Extensive archival and records research was not requested as part of the Calvert Cliffs survey. Instead, Panamerican reviewed internal company reports dealing with the maritime history of Maryland and visited the Calvert Marine Museum in Solomons to inventory known shipwrecks in the area (there were none), and potentials for the same (considered low, as discussed in Chapter II). In addition, Panamerican had a conference call with local geoarchaeologist Darrin Lowery with regard to any known locations of submerged prehistoric sites (none are recorded) and the potentials for such (considered). In summary, potential for shipwreck remains within the project area is considered low, but potential for submerged prehistoric remains in the project area is considered possible to good, depending on the paleotopographic (sea level regressed) setting.

Sea conditions were slightly choppy to smooth, allowing for good to excellent sidescan and subbottom profiler imagery. The magnetometer towfish and data recording is not as affected by sea conditions as the acoustic data.

GEODETIC PARAMETERS

Geodetic parameters for the project are Maryland State Plane coordinates (MD-1900), 1983 North American Datum (NAD 83) in meters. All maps, tables, and data are presented in this projection and datum.

REMOTE SENSING SURVEY RESULTS

The additional area, as presented in Figures 1 and 2, was surveyed with magnetometer, sidescan sonar, and subbottom profiler.

MAGNETOMETER

Nine lines of magnetometry data were recorded and processed for contouring and analysis of anomalies. Figure 31 below shows magnetic strength contours at the Calvert Cliffs survey area. Contour intervals are at 10 nanoteslas; blue contours are below background (50,500 ±10) and red contours are above background. Details of the individual target characteristics are presented in Table 5.

All of the anomalies located during the survey fall outside the APE of the proposed dredging area as shown on Figure 31. Of the three anomalies listed in Table 5, only one (M101) occurs over two or more lines. All other targets appear to be isolated single-source items that are likely modern ferrous materials. One anomaly, M101, meets the criteria established in Chapter III for existence of potentially significant submerged cultural resources. M102 meets criteria for strength and duration, but is present on only one survey line, and so likely represents isolated ferrous debris. M103 does not meet any criteria. Anomaly M101 was selected for further investigation in the diving phase of the project, as detailed below. No further work was considered for either M102 or M103.

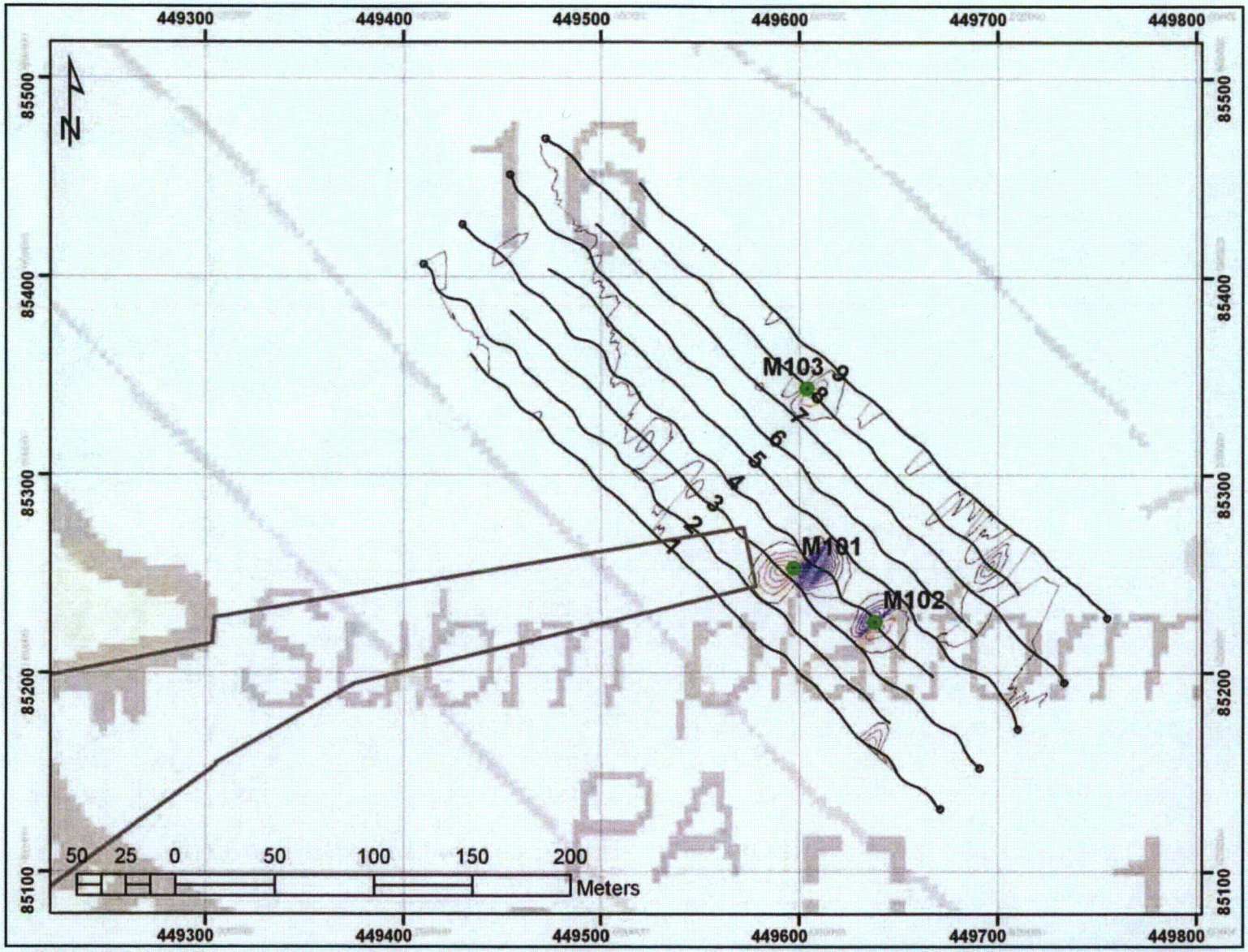

Figure 31. Tracklines, magnetic strength contours, and anomalies at Calvert Cliffs survey area. Proposed channel alignment in grey; contour intervals 10-nanotesla, blue contours below background, red contours above. As indicated on the map, gridlines are spaced every 100 meters (328 feet). Data presented in Maryland State Plane, NAD83, meters.

Table 5. Magnetic anomalies from the Calvert Cliffs remote sensing survey.*

Anomaly	Line	X	Y	Sensor Height (m)	Amplitude (peak to peak [nT])	Duration (m)	Signature	Associated Anomalies	Identification	Avoidance
M101	3–4	449608	85253	3	156	32	dipole	none	unknown	none†
M102	4	449638	85226	3	96	28	dipole	none	unknown	none‡
M103	8	449604	85344	3	33	20	dipole	none	unknown	none‡

*Data presented in Maryland State Plane, NAD83, meters.
†Avoidance not necessary, as target was investigated by divers.
‡ Avoidance not necessary, as target did not meet criteria.

Sidescan Sonar

No isolated objects indicative of potentially significant submerged cultural resources were identified in the sidescan record. The sidescan record also revealed the rocky nature of the bay bottom and that the layering of the cliffs nearby seems to continue below the waterline. Figure 32 (mosaic with magnetic contour overlay) illustrates the sidescan record.

The sidescan record reveals the layered nature of the bay bottom along Calvert Cliffs, which is that the facies sediment beds continue below the waterline showing different areas of rocky and less rocky appearance. These beds created high backscatter returns (bright areas with and without shadows) indicating rocky and sandy areas. Lower backscatter areas (dark areas) indicate silty or clayey sediments. Whether these are eroded, calved beds in secondary deposition, or exposed Miocene beds was not determined. Areas of high reflectivity representing rock outcrops in the sidescan data on the inner lines appear to be a continuation of exposed rock surfaces noted during the 2008 investigation (Faught 2009). They are interspersed in areas of lower reflectivity suggesting a rock layer continuing under sediment outward from the shore (Figure 33)

Subbottom Profiler

The subbottom profiler was employed to penetrate the sediment beds, with the possibility that paleochannels, paleolandscape settings, or mounded midden features might be sensed. However, much of the Calvert Cliffs sediment beds are sand (or pebbly sand), silt, and clay beds that preclude deep penetration. The device was generally effective to a depth of more than 2 meters. Either these beds are the result of calved and collapsed beds of the cliff face, or they are exposed portions of similar—but earlier—beds below. Examination of the subbottom data revealed the presence of numerous rock outcrops and an area of high signal attenuation indicative of rock or sandstone in the vicinity of M101 (presented and discussed below). There were no paleochannels, buried paleosurfaces, or buried objects indicative of cultural resources present in the data. Figure 34 shows a typical subbottom profile for the additional survey area.

Target Refinement

Prior to diver investigation of the three magnetic anomalies located in the previously surveyed area during the 2008 investigation, the target locations were refined using magnetometer and sidescan sonar. Ten lines of refinement were undertaken to relocate the targets, confirm they were still present, and better pinpoint their locations to enable easier location by divers. Magnetic refinement relocated all three previous targets (Figure 35, Table 6), indicating they were still *in situ*. In addition, objects were located by sidescan sonar in the vicinity of two magnetic anomalies (Table 7).

Table 6. Refined locations of 2008 magnetic anomalies.*

Anomaly	Line	X	Y	Sensor Height (m)	Amplitude (peak to peak [nT])	Duration (m)	Signature	Associated Anomalies	Identification	Avoidance
M03	4	449487	85204	3	209	42.5	dipole	C03	--	none
M05	5	449480	85235	3	116	29	dipole	C05	--	none
M06	8	449392	85229	3	2000	50	dipole	none	--	none

*Data presented in Maryland State Plane, NAD83, meters.

Table 7. Sidescan sonar contacts associated with refined anomaly locations.

Contact	Line	X	Y	Sensor Height (m)	Length (m)	Width (m)	Height (m)	Associated Anomalies	Identification	Avoidance
C03	4	449489	85202	3	7.2	0.5	0.1	M03	--	none
C05	5	449480	85229	3	7.3	3.8	1	M05	--	none

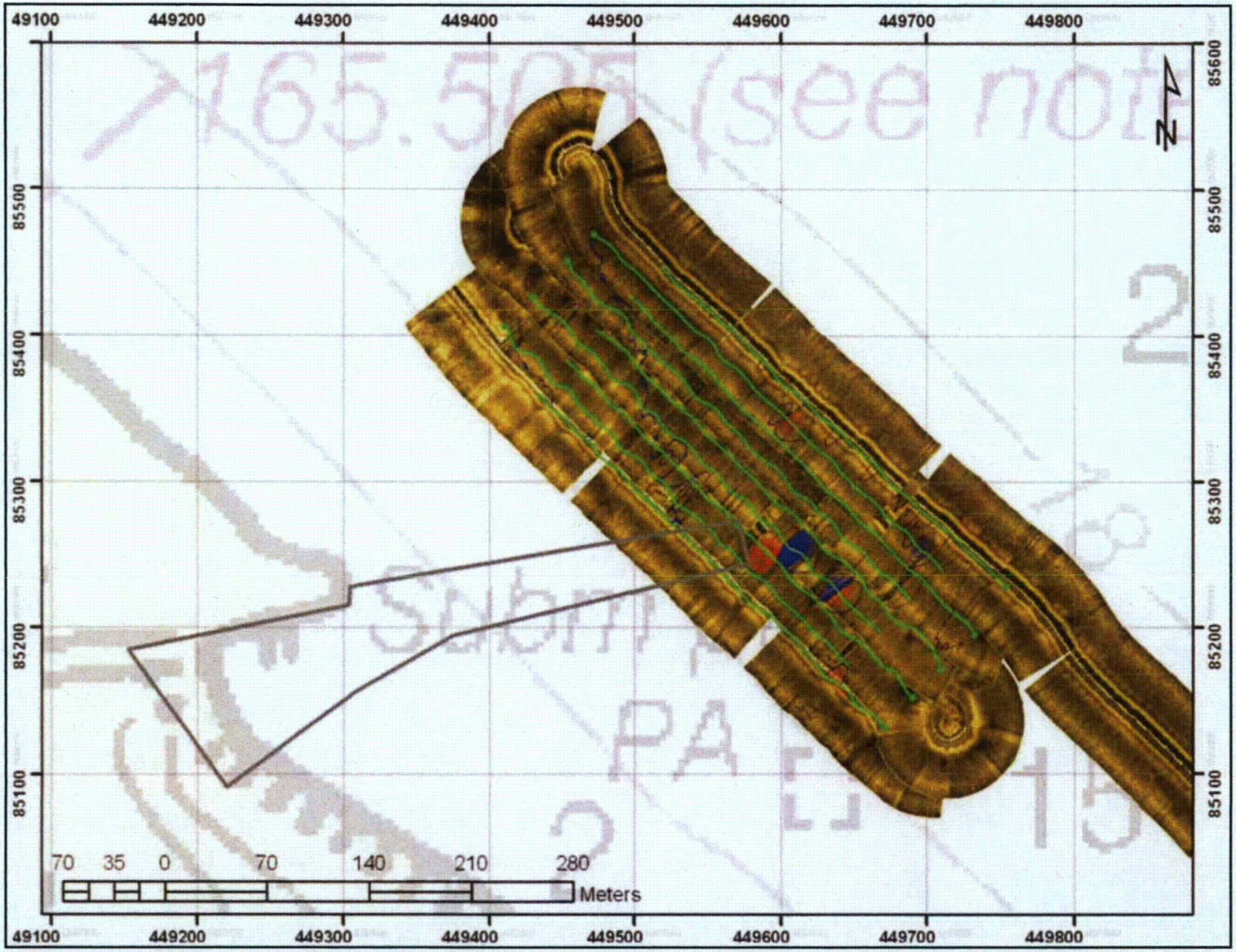

Figure 32. Mosaic of sidescan sonar data with magnetic contours. As indicated on the map, gridlines are spaced every 100 meters (328 feet). Data presented in Maryland State Plane, NAD83, meters.

