

Deepwater Horizon Oil Spill (DWHOS)

NRDA SEAMAP Plankton Sampling Plan & Fall 2010 Cruise Plan

November 15, 2010

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Proposed Cruise Dates

R/V *Gordon Gunter* – August 24 to September 30, 2010

Leg 1: August 24 – September 10, 2010

Leg 2: September 15 – 30, 2010

Background/Justification

Conceptual Model – Water Column Organisms

The trustees have developed a preliminary conceptual model of the DWH release, potential pathways and routes of exposure, and potential receptors. This preliminary model has informed the trustees' decision to pursue the studies outlined in the work plan. By signing this work plan and agreeing to fund the work outlined, BP is not endorsing the model articulated in the work plan.

Release and Pathway

Oil released from the broken well head both dispersed at depth and rose through nearly a mile of water column. The composition of the released gas-liquid mixture changed over time and space as the result of dilution, changes in pressure, dissolution, and addition of other constituents such as dispersants, methanol, and anti-foaming additives. Of oil that made it to the water surface, some entrained water forming mousse, was dispersed into the water column naturally and by application of dispersants, and some was removed mechanically or by in situ burning. Floating oil, oil droplets and dissolved components were transported large distances at various levels of the water column. Oil also picked up sediments, and other particulate material, some of which became neutrally or slightly negative buoyant, sinking to various depths. The oil dispersed at the wellhead (both via turbulence or by injection of dispersants) was transported by currents that varied in time and space, yielding a complex pathway of subsurface oil contamination that affected abyssal, bathypelagic, and meso-pelagic waters of the offshore Gulf of Mexico.

Routes of Exposure

Fish and invertebrates in the water column are exposed to contaminants by swimming through the water column, passing contaminated water over respiratory structures, and ingesting water and oil droplets as part of feeding. Additionally, sensitive life stages of pelagic fish and invertebrates come in direct contact with floating oil that covers and is mixed into the neuston layer (upper ~0.5m) where many embryos and larvae develop. Other neustonic organisms exposed to surface oil include many small invertebrates important to the food web. In the water column, organisms are also exposed to

suspended oil droplets, which can foul appendages or other body surfaces. Water column organisms have also been exposed to dispersants dissolved in water, on oil droplets and adsorbed to suspended particulate matter. Water column organisms were also exposed to dissolved and water-borne chemical additives such as methanol and anti-foaming agents.

Plankton in the north-eastern Gulf of Mexico, which include early life history stages of fish and invertebrates, as well as smaller invertebrate holo-plankton and gelatinous zooplankton, are among those biota exposed to the released oil and spill-related chemicals. Plankton in the upper 200m of the water column were exposed both offshore and on the shelf. Figure 1 shows the approximate cumulative extent of oil on the water surface through July 2010, which indicates areas potentially affected.

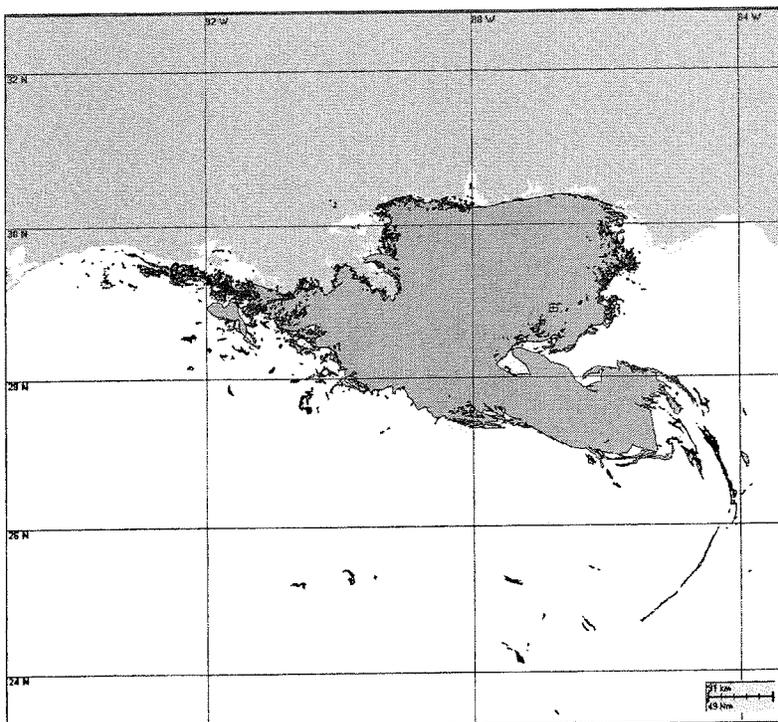


Figure 1. Cumulative potential surface oil extent of the Deepwater Horizon spill. (Figure derived from compositing April, May, June, and July radar shape files available on the NOAA ERMA website. Note that radar images with noted anomalies were not included in composite.)

