PUBLIC NOTICE
U.S. Environmental Protection Agency, Region 4
Water Protection Division
NPDES Permitting and Enforcement Branch
Atlanta Federal Center
61 Forsyth Street, S.W.
Atlanta, Georgia 30303
(404) 562-9783

Public Notice No. **16FL00001** Date: June 15**,** 2016

NOTICE OF PROPOSED ISSUANCE OF
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

The United States Environmental Protection Agency Region 4 intends to issue National Pollutant Discharge Elimination System (NPDES) Permit No. FL0944858 to LLOG Exploration Offshore, L.L.C., 1001 Ochsner Boulevard, Suite 200, Covington, Louisiana 70433. The applicant has applied for an individual permit for the purpose of oil and gas exploratory drilling operations in Desoto Canyon, 713, OCS-G-31567. The subject lease is located approximately 139 miles south of the Alabama-Florida state line in Federal offshore waters. Discharges associated with this type of operation consists of water-based drilling fluids, drilling cuttings associated with non-aqueous drilling fluids, well treatment, completion and workover fluids, treated sanitary wastewater, domestic wastewater and deck drainage. The receiving waterbody is the Federal water of the eastern Gulf of Mexico.

The draft NPDES permit establishes limitations on the amounts of pollutants allowed to be discharged and was drafted in accordance with the provisions of the Clean Water Act (33 U.S.C. Section 1251, et seq.) ("Act") and other lawful standards and regulations. The draft permit is tentative and open to comment from the public. Specifically, the draft NPDES permit includes best conventional pollutant control technology (BCT), best available technology economically achievable (BAT) limitations for existing sources, and new source performance standards (NSPS) limitations for new sources as promulgated in the effluent guidelines for the offshore subcategory at 58 FR 12454 and amended at 66 FR 6850 (March 4, 1993 and January 22, 2001, respectively).

Persons wishing to comment upon or object to any aspects of a draft permit are invited to submit same in writing to the Water Protection Division, U.S. EPA, Atlanta Federal Center, NPDES Permitting Section, 61 Forsyth Street, S.W., Atlanta, Georgia 30303, ATTENTION: Ms. Bridget Staples, NPDES Offshore Oil and Gas Coordinator. Comments may also be send via email to: staples.bridget@epa.gov. Pursuant to 40 C.F.R. § 124.13, any person who believes that any permit condition is inappropriate must raise all reasonably ascertainable issues and submit all reasonably available arguments in full, supporting his or her position, by the close of the comment period. The public notice number and NPDES permit number should be included in the first page of comments.

All comments received within the public comment period will be considered in the formulation of a final determination regarding the draft permit. Also, within the public notice period, any interested person may request a public hearing. Where there is significant degree of public interest in a draft permit issuance, the EPA Regional Administrator will schedule and hold a public hearing which would be formally announced in accordance with 40 C.F.R. §§ 124.10 and 124.12.

After consideration of all written comments and the requirements and polices in the Act and appropriate regulations, the EPA Regional Administrator will make a determination regarding the permit issuance. If the determination is substantially unchanged from that announced by this notice, the EPA Regional Administrator will so notify all persons submitting written comments. If the determination is substantially changed, the EPA Regional Administrator will issue a public notice indicating the revised determination. Request(s) for an evidentiary hearing may be filed after the Regional Administrator makes the above-described determination. No issues shall be raised by any party that were not submitted

to the administrative record as part of the preparation of and comment on the draft permit, unless good cause is shown for the failure to submit them in accordance with 40 C.F.R. § 124.76. Additional information regarding an evidentiary hearing is available in 40 C.F.R. § 124, Subpart E, or by contacting the Office of General Counsel at the address above or at (404) 562- 9525.

The administrative record, including the draft permit, fact sheet, a sketch showing the exact location of the permit area, comments received and additional information on hearing procedures is available at cost by writing to the EPA at the address above, for review and copying at Atlanta Federal Center, 61 Forsyth Street, S.W. Atlanta, Georgia, between the hours of 8:15 a.m. and 4:30 p.m., Monday through Friday (copies will be provided at a minimal cost per page), or by downloading these documents from http://www.epa.gov/aboutepa/about-epa-region-4-southeast.

Please bring the foregoing to the attention of persons whom you know will be interested in this matter. If you would like to be added to our public notice mailing list, submit your name and mailing address to the EPA, at the address given above.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

JUN 15 2016

[See Attached Addressee List]

RE: Draft NPDES Individual Permit, No. FL0944858 for Offshore Oil and Gas Activities in the Eastern Portion of the Outer Continental Shelf of the Gulf of Mexico

Dear Addressee:

The Environmental Protection Agency Region 4, intends to issue the National Pollutant Discharge Elimination System (NPDES) individual permit for an exploratory offshore oil and gas operation in the Eastern Gulf of Mexico. The applicant, LLOG LLC plans to drill up to three exploratory wells in Lease Block 713, which is approximately 139 miles south of the Alabama-Florida state line in federal waters. Enclosed are the fact sheet and draft permit which show the intended proposed conditions to be incorporated as part of the final NPDES permit. Particular attention should be given to the effluent limitations, schedule of compliance, monitoring requirements, e-reporting requirements, and reporting dates. The Essential Fish Habitat Evaluation, Clean Water Act Section 403 Determination, and Endangered Species Act Biological Evaluation are also attached as supporting documents.

The public notice date has been scheduled for June 15, 2016, and will end on July 15, 2016. We are requesting your comments during the public notice period. Please submit your comments on the draft permit no later than 30 days from the receipt of this letter. Comments should be sent to shell.karrie-jo@epa.gov with a cc: to staples.bridget@epa.gov. Please feel free to call me at (404) 562-9308, if you have any questions.

Sincerely,

Karrie-Jo Robinson-Shell, P.E.
Environmental Engineer
NPDES Permits and Enforcement Branch

Enclosure (5)

1. Preliminary Draft Permit
2. Fact Sheet
3. Essential Fish Habitat Evaluation
4. Clean Water Act Section 403 Determination
5. Endangered Species Act Biological Evaluation Document

Interested Party Mail List

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Permit No. FL0944858
Minor Industrial

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended (33 U.S.C. 1251 et seq.; the "Act"), the

LLOG Exploration Offshore LLC
1001 Ochesner Boulevard - Suite 200
Covington, Louisiana 70433

is authorized to discharge from exploratory drilling and completion operations from wells located in Outer Continental Shelf area G-31567, Desoto Canyon Block 713

well A: lat. 28.00° 16.00' 12.69'' ; long. 87.00° 30.00' 05.50"
well B: lat. 28.00° 15.00' 52.52" ; long. 87.00° 30.00' 05.40"
well C: lat. 28.00° 15.00' 29.99'' ; long. 87.00° 30.00' 05.15''

Approximately 139 miles off the coast of Alabama to receiving

waters named **Gulf of Mexico**

in accordance with effluent limitations, monitoring requirements and other conditions set forth herein. The permit consists of this cover sheet. Part I 29 pages, Part II 16 pages, Part III 4 pages, Part IV 9 pages, Part V 26 pages, Appendix A (CORMIX tables), and Appendix B (Summary Effluent Limitations Table).

This permit shall become effective on August 1, 2016.

This permit and the authorization to discharge shall expire at midnight, July 31, 2018.

Date Issued

James D. Giattina, Director
Water Protection Division

DRAFT

Part I . Effluent Limitations and Monitoring Requirements for New and Existing Sources

The following limitations and monitoring requirements are summarized in Part V, Table 1 of this permit.

1. Drilling Fluids

a. Prohibitions

i. Non-Aqueous Based Drilling Fluids (NAFs) [including Synthetic-Based Drilling Fluids (SBFs)]. There shall be no discharge of NAFs, except that which adheres to cuttings, or which are considered de minimus discharges (see Part I.D.1) or as small volume discharges (see Part I.D.2).

Exception - NAFs may be used as a carrier fluids (e.g., transporter fluid), lubricity additive or pill in water-based drilling fluids, and may be discharged with those drilling fluids provided the discharge continues to meet the no Free Oil limit, the 96-hour LC_{50} toxicity limits, and the pill is removed prior to discharge.

ii. Oil-Based Drilling Fluids. There shall be no discharge of oil-based drilling fluids and inverse emulsion drilling fluids.

iii. Oil-Contaminated Drilling Fluids. There shall be no discharge of drilling fluids to which waste engine oil, cooling oil, gear oil or any lubricants which have been previously used for purposes other than borehole lubrication have been added.

iv. Diesel Oil. There shall be no discharge of drilling fluids to which any diesel oil has been added as a lubricant or pill.

v. No Discharge Near Areas of Biological Concern. Unless otherwise authorized by the Director, there shall be no discharge of drilling fluids and drill cuttings from those facilities within 1000 meters (or as determined by the Director) of an ABC.

vi. No Discharge Near Federally Designated Dredged Material Ocean disposal Sites. Unless otherwise authorized by the Director, there shall be no discharge of any drilling fluids, drill cuttings or produced waters from those facilities within 1000 meters (or as determined by the Director) of a Federally Designated Dredged Material Ocean Disposal Site. See 40 C.F.R. § 228.15(f) for a list of sites covered by this general permit.

b. Limitations

i. Mineral Oil. Mineral oil may be used only as a carrier fluid (e.g., transporter fluid), lubricity additive, or pill. If mineral oil is added to a water-based drilling fluid, the drilling fluid may not be discharged, unless the 96-hr LC_{50} of the drilling fluid is greater than 30,000 ppm (3% by volume) using the Suspended Particulate Phase (SPP) Toxicity Test and the sample passes the Static Sheen Test for free oil. The analytical methods for the SPP Toxicity Test and free oil are contained in Part I.B.1(b)(3) and (4) below. Samples must be taken at the nearest accessible location prior to discharge, or prior to combining with any other wastewaters.

ii. Cadmium and Mercury in Barite. There shall be no discharge of drilling fluids to which barite has been added if such barite contains mercury in excess of 1.0 mg/kg (dry weight) or cadmium in excess of 3.0 mg/kg (dry weight). The permittee shall analyze a representative sample of each supply of stock barite prior to drilling each well and submit the results for total mercury and cadmium on the DMR. If more than one well is being drilled at a site, new analyses are not required for subsequent wells, provided that no new supplies of barite have been received since the previous analysis. In this case, the results of the previous analysis should be used for completion of the DMR. Alternatively, the permittee may provide certification, as documented by the supplier(s), that the barite being used on the well will meet the above limits. The concentration of the mercury and cadmium in the barite shall be reported on the DMR as documented by the supplier. Analyses for cadmium shall be conducted by EPA Methods 200.7, 200.8 or EPA Method 3050 B followed by 6010 B or 6020A (EPA SW 846), and results shall be expressed in mg/kg (dry weight) of stock barite. Analysis for mercury shall be conducted using EPA Method 245.7 or EPA method 7471 A (EPA SW 846), and expressed as mg/kg (dry weight) of stock barite.

iii. Toxicity. Discharged water-based drilling fluids shall meet both a daily minimum and a monthly average minimum effluent toxicity limitation of 30,000 ppm (3.0% by volume), using a volumetric mud-to-water ratio of 1 to 9. The analytical method is cited in 40 C.F.R. Part 435, Appendix 2 of subpart A, entitled, "Drilling Fluid Toxicity Test." Monitoring shall be performed at least once per month by a grab sample taken from beneath the shale shaker for both the daily minimum and the monthly average minimum. If there are no returns across the shaker, the sample must be taken from a location that is characteristic of the overall mud system to be discharged. An end-of-well sample (See definition in Part V.B) is also required. The end-of-well test sample can also be used for the last monthly grab sample. The lowest daily minimum and lowest monthly average

for the quarterly reporting period must be reported on the DMR. Copies of the summary sheets for laboratory reports must also be submitted with the DMR. If a failure occurs, the facility must submit the entire laboratory report with the DMR.

Samples for this parameter must be taken at the nearest accessible location prior to discharge, or prior to combining with any other wastewaters.

iv. Free Oil. There shall be no discharge of drilling fluids that fail the Static Sheen Test. Monitoring shall be performed once per week using the Static Sheen Test method in accordance with the method provided in Part V.A.3, as published in 40 C.F.R. Part 435, Appendix 1 of subpart A. The results of each sheen test must be recorded for the fluids that are discharged and the number of days a sheen is observed must be reported on the DMR.

v. Maximum Hourly Discharge Rate. The maximum discharge rate (water-based drilling fluids) shall not exceed 1,000 barrels per hour. The maximum hourly discharge rate for each month must be recorded. The highest hourly discharge rate for the quarterly reporting period must be reported on the DMR in barrels/hour.

Exception - The Maximum Hourly Discharge Rate Limitation shall not apply to Water-Based Drilling Fluids discharged prior to the installation of the marine riser.

c. Monitoring Only Requirements
In addition to the above limitations, the following monitoring and reporting requirements also apply to drilling fluids discharges.

i. Drilling Fluids Inventory. The permittee shall maintain a precise chemical usage record of all constituents and their total volume, and mass added for each well. Information shall be recorded and retained for no less than the five years from the effective date of this permit.

ii. Volume. The total monthly volume (bbl/month) of bulk discharged drilling fluids must be estimated and recorded. The highest monthly volume (in bbl/month) and the average volume during the monitoring period shall be reported on the DMR.

2. Drill Cuttings

Except for the maximum hourly discharge rate, the permit prohibitions and limitations that apply to drilling fluids also apply to fluids that adhere to drill cuttings. Any permit condition that applies to the drilling fluid system, also applies to cuttings discharges. Monitoring requirements, however, may not be the same.

a. Prohibitions

i. Cuttings from Oil-Based Drilling Fluids. The discharge of cuttings is prohibited when they are generated while using an oil-based or invert emulsion mud.

ii. Cuttings from Oil Contaminated Drilling Fluids. There shall be no discharge of cuttings that are generated using drilling fluids that contain waste engine oil, cooling oil, gear oil or any lubricants which have been previously used for purposes other than borehole lubrication.

iii. Cuttings Generated Using Drilling Fluids Which Contain Diesel Oil. There shall be no discharge of drill cuttings generated using drilling fluids to which any diesel oil has been added as a lubricant.

iv. Cuttings Generated Using Mineral Oil. The discharge of cuttings generated using drilling fluids which contain mineral oil is prohibited except when the mineral oil is used as a carrier fluid (e.g., transporter fluid), lubricity additive, or pill.

v. No Discharge Near Areas of Biological Concern. There shall be no discharge of drill cuttings from those facilities within 1000 meters (or as determined by the Director) of an ABC.

vi. No Discharge Near Federally Designated Dredged Material Ocean Disposal Sites. There shall be no discharge of any drilling fluids, drill cuttings or produced waters from those facilities within 1000 meters (or as determined by the Director) of a Federally Designated Dredged Material Ocean Disposal Site. See 40 C.F.R. § 228.15(f) for a list of sites in the general permitting area.

vii. Cuttings Generated Using Synthetic-Based Drilling Fluid. There shall be no discharge of non-aqueous based drilling fluid, except that which adheres to cuttings, de minimus discharges (see Part I.D.1) and small volume discharges (see Part I.D.2).

Exception - NAFs may be used as a carrier fluid (e.g., transporter fluid), lubricity additive or pill in water-based drilling fluids and discharged with those drilling fluids

provided the discharge continues to meet the no free oil and 96-hour LC_{50} toxicity limits, and a pill is removed prior to discharge.

b. Limitations which apply to all drill cuttings

i. Mineral Oil. There shall be no discharge of mineral oil.
Exception - Cuttings from a water-based mud system may be discharged when mineral oil pills or mineral oil lubricity additives have been introduced if they meet the limitations below for aquatic toxicity and free oil.

ii Free Oil. No free oil shall be discharged. Monitoring shall be performed on cuttings discharges once per week using the Static Sheen Test method in accordance with the method provided in Part V.A.3. Samples must be taken at the nearest accessible location prior to discharge, or prior to combining with any other wastewaters. There shall be no discharge of cuttings that fail the static sheen test. The results of each sheen test for fluids that are discharged must be recorded and the number of observations of a static sheen must be reported on the DMR.

iii. Suspended Particulate Phase Toxicity. Discharged cuttings shall meet both a daily minimum and a monthly average minimum effluent toxicity limitation of at least 30,000 ppm (3.0 % by volume), using a volumetric mud-to-water ratio of 1 to 9. The analytical method is cited in 40 C.F.R. Part 435, Appendix 2 of subpart A, entitled, "Drilling Fluid Toxicity Test." Monitoring shall be performed at least once per month by taking a grab sample from beneath the shale shaker for both the daily minimum and the monthly average minimum limits. The toxicity test may be satisfied by the same sample used for the drilling fluid. An end-of-well sample is also required. The end-of-well test sample may also be used as the last monthly grab sample. The lowest daily minimum value for the 12-month reporting period as well as the lowest monthly average test result must be reported on the DMR. Copies of the summary sheets for laboratory reports also must be submitted with the DMR. If a failure occurs, the facility must submit the entire laboratory report with the DMR.

c. Discharge Limitations Applicable to Synthetic-Based Drill Cuttings

Except for the toxicity testing requirements for drilling fluids in Part I.B.1.b.(iii), all the limits for drill cuttings in Part I.B.2.(b), above, apply to synthetic-based drill cuttings.

i. Formation Oil. There shall be no discharge of formation oil. Monitoring of the drilling fluids shall be performed, as follows:

(1). Once prior to drilling using the gas chromatography/mass spectrometry test (GC/MS) method specified in Appendix 5 of 40 C.F.R. Part 435, subpart A. Part I

Alternatively, the permittee may provide certification, as documented by the supplier(s) that the drilling fluid being used on the well contains no formation oil as determined using the GC/MS method in Appendix 5 of 40 C.F.R. Part 435, subpart A.

(2). Once per week during drilling using the Reverse Phase Extraction (RPE) test method specified in Appendix 6 of 40 C.F.R. Part 435, subpart A. If an operator wishes to confirm the results of the RPE method, the GC/MS method may be used, and results of this method shall supersede the results of the RPE method. Alternatively, the operator may use the GC/MS method instead of the RPE method. All test results shall be reported with the DMR.

ii. Drilling Fluid Sediment Toxicity Ratio. The sediment toxicity test ratio shall not exceed 1.0 and shall be calculated based on the following:

$$\text{Drilling Fluid Sediment Toxicity Ratio} = \frac{\text{4-day } LC_{50} \text{ of } C_{16}\text{-}C_{18} \text{ internal olefin reference drilling fluid}}{\text{4-day } LC_{50} \text{ of drilling fluid removed from the drill cuttings at the solids control equipment}}$$

The approved test method is ASTM method no. E1367-92 (or the most current EPA approved method) and monitoring for this parameter shall be once per month per well. Samples shall be collected and analyzed in accordance with the sampling protocol in Part V.12.

iii. Base Fluid Retained on Cuttings. For NAFs that meet the stock limitation of C_{16}-C_{18} internal olefin, the maximum weighted mass ratio averaged over all non-aqueous-based drilling fluid well sections shall not exceed 6.9 g NAF per 100 g of wet drill cuttings. For NAFs that meet the stock limitation of C_{12}-C_{14} esters or C_8 ester, the maximum weighted mass ratio averaged over all NAF well sections shall not exceed 9.4 g non-aqueous-based drilling fluid per 100 g of wet drill cuttings. A default value of 14% of base fluid retained on drill cuttings may be used for determining compliance with the base fluids retained on cutting limit where seafloor discharges are made from dual gradient drilling. In those cases, 15% will be used as a default value for the mass fraction of cuttings discharged at the sea floor. The default values will be averaged with results obtained from daily monitoring to determine compliance with the retention limitations. Monitoring for this parameter shall be once per day by grab sample except when meeting the conditions of the Best Management Practices described in Part I.V.3.g., or one sample for every 500 feet drilled, up to three samplings per day, using the American Petroleum Institute (API) Retort method specified in 40 C.F.R. Part 435, subpart A of Appendix 7. The weighted mass ratio averaged over all non-aqueous-based drilling fluid well sections shall be reported on the DMR. The sample for the drilling fluid retained on cuttings shall be taken at the solids control equipment.

d. Base Drilling Fluid Stock Limitations Applicable to Synthetic-Based Drill Cuttings

i. Polynuclear Aromatic Hydrocarbon (PAH) Content. The PAH mass ratio shall not exceed $1x10^{-5}$. Monitoring shall be by grab sample taken once per year on each fluid blend using EPA Method 1654A (or the most current version), in conjunction with the following equation:

$$\text{PAH mass ratio} = \frac{\text{mass (g) of PAH (as phenanthrene)}}{\text{mass (g) of stock base fluid}}$$

The PAH ratio shall be reported on the DMR.

ii. Stock Drilling Fluid Sediment Toxicity Ratio. The sediment toxicity ratio shall not exceed 1.0, and shall be calculated as follows:

For NAF base fluid of C_{16}-C_{18} internal olefin,

$$\text{Sediment Toxicity Ratio} = \frac{\text{10-day } LC_{50} \text{ of } C_{16}\text{-}C_{18} \text{ internal olefin reference fluid}}{\text{10-day } LC_{50} \text{ of stock base fluid}}$$

For NAF base fluids of 100% C_{12}-C_{14} ester or C_8 ester content,

$$\text{Base Fluid Sediment Toxicity Ratio} = \frac{\text{10-day } LC_{50} \text{ of } C_{12}\text{-}C_{14} \text{ ester or } C_8 \text{ ester reference base fluid*}}{\text{10-day } LC_{50} \text{ of stock base fluid}}$$

* Chemical Abstract No. 135800-37-2

Monitoring for the parameter shall be performed at least once per year on each fluid blend using the 10-day LC_{50} sediment toxicity test specified in ASTM E1367-92 (or the most current EPA approved method), and reported on the DMR. Samples shall be collected and analyzed using the sampling protocol in Part V.12.

iii. Biodegradation Rate Ratio. The biodegradation rate ratio of the stock base fluid shall not exceed 1.0, and shall be calculated using the following equation:

For NAF base fluid of C_{16}-C_{18} internal olefin,

$$\text{Biodegradation Rate Ratio} = \frac{\text{Cumulative gas production (ml) of } C_{16}\text{-}C_{18} \text{ internal olefin reference base fluid at 275 days}}{\text{Cumulative gas production (ml) of stock base fluid at 275 days}}$$

For NAF base fluid of 100% C_{12}-C_{14} ester or C_8 ester content,

$$\text{Biodegradation Rate Ratio} = \frac{\text{Cumulative gas production (ml) of } C_{12}\text{-}C_{14} \text{ ester or } C_8 \text{ ester reference base fluid* at 275 days}}{\text{Cumulative gas production of (ml) of stock base fluid at 275 days}}$$

* Chemical Abstract No. 135800-37-2

Monitoring for the parameter shall be performed at least once per year on each fluid blend using International Standards Organization (ISO) Method 11734:1995 (or the most current EPA approved method) and results reported on the DMR. See Parts V.13 and 14 for additional requirements. Samples shall be collected and analyzed using the sampling protocol in Part V.12.

iv. Mercury and Cadmium in Stock Barite. There shall be no discharge of drilling fluids to which barite has been added, if such barite contains mercury in excess of 1.0 mg/kg (dry weight) or cadmium in excess of 3.0 mg/kg (dry weight). The permittee shall analyze a representative sample of each supply of stock barite prior to drilling each well and submit the results for total mercury and total cadmium on the DMR. If more than one well is being drilled at a site, new analyses are not required for subsequent wells, provided that no new supplies of barite have been received since the previous analysis. In this case, the results of the previous analysis should be used for completion of the DMR. Alternatively, the permittee may provide certification, as documented by the supplier(s), that the barite being used on the well will meet the above limits. The concentration of the mercury and cadmium in the barite shall be reported on the DMR as documented by the supplier. Analyses for cadmium shall be conducted by EPA Methods 200.7, 200.8 or EPA Method 3050 B followed by 6010 B (EPA SW 846) and results expressed in mg/kg (dry weight) of stock barite. Analysis for mercury shall be conducted using method 245.7 or EPA Method 7471 A (EPA SW 846), and expressed as mg/kg (dry weight) of stock barite.

Exception - Stock limitations are designed to ensure that only base fluids meeting Best Available Technology (BAT) criteria are added to existing drilling fluids. As long as fluids or blends of fluids that are added to a built whole mud meet stock limitations criteria, it is acceptable to mix a base fluid to a built whole mud that differs from that originally used to make that mud. It is also acceptable to mix together two built whole mud systems that contain different base fluids so long as they are themselves built with base fluids that are compliant with the stock limitations. If the permittee chooses to mix previously compliant fluids, or blends of fluids, must analyze the mixture to show compliance with the limitations for:

Formation Oil (see Part I.B.2.c.i (1)),
SPP toxicity (see Part I.B.1.b.iii), and
Drilling Fluid Sediment Toxicity (see Part I.B.2.c.ii).

All test results shall be submitted with the DMR.

e. Monitoring Only Requirements

Volume. The monthly total discharge of drill cuttings must be estimated. The estimated highest monthly volume (in bbl/month) and the average volume for the monitoring period for cuttings discharged shall be reported on the DMR.

3. Produced Water: Only de minimus produced water discharges associated with exploratory operations are authorized. The permittee will need to seek cover under the EPA Region 4 General Permit or obtain a subsequent NPDES permit for new sources prior to discharging produced water from production operations.

a. Prohibitions

i. No Discharge Near Areas of Biological Concern. There shall be no discharge of produced water from those facilities within 1000 meters (or as determined by the Director) of an ABC.

ii. No Discharge Near Federally Designated Dredged Material Ocean Disposal Sites. There shall be no discharge of produced water from those facilities within 1000 meters (or as determined by the Director) of a Federally Designated Dredged Material Ocean Disposal Site. See 40 C.F.R. § 228.15(f) for a list of sites in the general permitting area.

b. Limitations

i. Oil and Grease. Produced water discharges shall not exceed both a daily maximum limitation of 42.0 mg/l and a monthly average limitation of 29.0 mg/l for oil and grease. A grab sample must be taken at least once per month. The daily maximum sample may be based on the average concentration of four grab samples taken within the 24-hour period. If only one sample is taken for any one month, it must meet both the daily and monthly limits. If more samples are taken, they may exceed the monthly average for any one day, provided that the average of all samples taken meets the monthly limitation. The gravimetric method is specified in 40 C.F.R. Part 136. Samples must be taken at the nearest accessible location after final treatment and prior to combining with any other wastewaters. The highest daily maximum concentration and the highest monthly average concentration shall be reported on the DMR.
In addition, a produced water sample shall be collected, within two (2) hours of when a sheen is observed in the vicinity of the discharge or within two hours after startup of the system if it is shut down following a sheen discovery, and analyzed for oil and grease.

ii. Toxicity. Produced water discharges must meet the limiting permissible concentration (LPC) at the edge of a 100-meter mixing zone. The LPC is defined as the No Observed Effect Concentration (NOEC). The LPC must be equal to, or greater than, the predicted effluent concentration at the edge of a 100-meter mixing zone. Predicted effluent concentrations, referred to as critical dilutions, are presented in Tables 3 and 4 of Appendix B for a range of discharge rates and

pipe diameters. The critical dilution shall be determined using Tables 3 and 4 of Appendix B of this permit based on the highest monthly average discharge rate for the three months prior to the month in which the test sample is collected, discharge pipe diameter, and depth difference between the discharge pipe and the sea bottom. Facilities which have not previously reported produced water flow on the DMR shall use the estimated monthly average flow that was discharged during the first three months of produced water flow for determining the critical dilution from Tables 3 and 4 of Appendix B of this permit.

The NOEC shall be calculated by conducting 7-day chronic toxicity tests in accordance with methods published in *Short Term Methods for Estimation Chronic Toxicity of Effluents and Receiving Water to Marine and Estuarine Organisms* (EPA/821-R-02-014), or most current edition.

For facilities that had not previously reported produced water, testing to determine the NOEC shall begin after the third month of produced water discharge and shall be done every two months until the permittee passes and reports three consecutive produced water toxicity tests. Permittees that pass three consecutive produced water toxicity tests will be allowed to reduce to a sampling frequency of once every six months.

Permittees that were covered under the previous general permit, and that are currently performing routine toxicity tests every six months, shall continue testing with a frequency of once every six months. If at any time, a test result indicates a failed test, the permittee must resume testing at a greater frequency, as set forth in Part V.A.15, until such time that the facility passes three consecutive tests. If a new well is drilled into a formation currently not producing, which contains produced water, the permittee shall perform a new toxicity test on the discharge beginning after the end of the first three months of flow.

The results for both species shall be reported on the DMR. See Part V.A.15 of this permit for Whole Effluent Toxicity Testing Requirements.

Samples must be taken at the nearest accessible location prior to discharge, or prior to combining with any other wastewaters. In the case where seawater is added in accordance with the exception below, samples may be taken downstream of the point where seawater is added.

Exception - Permittees wishing to increase mixing may use a horizontal diffuser, add seawater, or may install multiple discharge ports (e.g.,vertical diffuser). Permittees using a horizontal diffuser or multiple discharge ports shall install the system such that the NOEC is greater than or equal to the critical dilution. The projected percent effluent (critical dilution) at the edge of the mixing zone will be calculated using CORMIX2 (for horizontal diffusers) and CORMIX1 (for vertical diffusers), with the following input conditions:

Density Gradient = 0.163 $kg/m^3/m$
Ambient seawater density at diffuser depth (or at surface for vertical diffuser) = 1023.0 kg/m^3
Produced water density = 1070.2 kg/m^3
Current speed = 5 cm/sec (<200 m water depth); 15 cm/sec (>200 m water depth)

The permittee shall submit a certification that the diffuser, seawater addition, or multiple discharge ports has been installed and state the critical dilution and corresponding NOEC in the certification. The certification shall be submitted along with the first DMR for produced water discharges to: Director, Water Protection Division, U.S. EPA-Region 4, Sam Nunn Atlanta Federal Center, 61 Forsyth Street, SW, Atlanta, GA 30303-8960. All modeling runs shall be retained by the permittee as part of its NPDES records.

Permittees using vertically aligned multiple discharge ports/vertical diffuser shall provide vertical separation between ports which is consistent with Table 5 of Appendix A of this permit. When multiple discharge ports are installed, the depth difference between the discharge port closest to the seafloor and the seafloor shall be the depth difference used to determine the critical dilution from Tables 3 and 4 of Appendix A of this permit.

Permittees discharging produced water at conditions other than those covered in Tables 3 and 4 of Appendix A (e.g., at a rate greater flows and pipe diameters) shall determine the critical dilution using the appropriate CORMIX model with the above input parameters. Permittees shall retain the model runs as part of the NPDES records.

The critical dilution value shall be based on the port flow rate (total flow rate divided by the number of discharge ports) and based on the diameter of the discharge port (or largest discharge port if they are of different styles).

When seawater is added to produced water prior to discharge, the total produced water flow, including the added seawater, shall be used in determining the critical dilution from Tables 3 and 4 of Appendix A. When freshwater is added to produced water prior to discharge, the total produced water flow, including the added freshwater, shall be used in determining the critical dilution from Table 7 of Appendix A.

Permittees wishing to reduce a produced water flow rate and thereby the critical dilution through operational changes must provide to EPA a description of the specific changes that were made and the resultant low rate. The permittee must certify that this flow rate will not be exceeded for the remainder of the DMR period, unless the permittee re-certifies.

c. Monitoring Requirements

Flow. Once per month, an estimate of the flow must be recorded in units of barrels per day (bbl/day). The highest monthly discharge flow rate (in bbl/day) shall be estimated and reported on the DMR.

4. Deck Drainage

Limitations

Free Oil. No free oil shall be discharged. Monitoring shall be performed on each day of discharge during daylight hours using the visual sheen test method in accordance with the method provided at Part V.A.4. Discharge of deck drainage that fails the visual sheen test shall be a violation of this permit. The results of each visual must be recorded and the number of observations of a sheen must be recorded for the monitoring period and reported on the DMR. Note: An observation of deck drainage sheen is not required when the facility is not being manned.

5. Produced Sand

There shall be no discharge of produced sand. Wastes must be hauled to shore for treatment and disposal.

6. Well Treatment Fluids, Completion Fluids, and Workover Fluids

a. Limitations

i. Free Oil. No free oil shall be discharged. Monitoring shall be performed prior to discharge and on each day of discharge using the static sheen test method in accordance with the method provided at Part V.A.3. There shall be no discharge of well treatment, completion, or workover fluids that fail the static sheen test. Samples must be taken at the nearest accessible location after final treatment and prior to discharge, or prior to combining with any other wastewaters. The results

of each sheen test for discharged fluids must be recorded and the number of observations of a sheen must be reported for the monitoring period on the DMR.

ii. Oil and Grease. Well treatment fluids, completion fluids, and workover fluids discharges must meet both a daily maximum of 42.0 mg/l and a monthly average of 29.0 mg/l limitation for oil and grease. A grab sample must be taken at least once per month when discharging. Samples must be taken at the nearest accessible location after final treatment and prior to discharge, or prior to combining with any other wastewaters. The daily maximum concentration may be based on the average of four grab samples taken within the 24-hour period. If only one sample is taken for any one month, it must meet both the daily and monthly limits. If more samples are taken, they may exceed the monthly average for any one day, provided that the average of all samples taken meets the monthly limitation. The analytical method is the gravimetric method, as specified in 40 C.F.R. Part 136. The highest daily maximum and the highest monthly average for the monitoring period shall be reported on the DMR.

iii. Priority Pollutants. For well treatment fluids, completion fluids, and workover fluids, the discharge of priority pollutants is prohibited except in trace amounts. If multiple fluids are mixed, each fluid must be checked for priority pollutants. "Trace amounts" shall mean the amount equal to or less than the most sensitive method detection limit listed in 40 CFR Part 136 for the applicable parameter. Vendor certification indicating the fluids contain no priority pollutants is acceptable for meeting this requirement. Information on the specific chemical composition of any additives containing priority pollutants shall be recorded and retained on site for no less than five years from the issuance date of the permit. Records should be kept on the rig while the rig is on the permitted location and thereafter at the permittee's shorebase or office. These record retention requirements supersede those found in Part II.C.5. of this permit.

Note: If materials added downhole as well treatment, completion, or workover fluids contain no priority pollutants as determined by using analytical methods in 40 CFR Part 136, the discharge is assumed not to contain priority pollutants.

b. Monitoring Requirements

Volume. The highest monthly total discharge and the 3-month average discharge must be estimated and reported on the DMR in barrels per month.

c. This discharge shall be considered "produced water" when commingled with produced water.

7. Sanitary Waste (Facilities Continuously Manned by 10 or More Persons)

a. Prohibitions

Solids. There shall be no discharge of floating solids. Observations must be made once per day, during daylight in the vicinity of sanitary waste outfalls, and at the time during maximum estimated discharge. The number of days solids are observed during the quarter shall be recorded on the DMR.

b. Limitations

Total Residual Chlorine. Discharges of sanitary waste must contain a minimum of 1.0 mg residual chlorine per liter and shall be maintained as close to this concentration as possible at all times. A grab sample must be taken once per month and the minimum and average concentrations for the monitoring period shall be reported on the DMR. The approved analytical methods are Hach CN-66-DPD or the EPA method specified in 40 C.F.R. Part 136 for Total Residual Chlorine. Samples must be taken at the nearest accessible location prior to discharge and after final treatment.

Exception - Any facility which properly maintains a marine sanitation device (MSD) that complies with pollution control standards and regulations under Section 312 of the Act shall be deemed in compliance with permit prohibitions and limitations for sanitary waste. The MSD shall be tested annually for proper operation and the test results maintained at the facility or at an alternative site if not practicable. The operator shall indicate use of an MSD on the DMR.

8. Sanitary Waste (Facilities Continuously Manned by 9 or Fewer Persons or Intermittently by Any Number)

Prohibition. There shall be no discharge of floating solids. An observation must be made once per day when the facility is manned, during daylight in the vicinity of sanitary waste outfalls, and at a time during maximum estimated discharge. The number of days solids are observed shall be recorded.

Exception - Any facility which properly maintains an MSD that complies with pollution control standards and regulations under Section 312 of the Act shall be deemed in compliance with permit prohibitions and limitations for sanitary waste. The MSD shall be tested annually for proper operation and the test results maintained at the facility or at an alternative site if not practicable. The operator shall indicate use of an MSD on the DMR.

9. Domestic Waste

a. Prohibitions

Solids. There shall be no discharge of floating solids.

b. Limitations

Solids. See Part I.C.4 - Rubbish, Trash and Other Refuse

c. Monitoring Only Requirements

Solids. An observation must be made during daylight in the vicinity of domestic waste outfalls, and at a time during maximum estimated discharge. The number of days solids are observed must be recorded and reported on the DMR.

10. Miscellaneous Discharges

The following miscellaneous discharges are authorized for discharge: Desalination Unit Discharge; Blowout Preventer Control Fluid; Uncontaminated Ballast Water; Uncontaminated Bilge Water; Mud, Cuttings, and Cement at the Seafloor; Uncontaminated Seawater; Uncontaminated Freshwater; Boiler Blowdown; Source Water and Sand; Diatomaceous Earth Filter Media; Subsea Wellhead Preservation Fluids; Subsea Production Control Fluids; Umbilical Steel Tube Storage Fluid; Leak Tracer Fluid, Riser Tensioner Fluid, Well Test Fluids, Bulk Transfer Operations Powder; Excess Cement Slurry and Cement Equipment Washdown and Hydrate Control Fluid.

Additional miscellaneous discharges associated with subsea operations may be discharged based on the requirements set forth in Parts I.C.6 and V.A.15 of this permit.

a. Prohibitions. Discharges of waste streams not mentioned above, including contaminated freshwater, contaminated seawater, contaminated bilge water and contaminated ballast water, are prohibited. ("Contaminated" refers to wastewater that has failed a Visual Sheen Test.)

b. Limitations

Free Oil. There shall be no discharge of free oil. Monitoring shall be performed using the visual sheen test method once per week when discharging on the surface of the receiving water, or by use of the Static Sheen Test method. Tests shall be conducted in accordance with the methods contained in Part V.A.3 and V.A.4. Discharges are limited to those times that a visual sheen observation is possible. If the Static Sheen Test is used, samples must be taken at the nearest accessible location after final treatment and prior to discharge, or combination with any other wastewaters. The number of days a sheen is observed must be recorded and reported on the DMR.

Exception - Miscellaneous discharges may be discharged from platforms that are on automatic purge systems without monitoring for free oil when the facility is not manned. Discharges are not restricted to periods when observation is possible; however, the static sheen test method must be used during periods when observation of a sheen is not possible, such as at night or during inclement conditions. The static sheen testing is not required for miscellaneous discharges occurring at the sea floor.

Toxicity. Fluids which are used as Subsea Wellhead Preservation Fluids, Subsea Production Control Fluids, Umbilical Steel Tube Storage Fluids, Leak Tracer Fluids, and Riser Tensioning Fluids shall have a 7-day No Observable Effect Concentration (NOEC) of no less than 50 mg/l. The 7-day NOEC shall be measured using Mysidopsis bahia (Mysid shrimp) chronic static

renewal 7-day survival and growth test and Menidia beryllina (Inland Silverside minnow) chronic static renewal 7-day larval survival and growth test (Method 1006.0) as described in Part V.A.15 of this permit. Compliance with this limit shall be measured at least annually (beginning from the effective date of this permit) using the survival and sub-lethal endpoints on each fluid added to an operation after the effective date of this permit. If the effluent fails the survival or sub-lethal test endpoint in any test, any discharge associated with the use of the product will be considered to be in violation of this permit.

11. Miscellaneous Discharges of Freshwater and Seawater In Which Treatment Chemicals Have Been Added, including, but not limited to: 1) excess seawater which permits the continuous operation of fire control and utility lift pumps, 2) excess seawater from pressure maintenance and secondary recovery projects, 3) water released during training of personnel in fire protection, 4) seawater used to pressure test, or flush, new and existing piping and pipelines, 5) ballast water, 6) water flooding discharges and, 7) once through non-contact cooling water.

a. Limitations

Free Oil. There shall be no discharge of free oil. Monitoring shall be performed using the Visual Sheen Test method once per day when discharging on the surface of the receiving water or by use of the static sheen method at the operator's option. Both tests shall be conducted in accordance with the methods contained in Part V.A.3 and V.A.4. Samples must be taken at the nearest accessible location prior to discharge, or prior to combining with any other wastewaters. Discharges are limited to those times that a visual sheen observation is possible. The number of days a sheen is observed must be recorded and reported on the DMR.

Exception - Miscellaneous discharges may be discharged from platforms that are on automatic purge systems without monitoring for free oil when the facility is not manned. Discharges are not restricted to periods when observation is possible; however, the static sheen test method must be used during periods when observation of a sheen is not possible, such as a night or during inclement conditions. The static sheen testing is not required for miscellaneous discharges occurring at the sea floor.

b. Treatment Chemicals (see definition in Part V.B). The concentration of treatment chemicals in discharged chemically treated freshwater and seawater shall not exceed the most stringent of the following three constraints:

i. the maximum concentrations and any other conditions specified in the EPA product registration labeling if the chemical is an EPA registered product,
ii. the maximum manufacturer's recommended concentration, or
iii. 500 mg/l of the treatment chemical.

c. Toxicity. The toxicity of discharged freshwater or seawater in which chemicals have been added shall be limited as follows:

The 7-day minimum and monthly average minimum NOEC, must be equal to or greater than the critical dilution concentration specified in this permit in Table 6 for seawater discharges and Table 7 for freshwater discharges. Critical dilution shall be determined using either Table 6 or 7 of this permit in conjunction with (1) the discharge rate, (2) discharge pipe diameter, and (3) the water depth between the discharge pipe and bottom. The monthly average minimum NOEC value is defined as the arithmetic average of all 7-day minimum NOEC values determined during the month. Compliance with the toxicity limitation shall be demonstrated by conducting 7-day chronic toxicity tests, using *Mysidopsis bahia (Americamysis bahia* (Mysid

shrimp)) and *Menidia beryllina* (Inland silverside minnow). The 7-day chronic toxicity test method is published in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (EPA/821-R-02-014), or the most current edition. The results for both species and the critical dilution shall be reported on the DMR. The operator shall also submit a copy of the summary sheets for all laboratory reports with the DMR. See Part V.A.15 of this permit for Whole Effluent Toxicity testing requirements.

Testing to determine the 7-day minimum and monthly average minimum NOEC shall begin after the third month of chemically treated water discharge and shall be done every two months until the permittee passes and reports three consecutive chemically treated water toxicity tests.

Toxicity testing for intermittent or batch discharges shall be performed at least once per discharge but are required to be monitored no more frequently than the corresponding frequencies specified above for continuous discharges, unless otherwise specified by the Director.

Samples shall be collected after addition of any substances, including seawater that is added prior to discharge and before the flow is split from multiple discharge ports. Samples also shall be representative of the discharge. Methods to increase dilution also apply to seawater and freshwater discharges which have been chemically treated previously described for produced water in Part I.B.3.

Permittees that pass three consecutive chemically treated water toxicity tests will be allowed to reduce to a sampling frequency of every six months after notification from the EPA-Region 4 Water Protection Division. Permittees that were covered under the previous general permit, and that are currently performing routine toxicity tests, shall continue testing with a frequency of at least every six months. If at any time any toxicity test (i.e., for continuous or intermittent discharges) results indicates a failure, the permittee must resume more frequent toxicity testing intervals, in accordance with Part V.A.15, or as specified by the Director. Miscellaneous discharges of seawater and freshwater to which only chlorine or hypochlorite have been added are excluded from the monitoring requirement.

d. Monitoring Only Requirements for discharges of chemically treated freshwater and seawater.

Flow. The average flow (in barrels per day) must be estimated each month and the highest average monthly flow for the monitoring period shall be recorded on the DMR.

C. Other Discharge Limitations

1. Floating Solids or Visible Foam

There shall be no discharge of floating solids or visible foam from any source other than in trace amounts.

2. Halogenated Phenol Compounds

There shall be no discharge of halogenated phenol compounds as a part of any waste streams authorized in this permit.

3. Dispersants, Surfactants, and Detergents

The facility operator shall minimize the discharge of dispersants, surfactants, and detergents, except as necessary, to comply with the safety requirements of the Occupational Safety and Health Administration and MMS. This restriction applies to tank cleaning and other operations which do not directly involve the safety of workers. (The restriction is imposed because detergents disperse and emulsify oil, potentially increasing toxic impacts and making the detection of a discharge of free oil more difficult.)

Waste water associated with tank and pit cleaning operations shall be classified as the same as the former contents of the tank or pit. (For example, wash water generated from cleaning drilling fluid pits would be subject to the same discharge limitations as the drilling fluid formerly contained in those pits.) The waste water is deemed to have the same compliance status as the whole fluid that was originally in the tank or pit. No additional sampling/monitoring of the waste water is required.

4. Rubbish, Trash, and Other Refuse

There shall be no discharge of any solid material not authorized in the permit.

This permit includes limitations set forth by the U.S. Coast Guard in regulations implementing Annex V of MARPOL 73/78 for domestic waste disposal from all fixed or floating offshore platforms and associated vessels engaged in exploration of seabed mineral resources (33 C.F.R. 151). These limitations, as specified by Congress (33 U.S.C. 1901, the Act to Prevent Pollution from Ships), apply to all navigable waters of the United States.

This permit prohibits the discharge of "garbage." Comminuted food waste (able to pass through a screen with a mesh size no larger than 25 mm, approximately one inch) may be discharged when 12 nautical miles or more from land. Greywater, drainage from dishwater, shower, laundry, bath, and washbasins are not considered garbage within the meaning of Annex V. Incineration ash and non-plastic clinkers that can pass through a 25-mm mesh screen may be discharged beyond three miles from nearest land. Otherwise, ash and non-plastic clinkers may be discharged beyond 12 nautical miles from nearest land.

5. Dual Gradient Drilling Discharges

A permittee performing dual gradient drilling operations may require seafloor discharges of large cuttings (greater than 1/4") to ensure the proper operation of subsea pumps (e.g., electrical submersible pumps). A permittee performing dual gradient drilling operations which lead to seafloor discharges of large cuttings for the proper operation of subsea pumps shall either:

a. measure the mass percent NAFs retained on cuttings value [% Base Fluid (BF)] and mass NAF-cuttings discharge fraction (X) for seafloor discharges each time a set of retorts is performed,

b. use the following set of default values, (%BF=14%; X=0.15) or,

c. use a combination for %BF and measure (X).

Additionally, a permittee performing dual gradient drilling operations which lead to seafloor discharges of large cuttings for the proper operation of subsea pumps shall also perform the following tasks:

a. use side scan sonar of shallow seismic to determine the presence of high density chemosynthetic communities. Chemosynthetic communities are assemblages of tube worms, clams, mussels, and bacterial mats that occur at natural hydrocarbon seeps or vents, generally in water depths of 500 meters or deeper. Seafloor discharges of large cuttings for the proper operation of subsea pumps shall not be permitted within 1000 feet of a high density chemosynthetic community;

b. seafloor discharges of large cuttings for the proper operation of subsea pumps shall be visually monitored and documented by a Remotely Operated Vehicle (ROV) within the tether limit (approximately 300 feet). The visual monitoring shall be conducted prior to each time the discharge point is relocated (cuttings discharge hose) and conducted along the same direction as the discharge hose position. Near-seabed currents shall be obtained at the time of the visual monitoring and;

c. seafloor discharges of large cuttings for the proper operation of subsea pumps shall be directed within a 150 foot radius of the wellbore.

6. Un-mixed Chemicals or Products

There shall be no discharge of any chemical or product not already mixed for use in any wastestream. Such unused chemicals or products shall be shipped onshore for final disposal or reuse. [Exception – This does not apply to the discharge of Bulk Transfer Operations Powder.]

D. <u>Special Conditions</u>

1. De minimus Discharges

De minimus discharges of non-aqueous based drilling fluids not associated with cuttings shall be contained to the extent practicable to prevent discharge. Allowable de minimus discharges can include wind blown drilling fluids from the pipe rack and minor drips and

splatters around mud handling and solids control equipment. Such de minimus discharges are not likely to be measurable and are not considered in the base fluids retained on cuttings limit.

2. Small Volume Discharges

Small volume drilling fluid discharges which are associated with cuttings, and for which discharge is authorized, include; displaced interfaces, accumulated solids in sand traps, pit clean-out solids, and centrifuge discharges made while changing mud weight. To determine the percent drilling fluids retained on cuttings for those discharges, the permittee may either monitor the discharge using the retort test method, or use a default value of 25% to determine compliance with the limitation. Required discharge monitoring for small volume discharges consists only of static sheen tests and retention on cuttings (or use of the default retention on cuttings value).

3. Cooling Water Intake Structure Requirements

Applicability: These requirements apply to new facilities for which construction was commenced after July 17, 2006, with a cooling water intake structure having a design intake capacity of greater than 2 million gallons of water per day, of which at least 25% is used for cooling purposes. New facilities with a design intake capacity of less than or equal to 2 million gallons per day and all existing facilities will be required to reduced entrainment and impingement to the greatest extent practicable using Best Professional Judgment.

a. **Baseline Study requirements**

These baseline study requirements are effective one year after the effective date of this permit. As described below, operators of cooling water intake structures subject to Part I.D.3 may either conduct a study at each new facility or they may participate in an industry wide study. Operators may participate after the close of the study.

Operators of new facilities must submit sufficient information to characterize the biological community of commercial, recreational, and forage base fish and shellfish in the vicinity of the intake structure and to characterize the effects of the cooling water intake structure's operation on aquatic life. This biological characterization must include any available existing information along with field studies to obtain localized data. At a minimum, the information must include:

i. A list of the data required by this section that are not available and efforts made to identify sources of the data;

ii. A list of species (or relevant taxa) for all life stages and their relative abundance in the vicinity of the cooling water intake structure;

iii. Identification of the species and life stages that would be most susceptible to impingement and entrainment. Species evaluated should include the forage base as well as those most important in terms of significance to commercial and recreational fisheries;

iv. Identification and evaluation of the primary period of reproduction, larval recruitment, and period of peak abundance for relevant taxa;

v. Data representative of the seasonal and daily activities (e.g., feeding and water column migration) of biological organisms in the vicinity of the cooling water intake structure;

vi. Identification of all threatened, endangered, and other protected species that might be susceptible to impingement and entrainment at the cooling water intake structures;

vii. If the information above is supplemented with data from field studies, the supplemental data must include a description of all methods and quality assurance procedures for sampling and data analysis including a description of the study area; taxonomic identification of sampled and evaluated biological assemblages (including all life stages of fish and shellfish); and sampling and data analysis methods. The sampling and/or data analysis methods you use must be appropriate for a quantitative survey and based on consideration of methods used in other biological studies performed within the same source water body. The study area should include, at a minimum, the area of influence of the cooling water intake structure.

Alternatively, operators may comply with these requirements and the entrainment monitoring requirements in Part I.D.3.d. of this permit through participation in an EPA approved industry wide study. That study may include a smaller, statistically representative number of facilities. Any industry wide baseline study which is conducted must be commenced within two years after the effective date of this permit and completed within three years after the effective date. The study report shall be submitted to the Director of the Water Protection Division, EPA Region 4, 61 Forsyth Street, Atlanta, GA 30303. A Gulf of Mexico Industry-wide Study that includes facilities in the eastern Gulf of Mexico may satisfy the requirements of Part I.D.3.a.

b. Supplemental Notification Requirements

Design information must be submitted at least 30 days in advance of a facility commencing operations in the geographical area covered by this permit. Design information required to be submitted for cooling water intake structures is only required to be submitted once for any facility that these requirements are applicable. Design information is not required to be resubmitted for additional leases where the facility subsequently operates or for a subsequent permit. EPA will notify the operator if additional information is required. Owners/operators of Mobile Offshore Drilling Units (MODUs) must also submit an NOI, in accordance with Part I.A.4 of this permit. The NOI shall be submitted and postmarked prior to operating.

New non-fixed facilities must submit:

A narrative description and/or maps providing sufficient information on predicted locations during the permit term in sufficient detail for the Director to determine the appropriateness of additional impingement requirements. This information is only required to be submitted once for any facility.

Velocity information, including:

i. A narrative description of the design, structure, equipment, and operation used to meet the requirements of a maximum through screen intake velocity of 0.5 ft/s at each cooling water intake structure; and

ii. For surface cooling water intake screens only, design calculations showing that the velocity requirement will be met at the minimum ambient source water surface elevation and maximum head loss across the screens or other device.

Cooling water intake structure data, including:

i. Design and construction technology plans and a description of operational measures which will be implemented to minimize impingement, including:

1) A narrative description of the design, operation of the design, and construction technologies including fish handling and return systems that the facility will utilize to maximize the survival of species expected to be most susceptible to impingement. Provide species specific information that demonstrates the efficacy of the technology; and

2) Design calculations, drawings, and estimates to support the descriptions above.

ii. A narrative description of the configuration of each of your cooling water intake structures and where it is located in the water body and in the water column;

iii. A narrative description of the operation of each of your cooling water intake structures, including design intake flows, daily hours of operation, number of days of the year in operation, and seasonal changes, if applicable;

iv. A flow distribution and water balance diagram that includes all sources of water to the facility, recirculating flows, and discharges; and

v. Engineering drawings of the cooling water intake structure.

New Fixed Facilities must submit:

Source water physical data, including:

i. A narrative description and scaled drawings showing the physical configuration of all source water bodies used by your facility, including aerial dimensions, depths, salinity and temperature regimes, and other documentation that supports your determination of the water body type where each cooling water intake structure is located;

ii. Identification and characterization of the source water body's hydrological and geomorphological features, as well as the methods you used to conduct any studies to determine your intake's area of influence within the water body and the results of such studies; and

iii. Locational maps.

Cooling water intake structure data, including:

i. Design and construction technology plans and a description of operational measures which will be implemented to minimize impingement, including:

1) A narrative description of the design and operation of the design and construction technologies including fish handling and return systems that the facility will utilize to maximize the survival of species expected to be most susceptible to impingement;

2) For those new fixed facilities that do not employ sea chests as cooling water intake structures, a narrative description of the design, operation, and construction technologies that the facility will utilize to minimize entrainment of those species most susceptible to entrainment.

3) Design calculations, drawings, and estimates to support the design technologies.

ii. A narrative description of the configuration of each of your cooling water intake structures and where it is located in the water body and in the water column;

iii. Latitude and longitude in degrees, minutes, and seconds for each of your cooling water intake structures;

iv. A narrative description of the operation of each of your cooling water intake structures, including design intake flows, daily hours of operation, number of days of the year in operation and seasonal changes, if applicable;

v. A flow distribution and water balance diagram that includes all sources of water to the facility, re-circulating flows, and discharges; and

vi. Engineering drawings of the cooling water intake structure.

Velocity information, including:

i A narrative description of the design, structure, equipment, and operation used to meet the requirement of a maximum through-screen intake velocity of 0.5 ft/s at each cooling water intake structure; and

ii. For surface cooling water intake screens only, design calculations showing that the velocity requirement will be met at the minimum ambient source water surface elevation and maximum head loss across the screens or other device.

c) **Cooling Water Intake Structure Requirements**

New non-Fixed Facilities

i. The cooling water intake structure(s) must be designed and constructed so that the maximum through-screen design intake velocity is 0.5 ft/s or less;

ii. The operator must minimize impingement mortality of fish and shellfish through use of cooling water intake design and construction technologies or operational measures.

New Fixed Facilities that do not employ sea chests as intake structures

i. The cooling water intake structure must be designed and constructed so that the maximum through-screen design intake velocity is 0.5 ft/s; and

ii. The operator must minimize impingement mortality of fish and shellfish and minimize entrainment of entrainable life stages of fish and shellfish through the use of cooling water intake design and construction technologies or operational measures.

New Fixed Facilities that Employ Sea Chests as Intake Structures

i. The cooling water intake structure(s) must be designed and constructed so that the maximum through-screen design intake velocity is 0.5 ft/s or less; and

ii. The operator must minimize impingement mortality of fish and shellfish through cooling water intake design and construction technologies or operational measures.

d) **Monitoring Requirements**

New non-Fixed Facilities

i. Beginning two years after the effective date of this permit, the operator must conduct either visual inspections or use remote monitoring devices during the period the cooling water intake structure is in operation. The operator must conduct visual inspections at least weekly, or at a lesser frequency as approved by the director, to ensure that the required design and

construction technologies are maintained and operated so they continue to function as designed. Alternatively, the operator must inspect using remote monitoring devices to ensure that the impingement and entrainment technologies are functioning as designed.

However, visual or remote monitoring is not required when conditions such as storms, high seas, evacuation, or other factors make it unduly hazardous to personnel, the facility, or the equipment utilized. The operator must provide an explanation for any such failure to visually or remotely monitor with the subsequent DMR submittal.

ii. For facilities that employ surface intake screens systems, the operator must monitor intake velocity by measuring the head loss across the intake screens and correlating the measured value with the design intake velocity. The operator must measure the head loss at the minimum ambient source water surface elevation using best professional judgment based on available hydrological data. The operator must use the maximum head loss across the screen for each cooling water intake structure to determine compliance with the velocity requirement. For facilities utilizing devices other than surface intake screens, the facility shall monitor intake velocity at the point of entry through the intake device or through a comparable method such as pump curve calculations. The operator shall monitor either head loss or velocity during initial facility startup, and thereafter, at a frequency of no less than once per quarter.

New Fixed Facilities that do not employ sea chests as intake structures

i. Beginning two years after the effective date of this permit, the operator must conduct either visual inspections or use remote monitoring devices during the period the cooling water intake structure is in operation. The operator must conduct visual inspections at least weekly, or at a lesser frequency as approved by the director, to ensure that the required design and construction technologies are maintained and operated so they continue to function as designed. Alternatively, the operator must inspect using remote monitoring devices to ensure that the impingement and entrainment technologies are functioning as designed.

However, visual or remote monitoring is not required when conditions such as storms, high seas, evacuation, or other factors make it unduly hazardous to personnel, the facility, or the equipment utilized. The operator must provide an explanation for any such failure to visually or remotely monitor with the subsequent DMR submittal.

ii. Beginning two years after the effective date of the permit or after commencement of operations, whichever is later, the operator must monitor for entrainment. The operator must collect samples to monitor entrainment rates (simple enumeration) for each species over a 24-hour period and no less than biweekly during the primary period of reproduction, larval recruitment, and peak abundance identified during the Source Water Baseline Biological Characterization Study. Representative species may be utilized for this monitoring consistent with their use in the Source Water Baseline Characterization Study. The operator must collect

samples only when the cooling water intake structure is in operation. After 24 months of monitoring, the permittee may request from EPA a reduced monitoring frequency for the remainder of the permit.

Alternatively, operators may comply with these requirements through participation in an EPA approved industry-wide study. That study may include a smaller, statistically representative number of facilities. See also Part I.D.3 of this permit. Any industry wide study conducted to meet the entrainment monitoring requirements in Part I.D.3 must be commenced within two years after the effective date of this permit and must be completed and submitted to EPA Region 4 three years after the effective date of this permit.

iii. For facilities that employ surface intake screens systems, the operator shall monitor intake velocity by measuring the head loss across the intake screens and correlating the measured value with the design intake velocity. The operator must measure head loss at the minimum ambient source water surface elevation using best professional judgment based on available hydrological data. The operator must use the maximum head loss across the screen for each cooling water intake structure to determine compliance with the velocity requirement. For facilities utilizing devices other than surface intake screens, intake velocity shall be monitored at the point of entry through the intake device or through a comparable method such as pump curve calculations. The operator shall monitor either head loss or velocity during initial facility startup, and thereafter, at a frequency of no less than once per quarter.

New Fixed Facilities that Employ Sea Chests as Intake Structures

i. Beginning two years after the effective date of this permit, the operator must conduct either visual inspections or utilize remote monitoring devices during the period the cooling water intake structure is in operation. The operator must conduct visual inspections at least weekly, or at a lesser frequency as approved by the director, to ensure that the required design and construction technologies are maintained and operated so they continue to function as designed. Alternatively, the operator must inspect using remote monitoring devices to ensure that the impingement and entrainment technologies are functioning as designed.

However, visual or remote monitoring is not required when conditions such as storms, high seas, evacuation, or other factors make it unduly hazardous to personnel, the facility, or the equipment utilized. The operator must provide an explanation for any such failure to visually or remotely monitor with the subsequent DMR submittal.

ii. For facilities that employ surface intake screens systems, the operator shall monitor the intake velocity by monitoring the head loss across the intake screens and correlating the measured value with the design intake velocity. The operator must measure head loss at the minimum ambient source water surface elevation using best professional judgment based on available hydrological data. The operator must use the maximum head loss across the screen for

each cooling water intake structure to determine compliance with the velocity requirement. For facilities utilizing devices other than surface intake screens, intake velocity shall be monitored at the point of entry through the intake device or through a comparable method such as pump curve calculations. The operator must monitor either head loss or velocity during initial facility startup, and thereafter, at a frequency of no less than once per quarter

iii. No monitoring for entrainment is required.

A status report of the required biological monitoring for each cooling water intake structure must be provided to EPA with the annual DMR for fixed facilities that do not employ sea chests.

The permit may be reopened and modified or revoked and reissued to require additional monitoring or to change the cooling water intake structure requirements if found warranted by the director as a result of either baseline study or entrainment monitoring.

4. Reference Drilling Fluid Formulation

The reference C_{16}-C_{18} internal olefin drilling fluids used to determine the drilling fluid sediment toxicity ratio and compliance with the BAT sediment toxicity discharge limitation shall be formulated to meet the specifications in Table 1 of Appendix 8 of 40 C.F.R. Part 435, subpart A.

5. Preparation of Live-Bottom Survey and Live Bottom Reports Using High Resolution Acoustical Data

Side-scan sonar data in the 100 kHz frequency or 500 kHz frequency if available (use data set providing best image quality) will be used to interpret for the presence of hard structure that could provide potential habitat for marine plant and animal communities. The area included in this interpretation should consist of a rectangular portion of the seabed with the proposed wells in the center. The sides of the rectangle should be at a distance of 1000 meters from the proposed wells. If several wells are proposed throughout the lease block, a separate live-bottom report shall be provided for each.

The live-bottom report shall consist of text and appropriate figures including a brief description of the lease block, proposed project, location of wells and water depth. The report shall contain a section describing the methods used to acquire sonar data including sonar and positioning equipment, frequencies, range setting, lane spacing and overlap, cable layback and vessel speed.

The report will include a narrative interpretation of the seabed within the survey area and any discrete features based on acoustical reflection of the seabed. The interpretation shall include a description of features, their relative position within the survey area, the dimensions of discrete features and surface area of scattered targets. The report will include a figure consisting of a sonar mosaic of the sonar lane segments comprising the survey area fitted to a standard page.

The mosaic figure shall be a color print (no photocopies). The location of seabed features referred to in the text, including any small or large acoustical targets, scattered or individual, should be shown in a separate figure, consisting of a diagram of the survey area and proposed well locations.

The EPA will not accept previously prepared geophysical survey reports for lease blocks in substitution for the live-bottom survey report described. Remote sensing data from other instruments such as echosounders, magetometers, subbottom profilers and seismic data should not be included in the live-bottom survey report. Reports containing photocopies of acoustical imagery will not be accepted.

Part II. Standard Conditions for NPDES Permits

A. General Conditions

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the CWA and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. The permittee shall comply with effluent standards or prohibitions established under section 307(a) of the CWA for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the CWA within the time provided in the regulations that establish these standards or prohibitions or standards for sewage sludge use or disposal, even if the permit has not yet been modified to incorporate the requirement.

[40 C.F.R. §§ 122.41(a) and 122.41(a)(1)]

2. Penalties for Violations of Permit Conditions

The CWA provides that any person who violates section 301, 302, 306, 307, 308, 318 or 405 of the Act, or any permit condition or limitation implementing any such sections in a permit issued under section 402, or any requirement imposed in a pretreatment program approved under sections 402(a)(3) or 402(b)(8) of the Act, is subject to a civil penalty not to exceed $37,500 per day for each violation. The CWA provides that any person who negligently violates sections 301, 302, 306, 307, 308, 318, or 405 of the Act, or any condition or limitation implementing any of such sections in a permit issued under section 402 of the Act, or any requirement imposed in a pretreatment program approved under section 402(a)(3) or 402(b)(8) of the Act, is subject to criminal penalties of $2,500 to $25,000 per day of violation, or imprisonment of not more than one year, or both. In the case of a second or subsequent conviction for a negligent violation, a person shall be subject to criminal penalties of not more than $50,000 per day of violation, or by imprisonment of not more than two years, or both. Any person who knowingly violates such sections, or such conditions or limitations is subject to criminal penalties of $5,000 to $50,000 per day of violation, or imprisonment for not more than three years, or both. In the case of a second or subsequent conviction for a knowing violation, a person shall be subject to criminal penalties of not more than $100,000 per day of violation, or imprisonment of not more than six years, or both. Any person who knowingly violates section 301, 302, 303, 306, 307, 308, 318 or 405 of the Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of the Act, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, shall, upon conviction, be subject to a fine of not more than $250,000 or imprisonment of not more than 15 years, or both. In the case of a second or subsequent conviction for a knowing endangerment violation, a person shall be subject to a fine of not more than $500,000 or by imprisonment of not more than 30 years, or both. An organization, as defined in section 309(c)(3)(B)(iii) of the CWA, shall, upon conviction of violating the imminent danger provision, be subject to a fine of not more than $1,000,000 and can be fined up to $2,000,000 for second or subsequent convictions.

[40 C.F.R. § 122.41(a)(2)]

Any person may be assessed an administrative penalty by the Administrator for violating section 301, 302, 306, 307, 308, 318 or 405 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act. Administrative penalties for Class I violations are not to exceed $16,000 per violation, with the maximum amount of any Class I penalty assessed not to exceed $37,500. Penalties for Class II violations are not to exceed $10,000 per day for each day during which the violation continues, with the maximum amount of any Class II penalty not to exceed $187,500.

[40 C.F.R. § 122.41(a)(3)]

3. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" Section B, Paragraph 3, and "Upset" Section B, Paragraph 4, nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

4. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

[40 C.F.R. § 122.41(d)]

5. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

[40 C.F.R. § 122.41(f)]

6. Toxic Pollutants

If any applicable toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the CWA for a toxic pollutant and that standard or prohibition is more stringent than any limitation on the pollutant in the permit, the Director shall institute proceedings under these regulations to modify or revoke and reissue the permit to conform to the toxic effluent standard or prohibition.

[40 C.F.R. § 122.44(b)(1)]

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Effect of a Permit

Except for any toxic effluent standards and prohibitions imposed under section 307 of the CWA and "standards for sewage sludge use or disposal" under 405(d) of the CWA, compliance with a permit during its term constitutes compliance, for purposes of enforcement, with sections 301, 302, 306, 307, 318, 403, and 405 (a)-(b) of the CWA. However, a permit may be modified, revoked and reissued, or terminated during its term for cause as set forth in 40 C.F.R. Sections 122.62 and 122.64.

Compliance with a permit condition which implements a particular "standard for sewage sludge use or disposal" shall be an affirmative defense in any enforcement action brought for a violation of that "standard for sewage sludge use or disposal" pursuant to sections 405(e) and 309 of the CWA.

[40 C.F.R. § 122.5(a)]

10. Property Rights

This permit does not convey any property rights of any sort, or any exclusive privilege.

[40 C.F.R. § 122.5(b) & 40 C.F.R. § 122.41(g)]

The issuance of a permit does not authorize any injury to persons or property or invasion of other private rights, or any infringement of State or local law or regulation.

[40 C.F.R. § 122.5(c)]

11. Onshore or Offshore Construction

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any waters of the United States.

12. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

[40 C.F.R. § 124.16 paraphrased]

13. Duty to Provide Information

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the Director upon request, copies of records required to be kept by this permit.

[40 C.F.R. § 122.41(h)]

B. <u>Operation and Maintenance of Pollution Controls</u>

1. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are

installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

[40 C.F.R. § 122.41(e)]

2. Need to Halt or Reduce not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

[40 C.F.R. § 122.41(c)]

3. Bypass of Treatment Facilities

a. Definitions

(i) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

(ii) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations.

The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs (c.) and (d.) of this section.

c. Notice

(i) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(ii) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Section D, Paragraph 8 (24-hour notice).

d. Prohibition of bypass

(i) Bypass is prohibited, and the Director may take enforcement action against a permittee for bypass, unless:

(1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(3) The permittee submitted notices as required under paragraph (c) of this section.

(ii) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in paragraph (m)(4)(i) of 40 CFR § 122.41.

[40 C.F.R. § 122.41(m)(1)-(4)]

4. Upsets

a. Definition

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. Effect of an upset

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph (c) of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(i) An upset occurred and that the permittee can identify the cause(s) of the upset;

(ii) The permitted facility was at the time being properly operated;

(iii) The permittee submitted notice of the upset as required in Section D, Paragraph 8 (24 hour notice); and

(iv) The permittee complied with any remedial measures required under paragraph (d) of this section.

d. Burden of proof

In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

[40 C.F.R. § 122.41(n)(1)-(4)]

5. Removed Substances

This permit does not authorize discharge of solids, sludge, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters of the United States unless specifically limited in Part I.

C. Monitoring and Records

1. Representative Sampling

Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

[40 C.F.R. § 122.41(j)(1)]

All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to ensure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than $\pm$ 10% from the true discharge rates throughout the range of expected discharge volumes. Once-through condenser cooling water flow which is monitored by pump logs, or pump hour meters, and based on the manufacturer's pump curves shall not be subject to this requirement. Guidance in selection, installation, calibration, and operation of acceptable flow measurement devices can be obtained from the following references. These references are available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. (800) 553-6847 or (703) 487-4650.

"A Guide to Methods and Standards for the Measurement of Water Flow," U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 421, May 1975, 100 pp. (Order by NTIS No. COM-7510683.)

"Water Measurement Manual," U.S. Department of Interior, Bureau of Reclamation, Revised Edition, 1984, 343 pp. (Order by NTIS No. PB-85221109.)

"Flow Measurement in Open Channels and Closed Conduits," U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 484, October 1977, 982 pp. (Order by NTIS No. PB-273535.)

"NPDES Compliance Flow Measurement Manual," U.S. Environmental Protection Agency, Office of Water Enforcement, Publication MCD-77, September 1981, 149 pp. (Order by NTIS No. PB-82131178.)

3. Monitoring Procedures

Monitoring results must be conducted according to test procedures approved under 40 C.F.R. Part 136 or, in the case of sludge use or disposal, approved under 40 C.F.R. Part 136 unless otherwise specified in 40 C.F.R. Part 503, unless other test procedures have been specified in the permit.

[40 C.F.R. § 122.41(j)(4)]

4. Penalties for Tampering

The CWA provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than two years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four years, or both.

[40 C.F.R. § 122.41(j)(5)]

5. Retention of Records

Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 C.F.R. Part 503), the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time. For the purposes of this permit, all records can be scanned and saved electronically, and electronic records are acceptable for inspector's review.

[40 C.F.R. § 122.41(j)(2)]

6. Record Contents

Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical techniques or methods used; and
f. The results of such analyses.

[40 C.F.R. § 122.41(j)(3)(i)-(vi)]

7. Inspection and Entry

The permittee shall allow the Director, or an authorized representative (including an authorized contractor acting as a representative of the Administrator), upon presentation of credentials and other documents as may be required by law, to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the CWA, any substances or parameters at any location.

[40 C.F.R. § 122.41(i)(1)-(4)]

D. Reporting Requirements

1. Change in Discharge

Planned changes. The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in § 122.29(b); or
b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under Section D, Paragraph 10.
c. The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

[40 C.F.R. § 122.41(l)(1)(i)-(iii)]

2. Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

[40 C.F.R. § 122.41(l)(2)]

Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Director.

3. Transfer of Ownership of Control

a. This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the CWA.

[40 C.F.R. § 122.41(l)(3)]

b. Automatic transfers. As an alternative to transfers under paragraph (a) of this section, any NPDES permit may be automatically transferred to a new permittee if:

(i) The current permittee notifies the Director at least 30 days in advance of the proposed transfer date in paragraph (b)(2) of this section;

(ii) The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

(iii) The Director does not notify the existing permittee and the proposed new permittee of his or her intent to modify or revoke and reissue the permit. A modification under this

subparagraph may also be a minor modification under 40 C.F.R. § 122.63. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph (b)(2) of this section.

[40 C.F.R. § 122.61(b)]

4. Monitoring Reports

Monitoring results shall be reported at the intervals specified elsewhere in this permit. See Part III of the permit.

[40 C.F.R. § 122.41(l)(4)]

Monitoring results must be reported on a Discharge Monitoring Report (DMR) or forms provided or specified by the Director.

[40 C.F.R. § 122.41(l)(4)(i)]

5. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by the permit using test procedures approved under 40 C.F.R. Part 136 or, in the case of sludge use or disposal, approved under 40 C.F.R. Part 136 unless otherwise specified in 40 C.F.R. Part 503, or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the Director.

[40 C.F.R. § 122.41(l)(4)(ii)]

6. Averaging of Measurements

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

[40 C.F.R. § 122.41(l)(4)(iii)]

7. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

[40 C.F.R. § 122.41(l)(5)]

Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

8. Twenty-Four Hour Reporting

The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances; contact the National Response Center at (800) 424-8802. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

The following shall be included as information which must be reported within 24 hours under this paragraph.

a. Any unanticipated bypass which exceeds any effluent limitation in the permit. (See 40 C.F.R. § 122.41(g)).
b. Any upset which exceeds any effluent limitation in the permit.
c. Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in the permit to be reported within 24 hours. (See 40 C.F.R. § 122.44(g).)

The Director may waive the written report on a case-by-case basis for reports under this section's paragraph if the oral report has been received within 24 hours.

[40 C.F.R. § 122.41(l)(6)]

9. Other Noncompliance

The permittee shall report all instances of noncompliance not reported under Section D at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph D-8.

[40 C.F.R. § 122.41(l)(7)]

10. Other Information

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information to the Director.

[40 C.F.R. § 122.41(l)(8)]

11. Changes in Discharge of Toxic Substances

The following conditions apply to all NPDES permits within the categories specified below:

a. *Existing manufacturing, commercial, mining, and silvicultural dischargers.* All existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Director as soon as they know or have reason to believe:

(i) That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) One hundred micrograms per liter (100 ug/l);
(2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony;
(3) Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 C.F.R. § 122.21(g)(7); or

[40 C.F.R. § 122.42(a)(1)(i-iii)]

(ii) That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) Five hundred micrograms per liter (500 µg/l);
(2) One milligram per liter (1 mg/l) for antimony;

(3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 C.F.R. § 122.21(g)(7).

[40 C.F.R. § 122.42(a)(2)(i-iii)]

b. *Publicly owned treatment works.* All POTWs must provide adequate notice to the Director of the following:

(i) Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the CWA if it were directly discharging those pollutants;

(ii) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit; and

(iii) For purposes of this paragraph, adequate notice shall include information on:

(1) the quality and quantity of effluent introduced into the POTW, and

(2) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

[40 C.F.R. § 122.42(b)]

12. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit.

[40 C.F.R. § 122.41(b)]

The application should be submitted at least 180 days before the expiration date of this permit. The Regional Administrator may grant permission to submit an application later than the 180 days in advance, but no later than the permit expiration date.

[40 C.F.R. § 122.21(d) paraphrased]

When EPA is the permit-issuing authority, the conditions of an expired permit continue in force until the effective date of a new permit if the permittee has submitted a timely application which is a complete application for a new permit; and the Regional Administrator, through no fault of the permittee does not issue a new permit with an effective date on or before the expiration date of the previous permit.

[40 C.F.R. § 122.6(a) paraphrased]

Permits continued under this section remain fully effective and enforceable.

[40 C.F.R. § 122.6(b)]

13. Signatory Requirements

All applications, reports, or information submitted to the Director shall be signed and certified.

[40 C.F.R. § 122.41(k)(1)]

a. *Applications.* All permit applications shall be signed as follows:

(i) *For a corporation.* By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(1) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or

(2) The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

NOTE: EPA does not require specific assignments or delegations of authority to responsible corporate officers identified in 40 C.F.R. § 122.22(a)(1)(i). The Agency will presume that these responsible corporate officers have the requisite authority to sign permit applications unless the corporation has notified the Director to the contrary. Corporate procedures governing authority to sign permit applications may provide for assignment or delegation to applicable corporate positions under 40 C.F.R. § 122.22(a)(1)(ii) rather than to specific individuals.

(ii) *For a partnership or sole proprietorship.* By a general partner or the proprietor, respectively; or

(iii) *For a municipality, State, Federal, or other public agency.* By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(1) The chief executive officer of the agency, or

(2) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

b. All reports required by permits, and other information requested by the Director shall be signed by a person described in paragraph (a) of this section, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(i) The authorization is made in writing by a person described in paragraph a. of this section;

(ii)The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company, (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) and

(iii)The written authorization is submitted to the Director.

c. *Changes to authorization.* If an authorization under paragraph (b) of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph b. of this section must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

d. *Certification.* Any person signing a document under paragraph (a) or (b) of this section shall make the following certification:
"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

[40 C.F.R. § 122.22]

14. Availability of Reports

Except for data determined to be confidential under 40 C.F.R. Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Permit Issuing Authority. As required by the Act, permit applications, permits and effluent data shall not be considered confidential.

[40 C.F.R. §§ 124.18 & 122.7 paraphrased]

15. Penalties for Falsification of Reports

The CWA provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $16,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

[40 C.F.R. § 122.41(k)(2)]

E. <u>Definitions</u>

1. Permit Issuing Authority

The Regional Administrator of the EPA Region 4 or his/her designee, unless at some time in the future the State or Indian Tribe receives authority to administer the NPDES program and assumes jurisdiction over the permit; at which time, the Director of the State program receiving the authorization becomes the issuing authority. The use of the term "Director" in this permit shall apply to the Water Protection Division Director for EPA Region 4.

2. Act

"Act" means the CWA (formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended by Public Law 95-217 and Public Law 95-576, 33 U.S.C. 1251 et seq.

[40 C.F.R. § 124.2]

3. Mass/Day Measurements

a. The "average monthly discharge" is defined as the total mass of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such month. It is therefore, an arithmetic mean determined by adding the weights of the pollutant found each day of the month and then dividing this sum by the number of days the

tests were reported. This limitation is identified as "Daily Average" or "Monthly Average" in Part I of the permit and the average monthly discharge value is reported in the "Average" column under "Quantity or Loading" on the Discharge Monitoring Report (DMR).

b. The "average weekly discharge" is defined as the total mass of all daily discharges sampled and/or measured during the calendar week on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such week. It is, therefore, an arithmetic mean determined by adding the weights of pollutants found each day of the week and then dividing this sum by the number of days the tests were reported. This limitation is identified as "Weekly Average" in Part I of the permit and the average weekly discharge value is reported in the "Maximum" column under "Quantity or Loading" on the DMR.

c. The "maximum daily discharge" is the total mass (weight) of a pollutant discharged during a calendar day. If only one sample is taken during any calendar day, the weight of pollutant calculated from it is the "maximum daily discharge." This limitation is identified as "Daily Maximum," in Part I of the permit and the highest such value recorded during the reporting period is reported in the "Maximum" column under "Quantity or Loading" on the DMR.

d. The "average annual discharge" is a rolling average equal to the arithmetic mean of the mass measured in all discharges sampled and/or measured during consecutive reporting periods which comprise one year. For parameters that are measured at least once per month, the annual average shall be computed at the end of each month and is equal to the arithmetic mean of the monthly average of the month being reported and each of the previous eleven months. This limitation is defined as "Annual Average" in Part I of the permit and the average annual discharge value is reported in the "Average" column under "Quantity or Loading" on the DMR.

4. Concentration Measurements

a. The "average monthly concentration," other than for bacterial indicators, is the sum of the concentrations of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such month (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the case of grab samples is the arithmetic mean (weighted by flow value) of all the samples collected during that calendar day. This limitation is identified as "Monthly Average" or "Daily Average" under "Other Limits" in Part I of the permit and the average monthly concentration value is reported under the "Average" column under "Quality or Concentration" on the DMR.

b. The "average weekly concentration," other than for bacterial indicators, is the sum of the concentrations of all daily discharges sampled and/or measured during a calendar week on which daily discharges are sampled and measured divided by the number of daily discharges sampled and/or measured during such week (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or

in the case of grab samples is the arithmetic mean (weighted by flow value) of all the samples collected during that calendar day. This limitation is identified as "Weekly Average" under "Other Limits" in Part I of the permit and the average weekly concentration value is reported under the "Maximum" column under "Quality or Concentration" on the DMR.

c. The "maximum daily concentration" is the concentration of a pollutant discharged during a calendar day. It is identified as "Daily Maximum" under "Other Units" in Part I of the permit and the highest such value recorded during the reporting period is reported in the "Maximum" column under "Quality or Concentration" on the DMR.

d. The "average annual concentration," other than for bacterial indicators, is a rolling average equal to the arithmetic mean of the effluent or influent samples collected during consecutive reporting periods which comprise one year. For parameters that are measured at least once per month, the annual average shall be computed at the end of each month and is equal to the arithmetic mean of the monthly average of the month being reported and the monthly average of each of the previous eleven months. This limitation is identified as "Annual Average" under "Other Limits" in Part I of the permit and the average annual concentration value is reported in the "Average" column under "Quality or Concentration" on the DMR.

5. Other Measurements

a. The effluent flow expressed as million gallons per day (MGD) is the 24-hour average flow averaged over a monthly period. It is the arithmetic mean of the total daily flows recorded during the calendar month. Where monitoring requirements for flow are specified in Part I of the permit, the flow rate values are reported in the "Average" column under "Quantity or Loading" on the DMR.

b. An "instantaneous flow measurement" is a measure of flow taken at the time of sampling, when both the sample and flow are representative of the total discharge.

c. Where monitoring requirements for pH, dissolved oxygen, or bacterial indicators are specified in Part I of the permit, the values are generally reported in the "Quality or Concentration" column on the DMR.

d. The "average annual discharge" for bacterial indicators shall be calculated in the same manner as that for mass limitations (see Paragraph II.E.3.d.).

6. Types of Samples

a. Composite Sample: A "composite sample" is a combination of not less than 8 influent or effluent portions, of at least 100 ml, collected over the full time period specified in Part I.A. The composite sample must be flow proportioned by either a time interval between each aliquot or by volume as it relates to effluent flow at the time of sampling or total flow since collection of the previous aliquot. Aliquots may be collected manually or automatically.

b. Grab Sample: A "grab sample" is a single influent or effluent portion which is not a composite sample. The sample(s) shall be collected at the period(s) most representative of the total discharge.

7. Calculation of Means

a. Arithmetic Mean: The "arithmetic mean" of any set of values is the sum of the individual values divided by the number of individual values.

b. Geometric Mean: The "geometric mean" of any set of values is the Nth root of the product of the individual values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

c. Weighted by Flow Value: "Weighted by flow value" means the sum of each concentration times its respective flow divided by the sum of the respective flows.

8. Calendar Day

A "calendar day" is defined as the period from midnight of one day until midnight of the next day. However, for purposes of this permit, any consecutive 24-hour period that reasonably represents the calendar day may be used for sampling.

9. Hazardous Substance

A "hazardous substance" means any substance designated under 40 C.F.R. Part 116 pursuant to Section 311 of the CWA.

[40 C.F.R. § 122.2]

10. Toxic Pollutants

A "toxic pollutant" is any pollutant listed as toxic under Section 307(a)(1) of the CWA or, in the case of "sludge use or disposal practices," any pollutant identified in regulations implementing section 405(d) of the CWA.