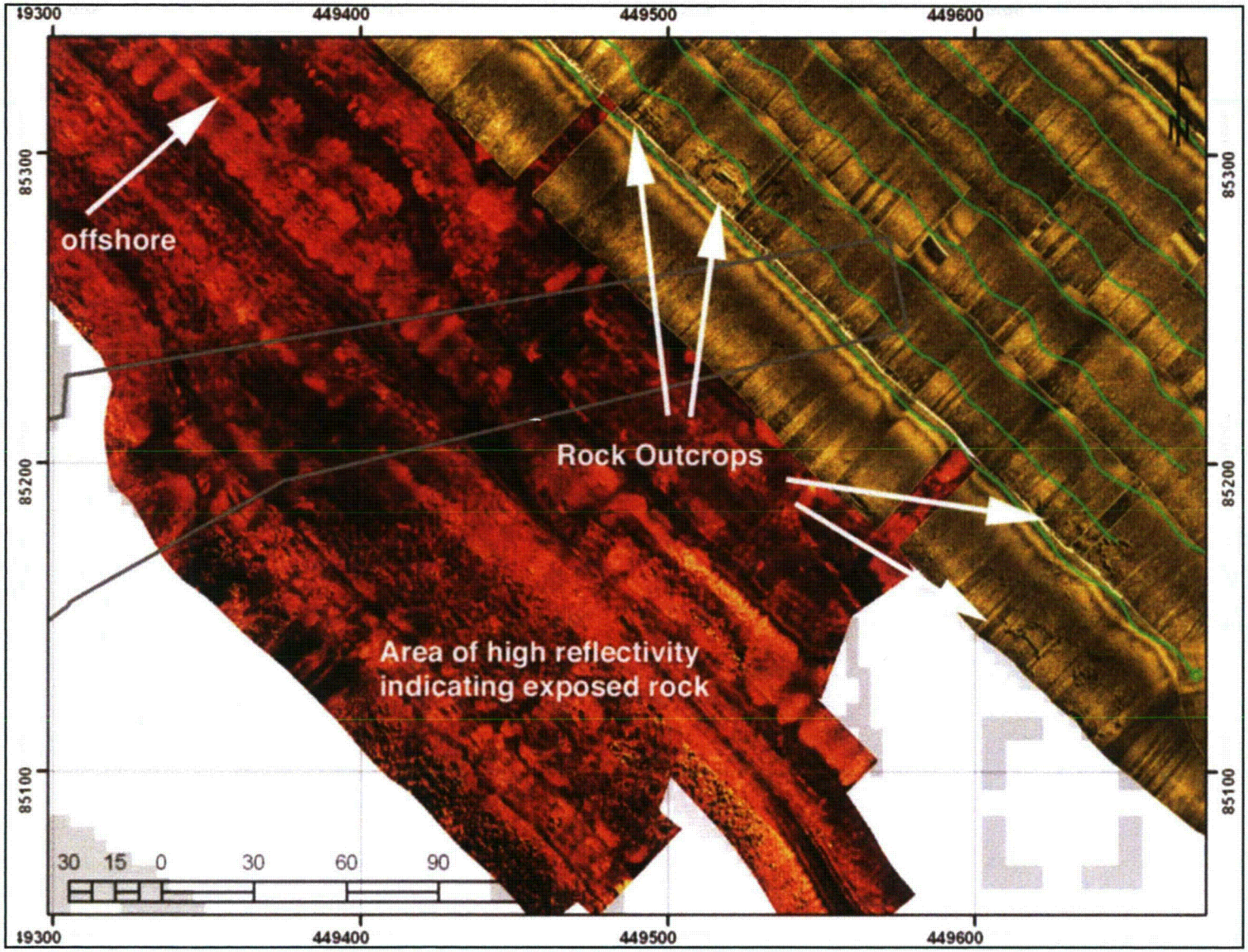

Figure 33. 2008 sidescan mosaic (red) showing location of exposed rock and 2011 sidescan mosaic (yellow) showing location of rock outcrops. Data presented in Maryland State Plane NAD83 meters.

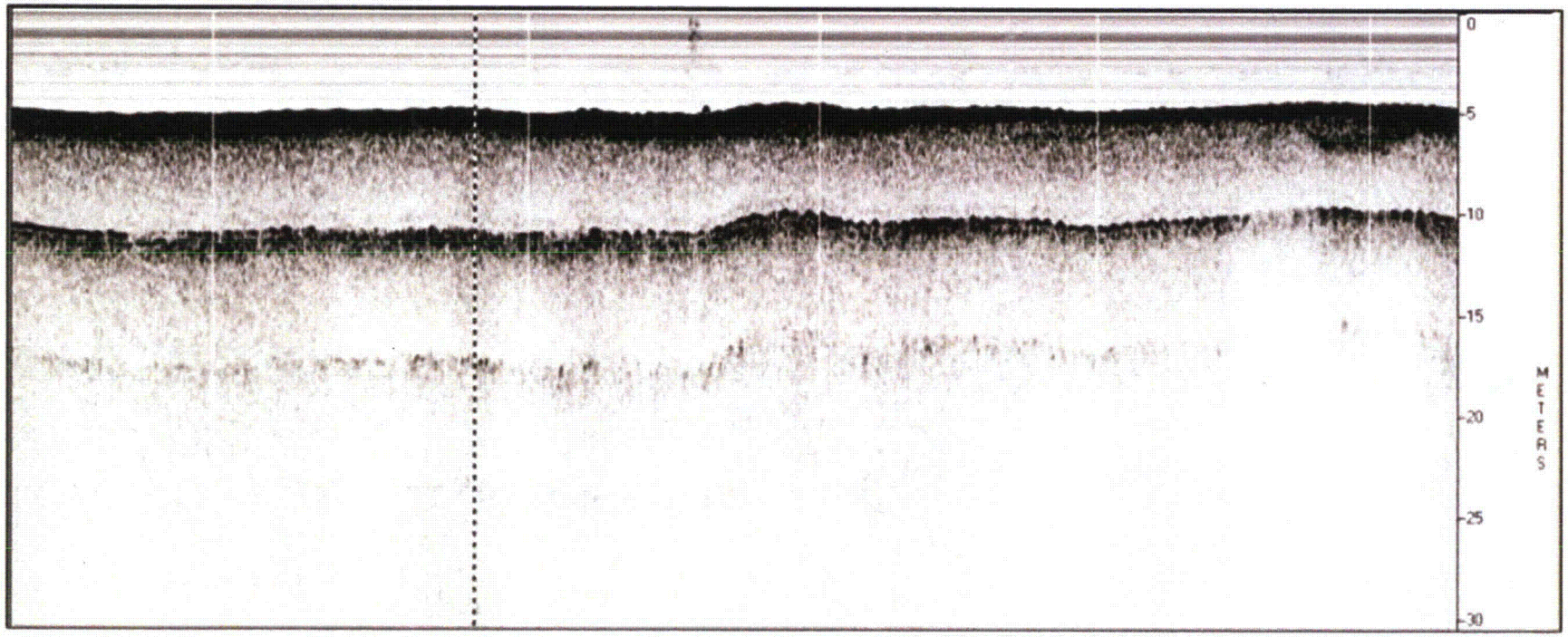

Figure 34. Subbottom profile Line 5. Vertical lines have 30-meter spacing, depth scale to the right in meters. Data presented in Maryland State Plane, NAD83, meters.

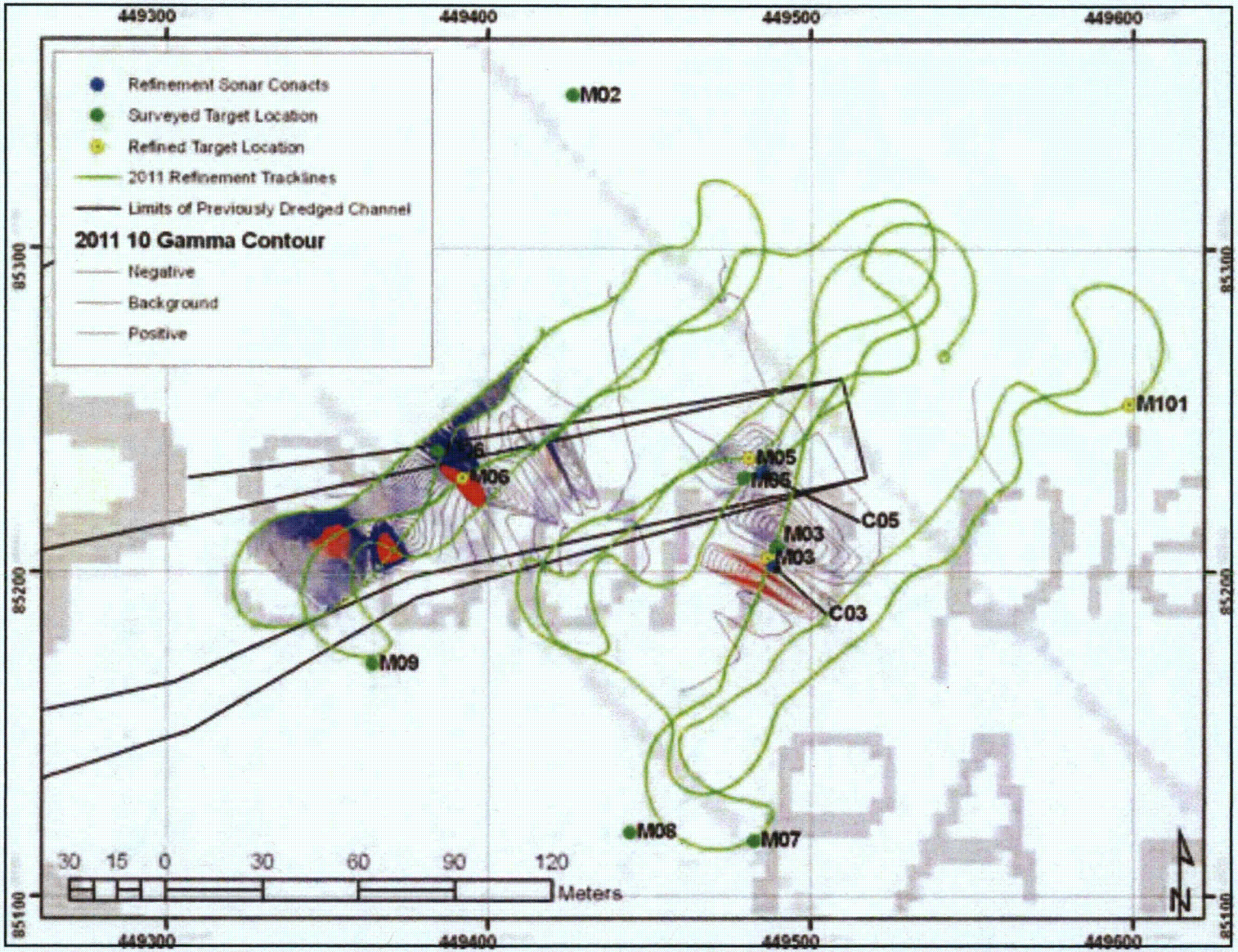

Figure 35. Magnetic refinement contour map of previously located targets indicating surveyed location, refined location, and dredged channel. Data presented in Maryland State Plane, NAD83, meters.

