MMS FEASIBILITY STUDY FINAL REPORT
Sampling of Outer Continental Shelf Shell Mounds Associated With Platforms Located In The Santa Barbara Channel And Santa Maria Basin

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1.0 INTRODUCTION

The Minerals Management Service, Pacific OCS Office (MMS) has been conducting studies to characterize the size and configurations of shell mounds associated with the Pacific Region oil and gas platforms. The first phase of the study consisted of multi-beam surveys of 16 OCS platforms in the Santa Barbara Channel and Santa Maria Basin. This study also evaluated a variety of factors that can affect the size and configuration of the mounds. The results of these surveys are presented in a final study report titled "An Assessment and Physical Characterization of Shell Mounds Associated with Outer Continental Shelf Platforms Located in the Santa Barbara Channel and Santa Maria Basin, California" that was prepared by MEC and Sea Surveyor (2003).

As the next phase of these studies, MMS plans to sample representative shell mounds to develop information on the physical, chemical, and potential toxicological characteristics of the mounds. Prior to initiating planning for the sampling effort, it is first necessary to screen and select candidate platforms with representative shell mounds and then to evaluate the issues and appropriate approaches for safely conducting the sampling operation. Factors considered in the selection of candidate platforms include: water depth, bottom slope, age of platform, shell mound size, distance from port and other candidate platforms, and platform development considerations (e.g., type of drilling mud used). Factors evaluated in establishing feasibility of sampling options include consideration of: technical and logistical issues (i.e., can sampling be performed); scientific utility (i.e., can the sampling be performed in a way to adequately address the question being asked); safety (i.e. what are the potential hazards associated with the sampling and is it possible to mitigate those hazards to an acceptable level); and costs/schedule (i.e., given the technical, logistical, and safety issues can the sampling be performed within the budget and time constraints of the project). Technical/logistical issues include equipment selection, associated operational considerations, platform accessibility (e.g., operator's willingness to participate in this study), logistics of working within or next to the platform jacket from a vessel, and access for working directly from the platform. Safety considerations include identification of potential hazards associated with sampling on or near a working platform such as identification of potential obstructions, entanglements, or other hazards (e.g., power cables, pipelines), and operational considerations (e.g., noise, H_2S, work space restrictions, weather restrictions, marine mammal issues, etc.) that may result in injury to personnel and/or damage to equipment or the platform. Finally, in order to be feasible, the sampling must be completed within the time (October 30, 2006) and budget ($120K) allocated for this project.

This report addresses the feasibility of conducting sampling operations from selected operating production platforms with representative shell mounds, and alternatives to sampling from a platform and represents the first step in the process of planning and conducting the shell mound sampling. Results from this effort will provide guidance concerning project objectives, safe and effective sampling methods, equipment, and approaches, and the most appropriate protocols for preparing the sampling and analysis plan (SAP) and finalizing cost estimates.

2.0 PROJECT BACKGROUND

Since 1958, offshore oil and gas platforms have been part of the Southern California marine ecosystem. At the present time there are 23 offshore platforms in Federal waters. These platforms have a finite economic lifespan. Over the life of the platform, discharges of drilling muds and cuttings inter-layered with shells and marine organisms falling from the platform infrastructure accumulate as mounds, representing sizable bathymetric features beneath and adjacent to some of these platforms. MMS regulations require the removal of platform structures and associated debris, including shell mounds, following decommissioning.

There are multiple possible options for addressing this requirement for site clearance, including dredging, capping, and leaving-in-place. Evaluations of possible options require information on the physical and chemical characteristics of the mounds. However, with the exception of recent data from previous sampling at the 4H shell mounds in State waters of the Santa Barbara Channel, relatively little information presently exists on the physical and chemical characteristics of shell mounds in Federal waters. Therefore, further analysis and documentation is necessary to evaluate options for determining thedisposition of these shell mounds. An objective of the present study is to provide information for planning a sampling effort to characterize the physical and chemical properties of Pacific OCS shell mounds that can be used for future assessments of shell mound remediation options.

3.0 PLATFORM SELECTION

3.1.1 Selection Criteria

For the present phase of the shell mound characterization study, MMS plans to sample shell mounds for their physical, chemical, and potential toxicological characteristics at up to three of the OCS platforms. Thus, it was necessary to determine the criteria used for platform selection, and then use this criteria to screen and select candidate platforms for the MMS shell mound characterization study. Ideally, the selected platform sites would represent a range of conditions with respect to platform age (installation date), water depth, bottom slope, and height and volume of the mound. These factors are important for platform selection because the results of the Phase I study (MEC and Sea Surveyor, 2003) indicated that the size of a shell mound at an OCS platform appeared to be related to the age of the platform, bottom slope, and water depth. Platform age also may reflect the chemical characteristics of the mounds because the types and quantities of drilling mud additives permitted for discharge by the regulatory agencies have changed over time.

3.1.2 Initial Platform Screening

Relevant information on the Pacific OCS platforms is summarized in Table 1. As shown, these platforms were installed over a period of several decades (1968 to 1989), occur in a range of water depths (96 to 1,197 feet) and bottom slopes (up to 5.6 degrees), and have shell mounds with estimated volumes ranging from less than 500 to 12,500 cubic yards. The size, configuration, and location of the shell mounds relative to the platform footprints are described in the Phase I report (MEC and Sea Surveyor, 2003). In general, results of the Phase I report showed that platforms located in deeper waters tended to have shallower shell mounds dispersed over a greater area due to increased settling time and higher current velocities relative to platforms located in shallower environments. In addition many of the platforms in deeper water were installed more recently relative to platforms located in shallower environments (i.e. those located in state waters). Consequently there was less time for mound formation beneath these newer platforms.

An initial screening of this list of OCS platforms eliminated several of the candidate sites because they were too deep (> 300 feet) and, therefore, beyond the limits for sampling using commercially available sediment coring equipment (Platforms Eureka, Gail, Hondo, Heritage, Harmony, Hermosa, Hidalgo, and Harvest), too far from likely sampling mobilization/demobilization locations (Platform Edith, Ellen, Irene), or did not have available well slots for sampling (Platforms Elly, Gina, and Henry).

The nine remaining platforms (i.e., those high lighted in yellow in Table 1) are located in the Pitas Point Unit, Carpenteria Area, and Santa Clara Unit, and are relatively close to possible staging areas for the sampling surveys. These platforms were installed between 1967 and 1981 and, therefore represent current ages from 24 to 38 years. The platforms occur in water depths ranging from 152 feet (Hogan) to 318 feet (Grace), with bottom slopes from 0.3 to 1.1 degrees. The shell mounds associated with these OCS platforms have volumes ranging from 4500 to 12,500 cubic yards. Although these nine platforms represent the lower end of the ranges for depth and slope, they are considered representative of the ranges in shell mound age and size for all of the OCS platforms and, therefore, appropriate for this characterization study. Additionally, multi-beam data from the Phase I study were collected at each of these nine platforms.

Table 1. General features of OCS candidate platforms

Area/Production Unit	Platform Name	Operator	Date Installed	First Production	Water Depth (m/ft)	Distance from Shore (miles)	Years Platform Installed at Time of Survey	Years in Production	Shell Mound Volume (yds3)	Shell Mound Height (ft)	Estimate Shell Mound size (ft)	Center of Shell Mound Location	Bottom Slope (%)	# of Slots	Comments
San Pedro Unit	Edith	DCOR	1/12/1983	1/21/1984	49/161	8.5	20	19			NA	NA	NA	49	too isolated relative to other top ranked candidate platforms.
	Elly	Aera	3/12/1980		78/256	8.6	23	Na			NA	NA	NA	n.a.	unclear as to whether any slots are available
	Ellen	“	1/15/1980	1/13/1981	81/266	8.6	23	22			NA	NA	NA	16	too isolated relative to other top ranked candidate platforms.
	Eureka	“	7/8/1984	3/17/1985	213/699	9	19	18			NA	NA	NA	0	too deep; no slots
Pt. Hueneme Unit	Gina*	DCOR	12/11/1980	2/11/1982	29/96	3.7	21	21	4200	13	150x210	North side	1.01	3	small number of slots
Santa Clara Unit	Gail*	Venoco	4/5/1987	8/8/1988	225/740	9.9	14	15	<500	3	4 Scattered small mounds		3.6	14	too deep
	Grace*	DCOR	7/30/1979	7/25/1980	97/318	10.5	22	23	5500	13	200x390	Northwest side	0.38	13	Platform Grace has a significant shell mound centered on the NW corner of the platform with lesser amounts outside the platform footprint. The platform has been undergoing some refurbishment in support of the operator's proposed "re-commissioning". The drill deck is presently unobstructed by a drilling rig or other large equipment.
	Gilda	"	1/6/1981	12/19/1981	63/208	8.8	21	21	7370	18	220x285	North side	1.1	32	Possible candidate for deeper platform, plenty of available slots. Shell mound centered along the north edge of the platform with smaller areas away from platform. The platform rig has recently been reinstalled after being inspected and recertified at an onshore location. The operator is using the rig to perform down hole repairs and work overs on several platform wells. This work will be ongoing throughout the next few months, and may be punctuated by interruptions when the rig crew is needed at other platforms. The drill deck is mostly occupied by equipment in support of the rig operations.
Pitas Point Unit	Habitat	"	10/8/1981	12/15/1983	89/293	7.8	21	20	6840	19	Dia 250	Centered	0.4	4	Small number of slots available, shell mound appears to be centered beneath the platform. The operator has recently proposed the advent of an artificial lift conversion program where a second tubing string will be run into the wells to help unload excessive water that kills the wells' gas production. The operator is expected to submit the necessary permits for the proposed well modifications this month, with the actual work occurring in the months thereafter. The drill deck is currently cluttered by a large drilling rig and related supporting equipment.
Carpentaria Area	Hogan	Pacific	9/1/1967	6/10/1968	47/152	3.7	35	35	12500	26	Dia 260	Western side	0.33	26	Hogan appears not to have much shell mound beyond the platform footprint. The operator is currently actively engaged in the drilling of sidetrack wells at the platform. This work will likely last through the end of this year. Additionally, much scaffolding has been installed under the production deck and is being used for extensive refurbishing work (sandblasting, prepping, and painting of platform components) associated with the facility's reinstatement of their maintenance program. The drill deck is a mix of drilling related equipment with little room for anything else.
	Houchin*	“	7/1/1968	4/28/1969	50/163	4.1	33	34	10900	21	Dia 280	Centered	0.38	24	Older platform with the second largest mound. The operator is currently actively engaged in routine well work overs at the platform. The drill deck and pipe deck at this platform serve as a storage area for much of the drilling equipment and supplies that can not be accommodated next door, at Platform Hogan. While these decks are somewhat cluttered by this material, there may be some available space over the empty slots.
	Henry*	DCOR?	8/31/1979	5/15/1980	53/172	4.3	22	23	7200	19	Dia 250	Centered	0.67	0	No slots available
	Hillhouse	DCOR	11/26/1969	7/21/1970	58/190	5.5	33	33	6800	22	180x270	Western side	0.88	8	Smaller number of available slots; Carpentaria area platforms generally have shell mounds centered beneath the platform with only small areas extending much beyond the platform footprint. All of these platforms have rigs on them that are used sporadically to perform well work over operations as needed. No major projects have been identified or applied for at this time. The drill decks are relatively free of clutter. Platform Hillhouse is currently performing construction and maintenance on a number of structural components. This work is ongoing and should be completed by December 2005.
	A	“	9/14/1968	3/3/1969	58/190	5.8	34	34	7260	20	140x260	Centered	1.02	0	No available slots; Carpentaria area platforms generally have shell mounds centered beneath the platform with only small areas extending much beyond the platform footprint. All of these platforms have rigs on them that are used sporadically to perform well work over operations as needed. No major projects have been identified or applied for at this time. The drill decks are relatively free of clutter. Platform Hillhouse is currently performing construction and maintenance on a number of structural components. This work is ongoing and should be completed by December 2005.
	B	“	11/8/1968	7/19/1969	58/190	5.7	34	34	8590	18	160x210	Centered	1.03	8	Smaller number of available slots; Carpentaria area platforms generally have shell mounds centered beneath the platform with only small areas extending much beyond the platform footprint. All of these platforms have rigs on them that are used sporadically to perform well work over operations as needed. No major projects have been identified or applied for at this time. The drill decks are relatively free of clutter. Platform Hillhouse is currently performing construction and maintenance on a number of structural components. This work is ongoing and should be completed in a month or so.
	C	“	2/28/1977	8/1/1977	59/193	5.7	25	26	4590	13	160x235	Southwest corner	1.14	17	Carpentaria area platforms generally have shell mounds centered beneath the platform with only small areas extending much beyond the platform footprint. All of these platforms have rigs on them that are used sporadically to perform well work over operations as needed. No major projects have been identified or applied for at this time. The drill decks are relatively free of clutter. Platform Hillhouse is currently performing construction and maintenance on a number of structural components. This work is ongoing and should be completed iby December 2005.