Summary of Historical Shelf and Offshore Plankton Data

The NMFS/NOAA SEAMAP program is a long-standing plankton survey that covers nearly all of the Gulf of Mexico. With 25 years of data, this program offers a significant resource for understanding the characteristics of the natural state of this community. This is augmented by several state-based surveys that sample in waters closer to shore. In 2009, the SEAMAP program completed a winter, spring, and fall plankton survey. Each of these surveys took over a month to complete. The spring and fall surveys sample using the bongo and neuston net procedures; the strength of this data set is the longevity, 2009 was the 28th year¹. The winter survey targets fishes that are underrepresented by the spring/fall

¹ NOAA, 2010. Annual Report of the Southeast Area Monitoring and Assessment Program (SEAMAP). Number 177.

sampling procedures and attempts to capture the presence of winter-spawning species. The major drawback to the historical SEAMAP plankton surveys is that only the spring survey covers the offshore area. Plankton in the nearshore waters are well covered over all the seasons as plankton samples are collected in conjunction with the shrimp/groundfish surveys. Figures 1-10 of Attachment 1 summarize the historical and current datasets for plankton fish and crustaceans.

Objectives and Approach: Plankton Sampling Plan

This plan is for the first of a series of cruises to be conducted to evaluate the distribution and densities of ichthyoplankton and other zooplankton in Gulf of Mexico waters potentially affected by the Deepwater Horizon oil spill and in surrounding areas. Plankton in the upper 200m of the water column of the Gulf of Mexico, from Texas to Florida, have been sampled by the NMFS/NOAA SEAMAP program over the past 25 years (see above; attachment 1). The NRDA SEAMAP sampling plan takes advantage of this historical data set and plans for continuation of the program by the NMFS Southeast Fisheries Science Center (SEFSC). In order to maximize the use of the existing data, additional sampling will be completed to determine the background state of plankton in the Gulf of Mexico. This can be completed outside the area of impact and be compared to the 25-year dataset to generate an estimate of pre-spill densities.

SEAMAP sampling was conducted this year and additional sampling using the SEAMAP methods was completed during May in conjunction with other sampling efforts for the MC252 incident site (Figure 9-10 in Attachment 1). Additionally, as part of other NRDA sampling plans, other sampling methods (holographic camera, particle profilers) are being used to document the plankton in close proximity to the MC252 incident site where the presence of oil precludes the use of small mesh nets. The particle profilers are also being used in areas further from the well to document distributions and densities of plankton. Comparative studies between these plankton imaging systems and traditional net-based sampling techniques have been carried out by various investigators (i.e. Broughton and Lough, 2006). These studies have shown the advantages and limitations of imaging systems. For example small gelatinous organisms are easily identified and quantified by imaging, whereas in net sampling this group is under sampled.

The existing data that describes plankton distributions in potentially affected areas has several major gaps. First, the composition and density of plankton in the vicinity of the MC252 incident and the subsequent areas of impact is poorly characterized, especially in the deep-water areas surrounding the release site. Second, vertically stratified sampling in the upper water column is sparse. The NRDA expanded SEAMAP sampling plan described herein for the fall of 2010 addresses, in part, the first and second major gaps. Other data gaps for planktonic organisms include the underrepresentation of soft bodied organisms in net based surveys and a general paucity of information about organisms in the deeper layers. These data needs will be addressed elsewhere.

Finally, subsequent sampling in other seasons will likely be needed, particularly in spring and summer. Fully evaluating the post spill condition of the plankton community will require long-term sampling of the MC252 incident site and surrounding areas. Future sampling will likely need to occur in the months and years following the spill to document the plankton community immediately post incident and subsequent communities and densities in future time periods. The plan is to perform sampling in each of the four seasons over the next several years (extent of the program to be determined). Because

plankton are transported over wide areas, and populations are connected across the northern Gulf of Mexico, sampling plans need to be broad in geographic scope. Thus, a system wide survey is planned.