TARGET INVESTIGATIONS

Listed in Table 8, a total of four target locations were investigated as part of the diving phase of this project, including three previously identified anomalies (M03, M05, and M06; see Table 2 above) and one (M101) identified during the current survey (see Table 3 above). Investigations of each target consisted of a remote sensing refinement, and physical inspection of the target location by a diver, which included arc searches in 3-meter (10-foot) intervals and, in the event diver arcs failed to locate the source of the target, physical hydro-probing. Each target is discussed in turn in the following paragraphs and results are summarized in Table 8 (coordinates presented in Table 8 are the refined locations).

Table 8. Results of target investigations. *†

Anomaly	Line	X	Y	Sensor Height (m)	Amplitude (peak to peak [nT])	Duration (m)	Signature	Associated Anomalies	Identification	Avoidance
M101	**3-4**	449608	85253	3	156	32	dipole	none	assumed modern debris	none
M03	4	449487	85204	3	209	42.5	dipole	C03	3 meter pipe	none
M05	5	449480	85235	3	116	29	dipole	C05	prop and rudder from modern vessel	none
M06	8	449392	85229	3	2000	50	dipole	none	assumed modern debris	none

*Data presented in Maryland State Plane, NAD83, meters.

†Coordinates for anomalies located during previous investigation (M03, M05 and M06) represent refined locations.

M05

The magnetic refinement of M05 located a dipole magnetic anomaly with a total magnetic deviation of 116 nanoteslas and a total duration of 29 meters (95 feet) in the vicinity of the original anomaly (Table 6, Figures 35 and 36). The strength of the refined anomaly is slightly smaller than the original 155-nanotesla/31.5-meter (95 feet) dipole. This discrepancy can be explained via a difference in the proximity of the magnetometer sensor to the target between the survey and refinement.

Examination of the sidescan refinement data for M05 indicated the presence of a rectangular object approximately 2-x-3 meters (6.5-x-10 feet; Figures 36 and 37), the location of which coincides with both the refinement and survey magnetic data (Figures 38 and 39). Examination of the sidescan sonar data from the original 2008 survey indicates the presence of what appears to be a large rectangular object in the vicinity of M05 (Figures 39 and 40).

Diver examination of the target location indicated the presence of a propeller and rudder of modern origin. The propeller is 3 meters (10 feet) in diameter with four blades, located immediately adjacent to a 1.8-x-3-meter (6-x-10-foot) steel rudder. Discussions with Mark Hunter from the CCNPP indicated that a tugboat had lost its rudder and propeller near the barge dock in or around 2008 (Mark Hunter personal communication 2011). These objects are considered sufficient to account for both the survey and refinement anomalies.

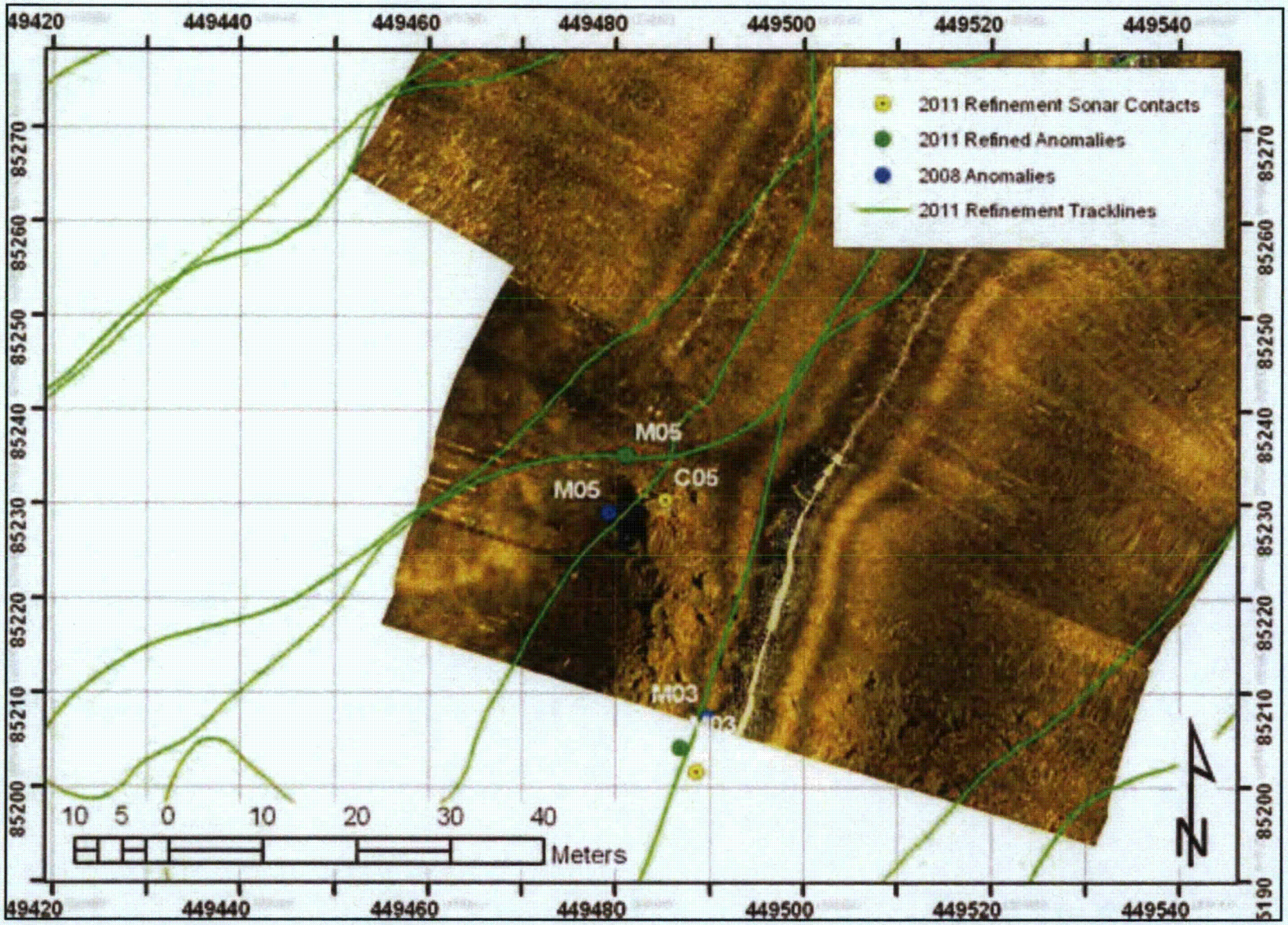

Figure 36. Refinement sonar image of anomaly M05, consisting of what appears to be a four-blade propeller 3 meters (10 feet) in diameter (center) and a large rectangular object approximately 3.5-x-2 meters (12-x-6 feet; center). Data presented in Maryland State Plane, NAD83, meters.

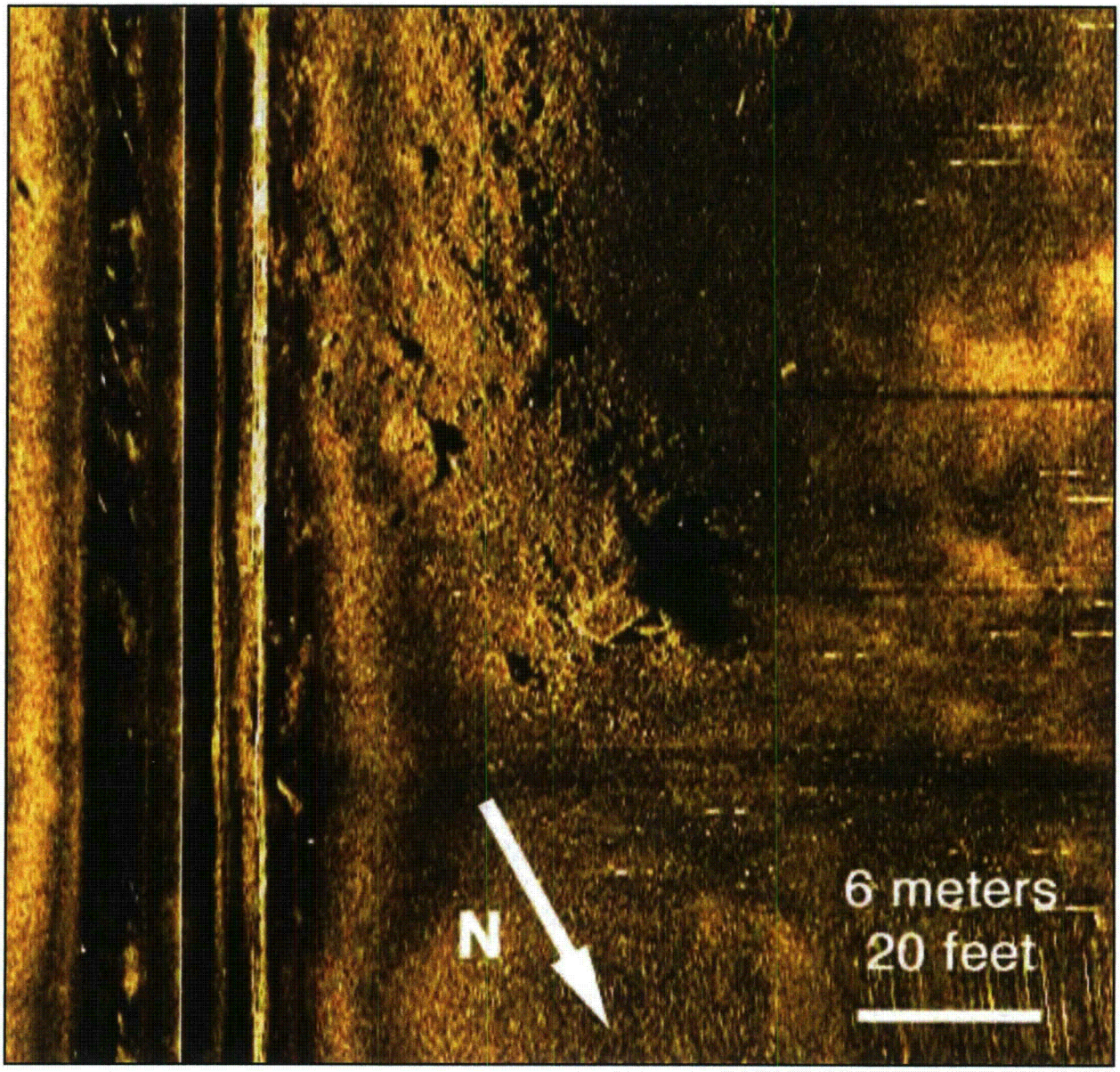

Figure 37. Raw sidescan sonar image of object associated with M05, collected during 2011 target refinement.