Area/Production Unit	Platform Name	Operator	Date Installed	First Production	Water Depth (m/ft)	Distance from Shore (miles)	Years Platform Installed at Time of Survey	Years in Production	Shell Mound Volume (yds3)	Shell Mound Height (ft)	Estimate Shell Mound size (ft)	Center of Shell Mound Location	Bottom Slope (%)	# of Slots	Comments
Santa Ynez Unit	Hondo*	Exxon Mobile	6/23/1976	4/2/1981	256/840	5.1	25	22	1500	9	3 mounds 40x170, 60x130, & 50x100		5.6	0	too deep
	Harmony	"	6/21/1989	12/30/1993	365/1197	6.4	14	10			NA	NA	NA	9	too deep
	Heritage	"	10/7/1989	12/18/1993	328/1076	8.2	14	10			NA	NA	NA	11	too deep
Pt. Arguello Unit	Hermosa*	Arguello Inc.	10/5/1985	6/9/1991	184/604	6.8	16	12	<500	2	2 mounds 30x60 & Dia 20		5	32	too deep
	Harvest	"	6/12/1985	6/3/1991	206/676	6.7	17	12			NA	NA	NA	29	too deep
	Hildago*	"	7/2/1986	5/27/1991	131/430	5.9	15	12	<500	<2	Small and scattered		4.3	46	too deep
Pt. Pedernales Unit	Irene	Torch	8/7/1985	4/13/1987	73/240	4.7	17	16	3720	9	Dia 215	Western side	0.71	48	too isolated relative to other top ranked candidate platforms.

NA - information not available.

3.2 Primary Platform Candidates

Following discussions with MMS personnel and platform operators, a subset of six platforms (Habitat, Hill house, A, B, C, and Gilda) was selected for further evaluation of sampling feasibility. All six candidate platforms are managed by a single operator (DCOR). With the exception of Gilda, all the selected platforms are just off the coast of Santa Barbara (approximately 5-8 miles) and within 2-3 miles of one another (Figure 1). All of the candidate platforms are in approximately 200 feet of water with the exception of Habitat which is in 290 feet of water. Results of a previous investigation utilizing side scan sonar (MEC and Sea Surveyor 2003), indicated shell mounds beneath each of the candidate platforms with projected heights ranging from 13 to 22 feet. The apex of the mounds associated with these platforms is always directly beneath the platform but not always centered (i.e., slightly closer to one of the edges).

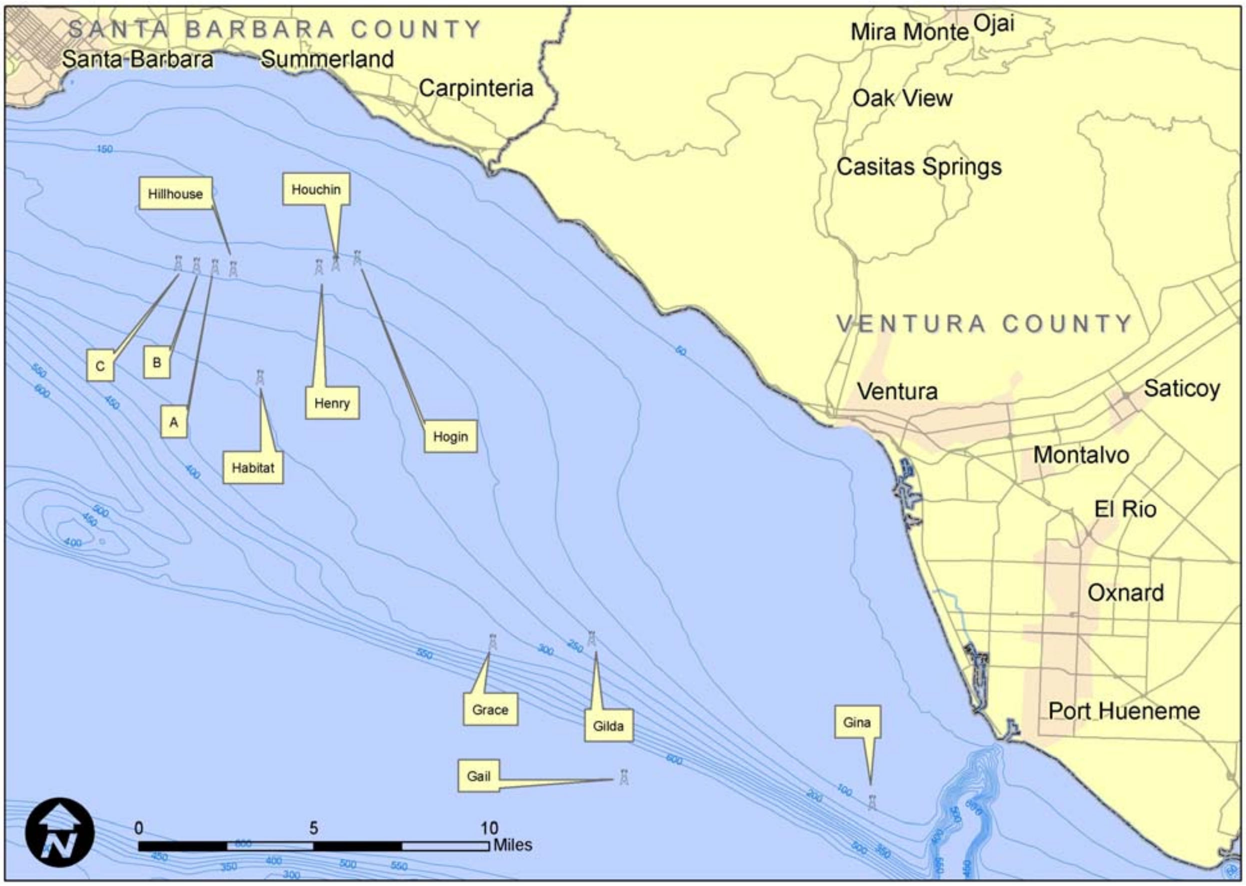

Figure 1. Map showing locations of primary candidate platforms

3.3 General Platform Characteristics

The six primary candidate platforms under consideration have been in operation between 24 to 36 years. All platforms still have active gas and oil producing wells. Currently, there are no active drilling operations on any of the platforms under consideration. All platforms under consideration have three general deck areas (Figure 2). The lowest of these decks known as “the 15-foot deck” (just above the embarkation/debarkation platform) is typically just an open grate catwalk with railings along the platform perimeter. On some of the platforms there are additional small work areas in the corners and/or in the center of the 15-foot deck. The superstructure of the platform at the 15-foot level consists of several cross-members (15 to 24 inch steel pipe) running between the legs of the platform just below the deck, to provide additional support to both the structure and conductors (i.e., conduits for the wells) (Figure 3). The conductors passing through this deck space are typically 15 inches in diameter occasionally with some pipes as large as 30 inches. The majority of the conductors run perpendicular to the water surface with a smaller number entering at an angle (>45 but <90). Conductor guides (flanged metal rings) welded between the cross members provide support to the conductors (Figure 4). These conductor guides typically have openings of 18 inches ID with one or two as large as 36 inches. In the open areas of the 15-foot deck, cables for the anodes can be seen. Some 20 to 30 feet above the 15-foot deck is the production deck. The production deck is the most active area of the platform, housing the majority of equipment associated with production (e.g., well heads) and processing of recovered oil and gas as well as the production offices (Figure 5). The deck itself is either solid steel plate or grating just above solid steel plate with railings and a liquid waste collection system running along the perimeter. In the well-bays there are covered openings for the open well slots these are typically of similar size as the conductor guides (18 to 36 inches in a few instances). Just above the production deck (15-20 feet) is the drilling deck. This deck consists of crew quarters, helicopter pad (usually on top of the crew quarters), typically two cranes, and a movable gantry housing the drill rig (Figure 6). The deck itself is steel plate (well slots are also covered with steel plate). Railings and a liquid waste collection system run along the perimeter. Well slot openings on the production deck, similar to the well deck, range in size from 18 to 36 inches on the drilling deck.