Part III. Monitoring Reports and Permit Modification

A. Monitoring Reports

The permittee shall be responsible for submitting monitoring results for each permitted facility (e.g., well) within the lease block. If there is more than one type of wastewater for each well, the discharge outfalls shall be designated in the following manner:

001 for Water-based Drilling Fluids
002 for Water-based Drill Cuttings
003 for Synthetic-based Drill Cuttings
004 for Produced Water
005 for Deck Drainage
006 for Well Treatment, Fluids, Completion Fluids, and Workover Fluids
007 for Sanitary Discharges
008 for Domestic Waste Discharges
009 for Miscellaneous Discharges
010 for Miscellaneous Discharges in Which Chemicals Have Been Added
011 for Status Updates for Required Studies and Plans

Monitoring results obtained for each 3-month period (i.e., quarter), starting with the first month of coverage under this permit, shall be summarized for that timeframe and reported on either a DMR form (EPA No. 3320-1) or optional EPA-Region 4 approved form, and shall be postmarked no later than the 28th day of the month following the completed quarterly period. For example, for coverage beginning on January 1, data for January 1 to March 31 shall be submitted by April 28th). If a failure of any permit limitation occurs, the permittee must report the incidents to the EPA Director, or their designated representative, orally within 24 hours and file a written report with the Director in accordance with the requirements in 40 CFR Part 122. All incidents shall be reported on the quarterly DMR along with the entire laboratory results for all non-compliant parameters, until such time as the facility returns to compliance. All laboratory reports submitted with DMRs should clearly indicate the permit number, outfall number(s), and any other identification information necessary to associate the report with the correct facility, waste stream, and outfall(s).

The Non-Compliance Report for Permit Exceedances shall include:

1. A description of the non-compliance and its cause,
2. The period of non-compliance, including dates and times,
3. The anticipated time the non-compliance is expected to continue (if it has not been corrected), and
4. Steps taken or planned to reduce, eliminate and prevent re-occurrence of the non-compliance.
5.

Signed copies of these and all other reports required by Part II.D. shall be submitted to the following address:

Director
Water Protection Division
U.S. EPA- Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960

Upon availability, but no later than January 1, 2017, the permittee will be able to electronically submit NOIs via the eNOI system and NOTs via email. Additionally, DMRs must be submitted via the Network Discharge Monitoring Report (NetDMR) tool. Once finalized, instructions for all electronic submittals will be posted on EPA website at:
http://www.epa.gov/aboutepa/about-epa-region-4-southeast
Until such time, signed copies of these and all other reports required by Part II.D. shall be submitted to the above address.

If no discharge occurs during the reporting period, sampling requirements of this permit do not apply. The operator must check the "No Discharge" block on the DMR or enter "NODI=C" for quantity and concentration in cases where there is no discharge from a particular outfall. In cases where there no discharge from any outfalls, the operator may include the facility on a "No Activity" list each monitoring period. If, during the term of this permit, the facility ceases discharge to surface waters, the Regional Director shall be notified within 60 days upon permanent cessation of discharge. This notification shall be in writing.

Additional Monitoring Requirements

1. For effluent monitoring of parameters in Part I of this permit, the permittee shall utilize an EPA-approved test procedure with a minimum level (ML) which is lower than the effluent limitations. The permittee must utilize a standard calibration where the lowest standard point is equal to, or less than, the concentration of the ML. In accordance with 40 CFR § 122.45.45(c), effluent analyses for metals shall measure "total recoverable metal."

2. The permittee shall report the analytical results on the DMR, as follows:
   a. Report for maximum daily, monthly or quarterly effluent limitation (or if no limitation applies but samples are collected during the reporting period):
      i. The maximum value of all analytical results, if the maximum value is greater than the ML; or
      ii. For no data (e.g., not quantifiable), report "NODI (Q)" on the DMR form, if the maximum value of all analytical results is greater than or equal to the laboratory's minimum detection limit (MDL), but less than the ML; or

iii. Report "NODI (B)" (e.g., below detection level), if the maximum value of all analytical results is less than the laboratory's MDL.

b. Report for average monthly or quarterly effluent limitation (or if no limitation applies but samples are collected during the reporting period):

i. As directed for maximum effluent limitation, if only one sample is collected during the monthly reporting period; or

ii. The average value of all analytical results where 0 (zero) is substituted for NODI (B) and the laboratory's MDL is substituted for NODI (Q), if more than one sample is collected during the reporting period.

c. Report an attachment to the DMR form for each value reported under paragraphs 2.a and 2.b:

i. The number or title of the approved analytical method, preparation procedure utilized by the laboratory, and MDL or ML of the analytical method for the pollutant available under 40 CFR 136:

ii. The laboratory's MDL for the analytical method computed in accordance with Appendix B of 40 CFR 136, the standard deviation (S) from the laboratory's MDL study, and the number of replicate analyses (*n*) used to compute the laboratory's MDL; and

iii. The lowest calibration standard (i.e., the ML, or lower value).

B. <u>Permit Modification</u>

1. This permit shall be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under sections 301(b)(2) (C) and (D), 304(b)(2), 307(b)(2) and 316(b) of the Act, as amended, if the effluent standard or limitation requirement so issued or approved:

a. Contains different conditions or is otherwise more stringent than any conditions in the permit; or

b. Controls any pollutant or disposal method not addressed in the permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

2. In accordance with Section 306(d) of the Clean Water Act, effluent limitations based on standards of performance for new sources in this permit shall not be made more stringent during a ten-year period beginning on the date of completion of such construction or during the period of depreciation or amortization of such facility for the purposes of Section 167 and/or 169 of the Internal Revenue Code of 1954, whichever period ends first. The provisions of Section 306(d) do not limit the authority of EPA to modify, or alternatively revoke and reissue, the permit to require compliance with a toxic effluent limitation promulgated under Best Available Technology (BAT) or toxic pollutant standard established under 307(a) of the Act, or to modify, as necessary to assure compliance with any applicable effluent standard or limitation issued or

approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Act, if the effluent standard or limitation so issued or approved:

a. Contains different conditions or is otherwise more stringent than any conditions in the permit; or

b. Controls any pollutant or disposal method not addressed in the permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

Note: Conditions of the permit section do not apply if EPA proposes/promulgates a different and applicable New Source Performance Standard (NSPS) prior to "start of construction" for any new sources, as defined in 40 CFR Section 122.29(b)(4) or 125.83. In such case, this permit shall be modified to comply with the requirements of such new NSPS.

Part IV. Best Management Practices/Pollution Prevention (BMP3) Plan

A. Objective

This part is directed towards developing and implementing best management practices plan that incorporates pollution prevention measures for the entire facility. The plan shall address measures towards reducing pollutants of concern and wastes from maintenance operations which discharge (or could discharge) to surface waters. For the purposes of this permit, pollutants of concern shall be limited to toxic pollutants, as defined below under Part IV.C.4, known to the discharger. If applicable, the plan shall address each component or system capable of generating or causing a release of NAF and identify specific preventative or remedial measures to be implemented.

B. General Requirements

In accordance with Section 304(e) and 402(a)(2) of the CWA as amended, 33 U.S.C. §§ 1251 et seq., and consistent with the policy of the Pollution Prevention Act of 1990, 42 U.S.C. §§ 13101-13109, the permittee must develop and implement a Best Management Practices (BMP) plan incorporating pollution prevention measures for the entire offshore facility. Note that this part does not require the permittee to incorporate pollution prevention measures that would jeopardize efficient operation or result in an unreasonable economic burden. If applicable, the plan shall also include measures to prevent, or minimize, the discharge of NAFs from the facility to waters of the United States through normal operations and ancillary activities. Ways to reduce impingement and entrainment of organisms in the cooling water intake structure shall also be evaluated.

A BMP plan developed as a requirement of a previous NPDES permit will satisfy the requirements of this part if it addresses both facility-wide and specific BMPs for NAFs per Appendix 7 of 40 C.F.R. Part 435, subpart A, to reduce the likelihood of spills or other releases of oil or oil contaminated water, chemicals, cleaning chemicals, and biocides that may enter waters of the United States. References which may be used in developing the plan are "Criteria and Standards for Best Management Practices Authorized Under Section 304(e) of the Act", found at 40 C.F.R.122.44(k), the Waste Minimization Opportunity Assessment Manual, EPA/625/7-88/003, and other EPA documents relating to BMP guidance.

Pollution prevention requirements per MMS (see 30 C.F.R. Part 250.300), or other federal requirements relating to BMP guidance, may be incorporated by reference.

The BMP plan is to be retained on-site. Within one year of coverage, operators must submit a certification statement that the BMP plan has been developed and is being implemented. Unless otherwise required by the Director, submittal of the BMP plan to EPA is not required.

C. Part IV Special Definitions

1. The term "pollutants" refers to conventional, non-conventional and toxic pollutants, as appropriate for the NPDES storm water program and toxic pollutants.

2. Conventional pollutants are: biochemical oxygen demand (BOD), suspended solids, pH, fecal coliform bacteria and oil & grease.

3. Non-conventional pollutants are those which are not defined as conventional or toxic, such as phosphorus, nitrogen or ammonia. (Ref: 40 C.F.R. Part 122, Appendix D, Table IV)

4. For purposes of this part, Toxic Pollutants include, but are not limited to: a) any toxic substance listed in Section 307(a)(1) of the CWA, any hazardous substance listed in Section 311 of the CWA, and b) any substance (that is not also a conventional or non-conventional pollutant) for which EPA has published an acute or chronic toxicity criterion, or that is a pesticide regulated by the Federal Insecticide, Fungicide, and Rodentcide Act (FIFRA).

5. "Pollution prevention" and "waste minimization" refer to the first two categories of EPA's preferred hazardous waste management strategy: first, source reduction and then, recycling.

6. "Recycle/Reuse" is defined as the minimization of waste generation by recovering and reprocessing usable products that might otherwise become waste; or the reuse or reprocessing of usable waste products in place of the original stock, or for other purposes such as material recovery, material regeneration or energy production.

7. "Source reduction" means any practice which: i) reduces the amount of any pollutant entering a waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment or disposal; and ii) reduces the hazards to public health and the environment associated with the release of such pollutant. The term includes equipment or technology modifications, process or procedure modifications, reformulation or substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control. It does not include any practice which alters the physical, chemical, or biological characteristics or the volume of a pollutant through a process or activity which itself is not integral to, or previously considered necessary for, the production of a product or the providing of a service.

8. "BMP3" means a Best Management Plan incorporating the requirements of 40 C.F.R. 122.44(k) and Addendum B of Appendix 7 of 40 C.F.R. Part 435, subpart A, plus pollution prevention techniques, except where other existing programs are deemed equivalent by the permittee. The permittee shall certify the equivalency of the other referenced programs.

9. "Waste Minimization Assessment" means a systematic planned procedure with the objective of identifying ways to reduce or eliminate waste.

10. The term "material" refers to chemicals or chemical products used in any plant operation (i.e., caustic soda, hydrazine, degreasing agents, paint solvents, etc.). It does not include lumber, boxes, packing materials, etc.

D. Specific BMP3 Plan Requirements

1. Facility-Wide Operations

The following requirements may be incorporated by reference from existing facility procedures:

a. name and description of facility, a map illustrating the location of the facility and adjacent receiving waters, and other maps, plot plans or drawings, as necessary;
b. overall objectives (both short-term and long-term) and scope of the plan, towards reduction of pollutants, anticipated dates of achievement of reduction, and a description of means for achieving each reduction goal;
c. a description of procedures relative to spill prevention, control and countermeasures and a description of measures employed to prevent storm water contamination, where the storm water can reasonably be expected to reach waters of the U.S. prior to treatment;
d. a description of practices involving preventive maintenance, housekeeping, record keeping, inspections, and plant security;
e. a description of a waste minimization assessment (WMA) plan for this facility, to determine actions that could be taken to reduce waste loadings and chemical losses to all wastewater and/or storm water streams, without compromising production efficiency or jeopardizing operations. The plan shall address both short-term and long-term opportunities for minimizing waste generation at this facility, particularly for high volume and/or high toxicity components of wastewater and storm water streams. Initially, the WMA plan should focus primarily on actions that could be implemented quickly, thereby realizing tangible benefits to surface water quality. Long term goals and actions pertaining to waste reduction shall include investigation of the feasibility of eliminating toxic chemical use, instituting process changes, raw material replacements, etc. At minimum, the WMA plan should include the following items:

(i) Material and Risk Assessment - A materials and risk assessment shall be developed and shall include the following:

(1) identification of the types and quantities of materials used at the facility;

(2) identification of the location and types of materials management activities which occur at the facility;

(3) an evaluation of the following aspects of materials compatibility: containment and storage practices for chemicals, container compatibility, chemical mixing procedures; potential mixing or compatibility problems; and specific prohibitions regarding mixing of chemicals;

(4) technical information on human health and ecological effects of toxic or hazardous chemicals presently used or manufactured (including by-products produced) or planned for future use or production;

(5) analyses of chemical use and waste generation, including input parameters for all pollutants, overall facility material balances and as necessary, internal process balances, for all pollutants. (When actual measurements of the quantity of a chemical entering a wastewater or storm water stream are not readily available, reasonable estimates should be made based on best engineering judgment.) The analyses should address reasons for using particular chemicals, and/or measures or estimates of the actual and potential chemical discharges via wastewater, wastewater sludge, storm water, air, solid waste or hazardous waste media.

(ii) Pollutant Reduction Methods - The WMA plan shall include, at a minimum, the following means of reducing pollutant discharges in wastewater streams or of otherwise minimizing wastes:

(1) process related source reduction measures, including any or all of the following, as appropriate: improved process controls; reduction in use of toxic or hazardous materials; chemical modifications and/or material purification; chemical substitution employing non-toxic or less toxic alternatives; and equipment upgrades or modifications or changes in equipment use.

(2) housekeeping/operational changes, including waste stream segregation, inventory control, spill and leak prevention, equipment maintenance; and employee training in areas of pollution prevention, good housekeeping, and spill prevention and response;

(3) in-process recycling, on-site recycling and/or off-site recycling of materials (such as non-hazardous rags, pads and filters, antifreeze, lube oil, cooking oil, etc);

(4) following all source reduction and recycling practices, wastewater treatment process changes, including the use of new or improved treatment methods, such that treatment degradation products are less toxic to aquatic or human life; and

(5) other means as agreed upon by the permit issuing authority and the permittee.

(iii) Storm Water Evaluation - For storm water discharges and instances where storm water enters the wastewater treatment/disposal system or is otherwise commingled with wastewater, the BMP3 shall evaluate the following potential sources of storm water contamination, at a minimum:

(1) loading, unloading and transfer areas for dry bulk materials or liquids;

(2) outdoor storage of raw materials or products;

(3) outdoor processing activities;

(4) dust or particulate generating processes;

(5) on-site waste and/or sludge disposal practices.

The likelihood of storm water contact in these areas and the potential for spills from these areas shall be considered in the evaluation. The history of significant leaks or spills of toxic or hazardous pollutants shall also be considered. Recommendations for changes to current practices which would reduce the potential for storm water contamination from these areas shall be made, as necessary.

Practices which reduce pollutant loading in wastewater or storm water discharges with a consequent increase in solid hazardous waste generation, decrease in air quality, or adverse affect to groundwater shall not be considered waste reduction for the purposes of this assessment planning.

2. Wastes From Maintenance Operations

Maintenance waste, such as removed paint and materials associated with surface preparation and coating operations, must be contained to the maximum extent practicable to prevent discharge. This includes airborne material such as spent or oversprayed abrasives, paint chips, and paint overspray. Measures such as vacuum abrasive blasting, covering grated areas with plywood, surrounding the area with canvas tarps and similar measures must be employed to capture as much material as practicable.

Prior to conducting sandblasting or similar maintenance activities, operators shall operate in accordance with company or site specific BMPs as needed. BMPs utilized must include specific containment measures which should be implemented to the maximum extent practicable. These measures should include, but not limited to:

a. enclose, cover, or contain blasting, sanding, painting, or mechanical cleaning activites, to prevent abrasives, dust, and paint chips from reaching the receiving water.

b. contain blasting, sanding, painting, or mechanical cleaning activities performed over open water.

c. prevent blasting, sanding, painting, or mechanical cleaning activities performed during windy and high precipitation conditions which render containment ineffective.

d. collect spent abrasives routinely and properly store pending shipment to shore for proper disposal.

e. mix paints and solvents in designated areas away form drains, ditches, piers, and surface waters, preferably indoors or under cover.

f. have absorbent and other cleanup items readily available for immediate cleanup of spills

g. allow empty paint cans to dry before disposal

h. use plywood and/or plastic sheeting to cover open areas between decks when water blasting, sandblasting and/or mechanical cleaning activities

3. Non-Aqueous Drilling Fluids

Operators are not required to use specific BMPs for NAFs if all cuttings are monitored in accordance with Appendix 7 of 40 C.F.R. Part 435, subpart A. (This special exemption for NAFs cuttings does not excuse the facility from developing and implementing BMPs for other areas/operations at the site.)

The following specific best management practices and pollution prevention activities are required in the BMP3 Plan when operators elect to control NAF discharges associated with cuttings by a set of BMPs:

a. The operator shall identify and document each NAF well that uses BMPs before starting drilling operations and the anticipated total feet to be drilled with NAF for that particular well.
b. Each facility component or system controlled through use of BMPs shall be examined for its NAF-waste minimization opportunities and its potential for causing a discharge of NAF to waters of the United States due to natural phenomena (e.g., rain, snowfall).
c. For each NAF wastestream controlled through BMPs where experience indicates a reasonable potential for equipment failure (e.g., tank overflow or leakage), natural conditions (e.g., precipitation), or other circumstances to result in NAF reaching surface waters, the BMP3 plan shall include a prediction of the total quantity of NAF which could be discharged from the facility as a result of each condition or circumstance. Specifically, the BMP3 plan should address how NAF cuttings will be handled during routine preventative maintenance or repairs periods for non-crucial equipment such as mud cleaner and high-speed centrifuge and crucial equipment such as the cuttings dryer and cuttings transport system. See Part II.B.c. for NPDES permit requirements regarding "anticipated bypass."
d. The operator must establish programs for identifying, documenting, and repairing malfunctioning NAF equipment, tracking NAF equipment repairs, and training personnel to report and evaluate malfunctioning NAF equipment.
e. The operator must establish operating and maintenance procedures for each component in the solids control system in a manner consistent with the manufacturer's design criteria.
f. The operator must use the most applicable spacers, flushers, pills and displacement techniques in order to minimize contamination of drilling fluids when changing from water-based drilling fluids to NAF, and vice versa.
g. A daily retort analysis shall be performed (in accordance with Appendix 7 to 40 C.F.R. Part 435, subpart A) during the first 0.33 X feet drilled with NAF, where X is the anticipated total feet to be drilled with NAF for that particular well. The retort analyses shall be documented in the well retort log. The operators shall use the calculation procedures detailed in Appendix 7 to subpart A of 40 C.F.R. Part 435 (see equations 1 through 8) to determine the arithmetic average ($\%BF_{well}$) of the retort analyses taken during the first 0.33 X feet drilled with NAF.
h. When the arithmetic average ($\%\ BF_{well}$) of the retort analyses taken during the first 0.33 X feet drilled with NAF is less than or equal to the base fluid retained on cuttings limitation or standard (see 40 C.F.R. §§ 435.13 and 435.15), retort monitoring of cuttings may cease for that particular well. The same BMPs and drilling fluid used during the first 0.33 X feet shall be used for all remaining NAF sections for that particular well.
i. When the arithmetic average ($\%\ BF_{well}$) of the retort analyses taken during the first 0.33 X feet drilled with NAF is greater than the base fluid retained on cuttings limitation or standard (see 40 C.F.R. §§ 435.13 and 435.15), retort monitoring shall continue for the next 0.33 X feet drilled with NAF, where X is the anticipated total feet to be drilled with NAF for that particular well. The retort analyses for the first and second 0.33 X feet shall be documented in the well retort log.

j. When the arithmetic average (% BF_{well}) of the retort analyses taken during the first 0.66 X feet (i.e., retort analyses taken from the first and second X feet) drilled with NAF is less than or equal to the base fluid retained on cuttings limitation or standard (see 40 C.F.R. §§ 435.13 and 435.15), retort monitoring of cuttings may cease for that particular well. The same BMPs and drilling fluid used during the first 0.66 X feet shall be used for all remaining NAF sections for that particular well.

k. When the arithmetic average (%BF_{well}) of the retort analyses taken during the first 0.66 X feet shall (i.e. retort analyses taken from first and second 0.33 X feet) drilled with NAF is greater than the base fluid retained on cuttings limitation or standard (see 40 C.F.R. §§ 435.13 and 435.15), retort monitoring shall continue for all remaining sections for that particular well. The retort analyses for all NAF sections shall be documented in the well retort log.

l. When the arithmetic average (%BF_{well}) of the retort analyses taken over all NAF sections for the entire well is greater that the base fluid retained on cuttings limitation or standard (see §§ 435.13 and 435.15), the operator is in violation of the base fluid retained on cuttings limitation or standard and shall submit notification of these monitoring values in accordance with NPDES permit requirements. Additionally, the operator shall, as part of the BMP3 Plan, initiate a re-evaluation and modification to the BMP3 Plan in conjunction with equipment vendors and/or industry specialists.

m. The operator shall include retort monitoring data and dates of retort-monitored and non-retort-monitored NAF-cuttings discharges managed by BMPs in their NPDES permit reports.

n. The operator shall establish mud pit and equipment cleaning methods in such a way as to minimize the potential for building-up drill cuttings (including accumulated solids) in the active mud system and solids control equipment system. These cleaning methods shall include, but are not limited to, the following procedures :

(1) Ensuring proper operation and efficiency of mud pit agitation equipment,

(2) Using mud gun lines during mixing operations to provide agitation in dead spaces, and

3. Pumping drilling fluids off of drill cuttings (including accumulated solids) for use, recycle, or disposal before using wash water to dislodge solids.

E. <u>Signatory Authority and Management Responsibilities</u>

The BMP3 plan shall contain a written and dated statement (with signatures) from the individual responsible for development and implementation of the BMP3 plan stating that the review has been completed and that the BMP3 plan fulfills the objective and specific requirements set forth in Parts IV. A. and D., above. The statement shall be publicized or made known to all facility employees.

F. Plan Certification

The operator shall certify that its BMP3 plan is complete, on-site, and being implemented. This certification shall identify the NPDES permit number and be signed by an authorized representative of the operator. This certification shall be kept with the BMP3 plan. The certification shall be made no later than one year from the effective date of coverage under this general permit, and must be submitted to EPA-Region 4.

G. Plan Documentation

The BMP3 plan shall be documented in narrative form, and shall include any necessary plot plans, drawings or maps, and shall be developed in accordance with good engineering practices. At a minimum, the BMP3 plan shall contain the planning, development and implementation, and evaluation/reevaluation components. Examples of these components are contained in "Guidance Document for Developing Best Management Practices," EPA document no. 833-B-93-004 (1993).

The permittee shall maintain a copy of the BMP3 plan and related documentation (e.g., training certifications, summary of the monitoring results, records of NAF-equipment spills, repairs, and maintenance) at the facility and shall make the BMP3 plan and related documentation available to EPA upon request.

H. Best Management Practices and Pollution Prevention Committee:

A Best Management Practices Committee (Committee) should be established to direct or assist in the implementation of the BMP3 plan. The Committee should be comprised of individuals within the plant organization who are responsible for developing, implementing, monitoring of success, and revision of the BMP3 plan. The activities and responsibilities of the Committee should address all aspects of the facility's BMP3 plan. The scope of responsibilities of the Committee should be described in the plan.

I. Employee Training

Employee training programs shall inform appropriate personnel of the components and goals of the BMP3 plan and shall describe employee responsibilities for implementing the plan. Training shall address topics such as good housekeeping, materials management, record keeping and reporting, spill prevention and response, as well as specific waste reduction practices to be employed. The plan shall identify periodic dates for such training.

J. Plan Development and Implementation

The BMP3 plan shall be developed and implemented within one year after the effective date of this coverage under this general permit.

K. Plan Review

The plan shall be reviewed by the permittee's designated responsible party (such as the facility drilling engineer) to ensure compliance with the BMP3 plan purpose and objectives set forth above.

If following review by EPA, the BMP3 plan is determined insufficient, EPA may notify the permittee that the BMP3 plan does not meet one or more of the minimum requirements of this Part. Upon such notification from the Director, or authorized representative, the permittee shall amend the plan and shall submit to the Director a written certification that the requested changes have been made. Unless otherwise provided by the Director of the Water Management Division-EPA Region 4, the permittee shall have 30 days after such notification to make the changes necessary.

L. Plan Modification

The permittee shall modify the BMP3 plan whenever there is a change in design, construction, operation, or maintenance, pertaining to the facility which has a significant effect on the potential for the discharge of pollutants to waters of the United States or if the plan proves to be ineffective in achieving the general objectives of reducing pollutants in wastewater or wet weather discharges.

At a minimum, the BMP3 plan shall be reviewed once every five years, and amended within three months if warranted. Any such changes to the BMP3 plan shall be consistent with the objectives and specific requirements listed in this permit. All changes in the BMP3 plan shall be reviewed by the operator's drilling engineer and authorized on-site representative.

At any time, if the BMP3 plan proves to be ineffective in achieving the general objective of preventing and minimizing the discharge of toxic pollutants and/or NAF-wastes, the BMP3 plan be subject to modification. If the BMP3 requirements in the permit are modified, the BMP3 plan must be modified to incorporate the revised BMP3 requirements within three months.

In particular, for those NAF-waste streams controlled through BMPs, the operator shall amend the BMP3 plan within 30 days whenever there is a change in the facility or in the operation of the facility which materially increases the generation of those NAF wastes or their release, or potential release to the receiving waters.

Modifications to the plan may be reviewed by EPA in the same manner as described above.

Part V. Test Procedures and Definitions

A. Test Procedures

1. Samples of Wastes

If requested, the permittee shall provide EPA with a sample of any waste in a manner specified by the Agency.

2. Drilling Fluids Toxicity Test (Suspended Particulate Phase Toxicity Test)

The approved sampling and test methods for permit compliance are provided in the final effluent guidelines published at 58 FR 12507 on March 4, 1993, as Appendix 2 to subpart A of 40 C.F.R. Part 435.

3. Static Sheen Test

The approved sampling and test methods for permit compliance are provided in the final effluent guidelines published at 58 FR 12506 on March 4, 1993 as Appendix 1 to subpart A of 40 C.F.R. Part 435.

4. Visual Sheen Test

The visual sheen test is used to detect free oil by observing the surface of the receiving water for the presence of a sheen while discharging. A sheen is defined as a "silvery" or "metallic" sheen, gloss, or increased reflectivity; visual color; iridescence; or oil slick on the surface (see 58 FR 12507). The operator must conduct a visual sheen test only at times when a sheen could be observed. This restriction eliminates observations at night or when atmospheric or surface conditions prohibit the observer from detecting a sheen (e.g., during rain or rough seas, etc.). Certain discharges can only occur if a visual sheen test can be conducted.

The observer must be positioned on the rig or platform, relative to both the discharge point and current flow at the time of discharge, such that the observer can detect a sheen should it surface down current from the discharge. For discharges that have been occurring for at least 15 minutes, observations may be made any time thereafter. For discharges of less than 15 minutes duration, observations must be made both during discharge and 5 minutes after discharge has ceased.

5. Produced Water Toxicity Tests

Operators may choose to demonstrate compliance with the toxicity testing requirements for produced water by performing a 7-day chronic toxicity test in accordance with methods for determining the 7-day NOEC is *Short Term Methods for Estimation Chronic Toxicity of Effluents and Receiving Water to Marine and Estuarine Organisms* (EPA/821-R-02-014). The species to be used for compliance testing for this permit are *Mysidopsis bahia (Americamysis bahia* (Mysid shrimp)) and *Menida beryllina* (Inland silverside minnow).

6. Base Fluid Sediment Toxicity Test

The approved test method for permit compliance is identified as ASTM E1367-92 (or most current EPA approved method) entitled, *Standard Guide Conducting 10-day Static Sediment Toxicity Tests with Marine and Estuarine Amphipods* (or the most current EPA approved method), with *Leptocheirus plumulosus* as the test organism and sediment preparation procedures specified in Appendix 3 of 40 C.F.R. Part 435, subpart A.

$$\text{The base fluid sediment toxicity ratio} = \frac{\text{10-day } LC_{50} \text{ of reference fluid*}}{\text{10-day } LC_{50} \text{ of stock base fluid}}$$

*C_{16}-C_{18} internal olefin, C_{12}-C_{14} ester or C_8 ester

7. Base Fluids Biodegradation Rate

The approved method for permit compliance is identified as International Standards Organization (ISO) 11734:1995 (or the most current EPA approved method) entitled, *Water quality - Evaluation of the ultimate anaerobic biodegradability of organic compounds in digested sludge - Method by measurement of the biogas production* (1995 edition), supplemented with modifications in Appendix 4 of 40 C.F.R. Part 435, subpart A. Compliance with the biodegradation limit will be determined using the following ratio. As described in Section 5.1 of this permit ("Total Gas monitoring procedures") the term "Cumulative gas production" in the following ratio refers to head space gas. This is consistent with the Western Gulf of Mexico Outer Continental General Permit (GMG290000).

$$\text{Biodegradation rate ratio} = \frac{\text{Cumulative gas production (ml) of reference fluid *}}{\text{Cumulative gas production (ml) of stock base fluid, both at 275 days}}$$

*C_{16}-C_{18} internal olefin, C_{12}-C_{14} ester or C_8 ester

8. Polynuclear Aromatic Hydrocarbons

The approved method for permit compliance is EPA Method 1654A entitled, *PAH Content of Oil by High Performance Liquid Chromatography with a UV Detector*.

$$\text{PAH mass ratio} = \frac{\text{Mass (g) of PAH (as phenanthrene)}}{\text{Mass (g) of stock base fluid}}$$

9. Formation Oil

a. Contamination of Non-Aqueous Based Drilling Fluids

The approved test method for permit compliance is Gas Chromatography/Mass Spectrometry (GC/MS) contained in Appendix 5 of 40 C.F.R. Part 435, subpart A (or most current EPA approved method). This test shall be performed prior to drilling.

The GC/MS method reports results for the GC/MS test as a percentage crude contamination when calibrated for a specific crude oil. In order to define an applicable pass/fail limit to cover a variety of crude oils, the same crude oil used in calibration of the Reverse Phase Extraction (RPE) test shall be used to calibrate the GC/MS test results to a standardized ratio of the target ION Scan 105 (or most current EPA approved method). Based on the performance of a range of

crude oils against the standardized ratio, a value will be selected as a pass/fail standard which will represent detection of crude oil.

b. Contamination of Discharged Non-Aqueous Based Drilling Fluids Retained on Cuttings

The approved test method for permit compliance is the RPE method in Appendix 6 of 40 C.F.R. Part 435, subpart A, which is applied to drilling fluid removed from drill cuttings. If the operator wishes to confirm with results of the RPE method (Appendix 6 of 40 C.F.R. Part 435, subpart A), the operator may use the GC/MS compliance assurance method (Appendix 5 of 40 C.F.R. Part 435, subpart A). Results from the GC/MS compliance assurance method shall supercede the results of the RPE method.

10. Drilling Fluids Sediment Toxicity

The approved test method for permit compliance is identified as ASTM E1367-92 (or the most current EPA approved method) entitled, *Standard Guide Conducting 10-day Static Sediment Toxicity Tests with Marine and Estuarine Amphipods*, with *Leptocheirus plumulosus* as the test organism and sediment preparation procedures specified in Appendix 3 of 40 C.F.R. Part 435, subpart A.

$$\text{The drilling fluid sediment toxicity ratio} = \frac{\text{4-day } LC_{50} \text{ of } C_{16}\text{-}C_{18} \text{ internal olefin}}{\text{4-day } LC_{50} \text{ drilling fluid removed from drill cuttings at the solids control equipment}}$$

11. Retention of Non-Aqueous Based Drilling Fluid on Cuttings

The maximum permissible retention of NAF base on wet drill cuttings averaged over drilling intervals using NAFs shall be determined by the American Petroleum Institute Retort method contained in Appendix 7 of 40 C.F.R. Part 435, subpart A. The required sampling, handling, and documentation procedures are listed in Addendum A of Appendix 7 of 40 C.F.R. Part 435, subpart A.

12. Sampling Protocol for Stock Drilling Fluid Sediment Toxicity Test, Drilling Fluid Sediment Toxicity Test and Biodegradation Rate Test

Compliance with the 1.0 permit limit shall be based on the ratio of the arithmetic average of up to three test results from two grab samples. The first grab sample must be split into two aliquots (e.g., grab1A and grab1B) and analyzed separately. The second grab sample (grab2) shall be a backup sample, which shall be retained following proper storage and handling procedures. The second grab sample will be collected within 15 minutes of the first grab sample, and in the case of base fluid testing, will be from the same production lot. Permittees shall show compliance based on results from grab1A, or from the ratio of the arithmetic average of grab1A, grab1B, and if necessary grab 2. All test results obtained shall be submitted with the DMR and all ratios shall be rounded to the nearest tenths.

All test results shall be generated as follows:

a. The 10-day stock base fluid toxicity test results consist of individual stock base fluid LC_{50}s and individual reference fluid LC_{50}s (paired results). The arithmetic average of the LC_{50} for the test fluid sample(s) will be compared to determine compliance with the 1.0 ratio permit limit.

b. The stock base fluid biodegradation test results consist of individual stock base fluid cumulative gas production (ml) and individual reference fluid cumulative gas production (ml) tests (paired results). The arithmetic average of the cumulative gas production (ml) for the test fluid samples(s) will be compared against the arithmetic average of the cumulative gas production (ml) of the reference fluid sample(s) to determine compliance with the 1.0 ratio permit limit.

c. The 4-day drilling fluid mud toxicity test results consist of the individual field mud LC_{50}s and individual reference mud LC_{50}s (paired results). The arithmetic average of the LC_{50} for the field mud sample(s) will be compared against the arithmetic average of the LC_{50} of the reference mud sample(s) to determine compliance with the 1.0 ratio permit limit.

13. Rounding of Ratios (to be applied in measuring compliance with the sediment toxicity and biodegradation tests)

All ratios shall be rounded as follows:

The following rounding procedures shall only be applied to the sediment toxicity and biodegradation limitations and standards in this permit:

a. If the digit 6, 7, 8, or 9 is dropped, increase preceding digit by one unit.
   Example: a calculated sediment toxicity or biodegradation ratio of 1.06 should be rounded to 1.1 and reported as a violation of the permit limit.
b. If the digit 0, 1, 2, 3, or 4 is dropped, do not alter the preceding digit.
   Example: a calculated sediment toxicity ratio of 1.04 should be rounded to 1.0 and reported to EPA as compliant with the permit limit.
c. If the digit 5 is dropped, round off preceding digit to the nearest even number.
   Example: a calculated ratio of 1.05 should be rounded to 1.0 and reported to EPA as compliant with the permit limit.

14. Protocol for the Determination of Degradation of Non aqueous Base Flids in a Marine Closed Bottle Biodegradation Test System: Modified ISO 11734

Section 1: Summary of Method

This method determines the anaerobic degradation potential of mineral oils, paraffin oils and non aqueous fluids (NAF) in sediments. These substrates are base fluids for formulating offshore drilling fluids. The test evaluates base fluid biodegradation rates by monitoring gas production due to microbial degradation of the test fluid in natural marine sediment.

The test procedure places a mixture of marine/estuarine sediment, test substrate (hydrocarbon or controls) and seawater into clean 120 ml (150 ml actual volume) Wheaton serum bottles. The test is run using four replicate serum bottles containing 2000 mg carbon/kg dry weight concentration of test substrate in sediment. The use of resazurin dye solution (1 ppm) evaluates the anaerobic (redox) condition of the bottles (dye is blue when oxygen is present, reddish in low oxygen conditions and colorless if oxygen free). After capping the bottles, a nitrogen sparge removes air in the headspace before incubation begins. During the incubation period, the sample should be kept at a constant temperature of 29 (+/-1)ºC. Gas production and composition is measured approximately every two weeks. The samples need to be brought to ambient temperature before making the measurements. Measure gas production using a pressure gauge. Barometric pressure is measured at the time of testing to make necessary volume adjustments.

ISO 11734 specifies that total gas is the standard measure of biodegradation. While modifying this test for evaluating biodegradation of NAF's, methane was also monitored and found to be an acceptable method of evaluating biodegradation Appendix 1 contains the procedures used to follow biodegradation by methane production. Measurement of either total gas or methane production is permitted. If methane is followed, determine the composition of the gas by using gas chromatography (GC) analysis at each sampling. At the end of the test when gas production stops, or at around 275 days, an analysis of sediment for substrate content is possible. Common methods which have been successfully used for analyzing NAF's from sediments are listed in Appendix 2.

Section 2: System Requirements

This environmental test system has three phases, spiked sediment, overlying seawater, and a gas headspace. The sediment/test compound mixture is combined with synthetic sea water and transferred into 120 mL serum bottles. The total volume of sediment/sea water mixture in the bottles is 75 mL. The volume of the sediment layer will be approximately 50 mL, but the exact volume of the sediment will depend on sediment characteristics (wet:dry ratio and density). The amount of synthetic sea water will be calculated to bring the total volume in the bottles to 75 mL. The test systems are maintained at a temperature of 29 ºC during incubation. The test systems are brought to ambient temperatures prior to measuring pressure or gas volume.

Section 2.1: Sample Requirements

The concentration of base fluids are at least 2000 mg carbon test material/kg dry sediment. Carbon concentration is determined by theoretical composition based on the chemical formula or by chemical analysis by ASTM D5291-96. Sediments with positive, intermediate and negative control substances as well as a C1618 Internal Olefin type base fluid will be run in conjunction with test materials under the same conditions. The positive control is ethyl oleate (CAS 111-62-6), the intermediate control is 1-hexadecene (CAS 629-73-2), and the negative control is squalane (CAS 111-01-3). Controls must be of analytical grade or the highest grade available. Each test control concentration should be prepared according to the mixing procedure described in Section 3.1.

Product names will be used for examples or clarification in the following text. Any use of trade or product names in this publication is for descriptive use only, and does not constitute endorsement by EPA or the authors.

Section 2.2: Seawater Requirements

Synthetic seawater at a salinity of 25 ppt should be used for the test. The synthetic seawater should be prepared by mixing a commercially available artificial seawater mix, into high purity distilled or de-ionized water. The seawater should be aerated and allowed to age for approximately one month prior to use.

Section 2.3: Sediment Requirements

The dilution sediment must be from a natural estuarine or marine environment and be free of the compounds of interest. The collection location, date and time will be documented and reported. The sediment is prepared by press-sieving through a 2000-micron mesh sieve to remove large debris, then press-sieving through a 500-micron sieve to remove indigenous organisms that may confound test results. The water content of the sediment should be less than 60%(w/w) or a wet to dry ratio of 2.5. The sediment should have a minimum organic matter content of 3% (w/w) as determined by ASTM D2974-87 (95) (Method A and D and calculate organic matter as in section 12 of method ASTM D2974-87).

To reduce the osmotic shock to the microorganisms in the sediment the salinity of the sediment's pore water should be between 20-30 ppt. Sediment should be used for testing as soon as possible after field collection. If required, sediment can be stored in the dark at 4°C with 3-6 inches of overlying water in a sealed container for a maximum period of 2 months prior to use.

Section 3: Test Set up

The test is set up by first mixing the test or control substrates into the sediment inoculum, then mixing in seawater to make a pourable slurry. The slurry is then poured into serum bottles, which are then flushed with nitrogen and sealed.

Section 3.1: Mixing Procedure

Because base fluids are strongly hydrophobic and do not readily mix with sediments, care must be taken to ensure base fluids are thoroughly homogenized within the sediment. All concentrations are weight-to-weight comparisons (mg of base fluid to kg of dry control sediment). Sediment and base fluid mixing will be accomplished by using the following method.

3.1.1. Determine the wet to dry weight ratio for the control sediment by weighing approximately 10 sub-samples of approximately 1.0 g each of the screened and homogenized wet sediment into tared aluminum weigh pans. Dry sediment at 105 C for 18-24 h. Remove the dried sediments and cool in a desiccator. Repeat the drying, cooling, and weighing cycle until a constant weight is achieved (within 4% of previous weight). Re-weigh the samples to determine the dry weight. Calculate the mean wet and dry weights of the 10 sub-samples and determine the wet/dry ratio by dividing the mean wet weight by the mean dry weight using Formula 1. This is required to determine the weight of wet sediment needed to prepare the test samples.

$$\frac{\text{Mean Wet Sediment Weight (g)}}{\text{Mean Dry Sediment Weight (g)}} = \text{Wet to Dry Ratio} \qquad [1]$$

3.1.2. Determine the density (g/ml) of the wet sediment. This will be used to determine total volume of wet sediment needed for the various test treatments. One method is to tare a 5 ml graduated cylinder and add about 5 ml of homogenized sediment. Carefully record the volume then weigh this volume of sediment. Repeat this a total of three times. To determine the wet sediment density, divide the weight by volume per the following formula:

$$\frac{\text{Mean Wet Sediment Weight (g)}}{\text{Mean Wet Sediment Volume (ml)}} = \text{Wet Sediment Density (g/ml)} \qquad [2]$$

3.1.3. Determine the amount of base fluid to be spiked into wet sediment in order to obtain the desired initial base fluid concentration of 2000 mg carbon/kg dry weight. An amount of wet sediment that is the equivalent of 30 g of dry sediment will be added to each bottle. A typical procedure is to prepare enough sediment for 8 serum bottles (3 bottles to be sacrificed at the start of the test, 4 bottles incubated for headspace analysis, and enough extra sediment for 2 extra bottles). Extra sediment is needed because some of the sediment will remain coated onto the mixing bowl and utensils. Experience with this test may indicate that preparing larger volumes of spiked sediment is a useful practice, then the following calculations should be adjusted accordingly.

3.1.3.1 Determine the total weight of dry sediment needed to add 30 g dry sediment to 8 bottles. If more bottles are used then the calculations should be modified accordingly. For example:
30 g dry sediment per bottle x 8 = 240 g dry sediment [3]

3.1.3.2 Determine the weight of base fluid, in terms of carbon, needed to obtain a final base fluid concentration of 2000 mg carbon/kg dry weight. For example:

$$\frac{\text{2000 mg carbon}}{\text{per kg dry sediment}} \times \frac{\text{240 g}}{\text{1000}} = \text{480 mg carbon} \qquad [4]$$

3.1.3.3 Convert from mg of carbon to mg of base fluid.
This calculation will depend on the % fraction of carbon present in the molecular structure of each base fluid. For the control fluids, ethyl oleate is composed of 77.3% carbon, hexadecene is composed of 85.7% carbon, and squalane is composed of 85.3% carbon. The carbon fraction of each base fluid should be supplied by the manufacturer or determined before use. ASTM D5291-96 or equivalent will used to determine composition of fluid.

To calculate the amount of base fluid to add to the sediment, divide the amount of carbon (480 mg) by the percent fraction of carbon in the fluid.

For example, the amount of ethyl oleate added to 240 g dry weight sediment can be calculated from the following equation:

480 mg carbon ÷ (77.3/100) = 621 mg ethyl oleate [5]

Therefore, add 621 mg of ethyl oleate to 240 g dry weight sediment for a final concentration of 2000 mg carbon/kg sediment dry weight.

3.1.4. Mix the calculated amount of base fluid with the appropriate weight of wet sediment.

3.1.4.1 Use the wet:dry ratio to convert from g sediment dry weight to g sediment wet weight, as follows:
240 g dry sediment x wet:dry ratio = g wet sediment needed [6]

3.1.4.2 Weigh the appropriate amount of base fluid (calculated in section 3.1.3.3) into stainless mixing bowls, tare the vessel weight, then add the wet sediment calculated in equation 5, and mix with a high shear dispersing impeller for 9 minutes.
The sediment is now mixed with synthetic sea water to form a slurry that will be transferred into the bottles.

Section 3.2: Creating Seawater/Sediment Slurry
Given that the total volume of sediment/sea water slurry in each bottle is to be 75 mL, determine the volume of sea water to add to the wet sediment.

3.3.1 If each bottle is to contain 30 g dry sediment, calculate the weight, and then the volume, of wet sediment to be added to each bottle

30 g dry sediment x wet:dry ratio = g wet sediment added to each bottle [7]

g wet sediment ÷ density (g/mL) of wet sediment = mL wet sediment [8]

3.3.2 Calculate volume of sea water to be added to each bottle
75 mL total volume - mL wet sediment (from eq. 8) = mL of sea water [9]

3.3.3 Determine the ratio of sea water to wet sediment (volume:volume) in each bottle

$$\frac{\text{volume sea water per bottle (eq. 9)}}{\text{volume sediment per bottle (eq. 8)}} = \text{ratio of sea water:wet sediment} \quad [10]$$

3.3.4 Convert the wet sediment weight from equation 6 into a volume using the sediment density.
g wet sediment (eq. 6) ÷ density = volume (mL) of sediment [11]

3.3.5 Determine the amount of sea water to mix with the wet sediment.
mL wet sediment (eq. 11) x sea water:sediment ratio (eq. 10)
= mL sea water to add to wet sediment [12]

Mix sea water thoroughly with wet sediment to form a sediment/sea water slurry.

Section 3.3: Bottling the Sediment Seawater Slurry

The total volume of sediment/sea water slurry in each bottle is to be 75 mL. Convert the volume (mL) of sediment/sea water slurry into a weight (g) using the density of the sediment and the sea water.

3.4.1 Determine the weight of sediment to be added to each bottle
mL sediment (eq. 8) x density of wet sediment (g/mL) = g wet sediment [14]

3.4.2 Determine the weight of sea water to be added to each bottle
mL sea water (eq. 9) x density of sea water (1.01 g/mL) = g sea water [15]

3.4.3 Determine weight of sediment/sea water slurry to be added to each bottle
g wet sediment (eq. 14) + g sea water (eq. 15) = g sediment/sea water slurry [16]

This should provide each bottle with 30 g dry sediment in a total volume of 75 mL.

3.4.4 Putting the sediment:seawater slurry in the serum bottles.
Note: The slurry will need to be constantly stirred to keep the sediment suspended.

Place a tared serum bottle on a balance and add the appropriate amount of slurry to the bottle using a funnel. Once the required slurry is in the bottle remove the funnel, add 2-3 drops (25 µl) of a 1gram/L resazurin dye stock solution. Cap the bottle with a butyl rubber stopper (Bellco Glass, Part #2048- 11800)and crimp with an aluminum seal (Bellco Glass Part #2048-11020).

Using a plastic tube with a (23 gauge, 1 inch long) needle attached to one side and a nitrogen source to the other, puncture the serum cap with the needle. Puncture the serum cap again with a second needle to sparge the bottle's headspace of residual air for two minutes. The nitrogen should be flowing at no more than 100 mL/min to encourage gentle displacement of oxygenated air with nitrogen. Faster nitrogen flow rates would cause mixing and complete oxygen removal would take much longer. Remove the nitrogen needle first to avoid any initial pressure problems. The second (vent) needle should be removed within 30 seconds of removing the nitrogen needle.

Triplicate blank test systems are prepared, with similar quantities of sediment and seawater without any base fluid. Incubate in the dark at a constant temperature of 29 ^{o} C.

Record the test temperature. The test duration is dependent on base fluid performance, but at a maximum should be no more than 275 days. Stop the test after all base fluids have achieved a plateau of gas production. At termination, base fluid concentrations can

be verified in the terminated samples by extraction and GC analysis according to Appendix 2 of ISO 11734.

Section 4: Concentration Verification Chemical Analyses

Because of the difficulty of homogeneously mixing base fluid with sediment, it is important to demonstrate that the base fluid is evenly mixed within the sediment sea water slurry that was added to each bottle. Of the seven serum bottles set up for each test or control condition, three are randomly selected for concentration verification analyses. These should be immediately placed at 4 C and a sample of sediment from each bottle should be analyzed for base fluid content as soon as possible. The coefficient of variation (CV) for the replicate samples must be less than 20%. The results should show recovery of at least 70% of the spiked base fluid. Use an appropriate analytical procedure described in Appendix 2 to perform the extractions and analyses. If any set of sediments fail the criteria for concentration verification, then the corrective action for that set of sediments is also outlined in Appendix 2.

The nominal concentrations and the measured concentrations from the three bottles selected for concentration verification should be reported for the initial test concentrations. The coefficient of variation (CV) for the replicate samples must be less than 20%. If base fluid content results are not within the 20% CV limit, the test must be stopped and restarted with adequately mixed sediment.

Section 5 Gas monitoring procedures

Biodegradation is measured by total gas as specified in ISO 11734. Methane production can also be tracked and is described in Appendix 1.

Section 5.1 Total Gas monitoring procedures

Bottles should be brought to room temperature before readings are taken. The bottles are observed to confirm that the resazurin has not oxidized to pink or blue. Total gas production in the culture bottles (head space gas) should be measured using a pressure transducer (one source is Biotech International). The pressure readings from test and control cultures are evaluated against a calibration curve created by analyzing the pressure created by known additions of gas to bottles established identically to the culture bottles. Bottles used for the standard curve contain 75 mL of water, and are sealed with the same rubber septa and crimp cap seals used for the bottles containing sediment. After the bottles used in the standard curve have been sealed, a syringe needle inserted through the septa is used to equilibrate the pressure inside the bottles to the outside atmosphere. The syringe needle is removed and known volumes of air are injected into the headspace of the bottles. Pressure readings provide a standard curve relating the volume of gas injected into the bottles and headspace pressure. No less than three points may be used to generate the standard curve. A typical standard curve may use 0, 1, 5, 10, 20 and 40 ml of gas added to the standard curve bottles.

The room temperature and barometric pressure (to two digits) should be recorded at the time of sampling. One option for the barometer is Fisher Part #02-400 or 02-401. Gas production by the sediment is expressed in terms of the volume (mL) of gas at standard temperature ($0^oC = 273^oK$) and pressure (1 atm = 30 inches of mercury (Hg)) using Eqn.17.

$$V_2 = \frac{P_1 * V_1 * T_2}{T_1 * P_2} \qquad [17]$$

Where:
V_2 = volume of gas production at standard temperature and pressure
P_1 = barometric pressure on day of sampling (inches of Hg)
V_1 = volume of gas measured on day of sampling (mL)
T_2 = standard temperature = 273^oK
T_1 = temperature on day of sampling ($^oC + 273 = {}^oK$)
P_2 = standard pressure = 30 inches Hg

A estimation can be made of the total volume of anaerobic gas that will be produced in the bottles. The gas production measured for each base fluid can be expressed as a percent of predicted total anaerobic gas production.

5.1.1. Calculate the total amount of carbon in the form of the base fluid present in each bottle

Each bottle is to contain 30 g dry weight sediment. The base fluid concentration is 2000 mg carbon/kg dry weight sediment. Therefore:

2000 mg carbon/kg sediment x (30 g/1000) = 60 mg carbon per bottle [18]

5.1.2. Theory states that anaerobic microorganisms will convert 1 mole of carbon substrate into 1 mole of total anaerobic gas production

Calculate the number of moles of carbon in each bottle.

The molecular weight of carbon is 12 (i.e. 1 mole of carbon = 12 g). Therefore, the number of moles of carbon in each bottle can be calculated.

(60 mg carbon per bottle/1000) ÷ 12 g/mole = 0.005 moles carbon [19]

5.1.3. Calculate the predicted volume of anaerobic gas

One mole of gas equals 22.4 L (at standard temperature and pressure), therefore, 0.005 moles x 22.4 L = 0.112 L (or 112 mL total gas production). [20]

Section 5.2 Gas Venting

If the pressure in the serum bottle is too great for the pressure transducer or syringe, some of the excess gas must be wasted. The best method to do this is to vent the excess gas right after measurement. To do this, remove the barrel from a 10-mL syringe and fill it 1/3 full with water. This is then inserted into the bottle through the stopper using a small diameter (high gauge) needle. The excess pressure is allowed to vent through the water until the bubbles stop. This allows equalization of the pressure inside the bottle to atmospheric without introducing oxygen. The amount of gas vented (which is equal to the volume determined that day) must be kept track of each time the bottles are vented. A simple way to do this in a spreadsheet format is to have a separate column in which cumulative vented gas is tabulated. Each time the volume of gas in the cultures is analyzed, the total gas produced is equal to the gas in the culture at that time plus the total of the vented gas.

To keep track of the methane lost in the venting procedure, multiply the amount of gas vented each time by the corrected % methane determined on that day. The answer gives the volume of methane wasted. This must be added into the cumulative totals similarly to the total gas additions.

Section 6: Test Acceptability and Interpretation

Section 6.1 Test acceptability

At day 275 or when gas production has plateaued, whichever is first, the controls are evaluated to confirm that the test has been performed appropriately. In order for this modification of the closed bottle biodegradation test to be considered acceptable, all the controls must meet the biodegradation levels indicated in Table 1. The intermediate control hexadecene must produce at least 30% of the theoretical gas production. This level may be reexamined after two years and more data has been generated.

Table 1: Test Acceptability Criteria

Concentration	Percent Biodegradability as a Function of Gas Measurement		
	Positive control	Squalane negative control	Hexadecene intermediate control
2000 mg carbon/kg	$\geq$ 60% theoretical	$\leq$ 5% theoretical	$\geq$ 30% theoretical

Section 6.2 Interpretation

In order for a fluid to pass the closed bottle test, the biodegradation of the base fluid as indicated by the total amount of total gas (or methane) generated once gas production has plateaued (or at the end of 275 days, which ever is first) must be greater than or equal to the volume of gas (or methane) produced by the reference standard (internal elefin or ester).

The method for evaluating the data to determine whether a fluid has passed the biodegradation test must use the equations:

$$\frac{\text{\% Theoretical gas production of reference fluid}}{\text{\% Theoretical gas production of NAF}} \geq 1.0$$

Where: NAF = stock base fluid being tested for compliance

Reference Fluid = C_{16}-C_{18} internal olefin or C_{12}-C_{14} or C_8 ester reference fluid

15. Whole Effluent Toxicity Testing

The following Whole Effluent Toxicity testing requirements apply to - 1) Produced Water Discharges; 2) Miscellaneous Discharges of Seawater and Freshwater to which chemicals have been added; and 3) chemicals used in subsea operations, including but not limited to, Subsea Wellhead Preservation Fluids, Subsea Production Control fluids, Umbilical Steel Tube Storage Fluid, Leak Tracer Fluids and Riser Tensioner Fluids.

The control and dilution water will be natural or synthetic seawater at 25 ppt salinity as described in EPA-821-R-02-014, Section 7, or the most current edition. A standard reference toxicant quality assurance chronic toxicity test shall be conducted concurrently with each species used in the toxicity tests and the results included in summary laboratory report, which is to be submitted with the DMR. Alternatively, if monthly QA/QC reference toxicant tests are conducted, these results must be included in the summary laboratory report. The permittee shall submit a full laboratory report in the event a failure occurs for any test, or upon specific request of EPA. Any deviation from the bioassay procedures outlined or cited herein shall be submitted in writing to the EPA for review and approval prior to use.

1. a. The permittee shall conduct a mysid, Mysidopsis bahia, Survival and Reproduction test and a Inland silverside minnow, Menida beryllina, Larval Survival and Growth test. All tests shall be conducted using a control (0% effluent) and the following dilution concentrations: 0.25 times the critical dilution (CD), 0.5 times the CD, the CD, two times the CD and, four times the CD. The measured endpoints will be the survival and growth No Observed Effect Concentration (NOEC) concentration for each species. The survival and growth responses will be determined based on the number of Mysidopsis bahia or Menida beryllina larvae used to initiate the test.

b. For each set of tests conducted, a grab sample of final effluent shall be collected and used to initiate the test within 36 hours of collection.

c. If control mortality exceeds 20% in any test, the test(s) with that species (including the control) shall be repeated. For either species, a test will be considered valid only if control mortality does not exceed 20%. Each test must meet the test acceptability criteria

for each species as defined in EPA-821-R-02-014, Section 13.12 and Section 11.12, respectively, or the most current edition. Additionally, all test results must be evaluated and reported for concentration-response relationship based on "Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing (40 C.F.R. Part 136)," EPA/821/B-00/004, or the most current edition. If the required concentration-response review fails to yield a valid relationship per EPA/821/B-00/004 (or the most current edition), that test shall be repeated. Any test initiated but terminated prior to completion must be reported with a complete explanation for the termination. If the conditions of test acceptability are met as described above and in Part V.15.4, and the percent survival of the test organism is equal to or greater than 80% in the critical dilution concentration and all lower dilution concentrations, the survival test shall be considered to be passing and the permittee shall report a survival NOEC of not less than the critical dilution in the DMR.

2. a. The toxicity tests specified above shall be conducted once every two months for the first year of the permit until three consecutive valid bimonthly tests with passing results are completed. The permittee may reduce monitoring frequency to once per every six months thereafter for the duration of the permit for Produced Water discharges and once per every six months period thereafter for the duration of the permit for continuous discharges of Miscellaneous Discharges to Which Chemicals Have Been Added. These tests are referred to as "routine" tests.

Exception - Toxicity testing for chemicals/fluids used in subsea operations shall be once prior to use during the term of this general permit and at least annually thereafter on each product added to an operation after the effective date of this permit. Additionally, permittees that were covered under the previous general permit and that are currently performing toxicity tests for Produced Water discharges and have passed the most recent three consecutive toxicity test results shall continuing begin with a frequency of at least every six months, unless a subsequent non-compliance occurs or if the fluid formulation changes.

b. Results from routine tests shall be reported according to EPA-821-R-02-014, Section 10, or the most current edition. All results shall also be recorded and submitted on the Discharge Monitoring Report (DMR) in the following manner: If the NOEC of a test species is less than CD% effluent, this constitutes a test failure and "1" shall be entered on the DMR for that species. If the NOEC of a test species is greater than or equal to the CD% effluent, this constitutes a pass, and "0" shall be entered on the DMR.

c. The summary laboratory reports shall include, as a minimum, the following information:
   (1) Permittee's Name
   (2) Name of test and test method number
   (3) Name of test species
   (4) Outfall identification designation and type of wastewater
   (5) Name of biomonitoring laboratory
   (6) Date sample was collected
   (7) Date and time test initiated
   (8) Critical Dilution
   (9) Indicate if test is "valid". If not, state reasons why.
   (10) For each species, the percent effluent corresponding to each NOEC for both the growth test and the survival test.

3. a. An NOEC of less than CD% effluent in any valid routine or additional definitive Survival or Growth test for either species will be a violation of this permit.

   b. If an NOEC of less than CD % effluent is found in a routine test, the permittee shall conduct three valid additional tests on each species indicating the violation and report each NOEC obtained. A valid additional definitive test result cannot be used to negate a permit violation based on failure of a routine test.

   c. The first valid additional test shall be conducted using a control (0% effluent) and a minimum of five dilutions: 0.5 times the CD, CD, two times the CD, four times the CD and eight times the CD. The dilution series may be modified in the second and third valid tests to more accurately identify the toxicity.

   d. For each additional test, the sample collection requirements and the test acceptability criteria and concentration-response relationships specified in sections 1.b. and c. above, respectively, must be met for the additional test to be considered valid. The first additional test shall begin within two weeks of the end of the routine test failure, and shall be conducted every two weeks thereafter until three consecutive additional valid tests are completed.

   e. Results from additional tests, required due to a chronic toxicity violation in a routine test, shall be submitted in a single report prepared according to EPA-821-R-02-014, Section 10, or the most current edition and submitted within 30 days of completion of the third valid additional test.

   f. After compliance is demonstrated for the three consecutive additional tests, the permittee may return to the testing frequency prior to the non-compliance.

4. To assess within test variability, test results must be evaluated for, and reported with the DMR in terms of the percent minimum significant difference (PMSD), in accordance with Section 10.28 of EPA/821-R-02-014. If toxicity is not found at the critical dilution concentration based on the value of the effect concentration estimate and the PMSD measured for a given test exceeds the upper PMSD bound as provided in this section, then the test shall not be accepted, and a new test must be conducted promptly on a newly collected sample.

5. This permit may be reopened to require chemical specific effluent limits, additional testing and/or other appropriate actions to address toxicity.

B. Other Definitions

1. Administrator means the Administrator of the U.S. Environmental Protection Agency.
2. Annual monitoring period means the 12-month period after the effective date of this permit.
3, Applicable effluent standards and limitations means all state and Federal effluent standards and limitations to which a discharge is subject under the Act, including, but not limited to, effluent limitations, standards or performance, toxic effluent standards and prohibitions, and pretreatment standards.
4. Areas of Biological Concern for water within the territorial seas (shoreline to 3-mile offshore) are those defined as "no activity zones" for biological reasons by the states of Alabama, Florida and Mississippi. For offshore waters seaward of three miles, areas of biological concern include "no activity zones" defined by the Department of Interior (DOI) for biological reasons, or identified by EPA in consultation with the DOI, the states, or other interested federal agencies, as containing biological communities, features or functions that are potentially sensitive to discharges associated with the oil and gas industry.
5. Base fluid means the continuous phase or suspending medium of a drilling fluid formation.
6. Base fluid retained on cuttings refers to the American Petroleum Institute Recommended Practice 13B-2 supplemented with the specifications, sampling methods, and averaging method for retention values provided in 40 C.F.R. Part 435, subpart A, Appendix 7.
7. Batch or Bulk Discharge is any discharge of a discrete volume or mass of effluent from a pit, tank, or similar container that occurs on a one-time, infrequent, or irregular basis.
8. Biodegradation rate refers to the ISO 11734:1995 (or most current EPA approved method), "Water quality - Evaluation of the ultimate anaerobic biodegradation of organic compounds in digested sludge-Method by measurement of the biogas production (1995 edition)," supplemented with modifications in Appendix 4 of 40 C.F.R. Part 435, subpart A.
9. Blow-Out Preventer Control Fluid means fluid used to actuate the hydraulic equipment on the blow-out preventer or subsea production wellhead assembly.
10. Boiler Blowdown means discharges from boilers necessary to minimize solids build-up in the boilers, including vents from boilers and other heating systems.

11. Bypass means the intentional diversion of waste streams from any portion of a treatment facility. (See Part II.B.3 of this permit.)
12. C_{12}-C_{14} Ester and C_8 Ester means the fatty-acid/2-ethylhexyl esters with carbon chain lengths ranging from 8 to 16 and represented by the Chemical Abstracts Service (CAS) No. 135800-37-2.
13. C_{16}-C_{18} Internal Olefin means a 65/35 blend, proportioned by mass, of hexadecene and octadecene, respectively. Hexadecene is an unsaturated hydrocarbon with a carbon chain length of 16, an internal double carbon bond, and is represented by the CAS No. 26952-14-7. Octadecene is an unsaturated hydrocarbon with a carbon chain length of 18, an internal double carbon bond, and is represented by CAS No. 27070-58-2.
14. C_{16}-C_{18} Internal Olefin Drilling Fluid means a C_{16}-C_{18} internal olefin drilling fluid formulated as specified in Appendix 8 of C.F.R. Part 435, subpart A.
15. Clinkers are small lumps of residual material left after incineration.
16. Cooling Water means water used for contact or noncontact cooling, including water used for equipment cooling, evaporative cooling tower make-up, and dilution of effluent heat content.
17. Cooling Water Intake Structure means the physical equipment with a design intake flow greater than or equal to 2 MGD, used to intake seawater, of which 25%, or more, is used for cooling water purposes.
18. Completion Fluids are salt solutions, weighted brines, polymers and various additives used to prevent damage to the well bore during operations which prepare the drilled well for hydrocarbon production. These fluids move into the formation and return to the surface as a slug with the produced water. Drilling muds remaining in the wellbore during logging, casing, and cementing operations or during temporary abandonment of the well are not considered completion fluids and are regulated by drilling fluids requirements.
19. Daily Discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the daily discharge is calculated as the total mass of the pollutant or waste stream discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the sampling day. Daily discharge determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily discharge determination of concentration shall be the average (weighted by flow value) of all samples collected during that sampling day.

20. Daily Average (also known as monthly average) discharge limitations means the highest allowable average of daily discharge(s) over a calendar month, calculated as the sum of all daily discharge(s) measured during a calendar month divided by the number of daily discharge(s) measured during that month. When the permit establishes daily average concentration effluent limitations or conditions, the daily average concentration means the arithmetic average (weighted by flow) of all daily discharge(s) of concentration determined during the calendar month where C = daily concentration, F = daily flow, and n = number of daily samples; daily average discharge =

$$\frac{C_1F_1 + C_2F_2 + \ldots + C_nF_n}{F_1 + F_2 + \ldots + F_n.}$$

21. Daily Maximum is the total mass (weight) of a pollutant discharged during a calendar day. If only one sample is taken during any calendar day, the weight of pollutant calculated from it is the "maximum daily discharge". This limitation is identified as "Daily Maximum" in Part I of the permit and the highest such value recorded during the reporting period is reported in the "Maximum" column under "Quantity or Loading" on the DMR.
22. Deck Drainage is all waste resulting from platform washings, deck washings, deck area spills, equipment washings, rainwater, and runoff from curbs, gutters, and drains, including drip pans and wash areas, pans and work areas within facilities subject to this permit.
23. Desalination Unit Discharge means waste water associated with the process of creating freshwater from seawater.
24. Development Drilling means the drilling of wells required to efficiently produce a hydrocarbon formation or formations.
25. Development Facility means any fixed or mobile structure that is engaged in the drilling of productive wells.
26. Diatomaceous Earth Filter Media is the filter media used to filter seawater or other authorized completion fluids and subsequently washed from the filter.
27. Diesel oil refers to the grade if distillate fuel oil, as specified in the American Society of Testing and Materials Standard Specifications for Diesel Fuel Oils D975-91, that is typically used as the continuous phase in conventional oil-based drilling fluids.
28. Director means the Director, EPA Region 4, Water Management Division
29. Domestic waste means materials discharged from sinks, showers, laundries, safety showers, eye-wash stations, hand-wash stations, fish cleaning stations, and galleys located within facilities subject to 40 C.F.R. Part 435, subpart A.
30. Drill cuttings means the particles generated by drilling into subsurface geologic formations and carried out from the wellbore with the drilling fluid. Examples of drill cuttings include small pieces of rock varying in size and texture from fine silt to gravel and particles of cured cement. Drill cuttings are generally generated from solids control equipment and settle out and accumulate in quiescent areas in the solids control equipment or the equipment processing drilling fluid (i.e., accumulated solids).

a. Wet drill cuttings means the unaltered drill cuttings and adhering drilling fluid and formation oil carried out from the wellbore with the drilling fluid.

b. Dry drill cuttings means the residue remaining in the retort vessel after completing the retort procedure specified in Appendix 7 of 40 C.F.R. Part 435, subpart A.

31. Drilling fluid means the circulating fluid (mud) used in the rotary drilling of wells to clean and condition the hole and to counterbalance formation.

a. Water-based drilling fluid means the continuous phase and suspending medium for solids is a water-miscible fluid, regardless of the presence of oil.

b. Non-aqueous drilling fluid means the continuous phase and suspending medium for solids is a water-immiscible fluid, such as oleaginous materials (e.g., mineral oil, paraffinic oil, C_{16}-C_{18} internal olefins, and C_8-C_{16} fatty acid/2-ethylhexyl esters).

i. Oil-based means the continuous phase of the drilling fluid consists of diesel oil, mineral oil, or some other oil, but contains no synthetic material or enhanced mineral oil.

ii. Enhanced mineral oil-based means the continuous phase of the drilling fluid is enhanced mineral oil.

iii. Synthetic-based means the continuous phase of the drilling fluid is a synthetic material or a combination of synthetic materials.

32. Dual Gradient Drilling means well drilling where a pump is used at the seafloor to lift drilling fluids and cuttings to the surface. This allows for a dual pressure gradient - one from the hydrostatic weight of water in the riser and one from the mud weight in the well. Dual gradient drilling can include a discharge of the larger size cuttings at the seafloor.

33. End of Well Sample means the sample taken after the final log run is completed and prior to bulk discharge.

34. Enhanced mineral oil as applied to enhanced mineral-oil based drilling fluid means a petroleum distillate which has been highly purified and is distinguished from diesel oil in having a lower polynuclear aromatic hydrocarbon (PAH) content. Typically, conventional mineral oils have a PAH content on the order of 0.35 weight percent expressed as phenanthrene, whereas enhanced mineral oils typically have a PAH content of 0.001 or lower weight percent PAH expressed as phenanthrene.

35. Excess Cement Slurry means the excess mixed cement, including additives and wastes from equipment washdown after a cementing operation.

36. Existing Sources are facilities conducting exploration activities and those that have commenced development or production activities that were permitted as of the effective date of the Offshore Guidelines (March 4, 1993).

37. Exploratory facility means any fixed or mobile structure subject to 40 C.F.R. Part 435, subpart A that is engaged in the drilling of wells to determine the nature of potential hydrocarbon reservoirs.

38. Formation oil means the oil from a producing formation which is detected in the drilling fluid, as determined by Gas Chromatography/Mass Spectrometer (GC/MS) compliance assurance method specified in Appendix 5 of 40 C.F.R. Part 435, subpart A, when the drilling fluid is analyzed prior to drilling and as determined by the Reverse Phase Extraction (RPE) method specified in Appendix 6 of 40 C.F.R. Part 435, subpart A, or the GC/MS method when the drilling fluid is analyzed at the offshore point of discharge. Detection of formation oil by the RPE method may be confirmed by the GC/MS method, and the results of the GC/MS compliance assurance method shall supersede those of the RPE method.
39. Four (4)-day LC_{50} as applied to the sediment toxicity BAT effluent limitations and NSPS means the concentration (milliliters/kilogram dry sediment) of the drilling fluid in sediment that is lethal to 50 percent of the *Leptocheirus plumulosus* test organisms exposed to that concentration of the drilling fluids after four days of constant exposure.
40. Free Oil is oil that causes a sheen, streak, or slick on the surface of the test container or receiving water.
41. Garbage means all kinds of food waste, waste generated in living areas on the facility, and operational waste, excluding fresh fish and parts thereof, generated during the normal operation of the facility and liable to be disposed of continuously or periodically except dishwater, graywater, and those substances that are defined or listed in other Annexes to MARPOL 73/78 regulations.
42. Graywater is drainage from dishwater, shower, laundry, bath, and wash basin drains and does not include drainage from toilets, urinals, hospitals, and drainage from cargo areas (see MARPOL 73/78 regulations).
43. Inverse Emulsion Drilling Fluids are oil-based drilling fluids which also contain large amounts of water.
44. Live Bottom Areas are those areas that contain biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascideians sponges, bryozoans, sea grasses, or corals living upon and attached to naturally occurring hard or rocky formations with fishes and other fauna.
45. Maximum as applied to BAT effluent limitations and NSPS for drilling fluids and drill cuttings means the maximum concentration allowed as measured in any single sample of the barite for determination of cadmium and mercury content.
46. Maximum for any one day as applied to BCT and BAT effluent limitations and NSPS for oil and grease in produced water means the maximum concentration allowed as measured by the average of four grab samples collected over a 24-hour period that are analyzed separately. Alternatively, for BAT and NSPS the maximum concentration allowed may be determined on the basis of physical composition of the four grab samples prior to a single analysis.
47. Maximum Hourly Rate is the greatest number of barrels of drilling fluids discharged within one hour, expressed as barrels per hour.

48. Maximum weighted mass ratio averaged over all NAF well sections for BAT effluent limitations and NSPS for base fluid retained on cuttings means the weighted average base fluid retention for all NAF well sections as determined by the API Recommended Practice 13B-2, using the methods and averaging calculations presented in Appendix 7 of 40 C.F.R. Part 435, subpart A.
49. Method 1654A refers to the method "PAH Content of Oil by High Performance Liquid Chromatography with a UV Detector," which was published in Methods for the Determination of Diesel, Mineral and Crude Oils in Offshore Oil and Gas Industry Discharges, EPA-821-R-92-008 (incorporated by reference and available from the National Technical Information Service).
50. Minimum as applied to BAT effluent limitations and NSPS for drilling fluids and drill cuttings means the minimum 96-hour LC_{50} value allowed as measured in any single sample of the discharged waste stream. Minimum as applied to BPT and BCT effluent limitations and NSPS for sanitary wastes means the minimum concentration value allowed as measured in any single sample of the discharged waste stream.
51. Muds, Cuttings, and Cement at the Seafloor means discharges that occur at the seafloor prior to installation of the marine riser and during marine riser disconnect, well abandonment, and plugging operations.
52. National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under sections 307, 316, 318, 402, 403, and 405 of the Act.
53. New Source means any facility or activity of this subcategory that meets the definition of "new source" under 40 C.F.R. § 122.2 and meets the criteria for determination of new sources under 40 C.F.R. § 122.29(b) applied consistently with all of the following definitions: (i) the term "water area" as used in the term "site" in 40 C.F.R. § 122.29 and § 122.2 shall mean the water area and ocean floor beneath any exploratory, development, or production facility where such facility is conducting its exploratory, development or production activities and, (ii) the term "significant site preparation work" as used in 40 C.F.R. § 122.29 shall mean the process of surveying, clearing, or preparing an area of the ocean floor for the purpose of constructing or placing a development or production facility on or over the site. New Source does not include facilities covered by an existing NPDES permit immediately prior to the effective date of 40 CFR Part 435 pending EPA issuance of a new source NPDES permit.
54. Ninety-Six (96)-hour LC_{50} means the concentration (parts per million) or percent of the suspended particulate phase (SPP) from a sample that is lethal to 50 percent of the test organisms exposed to that concentration of the SPP after 96 hours of constant exposure.
55. No Activity Zones means those areas identified by the US Minerals Management Service where no structures, drilling rigs, or pipeline will be allowed. Those zones are identified in lease stipulations that are applied to MMS oil and gas lease sites Additional no activity zones may be identified by MMS during the term of this permit.
56. No Discharge Areas are areas specified by EPA where discharge of pollutants may not occur.

57. No discharge of free oil means that waste streams may not be discharged that contain free oil as evidenced by monitoring method specified for that particular stream, e.g., deck drainage or miscellaneous discharges cannot be discharged when they would cause a film or sheen upon or discoloration of the surface of the receiving water; drilling fluids or cuttings may not be discharged when they fail the static sheen test defined in Appendix 1 of subpart A of 40 C.F.R. Part 435.
58. No Observed Effect Concentration (NOEC) means the greatest effluent dilution which does not result in lethality or sublethal endpoints that are statistically different from the control (0% effluent) at the 95% confidence level.
59. Non-Operational Leases are those facilities from which no discharge has taken place within two years prior to the effective date of the reissued general permit, until such time that documentation is submitted to EPA that MMS had previously granted approval of aEP, DOCO, or DPD or submitted a new MMS-approved EP, DPP, or DOCD.
60. Operating Facilities are facilities from which a discharge has taken place within two years of the effective date of the reissued general permit.
61. Operational waste means all cargo associated waste, maintenance waste, cargo residues, and ashes and clinkers from incinerators and coal burning boilers.
62. Packer Fluids are low solids fluids between the packer, production string, and well casing. They are considered to be workover fluids.
63. PAH (as phenanthrene) means polynuclear aromatic hydrocarbons reported as phenanthrene.
64. Priority Pollutants are the 126 chemicals or elements identified by EPA, pursuant to section 307 of the CWA and 40 C.F.R. § 401.15.
65. Produced Sand means the slurried particles used in hydraulic fracturing, the accumulated formation sands and scales particles generated during production. Produced sand also includes desander discharge from the produced water waste stream, and blowdown of the water phase from the produced water treating system.
66. Produced Water means the water (brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, and can include formation water, injection water, and any chemicals added downhole or during the oil/water separation process. Produced water also includes any wastewater generated during separation and processing operations or any chemicals added downhole, subsea or during separation and processing operations.
67. Production facility means any fixed or mobile structure subject to this subpart that is either engaged in well completion or used for active recovery of hydrocarbons from producing formations. It includes facilities that are engaged in hydrocarbon fluids separation even if located separately from wellheads.
68. Quarterly means a calendar quarter.
69. Sanitary Waste means human body waste discharged from toilets and urinals.
70. Sediment Toxicity as applied to BAT effluent limitations and NSPS for drilling fluids and drill cuttings refers to the ASTM E1367-92 (or most current EPA approved method): Standard Guide for Conducting 10-day Static Sediment Toxicity Tests with Marine and Estuarine Amphipods with *Leptocheirus plumulosus* as the test organism and sediment preparation procedures specified in Appendix 3 of 40 C.F.R. Part 435, subpart A.

71. Severe Property Damage means substantial physical damage to property, damage to the treatment facilities which cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
72. Sheen means a silvery or metallic sheen, gloss, or increased reflectivity; visual color; iridescence; or oil slick on the water surface.
73. Solids Control Equipment means shale shakers, centrifuges, mud cleaners, and other equipment used to separate drill cuttings and/or stock barite solids drilling fluid recovered frm the wellbore.
74. Source Water and Sand are the water and entrained solids brought to the surface from non-hydrocarbon bearing formations for the purpose of pressure maintenance or secondary recovery.
75. Spotting means the process of adding a lubricant (spot) downhole to free stuck pipe.
76. SPP toxicity as applied to BAT effluent limitations and NSPS for drilling fluids and drill cuttings refers to bioassay test procedure presented in Appendix 2 of subpart A of 40 C.F.R. Part 435.
77. Static sheen test means the standard test procedure that has been developed for this industrial subcategory for the purpose of demonstrating compliance with the requirement of no discharge of free oil. The methodology for performing the static sheen test is presented in Appendix 1 of subpart A of 40 C.F.R. Part 435.
78. Stock barite means the barite that was used to formulate a drilling fluid.
79. Stock base fluid means the base fluid that was used to formulate a drilling fluid.
80. Synthetic material as applied to synthetic-based drilling fluid means material produced by the reaction of specific purified chemical feedstock, as opposed to the traditional base fluids such as diesel and mineral oil which are derived from crude oil solely through physical separation processes include fractionation and distillation and/or minor chemical reactions such as cracking and hydro processing. Since they are synthesized by the reaction of purified compounds, synthetic materials suitable for use in drilling fluids are typically free of polynuclear aromatic hydrocarbons (PAHs) but are sometimes found to contain levels of PAH up to 0.001 weight percent PAH expressed as phenanthrene. Internal olefins and vegetable esters are two examples of synthetic materials suitable for use by the oil and gas extraction industry in formulating drilling fluids. Internal olefins are synthesized from the isomerization of purified straight-chain (linear) alpha olefins. C_{16-18} linear alpha olefins are unsaturated hydrocarbons with the carbon to carbon double bond in the terminal position. Internal olefins are typically formed from heating linear alpha olefins with a catalyst. The feed material for synthetic linear alpha olefins is typically purified ethylene. Vegetable esters are synthesized from the acid-catalyzed esterfication of vegetable fatty acids with various alcohols. EPA listed these two branches of synthetic fluid base materials to provide examples, and EPA does not mean to exclude other synthetic materials that are either in current use or may be used in the future. A synthetic-based drilling fluid may include a combination of synthetic materials.

81. Territorial Seas means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles.
82. Trace Amounts means that if materials added downhole as well treatment, completion, or workover fluids do not contain priority pollutants in a quantity greater than the minimum detection method for that pollutant in accordance with 40 C.F.R. Part 136, then the discharge is assumed not to contain priority pollutants.
83. Track I means new offshore oil and gas facilities that will comply with the CWIS rule based on the requirements at 40 CFR § 125.84(b) or (c).
84. Track II means new offshore oil and gas facilities that will comply with the CWIS rule based on requirements at 40 CFR § 125.84(d).
85. Treatment Chemicals means biocides, corrosion inhibitors, or other chemicals which are used to treat seawater or freshwater to prevent corrosion or fouling of piping or equipment. Non-toxic scale inhibitors and dyes as well as chlorine and hyprochlorite (including electrically generated forms) are not considered treatment chemicals.
86. Uncontaminated Ballast/Bilge water means seawater added or removed to maintain proper draft that does not come in contact with surfaces that may cause contamination or a non-compliance of a limit in this permit.
87. Uncontaminated freshwater means freshwater which is discharged without the addition of chemicals, such as: (1) discharges of excess freshwater that permit the continuous operation of fire control and utility lift pumps, (2) excess freshwater from pressure maintenance and secondary recovery projects, (3) water released during training and testing of personnel in fire protection, and (4) water used to pressure test of flush new piping.
88. Uncontaminated seawater means seawater which is returned to the sea without the addition of chemicals, such as: (1) discharges of excess seawater which permit the continuous operation of fire control and utility lift pumps, (2) excess seawater from pressure maintenance and secondary recovery projects, (3) water released during training and testing of personnel in fire protection, (4) water used to pressure test, or flush, new piping and (5) non-contact cooling water which has not been treated with biocides.
89. "Wastes from Maintenance Operations" includes, but is not limited to, removed paint and materials associated with surface preparation and coating applications, airborne material such as spent or oversprayed abrasives, paint chips, and paint overspray.
90. Water-based Drilling Fluids is the conventional drilling mud in which water is the continuous phase and the suspending medium for solids, whether or not oil is present.
91. Well treatment fluids means any fluid used to restore or improve productivity by chemically or physically altering hydrocarbon-bearing strata after a well has been drilled. These fluids move into the formation and return to the surface as a slug with produced water. Stimulation fluids include substances such as acids, solvents, and propping agents.

92. Workover fluids means salt solutions, weighted brines, polymers, or other specialty additives used in a producing well to allow for maintenance, repair or abandonment procedures. High solids drilling fluids used during workover operations are not considered workover fluids by definition and therefore must meet drilling fluid effluent limitations before discharge may occur. Packer fluids, low solids fluids between the packer, production string, and well casing are considered to be workover fluids and must meet only the effluent requirements imposed on workover fluids.

93. 96-hour LC_{50} means the concentration (parts per million) or percent of the suspended particulate phase (SPP) from a sample that is lethal to 50 percent of the test organisms exposed to that concentration of the SPP after 96 hours of constant exposure.

