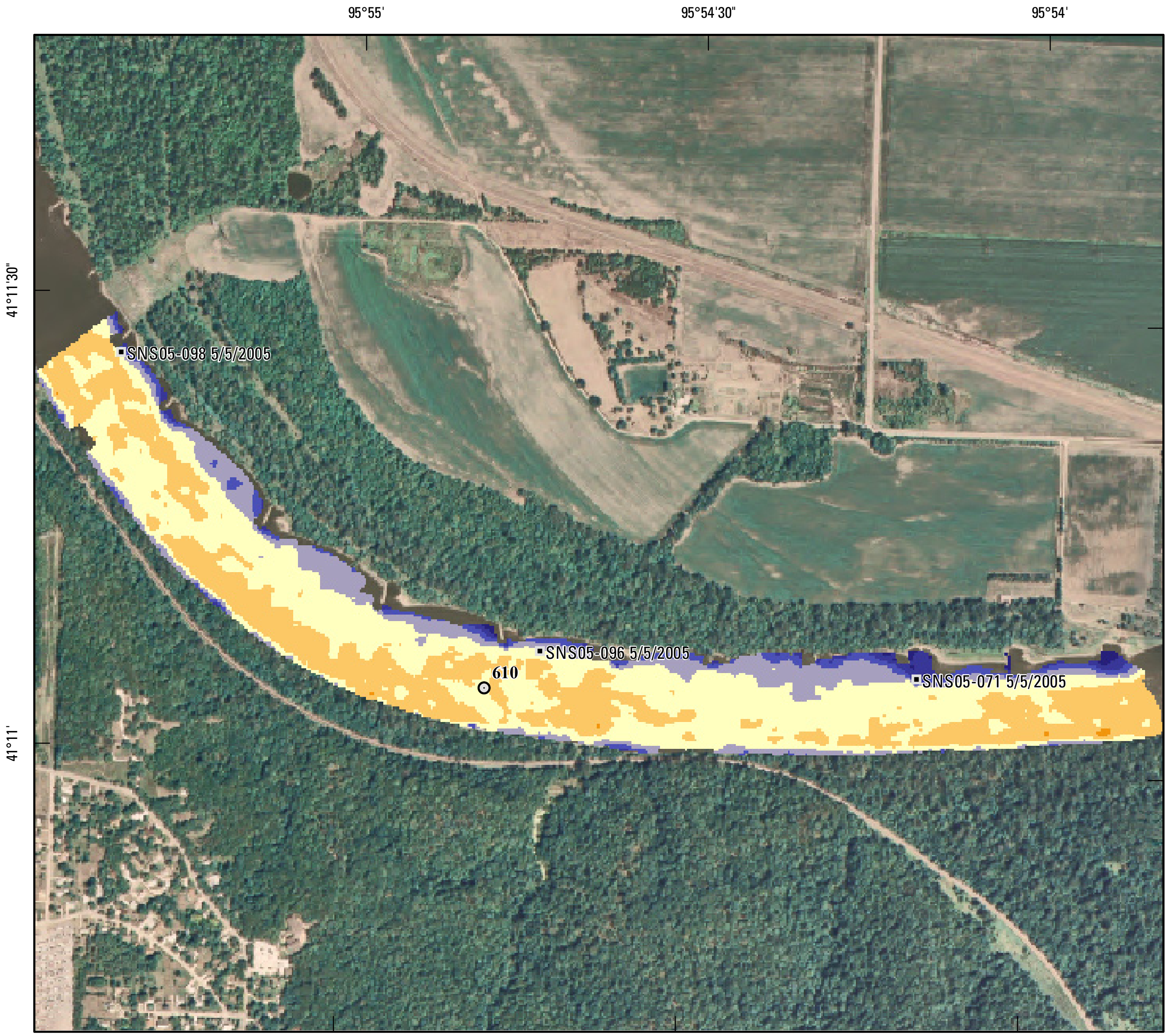
Figure 237. Map of depth based on data collected on May 6, 2005, in the vicinity of river mile 610.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 238. Map of generalized substrate based on data collected on May 6, 2005, in the vicinity of river mile 610.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation—Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker—Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 6, 2005.

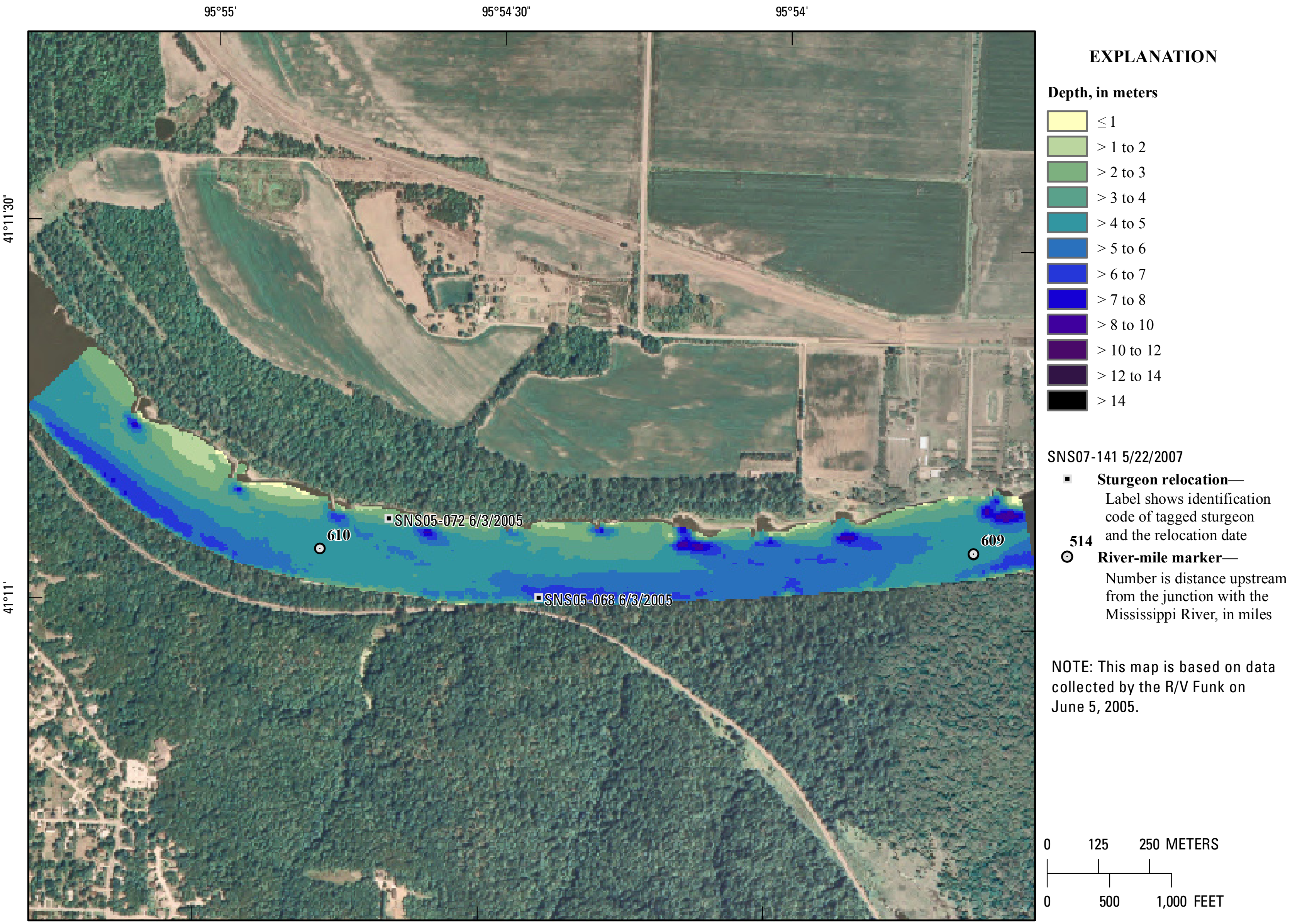
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

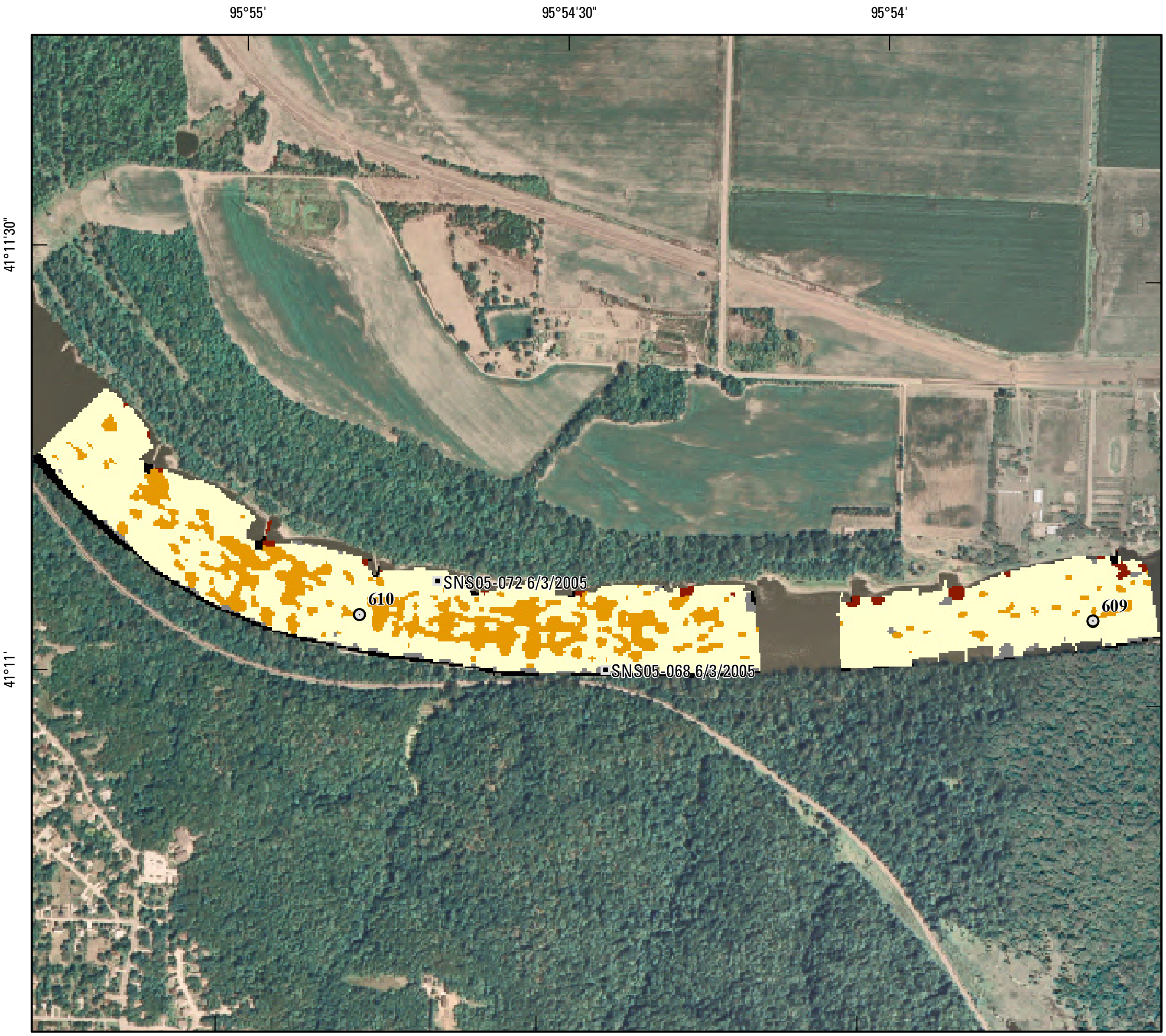
Figure 239. Map of depth-averaged velocity based on data collected on May 6, 2005, in the vicinity of river mile 610.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 240. Map of depth based on data collected on June 5, 2005, in the vicinity of river mile 610.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

Revetment, gravel, hard sand

Sand (dunes)

RoxAnn- and velocity-derived classes

Transporting sand

Fine sediment (mud, silt)

Classes derived from aerial photographs

Engineered structures (rock)

Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 5, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 241. Map of generalized substrate based on data collected on June 5, 2005, in the vicinity of river mile 610.

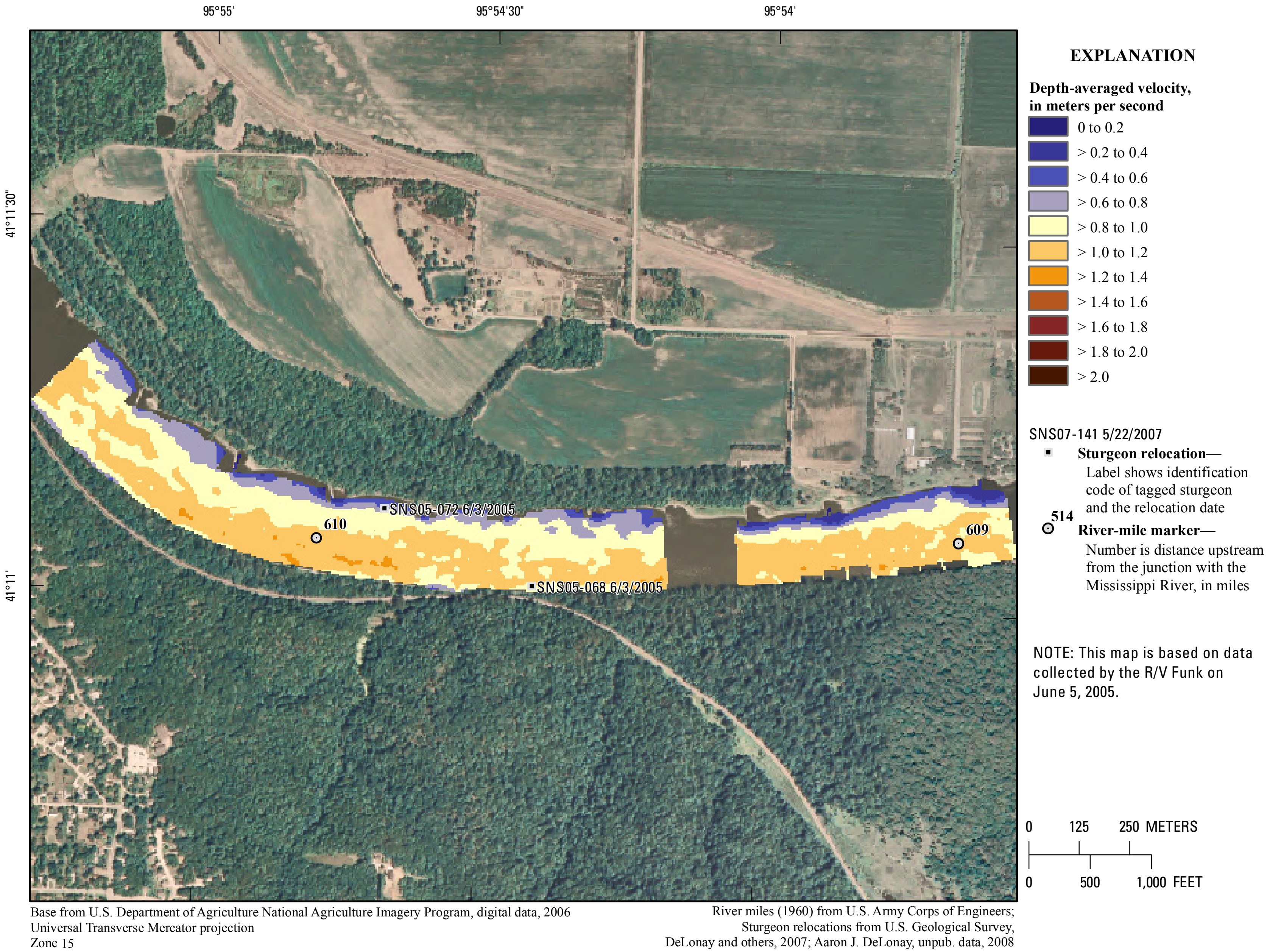
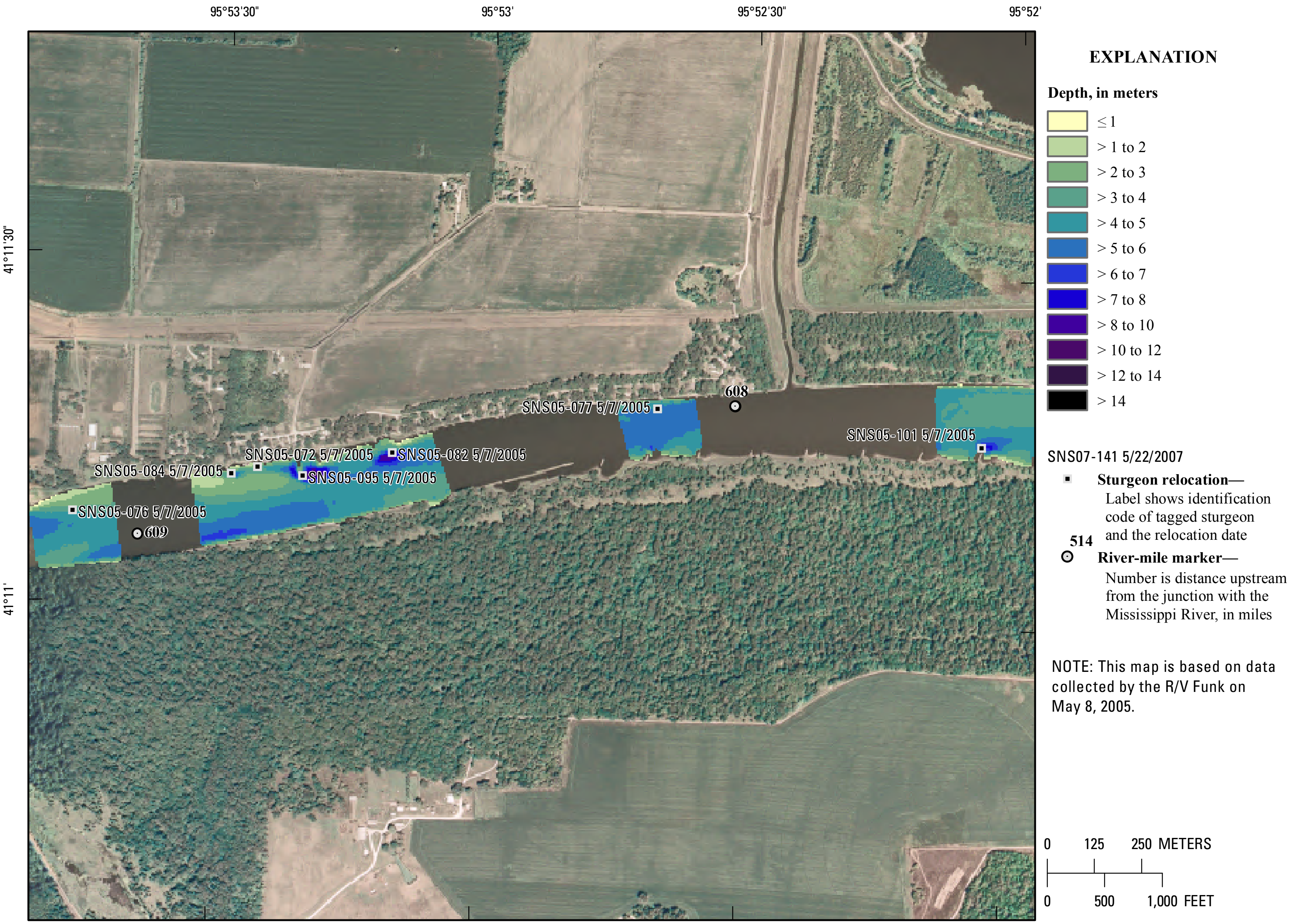


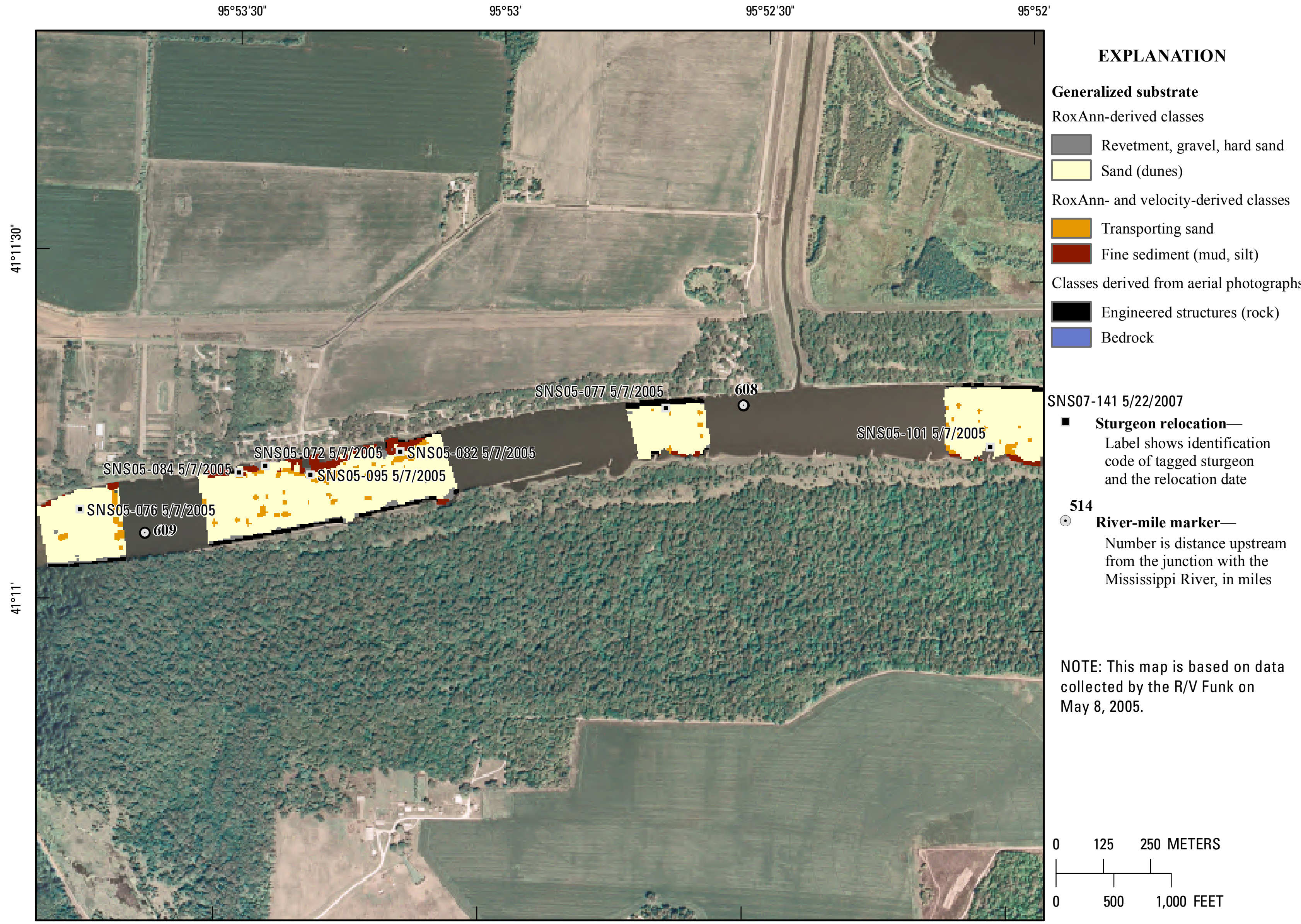
Figure 242. Map of depth-averaged velocity based on data collected on June 5, 2005, in the vicinity of river mile 610.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

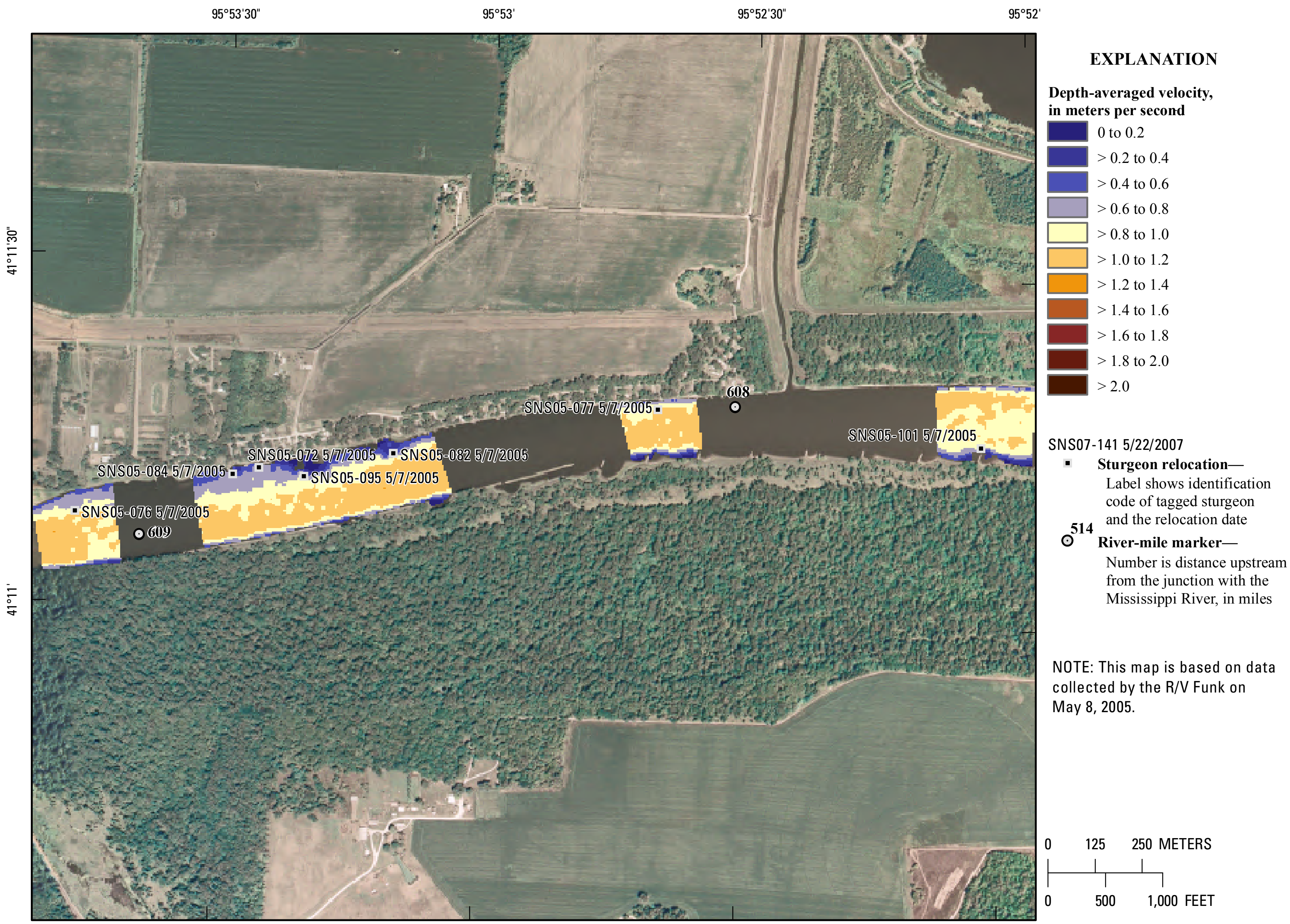
Figure 243. Map of depth based on data collected on May 8, 2005, in the vicinity of river mile 609.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 244. Map of generalized substrate based on data collected on May 8, 2005, in the vicinity of river mile 609.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 245. Map of depth-averaged velocity based on data collected on May 8, 2005, in the vicinity of river mile 609.

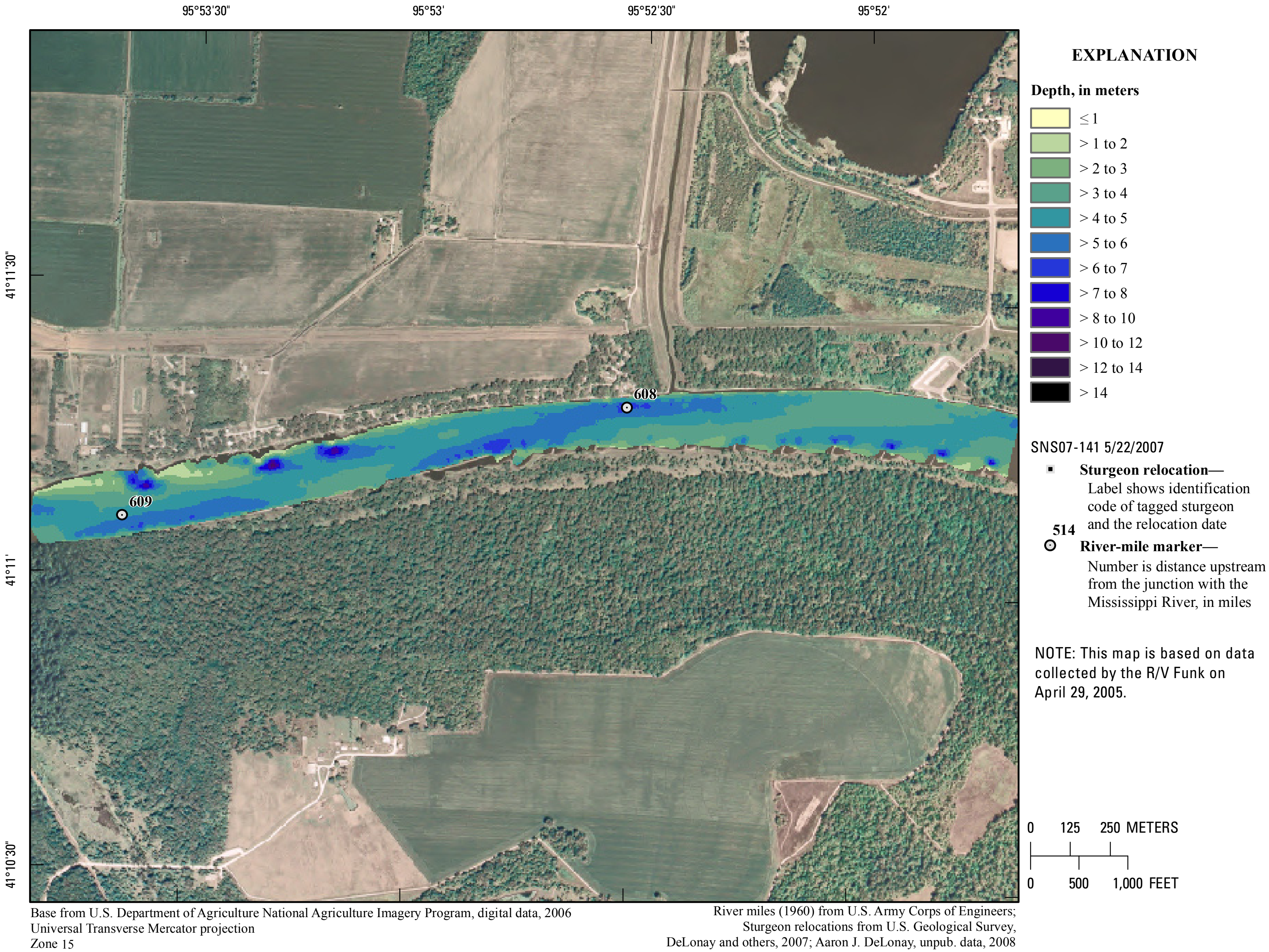


Figure 246. Map of depth based on data collected on April 29, 2005, in the vicinity of river mile 608.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

SNS07-141 5/22/2007 **Sturgeon relocation**—Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker**—Number is distance upstream from the junction with the Mississippi River, in miles

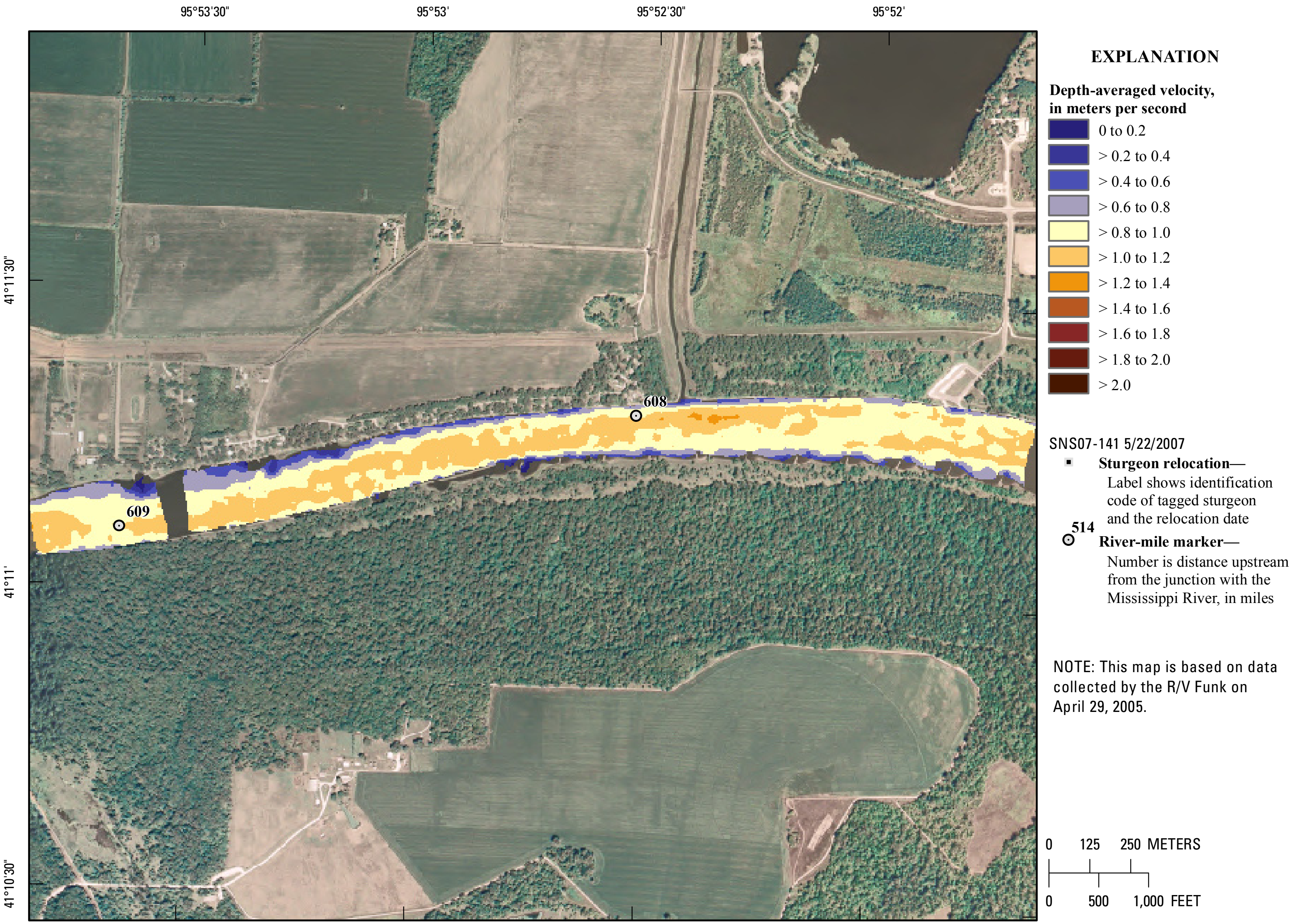
NOTE: This map is based on data collected by the R/V Funk on April 29, 2005.

0 125 250 METERS
0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 247. Map of generalized substrate based on data collected on April 29, 2005, in the vicinity of river mile 608.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 248. Map of depth-averaged velocity based on data collected on April 29, 2005, in the vicinity of river mile 608.

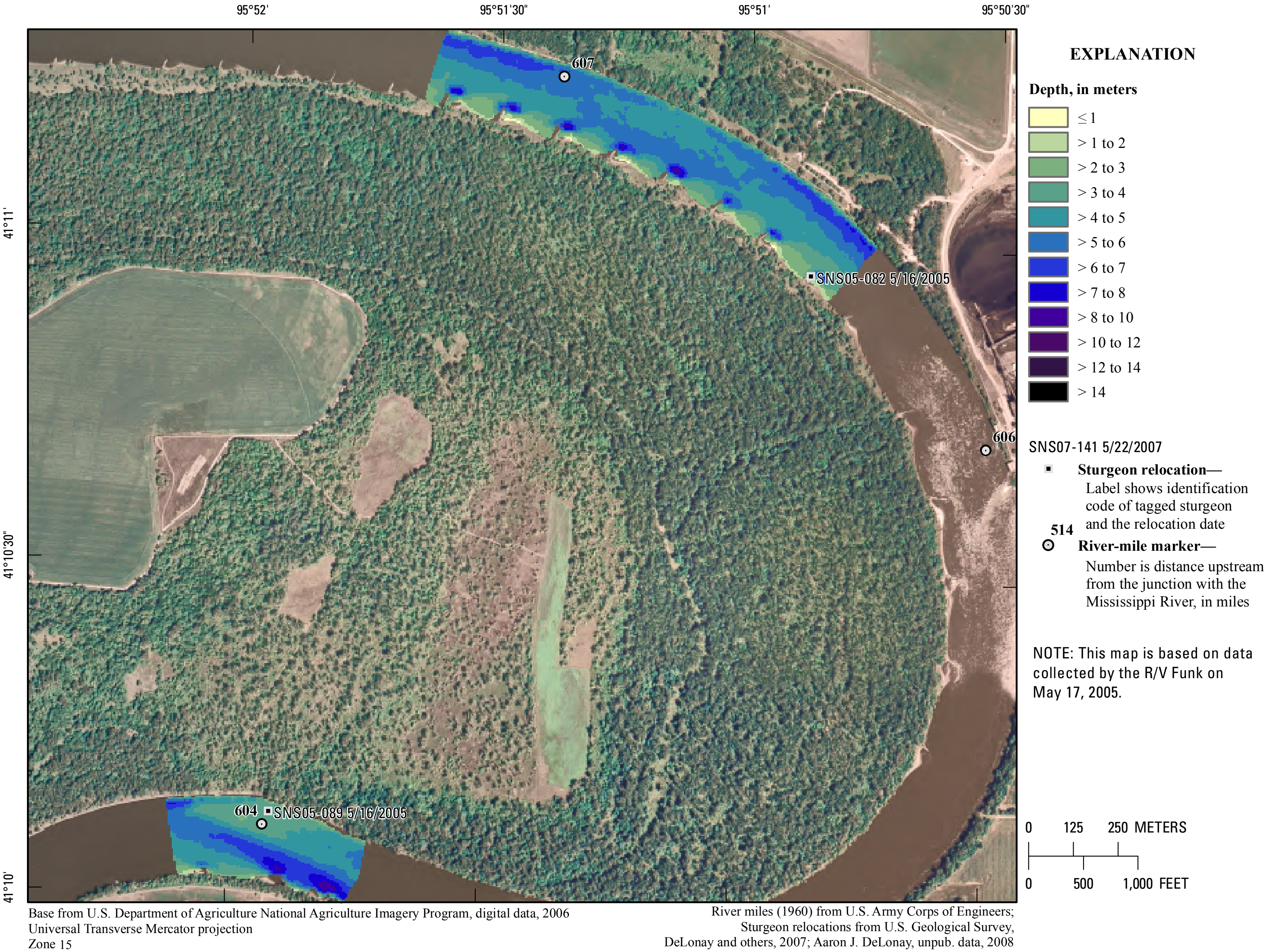
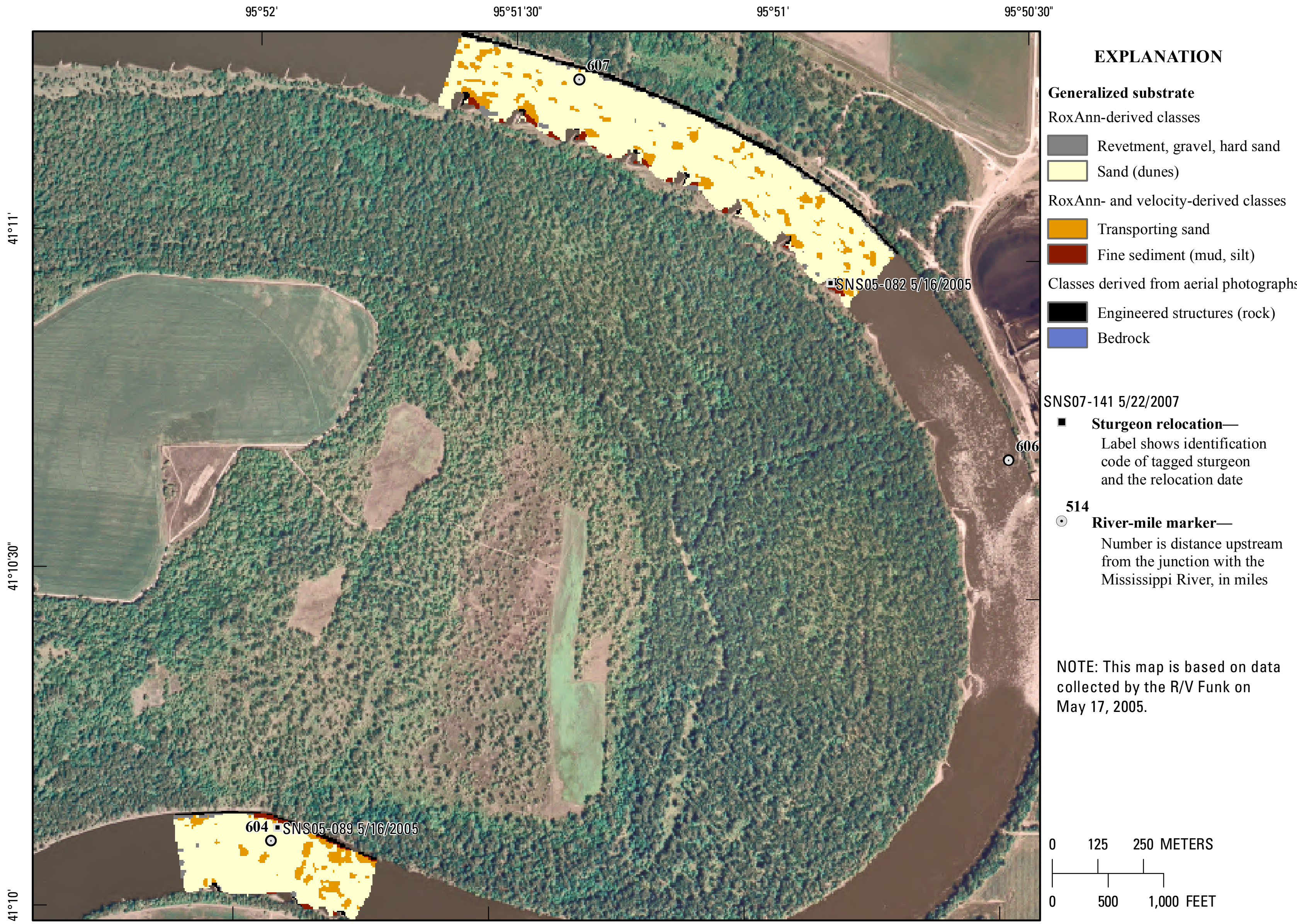


Figure 249. Map of depth based on data collected on May 17, 2005, in the vicinity of river mile 607.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 250. Map of generalized substrate based on data collected on May 17, 2005, in the vicinity of river mile 607.

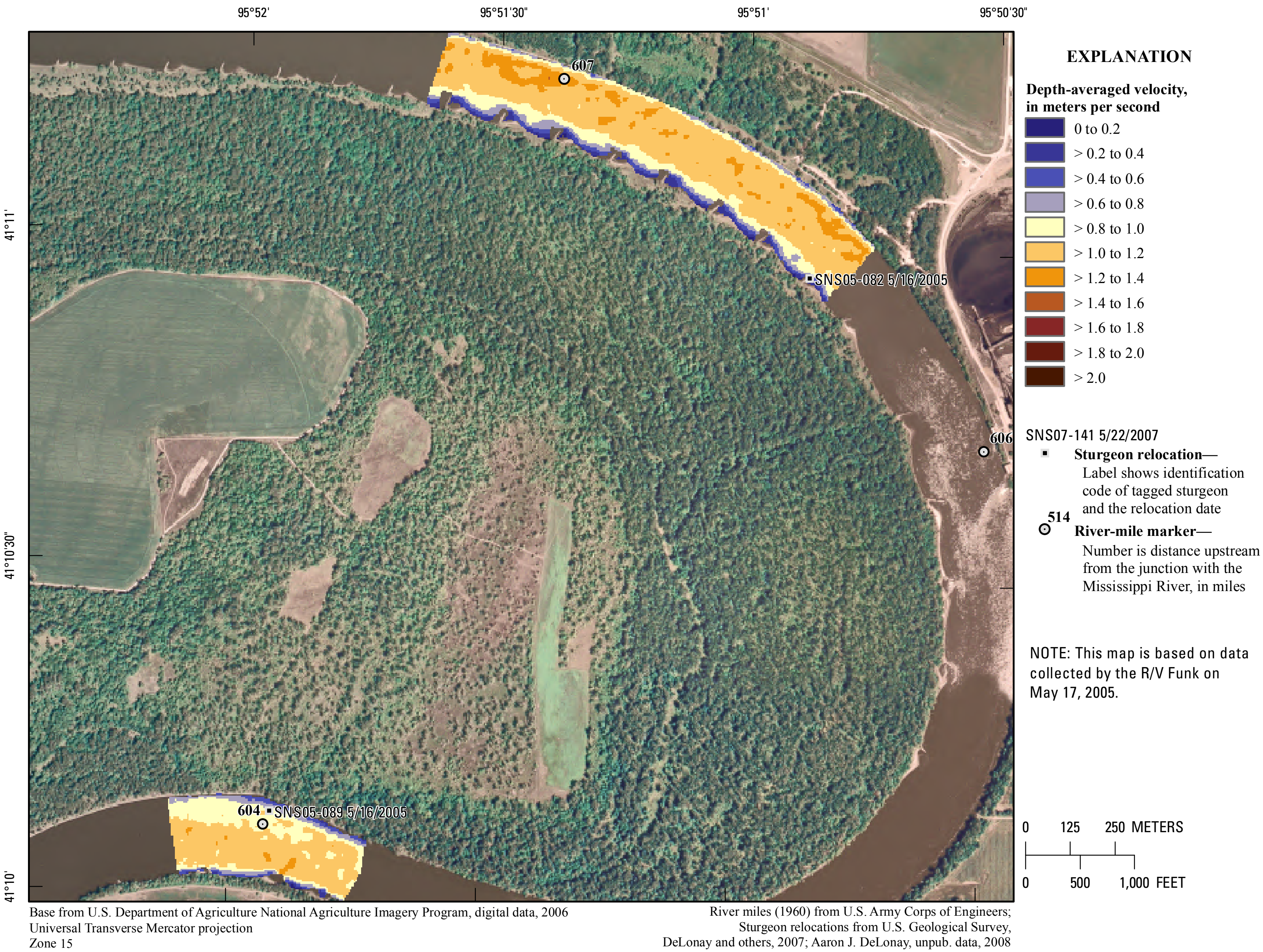


Figure 251. Map of depth-averaged velocity based on data collected on May 17, 2005, in the vicinity of river mile 607.

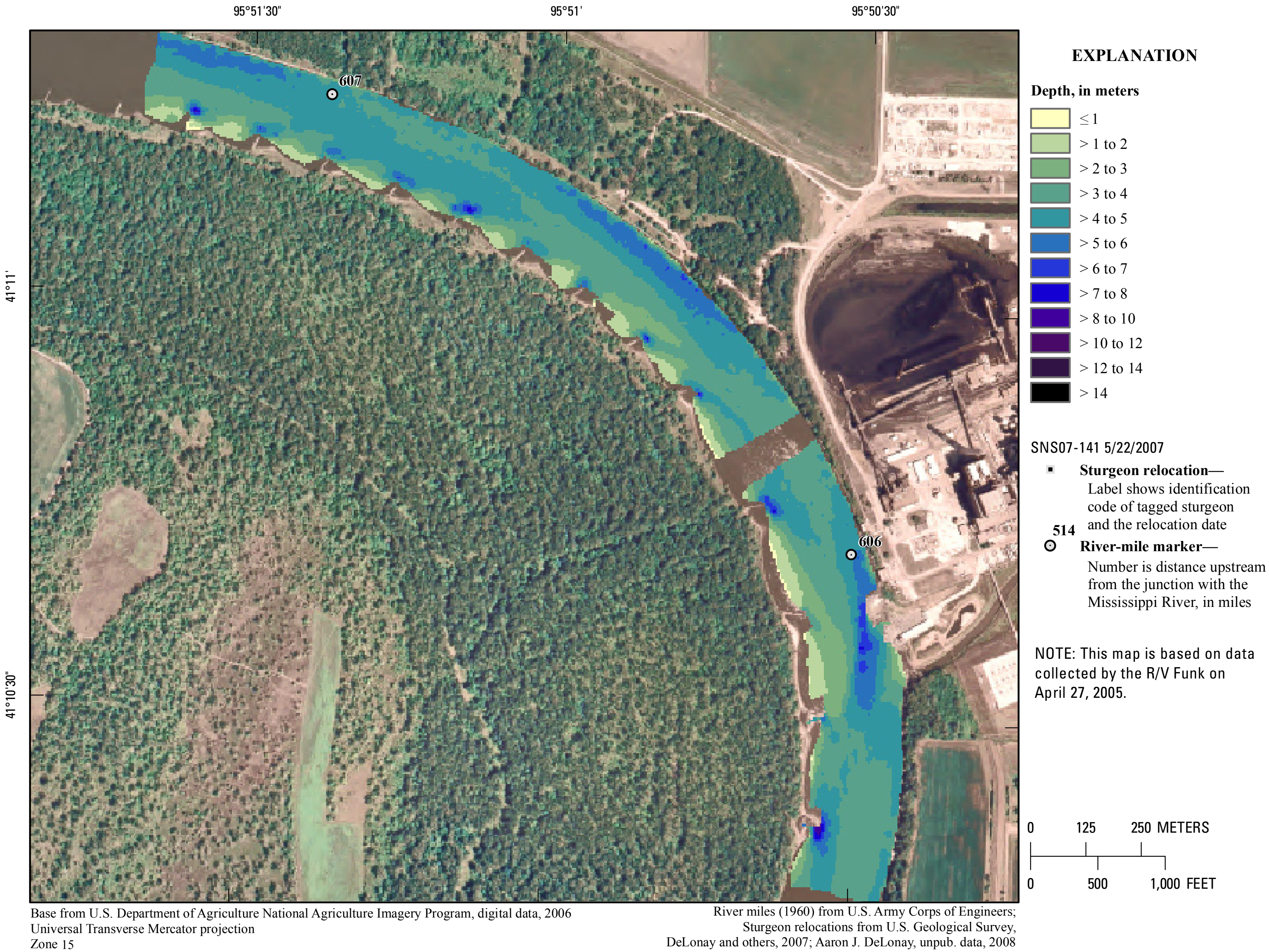


Figure 252. Map of depth based on data collected on April 27, 2005, in the vicinity of river mile 606.

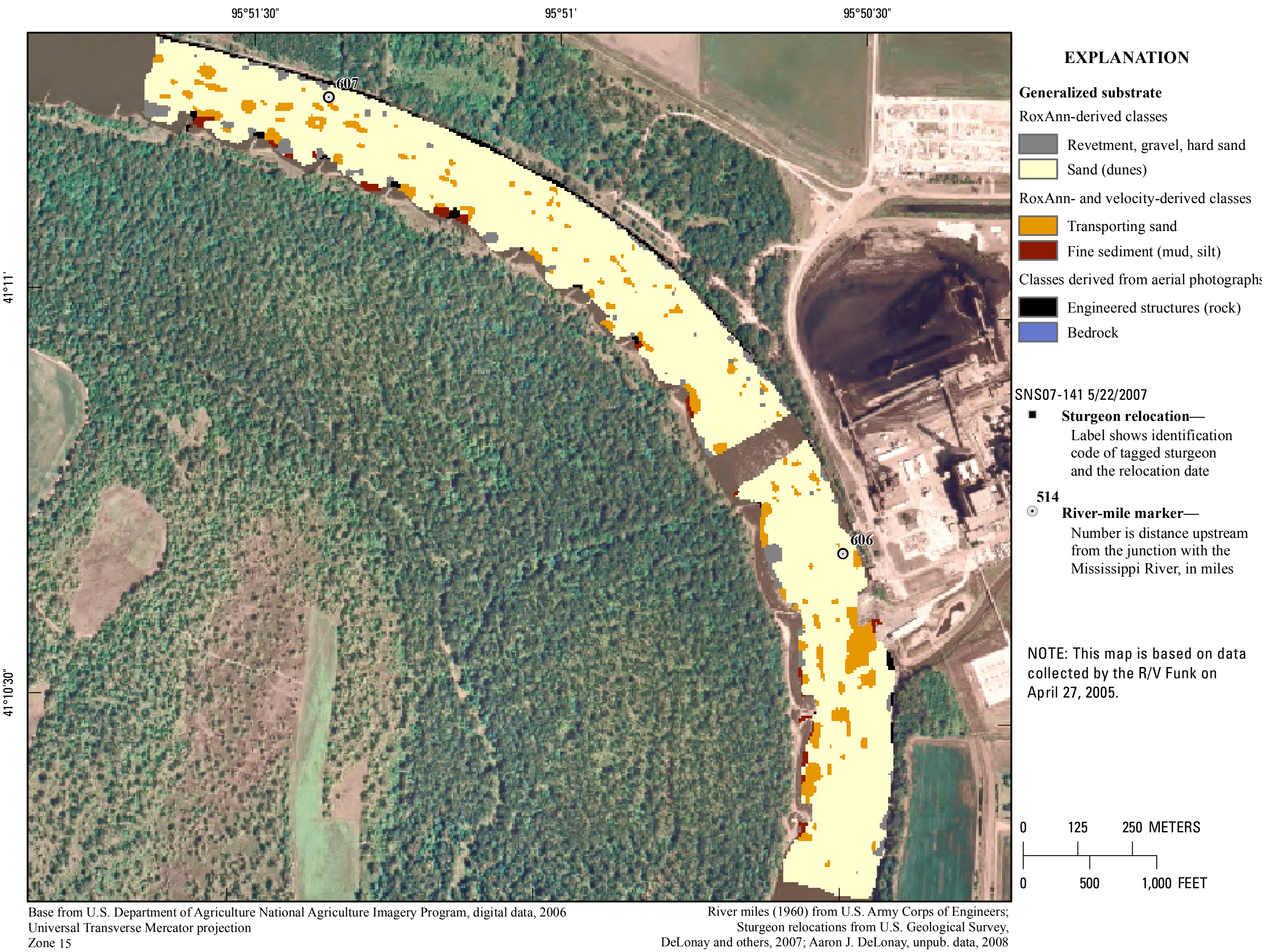
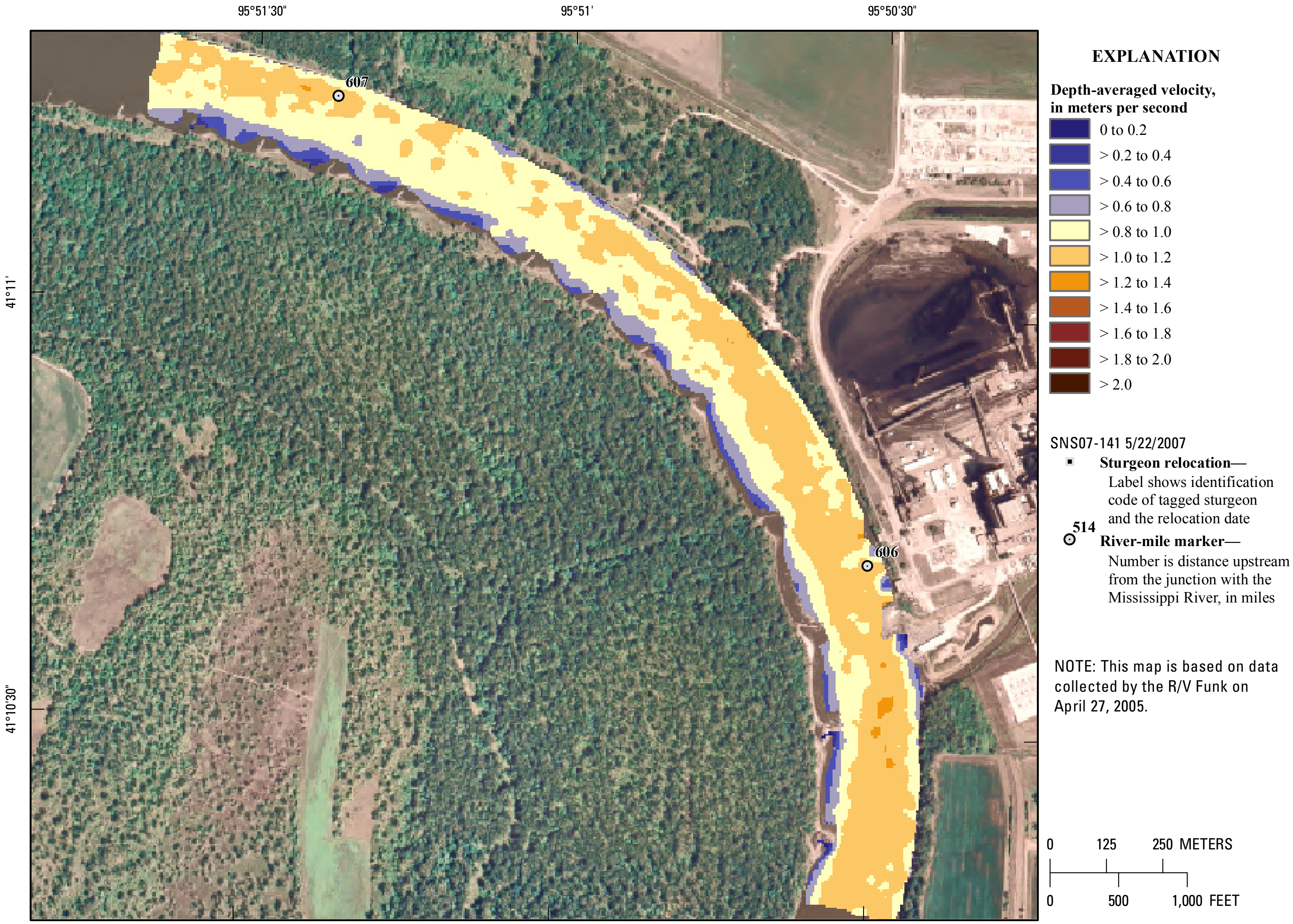


Figure 253. Map of generalized substrate based on data collected on April 27, 2005, in the vicinity of river mile 606.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

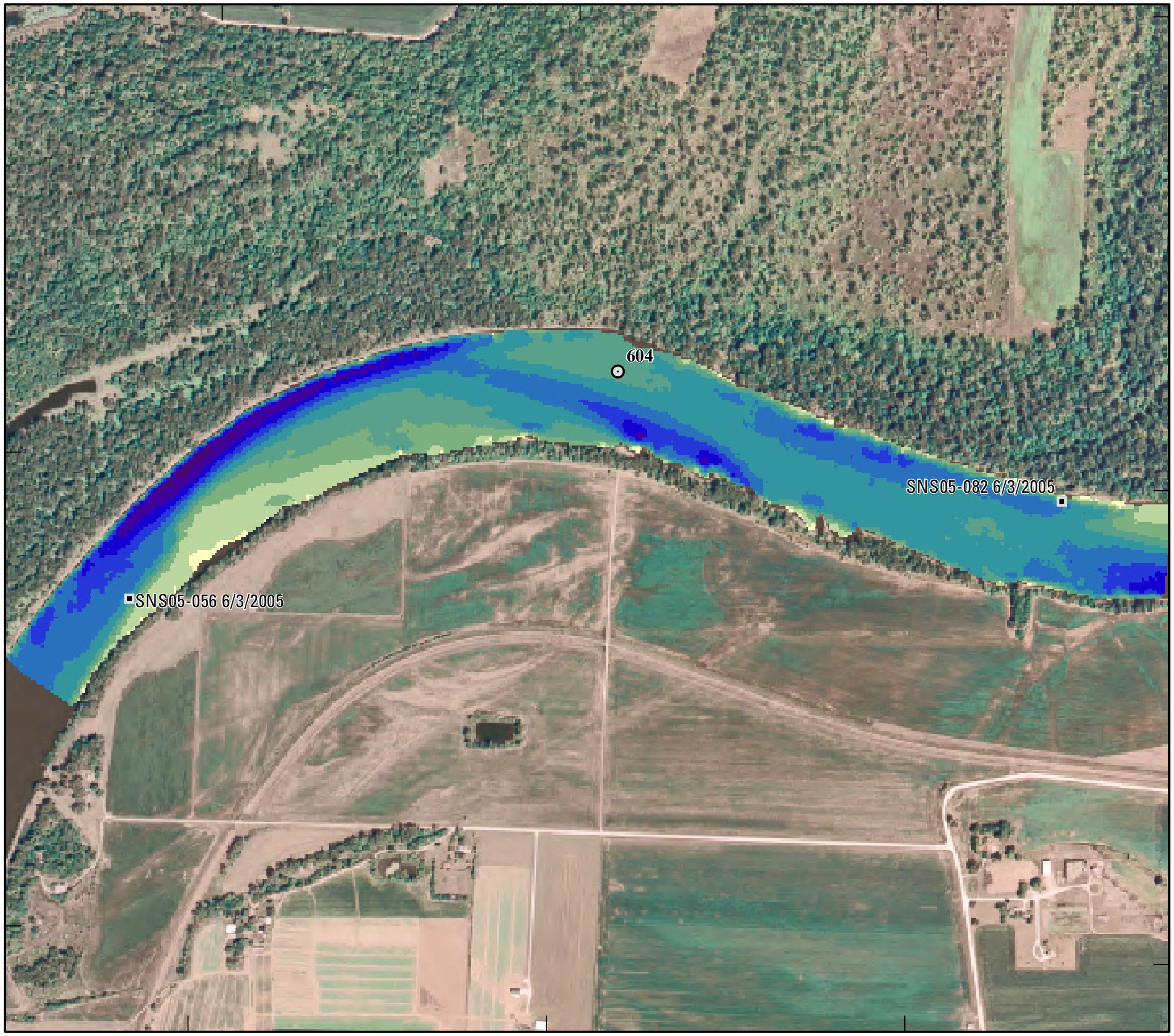
River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 254. Map of depth-averaged velocity based on data collected on April 27, 2005, in the vicinity of river mile 606.

95°52'30" 95°52' 95°51'30"

41°10'

41°9'30"



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 4, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 255. Map of depth based on data collected on June 4, 2005, in the vicinity of river mile 604.

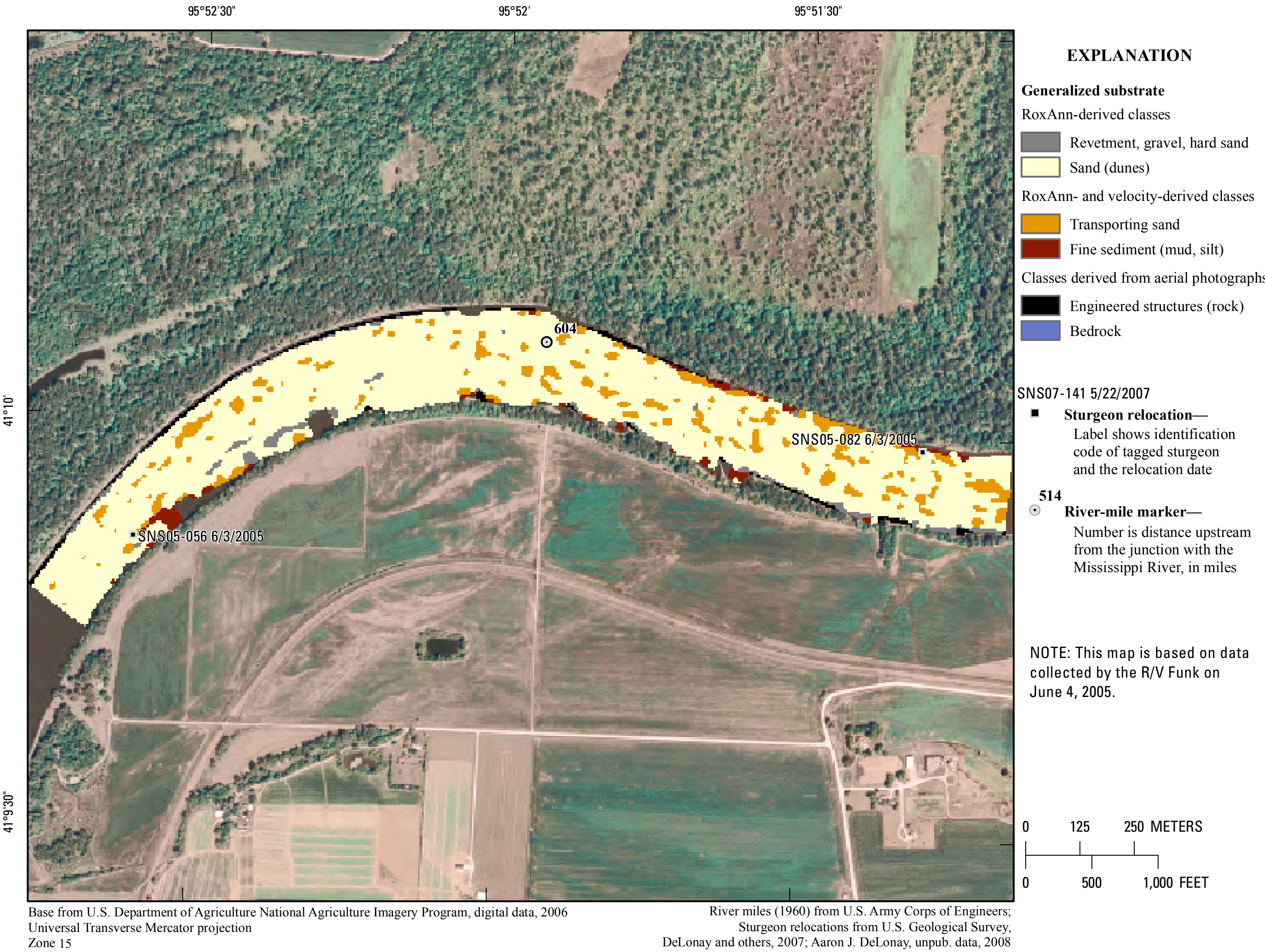
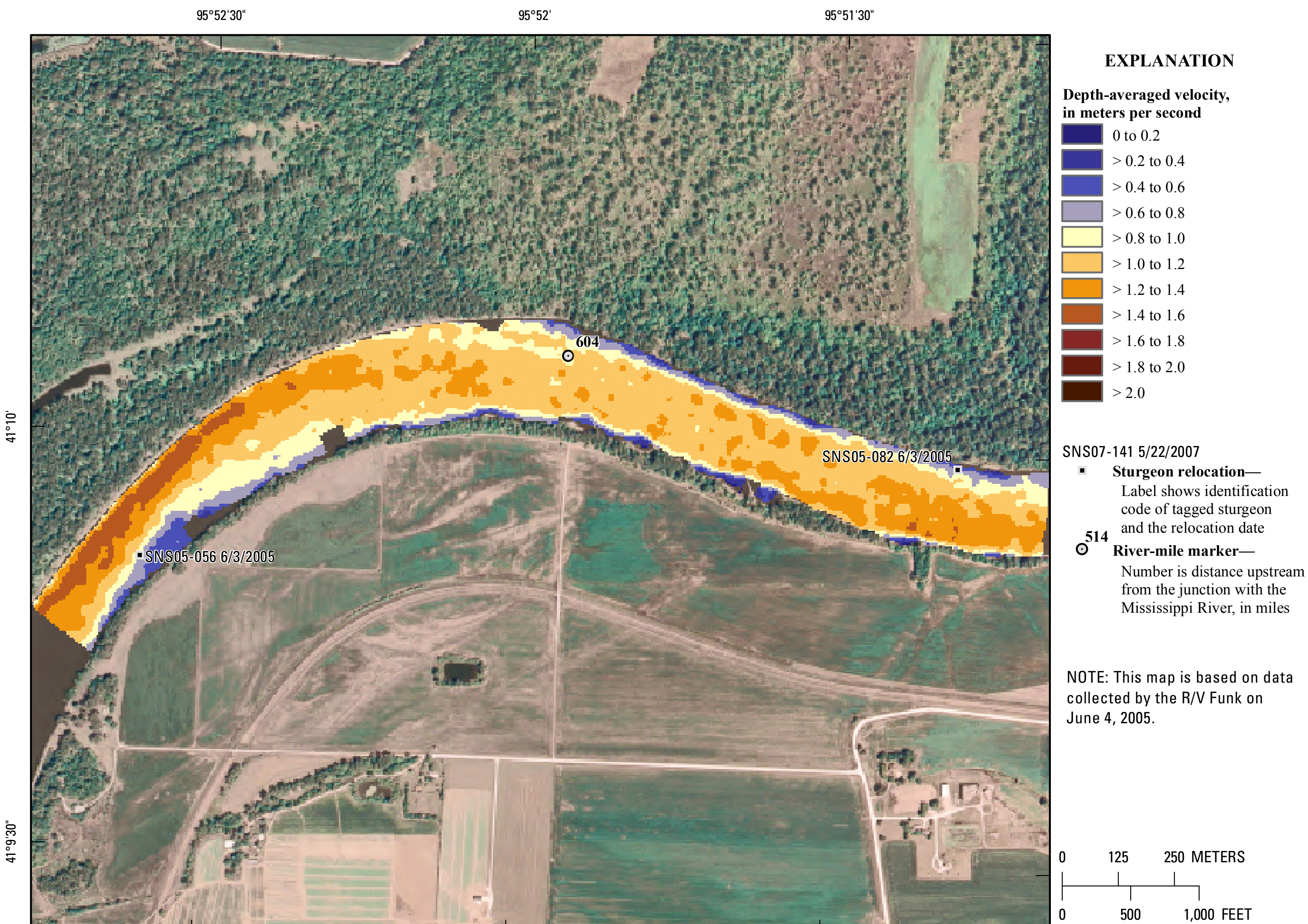


Figure 256. Map of generalized substrate based on data collected on June 4, 2005, in the vicinity of river mile 604.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 257. Map of depth-averaged velocity based on data collected on June 4, 2005, in the vicinity of river mile 604.

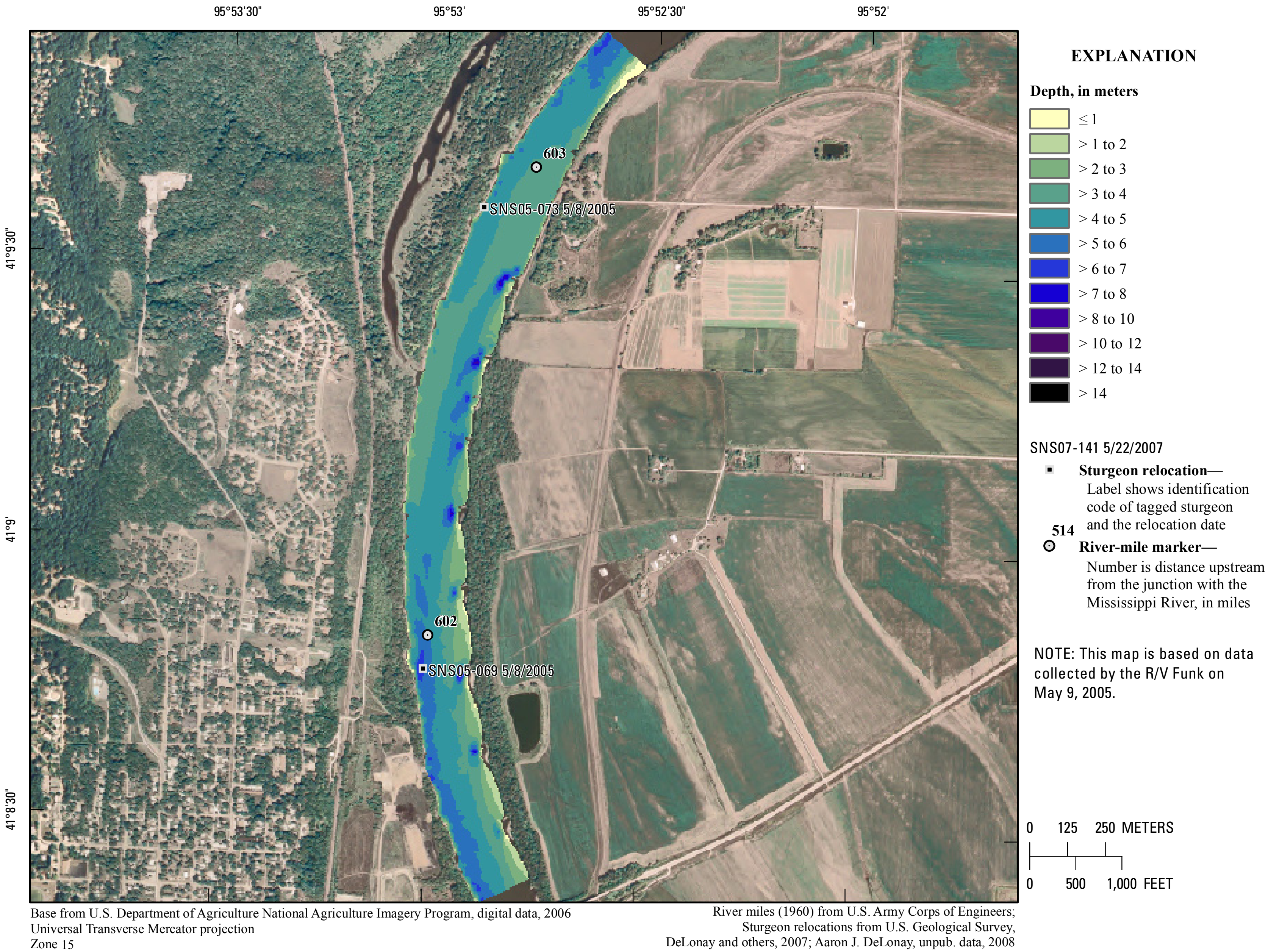
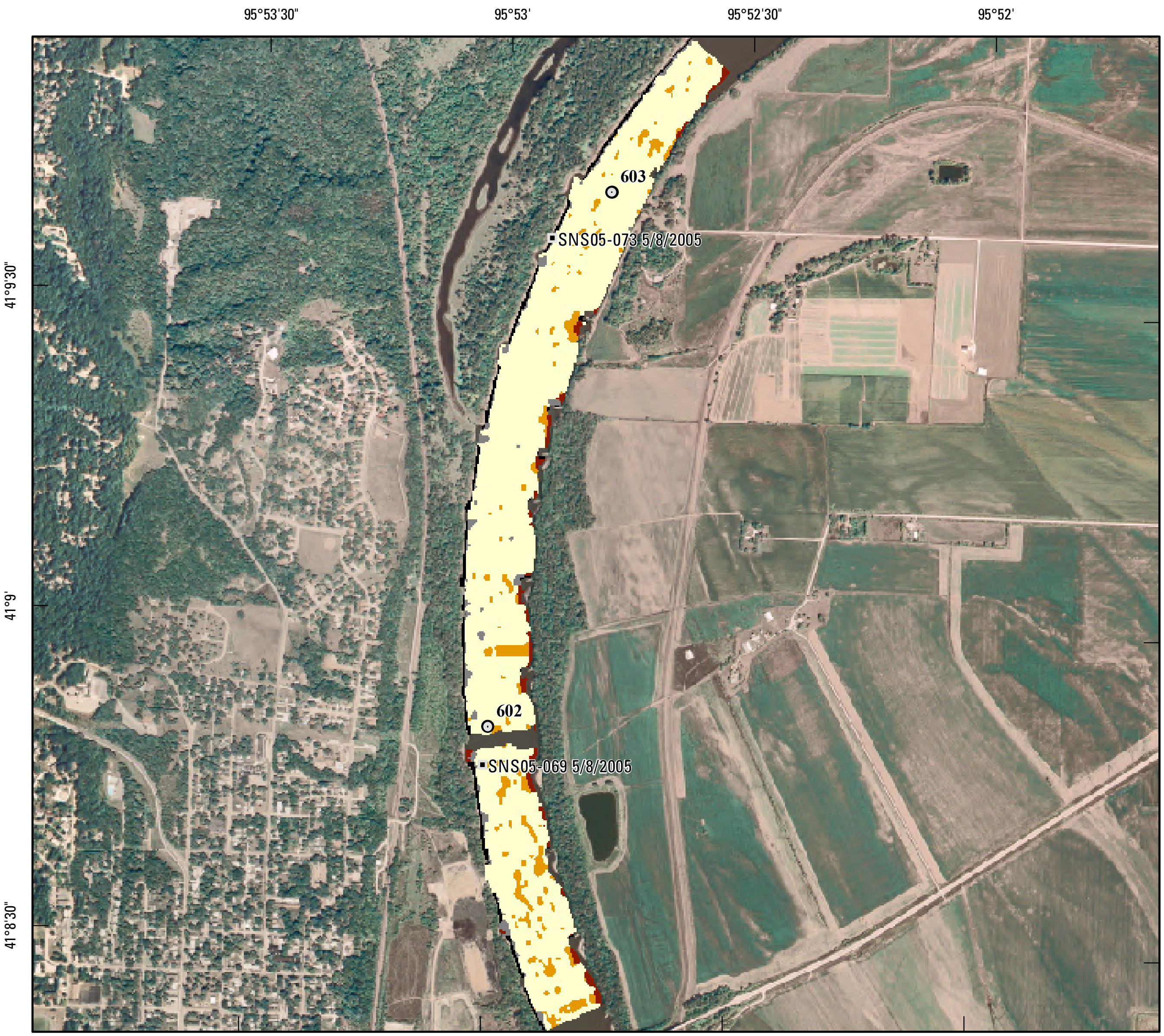


Figure 258. Map of depth based on data collected on May 9, 2005, in the vicinity of river mile 602.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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■ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514

⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 9, 2005.