Figure 2. Locations of platform decks and other features

Figure 3. 15-foot deck with conductors

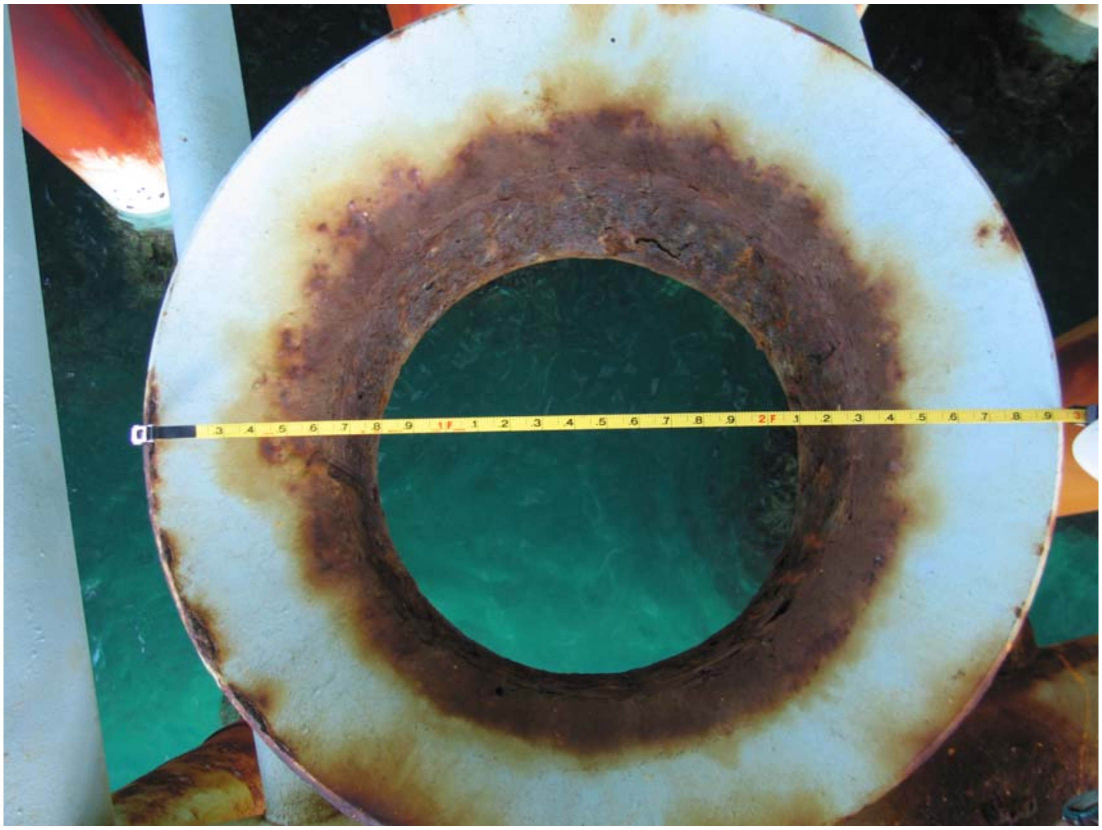

Figure 4. Conductor guide

Figure 5. Production deck

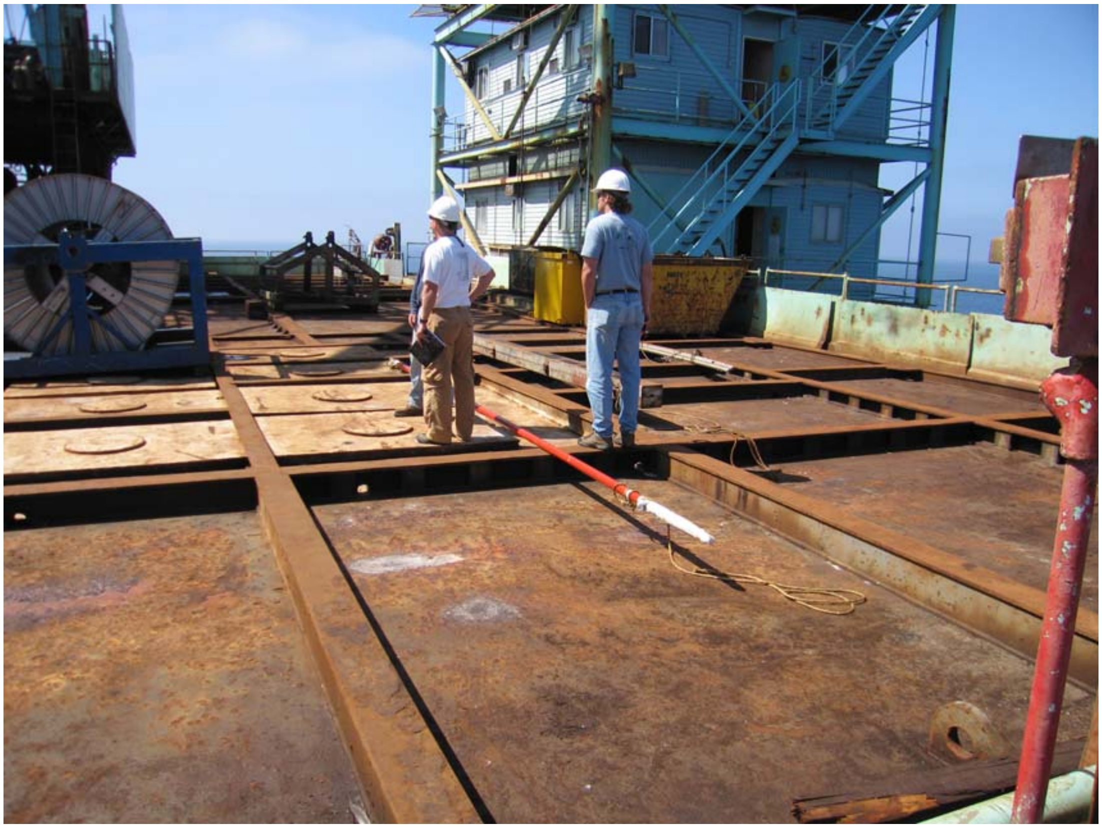

Figure 6. Drilling deck

4.0 SAMPLING FEASIBILITY

The purpose of the MMS sampling effort is to collect representative samples from platform shell mounds to provide an adequate profile of the physical, chemical and potential toxicological properties. Thus, the next step in this feasibility report was to evaluate the issues and appropriate approaches (e.g., equipment and locations on platforms) for safely conducting the sampling operation. Because of the restrictive nature of sampling beneath a working platform and the likelihood that only a single location will be sampled it is believed that the best opportunity for success is to collect a core sample from the apex (or as close to the apex as possible) of shell mounds beneath representative platforms. If only a single location can be sampled, the apex is preferred to the apron since it will more likely capture significant changes in sediment stratigraphy and the associated chemical and physical properties of the shell mounds.

4.1 Equipment Evaluation

Based on the program’s objective, a coring device will be required to collect samples through the highest portion of the shell mound to depths reflective of the surrounding environment (i.e., reflective of conditions prior to platform installation). Again, based on previous MMS studies, we can anticipate mound heights of approximately twenty feet, and therefore, coring equipment will be required to collect cores up to twenty feet in length.

There are a limited number of coring devices available for collection of cores up to twenty feet. Devices such as gravity corers, piston corers, and diver operated corers generally do not provide sufficient penetration for collection of cores of these lengths. Equipment capable of collecting twenty foot cores includes standard land-based drill rigs (auger or split spoon), direct push systems, hammer corers, and/or vibracorers. However, because water depths associated with OCS platforms range from 96 to 1,197 feet, use of standard land-based drilling operations, direct push, or hammer coring is impractical since these systems rely on the extension of bits or core tubes from surface operated machinery to the seafloor. While it may be possible to collect samples via drill rigs, direct push, or hammer cores, the time and expense associated with the use of such equipment render them infeasible for purposes of this study. Vibracores, which are essentially semi-autonomous coring units, consist of a vibratory head, coring tube, and some form of surface supplied power (pneumatic, hydraulic, or electric). The water depths associated with these platforms preclude the use of pneumatic or hydraulically powered vibracorers because the pressure drop in the supply lines as a result of the water depths would render the vibratory heads grossly under powered. While electric vibracores can be operated at depth, successful operation of electric vibracores at depths greater than 300 feet is unknown (as a result this depth limitation was used to initially screen candidate platforms). Consequently, it is recommended that an electric vibracore (Figure 7) be employed with sampling depths restricted to less than 300 feet.

Figure 7. Photo of representative electric vibracore

4.2 Evaluation of Sampling From a Platform

4.2.1 Factors Affecting the Feasibility of Sampling From a Platform

Since the majority of candidate platforms being evaluated have shell mounds centered within the platform footprint, an obvious option for sampling these mounds is to sample from the platform itself. There are two principal factors affecting the technical and logistical feasibility of sample collection from an operating platform. The first relates to the limitations of available sampling equipment to achieve the desired objective of collecting a continuous intact core to adequately represent the chemistry profile of a shell mound from an OCS platform (Section 4.1). The second of these factors relates more to constraints posed by the physical and operational features of the platforms themselves. The interplay between equipment limitations and the restrictions posed by physical and operational features of the platform will ultimately determine the technical and logistical feasibility of the proposed sampling program. Safety is the single most significant concern; the feasibility of sampling from a platform requires that potential hazards and the approaches to mitigate against those hazards be identified to assess whether it is possible within the funding and schedule constraints to safely conduct the sampling. To evaluate the feasibility of sampling from a platform, it is important to understand the operational constraints which differ by both platform and the proposed sampling area on a selected platform. In the sections that follow, operational constraints will be discussed by platform and sampling location. Ultimately, the feasibility of sampling shell mounds from the platform itself will be determined only for the best candidate platforms and sampling locations.