94. The term mg/l means milligrams per liter or parts per million (ppm).

95. The term μg/l shall means micrograms per liter or part per billion (ppb).

Appendix A

Table 1: CORMIX Ambient Input Parameters and Constant Discharge Input Parameters

Parameter	Units	Value
Surface Density (Δ_s)	kg/m^3	1023.00
Density Gradient ()Δ)	$Kg/m^3/m$	0.163 (Linear)
Current Speed for < 200 m	cm/sec	5
Current Speed for > 200 m	cm/sec	15
Wind Speed	m/sec	4
Darcy-Wiesbach Friction Factor (f)		0.02
Legal Mixing Zone	m	100
Discharge Density	kg/m^3	1070.2
Horizontal Discharge Angle (Φ)	degrees	0
Vertical Discharge Angle (2)	degrees	- 45

Table 2: Produce Water Discharge Pipe Diameters

Range on Table	Model Input	
(inches)	(inches)	(meters)
0 - 5	4	0.1016
>5 - 7	6	0.1524
>7 - 9	8	0.2032
>9 - 11	10	0.3048
>11 - 15	13	0.3302

Table 3: CORMIX Predicted Critical Dilutions (Percent Effluent) for Discharges with a Depth Difference Between the Discharge Pipe Outlet and the Sea Floor of Greater than 12 meters and in Waters Less than 200 meters

Discharge Rate	**Pipe Diameter (inches)**				
(bbl/day)	**>0" to 5"**	**>5" to 7"**	**>7" to 9"**	**>9" to 11"**	**>11" to 15"**
>0 to 500	0.11	0.11	0.11	0.11	0.11
501 to 1000	0.22	0.22	0.22	0.22	0.22
1001 to 2000	0.37	0.37	0.37	0.37	0.37
2001 to 3000	0.48	0.48	0.48	0.48	0.48
3001 to 4000	0.56	0.56	0.56	0.56	0.56

4001 to 5000	0.65	0.66	0.66	0.66	0.66
5001 to 6000	0.73	0.74	0.74	0.74	0.74
6001 to 7000	0.77	0.78	0.78	0.78	0.78
7001 to 8000	0.84	0.86	0.86	0.87	0.87

Table 4: CORMIX Predicted Critical Dilutions (Percent Effluent) for Discharges with a Depth Difference Between the Discharge Pipe Outlet and the Sea Floor of Greater than 12 meters and in Waters Greater than 200 meters

Discharge Rate	**Pipe Diameter (inches)**				
(bbl/day)	**>0" to 5"**	**>5" to 7"**	**>7" to 9"**	**>9" to 11"**	**>11" to 15"**
>0 to 500	0.08	0.08	0.08	0.08	0.08
501 to 1000	0.12	0.12	0.12	0.12	0.12
1001 to 2000	0.18	0.18	0.18	0.18	0.18
2001 to 3000	0.22	0.22	0.22	0.22	0.22
3001 to 4000	0.24	0.25	0.25	0.25	0.25

4001 to 5000	0.28	0.28	0.28	0.28	0.28
5001 to 6000	0.30	0.30	0.31	0.31	0.31
6001 to 7000	0.32	0.32	0.32	0.32	0.32
7001 to 8000	0.35	0.35	0.35	0.35	0.35

Table 5: Minimum Vertical Port Separation to Avoid Interference

Port Discharge Rate	Waters Less than 200 meters	Waters Greater than 200 meters
(bbl/day)	(meters)	(meters)
>0 to 500	3.0	3.0
501 to 1000	3.0	6.0
1001 to 2000	4.0	6.0
2001 to 5000	5.0	6.0
5001 to 7000	5.5	6.0
7001 to 10,000	6.0	6.0

Table 6: Critical Dilutions (Percent Effluent) for Toxicity Limitations for Seawater to which treatment chemicals have been added

Water Depth	Discharge Rate (bbl/day)	Pipe Diameter Range (actual diameter modeled)		
		>0 to 2" (1)	>2 to 4" (3)	>4 to 6" (5)
Less than 200 meters (shelf)	500 (0 to 1000)	0.29	0.81	1.23
	1000 (1000 - 2000)	0.31	0.86	1.34
	2000 (2000-4000)	0.34	0.88	1.43
	4000 (4000-8000)	0.33	0.98	1.48
	8000 (>8000)	0.29	1.02	1.68
	500 (0 to 1000)	0.32	1.03	1.65

Deeper than 200 meters (slope)	**1000 (1000-2000)**	0.28	0.99	1.65
	2000 (2000-4000)	0.24	0.89	1.57
	4000 (4000-8000)	0.20	0.78	1.42
	8000 (>8000)	0.17	0.66	1.24

Table 7: Critical Dilutions (Percent Effluent) for Toxicity Limitations for Freshwater to which treatment chemicals have been added

Water Depth	Discharge Rate (bbl/day)	Pipe Diameter (actual diameter modeled)		
		>0 to 2" (1)	>2 to 4" (3)	>4 to 6" (5)
Less than 200 meters (shelf)	500 (0 to 1000)	0.57	3.85	16.9
	1000 (1000 - 2000)	0.44	3.20	16.7
	2000 (2000-4000)	0.34	2.50	5.76
	4000 (4000-8000)	0.35	1.86	4.66
	8000 (>8000)	0.30	1.36	3.52

Deeper than 200 meters (slope)	**500 (0 to 1000)**	0.67	11.6	29.9
	1000 (1000 - 2000)	0.40	6.69	29.1
	2000 (2000-4000)	0.26	3.57	15.9
	4000 (4000-8000)	0.22	1.96	9.14
	8000 (>8000)	0.19	1.06	4.67

Table 1. Summary of Effluent Limitations, Prohibitions, and Monitoring Requirements for the Eastern Gulf of Mexico NPDES Permit for Existing Sources (Refer to permit for specific requirements)

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
Water-Based Drilling Fluids	Oil-based Drilling Fluids	No discharge			
	Oil-contaminated Drilling Fluids	No discharge			
	Drilling Fluids to Which Diesel Oil has been Added	No discharge			
	Mercury (Hg) and Cadmium (Cd) in Barite	No discharge of drilling fluids if added barite contains Hg in excess of 1.0 mg/kg or Cd in excess of 3.0 mg/kg (dry wt)	Once per new source of barite used	EPA SW846 method 6010B, or EPA 200.7 or 200.8 for cadmium & EPA SW846 method 7471A or EPA 245.7 for mercury	mg Hg/kg and mg Cd/kg in stock barite
	Toxicity[a]	30,000 ppm daily minimum 30,000 ppm monthly average of minimum values	Once/month Once/end of well[b] Once/month	Grab/96-hr LC_{50} using *Mysidopsis bahia;* Method at 58 FR 12507	Minimum LC_{50} of tests performed and monthly average LC_{50}

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
	Free Oil	No free oil	Once/week during discharge	Static sheen; Method at 58 FR 12506	Number of days sheen observed
	Maximum Discharge Rate	1,000 barrels/hr	Once/day	Estimate	Max. hourly rate in bbl/hr
	Mineral Oil	Mineral oil may be used only as a carrier fluid, lubricity additive, or pill.			
	Drilling Fluids Inventory	Record	Once/well	Inventory	Chemical constituents
	Volume	Report	Once/month	Estimate	Monthly total in bbl/month
Water-Based Drill Fluids (Continued)	Within 1000 Meters of an Areas of Biological Concern (ABC) or a Federally Designated Dredged Material Disposal Site	No discharge			
Water-Based Drill Cuttings	Note: Drill cuttings are subject to the same limitations/prohibitions as drilling fluids except Maximum Discharge Rate.				
	Free Oil	No Free Oil	Once/week	Static sheen; Method at 58 FR 12506	Number of days sheen observed

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
	Volume	Report	Once/month	Estimate	Monthly total in bbl/month
Produced Water	Oil and Grease	≤42.0 mg/l daily maximum and ≤29.0 mg/l monthly average	Once/month[c]	Grab/ Gravimetric	Daily max. and monthly avg.
	Toxicity	Chronic toxicity (NOEC); critical dilution as specified by the requirements at Part I.B.3(b).	Once/2 month (or semiannually after passing three consecutive bimonthly test)	Grab/7-day NOEC using *Mysidopsis bahia* and Inland Silverside minnows	"Pass" or "Fail" for both species and summary laboratory report
	Flow (bbl/month)		Once/month	Estimate	Monthly rate
	Within 1000 meters of an ABC or a Federally Designated Dredged Material Disposal Site	No discharge			
Deck Drainage	Free Oil	No Free Oil	Once/day when discharging[d]	Visual sheen	Number of days sheen observed
Produced Sand	No Discharge				
Well Treatment, Completion, and	Free Oil	No Free Oil	Once/day when discharging	Static sheen	Number of days sheen observed

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
Workover Fluids (includes packer fluids)[e]	Oil and Grease	≤42.0 mg/l daily maximum and ≤29.0 mg/l monthly average	Once/month	Grab/ Gravimetric	Monthly max. and monthly avg.
	Priority Pollutants	Non-detect for priority pollutants		Monitor added materials using methods in 40 CFR Part 136	
	Volume (bbl/month)		Once/month	Estimate	See permit
Sanitary Waste (Continuously manned by 10 or more persons)[f]	Solids	No floating solids.	Once/day, during daylight	Observation	Number of days solids observed
	Residual Chlorine	At least (but as close to) 1.0 mg/l.	Once/month	Grab/Hach CN-66-DPD or TRC method in 40 C.F.R. Part 136	Concentration
Sanitary Waste (Continuously manned by 9 or fewer persons or intermittently by any)[f]	Solids	No floating solids	Once/day, during daylight	Observation	Number of days solids observed

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
Domestic Waste	Solids	No floating solids; no food waste within 12 miles of land; comminuted food waste smaller than 25-mm beyond 12 miles.	Once/day following morning or midday meal at time of maximum expected discharge	Observation	Number of days solids observed
Miscellaneous Discharges[g] – 1.Desalination Unit 2.Blowout Preventer Fluid 3.Uncontaminated Ballast/Bilge Water 4.Mud, Cuttings, and Cement at the Seafloor 5.Uncontaminated Seawater 6.Boiler Blowdown 7.Source Water and Sand 8.Diatomaceous Earth Filter Media 9. Excess Cement Slurry 10.Uncontaminated Freshwater 11. Cement Equipment Washdown 12. Hydrate Control Fluid	Free Oil	No Free Oil	Once/week during discharge	Visual sheen	Number of days sheen observed

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
Miscellaneous Discharges to Which Treatment Chemicals Have Been Added	Free Oil	No Free Oil	Once/day when discharging	Visual Sheen	Number of days sheen observed
	Toxicity	7-day minimum and monthly average minimum NOEC	Rate Dependent	Grab	Lowest NOEC observed for either of the two species

[a] Toxicity test to be conducted using suspended particulate phase (SPP) of a 9:1 seawater:mud dilution. The sample shall be taken beneath the shale shaker, or if there are no returns across the shaker, the sample must be taken from a location that is characteristic of the overall mud system to be discharged.

[b] Sample shall be taken after the final log run is completed and prior to bulk discharge.

[c] The daily maximum concentration may be based on the average of up to four grab sample results in the 24 hour period.

[d] When discharging and facility is manned. Monitoring shall be accomplished during times when observation of a visual sheen on the surface of the receiving water is possible in the vicinity of the discharge.

[e] No discharge of priority pollutants except in non-detectable amounts using EPA methods in 40 CFR Part 136. Information on the specific chemical composition shall be recorded but not reported unless requested by EPA.

[f] Any facility that properly operates and maintains a marine sanitation device (MSD) that complies with pollution control standards and regulations under Section 312 of the Act shall be deemed to be in compliance with prohibitions and permit limitations for sanitary waste. The MSD shall be tested yearly for proper operation and test results maintained at the facility.

[g] Based on LC_{50} results, the following compounds may also be included as miscellaneous discharges:subsea wellhead preservation fluids, subsea production control fluids, umbilical steel tune storage fluid, leak tracer fluid, riser tensioner fluid.

Table 2. Effluent Limitations, Prohibitions, and Monitoring Requirements for the Eastern Gulf of Mexico NPDES General Permit Existing using Synthetic Based Drilling Fluids

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
Non-Aqueous Based Drilling Fluids	No discharge, except that which adheres to cuttings, de minimis discharges and small volume discharges.				
Drill Cuttings Generated Using Non-Aqueous-Based Drilling	Cuttings from Oil-Based Drilling Fluids	No Discharge			
	Cuttings from Oil Contaminated Drilling Fluids	No Discharge			
	Cuttings Generated Using Mineral Oil	No Discharge			
	Cuttings Generated Using Drilling Fluids Which Contain Diesel Oil	No Discharge			
	Areas of Biological Concern or a Federally Designated Dredged Material Disposal Site	No discharge within 1000 meters.			
	Free Oil	No Discharge	Once/week	Static sheen; method at 58 FR 12506	Number of days observed

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
	Volume	Report	Once/month	Estimate	Monthly total in bbl/month
	Formation Oil	No Discharge	RPE test once prior to drilling & RPE or GC/MS once/week.	GC/MS method at 40 C.F.R. Part 435, Appendix 5 of Subpart A	Number of Days
	Suspended Particulate Phase Toxicity	30,000 ppm daily minimum 30,000 ppm monthly ave of minimum values	Once/month and Once/end of well[b]	Grab/96-hr LC_{50} using *Mysidopsis bahia (*same as *Americamysis bahia*); Method 58 FR 12507	Minimum LC_{50} of tests performed and monthly ave LC_{50}
	Drilling Fluid Sediment Toxicity Ratio	≤ 1.0	Once/month by grab sample(s)	Grab(s)/ASTM E1367-92	Ratio
	Polynuclear Aromatic Hydrocarbons (PAH)	$\leq 1 \times 10^{-5}$	Once per year on each fluid blend	Grab/EPA Method 1654A	Ratio
	Sediment Toxicity Ratio	≤ 1.0	Once per year on each fluids blend	Grab(s)/ASTM E1367-92	Ratio

			Monitoring Requirement		
Discharge	Regulated & Monitored Discharge Parameter	Discharge Limitation/ Prohibition	Measurement Frequency	Sample Type/ Method	Recorded/ Reported Value
	Base Fluid Retained on Cuttings (C_{16-18} internal olefin)	≤6.9 g/100 g wet drill cuttings	Once per day by grab sample, up to three sampling episodes per day	API Retort Method; 40 C.F.R. Part 423, Subpart A, Appendix 7	g/ 100 g wet drill cuttings
	Base Fluid Retained on Cuttings (C_{12-14} ester)	≤9.4 g/100 g wet drill cuttings	Once per day by grab sample, up to three sampling episodes per day	API Retort Method; 40 C.F.R. Part 423, Subpart A, Appendix 7	g/ 100 g wet drill cuttings
	Biodegradation Rate	≤1.0	Once per year on each fluid blend	Grab(s)/ISO 11734:1995	Ratio
	Mercury in Stock barite	≤1.0 mg/kg (dry wt.)	Representative sample of each stock barite prior to drilling	EPA SWA 846 method 7471A	mg/kg
	Cadmium in Stock barite	≤3.0 mg/kg (dry wt.)	Representative sample of each stock barite prior to drilling	EPA SWA 846 method 6010B	mg/kg

[a] Toxicity test to be conducted using suspended particulate phase (SPP) of a 9:1 seawater:mud dilution. The sample shall be taken beneath the shale shaker, or if there are no returns across the shaker, the sample must be taken from a location that is characteristic of the overall mud system to be discharged.

[b] Sample shall be taken after the final log run is completed and prior to bulk discharge.

Biological Evaluation:

The Potential Effects of the Proposed Issuance of NPDES Permit No. FL0944858 for LLOG LLC

for Offshore Oil and Gas Exploration Activities in DeSoto Canyon, Lease Block 713 in the Federal Waters of the Eastern Gulf of Mexico

June 15, 2016

U.S. Environmental Protection Agency
Region 4
61 Forsyth Street, NW
Atlanta, GA 30303

Summary

This Biological Evaluation evaluates the direct, indirect, and cumulative effects of the proposed issuance of the National Pollutant Discharge Elimination System (NPDES) individual permit for LLOG for offshore oil and gas exploration activities to be performed in DeSoto Canyon Lease Block 713, which is approximately 139 miles due south of the Alabama-Florida state line in federal waters. The U.S. Environmental Protection Agency (EPA) Region 4 is proposing an individual permit with the same permit limitations, monitoring, and reporting requirements as those in the administratively continued (for certain operators) 2010 EPA Region 4 general permit for offshore oil and gas activities in the Eastern Gulf of Mexico, with the addition of requirements for more e-reporting requirements.

Correspondence from the U.S. Department of the Interior (DOI) Fish and Wildlife Service (FWS) and the U.S. Department of Commerce (DOC) National Oceanic and Atmospheric Administration (NOAA)/National Marine Fisheries Service (NMFS) (i.e., the Services) to EPA Region 4 (both dated February 23, 2015), as well as a letter dated May 20, 2016 from the FWS office in Lafayette, LA identified the following listed species and designated critical habitats for consideration on whether the proposed permit may affect resources in the permit coverage area.

Reptiles	
Eastern indigo snake (T) Green sea turtle (T/E) Kemp's ridley sea turtle (E)	Leatherback sea turtle and critical habitat (E) Hawksbill sea turtle and critical habitat (E) Loggerhead sea turtle and critical habitat (T)
Birds	
Audubon's crested caracara (T) Florida scrub-jay (T) Piping plover and critical habitat (T) Red knot (T) Red-Cockaded woodpecker (E)	Wood stork (T) Cape Sable seaside sparrow and critical habitat (E)* Mississippi sandhill crane and critical habitat (E)* Roseate tern (E)* Whooping crane (E)*
Fishes	
Atlantic (Gulf) sturgeon and critical habitat (T)	Smalltooth sawfish (E)
Mammals	
West Indian manatee and critical habitat (E) Alabama beach mouse and critical habitat (E)*	Choctawhatchee beach mouse and critical habitat (E)* Perdido Key beach mouse and critical habitat (E)* St. Andrew beach mouse and critical habitat (E)* Florida salt marsh vole (T)
Marine Mammals	
Blue whale (E) Finback whale (E) Humpback whale (E)	Sei whale (E) Sperm whale (E)
Invertebrates	
Lobed star coral (T) Mountainous star coral (T) Boulder star coral (T)	Elkhorn coral (T) Staghorn coral (T)
Flowering Plants	
Brooksville bellflower (E) Cooley's water-willow (E)	Florida bonamia (T) Pygmy fringe-tree (E)

Florida golden aster (E)	
Lichens	
Florida perforate cladonia	

*Species added to list based on correspondence from FWS on May 20, 2016.

Since the proposed operation is for exploratory drilling only, EPA Region 4 has not, and is not required to prepare a National Environmental Policy Act (NEPA) document for this permit action. Under NEPA, an analysis is required when an action is deemed a major federal action significantly affecting the quality of the human environment. A NEPA analysis is not required for drilling exploratory wells. CWA § 511(c) lists the only actions of the Administrator under the CWA that require any NEPA analysis. Section 511(c)(1) states: " Except for the provision of Federal financial assistance for the purpose of assisting the construction of publicly owned treatment works as authorized by Section 1281 of this title, and the issuance of a permit under Section 402 of this title for the discharge on any pollutant by a new source identified in Section 1316 of this title, no action of the Administrator taken pursuant to this chapter [the CWA] shall be deemed a major federal action significantly affecting the quality of the human environment within the meaning of NEPA." This same limiting language is reflected in 40 CFR §6.101(a). Because the act and implementing regulations are specifically inclusive as to what CWA actions require NEPA and is limited to those two annotated situations, existing sources are exempt from NEPA since they are not "deemed a major federal action significantly affecting the quality of the human environment within the meaning of NEPA."

Proposed Action and Action Area

EPA Region 4 proposes to issue an NPDES individual permit for offshore oil and gas exploration operations in DeSoto Canyon Lease Block 713 in the Eastern Gulf of Mexico. The operations are within the same jurisdictional area as the current, effective EPA Region 4 Offshore Oil and Gas NPDES General Permit for exploratory, development and production operations. The jurisdictional area for the general permit is in Federal waters of the Gulf of Mexico seaward of 200 meters depth contour offshore Alabama and Florida and seaward of the outer boundary of the territorial seas for offshore Mississippi and Alabama in Mobile and Viosca Knoll lease blocks.

Description of Federally Listed Threatened and Endangered Species and Other Species of Interest

The brief species descriptions in the following sections summarize available information and provide the rationale for EPA Region 4's determination that the species does not occur within the proposed individual coverage or potential impact areas.

Determination

Sea turtles in the Gulf of Mexico, and the Kemp's ridley in particular, appear to be under stress. With the proposed permit provisions in place, drilling fluids and cuttings, well treatment, completion, and workover fluids (WTCW), and miscellaneous and other discharges may result in unavoidable, but local, minor impacts to sea turtles should they swim near the areas immediately surrounding offshore mobile drilling unit. EPA Region 4 has determined that the activities under

the draft permit *may affect* turtles but are *not likely to adversely affect* sea turtles or their critical habitat. (See Section A.2.1 for the detailed discussion.). However, EPA Region 4 has also determined that issuance of the individual NPDES permit will have no effect (i.e., no possibility of species' or critical habitat exposure to action-caused stressors) any of the other above species and habitats (i.e., other than sea turtles).

SECTION A.: BIOLOGICAL RESOURCES – EXISTING CONDITIONS

A.1.1 Marine Mammals

The marine mammals of the Gulf of Mexico include cetaceans (whales, dolphin, and porpoises) and a sirenian (the Florida manatee). The NMFS 2014 summary stock assessment (Waring et al., 2015) lists 22 marine mammals for which it has published population estimates (Table 1.1). Discussion below are from NOAA stock assessment reports, Waring et al. (2012) or Waring et al. (2014), unless otherwise indicated. These assessments considered the impact of the UME that was declared in February, 2010 and continues to the present time.

A.1.1.a Sperm Whale (Waring et al., 2012)
Sperm whales are listed as endangered. They are found in deepwaters throughout the world's oceans. In the northern Gulf of Mexico aerial and ship surveys indicate that sperm whales are widely distributed and present in all seasons in continental slope and oceanic waters. Research conducted since 2000 confirms Gulf of Mexico sperm whales constitute a stock distinct based on several lines of evidence.

Measurements of Gulf of Mexico sperm whale total length indicate Gulf whales average 1.5 - 2.0 meters smaller than whales measured in other areas. Female/immature group size in the Gulf is about one-third to one-fourth that found in the Pacific Ocean, but similar to that found in the Caribbean. Also, an analysis of matrilineal mtDNA showed a significant genetic differentiation between northern Gulf of Mexico whales and western North Atlantic, North Sea, and Mediterranean Sea whales. However, analysis of biparentally-inherited nuclear DNA showed no significant difference between northern Gulf of Mexico whales and those from other areas of the North Atlantic, indicating that mature males move in and out of the Gulf.

Recordings of vocalizations from mixed groups in the Gulf indicate that Gulf sperm whales constitute a distinct acoustic clan that is rarely encountered outside of the Gulf, and from this it is assumed that groups from other clans enter the northern Gulf infrequently. The best abundance estimate available for northern Gulf of Mexico sperm whales is 1,665 based on pooled results from 2003 and 2004 oceanic surveys of waters from the 200-meter isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ).

Table 1.1 Gulf of Mexico Marine Mammal Population Estimates

Species	N_{best} (a)	N_{best} CV,	N_{min} (b)
Sperm whale	763	0.38	560
Dwarf Sperm whale + Pygmy sperm whale	186	1.04	90
Bryde's whale	33	1.07	16
Short-finned pilot whale	2,415	0.66	1,456
Cuvier's beaked whale	74	1.04	36
Blainville's beaked whale + Gervais'	149	0.91	77
Bottlenose dolphin, Gulf of Mexico stocks: continental shelf	51,192	0.10	46,926
eastern coastal	12,388	0.13	11,110
northern coastal	7,185	0.21	6,044
western coastal	20,161	0.17	17,491
oceanic	5,806	0.39	4,230
Barataria Bay	unknown		
St. Joseph's Bay	146	0.18	126

Choctawachee Bay	179	0.04	173
27 Bay, Sound, and Estuary Stocks	unknown for all but 4 of the 27 stocks		
Atlantic spotted dolphin	unknown		
Pantropical spotted dolphin	50,880	0.27	40,699
Striped dolphin	1,849	0.77	1,041
Spinner dolphin	11,441	0.83	6,221
Rough-toothed dolphin	624	0.99	311
Clymene dolphin	129	1.00	64
Fraser's dolphin	unknown		
Risso's dolphin	2,442	0.57	1,563
Pygmy killer whale	152	1.02	75
Melon-headed whale	2,235	0.75	1,274
Killer whale	28	1.02	14
False killer whale	unknown		

(a) N_{best} is the best estimated population size, with its associated Coefficient of Variation (CV).
(b) N_{min} represents an estimated minimum population size that, accounting for estimation precision and variability, provides reasonable assurance that the stock size is equal to or greater than the estimate.
Source: Waring et al., 2015

A.1.1.b Bryde's Whale (Waring et al., 2012)
Bryde's whales are reported from off the southeastern U.S. and the southern West Indies to Brazil. Most of the sighting records of Bryde's whales in the northern Gulf of Mexico are from NMFS abundance surveys between 1995 and 2006. Bryde's whales found in the northern Gulf may represent a resident stock; stranding records are found throughout the year. The best abundance estimate available for northern Gulf of Mexico Bryde's whales is 33, with a minimum size of 16, based on 2009 data covering waters from the 200-meter isobath to the seaward extent of the U.S. EEZ. Pooled data from surveys conducted 1996 - 2001 resulted in an average population size of 40 (CV=0.61). However, surveys from 2003 - 2004 ranging from the 200-meter isobath to the seaward extent of the EEZ produced an estimated abundance of 15 (CV=1.98) for Bryde's whales in oceanic waters.

A.1.1.c Blue, Fin, Humpback, Northern Right, and Sei Whales (Waring et al., 2012)
Blue whales are listed as endangered under ESA. The only record of blue whales in the Gulf of Mexico are two strandings, one each on the Louisiana and Texas coasts. However, the identifications for both strandings are questionable. There are few reliable reports of fin whales in the northern Gulf of Mexico. Based on a few confirmed sightings and one stranding event, humpback whales are rare in the northern Gulf of Mexico (BOEM, 2012a). The few published records for the Northern right whale in the Gulf of Mexico are thought to represent distributional anomalies, normal wanderings of occasional animals, or a more extensive historic range beyond its only known calving area off the coast of southeastern Georgia and northeastern Florida. The Sei whale is rare in the northern Gulf of Mexico and occurrence considered accidental, based on four reliable and one questionable strandings records in Louisiana and Florida (Jefferson and Schiro, 1997; Schmidley, 2004).

A.1.1.d Blanville's, Gervais', Sowerby's, and Cuvier's Beaked Whales (Waring et al., 2012)
Blanville's, Gervais', and Sowerby's beaked whales are three species of Mesoplodon known to occur in the Gulf of Mexico, as well as Cuvier's beaked whale. Identification of Mesoplodon to species in the Gulf of Mexico is very difficult, and in many cases Mesoplodon and Cuvier's

beaked whale cannot be distinguished. Sightings of beaked whales are often identified as Mesoplodon spp., Cuvier's beaked whale, or unidentified Ziphiidae. Thus, although some survey sightings may have included Cuvier's beaked whale, their identification from aerial surveys is problematic. Beaked whales were seen in all seasons during aerial surveys of the northern Gulf of Mexico from 1992 to 1998. Beaked whale sightings made during spring and summer vessel surveys have been widely distributed in waters >500 meters deep. There is currently little information on cetacean species abundance and distribution in Gulf of Mexico beyond U.S. waters. Sowerby's beaked whale in the Gulf of Mexico is considered extra-limital because there is only one known stranding of this species. Blanville's beaked whale has four documented strandings and two sightings in the northern Gulf of Mexico. Cuvier's beaked whale strandings have occurred throughout the year in the Gulf of Mexico. The estimate of abundance for Mesoplodon spp. and Cuvier's beaked whale in oceanic waters uses data from a summer 2009 oceanic survey. The best available abundance estimate for a combined estimate for Blanville's and Gervais' beaked whales is 149 (CV=0.91). The best abundance estimate available for Cuvier's beaked whale is 74 (CV=1.04). However, these estimates are biased low because the only sightings of beaked whales that were included were those in which animals could be positively identified to species. The estimate for the same time period for unidentified Ziphiidae is 74 (CV=1.04), which may also include an unknown number of Blanville's, Gervais', and Cuvier's beaked whales.

A.1.1.e Melon-headed Whale (Waring et al., 2012)
Melon-headed whale sightings in the northern Gulf of Mexico generally occurred in water depths >800 meters and west of Mobile Bay, Alabama. Sightings of melon-headed whales were documented in all seasons during aerial surveys of the northern Gulf of Mexico between 1992 and 1998. Based on a summer 2009 oceanic survey covering waters from the 200-meter isobath to the seaward extent of the EEZ, the best abundance estimate available for northern Gulf of Mexico melon-headed whales is 2,235 (CV=0.75).

A.1.1.f Short-finned Pilot Whale (Waring et al., 2012)
Short-finned pilot whale sightings in the northern Gulf of Mexico occur primarily on the continental slope west of 89°W. Short-finned pilot whales were seen in all seasons during aerial surveys of the northern Gulf of Mexico between 1992 and 1998. There are many confirmed records from Gulf of Mexico waters beyond U.S. boundaries, so short-finned pilot whales almost certainly occur throughout the oceanic Gulf of Mexico. The best abundance estimate available for northern Gulf of Mexico short-finned pilot whales is 2,415 (CV=0.66) based on a summer 2009 oceanic survey covering waters from the 200-meter isobath to the seaward extent of the EEZ.

A.1.1.g Dwarf Sperm and Pygmy Sperm Whales and Pygmy Killer Whales (Waring et al., 2012)
Dwarf sperm whale, pygmy sperm whale, and pygmy killer whale sightings in the northern Gulf of Mexico occur primarily in oceanic waters and were documented in all seasons during aerial surveys of the northern Gulf of Mexico from 1992 to 1998. Dwarf sperm whales and pygmy sperm whales are difficult to differentiate at sea, and sightings of either species are usually categorized as Kogia spp. Although there are only a few records from Gulf of Mexico waters beyond U.S. waters, dwarf and pygmy sperm whales and pygmy killer whales almost certainly occur throughout the oceanic Gulf of Mexico, which represents only about 40% of the entire Gulf of Mexico. Little information on cetacean species abundance and distribution are available for Gulf of Mexico waters belonging to Mexico and Cuba. Based on a summer 2009 oceanic survey covering waters from the 200-meter isobath to the seaward extent of the EEZ, the best

abundance estimate available for northern Gulf of Mexico dwarf and pygmy sperm whales is 186 (CV=1.04); the best abundance estimate available for northern Gulf of Mexico pygmy killer whales is 152 (CV=1.02).

A.1.1.h Killer Whale (Waring et al., 2011)
Killer whale sightings in the northern Gulf of Mexico during 1921 - 1995 occurred primarily in oceanic waters ranging from 256 to 2,652 meters in the north-central Gulf of Mexico. Sightings from 1996 - 2006 have occurred in oceanic waters of 1,000 meters depth or greater in the north-central Gulf. Despite extensive shelf surveys, no killer whales have been reported on shelf waters other than those reported in 1921, 1985, and 1987. Killer whales were seen only in the summer during aerial surveys of the northern Gulf of Mexico between 1992 and 1998. Thirty-two individuals have been photographically identified in the northern Gulf of Mexico; 6 individuals were sighted over a 5-year period and 1 whale has been sighted over 10 years. The best abundance estimate available for northern Gulf of Mexico killer whales is 28 (CV=1.02) based on a summer 2009 oceanic survey covering waters from the 200-meter isobath to the seaward extent of the EEZ.

A.1.1.i False Killer Whale (Waring et al., 2012)
False killer whale sightings in the northern Gulf of Mexico occur in oceanic waters, primarily in the eastern Gulf. False killer whales were seen only in the spring and summer during aerial surveys of the northern Gulf of Mexico between 1992 and 1998 and in the spring during vessel surveys reported in 2004. There are many confirmed records from Gulf of Mexico waters beyond U.S. boundaries, thus they almost certainly occur throughout the oceanic Gulf of Mexico. The current population size for the false killer whale in the northern Gulf of Mexico is considered unknown because the survey data are too old.

A.1.1.j Atlantic Spotted Dolphin and Pantropical Spotted Dolphin (Waring et al., 2012; Waring et al., 2014)
There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin and the pantropical spotted dolphin. The Atlantic spotted dolphin occurs in two forms, a the large, heavily spotted form that is usually found inside or near the 200-meter isobath on the continental shelf, and a smaller, less spotted form that has only been seen in the Atlantic Ocean. The Gulf of Mexico Atlantic spotted dolphins occur primarily from continental shelf waters 10 - 200 meters deep to slope waters. Sightings of pantropical spotted dolphins occur in oceanic waters of the northern Gulf of Mexico and were observed in all seasons during aerial surveys from 1992 and 1998. Because there are many confirmed records from Gulf of Mexico waters beyond U.S. they almost certainly occur throughout the oceanic Gulf of Mexico. The current population size for the Atlantic spotted dolphin in the northern Gulf of Mexico is unknown because the survey data are too old. For 1991 to 1994, the estimate was 3,213 (CV=0.44); for 1996 to 2001, the estimate was 175 (CV=0.84). These were underestimates because the continental shelf was not covered during these surveys. From 2000 to 2001, surveys covered shelf waters from the 20-meter to the 200-meter isobaths and estimated the abundance of Atlantic spotted dolphins; the pooled estimate was 37,611 (CV=0.28). From surveys in 2003 - 2004, the pooled abundance estimate for Atlantic spotted dolphins was 0 (Mullin, 2007). The best abundance estimate available for northern Gulf of Mexico pantropical spotted dolphins is 50,880 (CV=0.27), based on a 2009 survey covering waters from the 200-meter isobath to the seaward extent of the EEZ.

A.1.1.k Fraser's, Rough-Toothed, Striped, Spinner, Clymene Dolphins, and Risso's Dolphins (Waring et al., 2012; Waring et al., 2014)

Fraser's, rough-toothed, striped, and Risso's dolphin have been sighted throughout the Gulf of Mexico, while spinner dolphins are primarily found east of the Mississippi and Clymene's dolphins found primarily west of the Mississippi. In aerial surveys of the northern Gulf of Mexico between 1992 and 1998, they were seen in all seasons except for Clymene's dolphins, which were not seen in the fall. Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries for these species, these dolphins almost certainly occur throughout the oceanic Gulf of Mexico beyond the EEZ.

Fraser's dolphin have been sighted in the northern Gulf of Mexico in oceanic waters deeper than 200 meters. Rough-toothed dolphins occur in oceanic and continental shelf waters in the northern Gulf of Mexico. Spinner dolphin sightings in the northern Gulf of Mexico occur beyond the 100-meter isobath. Striped and Clymene dolphin are generally found in waters deeper than about 900 meters. Risso's dolphins occur throughout the oceanic waters of the Gulf, but are concentrated in the continental slope.

After a mass stranding in the Florida panhandle in 1997, 4 of 62 rough-toothed dolphins were rehabilitated, released, and tracked for 4 to 112 days. After 5 months they had remained in Gulf waters offshore of the original stranding site in waters depths averaging about 195 meters. In 2006, a Risso's dolphin that stranded on the Florida Gulf Coast was rehabilitated, tagged, and released southwest of Tampa Bay and travelled from its release site to the Atlantic Ocean, and north of Delaware over a 23-day period. Tracking of a rehabilitated and released adult female Risso's dolphin and young calf documented movements as far as Bahia de Campeche, Mexico and off Texas and Louisiana before returning to the shelf edge southwest of its stranding site off Florida. The effects of stranding and rehabilitation on post-release behavior is unknown, so such movements may not be representative.

The abundance estimate available for Fraser's dolphins in the Gulf is unknown. No sightings of groups of Fraser's dolphins were made during a 2009 survey. A small number of Fraser's dolphins probably continue to inhabit the northern Gulf of Mexico although sightings that were made consistently every 3 - 4 years since the early 1990's have not occurred or have been rare during more recent surveys. Based on a 2009 oceanic survey covering waters from the 200-meter isobath to the seaward extent of the EEZ in the northern Gulf of Mexico, the best abundance estimate for the rough-toothed dolphin was 624 (CV=0.99); for striped dolphins it was 1,849 (CV=0.77); for spinner dolphins it was 11,441 (CV=0.83); for Clymene dolphins it was 129 (CV=1.00); and for Risso's dolphins it was 2,442 individuals (CV=0.57).

A.1.1.l Bottlenose Dolphin (Waring et al., 2012)

NORTHERN GULF OF MEXICO OCEANIC STOCK. The species is not listed as threatened or endangered under ESA. Thirty-seven stocks have been provisionally identified for northern Gulf of Mexico bottlenose dolphins (Waring et al., 2010). Northern Gulf of Mexico inshore habitat has been separated into 32 bay, sound and estuarine stocks. Three northern Gulf of Mexico coastal stocks include nearshore waters from the shore to the 20-meter isobath. The northern Gulf of Mexico continental shelf stock encompasses waters from 20 to 200 meters deep. The northern Gulf of Mexico oceanic stock encompasses the waters from the 200-meter isobath to the seaward extent of the EEZ. Both "coastal/nearshore" and "offshore" ecotypes are genetically distinct, based on both mitochondrial and nuclear markers, but the distribution of each in the Gulf of Mexico is not known. Based on pooled data from 2003 and 2004 oceanic surveys covering waters from the 200-meter isobath to the seaward extent of the EEZ, the best abundance

estimate available for the northern Gulf of Mexico oceanic stock of bottlenose dolphins is 5,806 (CV=0.39).

Northern Gulf of Mexico Bay, Sound, and Estuary Stocks. Distinct stocks are provisionally identified in each of 32 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the northern Gulf of Mexico based on descriptions of relatively discrete dolphin communities in these areas. The term "community" emphasizes geographic, genetic and social relationships and includes resident dolphins that regularly share large portions of their ranges, exhibit similar distinct genetic profiles, and interact with each other to a much greater extent (>50% of associations) than with dolphins in adjacent waters. However, individuals from adjacent communities are known to interbreed, thus bottlenose dolphin communities do not constitute closed demographic populations. Nevertheless, the geographic nature of these areas and long-term, multi-generational stability of residency patterns suggest that many of these communities exist as functioning units of their ecosystems.

Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every site where photographic identification or tagging studies have been conducted in the Gulf of Mexico. For example, the Sarasota Bay community has been observed since 1970 and a span of at least five generations of identifiable residents currently inhabit the region, including some of those first identified in 1970. Sightings of dolphins tagged 12 - 15 years previously have been reported in Mississippi Sound. In Texas, some of the dolphins in the Matagorda-Espiritu Santo Bay area Aransas Pass, San Luis Pass, and Galveston Bay have all reported long-term residency while in Florida, long-term residency has been reported from Choctawhatchee Bay, Tampa Bay, Sarasota Bay, Lemon Bay, and Charlotte Harbor/Pine Island Sound. Residents also have been found to exhibit differential use of the bay, sound or estuary waters, with limited movements through passes to the Gulf of Mexico. Thus, for example, residents of Sarasota Bay, Florida lacked squid in their diet, unlike nonresident dolphins stranded on nearby Gulf beaches.

Genetic data also support the concept of bay, sound and estuary communities relatively distinct from adjacent Gulf coastal waters stocks. Analyses of mDNA[1] haplotype distributions indicate the existence of clinal variations along the Gulf of Mexico coastline. Also, differences in reproductive seasonality from site to site additionally suggest genetic-based distinctions between communities. Year-round residents can co-occur with non-resident dolphins, providing potential opportunities for genetic exchange, thus the finding that some of the calves in Sarasota Bay apparently have been sired by non-residents. Population size estimates for most of the stocks are greater than 8 years old and therefore the current population size for each of these stocks is considered unknown.

NMFS declared a UME for whales and dolphins in the Gulf of Mexico from February 2010 through the present (NMFS, 2016). Evidence of the UME was first noted by NMFS as early as February 2010, before the Deepwater Horizon event. As of February 2016, a total of 1,530 cetaceans have stranded since the start of the UME (6% stranded alive; 94% stranded dead) between Franklin County, Florida, and the Louisiana/Texas border. From February 1, 2010 through April 29, 2010, 114 cetaceans had stranded in the northern Gulf; from April 30, 2010 through November 2, 2010 another 122 cetaceans either stranded or were reported dead; from November 3, 2010 through July 5, 2015 another 1,173 cetaceans have stranded. The

[1] mDNA (mitochondrial DNA) is genetically transmitted maternally. Unlike nuclear DNA that is derived equally from both maternal and paternal lines of inheritance, mDNA is passed solely from mother to all offspring.

overwhelming majority of cetaceans (87%) are bottlenose dolphin and mDNA analyses of 75 carcasses showed they were all from the coastal ecotype. In addition to investigating all other potential causes, scientists are investigating what role *Brucella*, a bacterial pathogen, plays in the northern Gulf of Mexico UME. As of October 27, 2015, 68 out of 210 dolphins tested were positive or suspected positive for *Brucella* (NMFS, 2016).

Compared to UMEs since 1990, this UME is both the longest lasting (currently over 6 years; the previous longest since 1990 was 17 months), has the highest number of strandings by far (1,530 as of February 2016 versus a previous high of 344 strandings), and has the highest percentage of perinatal strandings (23% in 2010; 34% - 49% in 2011 - 2014 versus a previous high of 23%). Data currently favor multiple stressors acting on different demographic groupings to produce the ongoing UME. Extreme cold weather, fish kills of prey species, the Deepwater Horizon event in 2010, and extraordinary fresh water input in 2011 all are thought to be contributing factors.

The occurrence of poor health and prevalence of poor body condition, disease, and abnormalities among Barataria Bay bottlenose dolphins, which was the most heavily oiled area, were higher than seen in dolphins from less oiled areas in Florida or Texas. Diseases found in the Barataria Bay dolphins are not common, but are consistent with exposure to petroleum hydrocarbons. That other pre-existing environmental stressors rendered this population more vulnerable to oil spill impacts cannot be discounted at present. Earlier strandings, prior to the Deepwater Horizon event are thought likely due to direct cold weather impacts and indirect impacts to prey species. A large input of fresh water into Mobile Bay due to an unusually large snowmelt is thought a potential contributing factor to the UME subsequent to the oil spill. At this time, several potential causative factors have been identified and are being examined to better understand etiology of this UME. Current belief is that there is no single explanation, but that the interaction of several factors eventually will be revealed (Carmichael et al., 2012; Litz et al., 2014; Venn-Watson et al., 2015a; b).

A.1.1.m West Indian Manatee (Waring et al., 2009; 2012)
At present, manatees of the genus Trichechus are represented by three allopatric species: the West African manatee, the Amazonian manatee, and the West Indian manatee. The West Indian species is subdivided into two subspecies, the Antillean manatee and the Florida manatee. Such sub-speciation may reflect reproductive isolation brought on by temperature differences and strong currents in the Straits of Florida. West Indian manatees occur in the northern Gulf of Mexico and are listed as federally endangered under the ESA. The Florida manatee is protected by the State of Florida under the Florida Manatee Sanctuary Act of 1978. Federally, Florida manatees were originally listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966. The original listing was subsequently adopted under ESA and manatees continue to be identified as a federally endangered species.

Historically, the winter range of the Florida manatee was thought to focus on south Florida, with some animals ranging north of Charlotte Harbor on Florida's west coast. Movements out of this range occur and are typically seasonal, with animals travelling north during warmer periods and travelling south as temperatures decline. Documentation of manatee movements between Gulf and Atlantic coast populations in far south Florida is lacking, but significant genetic variation between coastal populations has not been demonstrated. Range extremes extend north to Virginia on the Atlantic coast, west to Louisiana on the Gulf coast, and the number of sighting reports outside of Florida has increased in recent years. The population size for Florida manatees is unknown but the minimum population is estimated at 1,822 animals, based on intensive

statewide winter aerial surveys at warm-water refuges in early February of 1995. A survey conducted in 1992 reported a previous high count of 1,856 manatees.

A.2.1 Sea Turtles

The five sea turtle species that may occur in the proposed permit area are: green turtle, hawksbill turtle, leatherback turtle, Kemp's ridley turtle, and loggerhead turtle. All five species are listed as endangered or threatened under ESA. Sea turtles are highly migratory and therefore have a wide geographic range. Each turtle species has the potential to occur throughout the entire Gulf of Mexico and may occur at suitable nesting beaches along the entire northern Gulf coast. There are no designated critical habitats or migratory routes for sea turtles in the northern Gulf. In general, however, the entire Gulf of Mexico coastal and nearshore area can serve as habitat for marine turtles.

A.2.1.a Green Turtle (BOEM, 2012a)
Green sea turtles are federally-listed as threatened except for the breeding populations of Florida and the Pacific coast of Mexico, which are listed as endangered. Green sea turtles are found throughout the Gulf and are known to nest on beaches, but reports of green turtles nesting along the Gulf coast are infrequent. The east coast of Florida is one of the most important nesting areas for green turtles. Between 1989 and 2010, the annual number of green sea turtle nests ranged from 267 to 9,091 with nests increasing 10-fold over the 22 years. The principal cause of past declines and local extinctions of green turtle assemblages has been the overexploitation of green turtles for eggs and meat. Significant current threats are primarily related to beach development.

A.2.1.b Hawksbill Turtle (BOEM, 2012a)
The hawksbill turtle is federally-listed as endangered and is considered critically endangered by the International Union for the Conservation of Nature (IUCN) based on global population declines of over 80% during the last three generations (105 years) (Meylan and Donnelly, 1999). Hawksbill sea turtles are highly migratory; in the Gulf of Mexico they are found primarily in Florida and Texas, although they have been recorded in all the Gulf coast states. The Atlantic Coast of Florida is the only area in the U.S. where hawksbills nest on a regular basis. Long-term trends in hawksbill nesting in Florida are unknown; no nesting trends were evident in Florida from 1979 to 2000. The primary cause of hawksbill decline has been attributed to centuries of exploitation for tortoise shell. Hawksbills also are threatened by exploitation for their meat, eggs, and the curio trade; beach development; nest depredation; oil pollution; incidental capture in fishing gear; ingestion of and entanglement in marine debris; and boat collisions.

A.2.1.c Leatherback Turtle (BOEM, 2012a)
The leatherback turtle is the most abundant sea turtle in waters of the northern Gulf of Mexico continental slope and appear to use both continental shelf and slope habitats (Mullin and Hoggard, 2000 as cited in BOEM, 2012a). Leatherback sea turtles are listed as endangered. Surveys suggest the region from Mississippi Canyon to De Soto Canyon, especially near the shelf edge, appears to be an important habitat for leatherbacks. Leatherbacks have been frequently sighted during both summer and winter. A substantial increase in leatherback nesting in Florida has occurred since 1989. On the Atlantic coast nesting numbers increased from 98 nests per season in 1988 to 800 - 900 nests in the early 2000s. Although nesting is very rare on Gulf of Mexico beaches, leatherbacks do occur in Gulf waters. Ongoing threats to leatherbacks include ingestion of marine debris, poaching of eggs and animals, and entanglement in longline fishing gear.

A.2.1.d Kemp's Ridley Turtle (BOEM, 2012a)
The Gulf coast from Port Aransas, Texas, through Cedar Key, Florida, appears to represent the primary habitat for subadult ridleys in the northern Gulf of Mexico. Along the 47-mile (76-kilometer) stretch of Alabama coastline, only one nest was reported in 2006, 2007, and 2008. Louisiana and Mississippi have few, if any, nests. Nearly 95% of worldwide Kemp's ridley nesting occurs in one confirmed *arribada* ("arrival") in the state of Tamaulipas, Mexico (NOAA Fisheries, 2016). A small number of females nest consistently in Veracruz, Mexico, and at Padre Island National Seashore, Texas, where their number appears to have increased in recent years. The Kemp's ridley is federally-listed as endangered and has declined to the lowest population level among the seven extant species of sea turtles in the world; internationally, the Kemp's ridley is considered the most endangered sea turtle (FWS, 2016). In February 2010, NMFS and FWS were petitioned to designate critical habitat for Kemp's ridley sea turtles for nesting beaches and for marine habitats in the Gulf of Mexico and Atlantic Ocean; the petition has not been acted on (NOAA Fisheries, 2016). Many threats to the species remain, including interactions with fishing gear, marine pollution, foraging habitat destruction, illegal poaching of nests, and development of nesting beaches.

A.2.1.e Loggerhead Turtles (BOEM, 2012a)
Loggerhead sea turtles are listed as a threatened species. NMFS has issued a final rule to list nine distinct population segments (DPS) of loggerhead sea turtles under the ESA (76 FR 58868, September 22, 2011); none of the DPS are located in the Gulf of Mexico. In the Gulf, loggerheads nest primarily in southwest Florida with minimal nesting outside of this range to the west. The species has seen substantial population fluctuations. The Florida panhandle subpopulation declined 6.6% annually from 1995 to 2005, nearly halving the population. But nest numbers in 2010 were above the average of the preceding 10-year period. Along the 47 miles of Alabama coastline the number of nests reported were 62, 53, 37, 45, 54, and 78 from 2003 to 2008, respectively. Ongoing threats to loggerhead populations are numerous and include: incidental takes from dredging, commercial trawling, and longline and gillnet fisheries; loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; nest predation by native and nonnative predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and disease.

A.3.1 Fish and Essential Fish Habitat

In the northern Gulf of Mexico, fish assemblages are typically categorized by habitat use. Demersal fishes live near or on the seafloor and are distinct from pelagic fishes that reside in the water column. Within these categories, fish can be further classified by their preferred depth and location along a transect running from the continental shelf to the abyssal plain. Habitat use also varies across life stages, with larvae and juveniles utilizing a different regime from adults.
The Gulf of Mexico supports numerous fish species whose distributions are related to variable ecological factors, including salinity, primary productivity, and bottom type. Characteristic fish resources are associated with various environments and not randomly distributed. Most finfish resources are linked directly and indirectly to the Gulf's vast estuaries that serve as nursery grounds for numerous species of marine fishes of the inner continental shelf (BOEM, 2013a).

Various differing fish assemblages occur in relatively discreet depth zones, roughly delineated into relatively shallow, nearshore depths (0 - 20 meters); deeper nearshore depths (0 - 50 meters) with different assemblages that vary by bottom type (i.e., muddy soft bottom versus shell or hard bottom); depths to about 200 meters, which also has assemblages that differ depending on bottom type; deepwater (below several hundred meters) demersal fish assemblages; pelagic fish

that occur throughout the water column; oceanic epipelagic species found to depths of about 200 meters; mesopelagic fish found during the day at depths of 200 to 1,000 meters but migrate daily to food-rich upper depths; and deep-dwelling, bathypelagic fish (depths >1,000 meters).

Epipelagic species include: sharks, swordfish, billfishes, flyingfish, halfbeaks, jacks, dolphinfish, and tunas. Mesopelagic fishes are dominated by lanternfishes, bristlemouths, and hatchetfishes. Mesopelagic species are less commonly known but are ecologically important because of their daily transfer of energy from epipelagic to mesopelagic zones. Bathypelagic fishes are not well understood and include: snipe eels, slickheads, bigscales, and whalefishes (BOEM, 2012a).

Pelagic fish resources can be found throughout the Gulf of Mexico at varying depths. However, most bottom-dwelling fish species in the Gulf, including many of the economically significant fish and shellfish species, utilize habitats less than 200 meters deep for adult, spawning, and juvenile habitat (EPA, 1998a). These data are summarized in Table 3-1 (shellfish and shallow water fish). The preferred habitat depth for most shellfish resources is less than 200 meters. Generally, spawning depth and the preferred depth for juveniles were found to be less than 100 meters and usually in estuaries, seagrasses, or other shallows.

The preferred habitat for most fish species of economic significance for the majority of their lifecycle extends into continental shelf waters. Spawning and juvenile habitats for these species are primarily estuaries and shallows, with the exception of mackerel, which has a spawning habitat that appears to be in offshore areas, possibly over 100 meters deep. Small mackerel juveniles also typically inhabit depths over 100 meters, but move inshore into coastal regions as they develop.

A large category of economically important fish species, reef fish, spend the majority of their adulthood associated with reefs to depths of 150 meters. However, some groupers, especially large individuals, can occur to depths well over 200 meters. For species for which spawning depth and juvenile depth have been determined, these depths generally do not exceed 40 meters (Table 3-2, reef fish; Table 3-3, outer continental shelf fish).

Table 3-1. Shellfish and Shallow Water Fishes Preferred Depth Ranges

Resource	Habitat Depth, m	Spawning Depth, m	Juvenile Depth, m	Comments
Pink Shrimp	Shore - 65	20 - 50	Seagrass beds	
Brown Shrimp	Shore - 110	25 - 110	Seagrass, estuaries	
White Shrimp	< 35 (preferred - 18)	10 - 30	Estuaries	
Royal Red Shrimp	180 - 550	U	U	
Rock Shrimp	15 - 80	U	U	
Blue Crab	<90, most <35	Estuaries & nearshore	Estuaries	
Stone Crab	Shore - 50	U	Shallows	
Oyster	<10	U	U	
Black/Striped Mullet	Continental Shelf	Shore - 40	Estuaries	
Gulf Menhaden	Shelf waters to 120	<20	Estuaries, deep bays	
Mackerel (various spp)	To continental shelf edge	Offshore	U	
King Mackerel	U	U	15 to 915 but average depth 35	Small juveniles ~11-135m; large juveniles < 15m

Table 3-1. Shellfish and Shallow Water Fishes Preferred Depth Ranges

Resource	Habitat Depth, m	Spawning Depth, m	Juvenile Depth, m	Comments
Red Drum	3 - 15	Estuaries	Primary or secondary bays	
Lady fish and Tarpon	U	Breed in coastal estuaries, salt marshes, mangroves	Within 100 m of the surface	Adults in bays, lagoons, coastal habitat or open ocean
Sharks	Four species groups: (1) Coastal-on the continental shelf); (2) Pelagic-range over upper zones of the entire Gulf; (3) Coastal/pelagic-intermediate, but no trans-oceanic travel; (4) Deep – dwelling	Usually coastal or estuarine bays	U	--
Cobia	10 - 55	U	U	Range is south of Mississippi to Dry Tortugas

U=Unknown
Source: EPA, 2004

Table 3-2. Gulf of Mexico Reef Fish Preferred Depth Ranges

Resource	Habitat Depth, m	Spawning Depth, m	Juvenile Depth, m	Comments
Queen Snapper	170 – 280	U	U	
Multon Snapper	100 – 180	U	U	Controversial, may also be found in shallow water
Schoolmaster	Shallow reefs	U	U	
Gulf Red Snapper	10 - 65, winter; 20 - 30, summer	20 - 40, over firm sand bottom	35 - 60 winter; 15 -30 summer	Max depth, 260 m
Cubera Snapper	30 - 40	U	U	
Dog Snapper	1 - 80	U	U	
Mahogany Snapper	Shallow	U	U	
Lane Snapper	10 - 400	U	U	
Silk Snapper	25 - 230	U	U	Max depth, 387 m
Wenchman	24 - 180	U	U	Prefers shelf edge; Max depth, 370 m
Voraz	60 - 400	U	U	Lower shelf edge; Max depth, 550 m
Vermillion Snapper	> 30	30 - 90	U	Max depth, 180m
Rock Hind	3 - 4	U	U	Max depth, 45m
Speckled Hind	30 - 190	U	U	
Yellow Grouper				
Red Hind				
Jewfish				
Warsaw Grouper				
Snowy Grouper				

Table 3-2. Gulf of Mexico Reef Fish Preferred Depth Ranges

Resource	Habitat Depth, m	Spawning Depth, m	Juvenile Depth, m	Comments
Nassau Grouper	Shoreline - 90	U	U	Larger fish at >50m; Max depth = 9 m; deeper water as size increases
Black Grouper	>20 - 150	U	<20	Migrate to deeper water as size increases
Gag	25 - 80	U	U	Juveniles, <1m
Scamp	25 - 90	U	U	
Yellowfin Grouper	35 - 120	U	U	Max depth, 145m
Sea Basses	20 - 120	U	U	
Tilefishes	20 - 600	U	U	
Amberjacks	U	U	U	
Triggerfish	U	U	U	
Grunts	25 - 100	U	U	
Porgies	25 - 100	U	U	

U=Unknown
Source: EPA, 2004

Table 3-3. Gulf of Mexico Outer Shelf Fish Preferred Depth Range

Resource	Habitat Depth, m	Spawning Depth, m	Juvenile Depth, m
Blackedge Moray (eel)	20 - 120	U	U
Ocellated Moray	20 - 120	U	U
Sand Diver	20 - 120	U	U
Offshore Lizardfish	20 - 120	U	U
Snakefish	20 - 120	U	U
Pancake Batfish	20 - 120	U	U
Bank Seabass	20 - 120	U	U
Rock Seabass	20 - 120	U	U
Smoothhead Scorpionfish	20 - 120	U	U
Marbled Puffer	20 - 120	U	U
Largescale Lizardfish	40 - 120	U	U
Mottled Cusk-Eel	40 - 120	U	U
Bass	40 - 120	U	U
Twospot Cardinalfish	40 - 120	U	U
Rough Scad	40 - 120	U	U
Red Goatfish	40 - 120	U	U
Longfin Scorpionfish	40 - 120	U	U
Horned Searobin	40 - 120	U	U
Spiny Searobin	40 - 120	U	U
Mexican Searobin	40 - 120	U	U
Shortwing Searobin	40 - 120	U	U
Anglefin Whiff	40 - 120	U	U

Table 3-3. Gulf of Mexico Outer Shelf Fish Preferred Depth Range

Resource	Habitat Depth, m	Spawning Depth, m	Juvenile Depth, m
Spotfin Flounder	40 - 120	U	U
Spotfin Tonguefish	40 - 120	U	U
Shortjaw Lizardfish	60 - 120	U	U
Lancer Stargazer	60 - 120	U	U
Sash Flounder	60 - 120	U	U
Horned Whiff	80 - 120	U	U

U=Unknown
Source: EPA, 2004

Demersal fish and shrimp catch data in the eastern Gulf have been quantified by species abundance, location, and depth to a maximum depth of 120 meters (Darnell and Kleypas as cited in EPA, 2004). The majority of species collected in this study were found at depths ranging from 0 to 80 meters, with habitat ranges largely limited to this depth in the water column. From 17 shrimp species and 347 fish species found to this depth, 32 species were abundant in a depth range of 80 to 120 meters. Three species were found to have a habitat depth range of 60 to 120 meters, while one species (the horned whiff) had a habitat range from 80 to 120 meters in depth. The distribution of horned whiff and other deeper water species suggests that these species occur deeper than the 120 meter depth limit of the study. A few species such as royal red shrimp, pelagic sharks, a few reef fish, and some outer shelf species occur at depths in excess of 200 meters (EPA, 2004).

A wide range of depths have been sampled throughout the northern Gulf of Mexico and several stations in Mexican waters (MMS, 2007). During a 2000 survey, fishes were captured at 31 of the 43 stations representing deep Gulf of Mexico transects ranging from 188 to 3,075 meter water depths. A total of 1,065 individual demersal fishes, 119 species, and 42 families were collected. Dominant species included the families Macrouridae (grenadiers or rattails), with 21 species; Ophidiidae (cuskeels), with 15 species; and Alepocephalidae (slickheads), with 8 species. Cluster analyses resulted in four major assemblages: a shelf assemblage between 188 and 216 meters, an upper slope assemblage between 315 and 785 meters, a mid-slope assemblage between 686 and 1,369 meters, and a deep assemblage between 1,533 and 3,075 meters. The ten most common demersal fish collected in trawls and reef fish collected in traps in 2010 are listed in Table 3-4.

Table 3-4. Ten Most Abundant Demersal and Reef Fish Species in Trawl and Trap Surveys of the Continental Shelf from Texas to Alabama

	Species	Total Number	Frequency %(a)
Demersal fish, Summer	Atlantic croaker	119,000	52
	Longspine porgy	77,667	69.9
	Atlantic bumper	44,374	48.9
	Blackwing sea robin	10,610	37.8
	Gulf butterfish	9,531	46
	Largescale lizard fish	8,989	40.6
	Silver seatrout	8,230	33.8
	Striped anchovy	6,381	25.6
	Atlantic cutlassfish	5,869	34.4
	Blackear bass	5,219	28.7

Demersal fish, Fall	Atlantic croaker	74,515	70.2
	Longspine porgy	38,520	61
	Atlantic bumper	13,713	37.9
	Silver seatrout	99,881	50.6
	Shoal flounder	9,874	53.7
	Spot	8,666	45.5
	Blackear bass	7,328	27
	Inshore lizardfish	5,580	60.4
	Star drum	5,440	18.8
	Bigeye sea robin	4,510	31.2
Reef fish	Vermillion snapper	210	1.5
	Red snapper	139	2.3
	Red porgy	45	2
	Red triggerfish	24	1.7
	Gray triggerfish	6	0.6

(a) Percentage occurrence in all trawls/traps
Source: SEAMAP, 2010 as cited in BOEM, 2012c

In summary, extensive fisheries resources occur in the eastern Gulf of Mexico above the 200-meter isobath. Whereas the most productive region appears to occur above the 100-meter isobath, many fish and shellfish species, including species of economic importance, also are abundant from 100 to 200 meters. The adult habitat for some species of fish, as well as royal red shrimp, extends to 200 meters or deeper.

The two ESA-protected fish species that may occur in the permit coverage area are the Gulf sturgeon and smalltooth sawfish, both inshore/nearshore inhabitants that rely heavily on resources and habitat available in rivers, estuaries, and adjacent continental shelf areas (BOEM, 2013a). Another species of note is the Nassau grouper, which NMFS proposed for listing as threatened on September 2, 2014 (79 FR 51929).

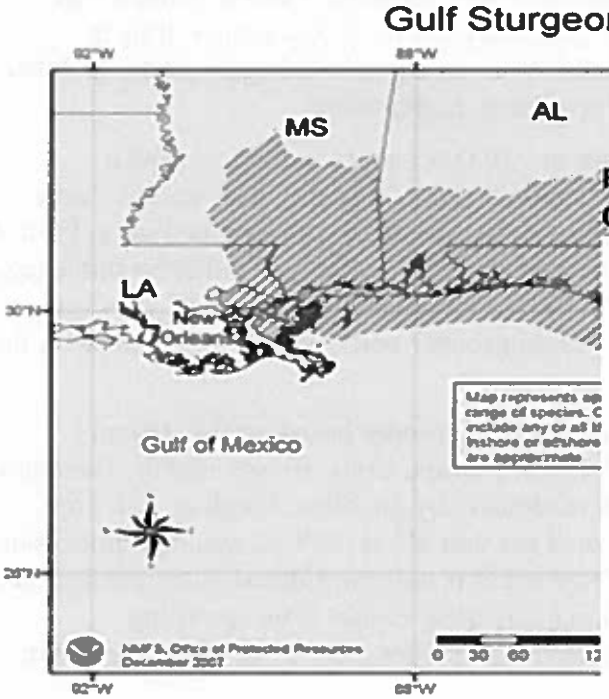
A.3.1.a Gulf Sturgeon

The Gulf sturgeon is a geographic subspecies of the Atlantic sturgeon and is listed as a threatened species. Historically, Gulf sturgeon ranged from the Mississippi River to Charlotte Harbor and Florida Bay. Today, this range has contracted to encompass major rivers and inner shelf waters from the Mississippi River to the Suwannee River, Florida (FWS and NMFS, 2009); see Figure 3-8.

Gulf sturgeon are anadromous fish, feeding during winter in marine waters, including bays and estuaries, and migrating upstream in the spring to freshwater coastal rivers to spawn on hard substrates (BOEM, 2012a; c). Gulf sturgeon are found over coarse sand and shell substrates in clear and well oxygenated waters less than 7 meters deep. In 2003 NMFS designated as critical habitat 14 riverine, estuarine, and marine areas that comprise some 2,783 kilometers of rivers and 6,042 square kilometers of habitat and range from Louisiana to the Florida panhandle (68 FR 133700).

A.3.1.b Smalltooth Sawfish

Figure 3-8. Range of Gulf Sturgeon in Coastal Gulf of Mexico



Source, NMFS, 2015e

Figure 3-9. NMFS Designated Smalltooth Sawfish Critical Habitat

Source: NMFS, 2015f

The smalltooth sawfish is listed as endangered under ESA. Historically, smalltooth sawfish were common throughout the Gulf of Mexico from Texas to Florida. However, the current range of this species has contracted to peninsular Florida; now only relatively common in the Everglades region at the southern tip of the state. Critical habitat for the smalltooth sawfish was designated on October 2, 2009 (74 FR 45353), and consists of two units that are located in the Eastern Planning Area along the southwestern coast of Florida between Charlotte Harbor and Florida Bay (Figure 3-9; BOEM, 2012c).

Smalltooth sawfish at all ages are usually found over muddy and sandy bottoms in sheltered bays, on nearshore shallow banks, and in estuaries or river mouths. Juveniles appear to prefer shallow environments (often less than 1 meter) with mud or sand bottoms as well as mangrove root habitat. Adults move to deeper water as they grow and large adults can be found in marine waters in depths up to at least 122 meters (BOEM, 2012c).

A.3.1.c Nassau Grouper

NMFS proposed to list the Nassau grouper as threatened on September 2, 2014 (79 FR 51929). The following information is from a 2003 assessment for the IUCN Red List of Threatened Species (Cornish and Eklund, 2003). The Nassau grouper is found from Bermuda and Florida throughout the Bahamas and Caribbean Sea in water depths to at least 130 meters and is most abundant in clear water with high relief coral reefs or rocky substrate. Post-settlement fish inhabit Laurencia macroalgal clumps, seagrass beds, and coral reefs. Generation time is estimated at 9 - 10 years, based on average fish size from an unexploited aggregation in Belize and the growth curve from five Cayman Island spawning aggregations.

Cornish and Eklund estimated the population size at >10,000 mature individuals and a population decline of 60% over the last three generations (27 - 30 years). Past declines were weighted by coral reef area rather than population size to give an overall decline figure. From the available data and most recent reports, Nassau subpopulations are likely to either be stable (e.g., the U.S. subpopulation) or in decline (e.g., Cuba, Belize subpopulations). Overall, it is very likely (80-100%) that the global population of Nassau grouper will continue to decline over the foreseeable future.

There is no evidence of distinct subpopulations of Nassau grouper based on fish genetics (mDNA and microsatellites) from a number of sites in Florida, Cuba, Belize, and the Bahamas. Nassau grouper are fished commercially and recreationally by handline, longline, fish traps, spear guns, and gillnets. Declines in landings, catch per unit effort (CPUE) and, by implication, abundance have been reported throughout its range and it is now considered to be commercially extinct in a number of areas. Much of the catch in many areas comes from spawning aggregations, which is troubling given that targeted aggregations have evidently collapsed in many countries.

Suitable habitat for the Nassau grouper is likely to be in decline. Of the estimated 20,000 square kilometers of coral reef in the Caribbean, 29% is estimated to be under high risk of degradation from human activities, 32% is at medium risk, and 39% is at low risk. Although Nassau grouper also inhabit rocky reefs, these are unlikely to be able to compensate for the loss of quality coral reef habitat.

A.3.1.d Essential Fish Habitat

GMFMC prepares fishery management plans (FMPs) for the Gulf of Mexico and has identified marine and estuarine essential fish habitats (EFHs) within its management area for a variety of fish and invertebrates. Due to the number of managed species, their different life history stages and the variety of habitats, almost the entire Gulf of Mexico is designated as EFH for one or multiple fishes (BOEM, 2012a). Estuarine and coastal EFH consist of submerged aquatic vegetation, emergent intertidal wetlands (marshes and mangroves), soft-bottom (mud, sand, or clay), live hard-bottom, oyster reefs, and estuarine water column. Offshore and marine EFH consist of coral reefs, marine water column, marine sediment, live-/hard-bottom, the continental slope, chemosynthetic cold seeps, Sargassum, and man-made structures (BOEM, 2012c).

A.4.1 Birds

A.4.1.a Non-Endangered Birds

The northern Gulf and its ecoregions possess a diverse bird fauna composed of resident marine and coastal species as well as migratory birds that may either pass through or overwinter in the northern Gulf region. The northern Gulf region supports well over 600 species, many of which are found in more multiple Gulf states, although there are a few that are only found in a particular state or locale (BOEM, 2012c). Many species do not occur in marine and coastal habitats where they could encounter OCS oil and gas activities. The marine and coastal birds that occur in the Gulf region for at least some portion of their life cycle are generally classified as seabirds, shorebirds, wetland birds, waterfowl, passerines, and raptors.

Seabirds include gulls, terns, loons, frigatebirds, pelicans, tropicbirds, cormorants, gannets, boobies, storm-petrels, and shearwaters. They spend a large portion of their lives on or over seawater and may be found both in offshore and coastal waters of the northern Gulf. They feed on fish and invertebrates; their temporal occurrence varies greatly (Sibley, 2016). Some seabirds, e.g., boobies, petrels, and shearwaters, only occur in pelagic habitats, including deeper waters of the continental slope and basin. Most seabird species of the northern Gulf, are found in the continental shelf and adjacent coastal and inshore habitats.

Shorebirds include plovers, oystercatchers, stilts, avocets, and sandpiper. Shorebirds typically are small wading birds that feed on invertebrates in shallow waters and along beaches, mudflats, and sand bars. Shorebirds are generally restricted to coastline margins except when migrating (Sibley, 2016). Shorebirds are generally solitary or occur in small- to moderate-sized flocks, although large aggregations of several species can occur during migration.

The wetland birds include a diverse array of birds that typically inhabit most coastal aquatic habitats of the northern Gulf of Mexico, including freshwater swamps and waterways, brackish and saltwater wetlands, and embayments (Sibley, 2016). Wetland birds feed on primarily fish and invertebrates and most are year-round residents. Wetland birds include wading birds, e.g., herons, egrets, cranes, rails, and storks, and diving birds, e.g., cormorants and grebes.

Waterfowl are a diverse and important group that comprise more than 30 species that include ducks, geese, loons, and swans. They occur in coastal waters, beaches, flats, sandbars, and wetland habitats in the northern Gulf (Sibley, 2016). Three distinct groups of ducks occur in the Gulf: surface-feeding ducks, e.g., mallards that use shallow freshwater and saltwater marshes and may be present year-round; bay ducks, e.g., ring-necked ducks that are diving ducks found in coastal bays and river mouths and typically are overwintering birds; and sea ducks that are diving ducks that occur in marine habitats.

The passerines are perching birds and include: sparrows, warblers, thrushes, blackbirds, wrens, and many others. The northern Gulf supports a wide diversity of year-round resident passerine species as well as migratory residents that appear in the fall, overwinter, and depart variously over the late winter and spring.

Raptors are the birds of prey. Two species are fish eaters, bald eagle and ospreys. If present, they forage in coastal freshwater and saltwater habitats and are seen year round nesting in suitable habitats in the Gulf (BOEM, 2012c).

A.4.1.b Threatened and Endangered Birds

There are 18 federally-listed avian species identified as threatened or endangered, previously delisted, or as candidate species in the Gulf of Mexico (Table 4.1). Of these species, 14 occur in

the EPA Region 4 jurisdictional area. Three species are listed as threatened; eight species are listed as endangered; and three species are delisted.

Table 4.1. Threatened or Endangered Avian Species

Species	Status (a)	Critical Habitat	EPA Region 4 States
Red Cockaded Woodpecker	E	None published	AL, FL, MS
Least Tern	E	None published	AL, FL, MS
Piping Plover	T	Designated	AL, FL, MS
Roseate Tern	E	None published	FL
Wood Stork	E	None published	AL, FL, MS
Whooping Crane	E	Designated	FL
Mississippi Sandhill Crane	E	Designated	MS
Everglades Snail Kite	E	Designated	FL
Cape Sable Seaside Sparrow	E	Designated	FL
Audubon's Crested Caracara	T	None published	FL
Bald Eagle	D	None published	AL, FL, MS
Peregrine Falcon	D	Designated	AL, FL, MS
Eastern Brown Pelican	D	None published	AL, FL, MS
Red Knot	T	None published	AL, FL, MS

(a) E – Endangered; T – Threatened; D – Delisted; C – Candidate
Source: Environmental Conservation Online System (ECOS)

Of those species found in the jurisdictional area of EPA Region 4, only two listed species are described in detail below and considered in this EA because their behavior and range could expose them to activities covered under the proposed action: the piping plover and red knot. There are several other listed species whose range includes inshore and coastal margin waters that are very unlikely to be exposed to the activities covered under the proposed Permit, but could be affected by onshore facility construction activity. However, no additional onshore facilities are expected over the term of the proposed permit.

A.4.1.c Piping Plover

The piping plover is a shorebird that inhabits coastal sandy beaches and mudflats. This species nests in sand depressions lined with pebbles, shells, or driftwood. Piping plovers forage for various small invertebrates along ocean beaches, on intertidal flats, and along tidal pool edges (NatureServe, 2015a). Three populations of piping plover are recognized under ESA: Great Lakes (endangered); Great Plains (threatened); and Atlantic (threatened) (BOEM, 2012a). Critical wintering habitat has been designated in all Gulf states for all three populations of piping plover (66 FR 36038, July 10, 2001); see Figure 3-10. Critical habitat rules have been published for piping plover, including designations for coastal wintering areas in Florida, Alabama, and Mississippi. The piping plover is considered a state species of conservation concern in all Gulf coast states (BOEM, 2012a).

Possibly as high as 75% of all breeding piping plovers, regardless of population affiliation, may spend up to eight months on wintering grounds in the Gulf of Mexico. They arrive from July through September, leaving in late February to migrate back to their breeding sites (BOEM, 2012a). Habitat used by wintering birds include beaches, mud flats, sand flats, algal flats, and washover passes (where breaks in sand dunes result in an inlet).

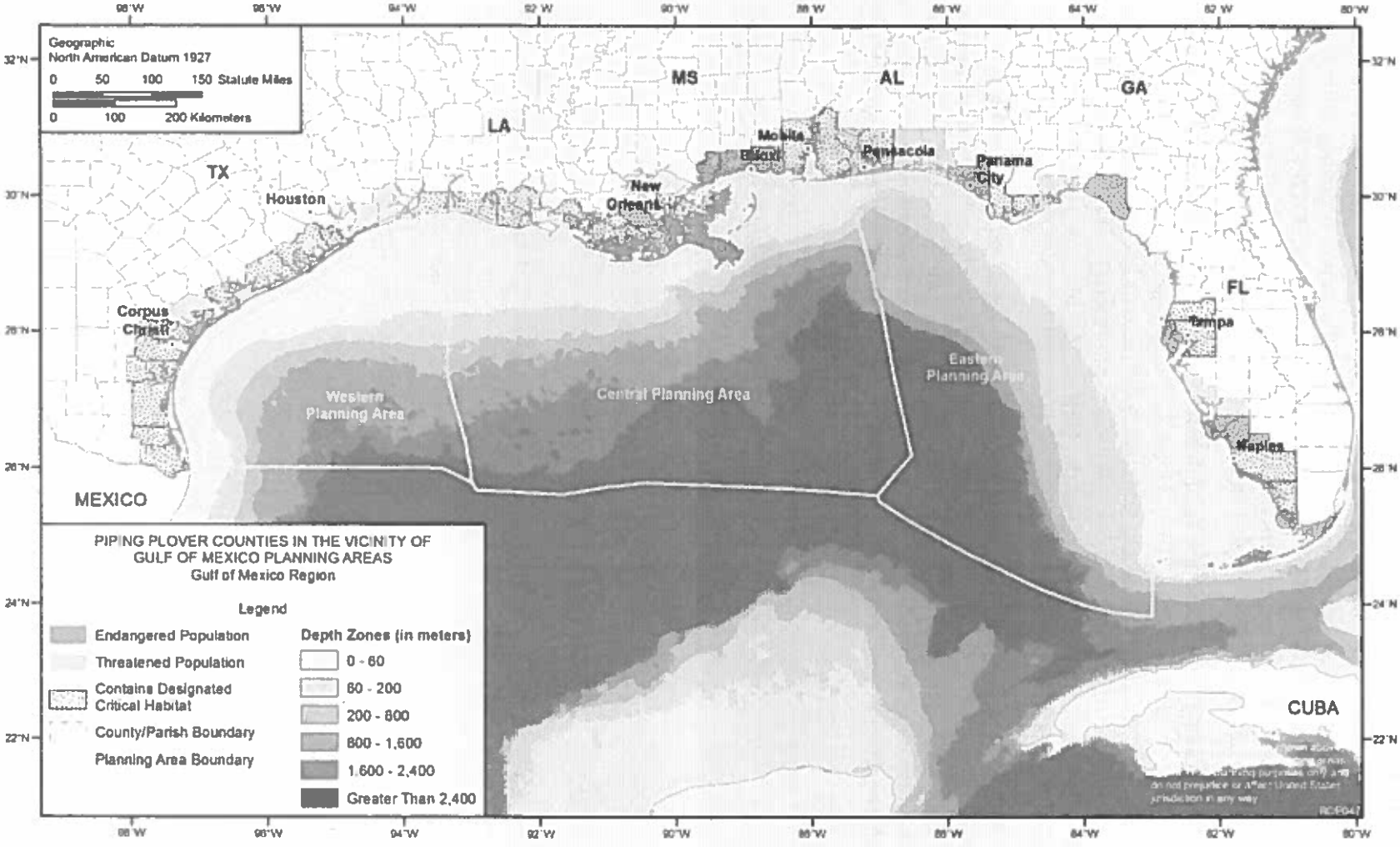
A.4.1.d Red Knot

The red knot was listed as threatened in 2014. Critical habitat rules have not been published for the species. Its population has exhibited a large decline in recent decades and is now estimated in the low ten-thousands (NatureServe, 2015b). This highly migratory species travels between nesting habitats in mid- and high-Arctic latitudes and southern non-breeding habitats in South America and the U.S. Atlantic and Gulf of Mexico coasts (BOEM, 2012c). It uses coastal spring and fall migration from its breeding grounds in the Arctic to its wintering grounds at Tierra del Fuego, Argentina, and back (BOEM, 2013a).

Red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks for bivalves, gastropods, and crustaceans (FWS, 2013). Horseshoe crab eggs are a critical food resource for this species, and the overharvesting and population declines of horseshoe crabs may be a major reason for the decline of red knot numbers. Within the northern Gulf of Mexico, this species has been reported in coastal counties of each of the Gulf of Mexico states. Figure 3-11 presents the designated critical habitats on the Gulf coast.

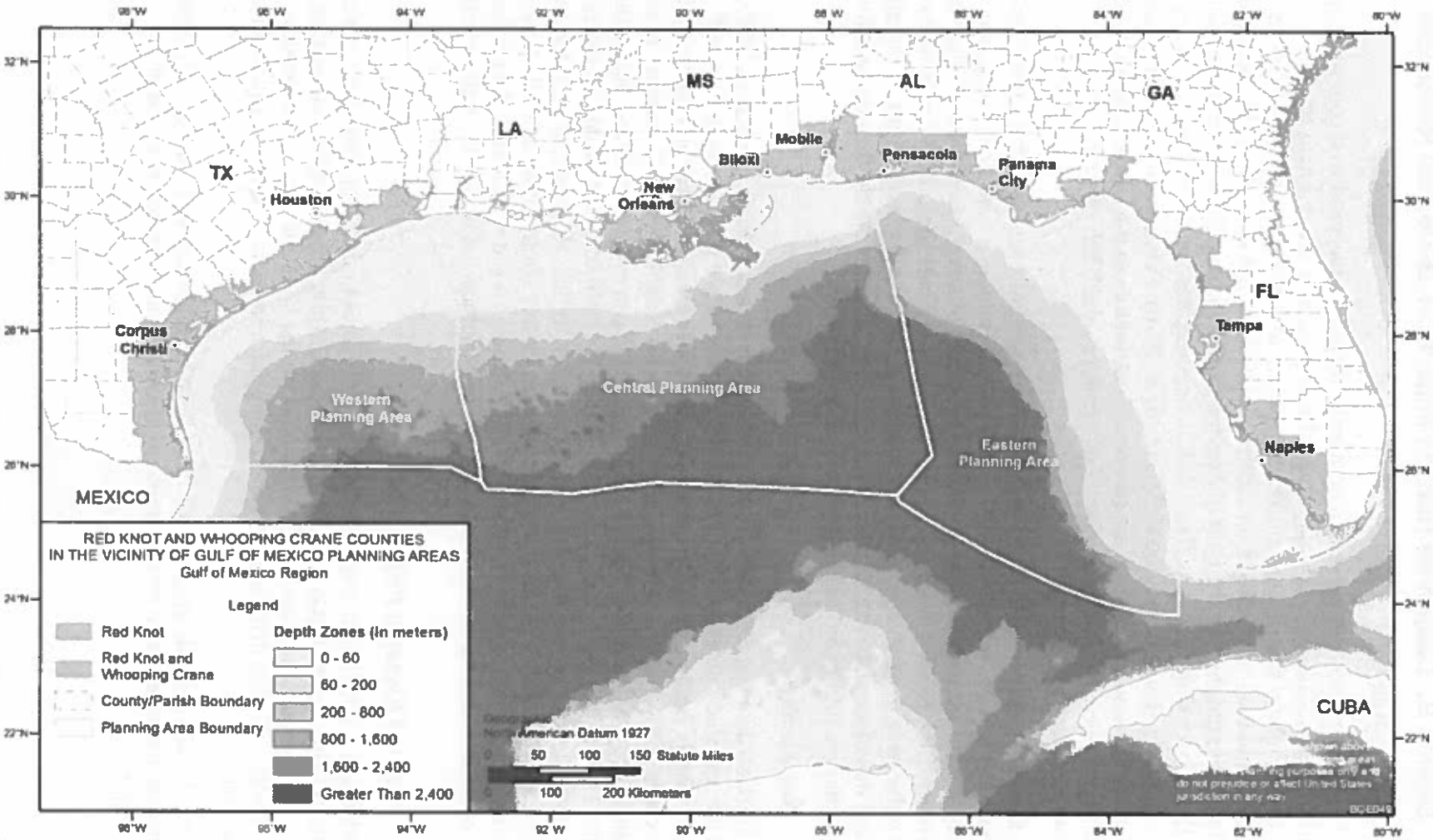
Within the Gulf of Mexico region, wintering red knots are found primarily in Florida, but the species also has been observed in Texas, Louisiana barrier islands and coastal headlands, Mississippi, and Alabama (e-Bird, 2013). It is considered a State Species of Conservation Concern in Florida and Mississippi. Reportedly, the numbers of wintering and staging red knots using coastal beaches in Gulf coast states other than Florida have declined dramatically (BOEM, 2013a).

Figure 3-10. NMFS Designated Piping Plover Critical Habitat



Source: BOEM, 2012c

Figure 3-11. NMFS Designated Red Knot Critical Habitat



Source: BOEM, 2012b

Section B.: Deepwater Horizon Impacts on Biological Resources

B. 1.1 Marine Mammals

The effect of the Deepwater Horizon event on marine mammals has produced confounding data on its potential impact. Although the Deepwater Horizon event is likely involved, the relationship of potentially significant contributing factors to the marine mammal UME in the Gulf and its potential long-term effects on these populations is not known. NMFS declared a UME for whales and dolphins in the Gulf of Mexico from February 2010, some three months prior to the Deepwater Horizon event. The UME is ongoing, has lasted far longer, and has seen many more strandings than any previous UME (NMFS, 2016). Persistent organic chemicals; principally, pesticides and insecticides are potential contributors to the UME (Balmer et al., 2014). Disease pathogens also are a potential contributor to the UME. A more detailed discussion can be found in Appendix D.

The current status of bottlenose dolphins in the northern Gulf of Mexico is that several stocks appears to be under a stress or stresses that are not yet understood. These stocks (e.g., the Barataria Bay stocks) are primarily located west of the area of coverage of the draft individual permit. However, EPA Region 4 did not identify data that indicate these stocks may be more sensitive or vulnerable to discharges authorized under the draft individual permit. Available data for whales and manatees also do not indicate that these populations would be more sensitive to any of the discharges authorized under the draft individual permit.

B.1.2 Sea Turtles

Deepwater Horizon data suggest that the spill may have resulted in acute impacts to Gulf of Mexico sea turtles. Study data have shown that the number of sea turtle nests in the Gulf declined significantly immediately following the Deepwater Horizon event and rebounded to previous levels in 2011 and 2012. Studies also show that a roughly four-fold increase in sea turtle strandings occurred compared to pre-Deepwater Horizon event strandings. Sea turtle strandings have remained about three times higher than pre-spill levels. Available data are not adequate to understand potential long-term impacts on sea turtles. However, as with the case of dolphins, there may be other natural and anthropogenic factors contributing as well. A more detailed discussion can be found in Appendix A. EPA Region 4 did not identify data to indicate turtles may be more sensitive or vulnerable to discharges authorized under the draft individual permit.