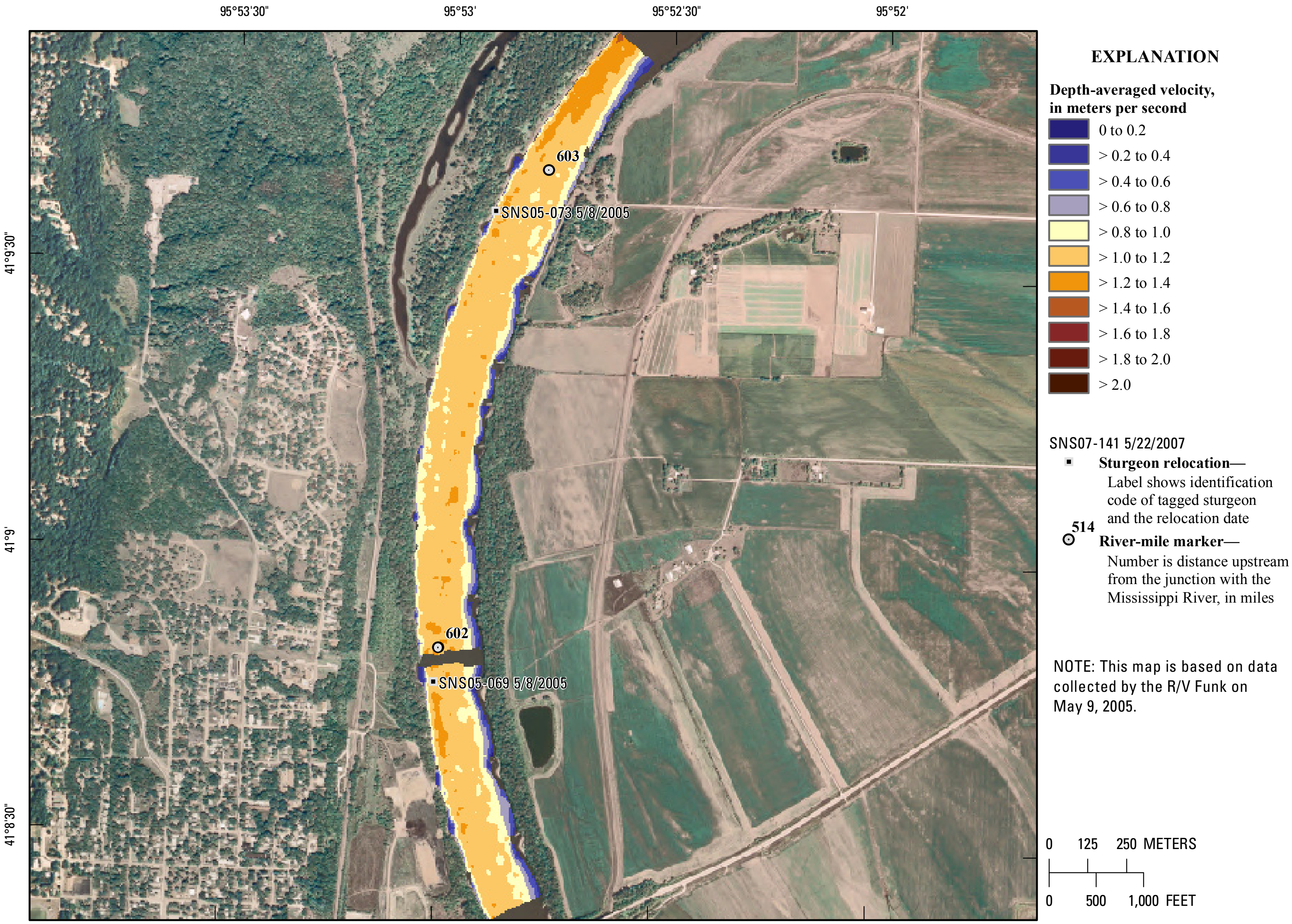
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

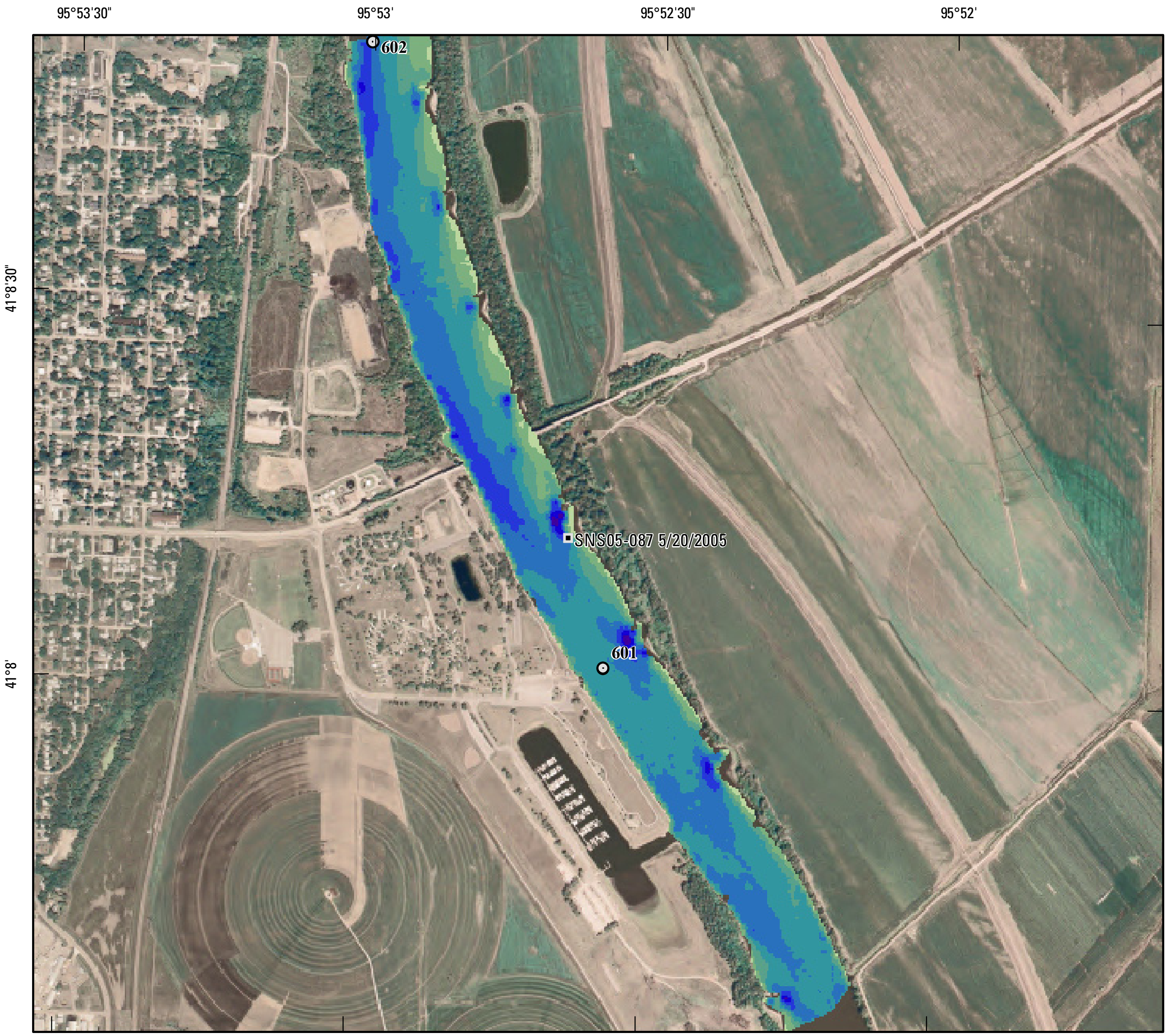
Figure 259. Map of generalized substrate based on data collected on May 9, 2005, in the vicinity of river mile 602.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 260. Map of depth-averaged velocity based on data collected on May 9, 2005, in the vicinity of river mile 602.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 22, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 261. Map of depth based on data collected on May 22, 2005, in the vicinity of river mile 601.

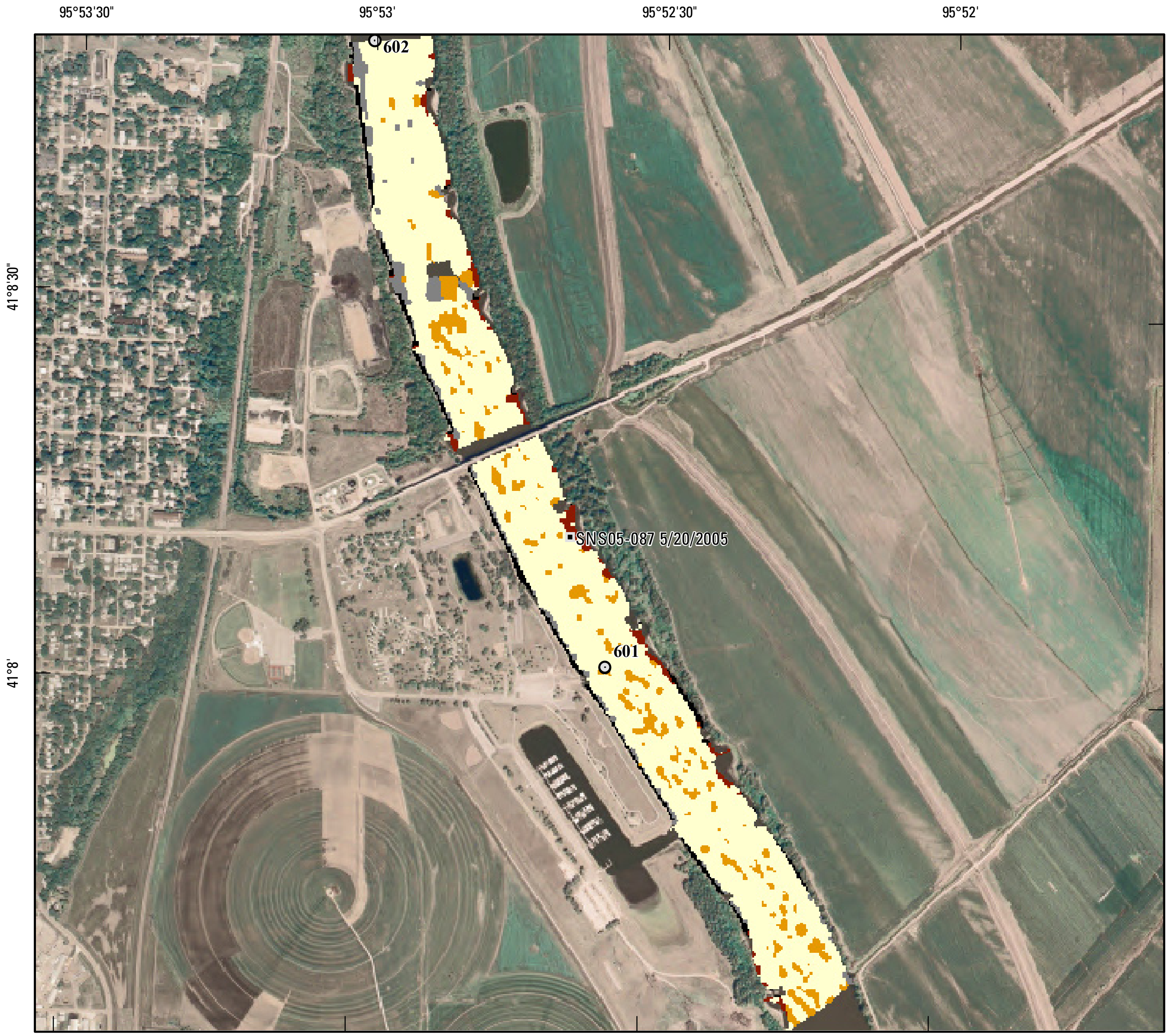
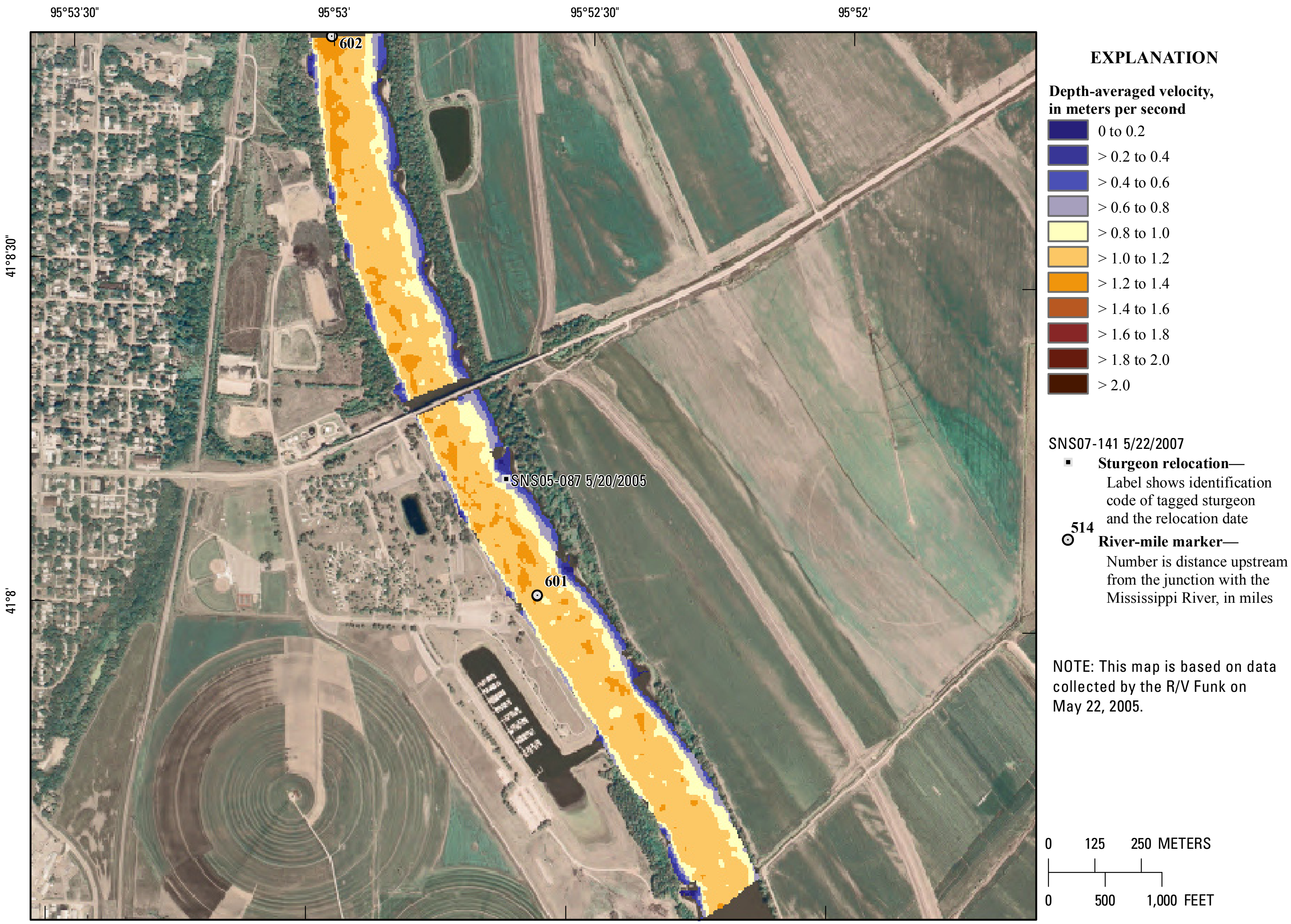


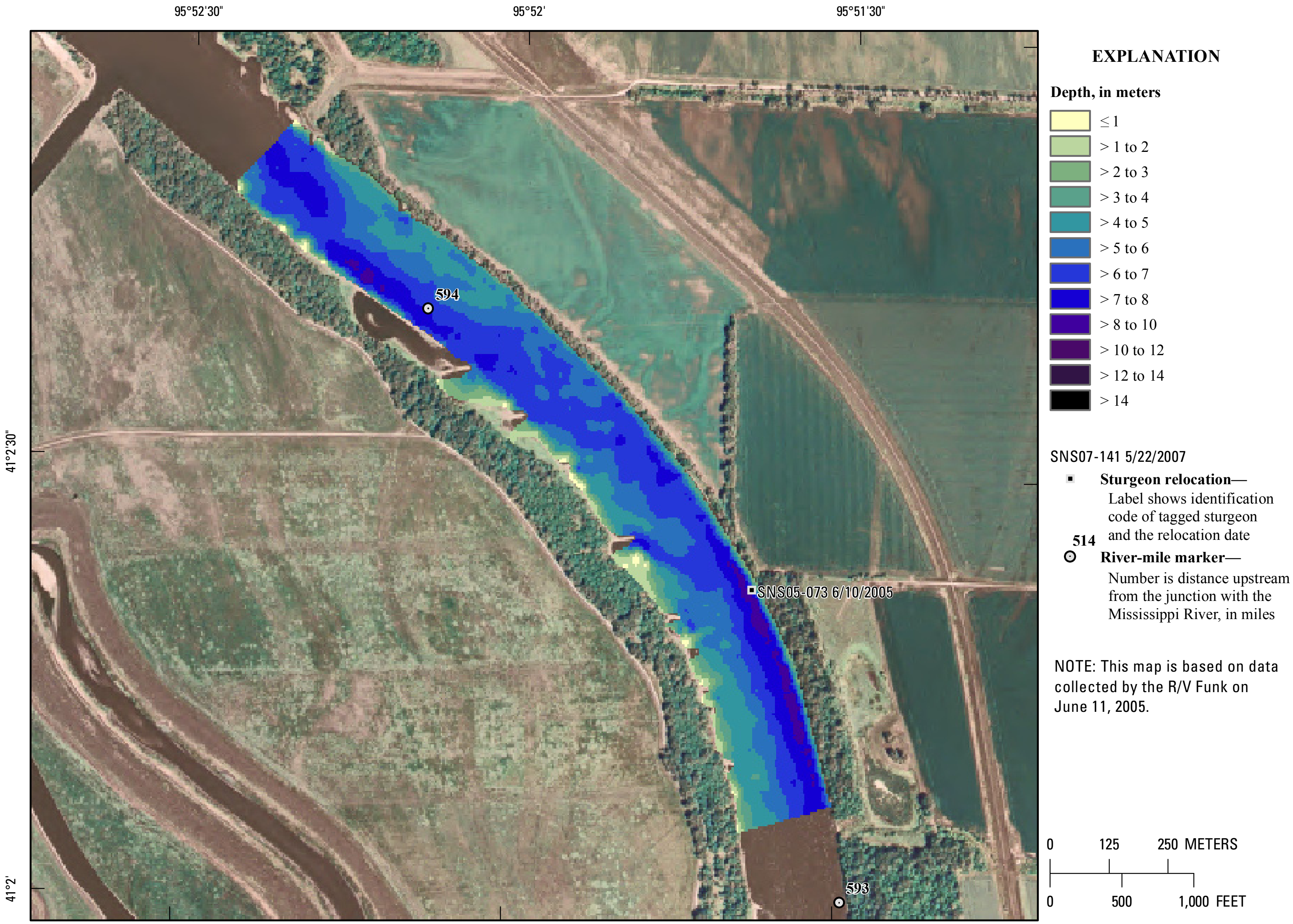
Figure 262. Map of generalized substrate based on data collected on May 22, 2005, in the vicinity of river mile 601.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

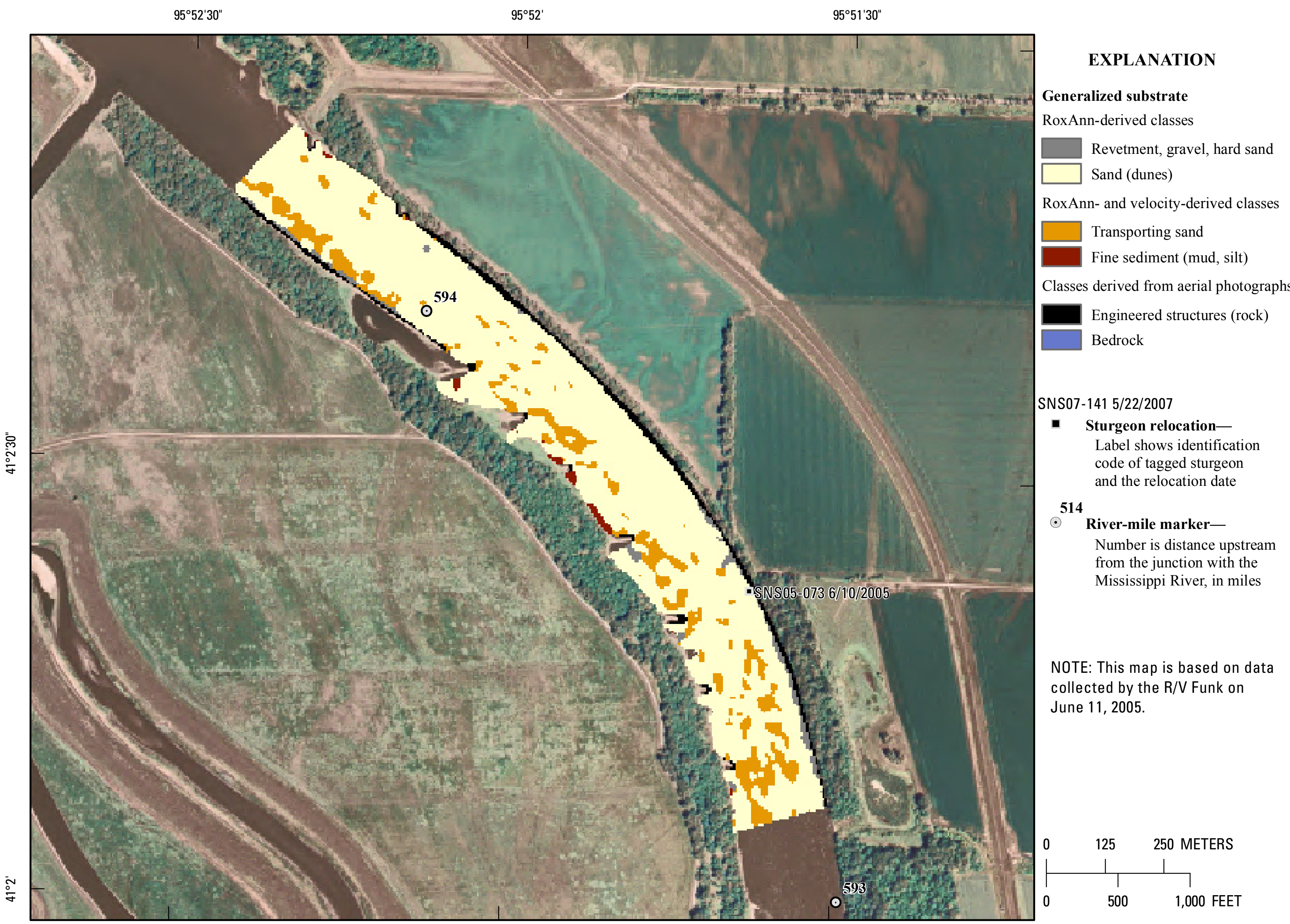
Figure 263. Map of depth-averaged velocity based on data collected on May 22, 2005, in the vicinity of river mile 601.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 264. Map of depth based on data collected on June 11, 2005, in the vicinity of river mile 594.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 265. Map of generalized substrate based on data collected on June 11, 2005, in the vicinity of river mile 594.

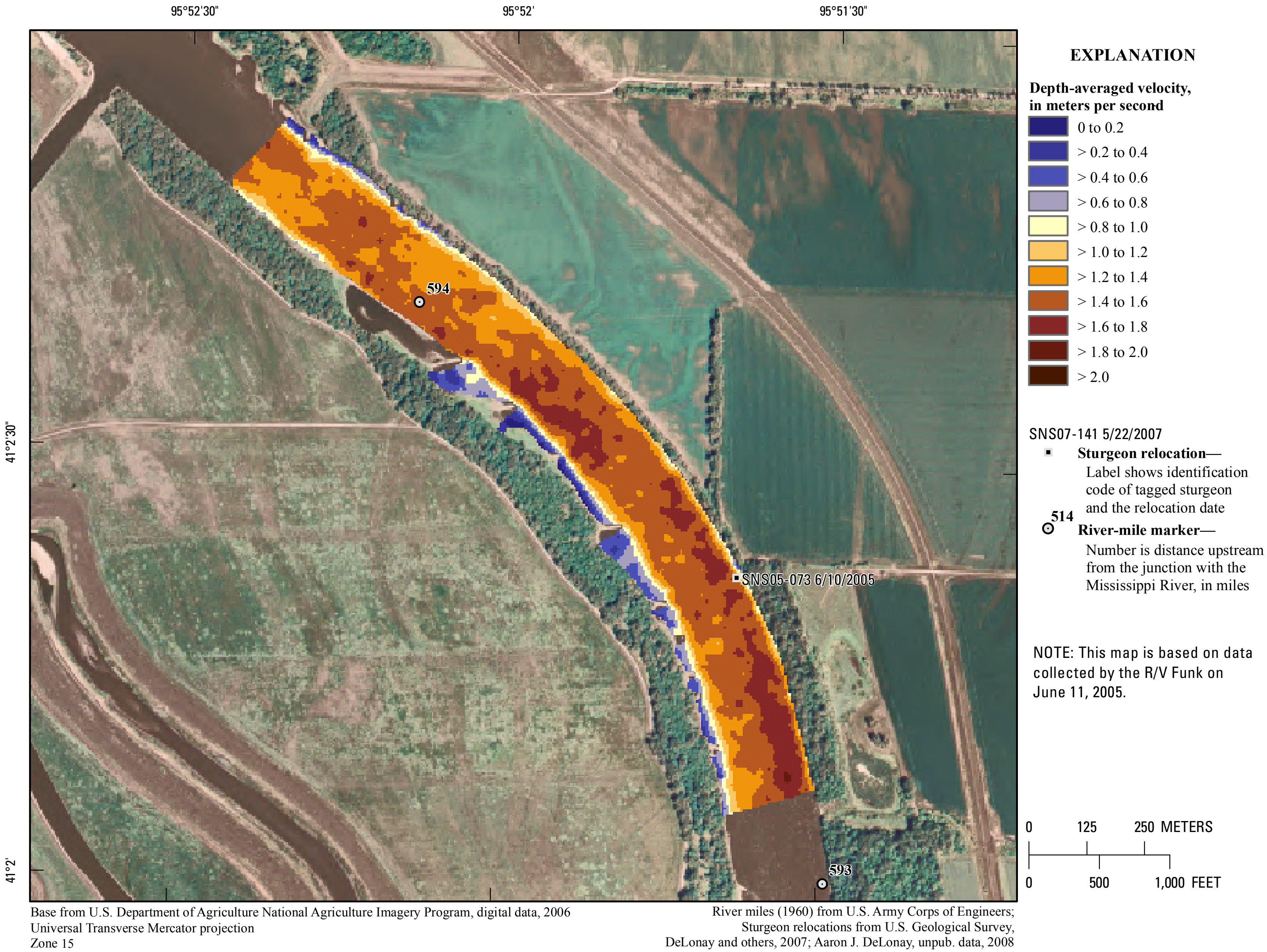
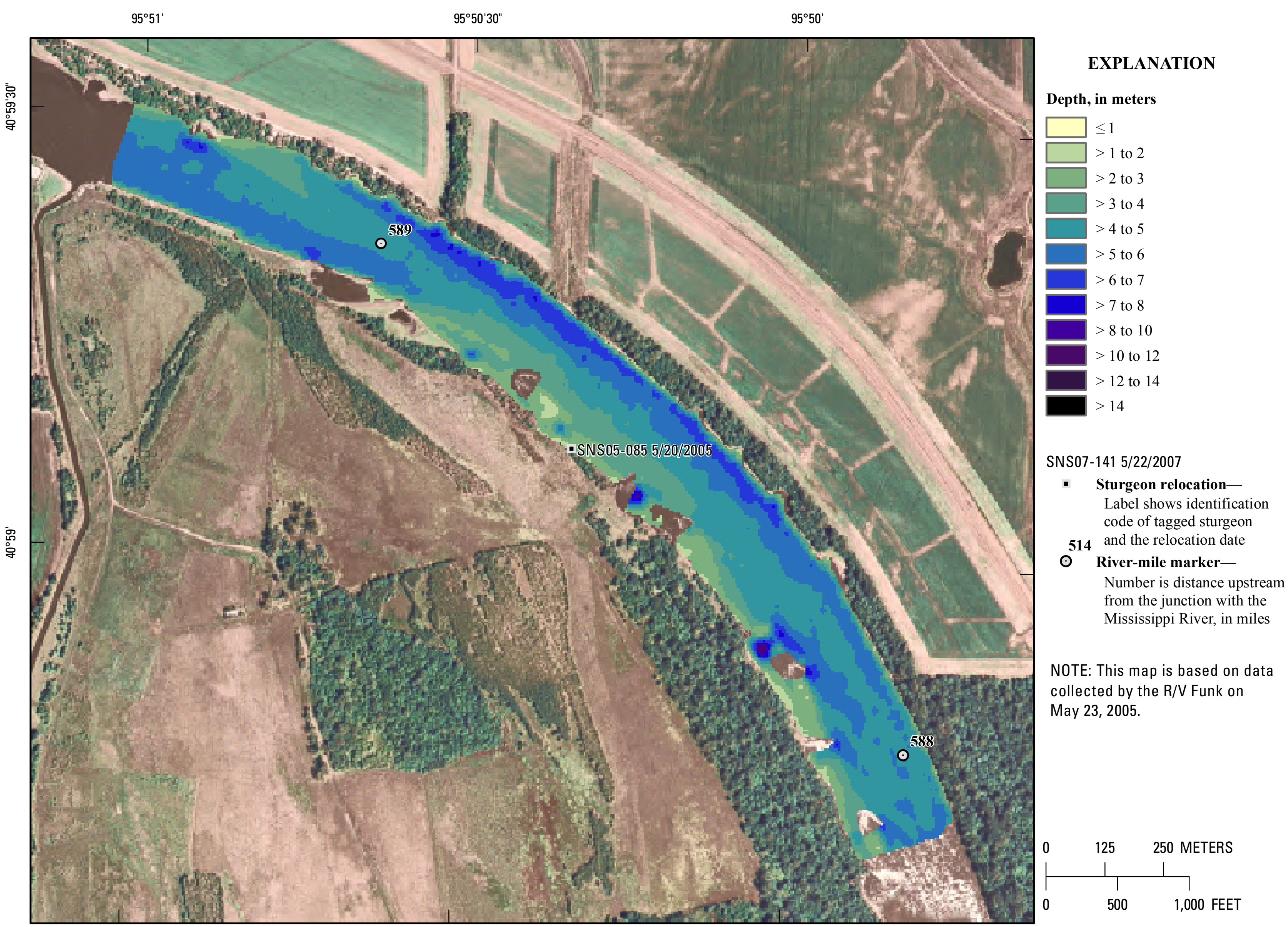


Figure 266. Map of depth-averaged velocity based on data collected on June 11, 2005, in the vicinity of river mile 594.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 267. Map of depth based on data collected on May 23, 2005, in the vicinity of river mile 589.

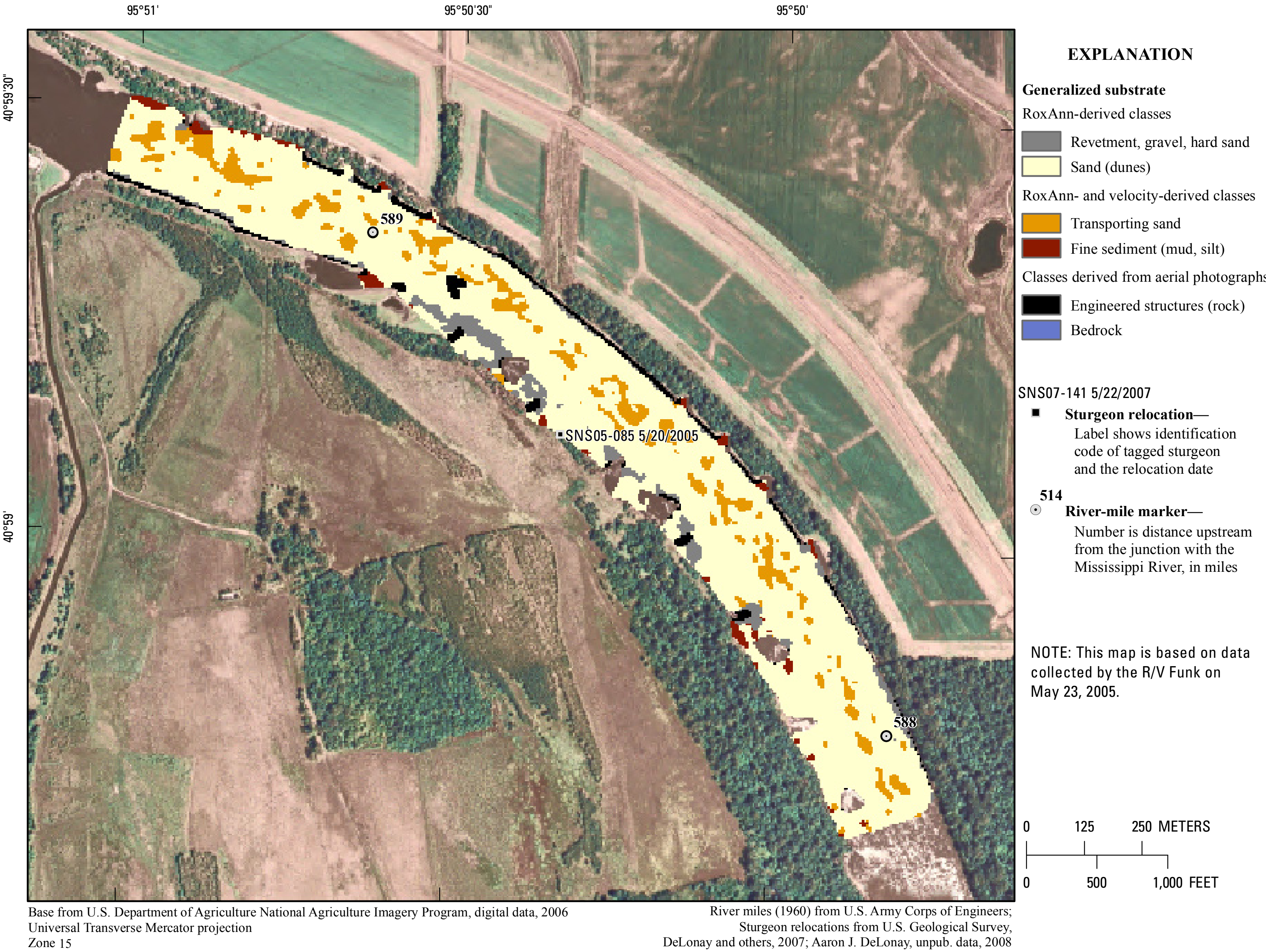
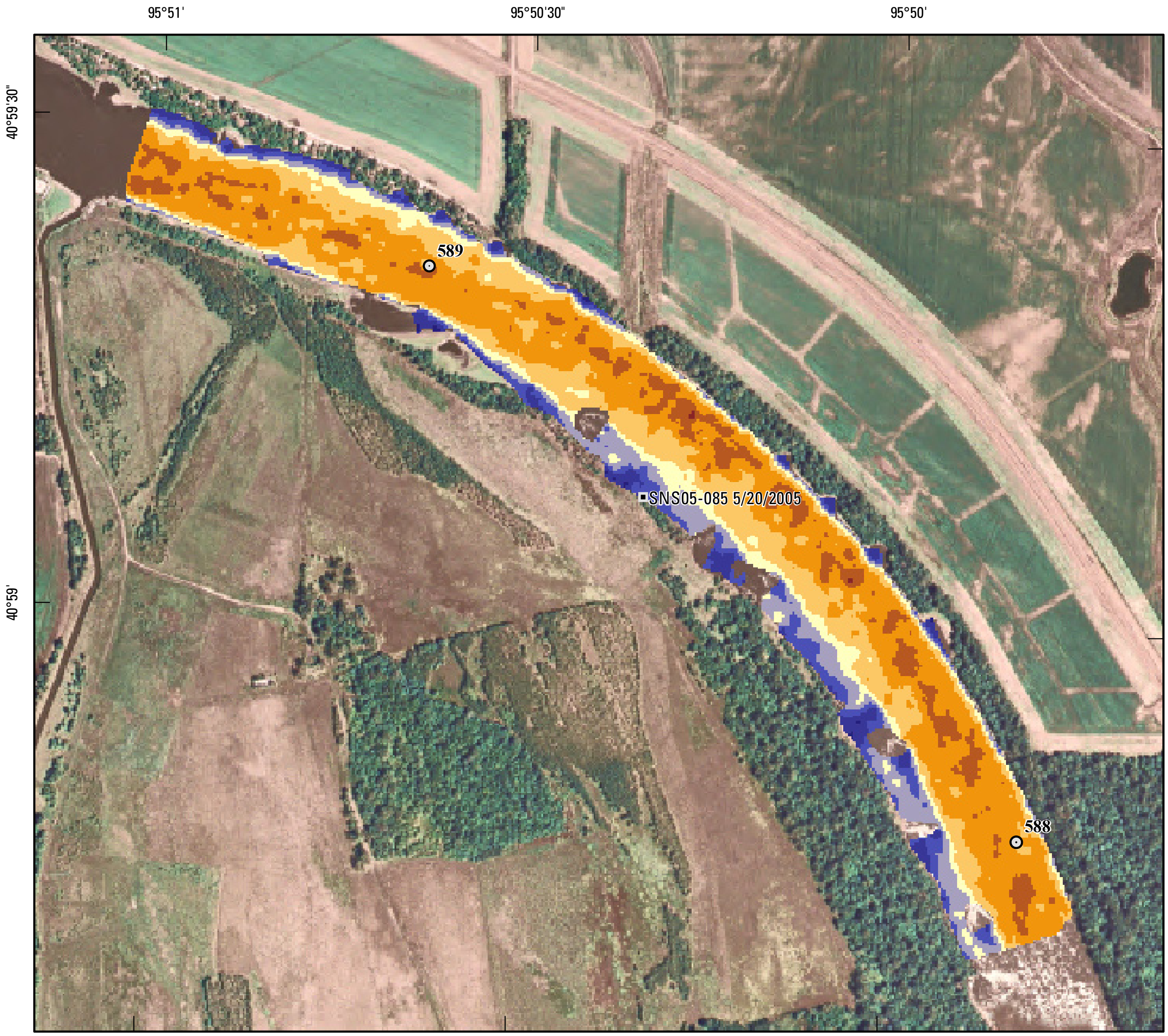


Figure 268. Map of generalized substrate based on data collected on May 23, 2005, in the vicinity of river mile 589.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on May 23, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 269. Map of depth-averaged velocity based on data collected on May 23, 2005, in the vicinity of river mile 589.

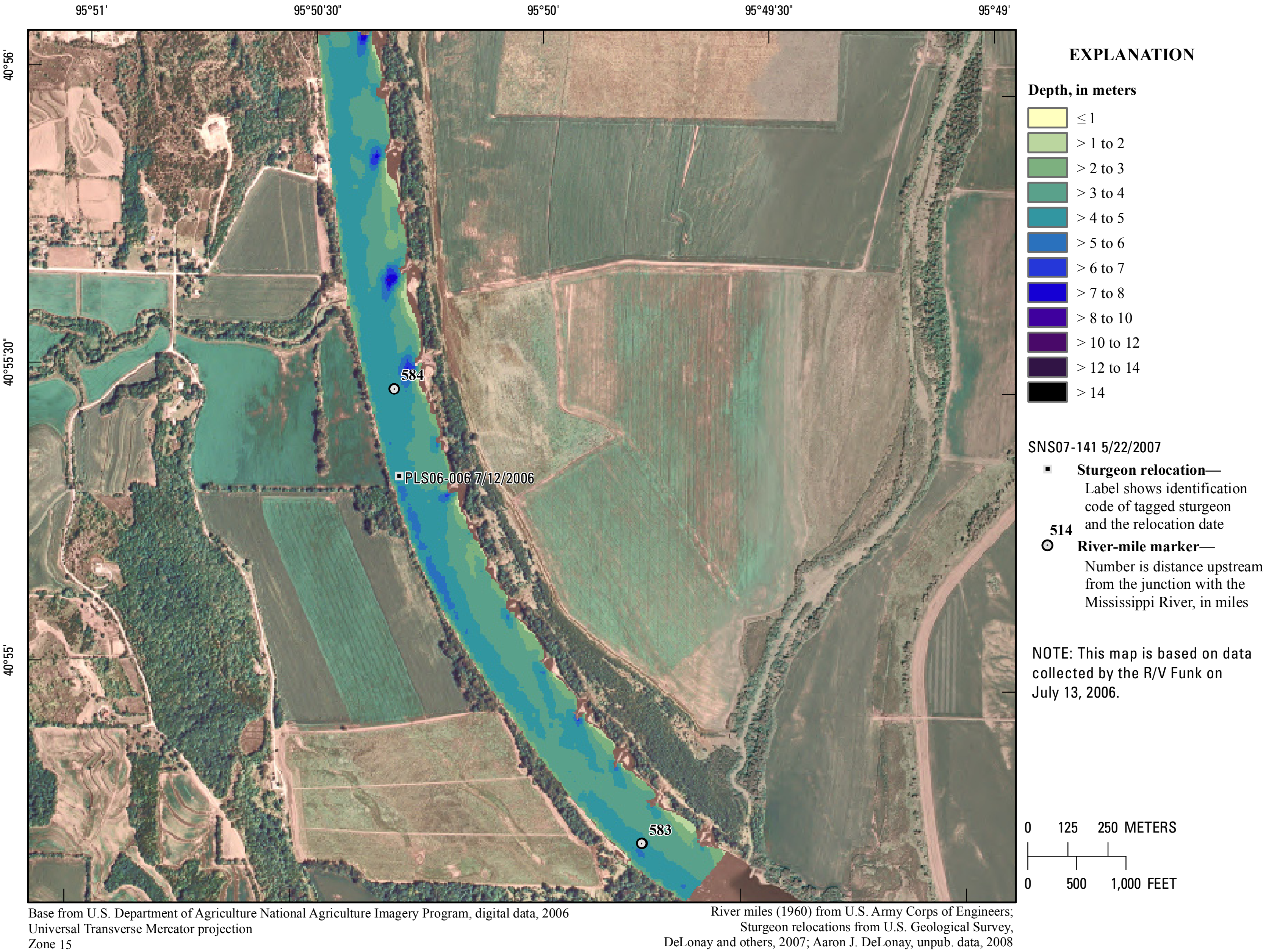
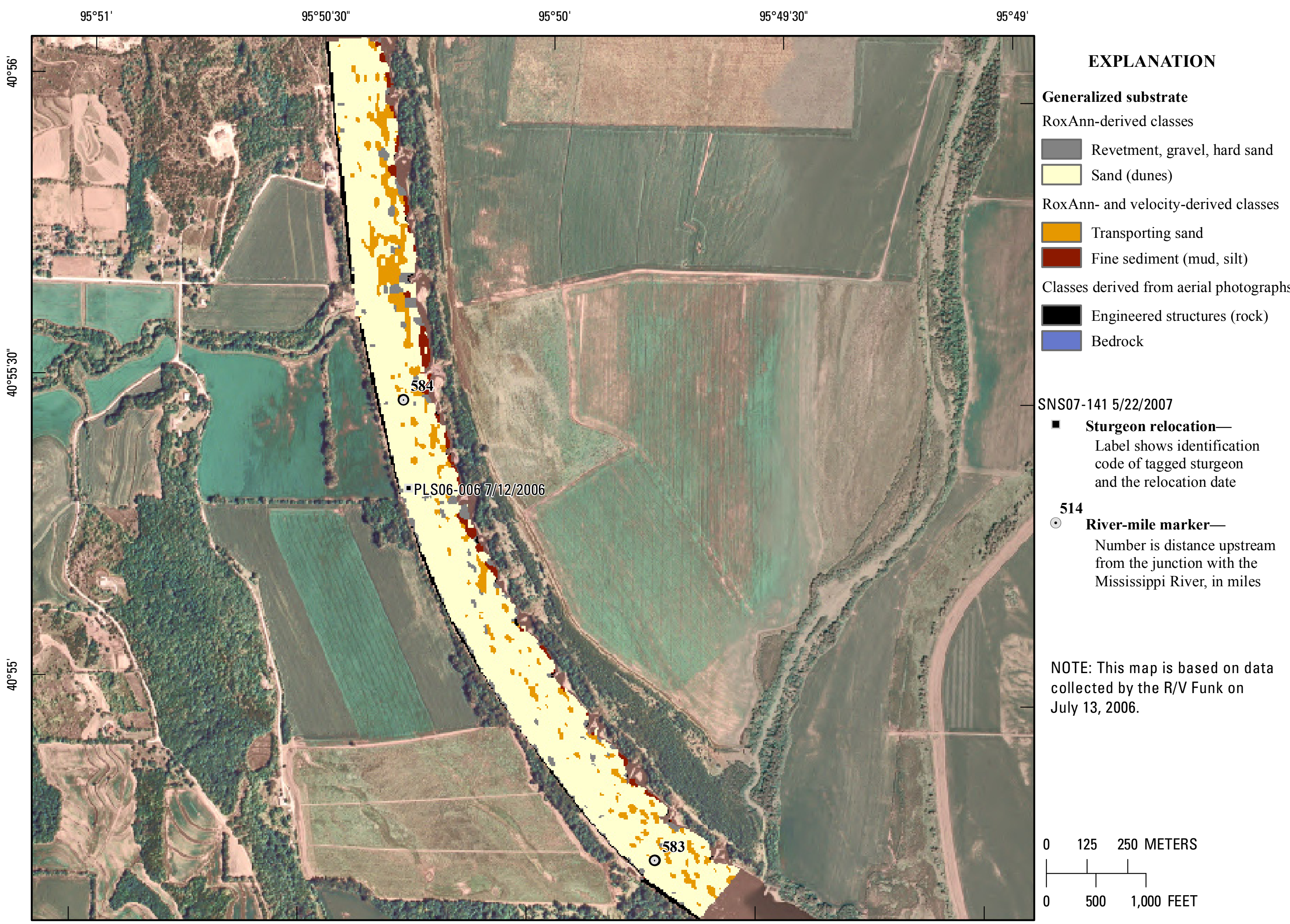


Figure 270. Map of depth based on data collected on July 13, 2006, in the vicinity of river mile 584.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 271. Map of generalized substrate based on data collected on July 13, 2006, in the vicinity of river mile 584.

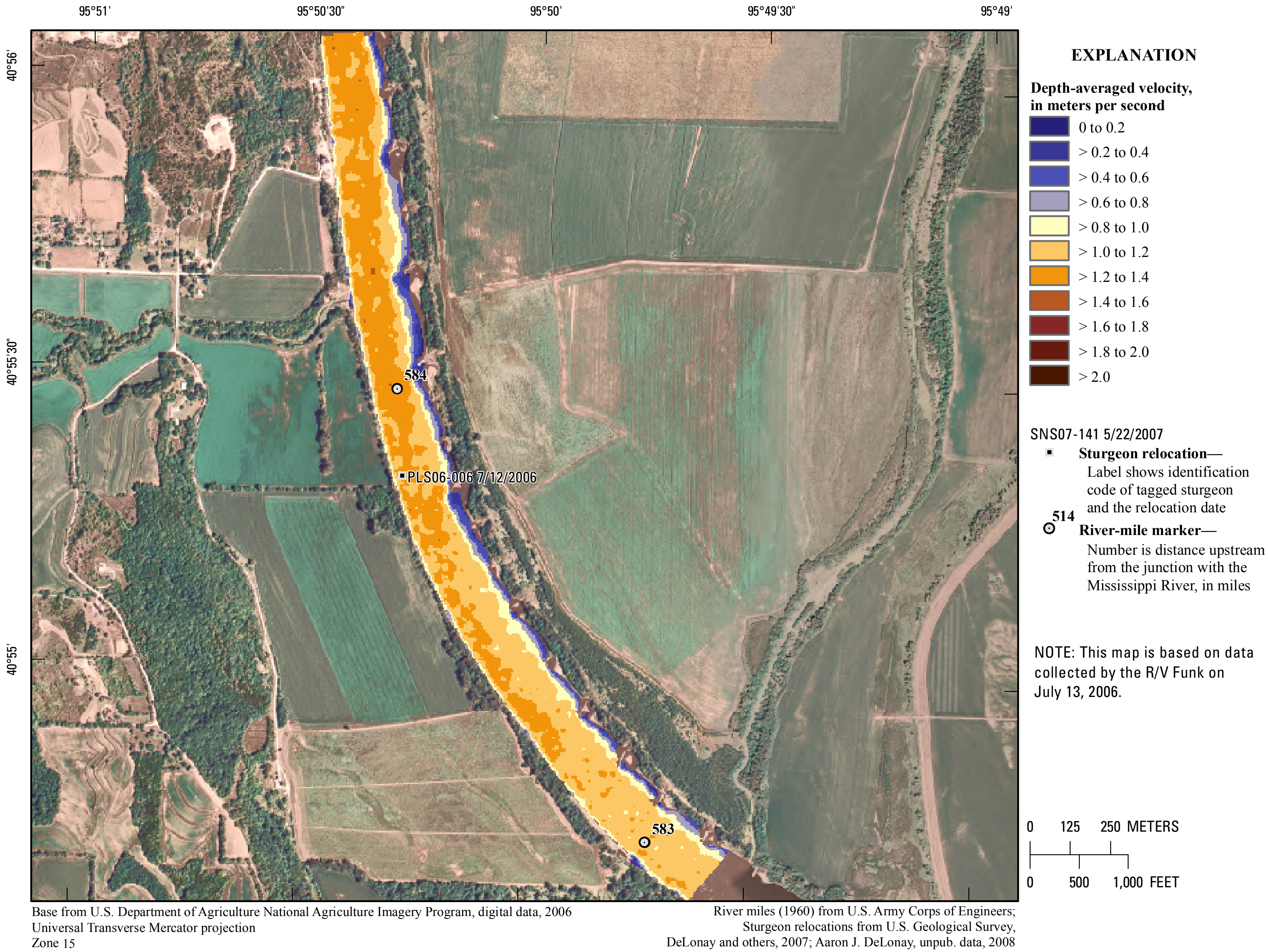


Figure 272. Map of depth-averaged velocity based on data collected on July 13, 2006, in the vicinity of river mile 584.

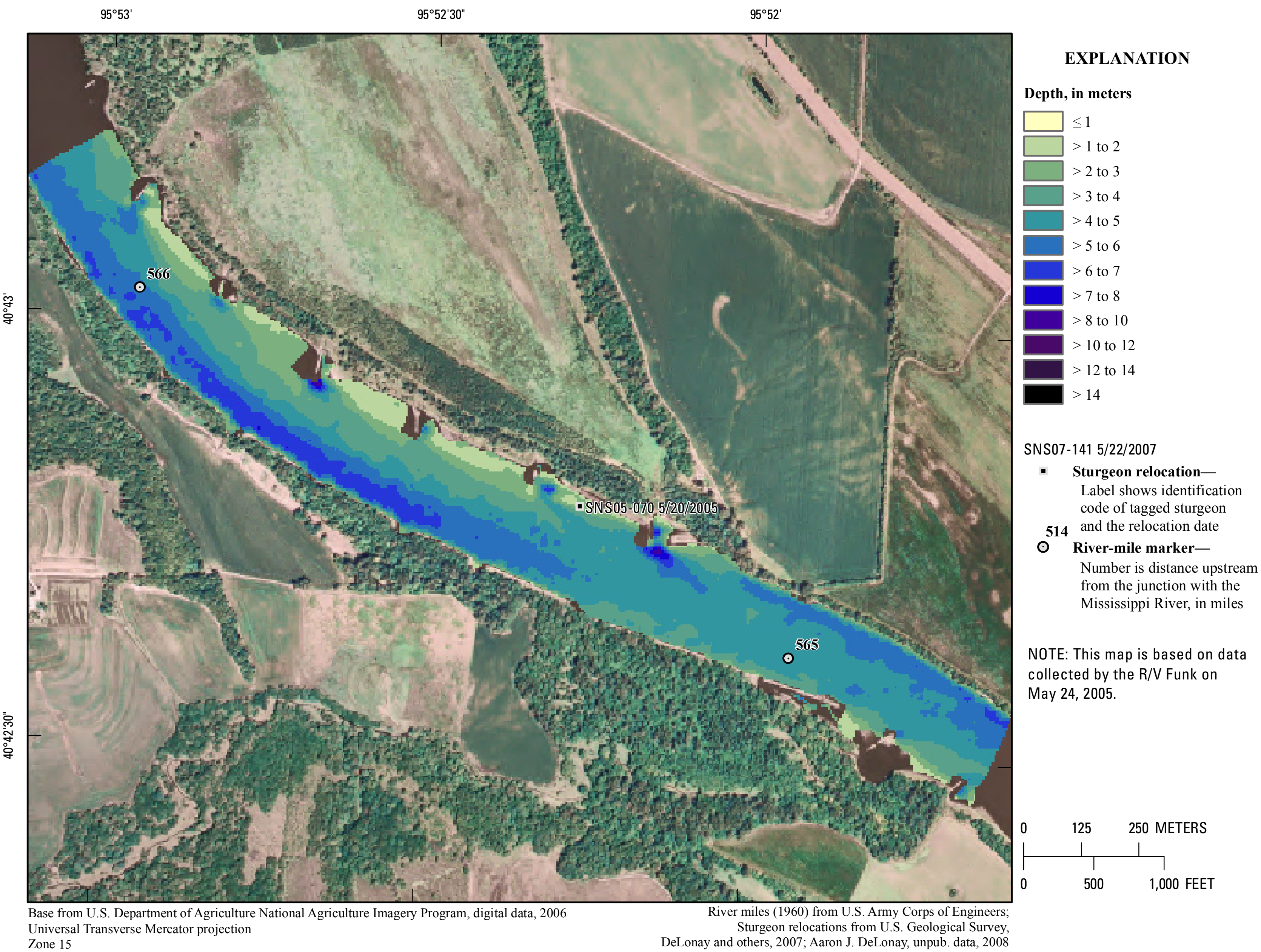
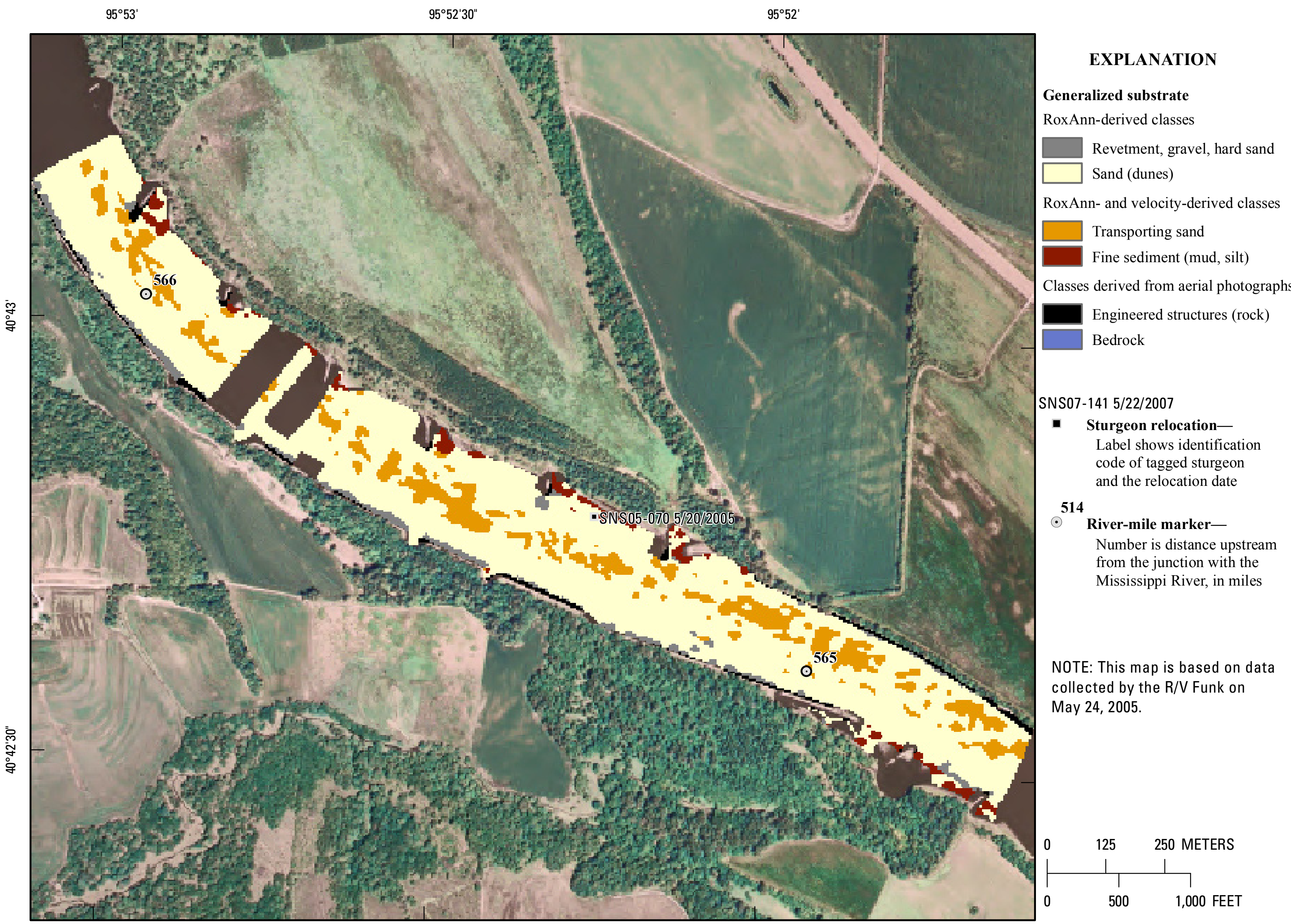


Figure 273. Map of depth based on data collected on May 24, 2005, in the vicinity of river mile 566.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 274. Map of generalized substrate based on data collected on May 24, 2005, in the vicinity of river mile 566.

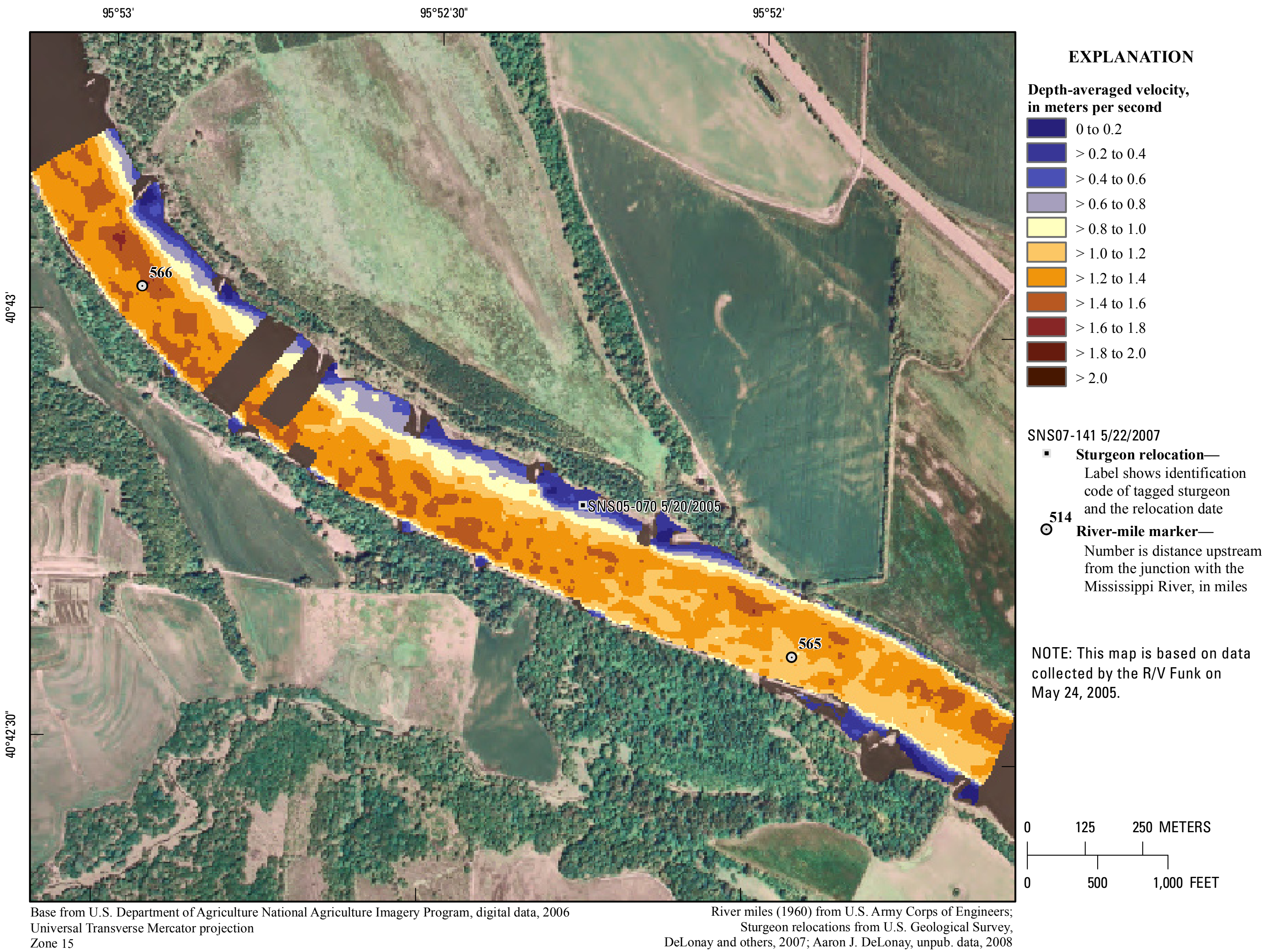


Figure 275. Map of depth-averaged velocity based on data collected on May 24, 2005, in the vicinity of river mile 566.

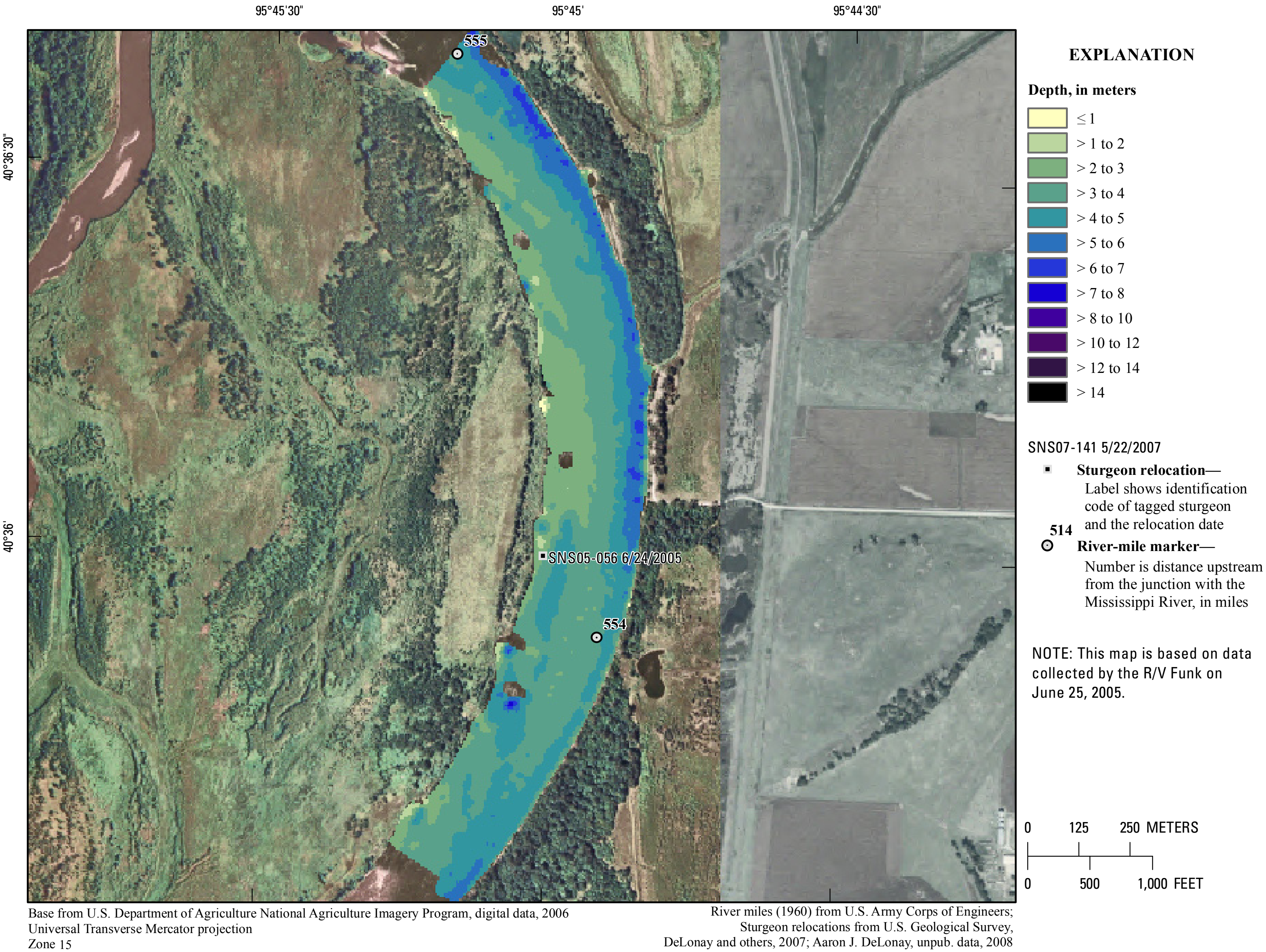


Figure 276. Map of depth based on data collected on June 25, 2005, in the vicinity of river mile 554.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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■ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514

⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on June 25, 2005.

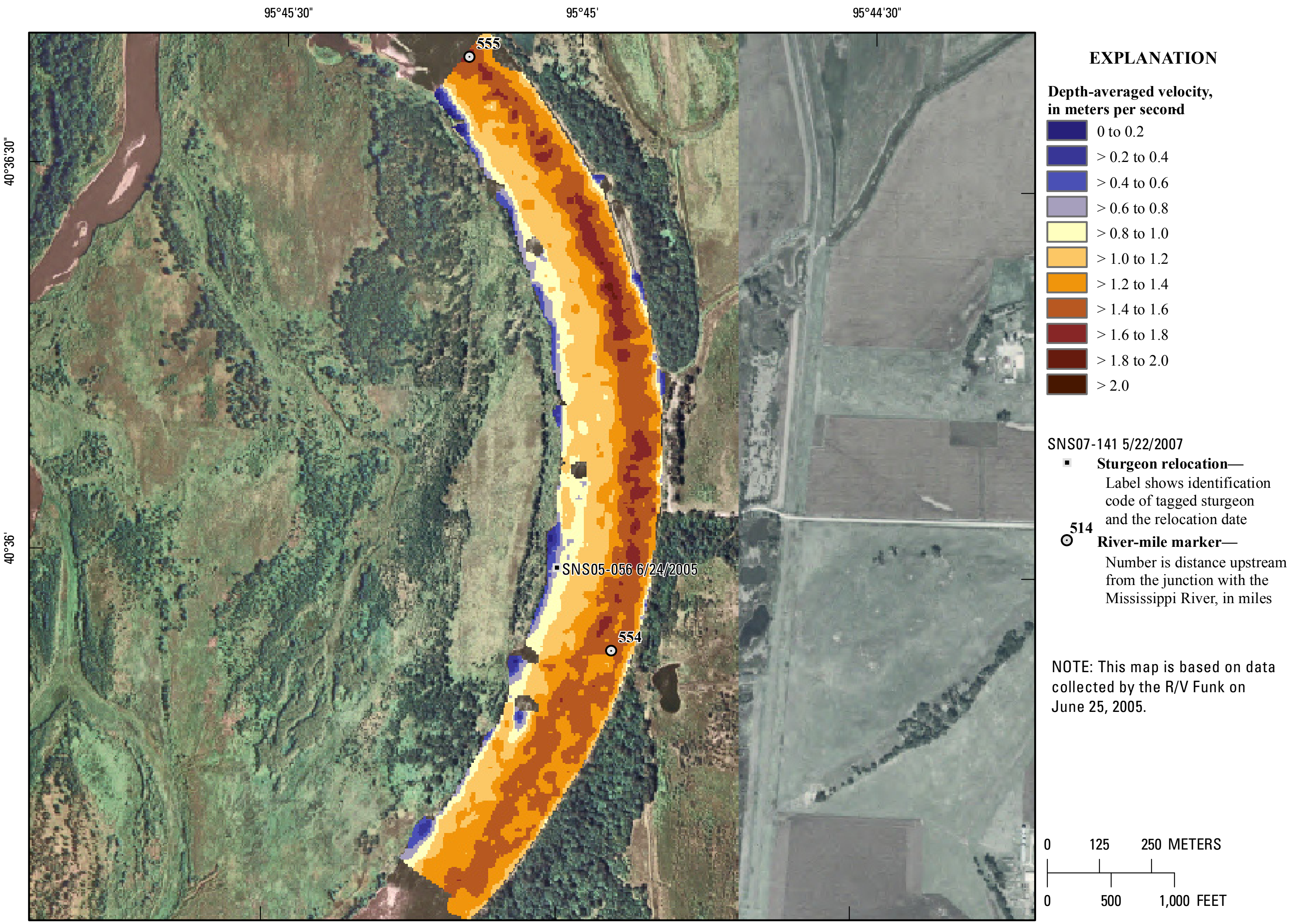
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

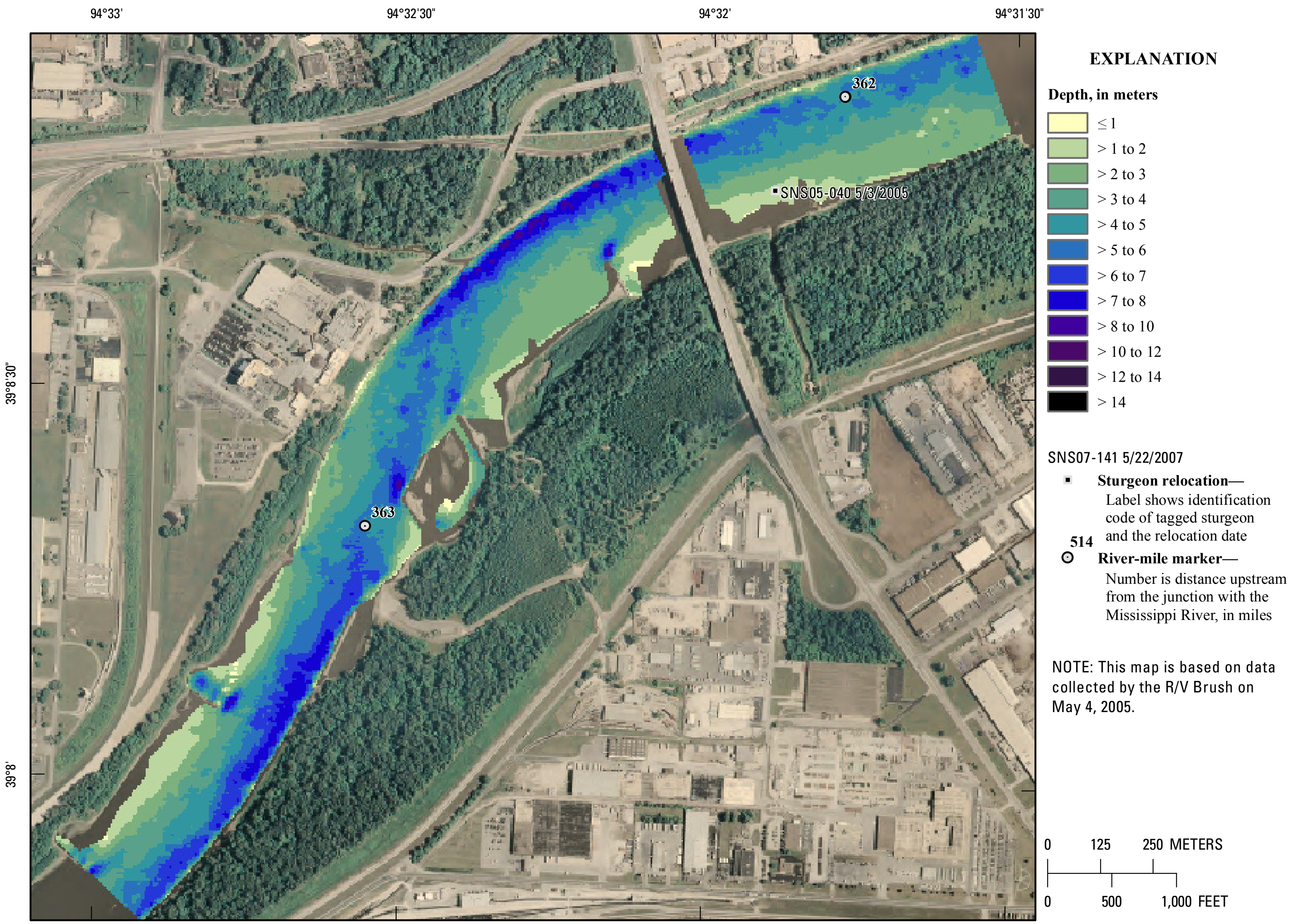
Figure 277. Map of generalized substrate based on data collected on June 25, 2005, in the vicinity of river mile 554.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

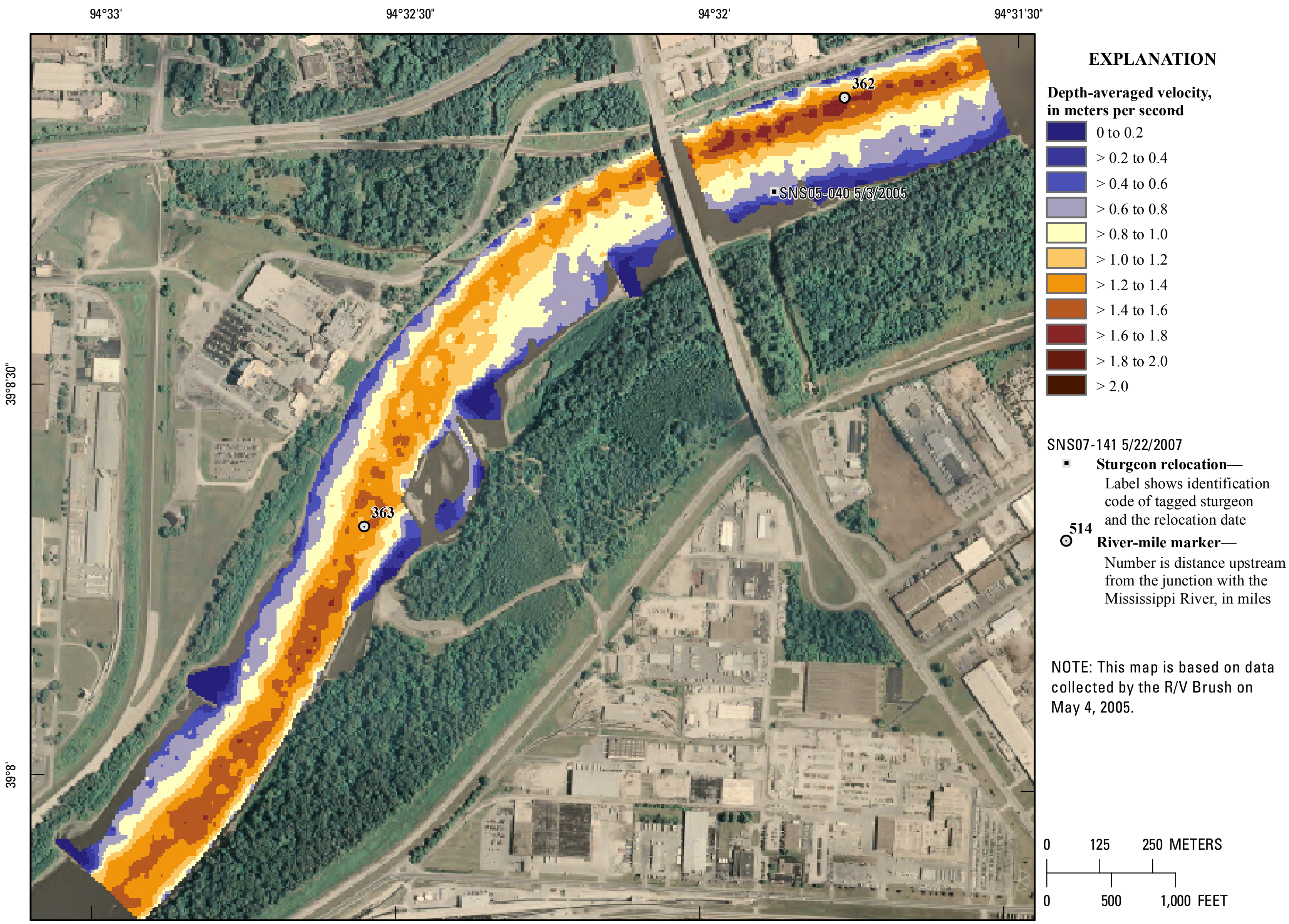
Figure 278. Map of depth-averaged velocity based on data collected on June 25, 2005, in the vicinity of river mile 554.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

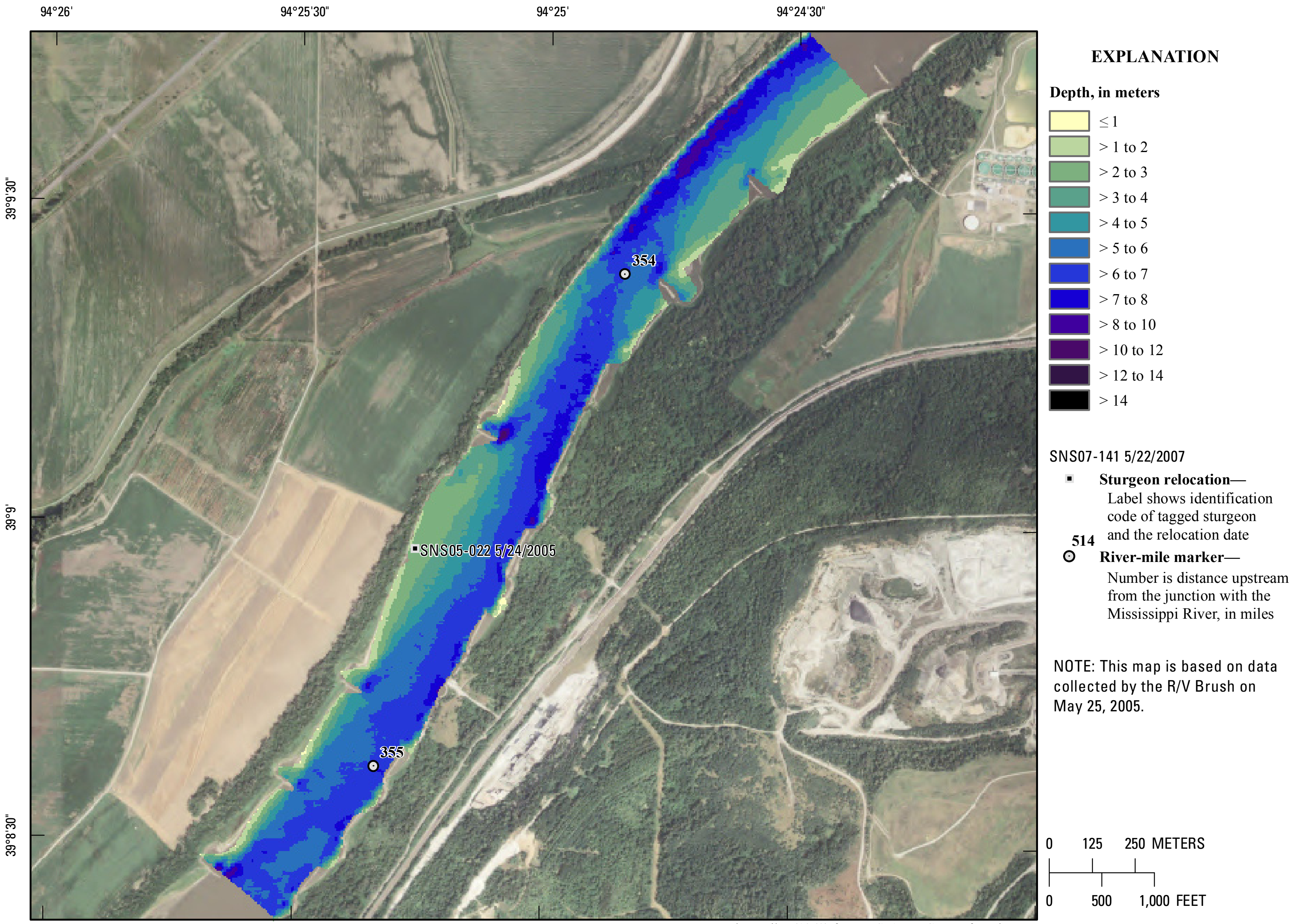
Figure 279. Map of depth based on data collected on May 4, 2005, in the vicinity of river mile 363.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

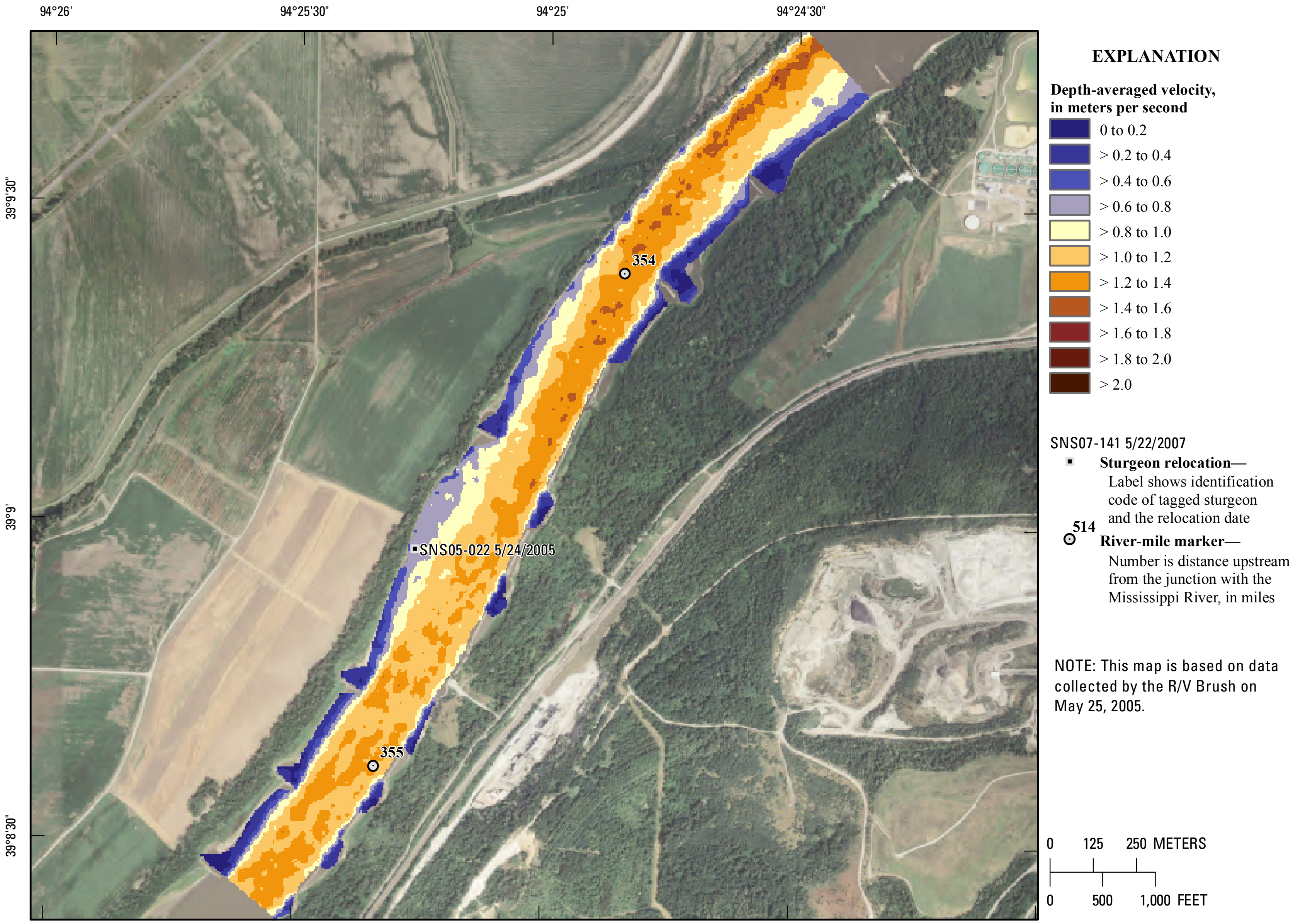
Figure 280. Map of depth-averaged velocity based on data collected on May 4, 2005, in the vicinity of river mile 363.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

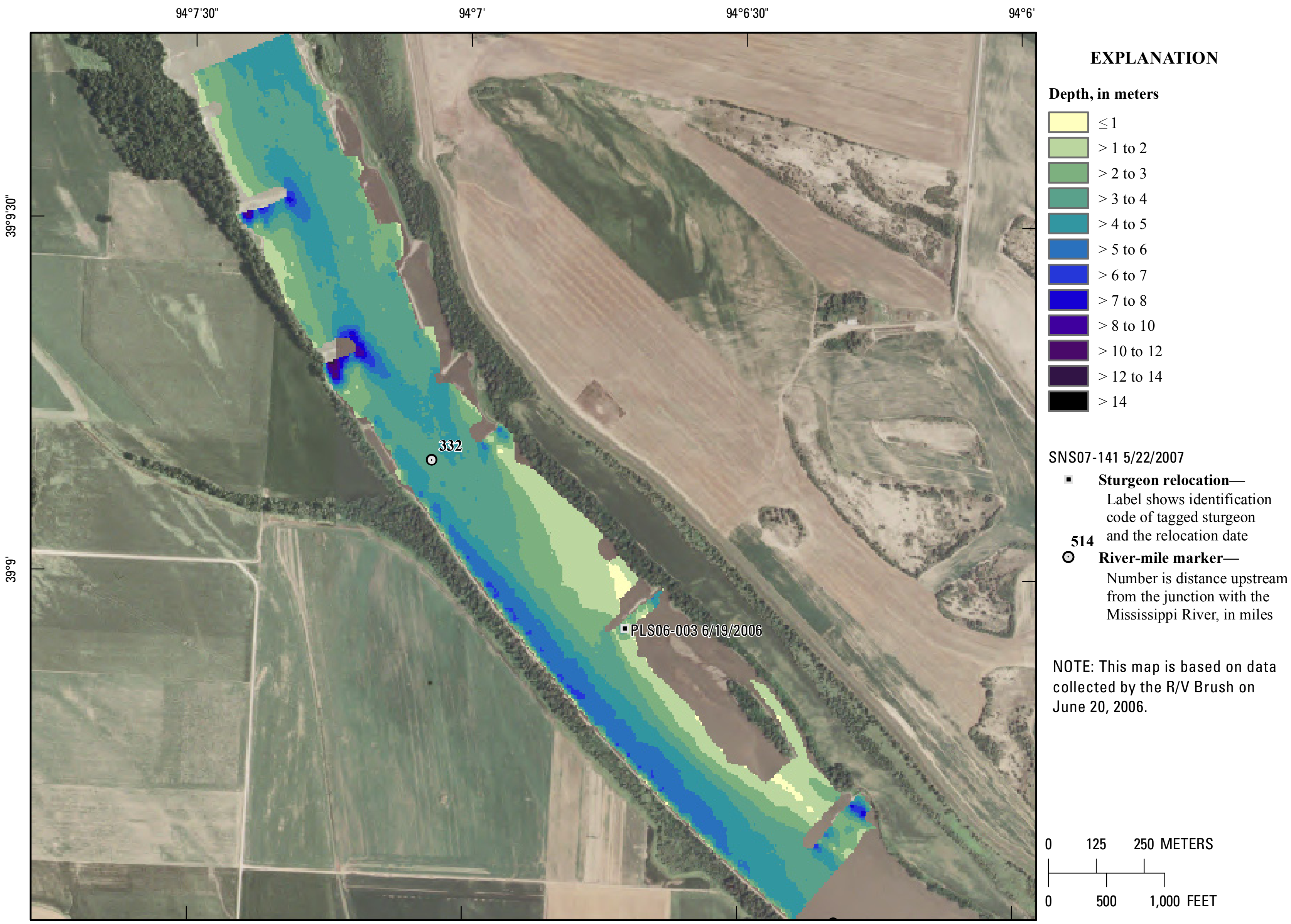
Figure 281. Map of depth based on data collected on May 25, 2005, in the vicinity of river mile 354.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 282. Map of depth-averaged velocity based on data collected on May 25, 2005, in the vicinity of river mile 354.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 283. Map of depth based on data collected on June 20, 2006, in the vicinity of river mile 332.