This plan describes a program of expanded fall SEAMAP plankton sampling to be conducted in August and September, 2010. The same sampling design will be followed in subsequent seasons as needed to capture data relevant to the injury assessment. The sampling and analysis protocols in the upper 200m of the water column are those used in the SEAMAP program. Ichthyo- and zooplankton will be sampled using paired bongo nets and at the water surface with a neuston net. Depth-discrete plankton samples taken at various intervals will be carried out using a Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS).

Methodology

NRDA SEAMAP Plan and Sampling Stations

The NOAA Ship *Gordon Gunter* will depart Pascagoula, MS on August 24, 2010 to conduct a portion of the standard SEAMAP Fall Plankton survey. The 34-day cruise will be conducted in 2 legs; one 18 day (August 24 – September 10) and one 16 day leg (September 15 – 30). In this work plan, the NRDA effort will support a portion of the standard fall SEAMAP sampling survey aboard the R/V *Gordon Gunter* and additional stations that fill the data gap in the deepwater areas near the spill (Figure 2). The expanded SEAMAP fall plankton survey will be cost shared between NRDA and NMFS.

The standard SEAMAP plankton sampling grid extends from the Texas shelf to the Florida west coast shelf. The grid runs from the coast out to the 200m bathymetric contour in the shelf waters of the gulf. Grid cells are 30 x 30 NM, with sampling stations located at the mid-point of each grid cell. For more detail on SEAMAP protocols see Attachment 3 "SEAMAP Field Operations Manual" and the annual SEAMAP environmental and biological atlas reports found at: http://www.gsmfc.org/default.php?p=sm_ov.htm#:content@8:links@4. The *Gunter* will sample a majority of the standard fall plankton SEAMAP stations on the shelf and offshore areas from Louisiana to Florida. Figure 2 shows the position of the shelf standard fall plankton SEAMAP stations that the *Gunter* will target. The remaining standard SEAMAP stations will be sampled by other vessels such as the *Oregon II* and by other state SEAMAP partners (Figure 2).

Due to the location of the oil spill (Figure 1), there is need to sample additional stations beyond the shelf region off the coast of Louisiana, Mississippi, Alabama, and Florida. The NRDA effort adds 31 stations to the survey in the deepwater areas where the spill occurred (approximately from 27° to 29°N, and 85° to 91°W) (Figure 2). The Deepwater offshore stations are located in >200m of water and specifically capture information about plankton beyond the shelf and in the vicinity of the release location of the oil spill. The position of the additional stations was determined by extending the standard 30NM fall SEAMAP sampling grid into the offshore vicinity of the spill site.

At these additional stations, the same sampling SEAMAP protocols and gear types will be deployed as well as use of a 1 m Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS). Attachment 2 (Cruise Instructions) describes the specifics of sampling during the cruise on the *Gunter*, as well as the sampling protocols and analysis procedures. Please note that the cruise instructions (Attachment 2) do not reflect the amended plan with the additional offshore stations. Instead, the Deepwater stations and MOCNESS sampling locations are contained within the body of this plan.

The tentative cruise plan for Leg 1 is to start sampling at station B247 (south of Louisiana) and move west to B243. Then a saw-tooth track will be followed back east along the shelf stations eventually ending up at the Deepwater stations (approximately as far east as the Florida panhandle). The vessel will then head back to port in Pascagoula for 5 days. During Leg 2 of the cruise the remaining Deepwater stations will get picked up first, working eastward finally down to South Florida.

The NRDA effort will also support the prioritization and accelerated processing of plankton samples from this cruise.