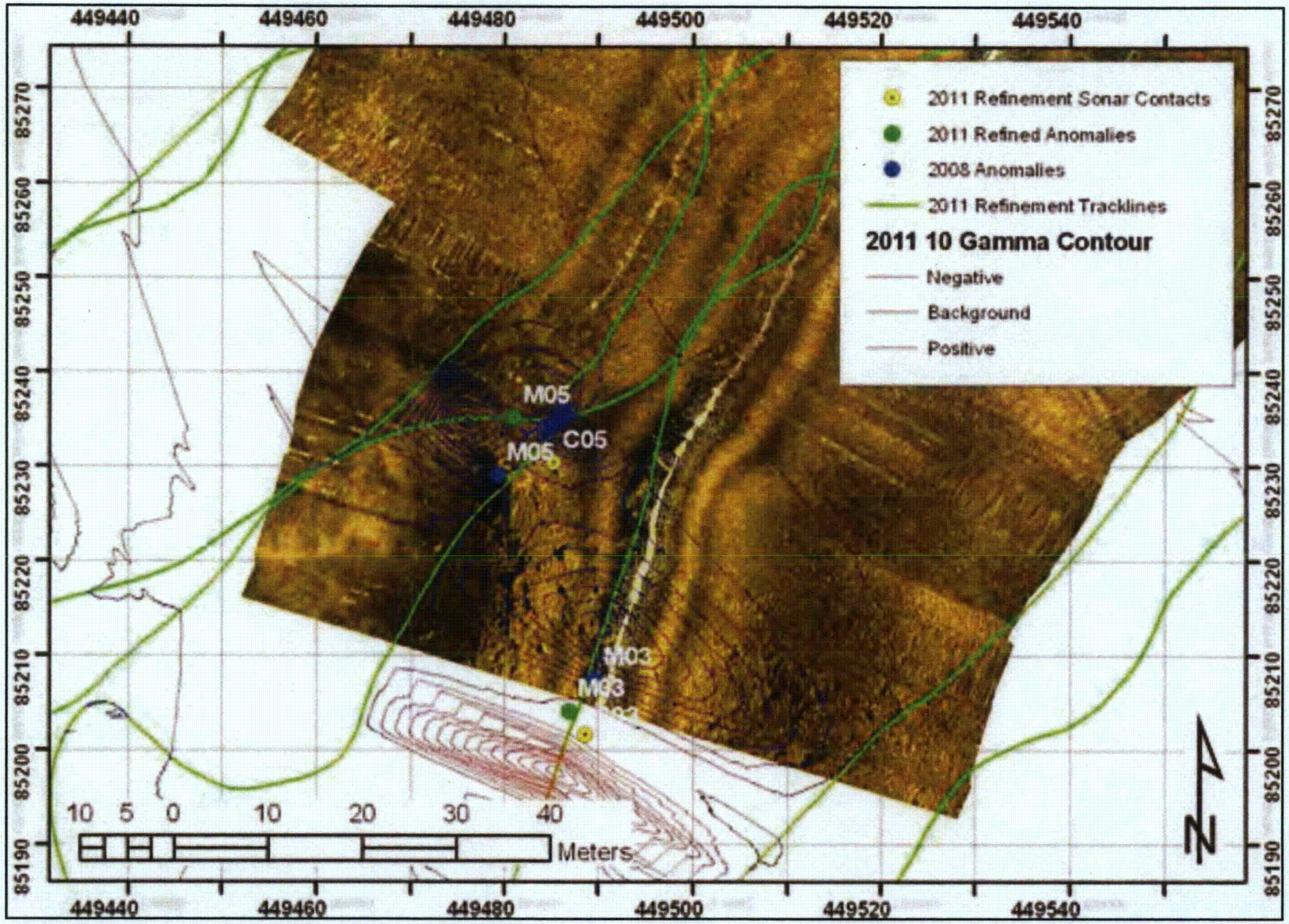

Figure 38. 2011 magnetic contour data overlaid on 2011 sidescan refinement data for target M05. Note presence of recognizable target in vicinity of 2011 refined target locations and absence of significant magnetic anomalies in the vicinity of 2008 anomaly M05. Data presented in Maryland State Plane, NAD83, meters.

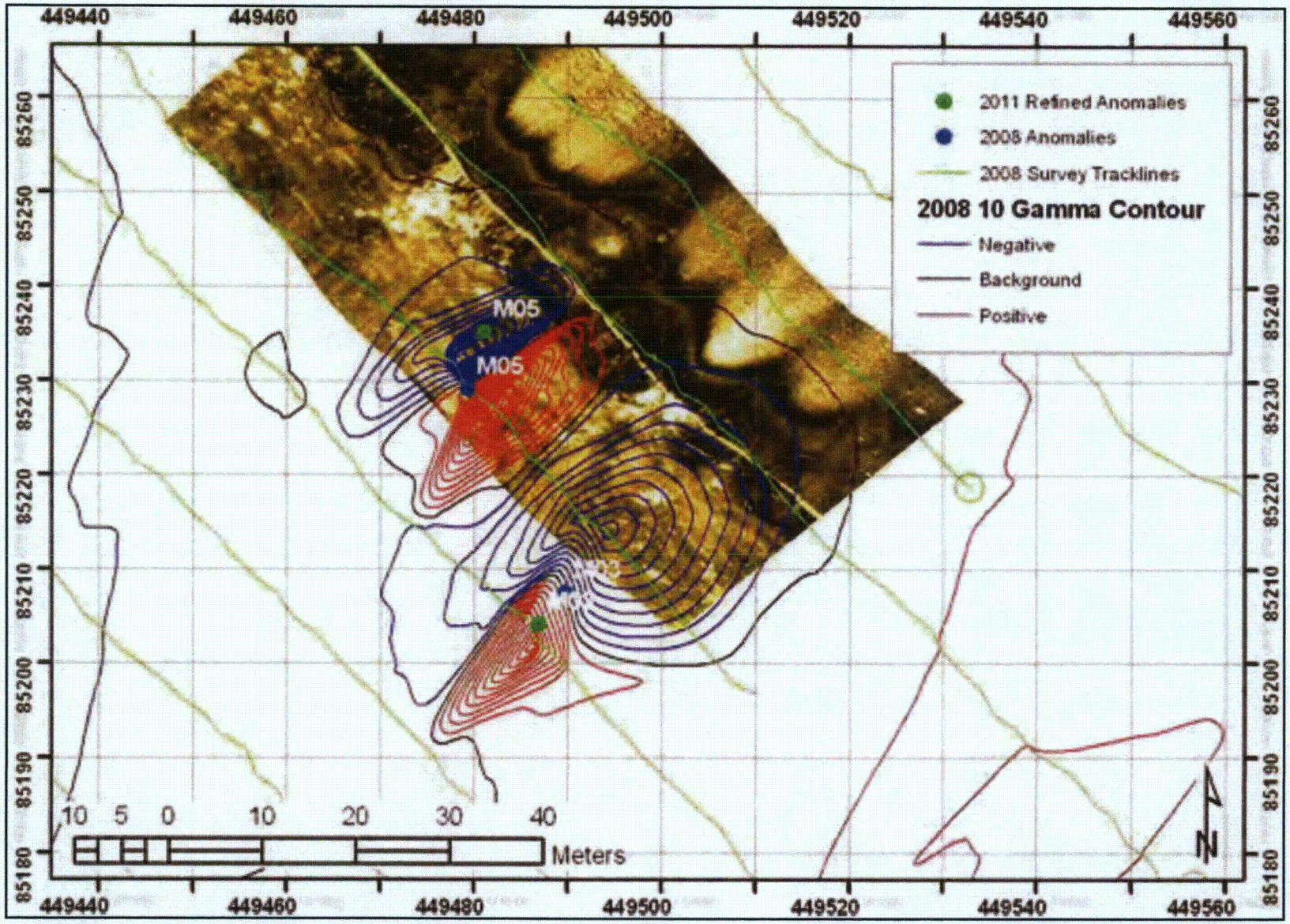

Figure 39. 2008 magnetic contour data overlaid on 2008 sidescan data showing the location of M05. Note absence of recognizable target in vicinity of 2011 refined target locations. Data presented in Maryland State Plane, NAD83, meters.

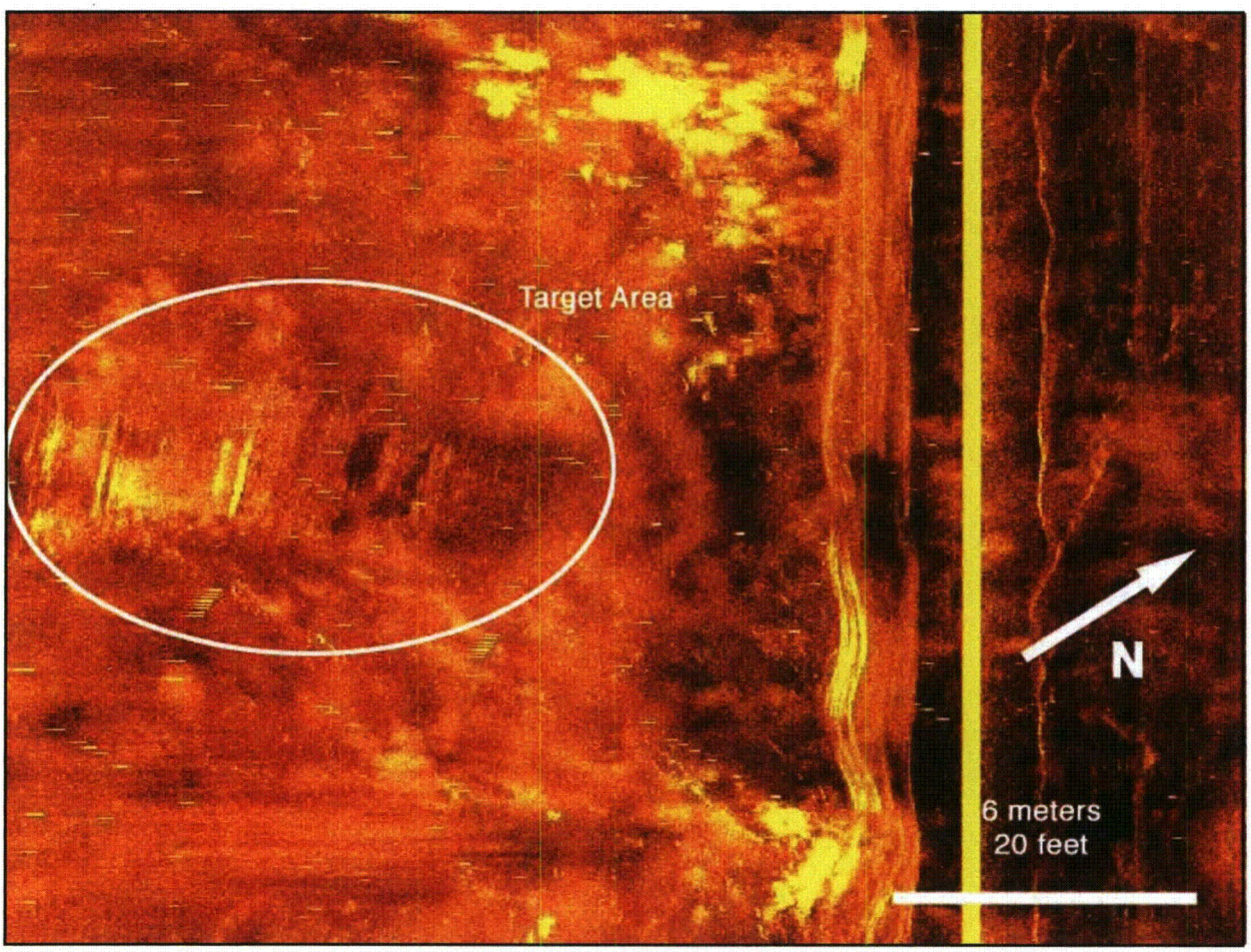

Figure 40. Raw sidescan sonar image of object associated with M05, collected during the 2008 remote sensing survey.

M03

The magnetic refinement of M03 indicated the presence of a 209-nanotesla dipole anomaly with a duration of 42.5 meters (140 feet; Table 6; Figure 35). This is smaller in intensity than the original 263-nanotesla anomaly, but also longer in duration. The discrepancy in strength can easily be accounted for by the difference in sensor distance from the target between the survey and the refinement, as in the case of M05 above. The discrepancy in duration can be accounted for by the difference in location of the refinement lines relative to the object associated with M03; the sensor passed directly over the object and through the longest dimension of its magnetic field during the refinement, resulting in a longer duration.

Review of the refinement sonar data indicated the presence of a linear object of approximately 5 meters (17 feet) in length at the refined location of M03 (Figures 41 and 42). This object coincides with the location of Object 1 from the 2008 survey (Figures 43 and 44). Diver investigation of the refined target location indicated the presence of a steel pipe 3 meters (10 feet) long and 0.5 meters (16-inches) in diameter.

The pipe is considered sufficient in size and location to account for both the survey anomaly (263 nanoteslas) and the refined anomaly (209 nanoteslas). This pipe is not considered historically significant and no further work is recommended.

