APPENDIX NO. 1

GUIDELINES FOR ARCHAEOLOGICAL RESOURCE FIELD SURVEYS

I. Introduction

Perform your archaeological resource field surveys using the navigation systems, line-spacing patterns, and instrumentation described below.

II. Archaeological Resource Survey Navigation

Use a state-of-the-art navigation system that can continuously determine the surface position of the survey vessel. Ensure that the precision of the navigation system is ± 5 meters for surveys in water depths less than 200 meters (656 feet) and ±15 meters for surveys in water depths 200 meters or greater. Log position fixes digitally at least every 12.5 meters (41 feet) along the vessel track and annotate them on all records at intervals no greater than 152 meters (500 feet). Show fixes on the final shot point chart at intervals no greater than 152 meters.

Use acoustic positioning of towed sensors for archaeological resource surveys conducted in water depths greater than 91 meters (300 feet) to facilitate sufficiently accurate mapping of any recorded contacts.

III. Archaeological Resource Survey Patterns

The MMS Internet website list will tell you whether to conduct the archaeological resource survey at a line spacing of no more than 50 meters (164 feet) or no more than 300 meters (984 feet). For OCS blocks that have a high probability for containing historic resources in water depths 200 meters or less, the survey line-spacing interval is no more than 50 meters. For OCS blocks that have a high probability for containing prehistoric archaeological resources, or historic resources in water depths greater than 200 meters (656 feet), the survey line-spacing interval is no more than 300 meters.

A. Lease Surveys

If it is likely that you will conduct multiple operations on a lease, it may be advantageous for you to conduct a lease survey. A lease survey covers the entire area of a lease, as well as any areas outside the lease that could be physically disturbed by your activities. The area of physical disturbances includes, but is not limited to, the area within which drilling vessel or work barge anchors may be placed, but does not include the area within which workboat anchors may be placed or the area within which similar minimal disturbances may occur. Depending upon the OCS block designation from the list on the MMS Internet website, run a lease survey along parallel primary lines spaced at a maximum of either 50 or 300 meters (164 or 984 feet) with cross-tie lines spaced at a maximum of 900 meters (2,953 feet). The MMS GOMR may direct

you to use a tighter line spacing pattern in areas of known significant or potentially significant archaeological resources. If an asterisk appears next to an OCS block on the MMS Internet website, an archaeological survey may only be necessary over a small portion of the block or an alternative survey methodology may be more effective. It is recommended that you contact the MMS GOMR Social Sciences Unit for specific guidance on how to proceed.

B. Single Drilling Site/Platform Surveys (Site-Specific Surveys)

A site-specific survey covers an area approximately 1,800 meters (5,906 feet) square centered upon a proposed drilling or platform site, as well as any areas outside this square that could be physically disturbed by your activities. The area of physical disturbances includes, but is not limited to, the area within which drilling vessel or work barge anchors may be placed, but does not include the area within which workboat anchors may be placed or the area within which similar minimal disturbances may occur. Depending upon the OCS block designation from the list on the MMS Internet website, run a lease survey along parallel primary lines spaced at a maximum of either 50 or 300 meters (164 or 984 feet), with three equidistant cross-tie lines. The MMS GOMR may direct you to use a tighter line spacing pattern in areas of known significant or potentially significant archaeological resources. You do not need to conduct a site-specific survey in any area that is sufficiently covered by an approved lease survey. If an asterisk appears next to an OCS block on the MMS Internet website, an archaeological survey may only be necessary over a small portion of the block or an alternative survey methodology may be more effective. It is recommended that you contact the MMS GOMR Social Sciences Unit for specific guidance on how to proceed.