4.2.2 Operational Constraints of Sampling From a Platform

Because the electric vibracore is tethered to the surface by a power supply and lift cable, the potential for entanglement and/or abrasion of the power cord is a concern. As a consequence it is recommended that constrictions or potential entanglements be avoided to the extent practicable. In addition there are electrical power supply cables and gas and oil transfer lines that run to and from platforms on the sea floor that will need to be avoided. Consequently, a video camera or diver survey will be required prior to sampling to ensure the selected sampling path and actual sampling location is free of entanglements and obstructions. A camera and/or guide wire may also be required during sampling to further reduce the risk of entanglement and/or damage to either equipment or adjacent platform structures. It is also recommended that sampling be restricted to clear days with sea states less than 3 feet to facilitate control during deployment and recovery operations.

Deployment and recovery of the vibracore will require sufficient space for the vibracore (minimum of 35 linear feet of deck space) and ancillary equipment such as air tuggers and core processing equipment (approximately 10 x 10 feet). In addition, an overhead clearance of about 25 feet is required for a 20 foot core tube. In the event sufficient deck space is not available on a selected platform for processing the core, it may be possible to transfer the core to an adjacent vessel for processing.

Utility requirements for sampling include an electrical power source (230V, 3 phase, 30 amp; standard 110V), compressed air for operation of air tugger, and clean rinse water (seawater or freshwater).

All sampling personnel will need to be 40 hour HAZWOPER certified, swing rope certified and receive appropriate safety briefings for the selected platforms and operational areas.

4.3 Evalution of Sampling From Candidate Platforms

Candidate platforms were evaluated for site-specific features that may affect the feasibility of performing sampling operations from the platform decks. This site reconnaissance was performed at California OCS Platforms; Habitat, Hill House, A, B and C on August 23 – 24, 2005. A planned site visit to Platform Gilda has not yet taken place and additional information from Gilda may be added when available.

4.3.1 Platform Habitat

Habitat is located further from shore (7.8 miles) (with exception of Gilda) and in deeper water (290 feet) relative to the other four candidate platforms under consideration. Habitat is approximately 2.5 miles from the Hillhouse, A, B, C group and about 12 miles from Gilda. It is a newer platform relative to Hillhouse, A, and B, beginning operations in 1981. There are only a small number of open well slots remaining (4) and the rig is currently undergoing conversion whereby a second string of tubing will be added to existing conductors to facilitate water removal and hopefully enhance gas production. There does not appear to be any slant drilling conductors on Habitat. A recent side scan sonar investigation (MEC and Sea Surveyors 2003) shows the shell mound to be centered beneath Habitat, measuring approximately 19 feet in elevation and containing about 7,000 cubic yards of material (Figure 8). Based upon the recent site reconnaissance there was a large rectangular opening (36” x 36”) through the production and drilling decks that may permit sampling from the drilling deck (Figure 9). There are also a few open areas at the 15-foot deck level that may provide an opportunity for sampling. The catwalk associated with this platform is a perimeter catwalk (though there is a section that traverses through the center) (Figure 10). There do not appear to be any obstructions adjacent to the center area, other than some supporting cross-members.

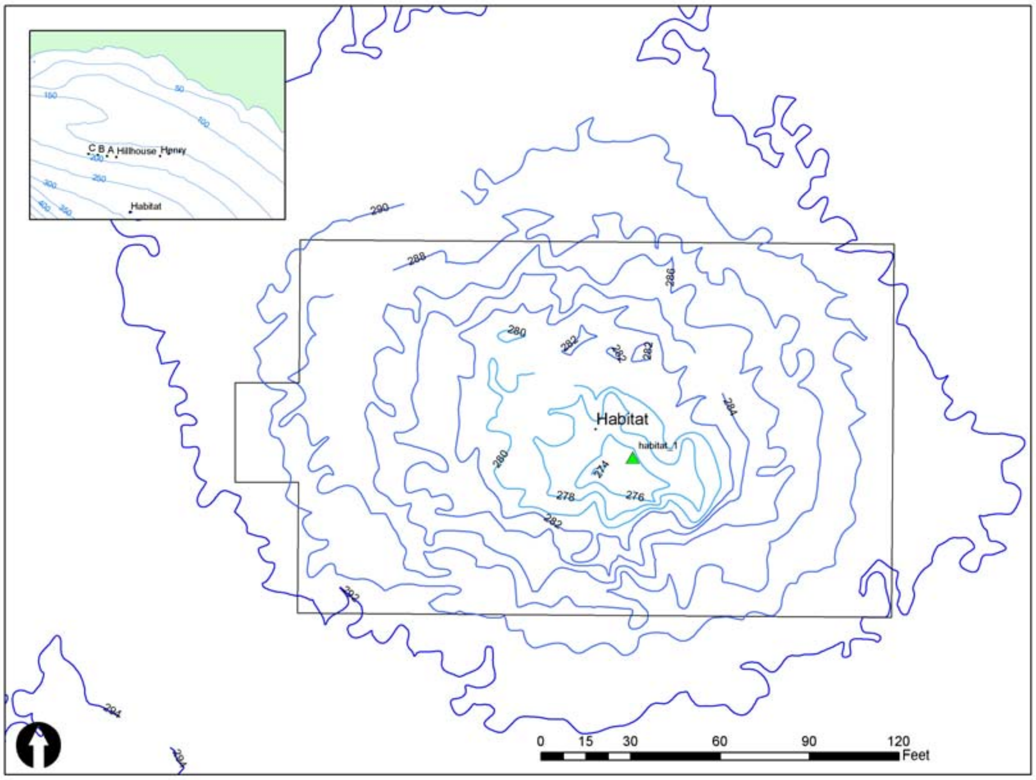

Figure 8. Side scan bathymetry beneath Habitat with location of open well slot indicated (green triangle).

Figure 9. Open well slot and openings through all three decks

Figure 10. Open area on 15-foot deck.

4.3.2 Platform Hillhouse

Hillhouse is located slightly closer to shore (approximately 5.5 miles) than either Habitat or Gilda, in close proximity (i.e., < 1 mile) to platforms A, B, and C, in about 190 feet of water. Hillhouse is one of the older platforms under consideration beginning operations in 1969. There are a small number of open well slots remaining (8) and the platform has both slant and straight well conductors. Platforms in the Hillhouse group are currently undergoing routine maintenance (removal of fouling communities from superstructure). The recent side scan sonar investigation (MEC and Sea Surveyor 2003) shows a shell mound approximately 22 feet in elevation centered along the Western edge of the platform (Figure 11). There are also a few open areas at the 15-foot deck level that may provide an opportunity for sampling. The catwalk associated with this platform includes a perimeter catwalk and a large central work deck (Figure 12). There was also a beam winch above the central work platform and there do not appear to be any obstructions adjacent to the center area, other than some supporting cross-members.

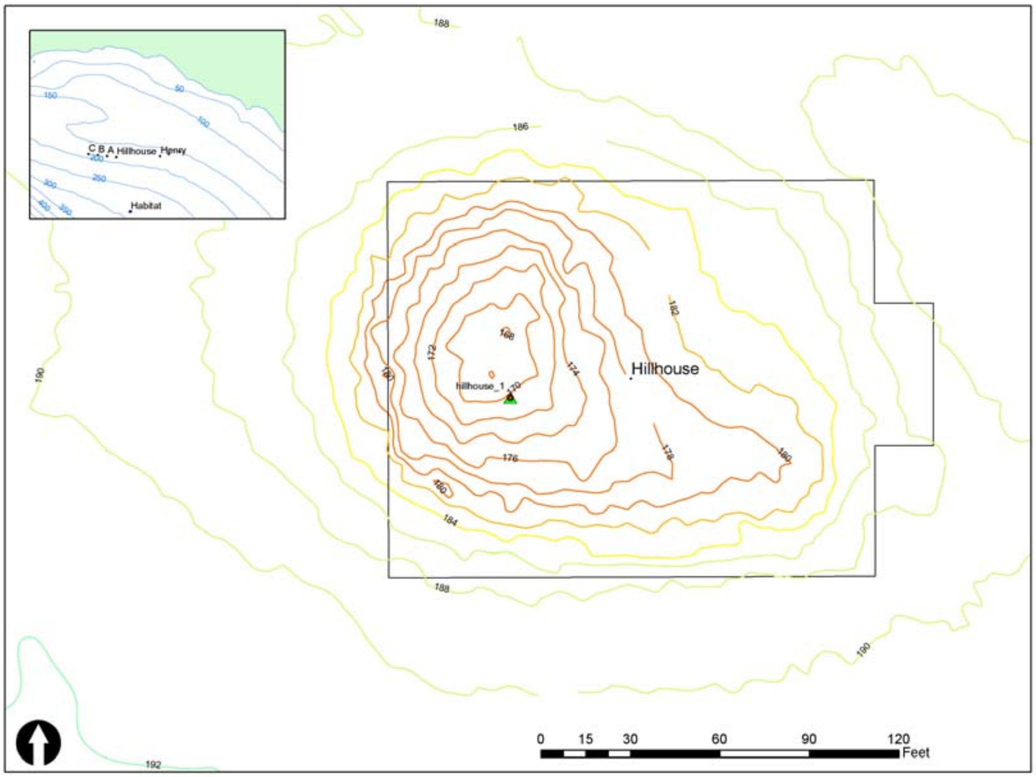

Figure 11. Side scan bathymetry beneath Hillhouse with location of open well slot indicated (green triangle).