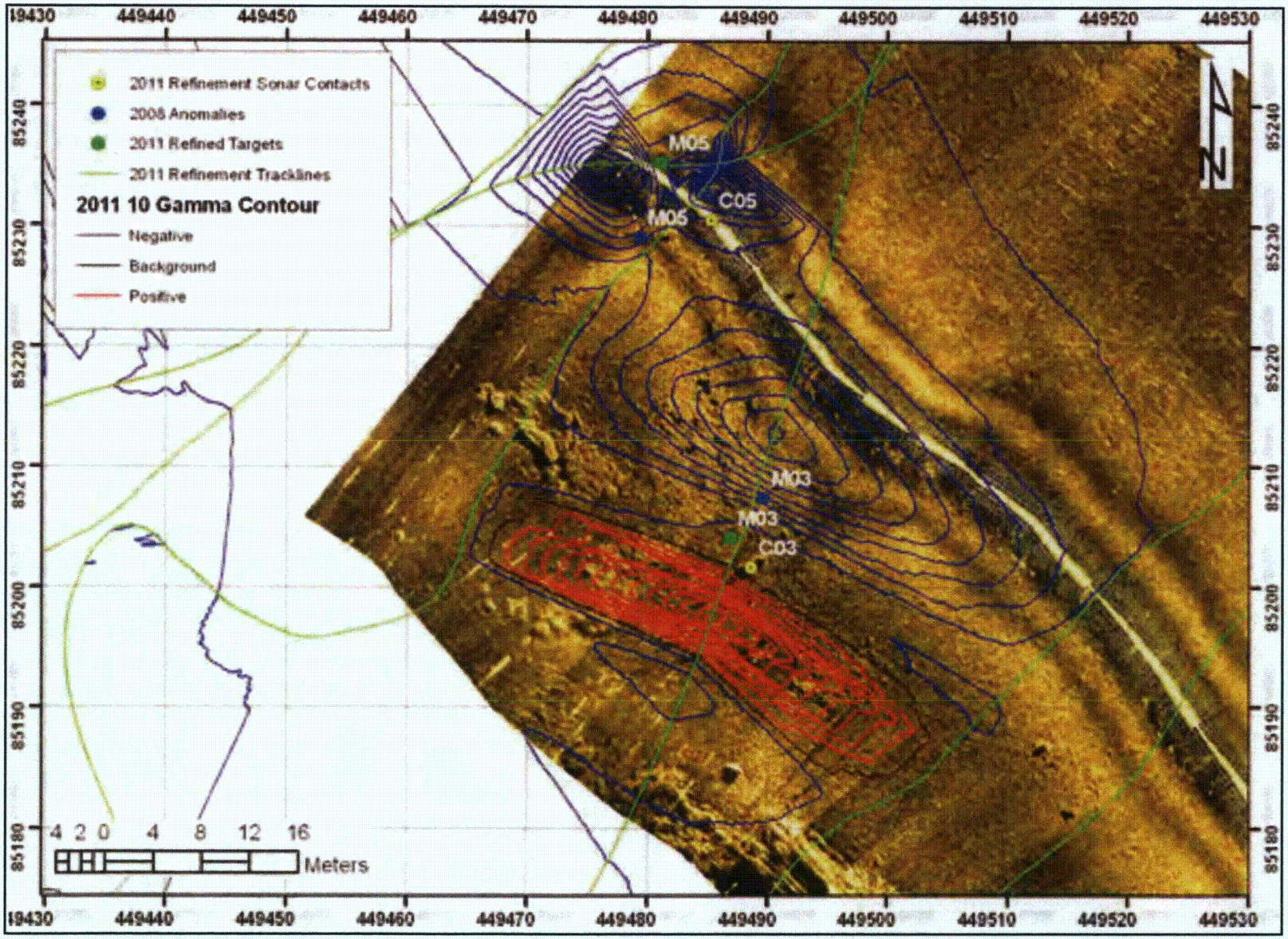

Figure 41. 2011 magnetic contour data overlaid on 2011 refinement survey sidescan sonar data, showing location of 2008 anomaly M03 and the 2011 refined location of M03. Data presented in Maryland State Plane, NAD83, meters.

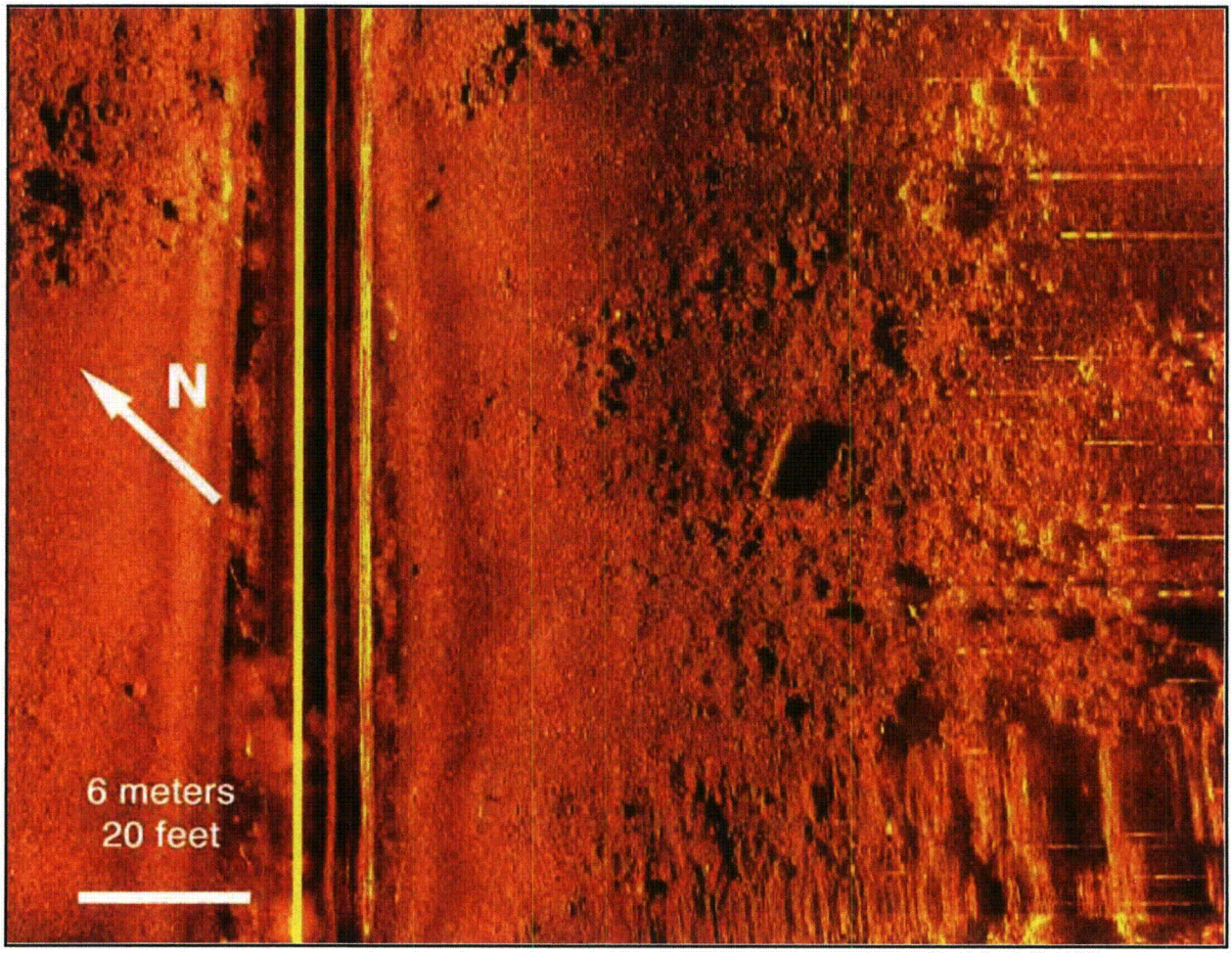

Figure 42. Raw sidescan sonar image of object associated with M03, collected during 2011 target refinement.

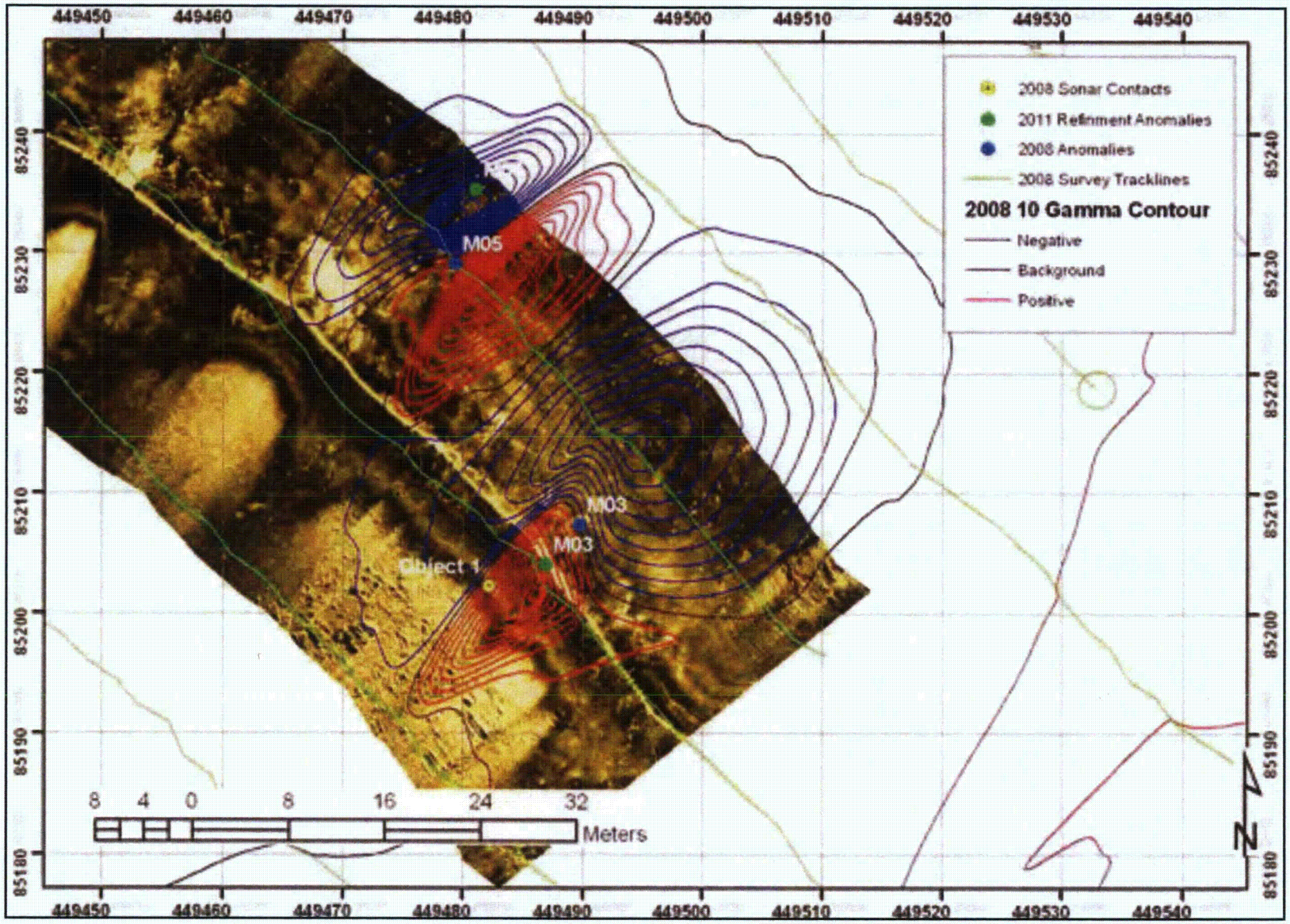

Figure 43. 2008 magnetic contour data overlaid on 2008 sidescan sonar data showing location of M03 and location of Object 1 (Faught 2009) and M03 as relocated during the 2011 refinement survey. Data presented in Maryland State Plane, NAD83, meters.