C. Right-of-way Pipeline Surveys

The survey pattern for all right-of-way pipelines consists of a line run along the proposed pipeline route (centerline), an offset parallel line on one side of the centerline (for 300-meter line spacing surveys only) located approximately 50 meters (152 feet) from the centerline, and a minimum of two additional offset parallel lines (on either side of the centerline) spaced at a maximum of 50 or 300 meters (164 or 984 feet), depending on the designation from the list on the MMS Internet website of the OCS blocks to be traversed by the pipeline. The number of offset parallel lines must be sufficient to provide coverage of the entire area that could be physically disturbed by your pipeline construction activities. The area of physical disturbances includes, but is not limited to, the area where pipeline lay barge anchors will be placed. If an asterisk appears next to an OCS block on the MMS Internet website, an archaeological survey may only be necessary over a small portion of the block or an alternative survey methodology may be more effective. It is recommended that you contact the MMS GOMR Social Sciences Unit for specific guidance on how to proceed.

D. Lease Term Pipeline Surveys

If a previously conducted lease or site-specific survey does not cover the route of a proposed lease term pipeline, conduct a survey that covers the route of the proposed pipeline. In this case, the survey pattern is the same as the one described for right-of-way pipelines in paragraph C above.

IV. Archaeological Resource Survey Data Acquisition Instrumentation

Make sure that geophysical instrumentation for your archaeological resource field surveys is representative of the state-of-the-art in technological development and is deployed in a manner that minimizes interference among the instrumentation systems. Interface all data recorders into the navigation system to ensure proper integration of information. Ensure that all instrumentation is adequately tuned and that all recorded data are readable, accurate, and properly annotated. Poor quality data resulting from inadequate acquisition or processing technique is not acceptable and may result in a resurvey. Use the following instrumentation to conduct an archaeological resource field survey:

A. Magnetometer

For all archaeological resource surveys you conduct in water depths less than 200 meters (656 feet), use a proton precession or cesium total field magnetometer to detect ferrous and other magnetically susceptible metals. Tow the magnetometer sensor as near as possible (but no more than 6 meters (20 feet) above the seafloor) and in a way that minimizes interference from the vessel hull and the other survey instruments.

Attach a depth sensor to the magnetometer sensor and annotate each survey line with tow sensor height off seafloor and with start of the line (SOL) and end of the line (EOL) times. Ensure that magnetometer sensitivity is one gamma (γ) or one nanoTesla (nT) or less, and that the data sampling interval does not exceed one (1) second. Ensure also that the background noise level does not exceed a total of 3 gammas peak to peak.

Record data on a digital medium in such a way that it can be linked to the positioning data. Make sure that the recording scales are set no higher than 1,000-gamma and 100-gamma full scale, respectively. Annotate shot points and recorder speed.

B. Dual Channel Sidescan Sonar

Use a towed, dual-channel, dual-frequency, sidescan sonar system to provide continuous planimetric images of the seafloor. For archaeological resource surveys run at a line spacing of 300 meters (984 feet), use a system that operates at no less than 100 kHz to provide sufficient resolution of seafloor conditions. For archaeological resource surveys run at a line spacing of 50 meters (164 feet), use a system that operates in the 300- to 500-kHz range.

Design the line spacing and display range to ensure 100 percent of the proposed survey area in the prime survey line direction is covered. This may require running tighter survey transects than what is specified on the MMS web page. Tow the sidescan sonar sensor above the seafloor at a distance that is 10 to 20 percent of the range of the instrument. As needed, run extra lines with the sidescan sonar operating at a frequency of 500 kHz or greater for detailed inspection of seafloor contacts. Ensure that the line spacing and display range you use are appropriate for the water depth. See Section V of this Appendix for suggested coverage areas.

Display the sidescan sonar data on a graphic recorder capable of adjusting the data for slant range effects and variable speed along line to give a true plan view of the seabed conditions as the survey progresses.

Record the data digitally to allow signal processing to improve data quality further and allow export to a workstation for integrated interpretation and mapping of the data. For all right-of-way pipeline surveys, image process and output the recorded data in mosaic form. Output such mosaics as a geo-referenced digital model of the seabed for use in interpretation and reporting.