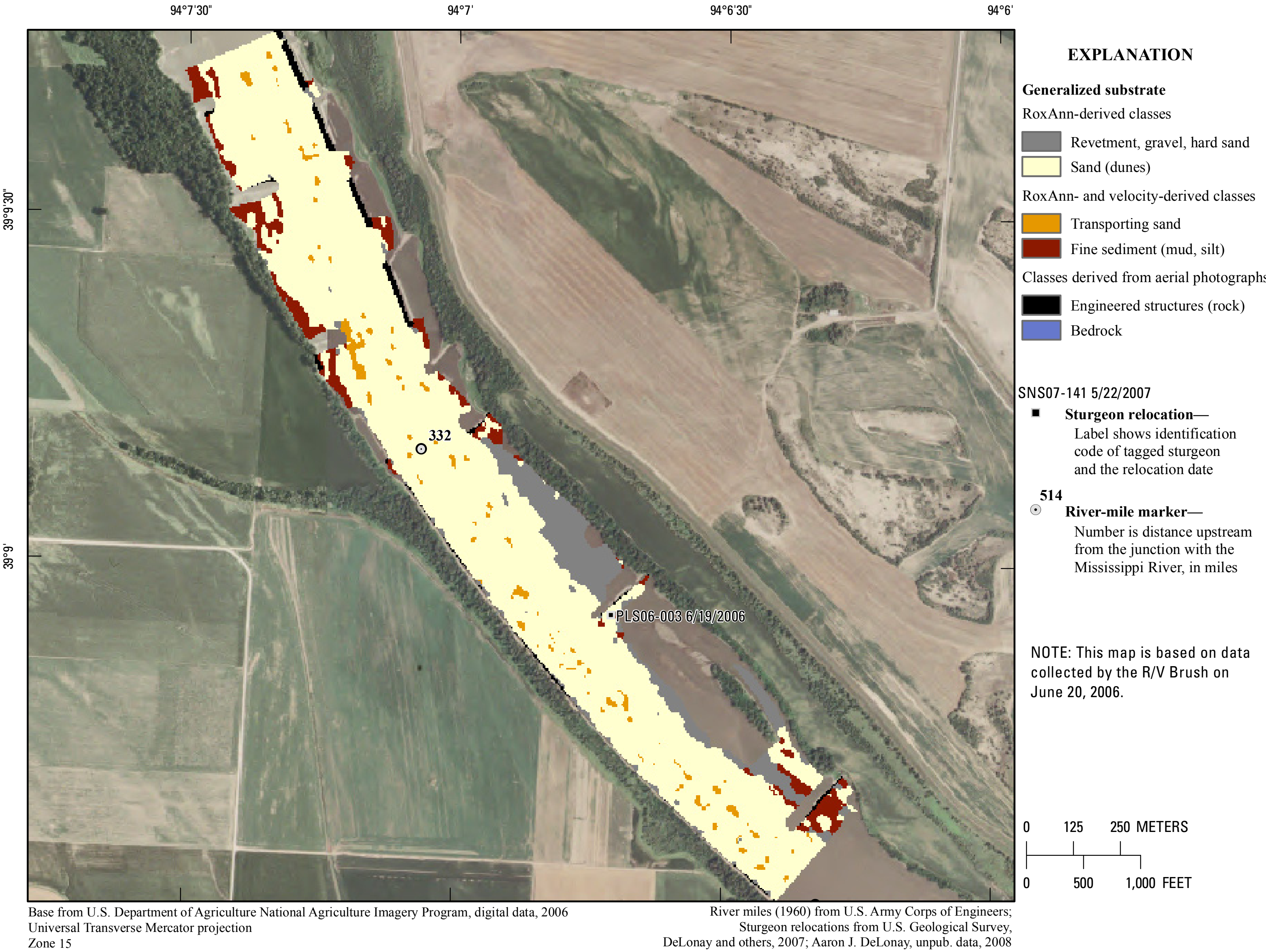
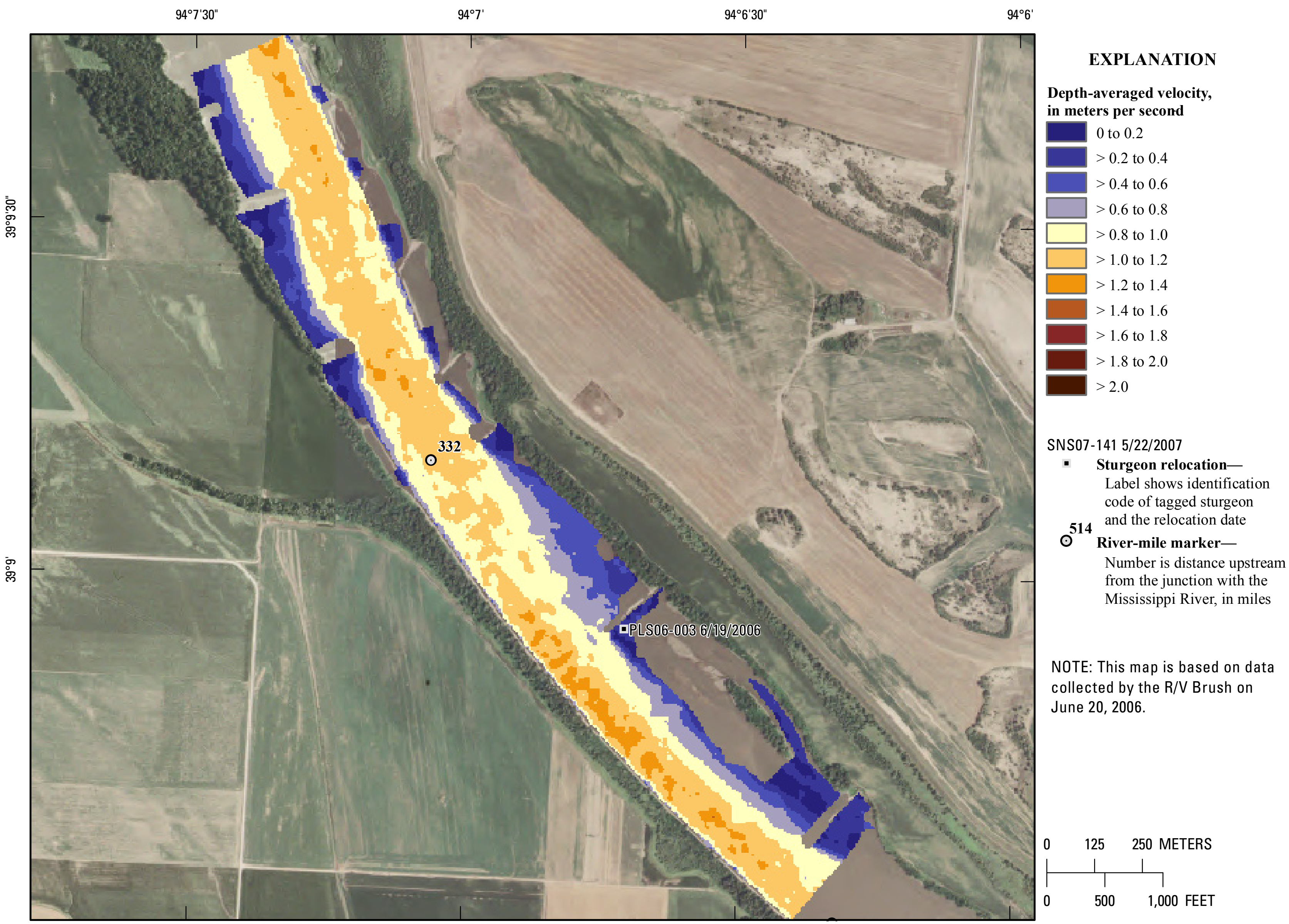


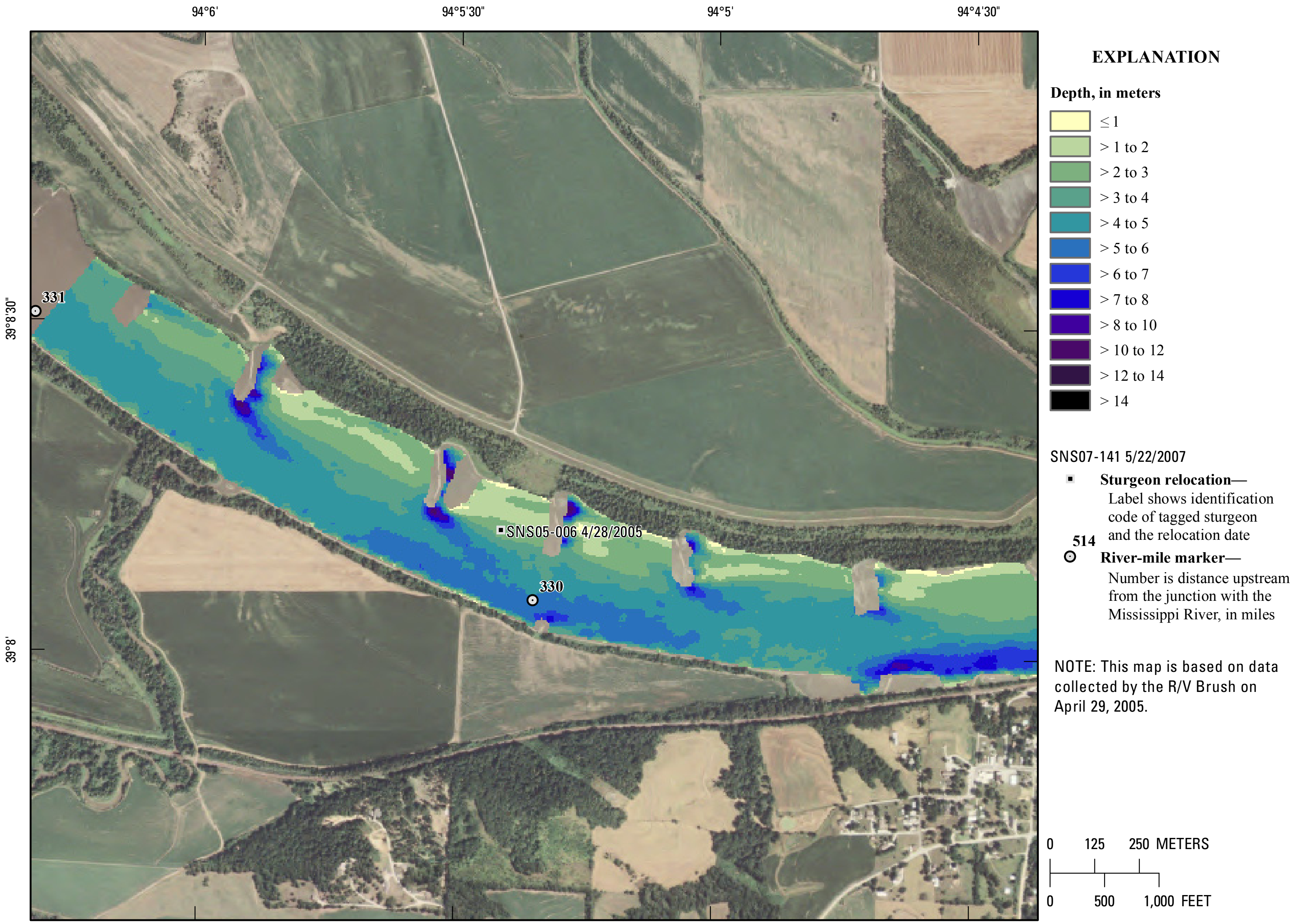
Figure 284. Map of generalized substrate based on data collected on June 20, 2006, in the vicinity of river mile 332.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

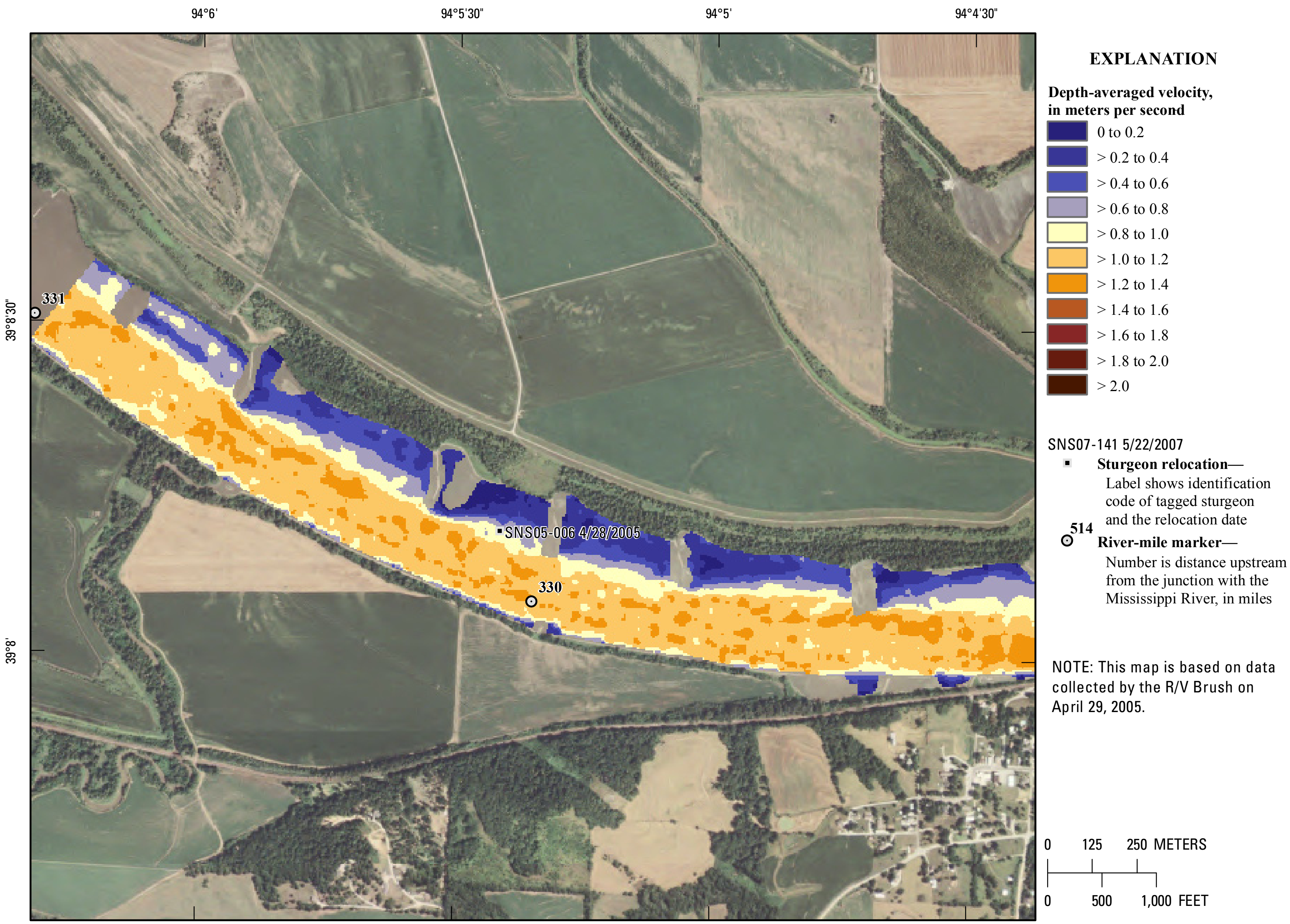
Figure 285. Map of depth-averaged velocity based on data collected on June 20, 2006, in the vicinity of river mile 332.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 286. Map of depth based on data collected on April 29, 2005, in the vicinity of river mile 330.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 287. Map of depth-averaged velocity based on data collected on April 29, 2005, in the vicinity of river mile 330.

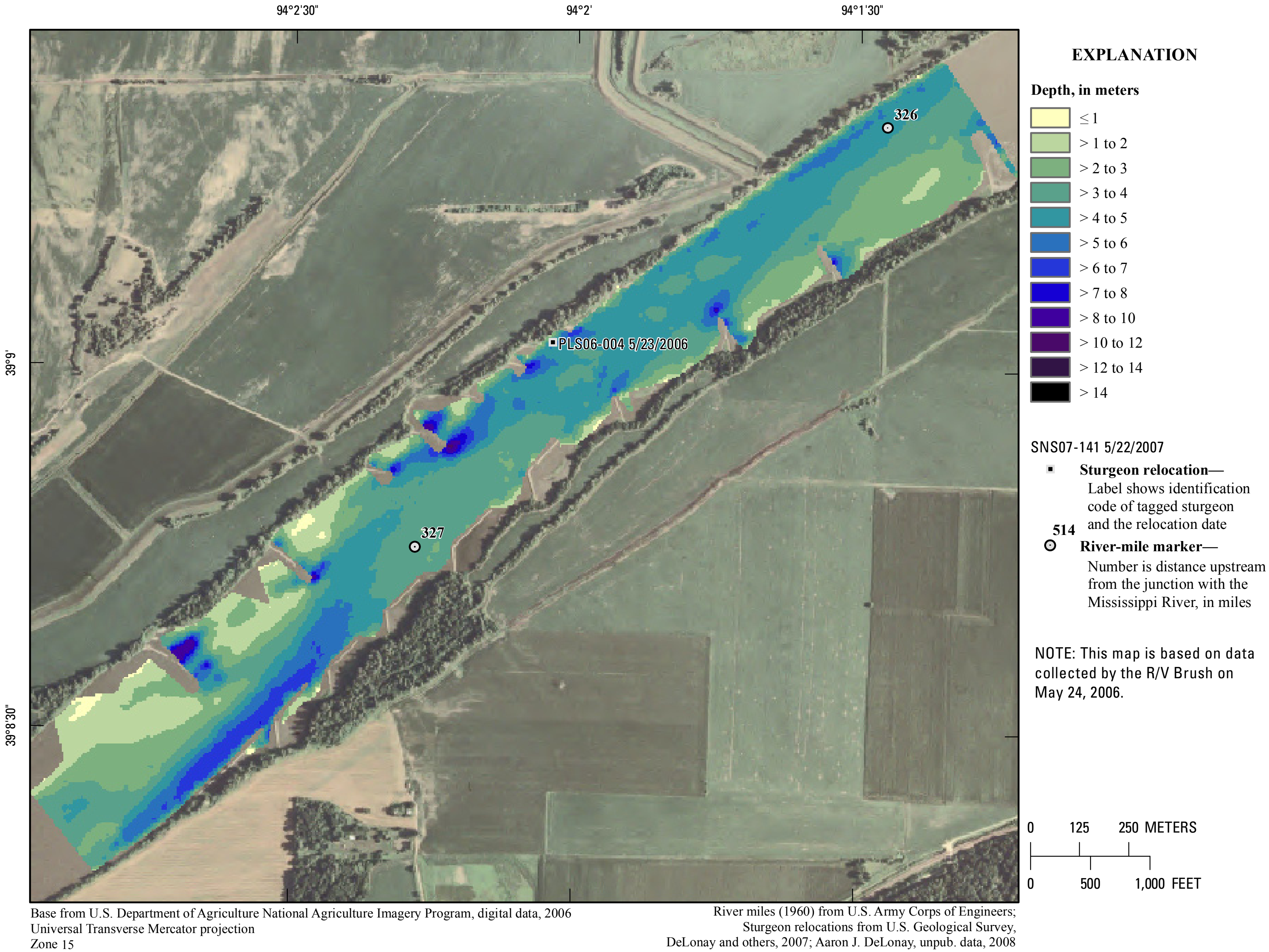
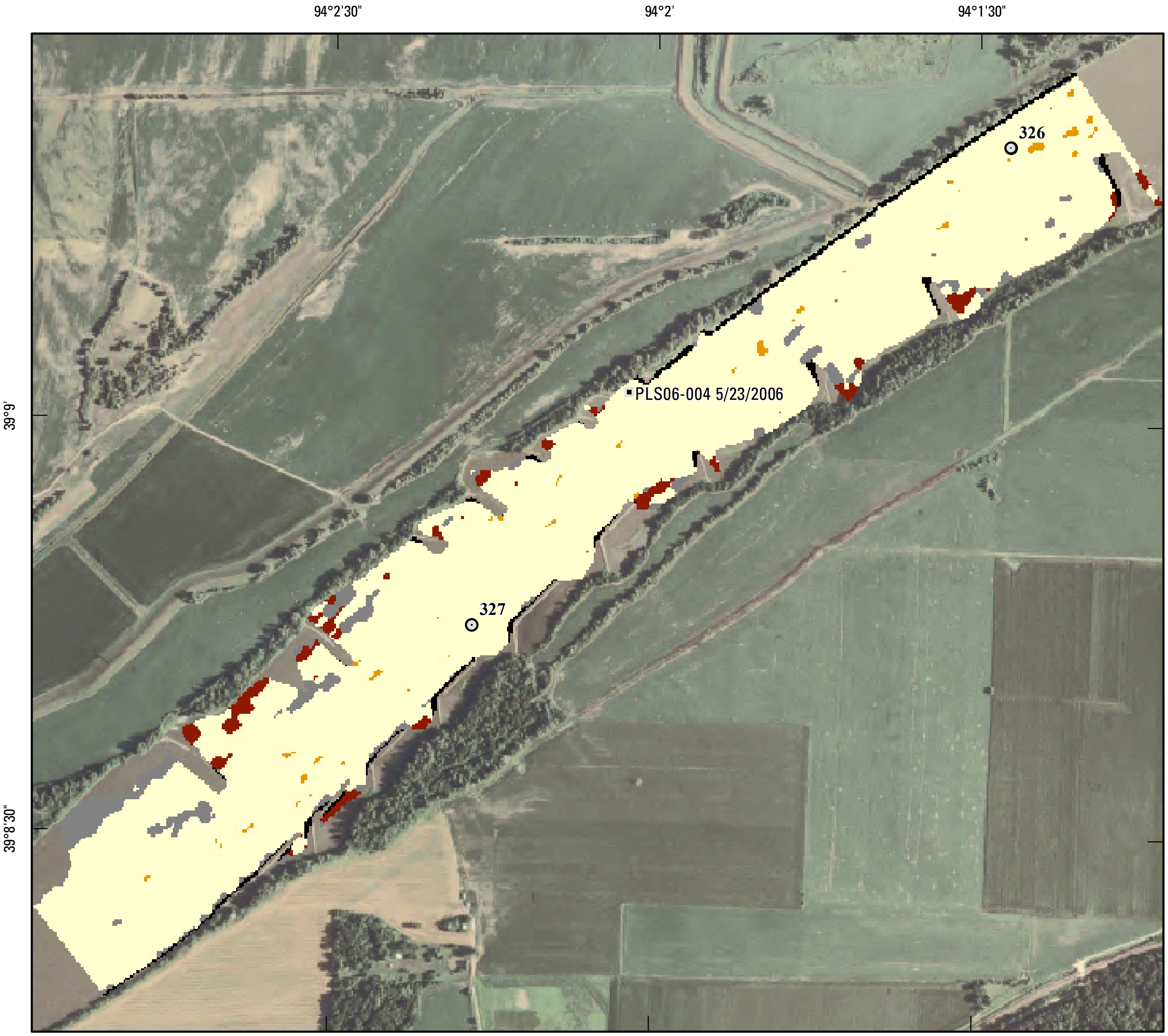


Figure 288. Map of depth based on data collected on May 24, 2006, in the vicinity of river mile 327.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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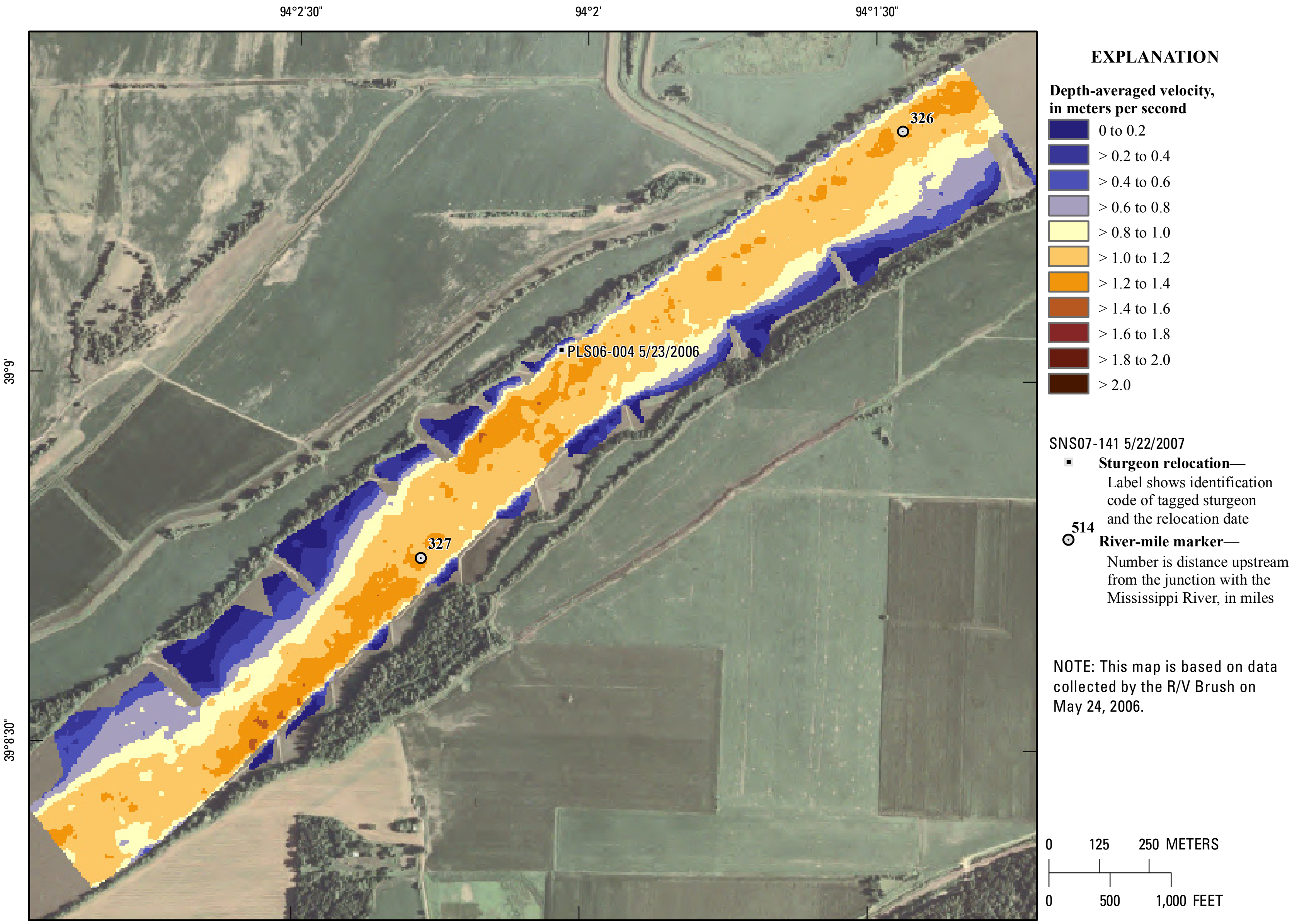
Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514
River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on May 24, 2006.

0 125 250 METERS
0 500 1,000 FEET

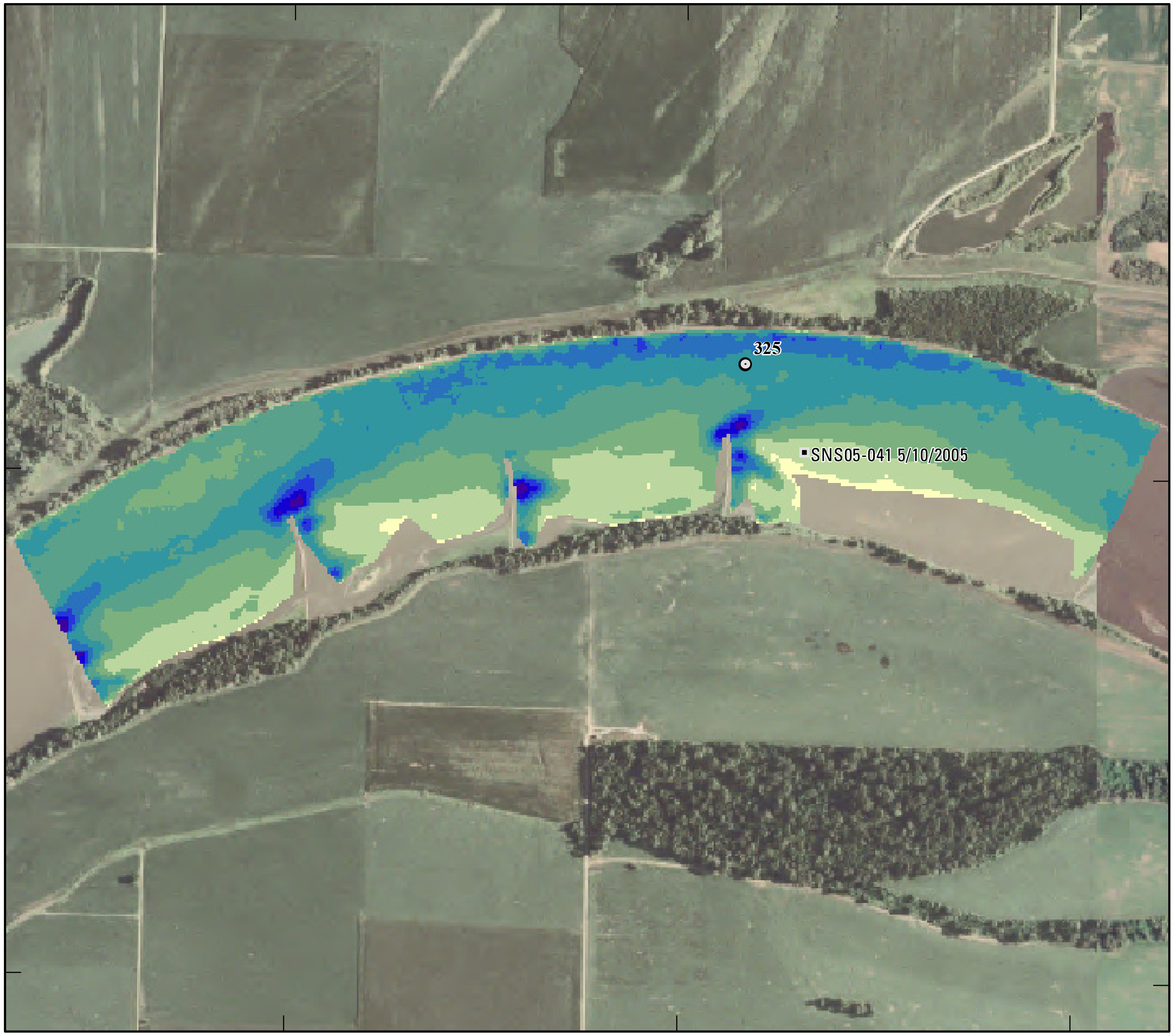
Figure 289. Map of generalized substrate based on data collected on May 24, 2006, in the vicinity of river mile 327.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 290. Map of depth-averaged velocity based on data collected on May 24, 2006, in the vicinity of river mile 327.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514
River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on May 11, 2005.

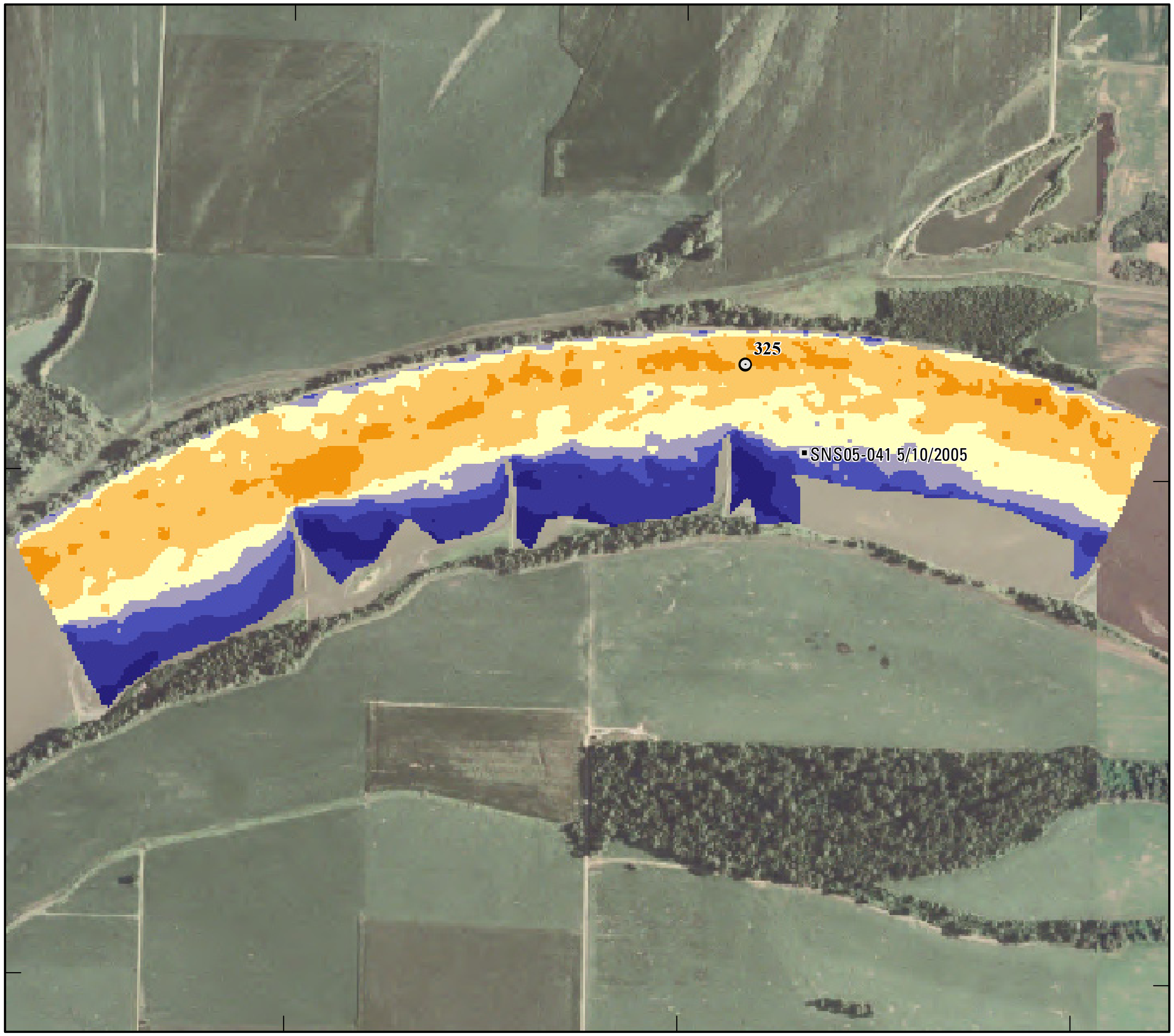
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 291. Map of depth based on data collected on May 11, 2005, in the vicinity of river mile 325.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514
River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on May 11, 2005.

0 125 250 METERS
0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 292. Map of depth-averaged velocity based on data collected on May 11, 2005, in the vicinity of river mile 325.

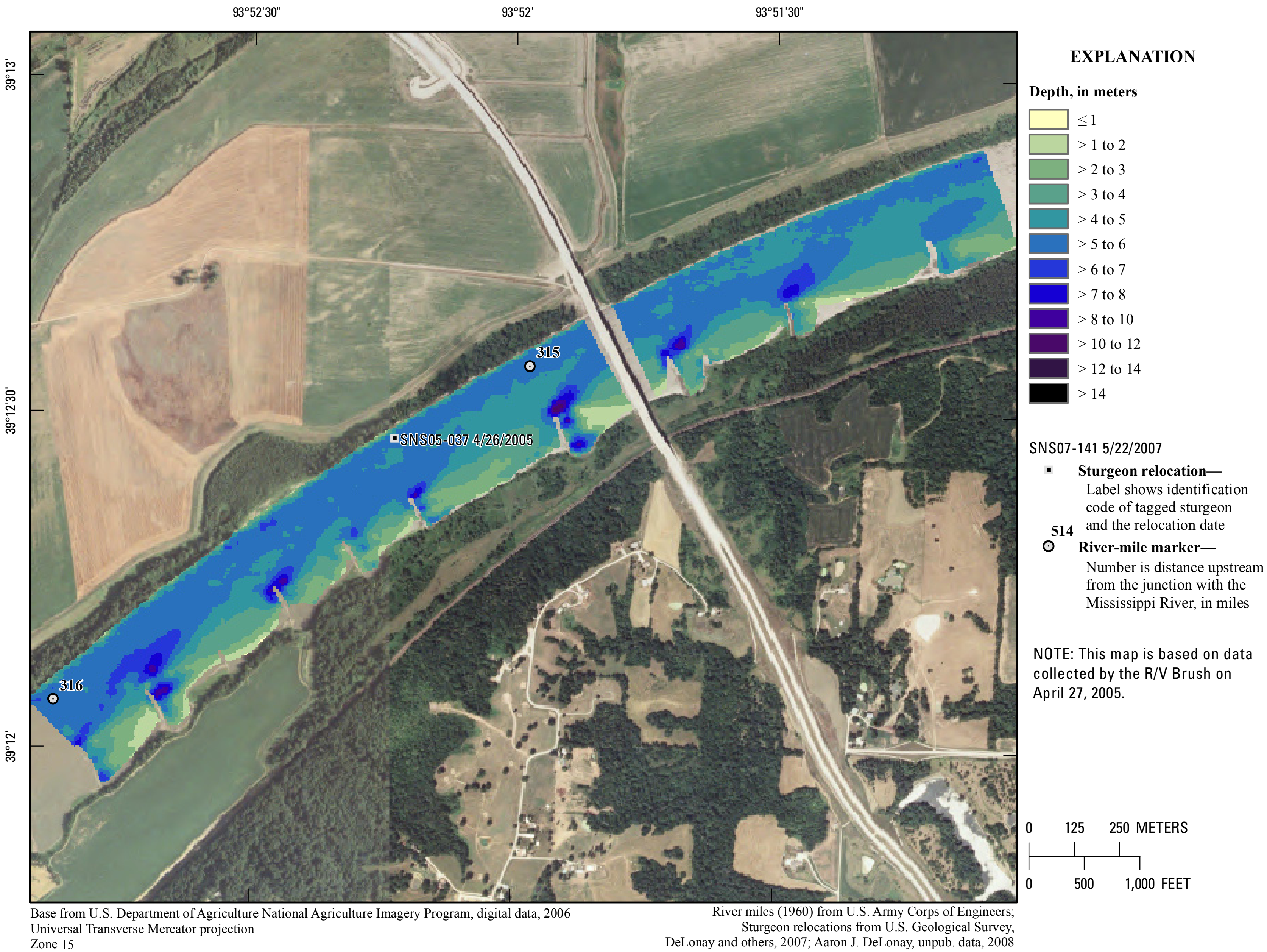


Figure 293. Map of depth based on data collected on April 27, 2005, in the vicinity of river mile 315.

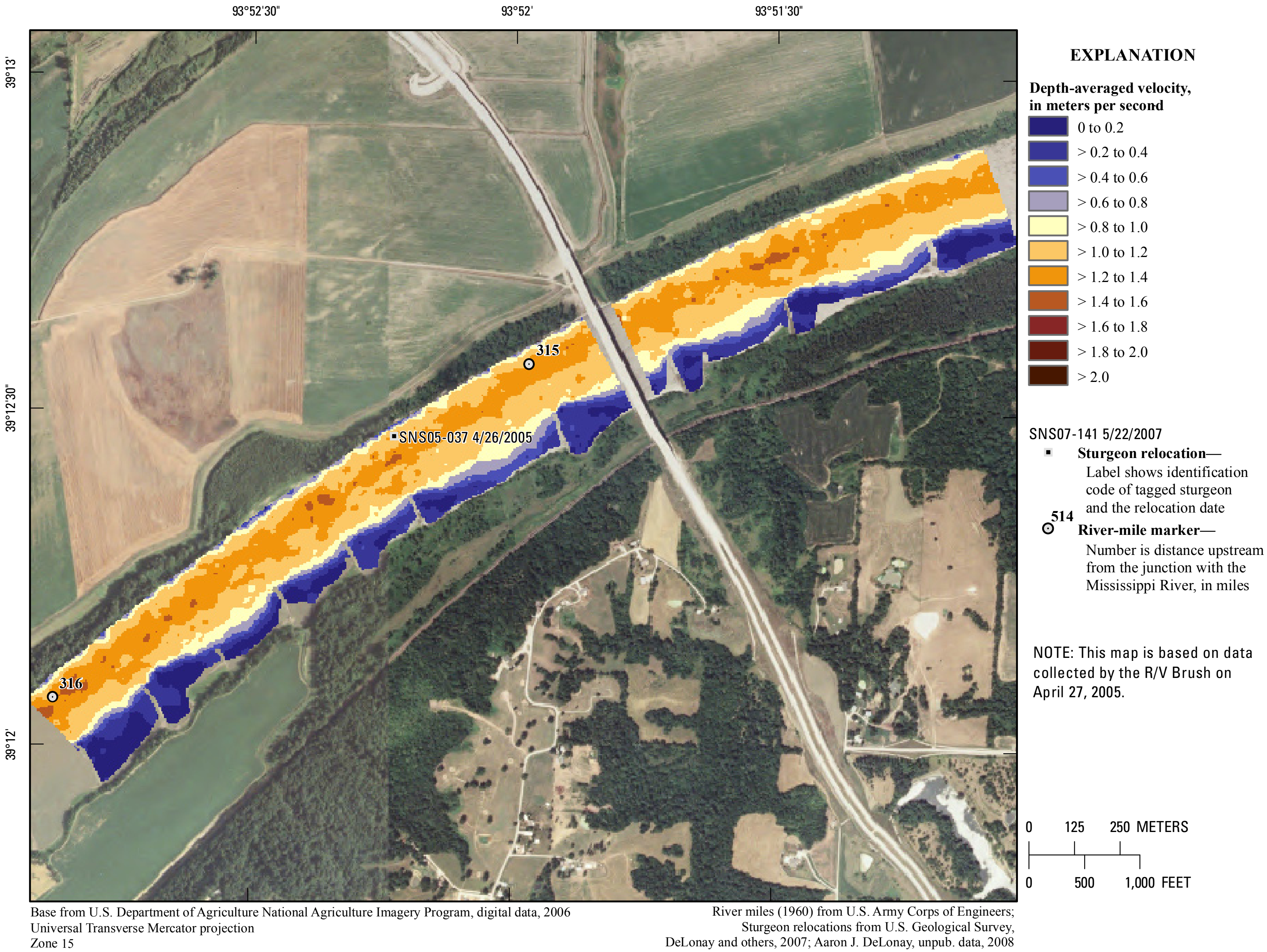
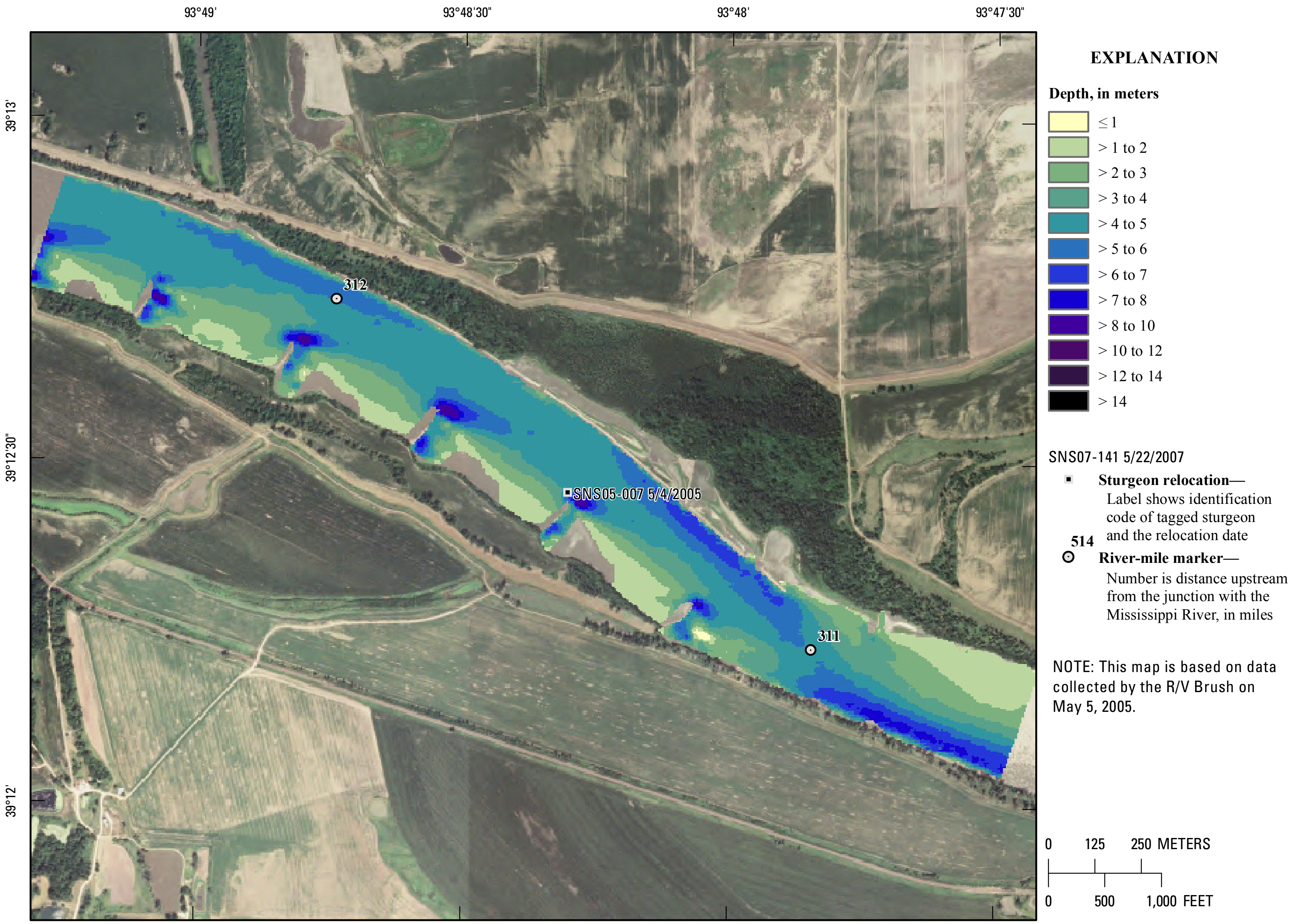


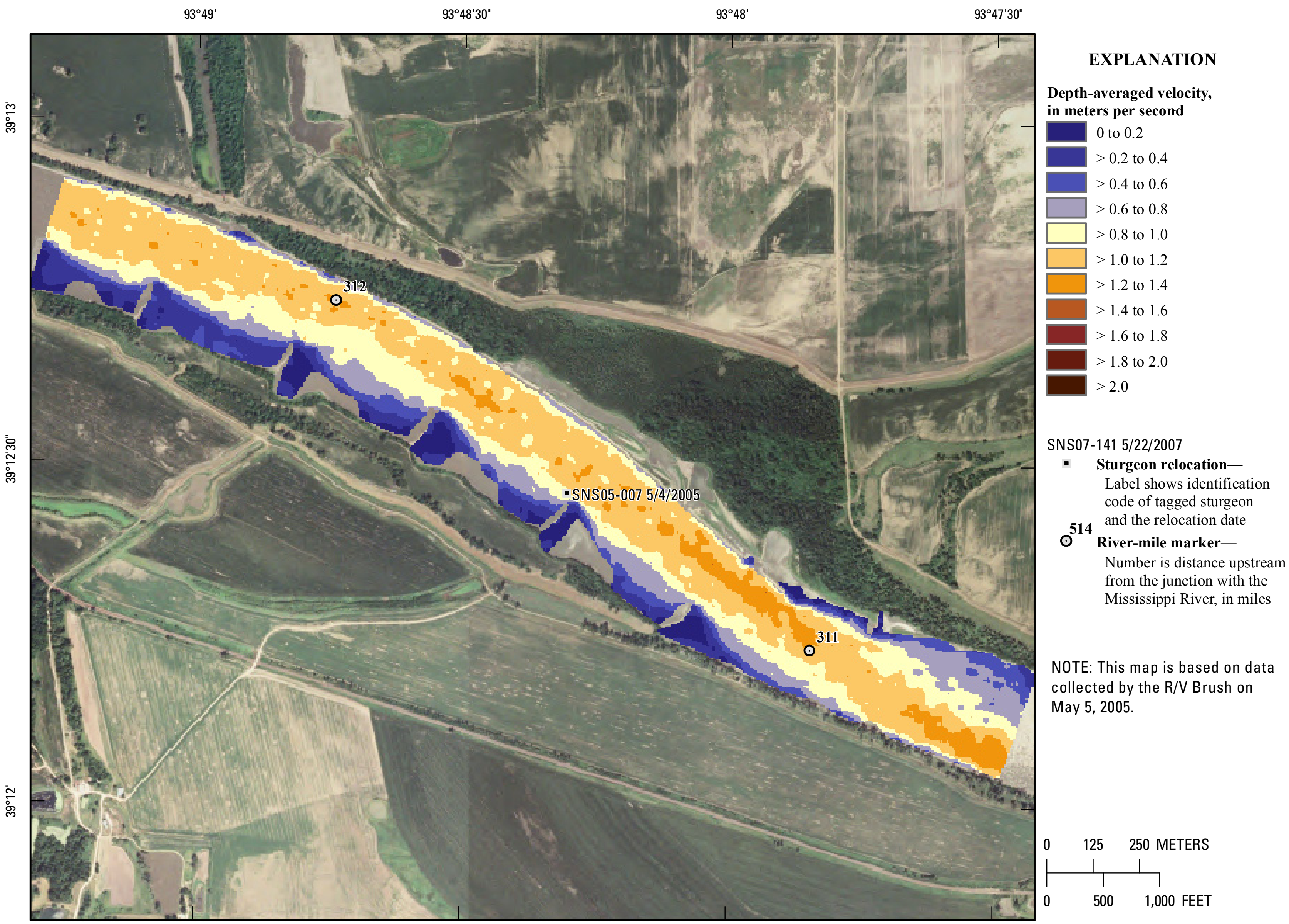
Figure 294. Map of depth-averaged velocity based on data collected on April 27, 2005, in the vicinity of river mile 315.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 295. Map of depth based on data collected on May 5, 2005, in the vicinity of river mile 312.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 296. Map of depth-averaged velocity based on data collected on May 5, 2005, in the vicinity of river mile 312.

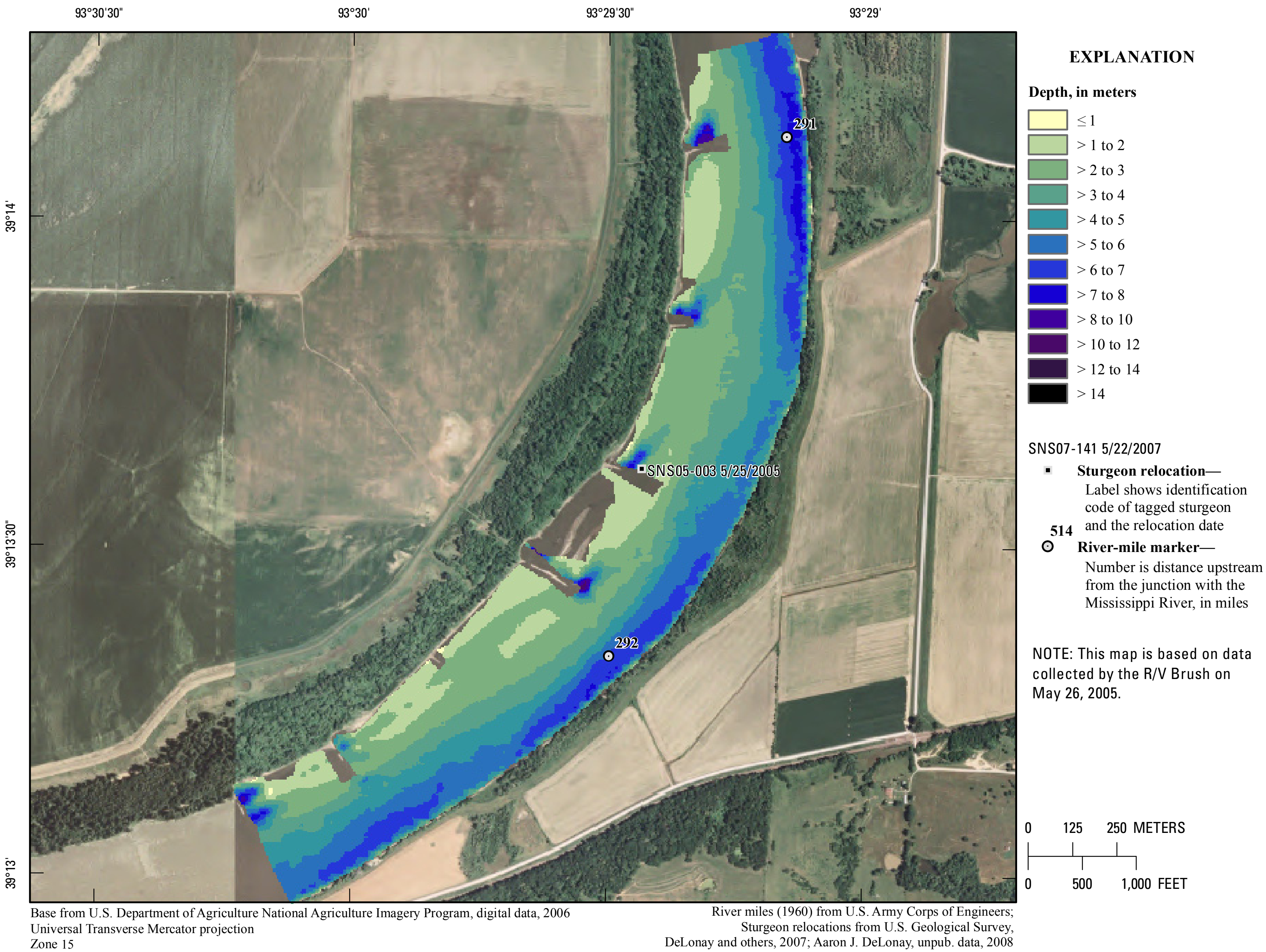


Figure 297. Map of depth based on data collected on May 26, 2005, in the vicinity of river mile 292.

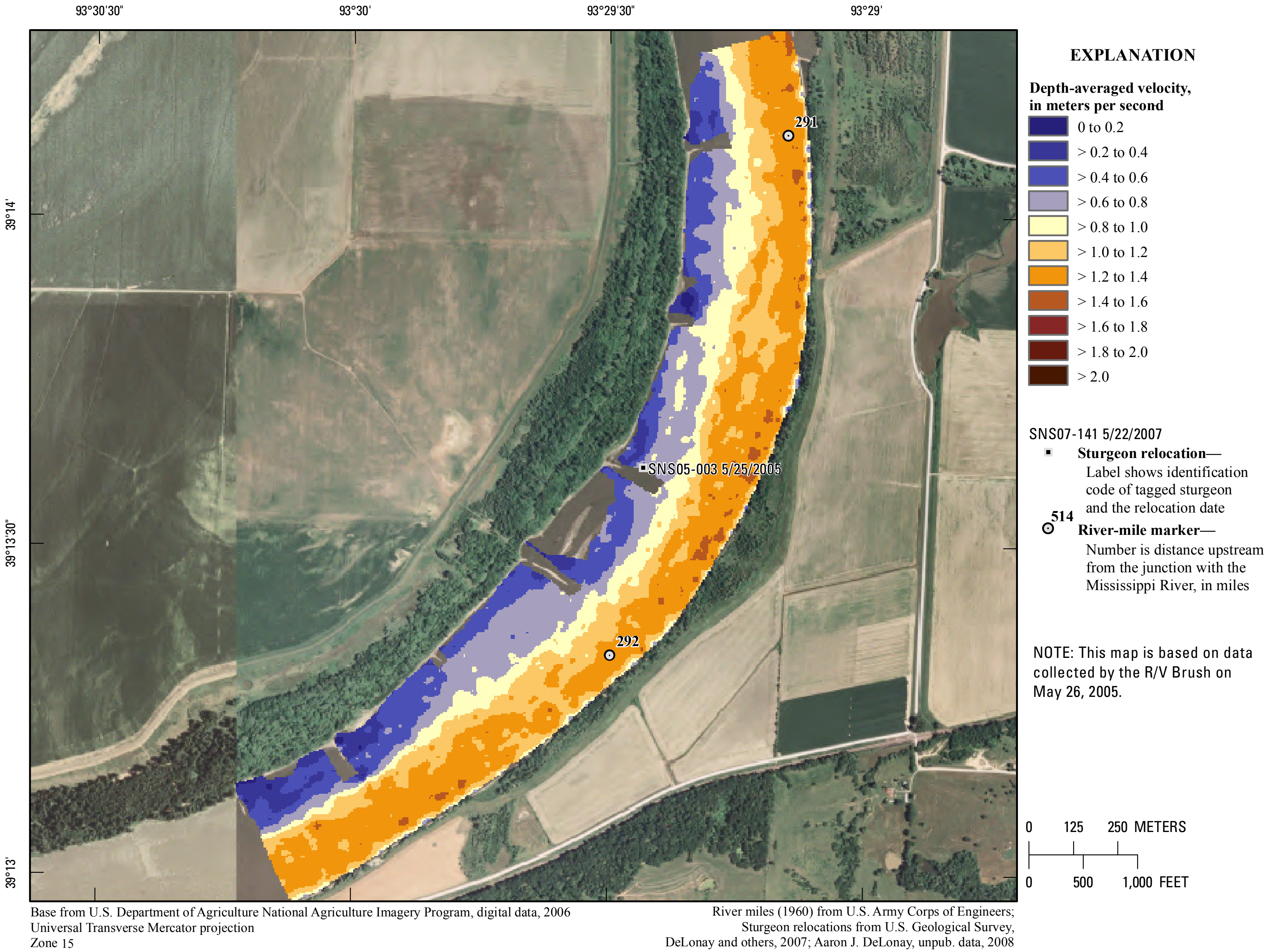


Figure 298. Map of depth-averaged velocity based on data collected on May 26, 2005, in the vicinity of river mile 292.

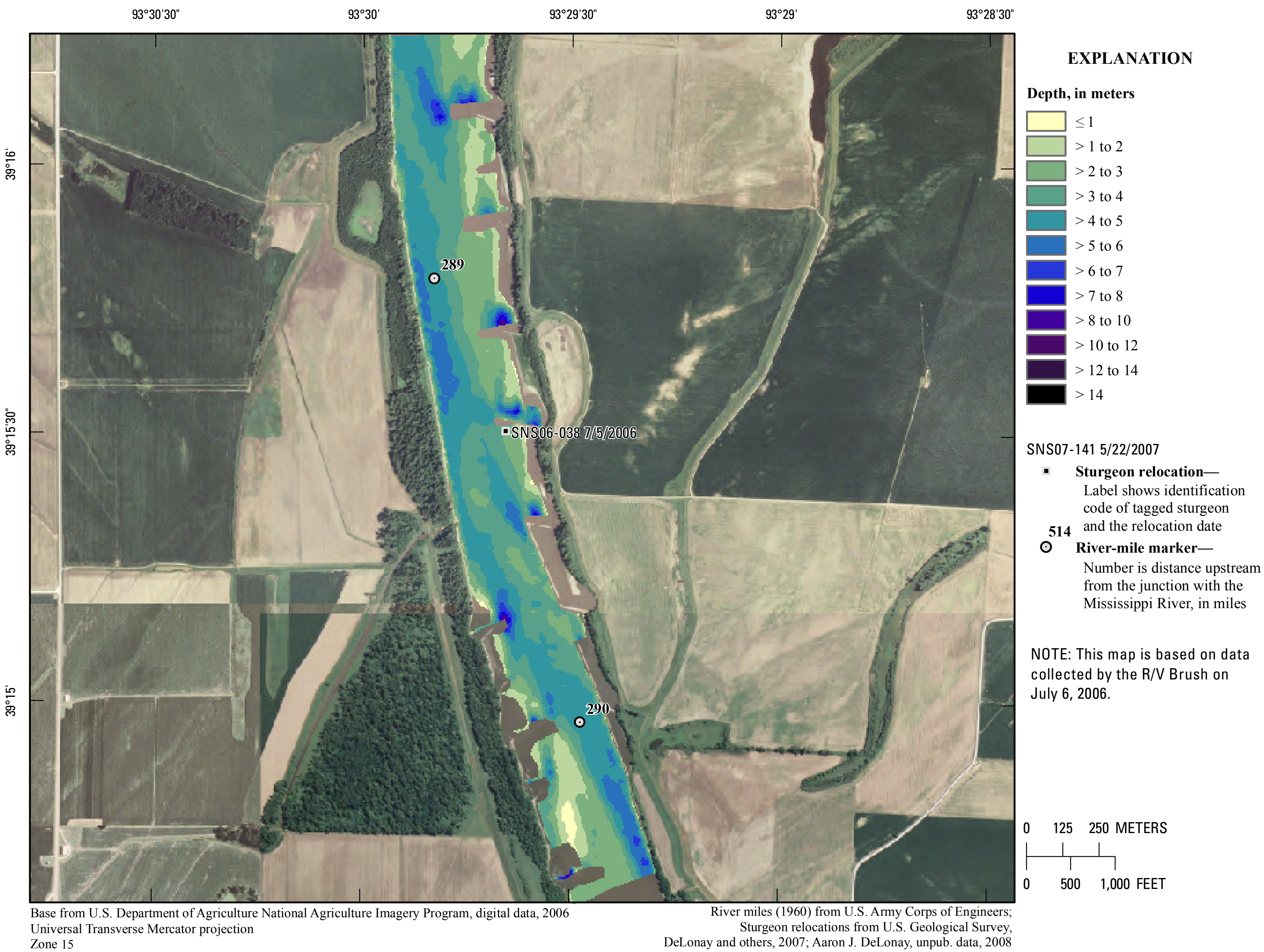


Figure 299. Map of depth based on data collected on July 6, 2006, in the vicinity of river mile 289.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on July 6, 2006.

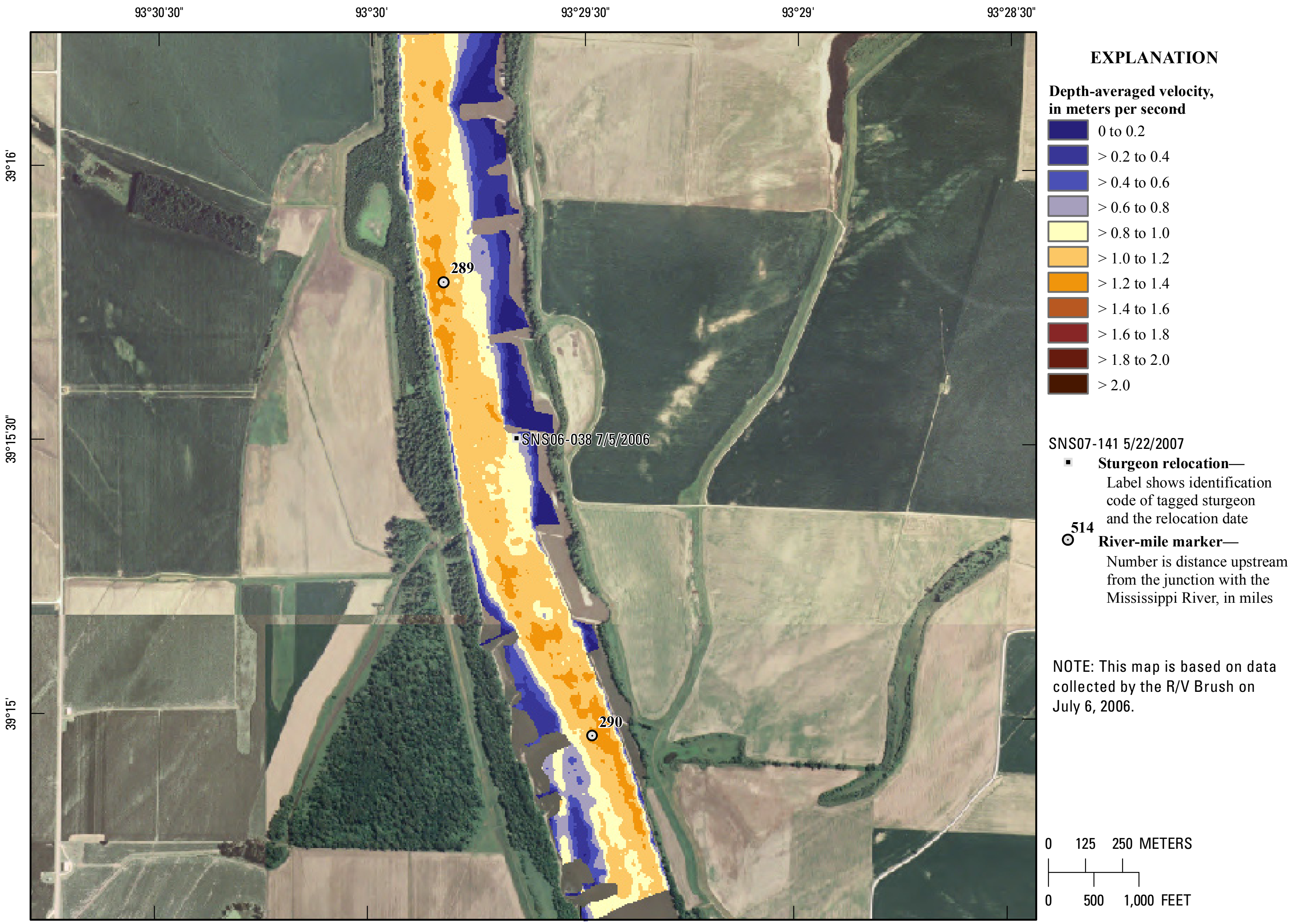
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers; Sturgeon relocations from U.S. Geological Survey, DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 300. Map of generalized substrate based on data collected on July 6, 2006, in the vicinity of river mile 289.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 301. Map of depth-averaged velocity based on data collected on July 6, 2006, in the vicinity of river mile 289.

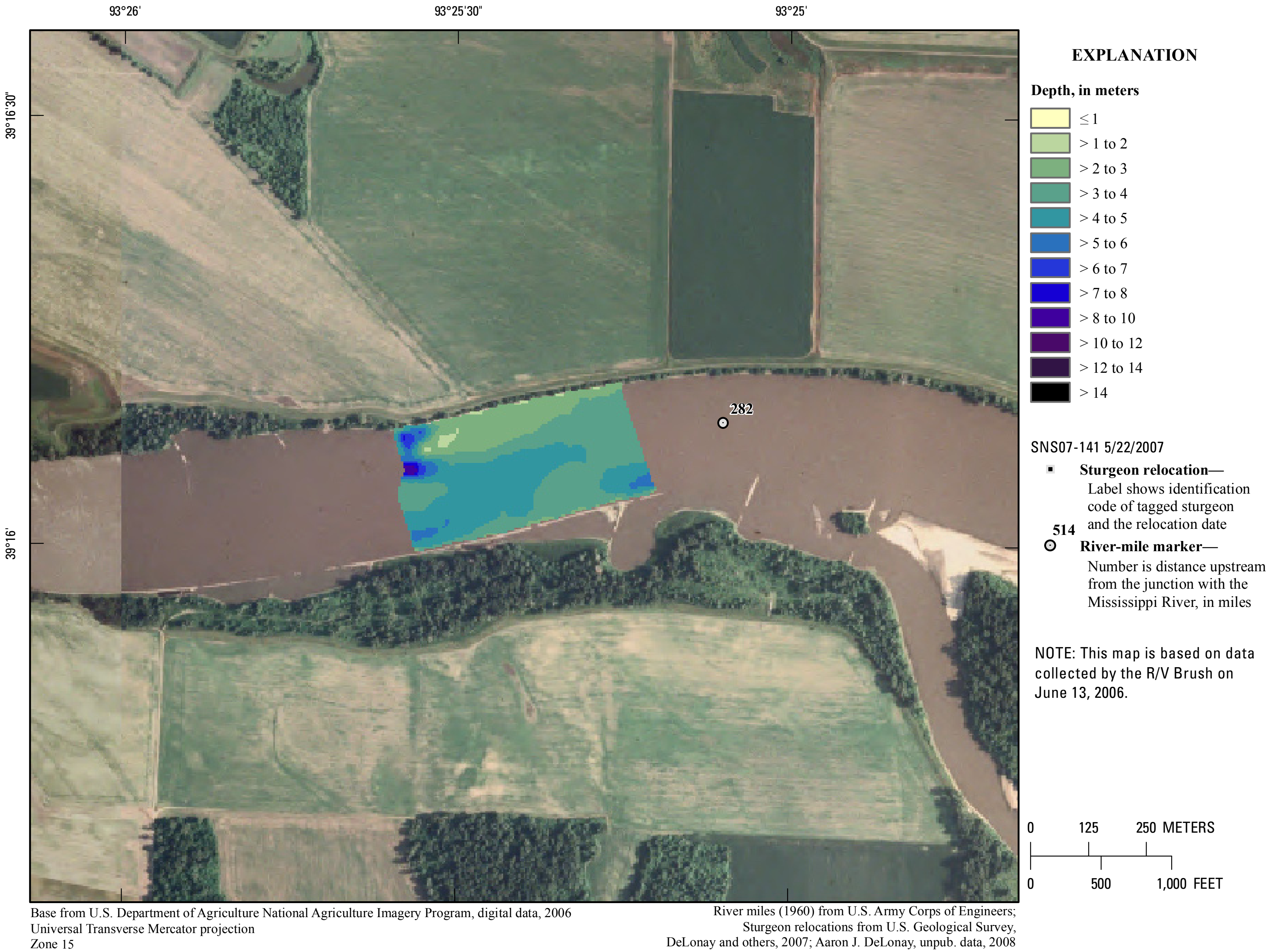
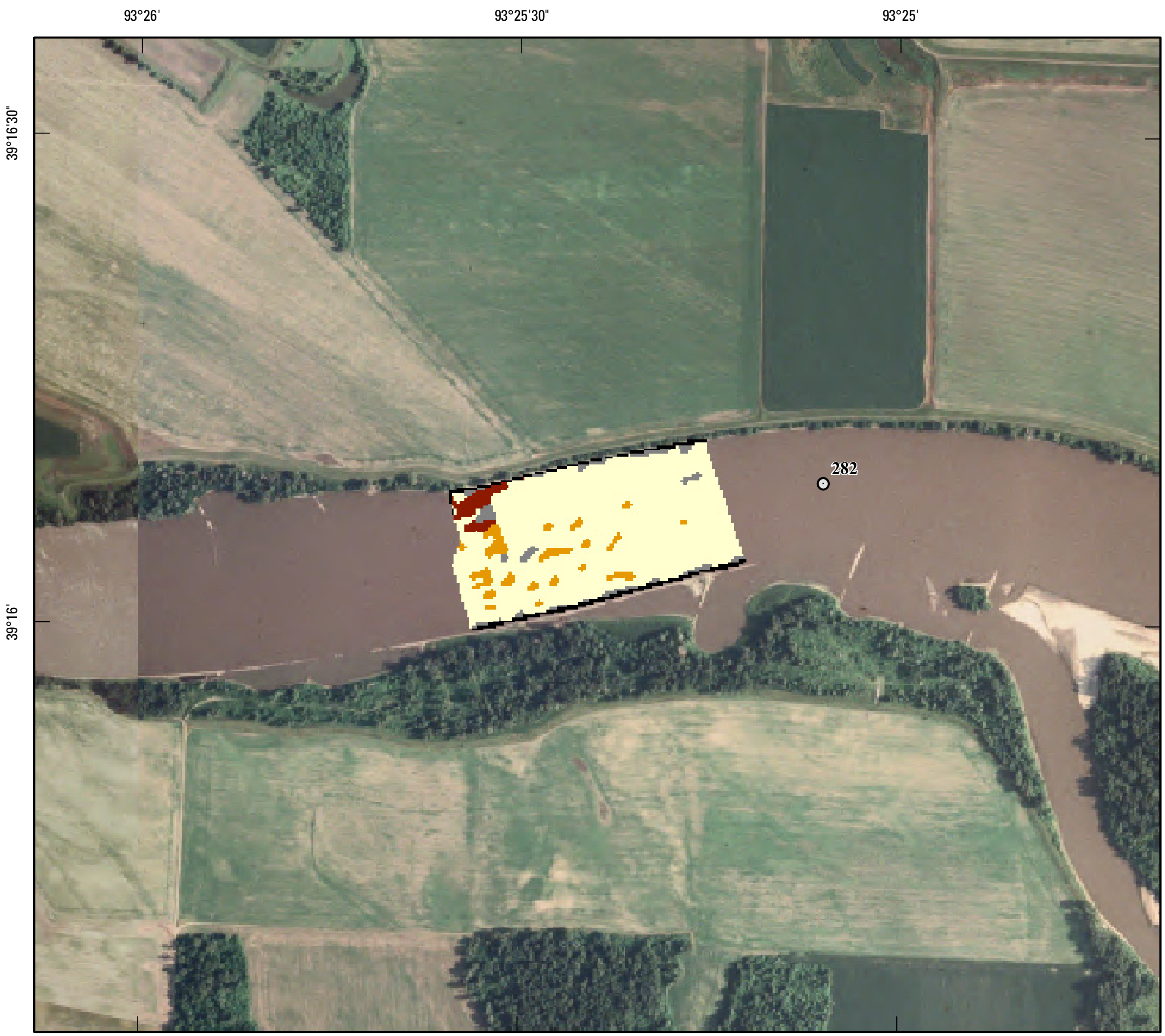


Figure 302. Map of depth based on data collected on June 13, 2006, in the vicinity of river mile 282.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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Sturgeon relocation—Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker—Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on June 13, 2006.