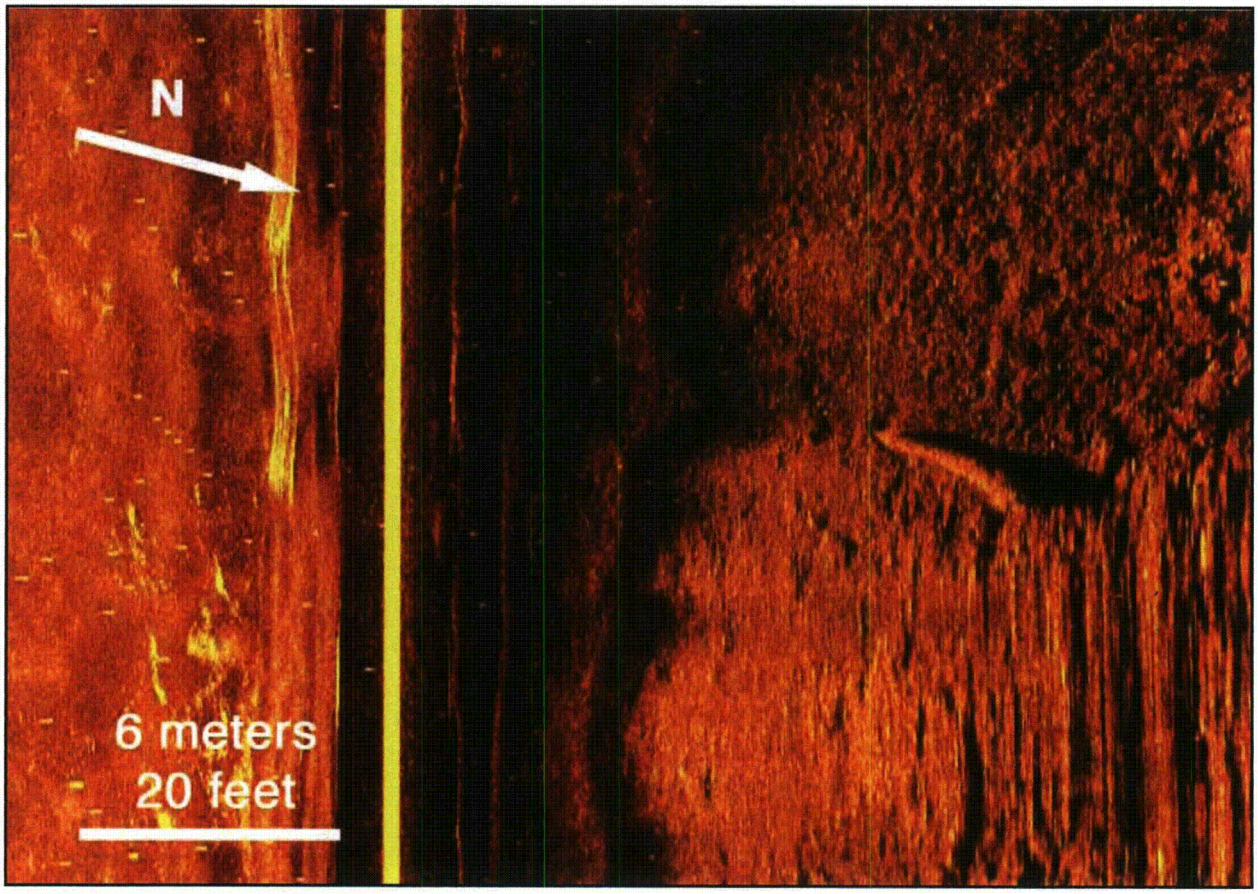

Figure 44. Raw sidescan sonar image of object associated with M03, collected during 2008 survey.

M06

The magnetic refinement of M06 indicated the presence of a 2,000-nanotesla dipole anomaly with a duration of 15 meters (50 feet; Table 6; Figure 45). The strength of the refined anomaly is significantly larger than the original 1,042-nanotesla dipole. This discrepancy can be explained via a difference in the proximity of the magnetometer sensor to the target between the survey and refinement. During the 2008 survey, the true target location likely fell between two survey lines, with the result being that the sensor did not pass very close to the target source. During the refinement, the sensor likely passed much closer to the target and was within 1 meter (≈ 3 feet) of the target source for several seconds, resulting in a much larger anomaly reading.

Examination of the sidescan refinement data does not indicate the presence of any object in the vicinity of either the refined or surveyed locations of M06 (Figures 45 and 46). Examination of the sidescan sonar data from the 2008 survey did not indicate the presence of any object in the vicinity of the magnetic anomaly (Figures 47 and 48).

A diver search of the bay bottom of a 30-meter (100-foot) radius in arcs with 3-meter (10-foot) intervals in the vicinity of the anomaly did not indicate the presence of any object or objects sufficient to account for the anomaly (Figure 45). A pattern of nine hydroprobes, spaced at 3-meter (10-foot) intervals in cardinal directions (out to 6 meters [20 feet] and to a depth of 2 meters [7 feet]), directly on the refined target location did not locate any objects sufficient to account for the anomaly (Figure 45). This failure to locate the object with a visual inspection and a pattern of subsurface probes indicates that the source object (or objects) consists of isolated marine debris (e.g., wire rope, rebar, fencing, railings, etc.) rather than a single large object, or is

(are) located below the 2-meter (7-foot) probe depth. Given the location of the target, in a previously dredged working channel for a power plant and near a working dock (see Figure 35 above), it would be expected that the target would consist of marine debris lost or disposed of overboard during docking or cargo transfer operations. This target is not considered historically significant and no further work is recommended.

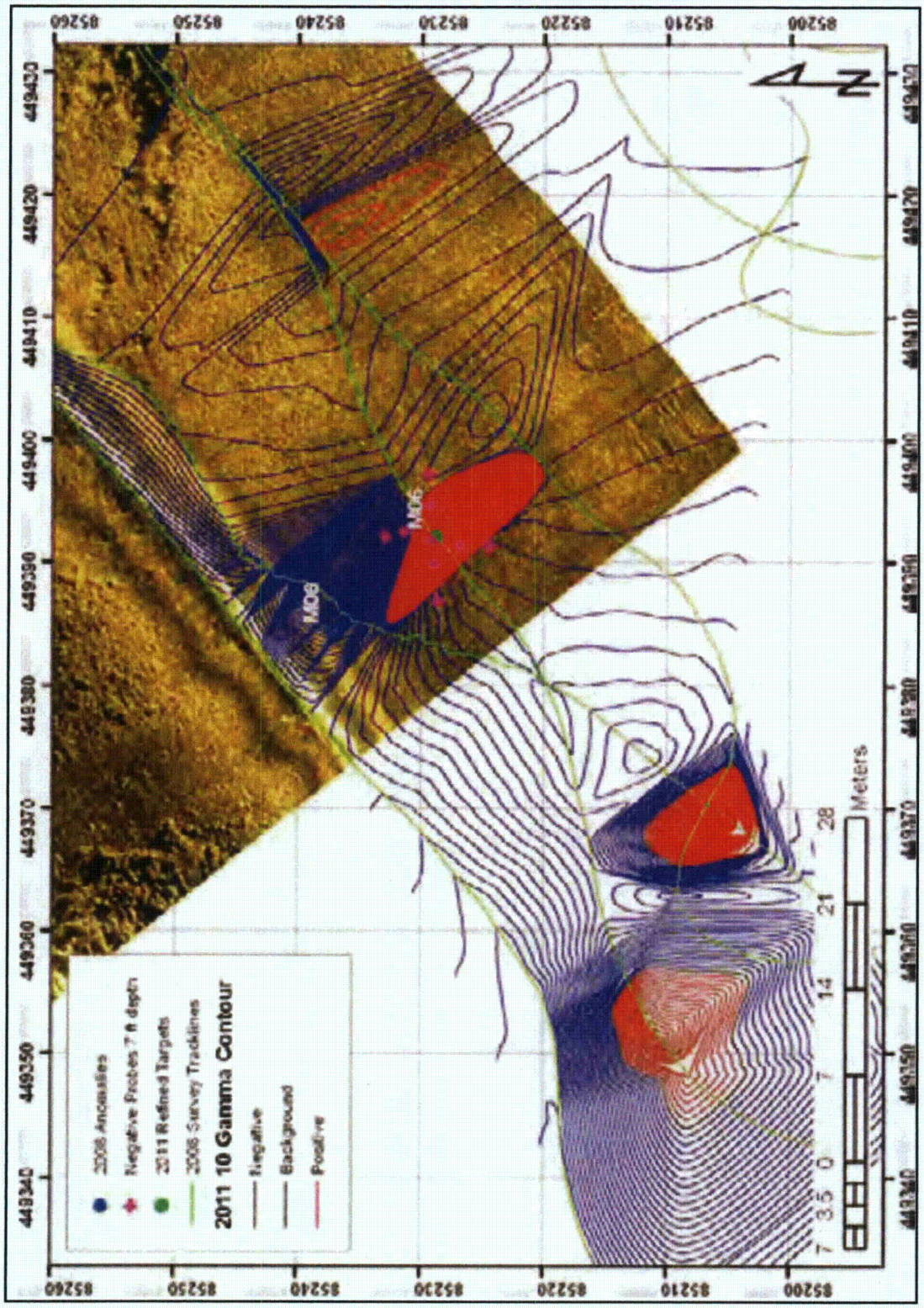

Figure 45. 2011 magnetic contour data overlaid on 2011 sidescan sonar data showing location of M06 and hydroprobe locations. Data presented in Maryland State Plane, NAD83, meters.

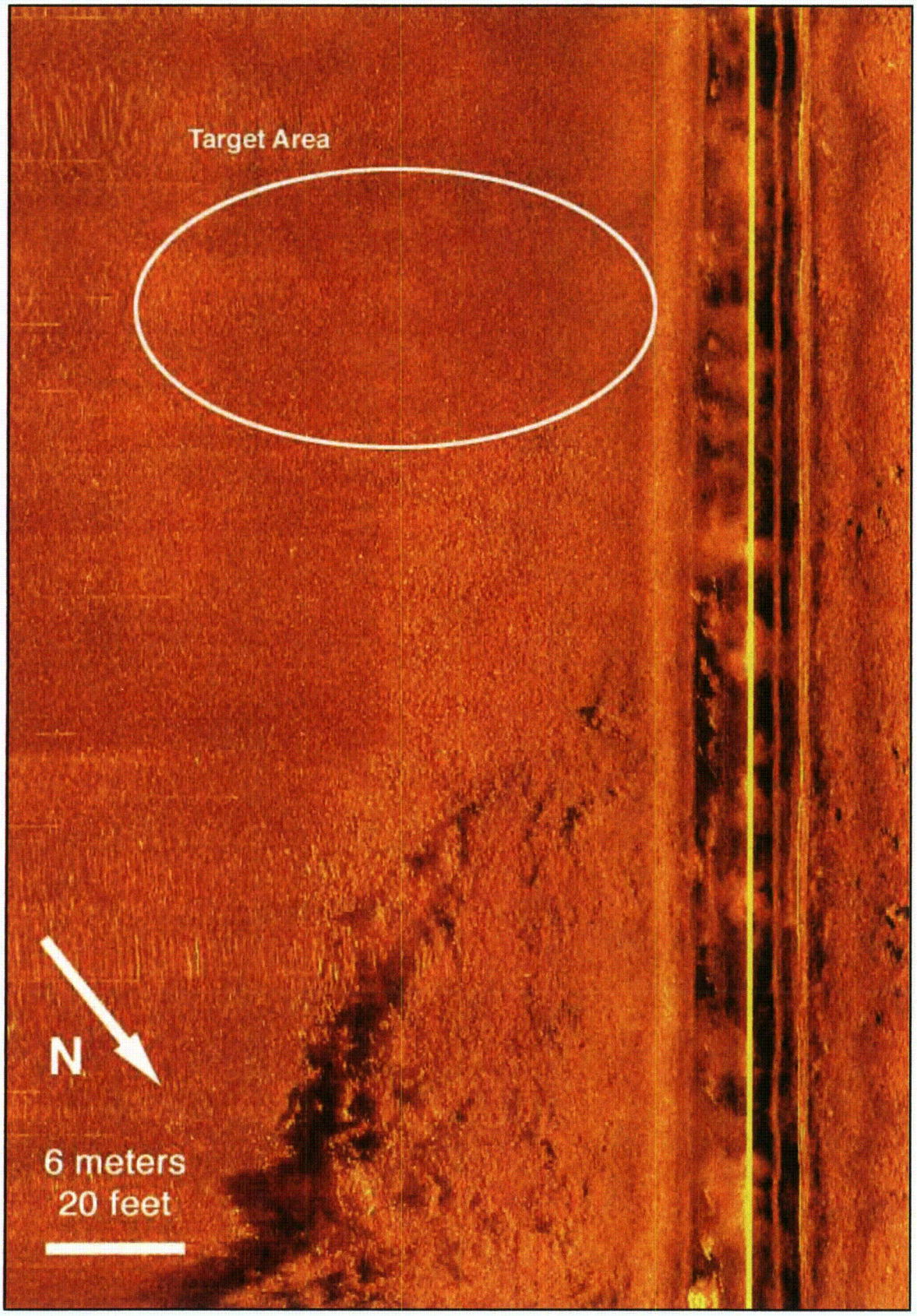

Figure 46. Raw sidescan sonar image of area surrounding M06, collected during 2011 refinement.