C. Subbottom Profiler

Use a very high-frequency subbottom acoustic profiler operating within the 1.5- to 4.5-kHz bandwidth to provide continuous and very high resolution information of near surface geological features within the uppermost 15 meters (50 feet) of sediment. Run the subbottom profiler system to provide penetration that exceeds the depth of disturbance (i.e., the equivalent of one-and-a-half times the spud can diameter for a jack-up rig, the maximum expected anchor penetration for an anchored rig or work barge, or the depth of a pipeline burial trench).

Make sure that the subbottom profiler system is capable of achieving a resolution of vertical bed separation of at least one (1) foot in the uppermost 15 meters (50 feet) below the mudline.

Record the data digitally to allow signal processing to improve data quality further and allow export to a workstation for integrated interpretation and mapping of the data.

D. Depth Sounder

Use a hull mounted, high-frequency, narrow beam hydrographic echo sounder to obtain bathymetric data. Display the data on a graphic recorder and log it digitally and continuously. Set up the depth sounder system to record with a sweep appropriate to the range of water depths expected in the survey area. Use a heave compensator in conjunction with the system to remove the effects of vessel movement from the data.

Calibrate water column sound velocity at the start and end of the survey by using a conductivity temperature depth (CTD) sensor or velocity probe capable of recording in the maximum water depth expected in the survey area.

E. Additional Investigations

For archaeological surveys, the MMS GOMR will not approve requests to use 3-D seismic data as a substitute for high-resolution sidescan sonar data. For EP's and DOCD's in deepwater lease blocks, autonomous underwater vehicle (AUV) or remotely operated vehicle (ROV) surveys may be appropriate. Contact the MMS GOMR Social Sciences Unit if you wish to discuss other survey options.

Under certain conditions, you may want to use, or the MMS GOMR may direct you to use, additional instrumentation and methods such as underwater television; still, video, or movie cameras; divers; remote or manned submersibles; coring; and additional survey lines.

V. Suggested Sidescan Sonar Coverage Areas

Height Above Seafloor	Range at 10% of Fish Altitude	Range at 20% of Fish Altitude
5 meters	50 meters/channel	25 meters/channel
10 meters	100 meters/channel	50 meters/channel
15 meters	150 meters/channel	75 meters/channel
20 meters	200 meters/channel	100 meters/channel

APPENDIX NO. 2

GUIDELINES FOR ARCHAEOLOGICAL RESOURCE REPORTS

I. Introduction

Include an evaluation and synthesis of the data you gathered during the archaeological resource survey in an archaeological resource report prepared, signed, and dated by an archaeologist and a geophysicist. Ensure that these professional personnel have the credentials and experience sufficient to qualify them to perform the necessary work (qualifications for professional archaeologists can be found at 36 CFR part 61). As needed, specialists in other fields may participate in data analysis and report preparation.

If your archaeological assessment is submitted with your shallow hazards report, include this assessment as a separate appendix. If you submit your report on CD-ROM's, ensure that they are in a separate portable document format (PDF) file and that you also prepare a digital copy of all survey maps addressed in paragraph II.D of this Appendix as DWG files oriented to the North American Datum of 1927 (NAD 27) coordinate system.

II. Contents of Archaeological Resource Reports

Include the following information in the archaeological resource report:

A. A description of the area that you surveyed, including lease number(s), block numbers(s), OCS lease area(s), and minimum and maximum water depths for each lease block covered in the report. In order to minimize possible delays in the review of your EP or DOCD by the MMS GOMR, you may submit an archaeological resource report for a lease survey or a site-specific survey before you submit the related EP or DOCD

B. A list of the individuals involved in survey planning, fieldwork, and report preparation, and a description of their duties when you submit your archaeological resource report.

C. A discussion of the archaeological resource field survey, including the following:

1. A brief description of the navigation system, including a statement of its estimated accuracy for the area you surveyed.