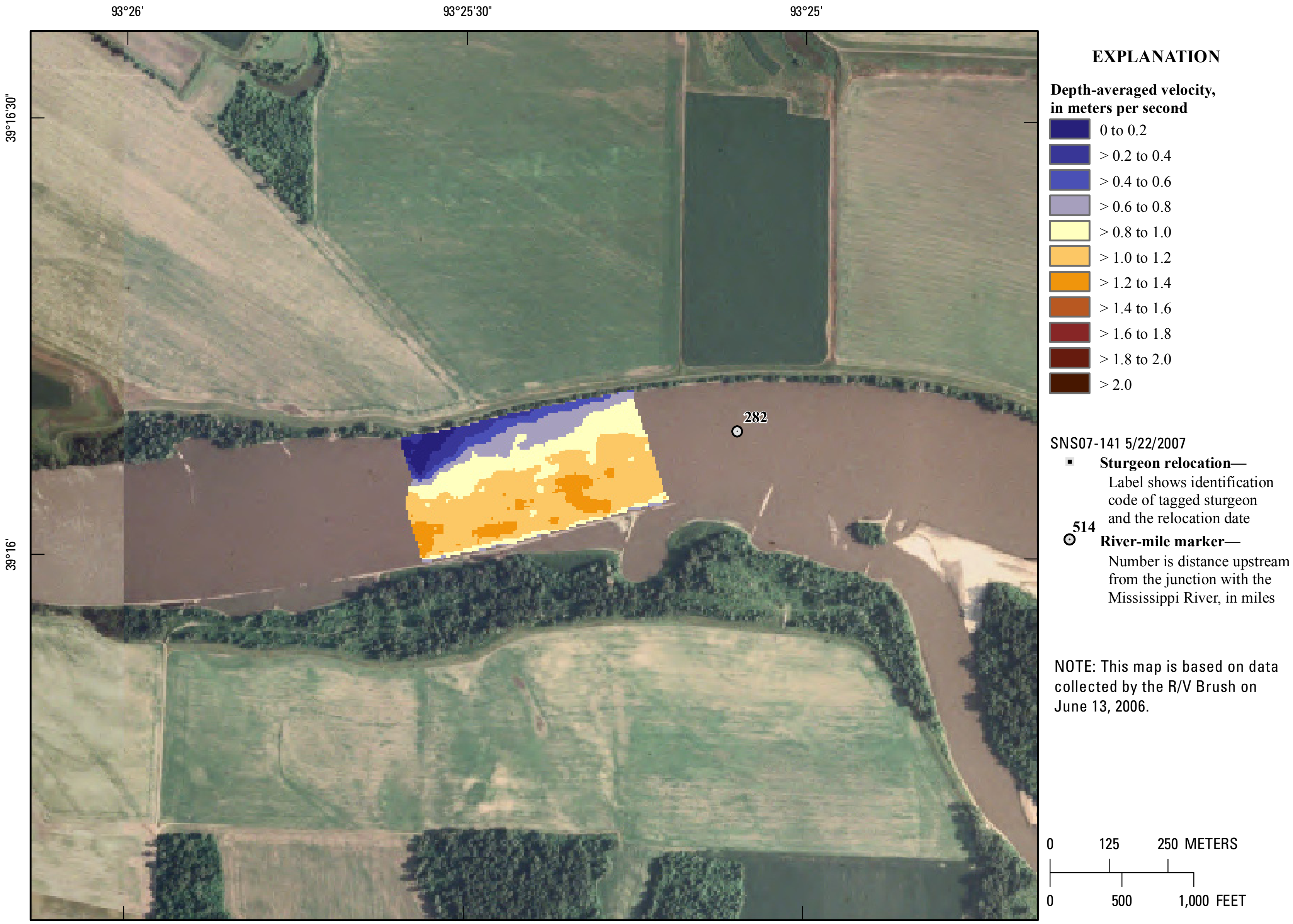
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

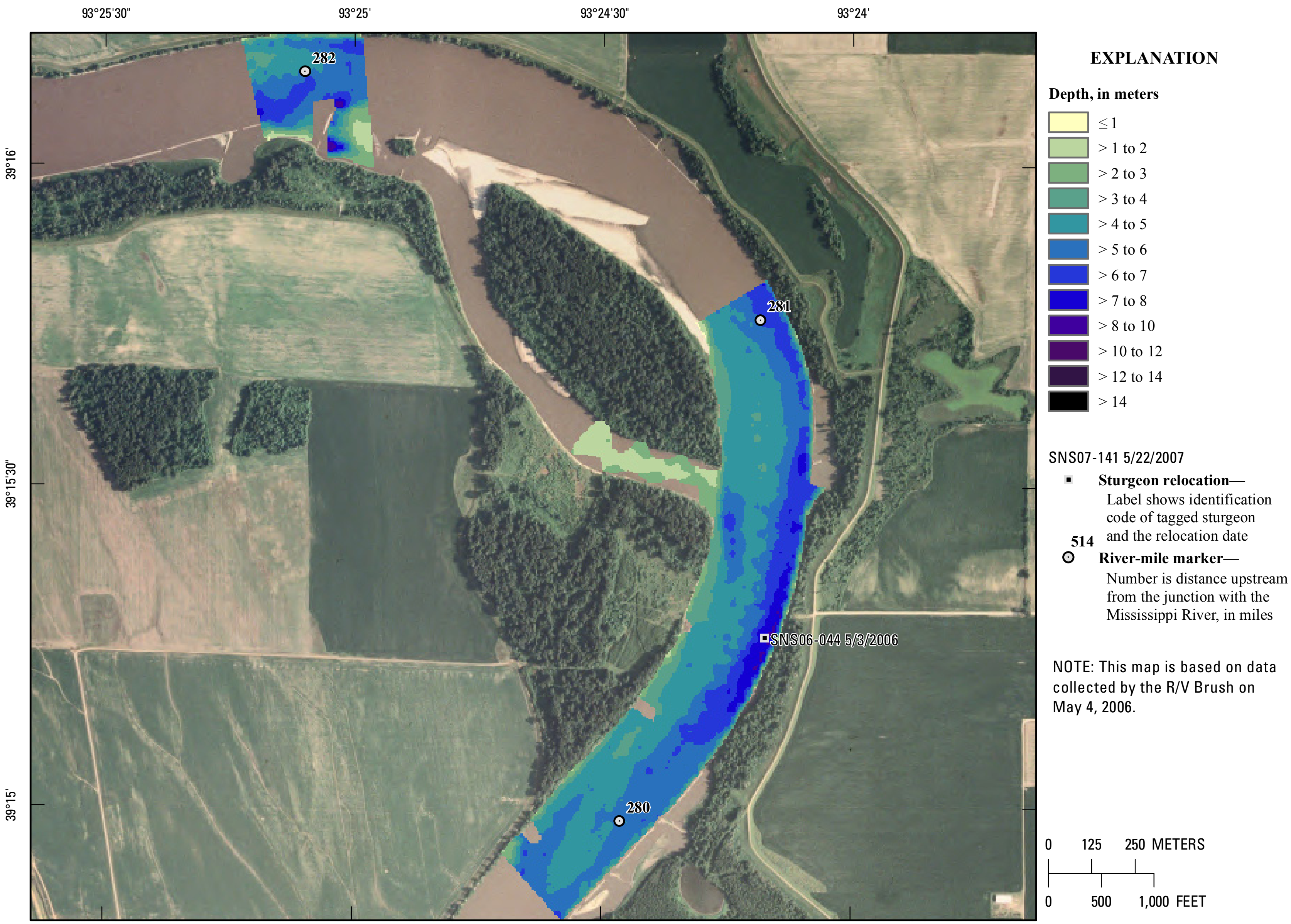
Figure 303. Map of generalized substrate based on data collected on June 13, 2006, in the vicinity of river mile 282.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

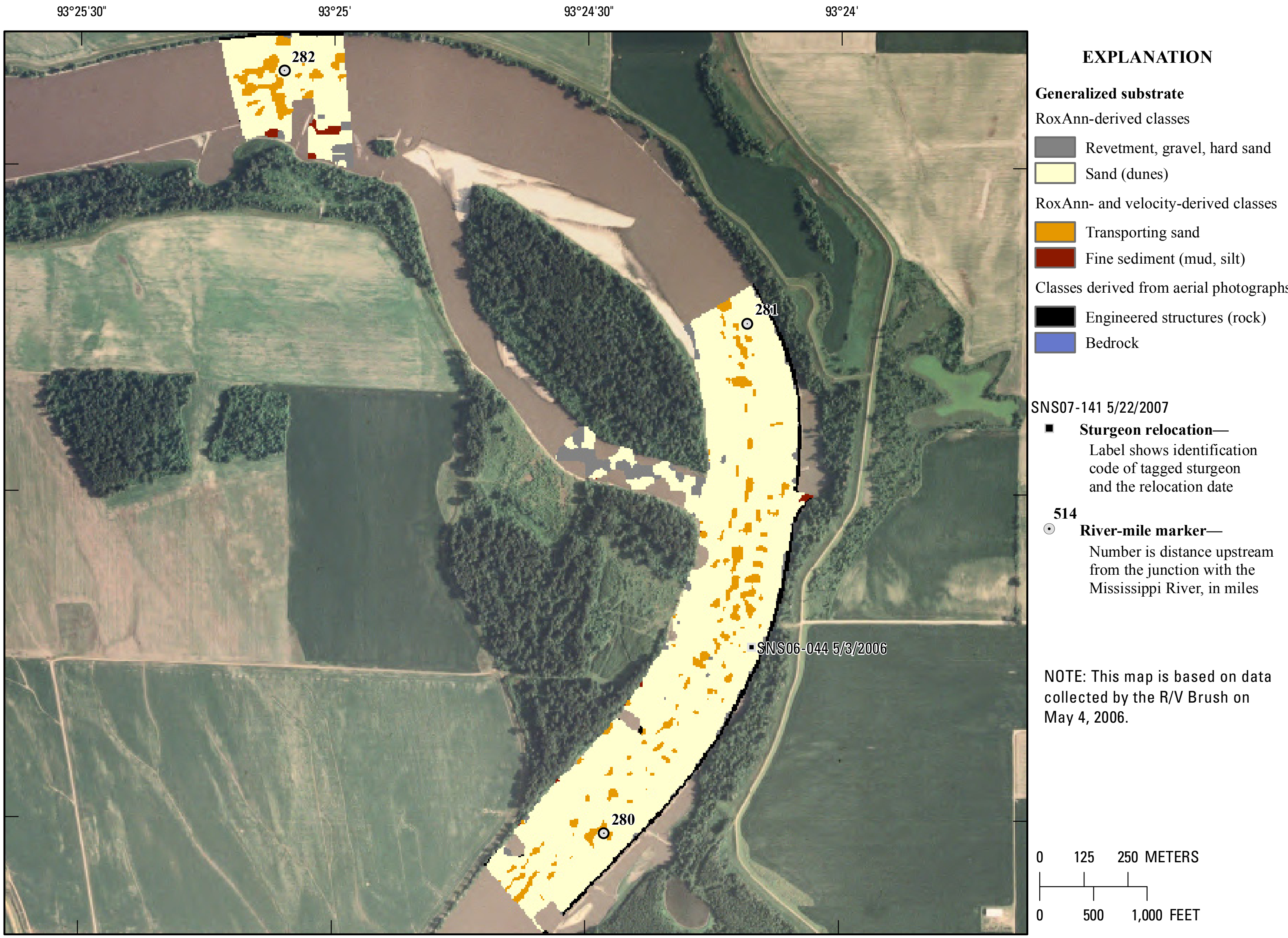
Figure 304. Map of depth-averaged velocity based on data collected on June 13, 2006, in the vicinity of river mile 282.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

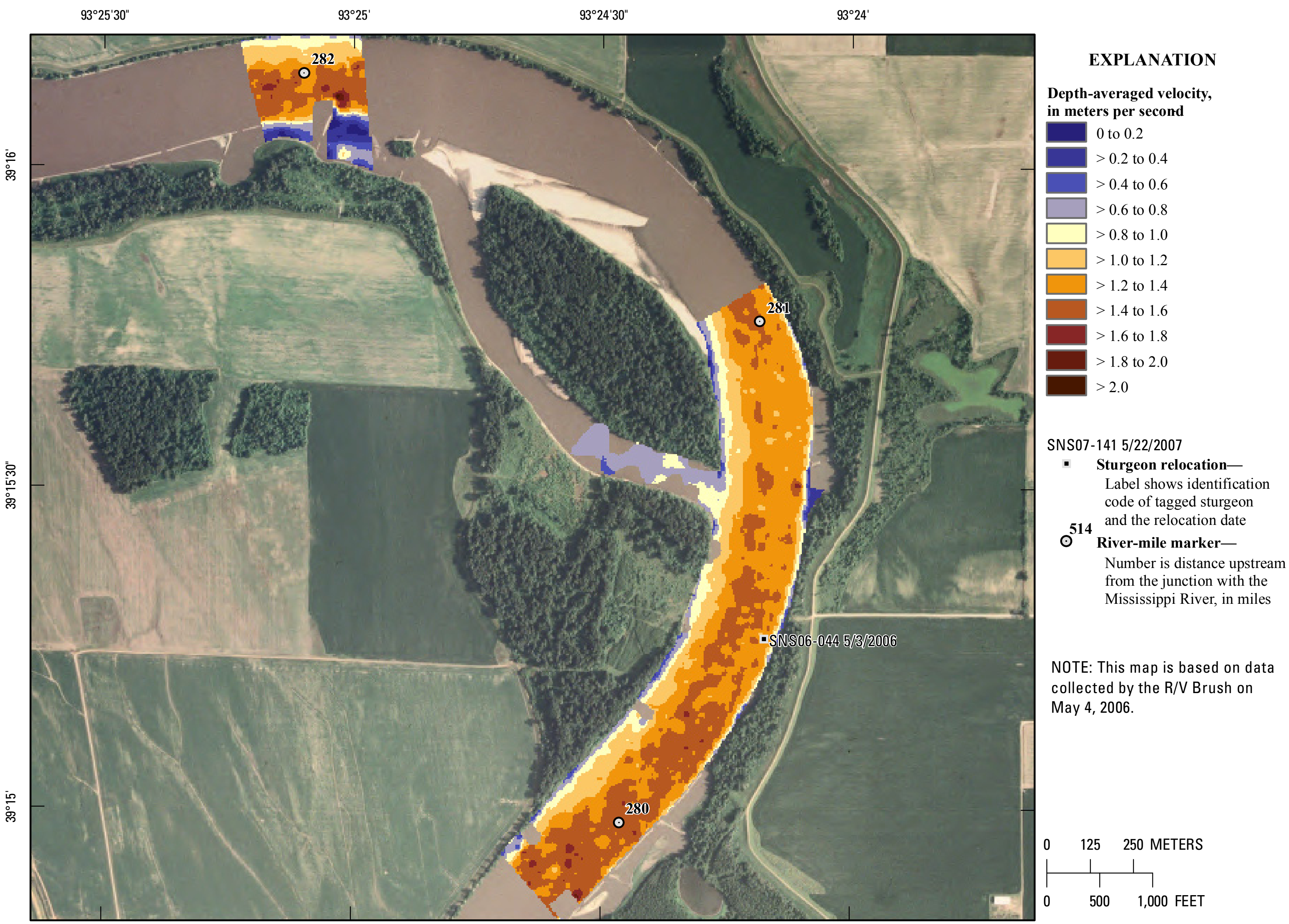
Figure 305. Map of depth based on data collected on May 4, 2006, in the vicinity of river mile 282.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

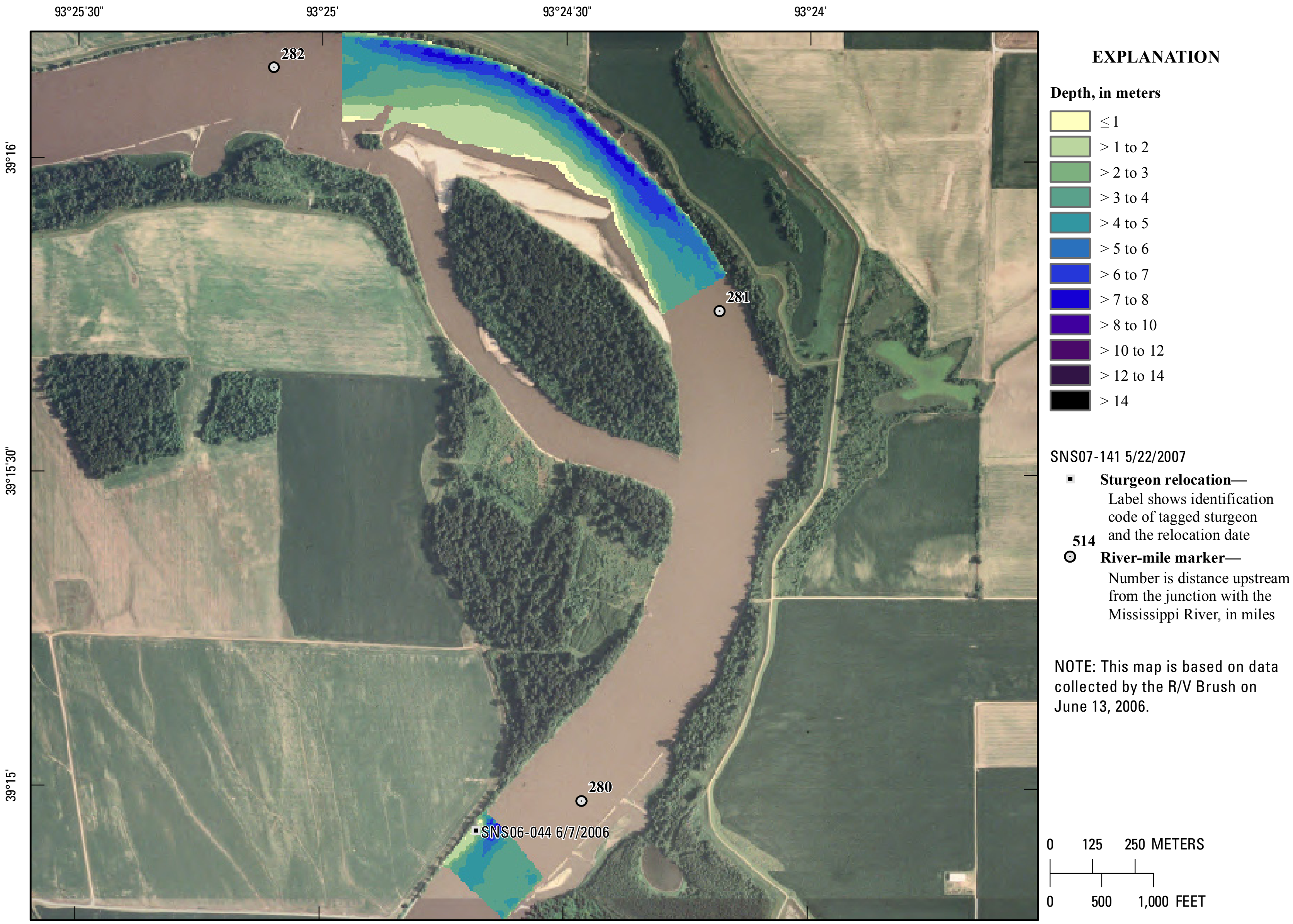
Figure 306. Map of generalized substrate based on data collected on May 4, 2006, in the vicinity of river mile 282.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 307. Map of depth-averaged velocity based on data collected on May 4, 2006, in the vicinity of river mile 282.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 308. Map of depth based on data collected on June 13, 2006, in the vicinity of river mile 282.

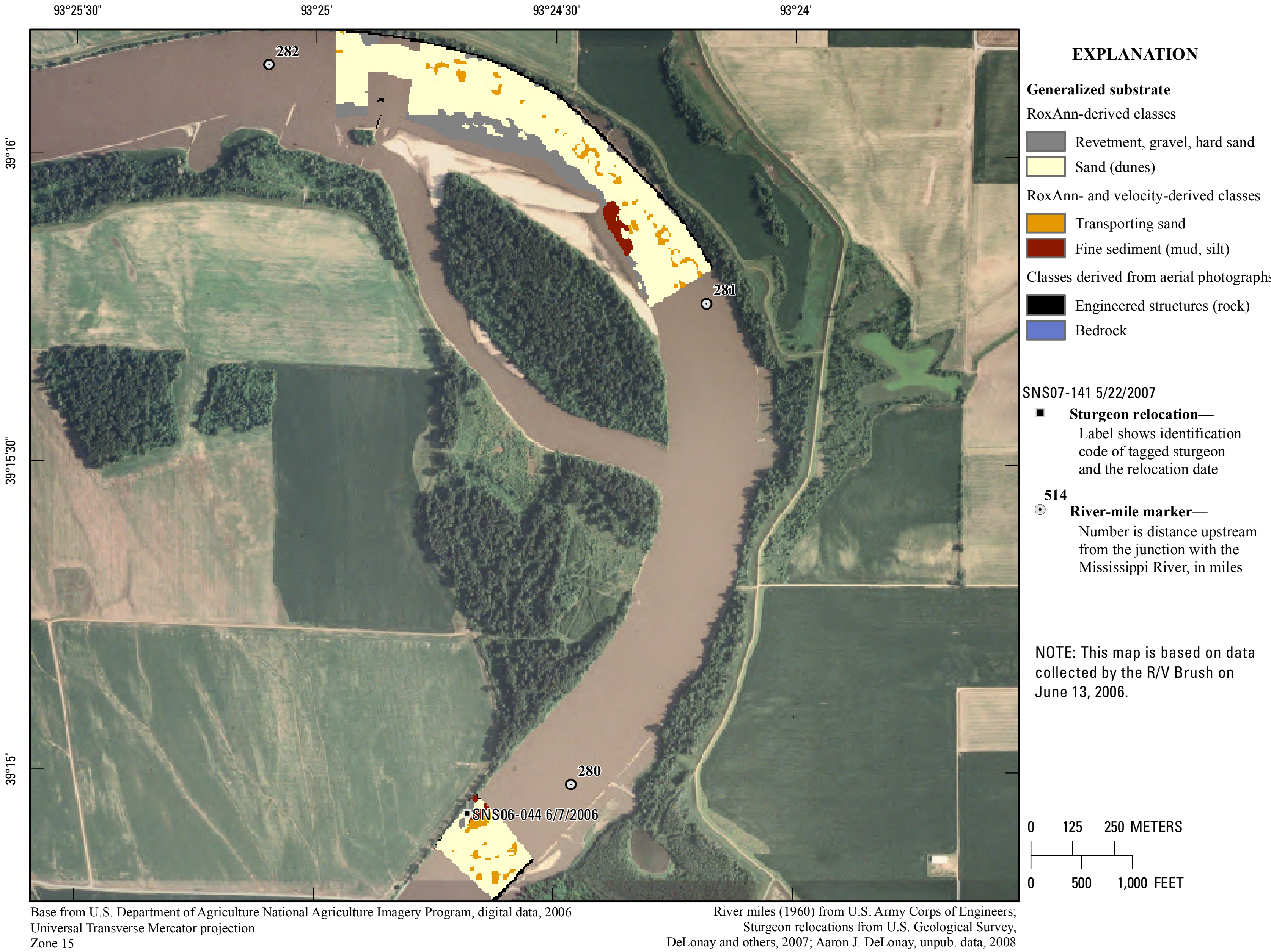
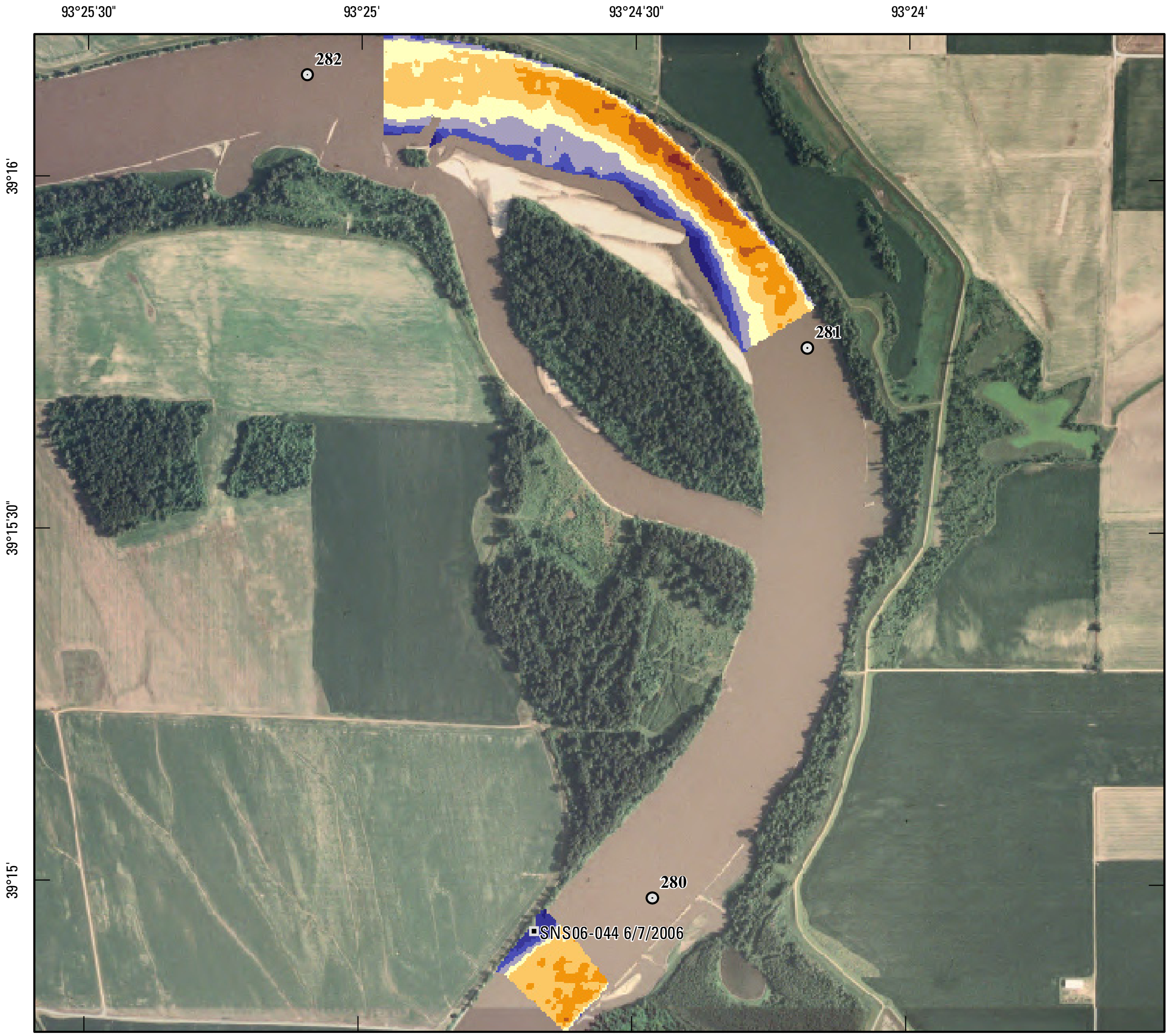


Figure 309. Map of generalized substrate based on data collected on June 13, 2006, in the vicinity of river mile 282.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on June 13, 2006.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 310. Map of depth-averaged velocity based on data collected on June 13, 2006, in the vicinity of river mile 282.

EXPLANATION

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected on June 27, 2006, June 28, 2006, and July 25, 2006.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 311. Map of side-scan sonar imagery based on data collected on June 27, 2006, June 28,2006, and July 25, 2006, in the vicinity of river mile 280.

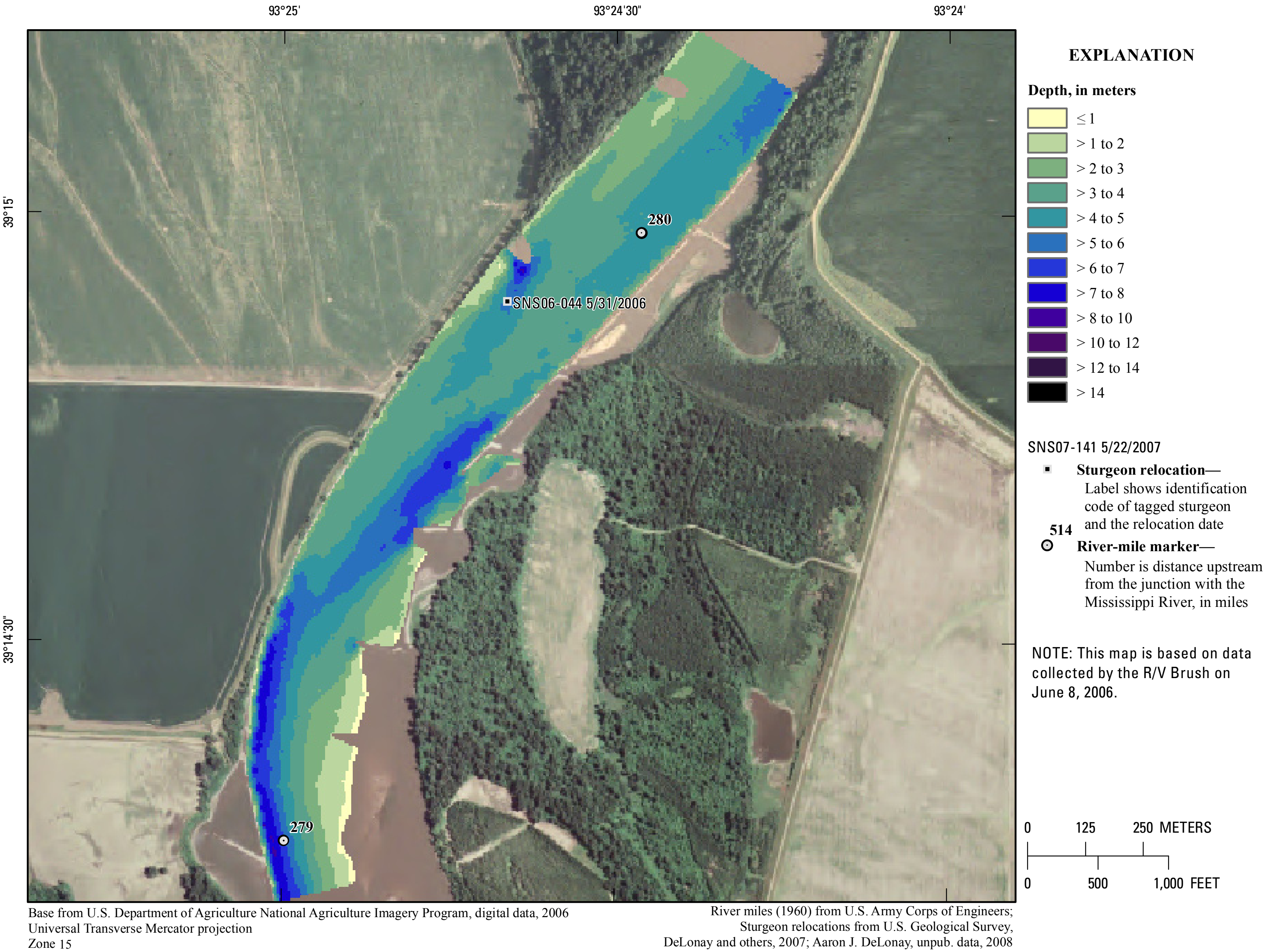
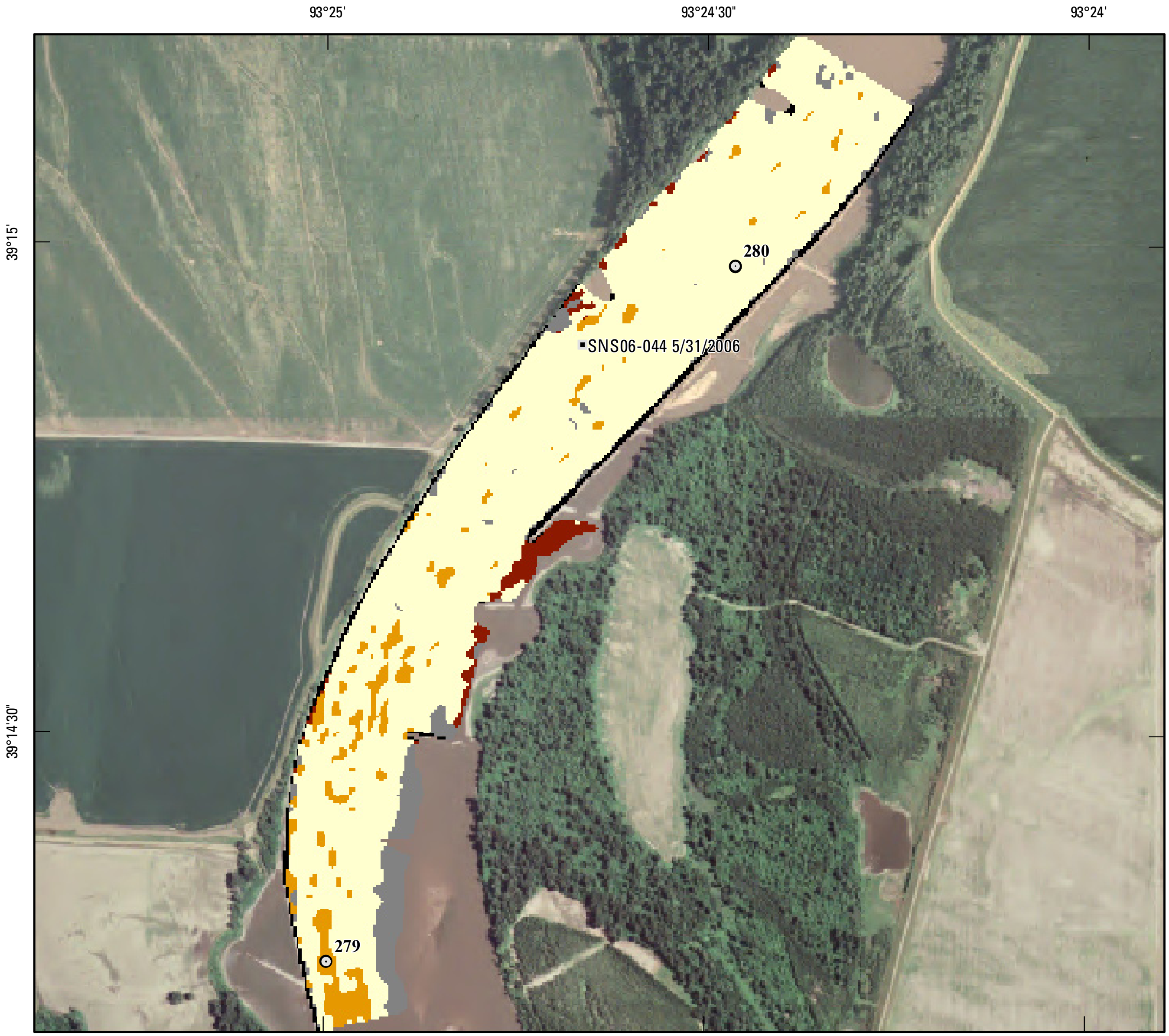


Figure 312. Map of depth based on data collected on June 8, 2006, in the vicinity of river mile 280.



EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

SNS07-141 5/22/2007

Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on June 8, 2006.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 313. Map of generalized substrate based on data collected on June 8, 2006, in the vicinity of river mile 280.

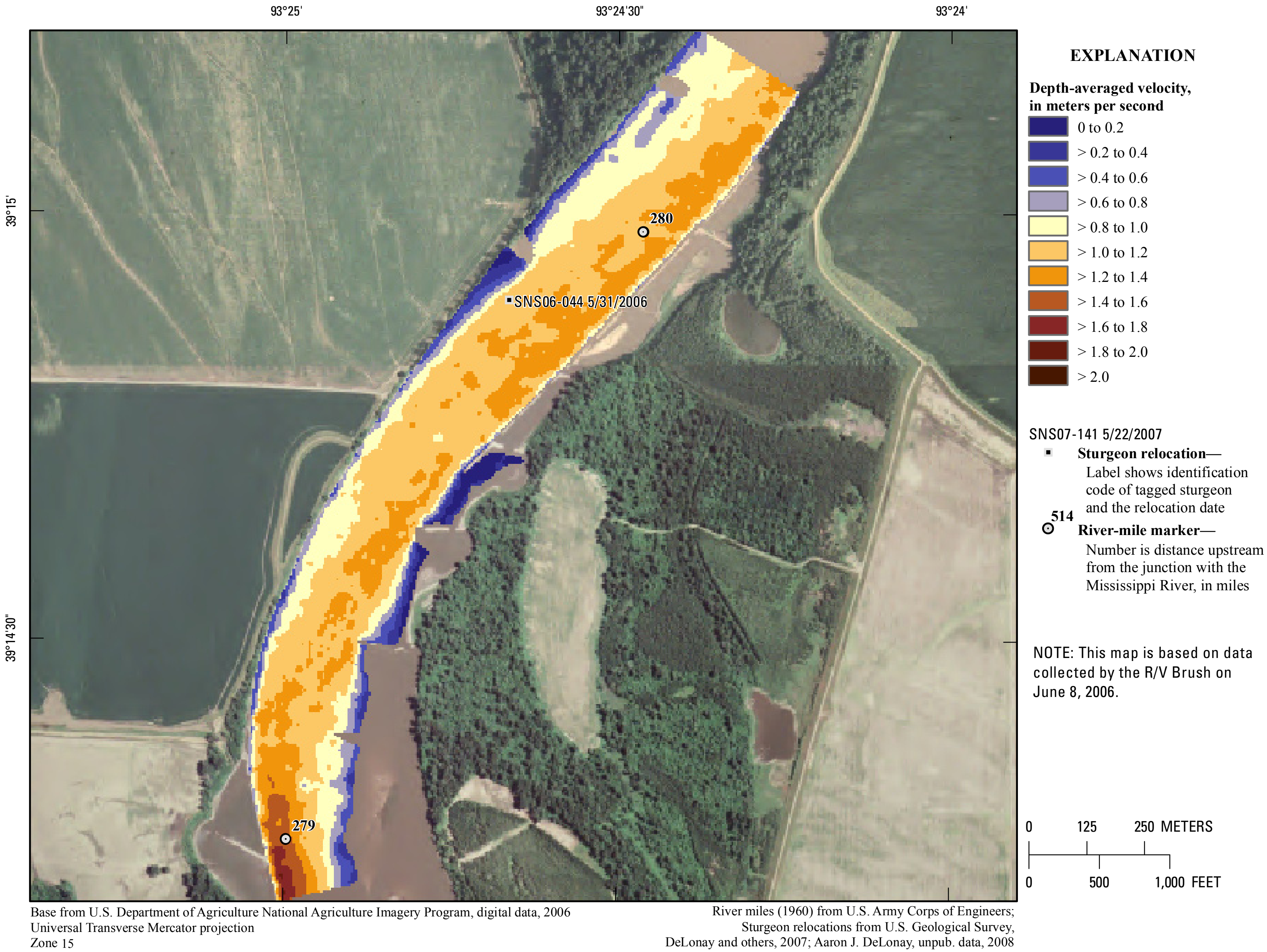
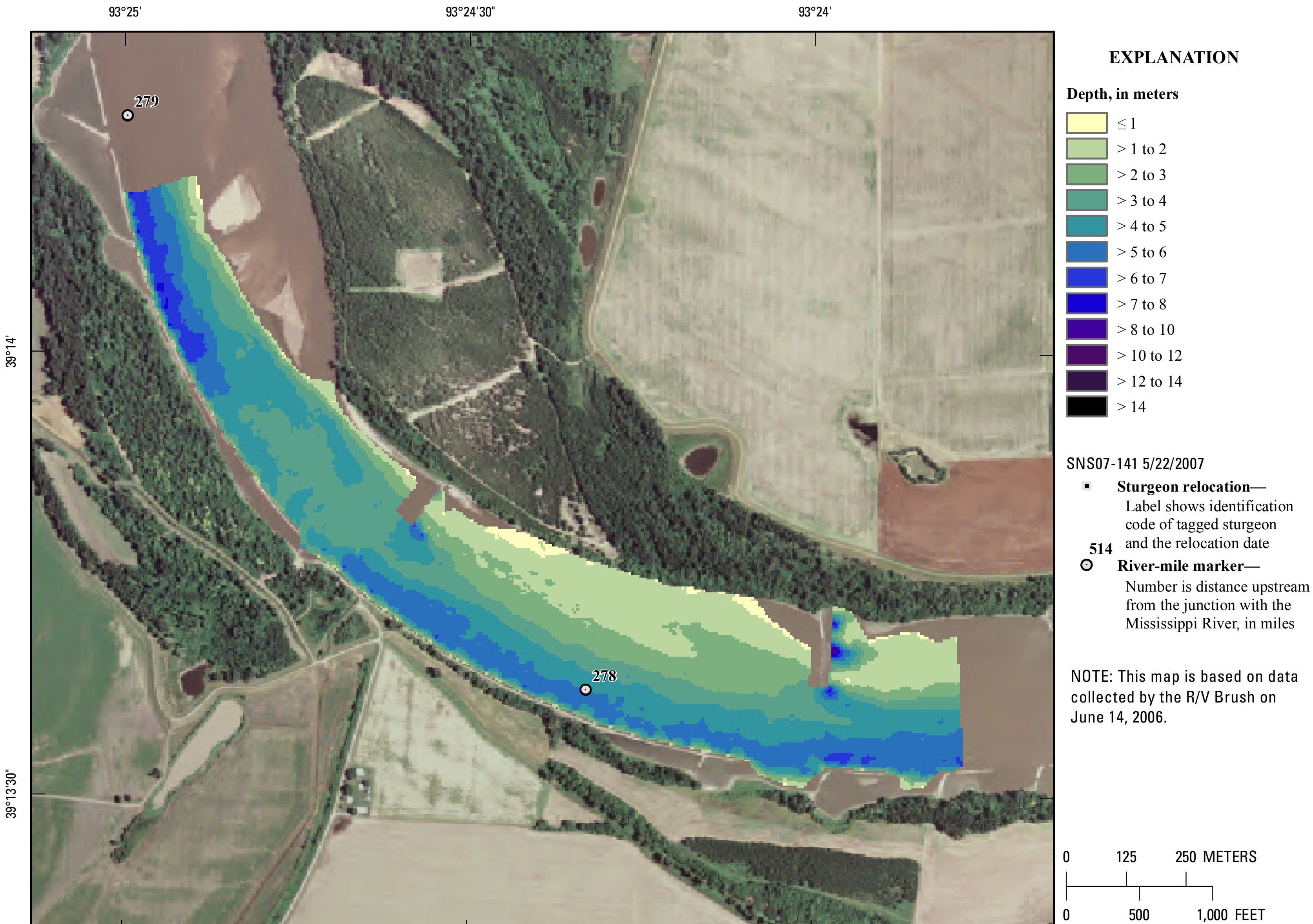


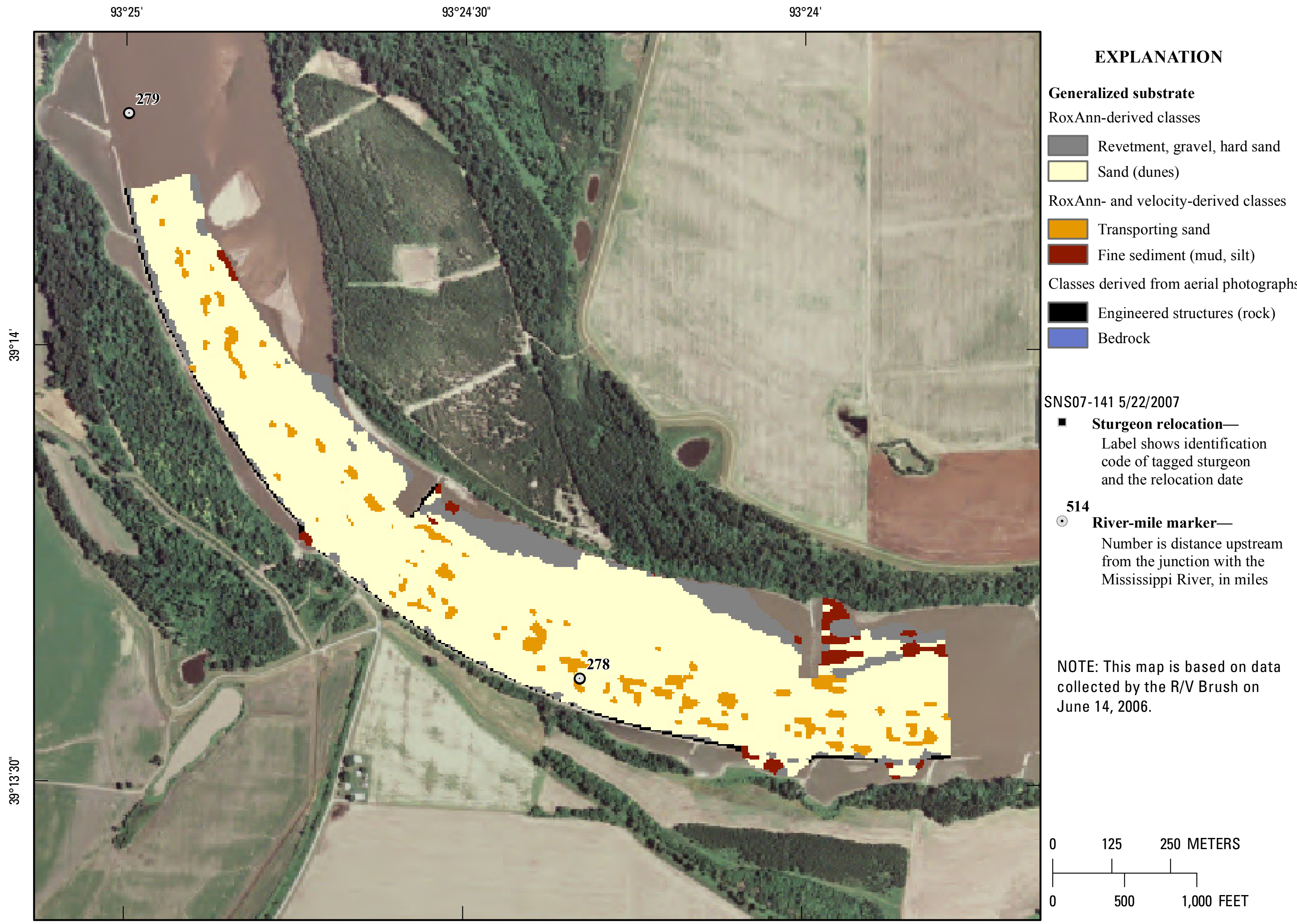
Figure 314. Map of depth-averaged velocity based on data collected on June 8, 2006, in the vicinity of river mile 280.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

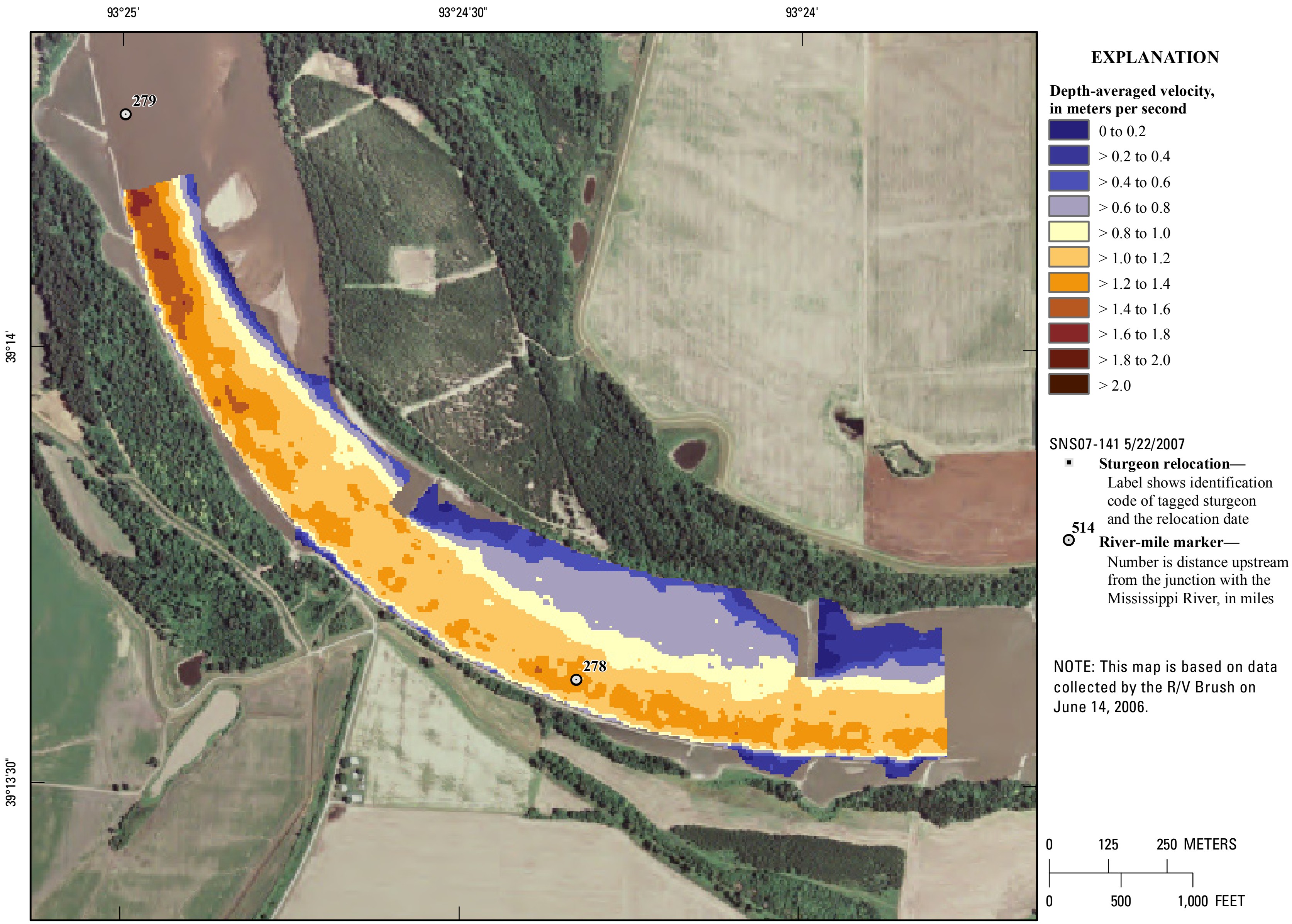
Figure 315. Map of depth based on data collected on June 14, 2006, in the vicinity of river mile 278.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

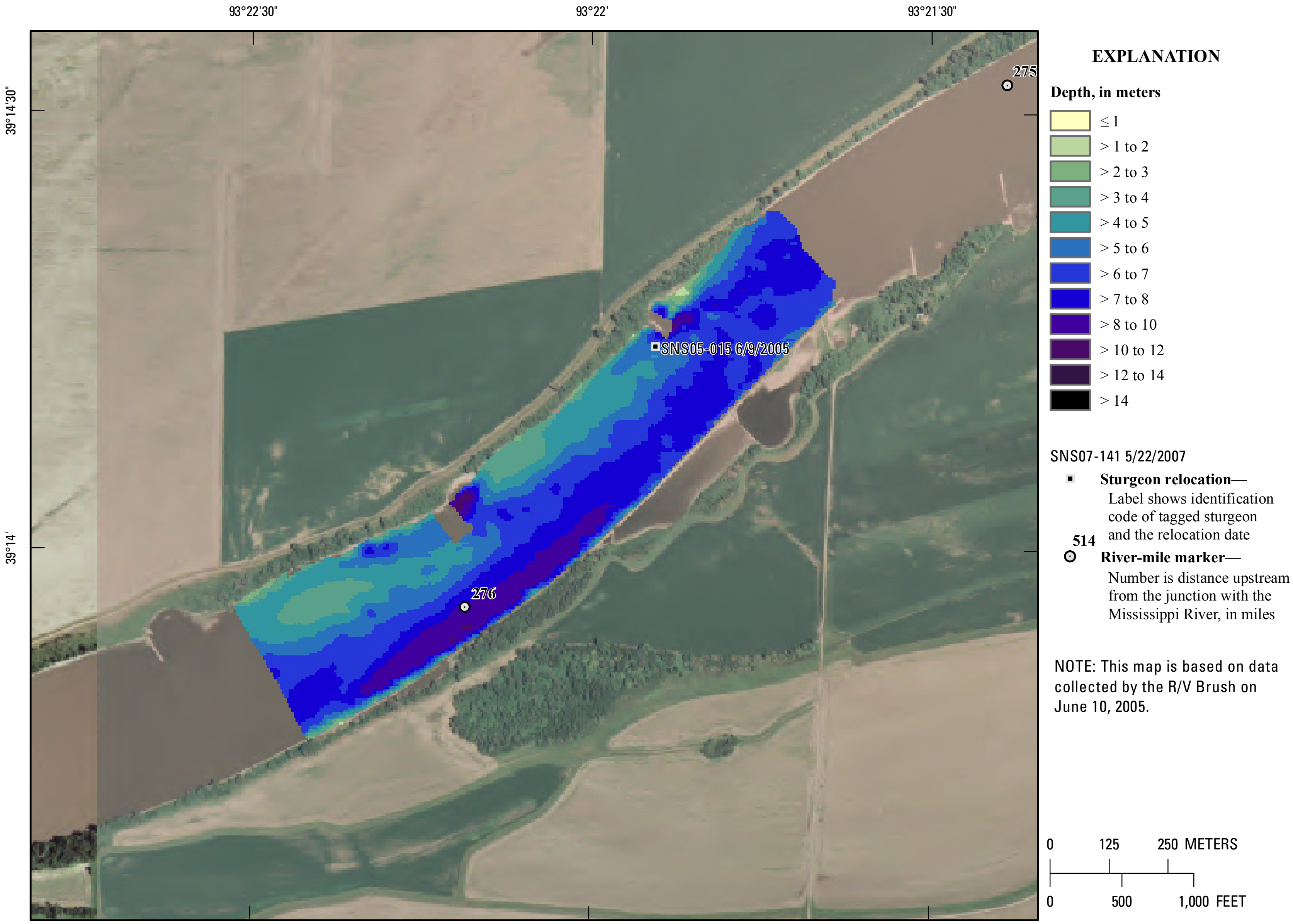
Figure 316. Map of generalized substrate based on data collected on June 14, 2006, in the vicinity of river mile 278.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

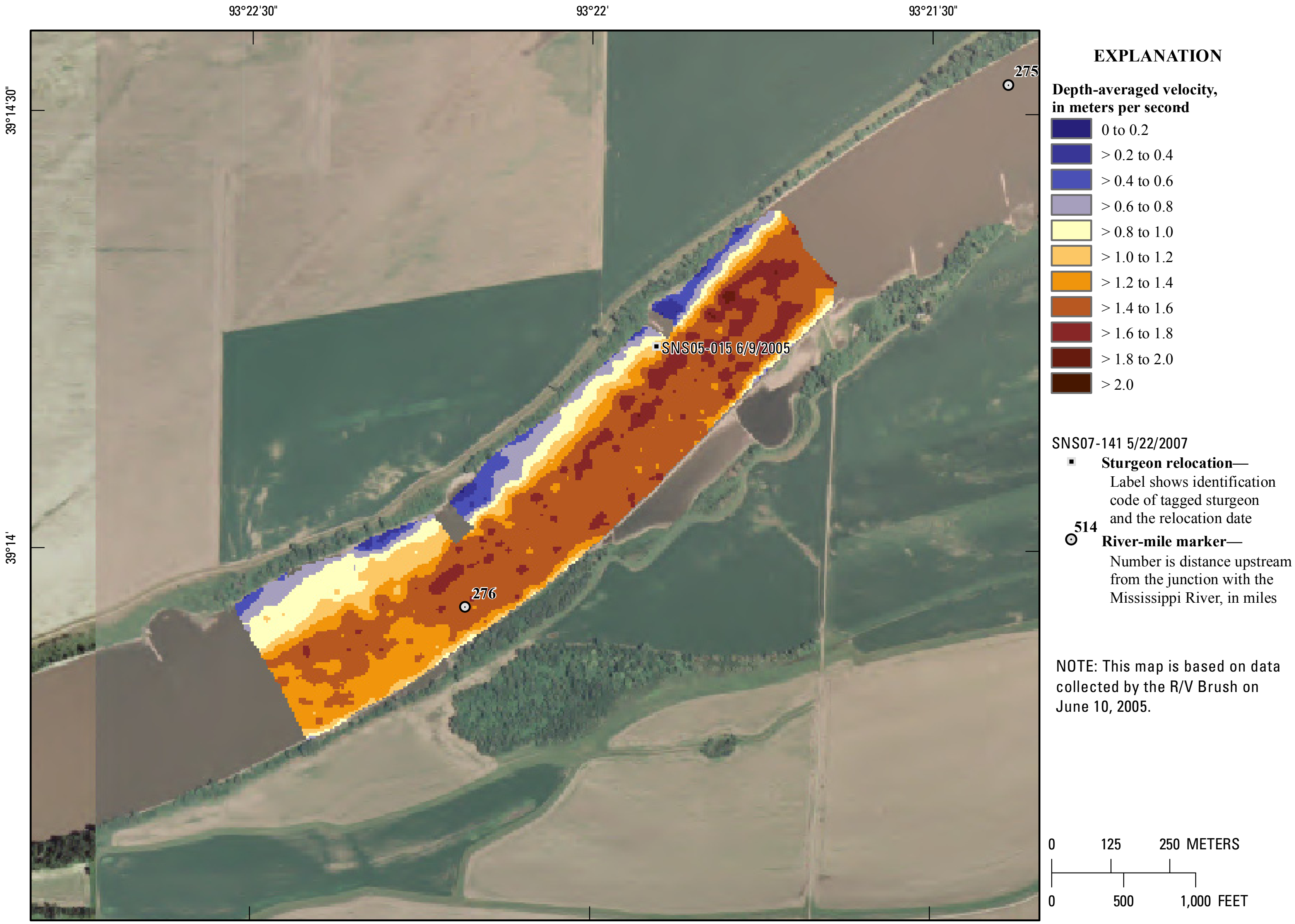
Figure 317. Map of depth-averaged velocity based on data collected on June 14, 2006, in the vicinity of river mile 278.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

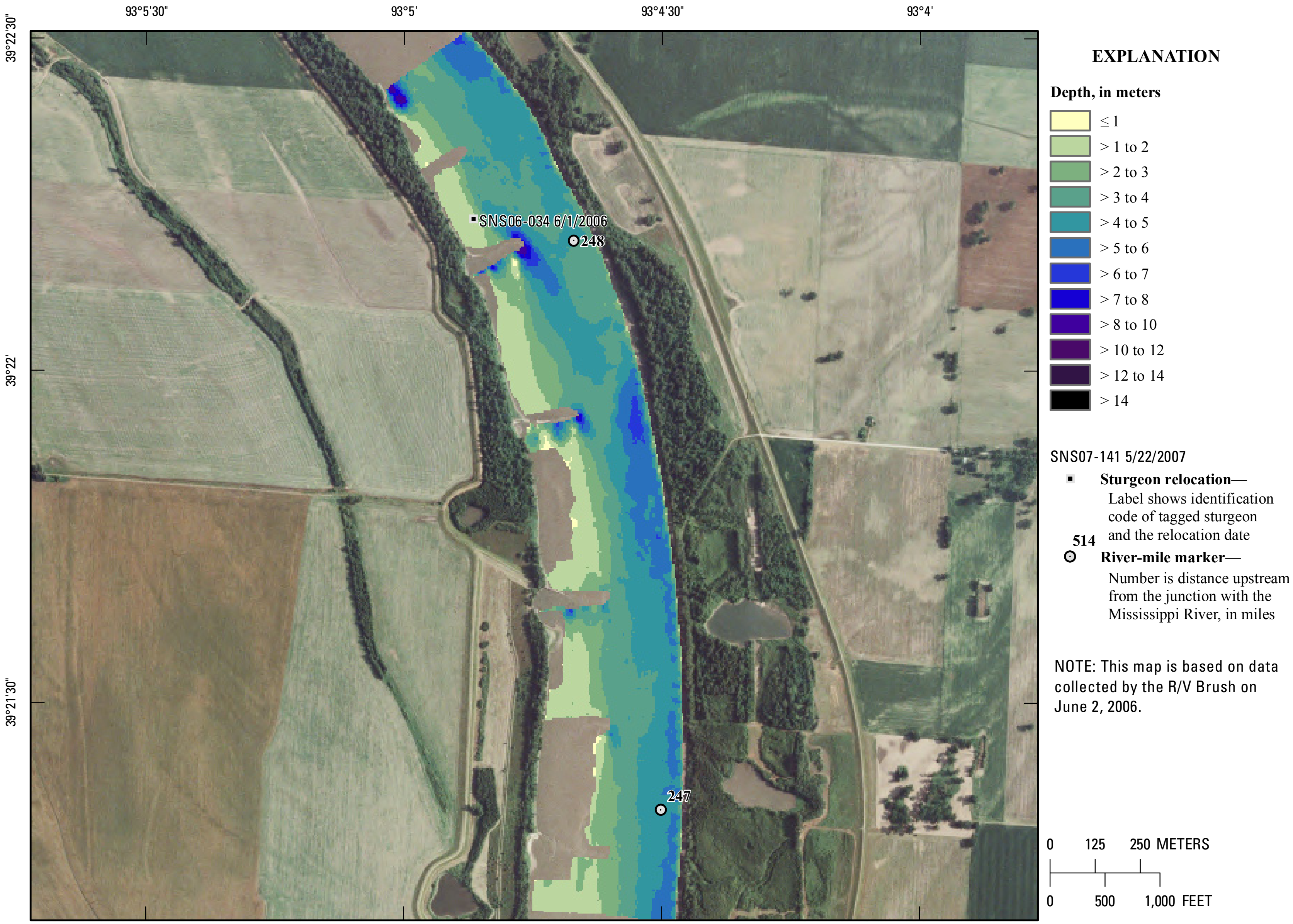
Figure 318. Map of depth based on data collected on June 10, 2005, in the vicinity of river mile 276.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

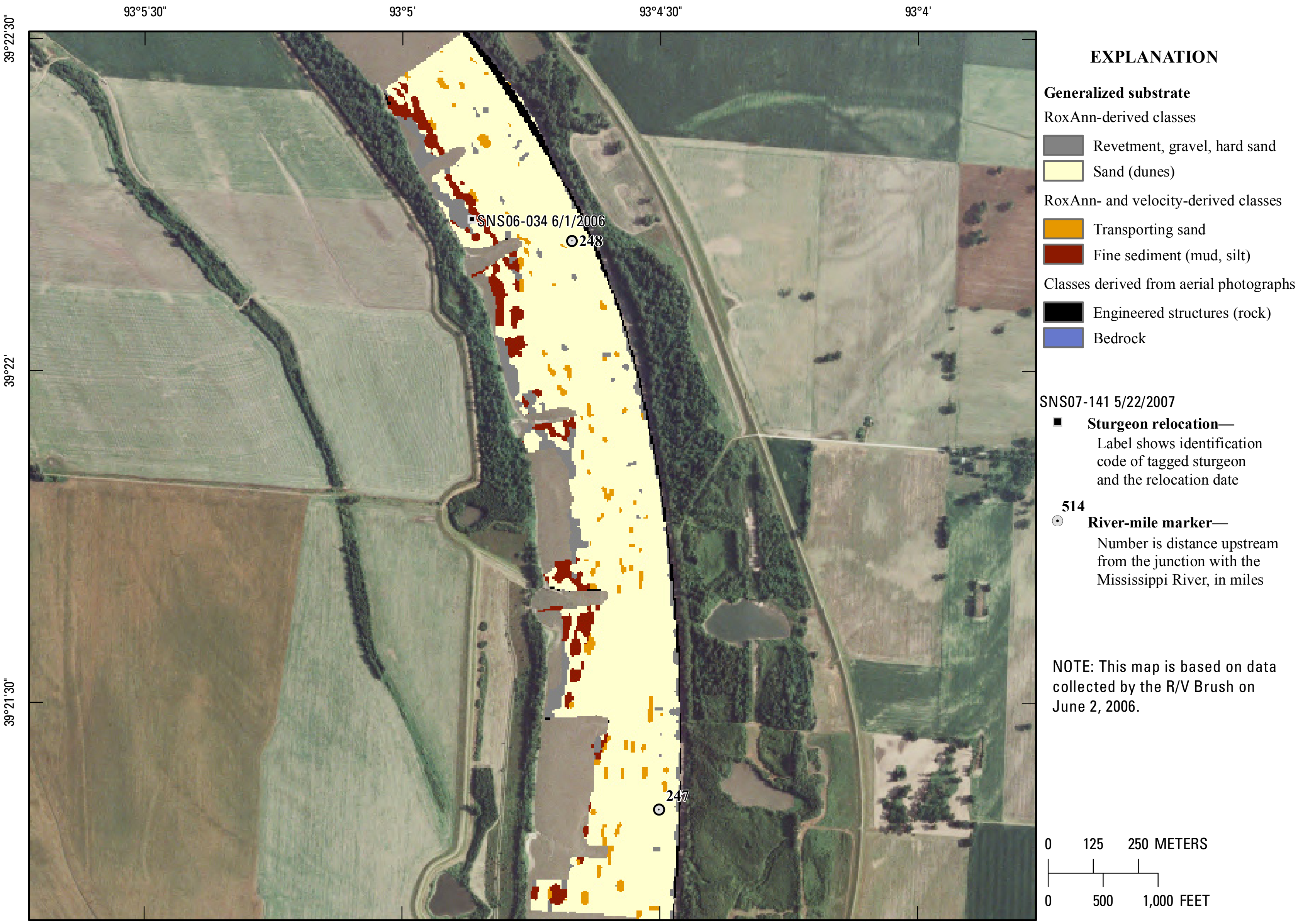
Figure 319. Map of depth-averaged velocity based on data collected on June 10, 2005, in the vicinity of river mile 276.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

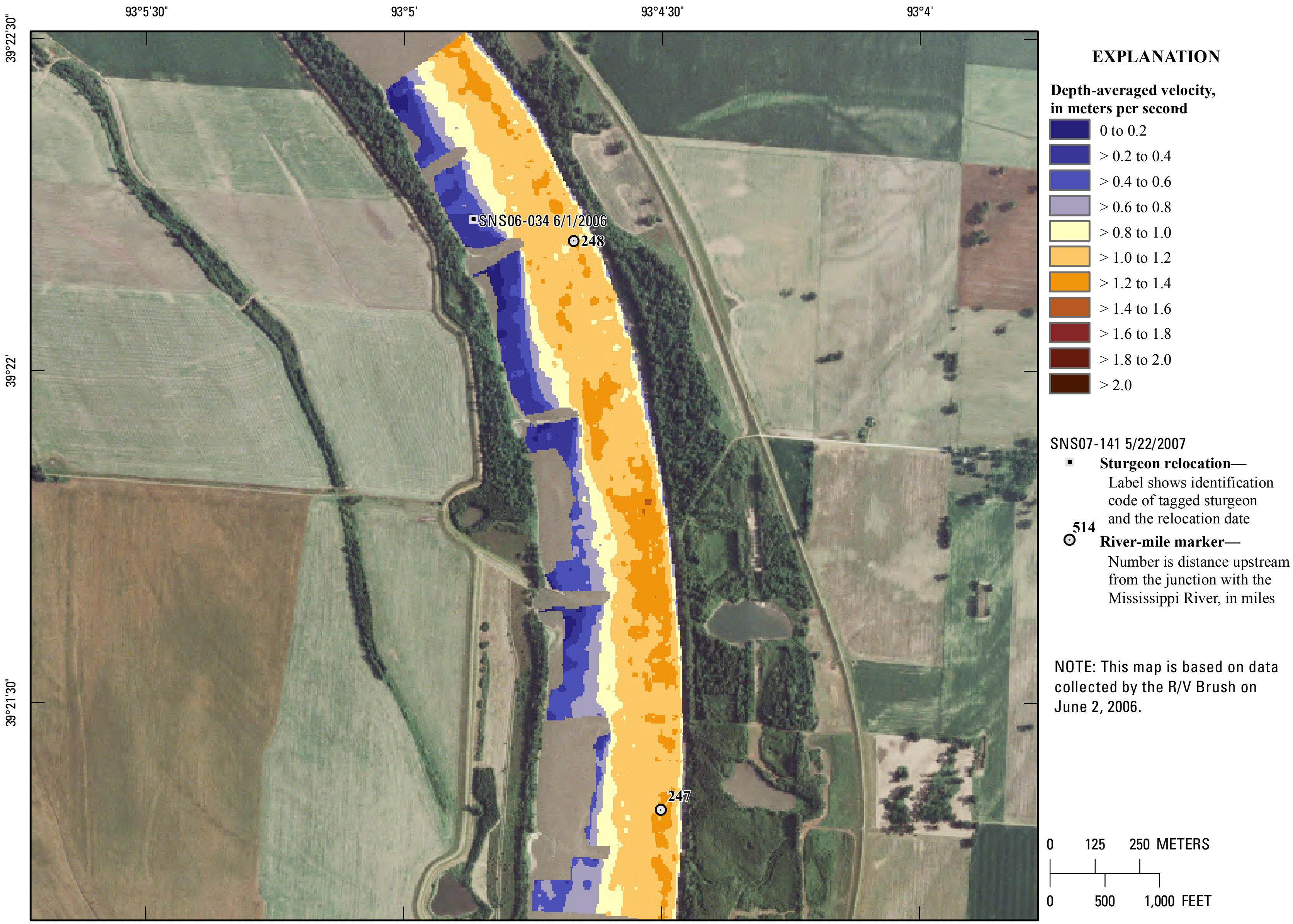
Figure 320. Map of depth based on data collected on June 2, 2006, in the vicinity of river mile 248.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

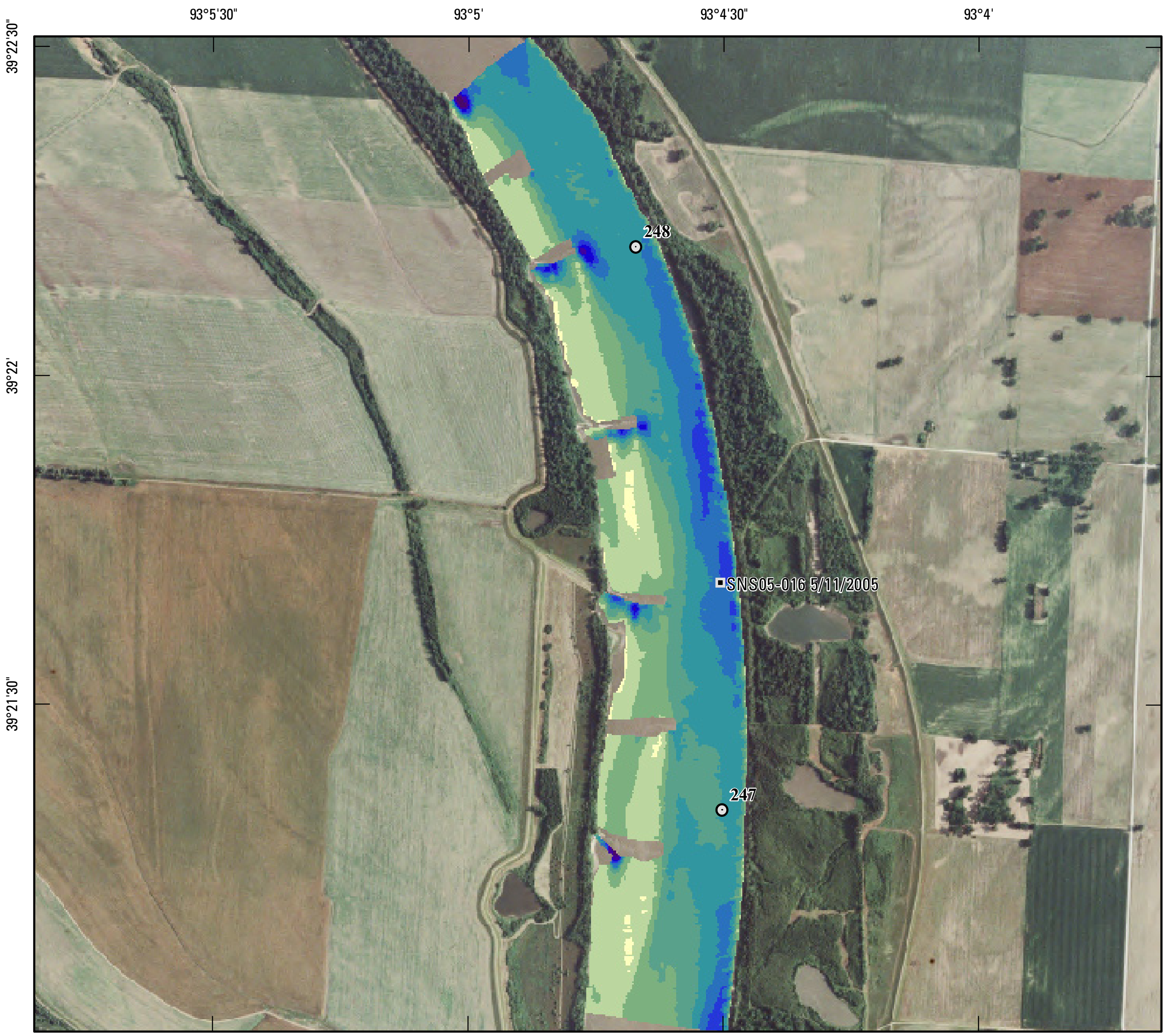
Figure 321. Map of generalized substrate based on data collected on June 2, 2006, in the vicinity of river mile 248.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 322. Map of depth-averaged velocity based on data collected on June 2, 2006, in the vicinity of river mile 248.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on May 12, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 323. Map of depth based on data collected on May 12, 2005, in the vicinity of river mile 248.

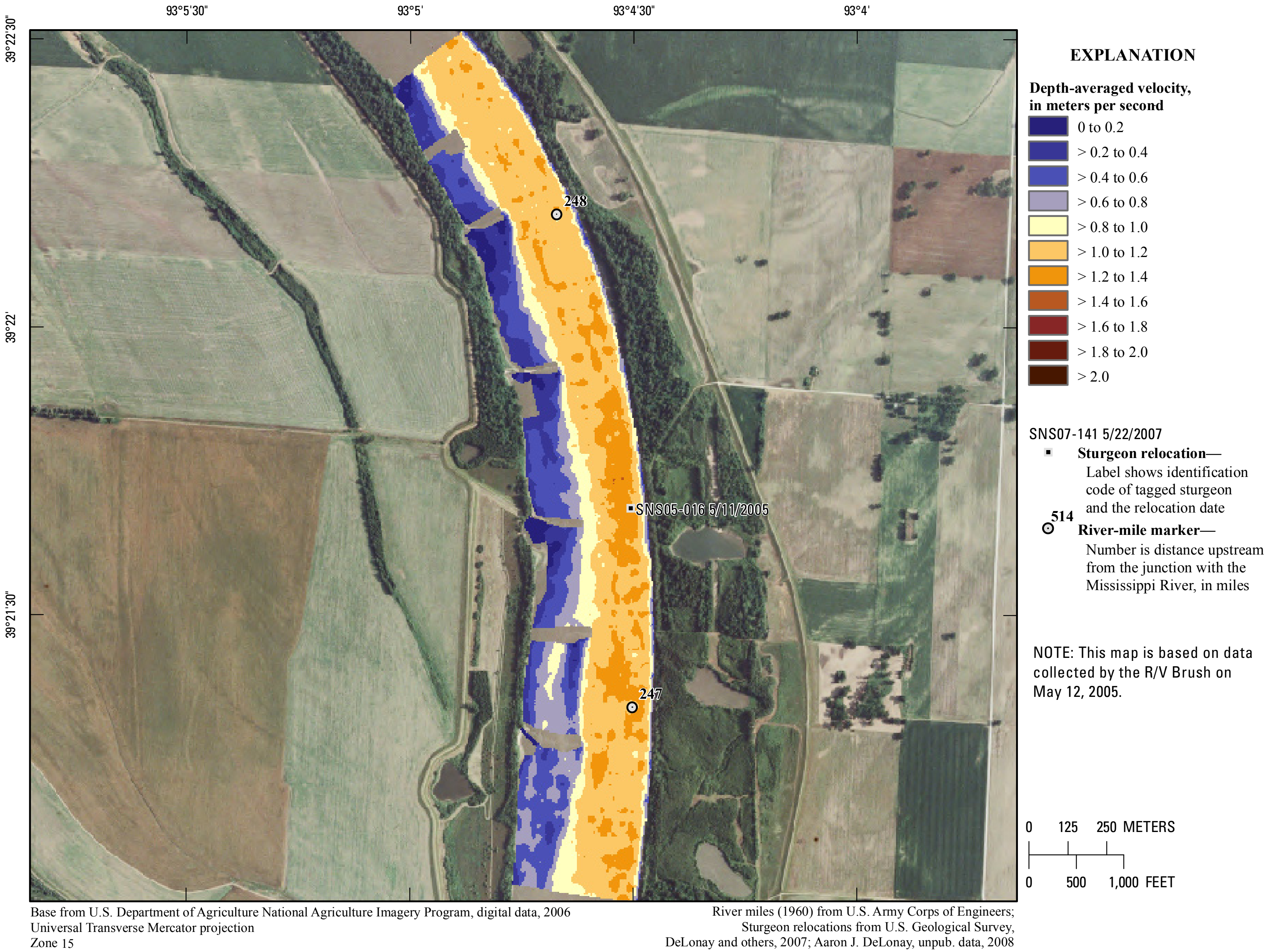
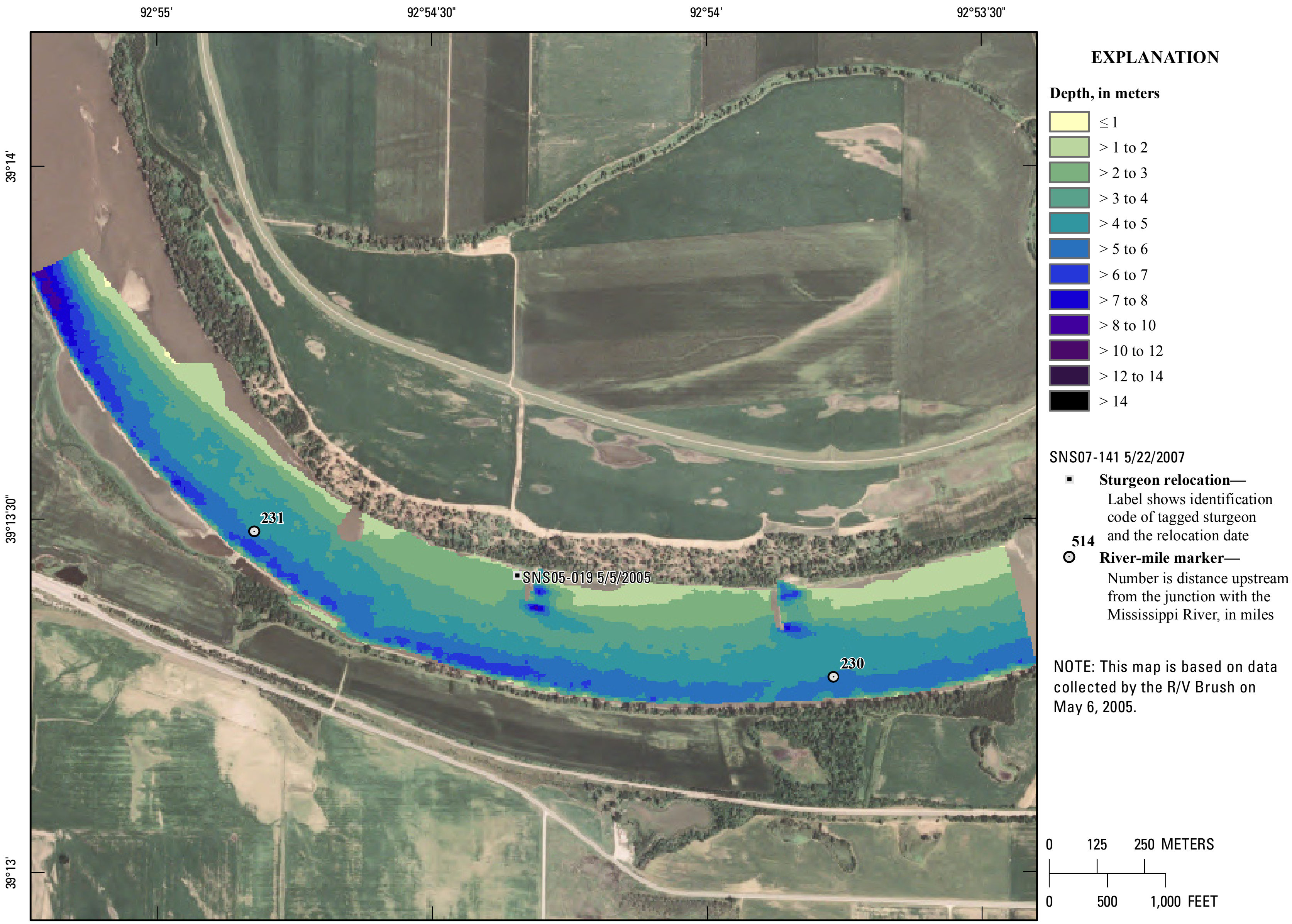


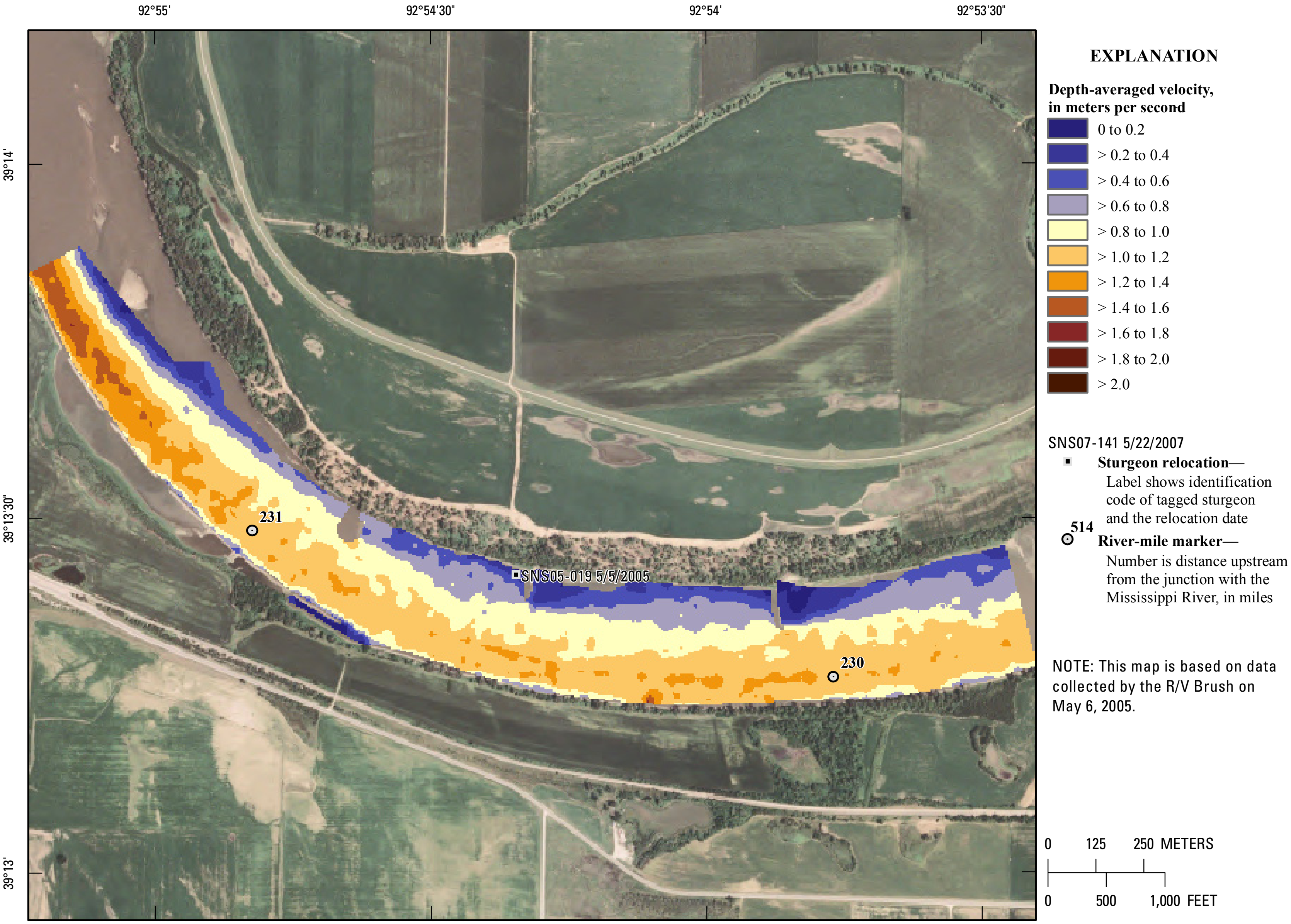
Figure 324. Map of depth-averaged velocity based on data collected on May 12, 2005, in the vicinity of river mile 248.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 325. Map of depth based on data collected on May 6, 2005, in the vicinity of river mile 231.