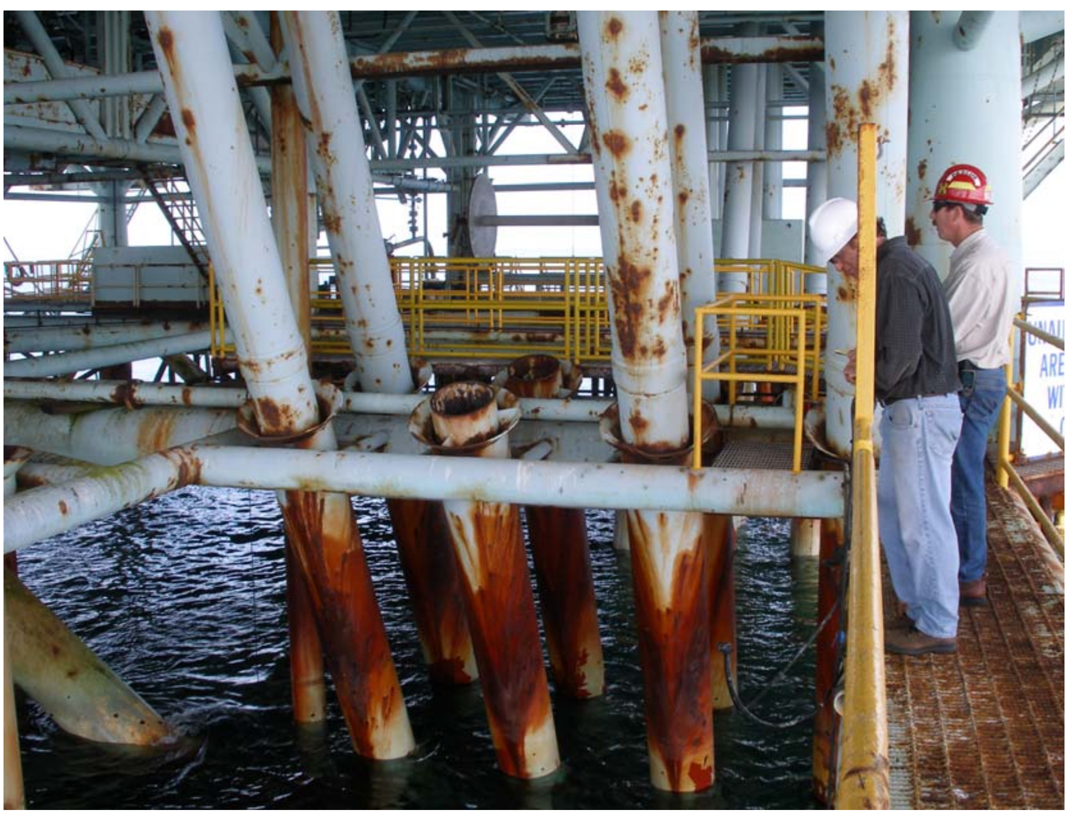

Figure 12. Work area on 15-foot deck of Hillhouse.

4.3.3 Platform A

Platform A is part of the Hillhouse, A B, C, group located relatively close to shore (approximately 5.5 miles) and within a mile of the platforms Hillhouse, B, and C, in about 190 feet of water. Platform A is one of the older platforms under consideration beginning operations in 1969. It was the site of the infamous blow-out in 1969 and the mound may have residual product related to that event. There are no open well slots remaining and the platform has both slant and straight well conductors. The platform is currently undergoing routine maintenance (removal of fouling communities from superstructure). The recent side scan sonar investigation conducted by MEC and Sea Surveyor (2003) shows a shell mound approximately 20 feet in elevation with the mound apex located in the southwestern edge of the platform footprint (Figure 13). There are a few open areas at the 15-foot deck level that may provide an opportunity for sampling with few apparent obstructions other than cross-members. The catwalk associated with this platform includes a perimeter catwalk and a large central work deck (Figure 14). There is also a beam winch above the central work platform (operational status unknown).

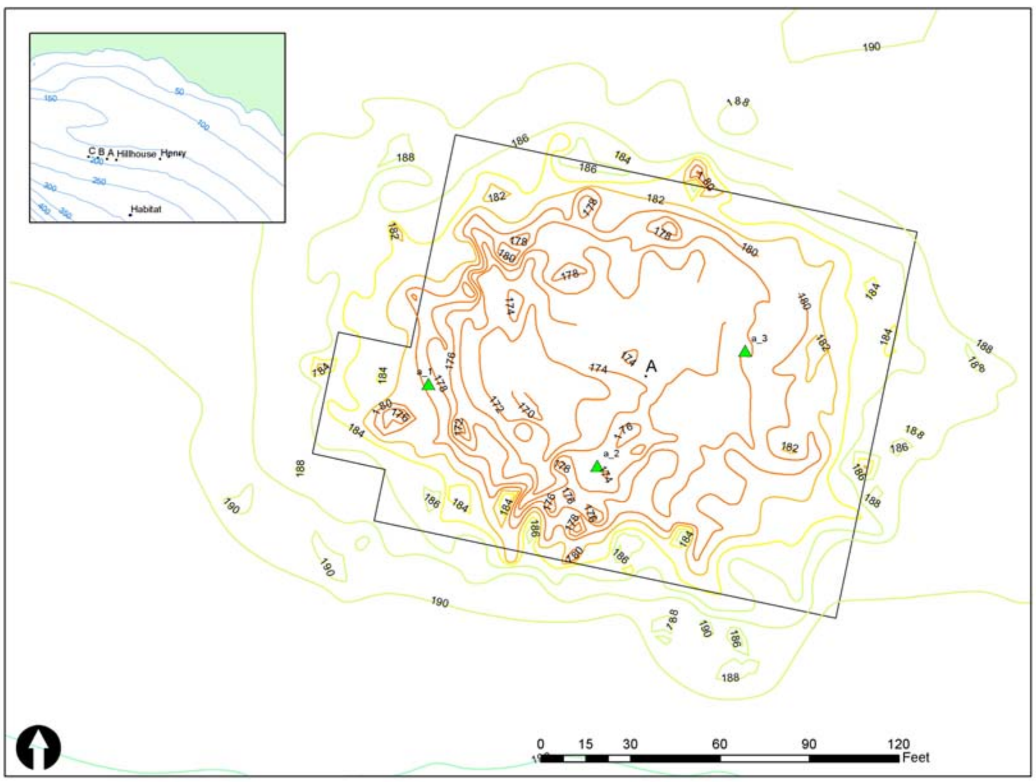

Figure 13. Side scan bathymetry beneath platform A with location of potential sampling locations indicated (green triangles).

Figure 14. 15-foot deck on platform A with central work deck.

4.3.4 Platform B

Similar to the other platforms in the Hillhouse group, Platform B is located relatively close to shore (approximately 5.5 miles) in 190 feet of water and within a mile of the adjacent platforms. Platform B began operating in 1969. There are a small number of open well slots and both straight and slant well conductors. The platform is currently undergoing routine maintenance (e.g., removal of fouling communities from the superstructure). The recent side scan sonar investigation (MEC and Sea Surveyor, 2003) shows a shell mound approximately 18 feet in elevation with the mound apex located in southwestern edge of the platform footprint. (Figure 15). There are a few open areas at the 15-foot deck level that may provide an opportunity for sampling with few apparent obstructions other than some supporting cross-members. The 15-foot deck associated with this platform includes a perimeter catwalk and a large central work deck (Figure 16). There is a beam winch above the central work platform (operational status unknown).

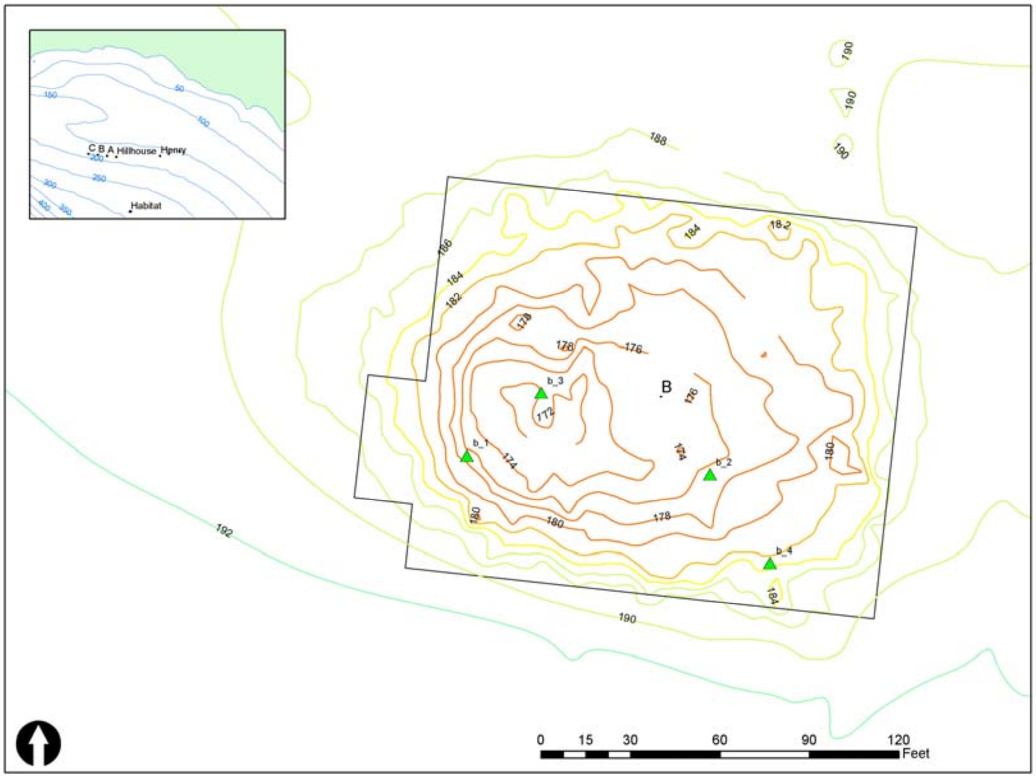

Figure 15. Side scan bathymetry beneath platform B with location of potential sampling locations indicated (green triangles).