B.1.3 Fish and Essential Fish Habitat

Studies conducted on population responses of estuarine fishes to the Deepwater Horizon spill indicate that fin fishes were largely unaffected. However, while the available data suggest there has been no major impact thus far on fish populations in the Gulf, the current information is not sufficient to make a reliable determination about long-term impacts. See Appendix D for more detailed discussion.

Available data do not presently suggest that there have been alterations resulting in fisheries resources that are more sensitive or vulnerable to discharges authorized under the draft individual permit.

B.1.4 Birds

Studies on the impact of the Deepwater Horizon event on bird populations indicate that lethal effects occurred to avian species, especially on seabirds whose range extensively overlaps that area in which the spill occurred. The currently available information is not sufficient to make a reliable determination about long-term or population-level impacts. See Appendix A for more detailed discussion.

An analysis of the data currently available on the Deepwater Horizon event and available non-Deepwater Horizon-related data do not presently suggest that there have been alterations resulting in avian resources that are more sensitive or vulnerable to discharges authorized under the draft individual permit.

SECTION C.: BIOLOGICAL RESOURCES – POTENTIAL ENVIRONMENTAL CONSEQUENCES

C.1.1 Marine Mammals

C.1.1.a Information Reviewed

EPA Region 4 considered the information in earlier NEPA reviews (EPA 1998a; 2004; 2009); new information on marine mammals; and new information related to potential changes in marine mammals resulting from the Deepwater Horizon event. NMFS declared a UME for whales and dolphins in the Gulf of Mexico in February 2010, before the Deepwater Horizon event that continues to the present. Since the start of the UME 1,530 cetaceans have stranded as of February, 2016 (NMFS, 2016). Since 1990, this UME is the longest (currently over 6 years; the previous longest was 17 months), has the highest number of strandings (1,530 versus a previous high of 344 strandings), and has the highest percentage of perinatal strandings (23% in 2010; 34% - 49% in 2011 - 2014 versus a previous high of 23%). The overwhelming majority of cetaceans are bottlenose dolphins (87%).

Earlier strandings, prior to the Deepwater Horizon event are thought likely due to direct cold weather impacts and indirect impacts to prey species. Cold weather and a large input of fresh water into Mobile Bay due to an unusually large snowmelt in 2011 are thought to be potential contributing factors to the UME subsequent to the oil spill. The Deepwater Horizon event is implicated in Barataria Bay dolphin as symptoms and diseases found in the dolphins are not common, but are consistent with exposure to petroleum hydrocarbons. Current belief is that there is no single explanation; current data favor multiple stressors acting on different demographic groupings to produce the ongoing UME.

New data available since the 2009 NEPA review and data related to the Deepwater Horizon event for whales and manatees are not sufficient to conclude the Deepwater Horizon event has resulted in populations that may be more sensitive or vulnerable to discharges authorized under the proposed Permit. Information on bottlenose dolphins is less ambiguous and, although not definitive, the Deepwater Horizon event is likely one contributor to the dolphin UME (Venn-Watson, 2015b). However, other pre-existing and concurrent environmental stressors appear to have contributed to the UME as well, and the relationship among the spill and several natural, contributing factors is not well understood.

The current status of bottlenose dolphins in the northern Gulf of Mexico is that several stocks appears to be under stress. However, these stocks are not located near or within the area of

coverage of the proposed Permit. There currently are no data to suggest that dolphin populations are more sensitive or vulnerable to discharges authorized under the proposed Permit.

C.1.1.b Permit Provisions to Minimize or Eliminate Potential Consequences

While a UME for marine mammals has been declared by NMFS, bottlenose dolphin are overwhelmingly the species most affected by the UME. Bottlenose dolphin stocks, primarily located in Louisiana and Mississippi, with lesser impacts along Alabama and the Florida panhandle, appear to be subject to an increased and incompletely understood environmental stress. However, under the draft individual permit, EPA Region 4 has proposed a number of permit terms, conditions and limitations to avoid or minimize potential consequences to marine mammals from authorized discharges:

- Limitations on drilling muds and cuttings that limit water column and sediment toxicity, hydrocarbon content, trace metal content, maximum discharge rates, and prohibition of mud components and discharges near sensitive areas.
- WTCW limitations include maximum oil and grease content and prohibition on discharge of toxics at greater than trace amounts
- Miscellaneous wastes are limited through prohibiting discharge of free oil, floating solids, or domestic wastes within 12 miles of shore and comminution of domestic waste more than 12 miles from shore; a residual chlorine limit; BMPs for maintenance operation wastes; and chronic toxicity for miscellaneous discharges to which treatment chemicals have been added.

C.1.1.c Cumulative Impacts

As previously discussed, the activities under the draft individual permit represent a low incremental contribution in the Gulf from the oil and gas industry, which itself is a relatively small contributor to water quality impacts of the Gulf. This relative activity assessment applies equally to the anticipated impact of the draft individual permit from vessel traffic. Also, the Gulf-wide oil and gas industry annual sediment loading to the Gulf of Mexico, estimated to be some 433,265 tons (EPA, 2000a), is a very small additional loading (0.2%) relative to the 200,000,000 metric tons from the Mississippi River Main Pass and Atchafalaya Diversion.

EPA Region 4 is proposing a number of permit terms, conditions, and limitations on all of the discharges authorized under the draft individual permit. Permit provisions limit toxicity of discharges that may impact water column and sediment quality; limit the content of trace metal and organic pollutants associated with the liquid, suspended particulate, solid phases of discharges; and prohibit the discharge of free oil, foam, floating solids, trash, debris, and toxic pollutants at higher than trace (detectible) amounts.

In response to the UME, data suggest multiple, direct and indirect, natural and anthropogenic contributing factors. The provisions of the proposed permit represent what EPA Region 4 considers a set of requirements that is highly protective of the marine resources of the Gulf of Mexico, including marine mammals.

With the proposed permit provisions in place, drilling fluids and cuttings, WTCW fluids, and miscellaneous and other discharges may result in unavoidable, but local minor impacts to marine mammals, including bottlenose dolphins. EPA Region 4 does not consider the potential impacts to this resource from the activities proposed under this EA to be significant based upon available

scientific information. However, should EPA Region 4 receive credible scientific evidence during the comment period that suggests otherwise, EPA Region 4 will consider this information prior to the issuance of our findings.

C.2.1 Sea Turtles

C.2.1.a Information Reviewed

EPA Region 4 considered the information in earlier NEPA reviews (EPA 1998a; 2004; 2009); new information on sea turtles; and new information related to potential changes in sea turtles resulting from the Deepwater Horizon event. Large numbers of stranded sea turtles in the north-central Gulf of Mexico have occurred since 2010. Possible reasons for the increase include commercial fishing, biotoxins, and impacts from the Deepwater Horizon event.

The timing of the spill and Kemp's ridley data implicate the Deepwater Horizon event as a factor in increased strandings. Nesting data suggest recovery may have occurred on a time scale of a year or two, but there is not yet any reliable explanation for the post-2012 increase in strandings. Our understanding is further limited because most sea turtle carcasses are found moderately or severely decomposed and provide little meaningful information. At this time, there are insufficient data to ascertain long term impacts on sea turtle resources in the Gulf. As with the case of dolphins, other natural and anthropogenic factors may be contributing as well.

C.2.1.b Permit Provisions to Minimize or Eliminate Potential Consequences

EPA Region 4 is proposing a number of conditions, limitations, and restrictions intended to minimize or eliminate potential adverse consequences of authorized discharges on sea turtles. The draft individual permit reduces potential water column impacts by including toxicity limitations on drilling fluids and cuttings, WTCW fluids, and any discharge to which treatment chemicals have been added; limiting discharge rates; limiting oil and grease; limiting priority pollutants to trace amounts; and prohibiting discharge of specified substances with known adverse impacts to the marine environment. Discharges are subject to dilution and dispersion that reduce the potential extent of acute water column impacts to within a few hundred meters of the discharge.

C.2.1.c Cumulative Impacts

Similar to cumulative impacts on marine mammals (Section 4.3.1.3), the discharges authorized by the proposed Permit that could potentially affect sea turtles represent small potential water and sediment quality impacts. This also is true for potential impacts from vessel traffic related to the individual permit issuance. The anticipated activity under the draft individual permit is a small, incremental contribution to the sediment load of the Gulf. Impacts to water and sediment quality, on which sea turtles depend, represent small, incremental cumulative impacts.

EPA Region 4 is proposing numerous permit provisions on all of the discharges authorized under the draft individual permit. These drafted permit provisions limit water column and sediment toxicity; limit the content of trace metal and organic pollutants associated with the liquid, suspended particulate, solid phases of discharges; prohibit the discharge of free oil, foam, floating solids, trash, debris, and toxic pollutants at higher than trace (detectible) amounts. All of the measures serve to avoid or minimize potential adverse impacts to marine resources.

In response to data on Kemp's ridley sea turtles, multiple natural and anthropogenic factors may be contributing to the observations, including the Deepwater Horizon event. It appears the

incident likely had an impact on these turtles. What is not yet clear is the extent of recovery that may have occurred and potential long-term impacts. The existing provisions of the proposed permit represent what EPA Region 4 considers a set of requirements that is highly protective of the marine resources of the Gulf of Mexico, including sea turtles.

Sea turtles in the Gulf of Mexico, and the Kemp's ridley in particular, appear to be under stress. However, with the proposed permit provisions in place, drilling fluids and cuttings, WTCW fluids, and miscellaneous and other discharges may result in unavoidable, but local minor impacts to sea turtles. EPA Region 4 does not consider the potential impacts to this resource from the proposed activities to be significant based upon available scientific information. However, should EPA Region 4 receive credible scientific evidence during the comment period that suggests otherwise, EPA Region 4 will consider this information prior to the issuance of our findings. EPA Region 4 also is continuing to coordinate with the FWS and NMFS on the Gulf-wide biological opinion which will cover oil and gas activities in EPA Region 4 jurisdictional waters.

C.3.1 Fish and Essential Fish Habitat

C.3.1.a Information Reviewed

EPA Region 4 considered the information in earlier NEPA reviews (EPA 1998a; 2004; 2009); new information on fish and EFH, including the endangered Gulf sturgeon, smalltooth sawfish, and recently listed Nassau grouper; and new information related to potential changes in fish and EFH resulting from the Deepwater Horizon event.

Limited data indicate sublethal effects on embryos, juvenile, and adult fish may have occurred from the Deepwater Horizon event. However, field studies either have not discerned any oil spill-related impacts or, if such impacts occurred, affected populations appear to have recovered within a few years of the spill. Combined with commercial and recreational fish data (see Section 3.6.2.3), it appears any Deepwater Horizon event impacts may have been transient. However, impacts that have not yet been expressed in present fish populations cannot be discounted and current information is not sufficient to make a reliable determination about long-term impacts.

C.3.1.b Permit Provisions to Minimize or Eliminate Potential Consequences

Under the draft individual permit, EPA Region 4 has included a number of permit terms, conditions and limitations to avoid or minimize potential consequences to fish resources and EFH from discharges authorized under the draft individual permit.

- Limitations on drilling muds and cuttings that limit water column and sediment toxicity, hydrocarbon content, trace metal content, maximum discharge rates, and prohibition of mud components and discharges near sensitive areas.
- Limitations on WTCW that include maximum oil and grease content and prohibition on discharge of toxics at greater than trace amounts.
- Miscellaneous wastes are limited through prohibiting discharge of free oil, floating solids, or domestic wastes within 12 miles of shore and comminution of domestic waste more than 12 miles from shore, a residual chlorine limit, BMPs for maintenance operation wastes, and chronic toxicity for miscellaneous discharges to which treatment chemicals have been added.

EPA Region 4 has reviewed the potential adverse environmental consequences of drilling fluids and cuttings, WTCW fluids, and miscellaneous and other discharges on endangered Gulf sturgeon, smalltooth sawfish, and Nassau grouper. The provisions in the proposed Permit that are protective of fish resources and EFH, as described above, are sufficient to protect these protected species.

C.3.1.c Cumulative Impacts

The discharges authorized by the draft individual permit represent a small incremental contribution that could potentially affect fish and essential fish habitat, including Gulf sturgeon, smalltooth sawfish, and Nassau grouper. This finding applies to both potential water and sediment quality impacts.

Under the draft individual permit, EPA Region 4 is including permit provisions to avoid or minimize potential adverse impacts to fish and EFH that cover all discharges authorized. These proposed permit provisions limit water column and sediment toxicity; limit the content of trace metal and organic pollutants associated with the liquid, suspended particulate, and solid phases of discharges; and prohibit the discharge of, free oil, foam, floating solids, trash, debris, and toxic pollutants at higher than trace (detectible) amounts.

The recreational fishery trend data suggest the Gulf of Mexico appears to provide relative sustainable recreational fishing despite the heavy industrial, commercial, and recreational uses occurring. Although the ex-vessel value of commercial fisheries landings appears relatively stable from 1994 - 2013, commercial fisheries appear to be in a gradual decline in terms of pounds landed from 1994 - 2005. However, landings have remained stable or perhaps increased somewhat from 2005 to 2013.

There is no information indicating a need for altering the terms, conditions, or limitations of the draft individual permit. The existing provisions of the draft permit represent what EPA Region 4 considers a set of requirements that is highly protective of the marine resources of the Gulf of Mexico, including fish resources and EFH, the Gulf sturgeon, smalltooth sawfish, and Nassau grouper.

With the proposed permit provisions in place, drilling fluids and cuttings, WTCW fluids, and miscellaneous and other discharges may result in unavoidable, but local minor impacts to fish and EFH. Information on fish and EFH also is considered relevant to the Gulf sturgeon, smalltooth sawfish, and Nassau grouper; proposed Permit provisions that are intended to avoid or minimize potential impacts to other fish and EFH apply to these protected species. EPA Region 4 does not consider the potential impacts from the activities proposed under this EA to this resource to be significant based upon available scientific information. However, should EPA receive credible scientific evidence during the comment period that suggests otherwise, EPA Region 4 will consider this information prior to the issuance of our findings.

C.4.1 Birds

C.4.1.a Information Reviewed

EPA Region 4 considered the information in earlier NEPA reviews (EPA 1998a; 2004; 2009); new information on avian resources; and new information related to potential changes in avian resources resulting from the Deepwater Horizon event. Limited data indicate the Deepwater

Horizon event resulted in lethal effects on avian species, especially on seabirds whose range extensively overlaps that area in which the spill occurred. While bird resource impacts were observed a few months after the Deepwater Horizon incident, population-level effects have not been well documented. Recovery appears to be occurring over a timescale of several years (BOEM 2031a; 2015). There still exists considerable uncertainty over whether any latent impacts can be determined and currently available information is not sufficient to make a reliable determination about long-term or population-level impacts.

There are no new data related to avian resources, including the endangered piping plover and red knot, to document any changes in their condition that would require any additional requirements be incorporated into the provisions of the draft individual permit.

C.4.1.b Permit Provisions to Minimize or Eliminate Potential Consequences

EPA Region 4 is proposing a number of permit terms, conditions and limitations to avoid or minimize potential consequences on birds from discharges authorized under the draft individual permit. These include limitations on drilling muds and cuttings that limit water column and sediment toxicity, hydrocarbon content, trace metal content, maximum discharge rates, and a prohibition on mud components and discharges near sensitive areas. Miscellaneous wastes are limited through prohibiting discharge of free oil, floating solids, or domestic wastes within 12 miles of shore and comminution of domestic waste more than 12 miles from shore, a residual chlorine limit, BMPs for maintenance operation wastes; and chronic toxicity for miscellaneous discharges to which treatment chemicals have been added.

C.4.1.c Cumulative Impacts

Impacts to air and water quality, on which avian resources depend, represent small, incremental cumulative impacts (see Sections 4.2.1 and 4.2.3). EPA Region 4 is proposing numerous permit provisions intended to avoid or minimize potential adverse impacts to avian resources that cover all discharges authorized under the proposed Permit. These proposed permit provisions limit water column and sediment toxicity; limit the content of trace metal and organic pollutants associated with the liquid, suspended particulate, and solid phases of discharges; and prohibit the discharge of free oil, foam, floating solids, trash, debris, and toxic pollutants at higher than trace (detectible) amounts.

There is no information indicating a need for altering the terms, conditions, or limitations of the draft individual permit. The existing provisions of the draft permit represent what EPA Region 4 considers a set of requirements that is highly protective of the marine resources of the Gulf of Mexico, including avian resources, the piping plover, and the red knot.

With the proposed permit provisions in place, drilling fluids and cuttings, WTCW fluids, and miscellaneous and other discharges may result in unavoidable, but local minor impacts to avian resources. EPA Region 4 does not consider the potential impacts to this resource from the activities proposed under this EA to be significant based upon available scientific information. However, should EPA Region 4 receive credible scientific evidence during the comment period that suggests otherwise, EPA Region 4 will consider this information prior to the issuance of our findings.

Appendix A

Deepwater Horizon Event and Potentially Affected Environmental Resources in EPA Region 4 Jurisdictional Area Outer Continental Shelf Gulf of Mexico

United States Environmental Protection Agency

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Updated April 2016

Table of Contents

Table of Contents 3
List of Figures and Tables 4
Summary 5
Deepwater Horizon Impacts on Physical Resources 6
Water Quality 6
Sediment Quality 7
Air Quality 10
Coastal Barrier Beaches 10
Onshore Waste Management 11
Deepwater Horizon Impacts on Biological Resources 12
Marine Mammals 12
Sea Turtles 13
Fish and Essential Fish Habitat 15
Birds 17
Deepwater Benthic Communities 19
Live Bottoms 20
Seagrasses 21
Wetlands 23
Deepwater Horizon Impacts on Socioeconomic Resources 24
Commercial Fishing 24
Recreational Fishing 26
Human Health 27
Environmental Justice 30
References 33

List of Figures and Tables

Figure 1 USGS Sites Sampled in Response to the Deepwater Horizon Oil Spill 6

Figure 2 Annual Sea Turtle Strandings, Gulf of Mexico, 2007-2015 14

Figure 3 Larval Abundance of Epipelagic Fish 16

Figure 4 Percentages of Total Birds Recovered and Total Oiled Birds Following the Deepwater Horizon Oil Spill and Response.....18

Figure 5 Total Petroleum Hydrocarbons Levels in Marsh and Inlet Sediment Samples 21

Figure 6 Shoreline Erosion and Percentages of Vegetation Alive at Distance from Shore, Oiled and Reference Sites, 10/10-01/12 22

Figure 7 Fishery Closure Boundary in Response to Deepwater Horizon Event 28

Figure 8 Extent of the Deepwater Horizon Oiling, April 22, 2010 – August 21, 2010.....29

Figure 9 Seafood Sampling Sites, April 28, 2010 - March 31, 2011.....30

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Table 1 Minority Populations Near Disposal Sites 31

Summary

The incident at the Deepwater Horizon drilling platform (Macondo-1 well) in April 2010 created the largest oil spill in the history of the U.S., releasing approximately 4.1 million bbl of crude oil into the Gulf of Mexico. After 87 days of flow, the well was capped in July 2010. The Macondo-1 well site was approximately 145 kilometers from the Louisiana coast, located southwest of the mouth of the Mississippi River. The wellsite is located in an area under the NPDES administrative jurisdiction of EPA Region 6, and is 32 kilometers from the administrative boundary of EPA Region 4. The bulk of the oil was released off the coast of Louisiana, but eventually oil spread east of the mouth of the Mississippi River along the Mississippi, Alabama, and Florida coastlines, reaching Panama City, Florida.

The oil spill and response represented a major event that had the potential to affect the environmental conditions in the area covered under the proposed EPA Region 4 NPDES Permit for exploratory drilling and well completion operations for LLOG Exploration Offshore, L.L.C. The material presented in this appendix discusses recently available information on the impacts of the event on environmental resources in the Gulf of Mexico and the potential for these impacts to change the environmental conditions of these resources and render them more vulnerable to potential impacts resulting from discharges authorized by the proposed Permit.

Deepwater Horizon Impacts on Physical Resources

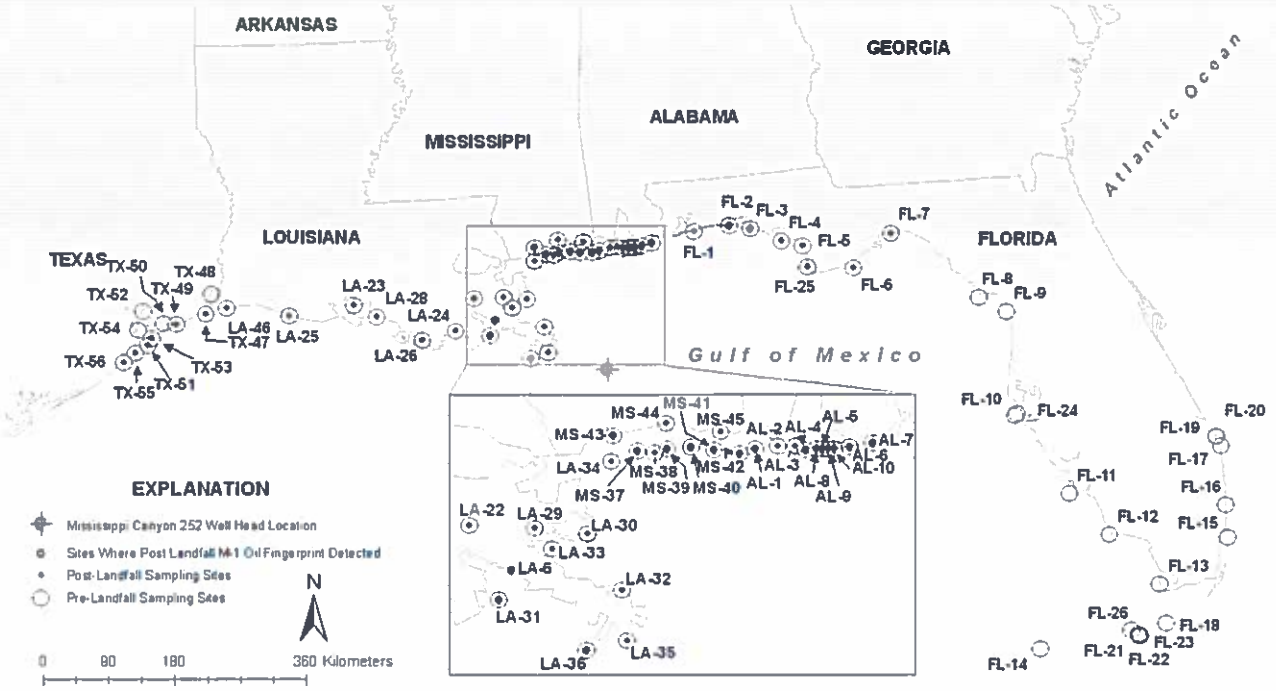
Water Quality

BOEM (2015b) re-examined the analysis for coastal and offshore water quality presented in its earlier NEPA documents (BOEM, 2012a; 2013a; 2014a) and concluded newly available information did not provide sufficiently compelling data that would change its environmental baseline for water quality to alter BOEM's conclusions in its earlier NEPA reviews.

Several studies, detailed below, have demonstrated the Deepwater Horizon incident adversely affected water quality, both at the spill site and in coastal waters from Louisiana to the Florida panhandle. These studies also support the relatively rapid return of water quality to near pre-spill conditions within a year for organic compounds. However, data on trace metals and other major elements were confounding and highly variable, with multiple aquatic life and human health exceedances in both pre-and post-spill surveys.

Coastal water samples at 70 sites from Texas to Florida were analyzed before (between May 7 and July 7, 2010) and six months post-landfall of Macondo-1 oil (October 4 to 14, 2010) (Figure 1; Nowell et al., 2011; 2012). High priority was given to coastal wetlands, Department of Interior lands at risk for oil contamination, such as NWR, Bureau of Land Management (BLM)

FIGURE 1 USGS SITES SAMPLED IN RESPONSE TO THE DEEPWATER HORIZON OIL SPILL



Source: Nowell et al., 2011; 2012

lands, National Seashore areas, and State Parks. Water samples were collected to represent surf and suspended-sediment conditions at the time of sampling. Samples were collected in water 0.6 to 0.9 meters in depth, from depths of 15 to 30 centimeters below the surface but at least 15 cm from the sea bottom to avoid collection of re-suspended bottom material.

In five post-landfall samples (four in Florida; one in Mississippi) toluene was the only organic with elevated levels). However, six trace metals or major elements were elevated in post-landfall samples. No samples exceeded aquatic benchmarks for human health for 11 organic contaminants with available benchmarks; only two elements had human-health aquatic benchmarks and neither was exceeded. Among 73 available aquatic life benchmarks, only one post-landfall sample from a South Pass/Mississippi River site had elevated levels of aromatic organics substances. However, for trace metals, chronic aquatic life benchmark exceedances occurred in pre-landfall samples in every state except Florida and all five states in post-landfall samples, including B (48 post-landfall samples); Cu (22 samples); Mn (12 samples); Ba (2 samples); and Pb, Ni, V, and Zn (1 sample each).

Total dissolved *n*-alkanes (C9 – C35) and PAH in suspended particulates from Macondo-1 oil were, respectively, some 10-fold higher in May samples than August samples in 2010 and 5-fold higher in May 2010 samples than May 2011 samples (Liu et al., 2014). The authors concluded surface waters were contaminated by the oil spill in May 2010, but rapid weathering and/or physical dilution had reduced hydrocarbon levels by August 2010. Their results are consistent to a degradation half-life of approximately 20 days for three Macondo-1 oil components (Zhou et al., 2013).

Seawater samples collected from April to July, 2010 by Sammarco et al. (2013) showed total petroleum hydrocarbons (TPH) levels peaked near Pensacola, Florida; a secondary peak occurred near Galveston but was not definitively shown to be from Macondo-1 oil. Two-, three-, and four-ring aromatic hydrocarbons showed a primary peak offshore Pensacola and a secondary peak south of the mouth of the Mississippi River. TPH and PAH levels were high with respect to human consumption and both chronic and acute marine biota (Sammarco et al., 2013), unlike levels previously reported that were below benchmark values (NOAA, 2010; Sammarco, 2010; Ylitalo et al., 2012: all as cited in Sammarco, 2013). The authors suggested the discrepancy between their data set and NOAA's could be from sampling equipment differences or from sampling a heterogeneous distribution of hydrocarbons.

Water quality impacts from hydrocarbons were closely monitored by NOAA, which issued 34 fishing closures in federal waters that peaked at some 230,000 square kilometers (37% of the Gulf), but were all cancelled by April 19, 2011 (NMFS, 2015d; NOAA, 2015b).

Based on the above water quality data, the acute water quality impacts of the Deepwater Horizon event appear to have been temporary. There is considerable uncertainty over whether any latent impacts (e.g., impacts to eggs or larvae) can be determined.

Sediment Quality

BOEM (2015b) re-examined the analysis for coastal and offshore sediment quality presented in its earlier NEPA documents (BOEM, 2012a; 2013a; 2014a) and concluded newly available

information did not provide sufficiently compelling data that would change the environmental baseline for sediment quality to alter BOEM's conclusions in its earlier NEPA reviews.

Studies have demonstrated organic and metal sediment chemistries were affected by the Deepwater Horizon event, with increased levels of contaminants observed on a time scale of at least years for both near coastal and deepwater environments. Data are not yet available to provide sufficient trend data from which recovery times could be determined or projected. Sediment toxicity data indicate sediments from coastal sites post-landfall may be slightly more toxic than seen in pre-landfall samples.

Sediment samples were collected from 70 inshore sites along the Florida, Alabama, Mississippi, Louisiana, and upper Texas coasts (Figure 3-16) in May and June 2010 before the Deepwater Horizon oil making landfall. Wet-sediment core samples were collected from a 2-square meter or larger area at the land/water interface (swash zone) on beaches and from bottom materials of streams that dissect wetland or marsh areas. For post-landfall samples, samples were collected from an area and at a depth horizon to which oil could have penetrated. Beach sediment samples were collected to a depth of 25 cm from the swash zone. Where possible, post-landfall sediment collection was conducted at a comparable stage of tide as the pre-landfall sample collection at the same site. Marsh sediment samples were collected from a depth of 10 to 15 cm in submerged sediment.

Comparing pre-spill sediment samples, with samples collected six months post-landfall, the concentrations in 20 of 49 organic analytes were significantly higher than in pre-spill samples; two analytes (naphthalene and oil and grease) had higher pre-landfall levels. The observed differences were not due to changes in sediment TOC. Post-landfall samples had a higher percentage that exceeded upper screening-value benchmarks than pre-landfall samples (37% versus 22%). However, there was no significant difference between pre- and post-landfall percentages of sediment samples that exceeded at least one benchmark value for organic contaminants (Nowell et al., 2011; 2012).

For alkylated PAHs with statistically higher concentrations in post-landfall samples, five coastal sites had the largest concentration differences (three in Alabama; one each in Louisiana and Mississippi). Diagnostic geochemical evidence in post-landfall sediment, tarballs, or both, indicated Macondo oil as contributor to PAH contamination at these five sites. In pre-landfall samples from these sites, the summed chronic equilibrium-partitioning sediment benchmark toxic-unit concentration (ΣESBTU) values for PAH mixtures resulted in no screening-level benchmark exceedances. However, ΣESBTU values from these five sites exceeded multiple upper screening-level benchmarks for total PAHs in six of seven samples, including at least one from each site (Nowell et al., 2011; 2012).

In pre-landfall samples, trace quantities of oil were detected at 45 of 69 nearshore, coastal waters sites in tar ball and sediment samples. Three different oil groups were identified, dispersed along the Gulf of Mexico coastline, but none correlated with the Macondo-1 well oil. Results at a site near Marathon, Florida, however, suggested some Macondo-1 oil may have

entered a loop current and been transported to the Florida Keys before the oil spill made landfall (i.e., "pre-landfall") along the northern Gulf coast.

In post-landfall sampling, Macondo-1 well oil was genetically linked with 11 of 49 sediment samples and 17 of 20 tarballs. None of the sediment hydrocarbon extracts from Texas correlated with Macondo-1 well oil. Oil-impacted sediments were confined to the shoreline adjacent to the cumulative oil slick of the Deepwater Horizon oil spill Louisiana, Alabama, Mississippi, and Florida, and no impact was observed outside of this area (Rosenbauer et al. 2010; 2011; and Wong et al., 2011).

A study of over 3,000 deepwater sediment samples collected at 534 sites around the Macondo-1 well site delineated a 3,200 km^2 area (equivalent to an approximate radius of 32 km) of sediment contamination from the Deepwater Horizon event that was estimated to represent 4% to 37% of the released oil. Results suggested a dual mode of deposition, one from an oil-rich layer of water impinging laterally on the continental slope at about 900 to 1,300 meters deep and a higher-flux, "fallout plume" from which suspended oil particles sank to sediments at 1,300 to 1,700 meters deep (Valentine et al., 2014).

In coastal sediments, a few trace and major elements showed significant differences in whole sediment between post-landfall and pre-landfall samples. Also, 40% of pre-landfall samples versus 57% of post-landfall samples exceeded empirical upper screening-value (i.e., probable-effect range) benchmarks. For the fine (< 63 µmeter) sediment fraction, concentration differences were insignificant. Lead and mercury were significantly higher in pre-landfall than post-landfall whole-sediment samples; authors noted differences in fine sediment levels could have contributed to this finding (Nowell et al., 2011; 2012).

Over a three-year time series at three deepwater stations, concentrations of redox sensitive metals (Cd, Mn, Re) changed, showing sediment Re levels had increased 3-4 times pre-spill values for the first two years, but had decreased in the third year (Hasting et al., in press).

Surficial sediment samples were collected from the 70 inshore sites along the Florida, Alabama, Mississippi, Louisiana, and upper Texas coasts (Figure 3-16) in May and June 2010 before the Deepwater Horizon oil making landfall (Biedenbach and Carr, 2011). Extended holding times and unacceptable temperatures during shipment resulted in 17 of those samples (representing 15 sites) meeting the criteria for quality control; therefore, only those 17 samples were tested in the pre-landfall sampling round. In October 2010, surficial sediment samples were resampled at 49 sites along the Gulf Coast. Despite variations in the sampling protocols between pre- and post-landfall, toxicity results are comparable as all tested samples were collected with inert materials and met the quality control criteria upon arrival at USGS.

Sediment toxicity was marginally affected based on pre- versus post-landfall sediment samples. Sediment fertilization toxicity was seen in 3 of 17 pre-landfall pore-water samples collected in each of the five affected states, although none were observed at below the detectable significance criteria (DSC) levels; 4 of 17 samples showed embryological sediment toxicity. Post-landfall analyses showed 3 of 49 samples exhibited fertilization toxicity and 6 samples exhibited embryological toxicity Biedenbach and Carr (2011).

Based on these sediment quality data, sediment quality impacts were observed a few months after the Deepwater Horizon oil spill; recovery appears to be occurring on a timescale of several years. Sediment toxicity shows no clearly quantifiable pattern, but appears to be spatially heterogeneous. The spatial extent appears to extend to some 40 km, but patchiness in the deposition of spilled oil confounds an effort to quantify reliably the magnitude of the impact. There is considerable uncertainty over whether any latent impacts (e.g., impacts to eggs or larvae) can be determined.

Air Quality

Air quality impacts, primarily localized, were observed as a result of the Deepwater Horizon event that persisted during the spill and response. Available data on the Deepwater Horizon event and current air quality data are sufficient to determine that impacts to ambient air quality ceased with the termination of the spill and response activities and are not expected to have any impact on the attainment status of current air quality resources in the Gulf area.

Coastal Barrier Beaches

BOEM (2015b) re-examined the analysis for coastal barrier beaches presented in its earlier NEPA documents (BOEM, 2012a; 2013a; 2014a) and concluded newly available information did not provide sufficiently compelling data that would change the environmental baseline for coastal barrier beaches to alter BOEM's conclusions in its earlier NEPA reviews.

Several studies examined the impact of the Deepwater Horizon event on beach microbial community structure and function. Oiling of beaches altered microbial community composition on a time scale of a few months; recovery to typical, if not identical, community composition appeared to have occurred within one to two years. PAHs were bioaccumulated in beach clams, but returned to pre-landfall levels within two years.

After oiling, changes in microbial communities of sandy beaches along the northwest coast of Florida showed a succession pattern from early populations that utilized aliphatic hydrocarbons to specialist populations that utilized aromatic hydrocarbons. Changes occurred within 3 months and lasted for up to one year following the oiling of beach sands, after which no oil was detected, and the population reestablished to typical, but different from pre-oiling, microbial beach communities (Rodriguez et al., 2015).

Pre-landfall sand microbial communities at two sandy Gulf coast beaches were typically fecal contamination-associated bacteria. After oiling, a significant shift occurred from fecal indicator taxa to taxa associated with open-water and marine systems similar to hydrocarbon degraders identified near the oil plume. Sand washing and tilling occurred on both beaches, and community changes also were correlated with sediment and grain size distributional changes (Engel and Gupta, 2014).

At two Louisiana beaches, the rate of biodegradation and microbial community composition varied with position relative to the tidal zone. The most efficient degradation occurred in supratidal samples and some intertidal, samples (Urbano et al., 2013). However, the intertidal

regime also was found to severely limit biodegradation of submerged oil mats (Elango et al., 2014).

From June through November, 2010, seven Gulf of Mexico beaches from Bay St. Louis, Mississippi, to St. George Island, Florida, had unique bacterial communities. Oiling increased the variability in community composition among all sequencing groups -- core, resident, and transient -- indicating community-wide impacts rather than an overprinting of oil hydrocarbon-degrading bacteria on the otherwise relatively stable sand communities (Newton et al., 2013).

Coquina clams from Florida panhandle beaches bioaccumulated PAHs (i.e., higher levels of PAHs relative to the sand substrate). PAH levels were highly variable but overall, decreased continuously to method detection limits in sand and clams, respectively, within one and two years after beach oiling (Snyder et al., 2015).

Based on these data, coastal barrier beach impacts were observed a few months after the Deepwater Horizon oil spill. Recovery appears to be occurring on a timescale of several years. However, available data are not sufficient to understand the potential long-term impacts to barrier beaches from the Deepwater Horizon event. There is considerable uncertainty over whether any latent impacts could be detected, and the data are insufficient to make a reliable determination about long-term impacts.

Onshore Waste Management

Collection and disposal of solid and liquid wastes from the Deepwater Horizon spill and response occurred under the direction and oversight of the Deepwater Horizon Unified Command. EPA worked with BP to identify landfills in the Gulf region that had appropriate design criteria and were legally permitted to receive the different types of waste generated from the spill and response. EPA and affected states reviewed the compliance history of each facility. BP's approved Waste and Material Tracking and Reporting Plan (BP, 2010) listed 20 landfills -- 3 in Mississippi, 13 in Alabama, and 4 in Florida -- that were approved to accept Deepwater Horizon wastes. In addition to state oversight and inspections, EPA conducted site visits to landfills twice each month.

Despite the large amount of wastes collected during the Deepwater Horizon event, the impact of these wastes for onshore waste management were negligible, based on a comparison of the amount of wastes generated to landfill capacity. As of November 28, 2010, the Deepwater Horizon solid wastes requiring onshore disposal totaled 89,202 tons; liquid wastes totaled 1,193,084 bbl (Kubendran, 2011), which assuming a 55-gallon drum and specific weight of 8.5 lbs/gallon, amounts a total of 278,883 tons.

Just considering waste capacity at one of the approved landfills, the Chastang Landfill in Alabama, the combined total of 368,085 tons represents 519 day-equivalents at the current disposal rate of 709 tons per day or 213 day-equivalents at the maximum permitted rate of 1,725 tons per day (Mobile County Solid Waste Disposal Authority, 2005). This one-time utilization amounts to 1.67% of the available Chastang landfill capacity. The Deepwater Horizon event had a negligible impact on available landfill capacity at just one landfill.

Deepwater Horizon Impacts on Biological Resources

Marine Mammals

The effect of the Deepwater Horizon event on marine mammals has produced confounding data on its potential impact. NMFS declared a UME for whales and dolphins in the Gulf of Mexico from February 2010, some three months prior to the Deepwater Horizon event. The UME is ongoing, has lasted far longer, and has seen many more strandings than any previous UME (NMFS, 2016). Persistent organic chemicals (POP; principally, pesticides and insecticides) also were potential contributors to the UME (Balmer et al., 2014). However, summed POP levels in 108 male dolphins did not differ significantly geographically, and overall POP levels were in the low-average range compared to previously reported levels for dolphins. Disease also was a potential contributor to the UME, and as of October 2015, a bacterial pathogen, Brucella, was positive or suspected positive in 68 of 210 dolphins tested.

Disease as a contributing factor was assessed. Venn-Watson et al. (2015a) compared post-Deepwater Horizon-exposed dolphins and a reference group of dolphins A low incidence of Brucellosis (7%) and morbillivirus (11%) infections were detected post-Deepwater Horizon, and biotoxin levels were low or absent, indicating infection was not a primary cause of death.

Bottlenose dolphins from heavily-oiled Barataria Bay were compared with oil–free dolphins from Sarasota Bay (Schwacke et al., 2013). The Barataria Bay dolphins had elevated occurrences of overall poor health and body condition, hypoadrenocorticism, and higher incidence of lung disease, which are uncommon effects consistent with petroleum hydrocarbon exposure. Bacterial pneumonia and thin adrenal cortices, which are rare, life-threatening, diseases consistent with exposure to petroleum compounds, were more likely in post-Deepwater Horizon dolphins, and elevated hydrocarbons were thought to contribute to dolphin mortalities.

Other environmental stressors also appear to have contributed to the UME and result in dolphin populations more vulnerable to effects from the event. Litz et al. (2013) reviewed data from multiple studies of UMES declared from 1990 -2014. (Hansen, 1992; Miller, 1992; Duignan et al., 1996; Colbert et al., 1999; Avens et al., 2012; Carmichael et al., 2012; USGS, 2013; as cited in Litz et al., 2013). Low temperature and low salinity were factors in six UMEs:

- 1990 – low temperature was determined to be a contributing factor the East Matagorda Bay, Texas, dolphin UME
- 1986-1990 -sea surface temperature was found to be inversely related to stranding in Texas
- 1992 - low salinity from heavy rainfall was determined to be a contributing factor in the Texas UME
- 2010 – in January, low air and water temperatures were determined to be causative in a severs sea turtle stranding event in Florida, including the Panhandle
- 2010 – increased dolphin strandings in Lake Pontchartrain from February to April occurred concurrently with lower than average salinity in the lake

- 2010 – early in the year, fish kills associated with cold water were reported in some bays, estuaries, and shallow water areas throughout the Gulf during early 2010
- 2011 – low temperatures and a large influx of freshwater from an unusually heavy snow pack was suggested as causative factors to dolphin mortalities in 2011.

Several authors have examined methodologies for assessing population level impacts. Williams et al. (2011) evaluated the methodologies that are used to assess potential cetacean population level impacts. Their analysis found that the estimated, historical carcass-detection rates for 14 cetacean species in the northern Gulf of Mexico represented only 2 - 6% of the estimated total population mortality. They concluded that failing to include an estimate of the carcass recovery rate would produce substantial underestimates of population effects. Using a statistical approach to estimating occupancy and number of manatees in Florida, Martin et al. (2014) estimated fewer than 2.4% of potentially affected manatee habitats may have been occupied, resulting in an upper estimate of 46 - 107 manatees affected by the Deepwater Horizon event.

In response to the Deepwater Horizon event, dispersants were used to break up oil slicks. The dispersants used in the response were later examined and found to be cytotoxic and genotoxic to sperm whale skin cells (Wise et al., 2014a). In addition, elevated Ni and Cr levels, which are known as genotoxic to sperm whales, were found in post-spill whale samples. How relevant these studies are to field impacts in not yet known.

EPA performed toxicity tests on Louisiana sweet crude (LSC) oil and a suite of dispersants, including Corexit 9500A, which was used in the Deepwater Horizon event response (Hemmer et al., 2010). Dispersant only, LSC only, and dispersant/oil mixtures were test using *Americamysis bahia*, an aquatic invertebrate, and *Menidia beryllina*, (inland silverside), a small estuarine fish. The concentration at which 50% of organisms exposed for 4 days to the test substances were estimated to survive (the 96-hour LC50) for Corexit9500A was some 15-fold less toxic than LSC only (LC50 = 42 ppm versus 2.7 ppm for mysids; LC50 = 130 ppm versus 3.5 ppm for Menidia). The Corexit 9500A/LSC mixture showed LC50s for mysids and Menidia, respectively of 5.4 ppm and 7.6 ppm. Thus, for both species, the Corexit9500A/LSC mixture reduced the 96-hour LC50 of the oil-only exposure by half. EPA results also indicated that none of eight dispersants tested, including Corexit 9500A, displayed biologically significant endocrine disrupting activity (EPA, 2010a).

Although the Deepwater Horizon event is likely involved, the relationship of potentially significant contributing factors to the marine mammal UME in the Gulf and its potential long-term effects on these populations is not known. The current status of bottlenose dolphins in the northern Gulf of Mexico is that several stocks appears to be under a stress or stresses that are not yet understood. These stocks (e.g., the Barataria Bay stocks) are primarily located west of the area of coverage of the proposed Permit.

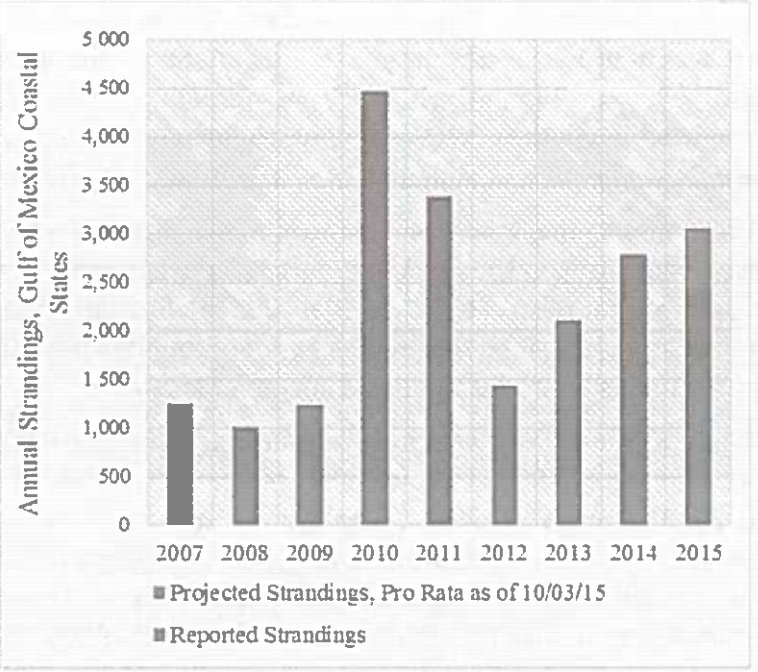
Sea Turtles

Kemp's ridley sea turtle nests increased exponentially from 1966 to 2009, when 19,163 nests were observed (Gallaway et al., 2013). In 2010, the number of nests declined to 12,377. The

number of nests appeared to rebound in 2011 and 2012, in which 19,368 and 20,197 were respectively observed. The authors indicated that the cause of the 2010 crash, and whether the number of nests will continue to increase, is not clear. During the spill and response, some 600 dead turtles were collected, of which 75% were Kemp's ridley turtles. Others have noted oil accumulated in sargassum mats, where young Kemp's ridleys tend to rest and eat (Ocean Conservancy, 2015).

The Sea Turtle Stranding and Salvage Network (STSSN) has documented large numbers of stranded sea turtles in the north-central Gulf of Mexico since 2010. The majority of these turtles have been endangered Kemp's ridleys, loggerhead, and green turtles. NOAA, with the STSSN and Gulf states is investigating many possible reasons for the increase, included: fishing; biotoxins, such as harmful algal blooms; and impacts from the Deepwater Horizon Event.

FIGURE 2 ANNUAL SEA TURTLE STRANDINGS, GULF OF MEXICO, 2007-2015



Source: NOAA Southeast Fisheries Science Center, 2015. http://www.sefsc.noaa.gov/stssnrep/SeaTurtleReportI.do?action=reportquery

The NOAA Southeast Fisheries Science Center (SEFSC, 2015) reported yearly strandings of sea turtles that were fairly stable from 2007 to 2009 (Figure 2). In 2010, a roughly four-fold increase occurred compared to pre-Deepwater Horizon event strandings. Strandings declined by two-thirds from 2010 to 2012, yet remained about twice as high as 2007-2009 strandings. Since 2012, strandings have steadily increased to about three times higher than pre-spill levels.

The timing of the spill and strandings pattern implicates the Deepwater Horizon event as a factor. Based on overall sea turtle annual stranding patterns, the overwhelming majority of Kemp's ridley turtles observed among collected dead turtles, and the dramatic decline in the number of their nests in 2010, inferentially it appears the Deepwater Horizon event may have had an acute impact on sea turtles. Nesting data suggest recovery may have occurred on a time scale of a year or two, but there are insufficient data to ascertain long term impacts beyond a few years.

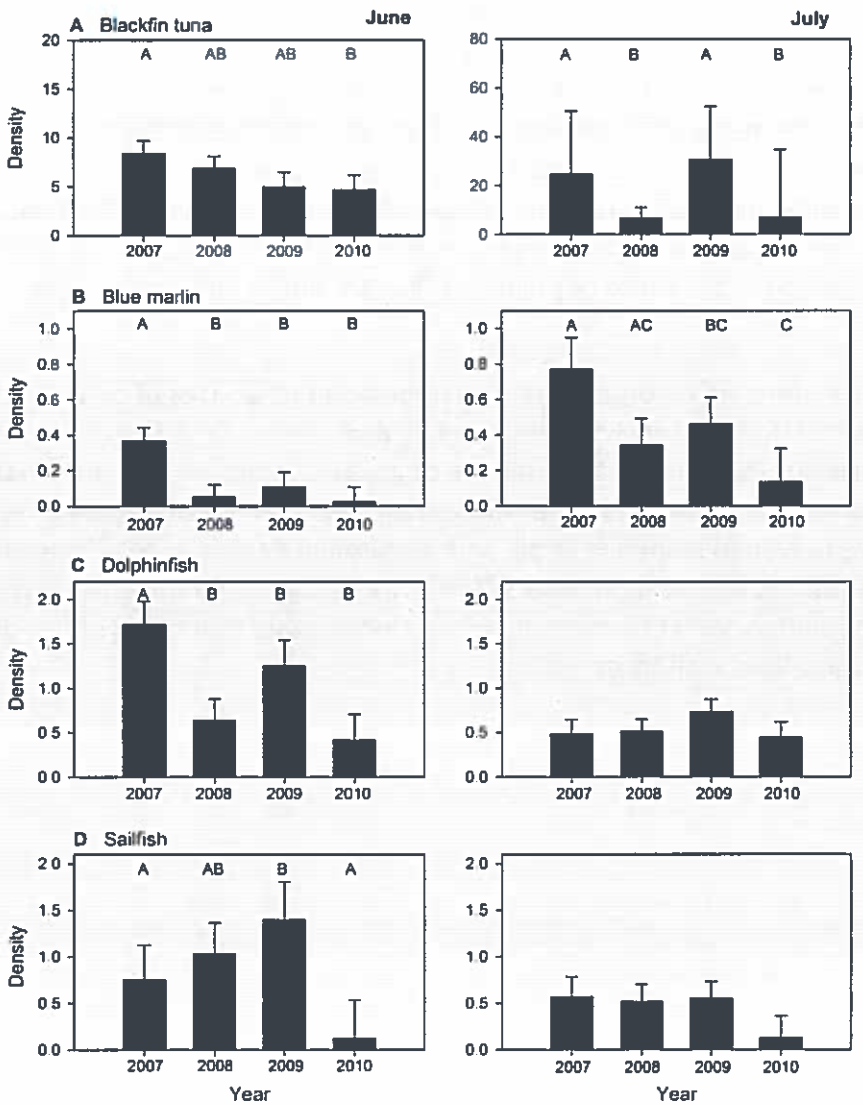
Strandings data are a source of concern with respect to long-term impacts of the spill, showing a quick decrease in the two years after the spill but a substantial increase over the following three years. Available data are not adequate to understand potential long-term impacts on sea turtles. However, as with the case of dolphins, there may be other natural and anthropogenic factors contributing as well. A substantial difficulty in determining a cause of death in sea turtles is most sea turtle carcasses wash ashore moderately or severely decomposed and provide little meaningful information. The current status of sea turtles is that the population appears to be under stress, and although the Deepwater Horizon event is likely involved, the relationship among potential contributing factors is not well understood. The current status of sea turtles suggest both the Deepwater Horizon event and other potential natural stressors, have resulted in sea turtle populations that are under increased stress.

Fish and Essential Fish Habitat

Studies conducted on organismal and population responses of estuarine fishes to the Deepwater Horizon spill were assessed by Fodrie et al. (2014). In ten of the organismal response studies reviewed, some type of positive (adverse) effect from the oil/dispersant exposure occurred. In six studies evaluating the response of populations, only one indicated a positive (adverse) response to oil, with a marginal decline in total catch numbers, although not within individual species numbers. The authors suggested the difference between organismal and population-level effects could result from factors that could either obscure or dampen population-level responses.

Larval abundance in 2010 for blackfin tuna, blue marlin, and dolphinfish generally were not significantly different from 2008 or 2009 (Figure 3). In contrast, sailfish larval abundance was not significantly different from 2007 (Rooker et al., 2013). Modeling and electronic tag data indicated the spill area coincided with areas used by adult blue marlin over the previous three years, although the occurrence of blue marlin in the spill area was noted as lower in 2010 than in previous years.

FIGURE 3 LARVAL ABUNDANCE OF EPIPELAGIC FISH



Source: Rooker et al., 2013

Juvenile coastal fish recruitment into the seagrass beds along the northern Gulf of Mexico from the Chandeleur Islands, Louisiana to St. Joseph Bay, Florida was examined by Fodrie and Heck (2011). Based on data from 853 trawls from July to October, 2006 through 2010, overall catch rates and CPUE of the most abundant species were consistently higher in 2010 than 2008 or 2009 and, in some areas, higher than all previous years. Twelve of the 20 most abundant taxa showed statistically higher catch rates in 2010; pre- and post-spill catch rates for remaining taxa were statistically indistinguishable.

A study of juvenile and adult marsh fish assemblages collected two and three years after the Deepwater Horizon event collected in Caminada, Terrebonne, and Barataria Bays, Louisiana,

found there were no significant differences in abundance or species comparisons between oiled and unoiled sampling sites in marsh habitats (Able et al., 2014).

A modeling study assessed the potential loss of bluefin tuna larvae from the Deepwater Horizon event and its potential population impact (Atlantic Bluefin Tuna Status Review Team, 2011). The estimated loss of larvae was about 20%, which resulted in less than a 4% reduction in spawning biomass, based on historical catch rates; this estimate did not account for any loss of adults to oil toxicity.

An oyster reef restoration project along the Alabama coast showed marshes subject to light oiling had a significant reduction in recruitment of transient species to coastal nursery habitats between 2009 and 2010, but appeared to return to pre-Deepwater Horizon event levels from 2011 through 2012 (Moody et al., 2013).

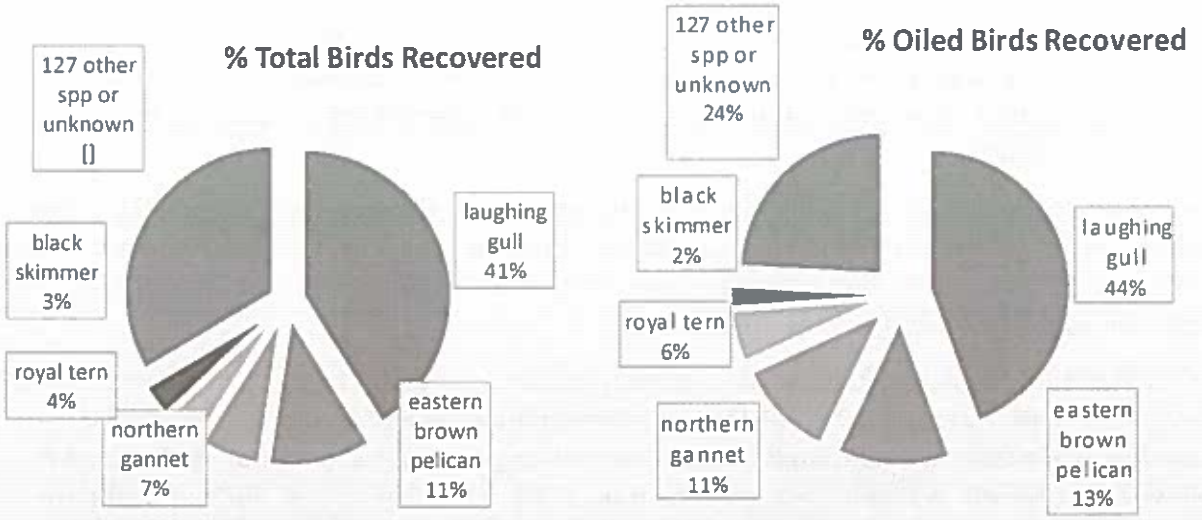
BOEM (2015b) re-examined its analysis for fish resources and EFH presented in its earlier NEPA reviews (BOEM, 2012a; 2013a; 2014a) and reviewed new, available information. BOEM concluded available information is incomplete and long-term effects cannot yet be known. However, currently available data indicate impacts from the Deepwater Horizon event are largely indistinguishable from natural variability or other anthropogenic (human-caused) activities and do not indicate significant population-level effects have occurred.

Limited data indicate sublethal effects on embryos, juvenile, and adult fish may have occurred from the Deepwater Horizon event. However, field studies either have not discerned any oil spill-related impacts or, if such impacts occurred, affected populations appear to have recovered within a few years of the spill. Combined with commercial and recreational fish data (Chapter 3.6.3.1 and 3.6.3.2, below), it appears any Deepwater Horizon event impacts may have been transient. However, impacts that have not yet been expressed in present fish populations cannot be discounted, e.g., differential age-class impacts that have yet to be observed. While the available data suggest there has been no major impact thus far on fish populations in the Gulf, the current information is not sufficient to make a reliable determination about long-term impacts.

Birds

BOEM (2015b) re-examined the analysis for birds presented in its earlier NEPA reviews (BOEM, 2012a; 2013a; 2014a) and reviewed newly available information. BOEM acknowledged there still is incomplete or unavailable information relevant to assessing the impacts of the Deepwater Horizon event on birds.

FIGURE 4 PERCENTAGES OF TOTAL BIRDS RECOVERED AND TOTAL OILED BIRDS FOLLOWING THE DEEPWATER HORIZON OIL SPILL AND RESPONSE



Source: FWS, 2011

As of May 12, 2011 as part of the FWS post-Deepwater Horizon event monitoring and collection process, 7,258, individual birds representing 132 different species/groups (104 identified species and 28 unidentified groups) were collected (FWS, 2011). More birds were recovered that were not oiled than birds that were oiled or of an unknown status (36.7% oiled; 46.7% unoiled; 16.9% unknown oiling). The five species most-impacted by the spill, based on the percentage of oiled versus un-oiled birds, were all representatives of the seabird group: laughing gull (1,182/2,981); Eastern brown pelican (339/826); northern gannet (297/475); royal tern (149/289); and black skimmer (55/253). The percentages of total birds that were recovered and total oiled birds are shown in Figure 4. All species listed above, except the northern gannet, have representative breeding populations in the northern Gulf of Mexico (Hunter et al., 2002, 2006; FWS, 2010d).

Population effects on seabirds affected by the 'persistent' Deepwater Horizon event and the 'rapid' 1989 Exxon Valdez spill were compared in Belanger et al. (2010). The study assessed live and dead bird collections on Days 38 - 110 and Days 110 - 138 of the Deepwater Horizon event and total live and dead birds from Deepwater Horizon and Exxon Valdez events. The average dead bird collection from Days 38 - 138 increased significantly (from 48.2/day to 63.2.day) while the average collection of live birds significantly decreased (from 20.8/day to 7.1/day).

The authors found the Exxon Valdez spill yielded 1,630 live birds (4.7%) and 35,000 dead birds while the Deepwater Horizon spill, some five-fold larger than the Exxon Valdez spill, yielded 2,080 live birds (26.9%) and 7,726 dead birds. The conclusion that a 'persistent' spill affected fewer birds than a 'rapid' spill was one of multiple reasons that could account for the lower numbers collected during the Deepwater Horizon event, e.g., the shift in live verses dead birds, the mode of collection, and lack of experienced collection personnel. The study also suggested

any response effort should entail a response surge as early as possible to collect and rehabilitate any live seabirds rather a drawn out continuous response effort.

Based on these recent studies on the impact of the Deepwater Horizon event on bird populations, limited data indicate lethal effects occurred to avian species, especially on seabirds whose range extensively overlaps that area in which the spill occurred. There is considerable uncertainty over whether any latent impacts can be determined. The currently available information is not sufficient to make a reliable determination about long-term or population-level impacts.

Deepwater Benthic Communities

BOEM (2105b) re-examined its analysis for deepwater benthic communities in its earlier NEPA reviews (BOEM, 2012a; 2013a; 2014a) and reviewed new data. BOEM noted the patchy distribution of chemosynthetic communities throughout the Gulf would minimize the proportion of communities potentially affected by any single event (BOEM, 2015b). BOEM also noted that although ongoing research projects are investigating these impacts, long-term effects may not yet be detectable and necessary information may not be obtained and available for years.

Sediment and biota samples from 170 stations, of which 68 were located 0.5 - 125 kilometers from the Macondo-1 wellhead, showed strong and moderate chemical impacts clustered mostly near the wellhead (Montagna et al., 2013). The most severe reduction of faunal abundance and diversity extended to 3 kilometers from the well in all direction; moderate impacts extended 8.5 kilometers to the NE, 17 kilometers SW, and 37 kilometers SW of the wellhead. There was no correlation to distance from natural oil seeps.

Impact of the Deepwater Horizon event on 11 deepwater coral community sites were examined 3 to 4 months after the well was capped and at 7 sites previously visited in September 2009 (White et al., 2012). Healthy coral communities were observed at all sites >20 kilometers from the well. At a site 11 kilometers SW of the well, of 43 coral images at the site, 23% of the images showed impact to more than 90% of the colony; 46% of the images exhibited evidence of impact on more than half of the colony; and 85% of the images exhibited some indication of impact. Hopanoid petroleum biomarkers isolated from a brown flocculent material (floc) covering coral indicated the material contained oil from the Macondo-1 well.

The effect of the floc on a deepwater coral community located 11 kilometers SW of the wellhead was examined during 5 trips over 17 months beginning on November 3, 2010 (Hsing et al., 2013). About 6 weeks after the initial cruise, on the second trip, hydroid colonization was present. Floc was absent after the third trip in March 2011. The authors noted impacts were patchy, suggesting constituents in the floc may not be homogenous. Hydroid colonization showed a significant positive correlation with the proportion of the coral initially showing visible impact. The apparent recovery of affected branches by March 2012 was inversely proportional to the level of initial impact to the colony.

Seafloor surveys deepwater corals were conducted by Fisher et al. (2014) after the Deepwater Horizon oil event. At one site within 6 kilometers SE of the wellhead over 90% (63/68) of the

coral showed signs of recent stress; a site 13 kilometers SSW of the wellhead showed 72% (39/54) of corals with signs of stress; and a site 22 kilometers ESE from the wellhead showed stressed corals were 23% (7/30) of those assessed. At sites 10 - 19 kilometers from the wellhead, low levels of stress were noted (5 - 20% of corals affected). Deepwater Horizon event impacts on deepwater coral communities appeared to be very heterogeneous.

Radiocarbon dating to determine the approximate age and growth rates of corals potentially impacted by the Deepwater Horizon event (sampled in 2010 and 2011) found the oldest corals within 11 kilometers of the oil spill were over 600 years old with radial growth rates between 0.34 - 14.20 µmeters/year (Prouty et al., 2014).

Based on these studies, the Deepwater Horizon event appears to have had serious adverse effects on deepwater coral, which are long-lived and slow growing. Deepwater Horizon impacts extend some 40 kilometers from the wellhead, but the impact pattern is very heterogeneous. Benthic surveys document multiple deepwater coral communities that were unaffected by the spill and some degree of recovery appeared to occur over a few years.

Although knowledge is limited, seriously affected coral do not appear to be common beyond 10 to 20 kilometers or so, except along transects aligned with predominant currents and bathymetry. The studies presented in this EA present knowledge of the immediate impacts to deepwater coral communities, but little understanding of 'long-term' impacts for communities that have existed for 460 to 600+ years (Prouty et al., 2014).

Based on these recent studies on the impact of the Deepwater Horizon event on deepwater coral communities, the limited data indicate the Deepwater Horizon incident has had significant adverse effects on certain deepwater coral communities. However, the impacts also appear to have occurred heterogeneously and, at most, within about 40 kilometers of the Macondo-1 wellhead. At this time the data are insufficient to make a reliable determination about long-term impacts.

Live Bottoms

BOEM (2015b) noted that the Pinnacle Trend feature nearest the Macondo-1 wellhead is approximately 60 kilometers to the north, and the highest concentration of Pinnacle features is 100 kilometers to the northeast. Documented benthic impacts northeast of the wellhead have not extended beyond 8.5 kilometers, far from the nearest low relief feature. The greatest impacts have been noted in the general direction nearly directly opposite that of Pinnacle Trend or live bottom, low relief habitats.

Investigations of deepwater corals following the Deepwater Horizon event indicate the distance to which observable impacts have been documented is determined by prevailing currents and bathymetry. Substantial chemical impacts, in all directions, appear to be found within 3 kilometers of the wellhead; moderate chemical impacts were noted 8.5 kilometers NE of the wellhead.

Coral impacts have not been documented far north of the Deepwater Horizon well. Substantial impacts were observed at communities 6 kilometers SE, 11 kilometers SW, and 13 kilometers

SSW from the wellhead and moderate impacts noted 22 kilometers ESE and 37 kilometers SW from the wellhead. However, other sites beyond approximately 20 kilometers showed low or no impacts. Impacts to deepwater communities appears to be highly heterogeneous.

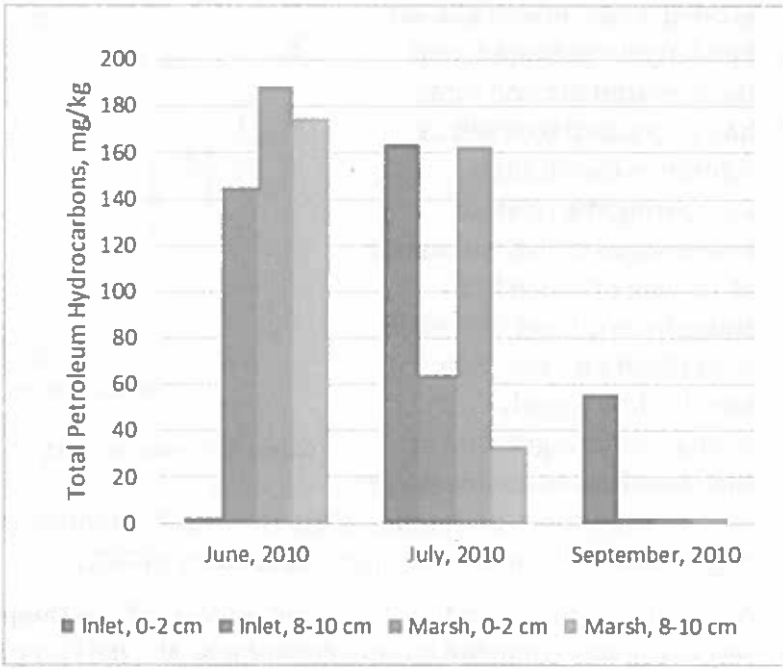
Based on studies on the impact of the Deepwater Horizon event, data indicate impacts from the Deepwater Horizon event have not extended to low relief, live bottom communities in the northern Gulf of Mexico (BOEM, 2015b). At this time the data are insufficient to make a reliable determination about long-term impacts.

Seagrasses

Microbial communities during and after the influx of petroleum hydrocarbons in a Gulf of Mexico coastal salt marsh on the eastern side of the Point Aux Pins peninsula, southwest of Bayou La Batre, Alabama were examined following the Deepwater Horizon oil spill (Beazley et al., 2012). Sediment cores were collected within the marsh stands ('Marsh' samples), in approximately 1 meter of water, 2 - 4 meters from shore outside the rush stand ('Shore' samples), and approximately 25 meters from the shore ('Inlet' samples).

Total hydrocarbon concentrations in salt marsh sediments were highest in June and July 2010 and decreased by September 2010 (Figure 5). Values were based on two or three replicates; the data show trends that generally indicated, with the exception of surficial inlet sediment, TPH levels were highest in June 2010 and fell to below detection by September 2010. For surficial inlet sediment, the limited data suggest a delayed process, with higher levels in July that decreased 66% by September (compared to the subsurface sediment decreasing by 56% between June and July, 2010).

FIGURE 5 TOTAL PETROLEUM HYDROCARBONS LEVELS IN MARSH AND INLET SEDIMENT SAMPLES



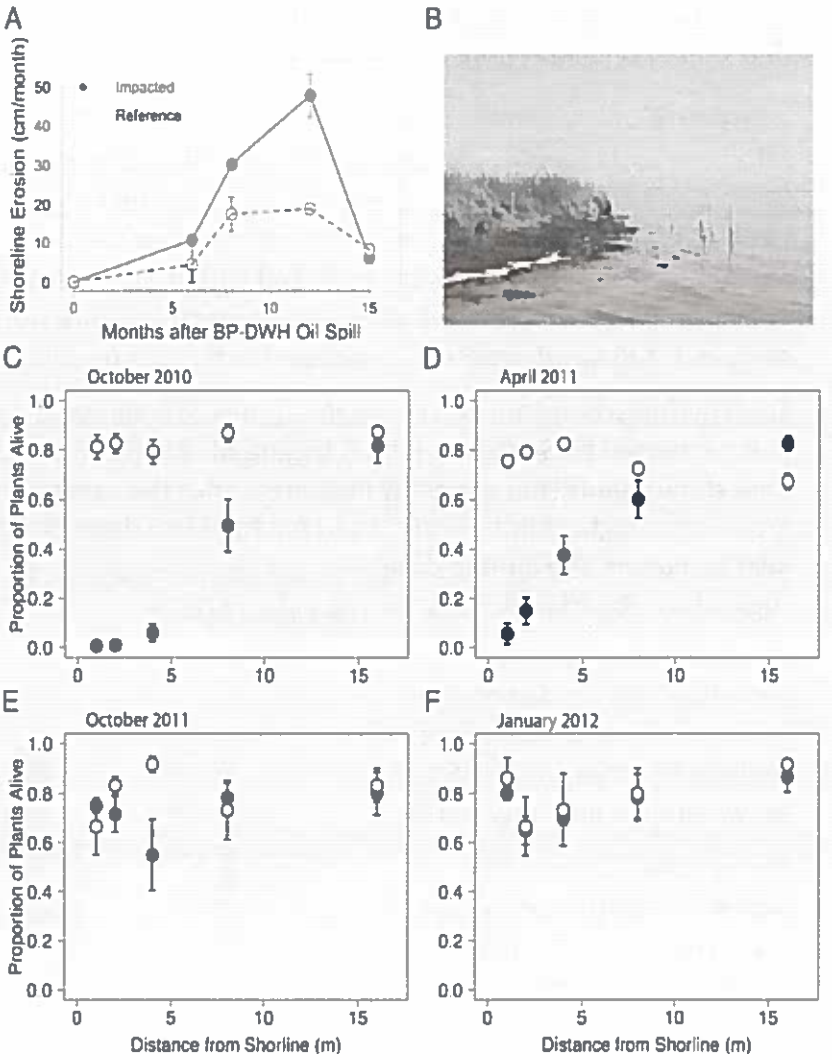
Source: Adapted from Beazley et al., 2012

The relative richness and abundance of the extant salt marsh hydrocarbon-degrading microbial community increased in hydrocarbon-contaminated sediments, then decreased once hydrocarbons fell below the detection limit. Functional genes involved in hydrocarbon degradation behaved similarly, enriched in hydrocarbon-contaminated sediments then declined once hydrocarbon concentrations decreased. A greater decrease in hydrocarbon levels in marsh grass sediments compared to inlet sediments

(lacking marsh grass) suggested the marsh rhizosphere microbial communities could also contribute to hydrocarbon degradation.

Salt-marsh recovery (high resilience) and permanent marsh area loss after the Deepwater Horizon oil spill in Barataria Bay, Louisiana were reported on by Silliman et al. (2012). The authors found oil coverage primarily concentrated on the seaward edge of marshes and thresholds of oiling were associated with the severity of salt-marsh damage. Oil-related plant death on the edges of the marshes more than doubled shoreline erosion that likely will be permanent. After 18 months, in previously oiled but non-eroded areas, marsh grasses had largely recovered, and the elevated erosion rates had decreased to levels at reference marsh sites. Comparing the relative percentages of live vegetation at varying distance from shore from oil and reference sites (Figure 6), the clear trend is from nearly extinguished vegetation at the shoreline, to no impact 15 meters from shore in October 2010, to virtually identical percentages of live vegetation regardless of distance from shore by January of 2012.

FIGURE 6 SHORELINE EROSION AND PERCENTAGES OF VEGETATION ALIVE AT DISTANCE FROM SHORE, OILED AND REFERENCE SITES, 10/10-01/12



Source: Silliman et al., 2012

An extensive review of the status and impacts of the Deepwater Horizon event on coastal resources was compiled by Mendelssohn et al. (2012). Approximately 430 miles of marsh shorelines were oiled, with 176 miles either heavily or moderately oiled. Most of the oil from the oil spill that reached coastal marshes had been extensively weathered and marsh shoreline, generally not marsh interior, were primarily exposed to weathered oil. The primary marsh types

affected were salt marshes; low- to intermediate- salinity marshes, and mangroves located on small islands and shorelines and as scattered stands within salt marshes.

Findings for the salt marshes in the Bay Jimmy area of northern Barataria Bay, Louisiana documented variable impacts depending on oiling intensity and species exposed. Thus, near complete mortality of the two dominant species were noted along heavily oiled shorelines. However, moderate oiling had no significant effect on *Spartina*, despite significantly affecting biomass and stem density of *Juncus*. As of fall 2011, many of the most heavily oiled shorelines had minimal to no recovery, and it is uncertain if natural re-vegetation can occur before shoreline erosion occurs. However, two years post-spill, some recovery had been noted, such as new shoots from oiled nodes on the stems and *Spartina* regenerated from rhizomes along moderately and some heavily oiled shorelines throughout Louisiana.

Although data on the impact of the Deepwater Horizon event on seagrasses are limited, based on the information discussed above, it appears the Deepwater Horizon event produced impacts commensurate with the amount of oiling that occurred in seagrass communities. Heavily oiled marshes were nearly completely devoid of live vegetation; whether these areas would re-vegetate before they erode is uncertain. Moderate to light oiling, however, resulted in relatively minor impacts and evidence of recovery to complete recovery appears within a few years. Longer-term impacts will take years of data collection and analysis before reliable assessments of impact are possible.

Based on these recent studies on the impact of the Deepwater Horizon event on seagrass communities, the limited data indicate the Deepwater Horizon event had significant adverse effects on certain seagrass communities. However, it is yet unclear whether heavily oiled areas will regenerate or be lost to erosion, in the relative short-term, and areas subject to moderate and light oiling appear capable of recovery.

Wetlands

Ten *Spartina* marshes were sampled in Louisiana in 2010 and 2011 after they were oiled by the Deepwater Horizon oil spill (McCall and Pennings, 2012). Abiotic conditions and plant variables were similar between oiled and non-oiled sites. *Spartina* leaf nitrogen content was higher in oiled sites and slightly higher in 2010 than 2011; *Littoraria* was unaffected by oil or sampling year. The density of crab burrows was higher in control sites and higher in 2011 than 2010. The terrestrial arthropod community was suppressed by 50% at oiled sites in 2010, but largely recovered in 2011. The authors reported similar patterns for five feeding guilds - predators, sucking herbivores, stem-boring herbivores, parasitoids, and detritivores tended to be suppressed at oiled sites by 25% to 50% in 2010 and had recovered in 2011. The authors offered that wetland vegetation may be less sensitive to oiling than fauna, which may be suppressed where plants show no visual signs of impact.

The utilization of salt-marsh habitats by transient and resident nekton was compared before and after the Deepwater Horizon event by Moody et al. (2013). They did not find significant differences in the recruitment of marsh-associated nekton in coastal Alabama following the spill, and they found little evidence for severe acute or persistent oil-induced impacts. The

authors also found recruitment of many species of invertebrates in an Alabama marsh was not negatively affected by the event.

Advanced Visible Infrared Imaging Spectrometer (AVIRIS) data from Barataria Bay in September 2010 and August 2011 was used to map oil contamination and to examine the impacts to vegetation (Khanna et al., 2013). Vegetation stress was highest at the shoreline, decreasing with distance from the water line to some 14 meters inland in 2010. The study found varying degrees of re-vegetation in 2011, with the poorest recovery adjacent to shorelines which had displayed the greatest oil stress.

A review of 32 oil spills and field experiments found many cases where recovery of marshes occurred within one to two growing seasons, even without treatment (Michel and Rutherford, 2014). Recovery was shortest for spills in a warm climate, light to heavy oiling of the vegetation only (not the marsh surface), medium crude oils, and less intensive treatment.

BOEM (2015b) has noted a large body of information regarding impacts of the Deepwater Horizon event upon coastal wetlands is being developed through the NRDA process. BOEM concluded from the available evidence that following initial impacts from an oil spill, wetland recruitment and recovery appear to begin within a year.

Data on the impact of the Deepwater Horizon event on wetlands are limited but indicate the Deepwater Horizon event has had adverse effects on oiled wetlands and that recovery appears to be occurring within a few years. However, at this time data are insufficient to make a reliable determination about long-term impacts.

Deepwater Horizon Impacts on Socioeconomic Resources

Commercial Fishing

Potential negative economic effects of the Deepwater Horizon event on commercial and recreational fishing, as well as mariculture in the U.S. Gulf area, was estimated by computing potential losses throughout the fish value chain (Sumaila et al., 2012). The authors stated estimates of loss in commercial, recreational, and mariculture fisheries are dependent on the combination of initial mortality of fish species due to the oil spill as well as the continued economic unmarketability that can result when consumers believe marine products from the Gulf are less desirable because of real or perceived pollutants.

The authors estimated the potential losses in total revenues, total profits, wages, number of jobs, and economic impact throughout the wider economy. Conservative estimates of the economic effects of the oil spill consider market recovery time rather than longer ecological recovery time horizons. The authors stated the total revenue is the product of ex-vessel price and catch in the case of commercial fisheries; the total expenditure in the case of recreational fisheries; and the product of ex-farm price and production quantity in the case of mariculture. The added value or impact through the fish value chain includes indirect economic effects of fisheries and mariculture (e.g., boat building or maintenance, equipment supply, and the restaurant demand).

The authors estimated the value of total revenues that would be lost in the commercial fishing sector due to the Deepwater Horizon event (over the seven years following publication of the study) to be in the range of $0.5 - $2.7 billion. The equivalent losses in total profits, wages, and total economic impact are estimated at $0.3 - $1.4 billion, $0.1 - $0.8 billion, and $1.5 - $8.4 billion, respectively.

The largest losses would be incurred among fishermen targeting crustaceans such as shrimp, who would experience nearly 85% of the total estimated economic impact (Sumaila et al., 2012). In addition, between 5,000 and 9,000 jobs may be lost by commercial fisheries in the U.S. Gulf region. For the three mariculture states, Florida, Alabama, and Louisiana, the authors calculated the total loss in revenue as $94 - $157 million, with an economic impact of about $293 - $488 million. The authors estimate a loss of $44 - $73 million in total profit and $19 - $31 million in wages. The sector may lose well over 210 jobs, both full- and part-time. Overall, the majority of economic losses will occur in oyster mariculture.

Yearly commercial industries landings for finfish and shellfish indicate impacts of the Deepwater Horizon event are complex (Table 3-12; NMFS, 2015g; 2015i). On a Gulf-wide basis, data indicate there was a 20 - 25% decrease in total, shellfish, and shrimp landings between 2009 and 2010. From 2001 to 2013, total landings varied from 87% - 110% of 2009 landings while shrimp landings remained depressed, ranging from 82% - 88% of the 2009 catch. However, the Gulf-wide ex-vessel values of the total, shellfish, and shrimp catch tell a different story. From 2010 to 2013 the total landings were valued at 99% - 147% of the 2009 value; the value of shrimp landings ranged from 103% - 156% of the 2009 value. Thus, while landings were depressed following the Deepwater Horizon event, the value of the Gulf fisheries were unaffected or increased.

However, the narrative of Gulf-wide impacts does not reveal that state-wide impacts were highly variable. Gulf-wide statistics notwithstanding, Alabama and Mississippi bore the brunt of Deepwater Horizon commercial fishery impacts. For example, the west coast of Florida and Texas had slight decreases in 2010 landings but had increased ex-vessel values of their total and shrimp fisheries that ranged from 118% - 132% of 2009 values. However, impacts in Alabama and Mississippi were markedly different, showing 2010 total and shrimp landings were decreased by 50% - 60% and ex-vessel values decreased to 58% - 68% of their 2009 values, amounting to losses of some $13 - $16 million dollars in ex-vessel fisheries values in Alabama and Mississippi in 2010. There were no estimates of CPUE associated with any of these landings data to better evaluate potential impacts of the Deepwater Horizon event.

BOEM (2015b) concluded that detailed information on species found in the Gulf of Mexico continues to be developed and serves to support a baseline for determining potential impacts. Morphological defects, reduced cardiac efficiency, and decreased swimming performance may result in reduced feeding success and increased susceptibility to predation, and BOEM assumed that early life stage acute exposure to oil results in decreased survival to maturity. Without knowing the extent to which spawning overlapped spatially and temporally with waters contaminated by the 2010 Deepwater Horizon event, it is difficult to estimate the potential impacts to pelagic species.

In the absence of additional information, BOEM (2015b) conservatively assumed near 100% mortality among exposed embryonic fishes. This assumption aligns with the NMFS status review team report in assuming a maximal reduction of 20% to the bluefin tuna 2010 cohort as a result of the Deepwater Horizon event and estimating a less than 4% reduction in future spawning biomass (Atlantic Bluefin Tuna Status Review Team, 2011).

BOEM (2015b) re-examined the analysis for commercial fisheries presented in its earlier NEPA reviews (BOEM, 2012a; 2013a; 2014a) and reviewed newly available information. BOEM acknowledged that incomplete or unavailable information remain, including information on potential impacts to embryonic pelagic fishes. BOEM noted recent studies suggesting fishes recruited near the time of the Deepwater Horizon event may not have suffered catastrophic losses (Fodrie and Heck, 2011; Atlantic Bluefin Tuna Status Review Team, 2011; NMFS, 2013; Rooker et al., 2013). BOEM (2015b) noted existing information supports commercial fishing as acutely affected, and having experienced significant adverse impacts from the event but acknowledged long term effects remain unknown.

Based on the above information on impacts to fishes and the available annual data on commercial (and recreational) landings, the short-term impact of the Deepwater Horizon event on commercial fishing appears to largely be restricted to the closures of fishing areas during the active oil spill and for several months thereafter. Landings data do not indicate the event had a catastrophic impact on commercial fishing. However, at this time data are insufficient to make a reliable determination about long-term impacts.

Recreational Fishing

Data on recreational fisheries were presented in Table 3-15. There was a 5% - 7% decrease in recreational anglers and trips in 2010, perhaps due to NOAA closures, but the values have increased each year and in 2012 there were more anglers taking more trips than in 2009. Unlike commercial fisheries impacts, Alabama and Mississippi did not show any greater impact from the Deepwater Horizon event. To the contrary, these states showed level or increased angler participation, while Florida showed a 7% - 9% decrease in angler participation and trips.

Impacts to the recreational fishing industry may be determined by the ability of people and businesses supporting the industry to withstand the impacts of the spill in certain areas BOEM (2013a). Approximate two-thirds of the Gulf remained open to fishing in the months after the spill, but a number of fishermen in affected areas were idled directly after the spill. Louisiana officials opened a number of areas to recreational fishing in mid-July 2010 (Federal Reserve Bank of Atlanta, 2010). Also, a number of people were supported over the short term by BP claims and by the Vessels of Opportunity Program, receiving approximately $740 million in compensation payments and more than 30,000 claims as of February 10, 2012 (Gulf Coast Claims Facility, 2012). The success of government policy initiatives also will affect this outcome, such as Louisiana's receipt of $78 million from BP to monitor seafood and to promote tourism. BOEM (2015b) re-examined the analysis for recreational fisheries presented in its earlier NEPA reviews (BOEM, 2012a; 2013a; 2014a) and newly available information and found no new significant information that changed its prior assessments on recreational fishing impacts.

Relevant information related to recreational fishing can also be found in Sections 3.3.3 and 3.4.2 of this EA. Based on this information on fishes and fisheries and available annual data on recreational seafood landings, the short-term impact of the Deepwater Horizon event on recreational fishing appears to largely be restricted to the closures of fishing areas during the active oil spill and for several months thereafter. Data on the impact of the Deepwater Horizon event on recreational fishing are more complete than for many other potentially affected resources and suggest that short-term impacts on recreational fishing were limited. Longer-term impacts may yet become apparent, e.g., differential age-class impacts, and at this time, data are insufficient to make a reliable determination about long-term impacts.