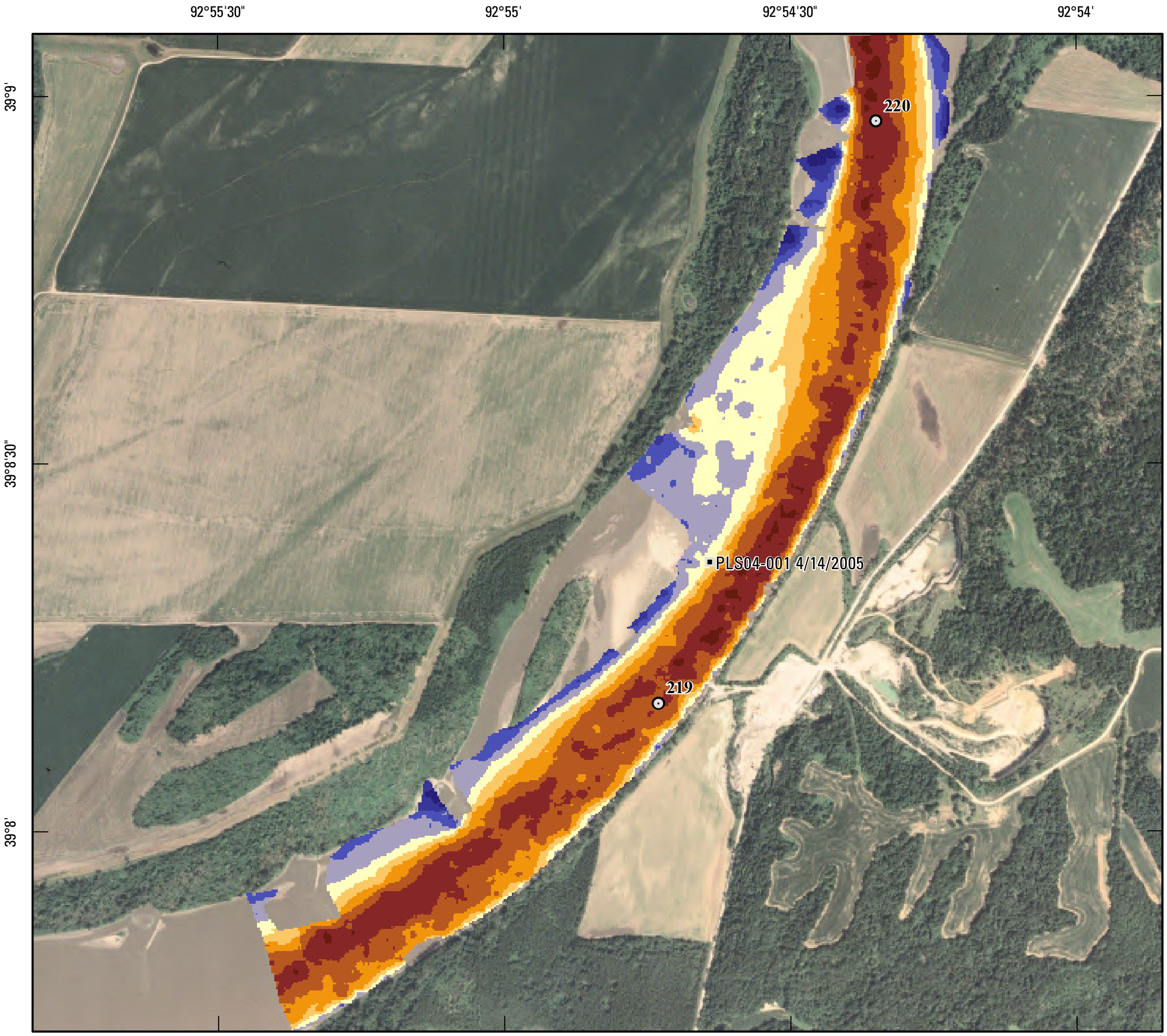


Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 326. Map of depth-averaged velocity based on data collected on May 6, 2005, in the vicinity of river mile 231.

Figure 327. Map of depth based on data collected on April 15, 2005, in the vicinity of river mile 219.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on April 15, 2005.

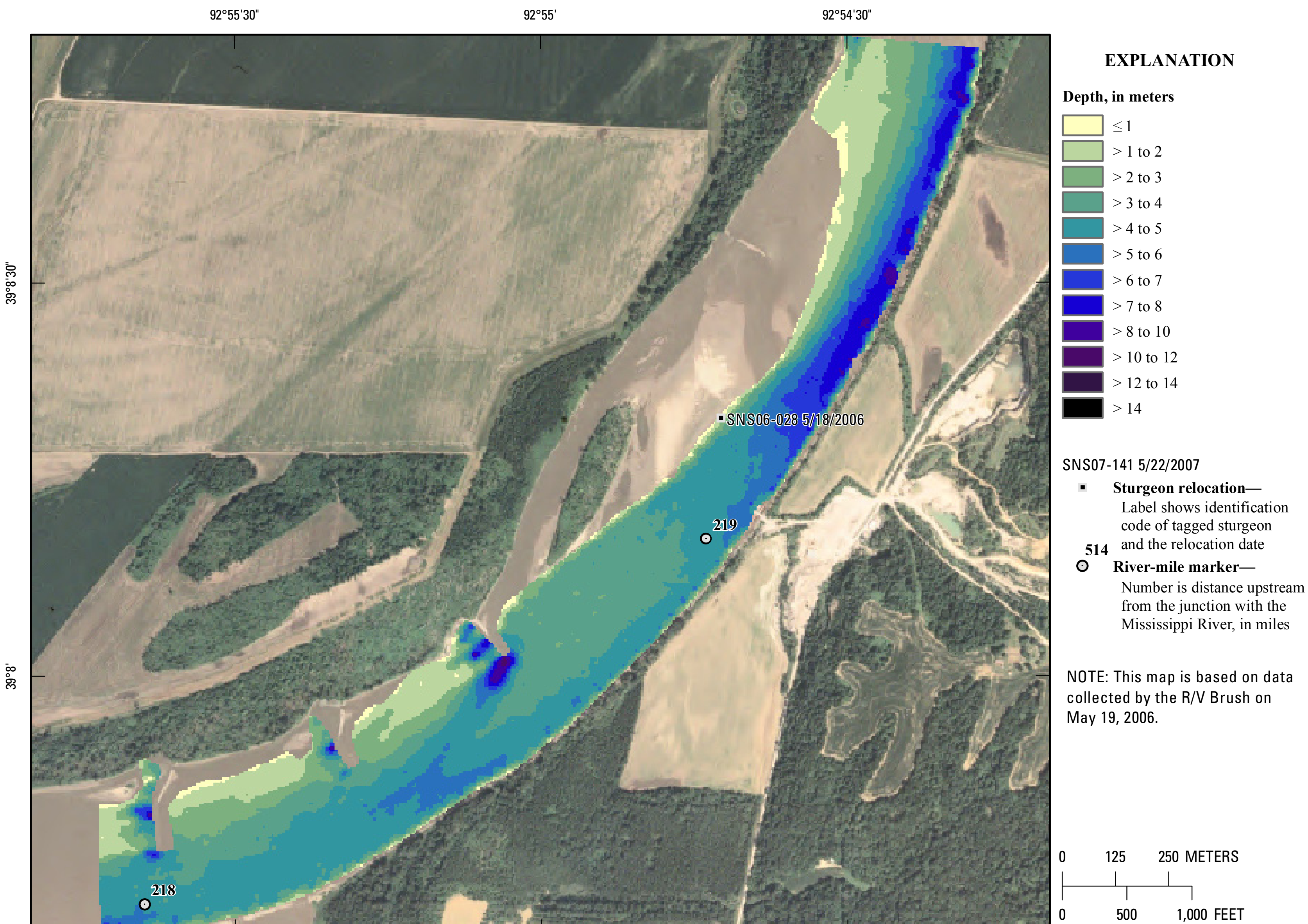
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

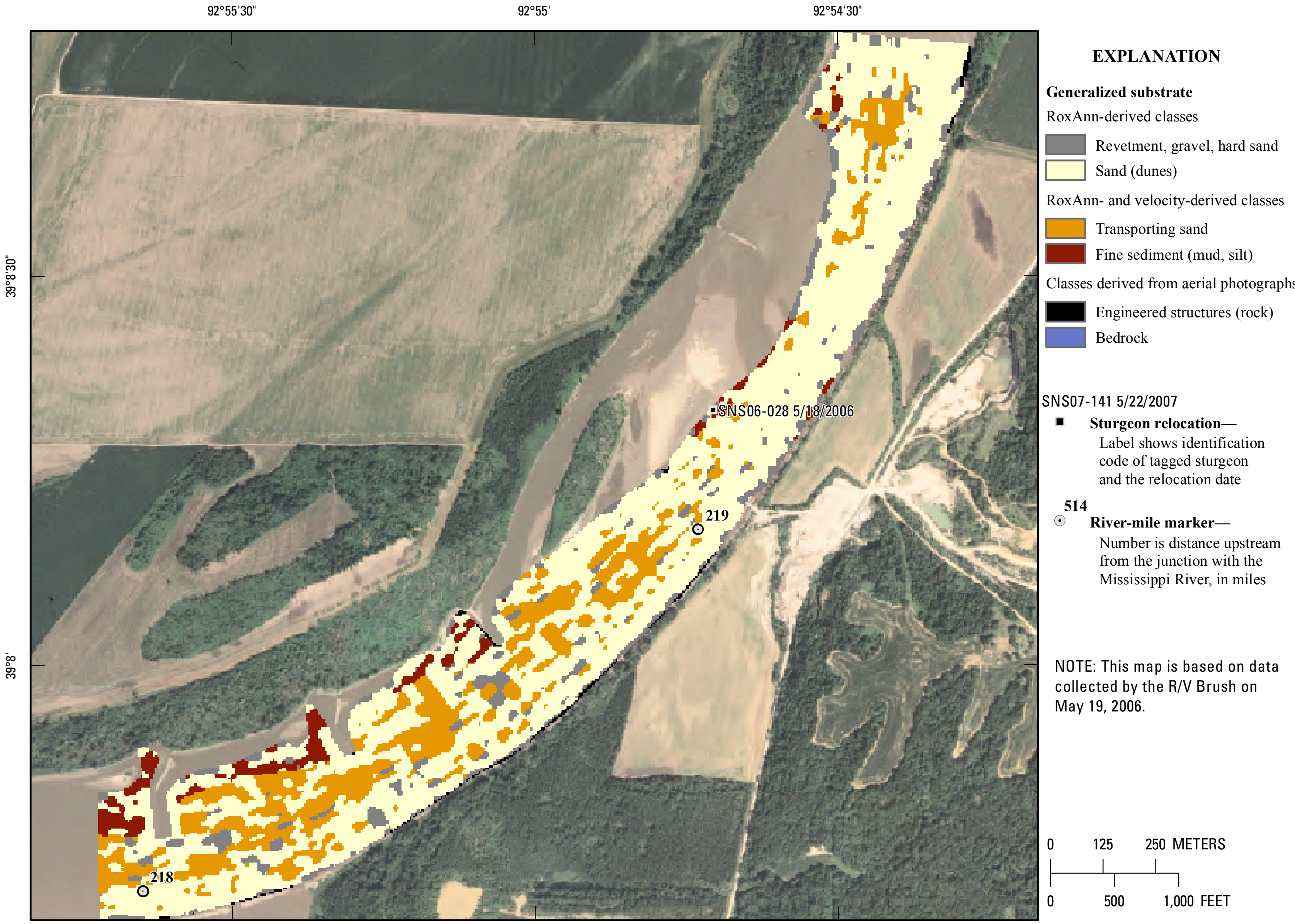
Figure 328. Map of depth-averaged velocity based on data collected on April 15, 2005, in the vicinity of river mile 219.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

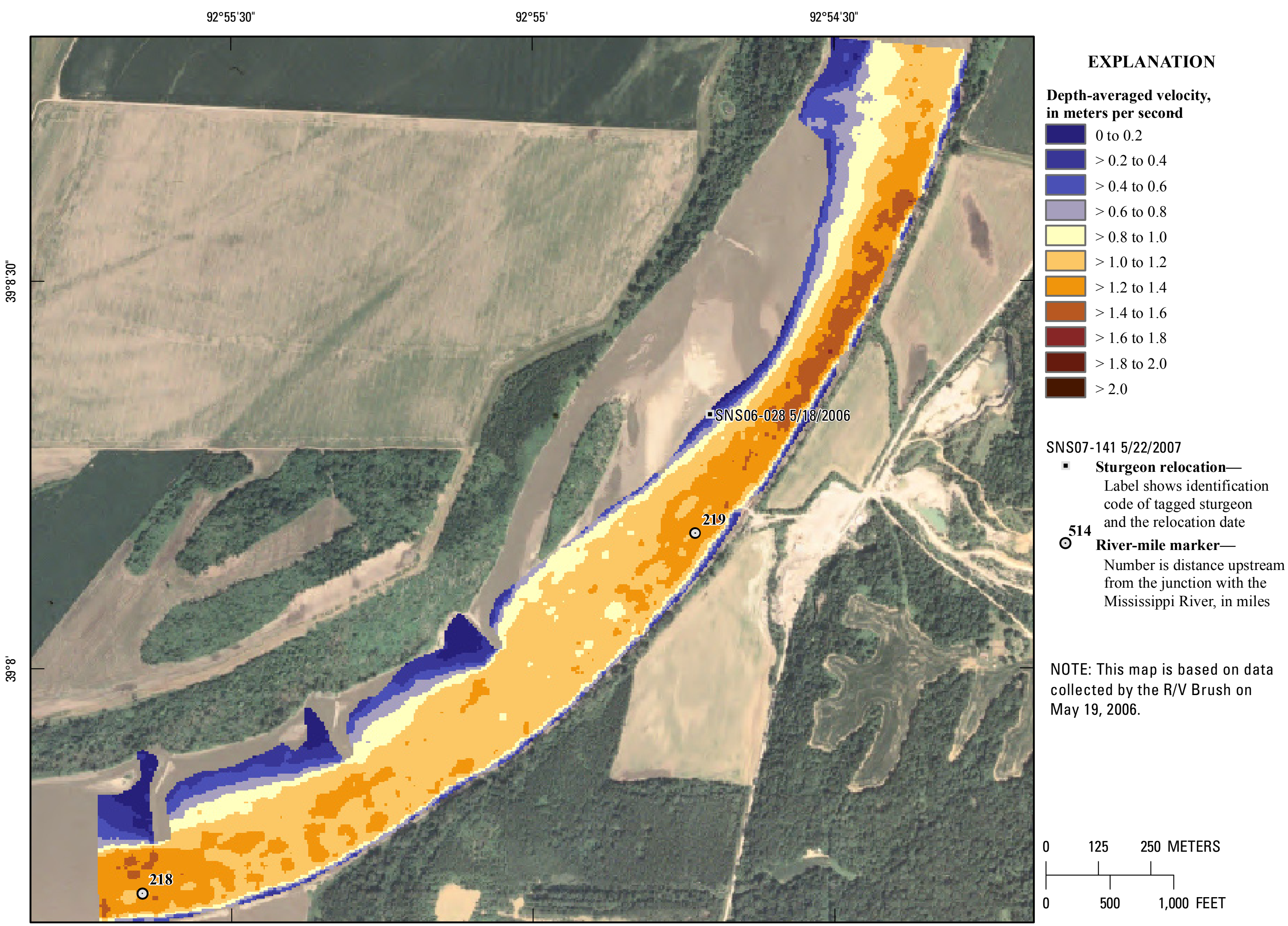
Figure 329. Map of depth based on data collected on May 19, 2006, in the vicinity of river mile 219.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 330. Map of generalized substrate based on data collected on May 19, 2006, in the vicinity of river mile 219.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 331. Map of depth-averaged velocity based on data collected on May 19, 2006, in the vicinity of river mile 219.

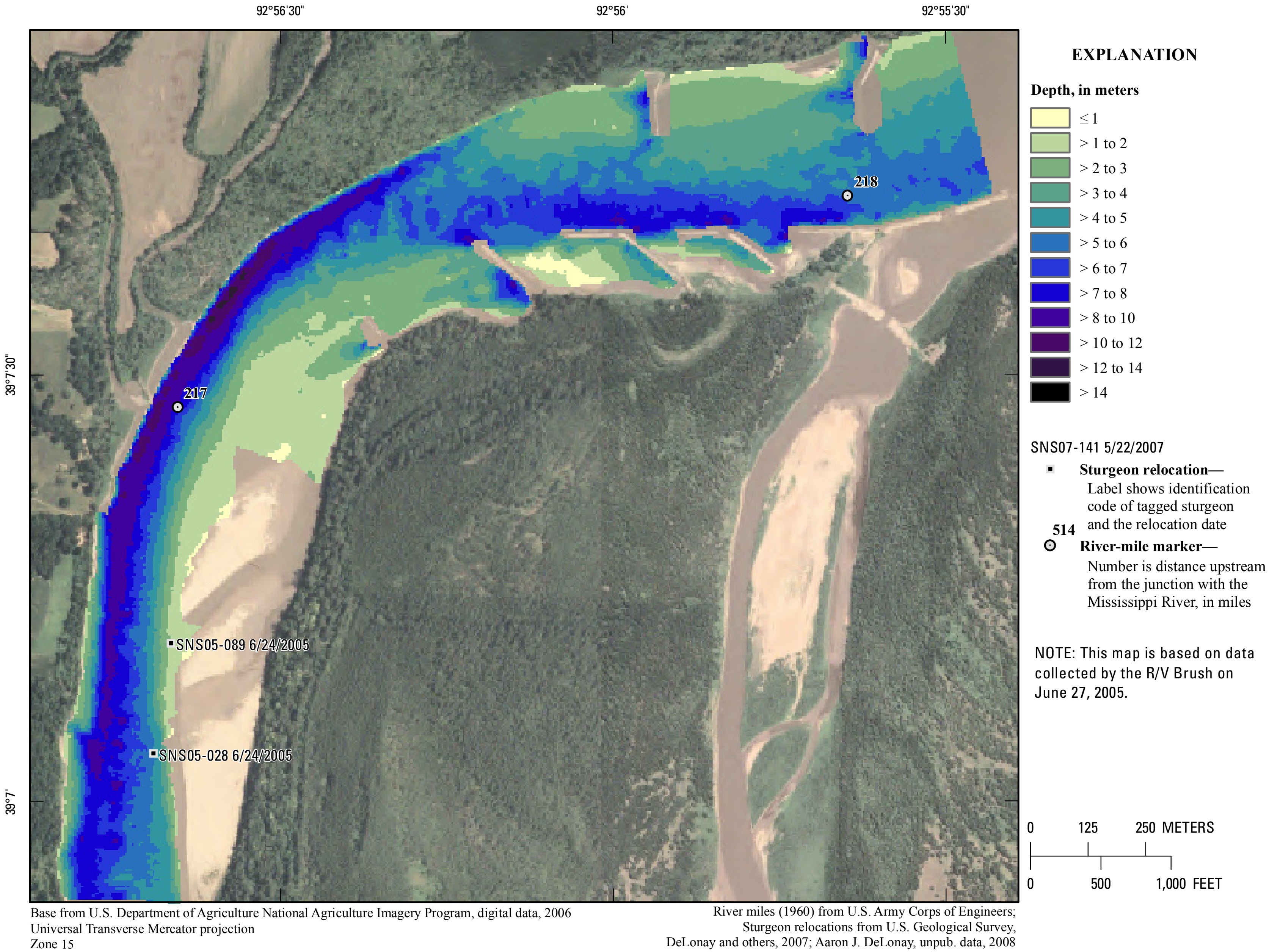
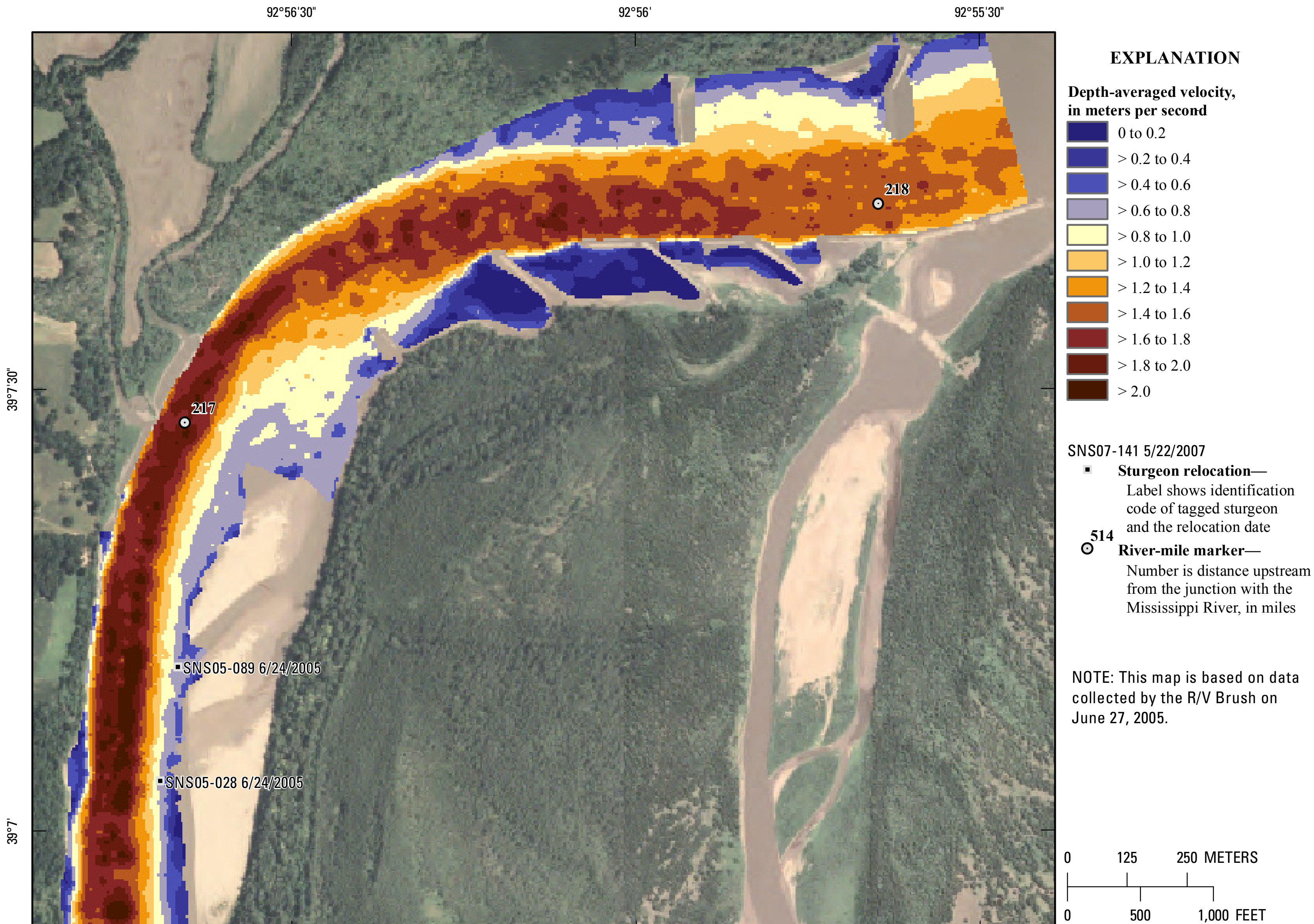


Figure 332. Map of depth based on data collected on June 27, 2005, in the vicinity of river mile 217.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 333. Map of depth-averaged velocity based on data collected on June 27, 2005, in the vicinity of river mile 217.

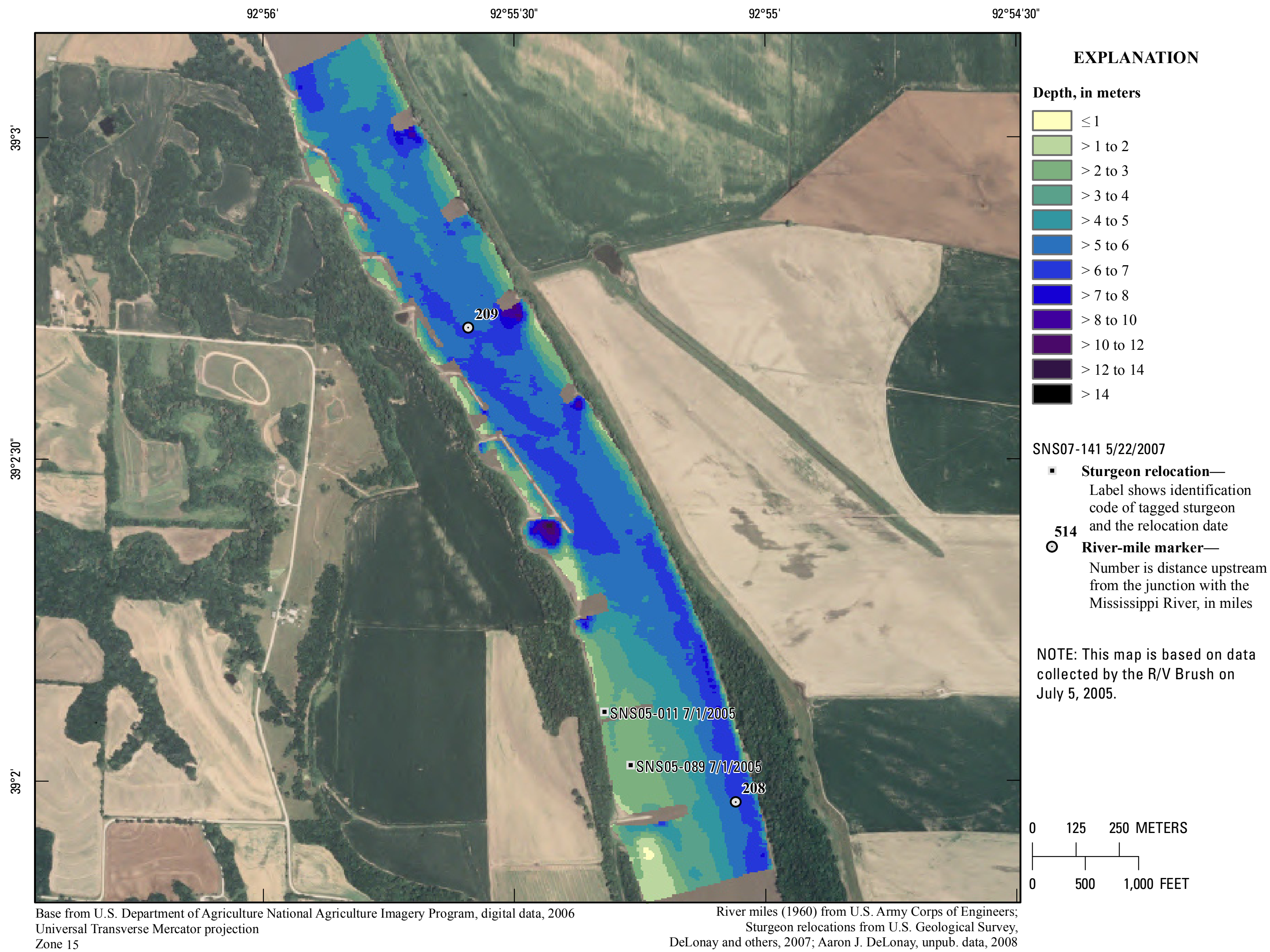


Figure 334. Map of depth based on data collected on July 5, 2005, in the vicinity of river mile 209.

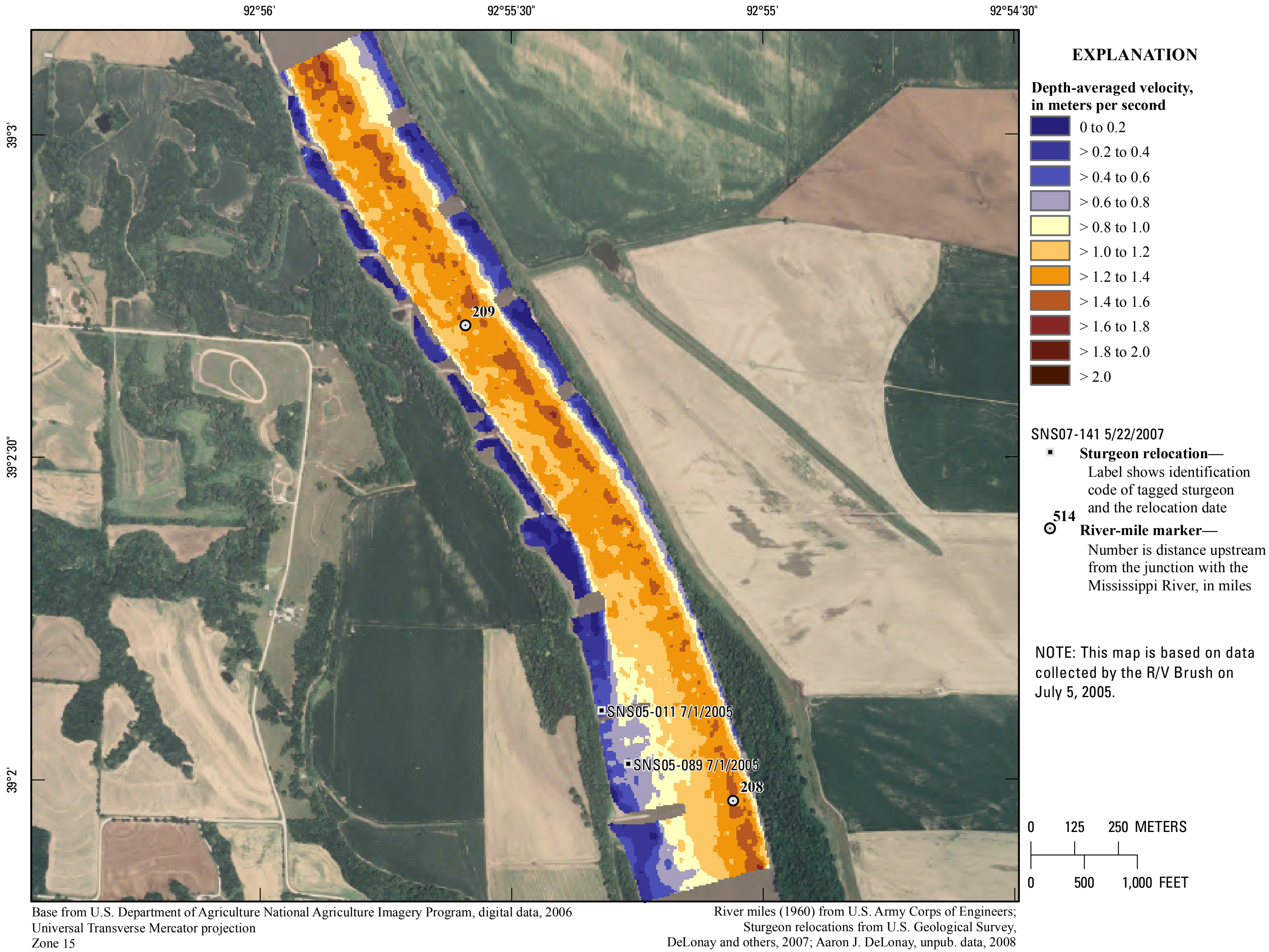
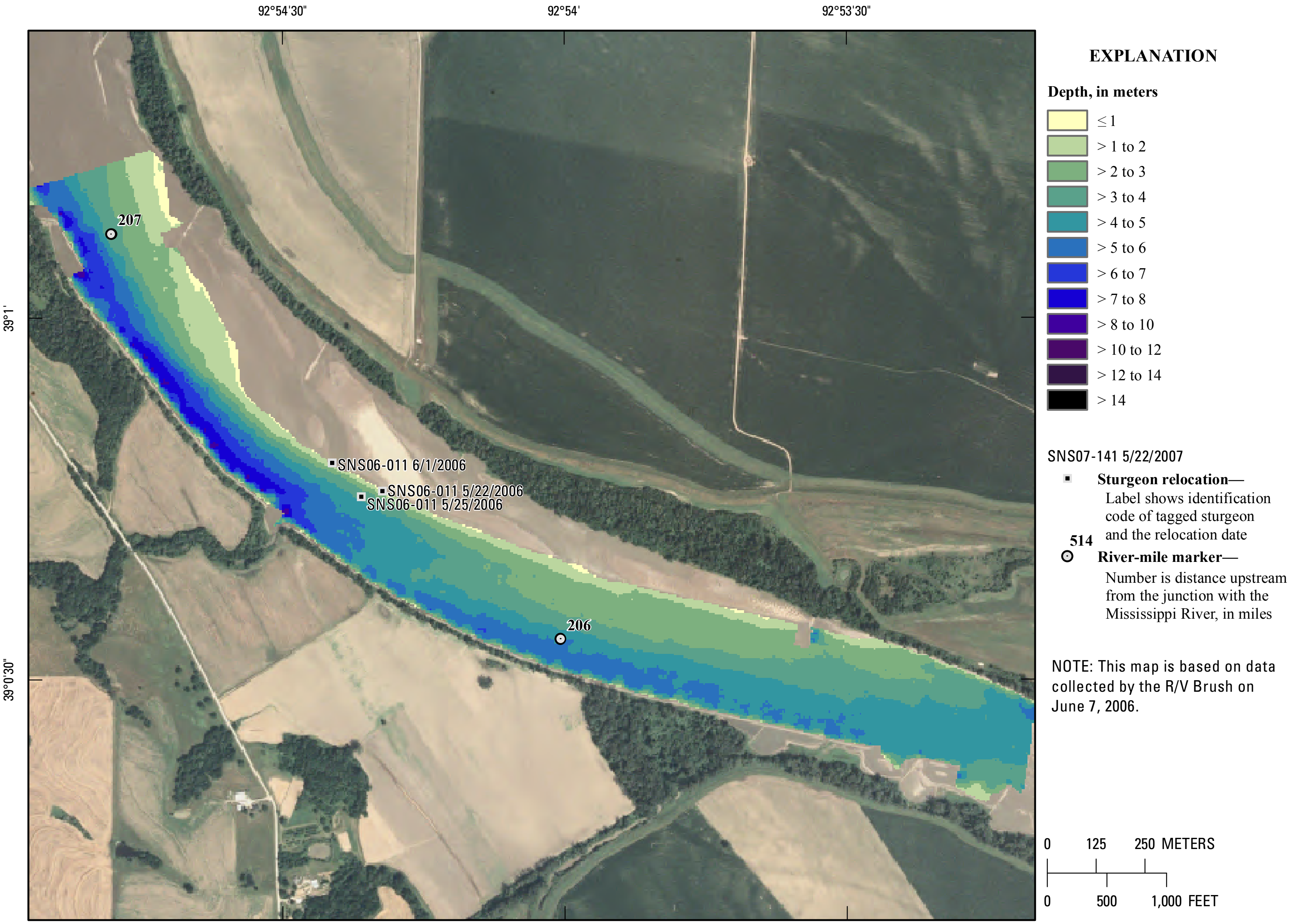


Figure 335. Map of depth-averaged velocity based on data collected on July 5, 2005, in the vicinity of river mile 209.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 336. Map of depth based on data collected on June 7, 2006, in the vicinity of river mile 206.

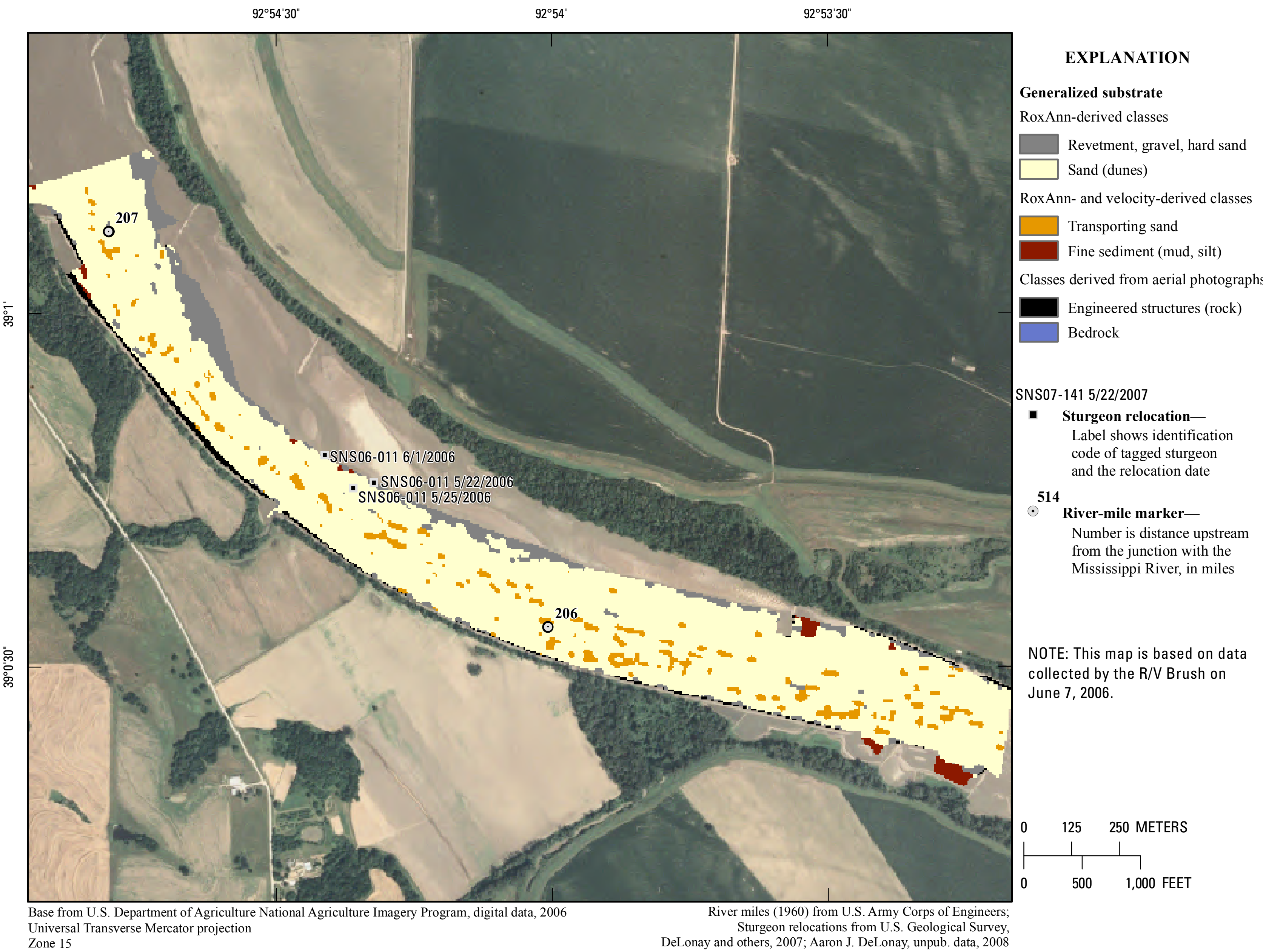
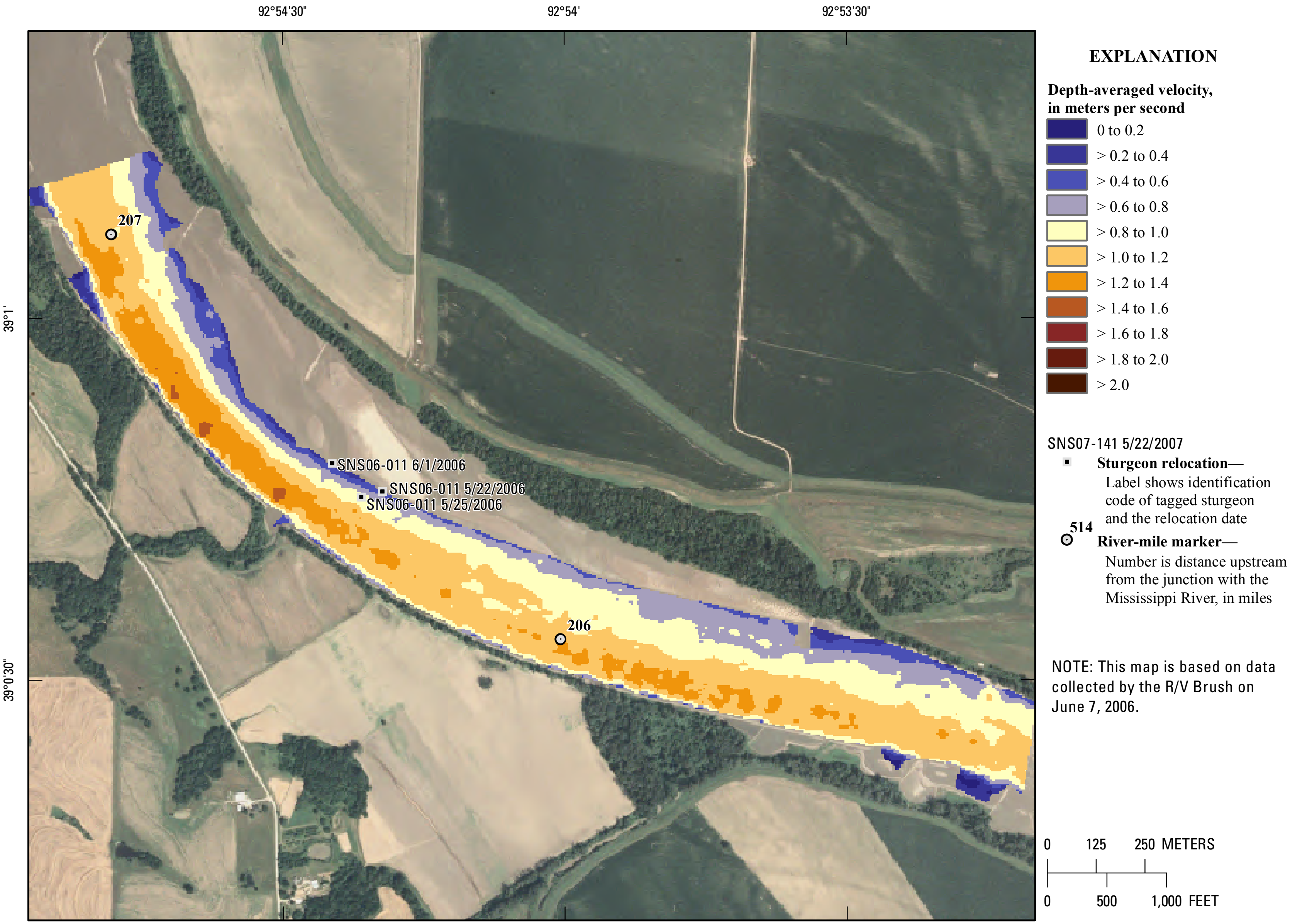


Figure 337. Map of generalized substrate based on data collected on June 7, 2006, in the vicinity of river mile 206.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 338. Map of depth-averaged velocity based on data collected on June 7, 2006, in the vicinity of river mile 206.

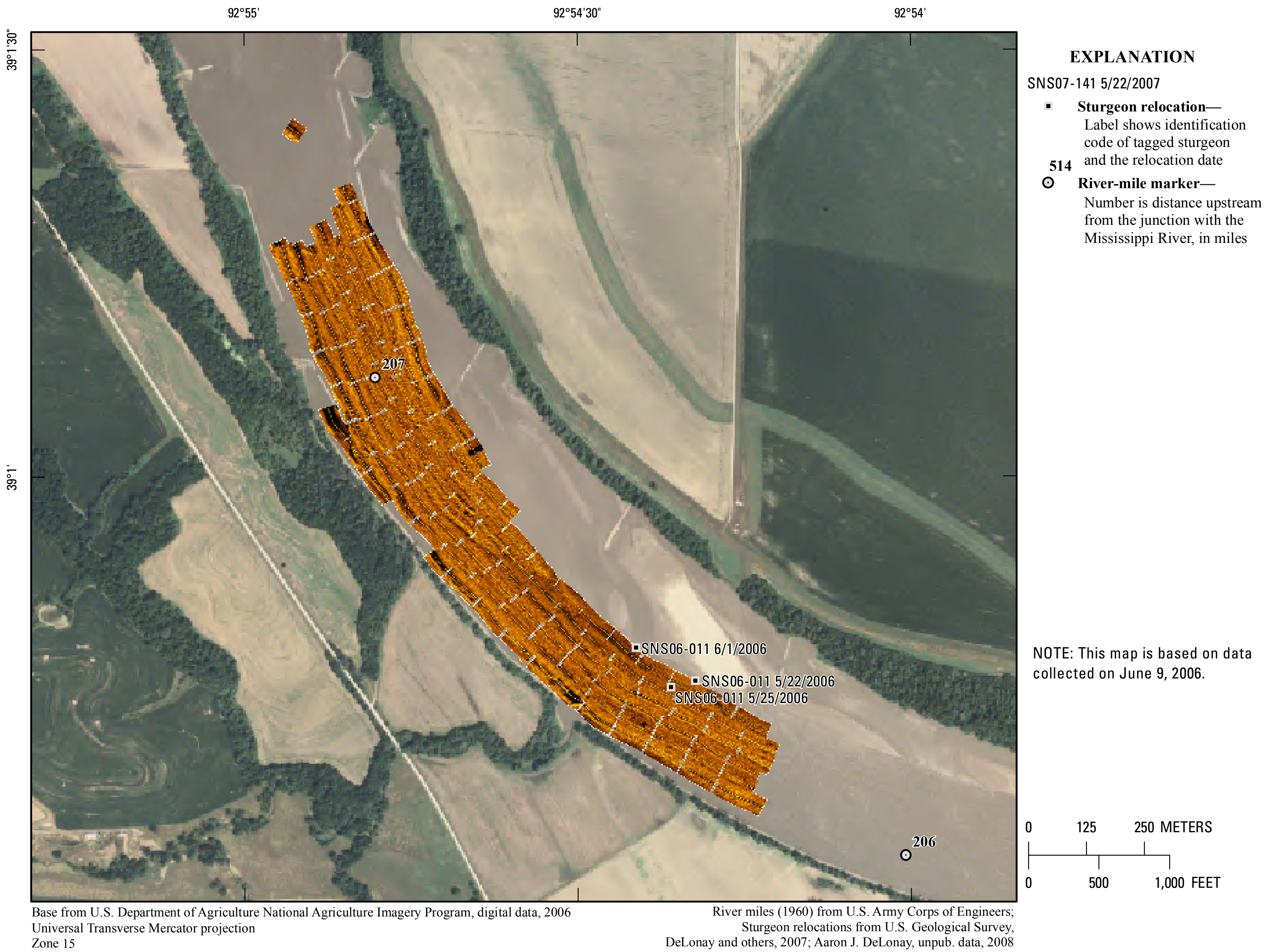


Figure 339. Map of side-scan sonar imagery based on data collected on June 9, 2006, in the vicinity of river mile 206.

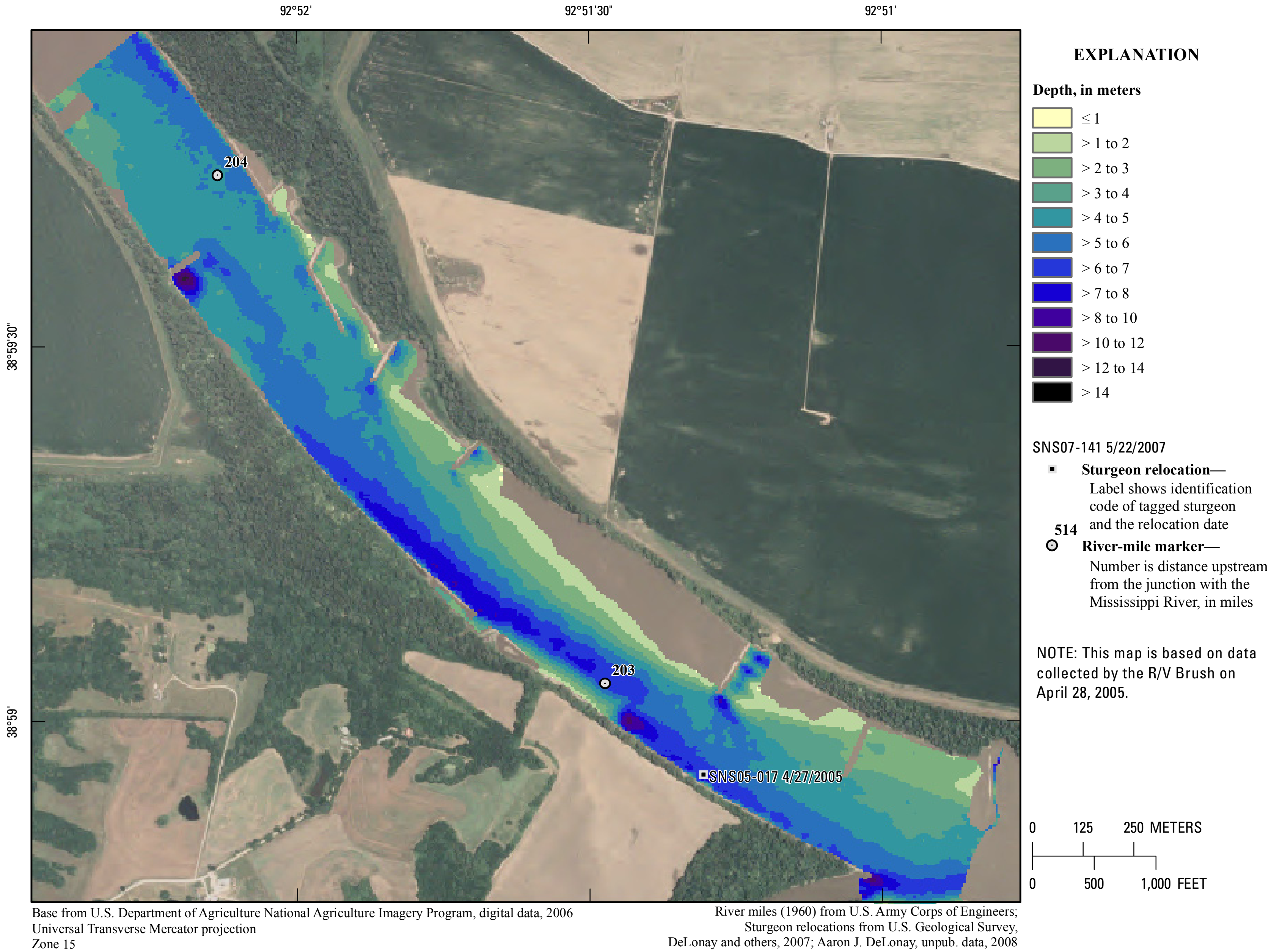
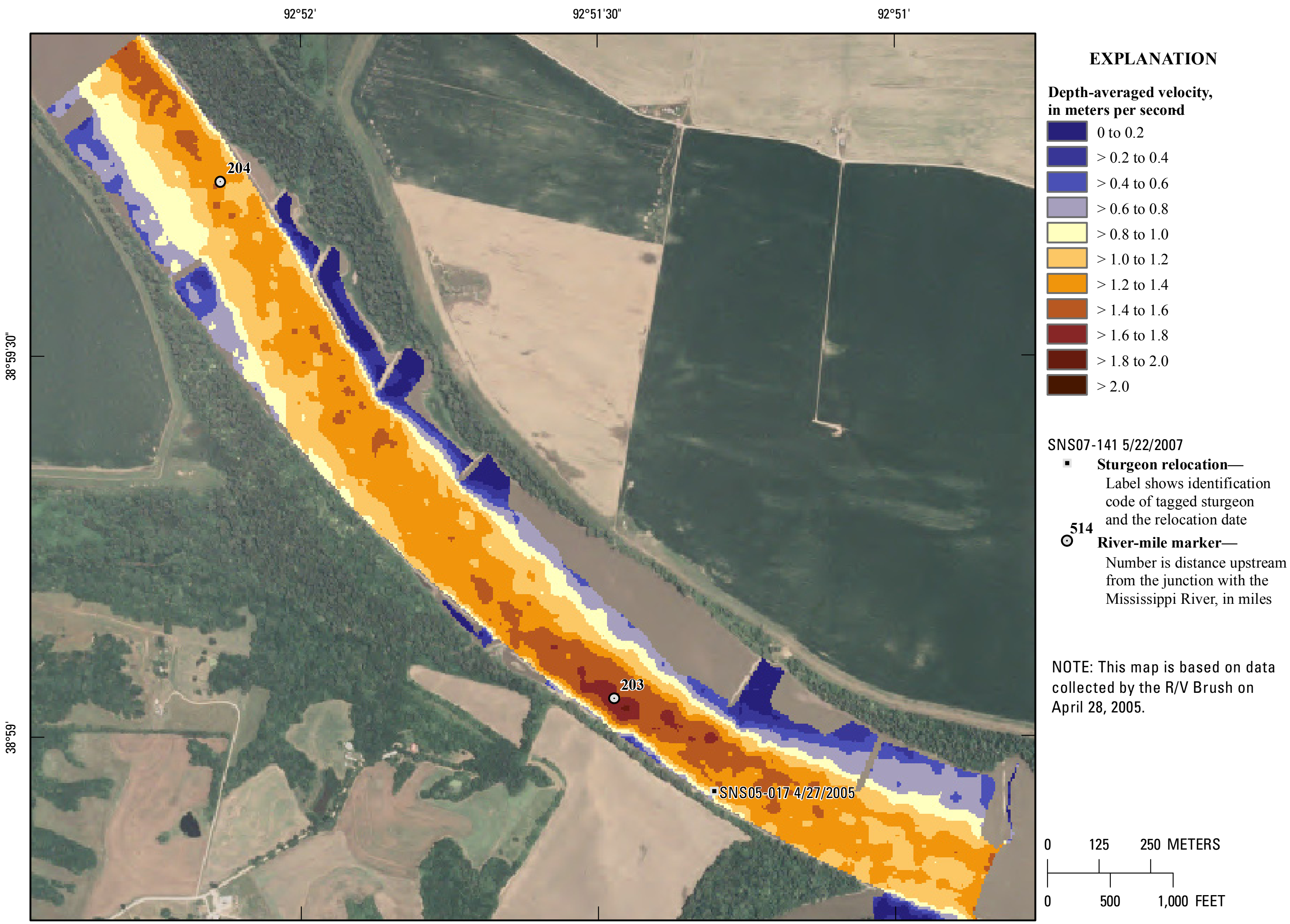


Figure 340. Map of depth based on data collected on April 28, 2005, in the vicinity of river mile 203.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 341. Map of depth-averaged velocity based on data collected on April 28, 2005, in the vicinity of river mile 203.

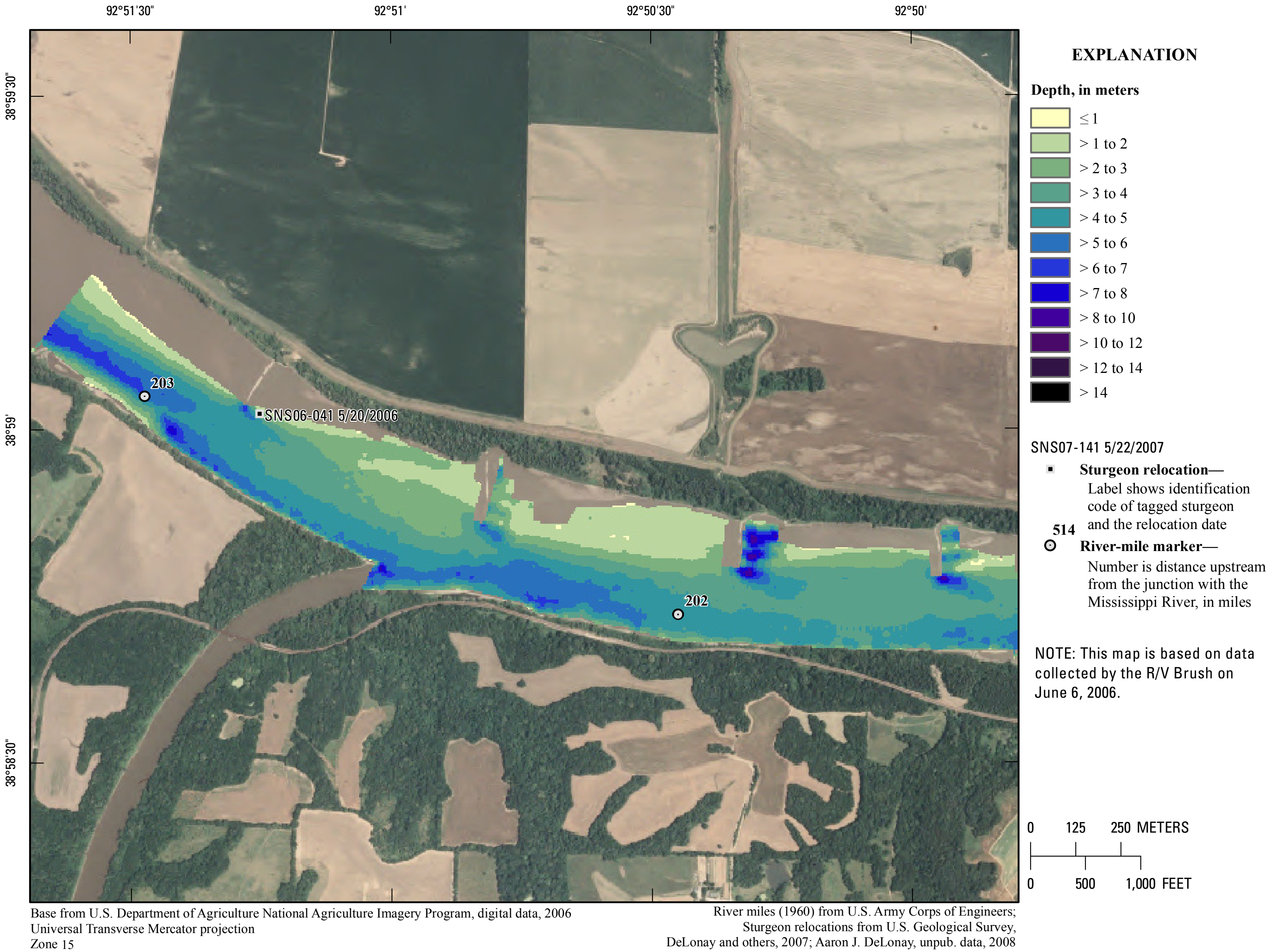


Figure 342. Map of depth based on data collected on June 6, 2006, in the vicinity of river mile 202.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

Revetment, gravel, hard sand

Sand (dunes)

RoxAnn- and velocity-derived classes

Transporting sand

Fine sediment (mud, silt)

Classes derived from aerial photographs

Engineered structures (rock)

Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on June 6, 2006.

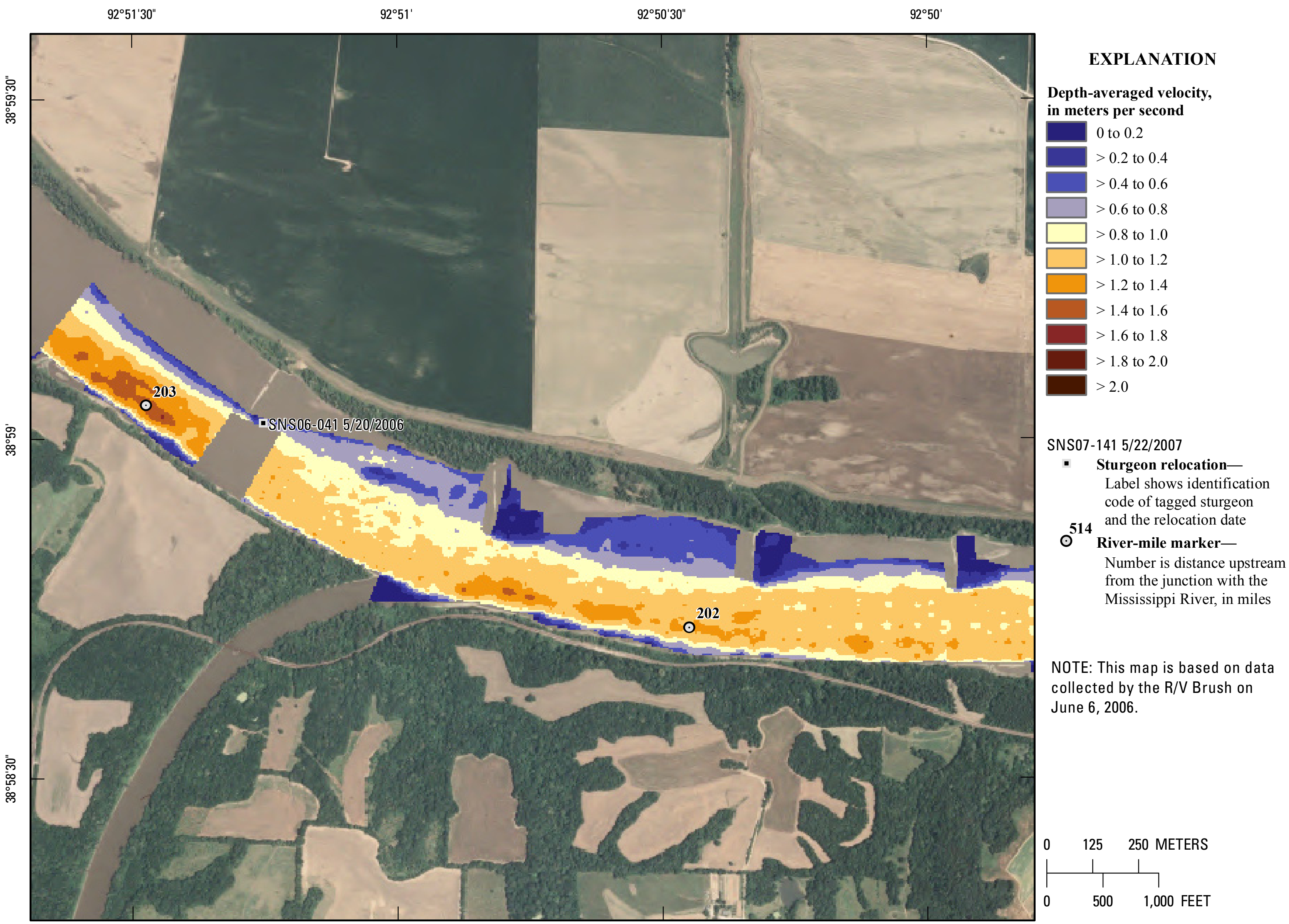
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 343. Map of generalized substrate based on data collected on June 6, 2006, in the vicinity of river mile 202.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 344. Map of depth-averaged velocity based on data collected on June 6, 2006, in the vicinity of river mile 202.

EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

SNS07-141 5/22/2007 **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on April 7, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 345. Map of depth based on data collected on April 7, 2005, in the vicinity of river mile 201.

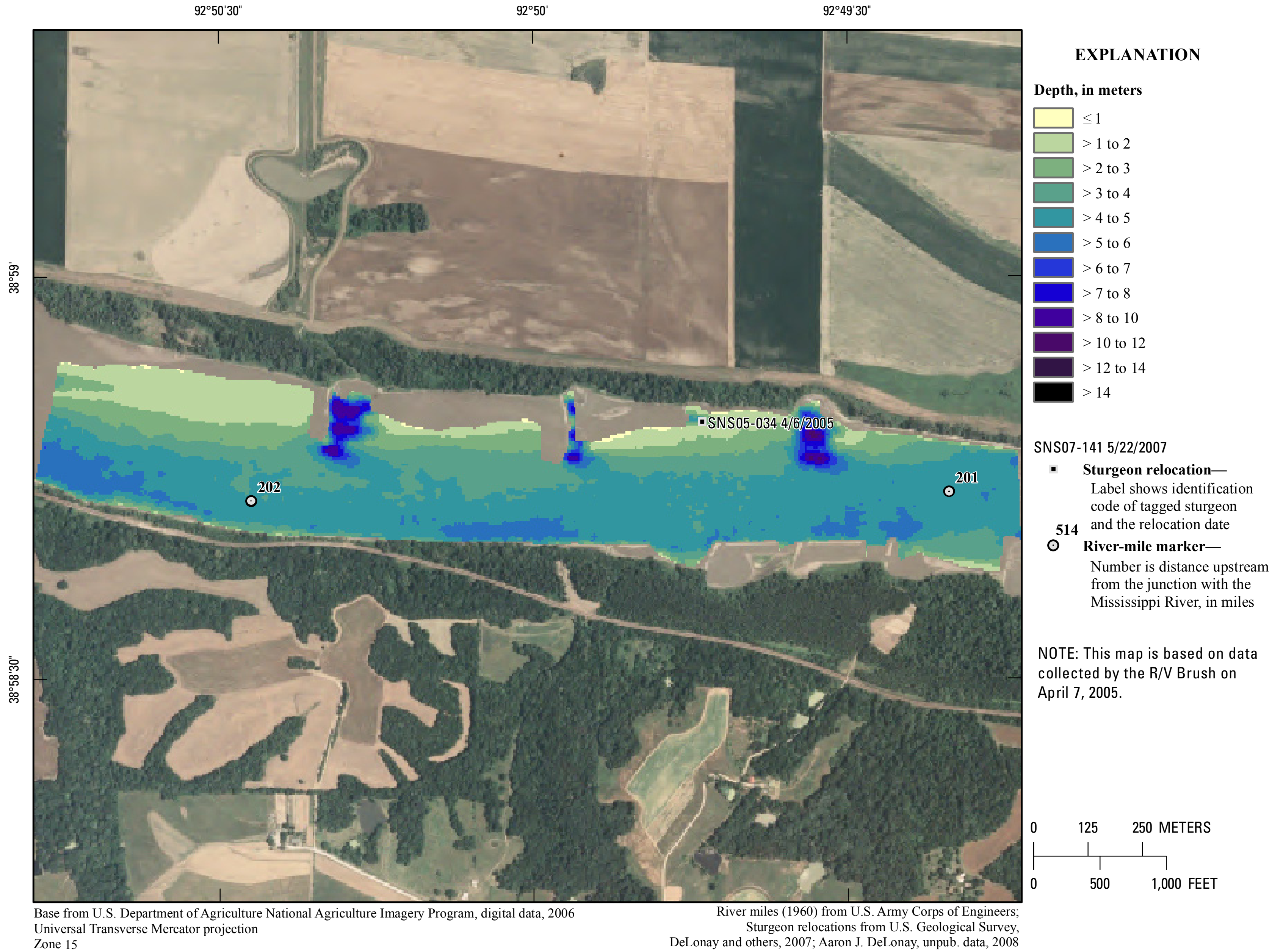
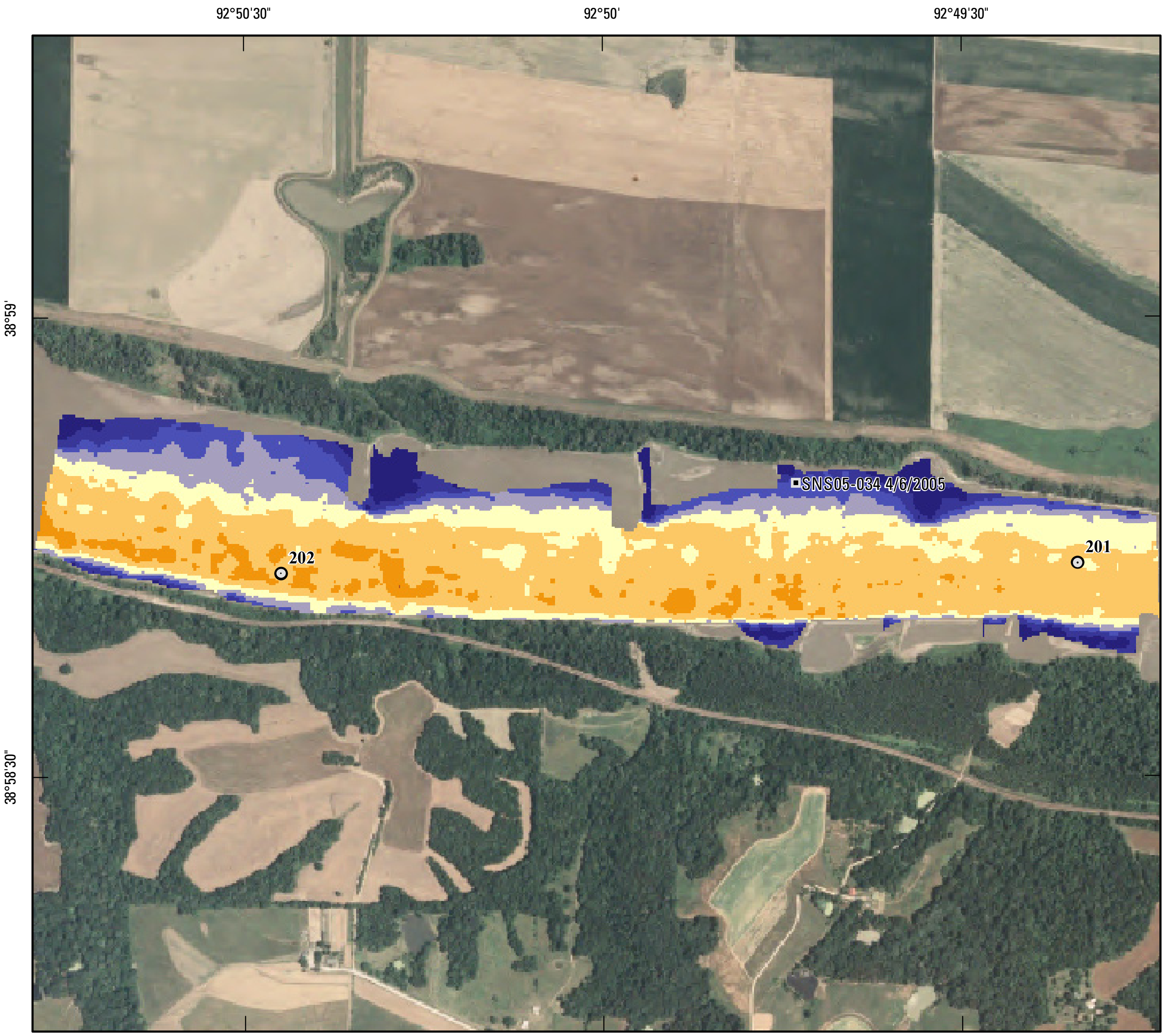


Figure 346. Map of depth based on data collected on April 7, 2005, in the vicinity of river mile 201.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on April 7, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 347. Map of depth-averaged velocity based on data collected on April 7, 2005, in the vicinity of river mile 201.

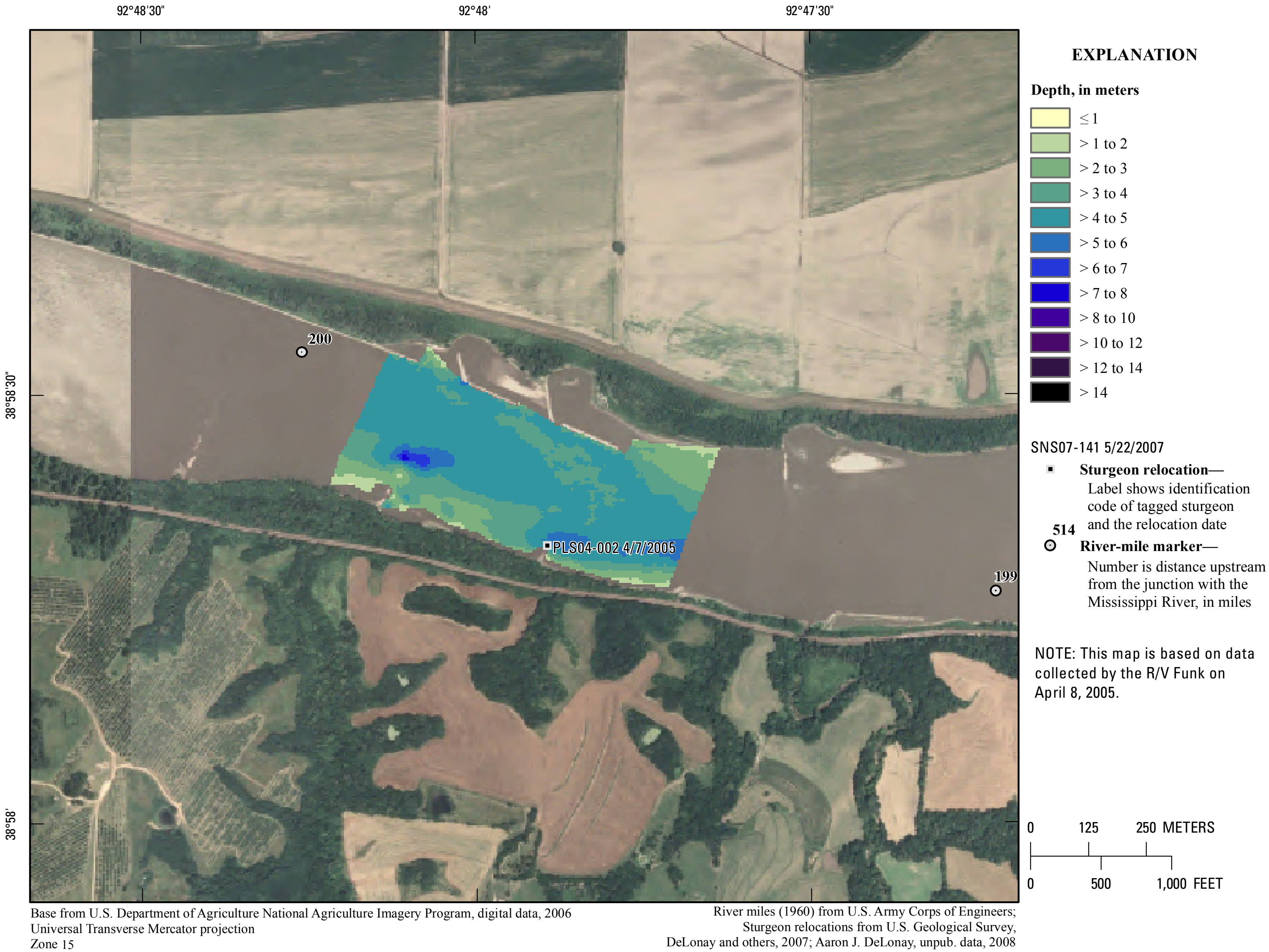

Figure 348. Map of depth based on data collected on April 8, 2005, in the vicinity of river mile 200.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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■ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

514 ⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on April 8, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 349. Map of generalized substrate based on data collected on April 8, 2005, in the vicinity of river mile 200.