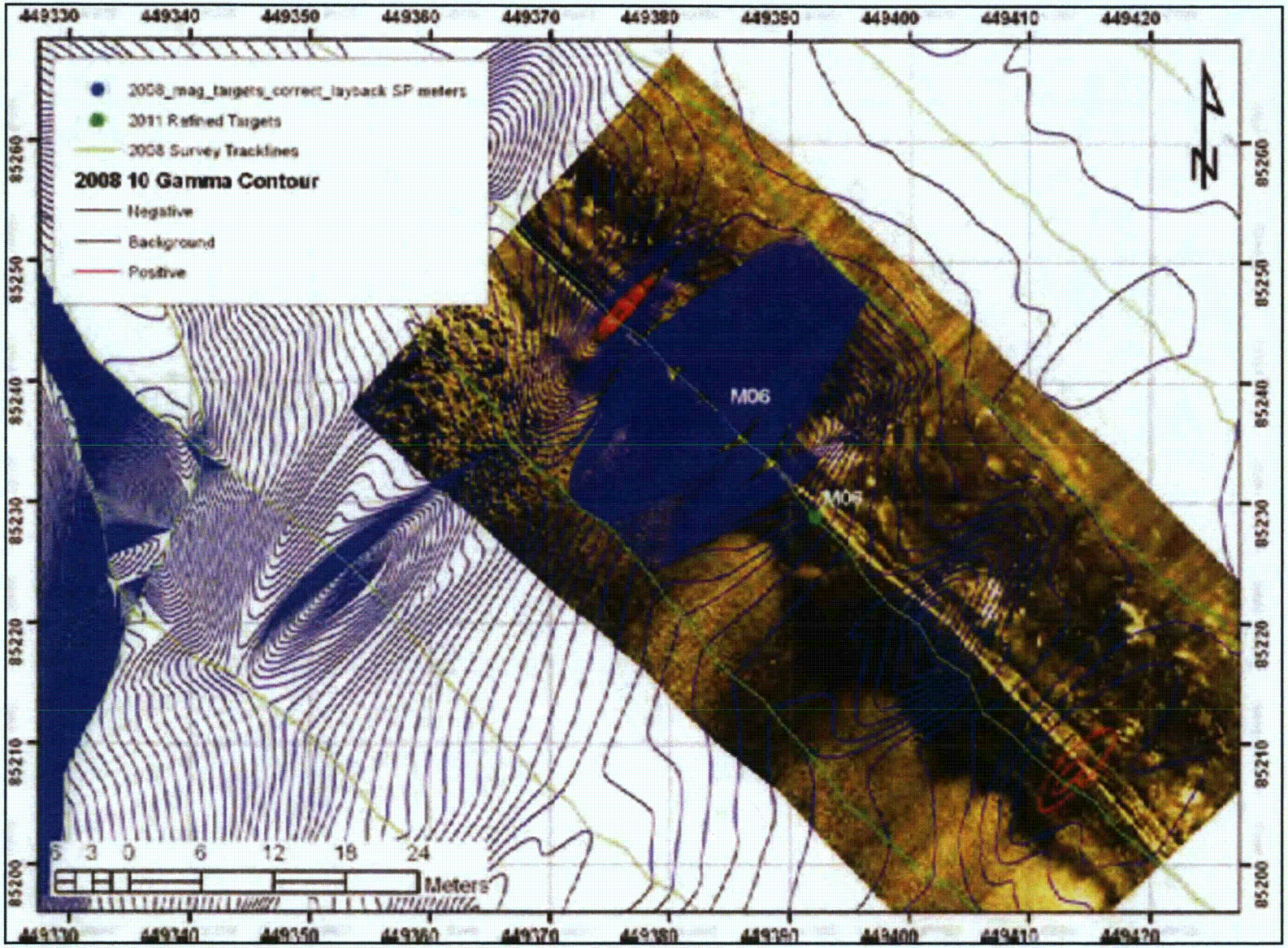

Figure 47. 2008 magnetic contour data overlaid on 2008 sidescan sonar data showing location of M06. Data presented in Maryland State Plane, NAD83, meters.

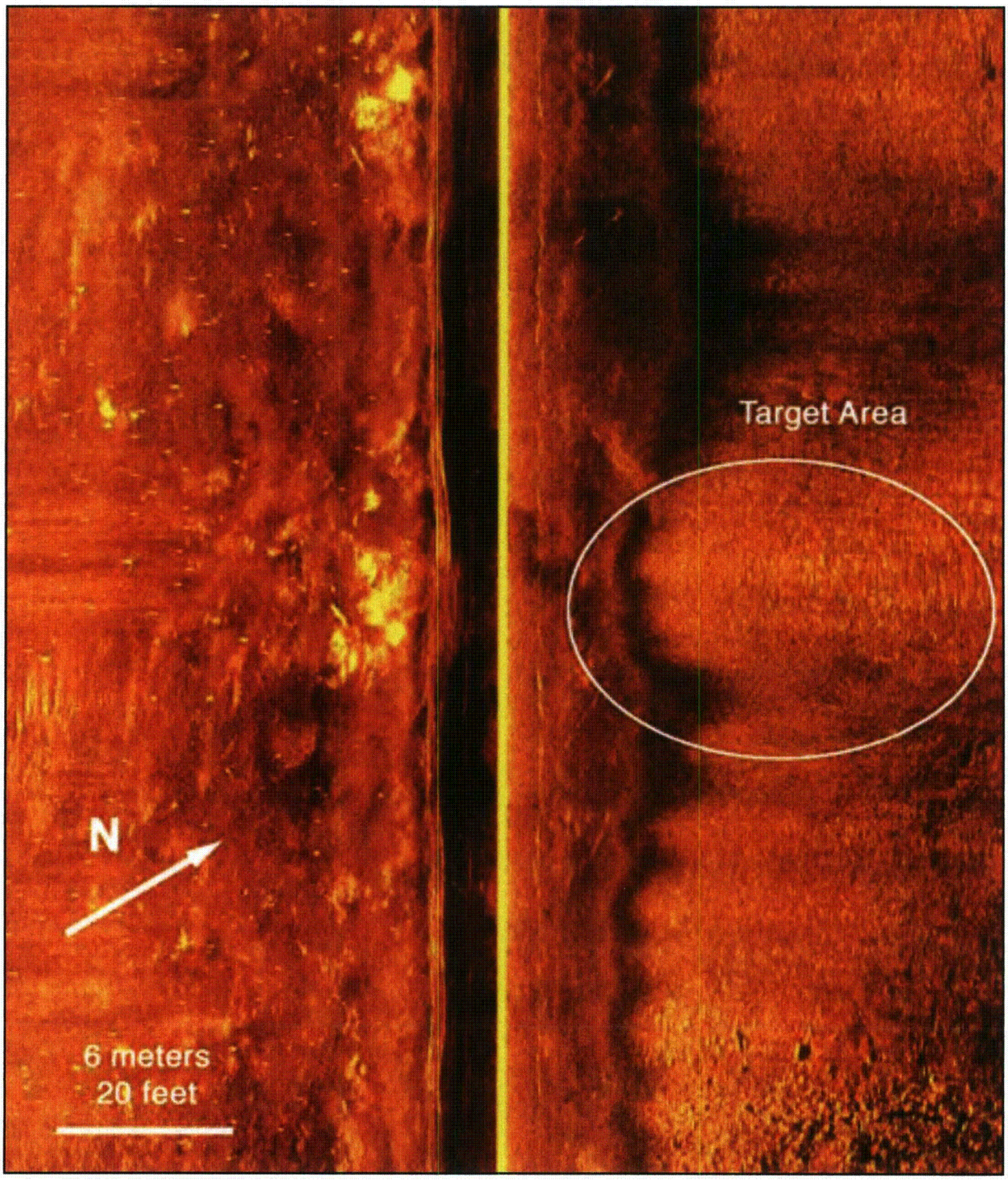

Figure 48. Raw sidescan sonar image of area surrounding M06, collected during 2008 survey.

M101

The survey data for M101 indicated the presence of a 156-nanotesla dipole anomaly with a duration of 32 meters (105 feet; Table 6; Figure 35). Examination of the sidescan sonar data indicated the presence of a possible linear object about 3 meters (10 feet) northwest of the anomaly location (Figures 49 and 50). However, a search of the bay bottom in the vicinity of the anomaly did not indicate the presence of any object (or objects) sufficient to account for the anomaly, indicating the object as seen in the sidescan data is likely the exposed rock located by the diver and discussed below. Following a search of an area of a 15-meter (50-foot) radius surrounding the target by the diver in arcs in a 3-meter (10-foot) interval with negative results, a pattern of nine hydroprobes, spaced at 3-meter (10-foot) intervals in cardinal directions (out to 6 meters [20 feet] in each direction and to a depth of 0.5 meters [2 feet]), did not locate any objects sufficient to account for the anomaly. The hydroprobes did indicate the presence of a hard layer at 0.5 meters (2 feet) below the bottom, which the probe was unable to penetrate.

Subbottom data for the survey indicated the presence of a layer of high-energy return with high signal attenuation below that return in the vicinity of the target (Figure 51). Such signal characteristics indicate a layer below the bottom surface that the subbottom profiler signal is unable to penetrate. This is represented by a dark layer indicating a high signal return, which in turn indicates a dense object or layer that is highly reflective to the frequency of signal being used. The most likely source of this high reflection is rock (Michael Faught personal communication 2011). Within 9 meters (30 feet) of the anomaly location, as reported by the diver, was exposed rock, indicating a fairly shallow accumulation of sediment in the vicinity of the anomaly location. Examination of the subbottom data from adjacent survey lines indicated the feature is 200–250 meters (650–800 feet) in width, extends over several lines, and likely represents not an area where rock extends upward, but rather where the sediment cover has been eroded. This can clearly be seen in Figure 51 as a depression, interpreted as reduced sediment cover, surrounding the target area. The spatial extent of the feature is illustrated in Figure 52 and it should be noted that it is located at the end of the dredged channel and the passage of vessels likely contributes to keeping the sediment cover light in the area.

Failure to locate the object with a visual inspection and a pattern of subsurface probes, coupled with a rock layer 2 feet below the bay bottom, indicates that the source object(s) consist(s) of isolated small marine debris such as wire rope or rebar, rather than a single large object such as a shipwreck. Given the shallow depth of sediment over solid material, any object greater than 2 feet in height would extend up through the sediment and be visible in the sidescan data and by divers. This target is not considered historically significant and no further work is recommended.