Human Health

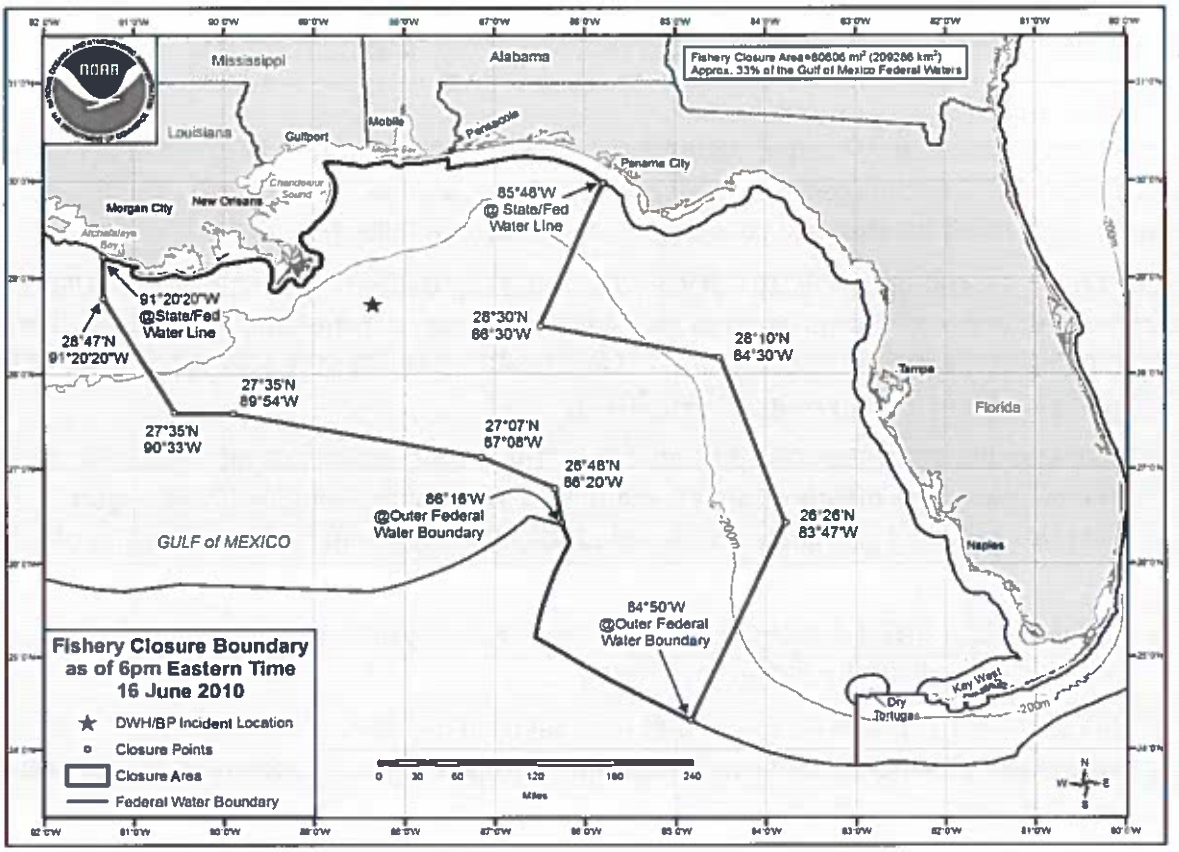
After the Deepwater Horizon event, NOAA Fisheries Service instituted fishery closures to ensure public safety. Closures changed in response to the plume, and on June 16, 2010, the fishery closure area reached the greatest coverage at 80,806 square miles (Figure 7).

A multi-agency Operational Science Advisory Team (OSAT), under the direction of the USCG, was convened to provide information to help guide response activities and to provide a better understanding of the potential environmental and health risks after the spill. A summary of the OSAT findings include the following (OSAT, 2014):

- In December 2010, OSAT-1 concluded that "there is no actionable oil or sediments in the deepwater or offshore zones." In addition, none of the roughly 17,000 water samples collected and analyzed exceeded the EPA's benchmarks for protection of human health.
- In July 2011, OSAT-1 Addendum stated that of 3,500 toxicity tests conducted, 90% showed no statistically significant effects.
- In February 2011, OSAT-2 found that residual oil in nearshore and sandy shoreline areas was highly weathered, and concentrations of constituents of concern were well below levels of concern for human health.

- In January and May 2014, OSAT-3 reported on attempts to locate and recover potential buried material. Field investigations found little or no visible oil in excavations across seven Louisiana barrier islands; less than 2% of augered holes had oil levels that required cleanup; and efforts to locate and recover potential material were ended.

FIGURE 7 FISHERY CLOSURE BOUNDARY IN RESPONSE TO DEEPWATER HORIZON EVENT



Source: NOAA Fisheries Southeast Regional Office, 2016

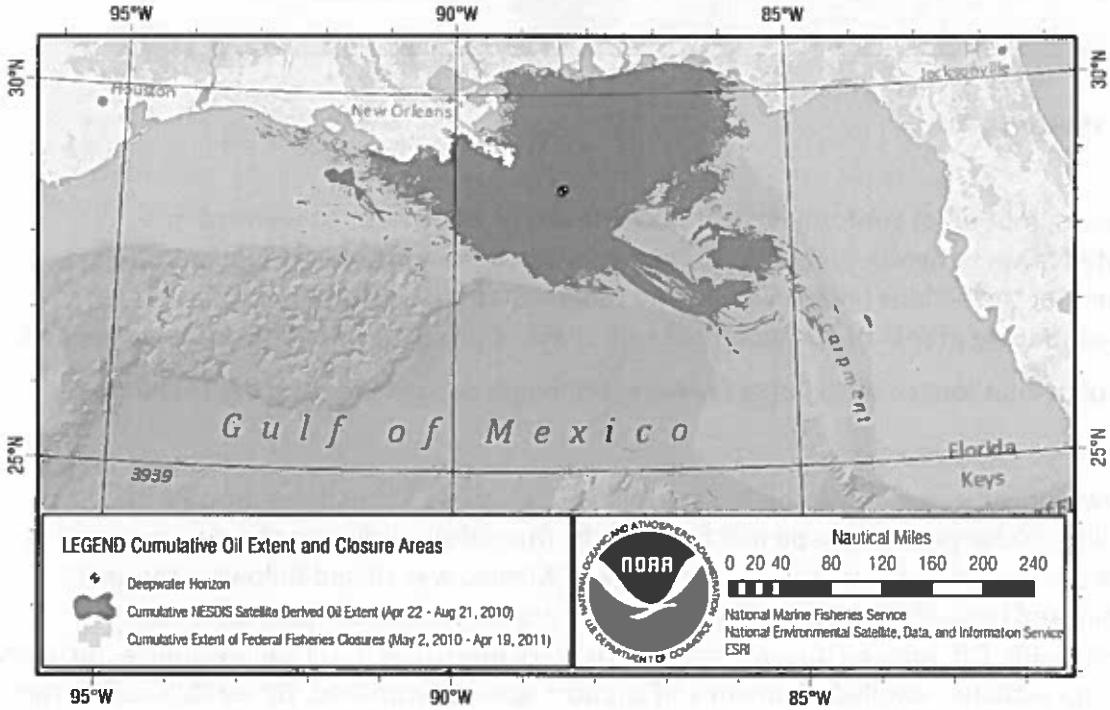
A collaboration of federal agencies that included FDA, NOAA, EPA, and Centers for Disease Control, as well as their counterpart state agencies, established a unified seafood protocol federal seafood safety response to the Deepwater Horizon event (Ylitalo et al., 2012). As part of the protocol, these agencies developed a seafood safety risk assessment approach for use in determining whether federal or state waters would be reopened to commercial and recreational fisheries. In developing the human health risk assessment, a suite of 13 PAH analytes were selected as indicators of human health risk. Of the 13 PAHs, cancer risk factors that were available for 7 PAHs; the 6 PAHs with non-cancer endpoints used their EPA reference dose (RfD) as the basis for their safety criteria.

The risk assessment was further developed based on a 5-year exposure, a lifetime cancer risk of 10^{-5}; the 90th percentile for U.S. seafood consumption (meal size) and the 90th percentile for U.S. seafood consumption frequency (16.4 seafood meals per month); an adult body weight of 80 kg; and an average lifetime of 78 years. The selection of a 5-year exposure period was based on the light crude oil spilled, warm sea temperatures, spill location 80 km offshore, and the metabolic capacities of the seafood species likely affected.

Sampling was based on the location and trajectory of the spill. Figure 8 depicts the extent of the spill from April 22 to August 21, 2010. Figure 9 shows the locations of the sites sampled from April 28, 2010 to March 31, 2011.

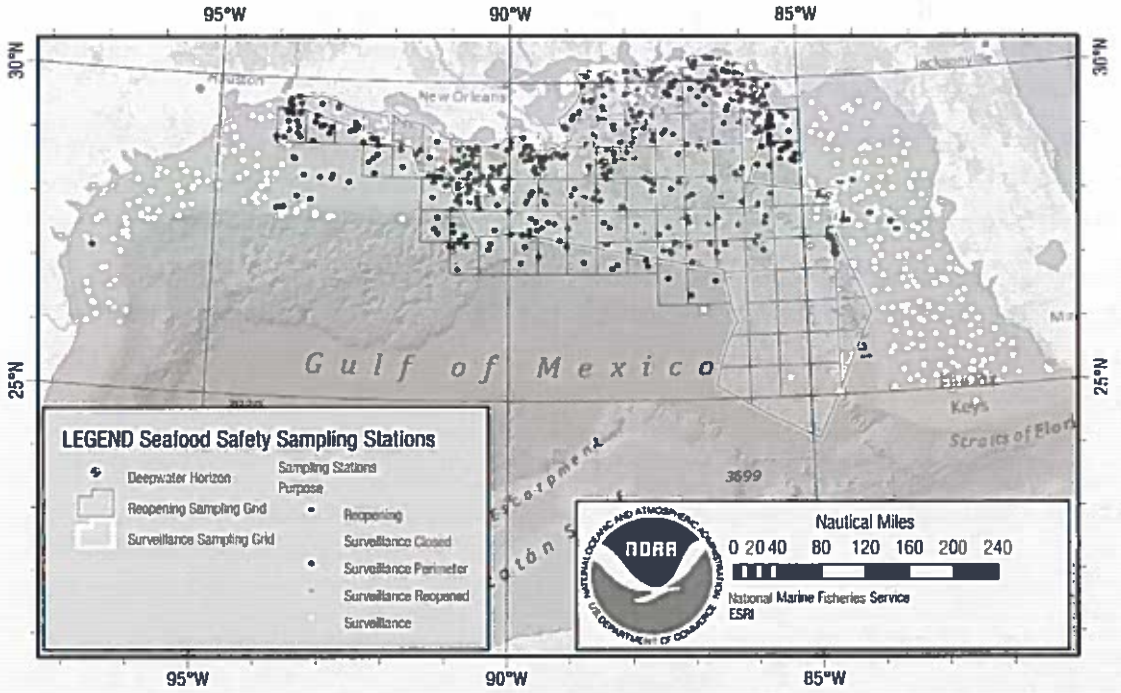
Concerns were raised about the selected or default values used to develop LOCs as not reflecting current risk assessment practices and protecting vulnerable populations (Rotkin-Ellman et al., 2012). The concerns stated that far more seafood samples exceed LOCs if the exposure is re-calculated for more sensitive subpopulations.

FIGURE 8 EXTENT OF THE DEEPWATER HORIZON OILING, APRIL 22, 2010 – AUGUST 21, 2010



Source: Ylitalo et al., 2012

FIGURE 9 SEAFOOD SAMPLING SITES, APRIL 28, 2010 - MARCH 31, 2011



Source: Ylitalo et al., 2012

To date, consumption of contaminated Gulf of Mexico seafood has not resulted in a documented adverse health outcome. At this time, available information supports the conclusion that the actions undertaken by the federal and state agencies responsible for ensuring continuing access of consumers to safe seafood products appear to have succeeded.

The possibility that longer-term impacts may yet become apparent cannot be discounted.

Environmental Justice

The Deepwater Horizon event is the largest spill in U.S. waters. In its three months of uncontrolled discharge of crude oil and the months thereafter, dramatic changes occurred in Gulf coast communities. Up to a third of the Gulf of Mexico was closed following the spill. Commercial and recreational fishing grounds were closed. Vessels of opportunity were contracted by BP. Offshore oil and gas operations were interrupted. Oil spill response, recovery, and clean-up activities swelled. Tourism and support services withered. BP established a claims center funded at $20 billion.

Communities were clearly affected, and the socioeconomic impacts of the Deepwater Horizon event will take years to sort out and quantify. The objective of the ongoing NRDA effort is to assess the costs incurred - environmental, social, and economic - by whom, i.e., which residents and industries were affected and to what degree, as a result of the incident.

Osofsky et al. (2012) discussed three broad environmental justice concerns related to the Deepwater Horizon event. One area of environmental justice concern was the spill response, including the distribution of waste disposal facilities among minority/low income communities as well as the actual distribution of disposed wastes among disposal facilities. The second concern related to compensation, and included federal, state, and local responses as well as public and private litigation. The third concern related to employment impacts (i.e., employment losses and opportunities in industrial sectors that benefitted and adversely affected by the event) and worker impacts (i.e., the vulnerability and health and safety concerns for cleanup workers and the safety and compensation of oil rig workers). Of the concerns listed by Osofsky et al. (2012), only waste disposal is relevant to the activities covered by the proposed Permit.

A study that examined the impacts of wastes resulting from the Deepwater Horizon cleanup found that wastes disposed at the approved landfills disproportionately affected minority communities along the Gulf (Bullard, 2010). Specifically, the percent minority residents living within one mile of the disposal facilities were higher than state averages (see Table 1). As discussed in Chapter 3.6.1.5, despite the amount of Deepwater Horizon event-related wastes that were sent to onshore waste handling facilities, the impact of this onshore disposal of was negligible (< 2%), in view of the capacity of available, nearby waste disposal facilities.

TABLE 1 MINORITY POPULATIONS NEAR DISPOSAL SITES

Landfill Location/Name		Tons Disposed	Minority Population Within One Mile Radius
Louisiana	Tide Water Landfill	2,204	93.6%
Florida	Springhill Regional Landfill	14,288	76.0%
Alabama	Chastang Landfill	6,008	56.2%
Louisiana	River Birch Landfill	1,406	53.2%
Louisiana	Jefferson Parish Sanitary Landfill	225	51.7%
Louisiana	Colonial Landfill	7,729	34.7%
Louisiana	Jefferson Davis Parish Landfill	182	19.2%
Alabama	Magnolia Landfill	5,966	11.5%

Source: Bullard, 2010

The commercial and recreational fishing industries are an example of the complexity of such interactions. Despite extensive closures of fishing grounds in both state and federal waters, the landings and ex-vessel values of these fisheries, on a Gulf-wide basis, appear to be minor. However, bearing the burden of Deepwater Horizon impacts was not shared equitably among the states (see the discussion on commercial fisheries in Chapters 3.4.1 and 3.6.3.1 and

recreational fisheries in Chapters 3.4.2 and 3.6.3.2 for detailed discussions). While Florida and Texas appear to have been unaffected, Alabama and Mississippi saw substantial decreases in seafood landings and ex-vessel values, with Louisiana falling between these two levels of impact. Such impacts, are not likely to have resulted in equitable effects among potentially affected commercial fishermen or operations because of a wide range of personal and business circumstances. Some potentially affected commercial fishermen or operations would have had better access to sufficient resources and be able to sustain themselves until the fisheries were again fully functional. Others, who may not have access to such resources, would have been more seriously affected by the fisheries closures that occurred as a result of the Deepwater Horizon event. Government and private responses have mitigated some of the potential adverse impacts.

Currently available data are not adequate to assess the impacts of the Deepwater Horizon event and environmental justice concerns. There are little or no data to assess whether the costs were equally shared across the demographic spectrum of Gulf coast communities.

References

Public Notice Date: June 15, 2016

INDUSTRIAL FACILITY FACT SHEET

APPLICATION FOR
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT TO DISCHARGE TREATED WASTEWATER
TO U. S. WATERS

Application No. FL0944858

Application Date: February 3, 2016
Permit Writer: Karrie-Jo Shell

1. SYNOPSIS OF APPLICATION

a. Name and Address of Applicant

LLOG Exploration L.L.C.
1001 Ochsner Boulevard
Covington, Louisiana 70433

b. Type of Facility

Crude Petroleum and Natural Gas (SIC Code 1311)

A dynamically positioned mobile offshore drilling unit will be used to drill up to three (3) exploratory wells in Federal Outer Continental Shelf (OCS) waters. Water depths in the DeSoto Canyon 713 lease block average range from 2,590 to 2,620 feet.

Well Location	Latitude	Longitude
A	28°00'12.69"	-87°30'05.50"
B	28°15'52.52"	-87°30'05.40"
C	28°15'29.99"	-87°30'05.15"

c. Design Capacity of Facility

There is no stated design. The project proposes up to drill three exploratory wells at approximately 51,445 barrels per well of water-based mud additives, 6.131 barrels per well of drill cutting generated from water –based drilling fluid, 113 barrels per well of cuttings generated while using synthetic-based drilling fluids, 20 barrels per well of well completion fluids, 100 barrels per well of clear brines, 1,168 barrels per well of sanitary wastewater, 18,320 barrels per well of miscellaneous waste from the living quarters, up to 400,00 barrels per well of uncontaminated cooling water, up to 100,000 barrels per well of emergency discharges and uncontaminated ballast/bilge water, up to 100 barrels per well of blowout preventer fluid, and 300 barrels per well of excess cement. The permit

prohibits
discharges associated with production activities.

d. Applicant's Receiving Water

Federal waters of the Gulf of Mexico in DeSoto Canyon Block 713, OCS-G-31567.

For a sketch showing the location of the discharge(s), see Attachment A.

e. Description of Wastewater Treatment Facilities

Marine Sanitation Device (MSD), which collects and treats sanitary wastes from the facility will be used. The effluent from the treatment unit is chlorinated before discharge.

f. Description of Discharges (as reported by applicant)

Outfalls 001, 002, 003 - Drill cuttings and fluids

Pollutant	**Daily Maximum**	**Daily Average**
Biochemical Oxygen Demand	No information provided	
Chemical Oxygen Demand	No information provided	
Total Organic Carbon	No information provided	
Total Suspended Solids	No information provided	
Ammonia (as N)	No information provided	
Temperature	No information provided	
pH	No information provided	
Flow	< 0.5 MGD per well	
Barium	No information provided	
Sulfate	No information provided	
Surfactants	No information provided	
Mercury	<1 mg/kg	<0.5 mg/kg
Cadmium	<3 mg/kg	<1.5 mg/kg

Outfall No. 004: Produced Water – The applicant reported that no discharge of produced water is anticipated.

No expected effluent quality information was provided by the applicant for the following outfalls:

Outfall No. 005: Deck Drainage
Outfall No. 006: Well Treatment, Fluids, Completion Fluids, and Workover Fluids
Outfall No. 007: Sanitary Discharges
Outfall No. 008: Domestic Waste Discharges
Outfall No. 009: Miscellaneous Discharges
Outfall No. 010: Miscellaneous Discharges in Which Chemicals Have Been Added

Description of Cooling Water Intake Structures

The cooling water intake structures (CWIS) are sea chests and will have pumps that create a velocity of less than or equal to 0.5 feet per second across the screens of the sea chest.

2. PROPOSED EFFLUENT LIMITATIONS:

The effluent limitations in the draft permit are identical to those in Region 4's Offshore Oil and Gas NPDES General Permit (GP) no. GEG460000, which was issued on March 15, 2010, expired on March 15, 2015, and is currently being administratively continued for existing dischargers that requested coverage until the reissuance of the subsequent GP. LLOG plans to operate within the same jurisdictional area as permit number GEG460000. This facility is not a New Source (as defined in the NPDES regulations) because the operation will be for exploratory drilling only. (Note according to the NPDES regulations, a New Source is not the same as a new discharger). For offshore oil and gas operations, New Sources do not include new exploratory facilities because exploration is conducted at a particular site for a short duration and generally consists of drilling only one to three wells. See 59 Federal Register (FR) 12454 dated March 4, 1993. In general, exploratory facilities differ from New Sources in that they do not have high volume discharges, and they do not discharge produced water. Moreover, the volume of drilling fluids and drill cuttings discharged from an exploratory facility is significantly less than from a development facility, where up to 50 production wells can be drilled. If at any time any of these exploratory wells will be converted to production, the Applicant will need to apply for an Individual Permit (IP) for each production well or seek coverage under the new GP if it is issued before any production can occur. If an IP is applied for, the application will include the required NEPA analysis for a new source (see discussion below).

Outfall No. 001: Water-based Drilling Fluids

Outfall No. 002: Water-based Drill Cuttings

Outfall No. 003: Synthetic-based Drill Cuttings and Drilling Fluids

Non-aqueous Drilling Fluids (NAFs) : No discharge

Cuttings Associated with NAFs

Effluent Characteristic	Discharge Limitations
Stock Limitations:	
(C_{16}-C_{18} internal olefin)	
Mercury, Total	1.0 mg/kg dry weight in the stock barite
Cadmium, Total	3.0 mg/kg dry weight in the stock barite
Polynuclear Aromatic Hydrocarbons (PAH)	PAH mass ratio shall not exceed 0.00001
Sediment toxicity	Base fluid sediment toxicity ration shall not exceed 1.0
Biodegradation rate	Biodegradation rate ratio shall not exceed 1.0
Discharge Limitations:	
Diesel Oil	No discharge

Toxicity - 96 hr LC_{50}	3% by volume - Daily Minimum 3% by volume - Monthly Average (Minimum)
Sediment Toxicity	Drilling fluid sediment toxicity ratio shall not exceed 1.0
Formation Oil	No discharge
Base Fluid Cutting Retention	For NAFs that meet the stock limitations (C_{16}-C_{18} internal olefin) in this table, the maximum weighted mass ratio averaged over all NAF well sections shall be 6.9 g-NAF base fluid/100 g-wet drill cuttings. For NAFs that meet the C_{12}-C_{14} ester or C_8 ester stock limitations, the maximum weighted mass ratio averaged over all NAF well sections shall be 9.4 g-NAF base fluid/100 g-wet drill cuttings.
Oil and Grease	No discharge of free oil

Outfall No. 004: Produced Water-refer to the draft permit
Outfall No. 005: Deck Drainage-refer to the draft permit
Outfall No. 006: Well Treatment, Fluids, Completion Fluids, and Workover Fluids-refer to the draft permit
Outfall No. 007: Sanitary Discharges-refer to the draft permit
Outfall No. 008: Domestic Waste Discharges-refer to the draft permit
Outfall No. 009: Miscellaneous Discharges-refer to the draft permit
Outfall No. 010: Miscellaneous Discharges in Which Chemicals Have Been Added-refer to the draft permit

BMPs will be used to control NAF discharges associated with drill cuttings in accordance with Part III.

3. BASIS FOR FINAL EFFLUENT LIMITS AND PERMIT CONDITIONS

a. Source of Discharges

LLOG proposes to drill up to three (3) exploratory wells in DeSoto Canyon Block 713. The proposed wells will be in excess of 2.590 feet of water. DeSoto Canyon Block 713 is located approximately 139 miles due south of the Alabama-Florida state line. LLOG plans to use a drillship type mobile drilling unit for the proposed drilling activities, and will utilize an existing support base at Port Fouchon, Louisiana, approximately 174 miles west northwest. All discharges will occur during exploratory drilling operations. LLOG plans to use synthetic-based drilling fluids/non-aqueous drilling fluids (SBFs/NAFs) for certain sections of the hole below the mud line. The receiving water will be the Gulf of Mexico in Federal Outer Continental Shelf (OCS) waters.

b. Total Cadmium and Total Mercury Requirements

These limitations are based on Best Available Technology (BAT), in accordance with 40 CFR Part 435, Oil and Gas Extraction Point Source Category, dated March 4, 1993, at 58 FR 12506, and revised for effluent limitations guidelines (ELGs) for non-aqueous drilling fluids (NAFs) and

associated cuttings published at 66 FR 6850, January 22, 2001.

c. Toxicity Requirements

Because the effluent from Outfall 001 may be toxic, toxicity testing requirements as contained in Part I have been included to insure that this individual permit is as stringent as the final NPDES general permit issued to the Gulf of Mexico for these types of activities and the Offshore Effluent Guidelines, issued on March 4, 1993, and amended to on January 22, 2001. The effluent from Outfall 001 establishes a 96-hr LC_{50} value of 3% by volume as a minimum (for Mysidopsis bahia) on the suspended particulate phase (SPP). NAFs associated with drill cuttings from Outfall 001 must meet toxicity requirements for stock base fluid and fluids retained on the drill cuttings. Failure to demonstrate compliance with these acute toxicity requirements will constitute a violation of the terms of the permit.

d. Free Oil/Static Sheen Test Requirement

The free oil limitations are based on offshore effluent guideline based on Best Available Technology (BAT), in accordance with 40 CFR Part 435, Oil and Gas Extraction Point Source Category, dated March 4, 1993, at 58 FR 12506. Additionally, the test shall be conducted in accordance with 40 CFR Part 435, Oil and Gas Extraction Point Source Category, dated March 4, 1993, at 58 FR 12506, Appendix 1 to Subpart A of Part 435 - Static Sheen Test.

e. Polynuclear Aromatic Hydrocarbon (PAH), Sediment Toxicity, Biodegradation Rate

The effluent limitations and monitoring requirements are based on the Best Available Technology, 40 CFR Part 435, Oil and Gas Extraction Point Source Category; Offshore Subcategory Effluent Guidelines and New Source Performance Standards; Final Rule, issued on March 4, 1993. Revised effluent limitations guidelines (ELGs) for non-aqueous drilling fluids (NAFs) and associated cuttings were published in 66 FR 6850 on January 22, 2001.

f. Oil and Grease

This limitation is based on Best Practicable Control Technology Currently Available (BPT), in accordance with 40 CFR Part 435, Oil and Gas Extraction Point Source Category, dated March 4, 1993, at 58 FR 12506, and revised for effluent limitations guidelines (ELGs) for non-aqueous drilling fluids (NAFs) and associated cuttings published at 66 FR 6850, January 22, 2001.

g. Clean Water Act Section 403(C) Determination

Any NPDES permit issued to the offshore oil and gas extraction industry must be in compliance with the Clean Water Act's Ocean Discharge Criteria, Section 403(c). Final Ocean Discharge Criteria guidelines were promulgated at 45 FR 65942 (October 3, 1980) (40 CFR § 125.120, Subpart M - Ocean Discharge Criteria). They require the Regional Administrator to determine, on the basis of available information, whether or not the discharge will cause unreasonable degradation of the marine environment.

g. Prohibitions for Drilling Fluids and Drilling Cuttings

The discharge prohibitions for drilling fluids contained in Part I.A.2 and drill cuttings contained in

Part I.A.2 of the permit are on based the Region 4 NPDES General permit no. GMG280000 for the Eastern Portion of the Outer Continental Shelf of the Gulf of Mexico, (63 FR 55718, dated October 16, 1998).

4. MONITORING REQUIREMENTS

The applicant will be required to monitor for flow and the above parameters with sufficient frequency to ensure adequate data is collected for compliance reviews. Frequency, methods of sampling, and reporting dates are specified in the permit.

5. PROPOSED SPECIAL CONDITIONS WHICH HAVE A SIGNIFICANT IMPACT ON THE DISCHARGE AND LEGAL REQUIREMENTS

The National Environmental Policy Act (NEPA) – Under NEPA, an analysis is required when an action is deemed a major federal action significantly affecting the quality of the human environment. A NEPA analysis is not required for drilling exploratory wells. CWA § 511(c) lists the only actions of the Administrator under the CWA that require any NEPA analysis. Section 511(c)(1) states: " Except for the provision of Federal financial assistance for the purpose of assisting the construction of publicly owned treatment works as authorized by Section 1281 of this title, and the issuance of a permit under Section 402 of this title for the discharge on any pollutant by a new source identified in Section 1316 of this title, no action of the Administrator taken pursuant to this chapter [the CWA] shall be deemed a major federal action significantly affecting the quality of the human environment within the meaning of NEPA." This same limiting language is reflected in 40 CFR §6.101(a). Because the act and implementing regulations are specifically inclusive as to what CWA actions require NEPA and is limited to those two annotated situations, existing sources are exempt from NEPA since they are not "deemed a major federal action significantly affecting the quality of the human environment within the meaning of NEPA."

The Coastal Zone Management Act (CZMA)- The CZMA requires that any Federally licensed or permitted activity affecting the coastal zone of a state that has an approved coastal zone management program (CZMP) be reviewed by that state for consistency with the state's program (16 USC 1456(c)(A)Subpart D). The Florida Department of Environmental Protection (FDEP) is designated as Florida's lead coastal management agency pursuant to section 306(c) of the Coastal Zone Management Act, 16 U.S.C. section 1456(c) and section 380.22, Florida Statues.

In a letter dated January 25, 2016, FDEP notified the Bureau of Energy Management that the states does not object to the coastal zone consistency provided by the permittee with the Exploration Plan, which was submitted to the Bureau of Energy Management for DC 713.

Endangered Species Act (ESA) - The ESA allocates authority to, and administers requirements upon, federal agencies regarding endangered species of fish, wildlife, or plants that have been designated as critical. The ESA's implementing regulations (50 CFR Part 402) require the RA to ensure, in consultation with the Secretaries of Interior and Commerce, that any action authorized, funded or carried out by EPA is not likely to jeopardize the continued existence of any endangered or threatened species or adversely affects its critical habitat (40 CFR § 122.49(c)). Implementing regulations for the ESA establishes a process by which agencies consult with one another to ensure that issues and concerns of both the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) collectively are addressed.

Essential Fish Habitat (EFH) Assessment - The Magnuson-Stevens Fishery Conservation and Management Act requires Federal agencies to consult with the Secretary of Commerce regarding any action or proposed action authorized, funded, or undertaken by the agency that may adversely affect EFH identified under the Act. EPA has determined that the discharge of drilling cuttings and associated NAFs is not expected to significantly degrade water quality within the discharge sites or in adjacent waters. Any increases in suspended particulate concentrations or soluble constituents are expected to be short term and minimal. These effects are localized, short-term effects dissipated by natural dispersion, mixing, and eventual sinking of particles. The water quality effects are not expected to effect the surf zones or beaches. The water quality effects are not expected to adversely effect marine organisms. The whole effluent toxicity (WET) testing in the permit will evaluate the potential for unacceptable toxic effects in both the benthos and water column. Our initial determination is that the proposed discharge would not have a substantial individual or cumulative adverse impact on EFH or Federally managed fisheries in the Gulf of Mexico.

Oil Spill Requirements - Routine discharges that are in compliance with NPDES permits are exempt from the provisions of section 311 of the Clean Water Act (CWA). However, any unauthorized discharges of oil and hazardous materials remain subject to the responsibilities, liabilities, and penalties covered under section 311 of the CWA.

Best Management Practices (BMPs) - LLOG is required to develop a specific set of BMPs to control non-aqueous drilling fluid (NAF) discharges associated with drill cuttings. This should include procedures for identifying, documenting, and repairing NAF equipment. It should also include a training program for personnel to identify and report NAF equipment malfunctions.

6. REQUESTED VARIANCES OR ALTERNATIVES TO REQUIRED STANDARDS

None.

7. EFFECTIVE DATE OF PROPOSED EFFLUENT LIMITS AND COMPLIANCE SCHEDULE

The proposed effluent limits will be effective immediately upon commencement of discharge.

8. STATE CERTIFICATION REQUIREMENTS

State certification will not be required on the draft permit, since the discharge occurs in Federal OCS waters.

9. DISCUSSION OF PREVIOUS NPDES PERMIT CONDITIONS

This the first issuance of an NPDES permit for an existing source.

10. COORDINATION WITH OTHER FEDERAL AND STATE AGENCIES

EPA Region 4 has coordinated with the following agencies regarding this proposed permit.

Industrial Permits Section
Water Division
Alabama Dept. of Environmental Management

Environmental Administrator
for Intergovernmental Programs
Florida Dept. of Environmental Protection

Bureau of Energy Management
U.S. Dept. of the Interior
Gulf of Mexico – OCS Region
Plans Section

U.S. Dept. of the Interior
Bureau of Safety and Environmental
Enforcement
Environmental Inspection and Enforcement Unit

Industrial Wastewater Program
Division of Water Resource Management
Florida Dept. of Environmental Protection

U.S. Dept. of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Habitat Conservation Division

U.S. Dept. of Commerce
National Oceanic and Atmospheric Administration
NOAA Fisheries Service
Southeast Regional Office

U.S. Dept. of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Habitat Conservation Division

State Geologist
Geological Survey of Alabama

Alabama Historical Commission

Florida Historical Commission
Bureau of Historic Preservation

State Historic Preservation Officer
Mississippi Department of Archives & History

Fish and Wildlife Services
Department of Interior
Daphne Ecological Services Field Office

Fish and Wildlife Services
Department of Interior
Panama City Ecological Services Field Office

Fish and Wildlife Services
Department of Interior
South Florida Ecological Services Field Office

Fish and Wildlife Services
Department of Interior
Jackson Ecological Services Field Office

Gulf Islands National Seashore
Department of Interior
National Park Service

Mississippi Bureau of Marine Resources
Coastal Zone Management Office

Alabama Dept. of Environmental
Management
Coastal Zone Management Program

11. PUBLIC NOTICE REQUIREMENTS

This permit is being publically notice in four newspaper for a minimum of 30 days along the eastern Gulf of Mexico coast.

12. EPA CONTACT

Additional information concerning the permit may be obtained at the address and during the hours noted in item 11 from:

Ms. Karrie-Jo Shell
Permit Writer
(404) 562-9308
Shell.karrie-jo@epa.gov

11. THE ADMINISTRATIVE RECORD, including application, draft permit, fact sheet, public notice (after release), 403(c) determination, comments received, and additional information is available by writing EPA, Region 4, or for review and copying at the Atlanta Federal Center, 61 Forsyth Street, S.W., Atlanta, Georgia 30303-3104 between the hours of 8:15 A.M. and 4:30 P.M.,

Monday through Friday. Copies will be provided at a minimal charge per page.

12. PROPOSED SCHEDULE FOR PERMIT ISSUANCE

Draft Permit to Applicant	June 15, 2016
Public Notice Date	June 15, 2016
Close Comment Period	July 15, 2016
Proposed Issuance Date	July 15, 2016

ESSENTIAL FISH HABITAT ASSESSMENT

National Pollutant Discharge Elimination System (NPDES) Permit for the LLOG Exploration Offshore, L.L.C. Exploratory Drilling and Completion Operations in OCS-G-31567 Lease, Desoto Canyon Block 713 Area.

FL0944858

Project Description

The Regional Administrator of EPA Region 4 is proposing to reissue a National Pollutant Discharge Elimination System (NPDES) permit for the LLOG Exploration Offshore, L.L.C. Exploratory Drilling and Completion Operations in OCS-G-31567 Lease, Desoto Canyon Block 713 Area for discharges in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category (40 Code of Federal Regulations (CFR) part 435, subpart A). The proposed permit authorizes discharges from exploration and development for three wells in Federal waters of the Gulf of Mexico seaward of the outer boundary of the territorial seas. The wells will be located approximately 190 miles southeast of New Orleans, Louisiana in water depths in excess of 8,000 ft.

As proposed, these NPDES permits include best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), and best available technology economically achievable (BAT) limitations for existing sources and new source performance standards (NSPS) limitations for new sources as promulgated in the effluent guidelines for the offshore subcategory at 58 FR 12454 and amended at 66 FR 6850 (March 4, 1993 and January 22, 2001 respectively).

Background Information Concerning NPDES Permits

Section 301(a) of the Clean Water Act (CWA or the Act), U.S.C. 1311(a), provides that the discharge of pollutants is unlawful except in accordance with the terms of a National Pollutant Discharge Elimination System (NPDES) permit. CWA section 402, 33 U.S.C. 1342, authorizes EPA to issue NPDES permits allowing discharges on condition they will meet certain requirements, including CWA sections 301, 304, and 401, 33 U.S.C. 1311, 1314, and 1341.

EPA may issue NPDES permits to operators of individual facilities or general permits to a class of similar dischargers within a discreet geographical area. Issuance of general permits is not controlled by the procedural rules EPA uses for individual permits, but is instead subject to section 4 of the Administrative Procedure Act (APA), 5 U.S.C. 553, as supplemented by EPA regulations, e.g., 40 CFR 124.58. EPA must, however, comply with the substantive requirements of the CWA without regard to whether it is issuing an individual or general NPDES permit.

Description of Activities, Facilities and Discharges Subject to the Proposed Draft Permit

The Oil and Gas Extraction Point Source Category (40 CFR part 435 - subpart A) includes facilities engaged in field exploration, development and well production and well treatment. Exploration facilities are fixed or mobile structures engaged in the drilling of wells to determine the nature of potential hydrocarbon reservoirs. A development facility is any fixed or mobile structure engaged in the drilling and completion of productive wells, which may occur prior to, or simultaneously with production operations. Production facilities are fixed or mobile structures engaged in well completion or used for active recovery of hydrocarbons from producing formations. This permit does not cover future production activities at this location.

The proposed permit will authorize the following discharges to occur in water depths in excess of 8,000 ft: drilling muds; drill cuttings; well treatment fluids; workover fluids; completion fluids; deck drainage, sanitary wastes; domestic wastes, desalinization unit discharges, blowout preventer fluid; fire control system test water; non-contact cooling water; uncontaminated ballast water; uncontaminated bilge water; excess cement slurry; and mud, cuttings and cement at the seafloor. The proposed permits will authorize discharges from facilities engaged in field exploration, development and well treatment.

Fish Habitat Overview

The proposed draft permit coverage area consists mainly of rapidly deposited clastic sediments overlying carbonates and debris deposited over geologic history off the Florida Terrace. There is no evidence of either low or high-relief live bottom habitat in the area. The project area could support any of the commercially important pelagic and deep-water fishes and invertebrates in the central, eastern and northern Gulf.

Assessment and Ecological Notes on the EFH Fisheries and Species

The seasonal and year-round locations of designated EFH for the managed fisheries are depicted on figures available on the NMFS' Galveston web page http://sero.nmfs.noaa.gov/maps_gis_data/habitat_conservation/efh_gom/. NMFS selected 27 species from seven existing Fisheries Management Units (FMUs). Table 1 lists the 26 species (plus various coral reef fish assemblages) which are known to reside in Gulf waters and which are managed under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The listed species are considered ecologically significant to their respective FMU, and their collective habitat types occur throughout marine and estuarine waters in the Gulf.

Table 1. Essential Fish Habitat Species within the Central and Eastern Gulf of Mexico

Species	EFH
Shrimp (Brown, White, Pink, Royal Red)	All estuaries; the US/Mexico border to Fort Walton Beach, Florida, from estuarine waters out to depths of 100 fathoms; Grand Isle, Louisiana, to Pensacola Bay, Florida, between depths of 100 and 325 fathoms; Pensacola Bay, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC out to depths of 35 fathoms, Crystal River, Florida, to Naples, Florida, to 25 fathoms and in Florida Bay to 10 fathoms. Marsh, seagrass, mangrove and open water habitats.
Coastal Migratory Pelagics	All estuaries; the US/Mexico border to Florida from estuarine waters out to depths of 100 fathoms.
Red Drum	All estuaries; Vermilion Bay, Louisiana, to the eastern edge of Mobile Bay, Alabama, out to depths of 25 fathoms; Crystal River, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; and Cape Sable, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC between depths of 5 and 10 fathoms.
Reef Fish	All estuaries; the US/Mexico border to the boundary between the areas covered by the GMFMC and the SAFMC from estuarine waters out to depths of 100 fathoms. Reef, seagrass, and mangrove habitat.
Spiny Lobster	From Tarpon Springs, Florida, to Naples, Florida, out to 10 fathoms; and Cape Sable, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC out to depths of 15 fathoms. Hardbottom habitats with macroalgae, seagrass and mangrove habitats.
Stone Crab	All estuaries; the US/Mexico border to Sanibel, Florida, from estuarine waters out to depths of 10 fathoms; and from Sanibel, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC from estuarine waters out to depths of 15 fathoms. Rock rubble, mangrove, salt marsh and seagrass habitats.
Coral	Distributed throughout the Gulf of Mexico including: the North and South Tortugas Ecological Reserves, East and West Flower Garden Banks, McGrail Bank, and the southern portion of Pulley Ridge; the pinnacles and banks from Texas to Mississippi, at the shelf edge and at the Florida Middle Grounds, the southwest tip of the Florida reef tract, and predominant patchy hard bottom offshore of Florida from approximately Crystal River south to the Florida Keys.
Deepwater Coral	The Viosca Knoll Lease Area south of Mississippi and the Green Canyon Lease Area south of central Louisiana. The Twin Ridges area south of Cape San Blas, Florida. Alderdice, McGrail, and Sonnier Banks off Louisiana.

Source: Final Report Gulf of Mexico Fishery Management Council 5-Year Review of the Final Generic Amendment Number 3. 2010.

The EFH assessment is based on species distribution maps and habitat association tables. In offshore areas, EFH consists of those areas depicted as “adult areas”, “spawning areas”, and “nursery areas”. A determination of potential impacts to the selected species according to the indicated abundance within the area of the permitted disposal site has been made.

Shrimp Fishery

The brown, white and pink shrimp yields in the Gulf are highly dependent upon the abundance and health of estuarine marshes and seagrass beds. The prey species (food source) for these shrimp also depend on similar vegetated coastal marshes and seagrass beds. The commercially valuable shrimp species discussed here are not likely to be found at project depths.

Brown Shrimp

Brown shrimp are generally more abundant in the central and western Gulf and found in the estuaries and offshore waters to depths of 360 feet. Postlarve and juveniles typically occur within estuaries while adults occur outside of bay areas. In estuaries, brown shrimp postlarve and juveniles are associated with shallow vegetated habitats, but also are found over silty sand and non-vegetated mud bottoms. In Florida, adult areas are primarily seaward of Tampa Bay, and associated with silt, muddy sand, and sandy substrates.

Spawning area: Florida waters to edge of continental shelf; *year round*

Nursery area: Tampa Bay

White Shrimp

White shrimp are offshore and estuarine dwellers, and are pelagic or demersal depending on their life stage. The eggs are demersal and larval stages are planktonic, and both occur in nearshore marine waters. Adult white shrimp are demersal and generally inhabit nearshore Gulf waters in depths less than 100 feet on soft mud or silty bottoms. In Florida, white shrimp are not common east or south of Apalachee Bay, and are not expected to be impacted by the discharges.

Spawning area: off Mississippi and Alabama; *March to October*

Nursery area: Mississippi Sound

Pink Shrimp

Juvenile pink shrimp inhabit most estuaries in the Gulf, but are most abundant in Florida. Juveniles are commonly found in estuarine areas with seagrass. Postlarve, juvenile, and subadults may prefer coarse sand/shell/mud mixtures. Adults inhabit offshore marine waters, with the highest concentration in depths of 30 to 144 feet. According to the NMFS species distribution map, pink shrimp use Tampa Bay from the larval stage until the species matures to

the late juvenile stage.

Spawning area: Mississippi, Alabama, and Florida offshore; year round

Nursery area: major nursery areas in Tampa Bay and Florida west coast state waters; *summer and fall in the northern Gulf*

Royal Red Shrimp

Royal red shrimp are most abundant in the northeastern Gulf in water depths between 820 and 1,640 feet. Little is known about the larvae. Distribution maps were not available by the NMFS for the royal red shrimp due to the limited knowledge and information available for the species. The permitted discharges will take place at or near the surface, thus there should be no impact on the primary EFH.

Spawning area: unknown

Nursery area: unknown

Red Drum Fishery

Red Drum

In the Gulf, red drum occur in a variety of habitats, ranging from depths of about 130 feet offshore to very shallow estuarine waters. They commonly occur in all of the Gulf's estuaries where they are associated with a variety of substrate types including sand, mud, and oyster reefs. Estuaries are important to red drum for both habitat requirements and for dependence on prey species which include shrimp, blue crab, striped mullet and pinfish. The GMFMC considers all estuaries to be EFH for the red drum. Schools of large red drum are common in the deep Gulf waters with spawning occurring in deeper water near the mouths of bays and inlets, and on the Gulf side of the barrier islands. The Tampa Bay EFH estuarine map shows red drum juveniles to be abundant or highly abundant in the fall and winter and common in the spring and summer.

Spawning area: Gulfwide from nearshore to just outside state waters, *fall and winter*

Nursery area: major bays and estuaries including Mobile Bay and Tampa Bay, *year round*

Reef Fishery

Many species of snapper and grouper (mutton, dog, lane, gray and yellowtail snapper- and red, gag and yellowfin groupers) occupy inshore areas during juvenile stages where they feed on estuarine-dependent prey. As these species mature they generally move to offshore waters and change their feeding habits. However, reef fishery species still depend on estuarine species for

prey. There is no evidence of reef habitat in the project area.

Red Grouper

The red grouper is demersal and occurs throughout the Gulf at depths from 10 to about 650 feet, preferring 100 to 400 foot depths. Juveniles are associated with inshore hard bottom habitat, and grassbeds, rock formations, while shallow reefs are preferred for nursery areas. Species distribution maps show that spawning for the red grouper occurs throughout much of the Gulf waters off Florida, including the Florida Middle Grounds. Nursery areas occur within and around the selected disposal site.

Spawning area: Florida continental shelf, well offshore, extending from south of Apalachicola Bay all the way to west of the Florida Keys; *April to May*

Nursery area: extensively throughout the continental shelf off Florida and along the northern *Gulf, year round*

Black Grouper

The black grouper occurs in the eastern half of the Gulf. The species is demersal and is found from shore to depths of 500 feet. Adults occur over wrecks and rocky coral reefs. Juveniles travel into estuaries occasionally (NCAA 1985). Species distribution maps for the black grouper indicate that the range of the species occurs within the Gulf, outside of state waters.

Spawning area: throughout eastern Gulf to 500 foot depth, *spring and summer*

Nursery area: probably the same as the red grouper

Gag Grouper

The gag grouper is demersal and is most common in the eastern Gulf, especially the west Florida shelf. Post larvae and pelagic juveniles move through inlets, coastal lagoons and high salinity estuaries in April-May where they settle into grass flats and oyster beds. Late juveniles move offshore in the fall. Adults prefer hard bottom areas, offshore reefs and wrecks, coral and live bottom. The species EFH distribution maps indicate presence throughout the Gulf including estuarine areas.

Spawning area: spawning areas are not specified on EFH maps

Nursery area: pelagic waters until post larvae or juvenile

Scamp

Scamp are demersal and widely distributed in the shelf areas of the Gulf, especially off of Florida. Juveniles prefer inshore hard bottoms and reefs in depths of 40 to 108 feet. Adults prefer high relief hard bottom areas. The species EFH distribution maps indicate presence throughout the Gulf including estuarine areas. Presence in these areas is based only on records for adults.

Spawning area: spawning area not specified in the EFH maps

Nursery area: nurseries not specified in the EFH maps

Red Snapper

Red snapper are demersal and found over sandy and rocky bottoms, around reefs, and underwater objects in depths to 656 feet. Juveniles are associated with structures, objects or small burrows, or barren sand and mud bottoms in shelf waters ranging from 55 to 600 feet. Adults favor deeper water in the northern gulf preferring submarine gullies and depressions, and over coral reefs, rock outcroppings, and gravel bottoms. Spawning occurs in offshore waters over fine sand bottoms away from reefs. Gulf distribution map show red snapper nursery areas within the estuarine waters of the Mississippi Sound, and Tampa Bay offshore of state waters

Spawning area: spawning occurs throughout the Gulf, *June to October*

Nursery area: extensive throughout the Gulf, *year-round***,** including Mississippi Sound and Tampa Bay

Vermillion Snapper

Vermillion snapper are found over reefs and rocky bottom from depths of 7 to 656 feet in the shelf areas of the Gulf spawning occurs in offshore areas, with juveniles occupying the same areas as the adults.

Spawning area: EHF maps not available, not specified in literature reviewed

Nursery area: EHF maps not available, not specified in literature reviewed

Gray Snapper

The gray snapper generally occurs in the shelf waters of the Gulf and is particularly abundant in south and southwest Florida. Gray snapper occur in almost all of the Gulf's estuaries but are most common in Florida. Adults are demersal and mid-water dwellers, occurring in marine, estuarine, and riverine habitats. They are found among mangroves, sandy grassbeds, and coral reefs, and over sandy muddy bottoms. Spawning occurs offshore, with post larvae moving into estuarine habitat over dense beads of *Halodule* and *Syringodium* grasses. Juveniles are marine, estuarine, and riverine found in most types of habitats. They appear to most prefer Thalassia grass flats,

marl bottoms, seagrass meadows and mangrove roots. Species distribution maps indicate that nursery areas exist within estuarine areas including the Mississippi Sound and Tampa Bay. Major adult areas are encountered from the Mississippi Sound across Gulf waters to west of Tampa Bay, where year round adult areas occur within Florida state waters and into the southern half of Tampa Bay.

Spawning area: spawning areas probably exist in the Gulf off many of the nursery areas, but have not been positively identified

Nursery area: found in coastal waters throughout the Gulf, including Mississippi Sound and Tampa Bay

Yellowtail Snapper

Juvenile yellowtail snapper are found in nearshore nursery areas over vegetated sandy substrate and in muddy shallow bays (NCAA 1985). *Thalassia* beds and mangrove roots are preferred habitat of the gray snapper. Late Juvenile and adults prefer shallow reef areas. According to the Gulf distribution map, this species has nursery areas within the 3 League Line and Tampa Bay. Spawning and adult areas occur in Gulf waters outside of the 3 League Line through the Florida Middle Ground and southern Apalachicola areas. EFH is not designated in the state waters of Mississippi or Alabama.

Spawning area: west and north of Tampa Bay; *spring and summer*

Nursery area: throughout the western and southern coast of Florida, including Tampa Bay

Lane Snappers

The snappers seem to prefer mangrove roots and grassy estuarine areas as well as sandy and muddy bottoms. Juveniles favor grass flats, reefs and soft bottom areas, to offshore depths of 66 feet (NCAA 1985). Adults occur offshore at sand bottoms, natural channels, banks, and manmade reef and structures. Gulf distribution maps indicate that the lane snapper use shallow coastal waters including the Mississippi Sound and Tampa Bay and areas outside of state waters as nursery areas.

Spawning area: throughout the adult areas, *summer*

Nursery areas: shallow coastal areas throughout the Gulf including Mississippi Sound and Tampa Bay.

Greater Amberjack

Greater amberjack seem to prefer habitats that are marine but not estuarine. Based on the Gulf distribution maps, greater amberjack occur outside the barrier islands across Gulf waters, and

usually over reefs, wrecks and around buoys. Spawning and nursery areas are similar.

Spawning area: throughout the adult areas in most of the Gulf; *year round*

Nursery area: throughout the adult areas; *year round*

Lesser Amberjack

Juvenile lesser amberjack are found offshore in the late summer and fall in the northern Gulf, along with smaller juveniles, in areas associated with sargassum. Adults and spawning areas are found offshore year round in the northern gulf where they are associated with oil and gas rigs and irregular bottom. The Gulf distribution map shows the range of the species throughout the majority of the Gulf and into the Atlantic coastline.

Spawning area: in adult areas, offshore, in the northern Gulf; *year round*

Nursery area: probably similar to adult areas year round; EHF map not available

Tilefish

Tilefish occur throughout the deeper waters of the Gulf. The permitted discharges will take place at or near the surface, thus there should be no impact on the primary EFH.

Spawning area: throughout the adult area from *March to September*

Nursery area: throughout the adult area; *year round*

Triggerfish

Larval and juvenile gray triggerfish are associated with grassbeds (Sargassum) and mangrove estuaries. Adults seem to prefer offshore waters associated with reefs. A general species distribution map was not available, however a map showing catches per hour by trolling methods within the Gulf was available from the National Oceanic and Atmospheric Administration (NOAA) Southeast Atlantic (SEA), the EFH web page (http://christensenmac.nos.noaa.gov/gom-efli/gtrigger.gif). This map indicated that there is a record of occupancy for gray triggerfish in state waters of Mississippi/Alabama and Florida.

Spawning area: EHF map not available; assumed to be adult preferred areas offshore.

Nursery area: EHF map not available; assumed to be estuarine areas throughout the Gulf

Coastal Migratory Pelagic Fishery

Collectively, these species are commonly distributed from the estuaries throughout the marine waters of the entire Gulf. However, estuaries are very important, since they contain the major prey base for these species.

King Mackerel

King mackerel are found throughout the Gulf and seldom venture into brackish waters. Juveniles occasionally use estuaries but are not estuarine dependent, and nursery areas occur in marine environments. According to the species distribution map, adult areas are also used for nurseries and spawning (May to November). These areas occur outside of the Mississippi Sound, across state waters, throughout the Gulf and into Tampa Bay.

> *Spawning area:* throughout the Gulf, estuaries and coastal waters in adult areas; *May to November*.
>
> *Nursery area:* adult areas; *year round***,** marine waters, estuaries used occasionally

Spanish Mackerel

Adult spanish mackerel tolerate brackish to oceanic waters and often inhabit estuaries. Estuarine and coastal waters also offer year round nursery habitat. Juveniles appear to prefer marine salinities and sandy bottoms. Adults and spawning areas typically occur in offshore areas. According to the species distribution map, EFH for adult and nursery areas occurs throughout the selected disposal site. Spawning areas occur in Gulf waters off the coast of Florida.

> *Spawning area:* waters off the coast on the western *(Summer and Fall)* and eastern Gulf *(Spring and Summer)*
>
> *Nursery area:* coastal waters throughout the Gulf

Cobia

Cobia only occasionally inhabit estuaries. Spawning occurs in nearshore areas and larvae are found in estuarine and offshore waters. Nursery areas are the same as the adult areas which include coastal areas, bays and river mouths (NCAA 1985). The range of cobia extends throughout the Gulf nearshore areas, with the summer adult areas and vear-round nursery areas from the Mississippi Sound into Gulf waters and to the adult area (spring, summer, and fall) and year round nursery area that extends from just inside Gulf water, halfway into Tampa Bay.

Spawning area: occurs throughout the adult areas except in bays and estuaries in the northern Gulf, Spring and Summer

Nursery area: coastal areas, bays and river mouths

Dolphin (Mahi-Mahi)

Dolphin are primarily an oceanic species, but occasionally enter coastal waters with high enough salinity. They are common in coastal waters of the northern Gulf mainly during the summer months. It is an epipelagic species known for aggregating underneath or near floating objects, especially Sargassum. Spawning occurs throughout the adult areas of the open Gulf year-round, with peaks in early spring and fall. Larvae are usually found over depths of greater than 50 meters and are most abundant at depths over 180 meters. Adults occur over depths up to 1,800 meters, but are most common in waters at 40 to 200 meters in depth. Nursery areas are year round in oceanic and coastal waters where salinity is high.

Spawning: throughout the adult areas in open waters of the Gulf; *year round*

Nursery area: throughout the adult areas in open waters of the Gulf; *year round*

Bluefish

Bluefish can be found in Gulf estuaries but are more common in estuaries and waters of the Atlantic Ocean. Spawning grounds are located on the outer half of the continental shelf Nursery areas occur inshore along beaches and in estuaries, inlets and rivers (NCAA 1985). Gulf distribution maps were not available for this species and therefore EFH could not be identified, but may be assumed to include nursery areas within the Mississippi Sound and Tampa Bay.

Spawning area: not specified in literature reviewed, EHF map not available

Nursery area: not specified in literature reviewed; EHF map not available, but probably exists within the Mississippi Sound and Tampa Bay

Little Tunny

Little tunny are pelagic species most often occurring in coastal areas with swift currents and near shoals. Spawning and nursery areas occur in the same coastal pelagic waters. Gulf distribution maps for adult areas indicate a range throughout the Gulf coastal areas.

Spawning area: EHF map not available; literature reviewed suggests the potential existence of spawning areas within the disposal site.

Nursery area: EHF map not available; literature reviewed suggests the potential existence of spawning areas within the disposal site.

Stone Crab Fishery

Stone Crabs

Adult stone crabs burrow under rock ledges, coral heads, dead shell or grass clumps and occasionally inhabit oyster bars and rock jetties. Juveniles are abundant on shell bottoms, sponges, and Sargassum mats, as well as in channels and deep grass flats. Some juvenile and small adults inhabit oyster reefs. Adults and juveniles appear to be hardy: they tolerate most environmental extremes within their distributional range and are capable of surviving salinities considerably higher or lower than 33 parts per thousand. Stone crab populations are dependent on prey produced in estuaries and seagrass beds along the west Florida coast particularly in the Everglades-Florida Bay area. The selected disposal site is within the range of the stone crab and extends throughout the entire Gulf with nursery areas in the estuaries, and spawning and adult areas in state and Gulf waters and the majority of the Florida Middle Ground.

Spawning area: State and Gulf waters, including the Mississippi Sound and waters off of Tampa Bay; *March to October*

Nursery area: not in the area of the proposed permitted discharge

Spiny Lobster Fishery

Spiny Lobster

The principal habitat for the spiny lobster is offshore reefs and seagrass. Spiny lobsters spawn in offshore waters along the deeper reef fringes. Adults are known to inhabit bays, lagoons, estuaries, and shallow banks. According to the species distribution map, spiny lobsters use the lower half of Tampa Bay for nursery areas. According to the GMFMC, Tampa Bay seems to be the upper limit for spiny lobster abundance due to the higher salinities found south of the Bay. The Tampa Bay-specific distribution map indicates that spiny lobster in the Bay are rare. However, the Gulf distribution maps indicate that Tampa Bay is used as an adult area year round, and as a nursery area. Spiny lobster are known to occur in northern and western Gulf habitats, but these area are not designated EFH.

Spawning area: throughout the adult area, particularly north and south of Tampa Bay; *March to July*

Nursery area: lower half of Tampa Bay used as nursery; *year-round*

Coral and Coral Reefs

The three primary areas in the Gulf where corals are concentrated are the East and West Flower Garden Banks, the Florida Middle Grounds, and the extreme southwestern tip of the Florida Reef Tract. No coral reefs exist within the area of coverage for the proposed draft permit.

Highly Migratory Species

In addition to the managed fish species described in the previous section, another group of fish with highly migratory habits have also been examined. This group includes billfish (blue marlin, white marlin and sailfish), swordfish, tunas (yellow fin, bluefin and skipjack), and of sharks (black tip, bull, dusky, silky, mako, Atlantic sharpnose, tiger and longfin mako). Most are found beyond the 50, 100 and 200 meter contours. Considering their highly mobile nature and the minor amount of area affected by the draft permit, relative to the entire available habitat, significant effects to these species would be unlikely.

Assessment of Essential Fish Habitat and Habitat Areas of Concern in the Gulf of Mexico

Table 2 shows the categories of Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for managed species which were identified in the Fishery Management Plan Amendments of the Gulf of Mexico Fishery Management Council and which may occur in marine waters of the Gulf. These habitats require special consideration to promote their viability and sustainability.

Table 2. Essential fish habitat and habitat areas of particular concern in open ocean environments of the Gulf of Mexico identified in Fishery Plan Amendments of the Gulf of Mexico and presence in area affected by the proposed draft permit.

Essential Fish Habitat	**Presence**
Water column	Yes
Vegetated bottoms	No
Non-vegetated bottoms	Yes
Live bottoms	No
Coral reefs	No
Geologic features	No
Continental shelf features	No

Mississippi/Alabama shelf	No
West Florida shelf	No
Habitat Areas of Particular Concern	**Presence**
Florida Middle Grounds	No: located greater than 100 nmi east of affected area
Florida Keys National Marine Sanctuary	No: located greater than 150 nmi south of affected area
Florida Bay	No: located greater than 150 nmi south of affected area
Flower Garden Banks National Marine Sanctuary	No: located greater than 300 nmi west of affected area
Apalachicola National Estuarine Research Reserve	No: located greater than100 nmi northeast of affected area
Rookery Bay National Estuarine Research Reserve	No: located greater than 100 nmi southeast of affected area
Weeks Bay National Estuarine Reserve	No: located greater than 20 nmi northwest of affected area
Grand Bay, Mississippi	No: located greater than 30 nmi northwest of affected area
Dry Tortugas	No: located greater than 150 nmi south of affected area
Grand Bay, Mississippi	No: located greater than 30 nmi northwest of affected area
Pulley Ridge	No: located greater than 50 nmi east of affected area
Madison-Swanson marine Reserve	No: located greater than 50 nmi east of affected area

A number of the habitat categories presented in Table 2 are not present in the area affected by the proposed draft permit. Impacts on habitats present or potentially present are discussed in the following paragraphs. Descriptions of the habitats were mostly excerpted from the "Generic Amendment for Addressing Essential Fish Habitat Requirements in the following Fishery Management Plans of the Gulf of Mexico."

Water Column

The major operational discharges resulting from exploration and development activities, drilling fluids, cuttings and well treatment discharges may have a minimum, short term effect on water column EFH.

Drilling Fluids: Federal water quality criteria are compared to effluent concentrations projected for the edge of a 100-m mixing zone to determine the ability of drilling fluid discharges to achieve sufficient mixing and occur at concentrations below criteria in the surrounding waters. The minimum number of dilutions to achieve sufficient mixing for drilling fluids is projected to be 118 (the number of dilutions required to meet the arsenic human health criterion). Based on drilling fluids modeling results, there appears to be significant probability that the criteria can be met by the edge of a 100-m mixing zone.

For comparison, the preferred option of the BOEM EIS for this development and production project specifies a maximum 400 bbl/hr discharge rate; water depths for the proposed activity area range from approximately 30 m to 150 m. For the generalized drilling fluid modeling approach that had been performed for EPA Region 10, a 500 bbl/hr discharge in a water depth of 20 m resulted in a minimum projected dilution of 1,035; even at a 1,000 bbl/hr discharge rate the available dilution is 655 at a water depth of 20 m and 731 at a water depth of 40 m. For a 1,000 bbl/hr discharge in a 70-m water depth, the dilutions achieved at 100 meters is 1,721, 10-fold greater than the amount required to meet the most stringent Federal water quality criteria in the Gulf of Mexico.

The low toxicity of whole drilling fluids in addition to mud plume dilution of priority pollutants to levels below Federal water quality criteria within a designated 100-m mixing zone is expected to ensure minimal impacts to water column EFH.

Vegetated Bottoms

Seagrasses and macroalgae have long been recognized as important primary producers in marine habitats. Due to the depths (>8,000 ft) of the areas affected by the proposed draft permit, seagrasses and macroalgae are not present. The distribution of benthic algae is ubiquitous throughout the Gulf of Mexico from bays and estuaries out to depths of 200 m. It is a significant source of food for fish and invertebrates. The wide gently sloping continental shelf, particularly in the eastern Gulf, provides a vast area where benthic species of algae can become established and drift along the bottom and continue to grow even when detached from the substrate. Benthic algae also form large mats that drift along the bottom.

Non-Vegetated Bottoms

The Gulf of Mexico can be divided into two major sediment provinces, carbonate to the east of DeSoto Canyon and southward along the Florida coast, and terrigenous to the west of DeSoto Canyon past Louisiana to the Mexican border. Fine sediments are also strongly represented on the outer shelf beyond the 80-m isobath. Surface sediments may affect shrimp and fish distributions directly in terms of feeding and burrowing activities or indirectly through food

availability, water column turbidity, and related factors. The depth of the project area, the rapid dilution and low toxicity of drilling fluids should minimize potential impacts to non-vegetated seafloor habitat.

Live Bottoms

Live bottoms are defined as those areas that contain biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascidians, sponges, bryozoans, seagrasses, or corals living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography favoring the accumulation of turtles and fishes. These communities are scattered across the shallow waters of the west Florida Shelf and within restricted regions of the rest of the Gulf of Mexico. The Florida Middle Ground is probably the best known and most biologically developed of these areas with extensive inhabitation by hermatypic corals and related communities. This area is 160 km west-northwest of Tampa and far from the project area. The faunal assemblages of the eastern Gulf are markedly different from those of the rest of the Gulf. This difference is partially attributed to the calcareous sediments found east of DeSoto Canyon as opposed to the terrigeneous muds and sands of the central and western Gulf and the influence of the upwelling associated with the Loop Current.

There is no evidence of livebottom habitat in or near the project area. In addition, the permit does not authorize discharges within 500 meters of livebottom habitat. In addition the rapid dilution and low toxicity of drilling fluids should further minimize potential impacts to livebottom habitat.

Geologic Features

Special geologic features in the project vicinity are discussed below in the discussion of the West Florida Shelf.

Continental Shelf Features

The Gulf of Mexico continental shelf varies in width from about 280 km off southern Florida to about 200 km off east Texas and Louisiana. The shelf narrows to 110 km off southwest Texas. The shelf is widest in southern Florida (300 km) and narrowest off the modern Mississippi River Delta (10 km). East of DeSoto Canyon, the shelf is mainly dominated by a thick accumulation of southeasterly trending carbonate rocks and evaporite sediments. This area has not been influenced by the massive terrigenous regime that has occurred in other parts of the Gulf. The continental shelf (0 - 200 m) occupies about 35.2 percent of the surface area of the Gulf, and provides habitats that vary widely from the deeper waters. The shelf and shelf edge of the Gulf of Mexico are characterized by a variety of topographic features. The value of these topographic features as habitat is important in several respects. Some of these features support hardbottom communities of high biomass and high diversity and an abundance of plant and animal species. These features are unique in that they are small, isolated, highly diverse areas within areas of much lower diversity. They support large numbers of commercially and recreationally important fish species by providing either refuge or food. Specific features in the project vicinity are discussed below in the discussion of the West Florida Shelf.

West Florida Shelf

The west Florida shelf is composed mainly of carbonate sediments. These sediments are in the form of quartz-shell sand (> 50 percent quartz), shell-quartz sand (< 50 percent quartz), shell sand, and algal sand. The bottom consists of a flat limestone table with localized relief due to relict reef or erosional structures. The benthic habitat types include low relief hardbottom, thick sand bottom, coralline algal nodules, coralline algal pavement, and shell rubble. The west Florida shelf provides a large area of scattered hard substrates, some emergent, but most covered by a thin veneer of sand, that allow the establishment of a tropical reef biota in a marginally suitable environment. The only high relief features are a series of shelf edge prominences that are themselves the remnants of extensive calcareous algal reef development prior to sea level rise and are now too deep to support active coral communities.

Along the west Florida shelf are areas with substantial relief. In an area south of the Florida Middle Grounds, in water depths of 46 to 63 m, is a ridge formed from limestone rock termed the Elbow, and it is about 5.4 km at its widest and has a vertical relief of 6.5 to 14 m. South of Panama City are two notable areas with high relief. The Whoopie Grounds (Madison Swanson Rocks) are located in 66 to 112 m of water and have rock ledges with 6 to 8 m of relief and are covered with coral and other invertebrate growth. The Mud Banks are formed by a ledge that has a steep drop of 5 to 7 m. The ledge extends for approximately 11 to 13 km in 57 to 63 m of water. The "3 to 5s", a series of ledges located southwest of Panama City, occur in water depths of 31 to 42 m of water. The ledges are parallel to the 36.5-m isobath and have relief of 5.5 to 9 m. The features listed above are part of a larger area of shelf-edge reefs that extend along the 75 meter isobath offshore of Panama City to just north of the Tortugus which also includes the Twin Ridges, The Edges, Steamboat Lumps (Koenig et. al: 2000). According to Koenig et. al, the northeastern portion of this area represents the dominant commercial fishing grounds for gag and contains gag and scamp spawning aggregation sites. Two of the areas (Madison/Swanson and Steamboat Lumps) were designated as marine reserves on June 19, 2002 for a four year period to protect a portion of the gag spawning aggregations and to protect a portion of the offshore population of male gag.

Another west Florida shelf region with notable coral communities is bounded by the waters of Tampa Bay on the north and Sanibel Island on the south. The area consists of a variety of bottom types. Rocky bottom occurs at the 18 m contour where sponges, alcyonarians, and the scleractinians *Solenastrea hyades* and *Cladocora arbuscula* are especially prominent.

Several factors limits impacts to geological features of the west Florida shelf. Most of the areas under discussion are protected by moratoria for all oil and gas exploration and production. The proposed permit project area is in deep water (>8,000 ft) seaward of the west Florida shelf. In addition, drilling fluids undergo rapid dilution, and the low toxicity of drilling fluids should further minimize potential impacts.

Impact Summary for Essential Fish Habitat and Federal Action Agency Determination

The Magnuson-Stevens Act implementing regulations (50 CFR 600.920(e)(3)) state that all EFH assessments must include the following information: 1) a description of the proposed action; 2) an analysis of the effects, including cumulative effects, of the proposed action on EFH, the managed species, and associated species, such as major prey species, including affected life history stages; 3) the Federal agency's view regarding the effects of the action on EFH; and 4) proposed mitigation, if applicable….

A description of the proposed action can be found on page 1 of this document. Any potentially harmful physical characteristics and chemical constituents present at the time of discharge should disperse rapidly as the waste streams undergo physical dilution processes. Major adverse impacts to any benthic or demersal EFH are, therefore, unlikely to occur as a result of these discharges. The high degree temporal and spatial patchiness with regard to the distribution of plankton assemblages in the water column should greatly limit plankton exposure to potentially harmful water quality conditions.

As a result of the analyses presented above, EPA has determined that the minimal short-term impacts associated with these discharges will not result in substantial adverse effects on EFH or managed species in any life history stage, either immediate of cumulative, in the project area. A summary of EPA's findings are presented in Table 3 below. Mitigation measures incorporated into the permit include:

Drilling Fluids and Cuttings

- Discharge limited to a rate of 1,000 bbl/hour
- Whole effluent toxicity (WET) must meet both a daily minimum and a monthly average minimum limitation of 30,000 ppm (3.0% by volume), using a volumetric mud-to-water ratio of 1 to 9
- No discharge of free oil as determined by the static sheen test
- No discharge of fluids to which barite has been added if the barite contains mercury in excess of 1.0 mg/kg (dry weight) or cadmium in excess of 3.0 mg/kg (dry weight)
- No discharge of oil based or synthetic based drilling fluids or

Drill Cuttings when synthetic fluids are used

- No discharge if formation oil is detected in the drilling fluid as determined by GC/MS
- Sediment toxicity test ratio shall not exceed 1.0
- Amount of SBM retained on cuttings must not exceed 6.9g SBM/100g wet cuttings for C_{16}-C_{18} IOs or 9.4g SBM/100g wet cuttings for C_{12}-C_{14} or C_8 esters; a default value of 14% retained fluid is used for compliance with discharges at the seafloor
- Polynuclear Aromatic Hydrocarbons (PAH) mass ratio must not exceed $1x10^{-5}$
- Biodegradation rate ratio of the stock base fluid shall not exceed 1.0

Table 3. Summary of Potential Impacts to Essential Fish Habitat (EFH) and Geographically Defined Habitat Areas of Particular Concern

Essential Fish Habitat	Presence	Impact Assessment
Water column	Yes	No Significant Impact: WQC met for all constituents within mixing zone. Impacts will be of short duration and limited in scope.
Vegetated bottoms	No	No Significant Impact: Not present
Non-vegetated bottoms	Yes	No Significant Impact
Live bottoms	No	No Significant Impact: Not present
Coral reefs	No	No Significant Impact: Not present
Geologic features	No	No Significant Impact: Not present
Continental shelf features	No	No Significant Impact: Not present
Mississippi/Alabama shelf	No	No Significant Impact: Not present
West Florida shelf	Yes	No Significant Impact: Not present.
Habitat Areas of Particular Concern		
Florida Middle Grounds	No	No Significant Impact: Avoided
Florida Keys National Marine Sanctuary	No	No Significant Impact: Avoided
Florida Bay	No	No Significant Impact: Avoided
Flower Garden Banks National Marine Sanctuary	No	No Significant Impact: Avoided
Apalachicola National Estuarine Research Reserve	No	No Significant Impact: Avoided
Rookery Bay National Estuarine Research Reserve	No	No Significant Impact: Avoided
Weeks Bay National Estuarine Reserve	No	No Significant Impact: Avoided

Essential Fish Habitat	Presence	Impact Assessment
Grand Bay, Mississippi	No	No Significant Impact: Avoided
Dry Tortugas	No	No Significant Impact: Avoided

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OCEAN DISCHARGE CRITERIA EVALUATION FOR THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE LLOG EXPLORATION OFFSHORE, L.L.C. EXPLORATORY DRILLING AND COMPLETION OPERATIONS IN OCS-G-31567 LEASE, DESOTO CANYON BLOCK 713 AREA. FL0944858

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CONTENTS

1. INTRODUCTION
1.1 Background 1-1
1.2 Scope 1-3
1.3 Description of Proposed Discharges 1.3
1.4 Area of Coverage 1-4
1.5 Document Overview 1-5

2. PHYSICAL AND CHEMICAL OCEANOGRAPHY
2.1 Physical Oceanography 2-1
2.1.1 Circulation 2-1
2.1.2 Climate 2-3
2.1.3 Temperature 2-3
2.1.4 Salinity 2-4
2.2 Chemical Composition 2-4
2.2.1 Micronutrients 2-5
2.2.2 Dissolved Gases 2-5
2.2.3 Seafloor Geomorphology 2-5

3. DISCHARGED MATERIAL
3.1 Discharges Covered Under an NPDES Permit 3-1
3.2 Drilling Fluids 3-1
3.2.1 Synthetic-Based Drilling Fluids 3-6
3.3 Drill Cuttings 3-9
3.4 Deck Drainage 3-11
3.5 Sanitary Waste 3-11
3.6 Domestic Waste 3-11
3.7 Cement 3-12
3.8 Well Treatment, Workover, and Completion Fluids 3-13
3.9 Blowout Preventer Fluids 3-16
3.10 Desalination Unit Discharges 3-16
3.11 Ballast Water and Storage Displacement Water 3-17
3.12 Bilge Water 3-17
3.13 Uncontaminated Seawater 3-17
3.14 Boiler Blowdown 3-17
3.15 Diatomaceous Earth Filter Media 3-17

4. TRANSPORT AND PERSISTENCE
4.1 Water Based Drilling Fluids 4-1
4.1.1 Physical Transport Processes 4-2
4.1.2 Seafloor Sedimentation 4-5
4.1.3 Biological Transport 4-7
4.1.4 Chemical Transport Processes 4-7
4.2 Discharge Modeling - Drilling Fluids 4-11
4.2.1 OOC Mud Discharge Model 4-12
4.2.2 Derivation of Generalized Dispersion/Dilution Estimates 4-12
4.2.3 Model Results from Generalized Input 4-13

4.3 Synthetic Based Drilling Fluids 4-16
4.3.1 Disposal and Accumulation of SBF Cuttings 4-16
4.3.2 Biodegradation of SBF's 4-17

5. TOXICITY AND BIOACCUMULATION
5.1 Overview 5-1
5.2 Toxicity of Drilling Fluids 5-1
5.2.1 Acute Toxicity 5-2
5.2.2 Chronic Toxicity 5-14
5.2.3 Long Term Sublethal Effects 5-16
5.2.4 Metals 5-18
5.3 Bioaccumulation Potential of Synthetic-Based Drilling Fluids 5-19

6. BIOLOGICAL OVERVIEW
6.1 Primary Productivity 6-1
6.2 Phytoplankton 6-2
6.2.1 Distribution 6-2
6.2.2 Principal Taxa 6-3
6.3 Zooplankton 6-4
6.4 Habitats 6-5
6.4.1 Seagrasses 6-5
6.4.2 Offshore Habitats 6-6
6.5 Fish and Shellfish resources 6-7
6.8 Marine Mammals 6-9
6.10 Endangered Species 6-9

7. COMMERCIAL AND RECREATIONAL FISHERIES
7.1 Overview 7-1
7.2 Commercial Fisheries 7-1
7.2.1 Recreational Fisheries 7-5

8. COASTAL ZONE MANAGEMENT PLAN AND SPECIAL AQUATIC SITES
8.1 Coastal Zone Management Consistency 8-1
8.2 Alabama Coastal Area Management Program 8-2
8.3 Mississippi Coastal Program 8-3
8.4 Florida Coastal Management Program 8-4
8.5 Special Aquatic Sites 8.4

9. FEDERAL WATER QUALITY CRITERIA AND STATE WATER QUALITY STANDARDS
9.1 Federal Water Quality Criteria 9-1
9.2 Florida Water Quality Standards 9-2
9.3 Alabama Water Quality Standards 9-3
9.4 Mississippi Water Quality Standards 9-5
9.5 Compliance with Federal Water Quality Criteria 9-7
9.5.1 Water-Based Drilling Fluids Discharges 9-7
9.5.2 Synthetic-Based Drilling Fluids Discharges 9-8
9.6 Compliance with State Water Quality Standards 9-11
9.6.1 Water Based Drilling Fluids Discharges 9-11

10. EVALUATION OF THE OCEAN DISCHARGE CRITERIA
10.1 Introduction 10-1
10.2 Evaluations of the Ten Ocean Discharge Criteria 10-1
10.3 Conclusion 10-7

11. REFERENCES 11-1

TABLES

Table 1.1 LLOG exploratory drilling and well completion discharges 1.3
Table 3-1 Functions of Common Drilling Fluid Chemical Additives 3-3
Table 3-2 Trace Metal Concentrations in Barite 3-4
Table 3-3 Drilling Fluid Pollutant Concentrations 3-7
Table 3-4 Synthetic-based Fluids Drilling Wastes Characteristics 3-8
Table 3-5 Mineral Composition of a Shale-Shaker Discharge from a Mid-Atlantic Well 3-10
Table 3-7 Garbage Discharge Restrictions 3-12
Table 3-8 Analysis of Fluids from and Acidizing Well Treatment 3-15
Table 4-1 Estimates of Distances Required to Achieve Specified Levels of Dilution of a Soluble Drilling Fluid Tracer in the Upper Plume at Fixed Current Speeds based on Field Study Data 4-5
Table 4-2 Summary of Sediment Trace Metal Alterations from Drilling Activities 4-10
Table 4-3 Summary of OOC Mud Model Drilling Fluid Plume Behavior 4-14
Table 4-4 Summary of OOC Mud Discharge Model Results by Discharge Rate 4-15
Table 4-5 Summary of OOC Mud Discharge Model Results by Water Depth for High Weight (17.4 lb/gal) Muds Discharged at 1,000 bbl/hr 4-15
Table 5-1 Summary of the Acute Lethal Toxicity of Drilling Fluid 5-3
Table 5-2 Comparison of Whole Fluid Toxicity and Aqueous and Particulate Fraction Toxicity for Some Organisms 5-4
Table 5-3 Drilling Fluid Toxicity to Grass Shrimp (*Palaemonetes intermedius*) Larvae 5-5
Table 5-4 Results of Continuous Exposure (48 hr) of 1-hr Old Fertilized Eggs of Hard Clams (*Mercenaria mercenaria*) to Liquid and Suspended Particulate Phases of Various Drilling Fluids 5-6
Table 5-5 Toxicity of API #2 Fuel Oil, Mineral Oil, and Oil-Contaminated Drilling Fluids to Grass Shrimp (*Palaemonetes intermedius*) Larvae 5-7
Table 5-6 Reported Toxicities of Synthetic-Based Fluids 5-9
Table 5-7 Minimum and Maximum LC50 Values for New Sediment Toxicity Data Presented as Comment Response on Either the Proposed Rule (12/99) or the Notice of Data Availability (4/00) for Effluent Limitations Guidelines for the Oil and Gas Extraction Point Source Category 5-12
Table 5-8 Bioaccumulation Data for Synthetic-Based Fluids and Mineral Oil Muds 5-20
Table 6-1 Significant Dinoflagellate Species of the Eastern Gulf of Mexico 6-5
Table 6-2 Federally Listed and Candidate Species in Impact Areas of the Eastern Gulf of Mexico 6-9
Table 7-1 Key Gulf of Mexico Region Commercial Species or species groups 7-2
Table 7-2 Total Weights and Values of Commercially Important Fishery Species in the GOM Region in 2009 7-2
Table 7-3 Value of Gulf Coast Fish Landings by Distance from Shore and State for 2009 7-3

Table 7-4 2012 Economic Impacts of the Eastern Gulf of Mexico Region Seafood Industry 7-4
Table 7-5 Total Landings and Landings of Key Species/Species Groups from 2009 to 2012 7-4
Table 7-6 Key Gulf of Mexico Region Recreational Species 7-5
Table 7-7 Estimated Number of People Participating in GOM Marine Recreational Fishing 7-5
Table 7-8 2012 Economic Impacts of Recreational Fishing Expenditures 7-6
Table 9-1 Federal Water Quality Criteria 9-1
Table 9-2 Florida Water Quality Standards 9-2
Table 9-3 Alabama Toxic Pollutant Standards 9-4
Table 9-4 Reference Doses, BCFs, and Cancer Potency Factors Used to Calculate Alabama Toxic Pollutant Standards 9-5
Table 9-5 Mississippi Toxic Pollutant Standards 9-7
Table 9-6 Comparison of Federal Water Quality Criteria to Projected Drilling Fluids Pollutant Concentrations at 100 Meters 9-8
Table 9-7 Comparison of Florida Water Quality Standards to Projected Drilling Fluids Pollutant Concentrations at 100 Meters 9-11
Table 9-8 Comparison of Alabama Water Quality Standards to Projected Drilling Fluids Pollutant Concentrations at 100 Meters 9-12
Table 9-9 Comparison of Mississippi Water Quality Standards to Projected Drilling Fluids Pollutant Concentrations at 100 Meters 9-13

FIGURES

Figure 1-1 Location of well sites in Desoto Canyon Block 713 ..... 1.4
Figure 2-1 Major current regime in the Gulf of Mexico 2-2
Figure 4-1 Approximate Pattern of Initial Particle Deposition 4-6
Figure 8-1 High Relief Live Bottom Areas in the Central and Eastern Gulf of Mexico 8-5

1. INTRODUCTION

The U.S. Environmental Protection Agency (EPA), Region 4, is proposing to issue a National Pollutant Discharge Elimination System (NPDES) permit for discharges from drilling and well completion activities in OCS-G-31567 Lease, Desoto Canyon Block 713 area. The permit will apply to exploration and development phases for three well sites. The wells will be located approximately 190 miles southeast of New Orleans, Louisiana in water depths in excess of 8,000 ft.

LLOG plans to drill two wells in 2016 and one well in 2017. It is expected that drilling and completion will take approximately 80 days per well. Discharges will include water based drilling muds and cuttings, cuttings from the synthetic drilling mud phase, well treatment fluids, well completion fluids, sanitary wastes, grey water, cooling water blowout preventer fluids and excess cement.

This Ocean Discharge Criteria Evaluation (ODCE) addresses the U.S. Environmental Protection Agency's (EPA) regulations for preventing unreasonable degradation of the receiving waters in portions of the Gulf of Mexico covered under this permit.

1.1 Background

Section 402 of the Clean Water Act (CWA) authorizes EPA to issue National Pollutant Discharge Elimination System (NPDES) permits to regulate discharges to waters of the United States. Sections 402 and 403 of the CWA require that an NPDES permit for a discharge into the territorial seas (baseline to 3 miles), or farther offshore in the contiguous zone or the ocean, be issued in compliance with EPA's regulations for preventing unreasonable degradation of the receiving waters in Title 40 of the Code of Federal Regulations [CFR] Part 125, Subpart M.

Prior to permit issuance, discharges must be evaluated against EPA's published criteria for determination of unreasonable degradation. Unreasonable degradation is defined in the NPDES regulations (40 CFR 125.121[e]) as the following.

1. Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities

2. Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms

3. Loss of aesthetic, recreational, scientific or economic values, which is unreasonable in relation to the benefit derived from the discharge.

Ten factors are specified at 40 CFR 125.122 for determining unreasonable degradation. They are the following.