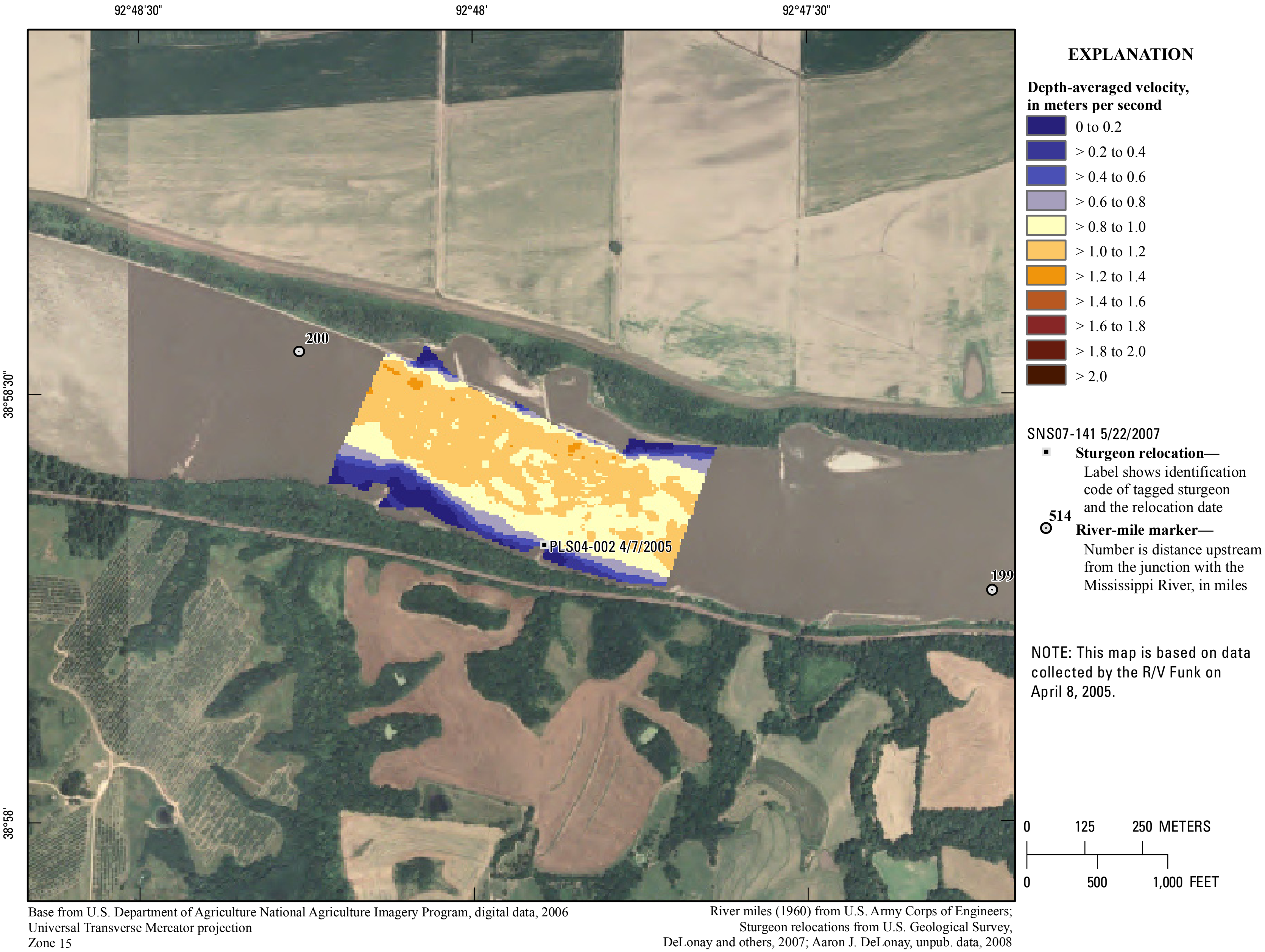
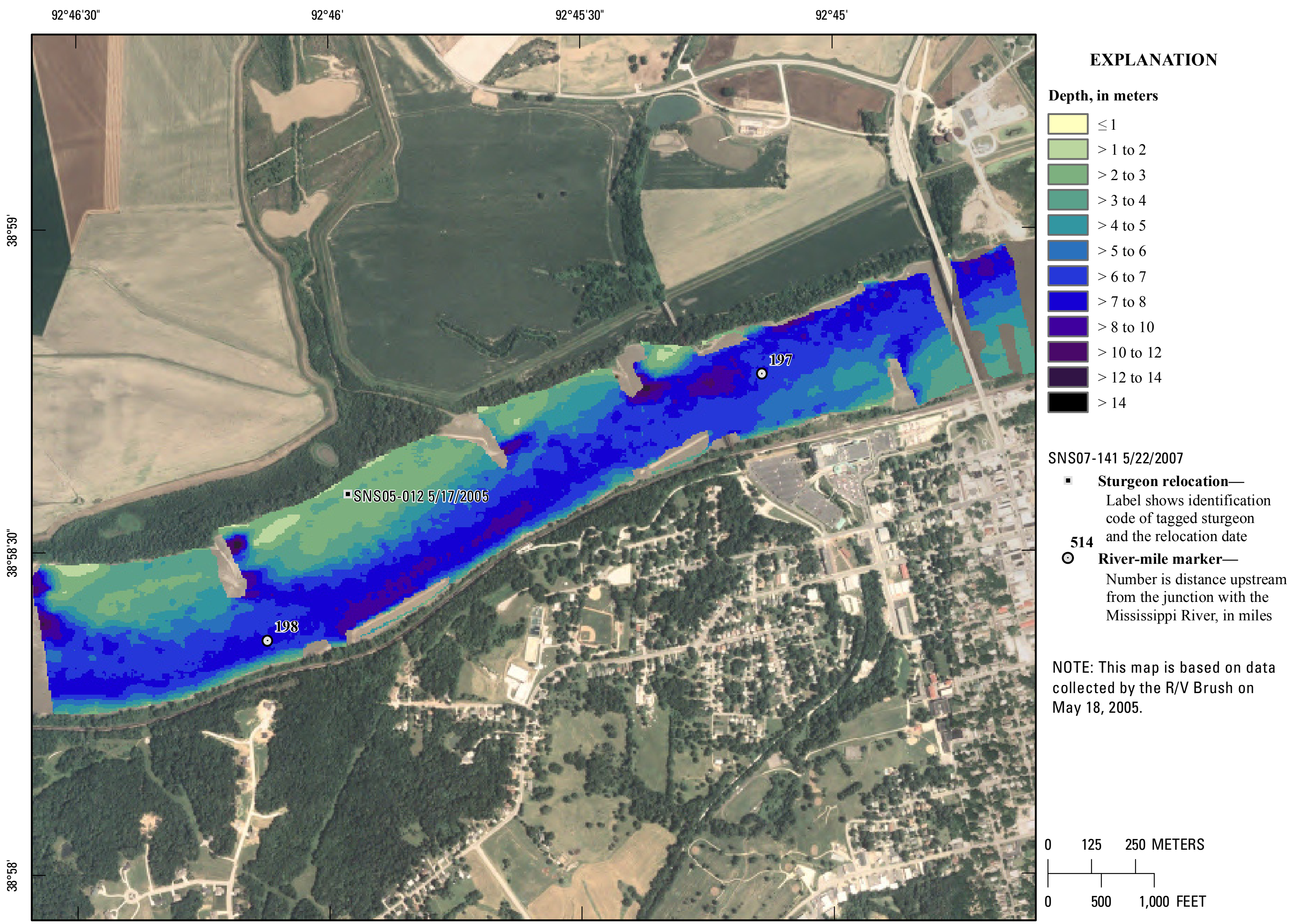


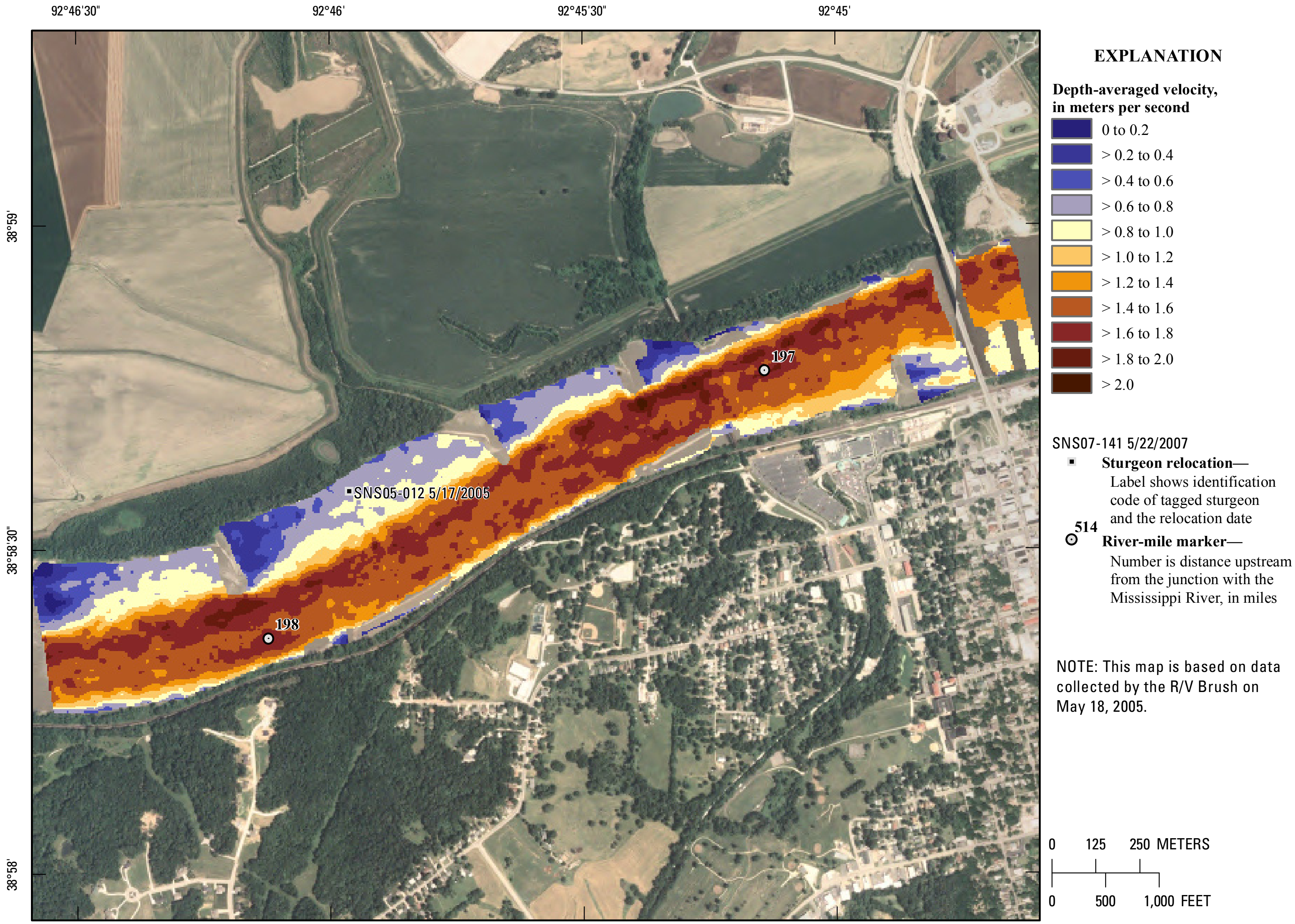
Figure 350. Map of depth-averaged velocity based on data collected on April 8, 2005, in the vicinity of river mile 200.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

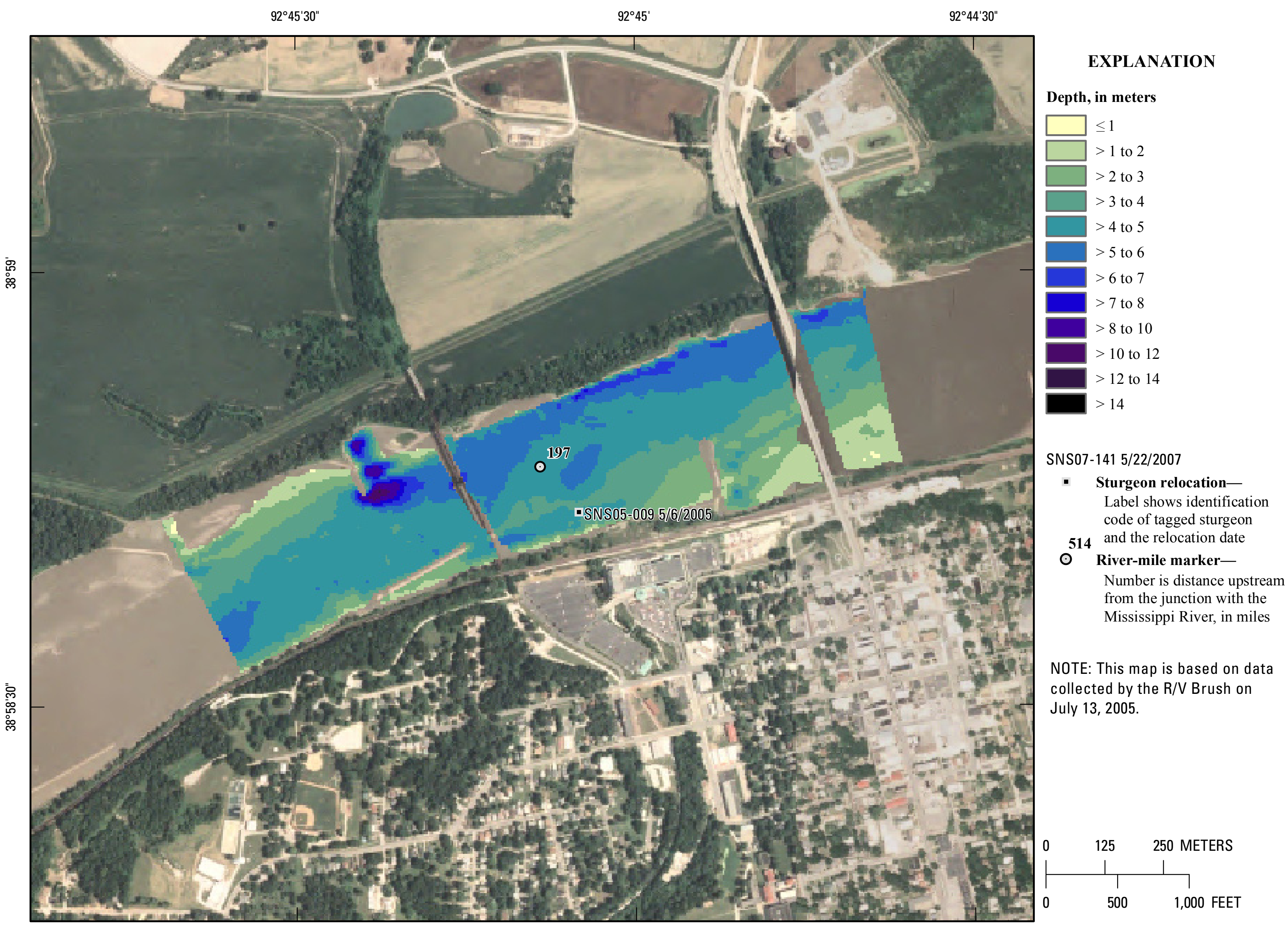
Figure 351. Map of depth based on data collected on May 18, 2005, in the vicinity of river mile 198.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

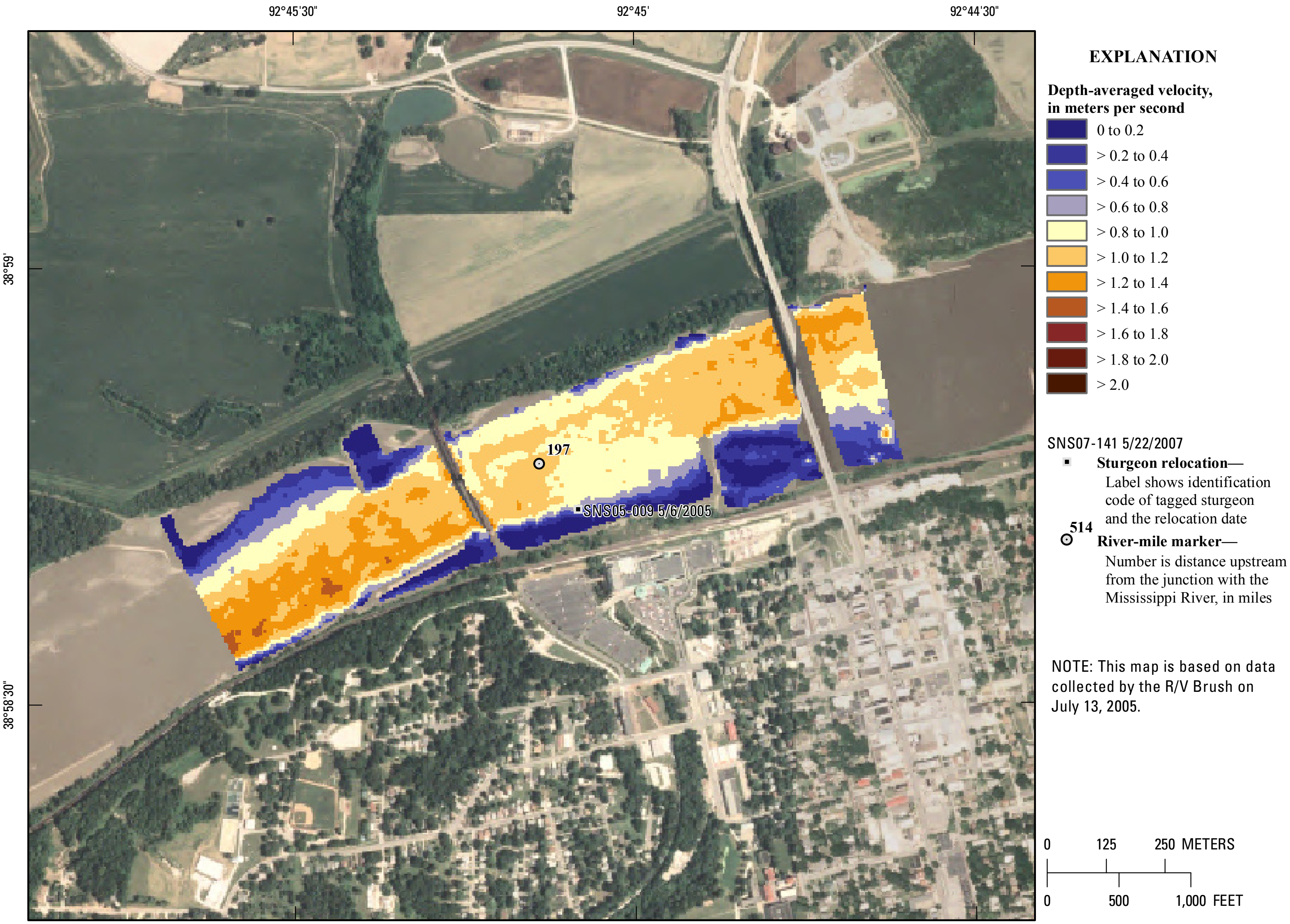
Figure 352. Map of depth-averaged velocity based on data collected on May 18, 2005, in the vicinity of river mile 198.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

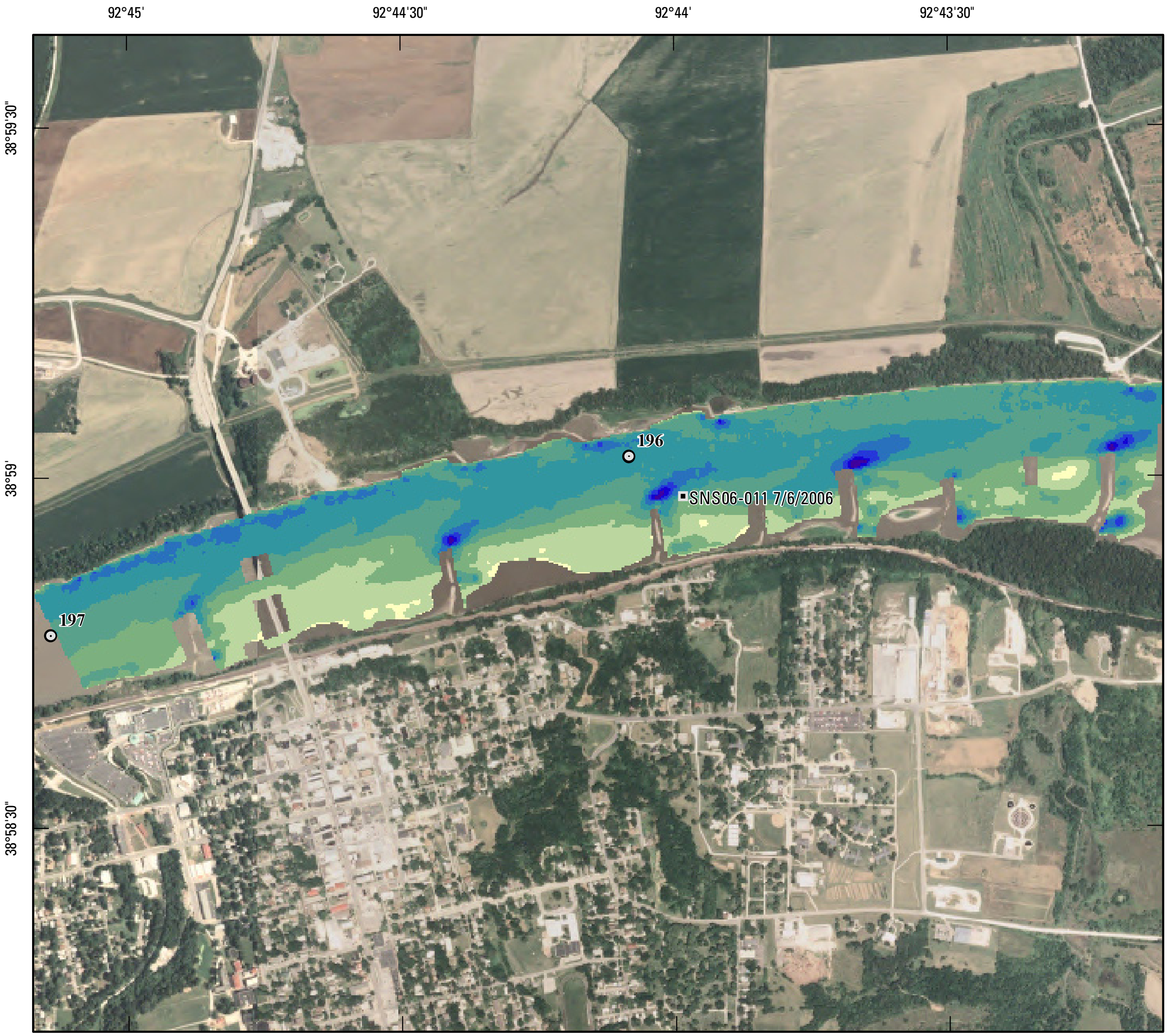
Figure 353. Map of depth based on data collected on July 13, 2005, in the vicinity of river mile 197.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 354. Map of depth-averaged velocity based on data collected on July 13, 2005, in the vicinity of river mile 197.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on July 7, 2006.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 355. Map of depth based on data collected on July 7, 2006, in the vicinity of river mile 196.

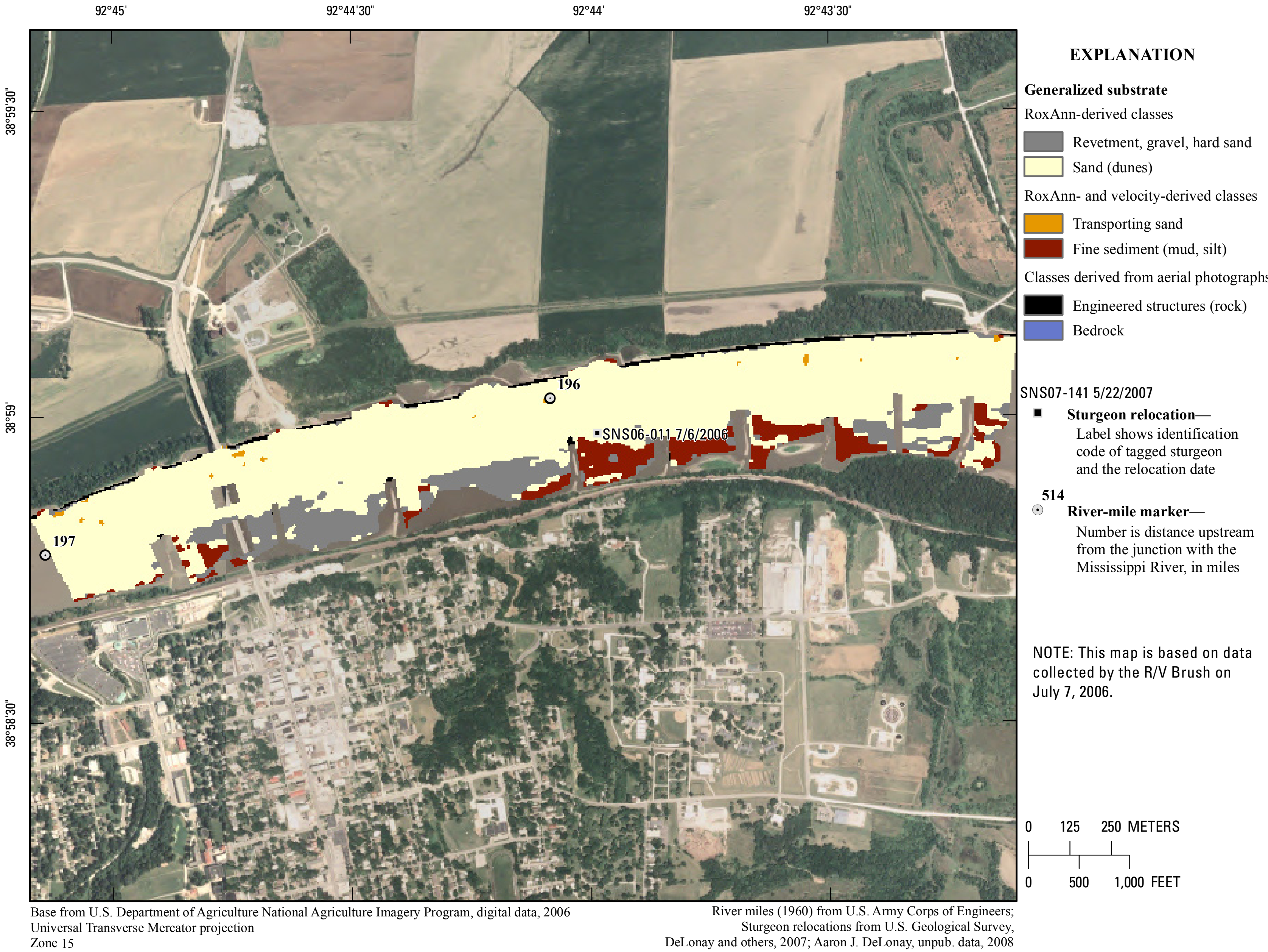
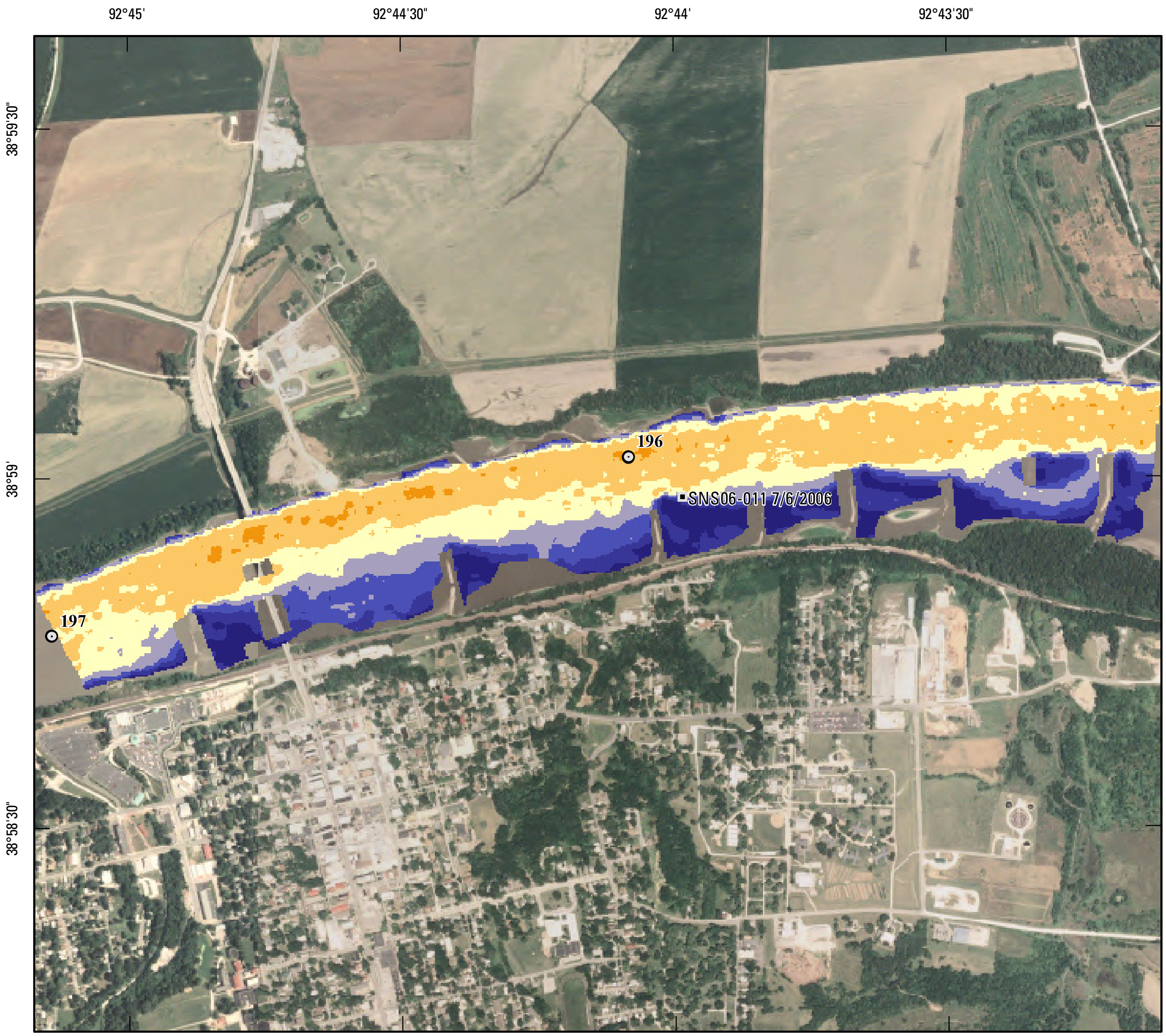


Figure 356. Map of generalized substrate based on data collected on July 7, 2006, in the vicinity of river mile 196.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on July 7, 2006.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 357. Map of depth-averaged velocity based on data collected on July 7, 2006, in the vicinity of river mile 196.

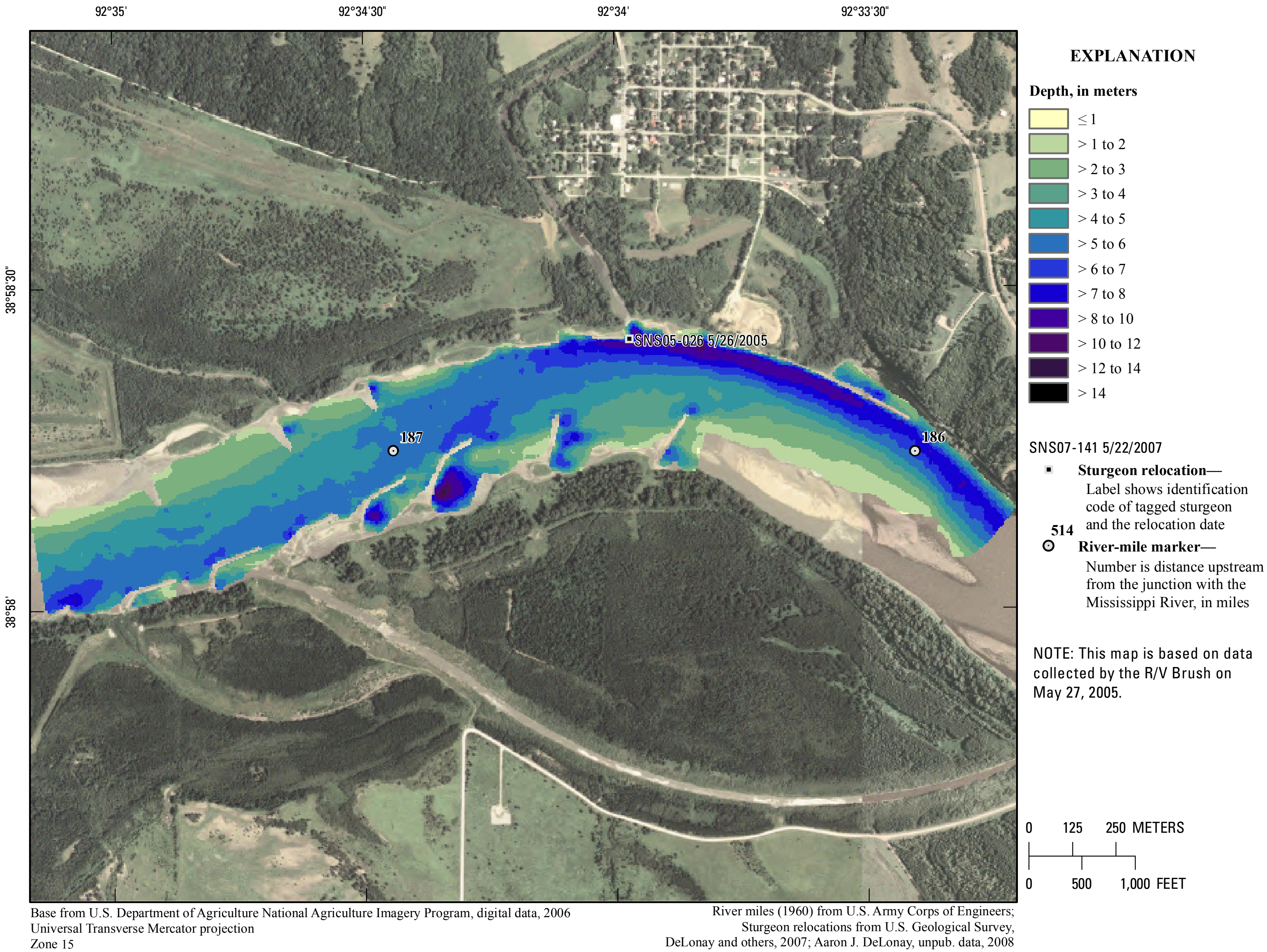
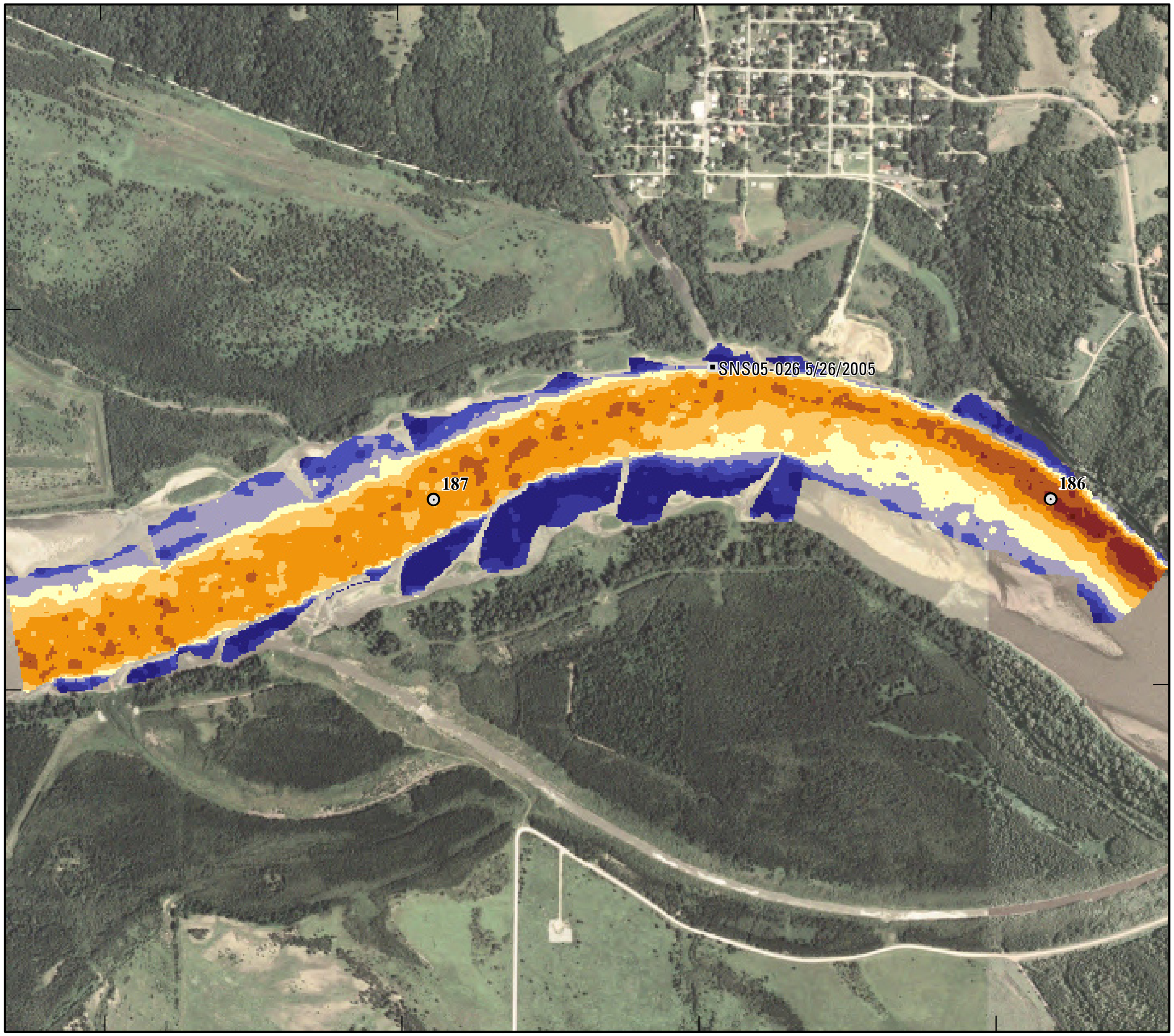


Figure 358. Map of depth based on data collected on May 27, 2005, in the vicinity of river mile 187.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on May 27, 2005.

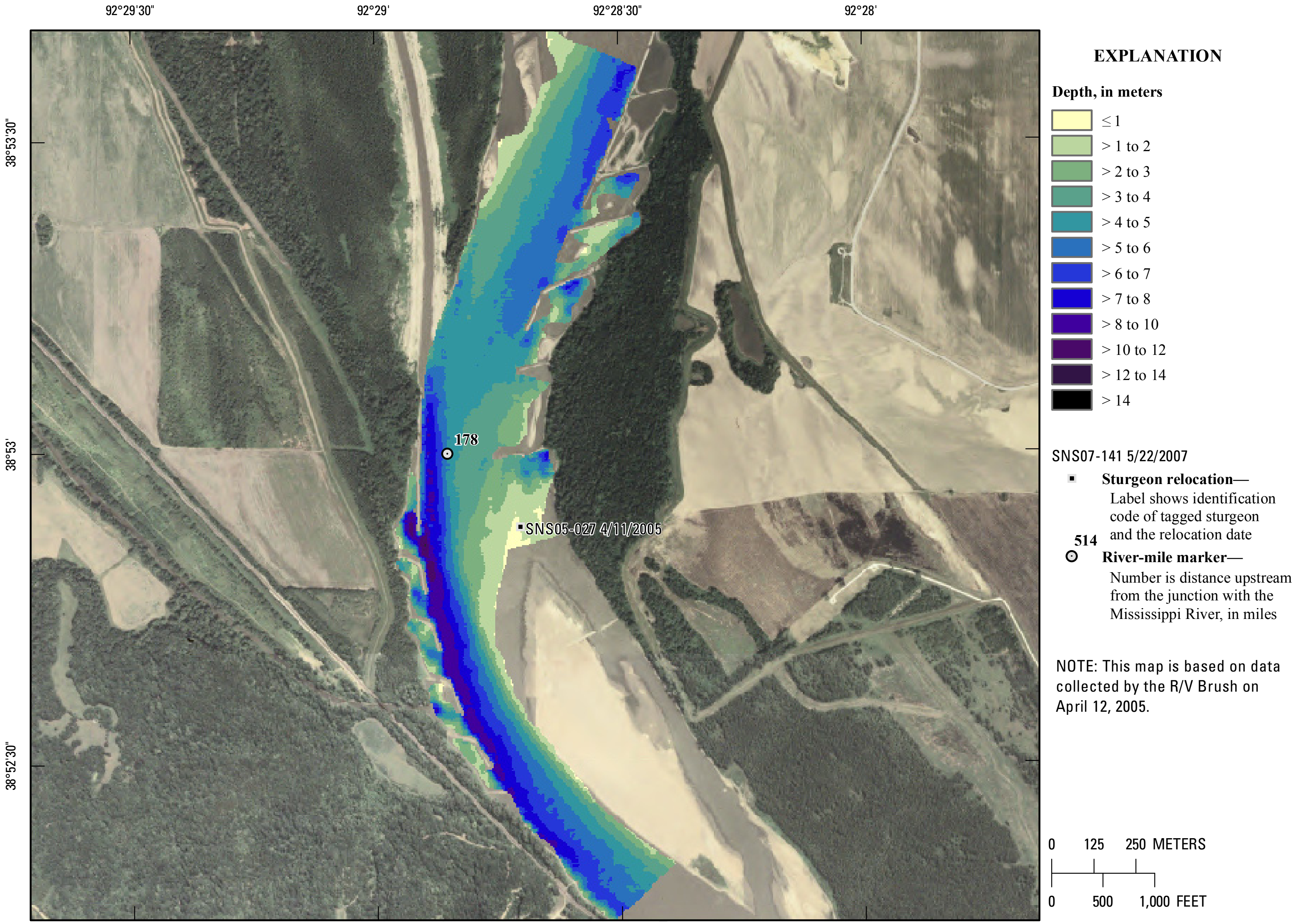
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

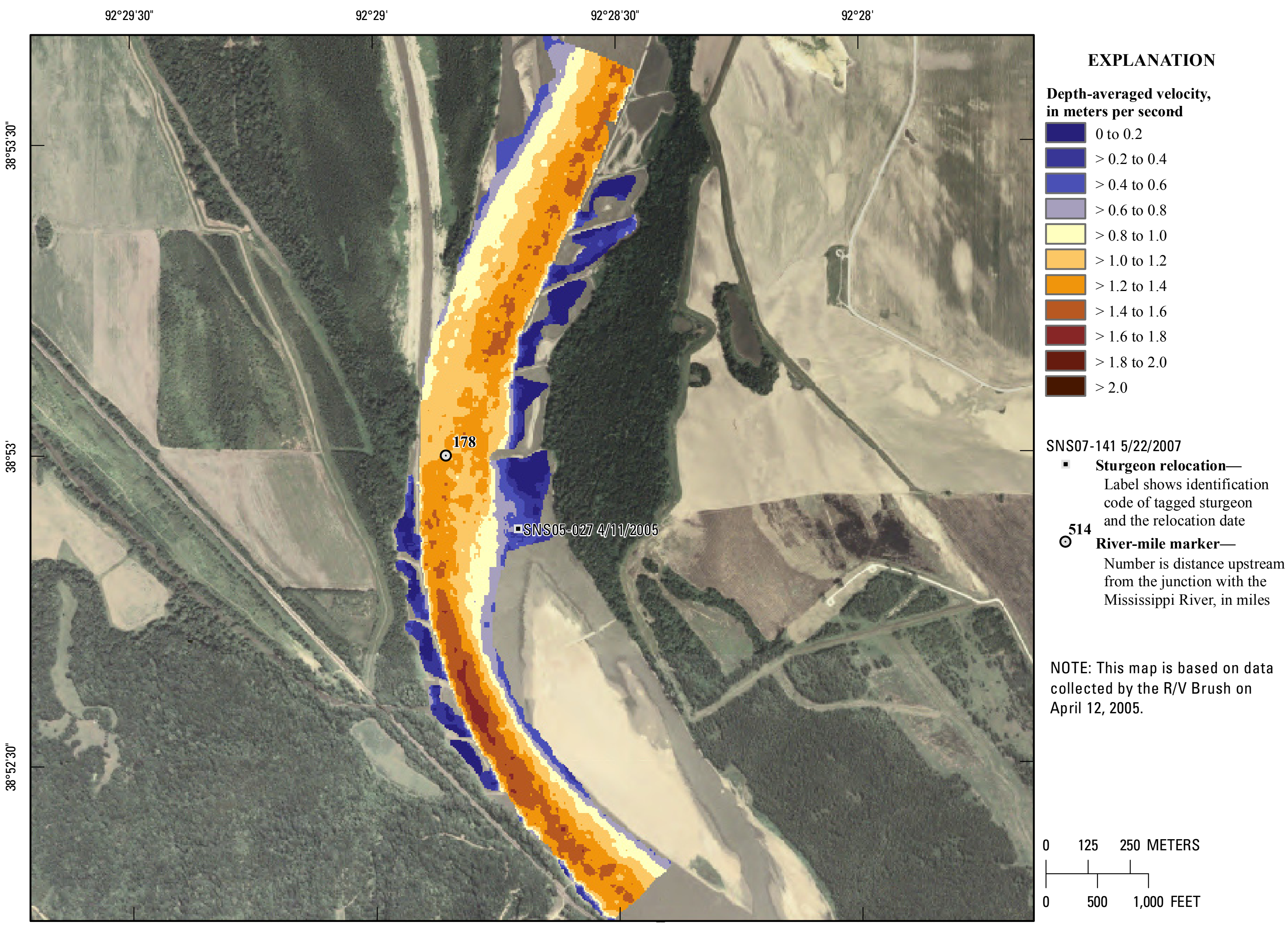
Figure 359. Map of depth-averaged velocity based on data collected on May 27, 2005, in the vicinity of river mile 187.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

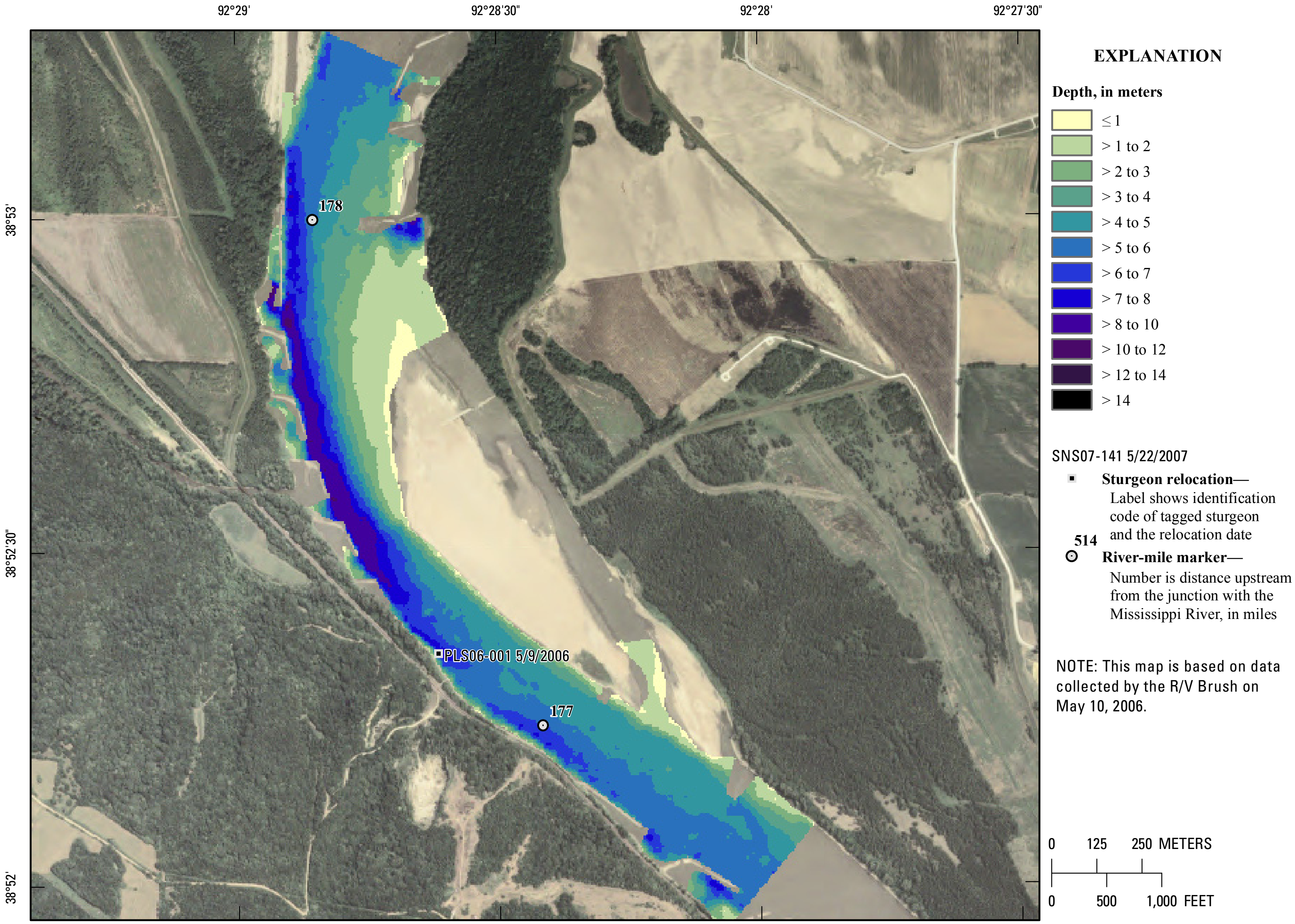
Figure 360. Map of depth based on data collected on April 12, 2005, in the vicinity of river mile 178.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

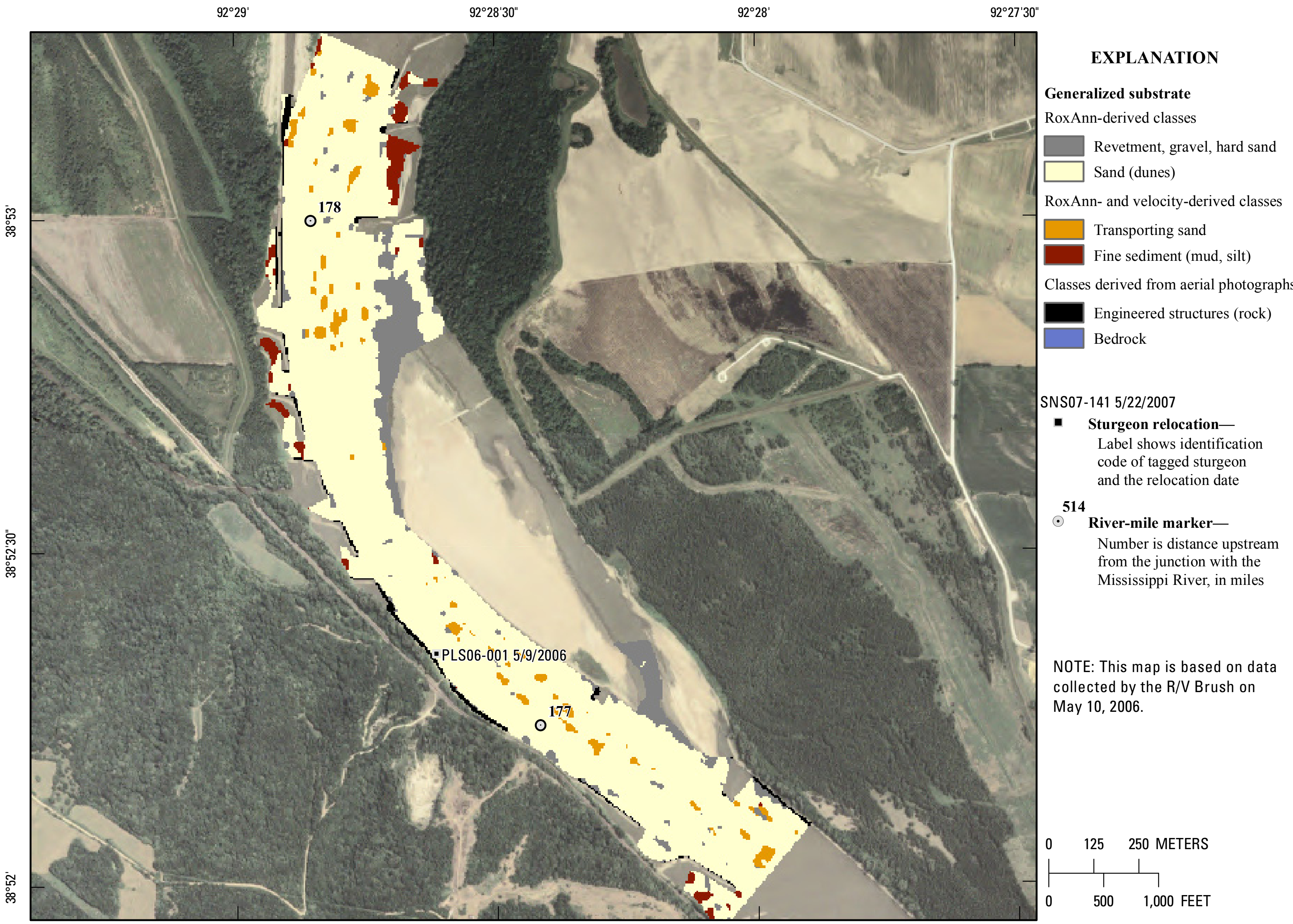
Figure 361. Map of depth-averaged velocity based on data collected on April 12, 2005, in the vicinity of river mile 178.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

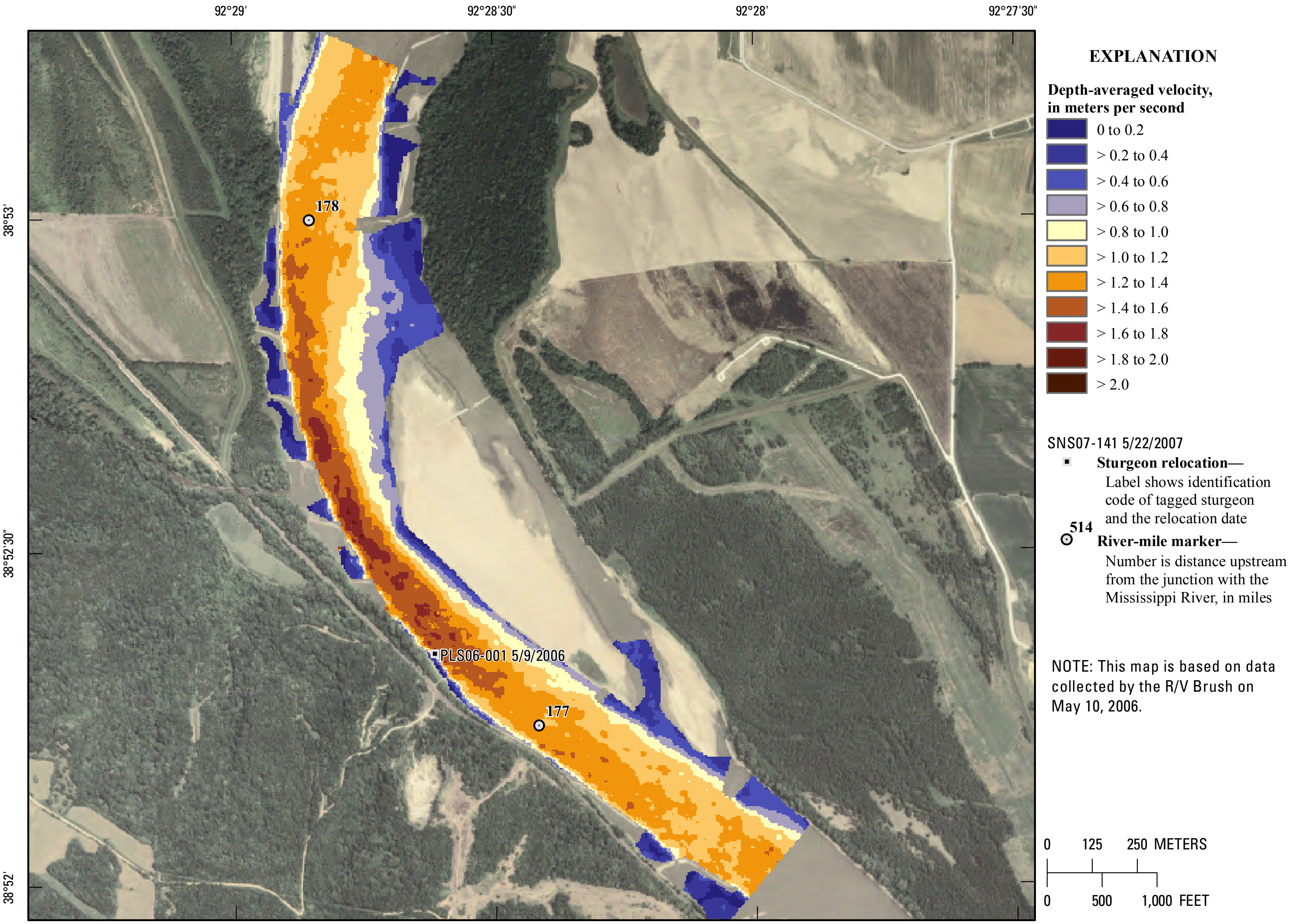
Figure 362. Map of depth based on data collected on May 10, 2006, in the vicinity of river mile 177.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 363. Map of generalized substrate based on data collected on May 10, 2006, in the vicinity of river mile 177.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 364. Map of depth-averaged velocity based on data collected on May 10, 2006, in the vicinity of river mile 177.

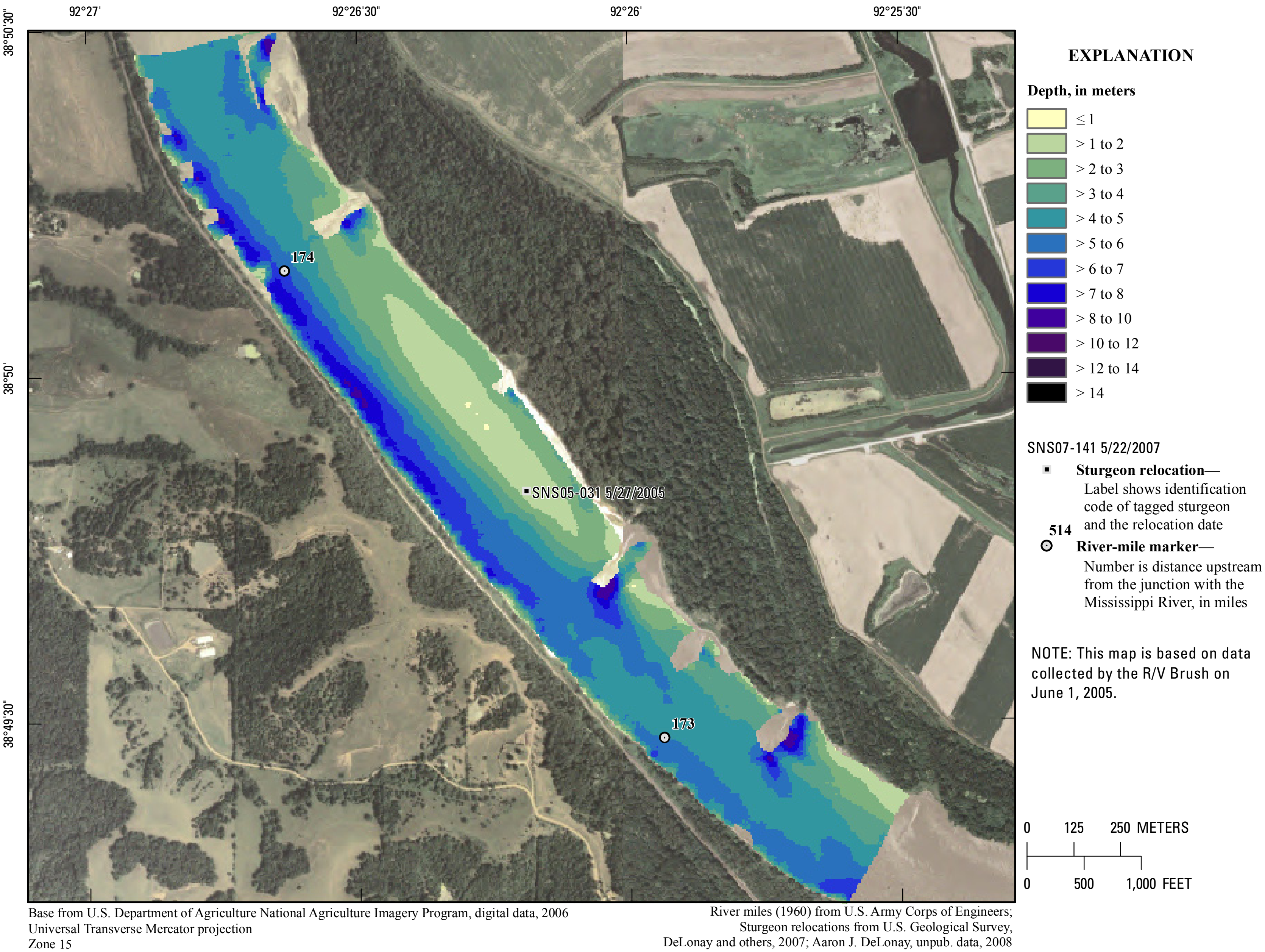
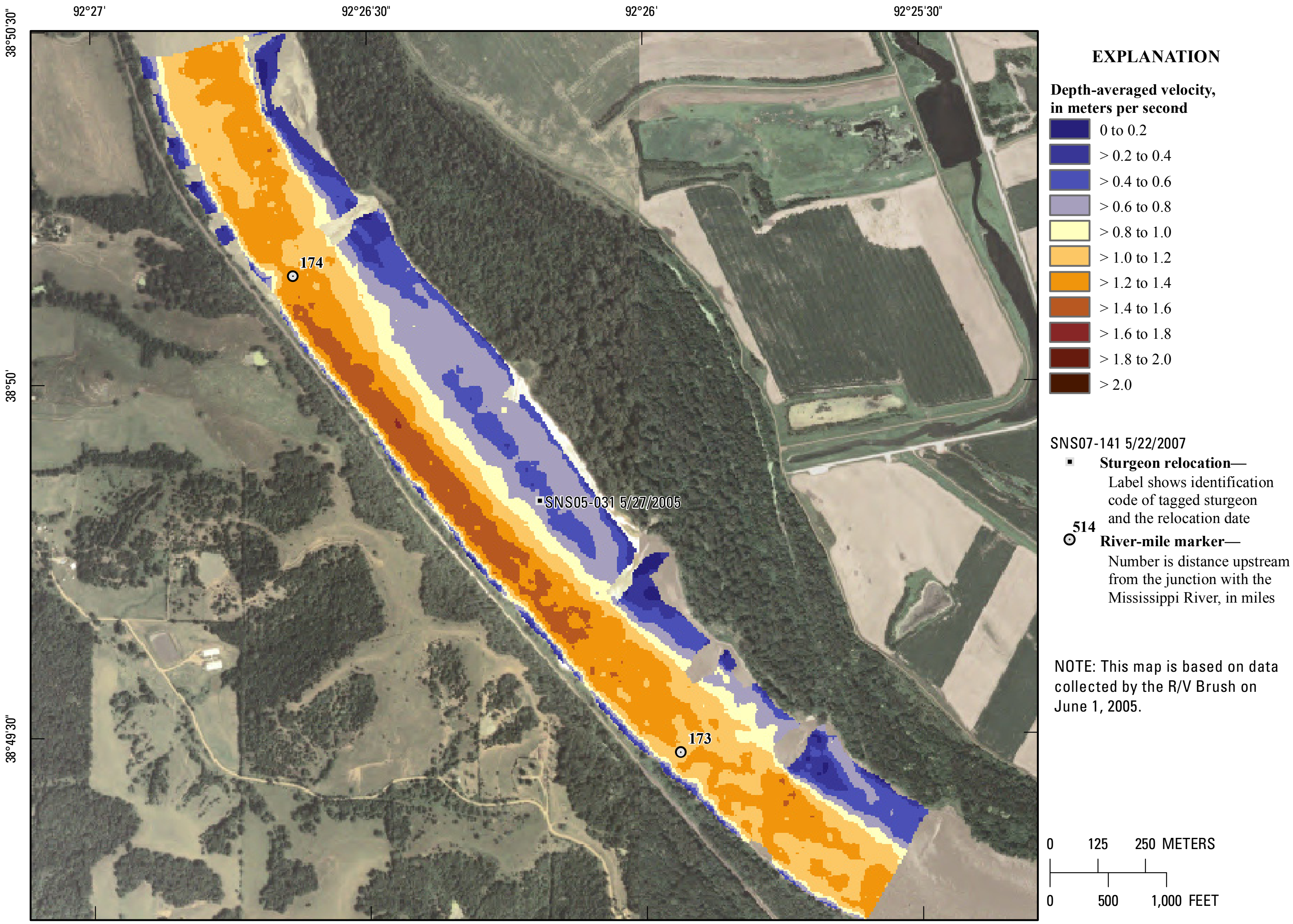


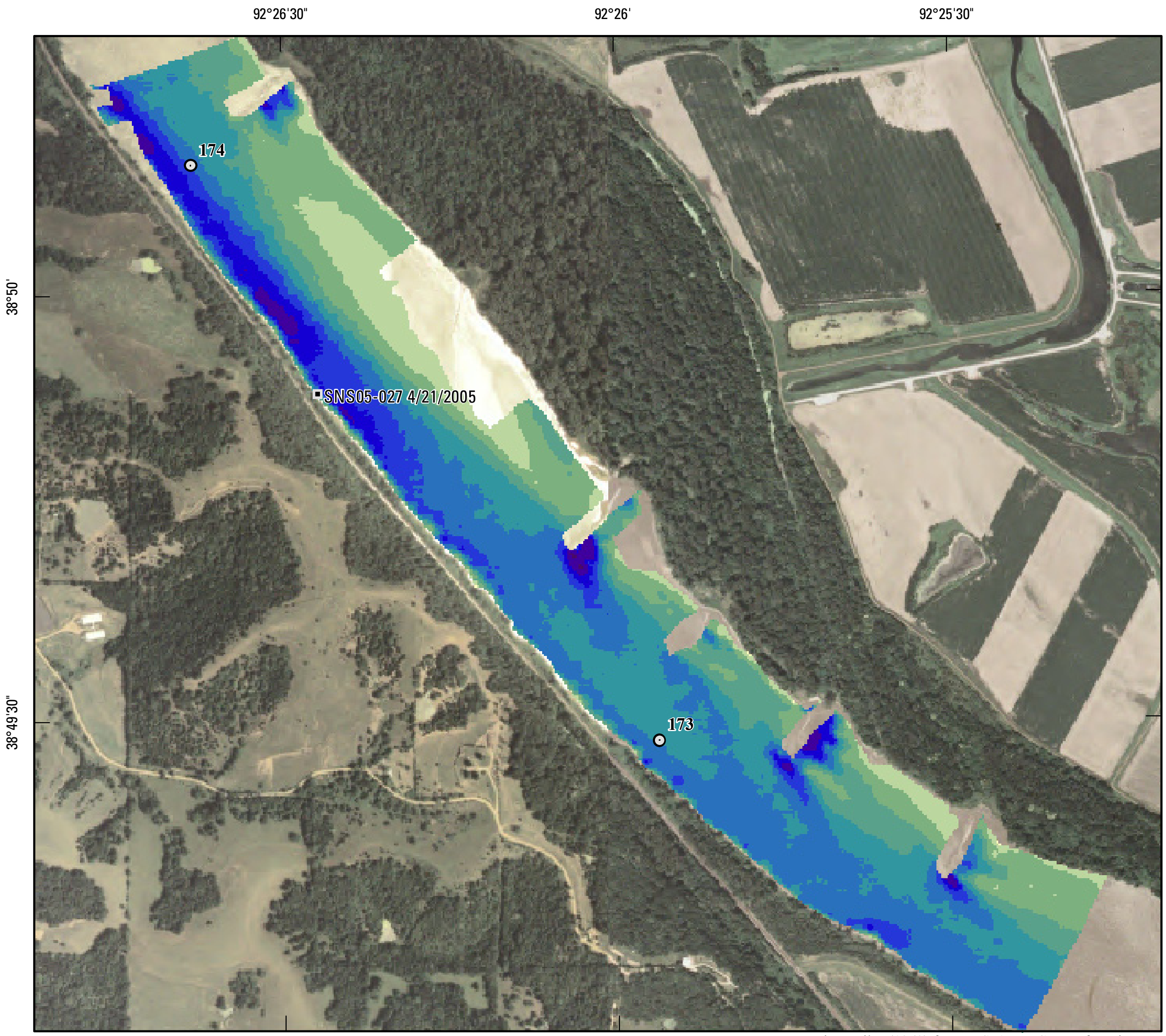
Figure 365. Map of depth based on data collected on June 1, 2005, in the vicinity of river mile 174.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 366. Map of depth-averaged velocity based on data collected on June 1, 2005, in the vicinity of river mile 174.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on April 22, 2005.

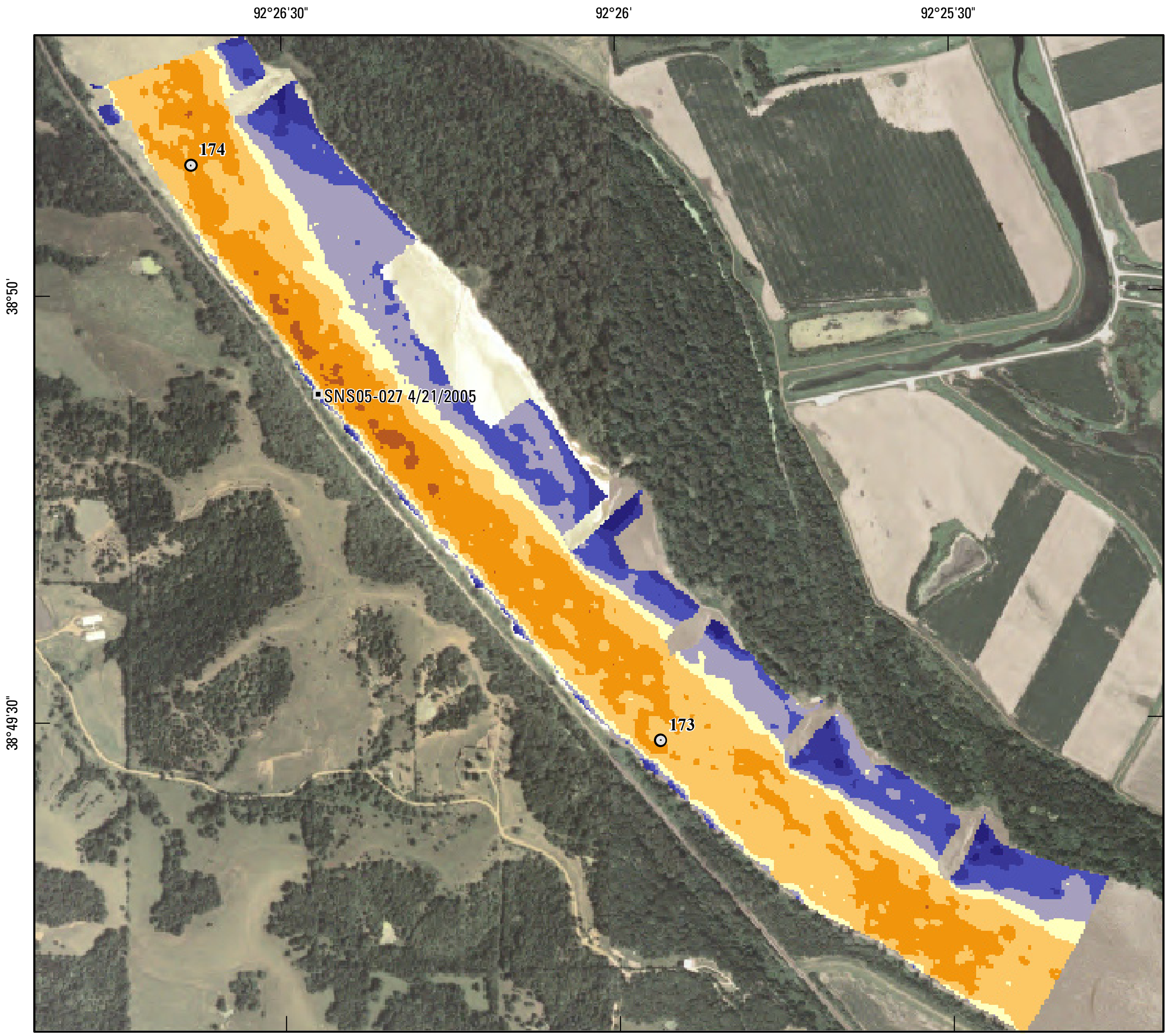
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 367. Map of depth based on data collected on April 22, 2005, in the vicinity of river mile 173.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514 **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on April 22, 2005.

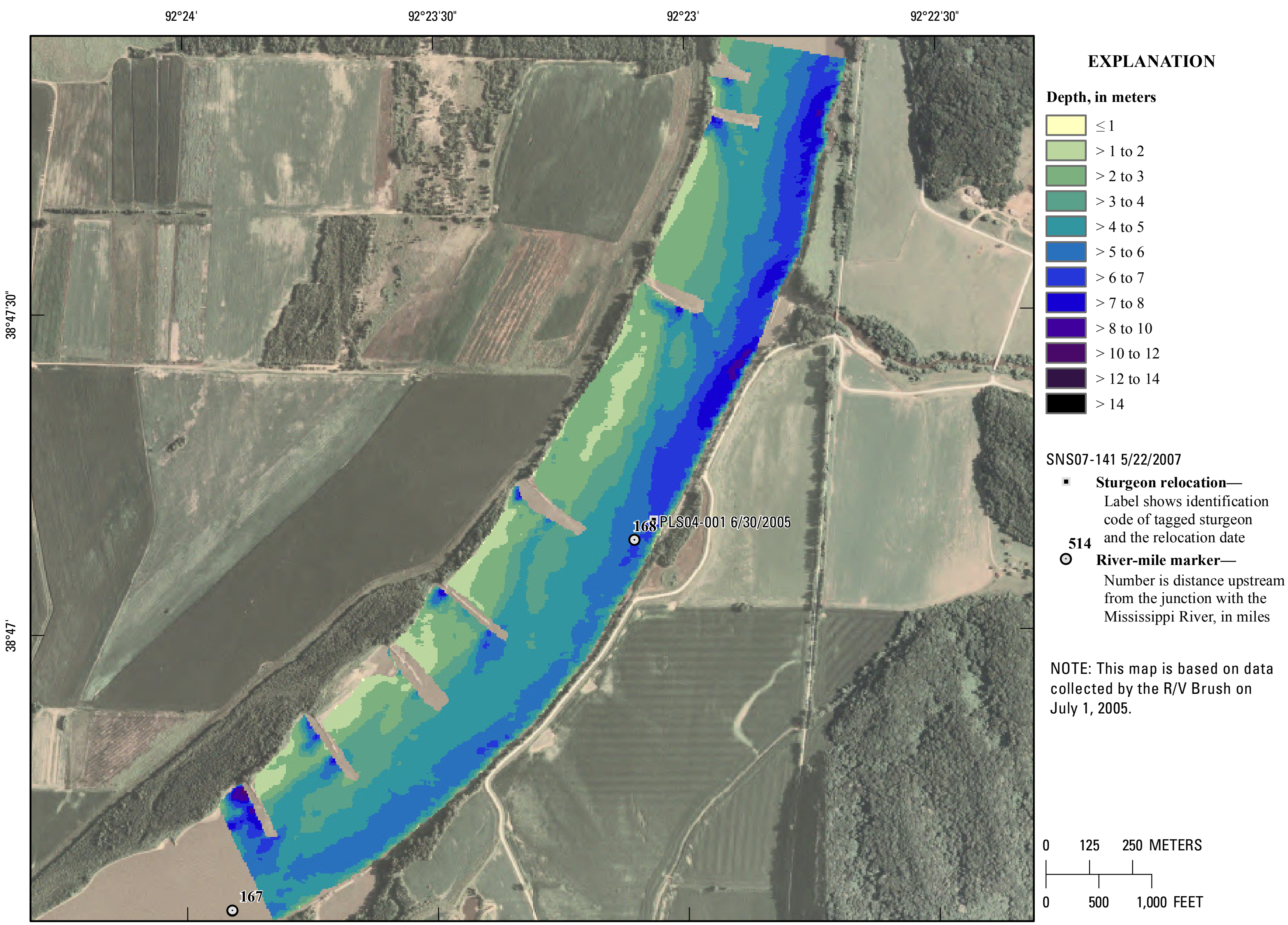
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 368. Map of depth-averaged velocity based on data collected on April 22, 2005, in the vicinity of river mile 173.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 369. Map of depth based on data collected on July 1, 2005, in the vicinity of river mile 168.

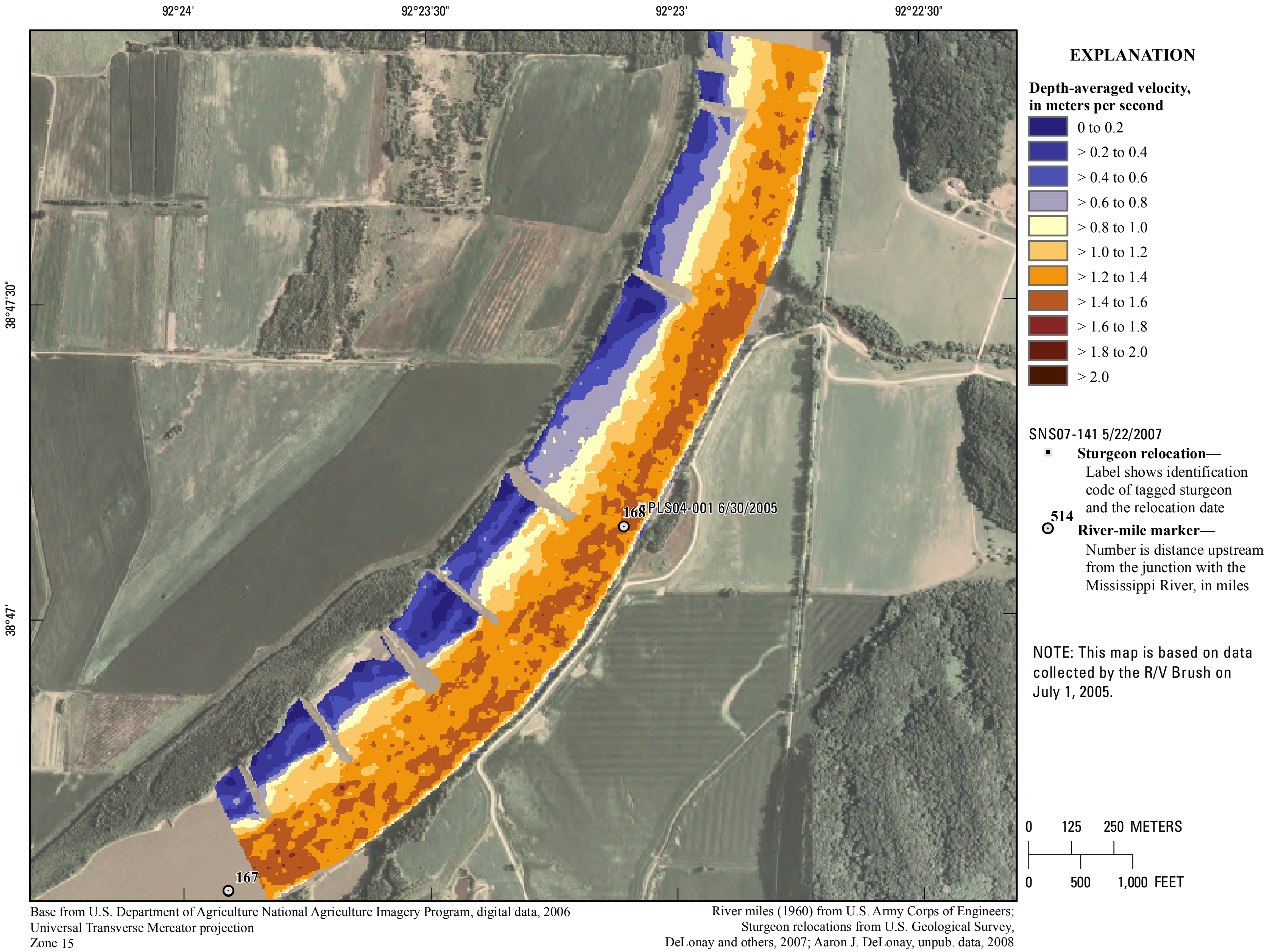
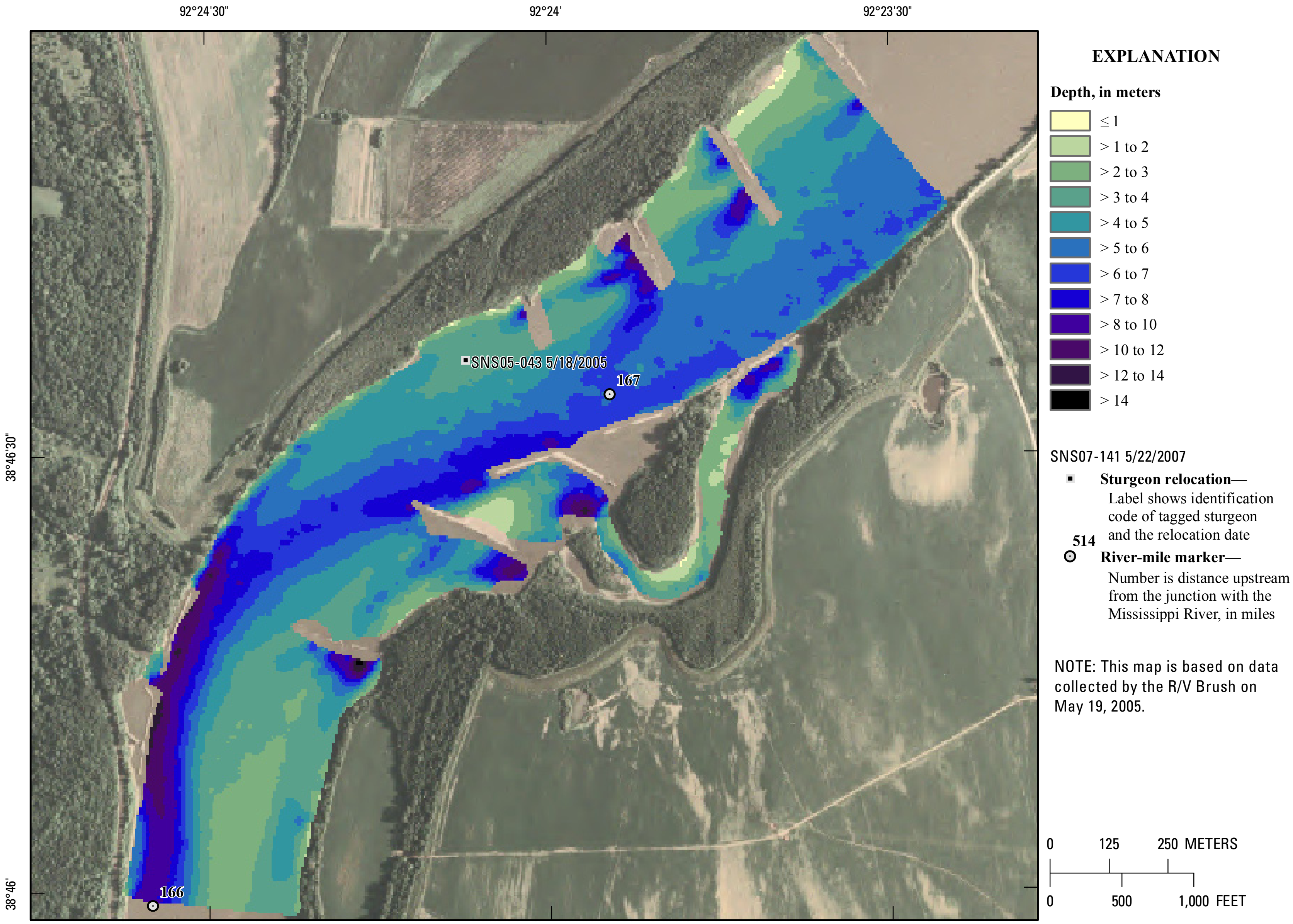


Figure 370. Map of depth-averaged velocity based on data collected on July 1, 2005, in the vicinity of river mile 168.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 371. Map of depth based on data collected on May 19, 2005, in the vicinity of river mile 167.

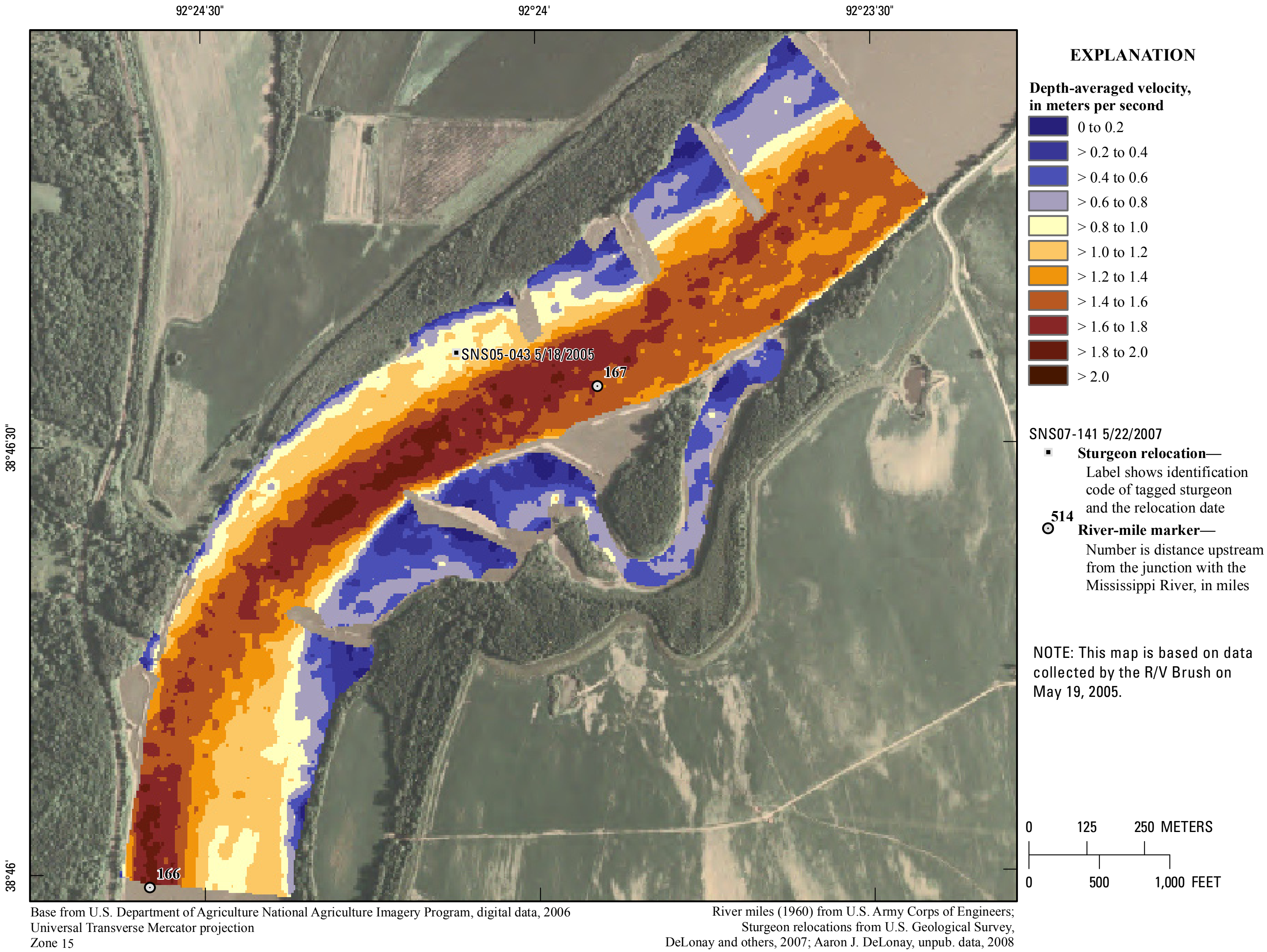
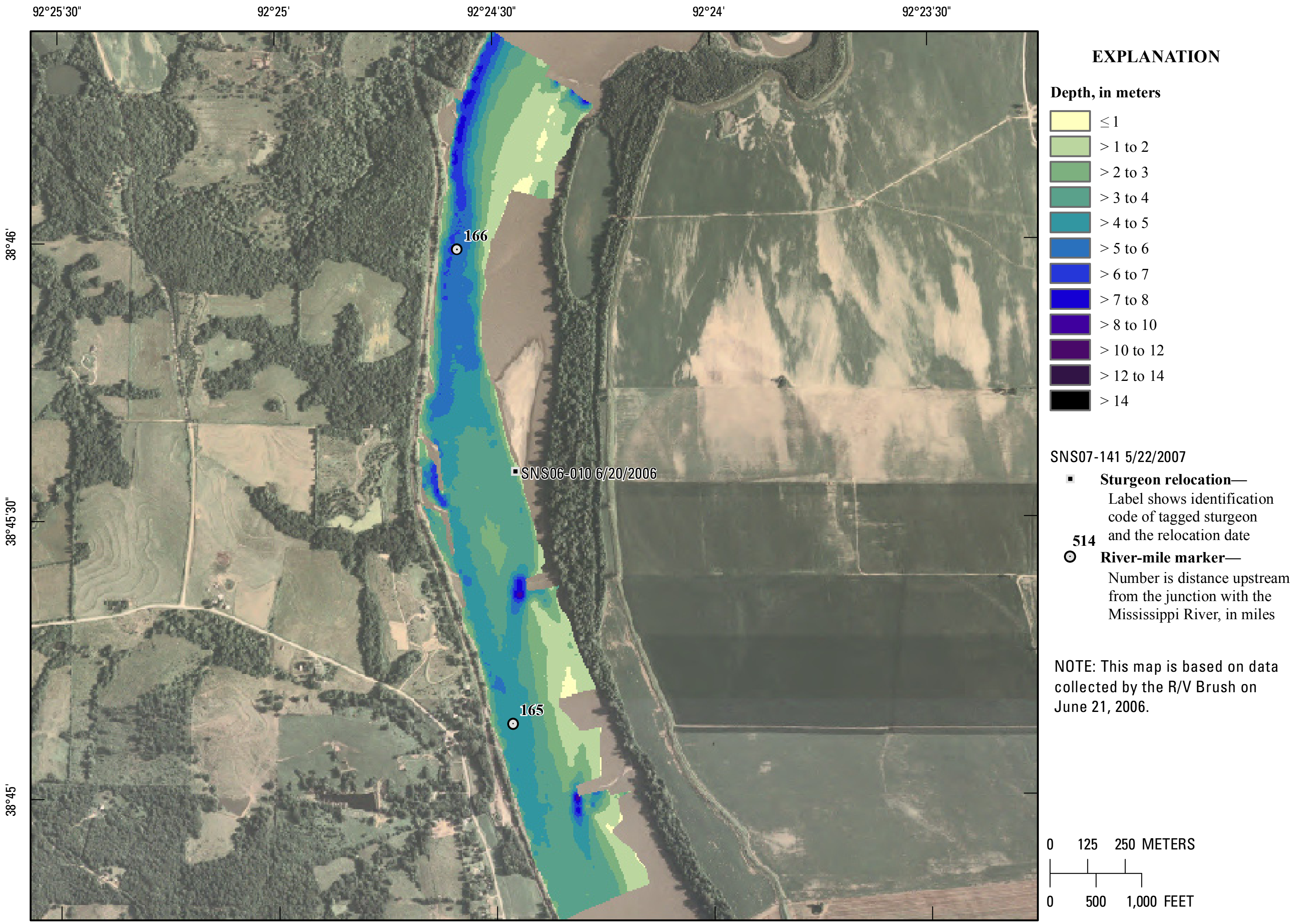


Figure 372. Map of depth-averaged velocity based on data collected on May 19, 2005, in the vicinity of river mile 167.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 373. Map of depth based on data collected on June 21, 2006, in the vicinity of river mile 166.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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■ **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

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⊙ **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on June 21, 2006.