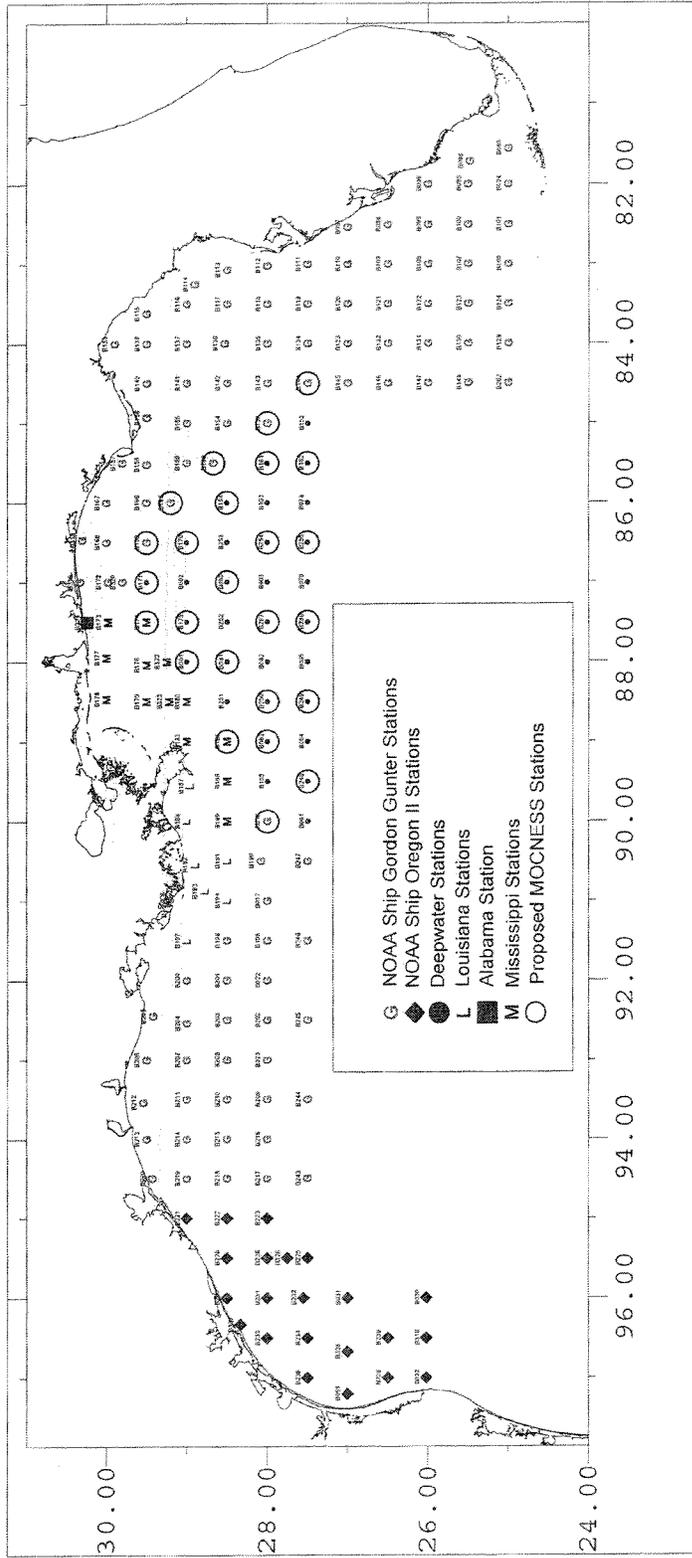


Figure 2. Fall plankton SEAMAP stations and additional deepwater stations to fill in gap where spill occurred. Symbols represent various ships/state SEAMAP partners and additional MOCNESS sampling sites. Note: stations to be sampled for the proposed cruise aboard the R/V *Gordon Gunter*, are marked as a red G (G NOAA Ship Gordon Gunter Stations) and a black dot (● Deepwater Stations). Stations with a black circle around them will be sampled with the MOCNESS.

Sampling Procedures

The primary objective of the survey is to assess the occurrence, abundance, and distribution of the early life stages of fall spawning fishes, especially king and Spanish mackerel, red drum, and snappers in U.S. continental shelf waters in the Gulf of Mexico. Early life stages of commercially important invertebrates (lobsters, decapods) will also be assessed.

In the upper 200m of the water column ichthyo- and zooplankton will be sampled using paired bongo nets and at the water surface using a neuston net. Standard SEAMAP sampling protocols will be followed at each station for the primary gear: oblique bongo tow to a maximum depth of 200 m, 10 min neuston tow, and CTD profile to a maximum depth of 200m. For detailed SEAMAP protocols and sample processing see Attachment 2 "Cruise Instructions" and Attachment 3 "SEAMAP Field Operations Manual".