1. The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged

2. The potential transport of such pollutants by biological, physical or chemical processes

3. The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain

4. The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism

5. The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs

6. The potential impacts on human health through direct and indirect pathways

7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing

8. Any applicable requirements of an approved Coastal Zone Management plan

9. Such other factors relating to the effects of the discharge as may be appropriate

10. Marine water quality criteria developed pursuant to Section 304(a)(1).

On the basis of the analysis in this ODCE, the Regional Administrator will determine whether the permit may be issued. The Regional Administrator can make one of three findings:

1. The discharges will not cause unreasonable degradation of the marine environment and issue the permit.

2. The discharges will cause unreasonable degradation of the marine environment, and may deny the permit or impose more stringent permit conditions and/or monitoring.

3. There is insufficient information to determine, before permit issuance, that there will be no unreasonable degradation of the marine environment, and issue the permit if, on the basis of available information, that:

   - Such discharge will not cause irreparable harm1 to the marine environment during the period in which monitoring will take place.
   - There are no reasonable alternatives to the on-site disposal of these materials.
   - The discharge will be in compliance with additional permit conditions set out under (40 CFR 125.123(d)).

1.2 Scope

The permit covers discharges from offshore oil and gas exploratory drilling operations, which identify the location of producing formations, and development operations conducted on platforms from which multiple wells are drilled.

In this evaluation the ODCE addresses the 10 factors for determining unreasonable degradation as outlined above and at 40 CFR 125.122. It also assesses whether the information exists to make a "no unreasonable degradation" determination, including any recommended permit conditions that may be necessary to reach that conclusion.

1.3 Description of Proposed Discharges

This Ocean Discharge Criteria Evaluation (ODCE) evaluates the impacts from the waste discharges regulated under the permit including drilling fluids; drill cuttings; deck drainage; well treatment, completion, and workover fluids; sanitary waste; domestic waste; and miscellaneous wastes. The quantities and composition of the discharged material from the proposed LLOG drilling and completion operations are shown in Table 1.1.

Table 1.1. LLOG exploratory drilling and well completion discharges.

Discharge	Quantity	Units per Well
Water based drilling fluids	6,772	bbls/day
Water based drill cuttings	807	bbls/day
Synthetic based drill cuttings	113	bbls/day
Well treatment fluids	20	bbls/hour
Uncontaminated seawater	100	bbls/hour
Domestic wastes (grey water)	2.7	bbls/hour
Sanitary wastes	1.8	bbls/hour

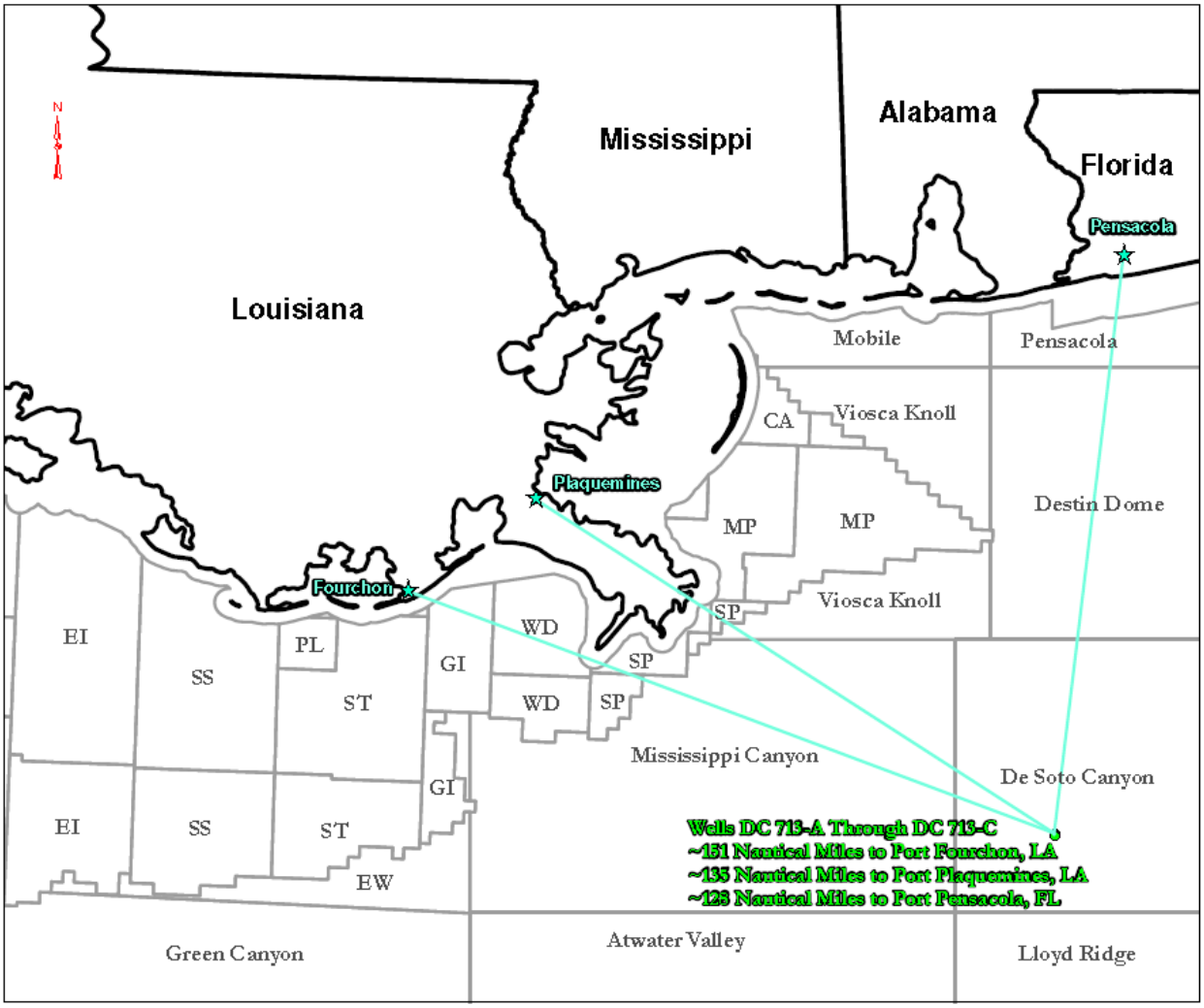
Expanded discussion of the waste streams resulting from exploratory and well completion activities including the use, function and composition of such discharges is found in Chapter 3.

The toxicity and bioaccumulation potential and transport mechanisms and persistence of the important constituents of these discharges are discussed at length in Chapters 4 and 5.

1.4 Area of Coverage

Figure 1 shows the location of the prosed exploratory wells in the Desoto Canyon Block 713. The Clean Water Act provides EPA with federal jurisdiction for NPDES permitting beginning three statute miles from the landward boundary of the territorial seas, or "baseline," for all states bordering the Gulf of Mexico.

Figure 1. Location of well sites in Desoto Canyon Block 713.



Source: Berger Geosciences, LLC. (2015)

1.5 Document Overview

Chapter 2 of this document provides a description of the physical environment relevant to the portions of the Desoto Canyon Block 917 areas covered by the permit (ODCE Factor 2). Chapter 3 describes the characteristics, composition, and quantities of materials that potentially will be discharged from the facility (ODCE Factor 1). Chapter 4 describes the transport and persistence of pollutants in the marine environment (ODCE Factor 2). Chapter 5 describes the toxicity and potential for bioaccumulation of contaminants in the waste streams covered by the proposed permit (ODCE Factors 1 and 6). Chapter 6 provides a biological overview of the affected environment (ODCE Factors 3 and 4). Chapter 7 provides information on commercial and recreational fisheries in the receiving water environment (ODCE Factor 7). Chapter 8 describes the Florida Coastal Zone Management Plan (CZMP) and Special Aquatic Sites (ODCE Factors 5 and 8). Chapter 9 provides a Federal Water Quality Criteria and State Water Quality Standards Analysis (ODCE Factor 10). Chapter 10 describes potential impacts on human health (ODCE Factor 6). Chapter 11 lists cited references. Factor 9, the consideration of additional factors, was not considered necessary in this evaluation.

2. The Physical Environment

2.1 Physical Oceanography

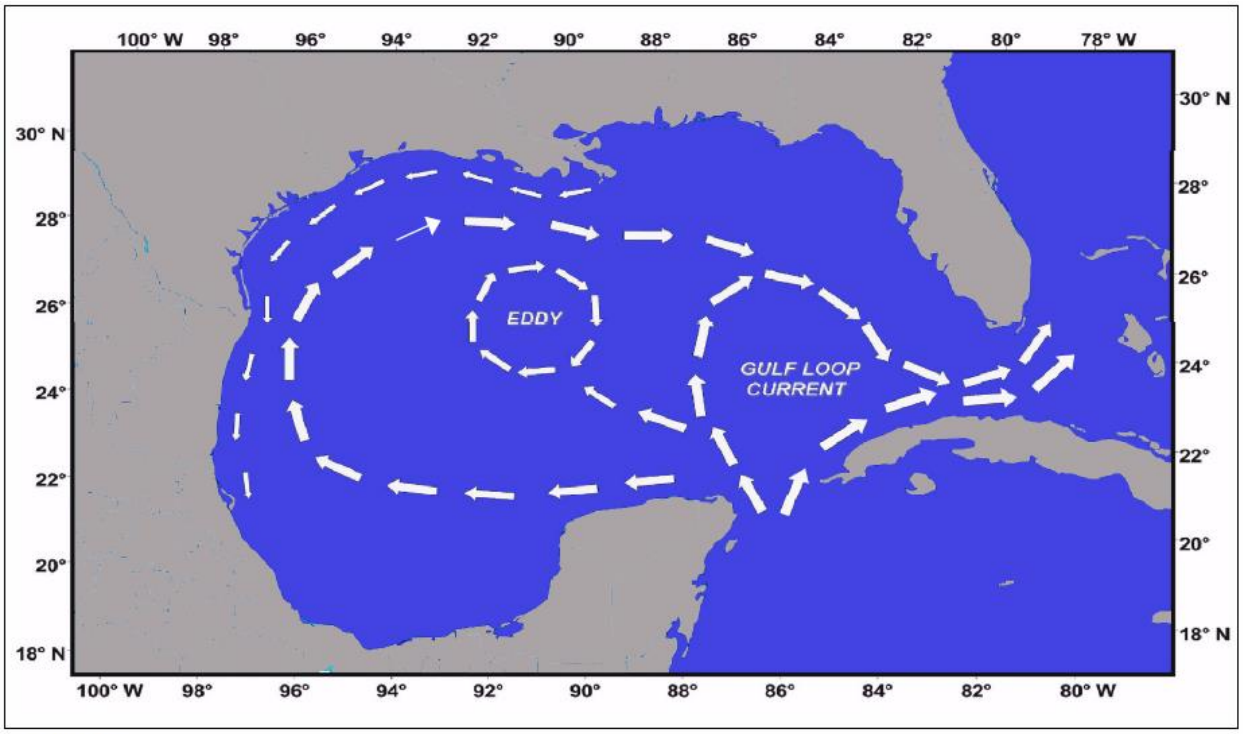
The Gulf of Mexico GOM is bounded by Cuba on the southeast; Mexico on the south and southwest; and the U.S. Gulf Coast on the west, north, and east. The GOM has a total area of 564,000 square kilometers (km2) (217,762 square miles [mi2]). Shallow and intertidal areas (water depths of less than 20 m) compose 38 percent of the total area, with continental shelf (22 percent), continental slope (20 percent), and abyssal (20 percent) composing the remainder of the basin.

The Gulf is separated from the Caribbean Sea and Atlantic Ocean by Cuba and other islands, and has relatively narrow connections to the Caribbean and Atlantic through the Florida and Yucatan Straits. The Gulf is composed of three distinct water masses, including the North and South Atlantic Surface Water (less than 100 m deep), Atlantic and Caribbean Subtropical Water (up to 500 m deep), and Subantarctic Intermediate Water.

2.1.1 Circulation

Circulation patterns in the Gulf of Mexico are characterized by two interrelated systems, the offshore or open Gulf, and the shelf or inshore Gulf. Both systems involve the dynamic interaction of a variety of factors. Open Gulf circulation is influenced by eddies, gyres, winds, waves, freshwater input, density of the water column, and currents. Offshore water masses in the eastern Gulf may be partitioned into a Loop Current, a Florida Estuarine Gyre in the northeastern Gulf, and a Florida Bay Gyre in the southeastern Gulf (Austin, 1970).

The strongest influence on circulation in the eastern Gulf of Mexico is the Loop Current (Figure 2). The location of the Loop Current is variable, with fluctuations that range over the outer shelf, the slopes, and the abyssal areas off Mississippi, Alabama, and Florida. Within this zone, short-term strong currents exist, but no permanent currents have been identified (MMS, 1990). The Loop Current forms as the Yucatan Current enters the Gulf through the Yucatan Straits and travels through the eastern and central Gulf before exiting via the Straits of Florida and merging with other water masses to become the Gulf Stream (Leipper, 1970; Maul, 1977). The Loop Current extends to about 1000 m depth with surface speeds as high as 150-200 cm/s, decreasing with depth (MMS 2000a).



Source: NOAA 2007

Figure 2-1 Major current regime in the Gulf of Mexico.

In the shelf or inshore Gulf region, circulation within the Mississippi, Alabama, and west Florida shelf areas is controlled by the Loop Current, winds, topography, and tides. Freshwater input also acts as a major influence in the Mississippi/Alabama shelf and eddy-like perturbations play a significant role in the west Florida shelf circulation. Current velocities along the shelf are variable. Brooks (1991) found that average current velocities in the Mississippi/Alabama shelf area were are about 1.5 centimeters per second and east-west and northeast-southwest directions dominate. MMS (1990) data showed that winter surface circulation is directed along shore and westward with flow averaging 4 cm/s to 7 cm/s. During the spring and summer, the current shifts to the east with flow averaging 2 cm/s to 7 cm/s. The mean circulation on the west Florida shelf is directed southward with mean flow ranging from 0.2 cm/s to 7 cm/s (MMS, 1990).

Wind patterns in the Gulf are primarily anticyclonic (clockwise around high pressure areas), and tend to follow an annual cycle; winter winds from the north and southeast and summer winds from the northeast and south (Figure 5). During the winter, mean wind speeds range from 8 knots to 18 knots. Several examples of mean annual wind speeds in the eastern Gulf are 8.0 millibars (mb) in Gulf Port, Mississippi; 8.3 mb in Pensacola, Florida; and 11.2 mb in Key West, Florida (NOAA, 1961-1986).

The tides in the Gulf of Mexico are less developed and have smaller ranges than those in other coastal areas of the United States. The range of tides is 0.3 meters to 1.2 meters, depending on

the location and time of year. The Gulf has three types of tides, which vary throughout the area: diurnal, semidiurnal, and mixed (both diurnal and semidiurnal). Wind and barometric conditions will influence the daily fluctuations in sea level. Onshore winds and low barometric readings, or offshore winds and high barometric readings, cause the daily water levels either to be higher or lower than predicted. In shelf areas, meteorological conditions occasionally mask local tide-induced circulation. Tropical storms in summer and early fall may affect the area with high winds (18+ meters per second), high waves (7+ meters), and storm surge (3 to 7.5 meters). Winter storm systems also may cause moderately high winds, waves, and storm conditions that mask local tides.

2.1.2 Climate

The GOM is influenced by a maritime subtropical climate controlled mainly by the clockwise wind circulation around a semi-permanent, high barometric pressure area alternating between the Azores and Bermuda Islands. The circulation around the western edge of the high pressure cell results in the predominance of moist southeasterly wind flow in the region. However, winter weather is quite variable. During the winter months, December through March, cold fronts associated with outbreaks of cold, dry continental air masses influence mainly the northern coastal areas of the GOM. Tropical cyclones may develop or migrate into the GOM during the warmer season, especially in the months of August through October. In coastal areas, the land-sea breeze is frequently the primary circulation feature in the months of May through October. (BOEM, 2013)

2.1.2 Temperature

In the Gulf, sea-surface temperatures range from nearly isothermal (29-30^{0}C) in August to a sharp horizontal gradient in January, ranging from 25^{0}C in the Loop core to values of 14-15^{0}C along the shallow northern coastal estuaries. A 7^{0}C sea-surface temperature gradient occurs in winter from north to south across the Gulf. During summer, sea-surface temperatures span a much narrower range. The range of sea-surface temperatures in the eastern Gulf tends to be greater than the range in the western Gulf, illustrating the contribution of the Loop Current.

Eastern Gulf surface temperature variation is affected by season, latitude, water depth, and distance offshore. During the summer, surface temperatures are uniformly 26.6^{0}C or higher. The mean March isotherm varies from approximately 17.8^{0}C in the northern regions to 22.2^{0}C in the south (Smith, 1976). Surface temperatures range as low as 10^{0}C in the Louisiana-Mississippi shelf regions during times of significant snow melt in the upper Mississippi valley (MMS, 1990).

At a depth of 1,000 m, the temperature remains close to 5^{0}C year-round (MMS, 1990). In winter, nearshore bottom temperatures in the northern Gulf of Mexico are 3-10^{0}C cooler than those temperatures offshore. A permanent seasonal thermocline occurs in deeper offshelf water throughout the Gulf. In summer, warming surface waters help raise bottom temperatures in all

shelf areas, producing a decreasing distribution of bottom temperatures from about 28EC at the coast to about 18-20^{0}C at the shelf break.

The depth of the thermocline, defined as the depth at which the temperature gradient is a maximum, is important because it demarcates the bottom of the mixed layer and acts as a barrier to the vertical transfer of materials and momentum. The thermocline depth is approximately 30-61 m in the eastern Gulf during January (MMS, 1990). In May, the thermocline depth is about 46 m throughout the entire Gulf (MMS, 1990).

2.1.3 Salinity

Characteristic salinity in the open Gulf is generally between 36.4 and 36.5 parts per thousand (ppt). Coastal salinity ranges are variable due to freshwater input, draught, etc. (MMS, 1990). During months of low freshwater input, deep Gulf water penetrates into the shelf and salinities near the coastline range from 29-32 ppt. High freshwater input conditions (spring-summer months) are characterized by strong horizontal gradients and inner shelf salinity values of less than 20l ppt (MMS, 1990).

2.2 Chemical Composition

Of the 92 naturally occurring elements, nearly 80 have been detected in seawater (Kennish, 1989). The dissolved material in seawater consists mainly of eleven elements. These are, in decreasing order, chlorine, sodium, magnesium, calcium, potassium, silicon, zinc, copper, iron, manganese, and cobalt (Smith, 1981). In addition to dissolved materials, trace metals, nutrient elements, and dissolved atmospheric gases comprise the chemical make-up of seawater.

2.2.1 Micronutrients

In Gulf of Mexico waters, generalizations can be drawn for three principal micronutrients; phosphate, nitrate, and silicate. Phytoplankton consume phosphorus and nitrogen in an approximate ratio of 1:16 for growth. The following nutrient levels and distribution values were obtained from MMS (1990): phosphates range from 0 ppm to 0.25 ppm, averaging 0.021 ppm in the mixed layer, and with shelf values similar to open Gulf values; nitrates range from 0.0031 ppm to 0.14 ppm, averaging 0.014 ppm; silicates range predominantly from 0.048 ppm to 1.9 ppm, with open Gulf values tending to be lower than shelf values.

In the eastern Gulf, inner shelf waters tend to remain nutrient deficient, except in the immediate vicinity of estuaries. On occasions when the loop current occurs over the Florida slope, nutrient-rich waters are upwelled from deeper zones (MMS, 1990).

2.2.2 Dissolved Gases

Dissolved gases found in seawater include oxygen, nitrogen, and carbon dioxide. Oxygen is often used as an indicator of water quality of the marine environment and serves as a tracer of the motion of deep water masses of the oceans. Dissolved oxygen values in the mixed layer of the Gulf average 4.6 mg/l, with some seasonal variation, particularly during the summer months when a slight lowering can be observed. Oxygen values generally decrease with depth to about 3.5 mg/l through the mixed layer (MMS, 1990). In some offshore areas in the northern Gulf of Mexico, hypoxic (<2.0 mg/l) and occasionally anoxic (<0.1 mg/l) bottom water conditions are widespread and seasonally regular (Rabalais, 1986). These conditions have been documented since 1972 and have been observed mostly from June to September on the inner continental shelf at a depth of 5 to 50 meters (Renauld, 1985; Rabalais et al., 1985).

2.2.3 Seafloor Geomorphology

The seafloor in the project area portion of Desoto Canyon Block 917 is nearly flat and consists of thick, rapidly deposited clastic sediments overlying carbonates and debris deposited over geologic history off the Florida Terrace. The sediments were mainly derived from the Mobile and Mississippi rivers. The water depth in this area is just over 8000 ft.

3. DISCHARGED MATERIAL

3.1 Discharges Covered Under the Permit

In this chapter, the following discharges are characterized by their sources and uses during drilling and production operations and by their physical and chemical compositions.

Exploration and development activities for the extraction of oil and gas include work necessary to locate, drill, and complete wells. Exploration activities are those operations that involve drilling wells to determine potential hydrocarbon reserves. Exploratory activities are usually of short duration at a given site, involve a small number of wells, and are generally conducted from mobile drilling units. Development activities involve drilling production wells once a hydrocarbon reserve has been discovered and delineated. These operations, in contrast to exploration activities, may involve a large number of wells which may be drilled from either fixed or floating platforms or mobile drilling units. The primary wastewater sources from the exploration and development phases of the offshore oil and gas extraction industry produce the following wastewater sources:

Drilling Fluids
Drill Cuttings
Deck Drainage
Sanitary Waste
Domestic Waste
Completion Fluids
Cement
Workover Fluids
Blowout Preventer Control Fluids
Desalination Unit Discharge
Ballast and Storage Displacement Water
Bilge Water
Uncontaminated Seawater
Boiler Blowdown

3.2 Drilling Fluids

Drilling fluids (muds), along with drill cuttings with adherent drilling fluid comprise the largest volume of waste discharges from drilling operations. Drilling fluids and drill cuttings are the most significant waste streams from exploratory and development operations in terms of volume and potentially toxic pollutants (EPA, 1993, 58 FR 12454, March 4, 1993, EPA 2009 citation from draft EA). The bulk of drilling muds consists of barite, clays, and a base fluid that can be any of a number of synthetic oils, mineral or diesel oil, or fresh/salt water that may or may not have an oil added for lubricity that are used in rotary drilling operations (EPA, 2009 citation from draft EA). The rotary drill bit is rotated by a hollow drill stem made of pipe, through which the drilling fluid is circulated. Drilling fluids are formulated for

each well to meet specific physical and chemical requirements. Geographic location, well depth, rock type, geologic formation, and other conditions affect the mud composition required. The number and nature of mud components varies by well, and several to many products may be used at any time to create the necessary properties. The primary functions of a drilling fluid include the following.

- Transport drill cuttings to the surface
- Control subsurface pressures
- Lubricate the drillstring
- Clean the bottom of the hole
- Aid in formation evaluation
- Protect formation productivity
- Aid formation stability (Moore, 1986).

The functions of drilling fluid additives and typical additives are listed on Table 3-1. Five basic components account for approximately 90 percent by weight of the materials that compose drilling muds: barite, clay, lignosulfonate, lignite, and caustic soda (EPA, 1993).

Barite. Barite is a chemically inert mineral that is heavy and soft. In water-based muds, barite is composed of over 90 percent barium sulfate. Synthetic-based fluids contain about 33% barium sulfate. Barium sulfate is virtually insoluble in seawater. Barite is used to increase the density of the drilling fluid to control formation pressure. The concentration of barite in drilling fluid can be as high as 700 lb/bbl (Perricone, 1980). Quartz, chert, silicates, other minerals, and trace levels of metals can also be present in barite. Barium sulfate contains varying concentrations of metals depending on the characteristics of the deposit from where the barite is mined. One study indicates that there is a correlation between cadmium and mercury and other trace metals in the barite (SAIC, 1991). EPA currently regulates cadmium and mercury concentrations in barite and refers to the stock barite that meets EPA limitations as “clean” barite. Table 3-2 provides mean metals concentrations in “clean” barite compared to their concentration in the earth's crust.

Clay. The most common clay used is bentonite, which is composed mainly of sodium montmorillonite clay (60 to 80%). It can also contain silica, shale, calcite, mica, and feldspar. Bentonite is used to maintain the rheologic properties of the fluid and prevent loss of fluid by providing filtration control in permeable zones. The concentration of bentonite in mud systems is usually 5 to 25 lb/bbl. In the presence of concentrated brine, or formation waters, attapulgite or sepiolite clays (10 to 30 lb/bbl) are substituted for bentonite (Perricone, 1980).

[a]

Table 3-1. Functions of Common Drilling Fluid Chemical Additives

Action	Typical Additives	Function
Alkalinity and pH Control	Caustic soda; sodium bicarbonate; sodium carbonate; lime	1. Control alkalinity 2. Control bacterial growth
Bactericides	Paraformaldehyde; alkylamines; caustic soda; lime; starch	Reduce bacteria count NOTE: Halogenated phenols are not permitted for OCS use
Calcium Removers	Caustic soda; soda ash; sodium bicarbonate; polyphosphate	Control calcium buildup in equipment
Corrosion Inhibitors	Hydrated lime; amine salts	Reduce corrosion potential
Defoamers	Aluminum stearate; sodium aryl sulfonate	Reduce foaming action in brackish water and saturated salt muds
Emulsifiers	Ethyl hexanol; silicone compounds; lignosulfonates; anionic and nonionic products	Create homogenous mixture of two liquids
Filtrate Loss Reducers	Bentonite; cellulose polymers; pregelated starch	Prevent invasion of liquid phase into formation
Flocculants	Brine; hydrated lime; gypsum; sodium tetraphosphate	Cause suspended colloids to group into "flocs" and settle out
Foaming Agents		Foam in the presence of water and allow air or gas drilling through formations producing water
Lost Circulation Additives	Wood chips or fibers; mica; sawdust; leather; nut shells; cellophane; shredded rubber; fibrous mineral wool; perlite	Used to plug in the well-bore wall to stop fluid loss into formation
Lubricants	Hydrocarbons; mineral oil; diesel oil; graphite powder; soaps	Reduce friction between the drill bit and the formation
Shale Control Inhibitors	Gypsum; sodium silicate; polymers; lime; salt	Reduce well collapse caused by swelling or hydrous disintegration of shales
Surface Active Agents (Surfactants)	Emulsifiers; de-emulsifiers; flocculants	1. Reduce relationship between viscosity and solids concentration 2. Vary the gel strength 3. Reduce the fluid plastic viscosity
Thinners	Lignosulfonates; lignite; tannis; polyphosphates	Deflocculate associated clay particles
Weighting Material	Barite; calcite; ferrophosphate ores; siderite; iron oxides (hematite)	Increase drilling fluid density
Petroleum Hydrocarbons	Diesel oil; mineral oil	Used for specialized purposes such as freeing stuck pipe

[a] Source: EPA, 1993.

Table 3-2. Trace Metal Concentrations in Barite[a]

Pollutant	Estimated Concentrations on Dry Weight Basis (mg/kg)	
	Barite	**Earth's Crust**
Aluminum	9,069.9	
Antimony	5.7	
Arsenic	7.1	2
Barium	359,747	
Beryllium	0.7	
Cadmium	1.1	0.2
Chromium	240	
Copper	18.7	45
Iron	15,344.3	50,000
Lead	35.1	15
Mercury	0.1	0.1
Nickel	13.5	80
Selenium	1.1	
Silver	0.7	
Thallium	1.2	
Tin	14.6	
Titanium	87.5	
Zinc	200.5	65

[a] Source: EPA, 1993.

Lignosulfonate. Lignosulfonate is used to control viscosity in drilling muds by acting as a thinning agent or deflocculant for clay particles. Concentrations in drilling fluid range from 1 to 15 lb/bbl. It is made from the sulfite pulping of wood chips used to produce paper and cellulose. Ferrochrome lignosulfonate, the most commonly used form of lignosulfonate, is made by treating lignosulfonate with sulfuric acid and

sodium dichromate. The sodium dichromate oxidizes the lignosulfonate and cross linking occurs. Hexavalent chromium supplied by the chromate is reduced during reaction to the trivalent state and complexes with the lignosulfonate. At high down-hole temperatures, the chrome binds onto the edges of clay particles and reduces the formation of colloids. Ferrochrome lignosulfonate retains its properties in high soluble salt concentrations and over a wide range of alkaline pH. It also is resistant to common mud contaminants and is temperature stable to approximately 177ºC (EPA, 1993).

Lignite. Lignite is a soft coal used in drilling muds as a deflocculant for clay, to control the filtration rate, and to control mud gelation at elevated temperatures. Concentrations vary from 1 to 25 lb/bbl (Perricone, 1980). Lignite products are more commonly used as thinners in freshwater muds.

Caustic Soda. Sodium hydroxide is used to maintain the pH of drilling muds between 9 and 12. A pH of 9.5 provides for maximum deflocculation and keeps the lignite in solution. A more basic pH lowers the corrosion rate and provides protection against hydrogen sulfide contamination by limiting microbial growth.

Drilling fluids can be water-based, oil-based, or synthetic-based. In water-based fluids (WBF), water is the suspending medium for solids and is the continuous phase, whether or not oil is present. Water-based drilling fluids are composed of approximately 50 to 90 percent water by volume, with additives comprising the rest. Historically, most drilling in the Gulf of Mexico has been performed with WBMs. WBMs are more cost effective in drilling many shallow wells, and WBM will continue to be used in those instances. However, for more complicated or deeper wells, SBM is often used.

WBFs have been classified into eight generic types based on their compositions (EPA, 1993).

1. Potassium/polymer fluids are inhibitive fluids, as they do not change the formation after it is cut by the drill bit. They are used in soft formations such as shale where sloughing may occur.

2. Seawater/lignosulfonate fluids are also inhibitive. This type of mud is used to maintain viscosity by binding lignosulfonate cations onto the broken edges of clay particles. It is also used to control fluid loss and to maintain the borehole stability. Under more complicated conditions, such as higher temperatures, this type of mud can be easily altered.

3. Lime (or calcium) fluids are inhibitive fluids. The viscosity of the mud is reduced as calcium binds the clay platelets together to release water. This type of mud system can maintain more solids. Lime fluids are used in hydratable, sloughing shale formations.

4. Nondispersed fluids are used to maintain viscosity, to prevent fluid loss, and to provide improved penetration, which may be impeded by clay particles in dispersed fluids.

5. Spud fluids are noninhibitive muds that are used in approximately the first 300 meters of drilling. This is the most simple mixture of mud and contains mostly seawater and a few additives.

6. Seawater/freshwater gel fluids are inhibitive muds used in early drilling to provide fluid control, shear thinning, and lifting properties for removing cuttings from the hole. Prehydrated bentonite

is used in both seawater and freshwater fluids and attapulgite is used in seawater when fluid loss is not a concern.

7. Lightly treated lignosulfonate freshwater/seawater fluids resemble seawater/ lignosulfonate muds except their salt content is less. The viscosity and gel strength of this mud are controlled by lignosulfonate or caustic soda.

8. Lignosulfonate freshwater fluids are similar to the muds at #2 and #7 except the lignosulfonate content is higher. This mud is used for higher temperature drilling.

Oil-based drilling fluids (OBF) are those with oil, typically diesel, as the continuous phase and water as the dispersed phase. These fluids were found to be toxic to marine organisms and are no longer permitted for discharge. Due to the high cost of hauling the muds to shore and proper land disposal, the use of oil-based muds, particularly in offshore areas, has decreased significantly.

3.2.1 Synthetic-Based Drilling Fluids

Synthetic-based drilling fluids represent a new technology which developed in response to the widespread permit discharge bans of oil-based drilling fluids. SBMs have drilling and operational properties similar to OBM systems and are used where OBMs are commonly used, e.g., in difficult drilling situations or highly directionally deviated holes, or where the properties of WBMs have limited performance, e.g., hydratable shales or salt. SBMs reduce drilling times compared to WBMs, reducing drilling rig costs, are less toxic than OBM, and have higher penetration rates in rock (MMS, 2003 as cited in EPA, 2009 cited in EA). An SBF has a synthetic material as its continuous phase and water as the dispersed phase. The types of synthetic material which have been used include vegetable esters, polyalpha olefins (PAO), linear alphaolefins, internal olefins, and esters (USEPA, 1996). A model SBF formulation consists of 47% synthetic base fluid, 33% solids, and 20% water (by weight), a 70%/30% ratio of synthetic base to water, typical of commercially available SBFs (USEPA 1999).

SBFs are reported to perform as well as or better than OBFs in terms of rate of penetration, borehole stability, and shale inhibition. Due to decreased washout (erosion), drilling of narrower gage holes, and lack of dispersion of the cuttings in the SBF, compared to WBF the quantities of muds and cuttings waste generated is reduced, reportedly in some cases by as much as 70 per cent. (Burke and Veil, 1995; Candler, et al, 1993).

The pollutants of concern from water-based muds discharges are primarily metals, most of which are associated with the barite added to the mud system and organics, which are added for lubricity or to free stuck pipe. The pollutant concentrations in water-based drilling fluid discharges characteristic of most offshore operations are presented in Table 3-3. The naphthalene concentration in Table 3-3 is based on a pill volume of 100 bbl and is calculated for an average well depth and mud volume.

According to standard formulation data, all of the solids in synthetic-based fluids are barite, making SBF a source of heavy metals and total suspended solids. SBFs are also one source of the conventional pollutant oil and grease. Table 3-4 shows the waste characteristics of SBFs.

Table 3-3. Water Based Drilling Fluids Pollutant Concentrations

Pollutant	Concentration in Whole Mud (µg/l)
Aluminum	4,123,615
Antimony	2,592
Arsenic	3,228
Barium	163,558,125
Beryllium	318
Cadmium	500
Chromium	109,116
Copper	8,502
Iron	6,976,260
Lead	15,958
Mercury	45
Nickel	6,138
Selenium	500
Silver	318
Thallium	546
Tin	6,638
Titanium	39,800
Zinc	91,157
Naphthalene	330

[a] Source: EPA, 1993.

Table 3-4. Synthetic-based fluids drilling waste characteristics. (Modified from USEPA, 1999).

Waste Characteristics	Value
SBF formulation	47% synthetic base fluid, 33%barite, 20% water (by weight)
Synthetic base fluid density	280 pounds per barrel
Barite density	1,506 pounds per barrel
SBF drilling fluid density	9.6 pounds per gallon
Percent (vol.) formation oil	0.2%
Pollutant Concentrations in SBF	
Conventionals	**lbs/bbl of SBF**
Total oil as synthetic base fluid	190
Total oil as formation oil	0.59
Total suspended solids as barite	133
Priority Pollutant Organics	**lbs/bbl of SBF**
Naphthalene	0.0010052
Fluorene	0.0005483
Phenanthrene	0.0013004
Phenol	7.22E-08
Priority Pollutant Metals	**mg/kg/Barite**
Cadmium	1.1
Mercury	0.1
Antimony	5.7
Arsenic	7.1
Berylium	0.7
Chromium	240
Copper	18.7
Lead	35.1
Nickel	13.5
Selenium	1.1
Silver	0.7
Thallium	1.2
Zinc	200.5
Non-Conventional Metals	**mg/kg Barite**
Aluminum	9069.9
Barium	120000
Iron	15344.3
Tin	14.6
Titanium	87.5
Non-Conventional Organics	**lbs/bbl of SBF**
Alkylated benzenes	0.0056587
Alkylated naphthalenes	0.0531987
Alkylated fluorenes	0.0064038

Alkylated phenanthrenes	0.0080909
Alkylated phenols	0.0000006
Total biphennyls	0.0105160
Total dibenzothiophenes	0.0000092

The discharge of neat synthetic-based drilling fluids is prohibited under this permit, however the permit will allow discharges of water-based fluids. Because of their cost, SBFs, used or unused, are considered a valuable commodity by the industry and not a waste. It is industry practice to continuously reuse the SBF while drilling a well interval, and at the end of the well, to ship the remaining SBF back to shore for refurbishment and reuse. Compared to water-based fluids, SBFs are relatively easy to separate from the drill cuttings because the drill cuttings do not disperse in the drilling fluid to the same extent. With WBF, due to dispersion of the drill cuttings, drilling fluid components often need to be added to maintain the required drilling fluid properties. These additions are often in excess of what the drilling system can accommodate. The excess "dilution volume" of WBF is discharged. This excess dilution volume does not occur with SBF. For these reasons, SBF is only discharged as a contaminant of the drill cuttings waste stream. It is not discharged as neat drilling fluid (drilling fluid not associated with cuttings).

3.3 Drill Cuttings

Drill cuttings are fragments of the geologic formation broken loose by the drill bit and carried to the surface by the drilling fluids that circulate through the borehole. They are composed of the naturally occurring solids found in subsurface geologic formations and bits of cement used during the drilling process. Cuttings are removed from the drilling fluids by a shale shaker and other solids control equipment before the fluid is recirculated down the hole. Removed cuttings are discharged (EPA 2009).

The volume of cuttings generated while drilling the SBF intervals of a well depends on the type of well (development or production) and the water depth. According to analyses of the model wells provided by industry representatives, wells drilled in less than 1,000 feet of water are estimated to generate 565 barrels of cuttings for a development well and 1,184 barrels of cuttings for an exploratory well. Wells drilled in water greater than 1,000 feet deep are estimated to generate 855 barrels of cuttings for a development well, and 1,901 cuttings for an exploratory well (USEPA, 2000). These values assume 7.5 percent washout, based on the rule of thumb reported by industry representatives of 5 to 10 percent washout when drilling with SBF. Washout is caving in or sluffing off of the well bore. Washout, therefore, increases hole volume and increases the amount of cuttings generated when drilling a well. Assuming no washout, the values above become, respectively, 526, 1,101, 795, and 1,768, barrels of dry cuttings.

As the drilling fluid returns from downhole laden with drill cuttings, it normally is first passed through primary shale shakers, vibrating screens, which remove the largest cuttings, ranging in size of approximately 1 to 5 millimeters. The composition of a shale-shaker discharge is presented in Table 3-4. The drilling fluid may then be passed over secondary shale shakers to remove smaller drill cuttings. Finally, a portion or all of the drilling fluid may be passed through a centrifuge or other shale shaker with a very fine mesh screen, for the purpose of removing the fines. It is important to remove fines from the drilling fluid in order to maintain the desired flow properties of the active drilling fluid system. Thus, the

cuttings waste stream usually consists of larger cuttings from a primary shale shaker, smaller cuttings from a secondary shale shaker, and fines from a fine mesh shaker or centrifuge. As a final step, the wet cuttings are sent to a dryer which uses high temperatures to separate SBFs from cuttings. The dried residue from the dryer consists of fine cuttings and SBF material and is transported to an onshore waste handling facility. The cleaned cuttings are then discharged overboard.

The recovery of SBF from the cuttings serves two purposes. The first is to deliver drilling fluid for reintroduction to the active drilling fluid system and the second is to minimize the discharge of SBF. The recovery of drilling fluid from the cuttings is a conflicting concern, because as more aggressive methods are used to recover the drilling fluid from the cuttings, the cuttings tend to break down and become fines. The fines are more difficult to separate from the drilling fluid (an adverse effect for pollution control purposes), but in addition they deteriorate the properties of the drilling fluid. Increased recovery from cuttings is more of a problem for WBF than SBF because in WBFs the cuttings disperse more and spoil the drilling fluid properties. Therefore, compared to WBF, more aggressive methods of recovering SBF from the cuttings waste stream are practical. These more aggressive methods may be justified for cuttings associated with SBF so as to reduce the incidental discharge of SBF. This, consequently, will reduce the quantity of toxic organic and metallic components of the drilling fluid discharged.

Table 3-5. Mineral Composition of a Shale-Shaker Discharge from a Mid-Atlantic Well[a]

Pollutant	Percent by Weight (Dry Basis)
Barium Sulfate	3
Montmorillonite	21
Illit	11
Kaolinite	11
Chlorite	6
Moscovite	5
Quartz	23
Feldspar	8
Calcite	5
Pyrite	2
Siderite	4

[a] Source: Adapted by NRC (1983) from Ayers et al. (1980b); 65% solids, density 1.7 g/cm^3.

3.4 Deck Drainage

Deck drainage is waste resulting from platform washings, deck washings, deck area spills, rainwater, and runoff from curbs, gutters, and drains, including drip pans and wash areas. The runoff collected as deck drainage also may include detergents used in deck and equipment washing.

In deck drainage, oil and detergents are the pollutants of primary concern. During drilling operations, spilled drilling fluids also can end up as deck drainage. Acids (hydrochloric, hydrofluoric, and various organic acids) used during workover operations may also contribute to deck drainage, but generally these are neutralized by deck wastes and/or brines prior to disposal. Based on an analysis of 950 platforms in the Gulf of Mexico from 1982-1983, EPA (1993) determined that the oil and grease levels reported for deck drainage discharges were 28 mg/l monthly average and 75 mg/l daily maximum, greatly exceeding the permit limit of no free oil as determined by visual sheen.

A typical platform-supported rig is equipped with pans to collect deck and drilling floor drainage. The drainage is separated by gravity into waste material and liquid effluent. Waste materials are recovered in a sump tank, then treated and disposed, returned for use in the drilling mud system, or transported to shore. The liquid effluent, primarily washwater and rain water, is discharged. It is expected that, following treatment, deck drainage discharge will meet the no free oil prohibition in the permit.

The 1993 EPA study determined that deck drainage quantities range from 1 to 4,304 bbl/day/platform with an average discharge of 50 bbl/day.

3.5 Sanitary Waste

The sanitary wastes discharged offshore are human body wastes from toilets and urinals. The volume and concentrations of these wastes vary widely with time, occupancy, platform characteristics, and operational situation. Usually the toilets are flushed with brackish water or seawater. Due to the compact nature of the facilities, the wastes have less dilution water than common municipal wastes. This creates greater waste concentrations. Some platforms combine sanitary and domestic waste waters for treatment; others maintain sanitary wastes separate for chemical or physical treatment by an approved marine sanitation device.

3.6 Domestic Waste

Domestic wastes (gray water) originate from sinks, showers, safety showers, eye wash stations, laundries, food preparation areas, and galleys on the larger facilities. Domestic wastes also include solid materials such as paper, boxes, etc. These wastes are governed by the Coast Guard under MARPOL 73/78 (the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto). The Coast Guard regulations at 33 CFR Part 151 specify regulations for disposal of garbage. These are summarized in Table 3-7.

3.7 Cement

In order to protect the well from being penetrated by aquifers, it is necessary to install a casing in the bore hole. The casing is installed in stages of successively smaller diameters as the drilling progresses. The casings are cemented in place after each installation.

A cement slurry is mixed on site and is pumped through a special valve at the well head through the casing to the bottom and up the annular space between the bore hole wall and the outside of the casing to the surface. The cement is allowed to harden and drilling is resumed.

Most wells are cemented with an ordinary Portland cement slurry. Additives are used to compensate for site-specific temperature and salt water conditions. The amount of cement used for each well depends on the well depth and the volume of the annular space. Typically, excess cement discharges are less than 10 barrels/year/well.

Table 3-7. Garbage Discharge Restrictions[a]

Garbage Type	Fixed or Floating Platforms & Associated Vessels[b] (33 CFR 151.73)
Plastics - includes synthetic ropes and fishing nets and plastic bags.	Disposal prohibited (33 CFR 151.67)
Dunnage, lining and packing materials that float.	Disposal prohibited
Paper, rags, glass, metal bottles, crockery and similar refuse.	Disposal prohibited
Paper, rags, glass, etc. comminuted or ground.[c]	Disposal prohibited
Victual waste not comminuted or ground.	Disposal prohibited
Victual waste comminuted or ground.[c]	Disposal prohibited less than 12 miles from nearest land and in navigable waters of the U.S.
Mixed garbage types.	See footnote d.

[a] Source: EPA, 1993.
[b] Fixed or floating platforms and associated vessels include all fixed or floating platforms engaged in exploration, exploitation, or associated offshore processing of seabed mineral resources, and all ships within 500 m of such platforms.
[c] Comminuted or ground garbage must be able to pass through a screen with a mesh size no larger than 25 mm (1 inch) (33 CFR 151.75).
[d] When garbage is mixed with other harmful substances having different disposal requirements, the more stringent disposal restrictions shall apply.

3.8 Well Treatment, Workover, and Completion Fluids

The following definitions are from the Development Document for the final effluent guidelines (EPA, 1993).

Well treatment fluids are any fluid used to restore or improve productivity by chemically or physically altering hydrocarbon-bearing strata after a well has been drilled.

Workover fluids are salt solutions, weighted brines, polymers and other specialty additives used in a producing well to allow safe repair and maintenance or abandonment procedures.

Completion fluids are salt solutions, weighted brines, polymers, and various additives used to prevent damage to the wellbore during operations which prepare the drilled well for hydrocarbon production.

The volume of fluids needed for workover, treatment, and completion operations depends on the type of well and the specific operation being performed. Chevron has based estimates average volumes of fluids (accounting for reuse of the fluids) as 300 bbl of workover fluids per job and 250 bbl of treatment fluids per treatment operation. Based on an assumption of one treatment or one workover every four years, an average of 200 bbl of treatment or workover fluid can be expected to be used per well every four years.

Well treatment fluids are acid in water solutions (using hydrochloric acid, hydrofluoric acid, and acetic acid). Formation solubility, reaction time, and reaction products determine the type of acid used. A treatment operation consists of a preparation solution of ammonium chloride (3-5 percent) to force the hydrocarbons into the formation; an acid solution; and a post-flush of ammonium chloride the remains in the formation for 12 to 24 hours to force the acid farther into the formation before being pumped out.

Solvents also may be used for well treatment, including hydrofluoric acid, hydrochloric acid, ethylene diaminetetraacetic acid (EDTA), ammonium chloride, nitrogen, methanol, xylene, and toluene. Additives such as corrosion inhibitors, mutual solvents, acid neutralizers, diverters, sequestering agents, and antisluding agents are often added to treatment fluid solutions. The pollutant concentrations for a well treatment fluid used in two wells at a THUMS facility in California are presented in Table 3-8.

Workover fluids are put into a well to allow safe repair and maintenance, for abandonment procedures, or to reopen plugged wells. During repair operations, the fluids are used to create hydrostatic pressure at the bottom of the well to control the flow of oil or gas and to carry materials out of the well bore. To reopen wells, fluids are used to stimulate the flow of hydrocarbons. Both of these operations must be accomplished without damaging the geologic strata.

Fluids used for hydraulic fracturing are considered well treatment or stimulation fluids in the proposed permit. To reopen or increase productivity in a well, hydraulic fracturing of the formation may be necessary. Hydraulic fracturing is achieved by pumping fluids into the bore hole at high pressure, frequently exceeding 10,000 psi. Proper fracturing accomplishes the following:

- Creates reservoir fractures thereby improving the flow of oil to the well
- Improves the ultimate oil recovery by extending the flow paths, and
- Aids in the enhanced oil recovery operation.

Hydraulic fracturing has also been used in the GOM since the early 1990's in combination with gravel packing as a type of well stimulation and sand control technology commonly referred to as "Frac Pack" operations (API, 2015). Most of the petroleum bearing formations in the GOM consist of highly permeable unconsolidated sands. Produced sand occurs when the loose formation sands back up into the well piping and production equipment. To limit and prevent sand production the gravel pack places a courser sand filter in the immediate vicinity of the well at the depth of production to limit migration of fine sands into the well pipe. The fracturing component uses treated seawater under high pressure to fracture the formation and force additional sand into the producing formation a greater distance from the well to increase the size of the sand filter (gravel pack). The Frac Pack sand filter may be up to 10 times larger than that resulting from a conventional gravel pack completion. The unconsolidated producing formations in the GOM make them less brittle than shales and tight sands therefore the fracture network produced by a Frac Pack completion are less dense and remain close to the bore hole (Middle East and Asia Reservoir Review, 2007; API, 2015).

Hydraulic fracturing used in repair of damaged formations or as well stimulation/sand control in the GOM differs from that used to recover hydrocarbons from low permeability shales, coal beds and other tight formations being produced in the continental U.S. mainly with regard to the magnitude of the intended fracturing in the surrounding formation. The permeability of these tight formations may be as low as 1/1000 of 1% of the permeability of the more conventional formations on the GOM shelf and, therefore, require much more extensive fracturing to stimulate flow (King, 2012). Typical Frac Pack completions in the GOM may inject 50,000lbs to over 200,000lbs of proppant into the producing formation within a radius of usually less than 30 meters of the well pipe, whereas a shale gas operation may inject up to 4 million lbs. of proppant suspended in 0.5-10 million gallons of water into a single well (USEPA, 2015). Fractures may extend for hundreds or several thousand feet from the well pipe (GWPC & IOGCC, 2016). Added chemicals in operations this large may range from 80-330 tons.

Deepwater (greater than 500 meters of water) oil and gas production is becoming more prevalent in the GOM following the discovery of significant reserves at water depths as great as 3000 meters. In these cases the oil bearing formations may be an additional 8000 meters below the mudline. The technical challenges to production include much higher overburden pressures and temperatures and may require larger scale fracturing to maximize production (Mullen et. al, 2003; Dribus et. Al., 2008; Dutton and Loucks, 2014).

New information indicates that hydraulic fracturing of oil may have the potential to cause potential health and environmental effects. Some of the pollutants released by hydrofracking include benzene, toluene, xylene and ethyl benzene (BTEX); particulate matter and dust; ground-level ozone; nitrogen oxides; carbon monoxide; formaldehyde; and metals contained in diesel fuel combustion. These pollutants can travel in the atmosphere. The exposure to these chemicals could cause short-term effects to human health and the environment (Shonkoff, 2014*;* Elliott, et. at. 2016). This information indicates that potential risks of hydrofracking may be greater from onshore activities as compared to offshore OCS-related activities (BOEM, 2015b). High solids drilling fluids used during workover operations are not considered workover fluids by definition and therefore must meet drilling fluid effluent limitations before discharge

may occur. Packer fluids, low solids fluids between the packer, production string, and well casing, are considered to be workover fluids and must meet only the effluent requirements imposed on workover fluids.

Table 3-8. Analysis of Fluids from an Acidizing Well Treatment [a]

Analyte	Concentration (ug/l)	Analyte	Concentration (ug/l)
Aluminum	53.1	Tin	6.66
Antimony	< 3.9	Titanium	0.68
Arsenic	< 1.9	Vanadium	36.1
Barium	12.6	Yttrium	0.19
Beryllium	< 0.1	Zinc	28.5
Boron	31.9	Aniline	434
Cadmium	0.4	Naphthalene	ND
Calcium	35.3	o-Toluidine	1,852
Chromium	19	2-Methylnaphthalene	ND
Cobalt	< 1.9		
		2,4,5-Trimethylanine	2,048
Copper	3.0	Oil and Grease	619
Iron	572	pH	2.48
Lead	< 9.82		
Magnesium	162		
Molybdenum	< 0.96		
Nickel	52.9		
Selenium	< 2.9		
Silver	< 0.7		
Sodium	1,640		
Thallium	5.0		

[a]Source: EPA, 1993.

Well completion occurs if a commercial-level hydrocarbon reserve is discovered. Completion of a well involves setting and cementing the casing, perforating the casing and surrounding cement to provide a passage for oil and gas from the formation into the wellbore, installing production tubing, and packing the well. Completion fluids are used to plug the face of the producing formation while drilling or completion operation are conducted in hydrocarbon-bearing formations. They prevent fluids and solids from passing into the producing formation, thereby reducing its productivity or damaging the oil or gas.

The production zone is a porous rock formation containing the hydrocarbons, either oil or gas, and can be damaged by mud solids and water contained in drilling fluids. The completion fluids create a thin film of solids over the surface of the producing formation without forcing the solids into the formation. A successful completion fluid is one that does not cause permanent plugging of the formation pores. The composition of the completion fluid is site-specific depending on the nature of the producing formation.

Drilling muds remaining in the wellbore during logging, casing, and cementing operations or during temporary abandonment of the well are not considered completion fluids and are regulated as drilling fluids discharges.

Treatment, workover, and completion fluids are either collected and disposed onshore if there are priority pollutants detected or otherwise treated for oil and grease, pH neutralized, and commingled with produced water for discharge (EPA, 2009). Region 4 is including the components of the fracking process as they occur in existing waste streams: slurried particles from hydraulic fracturing are covered under the produced sand waste stream; fluids and materials used in or derived from the fracking process are included in the well treatment, completion, and workover fluids waste stream.

3.9 Blowout Preventer Fluids

A vegetable or mineral oil solution or antifreeze (polyaliphatic glycol) is used as a hydraulic fluid in BOP stacks while drilling a well. The blowout preventer may be located on the seafloor and is designed to contain pressures in the well that cannot be maintained by the drilling mud. Small quantities of BOP fluid are discharged to the seafloor during weekly testing of the blowout preventer device. The volume of BOP fluid discharge ranges from 67 to 314 bbl/day when testing (EPA, 1993).

3.10 Desalination Unit Discharge

This is the residual high-concentration brine discharged from distillation or reverse-osmosis units used for producing potable water and high-quality process water offshore. It has a chemical composition and ratio of major ions similar to seawater, but with high concentrations. This waste is discharged directly to the sea as a separate waste stream. The typical volume discharged from offshore facilities is less than 240 barrels per day.

3.11 Ballast Water and Storage Displacement Water

Ballast and storage displacement water are used to stabilize the structures while drilling from the surface of the water. Two types of ballast water are found in offshore producing areas (tanker and platform ballast). Tanker ballast water would not be covered under an NPDES permit.

Platform stabilization (ballast) water is taken on from the waters adjacent to the platform and may be contaminated with stored crude oil and oily platform slop water. More recently designed and constructed floating storage platforms use permanent ballast tanks that become contaminated with oil only in emergency situations when excess ballast must be taken on. Oily water can be treated through an oil-water separation process prior to discharge.

Storage displacement water from floating or semi-submersible offshore crude oil structures is mainly composed of seawater. Much of its volume can usually be discharged directly without treatment. Water that is contaminated with oil may be passed through an oil-water separator for treatment.

3.12 Bilge Water

Bilge water, which seeps into all floating vessels, is a minor waste for floating platforms. This seawater becomes contaminated with oil and grease and with solids such as rust where it collects at low points in vessels. This bilge water is usually directed to the oil-water separator system used for the treatment of ballast water or produced water, or it is discharged intermittently. The total volume of ballast/bilge water discharged is from 70 to 620 bbl/day (EPA, 1993).

3.13 Uncontaminated Seawater

Seawater used on the rig for various reasons is considered uncontaminated if chemicals are not added before it is discharged. Included in this discharge are waters used for fire control equipment and utility lift pump operation, pressure maintenance and secondary recovery projects, fire protection training, pressure testing, and non-contact cooling.

3.14 Boiler Blowdown

Boiler blowdown discharges consist of water discharged from boilers as is necessary to minimize solids build-up in the boilers, including vents from boilers and other heating systems.

3.15 Diatomaceous Earth Filter Media

Diatomaceous earth filter media are used in the filtration unit for seawater or other authorized completion fluids. They are periodically washed from the filtration unit for discharge.

4. TRANSPORT AND PERSISTENCE

The discussion of transport processes affecting drilling wastes treats the two major waste streams, water-based drilling fluids (WBF) and synthetic-base drilling fluids (SBF) separately, due to differences in characteristics, mode of entry and behavior in the environment. The synthetic-based fluids associated with cuttings discharges are expected to behave differently from WBFs due to several important differences:

- Only SBF-cuttings are discharged, with retention of the SBF base fluid generally ranging between a low of 2 percent for the larger cuttings and a high of 20 percent for the smallest cuttings (fines). Effluent guidelines will limit the maximum retention to 6.9 percent. With WBFs, in addition to the WBF-cuttings, large volumes of WBF are discharged. Thus, for an equal volume of hole drilled, the volume of WBF-related discharge is expected to be much greater than the volume of SBF-related discharge.

- WBFs contain very high levels of suspended and settleable solids (and are, in fact, referred to as "muds" in the industry) that disperse in the water column and produce a plume with many fine particles that settle rather slowly. Hence, they may be transported large distances. SBF-cuttings, however, tend not to disperse in the water column nearly to the same extent as WBFs because the particles are "oil" wet with the synthetic material. Compared to WBF-cuttings, SBF-cuttings tend to be larger than WBF-cuttings. Again the reason is that SBFs do not disperse the cuttings particles to the same extent as WBFs. Because larger particles settle faster than smaller particles, SBF-cuttings tend to be deposited in a smaller impact area than WBF-cuttings.

- SBF-cuttings have a significant organic component that is not present in WBFs, namely the synthetic base fluid. The synthetic base fluid, in general, is insoluble in water and deposits in the sediment with the cuttings. The fluids separation technologies used on SBF cuttings remove the fine cuttings, causing what remains to settle rapidly upon discharge and accumulate nearer the point of discharge than WBF wastes.

These differences suggest that discharge plumes characteristic of WBF discharges will not be an important mechanism for the transport of SBF wastes.

4.1 Water-Based Drilling Fluids

Drilling fluids contain quantities of coarse material, fine material, dissolved solids, and free liquids. While all of these components are affected by the momentum of the discharge jet, density-driven turbulent mixing, and diffusive processes, the larger particulates of drilling fluids separate more rapidly from the fines and soluble portions of the discharge plume due to the additional effect of gravitational settling. Fall velocities are largely controlled by particulate size, with larger particulate separating out

more rapidly from the plume. Upon discharge, this mixture appears to separate rapidly. An upper plume is formed from shear forces and local turbulent flow at the discharge pipe. This upper plume contains about five to seven percent, by weight, of the total drilling fluid discharge (Ayers et al., 1980b). This plume migrates to its level of neutral buoyancy while particulates slowly settle to the bottom and is advected with prevailing currents. The fine solids settle at a rate depending on aggregate particle size, which is very dependent on flocculation.

A lower plume contains the remainder of the discharged drilling fluids. Coarser materials fall rapidly out of the lower plume. Ayers et al. (1980b) found that the lower plume components deposited on the bottom within a few meters of the discharge point from an outfall located 3 meters below the surface in a water depth of 23 meters. In deeper waters, settleable solids will deposit over a larger area, depending upon the total fall depth, the settling velocity of the particles, and current speeds. If water depths are great enough to prevent bottom impact of the discharge plume, fine particulates in the lower plume will reach a level of neutral buoyancy and will be advected with ambient current flow, similar to their behavior in the upper plume.

Both upper and lower plumes are affected by three different transport processes or pathways: physical, chemical, and biological. Physical transport processes affect concentrations of discharge components in the water column through dilution[1], dispersion[1], and settling. Physical processes include currents, turbulent mixing, settling, and diffusion. These processes include current speed and direction, tidal regime, kinetic energy availability, and the characteristics of the receiving water such as water depth and density stratification. Physical processes are the most understood of the three transport pathways.

Chemical and biological processes more frequently produce changes in the structure and/or speciation of materials that affect their bioavailability and toxicity. Chemical processes include the dissolution of substances in seawater, particle flocculation, complexing of compounds that may remove them from the water column, redox/ionic changes, and absorption of dissolved pollutants on solids. Biological processes include bioaccumulation and biomagnification in soft or hard tissues, fecal agglomeration and settling of materials, and physical reworking to mix solids into the sediment (bioturbation).

4.1.1 *Physical Transport Processes*

Pollutant concentrations resulting from offshore platform discharges are influenced by several factors related to the discharge and the medium into which it is released. Discharge-related factors include the solids content of the effluent, distribution of particle sizes and their settling rates, effluent chemical composition, discharge rates and duration, and density. Environmental factors that affect dispersion and transport of discharged materials include current speed, current direction, tidal influences, wave action, wind regime, density structure of the water column, topography of the ocean bottom, bottom currents, and turbulence caused by platform wake. These factors influence dispersion and dilution of effluents in the

[1]In analyzing the impacts of discharged drilling fluids, the behavior of either the mud solids or the aqueous portion of the effluent can be measured. In this document, the term “dispersion” refers to tracking the behavior of the plume with respect to its solids content; dilution refers to a volumetric tracking of plume behavior and is intended to apply to soluble components of drilling fluids. The term “dispersion” in the ODCE does not necessarily refer to settling and removal of solids from the water column as they settle on the seafloor, but may also only refer to the concentration of suspended solids in the water column.

water column, and resuspension and transport of solids settled on the seafloor. Areas of high hydrodynamic energy will disperse discharges more rapidly than less energetic areas. Current speed and boundary conditions also affect mixing because turbulence increases with current speed and proximity to the seafloor. Currents and turbulence can vary markedly with location and site characteristics and affect the movement of suspended matter and the entrainment, resuspension, and advection of sedimented matter.

Two studies by Houghton et al. (1980; 1981) suggest that turbulence induced by submerged portions of the drilling platform also may significantly contribute to the dispersion of the muds. Houghton et al. (1981) concluded that turbulence became a major source of dispersion when current speeds ranged from 5 to 10 cm/sec (0.16 to 0.32 ft/sec) or greater. However, this wake-effect has not been systematically studied at other locations. Ray and Meek (1980), for example, observed little change in plume dilution at Tanner Bank, offshore southern California, with current speed variations between 2 and 45 cm/sec (0.076 and 1.48 ft/sec).

Physical Transport Processes Affecting the Upper Plume

The upper plume contains only a small portion of the discharge effluent (some 5%), which is split off from the main, lower plume and is thought to be due to sheer forces in the immediate vicinity of the discharge pipe. Finer suspended materials are contained in the upper plume. Relative to the lower plume, the initial mixing of the upper plume (in which the momentum of the initial jet is dissipated) is less of a factor, and passive diffusion (in which the plume is transported at the speed and direction of prevailing currents) is a more important factor. Sinking rates of solids in the upper plume will largely depend on the following four factors:

- Discharged material properties
- Characteristics of receiving waters
- Currents and turbulence
- Flocculation and agglomeration.

The physical properties of the discharged materials affect mixing and sedimentation. For suspended clay particulates, particle size and both physical and biological flocculation will determine settling rates. While oil exhibits little tendency to sink, it has displayed the ability to flocculate clay particles and to adsorb to particulates and sink with them to the bottom (Middleditch, 1980).

One of the major receiving water characteristics influencing plume behavior is density structure and stratification. In a stratified water column, density drives the collapse of the plume, i.e., the spreading of the plume at its level of neutral bouyancy. After sufficient spreading, the spreading rate of the plume from dynamic forces declines to a rate comparable to that resulting from turbulence (“far-field” or “passive” dispersion). Density stratification may concentrate certain components along the pycnocline. If flocculation produces particles large enough to overcome the barrier, settling will continue. If density stratification is weak or the pycnocline is above the discharge point, it may not affect plume behavior.

Ecomar (1978), as reported in Houghton et al. (1981), noted that upper plumes in the Gulf of Mexico follow major pycnoclines in the receiving water. A similar finding has been observed by Trefry et al.

(1981), who traced barium levels along pycnoclines. This type of transport is a potential concern because sensitive life stages of planktonic, nektonic, and benthic organisms may collect along the pycnocline. Ayers et al. (1980a) observed that the bottom of the upper plume followed a major pycnocline after drilling fluid discharges at rates of 275 bbl/hr and 1,000 bbl/hr in the Gulf of Mexico.

Flocculation and agglomeration affect plume behavior by increasing sedimentation rates as larger particles are formed. Flocculation is enhanced in salt or brackish waters due to increased cohesion of clay particles (Meade, 1972). Agglomeration also occurs when larger particles are formed from a number of smaller ones through the excretion of fecal pellets by filter-feeding organisms.

Most studies of upper plume behavior have measured particulate components and paid less attention to the liquid and dissolved materials present. Presumably, these latter components are subject to the same physical transport processes as particulate matter, with the exclusion of settling. Studies suggest that suspended solids in the upper plume may undergo a higher dispersion rate than dissolved components.

Houghton et al. (1980) measured upper plume transport in Lower Cook Inlet, using a soluble, fluorescent dye (fluorescein) in current speeds of 41 to 103 cm/sec. The water depth at the site is 63 m (207 ft) but the plume never sank below 23 m (75 ft). From transmissometry data collected in the Gulf of Mexico, Ayers et al. (1980b) estimated upper plume volume and found that a 275 bbl/hr drilling fluid discharge exhibited a dilution ratio of 32,000:1 after 60 minutes and a 1,000 bbl/hr discharge showed a dilution ratio of 14,500:1 after 62 minutes. Dispersion ratios for suspended solids at these distances would be approximately one to two orders of magnitude greater than for soluble components.

From radiotracer data collected for offshore Southern California and Cook Inlet, Petrazzuolo (1983) estimates dilution rates of "soluble" tracers (based on generalized estimates of distances to specified levels of dispersion; Table 4-1).

Physical Transport Processes Affecting the Lower Plume

The physical transport processes affecting the lower plume differ little in nature from those influencing the upper plume; differences are more related to the relative contribution of the various processes. The lower plume contains the main body of the discharged material. The initial momentum of the discharge jet is more dominant a factor in lower plume behavior, but is still followed by a dynamic collapse phase and then passive diffusion. The lower plume contains a component composed of coarser material that settles rapidly to the bottom regardless of current velocity. This rapid settling is most pronounced during high-rate bulk discharges in shallow waters. With the high downward momentum of these discharges, the plume reaches the bottom. At Tanner Bank, the lower plume was relatively unaffected by average currents of 21 cm/sec (0.69 ft/sec) and bottom surges of up to 36 cm/sec (1.18 ft/sec; Ecomar, 1978).

Table 4-1. Estimates of Distances Required to Achieve Specified Levels of Dilution of a Soluble Drilling Fluid Tracer in the Upper Plume at Fixed Current Speeds based on Field Study Data[a]

Dilution Criterion	Distance Required (m)[b] Current Speed (cm/sec)		
	5	10	15
10^4	10 - 17	19 - 34	29 - 51
10^5	80 -146	169 - 291	240 - 437
5×10^5	355 - 657	709 - 1,313	1,063 - 1,970
10^6	673 - 1,256	1,345 - 2,512	2,018 - 3,768

[a]Source: Petrazzuolo, 1983.
[b]Ranges in distances represent discharge rates of 21 to 1,200 bbl/hr.

The amount of fine solids settling to the bottom from the lower plume appears to depend to some degree on the aggregation of clay particles, which in turn depends on suspended material concentration, salinity, and the cohesive quality of the material. Fine particles tend to flocculate more readily than larger particles. Houghton et al. (1981) cites earlier work by Drake (1976), which concluded that physical-chemical flocculation can increase settling rates an order of magnitude over rates for individual fine particles.

4.1.2 *Seafloor Sedimentation*

Houghton et al. (1981) produced an idealized pattern for drilling fluids sedimentation around an offshore platform located in a tidal regime (Figure 4-1). Zero net current was assumed. The area of impact may have been overestimated from the true field case. Because no initial downward motion was assumed, longer settling times and greater plume dispersion were achieved. The result was an elliptical pattern, with the coarse fraction (10 mm-2 mm) deposited within 125 to 175 m of the discharge point, the intermediate fraction (250 µm-2 mm) deposited at 1,000 to 1,400 m, and the medium fraction (250 µm-74 µm) deposited beyond that distance. This is the greatest areal extent of bottom sedimentation for continuous discharges under the assumed conditions. Discontinuous discharges will be transported by currents at the time of release, and will form a starburst pattern over time (Zingula, 1975).

Studies have shown the extent of drilling fluid accumulation on the bottom to be inversely related to the energy dynamics of the receiving water. Vertical mixing also appears to be directly related to energy dynamics. Analysis of sediments at Tanner Bank showed no visible evidence of cuttings or mud accumulation 10 days after the last discharge, even though over 800,000 kg (882 short tons) of solids had been discharged over an 85-day period (Ray and Meek, 1980). Size analysis also indicated little change in the grain size distribution.

Low-energy environments, however, are not subject to (or only intermittently subject to) currents removing deposited material from the bottom or mixing it into sediments. In the low-energy Mid-Atlantic environment, for example, Menzie (1982) reported that cuttings piles were visibly distinct one

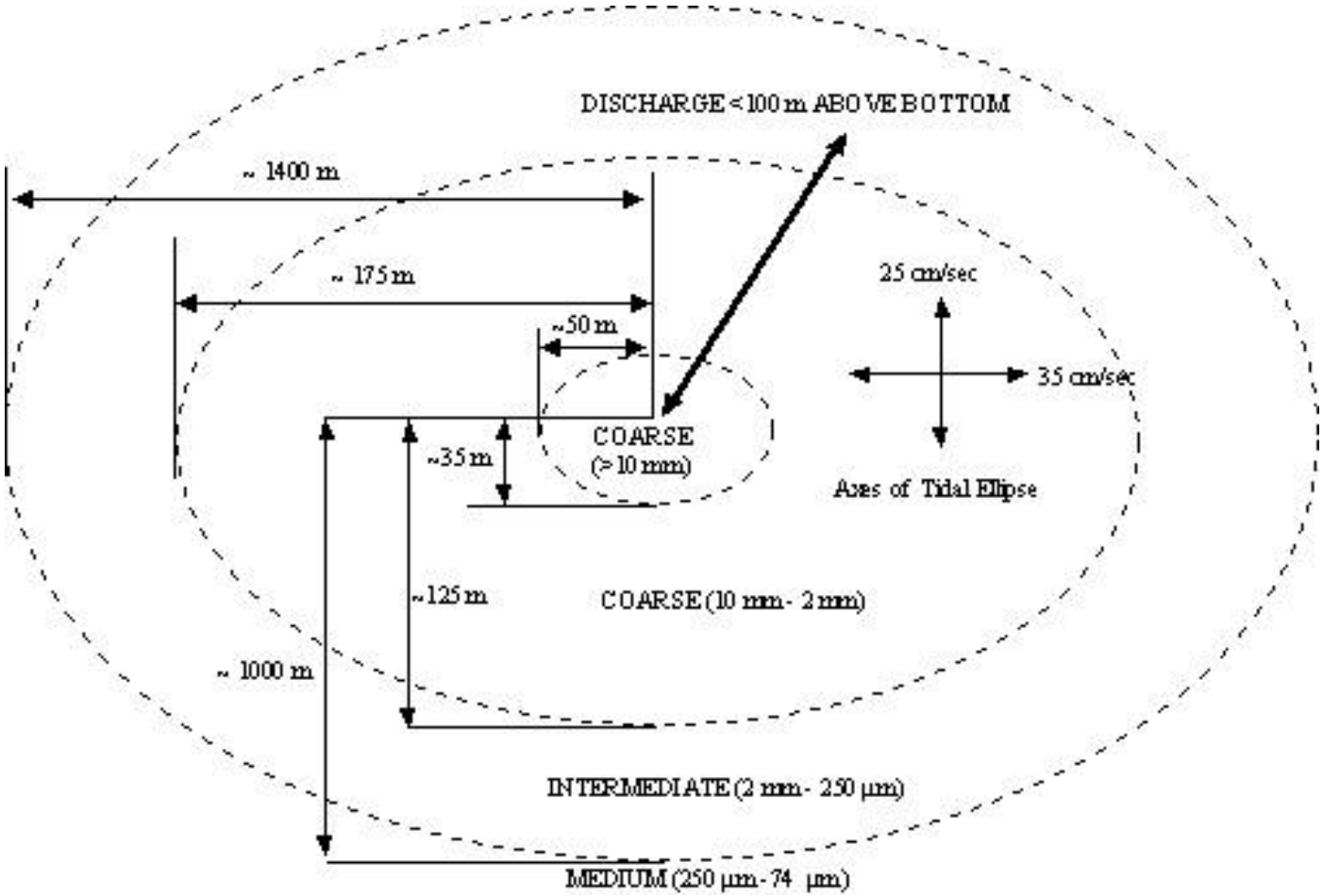


Figure 4-1. Approximate Pattern of Initial Particle Deposition (modified from Houghton et al., 1981)

year after drilling had ceased. Zingula (1975) also reported visible cuttings pile characteristics in the Gulf of Mexico shortly after drilling had terminated.

One study in the Gulf of Mexico (Ayers et al., 1980b) examined the short-term sedimentation of drilling fluids and cuttings in 23 m of water. Sediment traps were deployed only to a distance of 200 m. No distance-dependent quantitative estimates were possible from the data. More material, 10 to 100 fold, was collected in traps after a 1,000 bbl/hr discharge than after a 275 bbl/hr discharge. The relative barium, chromium, and aluminum contents of collected matter was more similar to that found in the initially discharged fluid for the 1,000 bbl/hr discharge than for the 275 bbl/hr discharge. This suggests a reduced influence of differential dispersion of drilling fluid components during the higher rate discharge.

Vertical incorporation of plume components into sediments is caused by physical and biological reworking of sediments. The relative contributions of these processes to vertical entrainment has not been well-described. Petrazzuolo (1983) cites a Gulf of Mexico operation where barium concentration was substantially enriched to a 4-cm (1.6 in) depth at both 100-m (330 ft) and 500-m (1,600 ft) distances. The upper 2 cm (0.8 in) of sediment was highly enriched with barium. This study was conducted along one transect (not aligned with major current flows) after four wells had been drilled at the platform. Boothe and Presley (1985) describe excess sediment barium concentrations that penetrate to depths of 5 to 20 cm (up to 30 cm at 30 m from one well site), with penetration depth generally decreasing with distance from the well site.

4.1.3 *Biological Transport*

Biological transport refers to the movement of pollutants through the environment via biological processes. Bioaccumulation, the accumulation of tissue burdens of pollutants contributes to transport of pollutants through the food web through predation. Bioaccumulation is discussed in Chapter 5. Another pathway of biological removal of pollutants involves a process known as bioturbation, benthic organisms reworking sediment and mixing surface material into deeper sediment layers.

Bioturbation generally mixes surface components into deeper sediment layers, although bioturbation can also expose previously buried materials. No work was found to quantify bioturbation effects, although a few studies have observed organisms living on a cuttings pile or in the vicinity of drilling discharges (Menzie et al., 1980; Ayers et al., 1980b). However, if the environment is one which rapidly removes cuttings piles, or where physical forces dominate resuspension and reworking processes, then biological mixing activities may not prove significant.

4.1.4 *Chemical Transport Processes*

Chemical transport of drilling fluids is poorly described. Much must be gleaned from general principles and studies of other related materials. Several broad findings are suggested, but the data for a quantitative assessment of their importance are lacking. Chemical transport will most likely arise from oxidation/reduction and reactions that occur in sediments. Changes in redox potentials will affect the speciation and physical distribution (i.e., sorption-desorption reactions) of drilling mud constituents.

Dissolved metals tend to form insoluble complexes through adsorption on fine-grained suspended solids and organic matter, both of which are efficient scavengers of trace metals and other contaminants. Trace metals, when adsorbed to clay particles and settled to the bottom, are subjected to different chemical conditions and processes than when suspended in the water column. If the sediments become anoxic, conversion of metals to insoluble sulfides is the most probable reaction, and the metals are then removed from the water column. Environments that experience episodic sediment resuspension favor metal release if reducing conditions existed previously in buried sediments; such current conditions also allow further exposure of organic matter complexes for further reduction and eventual release.

Alterations in Sediment Barium Levels

The long-term fate of discharge drilling fluids has been followed in several studies using sediment barium levels as a tracer. Four studies have been performed in the Gulf of Mexico from which data have been analyzed to estimate the dispersion of sediment barium. The subsequent fate of deposited material depends primarily on the physical processes that resuspend and transport particulates or entrain them into the sediments. Biological or chemical factors also could be important in stabilizing or mobilizing the material on the seafloor (e.g., through covalent binding of sediments or bioturbation). High concentrations of barium persistently found near a well site suggest a lower energy bottom environment, which favors deposition. If elevated levels cannot be found, even soon after drilling, resuspension and sediment transport have taken place and a higher energy bottom environment is suggested.

A series of power-law regression analyses were developed to relate average barium levels to distances from the discharge source (Petrazzuolo, 1983). These equations predicted the distance-dependent decreases in sediment barium levels that were obtained in four field studies. A multivariate analysis was used to estimate average sediment barium levels with respect to distance and number of wells. At locations of approximately 100 m to 30,000 m from a nine-well platform, this analysis suggested that sediment barium data collected early in the development phase of an operation may provide accurate predictions of sediment barium levels later in the operation.

Data from exploratory drilling operations have been used to examine deposition of metals resulting from drilling operations. These data indicate that any of several metals may be deposited, in a distance-dependent manner, around platforms, including cadmium, chromium, lead, mercury, nickel, vanadium, and zinc. These sediment metal studies, when considered as a group, suggested that the enrichment of certain metals in surficial sediments may occur as a result of drilling activities (Table 4-2). While confounding factors occur in most of these studies (i.e., seasonal variability and other natural and anthropogenic sources of metal enrichment), discharged drilling fluids and cuttings are probably not the only drilling-related source. The only two metals clearly associated with drilling fluids that appear to be elevated around rigs or platforms are barium and chromium.

Metals that appear to be elevated as a result of drilling activities, and are not solely related to drilling fluids, include cadmium, mercury, nickel, lead, vanadium, and zinc. Cadmium, lead, and zinc in drilling fluids are the result of the use of pipe dope or pipe thread compounds. Mercury, nickel, and zinc may originate from sacrificial anodes. Cadmium, lead, and vanadium may also originate from the release of oil in drilling operations. This release can result from burning, incidental discharges or spills from the rig or supply boat traffic, or use of oil as a lubricant in drilling fluids. Vanadium also may derive from wearing

of drill bits. In a Gulf of Mexico platform study, brine (formation water) discharges were identified as an additional potential source of metal contamination.

Although a variety of trace metals were variously found to be enriched in the sediment, enrichment factors were generally low to moderate, seldom exceeding a factor of 10. The spatial extent of this sediment enrichment also was limited. Either of two cases occurred: enrichment was generally distributed but undetectable beyond 300-500 m, or enrichment was directionally based by bottom current flows and extended further (to about 1,800 m) within a smaller angular component. These considerations suggest that exploratory activities will not result in environmentally significant levels of trace metal contamination. A study in the Canadian Arctic found that mercury would be the best trace metal tracer of discharged fluids (Crippen et al., 1980). However, reanalysis of the data also has suggested that the alterations in sediment mercury levels may have resulted from construction of the gravel island.

Alterations in sediment trace metal levels resulting from development drilling operations have not been as well characterized as those from exploratory operations. Two efforts have been made to estimate spatial distribution and fate of discharged material from a two-well operation in the Gulf of Mexico. One industry-sponsored analysis indicates that 49 percent of discharged barium is dispersed beyond a radius of 1,250 m from the platform (Mobil Oil Corporation, 1978). Another analysis of these data indicates that 78 percent of the barium is located within a 1,000-m radius, and essentially all of the barium (calculated as 111 percent) is located within 1,250 m.

Table 4-2. Summary of Sediment Trace Metal Alterations from Drilling Activities[a]

Location	Trace Metal								
	As	**Cd**	**Cr**	**Cu**	**Hg**	**Ni**	**Pb**	**V**	**Zn**
Gulf of Mexico, Mustang Island Area									
suspended sediment	ND[b]	-	+(8-31X)	+(7-10X)	ND	-	-	+(6-25X)	-
surficial sediment	ND	+(3-9X)	-	-	ND	-	-	-	+(2.5-3.5X)
Gulf of Mexico, Mustang Island Area	ND	±	±	±	ND	±	-	-	ND
Central Gulf of Mexico	ND	+	+	+	ND	+	+	+	
Mid-Atlantic	-	-	-	-	BLD	+(2.5X)	+(4-4X)	+(2-9.5X)	+(4X)
Mackenzie River Delta	+(1.2-2.5X)	+(2-6X)	+(4-7X)	ND	+(1.2-15X)	ND	+(1.5-2.2X)	ND	+(11.7X)
Beaufort Sea	ND	+(2-6X)	+(1.4-2X)	±	-	ND	+(1.2-2.6X)	ND	+(1.2-1.4X)

[a]Adapted from Tillery and Thomas (1980); Mariani et al. (1980); Crippen et al. (1980) in Petrazzuolo (1983).

[b]Abbreviations:

ND - not determined
+ - increased levels (magnitude change in parentheses) related to drilling
- - decreased levels related to drilling
± - isolated increases, not a clearly distance-related pattern
BLD - below the level of detection

Boothe and Presley (1985) conducted a survey of sediment chemistries around six platforms in the Gulf of Mexico. They concluded that only a small fraction of the total barium discharged is present in sediments near the discharge site. They estimated only 1 - 1.5% of discharged barium within 500 m of the discharge at shallower sites (13 - 34 m) and only 9 - 12% at deeper sites (76 - 102 m). Similarly, within a 3 km radius, their estimates accounted for 5 - 7% at the shallower sites and 47 - 84% at the deeper sites. Statistically significant barium enrichment (≥ twice background) existed in surface sediments at 25 of the 30 control stations located at a distance of 3 km from the drill sites.

In the Santa Maria Basin, offshore Southern California, barium was found to be the only metal enriched in sediments near development drilling operations (Steinhauer et al., 1994). Sporadic elevations in sediment trace metals also were noted by Boothe and Presley. Mercury and lead were significantly correlated to barium at several sites; distance dependent decreases were noted at two sites for mercury and one site for lead. Significant increases were noted generally only out to 125 m from the site; however the trend indicated increases perhaps to 300 - 500 m. The large statistical variability of the trace metal data set make statistical inferences difficult.

The general conclusion of this study is that barium and probably other drilling fluid contaminants associated with the settleable fraction of drilling muds appear to be relatively mobile. Thus, drilling discharges are expected to be spread over a large area (i.e., > 3 km from their discharge source) on time scales of a year or so. These data are consistent with other data that indicate drilling discharges can be distributed widely (Continental Shelf Associates, 1983; Ng and Patterson, 1982; Bothner et al., 1983 as cited in Boothe and Presley, 1985).

4.2 Discharge Modeling - Drilling Fluids

Two approaches have been used to project plume behavior for the purposes of water quality assessments. One approach uses a range of generalized operational, effluent, and ambient data to broadly assess plume behavior and water quality impacts. The second approach uses project-specific operational and a range of effluent and ambient data to assess these same parameters. Both approaches are discussed below; results of the water quality impact assessments are presented in Chapter 9 of this document.

The first approach uses two sets of Offshore Operator's Committee (OOC) Mud Discharge Model runs previously conducted for EPA Region 10 using a broad set of environmental and operational conditions. One set of OOC model scenarios (U.S. EPA Region 10, 1984) are based on a varied set of operational and environmental conditions for operations in Alaskan waters. A second set of model runs, intended to confirm and extend the earlier model runs conducted for Region 10, was completed for Region 10 by Dr. Maynard Brandsma (Brandsma Engineering, 1991). This last set of model runs was completed using the OOC Mud and Produced Water Discharge Model, Version 1.2F, which is an updated version of the 1983 OOC Mud Discharge Model used previously. Although these model runs were conducted for Region 10, many of these discharge scenarios are also generally appropriate to the present Gulf of Mexico analysis and were used to evaluate drilling fluids plume behavior.

The characteristics and results of these modeling exercises have been compiled and reviewed. A subset of cases was identified that comprise cases conducted for minimum water depths of 10 meters and at the

maximum discharge rate authorized in the Gulf of Mexico permit (1,000 bbl/hr). This subset is believed to represent a reasonable range of potential drilling fluid discharge scenarios and, therefore, presents a reasonable indication of the dilutions and dispersions that may be expected for high rate drilling fluid discharges. Mean drilling fluids dilution among these 1,000 bbl/hr discharge scenarios, for 15-meter, 40-meter, and 70-meter water depth scenarios, were used by the Region for the purpose of conducting water quality assessments.