2. A brief description of survey instrumentation, including scale, sensitivity settings, sampling rates, and tow heights off seafloor, as appropriate for each instrument.

3. A description of the survey vessel, including its size, sensor configuration, instrument set-backs, and navigation antennae locations.

4. Vessel speed and course changes.

5. Sea state and weather conditions.

6. A copy of the ***original*** daily survey operations log. Include sensor height off seafloor for the magnetometer and sidescan sonar for the beginning and end of each survey line.

7. A description of survey procedures, including a statement of survey and record quality, a comparison of survey line crossings, and discussion of any problems that may affect the ability of the report preparers to determine the potential for archaeological resources in the survey area.

8. An explanation of the problem(s) if you were unable to meet the survey line spacing or instrumentation guidelines in **Appendix No. 1** of this NTL.

D. A navigation postplot map of the survey area at a scale of 1:12,000 showing survey lines, shot points at 152-meter (500-foot) intervals, line direction in the grid projection in which the lease is described (e.g., UTM, Lambert, or geographic coordinates) with tics placed every five inches thereon, and with geodetic graticules every 60 seconds. For each copy of the report, submit one hardcopy and two digital copies (one in PDF format and one DWG format) of this map. Orient this map, or separate maps at the same scale that also show survey lines, shot points, and line direction, to true north and delineate the following, as appropriate:

1. The horizontal and vertical extent of all relict geomorphic features having potential for associated prehistoric sites. Such areas include, but are not limited to, tidal estuaries, embayments, barrier islands, beach ridge sequences, spits, alluvial terraces, and stream channels. When relict fluvial systems are recorded, make sure that the map

    a. differentiates between generations of channeling when more than one generation is present;

    b. shows any internal channel features such as point bar deposits and terraces;

    c. delineates any channel margin features such as natural levee ridges;

    d. indicates all depths of channel banks and channel axes (thalwegs); and

    e. delineates all areas recommended by your archaeologist for avoidance for potential archaeological resources.

    Note: An isopach map of channel fill sediments is often the most efficient means of conveying the above information, but this method alone will not allow differentiation between more than one generation of channeling.

2. Bathymetry.

3. All magnetic anomalies and seafloor sidescan sonar contacts of unknown source (for magnetic anomalies use map symbol: ▲; for sidescan sonar contacts use map symbol: ⊠). Identify these magnetic anomalies and sidescan sonar contacts using only the aforementioned symbols and a unique number keyed to the listings in the unidentified magnetic anomaly and sidescan sonar tables in the text (see paragraph F below). In congested areas with numerous unidentified magnetic anomalies, you may use a map(s) at a scale of 1:6,000 to depict the anomalies. If you do, tie this congested area map(s) into the 1:12,000 survey area map. ***Plot all recommended potential archaeological avoidance areas on the survey area map.***

4. Sites of proposed oil and gas operations (e.g., well locations, platform sites, and/or pipelines), when available at the time of report preparation.

5. Sites of former oil and gas operations (e.g., abandoned well locations, platform sites, and/or pipelines).

E. An analysis of the potential for prehistoric sites within the survey area that includes:

1. A review of current literature on late Pleistocene and Holocene geology, paleogeography, and sea level change in the area; marine and coastal prehistory; and previous archaeological resource reports in the area, if available. You may obtain a list of suggested references from the MMS Internet website at: http://www.gomr.mms.gov/homepg/regulate/environ/archaeological/introduction.html

2. A discussion of relict geomorphic features and their archaeological potential that includes the type, age, and association of the mapped features; the acoustic characteristics of channels and their fill material; evidence for preservation or erosion of channel margins; evidence for more than one generation of fluvial downcutting; and the sea level curves you used in the assessment.

3. A discussion, based on the capabilities of current technology in relation to the thickness and composition of sediments overlying the area of a potential site, of the potential for identification and evaluation of buried prehistoric sites.