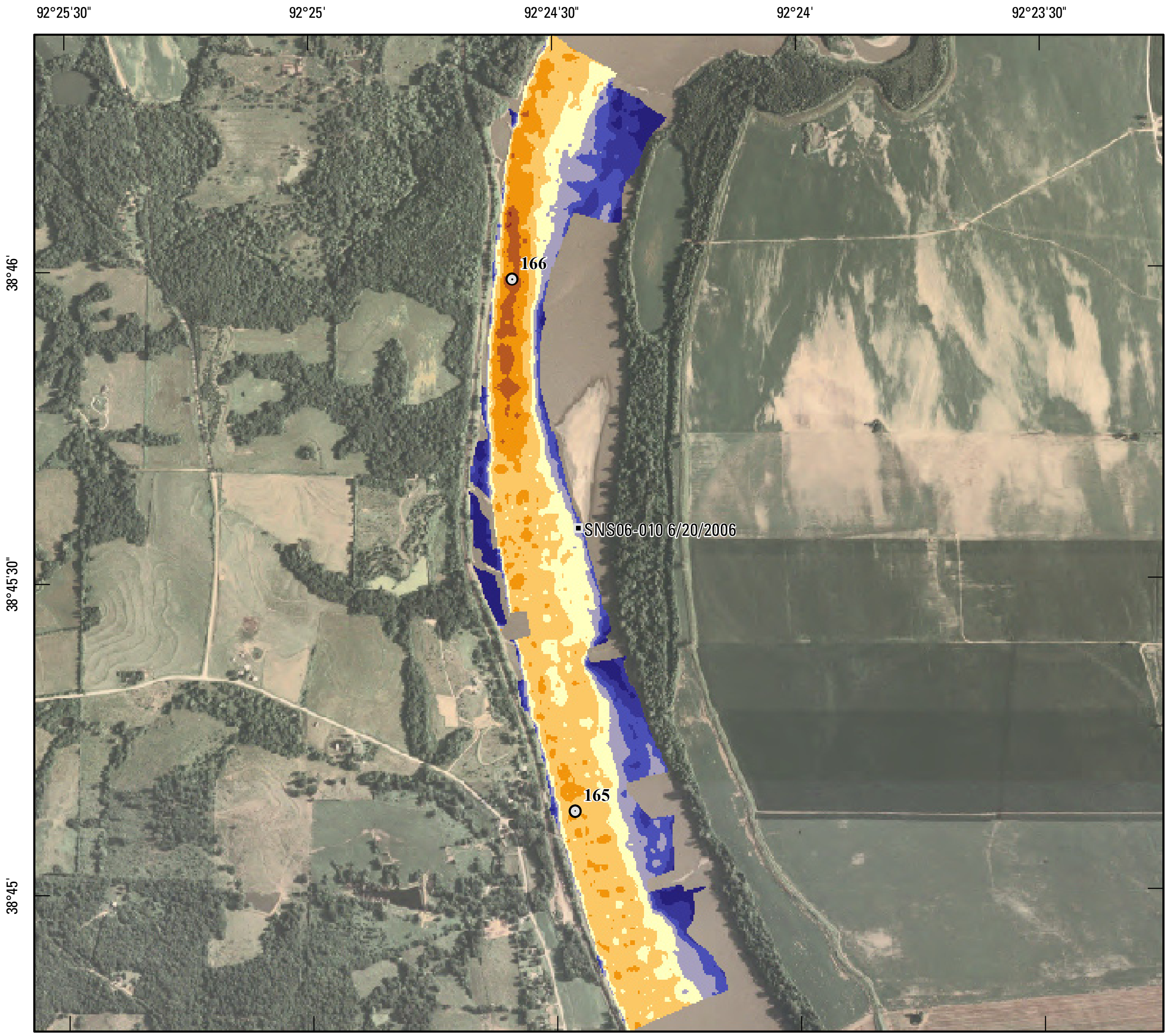
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 374. Map of generalized substrate based on data collected on June 21, 2006, in the vicinity of river mile 166.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514
River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on June 21, 2006.

0 125 250 METERS
0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 375. Map of depth-averaged velocity based on data collected on June 21, 2006, in the vicinity of river mile 166.

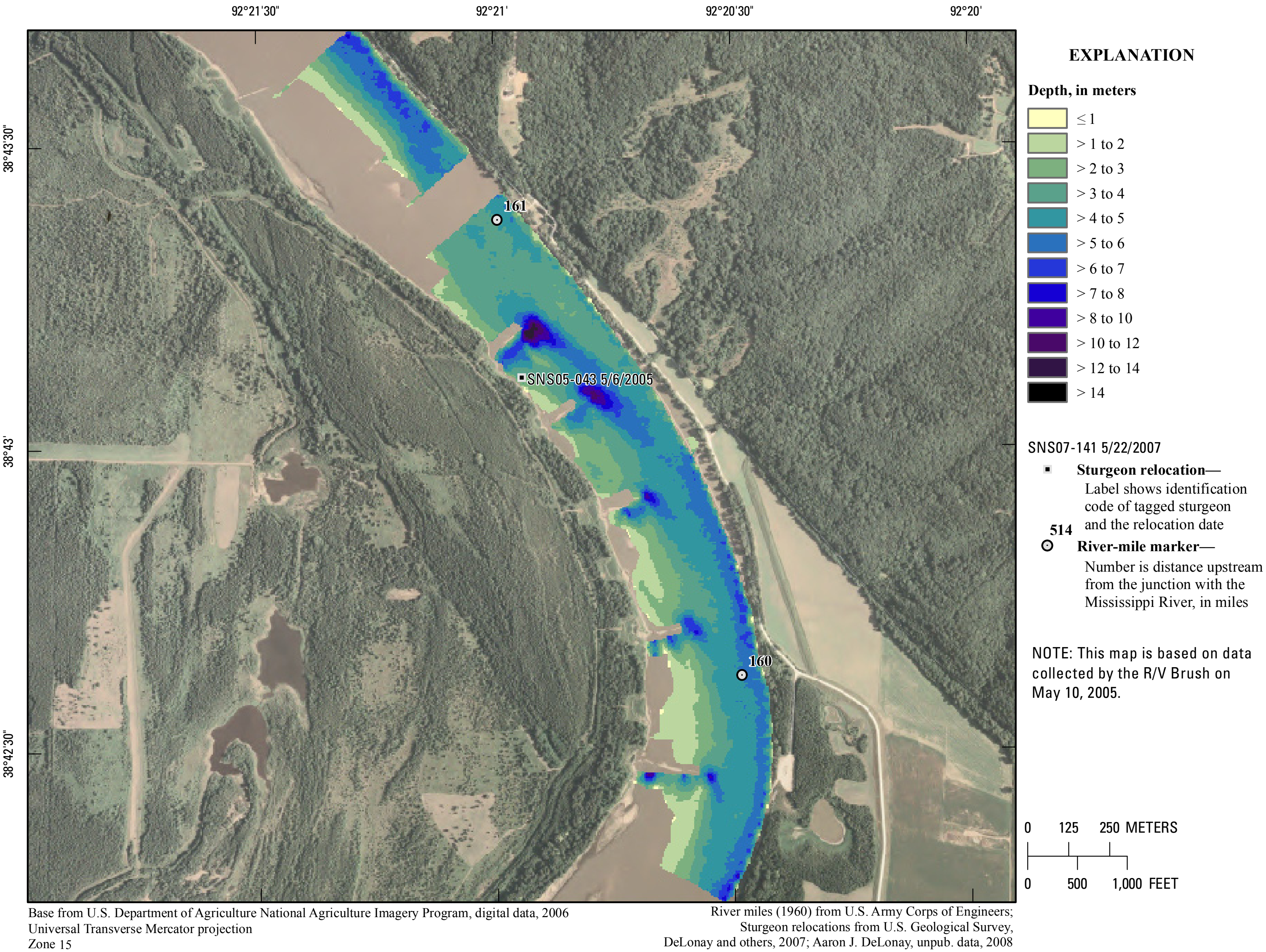
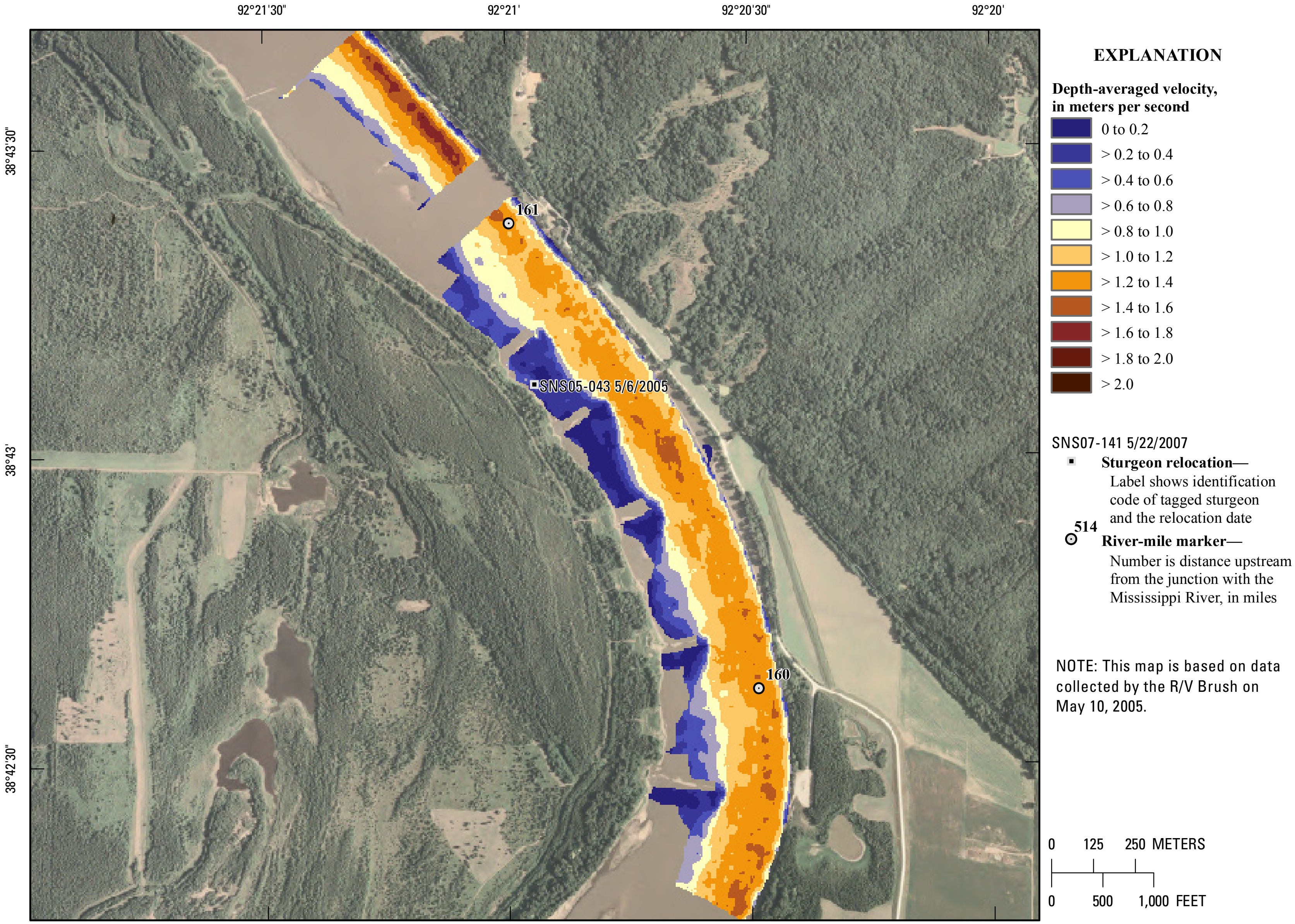


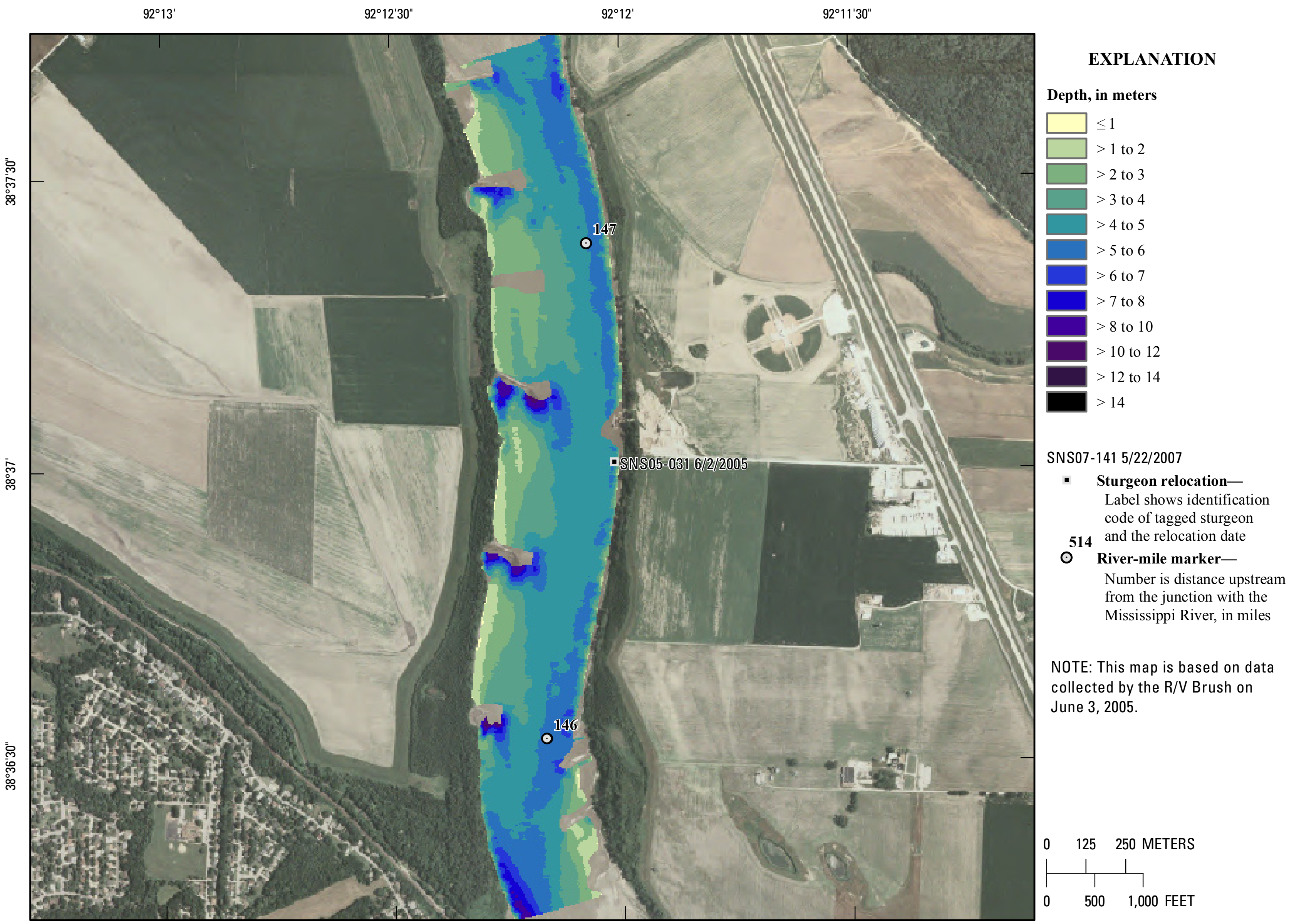
Figure 376. Map of depth based on data collected on May 10, 2005, in the vicinity of river mile 161.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

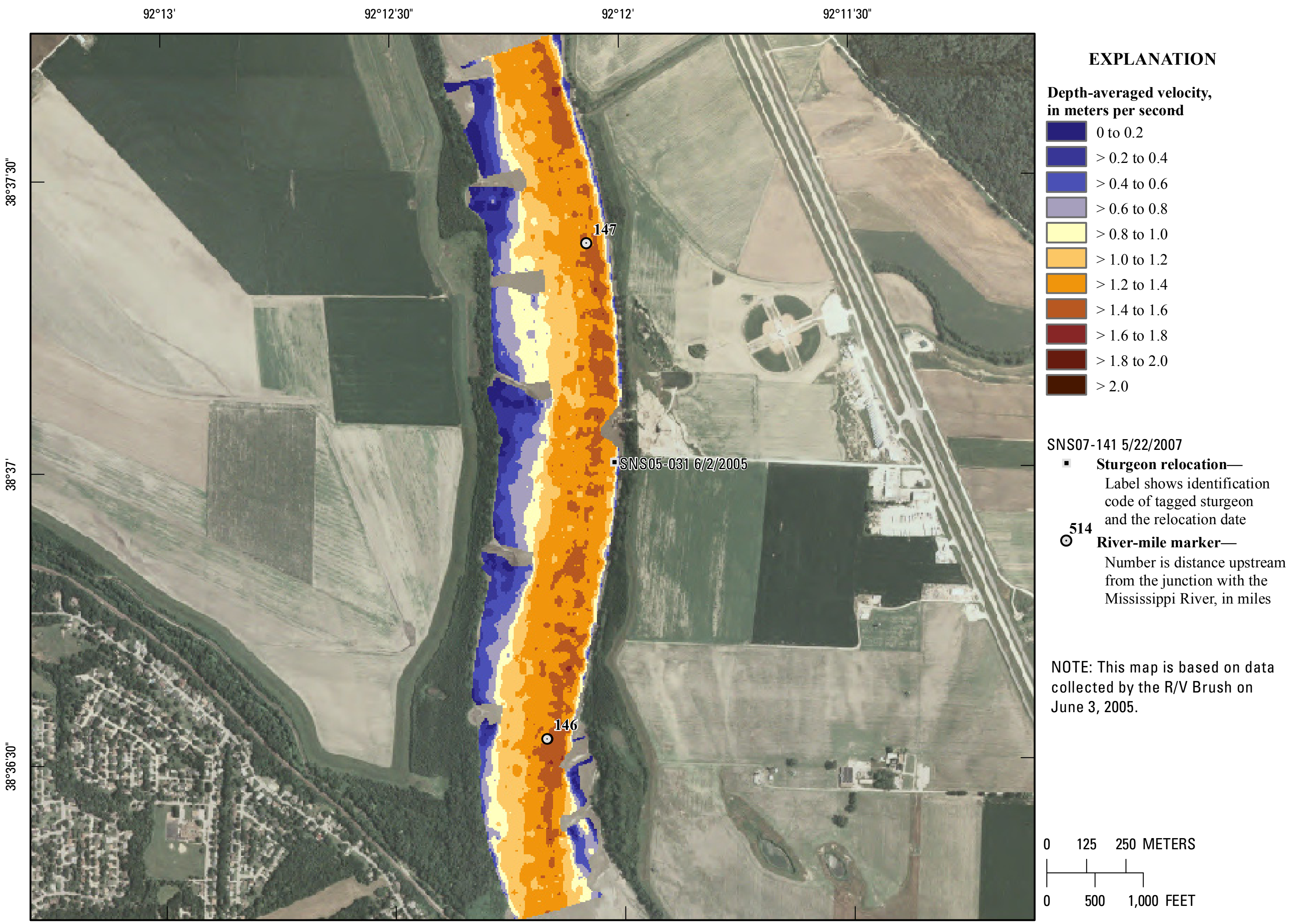
Figure 377. Map of depth-averaged velocity based on data collected on May 10, 2005, in the vicinity of river mile 161.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 378. Map of depth based on data collected on June 3, 2005, in the vicinity of river mile 147.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 379. Map of depth-averaged velocity based on data collected on June 3, 2005, in the vicinity of river mile 147.

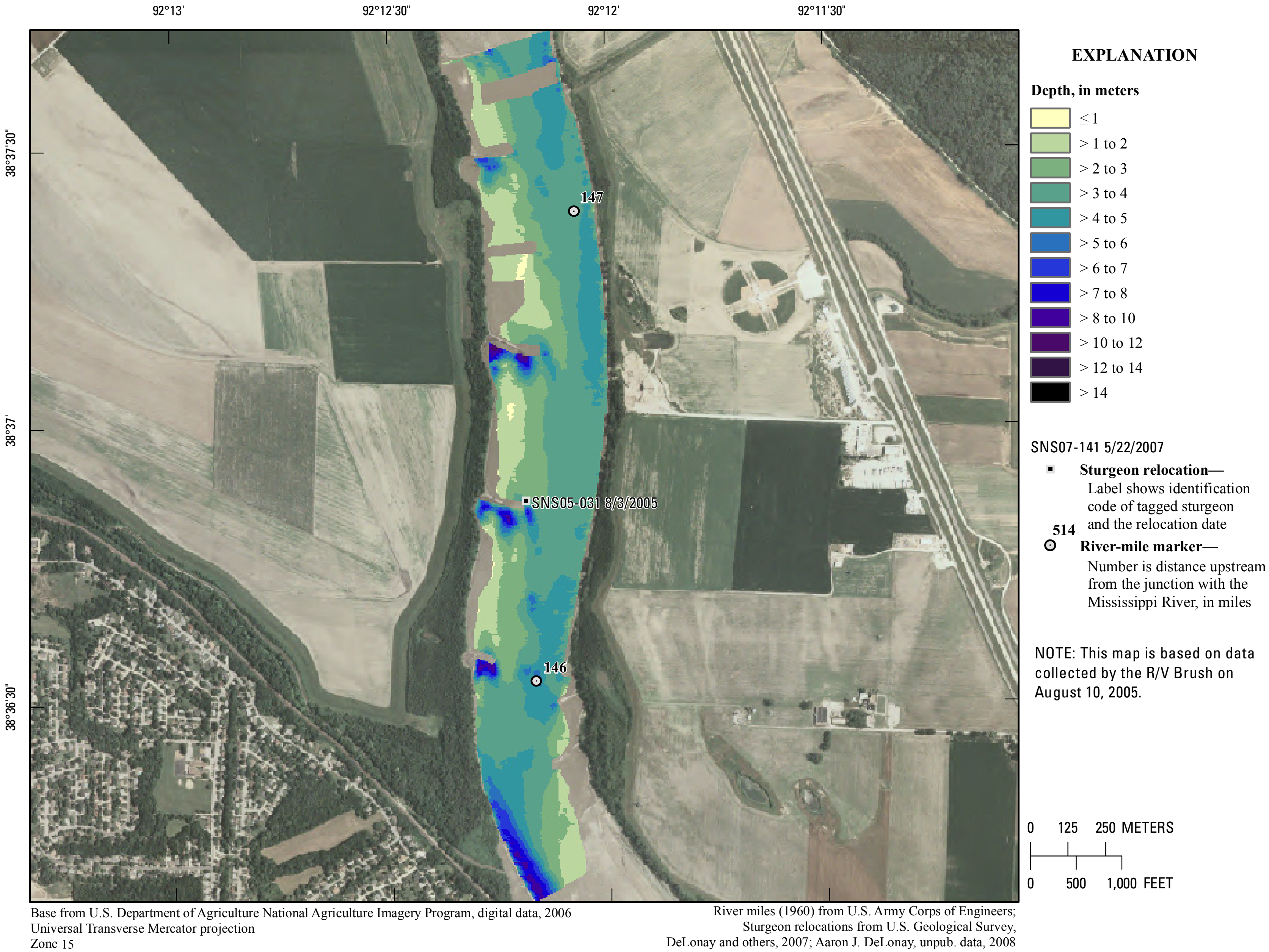
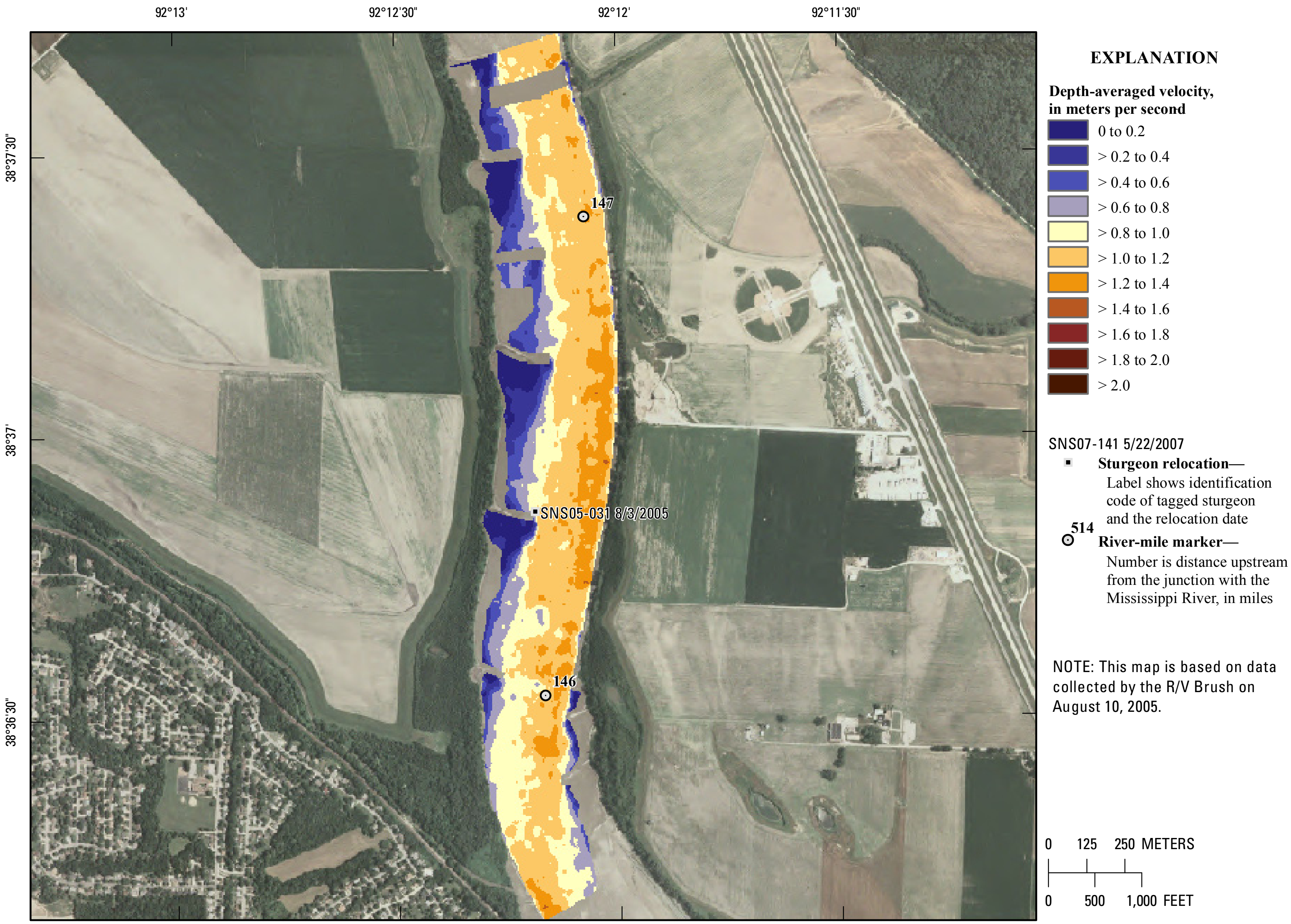


Figure 380. Map of depth based on data collected on August 10, 2005, in the vicinity of river mile 147.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 381. Map of depth-averaged velocity based on data collected on August 10, 2005, in the vicinity of river mile 147.

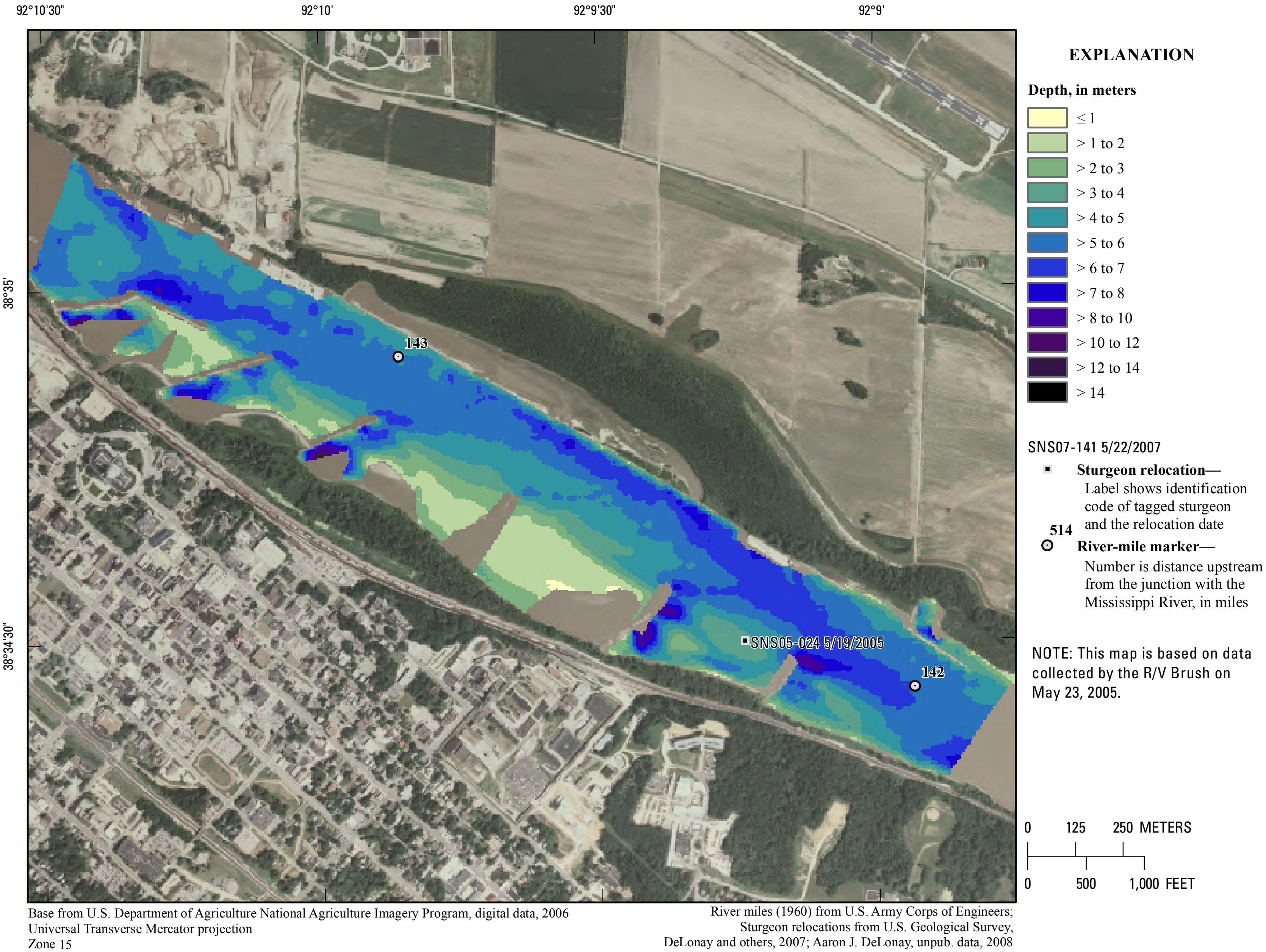


Figure 382. Map of depth based on data collected on May 23, 2005, in the vicinity of river mile 143.

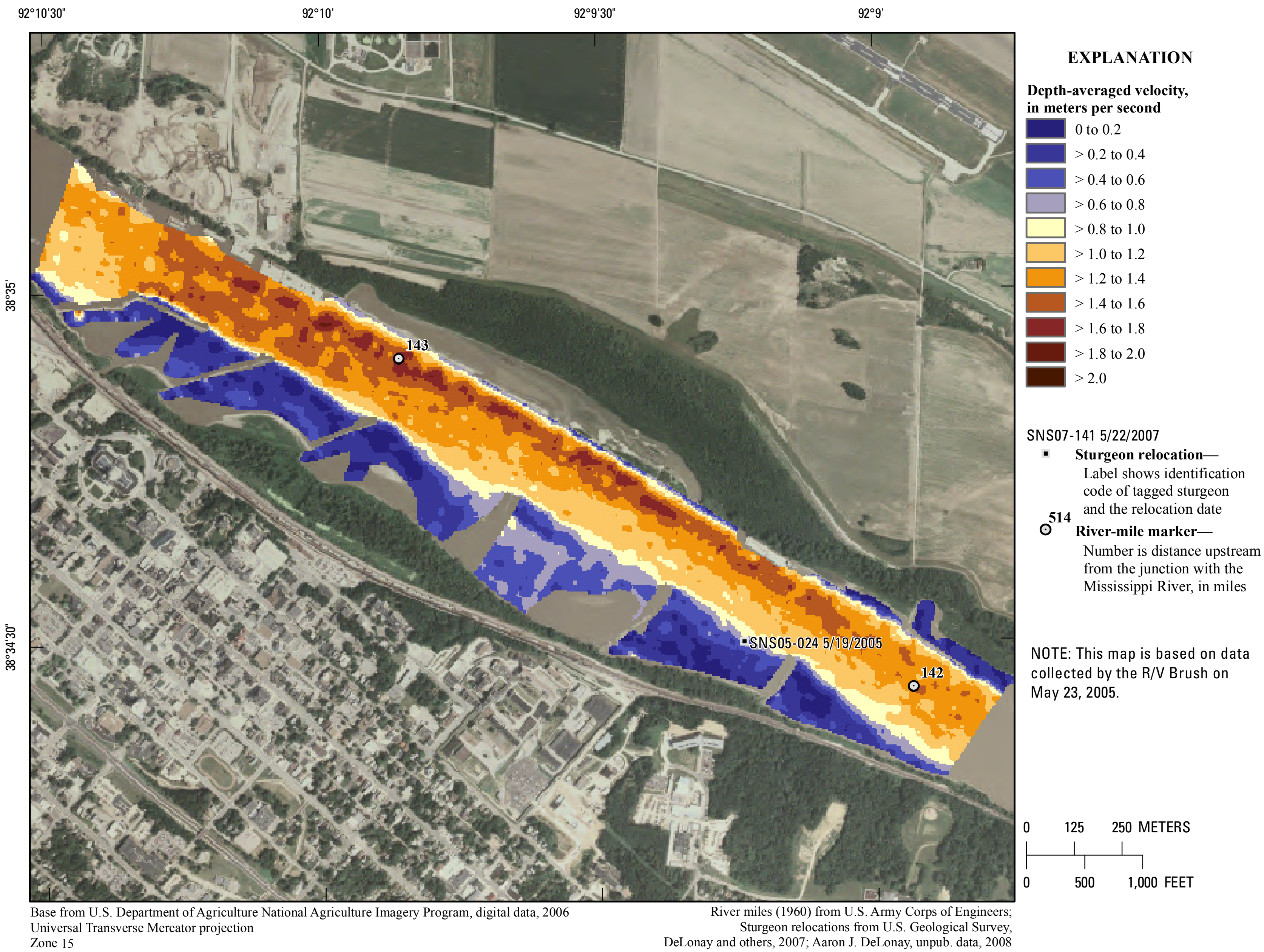
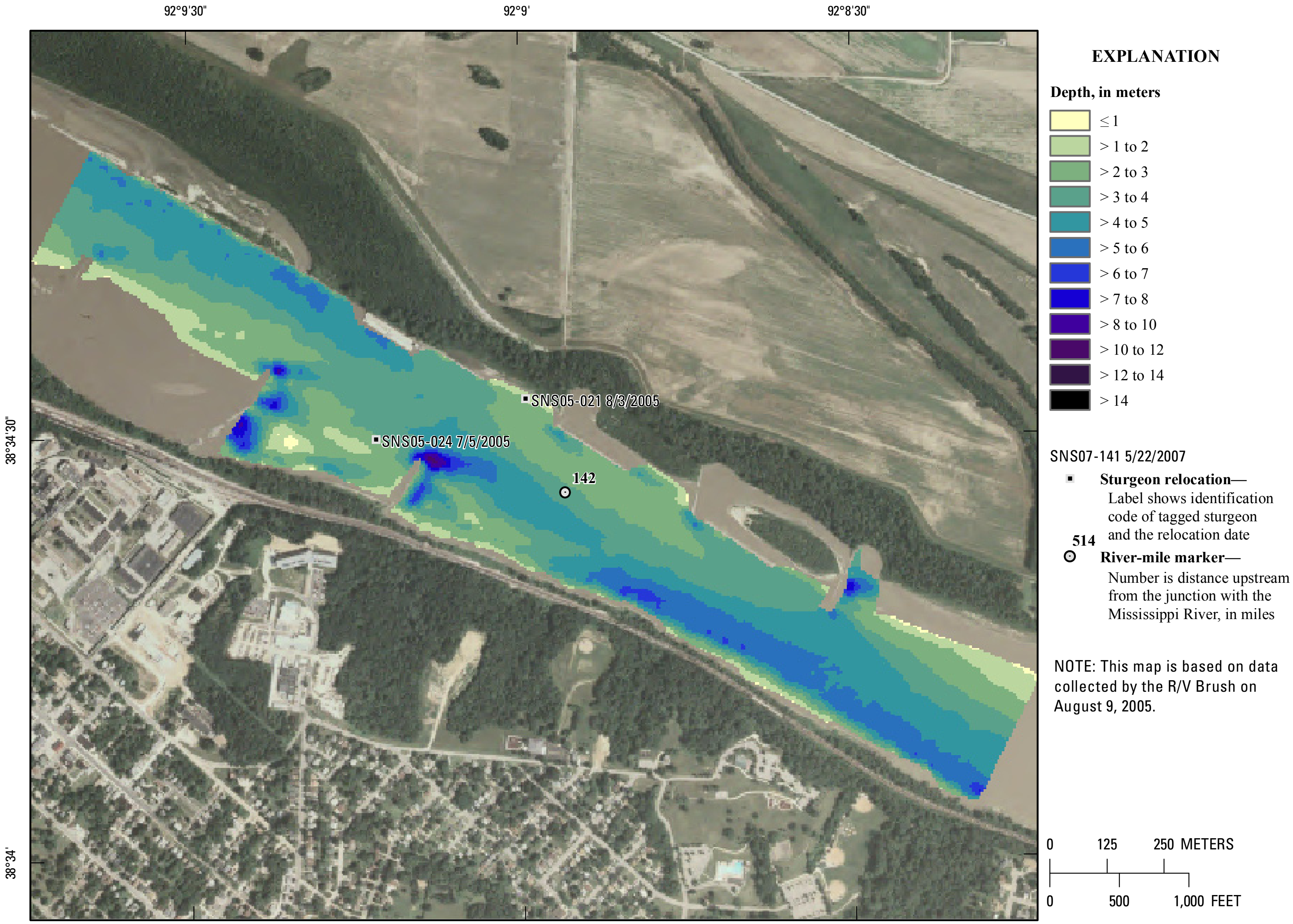


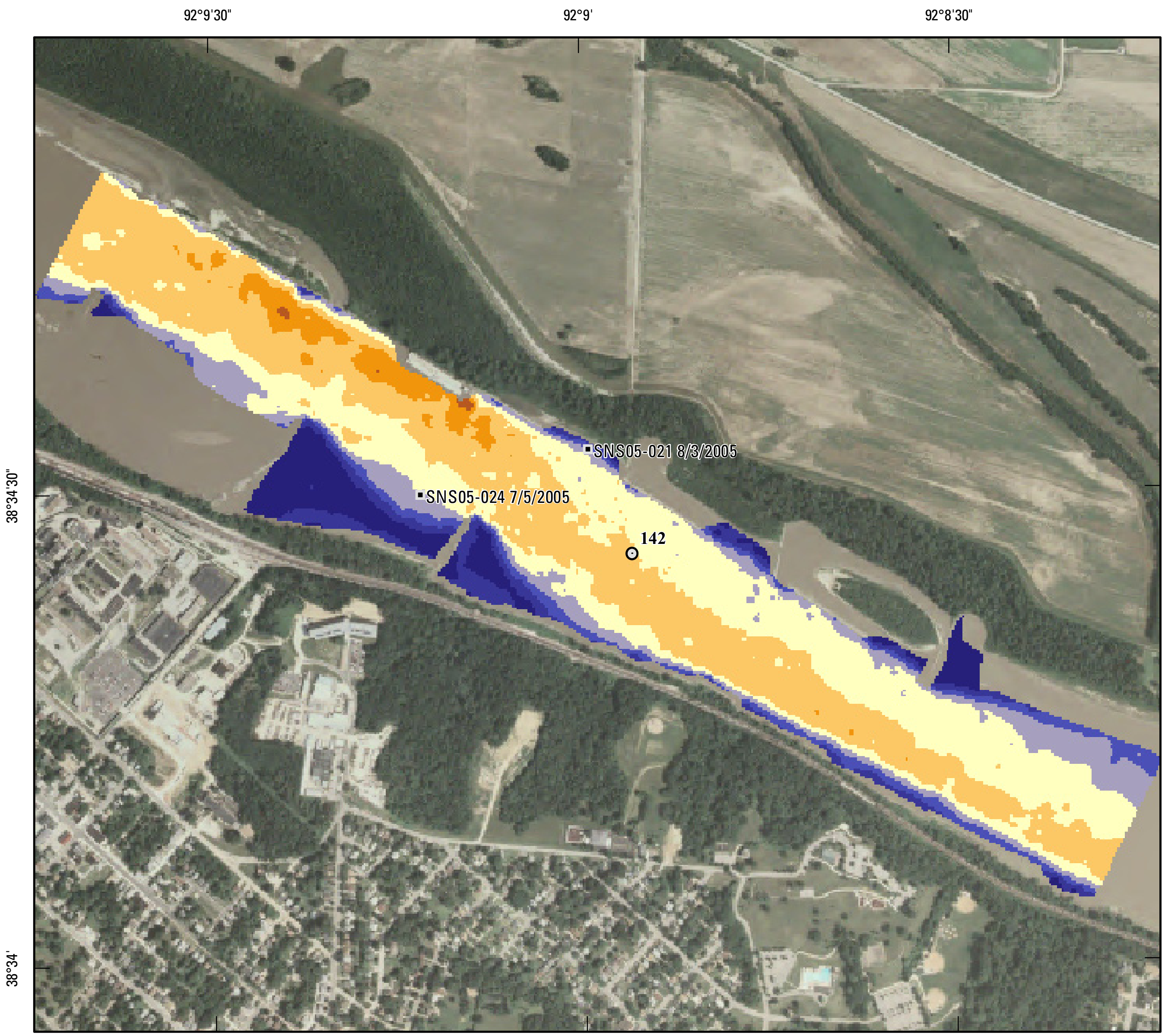
Figure 383. Map of depth-averaged velocity based on data collected on May 23, 2005, in the vicinity of river mile 143.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 384. Map of depth based on data collected on August 9, 2005, in the vicinity of river mile 142.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation—Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker—Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on August 9, 2005.

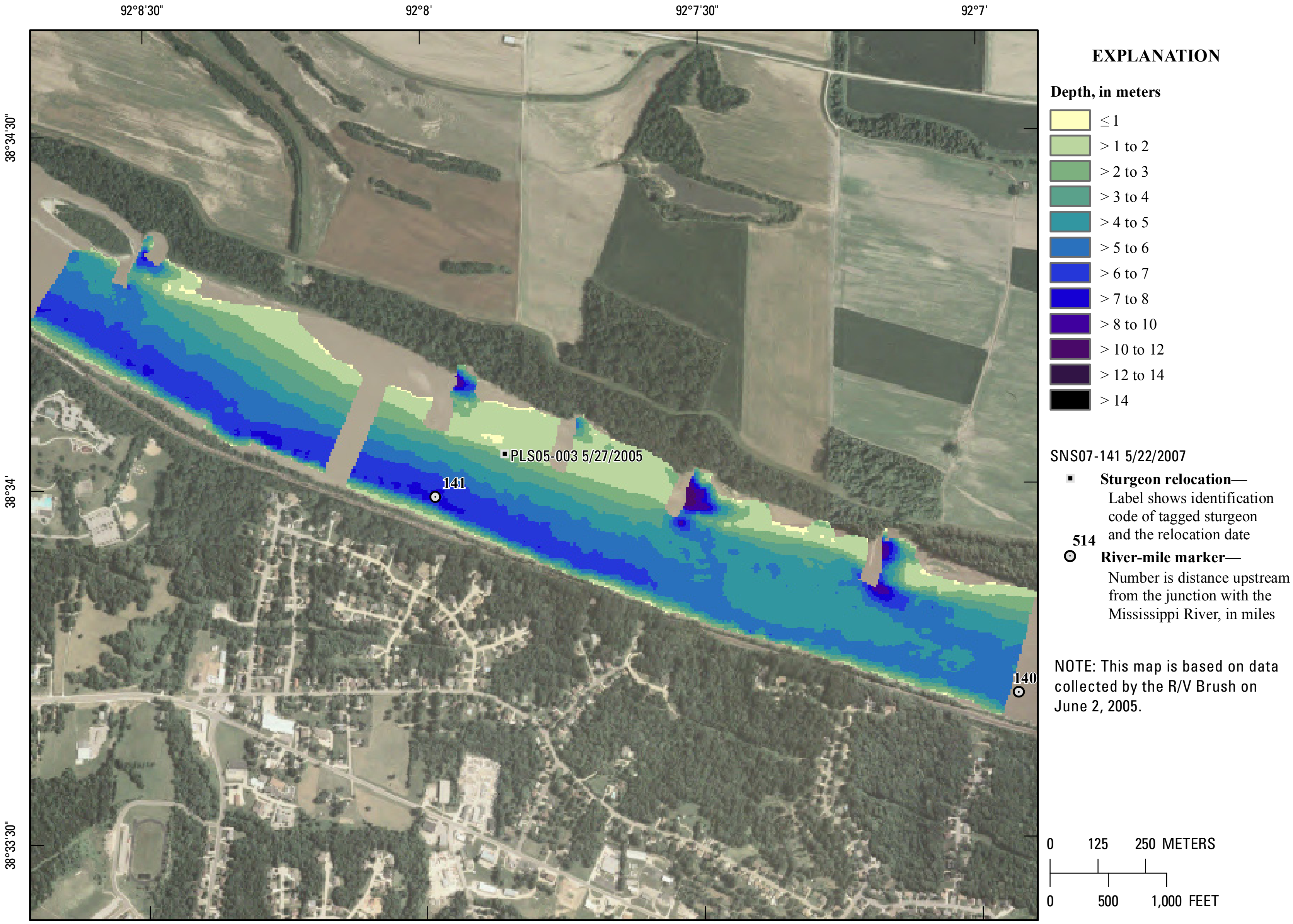
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

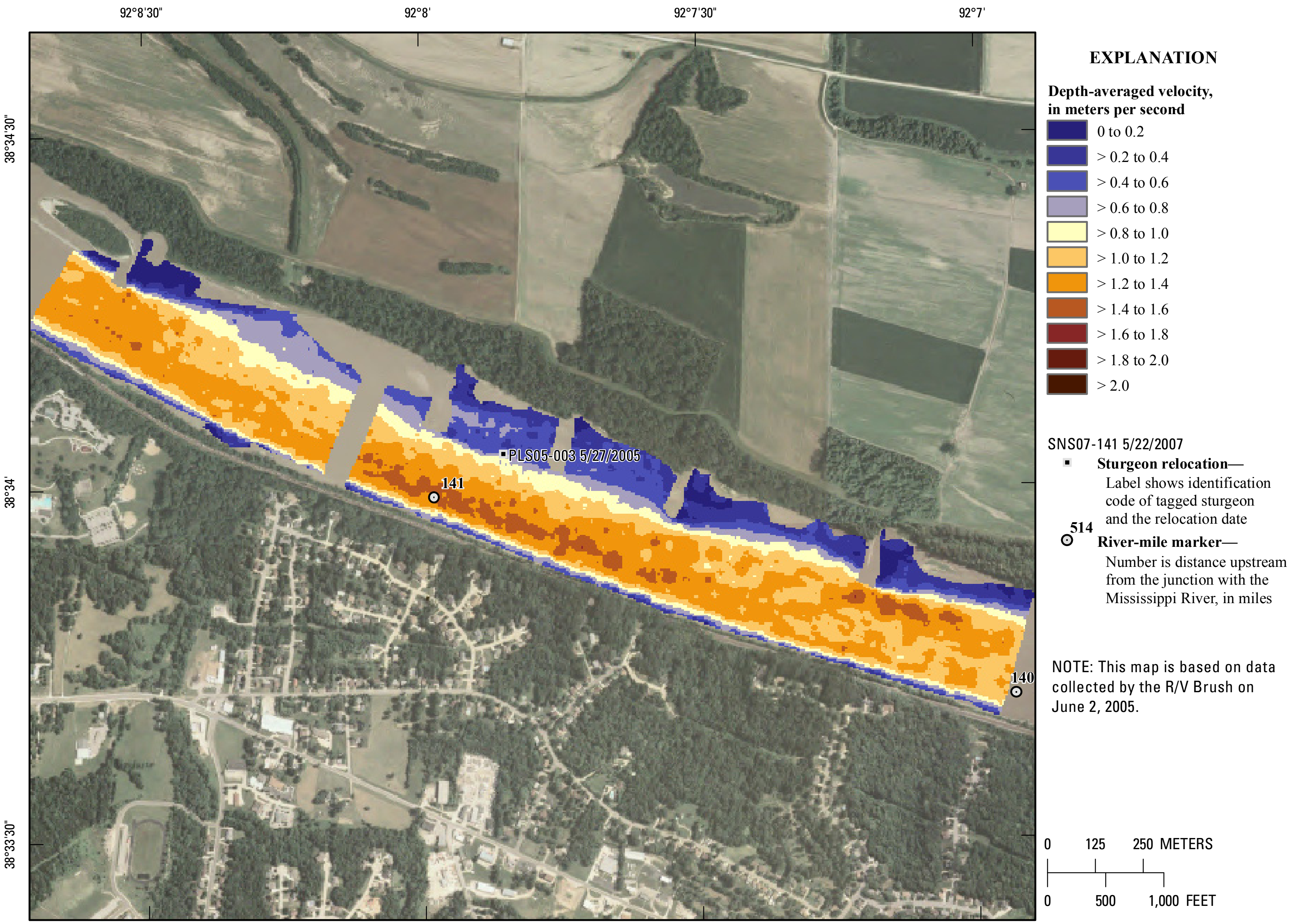
Figure 385. Map of depth-averaged velocity based on data collected on August 9, 2005, in the vicinity of river mile 142.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

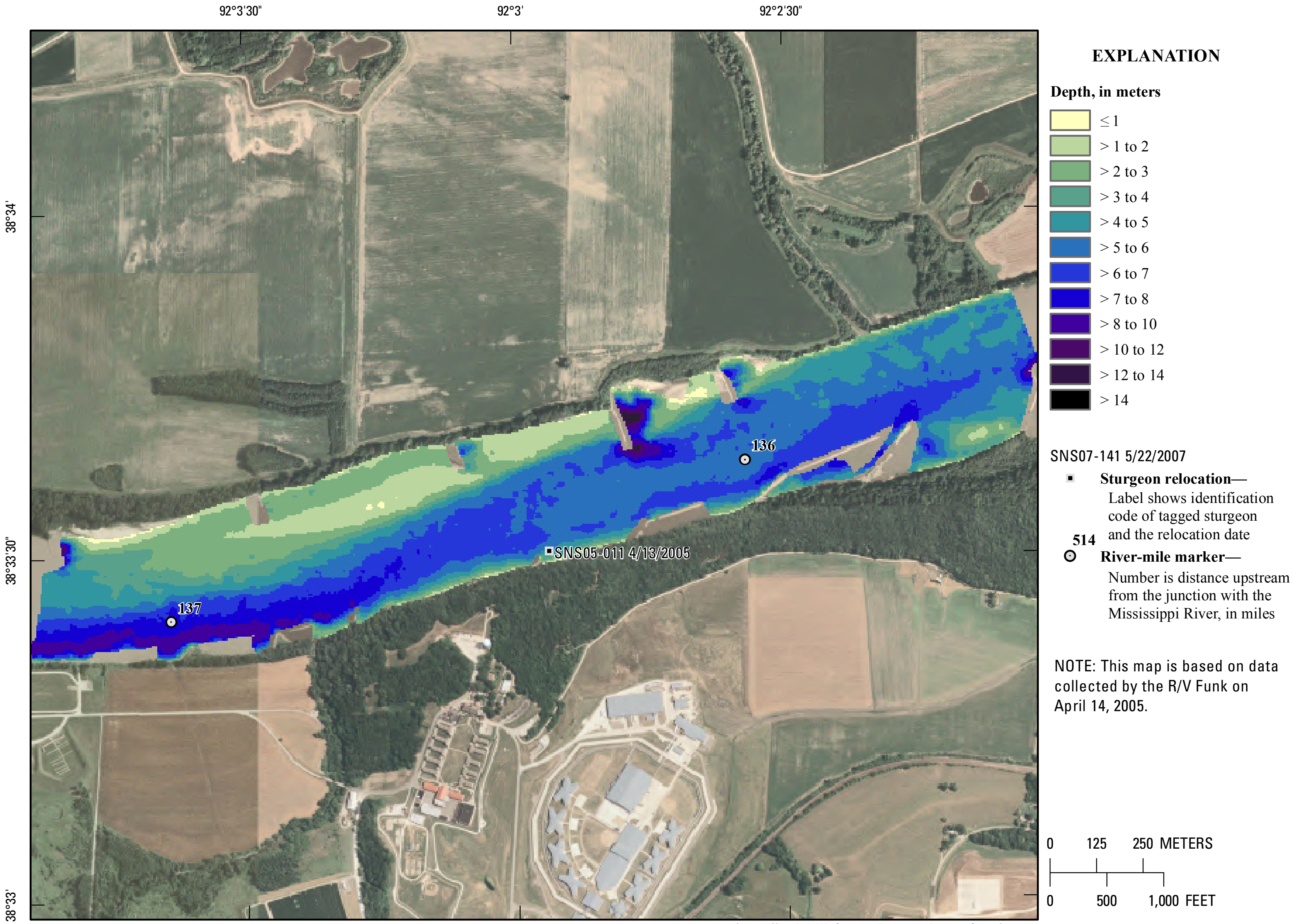
Figure 386. Map of depth based on data collected on June 2, 2005, in the vicinity of river mile 141.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 387. Map of depth-averaged velocity based on data collected on June 2, 2005, in the vicinity of river mile 141.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 388. Map of depth based on data collected on April 14, 2005, in the vicinity of river mile 136.

EXPLANATION

Generalized substrate

RoxAnn-derived classes

- Revetment, gravel, hard sand
- Sand (dunes)

RoxAnn- and velocity-derived classes

- Transporting sand
- Fine sediment (mud, silt)

Classes derived from aerial photographs

- Engineered structures (rock)
- Bedrock

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Funk on April 14, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 389. Map of generalized substrate based on data collected on April 14, 2005, in the vicinity of river mile 136.

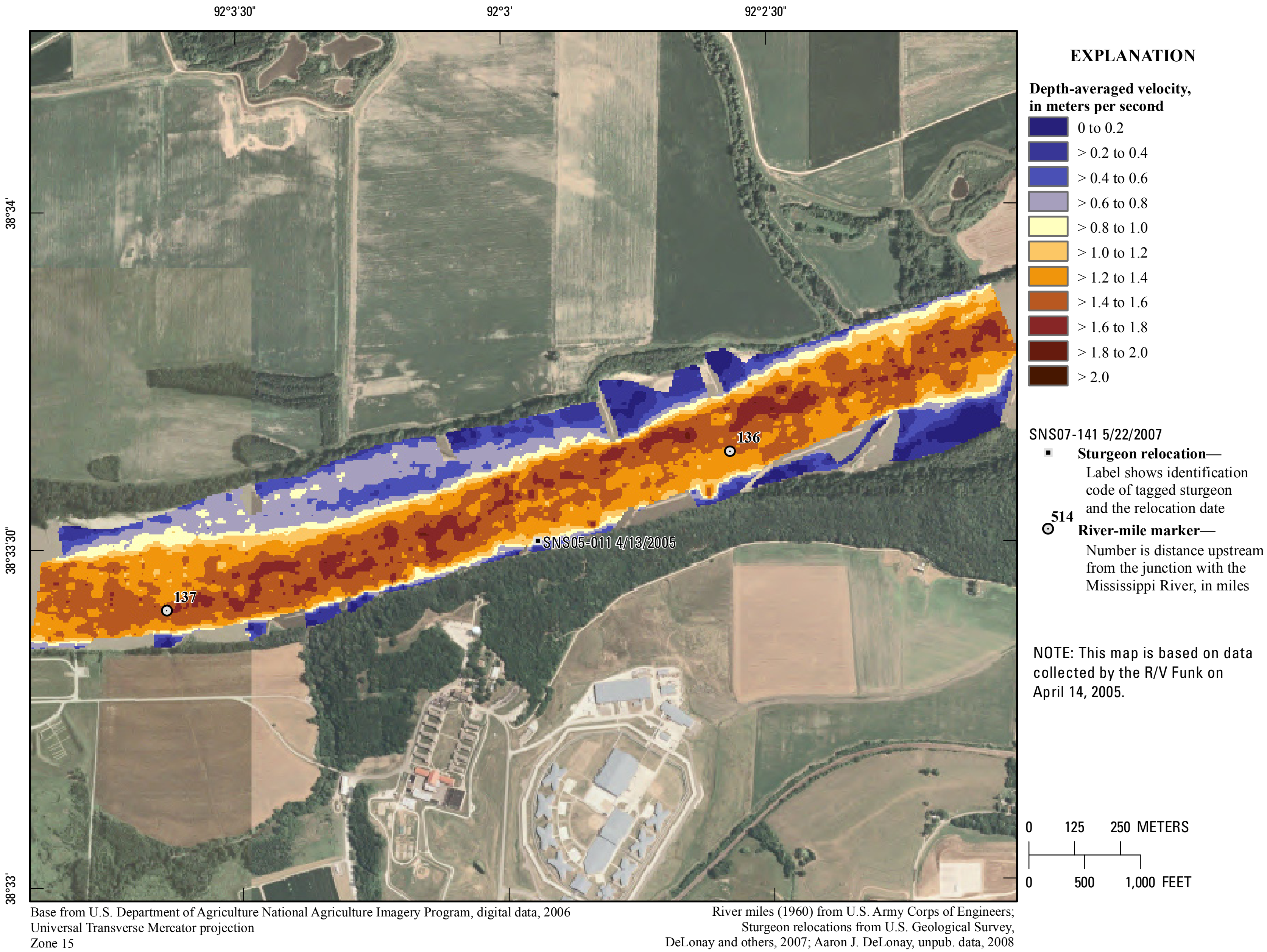


Figure 390. Map of depth-averaged velocity based on data collected on April 14, 2005, in the vicinity of river mile 136.

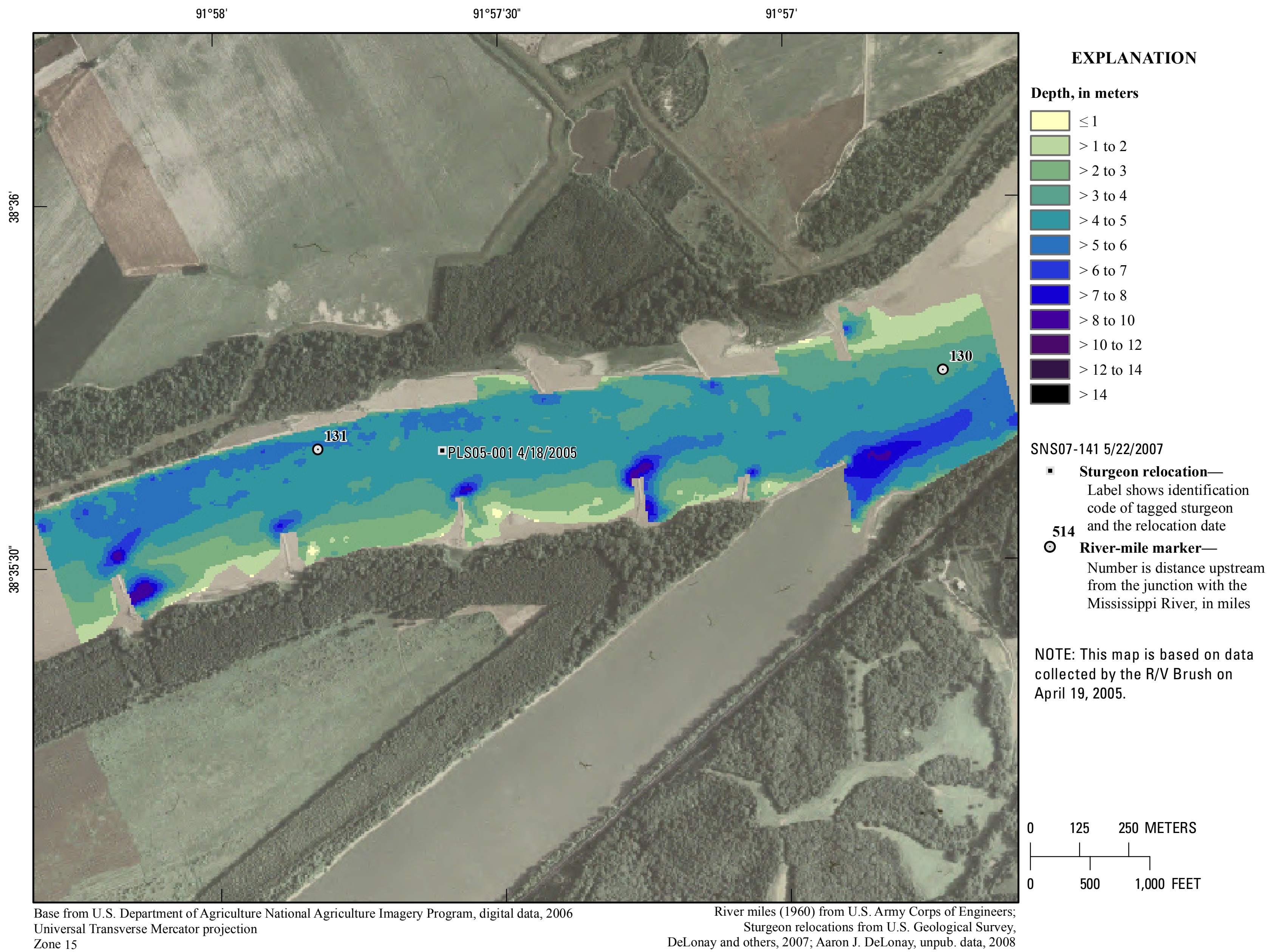
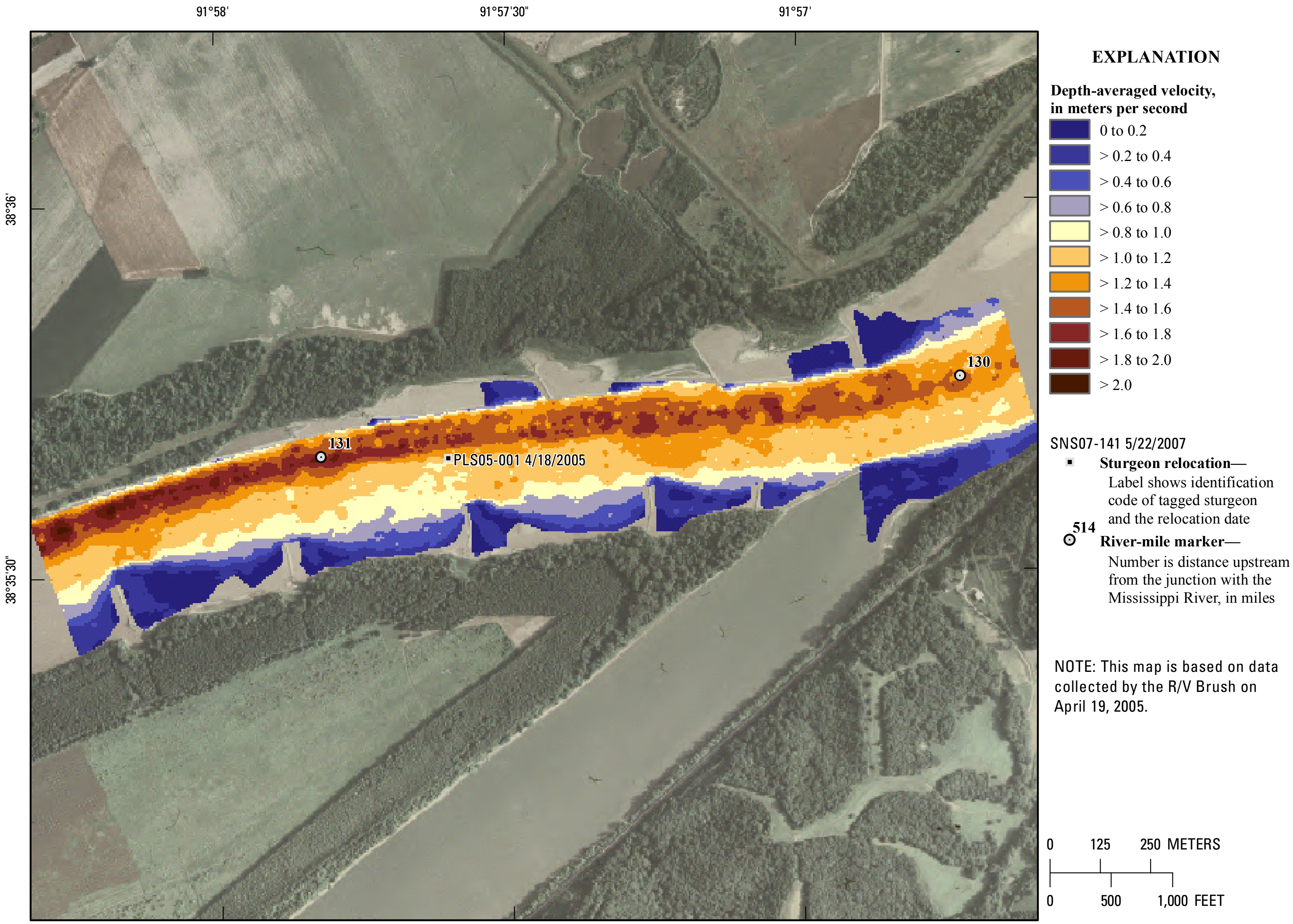


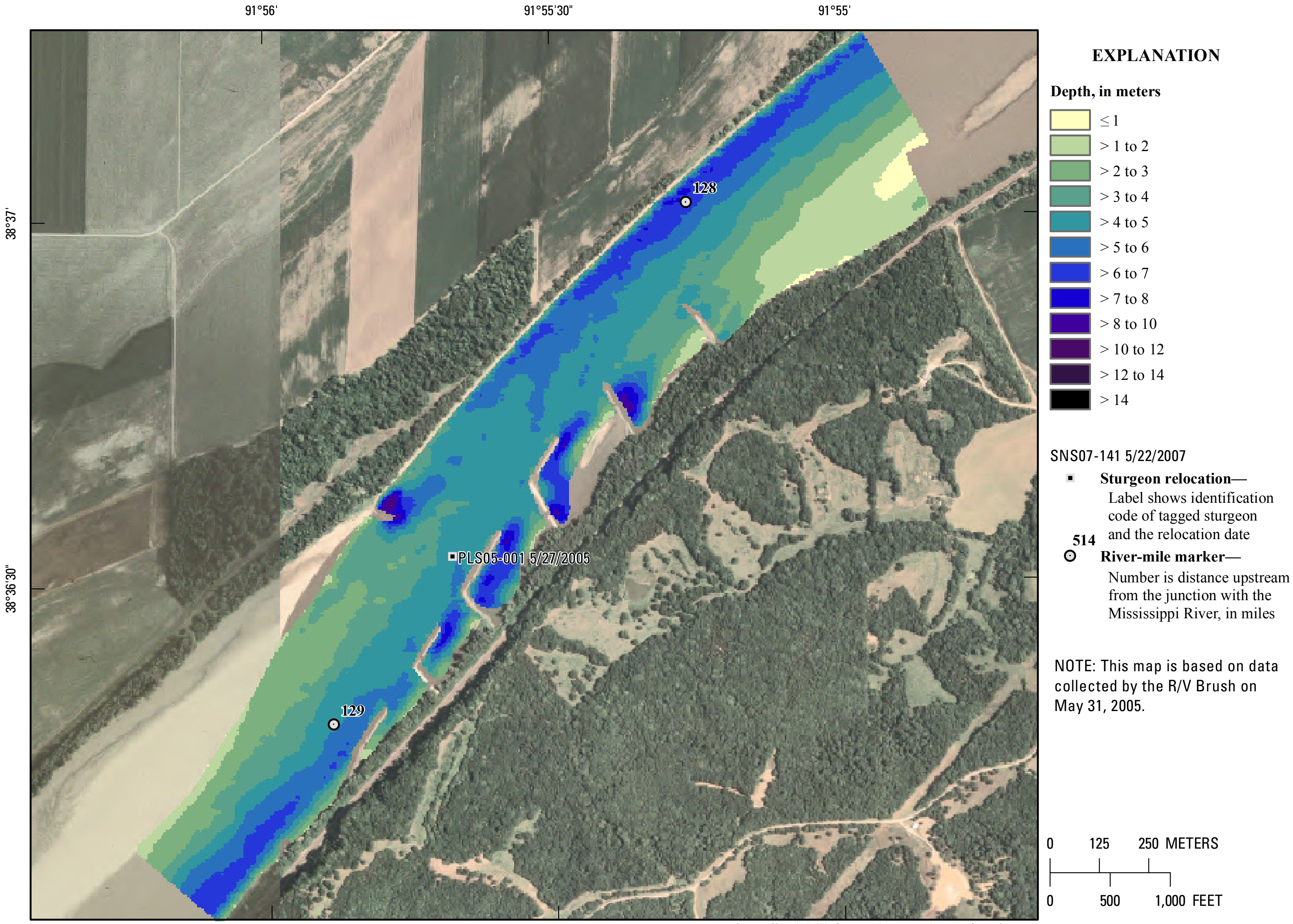
Figure 391. Map of depth based on data collected on April 19, 2005, in the vicinity of river mile 131.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 392. Map of depth-averaged velocity based on data collected on April 19, 2005, in the vicinity of river mile 131.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 393. Map of depth based on data collected on May 31, 2005, in the vicinity of river mile 129.

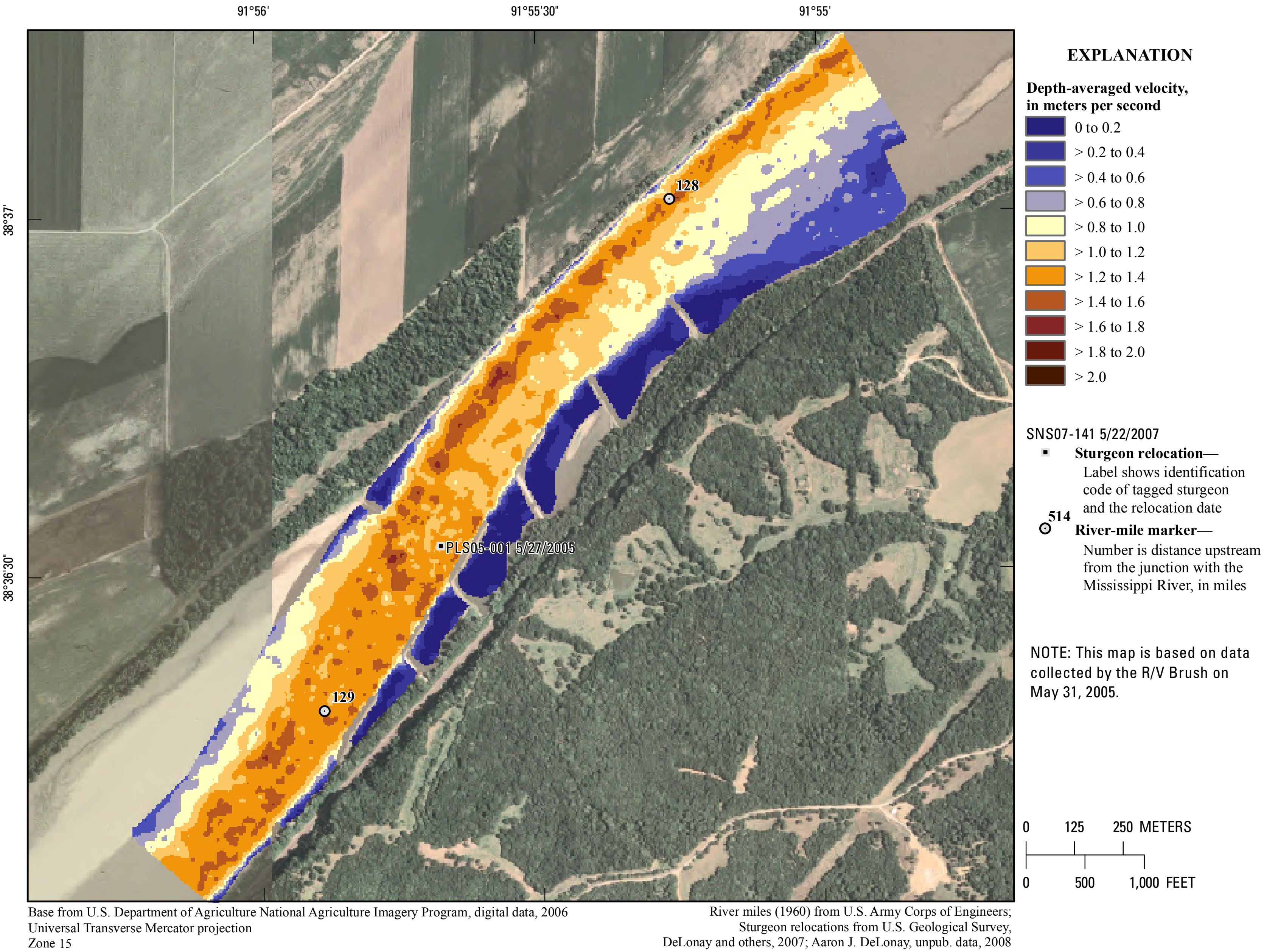
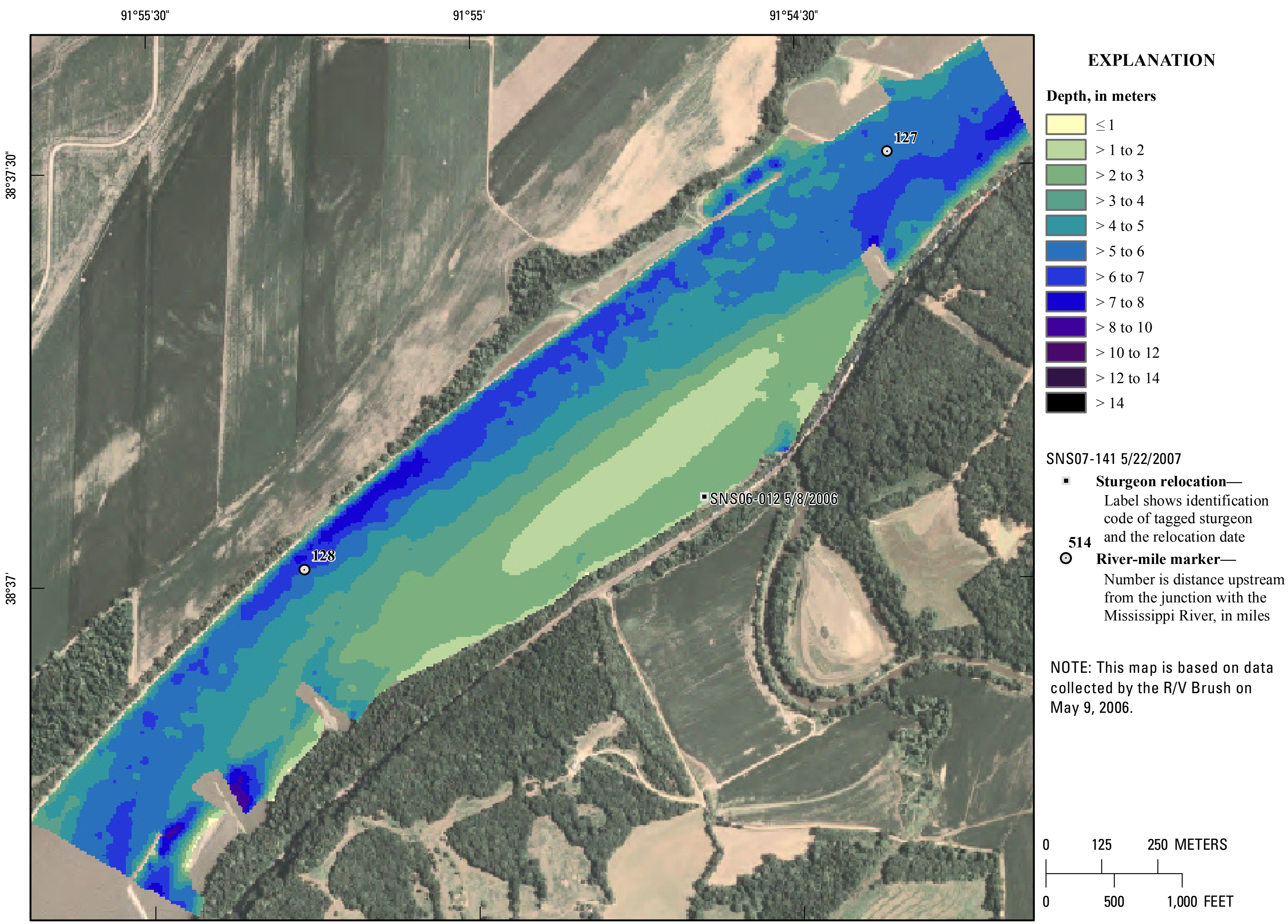


Figure 394. Map of depth-averaged velocity based on data collected on May 31, 2005, in the vicinity of river mile 129.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 395. Map of depth based on data collected on May 9, 2006, in the vicinity of river mile 128.