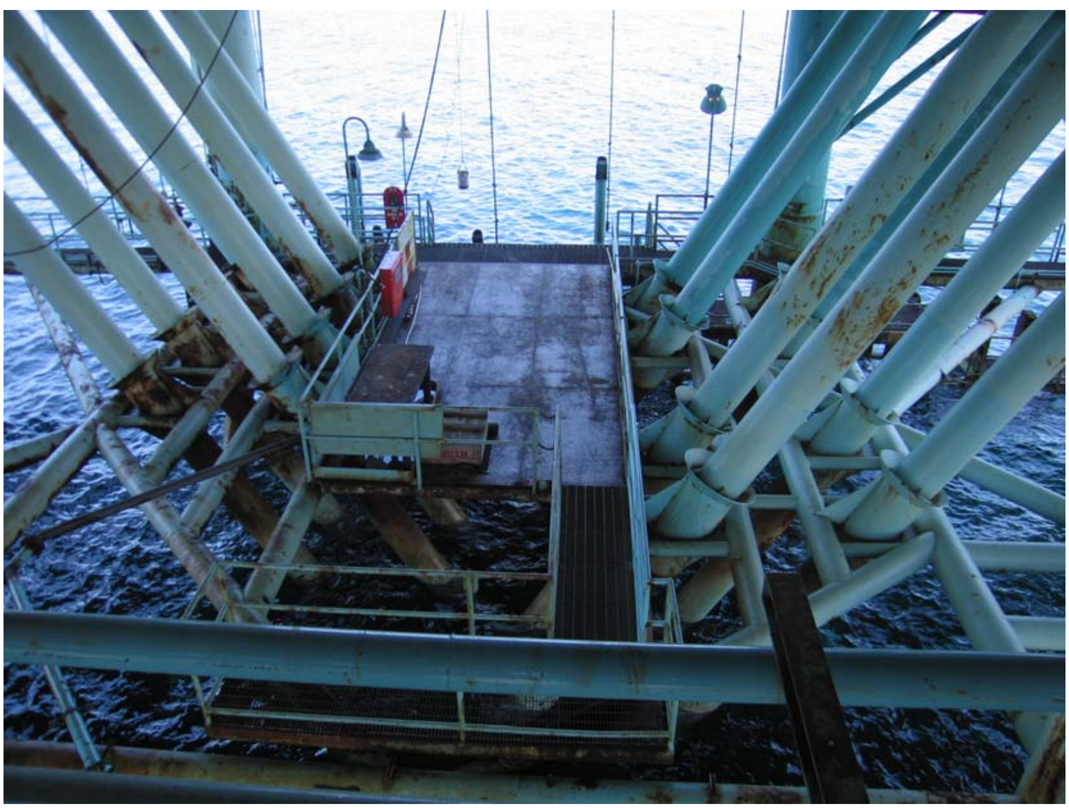

Figure 16. 15-foot deck on platform B showing central work deck.

4.3.5 Platform C

Platform C is part of the Hillhouse group located relatively close to shore in about 193 feet of water. It was placed in service in 1977, several years after the other associated platforms. There are a small number of open well slots and both straight and slant well conductors. The recent side scan sonar investigation (MEC and Sea Surveyor 2003) shows a smaller shell mound (relative to other candidate platforms) approximately 13 feet in elevation with the mound apex located in southwestern edge of the platform footprint (Figure 17). There are also a few open areas at the 15-foot deck level that may provide an opportunity for sampling with few apparent obstructions other than a few supporting cross members. The catwalk associated with this platform includes a perimeter catwalk only, with no central work deck (Figure 18).

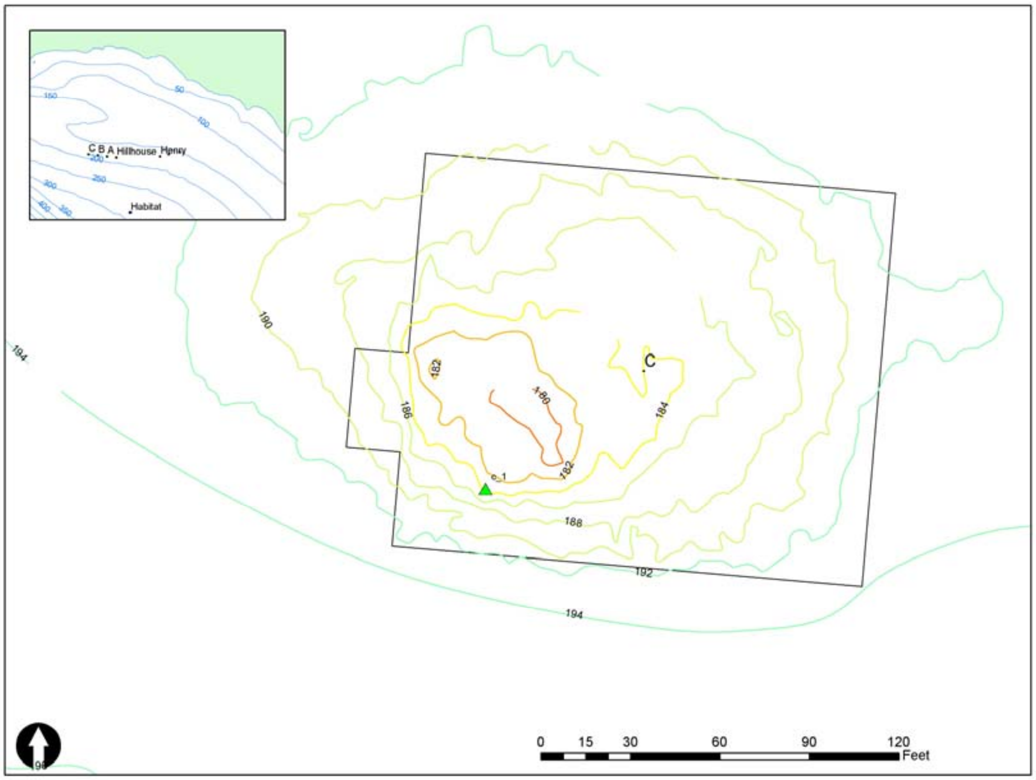

Figure 17. Side scan bathymetry beneath platform C with location of potential sampling locations indicated (green triangle).

Figure 18. The15-foot deck of platform C showing central work area.

4.3.6 Platform Gilda

Platform Gilda is located offshore of Ventura (about 8.8 miles) in about 200 feet of water. Gilda is a newer platform relative to the other platforms currently under consideration, beginning operation in 1981. There are a large number of open well slots (approximately 32). A recent side scan sonar investigation (MEC and Sea Surveyor 2003) shows a smaller shell mound (relative to other candidate platforms) approximately 18 feet in elevation with the mound apex located on the Northern edge of the platform and extending outside of the platform footprint (Figure 19). No site reconnaissance of this platform has been conducted to date.

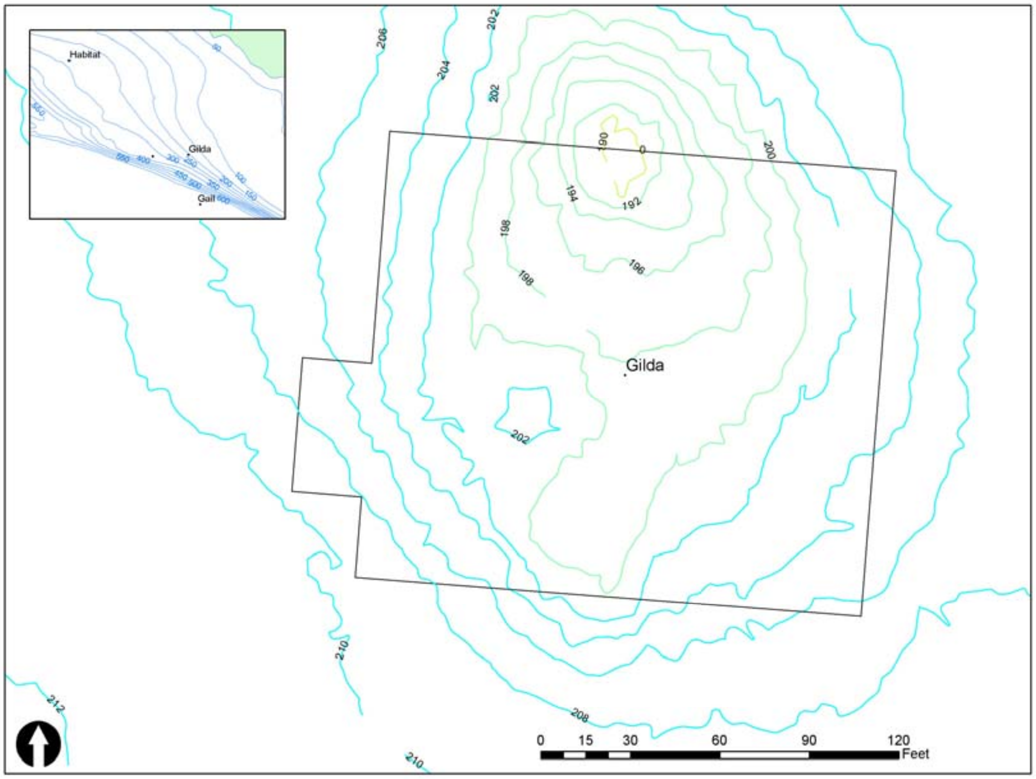

Figure 19. Side scan bathymetry beneath platform Gilda.

4.4 Potential Sampling Locations on Platforms

4.4.1 Drilling Deck

The drilling deck is the uppermost working deck on a platform and can be between 75 and 100 feet above the ocean surface. Drilling activities are conducted at this level. The drilling gantry is located on this deck and can be maneuvered over the various well slots in order to place and drill an oil well. Conducting vibracore sampling from the drilling deck would require the vibracore and barrel assembly to descend through a selected opening and down through successive openings in the decks below. Well slots on the drilling deck are characterized by a matrix of square, round, or oval openings with lids or covers on top. The lids may be loosely sitting on sills or welded to the deck surface (Figure 20). Well slot openings on the drilling deck range in size from approximately 18 to 36 inches depending on platform.

Figure 20. Drilling deck showing well slots with covers.

In addition to well slot openings each of the candidate platforms also have cutting chutes. The chutes were originally installed in order to convey drilling-generated waste materials such as cuttings, drilling muds and fluids, etc., to the sediment surface (note the discharge of cuttings and muds is no longer permitted). The topside end of the chutes are typically located near mud tanks on the drilling deck and may have a number of bends as they extend through all platform decks (Figure 21). The chutes extend below the ocean surface to roughly mid-water depths where they discharge drilling-related materials.