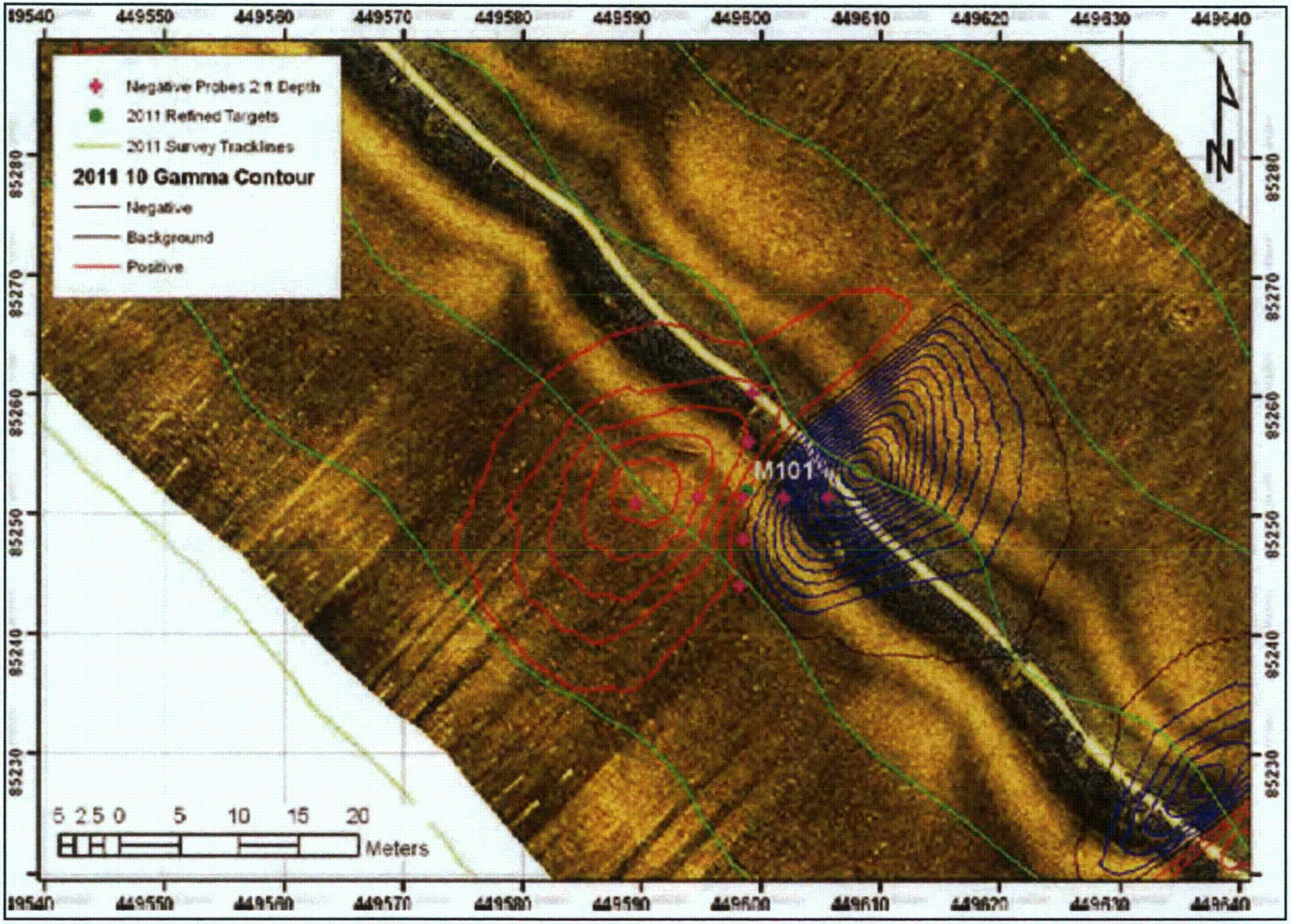

Figure 49. 2011 Magnetic contour map of M101 overlaid on sidescan sonar data, showing location of hydroprobes. Data presented in Maryland State Plane, NAD83, meters.

Figure 50. Raw sidescan sonar image of area surrounding M101 collected during 2011 survey. Note linear object, confirmed by diver inspection to be a rock outcrop.

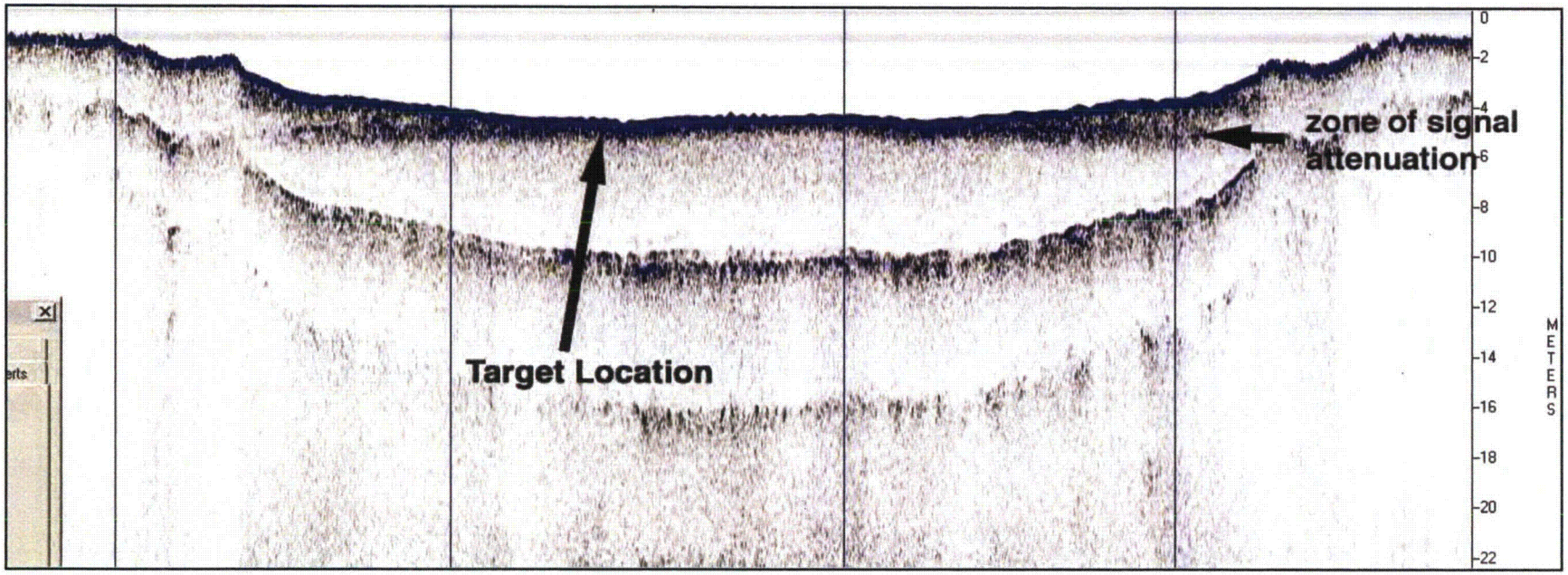

Figure 51. Subbottom data from survey Line 6, directly through M101, illustrating zone of signal attenuation below surface appearing as a dark horizontal region, representing an impenetrable rock layer. Vertical lines represent 100-meter intervals.

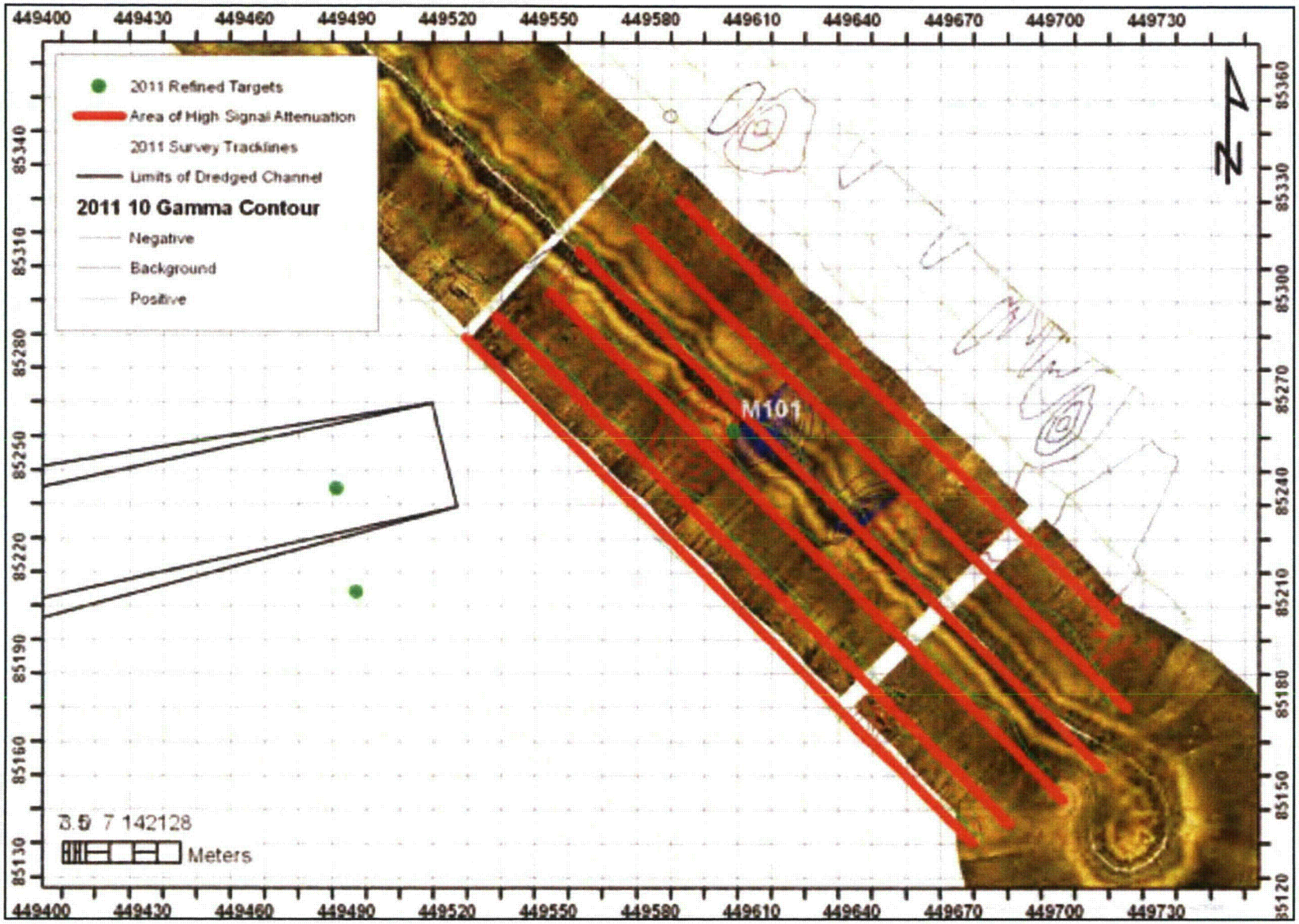

Figure 52. Spatial extent of subbottom feature interpreted as a rock layer within 0.50 meters (2 feet) of the surface. Data presented in Maryland State Plane NAD83 meters.

V. CONCLUSIONS AND RECOMMENDATIONS

In 2008, archaeologists with Panamerican conducted an intensive submerged cultural resources remote sensing survey for UniStar of a proposed offshore construction impact area associated with construction of a new nuclear generation unit (CC3) at the CCNPP located in Calvert County, Maryland. Located north of both Solomons Point and the mouth of Patuxent River, the survey recorded four potentially significant magnetic anomalies within the offshore area (Faught 2009). Subsequent to completion of the archaeological investigation, UniStar identified modifications to the proposed offshore facilities, requiring additional archaeological investigations. Panamerican was tasked with conducting a comprehensive remote sensing survey of the new 91.5-x-213.5-meter (300-x-700-foot) construction/restoration area for a proposed barge dock/slip, as well as archaeological diving investigations to identify the sources of the four magnetic anomalies, M03, M04, M05, and M06, located during the 2008 survey, and any potentially significant anomalies located during the current survey.

Results of the current remote sensing survey identified a total of three magnetic anomalies and no sidescan sonar targets. One of the magnetic anomalies, M101, met established criteria and was considered potentially significant for the purposes of this investigation, and was further investigated as part of the diving phase.

A re-examination of the survey data collected during the 2008 project revealed a post-processing error in the magnetic data that had resulted in a significant error being introduced into the number and positions of the recommended magnetic anomalies. Reprocessing of the 2008 data led to the elimination of one target entirely (M04) and the adjustment of the positions of the remaining three.

Incorporating the reprocessed 2008 survey data, a total of four targets were investigated and assessed, including magnetic anomalies M03, M05 and M06, located during the 2008 survey and magnetic anomaly M101, located during the current survey. Target M05 was accounted for by the presence of a large rudder and propeller, M03 by the presence of a 10-foot length of 0.5-meter (16-inch) diameter steel pipe, and M06, probed via hydroprobe to a depth of 2 meters (7 feet), was determined to likely consist of a large amount of isolated marine related debris. M101 was probed to a depth of 0.5 meters (2 feet), to a depth where a large impenetrable rock layer was encountered. The source of M101 is considered to be isolated marine debris above this rock layer but covered by sediment. None of the targets are considered historically significant and no further work is recommended.

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