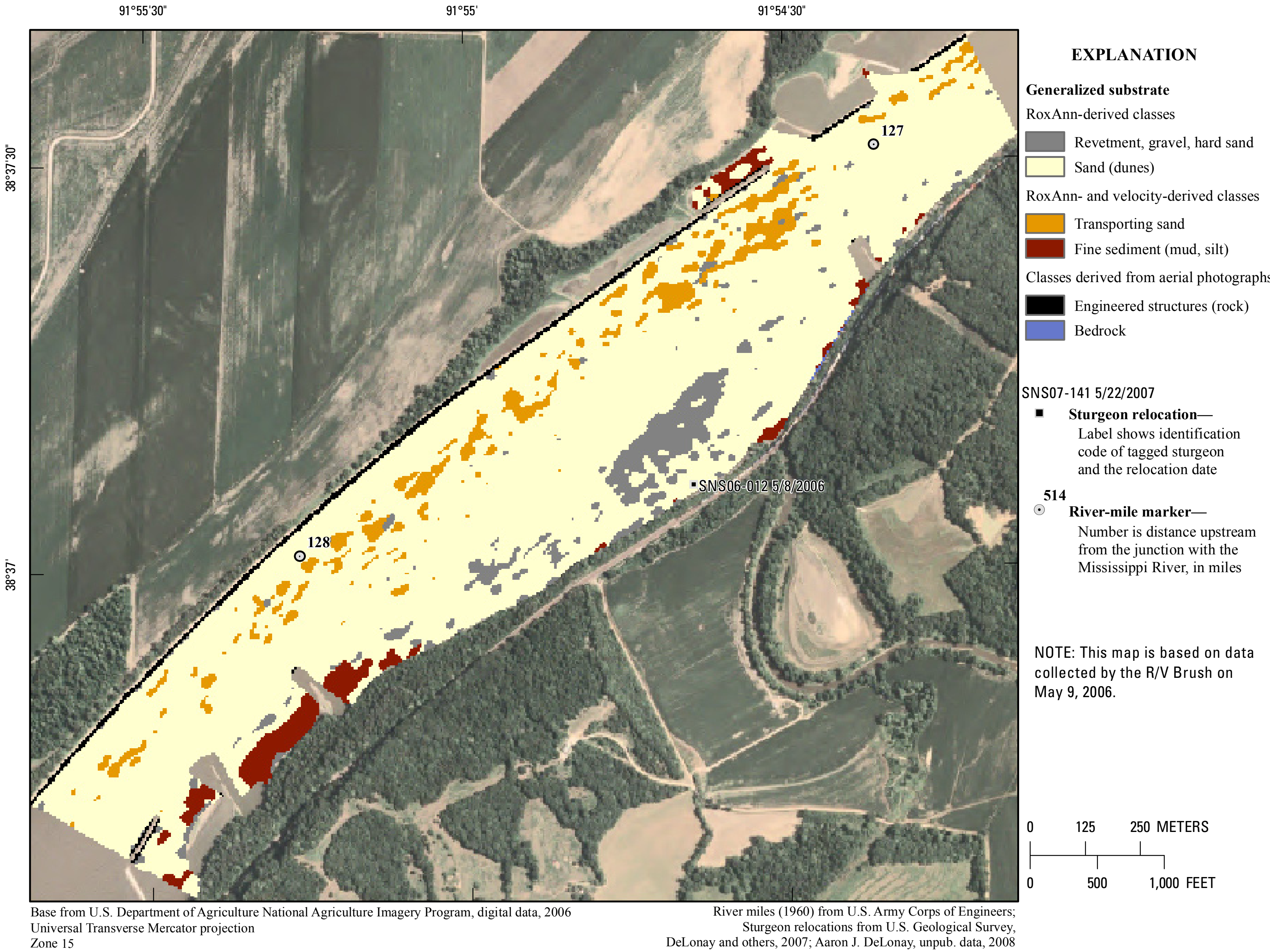
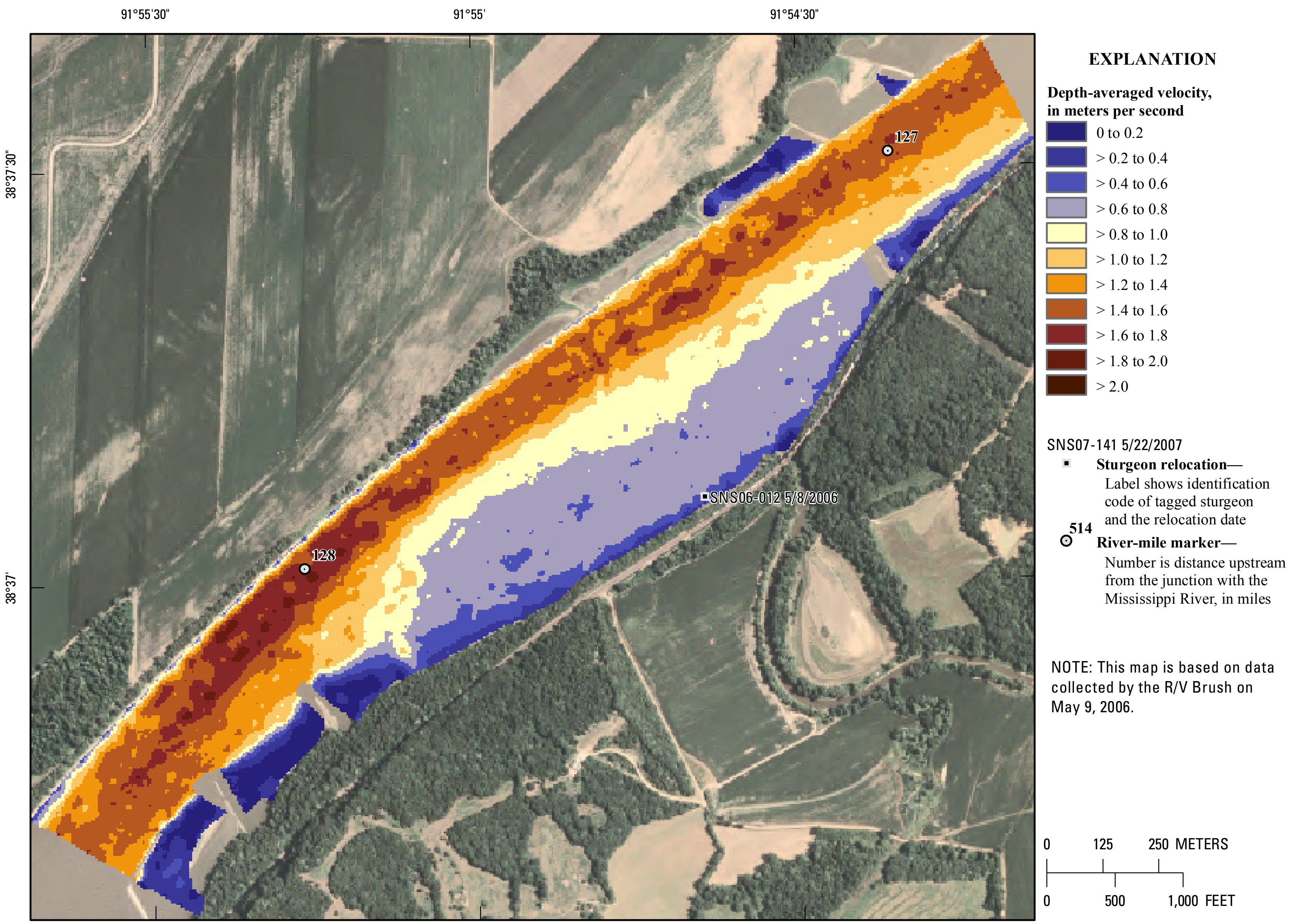


Figure 396. Map of generalized substrate based on data collected on May 9, 2006, in the vicinity of river mile 128.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 397. Map of depth-averaged velocity based on data collected on May 9, 2006, in the vicinity of river mile 128.

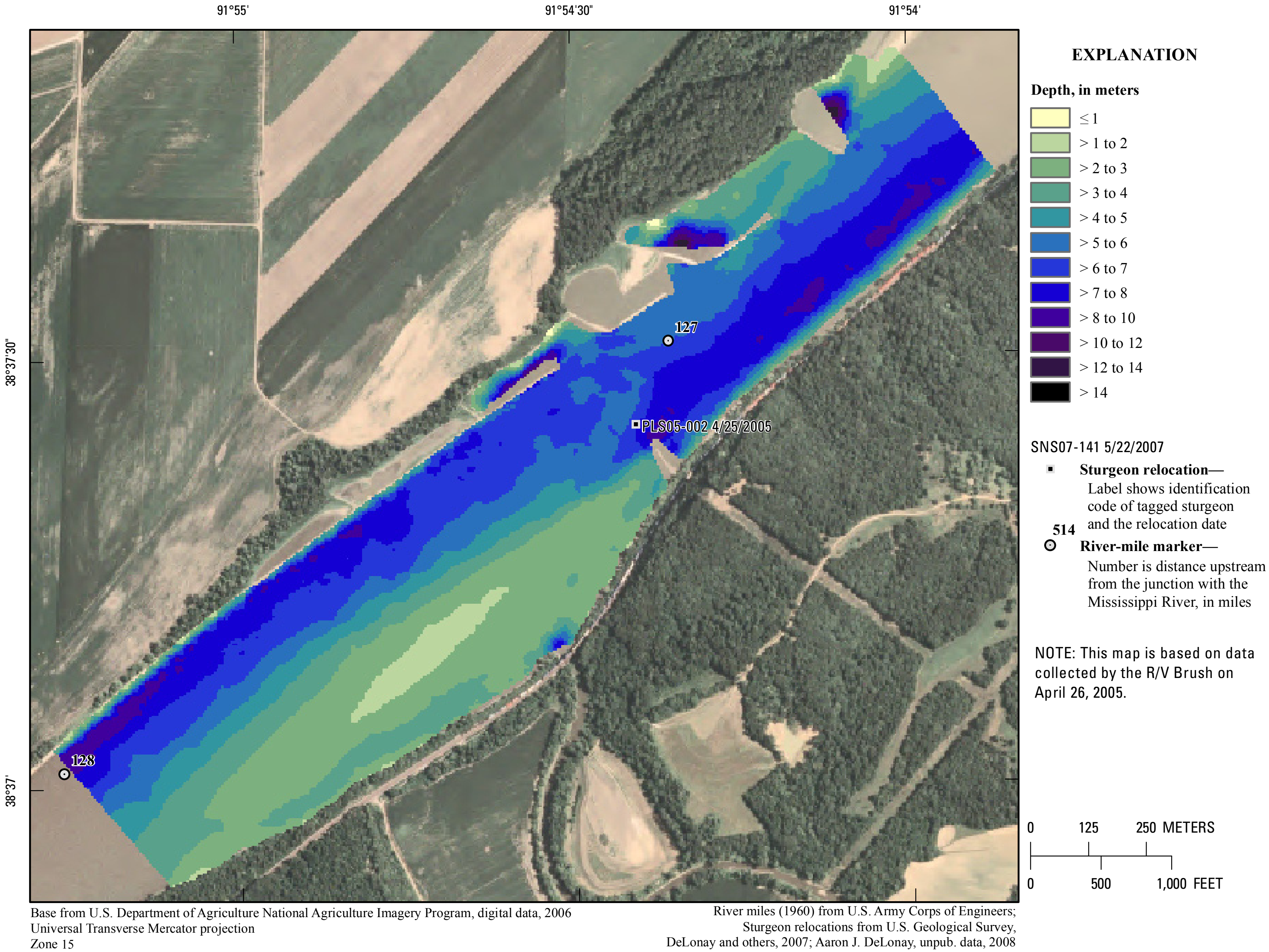
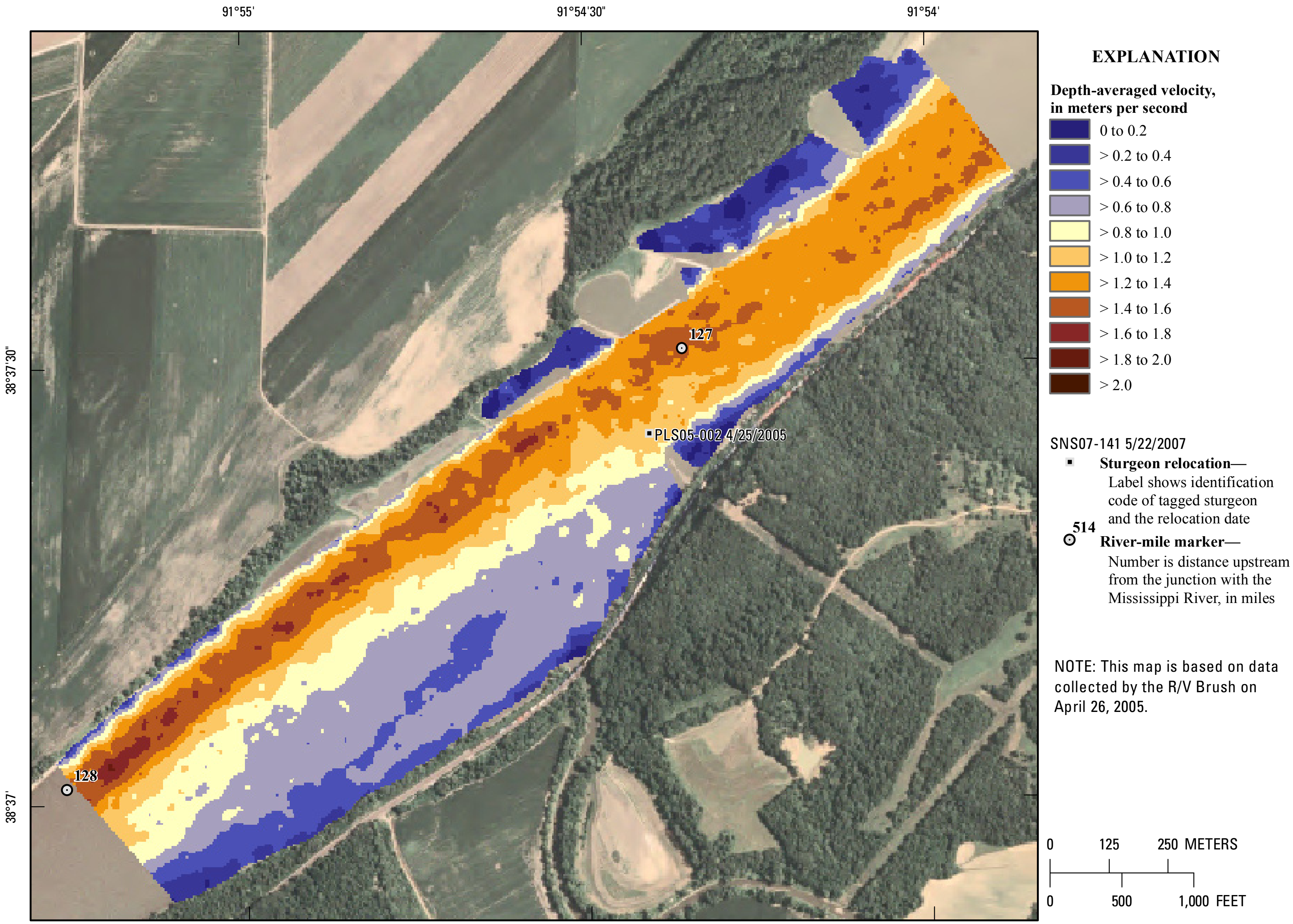


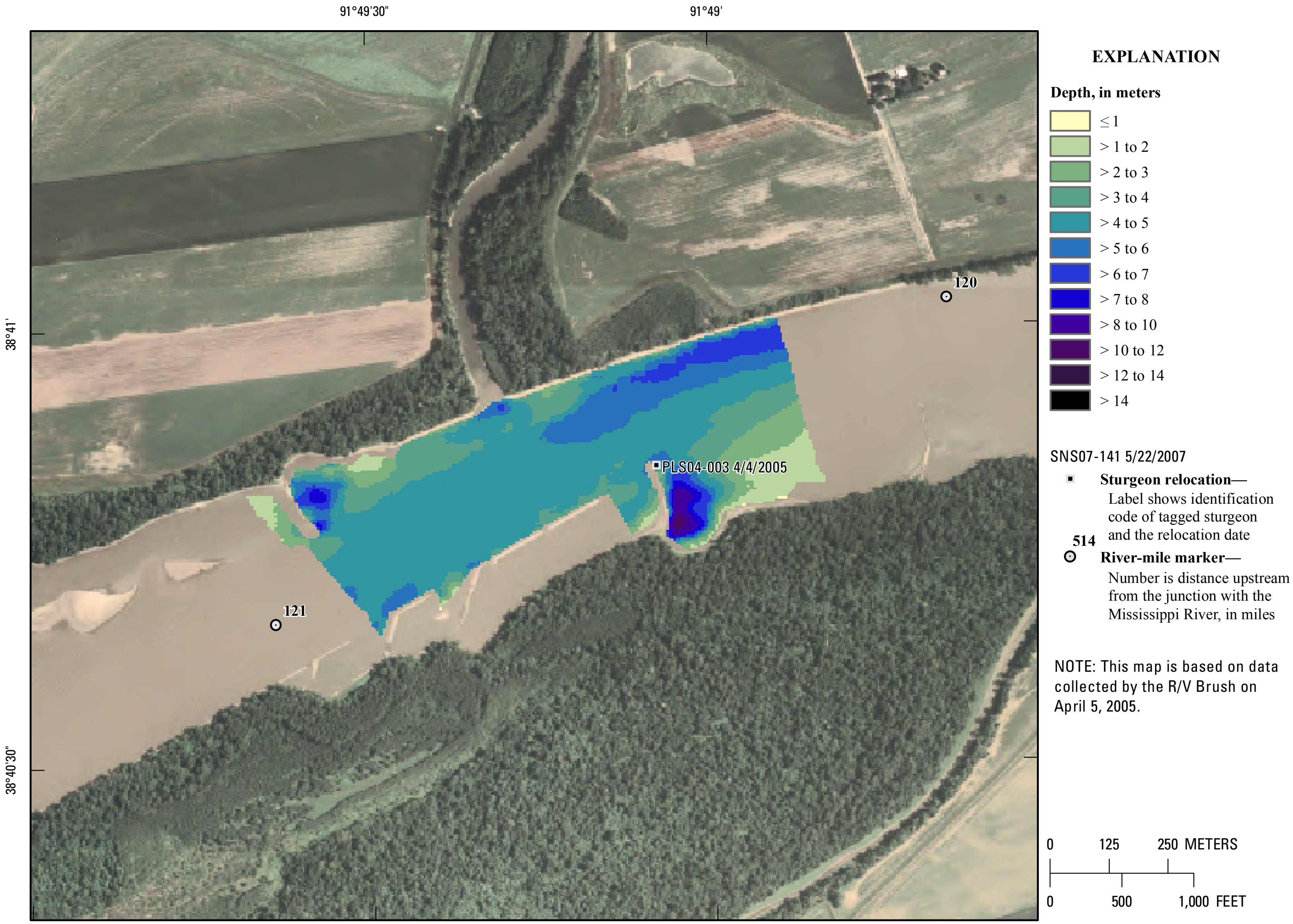
Figure 398. Map of depth based on data collected on April 26, 2005, in the vicinity of river mile 127.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

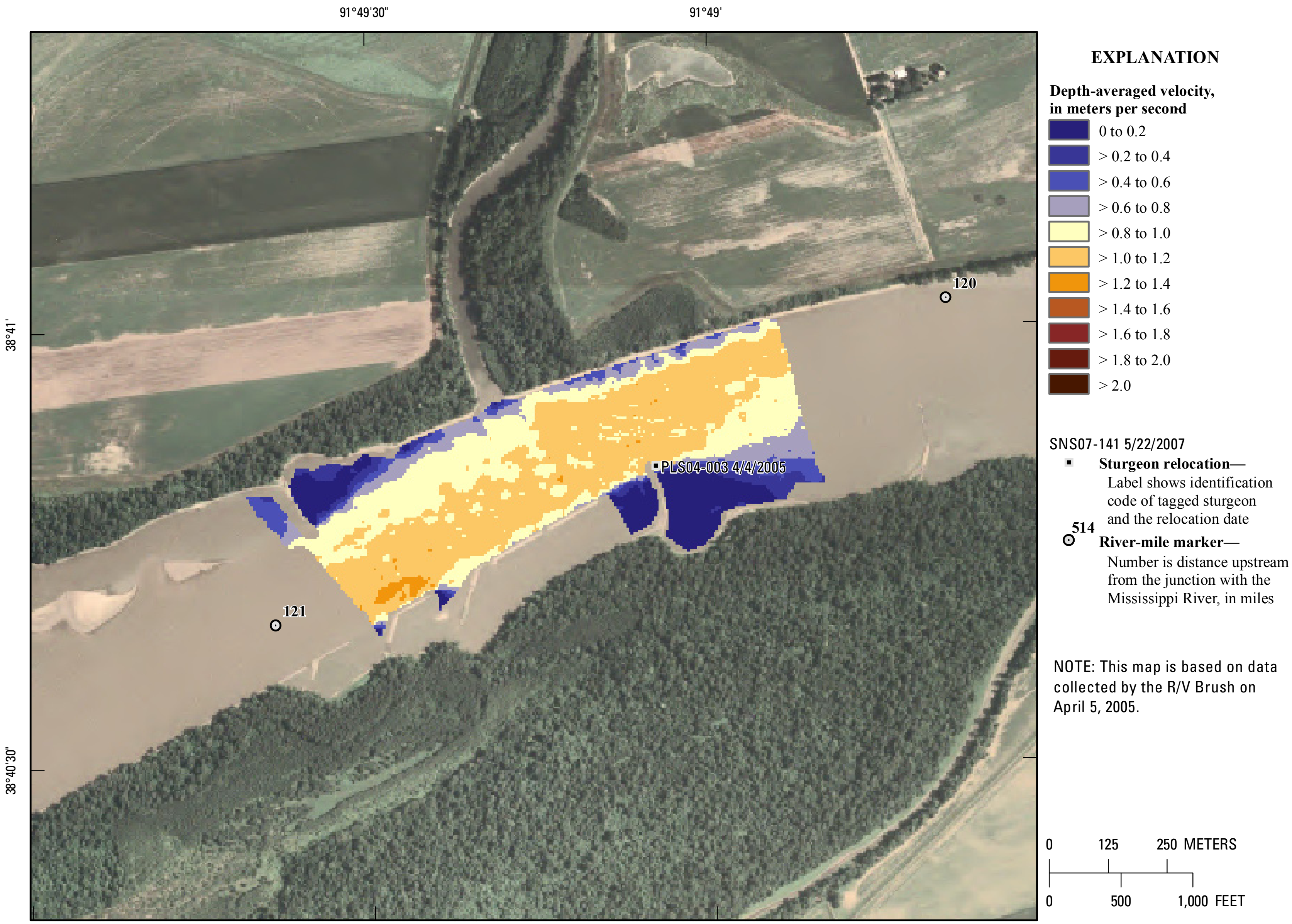
Figure 399. Map of depth-averaged velocity based on data collected on April 26, 2005, in the vicinity of river mile 127.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 400. Map of depth based on data collected on April 5, 2005, in the vicinity of river mile 121.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 401. Map of depth-averaged velocity based on data collected on April 5, 2005, in the vicinity of river mile 121.

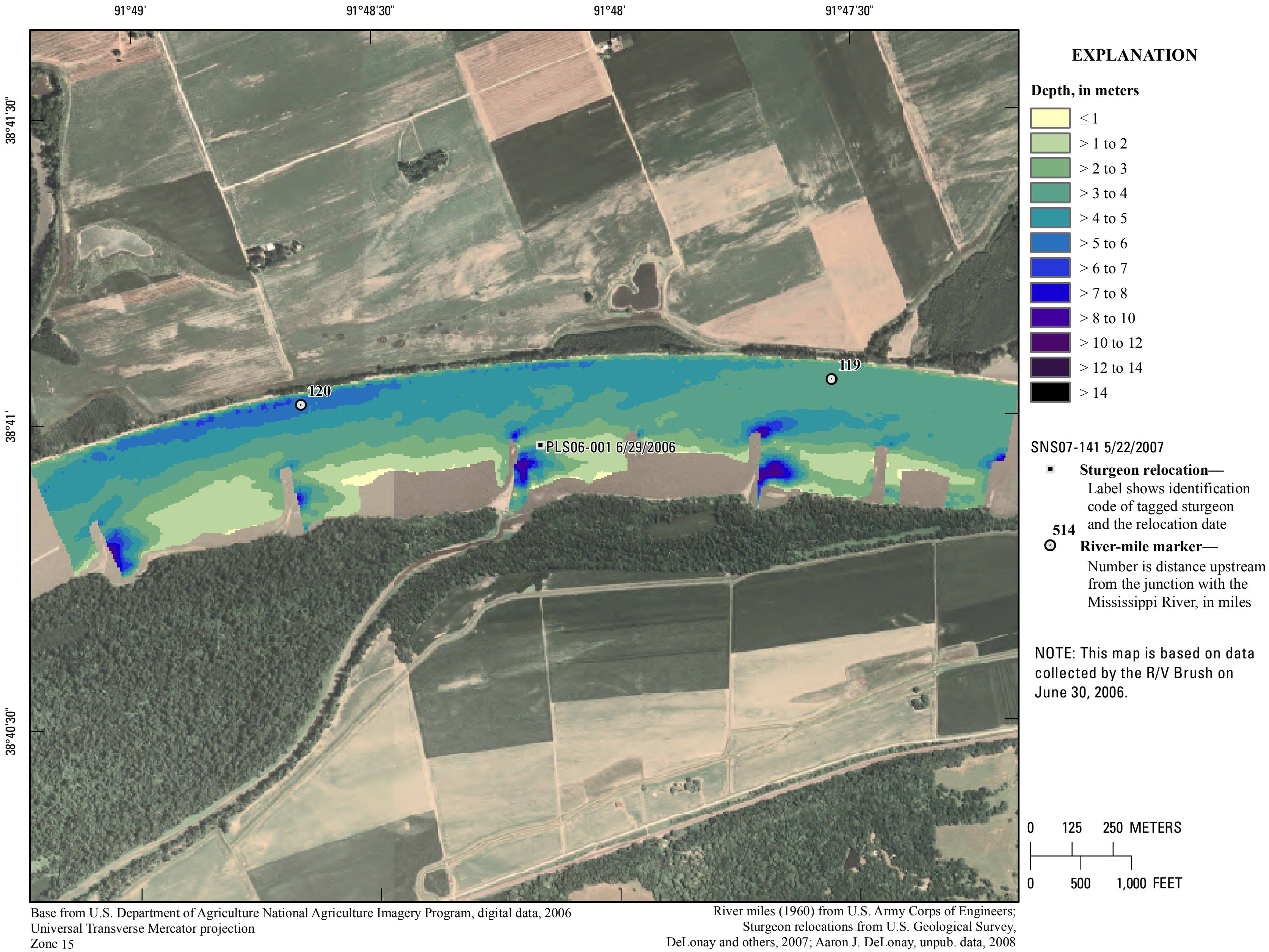
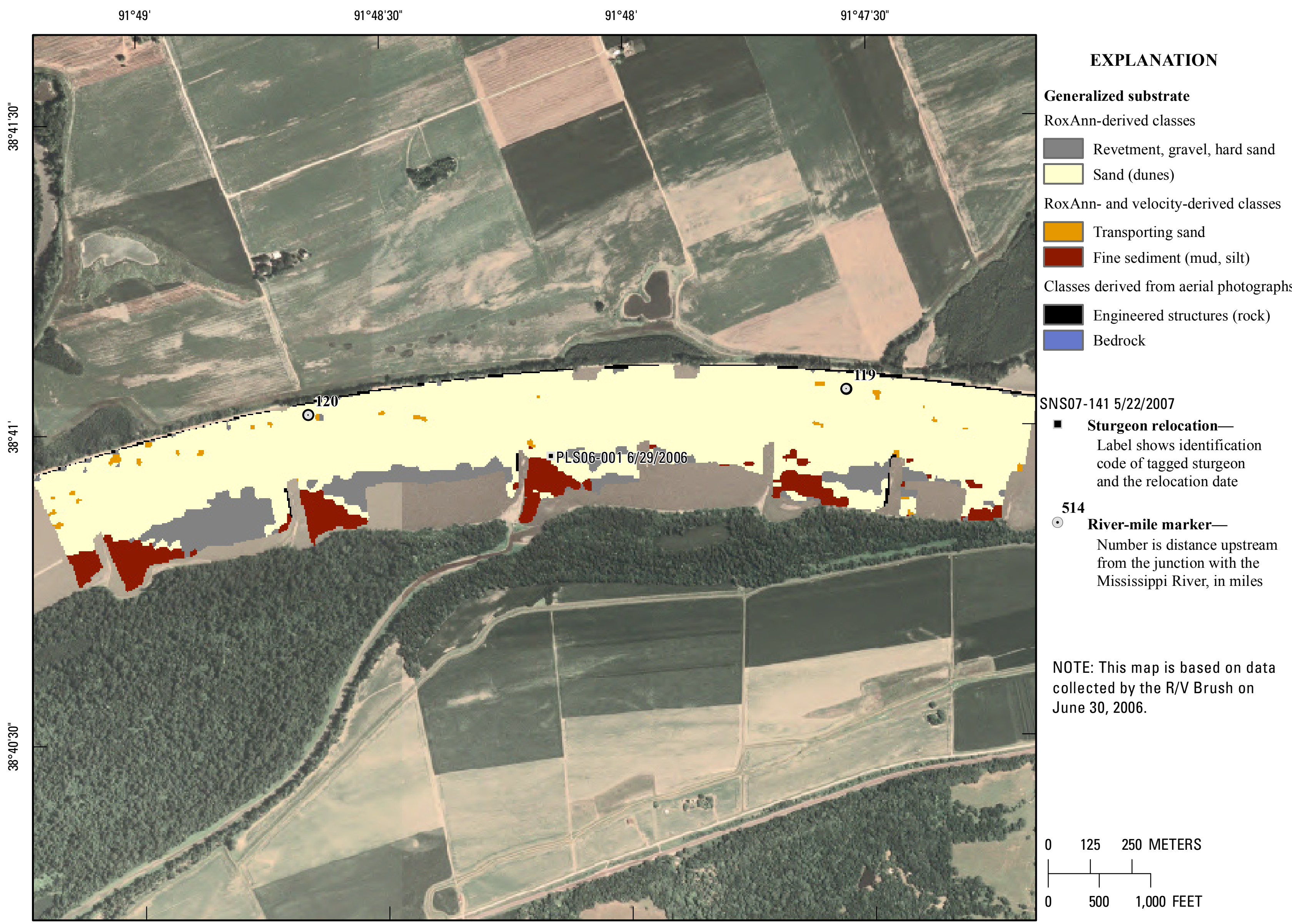


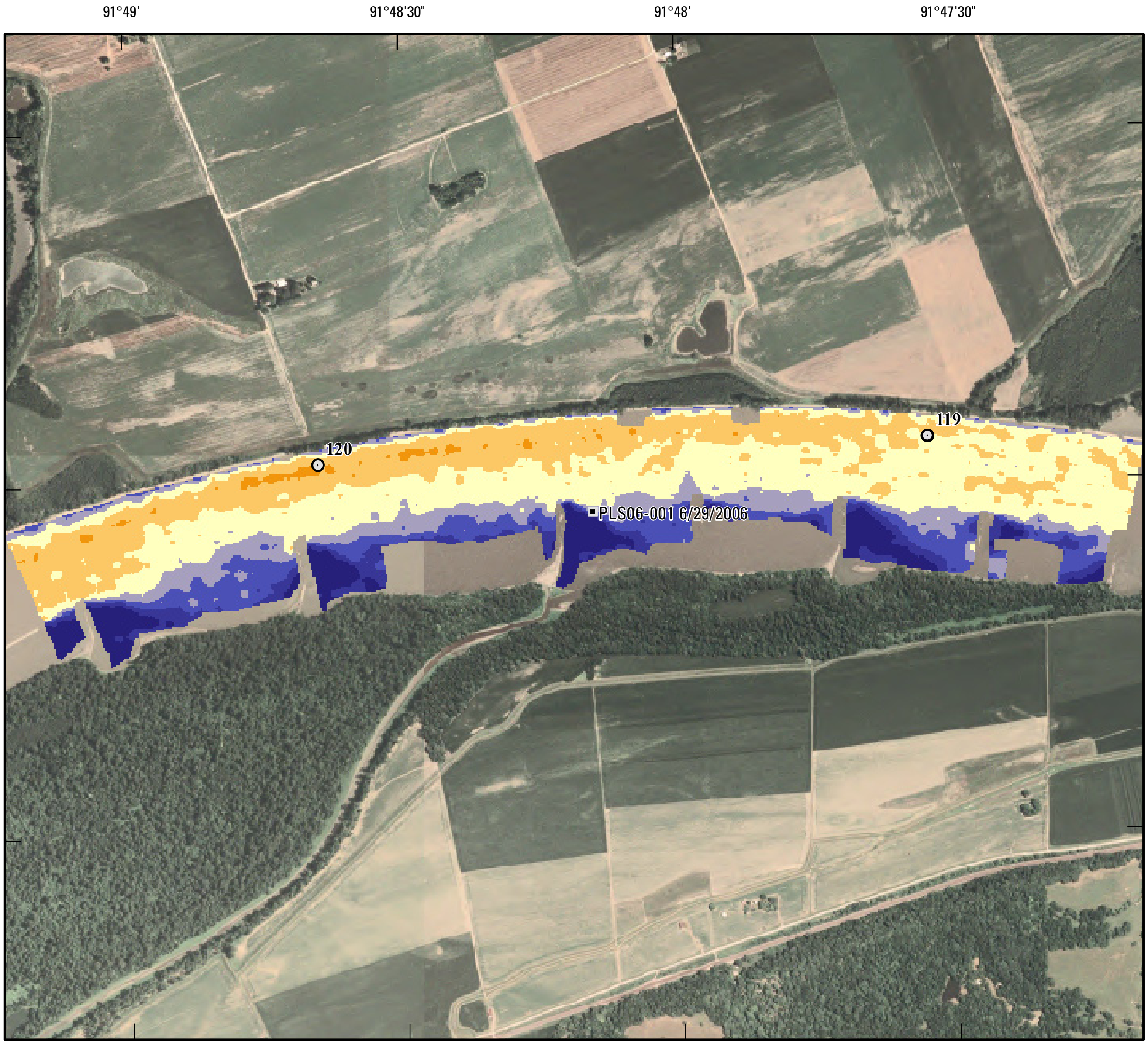
Figure 402. Map of depth based on data collected on June 30, 2006, in the vicinity of river mile 120.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 403. Map of generalized substrate based on data collected on June 30, 2006, in the vicinity of river mile 120.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

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River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on June 30, 2006.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 404. Map of depth-averaged velocity based on data collected on June 30, 2006, in the vicinity of river mile 120.

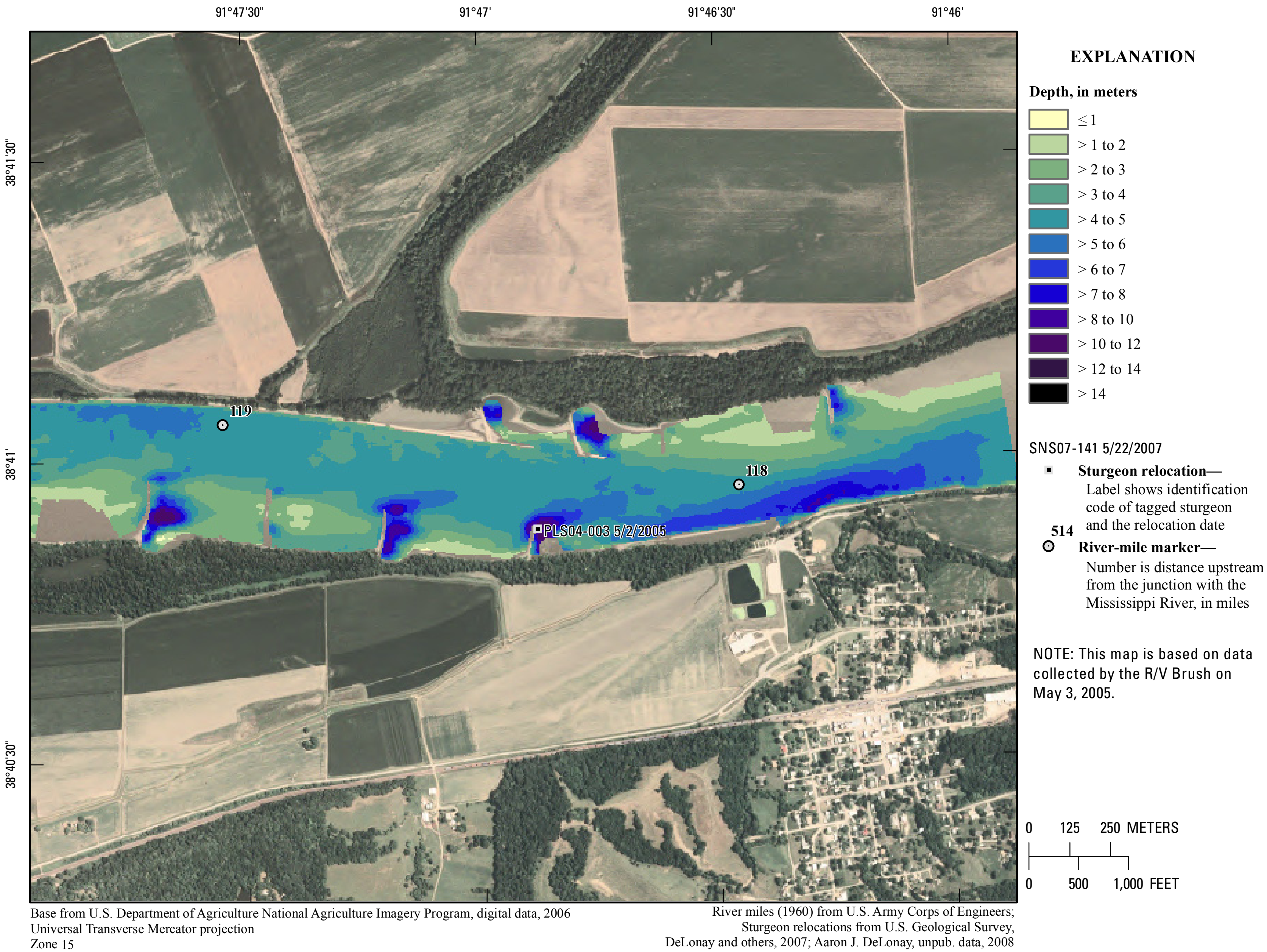
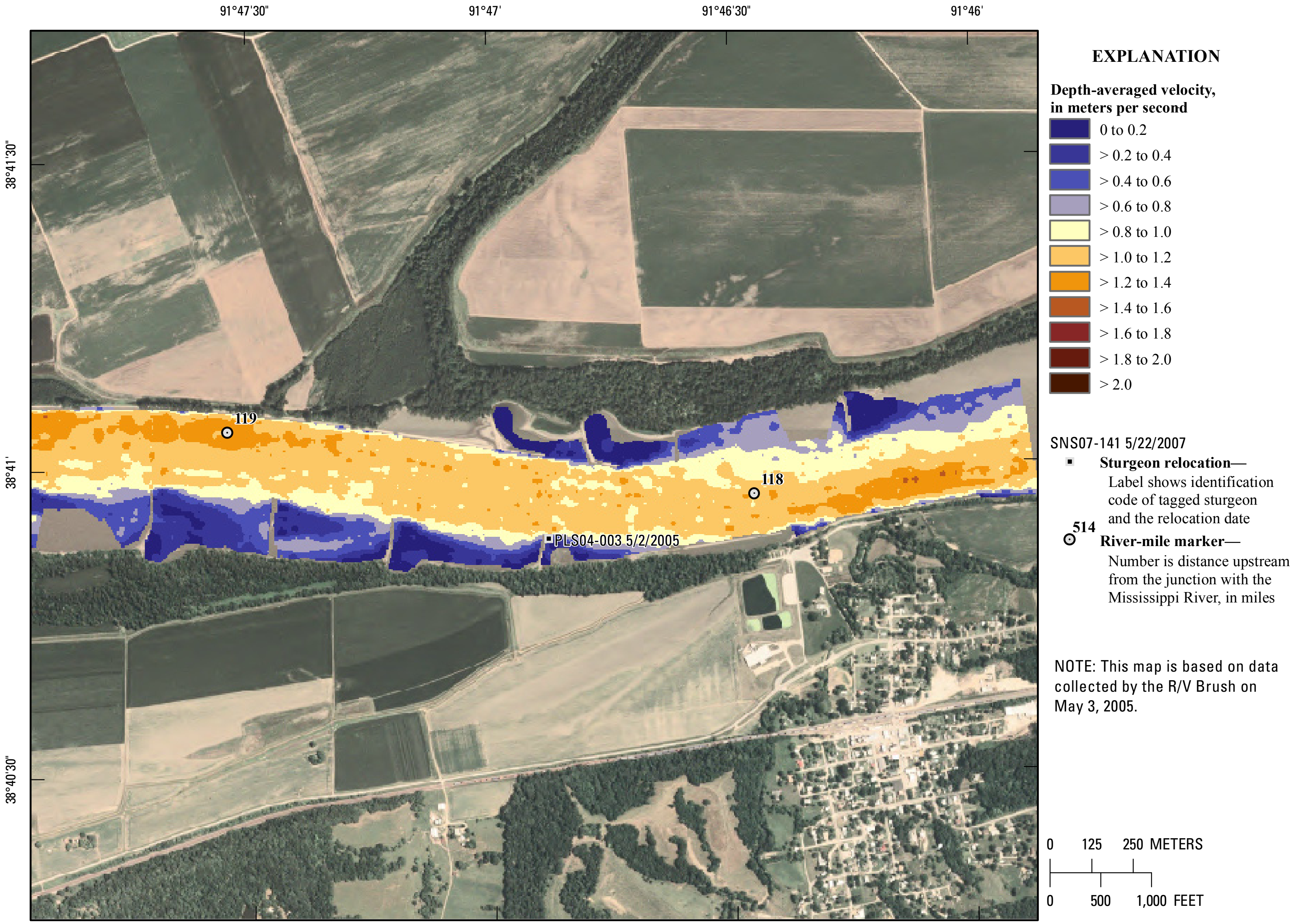


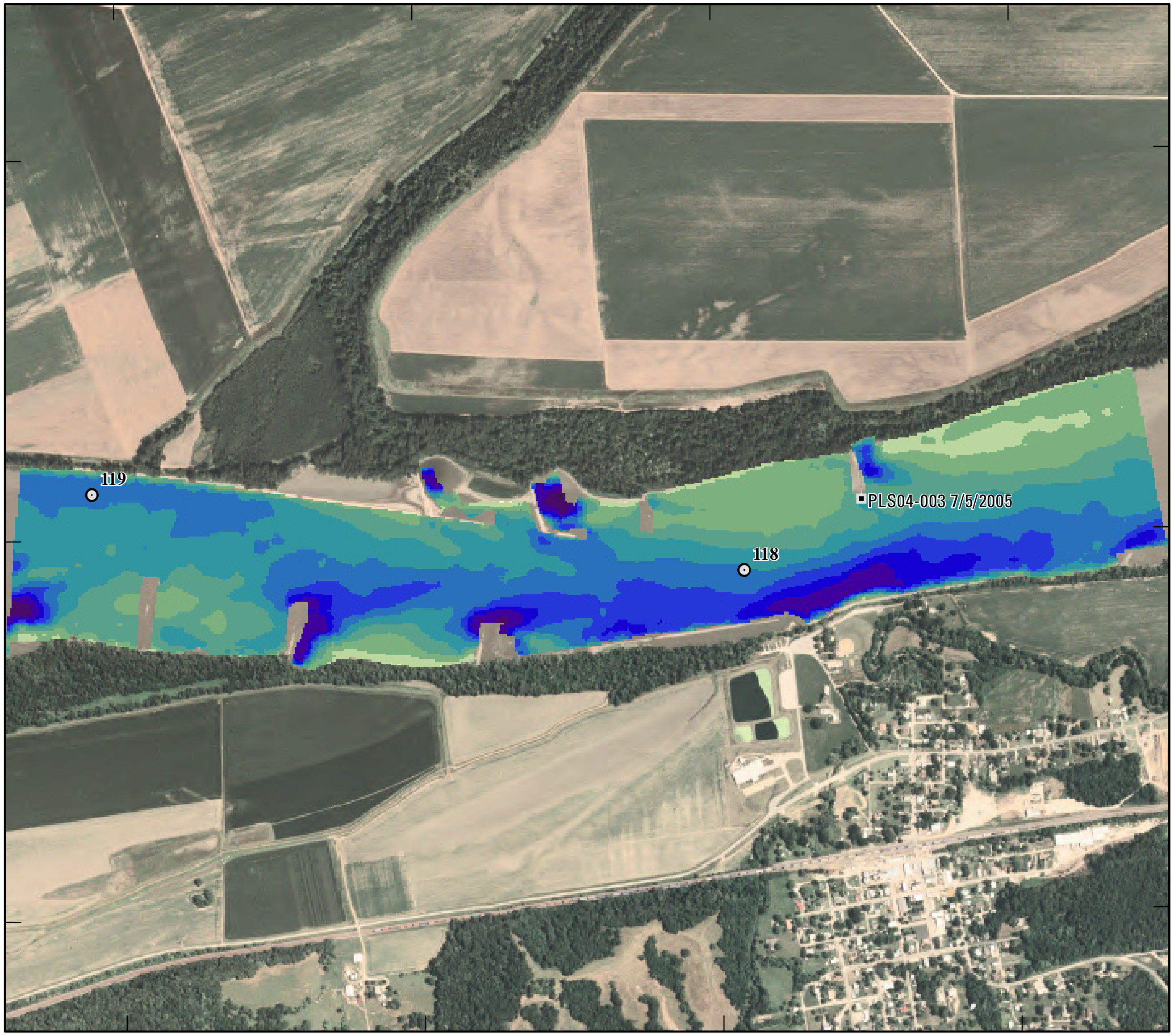
Figure 405. Map of depth based on data collected on May 3, 2005, in the vicinity of river mile 119.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 406. Map of depth-averaged velocity based on data collected on May 3, 2005, in the vicinity of river mile 119.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

SNS07-141 5/22/2007 **Sturgeon relocation—** Label shows identification code of tagged sturgeon and the relocation date

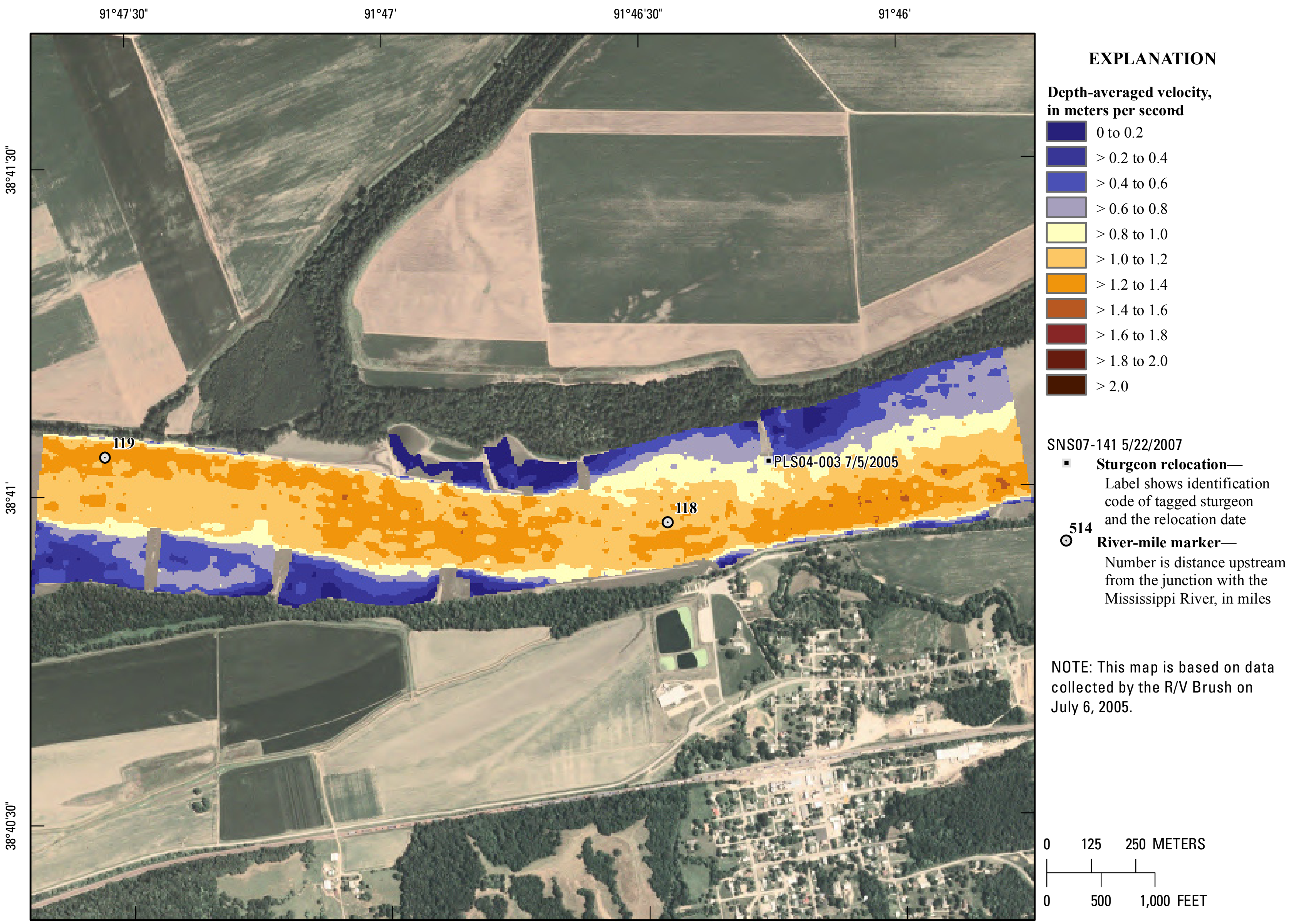
514 **River-mile marker—** Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on July 6, 2005.

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

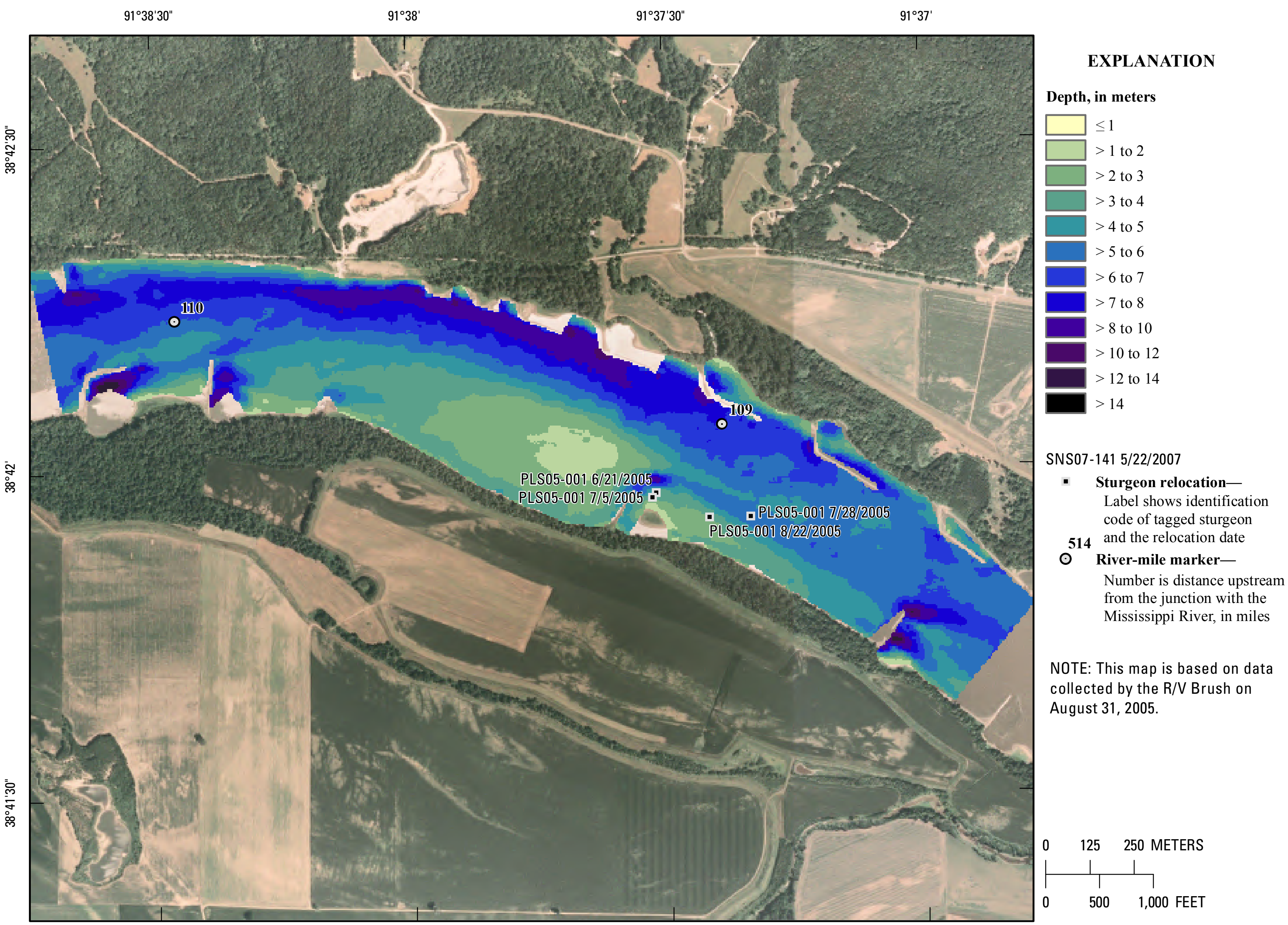
Figure 407. Map of depth based on data collected on July 6, 2005, in the vicinity of river mile 118.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

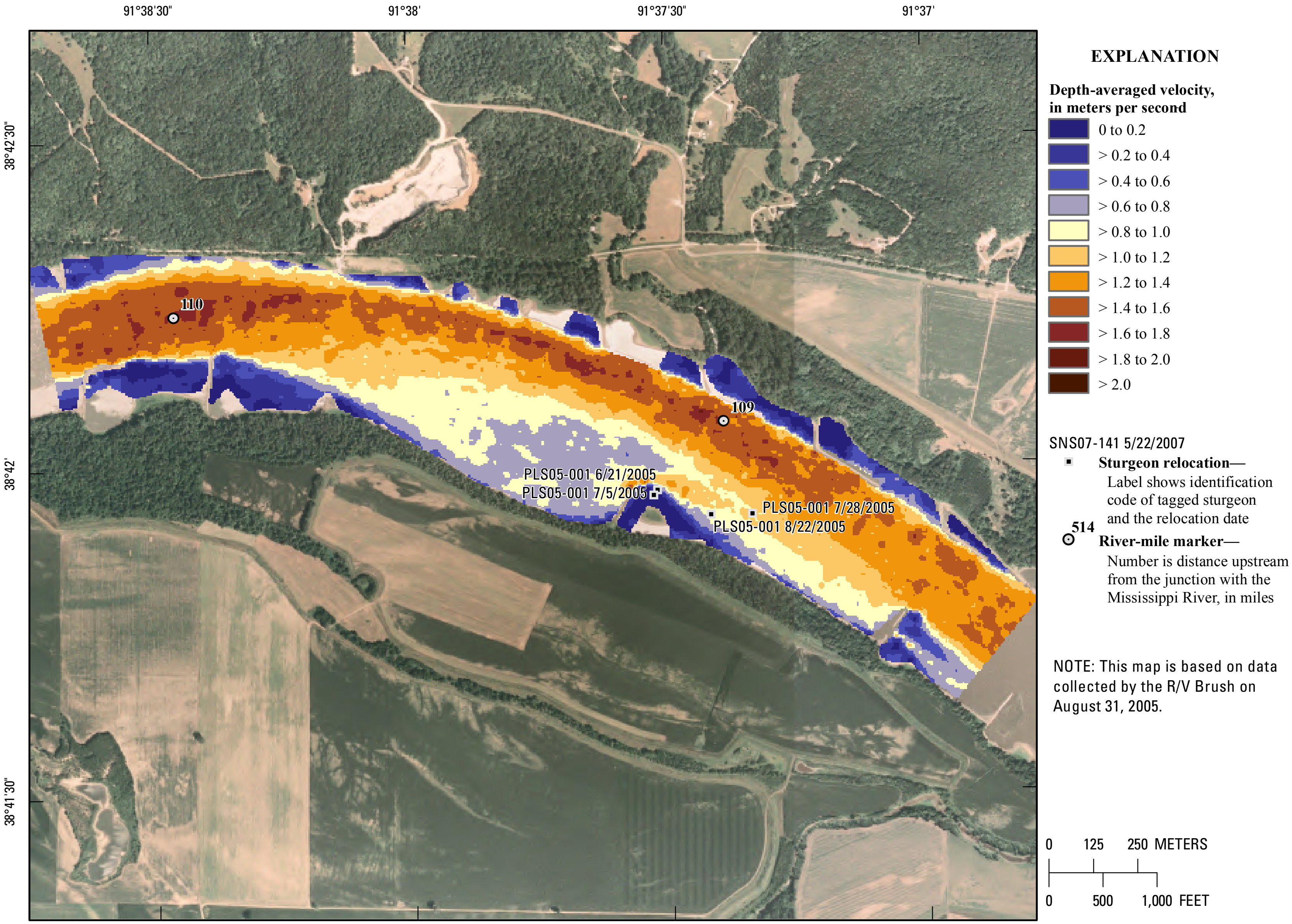
Figure 408. Map of depth-averaged velocity based on data collected on July 6, 2005, in the vicinity of river mile 118.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

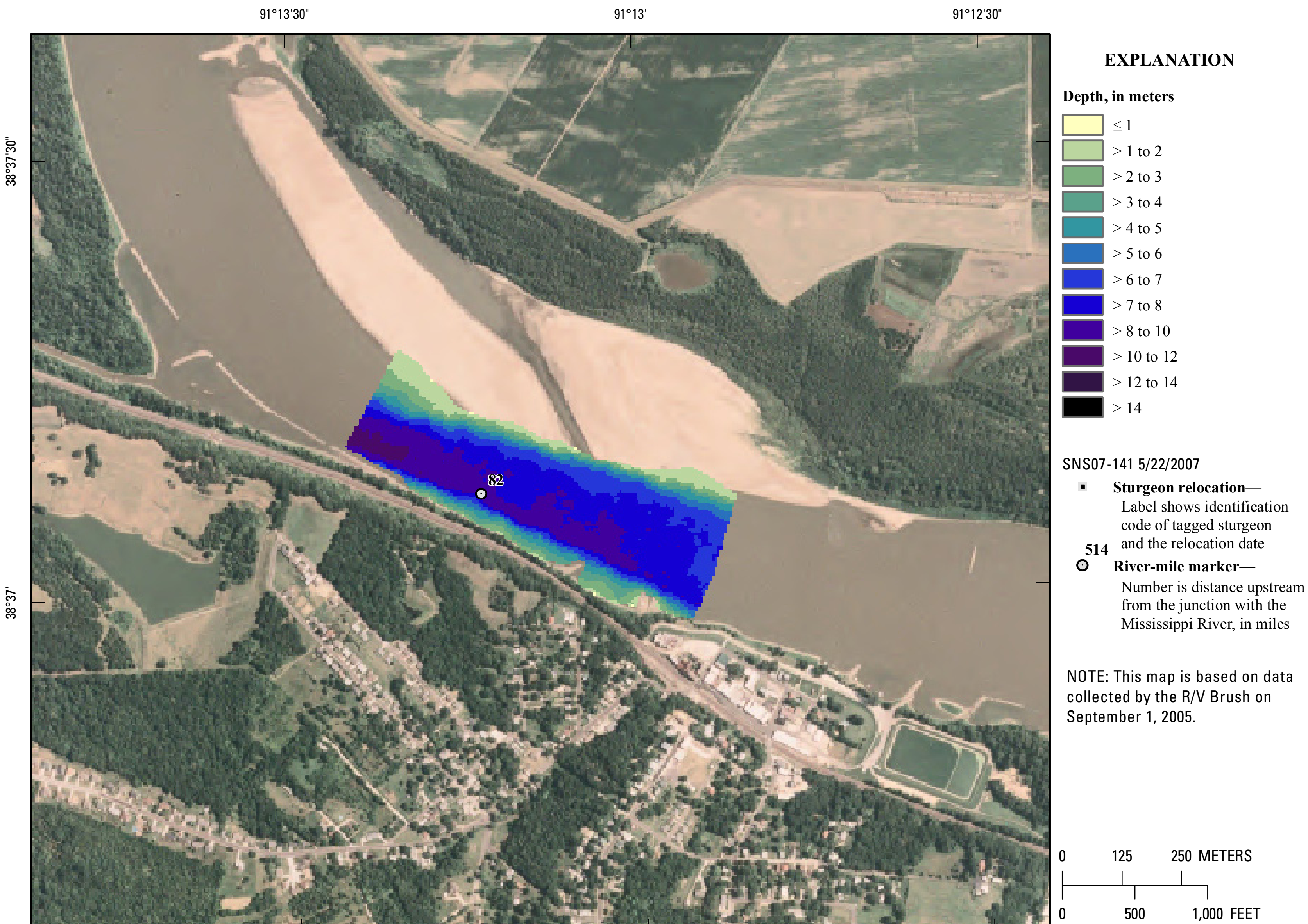
Figure 409. Map of depth based on data collected on August 31, 2005, in the vicinity of river mile 109.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 410. Map of depth-averaged velocity based on data collected on August 31, 2005, in the vicinity of river mile 109.



Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 411. Map of depth based on data collected on September 1, 2005, in the vicinity of river mile 82.

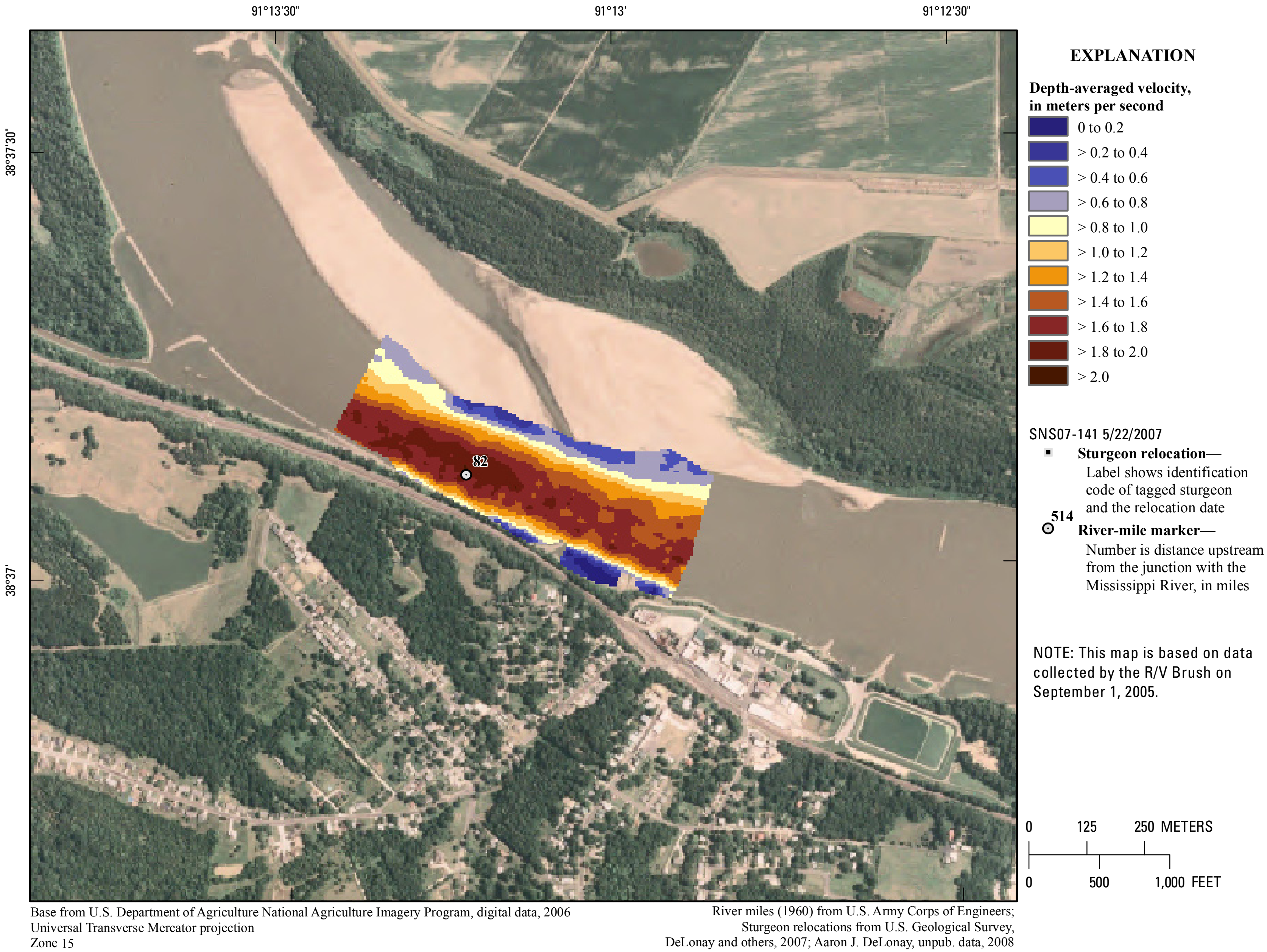
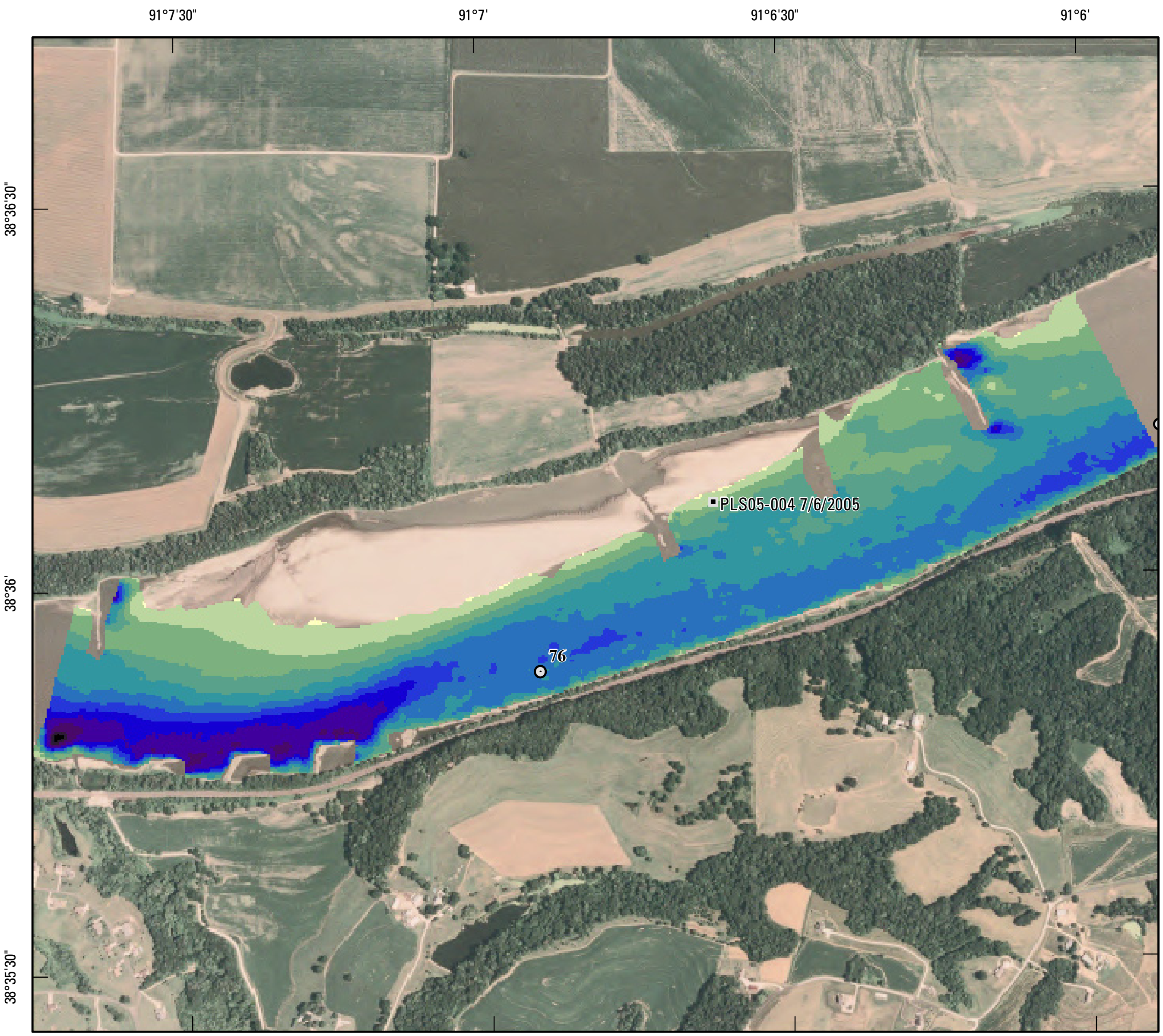


Figure 412. Map of depth-averaged velocity based on data collected on September 1, 2005, in the vicinity of river mile 82.



EXPLANATION

Depth, in meters

- ≤ 1
- > 1 to 2
- > 2 to 3
- > 3 to 4
- > 4 to 5
- > 5 to 6
- > 6 to 7
- > 7 to 8
- > 8 to 10
- > 10 to 12
- > 12 to 14
- > 14

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Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on July 7, 2005.

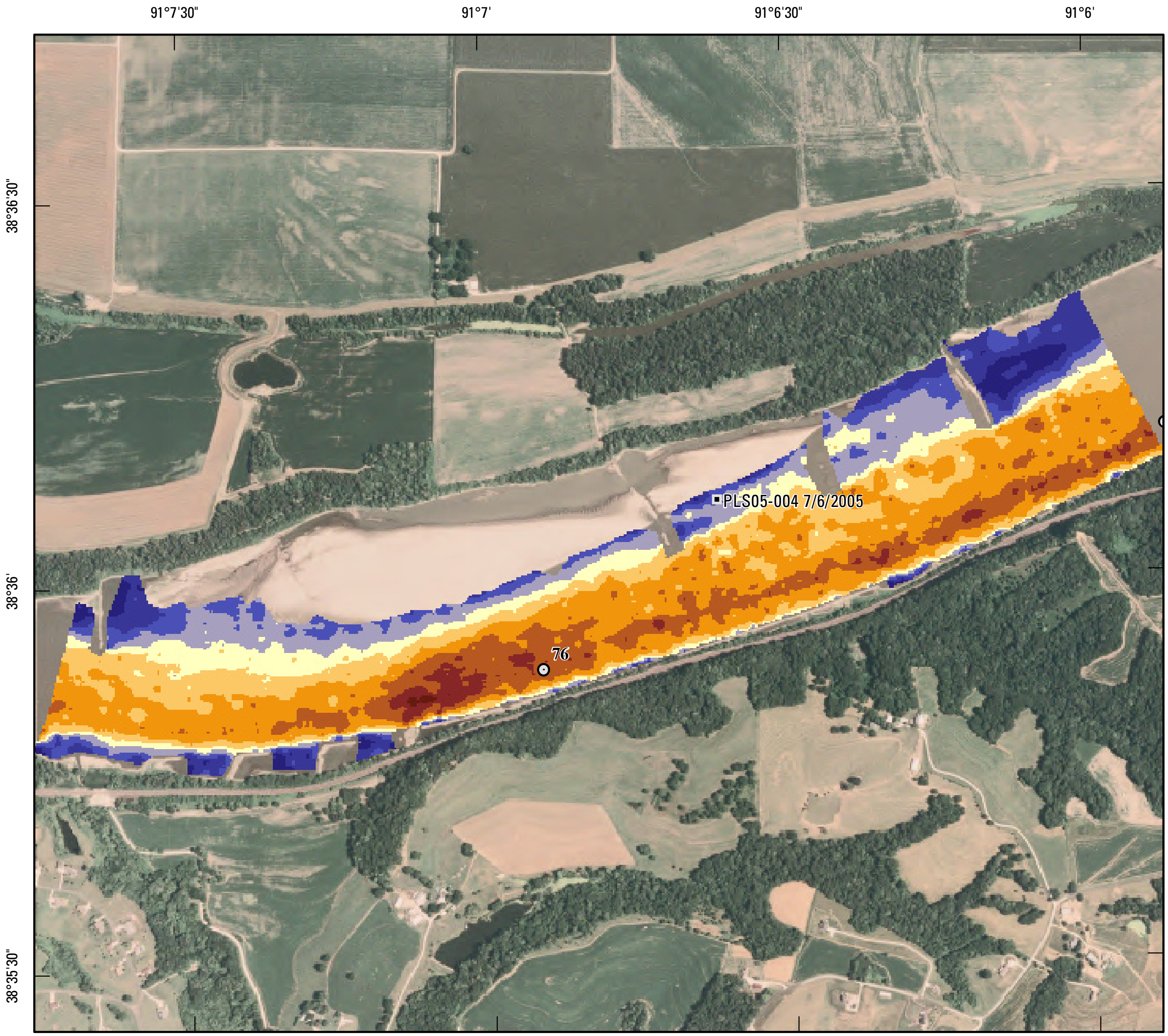
0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 413. Map of depth based on data collected on July 7, 2005, in the vicinity of river mile 76.



EXPLANATION

Depth-averaged velocity, in meters per second

- 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0
- > 1.0 to 1.2
- > 1.2 to 1.4
- > 1.4 to 1.6
- > 1.6 to 1.8
- > 1.8 to 2.0
- > 2.0

SNS07-141 5/22/2007

Sturgeon relocation— Label shows identification code of tagged sturgeon and the relocation date

514

River-mile marker— Number is distance upstream from the junction with the Mississippi River, in miles

NOTE: This map is based on data collected by the R/V Brush on July 7, 2005.

0 125 250 METERS

0 500 1,000 FEET

Base from U.S. Department of Agriculture National Agriculture Imagery Program, digital data, 2006
Universal Transverse Mercator projection
Zone 15

River miles (1960) from U.S. Army Corps of Engineers;
Sturgeon relocations from U.S. Geological Survey,
DeLonay and others, 2007; Aaron J. DeLonay, unpub. data, 2008

Figure 414. Map of depth-averaged velocity based on data collected on July 7, 2005, in the vicinity of river mile 76.

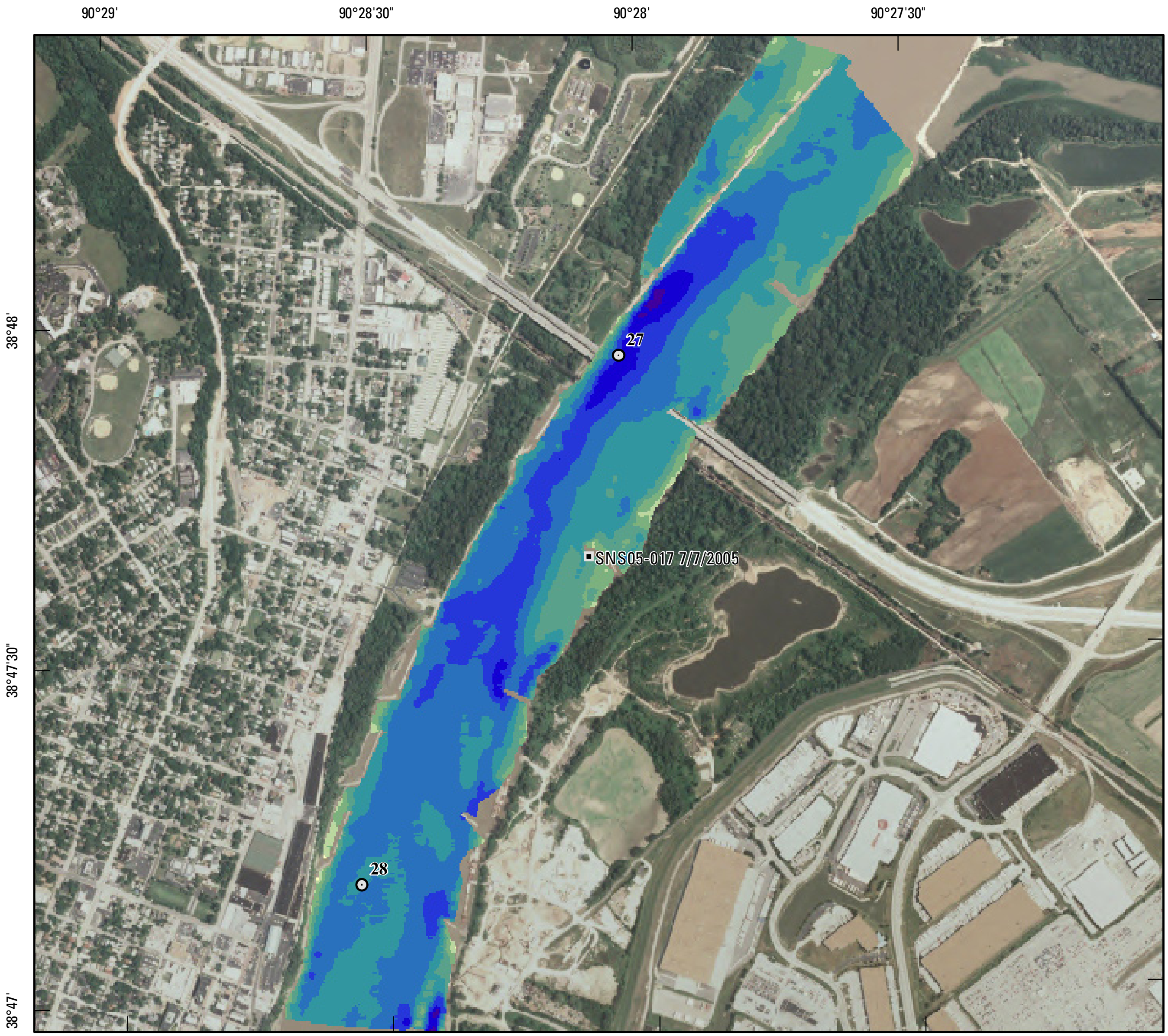


Figure 415. Map of depth based on data collected on July 8, 2005, in the vicinity of river mile 27.

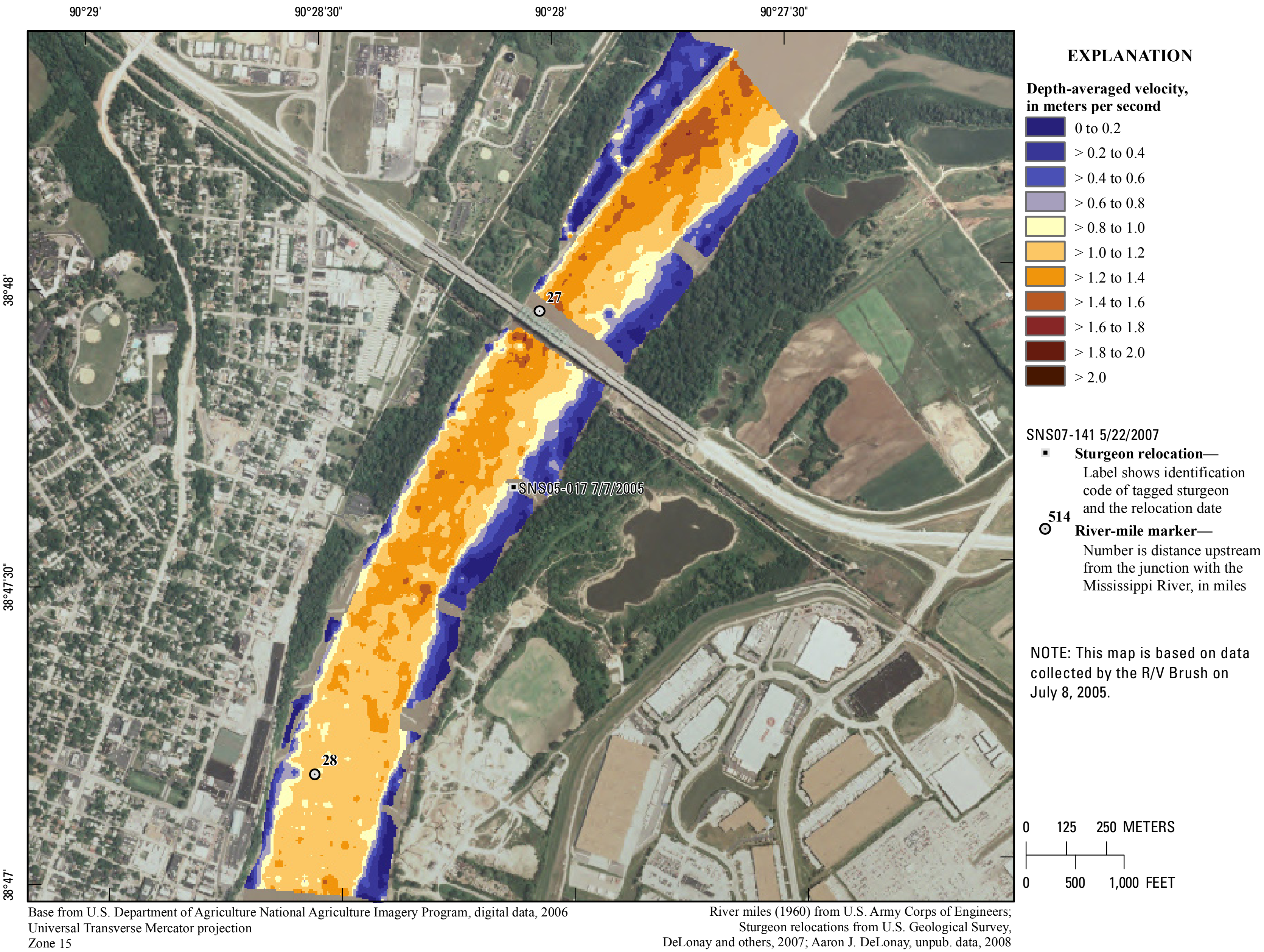


Figure 416. Map of depth-averaged velocity based on data collected on July 8, 2005, in the vicinity of river mile 27.

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