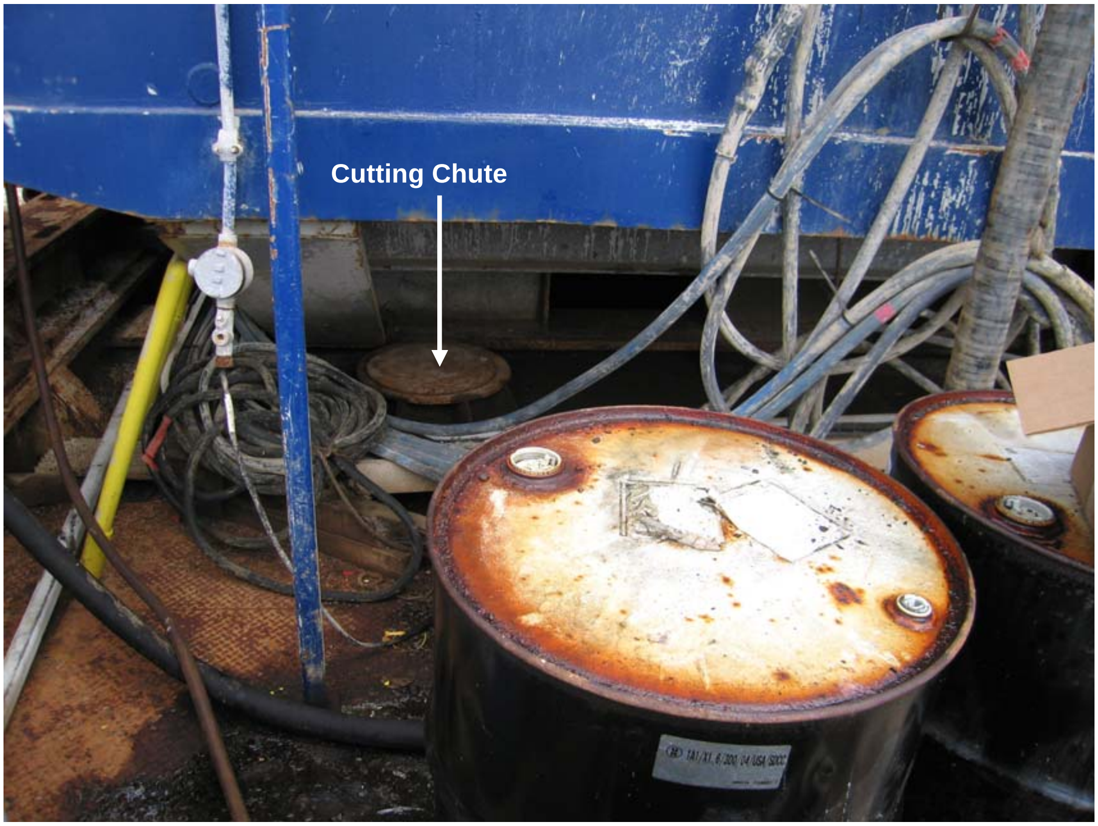

Figure 21. Cutting chute located beneath mud tank.

Since the discharge of drilling materials occurred through the cuttings chutes during historic oil production activities, the chutes were of initial interest as potential sampling locations. However, the narrow diameter of the chutes (approximately 15 to 18 inches), is insufficient to support vibracoring operations.

Sampling from platform drilling decks is favorable from the standpoint of site access, equipment and utility support, mobilization activities, and the containment of waste. However, difficulties with entanglements are anticipated while deploying and recovering the vibracore through the remaining platform decks and below surface features. Additional risks to the platform superstructure and vibracore power and wire cable are anticipated due to chafing. Sampling from the height of the drilling deck would add approximately an extra 100 feet of power and wire cable to the length needed to reach bottom. Finally, even where open well slots on candidate platforms are large enough to permit sampling by vibracore, openings on subsequent decks (i.e., Production and/or 15-foot deck) are generally not (i.e., generally less than 24”). Therefore, sampling from the drilling deck is not technically/logistically feasible due to the potential for entanglement and the limited size of available openings in the sampling path.

4.4.2 Production Deck (Well Bay)

The production deck houses the ‘Christmas trees’, the valves, pumps, and machinery necessary to convey oil from reserves beneath the platform to facilities used for processing the crude (Figure 5). Some platforms process recovered oil on site while others send it to nearby platforms for processing via pipeline. The space is relatively restrictive about 15 feet high and lies directly beneath the drilling deck. The deck is generally constructed of steel grating which can be removed in sections to access open well slots.

Conducting vibracore operations from the production deck would have to occur in the vicinity of the well bay in order to sample near the vicinity of the apex of the shell mound. However, vibracoring from this area would likely be prohibited due to the explosive and flammable nature of the location. The well bay is one of the most protected areas on an oil platform from fire and sparks and has extensive warning, detection, and suppression equipment installed. Vibracoring from this location would require use of electrical systems and support equipment and tools that would ultimately require deactivation of some or all of the emergency fire prevention systems on the deck. Additional sampling difficulties would be encountered on this deck due to insufficient overhead clearance to handle a vibracore with a 20-foot core barrel. Finally, the vibracore would have to be deployed through openings less than 24" inadequate to safely support vibracoring operations. Therefore, sampling from the production deck is not technically/logistically feasible due to safety considerations, the potential for entanglement, and the size of available openings in the sampling path.

4.4.3 15-Foot Deck

The 15-foot deck as the name implies, is approximately 15 feet above the ocean surface. The deck is largely comprised of a matrix of cross-members, pipelines, ladders, catwalks, and work platforms. The deck space is generally constructed of open steel grating. The average distance between the walking level of the 15-foot deck and the overhead (below the drilling deck) is about 28 feet. The deck space is occupied with well conductors, cuttings and processed water chutes, pipes and pipelines and some nominal machinery used for various maintenance activities. The 15-foot deck is not generally inhabited during platform operations.

Based on all platforms visited, the 15-foot deck is the preferred deck for vibracore sampling. There are minimal obstructions between the deck and the water's surface (it is noted that all the same potential underwater obstructions are still present and access would have to be found through this area in order to safely deploy and recover the sampling equipment). Additionally, the 15-foot deck is not an extreme fire and explosion hazard although similar precautions as those used for working on any other deck would be employed here as well. This includes the issuance of a 'hot permit' for all electrical work. Additionally workers on the 15-foot deck would be more exposed to the marine elements requiring training and safety precautions (life vest). Primary concerns that would have to be addressed for sampling on the 15-foot deck include: slip hazards resulting from work on metal grate surfaces and exposure to wet marine conditions, containment of investigation derived waste (IDW) collected during the coring process, identification of a sizable workspace for handling the vibracore and processing samples, prevention of possible oil slicks from rinsing the sampling equipment. Finally, the presence of sea lions on platform grates and deck surfaces is a concern (Figure 22). While sea lions tend to minimize contact with platform personnel, potential encounters could be further mitigated with the use of temporarily installed safety fencing around work areas.

The 15-foot decks on platforms A and B showed added potential for use in that work platforms of sufficient size were built onto the 15-foot decks, in relative proximity with the shell mounds. Additionally, electric beam winches (operational status unknown) installed over the central work area could be used in recovery and or transfer of core samples. An additional lifting point would have to be attached to the underside of the production deck to assist with vibracoring activities.

Based on this evaluation, it is technically/logistically feasible to use the 15-foot deck as a sampling area for vibracoring operations. Additional considerations for specific sampling locations are discussed in the sections that follow.

Figure 22. Sea Lions on the 15-foot deck.

4.4.4 Potential Sampling Locations on the 15-foot Deck

Several potential site-specific locations for vibracoring operations may exist on individual platforms. These locations may provide the best opportunity for success in terms of minimization of entanglement and chaffing by way of defining an unobstructed "through-hole" clear to the sediment surface. Some of the platforms under consideration utilize slant drilling technology in addition to traditional vertical well development techniques. This results in lower-deck and below-surface obstructions in and around the platform jacket. Identification of an open space access point first requires identifying the pathways of all vertical and slant well conductors from platform to sea bottom. Additional platform devices such as anodes typically run from the 15-foot deck to anchor points on the sediment surface (Figure 23). Electric currents that are applied to the anodes which are grounded in the ocean help reduce aggressive corrosion experienced in the marine environment. While it may also be possible to identify a sampling path from the edge of a platform to the sea floor, and therefore outside the internal maze of the platform's structure, it is likely that such a sampling location would be well away from the mound apex and potentially even outside the mound apron.

Figure 23. Open area at 15-foot deck level showing anode cable.

Results of the reconnaissance survey showed the existence of potential locations for vibracoring at a limited number of structural openings located on the 15-foot deck on some of the platforms. Specifically, Platforms A, B and C, which were based on a common design, had a large opening virtually in the center 15-foot deck area. Additionally, Platforms A and B had a work deck installed over a relatively large area adjacent to the most promising coring locations. The platform would be of sufficient size to accommodate vibracore deployment, recovery, and sample processing activities.

The identified areas did not have anodes extending, through the water column to the bottom thus reducing the potentials for entanglement. There are however a number of slant wells that run directly below the platforms and adjacent to the proposed coring location. Additionally, subsurface current patterns might affect the vibracore and verification of a clear path to the bottom would have to be made prior to sampling.

On platform B, an additional area with a small platform and adjacent catwalk were evaluated at the northeast corner underneath well room 3. A single anode was located on the outside edge of the area and believed not to be an obstruction; however, this would need to be verified prior to selecting this as a sampling location. At this time it appears that these sampling locations provide a technically/logistically feasible access point for conducting sampling operations consistent with the goal of the program (collection of a core samples near the mound apex). To ensure safety during the sampling operation, a "live feed" video camera would need to be in place prior to and during sampling operations.

4.5 Other Considerations for Sampling from Platforms

4.5.1 Evaluation of Platform Utilities Necessary for Vibracoring

Platform operations personnel may be able to provide or assist with a number of system utilities necessary for vibracoring. Utilities and systems needed to conduct vibracore operation include: electrical systems (220VAC, 3-phase power), compressed air for tugger operation, rinse water (sea water and/or fresh water), access to lifting equipment (cranes, winches, air tuggers, davits, etc.), and waste containment systems for excess sediment not deemed suitable for discharge back into the ocean.

4.5.1.1 Electricity

All platform operators volunteered to install 220 VAC 3-phase electrical outlets to the selected coring location. This would require the issuance of a Hot Work Permit which they were willing to pursue upon approval of company personnel. The sampling team would need to provide power specifications and/or a representative female connector to create a termination for the coring power supply.

4.5.1.2 Rinse Water

Both fresh and seawater sources were available in specific areas on all platforms. Operators were willing to share these resources with sampling personnel and hoses or water pipes could be run to the approved sampling locations.

4.5.1.3 Lift Equipment

Platform operators were willing to assist the sampling team by using on site cranes to lift the sampling equipment on and off of the platform from a survey vessel. Cranes cannot be used for sampling since the crane's wire must not come in contact with the ocean. Operators will not allow lubricants from the wire to be discharged into the ocean. Additional winches, tuggers, etc., could be installed at the expense of the sampling team. Operators would assist with the installation of air tuggers, and lifting blocks which would require welding and Hot Work permits.

4.5.1.4 Compressed Air

Platform operators routinely use compressed air for the operation of some tools and other operations. A compressed air line would be installed to the sampling area for use with an air tugger if this lifting device is selected for use.