4.2.1 *OOC Mud Discharge Model*

The OOC Mud Discharge Model is the most general of the available drilling fluid plume models and is the discharge model used for both approaches. It uses LaGrangian calculations to track material (clouds) settling out of a fixed pipe and a Gaussian formulation to sum the components from the clouds. The OOC model includes the initial jet phase, the dynamic collapse phase, and the passive diffusion phase of plume behavior.

The minimum waste stream data input requirements for the OOC Mud Discharge Model include effluent bulk density and particle size distribution. The dispersion of up to 12 drilling fluid particle size solid fractions (i.e., settling velocity fractions) can be followed. For each constituent particle fraction, its settling velocity and its fractional proportion of total solids must be input to the model. The OOC model requires the following operational data input: the depth of the discharge, diameter of the discharge pipe, discharge rate, and orientation of the discharge relative to ambient currents. Ambient environmental data input requirements of the OOC model include current, density stratification, and bathymetry.

Operational data are generally adequate to fulfill the data input needs for the OOC Mud Discharge Model. Waste stream input data requirements are adequately addressed by existing information, with the possible exception of settling velocities for drilling fluid solids fractions. Currently, these data are both extremely limited and a key model parameter. Existing settling velocity data are available for only a very few drilling muds. Thus, lacking data on more mud samples, it is difficult to know if the available data adequately represent drilling fluids. Also, settling velocity profiles are a key parameter in the model, forming the basis for calculating the effect of gravitational setting of drilling fluid solids. Thus, any shift in the particle size distribution (i.e., settling velocity distribution) will have significant effects on the calculated behavior of the plume. Particle size (settling velocity) data should be considered minimally adequate.

4.2.2 *Derivation of Generalized Dispersion/Dilution Estimates*

The first set of model scenarios run for Region 10 was conducted over a range of environmental and operational conditions. The mud weight used, with the exception of one 9.0 lb/gal case, was a 17.4 lb/gal mud with a total suspended solids concentration (TSS) of 1,441,000 mg/l. Surface current speeds ranged from 2 cm/sec to 32 cm/sec; density stratification ranged from 0.008 σ_t/m to 0.1 σ_t/m. Operationally, discharge rates ranged from 100 bbl/hr to 1,000 bbl/hr, the discharge was located 1 foot below the water line, and the discharge pipe was 12 inches in diameter. Water depths ranged from 5 meters to 120 meters.

The second data set on modeling of drilling fluids dispersion and dilution (Brandsma Engineering, 1991) was conducted to confirm and extend the first data set prepared for Region 10. Thus, the input data used

were the same as for the first data set. The principle alteration for this set of modeling data was that a newer, revised version of the OOC model was used. Also, in comparing the results of the earlier versus the more recent model runs, Brandsma noted that a computational error occurred in the derivation of soluble tracer dilution in the earlier data set. This error has been corrected for the first Region 10 data set in the ODCE review of the data.

4.2.3 *Model Results from Generalized Input*

The results of these two drilling fluids modeling data sets are compiled and presented in Table 4-3. Results have been sorted first by discharge rate and second, by dilution at 100 meters. These data have been analyzed in several ways. Data that were considered special cases of the model scenarios were eliminated from these analyses. These included model runs that excluded the rig wake effect from the model algorithm

Table 4-3. Summary of OOC Mud Model Drilling Fluid Plume Behavior

Case #	Water Depth (m)	Rate (bbl/h)	Current (cm/s)	Density Gradient (sigma-t/m)	100 m Dispersion	100 m Dilution
TT 8	10	100	10	0.07	3,859	2,579
TT 4	40	100	10	0.10	5,246	4,728
MB 3	5	250	10	0.10	2,318	222
MB 4	5	250	30	0.10	1,582	468
TT 18	5	250	10	0.02	6,109	662
TT 19	15	250	2	0.07	8,873	1,426
TT 20	15	250	10	0.07	2,558	1,617
MB 5	5	500	10	0.10	1,136	124
MB 6	5	500	30	0.10	770	211
MB 7	20	500	10	0.10	1,640	1,035
MB 8	20	500	30	0.10	1,626	1,583
MB 10	20	750	30	0.10	1,024	676
MB 9	20	750	10	0.10	1,305	789
TT 9	10	1,000	10	0.07	299	107
TT 5	5	1,000	10	0.02	4,810	127
TT 11	15	1,000	10	0.07	1,748	335
TT 6	10	1,000	10	0.07	1,785	341
TT 12	15	1,000	30	0.07	752	575
MB 11	20	1,000	10	0.10	942	655
TT 13	20	1,000	10	0.05	1,092	689
TT 14	40	1,000	10	0.01	731	755
TT 10	15	1,000	2	0.07	11,407	776
TT 3	40	1,000	10	0.10	905	818
MB 12	20	1,000	30	0.10	1,130	973
TT 15	70	1,000	10	0.04	1,803	1,721

Source: MB - Brandsma, 1991; TT - TetraTech, 1984.

and model runs that were conducted for pre-diluted drilling fluid discharges. Table 4-4 presents a summary of dilution results for data sorted by discharge rate. Table 4-5 presents a summary of dilution results for 1,000 bbl/hr discharges, sorted by water depth. These results are generally consistent with what would be expected for these discharges. Dilutions decrease with increasing discharge rates when they are considered in terms of their mean behavior, although there is considerable overlap between the ranges of dilution observed among the various discharge rates.

Table 4-4. Summary of OOC Mud Discharge Model Results by Discharge Rate

Discharge Rate (bbl/hr)	100-m Dilution Mean (Range)	100-m Dispersion Mean (Range
100	3,654 (2,579 - 4,728)	4,552 (3,859 - 5,246)
250	879 (222 - 1,617)	4,288 (1,582 - 8,873)
500	738 (124 - 1,583)	1,293 (770 - 1,640
750	733 (676 - 789)	1,165 (1,024 - 1,305)
1,000	656 (107 - 1,721)	2,284 (299 - 11,407)

Table 4-5. Summary of OOC Mud Discharge Model Results by Water Depth for High Weight (17.4 lb/gal) Muds Discharged at 1,000 bbl/hr

Water Depth (bbl/hr)	100-m Dilution Mean (Range)	100-m Dispersion Mean (Range)
5	127 (127)	4,810 (4,810)
10	224 (107 - 341)	1,042 (299 - 1,785)
15	562 (335 - 776)	4,636 (752 - 11,407)[a]
20	772 (655 - 973)	1,055 (942 - 1,130)
40	787 (755 - 818)	818 (731 - 905)
70	1,721 (1,721)	1,803 (1,803)

[a]Includes the only model run for 17.4 lb/gal muds at 1,000 bbl/hr at 2 cm/sec current speed (all others run at 10-30 cm/sec); if deleted from data set, the mean dispersion at 15 m is 1,250-fold.

Likewise, the general trend for dilution is to increase water depth; the effect of water depth on dispersion appears less clear from this data set, with no well-defined trend. Others (U.S. EPA, Region 10, 1984) noted an apparent biphasic behavior in their more homogenous data set.

For the water quality assessment (see Chapter 9), the results of mean dilution at the maximum authorized discharge rate were used. For this assessment, mean dilution at 100 meters for a water depth of 15 meters was 562 dilutions; for water depths of 40 meters and 70 meters, the respective means were 787 dilutions and 1,721 dilutions.

4.3 Synthetic-Based Drilling Fluids

4.3.1 Dispersal and Accumulation of SBF Drill Cuttings

Laboratory dispersal experiments showed that the various types of SBF's displayed a relative dispersibility as follows: Ester > Di-Ether >> Linear alkyl benzene > PAO > Low-Toxicity Mineral Oil. It is expected that the IOs and LAOs, the most commonly used synthetics today, should fall between esters and PAOs in dispersibility.

Because most SBF cuttings do not disperse efficiently in the water column following discharge, the rapid settling results in accumulation on the bottom near the platform discharge site. The field studies reviewed (Neff et al., 2000) show a high degree of variability in the depth of the SBF cuttings piles and distribution of cuttings on the seafloor. The variety of methods used in the studies and variation in discharge depths, discharge rates, total volumes discharged and oceanic conditions prevent drawing clear relationships between cuttings pile depths and distributions and SBF type, water depths and cuttings mass.

Generally, the distance from the rig to the highest concentration of SBF cuttings on the bottom varies depending on distance from the discharge to the seafloor, the net water current speed, and cuttings density. Results of some field studies indicate that SBF cuttings are distributed very heterogeneously in surface and subsurface sediments around deep-water drilling sites. The uneven distribution of cuttings on the bottom appears to be caused by clumping of the hydrophobic SBF-coated cuttings falling to the seafloor in large clumps. The distributions of SBF cuttings accumulations on the bottom is controlled by the direction and velocity of water currents at different depths in the water column.

Because of the variability in the data reviewed, it is not possible to draw any firm conclusions about rates of biodegradation, dilution, or washout of different types of SBF cuttings from sediments. Generally, the rate of loss of SBFs, other than esters, from sediments appears to be low. Ester concentrations in sediments near rigs using ester SBFs were lower than concentrations of other SBFs near the platforms using other SBFs. This observation lends support to the hypothesis that esters biodegrade rapidly in sediments.

Based on the data reviewed, no clear relationship can be determined between concentrations of SBFs in sediments and water depth, mass of cuttings discharged, or mass of SBFs discharged. There was a trend for SBF cuttings concentrations in sediments near discharging platforms to decrease as water depth increased. In most cases, SBF cuttings do not penetrate and mix deeply into surface sediments near the platform. SBF concentrations usually are higher in the surface layer (0 - 2 cm) of sediments than in deeper layers (2 - 5 cm and 5 - 8 cm). Approximately a year after completion of drilling, concentrations of SBF in the surface layer of sediments often decrease; however, concentrations at greater depths in the sediment core may increase or decrease. Temporal changes in SBF concentrations below the sediment surface probably are controlled by the amount of sediment reworking (by bioturbation and current-

induced bed transport) and biodegradation. After more than a year, SBF concentrations at all depths in sediment may decline to low values, particularly if ester SBF cuttings were discharged.

The distribution of SBF concentrations in sediments around platforms discharging SBF cuttings varied widely from one site to another. The distribution of SBF cuttings piles around drilling rigs in the UK Sector of the North Sea ranges from less than 2800 m^2 to 94,250 m^2. The cuttings are not evenly distributed in sediments around the rig with most cuttings settling in the direction of the net current flow.

The distance from the rig to the highest concentration of SBF cuttings on the bottom varied depending on distance from the discharge to the seafloor, the net water current speed, and cuttings density. In studies of SBF discharges to the UK Sector of the North Sea the highest concentrations of SBF in sediments were located 0 m to 224 m from the rig immediately after drilling. Approximately one year after completion of drilling, the highest SBF concentrations in sediments were located 5 m to 153 m from the former drilling sites. The distance from the rig sites to sediment SBF concentrations below about 1,000 mg/kg ranged from 40 m to about 500 m from the rigs.

4.3.2 Biodegradation of SBFs

Microbial metabolism is the main mechanism of degradation of SBF base materials into harmless byproducts. Natural populations of sediment-dwelling bacteria, fungi, and protists are able to biodegrade some hydrocarbons and related oxygen-containing organic chemicals (e.g., esters, ethers, acetals) and use the carbon fragments as a source of nutrition.

Hydrocarbons vary in their susceptibility to biodegradation. The biodegradation of paraffins and olefins decreases sharply with increasing carbon chain length and molecular weight. As a result, high molecular weight, insoluble SBF base chemicals, such as PAOs, are less bioavailable and biodegradable than lower molecular weight, slightly soluble base chemicals, such as IOs. As a general rule, linear hydrocarbons are more easily biodegraded than branched or aromatic hydrocarbons. Biodegradation rate of linear paraffins decreases as chain length increases. Branching of hydrocarbon chains tends to slow biodegradation. Carbon-carbon double bonds and internal oxygen atoms (e.g., esters) are more readily attacked by microbes than carbon-carbon single bonds. Hydrocarbons are biodegraded mainly by oxidation; therefore, biodegradation of SBF base materials and other hydrocarbons is much more rapid under aerobic conditions than in anaerobic environments.

A normal alkane (e.g., linear paraffin) or an alkene (e.g., LAO, IO, and PAO) is oxidized by microbes to an alcohol; the alcohol is oxidized further to a fatty acid. Two atoms of oxygen are consumed for each atom of fatty acid formed. Fatty acids are storage and structural nutrients for all plants and animals. The fatty acids derived from oxidation of SBF base chemicals are oxidized two carbons at a time through oxidation. The resulting acetate (CH_3COOH) molecules are incorporated into the energy and synthetic pathways of the microorganism. Thus, SBF base chemicals are biodegraded completely under aerobic conditions, with the reduction of a large amount of oxygen. Aerobic biodegradation of SBFs may deplete the oxygen in sediments, rendering the sediments anaerobic, if loading of the sediments with biodegradable organic matter from SBF cuttings is high and aeration of sediments is slow. In the absence of oxygen, SBF base chemicals are dehydrogenated to alcohols that are converted to fatty acids via chemical reactions are very inefficient under anaerobic conditions, and their rate probably limits the

overall net rate of SBF biodegradation in marine sediments. Carbon-carbon double bonds and ester linkages are more easily oxidized than carbon-carbon single bonds by marine anaerobic bacteria. Thus, esters and unsaturated SBF base chemicals would be expected to biodegrade more rapidly than paraffins, linear alkyl benzenes, ethers, and acetals in anoxic sediments. Under anaerobic conditions, fatty acid oxidation also is inefficient. Alternatives to oxygen (e.g., NO_3^- , SO_4^{-2}, and CO_2) are used by the microbes to oxidize fatty acids, producing byproducts, such as hydrogen sulfide, ammonia, and methane, that are toxic to some sediment-dwelling marine organisms. Sulfate is abundant in seawater (~ 29 mM) and marine sediments; therefore, it is the dominant terminal electron acceptor for microbial oxidation of SBF base chemicals in anoxic marine sediments. Methanogenesis (reduction of CO_2 to CH_4) occurs only when most of the available sulfur has been reduced to sulfide. Sulfate reducing bacteria are more aggressive than methanogens, and olefins and esters should biodegrade more rapidly in marine sediments than indicated by anaerobic biodegradation tests, most of which are based on methanogenesis. The most important environmental factors affecting biodegradation rate of SBFs in sediments are temperature, oxygen concentration, and seafloor energy.

Results of laboratory biodegradation tests reviewed by Neff et al. (2000) indicate that aerobic and anaerobic biodegradation rates of synthetics occur in the following order: ester>LA>IO>PAO> acetal>ether. Mineral oils are less biodegradable than SBF base chemicals, particularly under anaerobic conditions.

Considering the high concentrations of SBFs measured in surficial sediments within 100 m of some offshore platforms discharging SBF cuttings, it is probable that most SBF biodegradation will occur under anaerobic conditions after sediment oxygen concentration is reduced to low levels by the initial aerobic biodegradation of the SBF cuttings. In low energy environments where cuttings dispersion at the seafloor is a minor factor, anaerobic degradation of SBF cuttings probably is the rate-limiting step in recovery of benthic marine ecosystems contaminated with SBF cuttings. Anaerobic biodegradation rate is highest for esters, followed by LAOs. In general, SBF base chemicals, other than ester, do not biodegrade anaerobically at a substantially higher rate than mineral oils used in OBFs. Alkylbenzenes are not biodegraded under anaerobic conditions. Of the possible degradation products, alcohols are highly biodegradable, and ethers are resistant to anaerobic biodegradation.

5. TOXICITY AND BIOACCUMULATION

5.1 Overview

The release of drilling wastes from oil and gas platforms is of interest due to the potential toxicity and the potential for bioaccumulation. The following is a brief summary of the available data regarding water-based and synthetic-based drilling fluids. It is important to note that the permit limits the toxicity of drilling fluids (30,000 ppm of the suspended particulate phase), prohibits the discharge of any muds containing diesel, the discharge of neat synthetic-based fluids, and limits the cadmium and mercury content of muds so that only the less contaminated sources of barite may be use in mud formulations.

5.2 Toxicity of Drilling Fluids

Toxicity testing data are often used to assess the toxicological characteristics of an effluent. Toxicity tests have been conducted with a wide variety of drilling muds, drilling mud fractions, and test organisms. The presence of diesel oil in used drilling mud also has been shown to contribute to increased toxicity (Conklin et al., 1983; Duke and Parrish, 1984).

The "fractions" or “phases” of drilling fluids that have been used in toxicity testing include:

Suspended Particulate Phase (SPP). One part by volume of drilling fluid is added to nine parts seawater. The drilling fluid-seawater slurry is well mixed and the suspension is allowed to settle for one hour before the supernatant SPP is decanted off. The SPP is mixed for five minutes and then used immediately in bioassays. Testing protocol currently employed by EPA specifies testing of the SPP.

Layered Solid Phase (LSP). A known volume of drilling fluid is layered over the bottom of the test vessel or added to seawater in the vessel. Although little or no mixing of the slurry occurs during the test, the water column contains a residual of very fine particulates which do not settle out of solution.

Suspended Solids Phase (SSP). Known volumes of drilling fluids are added to seawater and the mixture is kept in suspension by aeration or mechanical means.

Mud Aqueous Fraction (MAF). One part by volume of drilling fluid is added to either four or nine parts seawater. The mixture is stirred thoroughly and then allowed to settle for 20-24 hours. The resulting supernatant MAF is siphoned off for immediate use in bioassays. The MAF is similar to the SPP but has a longer settling time, so the concentration of particulates in the supernatant is lower.

Filtered Mud Aqueous Fraction (FMAF). The mud aqueous fraction of whole drilling fluid is centrifuged and/or passed through a 0.45 µm filter and the resulting solution is the filtered mud aqueous fraction.

Because the synthetic-base fluids are water insoluble and the SBFs do not disperse in water as water-based drilling fluids (WBFs) do, but rather tend to sink to the bottom with little dispersion, most research has focused on determining toxicity in the sedimentary phase as opposed to the aqueous phase.

5.2.1 *Acute Toxicity*

Acute toxicity tests of whole drilling fluids have generally produced low toxicity. Petrazzuolo (1983) summarized the results of 415 such tests of 68 muds in 70 species and found 1 to 2 percent had LC50s ranging from 100 to 999 ppm, 6 percent had LC50s ranging from 1,000 to 9,999 ppm, 46 percent had LC50s ranging from 10,000 to 99,999 ppm, and 44 percent had LC50s of greater than 100,000 ppm (Table 5-1).

Test results also indicate that whole drilling fluid is more toxic than the aqueous or particulate fractions (Table 5-2). These data show whole fluid toxicity ranging from one to five times that of the aqueous fraction, and 1.3 times the toxicity of the particulate fraction. The reason for this increased toxicity is unclear, although a combination of chemical and physical interactions is possible. Also, in terms of using toxicity test results to project potential receiving water impacts, drilling fluids generally undergo a rapid physical separation of their solids components over once discharged.

Acute toxicity test results for used drilling fluids and drilling fluid components are presented in Appendix A. Criterion values for drilling fluid fractions in the table have been converted to whole fluid equivalents to provide greater comparability to whole fluid tests. For example, the MAF is prepared by mixing one part drilling mud with 9 parts seawater, so an LC50 value derived from 100 percent MAF is the supernatant from a 10 percent drilling fluid mixture and is therefore expressed as 100,000 ppm (10 percent whole fluid equivalent).

Petrazzuolo (1981) used a semi-quantitative procedure to rank organisms in terms of sensitivity to drilling fluids, based on laboratory tests. The results ranked groups of organisms as follows, in order of decreasing sensitivity: copepods and other plankton; shrimp; lobster; mysids and finfish; bivalves; crab; amphipods; echinoderms; gastropods and annelids; and isopods. This ranking is admittedly biased because it is limited by the actual bioassay test results that have been published, and not based on theoretical considerations. For example, if more tests, more toxic drilling fluids, and more sensitive life stages have been tested on certain types of organisms, they would appear to be more sensitive in the rankings. These shortcomings notwithstanding, the ranking is a reasonable general indicator of the relative sensitivity of organisms to drilling fluids.

Table 5-1. Summary Table of the Acute Lethal Toxicity of Drilling Fluid[a]

	Number of species tested	Number of fluids tested	Number of tests	Not determinable	Number of 96-hr LC50 values (ppm)[b]				
					< 100	100-999	1,000-9,999	10,000-99,000	> 100,000
Phytoplankton	1	9	12	5	0	0	7	0	0
Invertebrates									
Copepods	1	9	11	1	0	3	5	2	0
Isopods	2	4	6	0	0	0	0	1	5
Amphipods	4	11	22	0	0	0	0	7	15
Gastropods	5	5	10	0	0	0	0	2	8
Decapods									
Shrimp	9	23	66	0	0	6(1)[c]	5	36	19
Crab	8	18	32	1	0	0	3	17	11
Lobster	1	2	7	0	0	0	1	3	3
Bivalves	11	22	59	19	0	0	1	19	20
Echinoderms	2	2	4	0	0	0	0	1	3
Mysids	4	17	64	2	0	0	1	29	32
Annelids	7	14	34	3	0	0	0	12	19
Finfish	15	24	80	0	0	0	2	50	36
TOTALS	70	40[d]	407	31	0	4-9	25	179	0.00

[a]Source: Adapted from Petrazzuolo, 1983.

[b]Placement in classes according to LC50 value. Lowest boundary of range if LC50 expressed as a range.

Cited values if given as ">" or "<." There were 199 such LC50 values; 95 were >100,000 ppm; 20 were <3,200 ppm.

[c]These include tests conducted on drilling fluids obtained from Mobile Bay, Alabama, and which may not be representative of drilling fluids used and discharged on the OCS. The value in parentheses is the result of not including those drilling fluids.

[d]The fluids used in Gerber et al., 1980, Neff et al., 1980, and Carr et al., 1980 were all supplied by API. Their characteristics were very similar and they may have been subsamples of the same fluids. If so, the total number of fluids tested would be 35.

Table 5-2. Comparison of Whole Fluid Toxicity and Aqueous and Particulate Fraction Toxicity for Some Organisms

Organism	Whole fluid vs. aqueous fraction	Whole fluid vs. particulate fraction
Gammarus (amphipod)	> 1.4 to 3.6:1	
Thais (gastropod)	> 1.2:1	
Crangon (shrimp)	> 1.1 to 1.4:1	
Carcinus (crab)	> 1.1 to 1.5:1	
Homarus (lobster)	> 3.5 to 5.3:1	
Strongylocentrotus (sea urchin)	> 2:1	
Coregonus (whitefish)	< 1.7:1	
Neomysis (shrimp)		1.3:1

Source: Petrazzuolo, 1981

Toxicity tests also highlight the toxicity variations that occur during a given organism's life cycle. Larval stage organisms are generally more sensitive than adult stages, and invertebrates are more sensitive while molting than during intermolt stages. These variations affect the potential for impact associated with offshore operations. Drilling fluids discharged into an area occupied by an adult community will presumably cause less impact than if the area were occupied by juvenile communities or if the area serves as a spawning ground.

Toxicity tests with larvae of the grass shrimp (*Palaemonetes intermedius*; Table 5-3) indicate that they are not as sensitive to whole muds as mysids. Average 96-hour LC50 values for whole muds ranged from 142 to 100,000 ppm. *Mercenaria mercenaria* one-hour-old larvae showed a lack of development (48-hour EC50) at relatively low concentrations of the liquid and suspended solids phases of the muds (Table 5-4). Concentrations as low as 87 and 64 ppm (respectively) halted larval development. Similarly, embryogenesis of *Fundulus* and echinoderms was affected by drilling fluid exposure. "Safe" levels (defined as a concentration of 10 percent of that having an adverse effect on the most sensitive assay system) ranged from one to 100 ppm. A study of sublethal effects of drilling mud on corals (*Acropora cervicornis*) indicated a decrease in the calcification rate and changes in amino acids at concentrations of 25 ppm.

All of the muds tested in an earlier drilling mud study (Duke and Parrish, 1984) were found to contain some No. 2 fuel (diesel) oil. Surrogate "diesel" oil content ranged from 0.10 to 9.43 mg/g in the whole mud. Spearman rank order correlation of the relationship between toxicity and fuel oil content showed a significant correlation between these factors in all tests.

Table 5-3. Drilling Fluid Toxicity to Grass Shrimp (*Palaemonetes intermedius*) Larvae

Mud	Type	96-h LC50 (95% CI)	
MIB	Seawater Lignosulfonate	28,750 ppm	(26,332-31,274)
AN31	Seawater Lignosulfonate	2,390 ppm	(1,896-2,862)
SV76	Seawater Lignosulfonate	1,706 ppm	(1,519-1,922)
P1	Lightly Treated Lignosulfonate	142 ppm	(133-153)
P2	Freshwater Lignosulfonate	4,276 ppm	(2,916-6,085)
P3	Lime	658 ppm	(588-742)
P4	Freshwater Lignosulfonate	4,509 ppm	(4,032-5,022)
P5	Freshwater/Seawater	3,570 ppm	(3,272-3,854)
P6	Lignosulfonate	100,000 ppm	---
P7	Low Solids Nondispersed	35,420 ppm	(32,564-38,877)
P8	Lightly Treated Lignosulfonate	2,577 ppm	(2,231-2,794)
NBS	Seawater/Potassium/Polymer		
Reference		17,917 ppm	(15,816-20,322)

Source: Adapted from Duke and Parrish (1984). All tests conducted at 20 ppt salinity and 20+2°C with day-1 larvae.

Table 5-4. Results of Continuous Exposure (48 hr) of 1-hr Old Fertilized Eggs of Hard Clams (*Mercenaria mercenaria*) to Liquid and Suspended Particulate Phases of Various Drilling Fluids

Drilling Fluid	Liquid Phase EC50 (µl/l)[a]		Control % "D" Stage	Suspended Particulate EC50 (µl/l)[b]		Control % "D" Stage
AN31	2,427	(2,390-2,463)	88	1,771	(1,710-1,831)	93
MIB	>3,000		95	>3,000		95
SV76	85	(81-88)	88	117	(115-119)	93
P1	712	(690-734)	97	122	(89-151)	99
P2	318	(308-328)	97	156	(149-162)	99
P3	683	(665-702)	98	64	(32-96)	99
P4	334	(324-345)	98	347	(330-364)	99
P5	385	(371-399)	98	382	(370-395)	99
P6	>3,000		97	>3,000		93
P7	>3,000		97	2,799	(2,667-2,899)	93
P8	269	(257-280)	93	212	(200-223)	93

aEC50 and 95% confidence interval. The percentage of each test control (n = 625+125 eggs) that developed into normal straight-hinge or "D" stage larvae and the EC50 are provided.
Source: NEA, 1984.

Other studies also implicated diesel and mineral oil in the toxicity of certain drilling fluids. In these studies, the toxicity of drilling fluids with and without added diesel or mineral oil were compared (Table 5-5). The drilling fluids tested included "used" fluids as well as a National Bureau of Standards (NBS) reference fluid which contained no measurable amount of diesel. In each case, the addition of diesel or mineral oil increased the toxicity of the drilling fluids.

Conklin et al. (1983) also found a significant relationship between the toxicity of drilling fluids and diesel oil content. Their study was designed to assess the roles of chromium and petroleum hydrocarbons in the total toxicity of whole mud samples from Mobile Bay to adult grass shrimp (*Palaemonetes pugio*). The range of 96-hour LC50 values was from 360 to 14,560 ppm. The correlation between chromium concentration of the mud and the LC50 value was not significant; however, the correlation between diesel oil concentration and the LC50 value was significant. As the concentration of diesel oil in the muds increased, there was a general increase in the toxicity values. Similar toxicity tests using juvenile sheepshead minnows (*Cyprinodon variegatus*) showed higher LC50 levels but no significant correlation between either chromium or diesel oil content and toxicity.

Diesel oil appeared to be a key factor in drilling fluid toxicity. It may explain some of the increased toxicity of used versus unused drilling fluids. As a result of these data, EPA has prohibited the discharge of drilling fluids to which diesel oil has been added.

Table 5-5. Toxicity of API #2 Fuel Oil, Mineral Oil, and Oil-Contaminated Drilling Fluids to Grass Shrimp (*Palaemonetes intermedius*) Larvae

Materials Tested	Oil Added (g/l)	Total Oil Content (g/l)	96-hr LC50 (95% CI)[a] (ppm; µl/l)
API #2 fuel oil[b]	---	---	1.4 (1.3-1.6)
Mineral Oil[c]	---	---	11.1 (9.8-12.5)
P7 mud	None	0.68	35,400 (32,564-8,877)
P7 mud + API #2 fuel	17.52	18.20	177 (165-190)
P7 mud + API #2 fuel oil (hot-rolled)	17.52	18.20	184 (108-218)
P7 mud + mineral oil	17.52	18.20	538 (446-638)
P7 mud + mineral oil (hot-rolled)	17.52	18.20	631 (580-674)
NBS reference drilling mud	None	0	17,900 (15,816-20,332)
NBS mud + API #2 fuel oil	18.20	18.20	114 (82-132)
NBS mud + API #2 fuel oil (hot-	18.20	18.20	116 (89-133)
rolled)	18.20	18.20	778 (713-845)
NBS mud + mineral oil	18.20	18.20	715 (638-788)
NBS mud + mineral oil (hot-rolled)	None	18.20	142 (133-153)
P1 drilling mud			

[a]95% confidence intervals computed by using a "t" value of 1.96.
[b]Properties: Specific gravity at 20°C, 0.86; pour point -23°C; viscosity, saybolt, 38°C, 36; saturates, wt% 62; aromatics, wt% 38; sulfur, wt%, 0.32.
[c]Properties: Specific gravity at 15.5°C, 0.84-0.87; flash point, 120-125°C; pour point, -12 to -15°C; aniline point, 76-78°C; viscosity, cst 40°C, 4.1 to 4.3; color saybolt, +28; aromatics, wt%, 16-20; sulfur, 400-600 ppm.
Source: Adapted from Duke and Parrish, 1984.

SBFs have routinely been tested using the Suspended particulate phase (SPP) toxicity test and found to have low toxicity (Candler et al., 1997). Rabke et al. (1998), have recently presented data from an interlaboratory variability study indicating that the SPP toxicity results are highly variable when applied to SBFs, with a coefficient of variation of 65.1 percent. Variability reportedly depended on such things as mixing times and the shape and size of the SPP preparation containers. As part of the coastal effluent guidelines effort, published in December 1996, EPA identified the problems with applying the SPP toxicity test to SBFs due to the insolubility of the SBFs in water (USEPA, 1996).

North Sea testing protocols require monitoring the toxicity of fluids using a marine algae (*Skeletonema costatum*), a marine copepod (*Arcartia tonsa*), and a sediment worker (*Corophium volutator* or *Abra alba*). The algae and copepod tests are performed in the aqueous phase, whereas the sediment worker test uses a sedimentary phase. Again, because the SBFs are hydrophobic and do not disperse or dissolve in the aqueous phase, the algae and copepod tests are only considered appropriate for the water soluble fraction of the SBFs, while the sediment worker test is considered appropriate for the insoluble fraction of the

SBFs (Vik et al., 19960. As with the aqueous phase algae and copepod tests, the SPP toxicity test mentioned above is only relevant to the water soluble fraction of the SBFs (Candler et al., 1997).

Both industry and EPA identified the need for more appropriate toxicity test methods for assessing the relative toxicities of various SBFs. Data presented by industry and EPA have shown that the abbreviated acute toxicity test of 96 hours increases the discriminatory power between the toxicity of individual SBFs and between the toxicity of SBFs and diesel (USEPA 2000). Both EPA and industry data have indicated that esters are the least toxic followed by internal olefin (IO), linear alpha olefin (LAO) and paraffins. These data also indicate toxicity for all base fluids tested and variability within individual tests both increase with increased test duration. Industry data indicate that a suitable 100%-formulated sediment for dilution sediment has yet to be developed. The toxicity data on SBFs and SBF base fluids are summarized in Table 5-6 and Table 5-7.

Table 5-6. Reported Toxicities of Synthetic-Based Fluids (LC50s)	***Ampelisca abdita***	***Leptocheirus plumulosus***	***oxynius ronius***	***Corophium volutator***	***Abra alba***	***keletonema costatum***	***Acartia tonsa***	***Fundulus grandis***
BASE FLUID - Natural Sediment								
Candler, 1997 Rabke, 1998b Still, 1997	879 mg/kg 1.0 ml/kg 0.7 ml/kg	850 mg/kg	mg/kg	840 mg/kg				
Candler, 1997 Still, 1997	557 mg/kg	251 mg/kg	mg/kg	7146 mg/kg				
Candler, 1997 Rabke, 1998b Vik, 1996 Still, 1997	121 mg/kg 4.0 ml/kg 3.0 ml/kg	3.7 ml/kg 2,944 mg/kg	mg/kg	30,000mg/kg 7,100 mg/l	300 mg/l	2,050 mg/l	10,000 mg/l	
Candler, 1997 Rabke, 1998b Vik, 1996 Still, 1997	,690 mg/kg 13.4 ml/kg 12.5 ml/kg	9,636 mg/kg	mg/kg	30,000mg/kg 12.0 ml/kg 3.0 ml/kg	7,900 mg/l	3,900 mg/l	50,000 mg/l	
Vik, 1996a					100,000 mg/l	60,000 mg/l	50,000 mg/l	
Vik, 1996a					549 mg/l	100,000 mg/l	100,000 mg/l	
Vik, 1996a					1,021 mg/l	10,000 mg/l	10,000 mg/l	
BASE FLUID - Formulated Sediment								

Rabke, 1998b		1.0 ml/kg 0.7 ml/kg						
WHOLE FLUID - Natural Sediment								
Rabke, 1998b	1.5 ml/kg	9.4 ml/kg						
Rabke, 1998b Friedheim et al., 1996	1.5 ml/kg	2.3 ml/kg		7,131 mg/kg	303 mg/kg			
Rabke, 1998 Jones, 1991 Friedheim et al., 1996 Vik, 1996a	3.7 ml/kg	36.5 ml/kg		10,000 mg/kg >10,000 mg/l	572 mg/kg 7,000 mg/l	82,400 mg/l	50,000 mg/l	8.4% TPH
Vik, 1996a							00-145,000 mg/l	50,000 mg/l
Friedheim et al., 1996				1,268 mg/kg	277 mg/kg			
WHOLE FLUID - Formulated Sediment								
Rabke, 1998b		2.9 ml/kg 1.7 ml/kg 0.7 ml/kg 1.3 ml/kg						
Rabke, 1998b	3.6 ml/kg	2.5 ml/kg 2.7 ml/kg 10.5 ml/kg						

Hood, 1997		2,279 mg/kg 4,498 mg/kg 2,245 mg/kg 1,200 mg/kg 943 mg/kg						
Rabke, 1998b		<2.5 ml/kg						
WHOLE FLUID -No Sediment								
	Mysidopsis bahia							
Rabke, 1998a Hood, 1997	221,436 - >1,000,000 ppm (SPP) 56,500 - >1,000,000 ppm (SSP)							

Table 5-7. Minimum and Maximum LC50 Values for New Sediment Toxicity Data Presented as Comment Response on Either the Proposed Rule (12/99) or the Notice of Data Availability (4/00) for Effluent Limitations Guidelines for the Oil and Gas Extraction Point Source Category.

	Minimum and Maximum LC 50 Values (mg/kg)				
	96-h LC 50			10-day LC 50	
Base Fluid	**Minimum**	**Maximum**		**Minimum**	**Maximum**
Diesel NS[a]	NA	NA		343[b,c]	NA
	776[b,d]			340[b,d]	
	892[e]	1133[e]		585[e]	951[e]
	703[b,f]			138[f]	635[f]
Diesel FS[g]	255[e]	374[e]		157[e]	312
	450[h]	703[h]		495[h]	495[h]
Ester NS	7686[d]	21824[d]		4275[d]	10,219[d]
	>12,800[b,e]			8743[b,e]	
Ester FS	27,986[b,e]			2816[b,e]	
IO NS	5874[c]	6306[c]		464[c]	2501[c]
	2675[d]	>8000[d]		2416[d]	2530[d]
	10,306[e]	19,522[e]		1988[e]	5270[e]
	27,269[f]	37,035[f]		2075[f]	16,131[f]
IO FS	<500[c]	2624[c]		<500[b,c]	

	3128[e]	17,501[e]		626[e]	1422[e]
	2289[h]	5913[h]		--	--
Paraffin NS	--	--		111[c]	1047[c]
	2263[b,d]			1151[b,d]	
	3241[b,f]			600[b,f]	1233[b,f]
LAO NS	--	--		205[c]	407[c]
	930[d]	2921[d]		1065[d]	1207[d]
PAO NS	2841[b,e]			707[b,e]	
PAO FS	2275[b,e]			333[b,e]	

[a] natural sediment
[b] one data point reported
[c] reported by Commenter III.B.b.9 Public Comments PR
[d] EPA unpublished data
[e] Commenter A.a.13 NODA
[f] Commenter A.a.30 NODA
[g] Formulated Sediment
[h] Commenter A.a.29 NODA

Summary

Since the original EA for the proposed SBF guidelines, both EPA and industry have conducted studies to evaluate the sediment toxicity of SBFs. Industry's initial attempt to examine different test organisms yielded a series of range-finder data that lead to the use of the amphipod *Leptocheirus plumulosus* as the primary test organism. Industry also examined the use of formulated sediments. Results of testing formulated sediments and estuarine organisms appeared to be more difficult than expected and industry, although continuing research on the issue, has suspended further testing with formulated sediments. Both EPA and industry's data have led to the following assumptions on the toxicity of SBF.

- The ranking for the SBF toxicity from least toxic to most is esters-IOs-LAOs-PAOs-paraffins.

- Although formulated sediments appear to indicate more discriminatory power between individual base fluids, control mortality continues to be a problem with 100% formulated sediments.

- The abbreviated acute test of 96 hours increases discriminatory power between individual SBFs, however they are not to true measure of SBF toxicity.

- The toxicity of SBFs appear to increase with time (in comparison of a 96-hour exposure to a 10-day exposure).

5.2.2 *Chronic Toxicity*

Stress Tests on Corals

There has been considerable investigation regarding the effects of whole drilling fluids on corals, due to their sensitivity, ecological interest, and presence in the Texas Flower Garden Banks area. Respiration, excretion, mucous production, degree of polyp expansion, and clearing rates for materials deposited on the surface are all useful parameters for indicating stress.

Laboratory experiments using the corals *Montastrea* and *Diplora* showed essentially unchanged clearing rates after applications of calcium carbonate, barite, and bentonite. However, exposure to a used drilling fluid significantly decreased clearing rates, although dose quantification was not possible (Thompson and Bright, 1977). When seven coral species were studied using *in situ* exposures to used drilling fluid, *Montastrea* and *Agaricia* displayed no mortality after a 96-hour exposure to 316 ppm concentration, but 100 percent mortality at the 1,000 ppm level (Thompson and Bright, 1980). Stress reaction were displayed by six species at the 316-ppm exposure level, including partial or complete polyp retraction and mucous secretion. A similar response was observed after a 96-hour exposure to 100 ppm.

Thompson, in an undated report to the USGS, exposed *Montastrea* and *Porites* to used drilling fluids from a well of 4,200 m (13,725 ft) drilling depth. The corals were buried for eight hours under the fluid and then removed to a sand flat to observe recovery. The exposure produced tissue atrophy and decay, formation of loose strands of tissue, and expulsion of zooxanthellae (zooxanthellae are algae living within coral cells in a symbiotic relationship), all indicative of severe stress. The *Montastrea* colonies were dead 15 hours after removal, and the *Porites* colonies were dead after 10 days.

The effects of thin layer application to these species were also observed. *In situ* exposures of drilling mud produced no apparent effects on clearing rates; however, laboratory application did demonstrate effects. Applications of 10-mm thick carbonate sand or drilling fluid from a depth of either 4,200 m (13,800 ft) or 1,650 m (5,413 ft) were applied to the corals, with the following results:

- Colonies in the sand experiment cleared themselves in 4 hours
- Colonies in the 1,650-m fluid experiment cleared themselves in 2 hours
- Colonies in the 4,200-m fluid experiment were 20% (*Montastrea*) and 40% (*Porites*) cleared after 4 hours, 20% (*Montastrea*) and 100% (*Porites*) cleared after 26 hours.

Additional testing with *Porites* indicated that the 4,200-m fluid was more toxic than the 1,650-m fluid, probably because the use of additives increases with well depth. No data are available on actual drilling fluid composition, however.

Krone and Biggs (1980) exposed coral (*Madracis decactis*) to suspensions of 100-ppm drilling mud from Mobile Bay, Alabama, which had been spiked with 0, 3, and 10 ppm ferrochrome lignosulfonate (FCLS). The drilling mud was presumably one with a low (<1 ppm) FCLS concentration. The corals were exposed for 17 days, at which time they were placed in uncontaminated seawater and allowed to recover for 48 hours. All of the corals exposed to the FCLS-spiked mud exhibited short-term increases in oxygen consumption and ammonia excretion. Photographic documentation of the corals revealed a progressive development of the following conditions: 1) a reduction in the number of polyps expanded indicating little or no active feeding; 2) extrusion of zooxanthellae; 3) bacterial infections with subsequent algal overgrowth; and 4) large-scale polyp mortality in two of the colonies. Coral behavior and condition improved dramatically during the recovery period. Polyps of surviving corals reexpanded and fed actively on day two of the recovery period.

Dodge (1982) evaluated the effects of drilling fluid exposure on the skeletal extension of reef-building corals (*Montastrea annularis*). Corals were exposed to 0, 1, 10, or 100 ppm drilling fluid ("Jay" fluid) for 48 days in a flow-through bioassay procedure. The drilling mud composition was changed approximately weekly as new mud taken from the well was added. One significant change in mud composition was in the diesel oil content, which was 0.4% by weight from the fourth week to the end of the experiment. Corals exposed to 100 ppm had significantly depressed linear growth rates and increased mortality. Calcification rates of corals exposed to 100 ppm decreased by 53% after four weeks and by 84% after six weeks. There was no indication of lowered growth rates for either the 1- or 10-ppm exposure.

Hudson and Robbin (1980) exposed corals (*Montastrea annularis*) to unused drilling fluid in heavy doses of 2- to 4-mm layers applied four times at 150-minute intervals. Drilling mud particles were generally removed by a

combination of wave action, tentacle cleansing action, and mucous secretions. At the end of the exposure period, corals were placed in protected waters for six months. At the end of another six months, the corals were removed and examined for growth characteristics. Results of the growth analysis indicated that heavy concentrations of drilling mud applied directly to the coral surface over a period of only 7½ hours reduced growth rates and suppressed variability. Trace element analyses of the corals indicated that neither barium nor chromium incorporated into the skeletal materials.

Experiments with the coral *Acropora cervicornis* revealed reduced calcification rates after exposure to concentrations as low as 25 ppm of used Mobile Bay drilling mud (Kendall et al., 1983). Calcification rates in growing tips were reduced to 88%, 83%, and 62% of control values after 24-hour exposures to 25, 50, and 100 ppm (v/v) drilling mud, respectively. Effects on soluble tissue protein and ninhydrin positive substance were also noted at these or higher levels. Further experiments with kaolin, designed to reproduce the turbidity levels of the drilling mud without its chemical effects, revealed slight metabolic changes to the corals that were much less pronounced than those observed for the drilling mud treatments.

5.2.3 *Long Term Sublethal Effects*

Crawford and Gates (1981) examined the effect of a Mobile Bay drilling mud (mud XVI) on the fertilization and development of the sand dollar *Echinarachnius parma*. Fertilization studies showed that sperm were highly refractive to the toxic action of this drilling mud. Exposure even at 10,000 mg solids/ml (a 26-fold dispersion of the whole mud) reduced fertilization by only 7 percent. Eggs were more sensitive; exposure to 1,000 mg/ml (262-fold dilution of the whole fluid) reduced fertilization from 88-90 percent to 4-6 percent. No effect was noted at 100 mg/ml (2,620-fold whole mud dilution). At this same exposure level (100 mg solids/ml), no effects were observed in development. At 1,000 to 10,000 mg solids/ml, development was delayed.

No EC50/LC50 ratio could be determined from these data. However, the apparent lower limit of 1,000 ppm drilling mud as the lowest level that results in statistically significant sublethal reproductive changes is consistent with other data. For example, killifish (*Fundulus heteroclitus*) embryos were exposed to a seawater-lignosulfonate mud (Neff et al., 1980). Several parameters were examined, including percentage hatch, percentage increased time to hatch, percentage decreased heart rate, and anomalies at day 16. Although no EC50/LC50 ratios could be calculated, data were available to plot and obtain EC01 values. These ranged from 1,000 to 6,000 ppm. For the shrimp *Palaemonetes pugio*, exposure to 1,000 to 10,000 ppm of a high density lignosulfonate mud did not alter the duration of any larval instar (Neff et al., 1980).

The effects of 6-week exposures to the aqueous phases of both medium- and high-density lignosulfonate muds on the condition index (dry meat weight/shell weight) of oyster spat (*Crassostrea gigas*) have been reported (Neff et al., 1980). For the medium-density mud (12.6 lb/gal), no effect was noted at 5,000 ppm or 10,000 ppm whole mud equivalents. The index was reduced about 20 percent at 20,000 ppm. For the high-density mud (17.4 lb/gal), approximately a 30 percent reduction occurred in the index at all concentrations tested.

Mussels (*Mytilus* sp.) were exposed to 50 ppm TSS for 30 days by Gerber et al. (1980). Growth was 75 percent of that observed in control animals. It is not known, however, whether this represents a process of reversible growth retardation or irreversible growth inhibition.

Juvenile mysids were exposed to 15,000-75,000 ppm of the aqueous phase of a lignosulfonate mud for 7 days by Carr et al. (1980). On a dry-weight basis, no effect on respiration occurred. This contrasts with the increased respiration seen in shrimp exposed to 35,000 ppm of the same mud's aqueous phase and suggests that compensatory adaptation had occurred. Average dry weights were significantly lower in exposed shrimp.

When polychaetes (*Nereis* sp.) were exposed to 100,000 ppm of the aqueous phase of a lignosulfonate mud for 4 days, glucose-6-phosphate dehydrogenase activity was significantly decreased (Gerber et al., 1980). Activity recovered, however, during a 4-day depuration period.

Histologic alterations were noted following exposure of grass shrimp to 100 ppm or 500 ppm barite for 30 days (Conklin et al., 1980). Mortalities in two replicates of the experiment were 20 percent for control shrimp and 60 percent for exposed shrimp (no concentrations of barite given). In 40 percent of the surviving shrimp, there were no histologic changes. In the remainder of surviving shrimp, a variety of changes were noted, including: absence of posterior midgut epithelia (20 percent of the survivors); degenerative changes in microvilli; dilated and hypertrophied rough endoplasmic reticulum; and both nuclear and Golgi changes. Barite was also observed in statocysts. Although controls were provided with a sand substrate, exposed shrimp were not. Thus, it remains unclear whether such changes would occur in a sediment-barite mixture. Also, because of concerns over settling of barite particles, no dose-response relationship could be identified or constructed from the data.

Lobsters were exposed to a Jay field fluid (an onshore operation) for 36 days in a flow-through system by Atema et al. (1982). The exposure was nominal at 10 mg/l. However, settling of solids was noted and the actual exposure was undefined. The number of dead or damaged lobsters was not significantly different from controls. The number of dead plus damaged lobsters was significantly higher among treated animals. Although molts from larval stage IV to V were unaffected, molts from stage V to VI were delayed in exposed animals. Exposed lobsters also exhibited poor coordination and food alert suppression.

Three studies in a Gulf of Mexico laboratory examined the effects of drilling muds or drilling mud components on community recruitment and development of benthic macrofauna (Tagatz et al., 1980; Tagatz and Tobia, 1978) and meiofauna (Cantelmo et al., 1979). Test substances were mixed at various ratios with sediment, or were applied as a covering layer over sediment in a flow-through system.

The tests conducted with drilling mud indicated that annelids were the most sensitive group, exhibiting significant reductions in abundance at 1:10 and 1:5 mixtures of mud and sediment, as well as when exposed to a covering of drilling mud (Tagatz et al., 1980). This sensitivity of annelids was also observed for a similar experiment conducted with barite as the toxicant. Coelenterate abundance was also significantly reduced by exposure to the 1:5 mixture of mud and sediment and the drilling mud covering. Arthropods were affected only by a drilling mud covering. Mollusks were not significantly affected by exposure to drilling mud, but were reduced in abundance when exposed to barite covering (Tagatz and Tobia, 1978). Annelid abundance was also reduced by exposure to barite covering (Tagatz and Tobia, 1978), but no other groups were significantly affected. Exposure to barite as a mixture in sediment significantly increased the abundance of nematodes and increased total meiofaunal density, whereas barite layering slightly reduced total meiofauna density and densities of nematodes and copepods. The reduction was not statistically significant (Cantelmo et al., 1979).

Certain difficulties arise in the interpretation of these data. First, results for total abundance are apparently skewed by the greater sensitivity of a certain few predominant species. This does not affect the significance of the results within the constraints of this experiment, but may reduce the applicability of these results to areas *in situ* where community structure is not similar to those observed in this experiment. Second, any attempt to relate these studies to effects *in situ* is confounded by the absence of sediment barium levels given for these studies. Barium is the only useful tracer of drilling mud dispersion in the sediment.

5.2.4 *Metals*

The potential accumulation of metals in biota represents an issue of concern in the assessment of oil and gas impacts. Sublethal effects resulting from bioaccumulation of these highly persistent compounds are most often measured. Gross metal contamination from drilling fluids may also cause mortality, particularly in benthic species. Sources of metals include drilling fluids, produced waters, sacrificial anodes, and contamination from other minor sources. Drilling fluids and produced waters are the primary sources of the metals of concern: arsenic, barium, chromium, cadmium, copper, mercury, nickel, lead, vanadium, silver, and zinc.

Field studies of metal concentration in sediments around platforms suggest that enrichment of certain metals may occur in surface sediments around platforms (Tillery and Thomas, 1980; Mariani et al., 1980; Crippen et al., 1980; and others). In the review of these studies conducted by Petrazzuolo (1983), enrichment of metals around platforms is generally distance dependent with maximum enrichment factors seldom exceeding ten. In platforms studied, enrichment of metals that could be attributed to drilling activities was either generally distributed to 300-500 m around the platform, or distributed downcurrent in a plume to a larger distance from the structure.

The concentrations of metals required to produce physiological or behavioral changes in organisms vary widely and are determined by factors such as the physicochemical characteristics of the water and sediments, the bioavailability of the metal, the organism's size, physiological characteristics, and feeding adaptations. Metals are accumulated at different rates and to different concentrations depending on the tissue or organ involved. Laboratory studies on metal accumulation as a result of exposure to drilling muds have been conducted by Tornberg et al. (1980), Brannon and Rao (1979), Page et al. (1980), McCulloch et al. (1980), Liss et al. (1980), and others. Data from these laboratory studies are summarized in Appendix B. Maximum enrichment factors for the metals measured were generally low (<10) with the exception of barium and chromium, which had enrichment factors of up to 300 and 36, respectively.

Depuration studies conducted by Brannon and Rao (1979), McCulloch et al. (1980), and Liss et al. (1980) have shown that organisms tested have the ability to depurate some metals when removed from a zone of contamination. In various tests, animals were exposed to drilling fluids from 4-28 days, followed by a 1-14 day depuration period. Uptake and depuration of barium, chromium, lead, and strontium were monitored and showed a 40-90% decrease in excess metal in tissues following the depuration period. Longer exposure generally meant a slower rate of loss of the metal. In addition, if uptake was through food organisms rather than a solute, release of the excess metal was slowed.

The available laboratory data on metals accumulation are difficult to correlate with field exposure and accumulation. Petrazzuolo's review (1983) notes that in the field, bioaccumulation of metals in the benthos will result from exposure to the particulate components of drilling muds. However, laboratory studies have almost always used either whole fluids or mud aqueous fractions, and thus are either over- or underestimating potential accumulation.

Field studies of metal accumulation in marine food webs off southern California have been conducted by Schafer et al. (1982) and others. These data have indicated that most metals measured (including Cr, Cu, Cd, Ag, Zn) do not increase with trophic level either in open water or in contaminated regions such as coastal sewage outfalls.

5.3 Bioaccumulation Potential of Synthetic-Based Drilling Fluids

One factor considered in assessing the potential environmental impacts of discharged drilling fluids and drill cuttings is their potential for bioaccumulation. This section presents information concerning the bioaccumulation of oleaginous-base fluids, including the synthetic-base fluids and mineral oil.

Most of the available information has been developed by mud suppliers to provide information to government regulators to assess the acceptability of these materials for discharge into the marine environment. The available information on the bioaccumulation potential of synthetic base fluids is scant, comprising only a few studies on octanol:water partition coefficients (P_{ow}) and three on tissue uptake in experimental exposures. The P_{ow} represents the ratio of a material that dissolves or disperses in octanol (the oil phase) versus water. The P_{ow} generally increases as a molecule becomes less polar (more hydrocarbon-like). EPA reviewed the available information on the bioaccumulation potential of synthetic-base fluids (USEPA, 2000). The review covers four types of synthetics: an ester (two studies), internal olefins (IO; four studies), and poly alpha olefins (PAO; five studies). One study included a low toxicity mineral oil (LTMO) for comparative purposes. The types of synthetic-base fluids tested represent the more common of synthetic-base fluid types currently in use in drilling operations.

The data that EPA identified concerning the bioaccumulation potential of synthetic base fluids are summarized in Table 5-8. Nine reports provided original information. This information consisted of P_{ow} data (based on calculated or experimental data), dispersibility data, or subchronic exposure of test organisms to yield data for calculating BCFs or assessing uptake. log P_{ow} values less than three or greater than seven would indicate that a test material is not likely to bioaccumulate (Zevallos et al., 1996).

For PAOs, the log P_{ow}s reported were >10, 11.19, 11.9, 14.9, 15.4, and 15.7 in the five studies reviewed. The four studies of IOs that were reviewed reported log P_{ow}s of 8.57 (8.6) and >9. The ester was reported to have a log P_{ow} of 1.69 in the two reports in which it was presented. The LAO log P_{ow} was cited as 7.82 and a log P_{ow} of 15.4 was reported for an LTMO. The only BCF reported was calculated for

Table 5-8. Bioaccumulation Data for Synthetic Fluids and Mineral Oil Muds

Type of Synthetic Base Fluid or LTMO	Parameter Determined	Reference
PAO	log P_{ow}: 15.4 (calculated)	Friedheim et al., 1991
PAO	log P_{ow}: >10 (calculated)	Leutermann, 1991
PAO	log P_{ow}: 14.9 - 15.7 (measured)	Schaanning, 1995
PAO	log P_{ow}: 11.9 (measured)	Zevallos et al., 1996
PAO	log P_{ow}: 11.19	Moran, 2000
IO	log P_{ow}: > 9	Environment & Resource Technology, Ltd., 1994a
IO	log P_{ow}: 8.57	Zevallos et al., 1996; Moran, 2000
LAO	log P_{ow}: 7.82	Moran, 2000
Ester	log P_{ow}: 1.69	Growcock et al., 1994; Moran, 2000
LTMO	log P_{ow}: 15.4	Growcock et al., 1994
various	dispersibility: ranking = ester> di-ether >> detergent alkylate > PAO > LTMO	Growcock et al., 1994
IO	10-day uptake; 20-day depuration exposure gave log BCF: 5.37 (C16 forms); 5.38 (C18 forms)	Environment & Resource Technology, Ltd., 1994b; Moran, 2000
PAO	Uptake: no measured uptake in tissues after 30-day exposure; presence noted in 1 of 24 gut samples	Rushing et al., 1991; Moran, 2000
LTMO	Uptake: after 30-day exposure, detectable amounts in 50% of tissues analyzed (12 of 24) and 19 of 24 gut samples examined	Rushing et al., 1991
PAO	Subchronic effects: equal or better growth vs controls	Jones et al., 1991
LTMO	Subchronic effects: retarded growth vs controls	Jones et al., 1991

Type of Synthetic Base Fluid or LTMO	Parameter Determined	Reference
LAO	Mytilus edulis log BCF: 4.84	Moran, 2000

Abbreviations: PAO: poly alpha olefin; IO: internal olefin; LAO: linear alpha olefin; LTMO: low toxicity mineral oil

IOs; a value of 5.4 l/kg was determined. In 30-day exposures of mud minnows (*Fundulus grandis*) to water equilibrated with a PAO- or LTMO-coated cuttings, only the LTMO was reported to produce adverse effects and tissue uptake/occurrence. Growth retardation was observed for the LTMO and LTMO was observed at detectable levels in 50% of the muscle tissue samples examined (12 of 24) and most (19 of 24) of the gut samples examined. The PAO was not found at detectable levels in any of the muscle tissue samples and occurred in only one of twenty-four gut samples examined.

These limited data suggest that synthetic base fluids do not pose a serious bioaccumulation potential. Despite this general conclusion, existing data cannot be considered sufficiently extensive to be conclusive. This caution is specifically appropriate given the wide variety of chemical characteristics resulting from marketing different formulations of synthetic fluids (i.e., carbon chain length or degree of unsaturation within a fluid type, or mixtures of different fluid types).

6. BIOLOGICAL OVERVIEW

This chapter describes the biological communities and processes in the eastern Gulf of Mexico which may be exposed to pollutants, the presence of endangered species, any unique species or communities of species, and the importance of the receiving water to the surrounding biological communities. The species identified as threatened or endangered by the USFWS and NMFS are characterized in the last section of this chapter for compliance with Section 7 of the Endangered Species Act.

6.1 Primary Productivity

Primary productivity is "the rate at which radiant energy is stored by photosynthetic and chemosynthetic activity of producer organisms in the form of organic substances which can be used as food materials" (Odum, 1971). Primary productivity is affected by light, nutrients, and zooplankton grazing, as well as other interacting forces such as currents, diffusion, and upwelling.

The producer organisms in the marine environment consist primarily of phytoplankton and benthic macrophytes. Since benthic macrophytes are depth/light limited, primary productivity in the open ocean is attributable primarily to phytoplankton. The productivity of nearshore waters can be attributed to benthic macrophytes--including seagrasses, mangroves, salt marsh grasses, and seaweeds--and phytoplankton.

There are numerous methods for estimating primary productivity in marine waters. One method is to measure chlorophyll content per volume of seawater and compare results over time to establish a productivity rate. The chlorophyll measurement, typically of chlorophyll a, gives a direct reading of total plant biomass. Chlorophyll a is generally used because it is considered the "active" pigment in carbon fixation (Steidinger and Williams, 1970). Another method, the C^{14} (radiocarbon) method, measures photosynthesis (a controversy exists as to whether "net", "gross", or "intermediate" photosynthesis is measured by this method; Kennish, 1989). The C^{14} method introduces radiolabeled carbon into a sample and estimates the rate of carbon fixation by measuring the sample's radioactivity.

The units used to express primary productivity are grams of carbon produced in a column of water intersecting one square meter of sea surface per day (g $C/m^2/d$), or grams of carbon produced in a given cubic meter per day (g $C/m^3/d$).

C^{14} uptake throughout the Gulf is 0.25 g $C/m^3/hr$ or less, and chlorophyll measurements range from 0.05 to 0.30 mg/m^3 (ppb). Eastern regions of the Gulf of Mexico are generally less productive than western regions, and throughout the eastern Gulf, primary productivity is generally low. However, outbreaks of "red-tide" caused by pathogenic phytoplankton may occur in the mid- to inner-shelf. Also, depth-integrated productivity values in the area of the Loop Current (primarily the outer shelf and slope) are actually higher than western and central Gulf values. Enhanced productivity occurs in areas affected by

upwelling. Near the bottom of the euphotic zone, chlorophyll and productivity values are about an order of magnitude greater, probably due to the often intruded, nutrient-rich Loop undercurrent waters (MMS, 1990).

Productivity measurements in the oceanic waters of the Gulf of Mexico include:

- 0.1 g C/m^2/d yielding 17 g C/m^2/yr or 86 million tons of phytoplankton biomass (MMS, 1983)
- 103-250 g C/m^2/yr (Flint and Kamykowski, 1984)
- 103 g C/m^2/yr (Flint and Rabalais, 1981).

Biomass (chlorophyll a) measurements in the predominantly oceanic waters of the Gulf of Mexico include:

- 0.05-0.30 mg Chl a/m^3 (MMS, 1983a)
- 0.05-0.1 mg Chl a/m^3 (Yentsch, 1982)
- 0.22 mg Chl a/m^3 (El-Sayed, 1972)
- 0.17 mg Chl a/m^3 (Trees and El-Sayed, 1986).

For comparisons, the following data on primary productivity are presented for coastal wetland systems as compiled by Thayer and Ustach (1981):

· Salt Marshes	200-2000 g C/m^2/yr
· Mangroves	400 g C/m^2/yr
· Seagrasses	100-900 g C/m^2/yr
· *Spartina alterniflora*	1300 g C/m^2/yr
· *Thalassia*	580-900 g C/m^2/yr
· Phytoplankton	350 g C/m^2/yr

For the eastern Gulf of Mexico, biomass (chlorophyll a) measurements include the following (Yoder and Mahood, 1983):

- Surface mixed layer values of 0.1 mg/m^3
- Subsurface measurements at 40-60 m ranged from 0.2 to 1.2 mg/m^3
- Average integrated values for the water column over the 100-200 m isobath was 10 mg/m^2
- Average integrated values for the water column greater than 200 m isobath was 9 mg/m^2.

6.2. Phytoplankton

6.2.1 *Distribution*

Phytoplankton distribution and abundance in the Gulf of Mexico is difficult to measure. Shipboard or station measurements cannot provide information about large areas at one moment in time, and satellite imagery cannot provide definitive information about local conditions that may be important. Due to fluctuations in light and nutrient availability and the immobility of phytoplankton, distribution is temporally and spatially variable. Seasonal fluctuations in location and abundance are often masked by patchy distributions which human sampling designs must attempt to interpret. In addition, methods for measurement of chlorophyll or uptake of carbon cannot always resolve all questions concerning variability among or within species under different conditions, or concerning the effects of grazing on abundance.

As mentioned in the previous section, phytoplankton occupy a niche at the base of food chain as primary producers of our oceans. Herbivorous zooplankton populations require phytoplankton for maintenance and growth -- generally 30-50% of their weight each day and surpassing 300% of their weight in exceptional cases (Kennish, 1989). In the Gulf of Mexico, phytoplankton are also often closely associated with bottom organisms, and may also contribute to benthic food sources for demersal feeding fish.

Phytoplankton seasonality has been explained in terms of salinity, depth of light penetration, and nutrient availability. Generally, diversity decreases with decreased salinity and biomass decreases with distance from shore (MMS, 1990).

6.2.2 *Principal Taxa*

The principal taxa of planktonic producers in the ocean are diatoms, dinoflagellates, coccolithophores, silicoflagellates and blue-green algae (Kennish, 1989).

Diatoms. Many specialists regard diatoms as the most important phytoplankton group, contributing substantially to oceanic productivity. Diatoms consist of single cells or cell chains, and secrete an external rigid silicate skeleton called a frustule.

In 1969, Saunders and Glenn reported the following for diatom samples collected 5.6 to 77.8 km from shore in the Gulf of Mexico between St. Petersburg and Ft. Myers, Florida. Diatoms averaged 1.4 x $10^7 \mu^2$/l surface area offshore, 13.6 x $10^7 \mu^2$/l at intermediate locations and 13.0 x $10^8 \mu^2$/l inshore. The ten most important species in terms of their cellular surface area were: *Rhizosolenia alata, R. setigera, R. stolterfothii, Skeletonema costatum, Leptocylindrus danicus, Rhizosolenia fragilissima, Hemidiscus hardmanianus, Guinardia flaccida, Bellerochea malleus,* and *Cerataulina pelagica*.

Dinoflagellates. Dinoflagellates are typically unicellular, biflagellated autotrophic forms that also supply a major portion of the primary production in many regions. Some species generate toxins and when blooms reach high densities, mass mortality of fish, shellfish, and other organisms can occur (Kennish, 1989). Notably, *Gymnodinium breve* is responsible for most of Florida's red tides and several of the *Gonyaulax* species are known to cause massive blooms (Steidinger and Williams, 1970). Table 6-1 lists species and varieties of dinoflagellates found to be abundant during the Hourglass Cruises (a systematic sampling program in the eastern Gulf of Mexico.)

Coccolithophores. Coccolithophores are unicellular, biflagellated algae named for their characteristic calcareous plate, the coccolith, which is embedded in a gelatinous sheath that surrounds the cell. Phytoplankton of offshore Gulf of Mexico are reported to be dominated by coccolithophores (Iverson and Hopkins, 1981).

Silicoflagellates. Silicoflagellates are unicellular flagellated (single or biflagellated) organisms that secrete an internal skeleton composed of siliceous spicules (Kennish, 1989). Perhaps because of their small size (usually less than 30 µm in diameter) little specific information relative to Gulf of Mexico distribution and abundance, is available for this group.

Blue Green Algae. Blue green algae are prokaryotic organisms that have chitinous walls and often contain a pigment called phycocyanin that gives the algae their blue green appearance (Kennish, 1989). On the west Florida shelf, inshore blooms of the blue green algae *Oscillatoria erethraea* sometimes occur in spring or fall.

6.3 Zooplankton

Like phytoplankton, zooplankton are seasonal and patchy in their distribution and abundance. Zooplankton standing stocks have been associated with the depth of maximum primary productivity and the thermocline (Ortner et al., 1984). Zooplankton feed on phytoplankton and other zooplankton, and are important intermediaries in the food chain as prey for each other and larger fish.

As in many marine ecosystems, zooplankton fecal pellets contribute significantly to the detrital pool. The ease of mixing in Gulf coastal waters may make them extremely important to nutrient circulation and primary productivity, as well as benthic food stocks. Also contributing to the detrital pool is the concentration of zooplankton in bottom waters, coupled with phytoplankton in the nepheloid layer during times of greater water stratification.

Copepods are the dominant zooplankton group found in all Gulf waters. They can account for as much as 70% by number of all forms of zooplankton found (NOAA, 1975). In shallow waters, peaks occur in the summer and fall (NOAA, 1975), or in spring and summer, (MMS, 1983a). When salinities are low, estuarine species such as *Acartia tonsa* become abundant.

The following information on zooplankton distribution and abundance in the eastern Gulf of Mexico is summarized from Iverson and Hopkins (1981).

- During Bureau of Land Management-sponsored studies, small copepods predominated in net catches over the shelf regions of the eastern and western Gulf of Mexico.

- During Department of Energy-sponsored studies at sights located over the continental slope of Mobile and Tampa Bays, small calanoids such as *Parcalanus*, and *Clausocalanus* and cyclopoids such as *Farralanula, Oncaea*, and *Oithona* predominated at the 0-200 m depths; and larger copepods such as *Eucalanus, Rhincalnus*, and *Pleuromamma* dominated at 1,000 m depths. Euphausiids were also more conspicuous. Night-time samples taken near Tampa showed larger

crustaceans such as Lucifer and Euphasia. Biomass data for the same site revealed a decrease in zooplankton with increasing depth. The mean cumulated biomass value for the upper 1,000 m was 21.9 ml/m^2.

Table 6-1. Significant Dinoflagellate Species of the Eastern Gulf of Mexico

Species	Biomass Value (μ^3)
Amphisolenia bidentata	67,039 - 95,406
Ceratium carriense	637,219 - 1,115,367
C. carriense var. *volans*	622,206 - 1,196,643
C. contortum var. *karstenii*	943,121 - 1,655,573
C. extensum	189,709 - 323,546
C. furca	23,157 - 43,369
C. fusus	34,463 - 154,722
C. hexacanthum	687,593 - 1,384,016
Ceratium hircus	211,709
C. inflatum	145,897 - 221,276
C. massiliense	543,762 - 1,002,222
C. trichoceros	104,110 - 357,437
C. tripos var. *atlanticum*	518,659 - 964,436
Dinophysis caudata var. *pedunculata*	92,153 - 231,405
Gonyaulax splendens	51,651
Prorocentrum crassipes	329,540
P. gracile	25,773
P. micans	65,412

Source: Steidinger and Williams, 1970.

- Studies funded by the National Science Foundation in the east-central Gulf found diurnal patterns of distribution in the upper 1,000 m--with increases in the 50-m range at night and in the 300-600-m zone during the day--most likely attributable to vertical migration. In the upper 200 m, in addition to copepods, group such as chaetognaths, tunicates, hydromedusae, and euphausiids were significant contributors to the biomass.

Icthyoplankton studies for the eastern Gulf conducted during 1971-1974 found fish eggs to be more abundant in the northern half and fish larvae to be more abundant in the southern half of the eastern Gulf. Mean abundances were 5,454 eggs/m^2 and 3,805 larvae/m^2 in the northern Gulf and 4,634 eggs/m^2 and 4,869 larvae/m^2 in the southern Gulf. Eggs were more abundant in waters less than 450 meters deep, where as larvae were more abundant in depth zones greater than 50 meters (Houde and Chitty, 1976).

6.4 Habitats

6.4.1 *Seagrasses*

Seagrasses are vascular plants that serve a variety of ecologically important functions. As primary producers, seagrasses are a direct food source and also contribute nutrients to the water column. Seagrass communities serve as a nursery habitat for juvenile fish and invertebrates and seagrass blades provide substrate for epiphytes. Species such as *Thalassia testudinum* have an extensive root system that stabilize substrate, and broad ribbon-like blades that increase sedimentation. Seagrasses mainly occur in shallow, clear, highly saline waters. Seagrass beds do not occur in the proposed activity area (MMS, 2000).

Approximately 1.25 million acres of seagrass beds are estimated to exist in exposed, shallow, coastal/nearshore waters and embayments of the Gulf of Mexico**.** About 3% of these beds are in Mississippi. Florida with Florida Bay and coastal Florida accounting for more than 80%. True seagrasses that occur in the Gulf of Mexico are shoal grass, paddle grass, star grass, manatee grass, and turtle grass. Although not considered a true seagrass because it has hydroanemophilous pollination (floating pollen grains) and can tolerate freshwater, widgeon grass is common in the brackish waters of the Gulf. (BOEM 2013).

6.4.2 *Offshore Habitats*

Offshore habitats include the water column and the sea floor. The eastern Gulf benthos consist primarily of low relief live-bottom areas. Live-bottom areas contain biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascidians, sponges, bryozoans, seagrasses, or corals living upon and attached to naturally occurring hard or rocky formation with fishes and other fauna. Live-bottom types include pinnacle-trend, low-relief, offshore seagrasses, and coral reef communities. Coral reef communities are not found within the proposed permit coverage area and are therefore not discussed in this document. Within the eastern Gulf, live-bottom communities are scattered across the west Florida shelf and at the outer edge of the Mississippi/Alabama shelf.

Deepwater Benthic Resources

Deepwater benthic habitats, as discussed here, refer to those in water depths greater than 300 meters. These include a number of unique chemosynthetic habitat and community types occur in the deep waters of the Gulf of Mexico. Chemosynthetic communities consist of sessile invertebrates such as clams, mussels and tube worms and motile invertebrates similar to hydrothermal vent communities discovered in the eastern Pacific (Corliss et al., 1979). Detailed descriptions of deepwater benthic resources in the

central and eastern Gulf of Mexico are presented in a number of recent studies and reports including CSA International, Inc. 2007, and Brooks et. al., 2014 as well as several recent BOEM EIS documents (BOEM 2012; 2013).

Chemosynthetic communities are those that use a carbon source, from fluids venting from the seafloor, other than sun driven photosynthesis to support life. Primary production of chemosynthetic bacteria can support assemblages of higher organisms via symbiosis. The existence of deep benthic chemosynthetic communities was initially discovered in the eastern Pacific (Corliss et al., 1979). Communities using both hydrocarbon seepage and hydrogen sulfide vents were discovered during investigations in the Gulf during the 1980's with most occurring within the western and central Gulf (MMS 2000b).

Chemosynthetic communities are not known to be abundant within the area of the Gulf of Mexico under Region 4 permit authority. At present the only known chemosynthetic community in the Eastern Planning Area, and the first to be discovered in the Gulf of Mexico in 1983, was found in an area termed the Florida Escarpment at Vernon Basin 926 block about 400 km south of Apalachicola, FL (MMS 2000b). These communities are similar to deep sea hydrothermal vent communities of the eastern Pacific. The presence of hydrogen sulfide seeps on the Escarpment indicate the potential for additional chemosynthetic communities in this area.

The deepwater GOM consists mainly of soft mud bottoms with occasional patches of hard substrate that support non-chemosynthetic reef communities. Wherever hard substrate exists, deepwater live bottom communities, comprised of all phyletic groups of organisms found on the continental shelf and other marine environments including coral communities, can establish. Deepwater coral communities are now known to occur in many locations in the deep GOM (>300 m; 984 ft).

Investigations of 3D seismic data revealed over 16,000 hard sonar returns, most shown to be hard bottom substrate supporting nonchemosynthetic communities and/or live bottom reef communities. This data suggests that nonchemosynthetic and coral communities are much more common in the deepwater GOM than previously known (BOEM, 2013).

6.5 Fish and Shellfish Resources

Table 2-6 on pages 2-26 to 2-31 in *Final Environmental Impact Statement, National Pollutant Discharge Elimination System permitting for Eastern Gulf of Mexico Offshore Oil and Gas Extraction* (USEPA, 1998) provide a detailed list and information on fish and shellfish resources that occupy the waters of Alabama, Florida, and Mississippi.

The distribution of fish resources in the central and eastern Gulf of Mexico are highly dependant on a variety of factors including habitat type, chemical and physical water quality variables, biological, and climatic factors. The Gulf contains both a temperate fish fauna and a tropical fauna arrayed into inshore and offshore habitats depending on latitude. To the south of the 20°C winter isotherm, approximately middle Florida, the more tropical fish fauna occupies inshore habitats replacing the temperate fauna. To the north the tropical fauna is pushed further offshore to avoid cold winter temperature and by increased competition by temperate species able to tolerate cooler waters. In the northern Gulf where temperate

species dominate inshore, a well developed tropical fauna occurs on offshore structures, particularly reefs (Hoese and Moore, 1977). During warm weather the early life stages of the tropical fauna move further inshore around piers and jetties.

The temperate fish and invertebrate fauna of the north-central Gulf tend to be dominated by estuary dependant species such as sciaenids (i.e., croaker, red and black drum, spotted seatrout), menhaden, shrimp, oysters and crabs. These species require the transportation of early life stages into estuaries for grow out into mature adults or juveniles and migration out to shelf environments. Shellfish resources in the Gulf tend to be more estuarine dependant than finfishes. Gulf of Mexico shellfish habitats range from brackish wetlands to nearshore shelf environments. Of the 15 penaeid shrimp species found in the Gulf the brown, white and pink shrimp are the most important. Adults of these species spawn in offshore marine waters and the free swimming postlarvae move into estuaries to remain through their juvenile stages. Juvenile shrimp move back offshore to molt into adults.

Reef fish assemblages may consist of mainly temperate species in the more northern Gulf with increasing dominance of more tropical fish species, typically associated with coral reefs, further offshore and in the more southern portions of the Gulf. Natural reef habitat in the eastern Gulf ranges from low relief (>1 m) livebottom, high relief ridge habitats along the Florida shelf break and pinnacle formations of the Florida Middle Grounds on the west Florida shelf. Man-made or artificial reef habitats also exist from oil and gas platforms, sunken vessels and a variety of other structures placed intentionally for fisheries enhancement. These structures comprise critical habitats for many important commercial and recreational fishes such as groupers and snappers.

Pelagic fish species are distributed by water column depth and relationship to the shore. Coastal pelagics are those that move mainly around the continental shelf year round, singly or in schools of various size (MMS 2000b). These include some commercially important groups of fishes including sharks, anchovies, herring, mackerel, tuna, mullet, bluefish and cobia. Oceanic pelagics occur at or seaward of the shelf edge throughout the Gulf. Oceanic pelagics include many larger species such as sharks, tuna, bill fishes, dolphin and wahoo.

Deepwater Fishes

Extensive discussions of deepwater fishes are available in: *Deepwater Gulf of Mexico Environmental and Socioeconomic Data Search and Literature Synthesis, Volume 1: Narrative Report* (MMS, 2000c) and in several recent BOEM EIS documents (BOEM 2012; 2013).

Deepwater Pelagic Fishes

Mesopelagic fishes are restricted mainly to the midwater (200 m - 1000 m) environment in the Gulf. These are dominated by lanternfishes (myctophids) and bristlemouths (gonostomatids). The Stomiidae (dragonfishes) with 73 species is the most diverse family of fishes known for the Gulf of Mexico (Sutton and Hopkins 1996; McEachran and Fechhelm 1998). The second most diverse group is the myctophids represented by 49 species in the Gulf of Mexico (Backus et al. 1977; Gartner et al. 1987). Mesopelagic fishes make extensive vertical migrations, from 400-800 m to near or at the surface, at night to feed in the

upper portions of the water column and are important in the transfer of nutrients and energy between the mesopelagic and epipelagic (upper 200 m) zone (Hopkins and Baird, 1985).

Bathypelagic fishes live a depths greater than 1000 m and seldom move up into shallower waters. This group consists of little-know species such as slickheads, gulper eels, deep-sea anglers, whalefishes and bigscales and is not well studied in the Gulf.

Deepwater Demersal Fish

Deepwater demersal fishes are species that associate with benthic structure, living on or above it, from the shelf slope transition to the abyssal plain. In the Gulf this group consists of some 300 species (MMS 2000c). Studies by Pequegnat (1983) and Galloway et al. (1988) showed that the number of demersal species and the distribution of individuals among species declined with increasing depth. Several species of snapper, grouper and tilefish are caught commercially on demersal habitat in depths of up to 500 m.

6.8 Marine Mammals

Twenty-nine species of marine mammals (listed in EPA, 1998, Table 3-4) are known to occur in or migrate through the northern Gulf of Mexico based on sightings and/or strandings (Schmidly, 1981; Davis et al., 2000). Extensive discussions can be found in the 2016 EPA Environmental Assessment for the EPA Oil and Gas general NPDES permit (EPA 2016) and in several recent BOEM EIS documents (BOEM 2012; 2013). Cetaceans (whales, dolphins, and porpoises) are the most common. Five of the seven baleen whales in the Gulf are currently listed as threatened or endangered and of the 20 toothed whales present only the sperm whale is endangered. During 1978 to 1987, a total of 1,200 cetacean strandings/sightings was reported for Alabama, Florida and Mississippi to the Southeastern U.S. Marine Strandings Network. Ninety percent of these stranding/sighting occurred off Florida coasts (the Florida figure reflects strandings from both the Gulf and the Atlantic waters; NOAA, 1991). The cetaceans found in the Gulf include species that occur in most major oceans and, for the most part, are eurythermic, with a broad range of temperature tolerances (Schmidly 1981). An introduced species of pinniped, the California sea lion, occurred in small numbers only in the feral condition, however no sightings of this species has been reported in the Gulf since 1990. All marine mammals are protected under the Marine Mammal Protection Act of 1972.

6.10 Endangered Species

The USFWS and NMFS evaluate the conditions of species and their populations within the United States. Those species populations considered in danger of extinction are listed as endangered species per the Endangered Species Act of 1973. In addition, Section 7(a)(2) of the Endangered Species Act requires federal agencies to ensure that their action do not jeopardize the continued existence of listed species or destroy or adversely modify critical habitat. Threatened and endangered species that occur in the Gulf of Mexico are discussed extensively in the 2016 EPA Environmental Assessment for the EPA Oil and Gas general NPDES permit (EPA 2016) and in several recent BOEM EIS documents (BOEM 2012; 2013).

Table 6-2 provides an updated list of species either listed as threatened or endangered that potentially could occur in impacted areas of the central or eastern Gulf.

Table 6.2. Federally Listed Species in the Eastern Gulf of Mexico.

Species	Scientific Name	Status
Birds		
Piping plover	*Charadrius melodus*	Threatened
Wood stork	*Mycteria americana*	Endangered
Roseate tern	*Sterna dougallii*	Threatened
Interior Least turn	*Sterna antillarum athalassos*	Endangered
Whooping crane	*Grus americana*	Endangered
Mississippi Sandhill crane	*Grus canadensis*	Endangered
Everglades snail kite	*Rostrhamus sociabilis*	Endangered
Red knot	*Calidris cantunus*	Threatened
Reptiles		
American crocodile	*Crocodylus acutus*	Threatened
Loggerhead sea turtle	*Caretta caretta*	Threatened
Kemp's Ridley sea turtle	*Lepidochelys kempii*	Endangered
Green sea turtle	*Chelonia mydas*	Threatened
Hawks bill sea turtle	*Eretmochelys imbricata*	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Marine Mammals		
West Indian manatee	*Trichechus manatus*	Endangered
Finback whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Right whale	*Eubalaena glacialis*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Terrestrial Mammals		
Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*	Endangered
Alabama beach mouse	*Peromyscus polionotus ammobates*	Endangered
Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*	Endangered
Key Largo cotton mouse	*Peromyscus gossypinus allapaticola*	Endangered
Florida panther	*Puma concolor coryi*	Endangered
Key Largo woodrat	*Neotoma floridana smalli*	Endangered
Lower Keys rabbit	*Sylvilagus palustris hefneri*	Endangered
Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*	Endangered
St. Andrew beach mouse	*Peromyscus polionotus peninsularis*	Endangered
Rice rat	*Oryzomys palustris*	Endangered
Fishes		
Gulf sturgeon	*Acipenser oxyrhynchus desotoi*	Threatened
Smalltooth sawfish	*Pristis pectinata*	Endangered
Corals		
Staghorn coral	*Acropora cervicornis*	Threatened
Elkhorn coral	*Acropora palmata*	Threatened
Lobed star coral	*Orbicella faveolata*	Threatened
Boulder star coral	*Montastraea annularis*	Threatened
Mountainous star coral	*Orbicella faveolata*	Threatened
Pillar coral	*Dendrogyra cylindricus*	Threatened
Rough cactus coral	*Mycetophyllia ferox*	Threatened

Sources: USFWS 2010. Federally Listed Wildlife and Plants Threatened by Gulf Oil Spill
http://www.fws.gov/home/dhoilspill/pdfs/FedListedBirdsGulf.pdf

USFWS 2013. Gulf Restoration. **Threatened and Endangered Species on the Gulf Coast.** http://www.fws.gov/gulfrestoration/TandEspecies.html

NOAA. 2016. Endangered and Threatened Marine Species under NMFS' Jurisdiction http://www.nmfs.noaa.gov/pr/species/esa/listed.htm

7.0 COMMERCIAL AND RECREATIONAL FISHERIES

7.1 Overview

Though the Gulf of Mexico Region includes Alabama, Louisiana, Mississippi, Texas, and West Florida, much of the following discussion will focus on Gulf states in the eastern portion of the GOM. Federal fisheries in this region are managed by the Gulf of Mexico Fishery Management Council (GMFMC) and NOAA Fisheries (NMFS) under seven fishery management plans (FMPs): Red Drum, Shrimp, Reef Fish, Coastal Migratory Pelagic Resources (with SAFMC), Spiny Lobster (with SAFMC), Corals, and Aquaculture. The coastal migratory pelagic resources and spiny lobster fisheries are managed in conjunction with the South Atlantic Fishery Management Council (SAFMC).

The most recent change is the development of the Aquaculture FMP to establish a regional permitting process to manage the development of an environmentally sound and economically sustainable aquaculture industry in federal waters of the Gulf of Mexico (NMFS, 2014). The final rule was published in January, 2016. More information can be found at: http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/aquaculture/.