F. A current review of existing records for reported shipwreck locations in the survey area and adjacent areas, and the following, as appropriate:

1. A table of the unidentified magnetic anomalies with the OCS block, shot point, and survey line location (corrected for sensor offset); gamma intensity; lateral extent (duration); whether the anomaly is characterized by a dipolar, monopolar, or complex signature; the magnetometer sensor tow height off seafloor; the NAD 27 decimal degree coordinates of the center of each unidentified anomaly; and the recommended avoidance zone. A suggested format for this unidentified magnetic anomaly table is included in Section III of this Appendix;

2. A table of sidescan sonar contacts with the lease block, shot point, and survey line location (corrected for sensor offset); size; shape; height of protrusion above the seafloor; the NAD 27 decimal degree coordinates; and recommended avoidance distance of each. A suggested format for this unidentified sidescan sonar contact table is included in Section III of this Appendix;

3. A discussion of any magnetic anomalies and sidescan sonar contacts of unknown source in terms of their potential as historic shipwrecks (include an analysis of reported nearby wrecks and their potential association with these contacts on the basis of vessel size and anomaly characterization);

4. A discussion of any correlation between magnetic anomalies or sidescan sonar contacts and known or probable sources;

5. For any archaeological resources that can be positively identified from remote-sensing records, an analysis of their possible significance and recommendations for any further research or special precautions that may be necessary.

6. A discussion of the potential for shipwreck preservation in terms of bottom sediment type and thickness, and the effects of past and present marine processes in the survey area; and

7. A discussion of the potential for identification and evaluation of potential shipwrecks considering the capabilities of current technology in relation to the water depth, probable thickness and composition of sediments overlying the potential shipwreck location, and the preservation potential.

G. Representative data samples from each survey instrument to demonstrate the quality of the records. If appropriate, include the following data samples, which you may use in lieu of the representative data samples:

1. A sample of subbottom profiler data for ***each type of relict landform*** that you identify. When more than one generation of fluvial channeling is evident, include a sample that depicts each generation. Make sure that each sample is readable and includes horizontal and vertical scales. If you want to provide any interpretive highlighting or annotation of the sample data, do so on either a separate overlay or a copy of the sample data. Do not highlight original survey data.

2. Copies of all sidescan sonar data where contacts representing unidentified objects are recorded. Make sure that the copies are readable and include the scale. If you want to provide any interpretive highlighting or annotation of the sample sidescan sonar data, do so on either a separate overlay or a copy of the sample data. Do not highlight original survey data. For all right-of-way pipeline surveys, include a digital copy of the computer-generated mosaics as a geo-referenced Tagged Image Format (TIF) file.

H. A summary of conclusions and recommendations supported by the archaeological resource field survey data and archaeological analyses including:

1. A discussion of known or potential archaeological resources; and

2. Recommendations for avoidance or for further archaeological investigations.

I. A discussion of the data and results from any additional investigations (see Appendix No. 1, Section IV.E) that the MMS GOMR may have directed you to conduct.

III. Listing Unidentified Magnetic Anomalies and Sidescan Sonar Contacts

The following are suggested tables, including sample information, for listing unidentified magnetic anomalies and sidescan sonar contacts in archaeological resource reports.

A. Magnetic Anomalies

Anomaly Number	Area/ Block	Line No.	Shot Pt.	Tow Height (feet)	Signature	Intensity (gammas)	Duration (feet)	NAD 27 Coordinates (in decimal degrees)	Minimum Avoidance Dist. (feet)
1	MP 100	0020	11.4	20	Dipole	15	75		100

B. Sidescan Sonar Contacts

Anomaly Number	Area/ Block	Magnetometer Association	Dimensions LxWxH (ft)	Shape	NAD 27 Coordinates (in decimal degrees)	Minimum Avoidance Dist. (feet)
1	MP 100	Mag. Anomaly 1, Line 0020, Shot Point 11.4	100 x 50 x 5	Linear		100