4.5.2 Waste

Waste in the form of excess sediment not utilized in the vibracoring process is termed Investigation Derived Waste (IDW). Additional waste may include rinse water used in decontamination of the vibracore and core barrel as well as in preparation of core sampling equipment. Additional rinse water may be generated during routine decontamination and preparation of homogenization and sampling tools and equipment.

Platform operators universally requested that all unused material, IDW, rinsate, etc., be collected and transferred to existing mud tanks. These retention bins are used to store materials not suitable for ocean discharge until they are properly cleaned. Sampling from the 15-foot deck will require installation of decking, sills, barrels, etc. to capture any mud, rinsate, and IDW which would be transferred to mud bins located on the drilling deck. Essentially, a shallow box could be assembled to accommodate the vibracore and core tube upon retrieval to reduce the potential for IDW entering the water. Finally, the prevention of any sheen on the water's surface is critical. A boom could be placed around the sampling area and BMP's employed for cleaning the vibracore and barrel in order to minimize waste lost and any potential sheen.

4.5.3 Potential Hazards and Risks

A number of potential risks to personnel and equipment have been identified. The majority of these relate to conducting vibracore sampling operations in a "live" production environment and are focused on hazards with the sampling operation (i.e., potential for entanglement or contact with platform elements, management of IDW, etc.) as well as those potential hazards associated with working on an offshore platform in general (potential for wet marine conditions, overhead hazards associated with heavy equipment operation, explosion hazards, etc.). A major focus of this feasibility study has been on developing approaches to mitigate these potential hazards (e.g., use of appropriate PPE for protection of field personnel, safety briefings and training, identification of sampling locations and pathways to minimize potential entanglement or contact, etc.) This sampling program will require constant vigilance as well as an intimate daily knowledge of ongoing platform operations and it is recommended that a detailed communications plan be developed to keep vibracore team members and platform operations personnel appraised of each others' activities.

In addition to potential risks to equipment and personnel there is also the risk that sampling will not result in the successful collection of a core sample from the shell mound. While there is no guarantee that a specific sample will be collected even if deployment of the sampling gear is successful (e.g., sample material may preclude penetration by the coring tube; or sediment may be lost from the core during retrieval), the approach has been developed to maximize the likelihood of success by selecting equipment that has been used successfully in previous shell mound sampling operations. Constraining sampling depths to <300 feet (within the known operating depth of the equipment), and allowing for multiple attempts (albeit within a limited spatial area) also increases the potential success of the sampling operations. Our experience in the use of this equipment and applying the method in the sampling of shell pile materials is relatively unique and enhances the likelihood of success in sampling at a 'live' production setting.

4.5.4 Health and Safety Considerations

Personnel working on a platform will need OSHA 40-hour Hazwopper certification and be current with 8-hour refresher certification. A sampling effort will require a site specific Health and Safety Plan which will be reviewed and approved by platform operations safety personnel. Additional platform required certification may be required such as swing rope certification.

4.5.5 Personal Protective Equipment (PPE)

General personal protective equipment (PPE) required for work on off shore oil platforms includes: steel toed boots, long pants, safety glasses, hard hats, and hearing protection. Additional site-specific sampling equipment may include nitrile or latex gloves for sample handling, US Coast Guard certified Class V personal floatation devices (PFDs) for work in areas where accidental immersion may occur, and additional protective clothing as determined on an as-needed basis.

4.6 Alternatives to Sampling From a Platform

Sampling directly from a platform presents a number of challenges (logistical, health and safety, etc.) and restricts both the location and number of samples that can be collected. Other alternatives to be considered include sampling from a vessel either directly or using a remotely operated vehicle.

4.6.1 Sampling Using a Remotely Operated Vehicle (ROV)

Sampling beneath an active platform might be performed using an ROV. Unfortunately, there are no existing ROVs capable of collecting cores up to 20 feet in length. In addition, ROVs are generally tethered to a surface support vessel via a control umbilical which represents a potential entanglement hazard. Finally, sampling by ROV would require costs and planning outside the scope of this program. Therefore, sampling by ROV is not feasible from a technical/logistical, scientific utility, safety, and cost perspective within the context of this program.

4.6.2 Sampling From a Vessel

Previous sampling of shell mounds (4H platforms) was conducted using a motor vessel as the sampling platform. However, in the case of the 4H shell mounds, accessibility to the mound was not restricted by the platform structure (as it had been removed). Based on a review of side scan sonar data of shell mounds for the primary candidate platforms, it appears that the mounds generally reside directly beneath the platform structure, with the exception of Gilda where the mound apex and apron extend outside the platform footprint. Using a vessel to sample shell mounds centered below the platform superstructure is problematic. While, from a technical/logistical perspective, it is possible that a vessel equipped with a boom crane could be used to access the interior of the structure to sample the mound apex, from a safety perspective this would present a significant potential risk to both the vessel and the platform (e.g., were sea state or weather to change during sampling, contact between the boom and platform might be unavoidable). Therefore, the use of a boom crane to sample from a vessel within the confines of the structure is not considered feasible from a safety perspective. It is possible to use a vessel to safely sample those portions of the mound that extend beyond the footprint of the platform superstructure (i.e., the apron of the mound). While five of the six candidate platforms have mounds centered directly beneath the platform superstructure making sampling from a vessel problematic, platform Gilda has a shell mound whose apex and apron extends outside the platform foot print. Consequently, sampling from a vessel may be possible for Gilda and other similar platforms (e.g., Gina) where shell mounds are centered outside of the platform footprint. Sampling from a vessel would permit sampling of multiple locations and reduce or eliminate issues associated with waste management as well as the need for platform modifications to accommodate sampling. In addition, sampling outside the platform footprint would significantly reduce the potential for encountering below water obstructions during sampling operations.

5.0 FINDINGS AND RECOMMENDATIONS

Based on the evaluation performed, it is believed that vibracoring from the 15-foot deck in open areas close to the center of the platform footprint may provide the best opportunity for success for sampling of shell mounds centered beneath active platforms. An electric vibracore should be used for sample collection. As previously discussed, the electric vibracore is the only commercially available device capable of collecting cores up to twenty feet in length and operating at the target sampling depths of 200 to 300 feet. Based on the use of an electric vibracore, sample collection should be performed from open areas on the 15-foot deck adjacent to work areas of sufficient size to support ancillary equipment (e.g., air tugger) and processing requirements (e.g., core trays). Sampling from the 15-foot deck will offer a stable sampling platform and minimizes the potential for entanglement during vibracore deployment and retrieval. However, an additional pre-sampling reconnaissance survey using an underwater video camera and/or diver would be required to confirm that the proposed sampling path and collection location is free from entanglements and obstructions. Dependent on results of the pre-sampling reconnaissance survey, a guide wire, vibracore mounted video camera, and/or diver would also likely be required to minimize the potential entanglement or encountering of obstructions. Sampling should only be conducted under calm sea state and weather conditions. In order to minimize impacts on drilling operations and control costs it is likely that only a single location (at the apex or as close to apex of the mound as practical) can be sampled at each selected platform.

Even with additional reconnaissance surveys and incorporation of other mitigating elements (use of guide wires and video cameras during actual sampling operations) the potential for entanglement cannot be eliminated. Furthermore, sampling of a single location (albeit the mound apex) provides little information on the spatial heterogeneity of shell mound characteristics, and thus would only partially fulfill the goals of the program. Because of these limitations, and additionally cost and scheduling requirements that are outside the current scope, this approach is not considered feasible at this time.

It is therefore recommended that platforms with shell mounds centered outside the platform footprint be sampled from a vessel. This method of sampling has an established track record of success, enables the collection of multiple samples from multiple locations, and eliminates or reduces most of the logistical and technical concerns associated with sampling directly from a platform. Successful sampling from a vessel requires that the shell mounds be centered outside the platform footprint but within the prescribed depth limitations (<300 feet) of the selected sampling equipment (e.g., an electric vibracore). Two candidate platforms, Gina and Gilda, meet these requirements. Therefore it is recommended that characterization of platform shell mounds be conducted on the shell mounds associated with Gina and Gilda and sampling be performed from a vessel. Three to four sampling locations could be sampled at each shell mound providing better spatial representation of shell mound characteristics. No additional site reconnaissance would be required other than establishing location and position of any slant conductors associated with these platforms.

6.0 SUMMARY

This Feasibility Study represents the first step in the planning process for the OCS shell mound characterization sampling. Results of this feasibility study indicate that sampling of shell mounds centered directly beneath active platforms is not feasible at this time because of safety, cost, and scheduling concerns, and because of the limited information that would be collected when sampling only a single location on a shell mound. Consequently, it is recommended that platforms with shell mounds centered outside of the platform footprint (e.g., Gilda and Gina) be sampled from a vessel. Sampling from a vessel eliminates most of the potential hazards associated with sampling from a platform, enables the sampling of multiple locations and has a proven record of success. Other important accomplishments/findings of this feasibility study include:

- Selection of candidate platforms and representative shell mounds within the depth limitations of commercially available sampling equipment (e.g., <300 feet);
- Selection of appropriate sampling equipment (vibracore) based on sampling goals (i.e., continuous cores up to 20 feet in length), identification of the limitations of alternative commercially available sampling equipment and demonstration of the experience required for the use of the selected tools for collecting sediment cores from shell mounds at comparable sampling depths.
- Identification of specific locations on the platforms that can accommodate the required sampling equipment (based on overhead height, isolation from overhead and overwater hazards) without significant risk to personnel or structures above the water surface and which provide access to a sampling point at or near the mound apex.
- Identification of sampling limitations relating to capability of commercially available equipment and restrictions posed by platform structure and operations.
- Identification of data gap regarding potential obstructions below the water surface for sampling of mounds centered underneath the platform superstructure and recommendation to address via (1) subsurface remote or diver assisted video reconnaissance survey; (2) diver survey within diver depths; and/or (3) live video during actual sampling operations.
- Identification of two candidate platforms (Gina and Gilda) with shell mounds centered outside of the platform footprint and within the appropriate depth limitations (<300 feet) enabling sampling from a vessel.

7.0 REFERENCES

MEC Analytical Systems, Inc. and Sea Surveyor, Inc. 2003. As Assessment and Physical Characterization of Shell Mounds Associated with Outer Continental Shelf Platforms Located in the Santa Barbara Channel and Santa Maria Basin. Final Report prepared for Minerals Management Service, Pacific OCS, Camarillo, CA.