Several of the stocks or stock complexes covered in these fishery management plans, are currently listed as overfished: gag, gray triggerfish, greater amberjack, and red snapper. Other impacts to commercial fisheries in the GOM in recent years include a number of hurricanes, especially with major storms making landfall in Louisiana and Texas in 2005 (Hurricanes Katrina and Rita) and 2008 (Hurricanes Gustav and Ike). Locally, these storms severely disrupted or destroyed the infrastructure necessary to support fishing, such as vessels, fuel and ice suppliers, and fish houses. Current information on the status of US fisheries can be found at: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/.

The Deepwater Horizon MC252 oil spill in 2010 severely affected fisheries in the Gulf. Large parts of the GOM, including state and federal waters, were closed to fishing during May through October, 2010. Both Alabama and Mississippi reported less than half and Louisiana about three quarters of their annual shrimp landings compared to the average of the previous three years. The impacts of the spill remain under study and the long term consequences of the oil spill on fish stocks and the fishing industry have yet to be fully assessed.

7.2 Commercial Fisheries

National Marine Fishery Service (NMFS 2014; 2015) data show that in 2013, commercial fishermen in the Gulf of Mexico Region landed 1.4 billion pounds of finfish and shellfish, earning $937 million in landings revenue. In 2014 1.1 billion pounds were landed at a value of over $1.0 billion. From 2003 to 2013, most of the commercial fisheries revenue and catch (91% and 96% respectively) was dominated by ten key species or species groups (Table 7-1).

Table 7-1. Key Gulf of Mexico Region Commercial Species or species groups

Shellfish	Finfish
Crawfish	Groupers
Blue crab	Menhaden
Oysters	Mullets
Shrimp	Red snapper
Stone crab	Tunas

Commercially important species groups in the GOM include oceanic pelagic (epipelagic) fishes, reef (hard bottom) fishes, coastal pelagic species, and estuarine-dependent species. Landings revenue in 2012 was dominated by shrimp ($392 million) and menhaden ($87 million). These species comprised 63% of total landings revenue, and 90% of total landings in the Gulf of Mexico Region. Other invertebrates such as blue crab, spiny lobster, and stone crab also contributed significantly to the value of commercial landings. Other finfish species that contributed substantially to the overall commercial value of the GOM fisheries included red grouper, red snapper, and yellowfin tuna. In terms of landing weight, Atlantic menhaden far surpassed other commercial fish species in the GOM, accounting for approximately 73% of the total weight of landed commercial species in 2013 (Table 7-2). However, Atlantic menhaden accounted for only about 10% of the total value of the GOM commercial fishery. The portion of commercial fishery landings that occurred in nearshore and offshore waters of the GOM States is presented in Table 7-3.

TABLE 7.2. Total Weights and Values of Key Commercial Fishery Species in the GOM Region in 2013.

Species	Weight (thousands of pounds)	Value (Thousands of dollars)	% Weight	% Value
Menhaden	1,020,244	95,277	73.3	10.2
Shrimp	204,527	503,842	14.7	53.8
Blue crab	46,543	61,264	3.3	6.5
Oyster	19,230	76,729	1.4	8.2
Crayfish	19,823	16,593	1.4	1.8
Mullets	13,482	13,222	0.01	0.01
Stone crab	3,778	24,762	0.003	2.6
Groupers	7,280	23,396	0.005	2.5
Red snapper	5,286	20,493	0.004	2.2
Tuna	2,107	7352	0.002	0.008
Total	**1,392,364**	**936,660**		

Source: NMFS 2015.

TABLE 7-3 Value of Gulf Coast Fish Landings by Distance from Shore and State for 2012 ($1,000)

	Distance from shore	
State	0-3	3-200
Florida (GOM)	64,727	75,232
Alabama	15,870	27,195
Mississippi	29,767	19,509
Louisiana	232,710	95,242
Texas	63,135	130,813

https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/other-specialized-programs/preliminary-annual-landings-by-distance-from-shore/index

In 2013, the eastern GOM Region's seafood industry generated $527 million in sales in Alabama, $268 million in sales in Mississippi, and $15 billion in sales in Florida Table 7-4). Florida generated the largest employment, income, and value added impacts, generating 78,000 jobs, $2.9 billion, and $5.1 billion, respectively. The smallest income impacts were generated in Mississippi ($200 million) and the smallest employment impacts were also generated in Mississippi (6,432 jobs) (NMFS 2015).

Table 7-4. 2013 Economic Impacts of the Eastern Gulf of Mexico Region Seafood Industry (thousands of dollars)

	Landings Revenue	**Jobs**	**Sales**	**Income**	**Value Added**
Alabama	55,434	12,090	526,767	200,494	265,580
Mississippi	46,618	6,432	268,367	107,340	138,779
Florida	148,058	78,378	15,319,435	2,878,309	5,136,623

Source: NMFS 2015

In 2013 1.4 billion pounds of finfish and shellfish were landed in the Gulf of Mexico Region. This was a 6.7% decrease from the 1.5 billion pounds landed in 2004 and a 7.0% increase from the 1.3 billion pounds landed in 2012. Finfish landings experienced a 9.6% decrease between 2012 and 2013 while shellfish landings experienced a 1.6% decrease over the same period (Table

7-5).

Table 7-5. Total Landings and Landings of Key Species/Species Groups From 2010 to 2013 (thousands of pounds).

	2010	2011	2012	2013
Total landings	1,072,068	1,792,550	1,293,195	1,392,364
Finfish & other	810,649	1,472,798	987,374	1,092,148
Shellfish	261,419	319,752	305,821	300,216

Source: NMFS 2015

From 2004 to 2013, species or species groups with large changes in landings include tunas (decreasing 46%), groupers (decreasing 39%), and oysters (decreasing 23%). Species or species groups with large changes in landings between 2012 and 2013 include crawfish (increasing 66%), and red snapper (increasing 24%) (NMFS, 2015).

The DWH event had immediate effects on the GOM fishing industry between April and November 2010, with up to 40% of Federal waters being closed to commercial fishing in June and July (CRS 2010). Portions of Louisiana, Alabama, Mississippi, and Florida State waters have also been closed. These areas are some of the richest fishing grounds in the GOM for major commercial species such as shrimp, blue crab, and oysters, and as prices for these items have increased, imports of these species have likely taken the place of lost GOM coast production. NOAA continued to reopen areas to fishing once chemical tests revealed levels of hydrocarbons or dispersants in commercial species were not of concern to human health.

It cannot be determined from these data whether the decreases in fin and shell fish landings were the result of reduced stock sizes, changes in stock geographic distribution or changes in fishing effort, however studies are currently ongoing and it is not know at this time whether there are long term affects to fisheries due to the spill.

7.3 Recreational Fishing

The NMFS (2015) estimates that in 2013, over 3.3 million recreational anglers took 25 million fishing trips in the Gulf of Mexico Region. The key fish species or species groups making up most of the recreational fishery in the GOM are listed in Table 7-6.

Table 7-6. Key Gulf of Mexico Region Recreational Species

• Atlantic croaker	• Gulf and southern kingfish
• Sand and silver seatrout	• Spotted seatrout
• Sheepshead porgy	• Red drum
• Red snapper	• Southern flounder
• Spanish mackerel	• Striped mullet

Source: NMFS, 2015

Of the three eastern GOM States, western Florida had the highest number of anglers and fishing trips in 2013 (15.9 million), followed by Alabama (2.8 million), and Mississippi (1.8 million) (Table 7.7). Almost 67% of the fishing trips in the GOM coast left out of west Florida, followed by Alabama (7%), and Mississippi (5%). 41.8% of the total recreational fish landings (by weight) in the GOM occurred in Florida, 12.8% 33 in Alabama, and 5.3% in Mississippi. In Mississippi nearly all landings were made in inland waters (98.6%). While the inland catch was important in Alabama (50.0%) and Florida (44.0%), the offshore catch was larger in these States, with 34.1% of the total catch landed up to 5 km (3 mi) from shore, and 16% at more than 5 km (3 mi) in Alabama and 28.7% at less than 16 km (10 mi), and 27.3% at more than 16 km (10 mi) in Florida.

TABLE 7.7. Estimated Number of People Participating in Eastern GOM Marine Recreational Fishing in 2013 [a] (thousands).

	Coastal	Non-coastal	Out of state	Total
West Florida	1,813	NA	2,538	4,351
Alabama	279	224	549	1,050
Mississippi	171	67	101	339
GOM Total*	2,263	291	3,098	5,740

a Coastal, non-coastal, and out-of-State refer to place of residence of participants in marine recreation in each State.
*Texas does not collect angler data.
Source: NMFS, 2015

Recreational fishing contributes to the Gulf state economies mainly through employment, expenditures (fishing trips and durable good), and sales. Table 7-8 shows the economic impacts of recreational fisheries by Gulf state. Recreational fishing activities generated over 87,000 full- and part-time jobs in Alabama, Mississippi and West Florida, and over $10.0 billion in sales.

Table 7-8. 2013 Economic Impacts of Recreational Fishing Expenditures in the Eastern GOM (thousands of dollars)

	Trips	**Jobs**	**Sales**	**Income**	**Value Added**
Alabama	2,862	10,163	927,409	358,769	569,144
Mississippi	1,761	1,583	146,333	53,602	87,684
West Florida	15,949	76,236	9,086,311	3,423,836	5,341,420

Source: NMFS, 2015

8.0 COASTAL ZONE MANAGEMENT CONSISTENCY AND SPECIAL AQUATIC SITES

This chapter addresses two of the 10 ocean discharge criteria: (5) The existence of special aquatic sites including, but not limited to marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas and coral reefs, and (8) Any applicable requirements of an approved Coastal Zone Management plan.

8.1 Coastal Zone Management Consistency

The Coastal Zone Management Act requires that any Federally-licensed or permitted activity affecting the coastal zone of a state that has an approved coastal zone management program (CZMP) be reviewed by that state for consistency with the state's program (16 USC 1456(c)(A) Subpart D). Under the Act, applicants for Federal licenses and permits must submit a certification that the proposed activity complies with the state's approved CZMP and will be conducted in a manner consistent with the CZMP. The state then has the responsibility to either concur with or object to the consistency determination under the procedures set forth by the Act and their approved plan. For NPDES permits, the EPA is considered the applicant and must submit the permit and consistency determination to the affected states for concurrence. Consistency certifications are required to include the following information (15 CFR 930.58):
A detailed description of the proposed activity and its associated facilities, including maps, diagrams, and other technical data;

A brief assessment relating the probable coastal zone effects of the proposal and its associated facilities to relevant elements of the CZMP;

A brief set of findings indicating that the proposed activity, its associated facilities, and their effects are consistent with relevant provisions of the CZMP; and

Any other information required by the state.

The States of Mississippi, Alabama, and Florida have federally approved coastal zone management programs (CZMP). Each Gulf state has specific requirements in their CZM plans that outline procedures for determining whether the permitted activity is consistent with the provision of the program.

Discharges covered by this OCS permit will occur in Federal waters outside the boundaries of the coastal zones of the States of Alabama, Florida, and Mississippi. Though it is very unlikely that these discharges would have impacts on state waters, consistency determinations for the permit will be prepared and submitted to the States of Alabama, Florida, and Mississippi. The following summaries describe the requirements of each state’s management plan for consistency determination. The permitting agency must provide the necessary data and information for the State to determine that the proposed activities comply with the enforceable policies of the States’

approved program, and that such activities will be conducted in a manner consistent with the program. (See 16 U.S.C. 1456(c)(3)(A) and 15 CFR 930.76.)

8.2 Alabama Coastal Area Management Program

Alabama's Coastal Management Plan (ADEM Admin. Code R. 335-8-x-.xx, as revised 2013) contains a Review Process for Federally Regulated Activities (335-8-1-.09):

Pursuant to 15 CFR Part 930, Subpart D, uses which are federally licensed or permitted activities affecting the coastal area are required to be conducted in a manner consistent with the management program. The Department shall review and respond to a federal license or permit applicant's consistency certification in accordance with the provisions of 15 CFR Part 930, Subpart D.

The [Environmental Protection Agency] federal license and permit activities which are subject to review, listed pursuant to 15 CFR Part 930, Subpart D, are: Permits and licenses required under Sections 401, 402, 403, 404 and 405 of the Federal Water Pollution Control Act of 1972, as amended.

The Alabama Coastal Area Management Program requires compliance with Federal and state statutes and regulations that relate to the development and preservation of resources within the coastal area. In order to be deemed consistent with the Program, activities must comply with the relevant substantive requirements of those Federal and state statutes and any regulations adopted pursuant to these statutes to the extent applicable under the terms of those statutes or regulations.

In addition to the data and information required to be furnished to the Department with the consistency certification pursuant to 15 C.F.R. §§ 930.58, the following data and information must be provided:

1. An informational copy of the application for the license or permit;
2. A copy of the federal agency's written determination that the license or permit application is complete;
3. A copy of the federal agency's draft or proposed license or permit if a draft or proposed license or permit is required to be prepared by federal law or regulations;
4. A copy of any transcript of any public hearing conducted by the federal agency concerning the federal license or permit application and all written comments received by the federal agency during any comment period; and,
5. A copy of any draft Environmental Assessment or draft Environmental Impact Statement required under the National Environmental Policy Act §§ 102, 42 U.S.C. §§ 4332 or implementing federal regulations.

ADEM will issue a public notice at least 15 days prior to a decision regarding an activity requiring a federal permit to solicit public comment and may hold a public hearing on the proposed activity if any person has satisfactorily demonstrated that a relevant and significant issue cannot be effectively or fully communicated to the Department in writing or a significant public interest would be served thereby.

8.3 Mississippi Coastal Program

The Mississippi Coastal Program was approved by the Associate Administrator, Office of Coastal Zone Management, under provisions of Coastal Zone Management Act on September 30, 1980 and became effective October 1, 1980. The document entitled *Mississippi Coastal Program*, prepared by the Bureau of Marine Resources of the Mississippi Department of Wildlife Conservation, was used to prepare the following understanding of the requirements of the Mississippi Coastal Zone Management Plan. The Mississippi Commission on Wildlife Conservation (MCWC) was created by legislation in 1978 to implement the Mississippi Coastal Program.

Currently, implementation of the Mississippi Coastal Program is the primary responsibility of the Office of Coastal Resources. The Mississippi Coastal Program was legislatively mandated in Section 57-15-6 of the Mississippi Code of 1972 (MS Code Section 57-15-6, 2013).

The primary authority guiding the coastal management program is the Coastal Wetlands Protection Act. The Mississippi coastal zone includes the three coastal counties, as well as all adjacent coastal waters and the barrier islands of the coast.

In addition to coastal management responsibilities, Coastal Resources Management also administers the Coastal Preserves Program, Wetlands Permitting, and other special projects.

Coastal management consistency determination requirements are determined for coastal uses and activities based on their effect on water quality, water quantity, bottom disturbances, water pollution, sedimentation (runoff), shoreline erosion, marine aquatic life, and historical and archaeological sites. Oil and gas activities regulated under NPDES (section 402) permits are subject to management by the Mississippi Coastal Program under two sets of guidelines: wetlands management and policy coordination.

The Wetlands Management Guidelines are mainly concerned with the placing of structures and pipelines. These concerns are addressed by BOEM in lease stipulations or Army Corp. of Engineers dredge permits and are not covered under the NPDES program. The one guideline that does affect the NPDES permit is that no discharge of cuttings, drilling fluids, produced waters, sanitary wastes, and contaminated deck drainage shall be discharged into coastal waters. The permit does not permit discharges to state waters, and therefore, is in compliance with this guideline.

The Policy Coordination Guidelines protect the wetlands, waterfront sites, seafood, natural scenic qualities, and natural interests of publicly owned lands within the state's jurisdiction. Although the permit covers only Federal waters, the conclusions concerning potential effects demonstrate that the permit is consistent with the policy guidelines of Mississippi.

8.4 Florida Coastal Management Program

The Florida Coastal Management Program (FCMP) was approved by NOAA in 1981 and is codified at Chapter 380, Part II, F.S. The State of Florida's coastal zone includes the area encompassed by the state's 67 counties and its territorial seas. The FCMP consists of a network of 24 state statutes administered by eight state agencies and five water management districts.

Federal consistency reviews are integrated into other review processes conducted by the state depending on the type of federal action being proposed. The Florida State Clearinghouse administered by the DEP Office of Intergovernmental Programs, is the primary contact for receipt of consistency evaluations from federal agencies. The Clearinghouse coordinates the state's review of applications for federal permits other than permits issued under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act.

The review of federal activities is coordinated with the appropriate state agency. Each agency is given an opportunity to provide comments on the merits of the proposed action, address concerns, make recommendations, and state whether the project is consistent with its statutory authorities in the FCMP. Regional planning councils and local governments also may participate in the federal consistency review process by advising the Department of Economic Opportunity (DEO) on the local and regional impact of proposed federal actions. Comments provided by regional planning councils and local governments are considered by the DEO in determining whether the proposed federal activity is consistent with specific sections of Chapter 163, Part II, F.S., that are included in the FCMP. If a state agency determines that a proposed federal activity is inconsistent, the agency must explain the reason for the objection, identify the statutes the activity conflicts with and identify any alternatives that would make the project consistent.

As the designated lead coastal agency for the state, the DEP communicates the agencies' comments and the state's final consistency decision to federal agencies and applicants for all actions other than permits issued under Clean Water Act Section 404 and Section 10 of the Rivers and Harbors Act.

8.5 Special Aquatic Sites

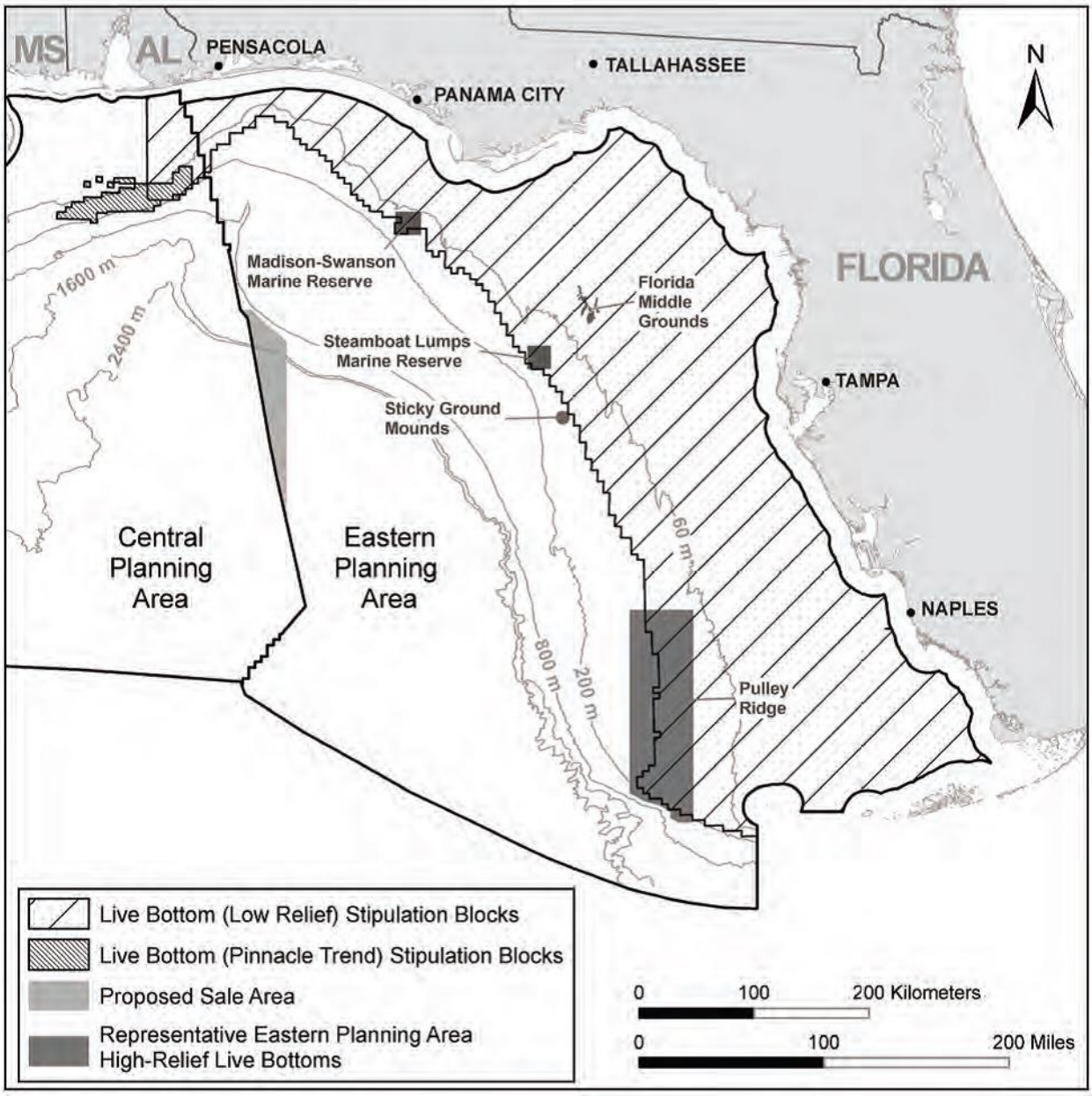
The Code of Federal Regulations, 40 CFR 230.3 q, Defines Special aquatic sites as "geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region."

Areas of high relief outcroppings (Pinnacle Trend) occur on the outer edge of the Mississippi-Alabama shelf between the Mississippi River and De Soto Canyon (Figure 8-1).

The Pinnacle Trend covers some 2,680 km^2 area in water depths of 60-200 meters. High-relief features have complex shape and structure that provide varied zones of microhabitat for attached organisms and attract large numbers of fish.

Areas of high relief live bottom habitat also occur off the west Florida coast. These include the Madison-Swanson Marine Reserve, Florida Middle Grounds, Pulley Ridge, Steamboat Lumps Special Management Area, and Sticky Ground Mounds (BOEM, 2013).

Figure 8-1. High Relief Live Bottom Areas in the Central and Eastern Gulf of Mexico.



Source BOEM 2013

Various species of sessile attached reef fauna and flora grow on the exposed hard grounds. Some taller species (e.g., sea whips and other gorgonians) appear to survive this intermittent sand movement and accretion. Surveys on the southwest Florida Shelf revealed that the biotic cover on the live bottom patches is generally low and that the patches tend to be dominated by either algae or encrusting invertebrates (Woodward-Clyde Consultants and CSA, 1983).

BOEM has included a Live Bottom Stipulation in NTL No. 2009-G39 designed to protect both high and low relief live bottom areas. The Stipulation designated affected lease blocks near the Pinnacle Trends and on the West Florida Shelf out to a 100-meter depth as Live Bottom Stipulation Blocks. A lease stipulation to avoid and protect pinnacle trend features has been made a part of relevant Central Planning Area OCS oil and gas leases since 1974. A lease stipulation to avoid and protect low relief features has been made a part of relevant OCS oil and gas leases since 1982. Both Pinnacle Trends and Low Relief Live Bottom Stipulations are intended to identify and protect these communities from bottom disturbances from activities such as platform and pipeline placement and well drilling. Requirements include preparing a live-bottom survey report containing a bathymetry map constructed from remote-sensing data and an interpretation of live-bottom area surveys that extend to at least 1,000 meters from the site of the proposed activity.

A portion of the Central Gulf of Mexico Planning Area and most of the Eastern Gulf of Mexico Planning Area is under moratoria until 2022 as part of the Gulf of Mexico Energy Security Act of 2006. The area restricted is that portion of EPA within 125 miles of Florida, all areas in the Gulf of Mexico east of the Military Mission Line (86º 41’ west longitude), and the area within the CPA that is within 100 miles of Florida.

9. FEDERAL WATER QUALITY CRITERIA AND STATE WATER QUALITY STANDARDS

Factor 10 of the 10 ocean discharge criteria used to determine no unreasonable degradation requires the assessment of Federal marine water quality criteria and applicable state water quality standards. This chapter evaluates compliance with the Federal water quality criteria at the edge of a 100-meter mixing zone. In addition, compliance with Florida, Alabama and Mississippi water quality standards has been analyzed.

9.1 Federal Water Quality Criteria

Federal water quality criteria are established as guidelines for protection of water quality and human health. Table 9-1 presents a list of Federal water quality criteria for priority pollutants found in drilling or production discharges.

Table 9-1. Federal Water Quality Criteria

Pollutant	Marine Acute Criterion (µg/l)	Marine Chronic Criterion (µg/l)	Human Health Criterion (µg/l)
Anthracene			110,000
Antimony			640
Arsenic	69	36	0.14
Benzene			51
Benzo(a)pyrene			0.018
Cadmium	40	8.8	
Chlorobenzene			21,000
Chromium (VI)	1100	50	
Copper	4.8	3.1	
Di-n-butylphthalate			4,500
2,4-Dimethylphenol			850
Ethylbenzene			29,000
Fluorene			5,300
Lead			
Manganese			100
Mercury	210	8.1	
Nickel			
Phenol	1.8	0.94	
Selenium	74	8.2	
Silver			
Thallium	290	71	6.3
Toluene	1.9		200,000
Zinc			
	90	81	

[a] Human health criteria for consumption of organisms only; risk factor of 10^{-6} for carcinogens.
Source: EPA, 2015

9.2 Florida Water Quality Standards

Water quality standards for the surface waters of Florida are established by the Department of Environmental Regulation in the Official Compilation of Rules and Regulations of the State of Florida, Chapter 62-302 -530 Surface Water Quality Standards (effective 08/01/2013). These standards are presented in Table 9-2 for use classes applicable to the Desoto Canyon receiving water.

Table 9-2. Florida Water Quality Standards

Parameter	Shellfish Propagation of Harvesting (Class II) and Recreation, Fish and Wildlife (Class III-Marine) [a] (µg/l)
Aluminum	1,500
Antimony	4,300
Arsenic (total)	50
Benzene	71.28 annual average
Beryllium	0.13 annual average
Biological Integrity [b]	not reduced <75% of natural background
BOD	DO shall not drop below depressed limit for class
Cadmium	8.8
Chlorides	not more than 10% above natural background
Chlorine (total residual)	10
Chromium (VI)	50
Copper	3.7
Detergents	500
Dissolved Oxygen	5,000 daily average
Fluorides	5,000
Iron	300
Lead	8.5
Manganese	100 [c]
Mercury	0.025
Nickel	8.3
Oil and Grease	none visible
dissolved or emulsified--	5,000
pH	natural background ± .2 unit; 6.5 min. - 8.5 max.
Phenol	300
Phenolic Compounds	1.0
Radioactive Substances --radium	5 pCi/l
(226+228)--	15 pCi/l
gross alpha--	
Selenium	71
Silver	0.05
Thallium	6.3
Turbidity	≤29 NTU above natural background
Zinc	86

[a] Shall be applied to all state waters except within the zones of mixing.
[b] According to the Shannon-Weaver diversity index of benthic macroinvertebrates.
[c] Standard applies only to Class II water use

The antidegradation policy of the standards requires that new and existing sources be subject to the highest statutory and regulatory requirements under Sections 301(b) and 306 of the Clean Water Act. In addition, water quality and existing uses of the receiving water shall be maintained and violations of water quality standards shall not be allowed.

Minimum criteria apply to all surface waters of the state and require that all places shall at all times be free from discharges that, alone or in combination with other substances or in combination with other components of discharges, cause any of the following conditions.

- Settleable pollutants to form putrescent deposits or otherwise create a nuisance
- Floating debris, scum, oil, or other matter in such amounts as to form nuisances
- Color, odor, taste, turbidity, or other conditions in such degree as to create a nuisance
- Acute toxicity (defined as greater than 1/3 of the 96-hour LC50)
- Concentrations of pollutants that are carcinogenic, mutagenic, or teratogenic to human beings or to significant, locally occurring wildlife or aquatic species
- Serious danger to the public health, safety, or welfare.

These general criteria of surface water apply to all surface waters except within zones of mixing. A mixing zone is defined as the surface water surrounding the area of discharge "within which an opportunity for the mixture of wastes with receiving waters has been afforded." Effluent limitations can be set where the analytical detection limit for pollutants is higher than the limitation based on computation of concentration in the receiving water.

9.3 Alabama Water Quality Standards

The Alabama Water Quality Criteria Standards are set forth by the Alabama Environmental Management Commission at Title 22, Chapter 335-6-10.

Toxic pollutant standards applicable to state waters are presented in Table 9-3. Alabama water quality standards provide instruction for calculating human health criteria based on pollutant-specific reference doses, bioconcentration factors, and cancer potency factors. These values used for the calculations are presented in Table 9-4.

Table 9-3. Alabama Toxic Pollutant Standards

Pollutant	Marine Acute Criteria (µg/l)	Marine Chronic Criteria (µg/l)	Human Health Criteria (µg/l)
Antimony			933
Arsenic	69	36	
Benzene			155
Benzo(a)pyrene			0.0675
Cadmium	40	8.8	
Chromium (VI)	1,100	50	
Copper	4.8	3.1	
2,4-Dimethylphenol			498
Di-n-butylphthalate			2,622
Ethylbenzene			6,222
Lead	210	8.1	
Mercury	2.1	0.025	0.121
Nickel	74	8.2	933
Phenol			1,000,000
Selenium	290	71	
Silver	1.9		
Thallium			133
Toluene			43,614
Zinc	90	81	

[a] Non-carcinogenic pollutant criteria calculated as:
[Human body weight (70 kg) x RfD]/[Fish consumption rate (0.030 kg/day) x BCF] x 1,000 µg/mg
RfD = Reference dose (Values presented in Table 9-4).
BCF = Bioconcentration factor (Values presented in Table 9-4).

[b] Carcinogenic pollutant criteria calculated as: [Human body weight (70 kg) x Risk level (1×10^{-5})]/
[CPF x Fish consumption rate (0.030 kg/day) x BCF] x 1,000 µg/mg
CPF = Cancer potency factor (Values presented in Table 9-4).

Source: Alabama Department of Environmental Management, Water Division - Water Quality Program

Table 9-4. Reference Doses, BCFs, and Cancer Potency Factors Used to Calculate Alabama Toxic Pollutant Standards

Pollutant	Reference Dose (RfD) [mg/(kg-day)]	Bioconcentration Factor (BCF) (l/kg)	Cancer Potency Factor (CPF) [kg/day)/mg]
Antimony	0.0004	1.0	
Benzene		5.2	0.029
Benzo(a)pyrene		30	7.3
Beryllium		19	4.3
Chromium (VI)	0.005	16	
2,4-Dimethylphenol	0.02	93.8	
Di-n-butylphthalate	0.1	89	
Ethylbenzene	0.1	37.5	
Mercury	0.0001	5,500	
Nickel	0.02	47	
Phenol	0.3	1.4	
Thallium	0.000068	116	
Toluene	0.2	10.7	

Source: Alabama Department of Environmental Management Water Division, Water Quality Program, September 29, 2015.

9.4 Mississippi Water Quality Standards

The Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters are set forth by the Mississippi Department of Environmental Quality as adopted June 28, 2012. The Mississippi water quality criteria general conditions require that the following be met in all waters of the state:

1. In open ocean waters there shall be no oxygen demanding substances added which will depress the dissolved oxygen content below 5.0 mg/1.
2. Although mixing zones are sometimes unavoidable they will not substitute waste treatment. Application of mixing zones shall be made on a case-by-case basis and shall only occur in cases involving large surface water bodies in which a long distance or large area is required for the wastewater to completely mix with the receiving water body.
3. The location of a mixing zone shall not significantly alter the designated uses of the receiving water outside its established boundary. Adequate zones of passage for the migration and free movement of fish and other aquatic biota shall be maintained. Toxicity and human health concerns within the mixing zone shall be addressed as specified in the *Environmental Protection Agency Technical Support Document* for Water Quality-Based Toxics Control (EPA-505/2-90-001, March 1991) and amendments thereof. Under no circumstances shall mixing zones overlap or cover tributaries, nursery locations, locations of threatened or endangered species, or other ecologically sensitive areas.

Minimal conditions that are applicable to all waters include the following:

Waters shall be free from substances attributable to municipal, industrial, agricultural, or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits.

Waters shall be free from floating debris, oil, scum, and other floating materials attributable to municipal, industrial, agricultural, or other discharges in amounts sufficient to be unsightly or deleterious.

Waters shall be free from materials attributable to municipal, industrial, agricultural, or other discharges producing color, odor, taste, total suspended or dissolved solids, sediment, turbidity, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated use. Except as prohibited in Rule 2.1.H. above, the turbidity outside the limits of a 750-foot mixing zone shall not exceed the background turbidity at the time of discharge by more than 50 Nephelometric Turbidity Units (NTU). Exemptions to the turbidity standard may be granted under the following circumstances:

(a) in cases of emergency to protect the public health and welfare
(b) for environmental restoration projects which will result in reasonable and temporary deviations and which have been reviewed and approved by the Department of Environmental Quality.

Waters shall be free from substances attributable to municipal, industrial, agricultural, or other discharges in concentrations or combinations that are toxic or harmful to humans, animals, or aquatic life. Specific requirements for toxicity are found in Rule 2.2.F.

Municipal wastes, industrial wastes, or other wastes shall receive effective treatment or control in accordance with Section 301, 306, and 307 of the Federal Clean Water Act. A degree of treatment greater than defined in these sections may be required when necessary to protect legitimate water uses. Mississippi numerical standards are presented in Table 9-5.

Table 9-5. Mississippi Toxic Pollutant Standards

Pollutant	Marine Acute Criteria (µg/l)	Marine Chronic Criteria (µg/l)	Human Health Criteria (µg/l)
Arsenic	69	36	0.14
Cadmium	40	8.8	168
Chromium (III)			140,468
Chromium (VI)	1,100	50	1470
Copper	4.8	3.1	1,000
Lead	210	8.1	
Mercury			0.153
Nickel	75	8.3	4,600
Phenol	300	58	860,000
Selenium	290	71	4200
Silver	1.9		
Zinc	90	81	26,000

Source: State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters, Adopted June 28, 2012. Mississippi Department of Environmental Quality.

9.5 Compliance with Federal Water Quality Criteria

9.5.1 *Water Based Drilling Fluids Discharges*

Federal water quality criteria are compared to effluent concentrations projected for the edge of a 100-m mixing zone to determine the ability of drilling fluid discharges to achieve sufficient mixing and occur at concentrations below criteria in the surrounding waters. Table 9-6 presents the results of calculating the minimum number of dilutions that will ensure that all criteria are met by drilling fluid discharges at 100 meters from the discharge point. The minimum number of dilutions to achieve sufficient mixing for drilling fluids is projected to be 118 (the number of dilutions required to meet the arsenic human health criterion). Compared to drilling fluids modeling results presented in Chapter 4, there appears to be significant probability that the criteria can be met by the edge of a 100-m mixing zone.

For comparison, the preferred option of the MMS EIS for this development and production project specifies a maximum 400 bbl/hr discharge rate; water depths for the proposed activity area range from approximately 30 m to 150 m. For the generalized drilling fluid modeling approach that had been performed for EPA Region 10, a 500 bbl/hr discharge in a water depth of 20 m resulted in a minimum projected dilution of 1,035; even at a 1,000 bbl/hr discharge rate the available dilution is 655 at a water depth of 20 m and 731 at a water depth of 40 m. For a 1,000 bbl/hr discharge in a 70-m water depth, the dilutions achieved at 100 meters is 1,721, 10-fold greater than the amount required to meet the most stringent Federal water quality criteria in the Desoto Canyon area.

Table 9-6. Comparison of Federal Water Quality Criteria to Projected Drilling Fluids Pollutant Concentrations at 100 Meters

Pollutant	Effluent Conc. [a] (mg/l)	Leach Factor [b]	Federal Criteria (µg/l) Marine Acute	Marine Chronic	Human Health	Minimum Dilutions Required [c]
Antimony	2,592	11%			110,000	<1
Arsenic	3,228	0.51%	69	36	0.14	118
Cadmium	0.50	11%	42	9.3		6
Chromium	109	3.4%	1,100	50		74
Copper	8.50	0.63%	4.8	3.1		17
Lead	15.9	2.0%	210	8.1		39
Mercury	0.045	1.8%	1.8	0.94	0.051	16
Nickel	6.138	4.3%	74	8.2	4,600	32
Selenium	0.50	11%	290	71	11,000	<1
Silver	0.318	11%	1.9			18
Thallium	0.546	11%			6.3	10
Zinc	91.16	0.41%	90	81	69,000	5

[a] See Table 3-3.

[b] The leach factor for metals for which no value was available is assumed to be 11%, equal to the highest value reported (cadmium).

[c] Calculated for each pollutant as: [(Effluent conc. x 1000 µg/mg) x leach factor]/lowest criterion value.

For the project-specific modeling approach, the minimum available dilutions under the most conservative scenario modeled was 150, which although closer to the required minimum dilution still affords an excess dilution under the least probable set of operational and environmental conditions. The occurrence of non-compliance with Federal water quality criteria appears to be highly unlikely based on the results of either modeling approach. And although the project-specific modeling approach and results have yet to be reviewed and verified by EPA, the comparability of the results lends some re-assurance to the likelihood that the project-specific approach will be found to be technically sound.

9.5.2 *Synthetic Based Drilling Fluids Discharges*

Assessments of water quality impacts from the discharge of cuttings with adhered synthetic based fluids (SBF-cuttings) rely on modeling data presented in a study (Brandsma, 1996) of the post-discharge transport behavior of oil and solids from cuttings contaminated with oil-based fluids (OBF-cuttings). Due to the similar hydrophobic and physical properties between SBFs and OBFs, EPA assumes that above 5% retention, that dispersion behavior of SBF-cuttings is similar to that of OBF-cuttings when discharged following shale shaker only (i.e. baseline technology) treatment of cuttings. However, at controlled discharge levels reflecting best-available technology treatment the cuttings are expected to disperse similar to WBF-cuttings.

The analyses in this chapter are somewhat conservative due to the assumption that discharged pollutants immediately leach into the water column. In the water column, total organic pollutant discharge concentrations are assumed to represent the soluble concentration. Metals are assumed to leach immediately into the water column at pollutant-specific amounts determined for mean seawater pH (as derived in Avanti Corporation, 1993).

To evaluate the relative water quality impacts of the current industry practice and regulatory options, EPA estimates the water column concentration of pollutants present in SBF drilling discharges under regulatory discharge options and compares them to Federal water quality criteria/toxic values. This comparative analysis applies only to those pollutants found in SBF discharges, and for which EPA has published numeric criteria, as presented in Table 9-1. Note that there are no criteria for the synthetic-based fluid compounds themselves.

In order to determine the water column pollutant concentrations, EPA used data regarding the transport of discharged drill solids and corresponding oil concentration in the water column. The study was performed by Brandsma (1996) and the data are published in the E&P Forum Summary Report No. 2.61/202 (1996). Following is a description of the Brandsma (1996) study from that E&P report.

Brandsma modeled the discharge of nine treatments of cuttings obtained from a North Sea drilling platform to obtain: (1) a maximum deposition density (g/m^2) of cuttings and oil; (2) water column concentrations of suspended solids and oil; (3) the maximum thickness (cm) of cuttings deposited on the seabed; and (4) the seabed area (ha) that would achieve a 100 ppm oil content threshold in the upper 4 cm or 10 cm of the sediment.

The treatment technologies included: (1) no treatment (lab formulated control), (2) untreated cuttings from shale shakers, (3) centrifugation, (4) solvent extraction, (5) thermal treatment, and (6) water washing. The bulk densities of the cutting ranged from 1,830 g/l to 2,430 g/l; oil content for the six types of cuttings ranged from 0.02% (dry weight basis) to 19.6%.

The author simulated four sites in the North Sea: Southern (30 m water depth and depth-averaged, root mean-squared current speed of 0.37 m/s); Central (100 m water depth and current speed of 0.26 m/s); Northern (150 m water depth and current speed of 0.22 m/s); and Haltenbanken (250 m water depth and current speed of 0.10 m/s).

The Offshore Operators Committee (OOC) drilling and production discharge model was used to simulate the concentrations and deposition of discharged cuttings. The OOC model utilized a mixture of 12 profile size classes of mud and cuttings particles (with adsorbed oil) and water. All other discharge conditions were fixed. All discharges simulated a 68.5-hour discharge of 152 m^3 of cuttings from a 0.3 m diameter pipe shunted to a depth of 15.2 m below mean sea level. This cuttings volume is the volume expected from a single well section of OBF-cuttings. Results presented are based on these 152 m^3 model efforts, however, results are scaled up to a 300 m^3 volume which was later determined by the project steering committee to be more representative of actual OBF-cuttings volumes generated using OBFs (representing two well sections).

Hydrographic conditions were conservatively selected to maximize predicted cuttings deposition on the seabed by choosing the minimum water column stratification at each site. The result is no density gradient at all sites but the Haltenbanken site which exhibited only a weak (0.0016 $kg/m^3/m$) gradient.

Water column results were determined at a radial distance of 1000 m downstream. For untreated and centrifuged OBF-cuttings, projected water column oil concentrations at 1000 m were below maximum North Sea background levels at all four sites; all other treatments resulted in projected 1000 m oil concentrations that exceeded maximum background levels (except through treatment at the Haltenbanken site). The explanation for this phenomenon is that while treatments other than centrifugation also reduce oil content (from an untreated level of 15.8% [w/w] to a range of 0.3% to 5.1%), these treatments also generate cuttings with finer particle sizes. Thus, according to the model, the untreated and centrifuged

OBF-cuttings would not reach the 1000 m mark to the same extent that the treated OBF-cuttings would because the finer particles created by the treatment have lower settling velocities and are transported farther in the water column (Brandsma, 1996).

Although Brandsma (1996) does not present oil concentration data for a radial distance of 100 m (the edge of the mixing zone established for U.S. offshore discharges by Clean Water Act Section 403, Ocean Discharge Criteria, as codified at 40 CFR 125 Subpart M), the study does present data on suspended solids and oil concentration as a function of transport time. Using current speeds representative of each geographic area (Gulf of Mexico; Cook Inlet, Alaska; and offshore California) and the transport times reported by Brandsma, EPA derived the corresponding oil concentrations and dilutions at 100 m. For example, assuming a mean current speed of 15 cm/s as representative of the Gulf of Mexico, a transport time of approximately 11 minutes is derived as the time required for the plume to reach 100 m (100 m/0.15 m/sec). Using data obtained from Brandsma's 1996 study, EPA conducted a regression analysis to determine the oil concentration at selected transport times. Based on the mean initial oil concentration of the 9 cuttings cases presented in the study (5.5% in water-washed cuttings), the dilutions achieved can be estimated for a selected time (i.e., distance) in the following manner. The 5.5% (w/w) oil content converts to 55 g oil/kg wet cuttings. Based on a reported mean OBF-cuttings density of 2.050 kg wet cuttings/l, the initial oil concentration of 112,750 mg oil/l (55 g/kg x 2.050 kg/l) is used to determine the dilutions achieved. For the Gulf of Mexico example, the oil concentration at 11 minutes of 3.0 mg/l is used to calculate a 37,425-fold dilution (112,750 mg/3.0127 mg) at 11 minutes (Bowler, 1999). As described above, 11 minutes represents the estimated time at which the plume would reach the edge of the mixing zone at 100 meters.

Projected water column pollutant concentrations at the edge of a 100-m mixing zone are calculated by dividing the drilling waste pollutant concentration by the dilutions available. The effluent concentrations for metals are further adjusted by a leach factor to account for the portion of the total metal pollutant concentration that is dissolved and therefore available in the water column. In terms of metal concentrations, this analysis is conservative in that it assumes that all leachable metals are immediately leached into the water column.

When comparing the Federal water quality criteria to the SBF concentration in the water column at 100 meters from the discharge, no exceedances of any of the Federal water quality criteria occurred for any model wells in the Gulf of Mexico using the current technology, nor under either the discharge or zero discharge options.

9.6 Compliance with State Water Quality Standards

9.6.1 *Water Based Drilling Fluids Discharges*

Tables 9-7 and 9-8 respectively summarize the state water quality standards and the minimum dilutions required for drilling fluid discharges to achieve them for Florida and Alabama. State standards for Florida and Alabama are the same for 7 of 12 common pollutants (Cd, Cr, Cu, Hg, Ni, Se, and Zn). Alabama standards for antimony and arsenic (933 and 36 mg/l, respectively) are more stringent than Florida; Florida's standards for lead, silver, and thallium are more stringent than Alabama's standards. Florida also lists three pollutants that are not listed in Alabama - aluminum, beryllium, and iron. From the tables, it is readily apparent that, based on comparisons of dispersion/dilution projections and the required dispersions/dilutions listed in these tables, complying with all Alabama standards is highly likely.

In contrast, the minimum dispersions/dilutions required to meet Florida standards are greater than the

minimum available dispersions/dilutions projected by either the generalized modeling approach or the project-specific approach in certain areas. Beryllium and aluminum, respectively, require 269 and 302 dispersions/dilutions; silver requires 700 and iron requires 2,558 dispersions/dilutions to meet state standards.

Table 9-7. Comparison of Florida State Water Quality Standards to Projected Drilling FluidsPollutant Concentrations at 100 Meters

Pollutant	Effluent Conc. [a] (mg/l)	Florida Standard (µg/l)	Minimum Dilutions Required
Aluminum	4,124	1,500	302
Antimony	2,592	4,300	>1
Arsenic	3,228	50	>1
Beryllium	0.318	0.13	269
Cadmium	0.50	9.3	6
Chromium	109	50	74
Copper	8.50	2.9	18
Iron	6,976	300	2,558
Lead	15.9	5.6	57
Mercury	0.045	0.025	32
Nickel	6.138	8.3	32
Selenium	0.50	71	1
Silver	0.318	0.05	700
Thallium	0.546	6.3	10
Zinc	91.16	86	4

[a] See Table 3-3.

Table 9-8. Comparison of Alabama Water Quality Standards to Projected Drilling Fluids Pollutant Concentrations at 100 Meters

Pollutant	Effluent Conc. [a] (mg/l)	Alabama Standards (µg/l)			Minimum Dilutions Required
		Marine Acute	Marine Chronic	Human Health	
Antimony	2,592			933	<1
Arsenic	3,228	69	36		<1
Cadmium	0.50	43	9.3		6
Chromium	109	1,100	50		74
Copper	8.50	2.9	2.9		18
Lead	15.9	220	8.5		37
Mercury	0.045	2.1	0.025		32
Nickel	6.138	75	8.3		32
Selenium	0.50	300	71		<1
Silver	0.318	2.3			15
Thallium	0.546			133	<1
Zinc	91.16	95	86		4

[a] See Table 3-3.

Using the generalized modeling approach, the projected minimum available dispersions/dilutions required for all pollutants but iron are sufficient to comply with Florida standards at the edge of the 100-m mixing zone. Only in the case of iron, which requires 2,552 dispersions/dilutions to achieve the state standard, is there an issue with respect to compliance with state standards. The results of the project-specific analysis indicates that for worst case analyses, the dilutions available are not sufficient to comply with Florida's standards for four pollutants (Be, Al, Ag, and Fe). For modeling scenarios other than those for which the minimum dispersion/dilution is projected, again, only iron remains a potential issue.

Several factors mitigate the potential water quality non-compliance projected above. First, these non-compliance issues occur for worst case conditions, which requires a set of assumptions that are not likely to be encountered except rarely. Second, for iron, which is the pollutant with the largest exceedances, a surrogate leach factor is used (11%) based on the most mobile trace metal (Cd) because no leach data are available for iron. Related to this factor, iron is expected to have a low leach factor; it has low solubility in seawater due to its ability to form precipitates from several anions that are in abundance in seawater. Third, compliance with state standards is being assessed at the edge of the 100-m mixing zone. While appropriate for discharges in state waters, this project is located some 16 miles from the state waters of Florida. It is expected that no state water quality standards will be violated within the territorial seas of the State of Florida.

In Mississippi, the projected maximum drilling fluid discharge rate would not cause any exceedances of the state water quality standards (Table 9- 8).

Table 9-9. Comparison of Mississippi Water Quality Standards to Projected Drilling Fluid Pollutant Concentrations at 100 meters (in µg/l)

Pollutant	Effluent Concentrations[a]	Extraction Factors[b]	Concentration at 100 meters			State Standard[e]		
			15 m water depth[c]	40m water depth[c]	70m water depth[c]	Marine Acute	Marine Chronic	Human Health
Arsenic	3,228	0.51%	0.029	0.021	0.010	69	36	0.14
Cadmium	500	11 %	0.098	0.070	0.032	43	9.3	168
Chromium VI	109,116	3.4%	6.60	4.714	2.156	1,100	50	3,365
Copper	8,502	0.63%	0.095	0.068	0.031	2.9	2.9	1,000
Lead	15,958	2.0%	0.568	0.406	0.185	140	5.6	
Mercury	45	1.8 %	0.001	0.001	0.0005			0.153
Nickel	6,138	4.3 %	0.470	0.335	0.153	75	8.3	4,584
Selenium	500	100 %	0.890	0.635	0.290	300	71	
Silver	318	100%	0.566	0.404	0.185	2.3		
Zinc	91,157	0.41 %	0.665	0.475	0.217	95	86	5,000

[a]See Table 3-3.
[b]The extraction factors represent the trace metal leach percentages from barite and drilling fluids.
[c]The average OOC Model run dilution results were used for each of the water depths (See Table 4-7). For 15m, dilution = 562, 40m = 787, and 70m = 1,721.
[d]See Table 9-5.
Source: Avanti, 1993.

10. EVALUATION OF THE OCEAN DISCHARGE CRITERIA

This chapter discusses the ten factors that the Regional Administrator must consider in the analysis of compliance of this permit with Section 403 of the Clean Water Act, how conditions and limitations included in the final permit for LLOG Exploration Offshore ensure compliance with these ocean discharge criteria, and the determination, under Section 403, that this NPDES permit will not cause unreasonable degradation of the marine environment with all permit limitations, conditions, and monitoring requirements in effect.

10.1 Introduction

The ten factors for determining unreasonable degradation were presented in Chapter 1. The chapters that followed discussed the available information concerning the issues to be evaluated. This chapter presents a summary of these issues, the conditions and limitations that are included by the Region in the final NPDES permit that ensure compliance with Section 403, and a discussion of the determination that no unreasonable degradation of the marine environment will result from discharges authorized by this permit.

10.2 Evaluation of the Ten Ocean Discharge Criteria

Factor 1 - Quantities, Composition, and Potential for Bioaccumulation or Persistence of Pollutants

The quantities and composition of the discharged material estimated from proposed LLOG Exploration Offshore operations was presented in Chapter 1. Expanded descriptions regarding composition of these waste streams is found in Chapter 3 and the potential for bioaccumulation or persistence was addressed in Chapter 5. For discharges other than drilling fluids, the volume and constituents of the discharged material are not considered sufficient to pose a potential problem through bioaccumulation or persistence. However, to confirm the Agency's decision and as a precaution against any changes in operational practices that could change the Agency's assumptions, the discharged volumes of deck drainage, well treatment, completion, and workover fluids, and sanitary waste must be recorded monthly and reported once each year on the compliance monitoring report.

EPA is limiting the potential for bioaccumulation or persistence of discharge-related pollutants by placing specific limitations on metals contained in the barite added to water-based drilling fluids. The limits on cadmium and mercury will ensure that not only these two metals but an entire suite of other trace metals found in barite will be reduced in concentration, and their potential for bioaccumulation and persistence thereby decreased. Discharge limitations in the proposed permit are as follows:

Water Based Drilling Fluids	Statutory Basis
Discharge limited to a rate of 1,000 bbl/hour	BPJ
Report volume discharged (bbl/month)	CWA §308
Whole effluent toxicity (WET) must meet both a daily minimum and a monthly average minimum limitation of 30,000 ppm (3.0% by volume), using a volumetric mud-to-water ratio of 1 to 9 [2]	BAT
No discharge of free oil as determined by the static sheen test	BCT/BAT
No discharge of fluids to which barite has been added if the barite contains mercury in excess of 1.0 mg/kg (dry weight) or cadmium in excess of 3.0 mg/kg (dry weight) [3]	BAT
No discharge within 100 meters of designated dredged material ocean disposal sites	BPJ
Record chemical usage inventory for each well	CWA §308

Synthetic Based Drilling Fluids	Statutory Basis
No discharge of OBM or SBM	BCT/BAT

Water Based Drill Cuttings	Statutory Basis
No discharge when using OBM or oil contaminated fluids	BCT/BAT
Report volume discharged (bbl/month)	CWA §308
WET must meet both a daily minimum and a monthly average minimum limitation of 30,000 ppm (3.0% by volume), using a volumetric mud-to-water ratio of 1 to 9	BAT
No discharge of free oil as determined by the static sheen test	BCT/BAT
No discharge of oil based drilling fluids	BCT/BAT
No discharge of fluids to which barite has been added if the barite contains mercury in excess of 1.0 mg/kg (dry weight) or cadmium in excess of 3.0 mg/kg (dry weight)	BAT
No discharge within 100 meters of designated dredged material ocean disposal sites	BPJ

Synthetic Based Drill Cuttings	Statutory Basis
No discharge if formation oil is detected in the drilling fluid as determined by GC/MS	BAT

[2] Methodology is specified at 40 CFR Part 435, Subpart A, Appendix 2, Drilling Fluid Toxicity Test (EPA Method 1619).

[3] Methodologies are EPA Methods 200.7, 200.8, or Method 3050B followed by 6010B for cadmium and EPA 245.7 or 7471 A for mercury.

Sediment toxicity test ratio shall not exceed 1.0 [4, 5]	BAT
Amount of SBM retained on cuttings must not exceed 6.9g SBM/100g wet cuttings for C_{16}-C_{18} IOs or 9.4g SBM/100g wet cuttings for C_{12}-C_{14} or C_8 esters;[6] a default value of 14% retained fluid is used for compliance with discharges at the seafloor	BAT
Polynuclear Aromatic Hydrocarbons (PAH) mass ratio must not exceed $1x10^{-5}$ [7]	BAT
Biodegradation rate ratio of the stock base fluid shall not exceed 1.0 [8]	BAT

Well Treatment, Completion and Workover Fluids	**Statutory Basis**
Report frequency/flow (bbl/month)	CWA §308
No discharge of free oil as determined by the static sheen test	BCT/BAT
Oil and grease must meet maximum limitation of 42.0 mg/l and monthly average limitation of 29.0 mg/l	BAT
No discharge of priority pollutants except in trace amounts	BAT

Sanitary Wastes	**Statutory Basis**
No discharge of floating solids	BCT
Manned by 10 or more: Total residual chlorine must be maintained at 1.0 mg/l at all times	BCT/BAT

Domestic Wastes	**Statutory Basis**
No discharge of floating solids or foam	BCT/BAT
No discharge except comminuted food waste (<25mm) may be discharged 12 nautical miles or more from land	BCT/MARPOL

Deck Drainage	**Statutory Basis**
Report frequency/flow	CWA §308
No discharge of free oil as determined by the visual sheen test	BCT/BAT

[4] Methodology is ASTM method no. E1367-92.
[5] Methodology is ASTM E1367-92 and equation in permit.
[6] Methodology is the API Retort method specified at 40 CFR §435, subpart A of Appendix 7.
[7] Methodology is EPA Method 1654A and equation in permit.
[8] Methodology is ISO Method 11734:1995 and equation in permit.

Miscellaneous Discharges	Statutory Basis
No discharge of free oil as determined by the visual sheen test	BCT/BAT
Toxicity limitation for Subsea Wellhead Preservation Fluids; Subsea Production Control Fluids; Umbilical Steel Tube Storage Fluids; Leak Tracer Fluids; and Riser Tensioning Fluids is a NOEC of no less than 50 mg/l	BPJ

Miscellaneous Discharges of Freshwater and Seawater to Which Treatment Chemicals Have been Added	Statutory Basis
Report average flow (bbl/day)	CWA §308
No discharge of free oil as determined by the visual sheen test	BCT/BAT
Concentration of chemicals must meet the most stringent of: maximum concentration of product labeling, manufacturer's recommended concentration, or 500 mg/l	BPJ
Toxicity limitation is that NOEC must be equal to or greater than the critical dilution concentration as specified in the permit based on discharge rate, pipe diameter, and water depth	BPJ

The EPA believes that the limits imposed on the operational discharges authorized under the proposed permit are sufficient that no significant adverse impacts are likely to occur.

Factor 2 - Potential for Biological, Physical, or Chemical Transport

Chapter 4 of this document is based on the literature available concerning the transport of water based and synthetic based drilling fluids in the marine environment. It is not possible to determine precisely the potential for physical transport at any facility due to varying currents, discharge rates and configurations, and fluctuating effluent characteristics. Therefore, for drilling fluids, generalizations and assumptions were made to project scenarios to describe the industry activity in the Gulf of Mexico. A protective modeling approach, which was appropriate to the area of coverage of this permit, was used to determine potential physical transport processes and to regulate discharges of drilling fluids based on the predicted dilutions and dispersions.

Drilling fluids are regulated based on the modeling predictions about how the waste streams will behave when introduced into the marine environment. Discharge rate restrictions for drilling fluids are the result of the predicted transport of the constituents of the effluent.

Biological and chemical transport processes are not as well understood for drilling fluid discharges. The literature available is inconclusive about these processes and computer models do not account for them. Bioturbation should serve to mix sediments vertically, thereby enhancing the dispersion of muds and cuttings. The physical transport of these waste streams is considered to be the most significant source for dispersion of the wastes and monitoring and regulation is based on the results of those investigations.

The EPA believes that the discharge limitations in the proposed permit plus rapid settling of particulates and high rates of dilution of dissolved constituents in the proposed waste streams should prevent the occurrence of significant adverse impacts

Factor 3 - Composition and Vulnerability of Biological Communities

The third factor used to determine no unreasonable degradation of the marine environment is an assessment of the presence of unique species or communities of species, endangered species, or species critical to the structure or function of the ecosystem. Chapter 6 describes the biological community of the eastern Gulf including the presence of endangered species and factors that make these communities or species vulnerable to the permitted activities.

Drilling fluids (and the drilling fluids that adhere to cuttings) have been shown to cause smothering effects when discharged to shallow waters. The permit covers areas in deep waters of the Gulf of Mexico and the permit prohibits the discharge of neat synthetic based fluids and restricts the water based fluids discharge rate to 1,000 bbl/hr for all areas. The potential impacts due to toxic effects from drilling fluids have been reduced by placing restrictions on total toxicity. This toxicity limitation ensures that the whole effluent will not be toxic to pelagic or benthic species once mixed with the receiving water.

In Chapter 6, the biological communities occurring in the eastern Gulf of Mexico and their health are described according to available literature. The permit coverage area of the proposed permit does not appear to contain deepwater biological communities that would be particularly sensitive to the discharges that may occur and special conditions have been implemented through the permit in any case. BOEM has special stipulations for chemosynthetic communities in the Gulf and when an operator proposes to commence drilling on a lease containing these communities, BOEM may require mitigations to protect them from impact.

Factor 4 - Importance of the Receiving Water to the Surrounding Biological Community

The importance of the receiving waters to the species and communities of the eastern Gulf is discussed in Chapter 6 in conjunction with the discussion of the species and biological communities. The receiving water is considered when determining the discharge rate restrictions. The dispersion modeling considered concentrations of pollutants that may have impacts on aquatic life (through evaluation of marine water quality criteria - see Factor 10, below) and the toxicity limitations on both drilling fluids ensure that levels of the effluent is below levels that could have impacts on local biological communities.

In addition, free oil, toxicity, oil content, oil and grease levels, solids, and chlorine concentrations are monitored in selected waste streams in order to ensure adequate water quality. Other requirements that apply to all discharges are no discharge of visible foam and minimal use of dispersants, surfactants, and detergents.

Factor 5 - Existence of Special Aquatic Sites

No designated Special Aquatic Sites are known to be present within the lease block under consideration or adjacent lease blocks.

Factor 6 - Potential Impacts on Human Health

Chapter 9 details the Federal and state human health criteria and standards for pollutants in drilling fluids. These criteria and standards are for marine waters based on based on fish consumption. These analyses compare projected pollutant concentrations at 100 m with these criteria and standards.

The permit prohibits the discharge of free oil, oil-based muds, synthetic based muds and muds with diesel oil added. These prohibitions are based on the potential effects of the organic pollutants in these discharges to human and aquatic life. In addition, the limitations that require low levels of cadmium and mercury in the barite added to drilling fluids also effectively lower the concentrations of other heavy metals found in barite.

Factor 7 - Recreational or Commercial Fisheries

The commercial and recreational fisheries businesses in Alabama, Florida, and Mississippi are assessed in Chapter 7. The conditions and limitations in the permit were determined to protect water quality and preserve the health of these fisheries. These permit conditions and limitations include no discharge of free oil, no discharge of oil-based or synthetic based muds, no discharge of diesel oil, discharge rate limitations around live-bottom areas, and limitations on the whole effluent toxicity of water based and synthetic based drilling fluids.

Factor 8 - Coastal Zone Management Plans

Chapter 8 provides an evaluation of the coastal zone management plans of Alabama, Florida, and Mississippi. The proposed LLOG wells are sites more than 100 miles from the nearest shoreline and discharges are not lot likely to affect state waters or resources. However, the states will have an opportunity to review the proposed permit to determine consistency with their plans. As detailed in Chapter 8, the permit meets the requirements of the plans implemented by the states and is considered by the Region to be in compliance with those plans.

Factor 9 - Other Factors Relating to Effects of the Discharge

The BAT (Best Available Technology Economically Achievable) and BCT (Best Conventional Pollutant Control Technology) effluent limitation guidelines for the Offshore Subcategory were promulgated in 1993. BAT conditions within the permit include: cadmium and mercury limitations in barite; toxicity limitations in drilling muds; no free oil discharge from drilling fluids, well treatment, completion, and workover (TWC) fluids, deck drainage, well test fluids or minor wastes; no oil-based drilling fluids discharge; produced water and TWC fluid oil and grease limitations; no discharge of produced sand; residual chlorine limitations in sanitary wastes; and no floating solids in either domestic or sanitary wastes. Final Effluent Limitation Guidelines and Standards for Synthetic-based Drilling Fluids (promulgated in 2001) prohibit the discharge of neat synthetic based drilling fluids and limit the amount retained on drill cuttings discharges.

Factor 10 - Marine Water Quality Criteria

The Federal and state marine water quality criteria and standards for pollutants found in drilling fluids are assessed in Chapter 9. The potential effects due to organic pollutants in drilling fluids have been eliminated with the prohibition of the use of oil-based muds and diesel oil and the discharge of neat synthetic based muds. The heavy metals that exist in drilling fluids have been reduced in concentration by requiring the use of clean barite measured by the concentration of cadmium and mercury. Because of the distance of the proposed operations from the nearest shore it is unlikely that the discharges will affect state water quality standards.

10.3 Conclusions

After consideration of the ten factors discussed above and elsewhere in this document, it is determined that no unreasonable degradation of the marine environment will result from the discharges authorized under this permit, with all permit limitations, conditions, and monitoring requirements in effect. After reviewing the available data, the Region has included a variety of technology-based, water quality-based, and Section 403-based requirements in the final permit to ensure compliance with Section 403 of the Clean Water Act, under a no reasonable degradation determination as well as other relevant sections of the Act.

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Appendix A. Acute Lethal Toxicities of Used Drilling Fluids and Components to Marine Organisms

Test Organism	Fluid Description[a]	Criterion Value (ppm)	Toxicity Rating
	USED DRILLING FLUIDS		
ALGA	Imco LDLS/SW	1,325-4,700 (96-h EC50)	4
Skeletonema costatum	Imco Lime/SW	1,375 (96-h EC50)	4
	Imco non-dispersed/SW	5,700 (96-h EC50)	4
	Lightly treated LS/SW-FW	3,700 (96-h EC50)	4
COPEPODS	Imco LDLS/SW	5,300-9,300	4
Acartia tonsa	Imco Lime/SW	5,600	4
	Imco non-dispersed/SW	66,500	5
	Lightly treated LS/SW-FW	10,000	5
	FCLS/FW	100-230	3
	Saltwater Gel	100	3
ISOPODS	FCLS/FW	70,000	5-6
Gnorimosphaeroma	XC-Polymer/Unical	314,000-500,000	6
oregonsis *Saduria*	CMC-Resinex Tannathin-Gel	530,000-600,000	6
entomon			
AMPHIPODS	FCLS/FW	10,000-50,000	5
Anisogammarus	FCLS/FW	10,000-200,000 (48-h	5-6
confervicolus	XC-Polymer/Unical	LC50)	6
	Spud mud	200,000-436,000	6
Onisimus sp./*Boekisima*	MDLS	100,000	5
sp. *Gammarus locusta*	MDLS (MAF)	74,000-90,000	6
	HDLS	100,000	5
	HDLS (MAF)	28,000-88,000	6
		100,000	
GASTROPODS	CMC-Resinex Tannathin-Gel	600,000-700,000	6
Nautica clausa, Neptuna	LDLS (MAF)	100,000	6
sp., & *Buccinum* sp.	LDLS	83,000	5
Littorina littorea	LDLS (MAF)	100,000	6
Thais lapillis	LDLS (suspended WM)	15,000	5
	MDLS	100,000	6
	MDLS (MAF)	100,000	6
	HDLS	100,000	6
	HDLS (MAF)	100,000	6
DECAPODS-SHRIMP	FCLS/FW	100,000 (48-h LC50)	6
Artemia salina	FCLS/FW	32,000-150,000	5-6
Pandalus hypsinotus		50,000-100,000 (48-h	5
	Spud mud (MAF)	LC50)100,000	6
Crangon septemspinosa	Seawater LS (MAF)	100,000	6
	LDLS	71,000	5
	LDLS (suspended WM)	15,000	5
	LDLS (MAF)	98,000-100,000	5
	MDLS	82,000	5
	MDLS (suspended WM)	15,000	5

Source: Adapted from Petrazzuolo, 1981; footnotes at end of table.

Test Organism	Fluid Description[a]	Criterion Value (ppm)	Toxicity Rating
	MDLS (MAF)	17,000	5
	MDLS (FMAF)	19,000	5
	HDLS	92,000	5
	HDLS (suspended WM)	15,000	5
	HDLS (MAF)	100,000	6
	HDLS (FMAF)	100,000	6
	HDLS (MAF)	65,000	5
Pandalus borealis	HDLS (FMAF)	55,000	5
Stage I larvae	Spud Mud (MAF)	100,000	6
Palaemonetes pugio	Seawater-chrome LS (MAF)	27,500	5
Stage I zoeae	MDLS (MAF)	35,000	5
Adults	HDLS (MAF)	18,000	5
	HDLS (SPP)	11,800	5
	Spud Mud (MAF)	100,000	6
	Seawater-chrome LS (MAF)	92,400	5
	MDLS (MAF)	91,000	5
Stage III zoeae	HDLS (MAF)	100,000	6
Late premolt stage	Lightly treated LS	201	3
D_2 - D_4	HDLS (SPP)	11,700-13,200	5
Palaemonetes pugio	Mobile Bay fluid	318-863	3
larvae	Mobile Bay fluid	360-14,560	3-5
	Seawater LS	1,706-28,750	4-5
	Lightly treated LS	142	3
	Freshwater LS	4,276-4,509	4
	Lime	658	3
	FW/SW-LS	3,570	4
	Non-dispersed	100,000	6
	LTLS	35,420	5
Penaeus aztecus	Seawater-K-polymer	2,557	4
juvenile	Seawater-chrome LS (MAF)	41,500	5
Orchestia traskiana	MDLS (MAF)	16,000	5
	Seawater-polymer	230,000	6
	Pelly gel Chemical XC	80,000	5
	KCI-XC-Polymer	14,000	5
	Weighted shell polymer	34,000	5
	Gel-SX-polymer	420,000-500,000	6
	Imnak gel-XC-polymer	560,000	6
DECAPODS-CRABS	LDLS	89,100	5
Carcinus maenus	LDLS (suspended WM)	15,000	5
	LDLS (MAF)	100,000	6
	MDLS	68,000-100,000	5-6
	MDLS (suspended WM)	15,000	5
	MDLS (MAF)	100,000	6
	HDLS (MAF)	100,000	6
	Seawater-chrome LS (MAF)	28,700	5
Clibanarius vittatus	MDLS (MAF)	34,500	5
	HDLS (MAF)	65,600	5
	Seawater polymer	530,000	6
Hemigrapsus nudus	Shell Kipnik-KCL polymer	53,000	5
	Pelly gell chemical XC	560,000	6
	KCI-XC-polymer	78,000	5

Source: Adapted from Petrazzuolo, 1981; footnotes at end of table.

Test Organism	Fluid Description[a]	Criterion Value (ppm)	Toxicity Rating
	Weighted shell polymer	62,000	5
	Pelly weighted gel-XC-polymer	560,000	6
	Imnak gel-XC-polymer	560,000	6
DECAPODS-LOBSTER			
Homarus americanus	LDLS (MAF)	5,000	5
Stage V larvae	MDLS	100,000	6
	MDLS (MAF)	29,000	5
Adult	LDLS	19,000-25,000	5
	LDLS (MAF)	100,000	6
Larvae	Mobile Bay/Jay fluids	73.8-500 ppm	2-3
BIVALVES	FCLS/FW	30,000	5
Modiolus modiolus		30,000 (14 day LC50)	5
	Spud mud (MAF)	100,000	6
Mytilus edilus	Seawater LS (MAF)	100,000	6
	MDLS (MAF)	100,000	6
	MDLS (suspended WM)	15,000	5
	HDLS (MAF)	100,000	6
	HDLS (suspended WM)	15,000	5
Macama balthica	LDLS	100,000	6
	LDLS (MAF)	100,000	6
	LDLS (suspended WM)	15,000	5
	HDLS	100,000	6
	HDLS (MAF)	100,000	6
	HDLS (FMAF)	100,000	6
	LDLS	49,000	5
Placopecten	MDLS	3,200	4
magellanicus	Spud mud (SPP)	100,000	6
Crassostrea gigas	MDLS (SPP)	50,000-53,000	5
	HDLS (SPP)	73,000-74,000	5
	Spud mud (SPP)	100,000	6
Donax variabilis	Seawater-chrome LS (SPP)	53,700	5
texasiana	MDLS (SPP)	29,000	5
	HDLS (SPP)	56,000	5
	Seawater polymer	320,000	6
	Kipnik-KC1 polymer	42,000	5
Mya arenaria	Polly gel chemical XC	560,000	6
	KC1-XC-polymer	56,000	5
	Weighted shell polymer	10,000	5
	Weighted gel XC-polymer	560,000	6
	Weighted KC1-XC-polymer	560,000	6
	Imnak gel-XC-polymer	560,0008	6
Mercenaria mercenaria	Seawater LS (LP)	7-3,000	2-4
Larvae	Seawater LS (SPP)	117-3,000	3-4
	LTLS (LP)	719-3,000	3-4
	LTLS (SPP)	122-2,889	3-4
	FWLS (LP)	319-330	3
	FWLS (SPP)	158-338	3
	FW/SW LS (LP)	380	3
	FW/SW LS (SPP)	82	2
	Lime (LP)	682	3

Source: Adapted from Petrazzuolo, 1981; footnotes at end of table.

Test Organism	Fluid Description[a]	Criterion Value (ppm)	Toxicity Rating
	Lime (SPP)	64	2
	Low solids non-dispersed (LP)	3,000	4
	Low-solids non-dispersed (SPP)	3,000	4
	Potassium polymer (LP)	269	3
	Potassium polymer (SPP)	220	3
ECHINODERMS	LDLS	55,000	5
Strongylocentrotus	LDLS (MAF)	100,000	6
droebachiensis	MDLS	100,000	6
	MDLS (MAF)	100,000	6
MYSIDS			
Neomysis integer	FCLS/FW	10,000-200,000 (48-h	5-6
		LC50)	5-6
Mysis sp.	CMC-Gel	10,000-125,000	6
	CMC-Gel-Resinex	142,000-349,000	5
	XC-polymer (supernatant)	58,000-93,000	6
Mysidopsis almyra	XC-polymer	250,000	5-6
	Spud mud (MAF)	50,000-170,000	6
	Seawater-chrome LS (MAF)	100,000	5
	MDLS (MAF)	27,000	5
	HDLS (MAF)	12,800-13,000	5
	MDLS (SPP)	16,000-32,500	5
	MDLS (MAF)	32,000	5
	MDLS (MAF) (static test)	26,800-66,300	5-6
	Reference mud (MAF) (static test)	72,100-113,000	6
		100,000	
Mysidopsis bahia	Seawater LS	429-1,557	3-4
	Seawater LS (LP)	150,000	6
	Seawater LS (SPP)	15,123-19,825	5
	Seawater LS (SP)	50,000	5
	LTLS	14-1,958	2-4
	LTLS (LP)	150,000	6
	LTLS (SPP)	1,641-50,000	3-5
	LTLS (SP)	1,246-2,437	3
	FWLS	301-1,500	3-4
	FWLS (LP)	97,238-121,476	5-6
	FWLS (SPP)	14,068-29,265	5
	Lime	87-98	2
	Lime (SPP)	650-791	3
	Lime (SP)	8,213-1,369,393	4-6
	FW/SW-LS	115-379	3
	FW/SW-LS (LP)	150,000	6
	FW/SW-LS (SPP)	11,380-38,362	5
	FW/SW-LS (SP)	50,000	5
	Low-solids non-dispersed	1,500	4
	Low-solids non-dispersed (LP)	150,000	6
	Low-solids non-dispersed (SPP)	50,000	5
	Low-solids non-dispersed (SP)	50,000	5
	Potassium polymer	1,500	4
	Potassium polymer (LP)	150,000	6

Source: Adapted from Petrazzuolo, 1981; footnotes at end of table.

Test Organism	Fluid Description[a]	Criterion Value (ppm)	Toxicity Rating
	Potassium polymer (SPP)	26,025-28,070	5
POLYCHAETES	CMC-Resinex-Tannathin	600,000	6
Melaenis loveni	CMC-Resinex-Tannathin-Gel	700,000	6
	Spud mud (MAF)	100,000	6
Nereis virens	Seawater-LS (MAF)	100,000	6
	LDLS	100,000	6
	LDLS (MAF)	100,000	6
	MDLS	100,000	6
	MDLS (MAF)	100,000	6
	HDLS	100,000	6
	HDLS (MAF)	100,000	6
	Spud mud (MAF)	100,000	6
Ophryotrocha labronica	Seawater-chrome LS (MAF)	100,000	6
	MDLS (MAF)	60,000	5
	HDLS (MAF)	100,000	5
	Seawater polymer	220,000	6
Neveis vexillosa	Kipnik-KC1 polymer	37,000	5
	Gel chemical XC	560,000	6
	KC1-XC-polymer	41,000	5
	Weighted shell polymer	23,000	5
	Weighted gel XC-polymer	320,000-560,000	6
	Imnak gel-XC-polymer	200,000	6
TELEOST FISH	Imco LDLS/SW	56,500-175,000	5-6
Menidia menidia	Imco Lime	43,000-53,000	5
	Imco non-dispersed	345,000-385,000	6
	Saltwater gel	100,000	6
	LDLS-SW/FW	48,500	5
	FCLS	100,000	6
	FCLS/FW	3,000-29,000	4-5
Oncorhynchus gorbuscha	FCLS/FW	100,000-200,000	6
Leptocuttus armatus	CMC-Gel	120,000	6
Myoxocephalus	CMC-Gel-Resinex	50,000-70,000	5
quadricornis	XC-Polymer	50,000-215,000	5-6
	XC-Polymer (supernatant)	250,000	6
	Lignosulfonate	350,000	6
	CMC-Gel	200,000	6
	XC-Polymer	57,000-370,000	5-6
Coregonus nasus	XC-Polymer (supernatant)	100,000-250,000	6
	Lignosulfonate	0-100,000	6
	CMC-Gel	170,000-300,000	6
	XC-Polymer	250,000	6
Elegonus naraga	Lignosulfonate	200,000-250,000	6
Boreogodus saida	Lignosulfonate	85,000-1,000,000	6
	Spud mud (MAF)	100,000	6
Coregonus autumnalis	Seawater-LS (MAF)	100,000	6
Fundulus heteroclitus	MDLS (suspended whole mud)	15,000	5
	MDLS (MAF)	100,000	6
	HDLS (suspended whole mud)	15,000	6
	HDLS (MAF)	100,000	6

Source: Adapted from Petrazzuolo, 1981; footnotes at end of table.

Test Organism	Fluid Description[a]	Criterion Value (ppm)	Toxicity Rating
	Kipnik-KC1 polymer	24,000-42,000	5
Salmo gairdneri (juvenile)	Seawater polymer	130,000	6
	KC1-XC polymer	34,000	5
	Weighted shell polymer	16,000	5
	Pelly gel chemical-XC	42,000	5
	Weighted gel XC-polymer	18,000-48,000	5
	Imnak-Gel XC-polymer	42,000	5
	Kipnik-KC1 polymer	29,000	5
	Seawater polymer	130,000	5
Oncorhynchus kisutch (juvenile)	KC1-XC polymer	20,000-23,000	5
	Weighted shell polymer	4,000-15,000	4-5
	Pelly Gel chemical-XC	28,000-130,000	5-6
	Weighted gel XC-polymer	24,000-190,000	5-6
	Imnak-Gel XC-polymer	23,000-30,000	5
	Kipnik-KC1 polymer	24,000	5
O. keta (juvenile) *O. gorbuscha* (juvenile)	Kipnik-KC1 polymer	41,000	5
DRILLING FLUID COMPONENTS			
Skeletonema costatum	Barite	385-1,650	3-4
	Aquagel	9,600	4
Arcartia tonsa	Barite	590	3
	Aquagel	22,000	5
Pandalus hypsinotus	Barite	100,000	6
	Aquagel	100,000	6
Molliensias latipinna	Barite	100,000	6
	Calcite	100,000	6
	Siderite	100,000	6
	Chrome lignosulfonate	7,800-12,200	4-5
	Quebracho	135-158	3
	Lignite	15,500-24,500	5
	Sodium acid pyrophosphate	1,200-7,100	4
Penaeus setiferus	Hemlock bark extract	265	3
	Polyacrylate	3,500	4
	$CaCO_3$ workover additive	1,925	4
	Chrome-treated lignosulfonate	465	3
	Lead-treated lignosulfonate	2,100	4

Table footnotes and references appear on following page.

Appendix A. Footnotes and References

[a] Drilling fluids abbreviations (test fractions in parenthesis):

WM = Whole mud
MAF = Mud aqueous fraction
FMAF = Filtered mud aqueous fraction
SPP = Suspended particulate phase
SP = Solid phase
LP = Liquid phase

SW = Saltwater dispersed
FW = Freshwater dispersed
LS = Lignosulfonate
LDLS = Low-density lignosulfonate
MDLS = Medium-density lignosulfonate
HDLS = High-density lignosulfonate

Source: Adapted from Petrazzuolo, 1981; footnotes at end of table.

LTLS = Lightly-treated lignosulfonate
FCLS = Ferrochrome lignosulfonate

[b] Toxicity ratings as per Hocutt & Stauffer, 1980.

1. Very toxic (1 ppm)
2. Toxic (1-100 ppm)
3. Moderately toxic (100-1,000 ppm)
4. Slightly toxic (1,000-10,000 ppm)
5. Practically non-toxic (10,000-100,000 ppm)
6. Non-toxic (100,000 ppm)

[c] References:

1. IMCO Services, 1977.
2. Shell Oil Co., 1976.
3. Atlantic Richfield, 1978.
4. Tornberg et al., 1980.
5. Gerber et al., 1980.
6. Neff et al., 1980.
7. Conklin et al., 1980.
8. Environmental Protection Service, 1976.
9. Conklin et al., 1983.
10. Capuzzo and Derby, 1982.
11. Duke et al., 1984.
12. Carr et al., 1980.
13. Grantham and Sloan, 1975.
14. Hollingsworth and Lockhart, 1975.
15. Chesser and McKenzie, 1975.

Source: Adapted from Petrazzuolo, 1981; footnotes at end of table.

Appendix B. Metal Enrichment Factors in Shrimp, Clams, Oysters, and Scallops Following Exposure to Drilling Fluids and Drilling Fluid Components

Test Organism	Test Substance Concentration (ppm)	Exposure Period (days)	Metals Enrichment Factor [a]				
			Ba	Cr	Pb	Sr	Zn
Palaemonetes pugio [b]	Barite						
Whole animal not gutted	5	7, 48-hr replacement	150			1.3	
	50	(after 14-d depuration)	350			1.9	
	5	(after 14-d depuration)	2.2			1.8	
	50		29			2.2	
	Barite	8 days post-ecdysis,					
Carapace	(500)	range = 8-21	7.7			1.2-2.5	
Hepatopancreas	(500)	(48-hour replacement)	13			1.9-2.8	
Abdominal muscle	(500)		12			1.5-2.8	
	Barite	106					
Carapace	(500)		60-100			1.6-7.4	
Hepatopancreas	(500)		70-300			0.03	
Abdominal muscle	(500)		50-120			0.71	
Rangia cuneata [c] (soft tissue)	12.7 lb/gal lignosulfonate fluid (50,000 MAF)	4, static (after 4-dy depuration)		1.4 1.1	1.7 1.2		
	13.4 lb/gal lignosulfonate fluid (100,000 MAF)	16, static (after 1-dy depuration) (after 14-dy depuration)		2.5 1.7 1.6			
	Layered solid phase	4, daily replacement (after 1-dy depuration)		4.3 2.0			
Crassostrea gigas [c] (soft tissue)	9.2 lb/gal spud fluid (40,000 MAF)	10, static			2.1		1.1
	(10,000 SPP)	4, 24-hr replacement		2.5			
	(20,000 SPP)			3.0			
	(40,000 SPP)			3.0			
	(60,000 SPP)			5.5			
	(80,000 SPP)			7.4			

Source: Adapted from Petrazzuolo, 1983; footnotes at end of table.

Source: Adapted from Petrazzuolo, 1981; footnotes at end of table.

Appendix B. Metal Enrichment Factors in Shrimp, Clams, Oysters, and Scallops Following Exposure to Drilling Fluids and Drilling Fluid Components (cont.)

Test Organism	Test Substance Concentration (ppm)	Exposure Period (days)	Metals Enrichment Factor [a]				
			Ba	Cr	Pb	Sr	Zn
Crassostrea gigas (soft tissue cont.)	12.7 lb/gal lignosulfonate fluid						
	(40,000 MAF)	10, static			2.3		1.4
	(20,000 MAF)	14		2.9			
	(40,000 MAF)	14		3.9			
	(10,000 SPP)	4, 24-hr replacement		2.2			
	(20,000 SPP)			4.4			
	(40,000 SPP)			8.6			
	(60,000 SPP)			24			
	(80,000 SPP)			36			
	17.4 lb/gal lignosulfonate fluid						
	(40,000 MAF)	10, static			0.56		1.0
	(20,000 MAF)	14		2.1			
	(40,000 MAF)	14		2.2			
Placopecten magellanicus [d]	Uncirculated lignosulfonate fluid						
Kidney	(1,000)	28	8.8	2.6			
Adductor muscle	(1,000)	28	10	1.2			
	Low density lignosulfonate fluid						
Kidney	(1,000)	14		1.6			
		27		2.1			
		(after 15-dy depuration)		2.3			
Adductor muscle	(1,000)	14		2			
		27		2			
		(after 15-dy depuration)		2			
	FCLS (30)	14		5.7			
		(after 15-dy depuration)		3.2			
	(100)	14		6.0			
		(after 15-dy depuration)		5.2			
	(1,000)	14		7.2			
		(after 15-dy depuration)		6.0			

[a] Enrichment factor = concentration in exposed group/concentration in controls.
[b] Source: Brannon and Rao, 1979.
[c] Source: McCulloch et al., 1980.
[d] Source: Liss et al., 1980.