In order to assess presence/absence, abundance, and diameter of oil droplets that are potentially in the surface layer, an additional 5 minute bongo tow will be carried out at most of the stations during the first leg (approximately 70 stations). This additional tow will be just below the surface and the sample will be taken from only one side (the right side) of the bongo array. Volume of water filtered will be recorded. Samples will be examined on ice under a microscope for oil droplets and notes will be recorded on frequency and size of any droplets that are observed. A 10g (wet weight) plankton subsample from this tow will be collected, placed in a Ichem pre-cleaned 4 oz vial and frozen and archived for chemical analysis (See Attachment 10 for detailed protocol).

Vertical distribution of plankton in the epipelagic zone (the top layer of the ocean where sunlight reaches and where photosynthesis can occur) will be measured by sampling at depth discrete intervals at a subset of the added offshore stations using a 1 m MOCNESS (0.505mm mesh). The MOCNESS will not be deployed at the same time as the other gear types while on station. The MOCNESS will be towed obliquely through the water column from a maximum depth of 130m. The first net will be open all the way down to 130m. Upon commencing the oblique tow back to the surface, the second net will be opened and cover the depth range from 130m to 100m. Additional nets will be opened and closed at depth intervals of 20m up to the surface. Much of the water column sampled by the MOCNESS will also be covered by the other plankton sampling gear. The advantage of the MOCNESS sampling is high resolution depth-discrete data, which is not achieved in the bongo tows. The target volume filtered for each depth strata is 250m³. For more detail on MOCNESS deployment and sample processing see Attachment 2.

For all sampling gears, detailed observations (abundance, wet weight volume, and species) of net-caught jellyfish, ctenophores, and other large zooplankton will be recorded. Sampling will occur 24-hours a day. Thus, samples will be obtained both in daylight and during the night. The changes in densities due to the diel cycle of zooplankton vertical migration will be evident in these data.

Additional NRDA Personnel for R/V Gordon Gunter:

1 NOAA Data Manager
1 ENTRIX employee

Vessel

Operations will be completed on the NOAA vessel R/V *Gordon Gunter*

Estimated Costs:

Based on the additional stations required for the NRDA effort, the MOCNESS sampling to get stratified sampling in the upper portion of the water column, and the need to bring on additional vessels to complete the field effort, a cost split between BP/NRDA and NMFS is being proposed. The accelerated timeframe for sample processing at the Sea Fisheries Institute, Plankton Sorting and Identification Center (ZSIOP), in Szczecin, Poland also results in a premium in cost. The budget will be presented with the cost distribution in the final version of the plan.

Fall - NRDA and SEAMAP plankton Cruise
24 Aug - 30 Sep, 2010
Gordon Gunter

Operations Cost		Days at Sea	BP share	NMFS share
Item	Cost/Day			
		34		
Vessel Base Pay (13)	1,934	65,755	32,878	32,878
Wage Marine Overtime	2,899	98,566	49,283	49,283
Employer Surcharge - 31%	600	20,384	10,192	10,192
NOAA Corps Officer Salaries	683	23,237	11,618	11,618
NC Special Pay/Benefits	447	15,190	7,595	7,595
Maintenance surcharge	4,560	155,040	77,520	77,520
Food/Supplies/Services	2,209	75,106	37,553	37,553
Fuel (\$2.50/gal)	4,125	140,250	70,125	70,125
MOC Shoreside Support (112.3% of WM and NOAA)	2,939	99,938	49,969	49,969
Operational Subtotal	20,396	693,465	346,733	346,733
SEFSC				
Labor NOAA-NMFS (8)	12044	409,496	204,748	204,748
Nets (Bongo, Neuston)		2,000	1,000	1,000
Labor & processing subtotal*		411,496	205,748	205,748
Grand Total		1,104,961	552,481	552,481

*Processing of samples by the Polish Sorting Center will be included as an addendum to the plan

Budgeting

The Parties acknowledge that this budget is an estimate, and that actual costs may prove to be higher due to a number of potential factors. As soon as factors are identified that may increase the estimated cost, BP will be notified and a change order describing the nature and cause for the increase cost in addition to a revised budget for BP's consideration and review.

Safety Plans

BP's full operations and safety plan is attached along with incident reporting form, SIMOPS protocols, and transfer protocols. In addition, the NOAA incident site safety plan (which all NOAA employees and contractors must sign prior to the cruise) is attached (Attachment 1).

Transfer of the shared electronic media in the onboard equipment to each of the party's hardware for retention and use.

Upon return to port, the vessel Operations Manager shall produce identical copies of the raw and processed electronic media generated during the cruise and deliver one of those copies each to NOAA (or its QA contractor) and to ENTRIX.

Laboratory

Sample handling, storage, and analysis will be handled by NOAA NMFS SEFSC as part of the SEAMAP program. SEAMAP, which is an ongoing survey with a long historical database, has established protocols and QA/QC guidelines for sample identification and handling, storage, and laboratory analysis. These same protocols will be followed for these samples. Processing of ichthyo- and zooplankton samples is carried out at Sea Fisheries Institute, Plankton Sorting and Identification Center (ZSIOP), in Szczecin, Poland, under a Joint Studies Agreement with NMFS. Samples collected from this cruise will be expedited and prioritized. Official NRDA chain of custody procedures will be followed for transfer from NMFS custody to the sampling laboratory.

Distribution of Laboratory Results

Each laboratory shall simultaneously deliver raw data, including all necessary metadata, generated as part of this work plan as a Laboratory Analytical Data Package (LADP) to the trustee Data Management Team (DMT), the Louisiana Oil Spill Coordinator's Office (LOSCO) on behalf of the State of Louisiana and to ENTRIX (on behalf of BP). The electronic data deliverable (EDD) spreadsheet with pre-validated analytical results, which is a component of the complete LADP, will also be delivered to the secure FTP drop box maintained by the trustees' Data Management Team (DMT). Any preliminary data distributed to the DMT shall also be distributed to LOSCO and to ENTRIX. Thereafter, the DMT will validate and perform quality assurance/quality control (QA/QC) procedures on the LADP consistent with the authorized Quality Assurance Project Plan, after which time the validated/QA/QC'd data shall be made available to all trustees and ENTRIX. Any questions raised on the validated/QA/QC results shall be handled per the procedures in the Quality Assurance Project Plan and the issue and results shall be distributed to all parties. In the interest of maintaining one consistent data set for use by all parties, only the validated/QA/QC'd data set released by the DMT shall be considered the consensus data set. The LADP shall not be released by the DMT, LOSCO, BP or ENTRIX prior to validation/QA/QC absent a showing of critical operational need. Should any party show a critical operational need for data prior to validation/QA/QC, any released data will be clearly marked "preliminary/unvalidated" and will be made available equally to all trustees and ENTRIX.

References

Broughton EA, Lough RG. 2006. A direct comparison of MOCNESS and Video Plankton Recorder zooplankton abundance estimates: Possible applications for augmenting net sampling with video systems. Deep Sea Research Part II: Topical Studies in Oceanography, 53, 2789–2807

Attachments:

- Attachment 1. Summary of Historical Shelf and Offshore Plankton Data
- Attachment 2. NMFS/NOAA SEAMAP Cruise Plan
- Attachment 3. SEAMAP Field Operations Manual
- Attachment 4. NOAA-NRDA_MC_252_Site_Safety_Plan_5.13.10
- Attachment 5. NRDA_Field_Sampler_Data_Management_Protocol_7_5_2010
- Attachment 6. MC 252_Incident_SIMOPS_Plan_May10_2010_Rev2 (2)
- Attachment 7. Transfer of Personnel and Material at Sea 070510
- Attachment 8. MC252 HSSE Incident Reporting Final 02 May 10 rev 1
- Attachment 9. MC252 Analytical QAP V2.1
- Attachment 10. Additional_BongoSample_Protocol.doc

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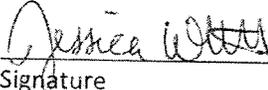
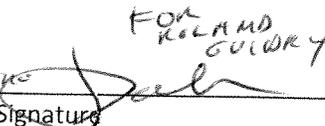
NRDA SEAMAP Plankton Sampling Plan
& Fall 2010 Cruise Plan

R/V *Gordon Gunter* – August 24 to September 30, 2010

November 15, 2010

Approvals

Approval of this work plan is for the purposes of obtaining data for the Natural Resource Damage Assessment. Parties each reserve its right to produce its own independent interpretation and analysis of any data collected pursuant to this work plan.

BP Approval	<u>Cash Fay</u> Printed Name	<u></u> Signature	<u>11/19/10</u> Date
Federal Trustee Approval	<u>Jessica White</u> Printed Name	<u></u> Signature	<u>11/17/10</u> Date
Louisiana Approval	<u>KAROLINE DOUSSARD</u> Printed Name	<u></u> Signature	<u>2/16/11</u> Date